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LANDFILL TECHNICAL GUIDANCE MANUAL

REVISED
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EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
Department of Environmental Protection
Division of Solid Waste Management

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PART I. TECHNICAL GUIDANCE

Solid Waste Management facilities in the Commonwealth of Massachusetts are regulated by 310 CMR 16.00 and 310 CMR 19.00. The purpose of this Landfill Technical Guidance Manual (Part I in particular) is to provide guidance to municipal officials, consultants, landfill operators and others involved in the planning and design, construction, operation, maintenance, monitoring, and assessment of landfills. This document is intended to fulfill two major functions: 1) to serve as a standard reference document for landfill design, construction and QA/QC activities; and 2) provide additional guidance on acceptable standards and methods for landfill design, construction and Quality Assurance/Quality Control procedures to ensure that a landfill will meet the performance and design standards established in Part II, Landfill Design and Operational Standards of the Solid Waste Management Facility Regulations, 310 CMR 19.000.

The manual is organized to provide guidance on specific topics of interest to those designing and constructing landfills or expansions thereof, including: design and construction of liners and final covers; quality assurance/quality control of liner and final cover construction; environmental monitoring systems; surface water control; and closure and post-closure guidance.

In a number of areas the manual goes into more detailed discussions of standard requirements for landfill design, operation, and closure. In areas where professional judgement is appropriate in making decisions on landfill operation and closure the manual gives suggestions on issues to be taken into account in making those decisions. The Department will require detailed documentation of rationale for requests to deviate from Department requirements and suggestions.

The revisions contained in this version of the manual have taken into account the comments of a number of people working with landfills. These comments were based on practical experiences with guidance contained in the previous editions of the manual. Some comments were editorial in nature and have been used, hopefully, to clarify issues that were unclear after the publication of the last revisions in September 1993. In an effort to keep up with this steadily evolving field, the Department welcomes further comments that would be considered for inclusion in subsequent editions of this manual.

PART II. ADMINISTRATIVE GUIDANCE

This Section on Administrative Guidance is meant to assist municipal officials, solid waste committee members, and landfill owners and operators to prepare for the required assessment and final closure of their sanitary landfills.

Chapter 9 addresses the costs of landfill assessment, closure, and post-closure. Chapter 10 discusses financing, fees and accounting considerations associated with solid waste management. Chapter 11 discusses the contracting process. A model Request for Proposal/Request for Qualifications (RFP/RFQ) is included in Appendix E for use in procurement of contracting services.

Chapters 12 and 13 discuss municipal planning activities for landfill assessment and closure implementation, and how the process fits into the integrated solid waste management framework.

Part II as a whole will provide information and techniques which will make the landfill assessment and closure process proceed more smoothly and keep costs to a minimum level while ensuring that environmental protection is maintained.

PART III. APPENDIX

The Appendices have been revised to reflect changes in earlier sections of the manual. Some examples: In addition to other changes to Appendix C, Attachment B (Gas Screening Questionnaire) was eliminated. Appendix H describes the current procedure to obtain GIS maps. Checklists for the different stages of landfill assessment which were formerly attachments to Appendix C have now been included at the end of the outlines for the assessments.

PART IV. GLOSSARY

This Section is intended to assist municipal officials, solid waste committee members, and landfill owners and operators who may not necessarily have technical backgrounds to understand technical terms used throughout the manual. A few words have been added to this section during this revision.

TABLE OF CONTENTS

CHAPTER 1 GROUNDWATER PROTECTION AND FINAL COVER SYSTEMS DESIGN AND CONSTRUCTION

I. INTRODUCTION

The solid waste management facility regulations require that a groundwater protection system (commonly referred to as a liner system) be installed at all new or expanding landfills. The purpose of a liner system is to prevent leachate from reaching groundwater by collecting leachate for treatment and disposal. By preventing the movement of leachate into groundwater, the liner serves to protect groundwater and surface water from pollution.

Liner systems should have the following characteristics:

- Be designed as contained systems for the collection of leachate generated within the landfill;
- Provide an effective hydraulic barrier during the active life, closure and post-closure periods of the landfill to impede the infiltration of leachate into groundwater;
- Have little or no chemical reaction with waste, thereby preventing an increase in the liner's permeability;
- Maintain its integrity and performance under all operating conditions for the expected life and post-closure period of the facility.

The following sections contain a number of minimum design and construction requirements for liners and other groundwater protection systems. Many of these requirements are stated in the Solid Waste Regulations. Some of the others have been added because of experiences reported from other states and the USEPA. In cases where a design engineer finds requirements and recommendations in this manual which conflict with their personal experiences, the Department will required detailed documentation to justify deviations from stated requirements and recommendations before approval.

II. MINIMUM LINER DESIGN

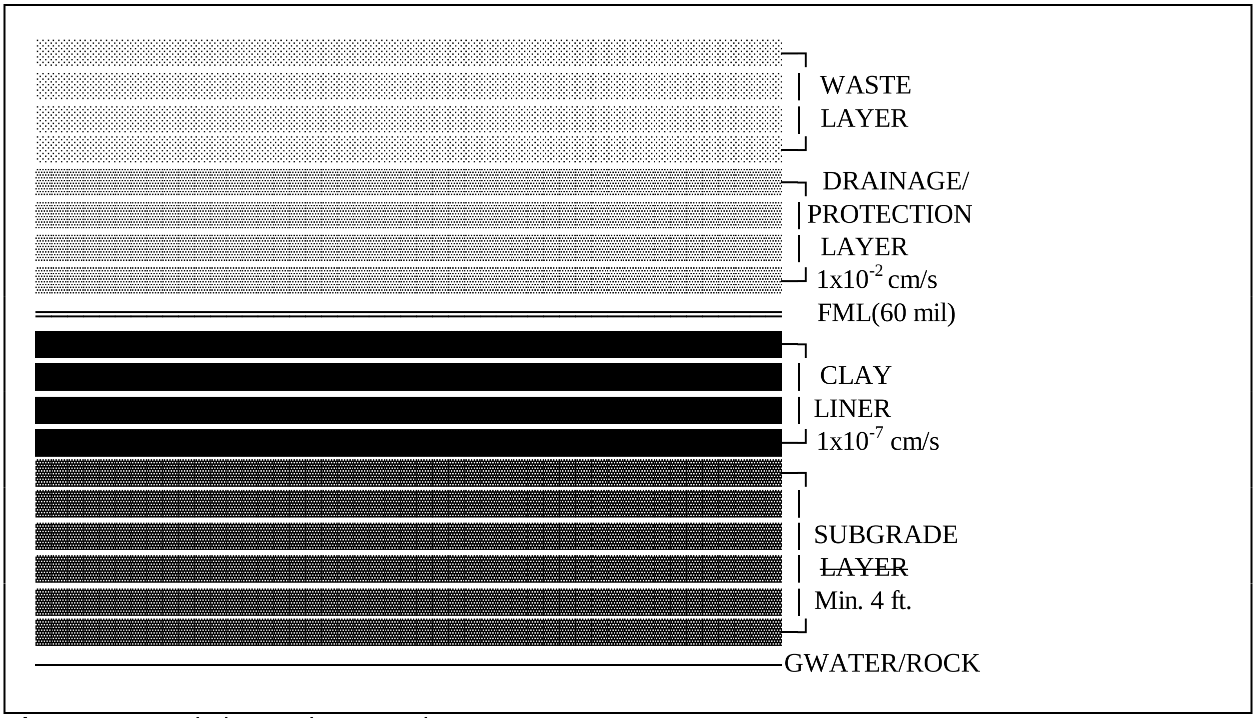

Figure 1-1: Minimum Liner Design

The minimum liner design required by the Solid Waste Management Regulations for landfills (19.110) must include:

? A four foot separation between the top of bedrock or the maximum high groundwater level and the bottom of the lowermost low permeability layer;

? A composite liner consisting of a two foot thick re-compacted soil liner with a maximum in-place saturated hydraulic conductivity (K) of 1 x 10^{-7} cm/sec overlain by a flexible membrane liner (FML) or geomembrane;

? A drainage/protection layer consisting of either soil or soil in combination with a synthetic drainage material or geonet. This layer must be a minimum of 18 inches thick, the lowermost 12 inches of which must have a minimum hydraulic conductivity (K) of 1 x 10^{-2} cm/sec and the uppermost 6 inches of which must have a minimum hydraulic conductivity of 1 x 10^{-3} cm/sec;

? A leachate collection system which has appropriately spaced pipes. Trunk lines must have a minimum slope of 1% and lateral lines a minimum slope of one-half percent (½%); and

- A leachate pumping facility, or a leachate storage facility if the landfill is not to be tied directly into a sewer system.

III. GENERAL LINER DESIGN CRITERIA

A. Purpose

In order for liners to effectively act as a barrier to the movement of leachate into groundwater and promote leachate collection, the liner must be properly designed and constructed. Liners must be capable of withstanding degradation by leachate or other mechanisms and must promote the drainage of leachate off the liner as efficiently as possible. However, the leachate containment strategy must also extend beyond the selection of the liner type and materials. The overall design of the system must be carefully examined to identify potential weak points in the design and to minimize or correct failure-prone elements of the design. Potential failure points include:

- Penetrations of the liner;
- Negligent installation practices or poor operating procedures resulting in perforations of the liner;
- Stability of the sub-grade;
- Areas of high stress; and
- Inadequate Quality Assurance/Quality Control program.

B. Design Considerations

Liner materials must have chemical properties which will prevent failure upon exposure to solid waste leachate. Liner materials should be tested for compatibility with leachate. The following test methods should be used to evaluate the compatibility of liner materials with leachate:

- Soil Liners - EPA test method 9100 (EPA Document SW-846)
- Flexible Membrane Liners (FMLs) - EPA test method 9090 (EPA Document SW-846)

Some general liner design characteristics include the following;

- Leachate compatibility. All low permeability materials must document that they will not fail (become more permeable) when exposed to leachate.
- Ability to withstand pressure gradients, including

static and external hydrological forces;

- ! Constructability uses methods and materials that can be successfully used in the field;

- ! Ability to withstand climatic conditions and stresses of daily operation.

Liners must be designed to withstand pressure gradients, including static head and external hydrological forces, variations in climatic conditions and the stresses of installation and daily operation.

IV. SUBGRADE DESIGN

A. Purpose

The soil underlying a landfill must provide a proper foundation for the landfill. It must be strong enough to support both the expected load of solid waste as well as operational vehicular traffic. To prevent the possibility of a failure due to subsidence or slumping, the foundation of the landfill must be designed to:

- ! Provide proper structural support for the liner and solid waste;

- ! Prevent differential settlement of the liner;

- ! Control seepage and prevent piping or pathways for leachate that has migrated through the liner; and

- ! Act as an attenuation layer for leachate.

B. Design and Construction Considerations

The subgrade needs to be inspected to ensure that it consists of suitable materials and is adequately compacted. If the suitability of the subgrade is not known, it is recommended that preparation of the site for the liner include the excavation and recompaction (95% of standard proctor/90% modified) of the top 1 to 2 feet of foundation soil in order to control settlement of the soil and determine the suitability of the subgrade materials. In addition, any cracks, sand lenses or sand seams in the foundation must be repaired prior to placement of the liner because such incongruities may serve as pathways for leachate migration and could cause piping failures in a soil liner.

Further requirements for preparation of the sub-grade include:

- A minimum four foot separation between the maximum high groundwater and the lowermost point of the impermeable layer located above the subgrade;
- Diversion of all surface drainage away from the landfill;
- Removal of all stones with sharp edges and/or points which might penetrate the overlying impermeable layers and all stones greater than 3 inches in diameter from the subgrade surface;
- Removal of all construction debris, solid wastes, organic debris and vegetation;
- A reasonably smooth surface. If the surface is not smooth, it should be rolled with a smooth steel drum roller;
- Have a bearing capacity adequate to support the total applied load.

V. LOW PERMEABILITY SOIL/ADMIXTURE LAYERS

A. Purpose

The low permeability soil layer acts to minimize the movement of leachate into the subgrade and groundwater as well as function as an attenuation layer. In order for a soil barrier layer to function as designed, careful consideration must be given to the method of compaction used. The selected compaction method should be one which has no adverse effects on the physical properties of the soil layer.

The soil liner shall be emplaced at optimum moisture content for proper compaction, consistent, and have a uniform thickness across the entire liner. A quality assurance/quality control program (QA/QC) must be developed for the installation of the liner. QA/QC is addressed later in this guidance document.

B. Design Considerations

Soils used for liners should have the properties specified in Table 1-1 to meet the design standards specified in the regulations at 310CMR19.112.

Table 1-1: Properties for Soils Used for Soil Liners

- ! Maximum hydraulic conductivity of 1.0 x 10-7 cm/sec
- ! Minimum of 40% of the soil by weight, should pass a #200 sieve
- ! Minimum of 20% of the soil by weight should consist of <2um clay size particles
- ! Plasticity index should be 10% or greater, but less than 40%
- ! Density should be, at minimum, 95% standard, or 90% Modified Proctor density
- ! Maximum clod size should not exceed 1/2 of the lift thickness
- ! Maximum rock size should not exceed 3/4 - 1 inch in top 6" of liner and < 3" in lower 18"
- ! Coarse fragments < 10% by weight (retained on a #4 sieve)

C. Admixtures

An admixture is a combination of native soils and a bentonite-type clayey material which when added to the native soil results in a low permeability material.

Construction of liner systems or portions of liner systems using admixtures should conform to the following:

- ! Bentonite added to native soils should be powdered to achieve the best mixing possible.
- ! A pugmill should be used to mix the soil and bentonite.
- ! A liner constructed of an admixture of bentonite and native soils must have a minimum thickness of 24 inches.

D. Soil Liner Construction Considerations

The following variables affect the ability to properly compact soil liner materials so that they meet design and performance standards:

- ! Water content,

- Type of compaction equipment,
- Compactive effort applied to the soil,
- Size of clods,
- Bonding between lifts,
- Depth and number of lifts,

Use of the following guidance will ensure that soil liners are compacted adequately and the in-place hydraulic conductivity, which must not exceed $1x10^{-7}$ cm/sec for each lift of a liner or cap, will be as low as possible:

- To minimize the hydraulic conductivity, soils should be installed wet of optimum as determined by moisture, density and permeability relationship. Laboratory soil analysis needs to be conducted to determine these relationships (see chapter 2). Dry soils should be adequately wetted prior to compaction. Wet soils should be spread and allowed to dry prior to compaction.
- Liners should be installed in loose lifts which are a maximum of 9 inches thick; compacted lifts should be a maximum of six inches thick.
- Two foot thick impervious soil liners should be constructed in four six-inch thick compacted lifts.
- Test pad liners should be built and tested in-situ with an infiltrometer to ensure that the soil and the compaction equipment and procedures will result in a liner that meets the standards established in the regulations.
- Clod size should be minimized to the extent possible to prevent preferential flow pathways for leachate.
- Soils should be protected against desiccation both prior to and after compaction. If large areas of a liner are to be exposed long enough for significant drying to occur then a protective cover should be placed over the liner.
- Partially penetrating sheeps foot compactors are recommended for compacting clay liners. The length of a foot of the roller should not exceed the depth of one

lift of the liner. It is recommended that compactors be a minimum of 30,000 kg.

- ! Generally, a sheeps foot compactor should make a minimum of four passes during compaction of a section of liner.

- ! Where a sheeps foot compactor is not used, each lift should be scarified prior to the installation of the succeeding lift to maximize the bonding between lifts to prevent horizontal seepage between lifts.

Table 1-2: Compaction Requirements

Area	ASTM Density Degree of Compaction
Trench Backfill	92% standard proctor
Landfill Cap and ~~Cover~~Liner	Minimum 9~~0~~5% standard proctor or 9~~5~~0% modified proctor or as required to meet permeability specification
General Fill	90% standard proctor

VI. FLEXIBLE MEMBRANE LINERS (FMLs)

A. Purpose

Flexible membrane liners or FMLs provide an additional barrier layer in the liner design. While FMLs provide an excellent barrier to the seepage of leachate from the landfill, the effectiveness of the FML in preventing leachate migration is highly dependant upon how well the FML has been installed.

B. Design Considerations

Table 1-3: Methods of FML Degradation

Mechanism	Method to Minimize Degradation
Ultraviolet Light	Cover with soil and maintain
Chemical Degradation	Ensure FML is resistant - require EPA 9090 evaluation for leachate
Swelling Degradation	PVC (highest) to HDPE (lowest) swelling. Process largely reversible. May not lead to degradation, but may cause secondary effects.
Extraction Degradation	Leaching of plasticizers. Ensure FML is resistant ! Require tests: Water extraction - ASTM D3083 Volatile loss - ASTM D1203
Delamination	Only scrim or reinforced or laminated liners.
Degradation	Ply adhesion test - ASTM D413
Oxidation Degradation	Anti-oxidants must be added to scavenge the free radicals
Biological Degradation	No documented case histories

FML materials are subject to degradation through a variety of mechanisms as specified in Table 1-3. Care in selection and installation of an FML will minimize degradation problems.

FMLs used shall be those approved by the National Sanitation Foundation (NSF) standards #54.

The following minimum design standards apply to liner systems constructed of synthetic liner materials or geomembranes.

- ! Construction survivability - Selected FML must have physical characteristics that prevent serious degradation during installation.

- ! Minimum thickness - 60 mils for HDPE materials, or a thickness providing equivalent protection if another synthetic liner material is used, but in no case less than 30 mils.

In addition to the minimum standards established above, the following physical properties before and after exposure to landfill leachate should be documented:

- burst strength;
- dimensional stability;
- hardness;
- elasticity;
- ply adhesion (for fabric reinforced materials);
- puncture resistance;
- seam strength of factory and field-produced seams;
- tear resistance;
- thickness;
- water vapor transmission;
- tensile strength;
- melt index.

! Adequate documentation of soil compatibility with the liner material should be presented, (ASTM D 3083, 1981).

! The liner material must be capable of withstanding the following stresses:

- Ultraviolet radiation
- The load of placement on steep slopes of large landfills
- Thermal degradation of the liner material, due to extreme climatic conditions
- Chemical/biological degredation from leachate;

! Seams should be capable of providing the same tensile strength as the parent material.

C. Construction Considerations

! Delivered FML materials should be closely inspected upon delivery for defects such as pinholes, cuts, cracks and defective factory seams. All defective materials should be rejected. FML materials which have been stored on-site should also be carefully inspected before being installed.

! The foundation surface should be free of all rocks >1", roots, desiccation cracks or standing water and smooth rolled. The foundation surface must be free of any materials which might abrade the FML.

! FML materials should never be dragged across their prepared foundation or subgrade, but should instead be unfolded or unrolled into place.

- The FML should be installed in direct contact with the underlying low permeability soil layer.

- FMLs installed on side slopes should be firmly anchored in anchor trenches.

- The FML must be clean and free of dust, dirt or other debris which would affect proper seaming of panels.

- FML materials should not be installed on windy days or during inclement weather that may result in poor seaming conditions. It is recommended that seaming operations take place only when the temperature exceeds 40^{o} F.

- FMLs must be installed and seamed by qualified seamers. Qualification standards shall be in accordance with Chapter 2.

- Field seams should run up and down side slopes and not horizontally across side slopes to the extent possible.

- Leachate cleanouts or manholes should be designed so as not to penetrate the liner. Any necessary penetrations of the liner must be constructed with flexible connections.

- The FML should be covered with the drainage layer as soon as possible to prevent unnecessary exposure to ultraviolet radiation. Properly sized (ground pressure) equipment placing the drainage blanket should always work across the lined area in such a way that it is supported by the drainage layer and is not directly on the liner.

- No equipment shall be allowed on top of the FML (other than required welding equipment)

- Trucks, large equipment, and tracked vehicles should not be allowed to drive directly on the drainage blanket until at least one lift of refuse has been placed in the landfill.

VII. LINER SIDESLOPE DESIGN

A. Purpose

The sidewalls of a landfill should be designed to remain stable. Slope stability analyses should be done on the soils to ensure that slumping will not occur once waste is placed in the landfill and compacted. The following guidelines should be used when designing sidewalls:

B. Design and Construction Considerations

! The bearing strength of the foundation material should be determined to prevent foundation or liner failure. An adequate margin of safety should be built into the sidewall design.

! Where FMLs are installed on side slopes, results of an analysis documenting the stability of all components of the proposed design, particularly the interface of different components, should be submitted to the Department. An adequate safety factor should be incorporated into the design.

! Sidewalls should not have a slope exceeding 3 horizontal to 1 vertical.

! Freeze/thaw and desiccation/hydration conditions should be considered when determining liner design and liner materials, especially with regard to the depth of the drainage/protection layer. Covering the entire lined area of a landfill with one lift of solid waste may be one way to protect the liner from freeze/thaw conditions. Possible solutions would need to be balanced with the need to minimize leachate production.

! Where HDPE is used, textured HDPE may be appropriate to increase the stability by increasing the interface angle of friction.

! If geonet is used, it is recommended that geotextile be placed below and above the geonet to prevent liner materials from entering the geonet and to prevent the plugging of the geonet by the protective blanket. The use of non-woven geotextiles are recommended.

VIII. LINER BASE DESIGN

A. Purpose

The liner must be designed to promote leachate drainage and collection and to minimize the seepage of leachate through the liner into the underlying soils and groundwater.

B. Design Considerations

The following guidelines should be used when designing the bottom of the liner:

- The liner should be sufficiently sloped to prevent puddling and ponding during construction and operation. The liner slope shall not be less than 2%.

- Extra soil liner thickness and compactive effort is recommended for the base of the sideslopes and underneath the leachate collection system main header piping to protect against seepage.

- Penetrations of the liner should be minimized and should be properly sealed with bentonite or other sealing methods. All penetrations should be designed to account for settlement and installation and operational stresses including expansion and contraction due to temperature changes.

- Geotextile materials should be placed above geonets to prevent piping of the liner materials into the geonet and to prevent plugging of the geonet by the drainage/protective blanket.

IX. DRAINAGE/PROTECTION LAYER - Natural Materials

A. Purpose

A drainage/protection layer serves as a high permeability pathway through which leachate can travel to collection pipes and as a protective layer over the liner system to prevent damage to the liner from vehicles and solid wastes. Drainage/protection layers generally consist of natural materials, but synthetic drainage materials can be used in combination with natural materials to enhance the effectiveness of the layer in draining leachate from the landfill.

B. Design Considerations

Drainage/protection layers consisting of natural materials should have the following characteristics in order to perform properly:

- ! The material must be compatible with leachate. Limestone based materials will react with municipal solid waste (MSW) leachate to form a precipitate which can clog the collection zone. Therefore, materials having a calcium carbonate content in excess of 10-15% should be avoided.

- ! For sandy soils, the soil must consist of clean sand, classified as SP by the Unified Soil Classification System (USCS), with no more than 5% passing through a #200 sieve.

- ! The layer must be at least 18 inches thick. The lower 12 inches must have a minimum hydraulic conductivity of 1×10^{-2} cm/sec. The upper 6 inches must have a minimum hydraulic conductivity of 1×10^{-3} cm/sec.

- ! Granular material should be no courser than 3/8" and should be smooth and rounded to prevent abrasion to the FML.

X. DRAINAGE PROTECTION BLANKET - Synthetic Materials

A. Design Considerations

The following guidance and recommendations apply to drainage/protection blankets which consist of synthetic materials such as geonets.

- ! Documentation should be provided to the Department which demonstrates compatibility of geonet or geotextiles with leachate.
- ! The following parameters, which are obtainable from the manufacturer, should be included in documentation provided to the Department:

  - @ resistance to puncture;
  - @ thickness;
  - @ permittivity;
  - @ transmissivity;
  - @ mass/unit area;
  - @ burst strength;
  - @ abrasive resistance;

- @ percent open area;
- @ ultraviolet resistivity;
- @ grab tensile/elongation;
- @ equivalent opening size;
- @ hydrostatic bursting strength;
- @ tearing strength (trapezoidal);
- @ compression behavior/crush strength;

! Geonets should have transmissivity values equivalent to the granular material they replace.

! Geonets should have a minimum transmissivity of 3×10^{-5} m^2/s

! Double drainage nets can increase the total flow area.

! Geosynthetic cushion layers (non-woven geotextile) can be used where large, granular materials are used for the drainage/protection layer material to protect the FML from abrasion.

B. Geotextile Design

Geotextiles, including woven and non-woven materials may be used at the interface between the various components of the liner or final cover system to maintain the integrity of each layer. Filter fabrics are one type of non-woven geotextile. The primary function of geotextiles is to prevent the migration of soil fines into drainage layers or into leachate collection systems. Another function of geotextiles is to act as a cushion or protective layer to prevent the intrusion of FML into geonets. Important elements to include in geotextile design, depending upon application, include:

! Compatibility with leachate and other design material.

! Adequate vertical flow or permeability - usually evaluated as permittivity - ASTM D4491.

! Soil retention - Apparent opening size - ASTM D4751.

! Clogging evaluation - Gradient ratio, CW-02215, or long-term flow - GRI-GT1.

! Ability to prevent piping.

! Durability after exposure to chemical or biological degradation.

- ! Geotextiles in the horizontal flow path of leachate can clog with anaerobic slimes. Sized sand and stone are preferable.

XI. WASTE BELOW WATER TABLE

Important items which must be considered when designing groundwater protection systems for existing unlined landfills involve issues associated with waste found below groundwater table. These situations are often encountered where the water table is shallow and/or when the landfill is located in or in close proximity to wetlands. Older landfills often placed waste directly into wetlands and below the water table. This situation leads to both aerobic and anaerobic decomposition of waste in water-logged environment.

A. Waste at Landfill

In the absence of a liner below the waste, leachate readily flows horizontally to locations downgradient of the landfill. Groundwater flowing from locations upgradient of the waste displace leachate produced within the waste. The leachate in the waste, therefore, flows to downgradient locations. When this situation is present at a landfill, it is recommended that operators and designers include barriers or groundwater interceptor trenches to prevent upgradient groundwater from reaching the waste located below the water table. This would be a factor considered for applications to continue landfill operations and also in the closure design review **particularly at site where potentially significant impacts to downgradient water resources are known to exist and regulatory limits of contaminants have been exceeded during groundwater monitoring.**

A barrier to prevent the flow of upgradient groundwater from coming into contact with waste below the water table at a landfill will be similar to slurry walls and liners constructed to prevent contaminated groundwater from reaching downgradient water resources. These barriers are generally vertical impermeable walls made of clay/bentonite materials having hydraulic characteristics similar to liners and slurry walls. Designers of barriers will be required to provide the location and rationale for the specific depth, width, and hydraulic characteristics of a barrier recommended for construction at a landfill site at which waste is present below the water table. Designs at similar landfills where waste is located below the water table but does not contain provisions for a barrier to prevent horizontal groundwater flow through the waste shall contain justification, **including prohibitive costs,** for the absence of such a barrier.

B. Consolidation of Waste

There are situations where waste is present below the water table. The Department has recommended, and required in some cases, that shallow waste layers (less than 10-15 feet) be consolidated into the main body of the waste before a cap or other closure activities are undertaken. Consolidation of waste involves physically removing the waste located outside the permitted area and placing it in the permitted area. Waste consolidation minimizes the surface area of the final cap and can result in lower capping costs.

Disturbance of waste below the water table during waste consolidation could, however, involve issues that are not usually addressed in consolidation of dry waste. If removal of the waste leads to the discharge of contaminated surface water and/or leachate a discharge permit from the Department's Industrial Wastewater Program may be required. A combination of temporary barriers, de-watering systems and treatment may be required to address the potential discharge.

XII. LEACHATE COLLECTION SYSTEMS

Leachate collection systems must be evaluated and provided at all new or expanded landfills.

A. General Design Considerations

- All proposals for new or expanded landfills must provide for active leachate control systems (i.e., leachate collection systems placed on a liner system, and the associated leachate collection tanks, treatment, discharge, and/or disposal systems).

B. Leachate Collection Piping Design Considerations

Leachate collection piping systems installed on a liner system should conform to the following:

- The expected efficiency of the leachate collection system should be calculated and submitted. The calculations should include the expected leachate quantities and the hydraulic head occurring during the first lift of landfilling, the middle lift of the phase and after final cover. Calculations for the above three scenarios should be done based upon both the average daily precipitation during the wettest month of the year and in response to a 25 year, 24 hour storm.

- The liner slope must be a minimum of 2%.

- Gravity drainage of leachate to external storage or disposal facilities. Once leachate is directed to the low end of the lined area the leachate may be removed through use of a riser system or by passing the collection pipe through the liner to an external collection tank. Penetrations of the liner should be minimized and carefully sealed.

- Hydraulic head may not exceed 1 foot of leachate on the liner at the lowest point of the lined area, except during storm events.

- The maximum leachate flow distance before leachate intercepts a collection pipe should not exceed 150 feet, with 50 feet being a reasonable minimum.

- Trunk lines must be installed to have a minimum 1% slope.

- Lateral lines should be installed to intercept the flow and must have a minimum slope of ½%.

- Pipes should be surrounded with suitable stone capable of transmitting leachate flows should the pipes fail. At a minimum, the stone bedding should consist of 3/4 inch rounded washed stone.

- The drainage blanket should be designed and constructed to provide for transport of the leachate within the collection system to a central collection point for disposal and treatment.

- The piping material should possess adequate structural strength to support the maximum anticipated static and dynamic loads and stresses to be imposed on the pipe by the drainage layer, gravel pack, overlying wastes, and any equipment used at the landfill. The supporting strength of the pipe should be equal to, or greater than, the loads and stresses imposed on the pipe.

- The piping material should be slotted or otherwise perforated to provide for sufficient area for drainage. Design should insure that perforations will not be easily clotted by sediments, chemical precipitation or biological growth.

- HDPE or PVC pipes should have a minimum diameter of 6 inches and be rated at SDR 17, or schedule 40 for refuse depths of less than 50 feet. For depths of refuse greater than 50 feet, the minimum pipe diameter should be 6 inches and the minimum thickness sufficient to accommodate the additional stress. The overburden pressure and pipe strength required to handle that overburden pressure should be calculated, allowing for a maximum ring deflection of 20%.

- The piping material should have a demonstrated chemical resistance to the wastes to which it will be exposed and the expected leachate to be produced within the landfill.

- The piping systems should be cleaned out before use.

- Piping system design should include sufficient clean out access for all collection lines. Generally, clean out access points should not be more than 500 feet apart.

- Leachate collection lines should be in direct contact with the lowest point of vertical migration of leachate. Perforations should be near, but not at, the pipe invert to help maintain the lowest possible hydraulic head, but the invert should be solid to allow for efficient pipe flow at low volumes.

XIII. LANDFILL FINAL COVER SYSTEMS (CAPS)

A. Introduction

The purpose of a landfill cap is to minimize percolation of water into and through the landfill. This serves to minimize the generation of leachate and associated groundwater pollution at unlined landfills. For lined landfills, the reduced amount of leachate generated would reduce expenditures associated with leachate collection and disposal. Costs of leachate collection and disposal during post-closure may range from 45% to 70% of total post-closure costs.

To remain effective the impermeable layer of a landfill cap must be protected from erosion, cracking, freeze-thaw actions, settlement, rodent damage, and other types of degradation. Sufficient soil cover and a well established vegetative layer assist in protection of the low permeability layer. In addition, the vegetative layer serves to reduce the amount of water which percolates into the final cover by maximizing evapotranspiration.

Landfill final covers have the following functions:

- ! Prevent or minimize percolation of precipitation into the landfill;
- ! Promote drainage of precipitation;
- ! Vent and control landfill gasses;
- ! Isolate solid wastes from the environment;
- ! Accommodate settling and subsidence.
- ! Promote site reclamation;
- ! Suppress vectors;
- ! Promote aesthetics;

Landfill final covers should have the following attributes:

- ! Resistance to wind and water erosion;
- ! Resistance to slumping and cracking;
- ! Resistance to slope failures;
- ! Resistance to cold-weather freeze-thaw cycles;
- ! Resistance to disruption by animals and plants.

B. Design Considerations

The following design features should be considered during closure of landfills and design of the final cover:

- ! The ultimate contours of the landfill;
- ! Storm water controls such as ditches, drains and terraces, particularly with regard to prevention of erosion (see chapter 3);
- ! Vegetation suitable for the climate and type of cover soil, with consideration of planting and upkeep of

vegetation;

The following items should be considered in determining the final design of a landfill cap:

- Prevent storm water infiltration
- The vegetative support/protection layer must be thick enough to protect the low permeability layer;
- The cover should minimize degradation of the cap due to freeze-thaw cracking;
- The final cover must be designed to prevent root penetration and animal penetration of the low permeability layer;
- The cover design must take site settlement and consolidation into consideration.
- Control landfill gas emissions including odor control.

C. Construction Considerations

The cap should be constructed over a foundation layer capable of supporting the weight of the cap and against which a clay cap can be adequately compacted. The cap itself should be compacted to not less than 90% Modified Proctor, ASTM method D1557-78. The cap material should also be compacted at a moisture content wet of optimum as determined by the Modified Proctor test.

The eighteen (18) inch thick impervious soil layer should be constructed in three six-inch compacted lifts.

XIV. LANDFILL CAP - MINIMUM DESIGN REQUIREMENTS

VEGETATIVE
* SUPPORT
* LAYER
(18 in.)
DRAINAGE
* LAYER
*$1x10^{-3} cm/s

CLAY or FML
* CAP
*#1X10^{-7} cm/s

-SUBGRADE/GAS
LAYER
*
* WASTE
* LAYER
*

Figure 1-2: Minimum Final Cover (Cap) Design

As specified in the landfill regulations, the minimum design standards for landfill final cover systems require:

- A subgrade layer;

- A gas venting layer (minimum hydraulic conductivity of $1x10^{-3}$cm/sec.);

- A low permeability layer with a thickness of at least 18 inches and a maximum hydraulic conductivity of $1x10^{-7}$ cm/sec or a Department approved FML. The cap should have a hydraulic conductivity no greater than the liner;

- A drainage layer consisting of either 6 inches of soil with a hydraulic conductivity of $1x10^{-3}$ cm/sec or a synthetic drainage net; and

- A vegetative support/protection layer with an overall thickness of at least 18 inches, of which at least 12 inches must be capable of supporting vegetation.

A. Design Considerations

1. Subgrade Layer

The subgrade layer should have the following attributes:

- Be free of materials which could abrade or penetrate the low permeability cap;
- Be of sufficient thickness and structural strength to support construction activity and provide for long-term final cover system integrity;
- Be a minimum of 12 inches thick. This may include the 6 inches soil gas venting layer.

2. Gas Venting Layer

The gas venting layer should have the following attributes:

- A minimum hydraulic conductivity of $1x10^{-3}$ cm/sec;
- Provide adequate filters above and below the gas venting layer if the layer is not self-filtering;
- Gas vent pipe penetrations should be designed to ensure that any geomembranes are not damaged should there be differential settlement between the pipe and the geomembrane; and
- Horizontal collection pipes imbedded within the layer should be considered where necessary.
- Be capable of functioning as a component of an active gas collection system if necessary.

3. Low Permeability Layer

The final cover impermeable layer should meet the materials specification and construction considerations of the impermeable layers (both soil and FML) specified in the groundwater protection system section of this guidance. Additional design considerations should include:

- The effects of consolidation and settlement on the layer;
- Evaluation of freeze/thaw impacts;
- Determination of slope stability of this component, particularly the interface with other components of the

final cover system; and,

- Consideration for erosion control when using clay for this layer.

4. Drainage Layer

This layer should include the design and construction considerations of the drainage layer used in the groundwater protection systems. However, the minimum hydraulic conductivity required for the soil drainage layer is $1x10^{-3}$ cm/sec and not $1x10^{-2}$ cm/sec as specified for soil drainage layers over a liner. Design considerations should include:

- An evaluation of the potential for fines to migrate from the upper layer and a determination of the need for a filter between layers;

- A determination of the volume and discharge points of water transported by the drainage layer;

- An evaluation of the need to provide additional drainage capacity through addition of perforated pipes or other materials;

- An equivalency determination where synthetic materials are substituted.

5. Vegetation Support/Protection Layer

The thickness of topsoil applied to the final cover affects the storage of water for use by vegetation. Greater thicknesses increase storage of water. This factor may result in greater leakage rates, but will also provide better conditions for vegetation and soil stability and decrease soil erosion.

The type of topsoil used directly affects runoff and evapotranspiration by controlling the rate of infiltration. Fine-grained topsoils have lower hydraulic conductivities; therefore, runoff is greater. In addition, infiltrated water remains nearer the surface for longer duration, providing greater availability for evapotranspiration. Fine-grained topsoils also have greater water storage and capillarity capabilities which increase evapotranspiration.

It is preferable to have as dense a stand of grasses as possible to protect the final cover from erosion, maintain the moisture content of the topsoil, and maximize evapotranspiration from the vegetation. Therefore, it is recommended that the vegetative support layer be, at least, one foot thick in order to promote good root growth to prevent penetration of roots into the clay cap layer, and prevent freeze-thaw cracking of the cap. In addition, the thicker the vegetative support layer the greater the vegetative height and density, both of which promote evapotranspiration.

The soil used for the vegetative layer of the final cover should be tested for pH, nutrients, organic matter content and bulk density. Soils should then be modified by adding fertilizers, lime and organic matter (such as composted leaves) or other materials to correct for deficiencies. Compacted soils should be scarified and similarly modified with organic matter prior to seeding.

A number of alternative materials (e.g. compost/paper sludge mixtures etc) have been presented to the Department for approval for use in topsoil. Consideration of alternative materials are done on a case by case basis considering the chemical and physical properties of the material proposed. It should be noted in this regard that consideration of alternative materials usually require other Department approvals such as Division of Solid Waste Beneficial Use Determination or Demonstration Project, Division of Water Pollution Control Land Application Certificate, etc. Proponents of alternative materials must document all other Department approvals required.

The vegetative support layer should:

- Have a total thickness of 18 inches, the top 12 inches of which should be capable of supporting vegetation and the bottom 6 inches of which can act as a drainage layer;

- Be constructed so that storm water is diverted away from exposed unvegetated slopes;

- Be vegetated ASAP to minimized erosion;

- Be tracked with bulldozer so that drozer marks run parallel with contour lines to reduce erosion and promote retention of seeds;

- Achieve 90% areal coverage of healthy grass growth, at least, 2" high within 90 days of seeding.

6. Vegetative Cover Layer

Vegetation growing on the final cover results in decreased runoff and increased evapotranspiration and lateral drainage. The most important function of a good vegetative layer is the reduction in erosion of the cover.

The type of vegetation chosen for the final cover should be tolerant of the conditions to be found in a landfill environment. These conditions include the presence of methane gas in the root zone, thin soil cover (and therefore a shallow root zone), and dry conditions. Semiannual mowing is recommended to encourage growth of most ground covers and to discourage the growth of shrubs and trees.

It is recommended that Vols. I and II of the Massachusetts Conservation Guides, <u>Erosion & Sediment Control in Site Development</u> and <u>Vegetative Practices in Site Development</u> (USDOA, SCS, 1983, Amherst) be consulted for further information on this subject.

XV. ALTERNATIVE LINER DESIGN

In order to allow flexibility in the design of liners and to allow for use of new materials in the future, the regulations (19.111) allow an owner or operator to propose groundwater protection system designs or final cover system designs which differ from the minimum design specified in the regulations. The proponent must, however, demonstrate that the alternative design will provide an "equivalent" level of protection to surface water and groundwater resources when compared to the standard liner design and have the characteristics outlined above.

An alternative liner design will be approved only when the applicant is able to demonstrate, to the satisfaction of the Department, that the alternative design will meet the following conditions: (see Solid Waste Regs @ section 19.105, Equivalency Review Standards and Procedures)

- Achieve the performance standards specified in the regulations;
- Protect surface and groundwater resources;
- Be equivalent or superior to the minimum design standards established in the regulations;
- Utilize materials, technologies or methods that have been demonstrated over time to be successful in similar applications; and,

- Be constructed using acceptable Quality Assurance/Quality Control procedures.

Where a proposed alternative design incorporates materials and/or technologies that have not previously been demonstrated to meet performance standards, the Department may choose to approve the alternative design as a demonstration project which will be limited only to a portion of the site.

XVI. GROUNDWATER PROTECTION SYSTEM AND FINAL COVER WAIVERS

The Department will consider granting a waiver from a specific design requirement of the groundwater protection system or final cover system components when it can be demonstrated to the Department's satisfaction that the minimum design is unnecessary to adequately protect groundwater or surface waters. Generally, a waiver will not be granted to entirely eliminate a design component, but rather to waive or modify the technical requirement of that component. Pursuant to 310 CMR 19.114, landfills handling municipal solid wastes or solid waste combustion facility ash may not apply for a waiver under this section. However, stump and brush landfills and inert waste landfills may be considered for waivers. Factors to be considered by the Department in reviewing waiver requests will include:

- The type of solid waste to be disposed;

- The quality and quantity of leachate likely to be generated; and,

- The physical or hydrogeological characteristics of the site.

XVI. ALTERNATIVE LANDFILL FINAL COVER SYSTEM DESIGN

Section 19.113 of the regulations provides two methods for proposing alternative final cover system designs. An alternative design may be approved if:

1. It is demonstrated to provide equivalent (or better) protection than the performance and design standards of the solid waste regulations at 19.112. [Section 19.105, Equivalency Review Standards and Procedures, establishes the requirements for demonstrating equivalency]; or

2. As a result of a site specific assessment performed

pursuant to 310 CMR 19.150, Landfill Assessment Requirements, the applicant demonstrates that an alternative design would adequately protect the public health, safety and the environment. In general, a request for an alternative of this type would be applicable to old landfills which have not been active for a period of time.

However, if an alternative final cover design is proposed to be constructed at a landfill deactivated after October 9, 1993, the final cover material must have a maximum hydraulic conductivity of 10^{-5} cm/sec.

Alternative Drainage/Vegetative Support Layer Design

Based on experience at a number of landfills, the Department recently determined that the alternative drainage/vegetative support layer design provided below is considered equivalent to the standard regulatory design. This alternative designs may be used during landfill closures, regardless of the type of material used for the impermeable layer. **It must, however, be stressed that the conditions at particular landfills would dictate the applicability of this alternative design.**

Comparison of Standard to Alternative Designs:

ITEM	Std Design	Alt Design
Drainage Sand (10^{-3} cm/sec)	6"	12"
Vegetative Support		
Lower	6" mineral soil with water holding capacity	none
Upper	6" topsoil/loam 3-5% organic	8-9" topsoil/loam 8-10% organic
Total	18"	20-21"

Placement, Monitoring, and Remediation Requirements for Alternative Design:

Placement Requirements:

Topsoil placed with a crawler dozer or equivalent to effectively mix the bottom 2 inches of topsoil with the top 2 inches of the drainage layer.

Measurement:

Surveyed validated depths, or

5 test pits per acre.

Erosion control mat used.

Seeding requirements:

Hydroseed or equivalent.

Monitoring Requirements

Verify depth of topsoil/loam vegetative layer after 1 year.

Vegetation evaluation 1 year later.

Determine root depth after 1 year.

Remediation

Repair localized erosion damage at least twice a year. Add additional 3-4 inches of topsoil/loam and re-seed if vegetation is not adequately established 1 year after placement.

CHAPTER 2
CONSTRUCTION CERTIFICATION, QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

I. INTRODUCTION

A Quality Assurance/Quality Control (QA/QC) program must be implemented during construction of the facility to ensure that both the materials and the construction of the liner or final cover will meet the performance and design standards established in the Solid Waste Management Facility Regulations.

A Quality Assurance program consists of a planned system of activities performed to ensure that the facility is constructed as specified in the design.

A Quality Control program consists of a planned system of inspections performed to control the quality of construction.

A Construction Certification program consists of the affirmation by a qualified professional engineer that the facility construction has been completed under his/her general supervision in compliance with the approved design plans and specifications. Construction is documented through inspection, observation, oversight and testing methods and procedures.

II. REGULATORY REQUIREMENTS

A. QA/QC Program Components

A QA/QC plan must be submitted as a part of the landfill design plan. The QA/QC plan should provide the basis for the construction certification required by 310 CMR 19.106. At a minimum, a QA/QC program is required for the groundwater protection system, the environmental monitoring systems and the final cover system. A QA/QC program for other appurtenances may be required by the Department or submitted by the applicant at the applicant's own initiative.

All recommended procedures established in this Chapter should be included in the QA/QC plan, but may be supplemented by additional or alternative procedures recommended by the manufacturer of the materials or components used in construction of the facility.

Table 2-1: Construction Quality Assurance/Quality Control Program Components for Liner/Final Cover Construction

- Qualifications and Responsibilities of Parties
- Chain-of-Command, Meetings and Reporting Structure
- Soil Components of the Ground Water Protection System or Final Cover System
  - Pre-construction testing of soil sources
  - Test fill construction and testing
  - Construction testing for material evaluation
  - Construction testing for performance properties
- Geosynthetic Components of the Ground Water Protection System or Final Cover System
  - Manufacturing
  - Fabrication
  - Handling, storage and transportation
  - Installation
  - Construction with other materials
- Documentation and Certification

A QA/QC program should address the following aspects of landfill construction:

- Design specifications;
- Construction/installation of each component of the liner or final cover;
- Inspection activities;
- Sampling and analysis activities for soils and geosynthetics; and
- Documentation of construction, inspection and sampling activities.

B. Role of the Certifying Engineer

Each phase of construction of a liner or cap needs to be carried out and inspected under the supervision of a qualified professional engineer who shall certify that each phase of construction was completed in accordance with approved plans and specifications.

C. Role of the Independent QA/QC Officer

To properly implement a QA/QC plan, a quality control officer under supervision of the certifying engineer should be at the site at all times during all phases of the construction at the landfill. This person should observe or perform and document all required inspections and sampling of the liner and final cover and other components of the facility and witness all remedial construction activities.

A QA/QC Officer's qualifications should consist of:

- Engineering training and/or training with practical, technical, and managerial experience in landfill related construction projects.

A QA/QC Officer's and/or Certifying Engineer's Role includes:

- Review of design criteria, plans, and specifications,
- Training of QA/QC staff,
- Scheduling and supporting QA/QC activities and inspections,
- Determination and certification that all materials and construction of the landfill adhere to approved design plans and specifications, including:
  - Determination of the initial and final grades of the landfill;
  - Oversight of the installation and construction of all components of the liner or final cover;
- Oversight of the installation and completion of run-on and run-off controls, pumps, monitoring devices and other appurtenances,
- Oversight of material and equipment used for QA/QC testing and verify all data generated through the testing program;
- Ensure that as-built plans, where required, accurately reflect the constructed facility; and

Table 2-2: Elements of a Construction Documentation Report

Major Elements	Components
Engineering Plans	@ Completed sub-base elevations @ Final clay liner grades @ Leachate collection lines, cleanouts, and manholes with spot elevation every 100 feet along the lines and at all manhole entrances and exits @ Drainage features @ All monitoring devices @ Spot elevations at all breaks in slope and on approximate 100-foot centers @ Document testing locations @ Other site information as appropriate
Engineering Cross-Sections	@ Minimum of two cross sections, bisecting each other
Comprehensive Narrative	@ Explaining how construction of the project was accomplished along with an analysis of all soil-testing data obtained. This report should also include an appendix containing all the raw data from the field and laboratory testing
Series of Photographs	@ Documenting all major aspects of site construction
Construction Certification	@ Should be certified by a registered

! Documentation of all construction and QA/QC activities.

Many liner or final cover failures are attributed to faulty installation or a lack of adequate QA/QC testing during installation. The DEP will not authorize operations or approve the closure of a landfill until it is documented that the liner or final cover has been constructed in a way which meets the performance and design standards established in the regulations.

D. Experience of the Liner Manufacturer and Installer

The liner installer should also have extensive experience in the trade including having installed at least 10 million square feet of similar materials. Installation of liners and final covers should be carried out under the direction of a person with extensive experience in the installation of liners and final covers. Installation of FML materials should be under the direction of a person who has installed a minimum of 1 million sq. ft. of similar liner material.

III. QA/QC TESTING GUIDANCE FOR SOILS

A. Introduction

QA/QC testing of soil materials to be used either for a liner or a final cover must consist of two components. The first component consists of tests at the source of the soil material to ensure that soils meeting the design requirements exist in sufficient quantity and with sufficient quality for the proposed application. The second component consists of tests on compacted soils to ensure that the in-place material meets the design standards. Tests on the in-place material may take two forms: laboratory tests on undisturbed samples removed from the compacted liner; and in-situ tests of the compacted liner.

QA/QC programs must incorporate both source testing and in-place compacted liner testing to ensure that the low permeability soil layer will function as designed (See Tables 2-3, 2-4 and 2-5.)

B. Subgrade or Foundation Layer Testing

The subgrade layer for liners or final covers must be capable of supporting the weight of the fill material or the final cover and be structurally stable. For liners, subsurface investigations should be conducted to determine the suitability of underlying layers to support the proposed fill.

Foundation soils for liners, if constructed as fill, should be tested with methods established in Table 2-3. The foundation layer should be built in six inch compacted lifts.

The foundation layer for a final cover will often vary in depth in order to provide a smooth even surface prior to cap placement. The foundation layer should be at least 12 inches thick. This may include the gas venting layer. Based on grain size analyses, it may be necessary to use a filter fabric between the foundation layer and any impermeable soil layer to prevent piping. In addition, the foundation layer must not consist of abrasive materials that would damage the impermeable layer.

Table 2-3: In-Place Sub-Grade Layer Testing ~~Requirements~~ Recommendations

Type of Test	Field Testing Method	Frequency (each 12" thickness in fill area)
Unconfined Compressive Strength	ASTM D 2166	1 test/acre
Direct Shear Tests	ASTM D 3080	1 test/acre
Triaxial Compression	ASTM D 2850	1 test/acre
Grain Size Analyses	ASTM D 421 ASTM D 422 ASTM D 1140	1 test/acre

C. Low Permeability Soil Borrow Source Testing

The source or sources for low permeability soils intended for use as liners or final covers must be periodically tested in order to ensure that a potential source will provide sufficient material which meets the specifications for the liner or final cover. The Department suggests that each source be tested for index parameters at the frequencies indicated in Table 2-5. Site specific conditions at the pit may indicate that more frequent testing be performed.

D. Low Permeability Soil In-Place Testing

Testing of compacted soils should incorporate both laboratory testing on (Bloch or Shelby Tubes) undisturbed samples removed from the low permeability soil and in-situ testing using infiltrometers. Laboratory measured soil permeabilities will demonstrate hydraulic conductivities only for a very small sample area while in-situ tests using infiltrometers will provide a more accurate indication of hydraulic conductivities actually produced in the field over a larger surface area. In-situ tests will provide a truer indication of whether the design standard of 1×10^{-7} cm/sec has been achieved since in-situ tests may measure hydraulic conductivities that are significantly larger than those

Table 2-4: In-Place Testing ~~Requirements~~ Recommendations for Low Permeability Soils
(Each Lift Unless Otherwise Noted)

Type of Test	Testing Frequency	Testing Method
In-place Density and Moisture Content	5 tests/acre	ASTM D 1556 or ASTM D 2922 and ASTM D 3017
Undisturbed permeability (Triaxial Cell Method with back pressure)	1 test/acre	U.S. Army Corps of Engineers Manual, EM 1110-2-1906 Appendix VII Permeability Tests
Atterberg limits (liquid limit and plasticity index)	1 test/acre	
Grain size & Hydrometer	1 test/acre	
Moisture-density curve (as per clay borrow requirements)	5,000 yd^3 and all changes in material	

measured using laboratory measurements. Table 2-4 presents recommendations for in-place testing of low permeability soils.

Guidance on soils testing includes the following:

- A QA/QC program to determine whether a soil liner meets the design standard for hydraulic conductivity should take into consideration the area of the liner in determining the minimum number of samples to take from the liner. Either a large area of the liner is tested using infiltrometers or several undisturbed samples are removed for laboratory testing.

- When nuclear methods are used to test in-place density and moisture content, a minimum of one sand cone test or balloon test should be taken for each twenty (20) tests taken using nuclear methods. A minimum of one sand cone test should be taken for each day of work at the site to confirm the results of nuclear methods.

- When the triaxial cell method is used to measure undisturbed permeability, the confining stress applied to the sample should be no greater than that present in the field. (i.e. 1 psi)

- The generally utilized method of removing undisturbed samples of compacted soils is with a Shelby tube.

The Quality Control Officer and the General Contractor shall prepare a "Permeability Curve" that documents and defines boundaries or required densities and water contents in order to achieve acceptable permeabilities. Permeability tests for each source should be performed at varying ranges of water content (i.e. from optimum to 8% above optimum) and densities. Densities should be maintained at or above 90% of maximum density as per modified proctor. The permeability tests should then be plotted on the moisture density curve. The acceptable range of density and water content to achieve the required permeability can then be plotted. As additional reconstructed permeability tests (not Shelby Tubes) are performed these results can be added to the "Permeability Curve" further defining the acceptable ranges. An example is shown in Figure 2.1. If the soil source changes during the project, a new permeability curve would be required.

E. Drainage/ Gas Venting Layer Testing

Minimum testing requirements for granular drainage/protection materials for liners or final covers are established in Table 2-6.

F. Topsoil Layer Testing

Minimum testing requirements for vegetative support/topsoil materials for final covers are established in Table 2-7.

G. Checklists

The EPA manual entitled "Seminars - Design and Construction of RCRA/CERCLA Final Covers" contains checklists of important geotechnical and construction parameters for impermeable soils and other soils used in final cover and liner systems. These checklists can be used for recording and reporting information relative to construction of final cover and liner systems.

Insert freelance drawing as figure 2.1

Table 2-5: Borrow Source Low Permeability Material Testing ~~Requirements~~ Recommendations

Type of Test	Testing Frequency *	Testing Method
Grain size	2,000 yd^3	ASTM D 422
Moisture content	2,000 yd^3	ASTM D 2216
Moisture-Density curve	5,000 yd^3	ASTM D 1557
Atterberg limits (liquid limit and plasticity index)	5,000 yd^3	ASTM D ~~423 and~~4318 ASTM D ~~424~~4318
Lab permeability (triaxial cell method with back pressure)	10,000 yd^3	U.S. Army Corps. Engineers Manual, EM 1110-2-1906 Appendix VII Permeability Tests

* Tests should be conducted at the established testing frequency or any change in material

Table 2-6: Granular Drainage Material Testing ~~Requirements~~ Recommendations

Type of Test	Testing Frequency	Testing Method
Grain size (to the #200 sieve)	1,500 yd^3	ASTM D422
Permeability	3,000 yd^3	ASTM D2434

Note: Applicable to gas vent testing

Table 2-7: Vegetative Support Layer
(Topsoil) Material Testing ~~Requirements~~ Recommendations

Type of Test	Testing Frequency	Testing Method
Grain size	1000 yd^3	
Ph	1000 yd^3	
Organic %	1000 yd^3	Ignition Test

IV. QA/QC TESTING GUIDANCE FOR GEOSYNTHETIC MATERIALS

A. FML Liner Testing

As with a QA/QC program for soils a QA/QC program for installation of FMLs must include a quality control component for the FML material and a quality assurance component for installation of the FML. The manufacturer of the FML material should maintain detailed quality control documentation and be able to provide certification of the quality of all delivered materials. Delivered materials should be carefully inspected to ensure that materials have not been damaged in transit or during storage at the landfill site.

Installation of the FML should be overseen by a person experienced in installation. Frequent seam testing must be done to ensure the integrity of the installed material. QA/QC requirements should include the following:

- FML welding equipment should be operated until a pre-weld sample has been run and the sample has been tested in the field in both peel and shear utilizing a micrometer separation device (tensiometer). Coarse screwed testing apparatus' are unacceptable.

- Each welding machine must pass pre-weld testing at least every 4 hours of operation, and after any noticeable change in temperature or humidity.

- The liner material should be continually inspected for uniformity, damage, and imperfections such as holes, cracks, abrasions, thin spots, or foreign materials. Immediately after installation and seaming the liner should be inspected to ensure the absence of tears, rips, blisters, or punctures. Any imperfections should be immediately marked and repaired, reinspected and surveyed;

- All field seams must be 100% quality tested after they have been allowed to develop to full strength according to appropriate techniques for the type of seaming procedure used;

- 100% of seams should be tested with either a vacuum box or pressure tested (double weld seams);

- Destructive seam tests for peel and shear strength should be done a minimum of every 500 feet of seam, but not less than 2 times per day, including the beginning, middle, and end of each work day.

B. Synthetic Drainage Material or Geonet Testing

Geotextiles and geonets should be tested so as to determine:

- Equivalent opening size;
- Hydrostatic bursting strength;
- Tearing strength (trapezoidal);
- Compression behavior/crush strength.

Table 2-8: Test Methods for Use With Geotextiles in Filter or Drainage Applications

Material	Test to Determine	Test Method
Geonet	Transmissivity	ASTM D4716
Geotextile	Permittivity	ASTM D4491
Geotextile	Apparent Opening Size	ASTM D4751
Geotextile	Gradient Flow	CW-02215*
Geotextile	Long Term Flow	GRI-GT1**

*Corps. of Engineers Test Method

**Geosynthetic Research Institute Test Method

C. FML Checklist

All FMLs used in liner and cap installations should be inspected and necessary installation testing completed in accordance with the manufacturer's requirements. Documentation of FML QA/QC testing should be included with the as-built records submitted to the Department.

Record drawings certified by the certifying engineer and registered land surveyor must identify the location of all seams, penetrations and repairs.

The EPA manual entitled "Seminars - Design and Construction of RCRA/CERCLA Final Covers" contains typical manufacturer's requirements for installation of a High Density Polyethylene (HDPE) FML. This is presented as a sample of the type of QA/QC associated with FML installation.

CHAPTER 3 STORM WATER MANAGEMENT and SURFACE WATER PROTECTION

I. INTRODUCTION

Storm water management refers to all measures incorporated into a landfill design and operation to control and manage storm water run-off and run-on.

Storm water run-off and run-on is generated from precipitation. At landfills run-on generally originates outside of the filled area and then flows onto the landfill because of grade differences between the landfill surface and the surrounding area. Run-on may also occur from higher to lower grades within a landfill. It is necessary to control both types of run-on because it may lead to increased infiltration of water into the waste resulting in increased production of leachate. Run-on which does not infiltrate into the waste may collect landfill contaminants at the surface and eventually be included in water that runs off the surface of the landfill.

Run-off refers to the movement of water from the surface of the landfill onto the area surrounding landfill. Run-off needs to be controlled because it causes erosion and transport of materials, which may have adverse impacts on the surrounding areas. Runoff from landfills can, therefore, potentially contaminate surface water bodies and/or groundwater if it is not managed properly.

Surface water protection refers to all measures instituted to protect surface water bodies - ponds, rivers, streams, wetlands, etc - from contamination, including erosion and sediment control, associated with landfills.

This chapter introduces the issues involved in storm water control and surface water protection. Performance goals for landfill management of storm water run-on and runoff are discussed. Methods to obtain these goals are presented with brief descriptions of storm water control methods, followed by design standards for landfill storm water control systems. The Chapter concludes with a discussion of state and federal regulations relating to landfills and storm water.

II. PERFORMANCE GOALS

Design of landfills shall incorporate controls for the management of storm water run-on and run-off, during the construction, active life and closure/post closure periods. Run-on and run-off shall be controlled in order to:

- ! Maintain the integrity of the landfill by preventing erosion of the liner, solid waste or cover material [310 CMR 19.115, 19.130(20)];

- ! Minimize the quantity of water running onto the filled areas to minimize leachate production by preventing ponding and the infiltration of water into the waste [310 CMR 19.115, 19.130(19)];

- ! Minimize the transport of contaminants, either in suspension or solution, from the landfill onto adjacent areas or into surface water bodies or groundwater.

III. STORM WATER CONTROLS

A number of storm water controls are available for use in addressing run-on and run-off conditions. This section defines the types of controls and purpose for which they can be used.

<u>Storm Water Management Plan</u>: A storm water management plan should include all measures needed to achieve the goals stated above. In particular, the plan needs to be designed in such a way that the specific requirements for storm water control of each stage of the landfill development are considered and addressed. These stages include construction (liner and final cover) active areas (i.e. ongoing landfilling), and long term maintenance areas (i.e. intermediate and final cover).

<u>Land Grading</u>: Grading refers to the reshaping of the ground surface to planned elevations as determined by engineering survey, evaluation and layout. It is used to provide more suitable topography for final cover materials, control surface water runoff, minimize soil erosion and provide for sedimentation control.

<u>Surface Roughening</u>: Roughening refers to using construction equipment on bare soil surface to make horizontal grooves running across the slope, stair stepping, or tracking. The roughened surface aids the establishment of vegetative cover from seed, reduces runoff velocity and increase infiltration, reduces erosion, and provides for sediment trapping.

<u>Temporary Seeding</u>: This refers to the planting of rapid-growing annual grasses, small grains, or legumes to provide initial, temporary cover for erosion control on disturbed areas. It is used to temporarily stabilize denuded areas that will not be brought to final grade for a period of more than 30 days.

Temporary seeding controls runoff and erosion until permanent vegetation or other erosion control measures can be established.

<u>Permanent Seeding</u>: This is the control of run-off and erosion on disturbed areas by establishing perennial vegetative cover with seed. It is used to reduce erosion and decrease sediment yield from disturbed areas, and to permanently stabilize such areas in a manner that is economical, and adapts to site conditions.

<u>Rock Riprap</u>: Riprap refers to a lose assemblage of stones designed to protect and stabilize areas subject to erosion. It is used to protect the soil surface from erosive forces and dissipate energy on steep grades or at drainage outlets.

<u>Diversions</u>: A temporary or permanent ridge or channel (or combination of the two) constructed on a designed grade across sloping land. It is used to protect work areas from upslope runoff, to divert sediment-laden water to appropriate traps or stable outlets, and to divert water from areas where it is in excess to locations where it can be used or released without erosion or flood damage.

<u>Diversion Dike</u>: This refers to a specialized diversion which consists of a ridge constructed along the perimeter and upslope of a disturbed construction area. It is used to prevent storm water runoff from entering a work area, and to prevent sediment-laden water from leaving the construction site.

<u>Grass-Lined Channel</u>: A grass-lined channel describes an open conveyance which is provided with vegetated cover. It is constructed at design grade and is used to convey and dispose of concentrated runoff without damage from erosion, deposition, or flooding. Riprap and paved channels can be used to provide similar function.

<u>Level Spreader</u>: This describes a non-erosive outlet for concentrated runoff constructed to disperse flow uniformly across a slope. It is used to convert concentrated flow to sheet flow and release it uniformly over a stabilized area.

<u>Temporary Sediment Trap</u>: This refers to a small ponding basin formed by an embankment or excavation to capture sediment. It is used to temporarily detain sediment laden runoff and trap the sediment to protect receiving streams, lakes, drainage systems, and protect adjacent property.

<u>Sediment Basin</u>: Sediment basin refer to an earthen embankment suitably located to capture sediment. It is used to retain sediment on the construction site and prevent sedimentation in

off-site streams, lakes and drainage ways.

<u>Detention Pond</u>: A detention pond is an earthen embankment or excavated pond whose main purpose is the temporary detention of storm water to control peak runoff rates. A detention basin is used to hold storm water temporarily, enabling outlet structures to effect a controlled discharge to wetland/waterway. It may also act as an effective means of removing pollutants such as sediments, phosphorus, organic matter, trace metals and hydrocarbons by settling; and controlling downstream bank erosion due to reduced velocities.

<u>Retention Pond</u>: This refers to an earthen embankment or excavated pond that usually contains a permanent pool whose main purpose is the storage of storm water runoff to allow for settlement of particulate pollutants and for the stored water to percolate into the ground. It has a high removal rate of sediment, BOD, organic nutrients and trace metals, and can remove soluble nutrients through the use of aquatic plants and algae.

In some cases where landfills are located adjacent to wetland areas, ponds constructed to retain runoff from a capped landfill may be designed in a way that allows some of the run-off to be discharged into the wetland. This will prevent undesirable decrease of water discharged to wetland areas resulting in adverse impacts to the wetland ecosystem.

<u>Infiltration Trench or Basin</u>: These refer to a trench or basin containing coarse stone or sand and gravel through which storm water runoff flows. It is effective at removing soluble and particulate pollutants, and can increase groundwater recharge.

<u>Vegetated Swale</u>: Is a grassed water course whose purpose is to retard the velocity of concentrated runoff which results in increased infiltration of the runoff into the ground. It provides moderate removal of particulate pollutants during small storm events.

<u>Sediment Fence</u>: Is a temporary barrier consisting of filter fabric buried at the bottom, stretched and supported by posts. It is used to retain sediment from small disturbed areas by reducing the velocity of sheet flows to allow sediment deposition. Staked hay bales are also commonly used to trap sediments.

In addition to the standard erosion controls listed above, landfill operators are encouraged to use erosion control "mats" during construction activities at landfills. These will further reduce the amount of erosion on active construction faces and reduce solids that may potentially be discharged to receiving surface waters around the landfill.

IV. DESIGN STANDARDS

The following design standards are recommended for use in properly managing storm water at sanitary landfill sites:

- Run-on and run-off controls shall be designed for, at a minimum, the peak discharge of a 24 hour 25 year storm;

- Drainage structures must be designed and maintained so as to minimize the effects of differential settling and to prevent undermining;

- Side slopes shall not exceed a slope of 3 horizontal to 1 vertical (3:1). Final top slopes shall be a minimum of 5%. Daily and intermediate slopes may be at other grades as justified by design;

- Terraces should be installed in side slopes for every 15-25 vertical feet of fill. Terraces should be wide enough to accommodate equipment needed for maintenance and repair;

- Methodology (including assumptions, formulas, and defined terms), analysis and calculations should be submitted as documentation for design basis of the storm water management systems.

A. Active Area

The active portion of the landfill is defined as that part of the landfill that has not received intermediate or final cover. The active portion of a landfill, which only has daily cover, represents the area where, potentially, the worst adverse impacts from poor storm water control can occur. These include erosion (cover and solid waste), contact of surface water with the solid waste, leachate outbreaks and subsequent off site transport of contaminants in solution or suspension, and infiltration of storm water into the waste resulting in leachate generation.

Run-on to the active area can usually be effectively controlled through the placement of berms to direct water away from the active area. Run-on can also be controlled by operational controls such as the progression of cell and row development and maintaining proper grades to promote drainage. In particular, the active face needs to be protected from run-on so that daily operations are not hindered. Additionally, the active face will readily allow the infiltration of water into the landfill enhancing leachate generation.

Proper selection and grading of materials used for daily cover should be the primary means to control adverse effects of run-off from the active portion of the landfill. Grading should promote sheet flow of run-off and prevent uncontrolled channelling which may promote erosion of the cover soils or the waste. Flow should be directed as much as possible away from the active (or other unstabilized) areas to stabilized slopes or conveyance devices such as swales or pipes.

Control of storm water run-off from the active portion of the landfill is intended to prevent or minimize discharge of contaminated run-off to any surface water or groundwater and minimize erosion. Any storm water that contacts refuse (or leachate) must be collected and managed as leachate. To verify that contaminated run-off is not migrating off-site, monitoring storm water run-off from the active portion of the landfill may be required.

If monitoring results reveal that the amount and quality of run-off from the active area is above acceptable levels, the Department may require collection and treatment of this run-off. Generally, acceptable levels will be established in the permit review process.

Control/treatment may include a range of options from sedimentation basins for suspended solids removal to collecting and treating the run-off water to remove chemical or biological constituents. If contaminated run-off is intended to be added to the leachate collection system, that system needs to demonstrate that it has the capacity to handle this flow. Uncontaminated surface water should be separated from contaminated waters in order to minimize treatment and/or disposal costs. In addition, if publicly owned sewers are being utilized it is likely that storm water will be prohibited from the conveyance system. It would be landfill operator's responsibility to conform with all necessary regulatory obligations associated with the treatment/disposal of runoff from the landfill.

B. Long Term Maintenance

Run-on/run-off control on portions of the landfill that have intermediate or final cover are primarily aimed at long term stabilization and erosion control of the cover materials. This may involve control of runoff volume and velocity with appropriate location of structures to control sediment load of the storm water run-off discharges. Slope angle, slope length, vegetation, terracing and sedimentation-detention basins, stable water conveyance structures (swales, culverts, pipes, etc) and energy dissipators are central elements in preventing erosion and controlling volume and velocity. In some cases, it may, however, be necessary to allow some of the runoff from control structures to be discharged into receiving water bodies to maintain flow and quantity necessary to support aquatic species adjacent to the landfill. Inclusion of such discharges should be adequately presented and justified in design reports and plans.

C. Design plans and Reports

Solid Waste Regulation (310 CMR 19.000) requires that the basis for storm water controls at the active portion of the landfill be a 24 hour, 25 year storm event (19.115). It is recommended that the design basis for storm water controls on other parts of the landfill also be a 24 hour, 25 year storm event. When wetlands are associated with the facility, the 24 hour 100 year storm should be used as the design basis.

The design report for the storm water management plan needs to identify the design method used as the basis for the proposed run-on/run-off control system. Usually a water balance approach is used to define the problem. The water balance equation is:

run-off = precipitation + run on -infiltration - surface storage - evaporation/transpiration.

Methodology and calculations need to be submitted to justify the chosen design. Commonly used methods for run-off modeling include the Soil Conservation Services (SCS) Method, the Rational Method and the Hydrologic Evaluation of Landfill Performance (HELP). The citation for these methods can be found in the references at the end of this manual.

The design report should evaluate run-off and run-on controls for, at least, the following five (5) stages of the landfill development:

1. Construction considerations during liner construction.

2. During initial landfilling in new phases or sections.

3. At mid life of the landfill during active development of a phase. Preferable when the largest amount of active area is exposed.

4. Construction considerations during final cover and closure activities.

5. Post closure.

Calculations and analysis need to include the volume, velocity, and discharge locations and/or fate of the run-off. Impacts to the surrounding properties and effects on local drainage basin(s) need to be evaluated. An engineering plan depicting drainage routes, flow patterns and areas on and off the site receiving the run-off needs to be provided. Engineering details of all run-on/run-off control measures including water ways, swales, ditches, terraces, pipes, etc. need to be provided.

Generalized erosion of cover material from the landfill is a common and persistent problem. The Department recommends a design goal of limiting erosion to less than 2 tons/acre/year. The Department strongly recommends that terraces/benches be incorporated into design of all side slopes. Placement of terraces/benches is recommended at a frequency of every 15-25 feet of vertical elevation change depending on slope steepness, slope length, type of soil, and volume of water from the top slope that may enter the side slope. Terraces should be built with reverse slope, with a minimum of 1 foot depth and should have a gradient of 1-2% to stable down slope conveyance outlets. Terraces should be wide enough to accommodate necessary maintenance equipment.

Stable outlets that go down side slopes need to be designed in a way that they are not undermined by erosion at their discharge points. Energy dissipaters, therefore, need to be provided at the discharge of all down slopes outlets and at all locations where velocity in the conveyance structure may cause erosion. Rapid stabilization of slopes is a primary goal of storm water management systems. Vegetation is an effective tool in slope stabilization. The use of mulches, compost, fertilizers and hydro-seeding is encouraged for establishing and maintaining vegetation. Vegetation should not be used solely for final covers but is recommended for use on slopes which have received intermediate cover as well. Other methods to stabilize slopes include the use of stone mulches and synthetic and natural fiber erosion control mats.

Unstabilized slopes, such as daily, intermediate, and final slopes before being stabilized by vegetation or other means, generally represent areas most susceptible to erosion. These slopes should be protected from run-on, the most common source of which is from the top slope of the landfill, to minimize the volume of water flowing down these slopes.

Temporary diversion structures, such as berms along the top of the slope, can be used to direct water to stabilized slopes and/or stable down slope conveyance structures. Additional temporary slope protection may be needed along the length of these slopes to control erosion. Additional erosion control measures include terraces, berms, erosion mats or synthetic covers.

Maintenance requirements of all storm water control structures should be incorporated into the standard operating procedures for the landfill. An Operation and Maintenance (O & M) report should identify the procedures and frequency at which storm water management structures would be inspected, tested, cleaned or otherwise maintained to ensure proper functioning.

The O & M report should also contain the testing parameters, frequency and sample collection requirements, if any, for the monitoring of run-off water from the active area.

Engineering design plans should include:

A. Design Report

- ! A report containing a description of all intended storm water management methods with calculations and analysis supporting the proposed design.

B. Engineering Plans

- ! A sheet showing volumes, flow directions and discharge locations of all storm water and

- ! A sheet of engineering details, in plan view and sections, of typical surface water control structures such as swales, sedimentation basins, down slope water conveyances, rip rap, etc.

C. Construction Specifications

- ! A sufficient description and details of methods and materials for constructing the storm water control system, and

- ! A description of methods employed to control storm water during construction.

D. Operation and Maintenance Manual

- ! An identification of all procedures and schedules needed to maintain the storm water control structures.

- ! An identification of run-off and storm water monitoring locations, frequency and parameter testing requirements.

V. REGULATIONS

Control of storm water is regulated by the Department's Divisions of Water Pollution Control, Wetlands and Waterways, as well as Solid Waste Management. The rest of this chapter discusses the regulatory procedures for these divisions, and those of the US Environmental Protection Agency. The applicability of each of these regulatory requirements should be considered in designing the landfill drainage system.

A. Division of Solid Waste Management

The Division of Solid Waste Management's landfill regulations address storm water management in the following sections.

<u>Storm Water Controls, Section 19.115:</u> 19.115(1) is the general performance requirement to prevent erosion or pollution from landfilling (from the initial construction phase through post-closure). 19.115(2) - Design Standards; specifies that the 24 hour - 25 year storm be controlled (i.e. collected) from the active portions of the landfill. This is the also required under the USEPA's RCRA Subtitle D Section 258.25.

<u>Surface and Groundwater Protection, Section 19.116:</u> Regulates the discharge of contaminated runoff or leachate to surface water or groundwater. It also addresses the Division of Water Pollution Control's surface water and groundwater discharge permits (314CMR5.00 and 7.00 respectively) as well as USEPA's National Pollutant Discharge Elimination Systems point source discharge permit.

<u>Top Slope and Side Slope, 19.130(18):</u> Requires a minimum top slope of 5% and a maximum side slope of 3:1.

<u>Storm Water Drainage, 19.130(19):</u> Requires storm water controls to promote drainage off the landfill, minimizing ponding and prevention of run-on through use of diversion structures, ditches, channels, etc.

<u>Erosion Control, 19.130(20):</u> Requires the prevention of erosion of daily, intermediate or final cover, the prevention of siltation off-site, the prevention of solid waste or leachate migration off-site, and the replacement or repair of cover material when damaged by settlement of erosion.

B. Federal Regulations

The USEPA's Resource Conservation and Recovery Act (RCRA) Subtitle D requires that landfills be designed to prevent run-on to the active portion during peak discharge of a 25-year storm. Owners or operators of landfills are also required to "design, construct, and maintain a system to control run-off from the active portion of the landfill [which must] collect and control, at a minimum, the water volume resulting from a 24-hour, 25-year storm." In a clarification, the EPA stated that the collected run-off should "be handled in accordance with the requirements of the Clean Water Act including, but not limited to, the NPDES requirements."

The Clean Water Act (CWA) protects surface waters of the U.S. from storm water pollution with the following general provisions:

- Non-point source discharges will be controlled through implementation of the statewide management plan mandated by Section 319 of the Clean Water Act.

- Point source discharges of pollutants into the waters of the U.S., including wetlands, that violate any requirements of the CWA, including but not limited to NPDES requirements, are also prohibited.

Sanitary landfills are regulated under NPDES as follows:

Landfills that accept industrial wastes will need to file NPDES permit applications. The NPDES regulates "areas of industrial activity." In addition to the sites on which industrial activities are carried out, landfills that accept the wastes from regulated industries are also required to file NPDES permit applications. Industrial wastes are defined as materials received from the following industrial activities:

> Lumber; paper mills; chemical; petroleum; rubber; leather tanning and finishing; stone, clay, and concrete; metal; enameled iron and metal sanitary ware; ship/boat manufacturing facilities; active and inactive mining and oil and gas operations; steam electric power generating facilities; sewage or wastewater treatment; food; tobacco; textile; apparel; wood kitchen cabinets; furniture; paperboard containers and boxes; converted paper/paperboard products; printing; drugs; leather; fabricated metal products; industrial and commercial machinery and computer equipment; electronic equipment; transportation equipment; measuring, analyzing, and controlling instruments; photographic, medical, and

optical goods; watches and clocks; and glass.

This definition includes most municipal solid waste (MSW) landfills.

In addition to industrial activity, NPDES regulates construction activity, which may produce run-off damaging to water quality. The broad language includes all construction activity except for disturbances of less than 5 acres of total land area which are not part of a larger common plan of development or sale. This may include the construction of a landfill cap or expansion when it involves more than 5 acres. This definition includes most sanitary landfills.

NPDES permit requirements are codified in Federal Register/Vol. 57, No. 187/Friday, September 25, 1992/Notices. Compliance with the general permit requires submission of a Notice of Intent (NOI) to EPA which includes a pollution prevention plan that identifies Best Management Practices (BMP) that will be incorporated into the activities on site to prevent adverse impacts to the waters of the Untied States from storm water discharges. References on how to develop pollution prevention plans and use of best management practices are identified in the reference section of this document.

C. Summary of Federal and Massachusetts Regulations

The following table lists the regulations which apply to storm water, how they would be applicable to the operation, closure or post-closure use of a sanitary landfill, what permit would be issued and who would issue it.

Regulation	Landfill Application	Permit Required
Clean Water Act		
!Storm Water Regulations (40 CFR 122).	Point source discharges at: New Construction (or constructing cap) totalling > 5 acres or Active portion if accepts industrial waste and serves community	NPDES general permit. FR/Vol.57/ No.187/Friday 9/25/92/ Part III+IV

!Other point source discharges that may be regulated (CWA section 402)	All types of landfills: Detention/sedimentation basins. Long term cover, intermediate, final, and post closure	NPDES permit issued jointly by EPA and DWPC or possible DWPC permit if discharge to groundwater
!Non-point source discharges. State or area wide water quality management plan	Prevent erosion and/or other impacts to surface water bodies from landfills	None
Massachusetts Wetlands Regulations 310 CMR 10.00	Limit destruction of wetlands during construction and closure of landfill. Prevent/minimize impacts to wetlands from storm water discharges. Minimize effects on flood control and storm storage	Order of Conditions from Local Conservation Commission

Regulation	Landfill Application	Permit Required
RCRA Subtitle D 40 CFR 258		
258.25 Run-on runoff	Active portion of landfill (not intermediate or final cover) collect and control 24-hour 25-year storm	DSWM (Approved State Program)
258.27 Surface water requirements NPDES	Prevent impacts to surface water	DSWM (Approved State Program)
Massachusetts Solid Waste Regulations 310 CMR 19.000		

19.115 Storm water controls	General performance requirement to prevent erosion or pollution from landfilling - initial phase through post closure. Guidance on BMP. Also specifies design requirement for active portion of landfill: control and collect 24-hour 25-year storm. RCRA D 258.25	DSWM
19.116 Surface and groundwater protection	! Prevent discharge of contaminated run-off or leachate to surface water or groundwater.	! DSWM ! NPDES and DWPC point source discharge permits ! DWPC non-point source pollution control requirements
19.130(18) Top slope and side slopes	Minimum top slope = 5% Maximum side slope 3:1	DSWM
19.130(19) Storm water drainage	! Promote drainage off landfill, minimize ponding and prevent run-on ! Diversion structures: ditches, channels, etc.	DSWM
19.130(20) Erosion control	! Prevent erosion of daily cover ! Prevent siltation off-site ! Prevent solid waste or leachate migration off site ! Replace/repair cover as needed due to settlement or erosion	DSWM

CHAPTER 4 ENVIRONMENTAL MONITORING PROGRAM

I. INTRODUCTION

An environmental monitoring program should be considered as integral a part of a landfill's operation as refuse compaction or daily cover. It is important to properly monitor the local environment around the landfill to ensure early detection of any environmental problems that may occur. A good monitoring program can provide an operator with reliable documentation of a groundwater protection system's effectiveness as well as information relevant to potential health effects associated with landfills.

To develop an adequate and successful monitoring program, a full environmental assessment must be performed to meet the performance and design standards as specified in 310 CMR 19.118. The groundwater, surface water, leachate and landfill gas monitoring programs are designed during the assessment/facility design process. Chemical parameters of concern are determined and a sampling frequency is established. Chapter 5 describes the assessment process and its importance in more detail. Each of the environmental monitoring programs are discussed separately in the sections that follow.

II. MASSACHUSETTS CONTINGENCY PLAN: Adequately Regulated

Many landfills have been subject to both the Solid Waste Management Regulations, 310 CMR 19.000 and 310 CMR 16.000, and the Massachusetts Contingency Plan (MCP) 310 CMR 40.000. The 1988 MCP applied to facilities permitted by the DSWM unless they obtained a Department waiver from those requirements. The Department rarely exempted facilities from MCP requirements.

However, the revised MCP which was released in 1993, contained provisions (40.0110 Adequately Regulated) that are designed to reduce regulatory overlap and duplication between the DSWM and the BWSC. The Adequately Regulated provisions waive the application of some, but not all, of the provisions of the MCP. The overall intent is to meet the MCP substantive requirements to eliminate significant risk while following the procedural requirements of solid waste regulations. Regardless of the procedures followed, the Department expects all landfill facilities with releases or threats of releases of oil or hazardous materials to be cleaned up to an equivalent extent with appropriate oppurtunities for public involvement. The adequately regulated provisions allow the full extent of oil and hazardous material releases to be addressed and may require activities to address problems beyond the solid waste facility. These provisions limit the applicability of the MCP in cases where response actions (assessment and remediation) are adequately overseen by the DSWM and these actions are conducted in accordance with DSWM permits or approval and certain provisions of the MCP.

If a site or response action is not adequately regulated as a solid waste management <u>all</u> of the provisions of the MCP will apply including the requirements regarding LSPs, approvals, tier classification, tier 1 permits, submittals etc... . For additional information regarding adequately regulated refer to the MCP Fact Sheet 1 provided in the Appendix.

A. Pre 1971 Landfills

This refers to landfills which ceased accepting waste prior to promulgation of the Solid Waste Management Regulations in 1971. Assessment at pre-1971 landfills are not considered adequately regulated under the MCP unless they are subject of an order or approval from the Department. Specifically, in order for a landfill to be considered adequately regulated the DSWM must either order that a final closure or post-closure plan be filed, or approve a plan for post closure use. For these pre-1971 sites to apply for post-closure use under DSWM regulatory authority, the owner should have a License Site Professional (LSP) prepare a Response Action Outcome (RAO). The RAO should be included with the request for post-closure use submitted to the DSWM and BWSC.

B. MCP Requirements Applicable to Solid Waste Landfills Considered to be Adequately Regulated:

These guidance reflect the January 13, 1995 version of the MCP. It should be pointed out that the MCP is periodically revised and the last version should always be consulted. In order to assure that landfill sites with releases or threats of releases of oil or hazardous material are cleaned up to standards established for hazardous waste sites (or equivalent extent) in the Commonwealth, the following provisions of the MCP must be followed at solid waste facilities:

<u>1. Notification Requirements</u>

(a) Notification of the Department of release or threat of release which requires notification within 2 or 72 hours, including imminent hazards; in addition to any other notifications required under other authorities (310 CMR 40.0300).

(b) Immediate Response Actions (IRA) in response to 2 and 72 hours notification must do so in accordance with MCP provisions of 310 CMR 40.0404-40.0429.

(c) Public Involvement provision activities in accordance with 310 CMR 40.1400 apply to Solid Waste facilities including notification of the Chief Municipal Officer and Board of Health about imminent hazards, response actions to imminent hazards, completion of phases in response actions, field work involving remediation and field work involving Level A, B, or C personal protection including residential properties. Additional public involvement activities are required for Public Involvement Plan Sites (310 CMR 40.1404).

The major provisions of the MCP that apply to solid waste facilities have been listed. However, additional important requirements are set forth at 40.0114 and should be consulted by all parties regulated by DSWM.

2. Two and Seventy-two Hour Notification Requirements:

In accordance with adequately regulated provisions of the MCP (40.0114), the Department shall be notified of releases or threats of release to groundwater or surface water releases that require 2 or 72 hour Notification. Refer to MCP 40.0311(1-9) & 40.0313 (1-4), and 40.0312 & 40.0314, respectively.

Those releases and threat of releases that require two (2) hour notification and are most likely to be encountered at solid waste facilities or associated with assessment of solid waste facilities are as follows:

(a) A release to the environment indicated by the measurement of oil and/or hazardous material in a private drinking water supply well at a concentration equal to or greater than a category RCGW-1 Reportable concentration, as described in 310 CMR 40.0360 through 40.0369 and listed at 40.1600.

(b) Any release of oil and/or hazardous material, in any quantity or concentration, that poses or could pose an imminent hazard, as described in 310 CMR 40.0321 and 40.0950;

An Imminent Hazard is a hazard which would pose a significant risk of harm to health, safety, public welfare or the environment if it were present for even a short period of time. Imminent hazards require notification of the Department within two hours.

40.0312(2) also defines Imminent Hazard as a threat of release to the environment of oil and/or hazardous material that is listed at 40.1600 or that exhibits or could pose an Imminent Hazard, as described in 310 CMR 40.0321, irrespective of the quantity likely to be released.

Due to the nature of Imminent Hazard releases, all Releases and Threat of Releases that pose an Imminent Hazard in accordance with 40.0321 are listed below as they appear in MCP.

40.0320: Releases and Threats of Release that Pose Imminent Hazards

40.0321: Reporting of Releases and Threats of Release that Pose or Could Pose an Imminent Hazard

(1) For the purpose of fulfilling the "Two Hour" release notification obligations of 310 CMR 40.0311(7), the following releases shall be deemed to pose an Imminent Hazard to health, safety, public welfare and/or the environment:

(a) a release to the environment which results in the presence of oil and/or hazardous material vapors within buildings, structures, or underground utility conduits at a concentration equal to or greater than 10% of the Lower Explosive Limit;

(b) a release to the environment of reactive or explosive hazardous material, as described in 310 CMR 40.0347, which threatens human health or safety;

(c) a release to a roadway that endangers public safety;

(d) a release to the environment of oil and/or hazardous material which poses a significant risk to human health when present for even a short period of time, as specified in 310 CMR 40.0950; or

(e) a release to the environment of oil and/or hazardous material which produces immediate or acute adverse impacts to freshwater or saltwater fish populations.

(2) For the purpose of fulfilling the "Two Hour" release notification obligations of 310 CMR 40.0311(7), the following releases could pose an Imminent Hazard to human health:

(a) a release to the environment indicated by the measurement of oil and/or hazardous material in a private drinking water supply well at a concentration equal to or greater than ten times the Category RCGW-1 Reportable Concentration, as described in 310 CMR 40.0360 through 40.0369 and listed at 310 CMR 40.1600; or

(b) a release to the environment indicated by the measurement of concentrations of hazardous material, equal to or greater than any of the following concentrations of hazardous material at the ground surface or within a depth of six inches below the ground surface, at any location within 500 feet of a residential dwelling, school, playground, recreation area or park, unless access by children is controlled or prevented by means of bituminous pavement, concrete, fence, or other physical barrier:

Hazardous Material	CAS number	Concentration (ug/g dry wt)
Arsenic (total)	7440382	40
Cadmium (total)	7440439	60
Chromium (VI)	18540299	10,000
Cyanide (available)	57125	100
Mercury (total)	7439976	300
Methyl Mercury	22967926	10
PCB (total)	1336363	10

(3) For the purpose of fulfilling the notification obligations of 310 CMR 40.0312(2), threats of release which pose or could pose an Imminent Hazard to health, safety, public welfare and/or the environment shall consist of any threat of release where, if the release were to occur, it is likely that release would meet any of the criteria described in 310 CMR 40.0321(1) or 40.0321(2).

(4) Notwithstanding the provisions of 310 CMR 40.0321(2) and 40.0321(3), a person required to notify under 310 CMR 40.0331 may demonstrate to the Department by a preponderance of the evidence that release or site conditions specified in 310 CMR 40.0321(2) and/or

40.0321(3) do not constitute an actual Imminent Hazard to human health, in conformance with the Imminent Hazard Evaluation process described in 310 CMR 40.0426, and in consideration of the site-specific factors and the risk assessment and risk management criteria contained in 310 CMR 40.0950. No such demonstration, however, shall relieve any person of the obligation to notify the Department of a release or threat of release under the provisions of 310 CMR 40.0311 or 40.0312.

(5) No provision contained in 310 CMR 40.0321 shall limit the Department's authority to determine that an Imminent Hazard exists at any site, consistent with the provisions of 310 CMR 40.0950, nor shall any such provision limit the Department's authority to undertake response actions, seek any reimbursement or compensation due to the Commonwealth, or pursue enforcement actions in accordance with any such determination.

3. Releases & Threats of Release Which Require Notification Within 72 Hours (310 CMR 40.0313 & 40.0313):

For a complete list of releases and threats of release that require notification refer to 310 CMR 40.0313 & 40.0314. Those releases that require notification within 72 hours most likely to be encountered at solid waste landfills are as follows:

40.0313(1): a release to the environment indicated by the presence of non-aqueous phase liquid (NAPL) having a measured thickness equal to or greater than ½ inch.

40.0313(3): a release to the environment indicated by the measurement of oil and/or hazardous material in groundwater at concentrations equal to or greater than RCGW-1 Reportable Concentrations, as described in 310 CMR 40.0360 through 40.0369 and listed at 40.01600, within:

15 (a) the Zone I of a public well; or

(b) 500 feet of a private water supply well; or

40.0313(4): a release to the environment indicated by the measurement within the groundwater equal to or greater than 5 milligrams per liter of total volatile organic compounds at any point located within 30 feet of a school or occupied residential structure, where the groundwater table is less than 15 feet below the surface of the ground.

C. Immediate Response Actions

Immediate Response Actions (IRA) in response to 2 and 72 hours notification must be done in accordance with MCP provisions of 310 CMR 40.0404 to 40.0429.

After identification of the Imminent Hazard and notification of the Department, the next step is to undertake response actions quickly to prevent or abate exposures that resulted in the Imminent Hazard. For a solid waste facility to be considered adequately regulated an Immediate Response Action must be taken to address the hazard. For releases requiring 2- and 72-hour nitifications a facility will most likely need to hire a License Site Professional (LSP) to perform Immediate Response Actions. A facility must decide whether a release is exempted from the requirement to hire an LSP. If the facility is not certain whether a release is exempted then an LSP should be hired.

An Immediate Response Action Completion statement is required but an LSP signature is not necessarily required. An IRA conducted at a facility is closed out by submitting an IRA Transmittal Form and an IRA Completion Statement to the BWSC with the Adequately Regulated box checked (**%**) off. Bureau of Waste Site Cleanup staff will coordinate with Division of Solid Waste Management staff in overseeing the response. In any case, the landfill owners must perform IRA to eliminate the 2 and/or 72 hour reporting condition.

D. Risk Characterization

The risk assessment requirements and procedures set at 310 CMR 40.0900 and 310 CMR 40.0100 are applicable to solid waste facilities, however, these requirements apply to locations outside the boundary of the landfill (beyond point of compliance) permitted pursuant to 310 CMR 19.020 or outside the boundary of a landfill that has closed in accordance with 310 CMR 19.140 (refer to chapter 8 for additional information regarding risk assessments)

E. Public Involvement Provisions

The public involvement provision activities that apply to solid waste facilities are described at 310 CMR 40.1400.

These provisions include:

1. Notification of Chief Municipal Officer & Board of Health about:

   a. Imminent Hazard

   b. Response Actions to Imminent Hazard

   c. Completion of Phases of Assessment

   d. field work involving level A,B, or C personal protection including residential properties.

Additional public protection activities are required for public involvement plan sites (310 CMR 40.1404).

A memorandum of understanding was signed between BWSC and BWP regarding the applicability and practicability of Public Involvement activities related to release and/or threat of release at solid waste facilities.

The major provisions of the MCP that apply to solid waste facilities have been listed. However, additional important requirements are set forth at 40.0114 and should be consulted by all parties regulated by DSWM.

III. MONITORING PROGRAMS

A. Groundwater Monitoring System

A groundwater monitoring program consists of a monitoring well network, sampling schedule, analytical list of parameters to be measured and quality assurance/quality control plan. Sections 19.118 and 19.132 of the solid waste regulations establish the minimum requirements for each of these components.

The monitoring well network consists of a sufficient number of monitoring wells and piezometers necessary to detect releases of contaminants to the environment and to characterize the groundwater flow regime. Section 19.118 specifies that a minimum of one upgradient well or cluster of wells and three downgradient wells or cluster of wells are required as groundwater monitoring points for a landfill. Rarely, however, is this number of monitoring wells sufficient to characterize the site hydrogeology or provide an adequate early detection system for contaminant releases to the environment (19.118)(2)(a)2.

Landfills are often large in size and/or are located in areas where the hydrogeology is complex, thus necessitating the installation of more than the minimum number of monitoring wells required to meet the Department's requirements. In order for a monitoring well to be considered within the point of compliance, the well should be located at maximum distance of 150 meters from the area where waste is actually present in the landfill (footprint).

For additional information regarding point of compliance refer to Chapter 8 which discusses Risk Assessment.

To ensure that the number of wells installed are sufficient, but not excessive, the monitoring system for new landfills should be based on a Hydrogeologic Study pursuant to 310CMR19.104(3). Monitoring systems for unlined landfills may be based on information from the ISA and revised based on information gathered for the CSA. If the wells are not properly placed, they will be unable to provide appropriate data on site hydrogeologic conditions. As such, the improperly placed wells would ultimately have to be abandoned and replaced, a costly and unnecessary task.

B. Surface Water Monitoring System

As with the groundwater monitoring system, the surface water monitoring system will generally be established during the CSA Scope of Work based on data collected during the ISA. Surface water monitoring will be necessary when a surface water body or stream exists in an area likely to receive either surface water run-off from the landfill or potentially contaminated groundwater discharge.

As with groundwater, when designing a surface water monitoring program, both the up-stream and down-stream water quality must be determined. This is necessary to establish that the source of contamination is not upstream of the site. A number of suspended and/or bottom sediment samples should also be collected to compliment the surface water sampling data.

Once the ISA is complete, the monitoring wells have been installed, surface water monitoring locations are established, and the analytical and QA/QC program is established, the groundwater and surface water monitoring programs can be initiated.

<u>Parameters</u>

The chemical parameters included in monitoring programs should be proposed based on the results of the ISA. However, there is a minimum list of chemical parameters that must be included in these monitoring programs. The list of parameters can be found in the regulations at 310 CMR 19.132 (1)(h).

In addition to chemical analysis, groundwater and surface water elevation readings must be collected as part of each monitoring programs. This information should be collected and recorded immediately prior to sample collection.

Schedule

Section 19.150 of the solid waste regulations require quarterly sampling of groundwater and surface water, at least, for the first year to establish background conditions. The reasons for this include:

1. Groundwater and surface waters are generally in motion and collect contaminants encountered during flow. The concentrations of contaminants may vary from location to location and from time to time within a contaminant plume. Only frequent sampling at the beginning of the monitoring program would enhance the chance to detect these potential variations in contaminant chemistry.

2. There are several points in the monitoring program and analytical procedures where the integrity of sampling may be compromised. These include, but are not limited to, variation in sampling methodology or sampling personnel, analytical error(s), and improper decontamination techniques in the field between sampling stations. Proper QA/QC and strict adherence to standard operating procedures will limit the occurrence and effect of the above, however, some combination of the above are likely to occur during the monitoring program.

3. Groundwater elevations generally vary from season to season. Groundwater is highest during early spring, and lowest in early fall. This fluctuation can result in the modification of groundwater flow direction. It can also affect concentrations detected in samples. Contaminants present at higher

concentrations in some soil horizons may or may not be present in the groundwater depending upon whether or not the groundwater intercepts the contaminated strata.

It is therefore necessary to have more than one round of sampling and analytical data to develop the groundwater and surface water monitoring programs. As noted above, there are too many variables inherent in the sampling and analytical process to rely on only one or two sampling events. Once a baseline is established and site conditions are understood, the sampling frequency may be reduced.

Reporting

The sampling schedule will be specified in the permit. The analytical results must be submitted to the Department within 60 days (or as stated in the most current version of the regulations) after the sampling event (310 CMR 19.132 (1)(f)). The submittal package must include:

1. The analytical data sheets completed by the laboratory. These sheets should include all relevant information regarding the sample and analytical process such as analytical method number, the sampling date, extraction date, and preservation method. (Analytical data sheet requirements are specified in more detail in the guidance outline found in the appendix.)

2. A site map with groundwater elevations plotted and contoured. Surface water elevations should also be plotted and contoured where relevant.

3. A separate site map should indicate all sampling locations and relative levels of contamination present.

4. All analytical data organized into an easily understood and readable format.

5. A letter report briefly summarizing and interpreting the results of the sampling event. The interpretation should discuss any unusual results or

apparent trends in the data. The report should also discuss items of concern observed during the sample collection such as leachate seeps, monitoring equipment in need of repair, deviations from the regular sampling program, or QA/QC problems. Any problems with monitoring equipment noted in the report must be corrected prior to the next scheduled sampling event.

6. All field QA/QC procedures including chain of custody information should also be submitted to the Department.

If the results indicate that compounds exceed the state drinking water standards or MCL's, the Department must be notified within 14 days (or as stated in the most current version of the regulations) of the finding, 310 CMR 19.132 (i)(1). At that time the need for additional analysis will be determined by the Department. In general, additional analysis will be required when a standard is exceeded for the first time, or when a significant change in contaminant levels are detected. Additional sampling may be required only at the monitoring location (groundwater or surface water) where the unusually high value is reported unless the high value is attributed to laboratory error. In cases of laboratory error(s), it may be necessary to resample all monitoring points.

C. Leachate Monitoring Program

Leachate Monitoring System

The Department determines the need for leachate monitoring on a site by site basis (19.132(3)). As with other monitoring systems, leachate sampling and analysis should be conducted as part of the CSA.

The analytical results are often used to aid in the design (or modification) of the groundwater and surface water sampling program. Comprehensive analysis of leachate can be compared to groundwater and surface water analysis and in some cases be used to predict worst case conditions in groundwater and surface water contamination.

The leachate monitoring system should include samples from leachate seeps around the landfill as well as samples from the leachate collection system (if present). When identifying sampling locations each "type" of leachate produced by the landfill should be identified and included. If there are seeps emanating from several locations around the site, at least one sample from each location should be collected. Samples from leachate seeps that are near each other can be composited if they:

- Are similarly colored;
- Have similar liquid phases; and

- ! Appear similar when scanned with field instruments.

Samples from different sides of the landfill should not be composited.

Unlike groundwater and surface water sampling, leachate sampling should occur shortly after a precipitation event. Leachate would be expected to be flowing at its highest volumes at this time.

Parameters

When leachate samples are collected as part of the ISA or CSA, they should be analyzed for the same parameters as groundwater samples. When the samples are part of a regular monitoring program, the required parameters will be established in the permit.

Schedule

A sampling schedule of the primary leachate collection system at a lined facility is typically established in the permit issued by the Division of Solid Waste Management. The collection of leachate seep samples would most likely occur during the ISA and CSA and the need for further periodic sampling would be determined by the Department. Leachate sampling is also required for the issuance of a groundwater discharge permit or sewer connection permit.

Reporting

The results of both leachate seep and/or leachate collection system sampling and analysis should be submitted with the groundwater/surface water results. Specific requirements for what should be contained in the leachate sampling submittal package are the same as previously listed for groundwater/surface water sampling results.

D. Monitoring of Secondary Leachate Collection or Leak Detection System

When a landfill is designed with a secondary leachate collection system or leak detection layer, the Department shall require monitoring of that layer. The owner/operator shall report the volume of leachate collected from the secondary leachate collection system for the given period as defined by the regulations or by the landfill permit. Leachate collection rates shall be reported to the Department for each inspection period as part of the inspection report. The owner/operator shall determine the rate of leachate collection per acre per day and compare the latest data with the designed rate, the historical rate and relevant meteorological data. If there is a significant increase in the rate of leakage (loss) the owner/operator shall identify the area from which the leak is occuring 19.132(2).

E. Landfill Gas Monitoring Requirements

The Solid Waste Management Regulations at 310 CMR 19.132(4) requires that landfills conduct landfill gas monitoring during the active and post-closure periods. At a minimum, monitoring shall be conducted quarterly for explosive gases. The Department may require testing of additional parameters including, but not limited to, hydrogen sulfide, volatile organic compounds. The Solid Waste Management regulations for landfill gas monitoring (310 CMR 19.132(a-f) have been revised to reflect the stricter requirements of the revised Massachusetts Contingency Plan (310 CMR 40.0321 (10/93)).

Imminent Hazards and 10% Lower Explosive Limit (LEL)

In accordance with the MCP, 310 CMR 40.0321, the following is deemed to pose an Imminent Hazard to health, safety, public welfare and/or the environment as it relates to landfill gas: "a release to the environment that results in the presence of oil and/or hazardous vapors within buildings, structures, or underground utility conduits at a concentration of 10% of the Lower Explosive Limits." The revised MCP regulations require that the Department be notified within 2 hours of the measured exceedance. The MCP regulations contained in Subpart C, 310 CMR 40.0321 list procedures for notification in the event of gas concentrations which pose an imminent hazard.

Additionally, where an imminent hazard has been identified, an Immediate Response Action, as described in 310 CMR 40.0400, subpart D, shall be taken to prevent, eliminate or abate all Imminent Hazards.

The Solid Waste Regulations at 310 CMR 19.132(4)(g) have been modified to reflect the lower gas reporting limit and shorter notification requirements.
The reporting limit of 10% of the LEL has replaced the 25% of the LEL reporting limit that was previously specified at 310 CMR 19.132(4)(g) for buildings, structures and utility conduits. Currently, 310 CMR 19.132(4)(g) states:

> *When, at any time, the concentration of explosive gases exceeds 10% of the lower explosive limit in any*

building, utility conduit, excluding gas control, gas recovery and leachate collection system components, the current owner/operator shall:

1. take immediate action to protect human health and safety;

2. notify the Department within two hours of the findings; and

3. undertake the actions specified under 310 CMR 19.150, Landfill Assessment and Corrective Action as required by the Department

As specified by 19.132(4)(i), if the concentration of the explosive gases exceed 25% of the LEL for individual components or total LEL at the property boundary or beyond (not including off-site buildings, structures or utility conduits covered under 10% of the LEL) the owner/operator shall:

1. take immediate action to protect human health and safety;

2. Notify the Department within 24 hours of the finding; and

3. Undertake the actions specified under 310 CMR 19.150. Landfill Assessment and Corrective Actions as required by the Department.

Additionally, if the concentration of any parameter for which monitoring is required at 19.132(f)1, 2, or 3 exceeds any permit standard, federal or state regulations the owner/operator shall notify the Department within 14 days and undertake actions specified under 310 CMR 19.150 Landfill Assessment as required by the Department.

1. Landfill Gas Characterization

The Department recommends that landfill gas characterization be undertaken at all landfills. Landfill gas characterization should determine if the landfill gas within the landfill itself will require treatment in order to ensure public health and safety as defined by the site's end use. Chemical characterization tests shall determine the composition of the gas within the solid waste disposal site. This characterization should be performed during operations and/or during the CSA prior to closure.

2. Inactive Landfills

Inactive unlined landfills with occupied dwellings within 1,500 feet of the landfill shall perform landfill gas screening at the property line unless the owner can demonstrate that landfill gas migration cannot occur beyond the site boundary. All on-site structures must be monitored and it must be determined if further landfill gas assessment work is required.

3. Landfill Gas Measuring Devices

There are essentially two types of monitoring devices for measuring the concentration of landfill gas in unsaturated soils: (1) probes and (2) wells. In this document the following definitions shall apply: Landfill Gas Monitoring Probes - are generally small in diameter (1/8" to 5/8"), shallow (typically 2-6 ft), temporary devices (refer to landfill gas monitoring probe designs Fig. B,C) without protective caps, and Landfill Gas Monitoring Well - are larger diameter (1.5" to 2.5"), deep or shallow (typically 5-40 ft), permanent devices, with locking or protective caps (refer to Figures D,E).

Which of the two devices used will depend on site specific considerations and the purpose of the assessment. Landfill gas probes are typically used as a screening tool to quickly evaluate an existing site. They can be installed quickly and cheaply and are most often used to evaluate the limits of landfill gas migration at existing sites which have no other landfill gas monitoring system in place. Additionally, probes are used at sites to evaluate the extent of migration in response to landfill gas that pose an Imminent Hazard (greater than 10% of the LEL in utility conduits or structures) or has been detected at equal to or greater than 25% LEL at the property line.

Landfill gas monitoring wells are typically installed at the point of compliance (property line) as permanent monitoring devices for routine monitoring. Landfill gas monitoring wells require more time and effort to install but can be used to screen deeper zones of unsaturated soils than probes can reach.

Comparison of Gas Probes and Wells

! Advantages of landfill gas monitoring probes:

- cheap and easy to install (therefore can be installed with denser spacing which results in a decreased chance of lateral gas migration between probes occurring and not been detected)

- can be installed with minimal equipment (hand-auger, portable powered auger)

- quick to install and sampling can occur almost immediately after construction

- good screening tool for identifying extent of migration

! Disadvantages of landfill gas monitoring probes

- typically used to sample to a limited depth (2-6 ft), thus cannot screen entire unsaturated zone

- radius of influence typically very limited

- installation and construction varies widely which in turn can dramatically affect readings (e.g. smearing of fines, tightness of seal between probe and ground)

- typically not designed to last more than a couple of years.

! Advantages of landfill gas monitoring wells:

- can be used to screen entire unsaturated zone

- radius of influence is larger than landfill gas monitoring probes

- landfill gas monitoring wells are designed to last more than a couple years

- installation and construction techniques are better standardized

The final landfill gas monitoring system must monitor the full unsaturated depth of the site or extend to the maximum depth of waste placement

! Disadvantages of landfill gas monitoring wells:

- more expensive than landfill gas probes

- typically requires a drilling rig for installation
- may not intercept actual gas migration pathway

In most situations landfill gas probes are not acceptable as the permanent monitoring devices for the site. This is because they cannot typically be installed to depths to monitor the full unsaturated depth of soils or extend to the maximum depth of waste placement. However when groundwater is very shallow probes may satisfy this particular requirement.

4. Landfill Gas Migration Monitoring

The Department recommends that a landfill gas perimeter survey be conducted for all active landfills which do not have perimeter landfill gas detection monitoring wells in place, in order to comply with the requirements of 310 CMR 19.132 (4). For landfills that are small in size with few potential receptors, it may be advisable to install permanent landfill gas monitoring devices without conducting a perimeter survey. The Department requires that the following goals be met by landfill gas perimeter screening:

Facility Structures/Perimeter Detection

! Ensure that landfill gas concentrations does not exceed 10% of the LEL for methane in facility structures (excluding gas control or gas recovery systems).

! Determine if landfill gas has the potential to migrate beyond the perimeter of the landfill.

! Ensure landfill gas migration is not occurring beyond the property boundary of the site, as required by 310 CMR 19.132 (4)(h).

! Identify the locations where permanent landfill gas monitoring wells shall be installed.

Landfill gas monitoring devices are installed within the property boundary of the landfill. The density of the soil gas probes/wells should take into account the location of sensitive receptors as listed in the Outline for Solid Waste Site Assessments and is to include testing within any occupied dwelling (i.e. homes, businesses, schools, etc.) that may be at risk based on evidence of landfill gas migration. Additionally, the location of all on-site utilities that may provide a pathway for migration (i.e. sewers, electrical conduits, etc.) should be located and monitored at selected locations on-site and at the perimeter of the site.

The probes/wells shall be installed within the landfill property line and outside the footprint of the refuse disposal area.

Wherever accessible, the probes/wells shall be located within 100 feet of the landfill property line. Any other distances require prior approval by the Department. The request for other distances shall include the reason for the request with all supporting information for Department evaluation.

The landfill owner/operator must submit a plan and supporting documentation for the installation of the landfill monitoring devices. The supporting documentation should include:

a. Gas monitoring devices installation methodology and probe/well design,

b. Quality Control/Quality Assurance Guidelines,

c. Design of any existing sampling probe/well system,

d. Off-site migration data from any existing sampling probe/well system,

e. Site geological conditions (above the watertable), depth to groundwater,

f. Landfill gas quality if previous testing has been undertaken,

g. Site proximity to inhabited property, surrounding population within 1/2 mile of landfill edge

h. Proposed monitoring locations shall be located on a map with a scale,

i. Gas sampling and analytical procedures.

<u>Minimum Guidelines</u>

(1) The probes/wells shall be installed outside of the refuse deposition area and installed along the property line. Perimeter probes/wells shall not be placed in refuse. The probes/wells should be installed in undisturbed soils whenever possible.

(2) The the Department recommends that the <u>average</u> spacing between probes/wells be determined based on the adjacent land use up to 1,500 feet from the boundary of the refuse disposal area as follows (SCAQMD, October 1985 - revised 1989):

Land use	Spacing
Residential/Commercial	100 ft
Public Access	500 ft
Undeveloped Open Space	650 ft
No Public Access	650 ft
Landfill with Liners	1000 ft

- **The recommended spacing is just that, recommended**. It may be appropriate to use alternative spacing based on site specific conditions. The exact positioning of landfill gas monitoring probes or wells will ultimately depend on ones understanding of the geology, hydrogeology and migration potential as it relates to sensitive receptors. Random landfill gas monitoring probe or well locations will not and can not, adequately monitor a site. It is important to remind oneself what one is trying to protect with the monitoring probe or well.

- Future land development should be considered when putting together a landfill gas monitoring system.

- Stressed vegetation is often an indicator that off-site landfill gas migration is occurring. Grasses and plants with shallow roots will be unaffected while larger trees will show signs of stress. This is a result of landfill gas displacing oxygen and nitrogen in the deeper strata while some oxygen and nitrogen still infiltrates the upper portions of the soils allowing the plants with shallower root systems to survive.

- No landfill gas sampling is required in soils where exposed groundwater and/or wetlands (provided the wetlands and/or exposed groundwater is not perched) is located between the landfill and off-site dwellings.

- Permanent landfill monitoring devices (cluster) design should incorporate screened intervals that monitor the full depth of the unsaturated zone or extend to the maximum depth of waste placement.

(3) Landfill gas samples shall be collected and analyzed quarterly as required by 310 CMR 19.132(4). One of these quarters will be during the winter when the frozen ground acts as a vertical barrier to vertical gas migration and another quarterly round during the summer months.

Figure 1
Typical Soil Gas Well

- Soil gas monitoring wells shall be isolated from the possibility of degassing or ambient air intrusion, via the installation of clay/grout surface seal and/or annular seal (Refer to Figure 1)

Sampling Procedures for Perimeter Probes/Wells

It is necessary to allow the probe/well to be in equilibrium with subsurface conditions prior to sampling. The Department requires that landfill gas monitoring devices be sampled: (1) prior to purging, (2) after purging. Collecting samples prior to purging is done to simulate gas build up in a closed space (worst case scenario). The probes/well should be purged of two bore volumes and the sample collected and/or measured, again. This is done to ensure a sample that reflects the current conditions in the soil is collected. Purging can be accomplished by the use of an aspirator or portable vacuum pump.

The samples should be analyzed via the connection of field analytical equipment directly to the sample port on the soil gas probe. A water trap may be necessary to protect instrumentation depending on the moisture content of the landfill gas and sensitivity of the field equipment.

There are several methods and instruments that are used in the field to determine the composition of landfill gas. The instruments include:

- Photo ionization meter - quantitatively measures a portion of the non-methane components (in ppm or ppb).

- Organic Vapor Analyzer - (flame ionization detector) quantitatively measure methane and other gaseous compounds when lower concentrations are present (ppm/ppb)

- Multi-gas meter - quantitatively measure % Methane, %LEL, % Oxygen, and hydrogen sulfide.

- Explosimeter - quantitatively measure gross levels of explosive gas present in a well or in ambient air (% methane).

  Many explosimeters are only capable of reporting % LEL up to 100% LEL or 5% methane by volume. When landfill gas is detected at concentration greater than 100% of the LEL it is not acceptable to report the data as > 100% LEL. Whenever equipment is used that report methane as % LEL the Department requires that all values greater than 100% of the LEL must be quantified as percentage methane.

Samples should be analyzed for the following parameters in the field:

TABLE 1

Parameter	**Equipment (Examples)**[1]
1. % Methane (% Lower Explosive Limit (LEL) calibrated for Methane)	1A. Multi-gas meter (Gas Tech), Explosimeter, 1B. OVA (Flame Ionization Detector (FID)[2]
2. Volatile Organic Compounds,	2. Photo Ionization Detector (PID), Field Gas Chromatograph (GC),
3. Hydrogen Sulfide,	3. Multi-gas meter, Draegar Tubes
4. % Oxygen	4. Multi-gas meter, Oxygen Meter

NOTES:

1. The equipment list is an example of equipment commonly used to measure each specified parameter. The equipment list is only a guide.

2. Using the OVA with a charcoal pre-filter can help improve the qualitative measure of methane concentrations in landfill gas. The charcoal filter adsorbs most of the non-methane gas which results in an OVA reading closer to the actual methane concentration of the gas sample (EPA/540/P-91/001).

3. Exceedances of 10% of the LEL in utility conduits, buildings or structures and 25% of the LEL at the property line in soils should be double checked with two different type of sampling devices. High concentrations methane can result in subsequent false high readings and it may be necessary to recalibrate the equipment.

Alternative sampling procedures may be proposed. All necessary documentation, standard operating procedures, and QA/QC procedures should be presented to the Department for review.

Quality Assurance/Quality Control

Gas sampling records should consider, but not be limited to the following information:

A schedule and procedures for calibrating monitoring equipment (i.e. OVAs, PIDs, LEL meters) shall be submitted.

The pressure regime within a landfill is related in various ways to weather conditions, barometric pressure, and soil conditions (Refer to Chapter 4, Section V., subpart A. Introduction). The Department recommends that landfill gas sampling be conducted when the following conditions are expected:

a. Barometric pressure is low, 29.75 in Hg or less,
b. The soil is moist/wet due to a recent rainfall events or frozen.

The following meteorological data shall be collected when conducting landfill gas sampling:

a. Date and time of sample collection,
b. Date and amount of precipitation from the most recent rainfall events,
c. Weather conditions (temperature, wind speed and variability, humidity, etc.),
d. Hourly barometric pressure readings for the day of sampling (12 hours before and for the entire sampling event),
e. Ground cover and soil conditions (e.g. snow, frozen ground, saturated soil, etc.).

Sampling Procedures for Landfill Gas Characterization

Landfill gas characterization involves taking samples of landfill gas from the interior of the landfill and submitting the samples for laboratory analysis. Samples may be taken from existing vents installed within the landfill and/or landfill gas extraction systems provided construction logs are available to verify proper construction. However, the technician should make certain the seal around the top of the vent does not allow air infiltration. The vent should have a sampling port or be fitted with a sampling port to prevent ambient air from diluting the sample.

If no vents are available a temporary monitoring device can be used for sampling. Due to the explosive nature and toxic hazards associated with landfill gas extreme caution should be taken when installing any probes/wells within a landfill. In that regard, an OSHA approvable Health and Safety Plan should be prepared and followed. Probes should be inserted below the cover materials and to a depth of, at least, **6** feet below the surface of the landfill cover material.

Samples shall be analyzed in the field for the parameters identified in TABLE 1 prior to purging.

The probe should be then purged of two bore volumes of gas. Purging can be accomplished by the use of an aspirator or portable vacuum pump. After purging, and before taking the sample, ensure that the total organic compound concentration (as methane) remain constant for at least 30 seconds. The sample may then be collected. The total organic concentration should be measured using an approved instrument and the results recorded.

Laboratory methods to determine landfill gas composition include the collection of gas in "SUMMA Polished" stainless steel canisters, tedlar bags, or adsorption of compounds onto appropriate adsorbent media in the field, and then purging the compounds in a laboratory for identification by gas chromatography.

- If tedlar bags are used, samples should be analyzed within 24 hours due to sample integrity problems encountered with some compounds (e.g. vinyl chloride). Tedlar bags should also be shielded from sunlight to prevent photochemical reactions from occurring within the bag.

- Field Gas Chromatograph - (flame ionization detector) qualitatively evaluates gas by breaking down the gas into its individual components. The individual compounds can then be identified and quantified.

- Draegar Tubes - They provide a <u>rough</u> estimate of the actual concentration and are only useful once the gas levels reach the part per million range. They can be used to measure many components, however, they are most useful at landfills when measuring hydrogen sulfide. A single draegar tube can only be used to measure a single predetermined constituent.

The Department requires that the landfill gas characterization include, at a minimum, the following:

! Volatile Organic Compounds (EPA TO-14) may be used in place of 12 compounds referenced below)

1. Vinyl Chloride	7. Benzene
2. 1,2 -Dibromethane	8. 1,2- Dichloroethane
3. Dichloromethane	9. Tetrachloroethene
4. Tetrachloromethane	10. 1,1,1 - Trichloroethane
5. Trichloroethane	11. Trichloromethane
6. Toluene	12. Xylene

The Department has changed its recommended landfill gas characterization parameter list from the 12 aforementioned compounds. EPA Method T0-14 can be used to analyze for most of the compounds listed. The test methods have a standard parameter list that includes many other compounds.

(NOTE: The 12 specified compounds above were selected from California list of 18 core compounds, based on their health effects associated with long term exposure, particularly carcinogeniety. Other factors considered in their selection include availability and compatibility of samples and analysis methods, previous detection in landfills and the cost of testing)

! Fixed Gases

1. methane
2. oxygen
3. nitrogen
4. carbon dioxide

Landfill gas is also analyzed for oxygen and nitrogen for information on sample integrity. Methane and carbon dioxide concentrations shall be analyzed to provide information on gas production.

5. non-methane organic compounds by EPA method 25A or equivalent

Sample Media Preparation Procedures

A QA/QC plan for disposal site testing should be prepared as part of the sampling plan. The plan should include:

! Decontamination procedures
! Sample collection procedures

- Sample container decontamination procedures, if applicable (stainless steel canisters)
- Sample handling
- Chain of custody
- Length of time before analysis
- Temperature control on samples
- Shipping procedures to prevent sample loss
- Checking containers for leaks
- Site map with sampling location(s)
- Analytical method(s)
  - detection limits
  - laboratory QA/QC plan
- The following meteorological/site information shall be collected when conducting landfill gas sampling:
  a. Date and time of sample collection,
  b. Date and amount of precipitation from the most recent rainfall events,
  c. Weather (temperature, wind speed and variability, humidity, etc.),
  d. Hourly barometric pressure readings for the day of sampling (12 hours before and for the entire sampling event),
  e. Ground cover and soil conditions (e.g. snow, frozen ground, saturated soil, etc.), weather conditions

IV. INSPECTIONS FOR DETECTION OF HAZARDOUS WASTE - SUBTITLE D AMENDMENT

This section discusses the requirements and procedures for the inspection and detection of Hazardous Waste at sanitary landfills. The section has been added to the manual to meet the requirements of Federal Regulations (40 CFR 257 and 258) issued pursuant to Subtitle D of the Resource Conservation Recovery Act (RCRA). It will describe the details of operations and will outline the procedures to follow after regulated hazardous wastes are identified at a landfill.

A. Details of Operations

Solid waste facilities are required by 310 CMR 19.104(5)(f)2 to have a contingency plan for identifying and excluding hazardous wastes regulated under the Massachusetts hazardous waste regulations, 310 CMR 30.00. At a minimum this plan must contain the following components:

- A training program for staff at the facility who are responsible for implementing the plan to exclude hazardous wastes. This training program shall teach staff how to recognize regulated hazardous wastes, how to conduct inspections and how to implement other facets of the plan.

- Safety procedures for staff to follow in the event hazardous wastes are found.

- A program of random inspections of incoming loads or other means of ensuring that incoming loads do not contain hazardous wastes.

- Procedures to record the time, date, identity of load inspected and results of each inspection.

- Procedures to follow in the event that regulated hazardous waste is discovered by an operator at a landfill.

B. Procedures

The following procedures should be followed upon identification or suspicion of regulated hazardous waste:

1. Notify the Department, including:

   (a) The Divisions of Solid Waste Management and Hazardous Waste in the appropriate regional office; and

   (b) The Division of Hazardous Waste in Boston.

2. Obtain an EPA I.D. Number (because the facility is now a generator);

3. Gather evidence to determine who is the responsible party. Evidence may consist of:

   (a) Numbers inscribed on containers,

   (b) Information contained on container l Labels.

4. If the problem is significant, the operator should call the Division of Hazardous Waste so that they may aid the operator in tracking the responsible party;

5. Correctly dispose of the hazardous waste. Disposal will require the operator to:

(a) Find a licensed transporter;

(b) Find a licensed hazardous waste facility which can accept and properly dispose of the hazardous waste; and

(c) Manifest the waste using procedures outlined in the Hazardous Waste Regulations, 310 CMR 30.000.

The following procedures should be followed upon spillage or a release of regulated hazardous materials at a landfill:

1. Compliance with the 21E regulations is required, in particular:

(a) Notification requirements,

(b) Response action requirements.

V. ANNUAL REPORT

Upon completion of each year of monitoring, an annual report shall be submitted to the Department. The purpose of the report is to summarize the results of the environmental monitoring program for the proceeding year, compare the results with previous years, and make recommendations accordingly. The report should provide a comprehensive interpretation of the whole sampling program. Any recommendations to either augment or reduce the monitoring program must be supported by data.

In addition to containing data generated during the quarterly or semi-annual sampling, the annual report must discuss how the data compares to historical sampling data at the site and the potential impacts on receptors in the area. Remedial actions taken or recommended must also be described. Additionally, when a compound is reported for the first time in the report, a toxicological profile of the compound must be presented.

VI. EMERGENCY ACTION

If the concentration of landfill gas in an utility conduit, building or structure exceeds 10% of the lower explosive limit (The lower explosive limit is the lowest percentage by volume of that gas in a mixture of explosive gases that will propagate a flame at 25 degrees celsius and atmospheric pressure), the Department must be notified within 2 hours. The Massachusetts Contingency Plan regulations at Subpart C, 310 CMR 40 list procedures for notification in the event of gases which pose an imminent hazard.

If landfill gas is detected at concentrations equal to or greater than 25% of the LEL at the property line, the Department must be notified as per 19.132(4)(h).

CHAPTER 5 LANDFILL ASSESSMENTS

I. INTRODUCTION

The purpose of the assessment is to determine the impact of the landfill on groundwater, surface water, and air quality by characterizing the nature and extent of the contamination and assessing the associated risks to public health and the environment. An assessment is required under the following conditions:

- When obtaining Site Assignment.
- When obtaining a permit for an expansion of an existing landfill.
- When monitoring results indicate contaminants are at unacceptable levels. For example, when:
  - Groundwater monitoring results indicate contaminants are above the MCL or the Department has determined that levels warrant an assessment and corrective action. [19.132 (1)(j)]
  - Surface water monitoring results indicate contaminant levels are above background. [19.132(1)(i)]
  - Leachate monitoring levels indicate that leachate is present in the secondary containment system or leak detection system in excess of design standards. [19.132(2)]
  - When gas monitoring results indicate that 25% of the LEL is exceeded beyond the site boundary or 10% in any building or utility conduit. [19.132(4)(g) 2.]
  - When preparing the landfill for closure. [19.140(3)]

In general, the assessment process involves compiling a site history, characterizing the subsurface, determining potential rates and pathways of contaminant migration, identifying potential sensitive receptors, and determining existing air, groundwater and surface water quality. The complexity of an investigation depends upon site specific geologic conditions, the size of the site and the site history.

The DEP has adopted a three phase approach for performing environmental assessments of solid waste disposal facilities to establish a process by which the site specific data necessary to fully characterize a site may be collected, analyzed and presented in a routine and organized manner. The process is intended to minimize duplicative work, expedite reviews, establish and maintain complete site histories and achieve regulatory compliance with all relevant DEP (and Federal) programs.

Each phase builds on the data gathered in the previous phase. In all cases, the assessment will follow the same general outline, whether the assessment is for site assignment or closure purposes, beginning with research into the site's history and hydrogeological setting. However, the difference are in the goal of each phase.

The goal of an assessment of an existing facility is to determine the extent of environmental impact caused by the landfill. For siting purposes, an assessment characterizes the hydrogeology of the site and identifies potential future pathways of contaminant migration. This aids the Department in determining if the site is appropriate and if so, where to properly place an environmental monitoring network for the site. Performing assessments prior to landfill construction provides the necessary data on background environmental quality, and provides up-front identification of potential contaminant pathways and receptors.

The Landfill Assessment and Closure Program of the Division of Solid Waste Management has prepared an outline for scopes of work for the Initial Site Assessment (ISA) and Comprehensive Site Assessment (CSA) entitled "OUTLINE FOR SOLID WASTE SITE ASSESSMENT". This document, available from the Division, should be used as guidance when developing an assessment scope of work (Refer to Appendix C).

The Initial Site Assessment (ISA) consists of a historical and literature review, an evaluation of existing data and the identification of sensitive receptors. The information gathered during this phase will be used to develop a Scope of Work for the Comprehensive Site Assessment that will include a monitoring network to sample solids, liquids and air at the landfill together with other field investigations to determine the site characteristics.

The third step to the process, the Corrective Action Alternatives Analysis (CAAA) refers to the process which involves the evaluation of steps to be taken to remediate adverse impacts of the landfill on the environment. The process in discussed in more detail further toward the end of this chapter.

Communities are encouraged, as a cost saving measure, to conduct some portion of the assessment work themselves, where feasible. Many of the tasks in the ISA can be performed by town employees, who would most likely be the information source for consultants hired by a town. Some of the CSA tasks can also be performed internally. As the work becomes more specialized, environmental consultants will have to be hired. However, it is still helpful and cost effective for municipal employees to work with the consultant in performing some of the less specialized tasks, e.g. surveying property boundaries, measuring water elevations and reviewing files.

The assessment process described below may not apply, in its entirety, to all landfills. For a number of existing facilities there may already exist a substantial compilation of site specific data and a moderately high level of understanding of the site. However, many existing facilities have undergone no prior assessment. For such facilities, the scope of the site investigation will be more comprehensive. It is the intention of the Department that all facilities address all tasks listed in the guidance during the course of an assessment.

II. INITIAL SITE ASSESSMENT (ISA)

The primary activities during the ISA are to gather and evaluate all existing information relating to the landfill site, develop a conceptual model of the site, identify potential receptors surrounding the site, and prepare a scope of work for the Comprehensive Site Assessment (CSA) that will follow. The goals of the ISA are to identify all areas that must be investigated, minimize duplicative work, and maximize the quality of data generated during the CSA.

The ISA consists of the following main components:

- Collection and evaluation of all available site data such as historical information and existing technical reports and/or plans;

- In conjunction with a site-visit, description of site conditions as well as local and regional geology and Hydrology, and the potential presence of contaminants;

- Identification and mapping of potential environmental and public health receptors that may be sensitive to contaminant releases;

- Development of a detailed scope of work for activities to be performed during the CSA.

Once the information has been gathered, it should be summarized following the format of the Outline contained in Appendix C. The ISA report will conclude with a detailed recommended scope of work for the CSA based on the results of the ISA. The rationale used in determining: groundwater monitoring well location and depth, other environmental sampling locations, the inclusion/exclusion of optional analytical parameters and other tasks in the guidance outline, should be included in the CSA scope of work.

The following explains in more detail the purpose of each portion of the ISA including potential sources of information.

TASK 1.1 BACKGROUND INFORMATION

The purpose of this task is to identify ownership, size and location of the site and abutting property land uses. Site ownership should be traced back to the time the site was first developed.

It is possible that adjacent properties, or historical operations are responsible for contaminants detected in the landfill monitoring system. Therefore, background information on adjacent land uses, present and past operations and materials used and generated, along with other hydrogeologic information, can help determine if the landfill is the source of contaminants detected in the monitoring system. The assessors' officer in the town where the site is located will supply most of the required information.

TASK 1.2 HISTORICAL RESEARCH/TASK 1.3 LITERATURE/DATA SEARCH

The goal of both these tasks is to gather, compile, and evaluate all existing information that relates to the site and local area.

This can be achieved through several means.

The operational and disposal history may provide information on waste-types received and specific areas where they may have been disposed on-site. If disposal records aren't available, which is often the case, a good source of this type of information are the past and present landfill operators.

Past and current industries located in the area of the landfill may indicate the types of industrial/commercial waste that was disposed at the landfill. To find out past and present industries located in the town, either the Town assessors office or the Sanborn Fire insurance library can be very useful. The Sanborn Fire Insurance library is located on the second floor at 156 State Street, Boston. They have historical maps depicting industries present in most Massachusetts towns.

An evaluation of the accuracy and usefulness of the data collected is an important part of the ISA. In addition, a list of reports and files reviewed and people interviewed should be compiled. Reasons for including or excluding information should be provided in the report.

An evaluation of existing monitoring systems, monitoring programs and monitoring data generated must be performed to validate and support recommendations to expand/reduce monitoring that will be considered as part of the CSA. This evaluation should address whether appropriate analytical parameters were measured as part of the program and whether appropriate analytical procedures were followed. If an evaluation of the existing reports and environmental monitoring system reveals the work was done properly and the system is still intact, the proposed CSA Scope of Work should incorporate and reflect the information. All pertinent laboratory data sheets, QA/QC data, chain of custody sheets from all previous groundwater, surface water, leachate, soil, sediment, and landfill gas sampling rounds should be appended to the ISA report. The <u>ISA is a stand alone document</u> and all laboratory data collected should be included in the report.

TASK 1.4 HYDROGEOLOGICAL DESCRIPTION

Information gathered during a literature search may also be used to complete other tasks such as description of local and regional geology, hydrology, water supplies, as well as any existing environmental monitoring reports at nearby sites or the landfill itself.

Regional and local hydrology and geology should be described and illustrated to the extent possible using available data. One of the intents is to gather sufficient information to determine appropriate placement of proposed borings/monitoring locations to be used for monitoring for the CSA.

Depending on the location of the landfill, sources for this type of information include:

- Local university theses;
- U.S Geological Survey papers and maps; and
- DEP files, particularly "21E" files.

Numerous environmental reports have been generated pursuant to MGL Chapter 21E, DEP's "hazardous waste cleanup" program, and can usually be considered a good source of information. A majority of these reports are likely to contain such relevant information as regional and sometimes local geology/hydrology and background groundwater quality. These reports are public information once they are submitted to the DEP office. Sometimes a 21E report is prepared and not submitted to the DEP. However, a town may be able to access the report from the property owner or potential buyer of the property for which the report was prepared.

TASK 1.5 SITE VISIT

A site visit must be made to confirm the site location and evaluate current site conditions. During a site visit, the following information should be gathered:

- Evidence of environmental impact;
- Evidence the area is used for unauthorized recreation (dirt bike tracks, empty beer cans, etc.), indicating the presence of a group of potential receptors that must be addressed;
- Location relative to potential sensitive receptors (nearby homes, schools, day care centers, elderly housing, water supplies, farms, wetlands, streams, rivers, etc.);
- Direct information on the site geology/hydrology such as rock outcrops and nature of natural soils;

- Status of existing monitoring wells and a determination on their integrity, (e.g. well seal, locking protective pipe, etc.);

- Unforeseen site specific restrictions on potential monitoring well locations. Often well locations are determined based on information contained on a site map. These often do not indicate locations of trees, steepness of slope, utility lines, or other features that would make well installation difficult.

All observations should be summarized and presented on an appropriately scaled (1"=40' to 1"=100') plan. The scope of work guidance (see Appendix C) contains a more detailed checklist that can be used as an outline during site visits.

TASK 1.6 MAPPING

An up to date site and regional map must be prepared during the ISA. At a minimum, the information listed in the guidance scope outline must be addressed. Any other available information deemed relevant, to assist in development of the CSA Scope of Work should also be included. The site map should be sufficiently detailed to include existing structures, water supplies, water bodies, and recreational areas in relation to site features and potential threats posed by the landfill.

The Mass Geographic Information System (MassGIS), at the Department of the Executive Office of Environmental Affairs manages a computer data-base of land-use information which can be used to readily produce customized maps. MassGIS has compiled all of the data needed to produce the locus map required under Section 1.6 B of the assessment guidelines. Information on local land-use, zoning and other potential sources of contamination is also available. Please refer to Appendix G.

Because the maps are computer generated, all of the information can be plotted on one sheet, regardless of the number of U.S. Geologic Survey quadrangle maps that are required to address a half-mile radius around the site. Since MassGIS is part of a State Agency, the information is public, and the cost for map production is minimal. It is recommended that the locus maps required under the assessment guidelines be produced by MassGIS simply for convenience. However, GIS maps are not required. Information on obtaining GIS maps is given in Appendix G.

TASK 1.7 FIELD SCREENING (OPTIONAL)

Environmental sampling or field screening can be done as part of the ISA and can be useful when characterizing contaminant levels or localized areas of contamination. Equipments used in field screening are usually not sufficiently sesitive to quantify the amount of contaminant(s). They may not detect very low concentrations of contaminant(s). They are, therefore, not used to preclude the presence of contaminant(s) at a landfill. They can, however, be used to obtain data on relative amounts of contaminants present.

Flame ionization detectors (FID) and photoionization detectors (PID) are often used in the field to screen for the presence of contaminants in soil. Generally, these instruments are used to screen the headspace above soil in a closed container. The soil is placed in the container, agitated, and then allowed to equilibrate. After a short time (five to ten minutes), a probe from the instrument is placed in the jar and a reading is taken. These instruments are sometimes used to measure the ambient air for contaminants.

A limited number of samples may be collected for laboratory analysis. Samples are usually collected when there are areas of known contamination or if there is a monitoring system in place that can be accessed. The data can then be used in preparing the sampling and analytical program for the CSA.

Non-intrusive geophysical methods can also be useful as field screening tools. The following is a list of some of the geophysical methods available and their applicability to site investigations:

! Seismic Reflection/Refraction: to determine the thickness of overburden deposits, depth to bedrock, etc.

! Electromagnetic (Terrain Conductivity) Survey: to locate plumes of leachate, depth to water table, edge of refuse, buried metal objects.

! Ground penetrating radar: to locate buried metal objects, subsurface utilities, large voids.

! Magnetometer Survey: to locate buried metal objects.

- ! Resistivity Profiling: to delineate thickness of landfill and track plumes.

- ! Borehole/Monitoring Well Logging (Electric Logging, Electromagnetic Induction Logs, Natural Gamma Radiation Logs, Neutron Logging and Temperature Logging): use existing wells to aid in interpretation of geologic logs by determining location of aquitards, high conductivity layers, and leachate plumes. Can be used to determine the placement of well screens for future monitoring wells .

TASK 1.8 DEVELOPMENT OF CSA SCOPE OF WORK

The final stage of the ISA is the preparation of the CSA scope of work. The scope should be sufficiently detailed to insure that the CSA is able to do the following:

- ! Determine if the landfill has had any negative impact on the local environment,

- ! Identify and characterize the extent of any impact which may be present, and

- ! Determine the need for remediation of the landfill site.

III. COMPREHENSIVE SITE ASSESSMENT

In the CSA, the data necessary to characterize the site's subsurface and evaluate environmental impact or potential impact are collected, recorded and analyzed. It is important that all activities, observations, computations and conclusions are recorded in a logical manner, in order to create a stand alone document for public review. The CSA Scope of Work consists of the following subsections: ISA summary, site mapping, drilling program, determination of hydraulic conductivity, sampling and analysis program, and health and safety plan and project schedule.

TASK 2.1 ISA SUMMARY

Conclusions drawn and recommendations made in the ISA must be summarized and any important facts or insight relating to the site must be highlighted in the ISA summary.

TASK 2.2 MAPPING

Mapping that takes place during CSA is usually limited to updates/corrections to the existing base map (inclusion of new sampling locations, for example) or addition of site topography. All other mapping activities should have occurred during TASK 1.6 of the ISA.

TASK 2.3 DRILLING PROGRAM

It is important to spend extra time to develop a drilling program to gather groundwater information to supplement data provided in the ISA. The most valuable information with respect to site characterization may be collected during this task.

Split spoon samples and bedrock cores are retrieved, monitoring wells and piezometers are installed, samples are taken and direct measurements of the subsurface can be made in this task. Since drilling can be one of the most costly parts of an assessment, it should be done efficiently. Careful consideration should go into choosing well locations, monitoring well construction materials and methods.

Documentation is of the utmost importance in this task. The rationale used to select sampling locations must be incorporated in the scope of work. Improperly placed, or constructed monitoring wells do not provide useful information and may provide a conduit for contaminants to enter the subsurface. Any wells the Department deems unacceptable will have to be properly abandoned (removed and/or closed) and replaced.

Excellent sources of guidance on how to site and construct a monitoring well include EPA's *Technical Enforcement Guidance Document* (TEGD) and the book Groundwater and Wells published by DRISCOLL. The Department's reference document *Standard References for Monitoring Wells* (WSC-310-91) provides detailed guidance on every aspect of field procedures performed as part of an assessment. *Standard References For Monitoring Wells* is available from the State House Bookstore.

TASK 2.4 DETERMINATION OF HYDRAULIC CONDUCTIVITY

Information gathered during this task will be used to evaluate the relative rate at which groundwater flows in the area where the landfill is located. This would give an indication on how rapidly contaminants may migrate once they enter the groundwater. A low hydraulic conductivity indicates that the soil is tight and/or the groundwater table is relatively flat, so that groundwater flow is relatively slow through the material. A high value would indicate that the rate of groundwater flow is more rapid. Hydraulic conductivity also yields information on potential contaminant dispersion rates; a high flow rate usually corresponds to a higher rate of dispersion.

This information will also be used to design the groundwater monitoring system. Therefore, in addition to simply determining the hydraulic conductivity, an effort should be made to identify and note the location(s) of high permeability layers encountered during well installation, test pit excavation, or in outcrops observed in the field. Contaminants tend to migrate through zones with high hydraulic conductivity. Monitoring wells should be installed and screened in these zones to increase the probability of encountering contaminant plumes if they exist.

The method(s) that will be used to collect and analyze the data should be described in the scope of work. Hydraulic conductivity tests can be run either during or after well installation. Tests are more often run after the well is installed and developed. Generally one of the following methods is used:

- Slug/falling/rising head test;
- Pump test.

The CSA should include all raw data and calculations performed to determine the hydraulic conductivities reported.

TASK 2.5 SAMPLING AND ANALYSIS PLAN

Sampling and analytical techniques used in the CSA must follow standard procedures. The methods chosen, and reasons for doing so, must be described in the CSA scope of work. The following guidelines should be observed at a minimum:

- All sampling must be performed according to standard EPA, American Standard Test Methods (ASTM) or DEP protocol. In addition to the proposed sampling technique(s), proper QA/QC of field activities must be described in the scope of work and implemented in the field.
- Samples must be analyzed within proper holding times.
- Groundwater sampling should begin with the least contaminated wells and end with the most contaminated wells, where possible.
- Groundwater samples should be collected immediately

after the well is purged. If the well has been bailed dry and is slow to recover, samples should be collected as soon as there is enough water in the well to satisfy the sample volume requirements. This would decrease the chance of lose of volatile constituents contained in the water.

! Appropriate sampling equipment must be used. It is not appropriate, for instance, to use equipment that may strip volatiles from the water (e.g. peristaltic pump) or to needlessly agitate the sample (bailer in excess of 1.5 feet in length) when collecting samples.

! Surface water and groundwater samples collected from different locations cannot be combined. This practice results in possible dilution of contaminant concentrations.

! Water samples must be collected directly into their respective sample bottles. The practice of collecting water into a large container then pouring off the water into sample bottles for shipment is not acceptable. This method results in unnecessary disturbance (and potential loss of volatiles) in the sample.

! Soil samples may be composited. However, the rationale for compositing and precautions for insuring that compositing does not result in contaminant dilution should be described in the scope of work.

! The following collection method is recommended when sampling a leachate seep :

Locate the seep(s) to be sampled;

Dig several inches into the origin of the seep with a shovel, creating a small collection area;

As the leachate begins to flow from its origin, place the sampling container against the side slope and collect the sample directly into the container.

Particularly when sampling for VOC's, limit the sample exposure time and agitation to the sample to reduce the loss of volatiles and chemical alteration of the sample from exposure to oxygen.

- All samples must be properly preserved and the preservation methods used must be described in the scope of work.

- All samples must be collected on the same day unless circumstances, which are clearly discussed in the scope of work and report, require otherwise.

  *Landfill gas samples are exempt from this requirement.

- At a minimum, landfill gas must be sampled and analyzed during both winter and summer seasons in addition to quarterly monitoring for combustible gas levels. This will allow for comparison between the two seasons allowing a general determination to be made of the effect of frozen ground conditions on gas migration.

The assessment outlines in Appendix C contain an analytical plan that should be used as reference when developing the CSA scope of work. The parameters proposed in the CSA scope, as well as their respective analytical method numbers (i.e. CAS #s), must be included in the scope of work. The rationale for the exclusion of parameters listed in the guidance must be documented in the proposed scope of work.

The Department recommends that available information be used in deciding the need for inclusion/exclusion of particular analytical parameters. For example, historical information which revealed that a pesticide manufacturing plant had operated in the town would indicate the need for extensive analysis for the presence of pesticides at and around the site. Prior sampling and analytical results may also be the basis for recommending other specific analyses. Additionally, if there is no information on historical disposal practices, an initial screening for all types of contaminants at key locations during the initial phase of the CSA may be necessary. These issues must be addressed in the sampling and analysis portion of the CSA scope of work.

Landfill Gas Monitoring

Refer to Chapter 4 for details on Landfill Gas Monitoring.

TASK 2.6 HEALTH AND SAFETY PLAN

Prior to beginning any field work, a Health and Safety Plan which complies with Occupational Safety and Health Association (OSHA) requirements addressing precautions to protect health and safety during work at the landfill must be submitted for the Department's files.

TASK 2.7 PROJECT SCHEDULE

The schedule should indicate estimated start and completion dates for each individual task. The schedule should be realistic.

TASK 2.8 CSA REPORT SUBMITTAL

This section of the guidance outline is fairly straightforward. Each of the items listed should be addressed in the CSA report.

Data Interpretations and Presentations

This section should evaluate and interpret the site environmental data by comparing sampling results to background values and make conclusions regarding the landfill's impact on the local environment. The local hydrogeology should be characterized by determining groundwater flow rate and direction. Groundwater and surface water quality, both upgradient and downgradient, should be defined. Potential contaminant migration paths must be identified and any potential risks or impacts on human health or the environment should be identified. All conclusions and recommendations in the report must be clearly supported by the data.

When an assessment is performed on an undeveloped site, the assessment should focus on the characterization of local hydrogeology, particularly definition of background conditions, groundwater flow direction and rate, and identification of potential contaminant pathways. This information will be used to develop the monitoring system for the new facility.

Maps Plans and Figures

All maps, plans and figures listed in the guidance outline should be prepared, compiled and submitted as part of the report. The geologic and piezometric maps should be described, interpreted and discussed in the text of the report.

Sampling and analytical results should be presented in figures, as necessary. The discussion of the results in the text should identify the location of contaminant plumes by referencing the site map and specific sample locations. Indicating the location of contaminant plumes, hot spots and their concentrations directly on a site map will be useful, particularly for the risk assessment portion of the report.

Summary Tables and Forms

All materials listed in the guidance outline should be prepared and included in summary tables and forms and discussed in the report. Well schematics and boring logs should be submitted as an appendix. Data tables should be inserted into the text where relevant. Tables of water quality data should include the applicable regulatory limits (e.g. MCLs) of constituents for comparison with concentrations measured in samples.

IV. Qualitative Risk Assessment

A risk assessment, which identifies and evaluates potential health risks resulting from the landfill, is required for existing facilities (refer to Chapter 8).

In the Qualitative Risk Assessment, required in the CSA, all potential receptors must be identified. Drinking water supplies, both private and public, are of utmost concern. Recreation areas, residences, schools, surface waters etc. should be included in the list of potential sensitive receptors.

Next, all contaminants, their maximum concentrations and where those levels were detected should be listed and the location where they are detected indicated (with media sampled identified) on a site map.

A qualitative evaluation of the potential pathways by which identified contaminants could reach the listed sensitive receptors should be conducted and then described in the text.

A secondary purpose of the risk assessment is to identify all non-health risks or impacts on local environments. All leachate breakouts and local groundwater discharge areas must be identified. A qualitative determination of the impact the landfill and associated contaminants have on the environment must be made.

The result of the qualitative risk assessment would be one of the following:

- Existing data is sufficient to indicate that there is no significant threat from the landfill;

- Existing data is not sufficient to make a decision on the level of risk posed by the landfill, additional assessment work is necessary; or,

- Existing data indicates there may be a significant risk to public health or the environment; therefore, a more detailed quantitative risk assessment is necessary and/or remedial measures are necessary.

The recommendation to perform a detailed risk assessment must be discussed with the appropriate the DEP site manager. The final determination on the adequacy of the qualitative risk assessment will be made by the Department.

All conclusions must be backed by data generated during the Comprehensive Site Assessment. The decision to require remedial measures will be based on the results of the risk assessment. The risk assessment will also be used to determine if the site qualifies for an alternative closure design, described in the following section.

Expanded List of Contaminants

If a quantitative risk assessment is required, at least, one round of groundwater sampling must be performed for all of the contaminants listed in Appendix II, Hazardous Constituents, or RCRA Subtitle D Part 258. These contaminants include all those compounds known to be present in household hazardous waste which may have been disposed at the landfill.

V. CORRECTIVE ACTION ALTERNATIVES ANALYSIS (CAAA)

A. Introduction

Corrective Action Alternatives Analysis (CAAA) refers to the stage in the landfill assessment and closure process which involves the evaluation of steps to be taken to remediate adverse impacts of the landfill on the environment. The CAAA is authorized by the Department's Solid Waste Management regulations which state at 310CMR19.150(6)(a) that the CAAA "shall analyze options for corrective actions to eliminate or mitigate the potential adverse impact caused by conditions at the (landfill) and to complete final closure in accordance with 310CMR19.140, *Landfill Closure Requirements*".

The CAAA is a pre-design stage of the landfill closure process. The main aim is to come up with a permanent solution(s), where achievable, to the problems caused by pollutants resulting from the prolonged deposition of solid waste at the site. The emphasis of the analysis will be focussed on the long-term effectiveness of the solution(s) identified. Once an action is selected by the CAAA, the regulations require, at 310CMR19.151(2), that the selected action(s) be conducted in two phases:

(a) Corrective Action Design, and

(b) Corrective Action Implementation.

In phase (a), "further engineering analysis shall be undertaken .... to complete the design of the Department's approved corrective action alternative". Phase (b) consists "of implementation of the approved corrective action design. This phase shall include construction and installation of all components, post-closure monitoring and any required operation and maintenance activities" at the landfill site.

B. Who & How CAAA Applies

The CAAA stage follows the Initial and Comprehensive Site Assessments and Risk Assessment during which adverse impacts associated with the site are identified. The assessments determine contaminants which are produced at the landfill and the route(s) that the contaminants follow out of the landfill. Additionally, the assessments identify where and how the contaminants impact public health and the environment.

The Risk Assessment stage is very important in determining the human and ecological impacts of contaminants associated with the landfill. The Risk Assessment is conducted in phases, namely: Qualitative Risk Assessment and Quantitative Risk Assessment (see Chapter 8). When the Qualitative Risk Assessment shows that there are no adverse impacts associated with the landfill, there is usually no need to undertake a Quantitative Risk Assessment. However, if the results of the Qualitative Risk Assessment indicate potential adverse human and/or environmental impacts, a Quantitative Risk Assessment is undertaken (after the Scope of Work for the Quantitative Risk Assessment has been approved) to quantify the impacts of contamination associated with the landfill.

The Department uses the recommendations of the Risk Assessment in addition to the findings of the Comprehensive Site Assessment to determine whether the landfill has adversely impacted public health and the environment. The CAAA is then used to determine if traditional closure methods described in Chapters One and Six are adequate for closure of the site or whether other measures need to be taken to protect human health and the environment.

The following flow charts summarize a few possible scenarios in the assessment and analysis process:

1. CSA **6** Q1RA (No adverse Impacts) **6** Closure Alternatives Analysis **6** Less Than Standard Cap

2. CSA **6** Q1RA (Minimum Impacts) **6** Closure Alternatives Analysis **6** Standard Cap

3. CSA **6** Q1RA (contaminants, pathways, receptors identified) **6** Q2RA (No significant risks identified) **6** Closure Alternatives Analysis **6** Standard Cap

4. CSA **6** Q1RA (contaminants, pathways, receptors identified) **6** Q2RA (significant risks identified) **6** Closure Alternatives Analysis **6** More than Standard Cap (including remedial measures)

Q1RA = Qualitative Risk Assessment
Q2RA = Quantitative Risk Assessment

In scenarios # 1 and 2, the Qualitative Risk Assessments show that the landfill has little or no adverse impacts on the environment and therefore leads to landfill closure using less than standard cap and a standard cap respectively.

Scenario # 3's Qualitative Risk Assessment indicates the need for a Quantitative Risk Assessment. The results of the Quantitative Risk Assessment identifies no significant risks. The Closure Alternatives Analysis leads to the installation of a standard cap on the landfill.

In scenario # 4, the Quantitative Risk Assessment identifies impacts which must be mitigated by measures beyond a standard cap.

C. Objectives of CAAA

Once it is determined that remediation is necessary, traditional closure using a standard cap will not be appropriate for a landfill. The objectives of the alternative corrective actions and the level of protection sought from the pollution (or potential pollution) must then be clearly established. Where possible, the objectives must be detailed and explicit enough to identify expected conditions of the site after remediation. In that regard, the Department may require that the results of the Quantitative Risk Assessment be used to identify residual concentration of contaminants that must be achieved by the end of the implementation of the corrective action. In landfill cases where the MCP is applicable, the clean-up standards are set in the appropriate sections of the MCP.

The risk to human health and the environment described in the Risk Assessment should be used to identify specific existing and potential problems that require remediation at a landfill. Understanding the risks involved, the objectives of the corrective actions, and the level of protection sought must form the basis of all actions taken. As emphasized in the Risk Assessment section of this manual (Chapter 8) the overall objective is of corrective action is to obtain a condition of "no significant risk" from pollution identified in the assessment stages of the evaluation. Until a condition of "no significant risk" is obtained at a landfill site, the corrective action taken is considered only temporary.

The objectives of the corrective action should consider the following:

- level of contamination that can be linked to the landfill;

- level of contamination of surrounding properties and land;
- use of surrounding properties;
- proximity of residents;
- site appearance;
- future land and resource use;
- other site-specific environmental issues.

The objectives must consider the views of all interested persons including:

- citizens living close to the landfill;
- owners of properties adjacent to the landfill;
- landfill owner/operators (responsible parties);
- regulatory agencies involved (e.g. DEP-DSWM; DEP-DWS; DEP-DAQC; US EPA, where applicable)

1. When Alternative Closure is Appropriate

A standard landfill closure is described in 310CMR19.112. It involves installation of a final cover system with the following layers:

sub-grade layer;
gas venting layer;
low permeability layer(s);
drainage layer;
filter material (when required);
layer capable of supporting vegetation;
vegetative layer; and,
other components as may be required by the Department.

Alternatives to the standard closure are appropriate in a number of cases. They must be considered when traditional standard methods of landfill closure are not appropriate or adequate to protect public health or environmental risks. Specifically, corrective actions are called for when:

* The CSA and Risk Assessment(s) identify pollutants that are migrating beyond the landfill boundary and threatening potential water supplies.

* Private or public drinking water supplies are contaminated by landfill related pollutants. In addition to other remediation measures to be undertaken, it will be required that alternative potable water sources be provided.

* High levels of landfill gas emissions are known to present a danger of explosion or a health concern due to exposure;

* Shellfish beds, wetlands or other environmental receptors are, or may be, contaminated with landfill related pollutants;

* Post closure use involves human access to the site and there is potential for contact with contaminants if standard closure methods alone are implemented.

Alternative closures can be considered when traditional closure which involves a standard closure design is overly protective and costly to implement. Alternative closure can be considered when:

* The CSA and Risk Assessment indicate that there is little or no threat or potential threat of contamination emanating from the landfill; AND

* There is no threat to public health or the environment by the landfill.

D. Process of Developing Corrective Actions

In-depth exploration of corrective actions must be undertaken only when the CSA and Risk Assessment(s) indicate a threat and there is a need to undertake mitigation or prevent pollution associated with the landfill from affecting public health and/or the environment. After the goals and objectives of the corrective actions are determined the following three-step process should be followed in selecting the technology(ies) which are appropriate and applicable to the specific landfill:

1. Listing of appropriate technologies;
2. Screening of technologies;
3. Integration of screened technologies into closure alternative option "packages", if necessary.

First, a list of potential technologies which are applicable to the site-specific conditions at the landfill should be completed. This list would comprise all feasible technologies which may be appropriate to address existing and potential pollution. Technologies relevant to each affected environmental medium at the site (air, groundwater, surface water, wetlands, soils) must be listed.

1. Applicable Technologies

For each environmental medium which is contaminated, there are a number of basic types of technologies which may be applied to the corrective action. The landfill owner/operator will be required to make recommendations to the Department regarding technologies applicable to the problem(s) identified at the landfill. The following summary (organized by media) should be used only as a starting point when developing a comprehensive list of applicable technologies.

* Groundwater
    * construction of barriers to migration (e.g. slurry wall);
    * construction of leachate collection systems including
        * subsurface drains AND/OR
        * vertical extraction wells
    * providing wellhead treatment where water source aquifers are affected;
    * groundwater recovery (pump and treat);
    * providing alternative water supply where potable water sources are affected or threatened;

* Air (landfill gas)
    * construction of passive gas elimination systems including
        * venting pipes
        * perimeter trench(es)
    * active gas elimination systems including
        * collection wells with flaring AND/OR
        * collection wells with energy recovery

* Surface Water
    * air stripping
    * neutralization
    * metals precipitation
    * biological treatment

* Wetlands
    * biological and/or chemical treatment of contaminated sediments
    * dredging and removal of contaminated materials
    * restoration of damaged wetland
    * replication of damaged wetland

* Soils
  * hot spot excavation and treatment/disposal at lined landfill
  * vapor extraction
  * Vacuum extraction
  * bio-remediation
  * soil flushing
  * solidification/stabilization

2. Screening of Technologies

The list of applicable technologies must be screened to determine which ones are appropriate to alleviate the problems associated with the landfill. The following questions must be answered in screening technologies for their appropriateness:

* Will the technology address the existing level (concentration) and extent (area - size) of contamination in the relevant media in a timely manner;

* Will the technology provide a practicable and long-term solution in a cost-effective manner;

* Has the performance record, including the inherent construction, operation, and maintenance problems, of the technology been identified and determined to be acceptable for the actions proposed.

* Is it necessary to, and can the technology be combined effectively with other appropriate technologies without adverse effects.

3. Integration of Technologies

Successfully screened technologies are integrated, if necessary, into alternative corrective action "packages" which will be weighed against each other. In addition to a "no action" alternative, and the standard traditional closure which are included for comparison purposes, a minimum of two alternative corrective action alternatives should be developed. The alternative corrective action options considered must be ones which have been successfully screened and it has been determined that they are capable of addressing pollution in all media of concern.

For example, an alternative package developed to address groundwater contamination and excessive levels of landfill gas might include a standard closure, wellhead treatment for a contaminated public drinking water supply well and gas extraction wells with flares. Alternatively, the package might include a standard closure, a groundwater recovery system and gas extraction wells with flaring. A third package to be considered might include standard closure, wellhead treatment and gas extraction wells with gas recovery.

In summary, the types of alternative corrective action packages could include:

* No action;
* Standard Closure;
* Alternative Package 1: standard closure plus successfully screened technologies;
* Alternative Package 2: standard closure plus <u>other</u> successfully screened technologies;
* Alternative Package 3: successfully screened technologies <u>without</u> including standard closure.

These alternatives are then compared against each other in the corrective action alternatives analysis which is described below.

E. Analysis of Corrective Actions

During the comparison of alternative corrective actions, a number of criteria are applied to each alternative package to determine whether it should be recommended for implementation to resolve the particular pollution situation identified at the specific landfill. A four step process is recommended to evaluate the alternatives which have been developed.

In the first step, selection criteria (further discussed below) are applied to each package. Some of the alternative packages may meet all of the criteria, others will meet some of them. The packages are then ranked according to their ability to meet these criteria. Each factor considered in the ranking must be specifically described and evaluated. Next, it is recommended that cost effectiveness and community acceptance are considered as weighing factors.

For example, a package may rank high because it meets many of the criteria, but it may be prohibitively expensive, or be unacceptable to the community. After these factors are considered, one alternative is recommended for implementation. The Department will consider the recommended alternative, together with others, and make a decision on the alternative to be implemented.

Selection Criteria

It is conceivable that one alternative package will stand out as the best technology to be implemented. It is also possible that several alternatives may provide similar or comparable long-term value. For each alternative considered, a thorough analysis of its ability to satisfy the following criteria must be conducted:

* Protectiveness
* Ability to comply with state, federal, local laws
* Long-term effectiveness
* Reduction of contaminant toxicity and volume to acceptable levels
* Implementability
* Cost

A discussion of each criterion follows.

Protectiveness

This criterion is used to evaluate the ability of an alternative to provide clearly defined protection of public health and the environment. The protection must result in adequate reduction of risk from exposure to existing and potential contamination. If an alternative can not provide adequate protection, it can not be recommended. It must be noted that a technology which does not result in "no significant risk" from the identified pollution will only be considered temporary solution and not a permanent solution.

Compliance

Each alternative considered must be evaluated in terms of it's ability to comply with all state (including MCP) and federal environmental laws and regulations in addition to local zoning considerations. Any alternative that would not comply with these can not be recommended.

Effectiveness

The long-term and short-term effectiveness of each alternative must be evaluated. Permanent solutions resulting in "no significant risk" should be considered to represent the highest level of long-term effectiveness. To conduct an evaluation, the alternative's reliability (whether or not it can be adequately maintained and controlled), permanence (whether it will provide a permanent solution to contamination problems which may persist), and its predicted useful life must be considered. In addition, the balance between any adverse and beneficial effects of the alternative must be evaluated. If the adverse effects of the alternative outweigh the beneficial effects, it should not be considered as a viable alternative.

Reduction of Toxicity and Volume

This criterion is used to evaluate the effectiveness of treatment technologies. It may, therefore, not be applicable to some corrective actions. For a treatment technology (such as groundwater pump and treat or hot spot excavation and removal) to be effective it must be able to diminish contamination to an acceptable level as well as minimize the amount of residuals which remain. The alternative(s) passing this criterion must be capable of reducing contaminants to acceptable levels which had been set during the initial process of developing goals and objectives of corrective action alternatives.

Implementability

A number of factors must be considered in evaluating the implementability of each corrective action package. The availability and technical feasibility of each technology must be considered. The performance of each technology must also have been demonstrated in a similar application. Additionally, the requirements for, and availability of, support services such as utilities, must be considered and documented.

It is also necessary to consider the time it would take to implement each technology taking into account the status of contamination at the landfill. If construction and start up time is too lengthy, the technology may not be appropriate for a site at which it is necessary to undertake immediate action because of imminent hazards (or threats of) to humans and the environment. Such disparities between the technology and project schedules would weigh heavily against implementability of a technology.

The safety of the implementation and continued operation of each technology must also be weighed. The operation and maintenance requirements, including monitoring of performance, must be factored into the evaluation of each alternative's implementability.

Cost

It must be remembered that a recommended alternative must be affordable both in construction and implementation. Therefore, the evaluation of alternatives must include consideration of the costs involved in the short and long term. In addition to the cost of construction and start up of alternatives it will be necessary to factor in costs related to operation and maintenance requirements, including monitoring of the performance of the technology. Chapter 10 of this manual discusses in more detail the financial aspects of landfill closure which are relevant to analysis of alternatives to be considered during selection of a corrective action at a landfill.

The above criteria are meant to serve as a guide in evaluating alternatives for implementation in landfill closure and corrective actions in general. The situation at an individual landfill will dictate which particular criteria (including additional ones) will be taken into account to evaluate potential closure alternatives. The challenge in the whole exercise of evaluating corrective action alternatives will be to select the alternative with the greatest long-term effectiveness at the lowest cost and is also acceptable.

CHAPTER 6 FINAL CLOSURE AND POST-CLOSURE GUIDANCE

I. INTRODUCTION

As a landfill reaches final elevation it must undertake a number of final closure and post-closure activities. Final closure and post-closure activities involve assessment of environmental impacts, remediation of problems where they exist, final capping of all uncapped portions of the site, installation of gas venting or collection systems, maintenance of the site, and monitoring of surface water, groundwater and landfill gas.

Following closure, landfills may be used for a variety of purposes including passive and active recreation. Post-closure uses, if any, should be planned well in advance of closure so that they may be considered in the closure design.

Closure and post-closure activities require expenditure of funds at a time when the landfill is no longer bringing in any revenue through, for example, tipping fees and may not included in the waste disposal budget. Therefore, it is essential that closure and post-closure costs be determined as early in the life of the facility as possible (at the landfill design stage, if possible) to plan for those costs through the life of the facility by establishing tipping fees or other budgetary arrangements.

II. REGULATORY REQUIREMENTS FOR CLOSURE

Landfill operators are required to notify the Department no later than six (6) months prior to the date the facility will stop accepting waste [310 CMR 19.045]. When a facility stops accepting waste, or even prior to that time, the owner or operator must undertake a landfill assessment in order to determine and evaluate the nature and extent of any adverse impacts of the facility on the environment [310 CMR 19.140]. The assessment should be used to develop an appropriate final closure/post-closure plan.

Upon closure of the facility, notice that a landfill was operated on the site [S. 19.141] must be recorded at the registry of deeds or in the registry section of the land court for the district in which the landfill is located.

The post-closure period has been established as 30 years during which monitoring and maintenance activities must be carried out [310 CMR 19.142]. This period may be extended by the Department where necessary, or reduced when the owner demonstrates that a shorter period is sufficient to protect public health, safety and the environment. Factors which may be considered to change the 30 year post-closure period include the type of solid waste disposed, the quality and quantity of leachate produced, monitoring results and the location of sensitive receptors relative to the site.

Post-closure uses of landfills, allowed under the regulations, must be approved in writing by the Department after review of post-closure use plans prior to closure. Certain limitations on post-closure use are contained within the regulations at 310 CMR 19.143.

A. Closure Requirements

Closure activities will vary from one landfill to another depending on practices at the site during the active life of the landfill. For example, where landfilling was not completed in phases and no monitoring system is in place, significantly more work will be required to properly close the site than if each phase of a landfill had been capped in succession and a proper groundwater monitoring system is in place.

1. Landfill Assessment

The first phase of landfill closure is assessment of the landfill. In general, a landfill assessment should be completed prior to submission of final closure/post-closure plans. Landfill assessments are discussed in detail in Chapter 5 of this manual.

Landfill assessments will play a major role in defining the final design of a landfill closure. Where no assessment has been undertaken, a landfill will be required to close in accordance with the final cover requirements specified in the regulations [19.112]. However, where an assessment has been accomplished in compliance with Department protocols, it may be used to demonstrate that an alternative final cover design is appropriate and will adequately protect public health, safety and the environment [19.113].

2. Closure Plans

Upon completion of landfill assessment, a final closure plan should be submitted to the Department for review and approval. Contents of a closure plan are detailed in section 19.104(6), with additional requirements specified at 19.140(4) of the Solid Waste Management Regulations. In addition, the final closure plan must include a report containing the findings of the landfill assessment and a proposed schedule of remedial actions, if any.

Closure plans and activities should address the following:

- ! Final cover design, including:
    - final grading of the landfill;
    - subgrade layer;
    - gas venting layer;
    - low permeability layer;
    - drainage layer;
    - filter layer;
    - vegetative support layer;
    - vegetative cover;
    - alternative final cover design or waiver request, if applicable;
- ! Leachate collection systems;
- ! Final landfill contours;
- ! Landscaping plan;
- ! Construction plans for any on-site structures;
- ! Storm water controls;
- ! Gas venting or gas collection and recovery systems; an evaluation to determine if methane gas from the landfill can be collected and utilized as a source of energy may be necessary. If such a system proves feasible, then a detailed plan for the collection and use of methane gas should be submitted to the Department for review and approval;
- ! Should methane gas collection and utilization plan not prove to be feasible, or be delayed, then an alternative or interim plan for venting and controlling methane gas generated by the landfill should be submitted to the Department for approval.

- ! Groundwater, surface water and gas monitoring systems;
- ! Site security;

3. Closure Guidance/Requirements

- ! Drainage Ditches:
  - Drainage ditches should be designed to prevent landfill surface erosion.
  - Drainage ditches should be designed to minimize channel erosion and periodically regraded to eliminate any standing water.
- ! Leachate Collection System:
  - Surface leachate breakouts must be systematically repaired before placement of final cover.
  - Existing manholes in and around the landfill must be raised so that routine inspections of the leachate collection system can be easily conducted after landfill closure.
  - A perimeter leachate collection system may be required to control leachate outbreaks. The necessity for such a system would be evident from the landfill assessment.
- ! Gas Monitoring System:
  - Gas monitoring wells and/or a system of gas probes should be installed around the perimeter of the landfill, upon Department approval of the design.
  - If gas appears in a monitoring well, a venting trench may need to be installed to protect abutters to the landfill.
- ! Filling Surface Cracks:
  - All cracks and eroded areas of the landfill need to be filled with suitable material prior to placement of the final cover.

- ! Top and Side Slopes

  - The top portion of the landfill should be graded to a slope of not less than 2% and not greater than 5%.

  - Side slopes should not exceed a 3:1 slope (i.e. 3 horizontal to 1 vertical).

- ! Site Security:

  - Access to the landfill will need to be controlled through the use of fencing, gates, locks or other appropriate means.

- ! Compliance:

  - Inspection and verification of compliance with the approved closure plans must be certified in writing by the supervising engineer and approved by the Department. The certification must include as-built plans.

  - No changes can be made in the approved closure plans without written approval from the Department.

  - If it is determined that the facility as designed, constructed, and closed does not adequately protect the public health and the environment, the Department will require the necessary remedial actions at that time.

III. POST-CLOSURE REQUIREMENTS

Following placement of the final cover, monitoring and maintenance activities will need to be carried out for the specified post-closure period. This period is established as 30 years in the regulations, but may be extended if the Department determine that a longer period of maintenance and monitoring is required to adequately protect human health and the environment. Alternatively, the post-closure period may be shortened upon demonstration by the operator that the site will not pose a threat to public health, safety or the environment. Such a determination will, in part, be based upon valid monitoring data.

A. Post-Closure Plans

Post-closure plans must be submitted at the same time as the closure plans. Requirements for post-closure plans are included at 19.104(6) and 19.140(4) of the Solid Waste Management Regulations. Post-Closure Plans should address the following:

- Leachate management plans;
- Settlement of the landfill and settlement monitoring;
- General maintenance procedures and schedule, including:
    - Inspection of the landfill surface for cracks, erosion, and vegetative growth;
    - Inspection and repair of drainage and run-on/run-off control structures;
    - Environmental monitoring systems;
    - Leachate collection system inspection, flushing, and clean out, including the inspection and maintenance of all pumps;
    - Repair and replacement of leachate collection lines and force mains; and
    - Site security;
- Monitoring requirements and schedule;
- Post-closure uses, if any.

B. Post-Closure Guidance

- Leachate Collection:
    - The collection and pumping of leachate must continue for the entire (30 years) post-closure period, or until it is demonstrated to the Department's satisfaction that the quality of the leachate will not pose a threat to groundwater or surface waters.
    - Leachate flow calculations should be continued throughout the post-closure period.
- Settlement Monitoring:

- Settlement of the landfill should be monitored after closure so that any low areas on the surface can be filled and approved grades maintained. At a minimum, this monitoring should be done on a quarterly basis.

- If the slope of the top of the landfill decreases to less than a 2% grade due to settlement then additional cover material should be placed on the landfill to reestablish the approved slope.

! Groundwater, Surface Water and Gas Monitoring:

- Groundwater, surface water and gas monitoring must continue for the length of the post-closure period.

- Sampling frequency and analysis parameters should be established in the closure plan.

- Monitoring should be conducted according to the approved schedule.

- Refer to Chapters 5 and 7 for additional guidance on groundwater, surface water, and gas monitoring, respectively.

! Repair of Erosion:

- The repair of erosion gullies will require a commitment of resources for the entire post-closure period, but the occurrence of erosion gullies may be minimized by the establishment of good vegetative growth.

! Compliance:

- No changes can be made in the approved post-closure plans without written approval of the Department.

- If, due to reports by the owner and/or inspections by the Department, it is determined that the facility as designed, constructed, and closed does not adequately protect the public health and the environment, the Department will require the necessary remedial actions at that time.

IV. POST-CLOSURE USE

It may be possible to use landfill sites for other purposes after closure of the facility. However, the use of the site must take into consideration the unique problems associated with old landfill sites. Some uses will be more compatible with the former use of the site than others. For example, using the site for passive recreation will present fewer problems than development of buildings on-site. As stated in Chapter 5 (Assessment) any post-closure use of a landfill site, particularly if the use involves active human recreation, will make it necessary to perform a Quantitative Risk Assessment to determine potential human and environmental impacts.

The major problems encountered in post-closure development of a site include: differential settlement of the fill; generation of leachate and landfill gas; the need to continually monitor and maintain the facility for up to 30 years and maintaining the effectiveness of the landfill cover. Landfills typically will settle from 10% to 30% of their original thickness. Landfill leachate and gas will continue to be generated by the landfill for many years and maintenance and monitoring of the site will be an ongoing concern.

The proposed use must be carefully designed to address the factors listed above.

Criteria for Post-Closure Use of Landfills

Post-closure use design plans must ensure that the proposed use of the site will protect public health, safety and the environment. The criteria to be addressed include the following:

- Integrity of the final cover must not be impaired by the proposed use. Design features such as additional cover material may be required to ensure protection of the low permeability barrier layer.

- The landfill must be adequately maintained, including; erosion control, leachate management and mowing of vegetation.

- The final cap, leachate collection system, drainage systems, gas vents or gas collection wells and monitoring program or other features of the landfill designed to protect public health, safety or the environment cannot be adversely affected by the proposed use.

- ! Gas control technology must be employed where necessary.
- ! Design and maintenance of the proposed use must address landfill settlement.

CHAPTER 7 LANDFILL GAS CONTROL

I. INTRODUCTION

Decomposition of MSW produces approximately equal amounts of methane and carbon dioxide, as well as, a small amount of non-methane organic compounds(NMOC) and trace elements.
These compounds combined with products disposed in landfills make up landfill gas. The landfill gases of concern are methane and non-methane organic compounds (NMOC). NMOC include volatile organic compounds (VOC),hazardous air pollutants (HAPs), and odorous compounds. VOC emissions contribute to ozone formation which can result in adverse effects to human health and vegetation. Ozone can penetrate into different regions of human respiratory tract and be absorbed through the respiratory system. The health effects of exposure to HAPs can include cancer, respiratory irritation, and damage to the nervous system. Methane emissions contribute to global climate change and can result in fires or explosions when they accumulate in structures on or off the landfill site.

These dangers make it necessary to adequately understand gas formation, migration, and possible control at each landfill. If it is found that landfill gas pose a risk, threat (or potential threat) to human health and the environment, it may be necessary to construct an adequate landfill gas collection and control system. Design criteria for the construction of the gas collection system should be considered prior to landfill installation. Factors, such as, type of collection system and interface with landfill apparatus make the total solid waste management of the landfill efficient and cost effective. However, an effective control system can also be designed (or original design modified) and implemented during the final closure stages, if necessary.

II. REGULATORY REQUIREMENTS

Component of landfill gas are regulated by the Division of Air Quality Control as well as the Division of Solid Waste Management. Solid waste regulations exist due to the origin of the gases in solid waste and the health risks associated with the explosivity and toxicity of the gas produced. Air quality regulations exist to maintain air quality standards throughout the state by regulating source emissions which present a hazard to public welfare. Both Solid Waste regulations and Air Quality regulations should be examined to ensure proper compliance with all regulations. Chapter 4 of this manual discusses sampling and monitoring requirements at landfills.

A. Solid Waste Regulations

Section 310 CMR 19.117 of the Solid Waste regulations require that all landfills control explosive and malodorous gases, and other air pollutants in order to maintain air quality and to prevent the occurrence of nuisance conditions or public health and safety problems. The gas control system shall be designed to maintain the concentration of explosive gases to no greater than 25% of the lower explosive limit (LEL) in soils at the property boundary. The landfill gas monitoring requirements, specified at 310 CMR 19.132(4), indicate that where concentrations of explosive gases exceed 25% of the LEL, excluding gas control or recovery components, a landfill assessment may be required. The landfill owner/operator must conduct landfill gas monitoring on a schedule established in the landfill permit or as required by the Department. At a minimum monitoring shall be done quarterly.

If the concentration of explosive gases exceeds 10% of the LEL in any on- or off-site structures, including utility conduits, the owner/operator must take immediate action to protect human health and safety pursuant to 310 CMR 19.132(4). In such cases the owner/operator must notify the Department within two (2) hours of the finding.

The solid waste regulations also require that, at a minimum, passive gas vents be provided at all facilities in areas over which final cover has been applied. Passive venting prevents the build up of explosive gases and minimize off site migration. The gas venting system must be designed to allow installation of an active gas recovery system should the conditions warrant active gas collection in the future.

B. Air Quality Regulations

The New Source Performance Standard (NSPS) for Municipal Solid Waste Landfills implements section 111 of the Clean Air Act (CAA). Landfills that have accepted Municipal Solid Waste at any time since November 8, 1987 are required to submit a design capacity report to the EPA as defined in the NSPS. Landfills with a design capacity greater than 2.5 million Mg (2.75 million tons) are subject to the requirements of the NSPS. Section 502 of the CAA requires any source subject to standards or regulations under section 111 of the CAA to obtain an Operating Permit.

Sources which are not subject to the NSPS, but whose potential emissions of NMOC's are greater than 55 tpy are required to obtain an Operating Permit. These sources are also subject to VOC RACT requirements.

1. Landfill Gas Production

Landfill gases are produced as a result of biological degradation of solid waste. Biological degradation occurs in three phases (1) aerobic, (2) facultative anaerobic and (3) methanogenic anaerobic.

- Phase I

  Solid waste initially decomposes aerobically when it is first placed in the landfill. The oxygen necessary for aerobic decomposition is the result of the air trapped within the solid waste during landfilling and diffusion of air into refuse at the surface of the landfill. Oxygen dissolved in precipitation may also react with the waste. Aerobic decomposition proceeds as long as oxygen is available and is usually of a short duration (weeks-months). During aerobic decomposition, heat and carbon dioxide are produced within the landfill.

- Phase II

  As the amount of oxygen and easily decomposable material decreases, facultative anaerobic organisms (mainly bacteria) become more abundant. These bacteria produce volatile acids and carbon dioxide which results in a lower pH in the landfill. The low pH is toxic to methanogenic bacteria.

- Phase III

  As the oxygen levels fall further, methanogenic bacteria gradually take over and convert the organic acids to methane and carbon dioxide at approximately a 50/50 ratio. This process may last from several years to several decades. This results in an increase in pH to more neutral values with some heat continued to be produced.

2. Factors Effecting Landfill Gas Production

Due to the fact that refuse is placed in the landfill at different times and consists of different types of solid waste, all three phases of biological degradation may be occurring simultaneously within the landfill. Gas production rates depend on the rate of decomposition, which in turn is affected by moisture content of the waste, temperature, soil cover permeability to water, amount of precipitation , composition of waste and landfilling practices, etc.

Moisture is essential for bacterial survival. Ideal moisture content for decomposition is one that approaches saturation. Biological reactions can be retarded if moisture drops below 40% and essentially stops when moisture content is below 20%. Thus, in very dry climates, methanogenic decomposition may never occur.

3. Constituents of Landfill Gas

The composition of landfill gas in roughly 50% methane 50% carbon dioxide with trace amounts of nitrogen, oxygen, non-methane volatile organic compounds (NMOCs), hydrogen sulfide and hydrogen. Trace compounds (NMOCs) that have been detected at Municipal Solid Waste (MSW) landfills are listed in the following table from the EPA.

SUMMARY OF NON-METHANE ORGANIC COMPOUNDS DETECTED IN LANDFILL GAS

CHEMICAL NAME	No. Times Quantified	Average Conc. ppm.	Average Conc. detected ppm	Highest Conc. ppm	Lowest Conc. ppm
Ethane	26	142.79	252.63	1780	0
Toluene	40	51.60	59.34	758	0.2
Methylene Chloride	37	19.70	24.5	174	0
Hydrogen Sulfide	3	16.5	252.97	700	11
Ethylbenzene	31	14.64	21.73	428	0.15
Xylene	2	14.52	333.85	664	3.7
1,2-Dimethyl Benzene	1	12.78	588	588	588
Limonene	1	10.22	470	470	470
Total Xylene Isomers	27	10.04	17.11	70.9	0
3 -Pinene	1	9.70	446	446	446

CHEMICAL NAME	No. Times Quantified	Average Conc. ppm.	Average Conc. detected ppm	Highest Conc. ppm	Lowest Conc. ppm
Dichlorodiflouro-methane	31	8.83	13.1	43.99	0
Ethylester Butanoic Acid	1	8.65	398	398	398
Propane	26	7.68	13.59	86.5	0
Tetrachloroethene	39	7.15	8.43	77	0
Vinyl Chloride	42	7.04	7.71	48.1	0
Methylester Butanoic Acid	1	6.63	305	305	305
Ethylester Acetic Acid	1	6.13	282	282	282
Propylester Butanoic Acid	1	5.50	253	253	253
1,2-Dichloroethene	37	5.09	6.33	84.7	0
Methy Ethyl Ketone	27	4.80	8.17	57.5	0
Thiobismethane	1	4.57	210	210	210
Methylcyclohexane	2	4.33	99.7	197	2.4
Trichloroethene	44	3.80	3.98	34	0.01
Nonane	1	3.63	167	167	167
Benzene	45	3.52	3.6	52.2	0
Ethanol	1	34.1	157	157	157
Acetone	26	3.36	5.94	32	0
2-Butanol	1	3.3	152	152	152
Octane	1	3.3	152	152	152
Pentane	26	3.19	5.64	46.53	0
Hexane	26	3.01	5.33	25	0
Methylester Acetic Acid	1	2.96	136	136	136
1-Methoxy-2-Methyl Propane	1	2.96	136	136	136

CHEMICAL NAME	No. Times Quantified	Average Conc. ppm.	Average Conc. detected ppm	Highest Conc. ppm	Lowest Conc. ppm
2-Butanone	1	2.80	129	129	129
1,1-Dichloroethane	33	2.52	3.51	19.5	0
1-Butanol	1	2.17	100	100	100
Butane	26	2.08	3.68	32	0
4-Methyl-2-Pentanone	1	1.93	89	89	89
2-Methyl Propane	1	1.83	84	84	84
1-Methylethylester Butanoic Acid	1	1.50	69	69	69
2-Methyl, Methylester Propanic Acid	1	1.50	69	69	69
Carbon Tetrachloride	37	1.49	1.85	68.3	0
Chloroethane	29	1.28	2.03	9.2	0
1,1,3 Trimethyl Cyclohexane	1	1.24	57	57	57
2-Methyl-1-Propanol	1	1.11	51	51	51
1,2-Dichloroethane	37	1.05	1.3	30.1	0
Trichlorofluoro-methane	46	0.99	0.99	11.9	0
Chloromethane	30	0.90	1.38	10.22	0
2,5 Dimethyl Furan	1	0.89	41	41	41
2-Methyl Furan	1	0.87	40	40	40
Chlorodifluoro-methane	27	0.79	1.35	12.58	0
Propene	1	0.78	36	36	36
Methyl Isobutyl Ketone	26	0.78	1.38	11.5	0
Ethyl Mercaptan	3	0.78	11.93	23.8	1
Dichlorofluoro-methane	28	0.73	1.2	26.11	0

CHEMICAL NAME	No. Times Quantified	Average Conc. ppm.	Average Conc. detected ppm	Highest Conc. ppm	Lowest Conc. ppm
1,1,1-Trichloro-ethane	38	0.69	0.84	9	0
Tetrahydrofuran	1	0.65	30	30	30
Ethylester Propanoic Acid	1	0.57	26	26	26
Bromodichloro-methane	29	0.45	0.71	7.85	0
Ethyl Acetate	1	0.43	20	20	20
3-Methylhexane	1	0.43	20	20	20
C10H16 Unsaturated Hydrocarbon	1	0.33	15	15	15
Methylpropane	1	0.26	12	12	12
Chlorobenzene	29	0.24	0.38	10	0
Acrylonitrile	26	0.18	0.32	7.4	0
Methylethyl-propanoate	1	0.16	7.3	7.3	7.3
1,1-Dichloroethene	32	0.16	0.23	3.1	0
Methyl Mercaptan	3	0.12	1.87	3.3	1
1,2-Dichloropropane	28	0.07	0.12	1.8	0
i-Propyl Mercaptan	2	0.07	1.55	2.1	1
Chloroform	36	0.06	0.08	1.56	0
1,1,2,2-Tetrachloro-ethane	28	0.06	0.1	2.35	0
1,1,2,2-Tetrachloro-ethene	2	0.06	1.33	2.6	0.05
2-Chloroethyvinyl Ether	28	0.05	0.08	2.25	0
t-Butyl Mercaptan	2	0.03	0.641	1	0.28
Dimethyl Sulfide	2	0.02	0.55	1	0.1
Dichlorotetrafluoro-ethane	1	0.02	1.1	1.1	1.1

CHEMICAL NAME	No. Times Quantified	Average Conc. ppm.	Average Conc. detected ppm	Highest Conc. ppm	Lowest Conc. ppm
Dimethyl Disulfide	2	0.02	0.55	1	0.1
Carbonyl Sulfide	1	0.02	1	1	1
1,1,2-Trichloro 1,2,2-Trifluoroethane	1	0.01	0.5	0.5	0.5
Methyl Ethyl Sulfide	1	0.01	0.32	0.32	0
1,1,2-Trichloroethane	28	0.00	0	0.1	0
1,3-Bromochloropropane	1	0.00	0.01	0.01	0.01
1,2-Dibromoethane	2	0.00	0	0	0
C-1,3-Dichloropropene	2	0.00	0	0	0
t-1,3-Dichloropropene	2	0.00	0	0	0
Acrolein	26	0.00	0	0	0
1,4-Dicholorobenzene	28	0.00	0	0	0
Bromoform	28	0.00	0	0	0
1,3-Dicholorpropane	26	0.00	0	0	0
1,2-Dicholorbenzene	29	0.00	0	0	0
1,3-Dichorobenzene	29	0.00	0	0	0
Dibromochloroemethane	28	0.00	0	0	0
Bromomethane	28	0.00	0	0	0

Note: Table obtained from EPA document (EPA, 1991:EPA-450/3/90-011a).

4. Landfill Gas Hazards

Landfill gas migration through unsaturated soils into adjacent structures has resulted in explosions, exposure to toxic compounds, property damage and in some cases loss of life.

Explosion Hazards

The principal explosive component of concern in landfill gas is methane. Methane gas is a colorless, odorless gas that is explosive in air at concentrations ranging from five (5) percent (the Lower Explosive Limit or LEL) to fifteen (15) percent (the Upper Explosive Limit or UEL) by volume in air.

The UEL is the maximum concentration of gas or vapor above which a substance will not burn when exposed to an ignition source. This does not mean concentrations above 15% methane are not of concern. Mixing methane with ambient air can quickly lower the concentration of methane to within the explosive range of 5% to 15%.

Methane is lighter than air and carbon dioxide is heavier than air. However, they ".. will not separate by their individual density.." but rather move "..as a mass in accordance with the density of the mixture and other gradients such as temperature and partial pressure" (EPA, April 1992).

Hydrogen gas is also explosive but it is most often detected as a trace constituent in landfill gas (<1%) and is readily converted to methane and hydrogen sulfide. However, higher concentrations of hydrogen have been detected (20%) in landfill gas. The appearance of higher levels is thought to be indicative of the transitional phase between the facultative anaerobic (II) and the methanogenic (III) phases.

Asphyxiation Hazards

Landfill gas can asphyxiate anyone entering an enclosure containing it. Landfill gas often displace oxygen in enclosed spaces or low lying areas. The following real life story illustrates the hazard associated with such a situation.

Two workers attempting to repair water pipes entered an open excavation at a trailer park. Both workers collapsed soon after entering the excavation. The trailer park was adjacent to a landfill. The landfill gas had migrated through the permeable sands in the area, across the property line and into the excavation. The landfill gas displaced the oxygen in the excavation and caused the workers to lose consciousness.

The two major components of landfill gas, methane and carbon dioxide, are asphyxiant. Hydrogen Sulfide is also an asphyxiant but is usually detected at trace concentrations (<1%) and is readily identified by its rotten egg smell.

Air Quality Hazards

Air quality is affected by the emissions of landfill gas. These include an increase in air pollutant concentrations - contributions to global warming and stratospheric ozone depletion.

- Toxic Hazards - Many of the compounds detected in landfill gas can be of a health concern if detected at elevated concentrations. For example, Hydrogen Sulfide is considered to be Immediately Dangerous to Life and Health (IDLH) at concentrations equal to or greater than 100 parts per million (NIOSH, June 94). Testing conducted at California landfills indicated that toxic chemicals are either introduced to or synthesized within the landfill, escape through the cover, and disperse into the atmosphere. Off-site ambient air testing adjacent to landfills in California revealed toxic compounds at concentrations exceeding California's state ambient air quality standards. Exposure to the detected toxic contaminants can cause acute health effects, chronic health effects, and/or increase the risk of cancer. Limited testing in Massachusetts has identified toxic compounds in landfill gas samples. California has implemented mandatory operational landfill gas extraction and treatment systems based on air quality hazards.

- Smog Formation - Gaseous hydrocarbons emitted from landfills react with oxides of nitrogen from other sources to form ozone in the lower atmosphere. Ozone is a component of photochemical smog.

- Global Warming and Destruction of the Ozone Layer - Several of the compounds detected in landfill gas are greenhouse gases. The following gases, detected at landfills, are reported to contribute to global warming: methane, methyl chloroform, trichloroethylene, and carbon dioxide.

  The Ozone layer protects humans, plants and animals from harmful ultraviolet radiation. Recent discoveries of the hole in the ozone layer have heightened awareness of this problem. Chlorinated fluorocarbons, methyl chloroform, carbon tetrachloride, chloroform, and perchloroethylene contained in landfill gas can contribute to depletion of the ozone layer.

- Vegetation Damage - Landfill gas displaces oxygen and nitrogen in the root zone resulting in vegetation death. This is a problem typically encountered when landfill operators try to establish vegetative cover on the landfill. In the process of reviewing Initial Site Assessments (ISAs) and Comprehensive Site Assessments (CSAs) the Department has noted several instances where the migration of landfill gas has killed vegetation several hundred feet from the landfill perimeter.

- Groundwater Contamination - Water soluble volatile organic compounds detected in landfill gas may dissolve in groundwater and contribute to groundwater contamination. Additionally, dissolved carbon dioxide from landfill gas can form carbonic acid lowering pH and resulting in increased leaching of contaminants from refuse.

5. Landfill Gas Migration

The production of landfill gas results in pressure gradients (advection) and concentration gradients (diffusion) between the landfill and the surrounding environments. Landfill gas will migrate from the source area (landfill) along the path of least resistance due to the effects of the pressure, density, and concentration gradients.

Geological Considerations

Landfill gas has been detected at distances of up to 1,500 feet from the edge of refuse at landfills. As with groundwater flow, coarse porous materials, such as fine to coarse sands and gravels, will provide more passage way for landfill gases than fine grained soils such as till, silts and clays. Gas flows along its own pressure and concentration gradient and can cause gas migration in a direction opposite to groundwater flow.

However, landfill gas migration differs from migrating contaminated groundwater in that landfill gas flow is impeded by soils that are saturated. For example, wetlands and other locations where exposed groundwater is situated, act as barriers to the migration of landfill gas. Perched water table conditions however, do not prevent landfill gas from migrating between the perched watertable interval and underlying watertable. The watertable (non perched) is in effect a vertical barrier to landfill gas migration.

Capping the landfill does not mean the end of landfill gas problems. Capping often marks the beginning or an intensification of the problem, especially at unlined facilities. Landfill capping is necessary to prevent rainfall from entering the landfill and producing leachate. Capping also reduces the available moisture thus reducing landfill gas production. However, the low permeability of the cap that prevents rainfall from entering the landfill also prevents landfill gas from escaping vertically from the landfill and results in increased gas pressure within the landfill. As discussed in the previous paragraph, pressure gradients are one mechanism that results in lateral landfill gas migration.

The Department requires that landfill gas vents be installed to provide a pathway for the landfill gas to escape, to help prevent lateral migration, and to protect the cap. However, many venting systems in the commonwealth are passive systems (Refer to Chapter 7, Section III Gas Control for more information on passive systems). The increased occurrence of off-site landfill gas migration at many uncapped sites indicates that many of these passive systems have vents that are too small in diameter, too shallow and too few in number to prevent lateral migration from occurring.

If a low permeability clay and/or synthetic liner is present, this will retard lateral landfill gas migration just as leachate is retarded. However, a passive or active venting system must still be installed to prevent landfill gas pressure buildup within the completely enclosed landfill (i.e. capped & lined).

Barometric Pressure

Soil gas pressure and landfill gas pressure are affected by changes in barometric (atmospheric) pressure. As barometric pressure changes, the landfill and adjacent soils adjust to the new barometric pressure. It is advantageous to make use of the resultant changes atmospheric pressure has on landfill gas migration. As such, landfill gas migration investigations (sampling) should be conducted during conditions when landfill gas migration is expected to be at its maximum (worst case scenario).

Scenario 1

The worst case scenario is expected when landfill gas pressures are greater than atmospheric pressure coupled with sustained saturated ground or frozen ground conditions. The above conditions are expected to occur after barometric conditions associated with high pressure fronts are replaced by lower atmospheric pressure (approximately 29.75 inches of mercury or less). Prior to the approach of a low pressure front, gas pressures within the upper part of the refuse/soil will be close to atmospheric pressures immediately above the landfill. As the atmospheric pressure falls due to the low pressure front, the pressure gradient increases between the landfill and the atmosphere resulting in an increased rate of flow of landfill gas.

There is often a lag time of two to three hours between atmospheric pressure changes and pressure changes within the landfill during periods of increased soil moisture (due to previous rainfall events). Sampling should thus be conducted a couple hours after the fall of the barometric pressure and prior to the onset of rising barometric pressure conditions.

Scenario 2

A sudden rise in the barometric pressure, due to the approach of a high pressure front, may result in air intrusion into the upper portions of the soils and the diluting and/or displacing landfill gas. Landfill gas pressures within the upper portion of the refuse and soils would be lower than atmospheric pressure prior to equilibrium being reached. Migration of landfill gas into the upper portions of off-site soils and/or refuse would be inhibited by the higher barometric pressures. As a result, a landfill gas perimeter survey conducted during rising barometric pressure may not reveal the presence of landfill gas migration that a survey conducted during low atmospheric conditions would detect.

Precipitation Effects

Precipitation also affects pressure gradients within a landfill. Rainfall decreases the amount of pore space within which diffusion can occur. This results in internal pressures to build and may result in lateral migration of landfill gas. The larger pressure gradients result in a larger driving force facilitating landfill gas migration. Additionally, increased rainfall promotes increased generation of landfill gas by providing moist conditions necessary for methanogenic bacteria to thrive.

III. GAS CONTROL

Landfill gas control systems may consist of either active gas collection or passive venting systems. Design of a gas control system should consider factors such as the location of the site relative to residences, odor problems associated with the landfill, the depth to groundwater, the size of the fill, the age of the facility, soil transmissivity and the potential for gas migration from the site. When there is a high risk of methane migration to buildings, passive control systems are usually inadequate to ensure protection of public safety.

In addition to control systems installed at the landfill, it may be necessary to install gas detectors and alarms in on-site or off-site structures which are located in close proximity to the landfill.

Information Required for Gas Control Design

Listed below are elements of design which should be considered when designing a landfill gas collection system:

- Physical site characteristics;
- Waste profile (age and composition);
- Geology and climate;
- History of gas migration incidents or vegetative distress on or near the site;
- Groundwater depth and flow directions;
- Proximity to buildings, utilities, or other structures;
- Adjacent land uses;
- Identification of possible migration pathways and patterns;

This information is typically collected during a landfill Comprehensive Site Assessment described in Chapter 5.

A. Passive Gas Control

Passive gas control systems rely on gas diffusion and convection processes caused by pressure gradients between gas contained within the landfill and ambient air. Passive control systems may consist of gravel filled gas venting trenches and/or perforated gas venting pipes.

Landfill gas may be vented through trenches constructed around the perimeter of the area containing the waste or through gas venting wells installed within the fill or around the perimeter of the site. The decision to use gas venting trenches or perimeter wells will depend, among other things, upon the proximity of buildings to the landfill, site geology, the depth to ground water or the base of the fill, the effectiveness of gas vents placed in the fill, the quantity of gas potentially migrating off-site, and the amount of space available around the landfill in which a system can be installed.

1. Gas Venting Trenches

Gas venting trenches constructed around the landfill perimeter prevent lateral landfill gas migration. The effectiveness of perimeter vents or trenches can be dramatically increased where relatively impermeable barrier walls are utilized to prevent off-site migration of gases. Barrier systems typically extend to a low permeability bottom seal or natural barrier (e.g., bedrock or groundwater). Impervious liner materials used to control gas flow include geomembranes or to a lesser extent natural clays. Selection of a geomembrane should be based on performance required.

2. Gas Wells

Gas extraction or venting wells are used in the interior of the landfill or around the perimeter of the waste to provide a conduit for the escape of landfill gas to the atmosphere. Gas well design should consider the following features:

- For unlined landfills: drilling to the water table or the base of the fill, whichever is less;
- For lined landfills: drilling to approximately 75% of the depth of the fill to avoid damage to the liner;
- Adequate well spacing to vent all portions of the landfill. Every 50 - 200 feet is typical;
- Screen the entire depth of the well except for a sufficient depth of unslotted pipe starting at the top to prevent air from being drawn into the well;
- Backfill with permeable gravel;
- Properly seal, particularly in an active system, to keep air from being drawn into the well;
- Equip with sampling ports to enable easy sampling of the gas from the well.

B. Active Gas Control

Where passive gas venting is ineffectual active gas collection may be used to collect landfill gas when human health or property is threatened. Active systems remove landfill gases by creating a vacuum, which induces gas flow toward the recovery wells.

The Department encourages all landfills to determine whether sufficient gas will be produced to support the generation of power through use of an active collection system. Where sufficient gas is not available a gas flare should be considered in order to destroy methane and non-methane organic compounds (NMOCs), and to reduce odors.

An active gas control program provides several advantages for the operator, including: environmental control of gas emissions and odors; conservation of natural resources through use of gas as a fuel; a positive community image; and an economic return.

The major components of a gas extraction system include:

- ! Gas extraction wells;
- ! Lateral gas well connections;
- ! Gas collection header;
- ! Blower;
- ! Condensate collection system;

In addition to collecting gas, a gas collection system will produce condensate, which is generally handled in the same manner as leachate. A properly designed gas collection header system will provide for gravity drainage of condensate to low points where it is stored and extracted from condensate collection tanks or it is piped directly to leachate collection system tanks.

IV. PRELIMINARY INVESTIGATION FOR ACTIVE GAS CONTROL DESIGN

The engineering tasks required to design an active collection system should include the following tasks:

- ! Preliminary evaluation of the site;
- ! Site production test;
- ! Collection system design;
- ! Facility design;

The following should be submitted with any active collection and gas recovery system application in order to satisfy both solid waste and air quality permit requirements:

- ! Analysis of the landfill gas, including:
    - CH_4;
    - CO_2;
    - Hydrogen sulfide;
    - Fluorides;
    - Non-methane organic compounds (NMOCs) (EPA Method 624);
- ! Analysis of condensate;
- ! Estimated quantity of condensate to be produced;
- ! Condensate management plan;
- ! Exhaust analysis for engines or turbine of choice, including the emission rates for:
    - NO_x;

- CO;
- CO_2;
- SO_2;
- Particulate Matter;
- Hydrocarbons;

! Noise impact analysis and control for each of the following:
- Compressors;
- Engines;
- Air Inlet;
- Air Exhaust;

! Summary of all local, state and federal approvals or permits required.

A. Gas Collection System

Gas collection systems must be designed to efficiently collect gas from the extraction wells and piped to a central collection or flaring location. Gas collection piping system design must address settlement of the landfill and be air tight.

The size and type of blower used to collect the gas will depend on the total gas flow rate, the pressure drop presented by the collection system and the vacuum requirements.

Each well should have a throttle installed to vary the flow rate of gas being extracted and to ensure that the well is not being overdrawn and air drawn into the system.

The gas collection piping system should be buried wherever possible to minimize vandalism.

B. Gas Flare Stations

Flare stations should be designed such that the destruction efficiency will meet the Department's air quality requirements. Flare station design should include the following:

! Automatic shutdown system when the percentage of gas moves beyond set low or high limits;
! Flame suppresser;
! Automatic restart where the flare is blown out;
! Automatic shutdown of the fans should occur when restart does not occur after three tries;
! Alternative source of fuel for startup of the flare;

Note: Designers should confer with DAQC for a comprehensive list of requirements.

V. OPERATOR RESPONSIBILITIES

The operator of an active gas collection system will need to carefully monitor operations and equipment. Routine analyses of the gas should also be performed. Operator responsibilities include:

- Routine monitoring, data review and interpretation
- Visual inspections of the system, including:
  - Settlement of wells and header assemblies;
  - Stressed flexible connections;
  - Vandalism.
- Prompt system maintenance and repair:
  - Vault settlement;
  - Header settlement;
  - Pipe integrity;
  - Clogging of pipes;
- Routine adjustments of the collection system to ensure proper vacuum and gas flow.

VI. MONITORING AND DATA REVIEW

Monitoring of active collection systems should include:

- Perimeter Probes:
  - Methane concentration;
  - Pressure;
- Extraction Wells:
  - Methane concentration;
  - Oxygen concentration;
  - Nitrogen concentration;
  - Pressure;
  - Gas flow;
  - Available header vacuum;
- Flare Station:
  - Methane concentration;
  - Oxygen concentration;
  - Gas flow;
  - Blower inlet and discharge pressure;
- Engines or Turbines.

VII. CONDENSATE MANAGEMENT

The condensate collected within a landfill gas collection system must be properly managed. A condensate management plan must be part of any gas collection system design.

- In unlined landfills, condensate should be collected and stored within collection tanks. These tanks should be pumped periodically and the condensate should be properly disposed.

- In lined landfills condensate collected within condensate traps may be allowed to return to the filled area beneath the final cover, or collected and be properly disposed.

- Condensate holding tanks should be double-walled and be equipped with a full tank alarm system.

CHAPTER 8 LANDFILL RISK ASSESSMENT

I. INTRODUCTION

The purpose for conducting a risk assessment is to identify the risks to human health, safety, public welfare and the environment which may have been caused by the landfill operations. This Chapter discusses the methodology for conducting risk assessments at solid waste landfills.

Risk Assessment for landfills consists of three possible steps:

1) Qualitative Risk Assessment

2) Quantitative Risk Assessment Scope of Work (in accordance with Massachusetts Contingency Plan (MCP)).

3) Quantitative Risk Assessment in accordance with MCP.

A. Qualitative Risk Assessment

Qualitative Risk Assessment characterizes the potential for adverse impacts to human health, safety and the environment. It is a screening tool to filter out landfills which do not require the in-depth analysis of a Quantitative Risk Assessment. This may be due to such factors as, the absence of contamination or the remoteness of the site. A Qualitative Risk Assessment is a required component of the Comprehensive Site Assessment (CSA). Refer to Chapter 5 for additional information regarding Comprehensive Site Assessments.

B. Quantitative Risk Assessment Scope of Work

All Quantitative Risk Assessments shall follow the Massachusetts Contingency Plan (MCP) methodologies and guidance unless modified herein. Prior to preparing a Quantitative Risk Assessment, a Scope of Work shall be prepared to plan the Quantitative Risk Assessment. Depending on the site's complexity, the level of effort of the Risk Assessment will vary from landfill to landfill. Every landfill is unique and the Quantitative Risk Assessment should be tailored to site-specific characteristics. The Department will review the Scope of Work and approve and/or modify the plan accordingly.

C. Quantitative Risk Assessment

The purpose of the Quantitative Risk Assessment is to quantify the risk of harm to public health, safety, welfare and the environment. In the past, many landfills were subject to both the DSWM (310 CMR 19:000) & MCP (310 CMR 40:000) regulatory, assessment and clean-up requirements, and oversight. The MCP contains a provision ***(40.0110 Adequately Regulated)*** that allows assessment and remediation of DSWM landfills to proceed with less regulatory overlap and duplication. The adequately regulated provision limits the applicability of the MCP in cases where response actions (response actions = assessment and cleanups) can be adequately overseen by DSWM. Thus, regardless of the regulatory procedures followed, all sites (landfills, hazardous waste sites, etc.) must be cleaned up to an equivalent extent beyond the point of compliance (refer to CH. 4 for more discussion of Adequately Regulated).

Chapter 4 discusses all MCP provisions that are applicable at Solid Waste Management Facilities. Before discussing the specific requirements and procedures involved in conducting Qualitative and Quantitative Risk Assessments at solid waste landfills, it is necessary to elaborate on the following:

1. Adequately Regulated Provision as it applies to MCP Risk Assessment Regulations and Guidance;

2. Differences between MCP disposal sites and DSWM Landfills

3. Boundary of the Landfill; also referred to as the Point of Compliance;

4. Risk Assessment and its link to Corrective Action Alternatives Analysis (CAAA).

II. RISK ASSESSMENT & MASSACHUSETTS CONTIGENCY PLAN

A. Adequately Regulated

In order for a solid waste facility to be considered adequately regulated, the MCP risk characterization procedures at 310 CMR 40.0900 and 310 CMR 40.1000 must be followed. However, these requirements apply only to locations outside the boundary of the landfill (beyond point of compliance; refer to Subection C below) permitted pursuant to 310 CMR 19.020 or outside the boundary of a landfill which has closed in accordance to 310 CMR 19.140.

The first modification in how MCP risk characterization is implemented at DSWM facilities is addressed within <u>310 CMR</u>

40.0114, Solid Waste Management Facilities, of the MCP. This provision states that a landfill is deemed adequately regulated provided the person undertaking a response action does so in accordance with Solid Waste Regulations 310 CMR 19.000 and in compliance with the terms and conditions of their permit, approval and order.

The rationale for the MCP risk characterization procedures to apply at DSWM facilities only beyond the boundary of the landfill is that as long as the landfill contaminants (leachate, landfill gas) are controlled within the landfill boundary, the threat is minimized. The terminology "boundary of the landfill" referred to in the MCP, therefore, needs to be defined to reflect DWSM performance and design standards (310 CMR 19.116, 19.117 & 19.118). The term "point of compliance" more accurately considers solid waste landfill design, monitoring and performance standards.

B. Differences Between MCP & DSWM Landfills

The MCP assessment process is analogous to the DSWM landfill assessment process (ISA, CSA, etc.). However, landfills are distinguished from most MCP sites because landfill sites are engineered to accept solid waste whereas other MCP sites result from a release or threat of release of oil/hazardous materials to the environment.

At MCP sites the removal of oil and hazardous materials is usually considered as possible remedial action. Removing the source of contamination is not usually considered at most landfills due to the infeasibility (high cost, hazards with removing landfilled materials, odors, etc) of such an operation. At landfills, containment response actions are often the only feasible remedial response.

Recently constructed landfills are designed with containment systems, such as liners and cover material, to prevent pollutants from the landfill from having detrimental effects on public health, safety, welfare and the environment. This fundamental difference between DSWM facilities and MCP sites necessitates some modifications in how the MCP risk assessment provisions are implemented at solid waste facilities.

DSWM Risk Assessment program differs from Massachusetts Contingency Plan requirements in that a Quantitative approach is not mandatory at all DSWM sites. The DSWM program requires a Qualitative Risk Assessment at all sites and a Quantitative Risk Assessment only under specific circumstances discussed herein. Qualitative Risk Assessments are not undertaken at MCP sites.

C. Point of Compliance

The point of compliance is where the facility's layout and containment system no longer control the migration of contaminants to the environment.

1. Point of Compliance for Groundwater

The groundwater point-of-compliance can be thought of as the location where the performance standard for groundwater protection systems [310 CMR 19.110(1)] would be applied. 310 CMR 19.110(1) requires that landfills "... minimize the migration of leachate ... into ... groundwater to the maximum practicable extent and prevent the pollution of groundwater..."

The groundwater point of compliance for solid waste landfills is 150 meters from the edge of the system designed to control waste or the property line, whichever is less.

2. Point of Compliance for Soils

The point of compliance for soils is the edge of the area to be capped.

3. Standards for Landfill Gas

There are two standards for landfill gas.

(1) The standard that needs to be met at the point-of-compliance for landfill gas migrating in soils is 25% of the Lower Explosive Limit (LEL) at the property line of the facility.

(2) The standard for landfill gas in utility conduits and structures is tied to the concentration of gas and not a specific location. Landfill gas that has migrated into utility conduits and/or structures (on-site or off-site) exceeds the standard when concentrations greater than or equal to 10% of the LEL excluding gas control, gas recovery and leachate control system are detected. The MCP regulations at subpart C, 310 CMR 40.0330 list notification requirements and procedures in the event an Imminent Hazard.

4. Point of Compliance for Surface Water, Sediments & Ambient Air

The point of compliance for surface water, sediments and ambient air is defined more loosely than it is for groundwater and landfill gas. The point of compliance for surface water, sediments and ambient air will vary depending on site-specific factors such as the location of wetlands and surface water bodies with respect to property boundaries and compliance with applicable regulations. However, at a minimum, the point of compliance will be the property boundary of the site assigned parcel for all landfills.

D. Corrective Action Alternative Analysis & Risk Assessment

The Risk Assessment defines the risks posed by the landfill. Once the risks that are unacceptable have been determined, the next step in the landfill assessment and closure process can be taken. How the risks are managed is determined in the Corrective Action Alternative Analysis (CAAA). One purpose of the CAAA is to analyze the options which eliminate or mitigate adverse impacts that are caused by the landfill (refer to Chapter 5 for more detailed description of the CAAA process).

EXAMPLES OF REMEDIAL ALTERNATIVES	
1:	Standard cap & tracking/monitoring of landfill & plume
2:	Standard cap with groundwater pump and treatment system

The following sections describe each of the components of the Risk Assessment in more detail.

III. QUALITATIVE RISK ASSESSMENT

Prior to conducting a Risk Assessment, the general data gathering phase must be completed as described in 310 CMR 19.150 (i.e. ISA & CSA). The data gathering activities include investigation of the physical characteristics of the contamination including; amount and type of contaminants as well as identification of background levels of the contaminants. The Risk Assessment is the final task of the CSA.

The Qualitative Risk Assessment is composed of the following four steps:

<u>Step I: Identification of Contaminants</u>

A major goal of the assessment is to characterize contamination in all media. Monitoring data collected during the assessment process shall be summarized, based on media (groundwater, surfacewater, sediment, soil, landfill gas, ambient air, etc.) from which it was collected. For all media, the number of samples, concentrations, location & trends shall be presented.

Step II: Identification of Receptors

Actual and potential human and environmental receptors identified in the ISA and CSA shall be identified and located on a map. It is important to consider current and future uses of the landfill and the surrounding area when identifying receptors. Groundwater and soil shall be classified as per the MCP 310 CMR 40.0930.

Step III: Identification of Pathway

Exposure routes by which contamination (Step 1) could reach identified receptors (Step 2) shall be identified.

All viable exposure pathways for the following media shall be discussed:

! Groundwater: exposure pathways may include drinking water, dermal contact with water, incidental ingestion of water, inhalation exposure to water.
! surface water: exposure routes may include ingestion, dermal contact, inhalation.
! sediments: exposure routes may include dermal absorption, incidental ingestion, inhalation of fugitive dust if sediments are dry.
! soil: routes may include dermal contact with contaminated soil, incidental ingestion of contaminated soil, inhalation of oil and hazardous material contaminated particles.
! air: routes may include inhalation of landfill gas and oil and hazardous materials.

Qualitative Risk Assessment Conclusions and Recommendations

At the completion of the Qualitative Risk Assessment, one has to determine the need for more detailed analysis in a Quantitative Risk Assessment. After completion of Steps I, II and III, one of the following conclusions can be made:

(1) A Quantitative Risk Assessment is not required; this would be due to;

Existing data is sufficient and analysis of contaminants, pathways and receptor information indicates there is no significant threat posed by the landfill to human health, safety, public welfare and/or the environment.

(2) A Quantitative Risk Assessment is required, when;

Existing data indicates there may be a risk to human health, safety, public welfare and/or the environment. A scope of work for a Quantitative Risk Assessment shall be prepared and submitted for DEP approval.

(3) Additional data is required before concluding (1) or (2), when;

Existing data is not sufficient to determine if the level of risk posed by the landfill necessitates a quantitative risk assessment.

If the following three statements can be made regarding a site then a Quantitative Risk Assessment should be seriously considered:

(1) Contamination is present at or beyond the point-of-compliance above background levels, or likely to migrate beyond the point of compliance;

(2) Potential Receptors are present;

(3) Pathways exist by which the contamination can reach identified receptors.

The sampling and analysis requirements described in the Solid Waste Management regulations and elaborated on in the "Outline for Solid Waste Site Assessment" will not include all of the information necessary to complete an adequate Risk Assessment. The risk assessor should be involved in the development of the sampling and analysis plan as soon as it is evident that a Quantitative Risk Assessment is necessary. In order to complete a proper Quantitative Risk Assessment, the following may be needed:

- additional location(s) and frequency of sampling to be used in statistical analysis required in Quantitative Risk Assessment;
- lower detection limits than is commonly found using EPA SW-846 Test Methods (e.g. using Test Method 524.2 in place of Test Method 8260)
- additional parameters (e.g. Total Organic Carbon)

The Department has identified the following circumstances when a Quantitative Risk Assessment is necessary <u>unless the Department specifically determines otherwise</u>:

<u>Private Wells</u>

- Detection of a release to the environment indicated by the measurement of oil and/or hazardous materials in a private well at concentrations exceeding any of the groundwater standards promulgated in the MCP at 310 CMR 40.097 including GW-1, GW-2, and GW-3 standards.

- Detection of compounds characteristic of leachate in a private well above background groundwater concentrations.

Post-Closure Use

- If a post-closure use is sought for the landfill site

UCL

- Exceedance of Method 3 Upper Concentration Limit (UCL) (310 CMR 40.099(5)) in soils, sediments, and/or groundwater beyond the point of compliance.

LANDFILL GAS

- Detection of landfill gas constituents within a building, structure or utility conduit excluding gas control, gas recovery and leachate control systems.

REPORTABLE CONCENTRATIONS

- Exceedance of MCP Reportable Concentrations (RCs) detected in groundwater and soils.

ALTERNATIVE CAP

- If an alternative landfill final cover system design is sought in accordance with 310 CMR 19.113.

In cases above, the site owner may bypass a Qualitative Risk Assessment and proceed directly to the Quantitative Scope of Work.

IV. QUANTITATIVE RISK ASSESSMENT SCOPE OF WORK

Before undertaking the preparation of a Quantitative Risk Assessment, it is recommended that a Scope of Work be submitted to the Department. The purpose of preparing a Scope of Work is to plan the approach that is to be taken to characterize the risk posed by the landfill. The Scope of Work affords the Department a chance to confirm the methodology & assumptions that will be used for preparing the risk assessment and may result in a higher quality, less costly Quantitative Risk Assessment.

The Scope of Work should provide as much information as possible. The Scope should clearly identify certain activities, such as, categorizing soil and groundwater and identify current and reasonably foreseeable use of the landfill and the surrounding area.

There may be some activities which will only be discussed in the Scope of Work and not actually performed until the risk assessment is done. These include activities such as: providing toxicity profiles or actually conducting the risk characterization. The planned approach for these activities should be clearly described. An outline for preparing a Scope of Work is included as an Appendix in this manual and should be used in conjunction with the Massachusetts Contingency Plan (MCP) 310 CMR 40.000 Guidance for Disposal/Site Risk Characterization - In Support of the Massachusetts Contingency Plan, July 1995, Chapter 9, Method 3 Environmental Risk Characterization in addition to current risk assessment practices.

V. QUANTITATIVE RISK ASSESSMENT

Quantitative Risk Assessment at solid waste landfills shall follow the MCP and Guidance for Disposal Site Risk Characterization in support of the MCP in accordance with 310 CMR 40.0900 and 40.1000 as discussed earlier in this chapter (Adequately Regulated). The Risk Assessment requirements of the MCP (310 CMR 40.0900) provide three methods for conducting a quantitative risk characterization. The specific regulation concerning Method 1, Method 2 and Method 3 risk characterization procedures are found at 310 CMR 40.0970, 40.0980 and 40.0990, respectively of the Massachusetts Contingency Plan (MCP).

In addition to the procedures referenced within the MCP, the DEP has published "Guidance for Disposal Site Risk Characterization, In Support of the Massachusetts Contingency Plan", Policy #WSC/ORS-95-141, July 1996. The following are additional guidance:

1. Assumptions Regarding Pathways & Contaminants Not Beyond Point-of-Compliance.

When remedial actions utilizing known technologies are proposed, it is often possible to project the effectiveness of those technologies in reducing contaminant concentrations and/or exposures. In the case of landfills, natural and synthetic caps are the most widely implemented remedial technology. Landfill covers not only significantly reduce infiltration of precipitation into the waste material but they also isolate solid waste from direct contact with virtually all potential human and environmental receptors.

Therefore, contact with solid waste that is placed in permitted areas does not have to be considered in the risk assessment at landfills which plan to install the standard cap and are not considering a post-closure use. Therefore, testing of the waste for concentrations of contaminants is not necessary where that waste has been placed in accordance with all operating and regulatory requirements and covered with a standard cap.

2. Endpoints: Temporary vs. Permanent Solutions

Risk characterization is used in the MCP to determine what remedial response actions are necessary and to document that a level of "No Significant Risk" of harm to health, safety, public welfare and the environment exists or has been achieved for a site. A risk characterization must be performed at each site seeking a Response Action Outcome (RAO), because determining whether a condition of "No Significant Risk" (Criteria)40.0993(7)) exists is a basic requirement for an RAO. Types A and E RAO are permanent solutions under the MCP whereas Types B and C are temporary solutions.

An RAO is not required for a solid waste landfill to be considered Adequately Regulated. To establish endpoints in the process, the DSWM shall define two types of solutions: (1) Permanent, and (2) Temporary Solutions for landfills that have undertaken CAAA or closure. This is necessary in order to distinguish between landfills that have implemented all remedial action in accordance with CAAA or closure plans and achieved a condition of "No Significant Risk" (Permanent Solution) and those that have implemented all remedial action but could not, or have not yet achieved a condition of "No Significant Risk" (Temporary Solution). A pre-requisite of all temporary and permanent solutions is elimination of substantial hazard.

If a condition of "No Significant Risk" has not been achieved or standard closure design is unlikely to achieve a condition of "No Significant Risk", a CAAA is recommended. If it is determined through the CAAA process that it is not possible to achieve a condition of "No Significant Risk" then only a temporary solution has been achieved. Sites that achieve temporary solutions shall continue to conduct environmental monitoring to determine the landfill's impact on human health, safety, welfare and the environment until a condition of "No Significant Risk" has been achieved. Only then will the Department consider the site to have reached a permanent solution.

Having reached a condition of "No Significant Risk", post closure monitoring will continue for the remainder of the 30 year period or as determined by the Department.

In order to achieve a Permanent Solution, the following additional statements must be true regarding the site:

(1) The Qualitative Risk Assessment concluded that a Quantitative Risk Assessment was not required. Alternatively, the Quantitative Risk Assessment conducted in accordance with MCP and guidance provided herein concluded that a condition of "No Significant Risk" had been achieved.

(2) All remedial actions (e.g. capping, detention basins, landfill gas flare, vent trench) have been completed.

(3) All assessment and remedial actions undertaken at the landfill are in compliance with permits, approvals, and/or orders issued by the DSWM, in addition to the adequately regulated provision of the MCP.

Sites that have achieved only a temporary solution must:

(1) Conduct a Substantial Hazard evaluation
(2) Conduct a CAAA;
(3) Monitor the site; and
(4) Take all actions necessary to protect health, safety and public welfare and the environment.

These actions may eliminate the current risks via institutional controls, such as, connecting homes to public water supplies. This will not, however, result in a condition of "No Significant Risk" under MCP methodologies if the affected media (soil, groundwater etc) has not been cleaned up to levels that result in "No Significant Risk" being achieved.

CHAPTER 9 LANDFILL ASSESSMENT AND CLOSURE COSTS

I. INTRODUCTION

This chapter provides an estimated cost breakdown of the assessment, closure, post-closure and corrective action components of the Solid Waste Management Facility Regulations found in Parts I and II of 310 CMR 19.000.

II. ASSESSMENT AND CLOSURE COSTS

A. Variables and Limitation of this Analysis

Projections of financial impact are difficult to develop because estimates are affected by site-specific variables. Factors which will determine the total cost of designing, constructing, operating and closing a landfill are dependent on site-specific variables such as hydrogeological features, the local availability of clay for use in liners and capping , the amount of site preparation work required, and the topographical features of the site which may require special consideration in design.

Another consideration which is difficult to factor into cost estimates is economies of scale. EPA notes in the background document for the Resource Conservation and Recovery Act (RCRA) Subtitle D solid waste regulations that there are substantial economies of scale for landfill construction costs.

Participation by communities in regional landfills allow smaller communities to take advantage of these economies of scale, even with the additional costs of transfer stations and transportation. Major goals of Chapter 584 of the Solid Waste Act of 1987 and the Department's Solid Waste Master Plan, are to encourage the development of such regional solutions to waste disposal.

A 1992 study [1.] of the effects of current regulations on various sized landfills compared the costs associated with various stages of a landfill's life cycle for different sized landfills. Table 9-1 below shows the results of the study which demonstrates that the unit cost of landfilling is inversely proportional to the size of the landfill.

Table 9-1: PER TON COST COMPARISON

Cost Category	250 TPD	750 TPD	1000 TPD	1500 TPD	3000 TPD
1. Pre-Development	$5.06	$1.80	$1.39	$0.96	$0.52
2. Construction	6.78	4.50	3.83	3.43	3.14
3. Operations	25.86	13.24	11.60	9.95	8.31
Subtotal	37.70	19.54	16.82	14.34	11.97
4. Closure	1.02	0.77	0.65	0.58	0.47
5. Post-Closure	9.38	3.88	3.05	2.30	1.46
Sub-total	10.40	4.65	3.70	2.88	1.93
TOTAL	$48.10	$24.18	$20.52	$17.22	$13.90

1. "Cost Implications of Subtitle D Criteria," James J. Walsh, SCS Engineers, Cincinnati, Ohio, 1992.

The table above is not intended to demonstrate the need to construct a few very large landfills but rather that it is very expensive for individual communities to own and operate relatively small landfills which meet current environmental standards. The point is to emphasize that regionalization/multi-community cooperation is an economically attractive alternative to the participants.

B. Costs of First Year Environmental Site Assessment

This involves the costs associated with the landfill assessment and closure. The estimates have been calculated to represent a typical municipal sanitary landfill which has undergone limited prior assessment. Included in the costs are the first year of quarterly environmental sampling. Table 9-2 provides an estimated breakdown of assessment costs for each of the required tasks.

Table 9-2: Estimated Landfill Assessment Costs

INITIAL SITE ASSESSMENT (ISA)	Low	High
TASKS:		
1. Background Information	$550	1300
2. Historical Research	$800	1550
3. Literature/Data Search	$1350	3800
4. Hydrogeological Description	$700	1550
5. Site Visit	$300	500
6. Mapping	$1100	5000
7. Field Screening (Optional)	($3000)	(12,000)
8. Development of Comprehensive Site Assessment Scope of Work	$1200	2500
SUBTOTAL	$9000	28,200
COMPREHENSIVE SITE ASSESSMENT (CSA)		
TASKS:		
1. ISA Summary	$300	800
2. Mapping	$3000	20,000
3. Drilling Program	$15,000	50,000
4. Estimation of Hydraulic Conductivit	$2000	8000
5. Sampling and Analysis	$20,000	65,000
6. Health and Safety Plan	$1000	3000
7. Project Schedule	$300	800
8. Report Preparation	$5000	20,000
9. Development of Preliminary Closure Alternatives Analysis Scope of Work	$1500	3000
SUBTOTAL	$48,100	170,600

(1500 - 2500 per well)
(4 rounds of 10 samples @ 500 - 750 per sample)

TOTAL RANGE	$57,100	198,800
BASELINE RISK ASSESSMENT (Qualitative)	$10,000	25,000
CORRECTIVE ACTIONS ALTERNATIVE ANALYSIS	$25,000	50,000
CLOSURE DESIGN ENGINEERING COSTS (includes permitting)	4-6% of Closure Construction	

Table 9-3: Cost Range for Closure and Post Closure Activities

COMPONENT[1.]	**COST/UNIT**	**COST/ACRE**
CLOSURE		
Site Grading		$2,000-10,000[2.]
Fill/Shaping	$4.00-6.00/cy	
Gas Venting Layer	$8.00-10.00/cy	
Clay or Synthetic Membrane	$9.00-16.00/cy $0.50-0.80/sf	 $21,780-34,850
Drainage Layer	$8.00-10.00/cy	
Filter Fabric		
Seeding/Fertilizer/Mulch	$.075-1.25/sy	$3,630-6,050
Drainage Downspouts	$10.00-25.00/lf	
Soil/Synthetic Testing		$750-1,500
Ditches	$2,00-5.00/lf	
Sedimentation Basin	$15,000-50,000each	
Gas Venting Trenches	$6.00-10.00/lf	
Gas Venting Wells	$50.00-60.00/lf	
Landscaping	Variable	
Contract Supervision[3.]	7-10% or construction cost	
Estimated Total		$100,000-125,000[4.]
POST-CLOSURE		
Inspections[5.]	$1,000-4,000	
Land Surface Care[6.]	$1,000-5,000	
Leachate Hauling and Treatment[7.]	$5,000-100,000	
Environmental Monitoring[8.]	$12,000-30,000	
Estimated Total	$19,000-175,000[9.]	

1. On a given site, not all of the components listed may be necessary.
2. Site grading varies significantly depending on site conditions at the time of closure.
3. Assumes full time resident inspector because of QA/AC requirements.
4. Does not include groundwater or landfill gas treatment/remediation.
5. Assumes Quarterly inspections.
6. Can possibly be done by town forces.
7. Cost varies tremendously depending on hauling distance, amount leachate generated, chemical/biological makeup of leachate, and disposal costs. Limited cost data provided by communities range from $5,000 - $100,000 per year for this item.
8. Assumes 6 samples @ 4 rounds per year. Cost per sample ranges from $500 - $1,250.
9. Does not include possible treatment costs for leachate, groundwater or landfill gas.

C. Landfill Final Cover Systems

An effective final cover system is critical in minimizing the amount of precipitation which will percolate through the landfill. An impermeable cap will significantly reduce leachate and the costs associated with its collection and treatment during the post-closure period. As seen in Table 9-3 the cost of a final cover system is estimated at $100,000 - $125,000 per acre. As with liners, alternative designs will be acceptable to the Department as long as they provide protection equivalent to the stated design. One possible alternative is to use synthetic capping materials rather than low permeability soils.

D. Post-closure Monitoring

Post closure monitoring may continue for 30 years after final closure of a landfill. Depending on the size of the site and the maintenance activities required at a landfill post-closure monitoring have been reported to cost from $19,000 to over $100,000 per year

E. Remediation Costs

Landfills with poorly designed and/or constructed groundwater protection systems will pollute groundwater, resulting in the need for remedial measures and potential legal liability for owners and operators because of damages caused to persons and property from the migration of pollutants from the landfill. Prevention of contamination is, therefore, generally more cost effective than cleanup of contamination caused by the landfill. Remediation activities may vary in level of complexity, from simply closing and capping a site to extraction of groundwater with subsequent treatment and discharge.

It is not uncommon to have public and private water supplies contaminated with landfill related pollutants causing the water supplies to become unusable. The costs in time and money to cope with and correct a situation where public water supplies have been contaminated are considerable. Some of these costs items include:

- Health and safety risks to residents, together with their inconvenience until the situation is corrected.

- Cost of providing a supply of potable water for the necessary length of time until a permanent solution is in place.

- Complexity created by the involvement of residents, and federal, state, and local agencies, together with the consultants engaged by them to study the situation and identify possible remedies.

- Ongoing cost of lab testing, consultant investigations, development of solutions, and preparation of cost estimates to carry out possible solutions.

- Length of time involved to carry out functions of all the participants.

- Actual cost of providing a permanent solution.

Examples of typical costs for various remedial measures are included in Tables 9-4 and 9-5. Table 9-4 refers to the 70-acre Charles George Landfill in Tyngsborough, MA and Table 9-5 refers to a 10-acre hypothetical landfill. These costs are included only as examples of the types of expenses which may be incurred in cleaning up contaminated groundwater at landfills. Costs for remediation of other types of contamination, such as contamination of surface water or landfill gas treatment, are not included. Costs will vary with each site, depending upon the contamination involved, the type of remedial measures necessary and the extent to which groundwater will need to be cleaned up. In some cases it may be more cost-effective to abandon the contaminated source of drinking water and to establish new sources.

1. Federal Solid Waste Regulations

The U.S. EPA issued new solid waste regulations under Subtitle D of the Resource Conservation and Recovery Act (RCRA) on October 9, 1991. These regulations contain siting, design, operation, monitoring, closure and post-closure requirements for landfills. The Massachusetts solid waste regulations parallel the Federal regulations and have provisions which are as stringent or more stringent than most of the Federal criteria.

In the July 5, 1995 issue of the Federal Register (Vol 60, No 128) the US EPA issued a "Notice of final determination of full program adequacy for the Commonwealth of Massachusetts' Municipal Solid Waste Landfill Permitting Program." This decision to approve the state's application under Subtitle D means that "After evaluating the Massachusetts program, Region I concludes that the Commonwealth of Massachusetts' MSWLF permitting program meets all of the statutory and regulatory requirements established by RCRA. Accordingly, the Commonwealth of Massachusetts is granted a determination of adequacy for all portions of its municipal solid waste permit program.

"The Massachusetts MSWLF permitting program is technically comparable to, no less stringent than, and equally as effective as the revised Federal criteria. The revised (Landfill Technical Guiandance Manual) is applicable to all existing MSWLFs and to all MSWLF permit applications effective July 1, 1993....."

Table 9-4: Remediation Costs for the Charles George Landfill*

Remediation System	Capital Costs[1]	Annual O&M Costs[2]
GW Extraction System	$ 1,064,000	$ 42,000
No Action Alternative	$ 151,000	$ 113,000
Extraction, Carbon Absorption, Discharge	$2,995,000	$ 686,000
Extraction, Air-stripping, discharge	$ 2,893,000	$ 695,000
Extraction, Biological Treatment, Discharge	$ 2,585,000	$ 750,000
Off-site Treatment and Disposal	$ 1,861,000	$12,259,000

* Costs estimated for a 70 acre landfill now on the Superfund list.
1. Includes construction costs of components, site preparation, utilities, engineering, permitting and contingency costs
2. Includes annual maintenance and operational costs and materials and electricity

Table 9-5: Remediation Costs* for a Hypothetical 10 Acre Landfill (From Tolman, et al., 1978)

GROUNDWATER CONTROLS

Remediation Method	Average Est. Costs
Bentonite Slurry Trench	$ 670,000
Grout Curtain	$1,400,000
Sheet Piling	$ 800,000

PLUME MANAGEMENT **

Remediation Method	Average Est. Costs
Drains	$ 23,000
Well Point Dewatering	$ 185,000
Deep Well Dewatering	$ 183,000
Injection/Extraction Barrier	$ 199,000
Spray Irrigation	$ 366,000
At-Grade Irrigation	$ 32,000
Subgrade Irrigation	$ 28,000

* For a hypothetical 10 acre landfill. Costs are average of high and low cost estimates.
** Costs include present worth of 20 years, operation, maintenance, and, where applicable, power for 10 acre landfill.

CHAPTER 10 SOLID WASTE FEES AND ACCOUNTING SYSTEMS

I. INTRODUCTION

Most municipalities have historically charged little or no fee for waste disposal with financing done through the general fund. Many residents now face a dramatic rise in waste disposal costs as communities have switched over to local or regional disposal facilities or are attempting to bring solid waste facilities into compliance with State and Federal regulations.

Additionally, separate collections for some items such as appliances and household hazardous wastes have resulted in higher disposal costs for these items. In some instances these increases have come when water and sewer rates have also drastically increased. It becomes very difficult for municipal officials to propose additional cost increases for waste disposal, but in most cases these increases are not optional.

The Department recommeds establishment of municipal solid waste fee systems which incorporate both fixed and variable components to finance waste collection and disposal costs. The Department supports the implementation of fee systems which are unit-price based as they provide the most equitable means of financing waste disposal, and have the additional advantage of promoting waste reduction. The Department also recommeds the use of enterprise funds which serve the dual purpose of tracking system revenues and separating these funds from general revenues.

A Unit-price based fee system (also known as variable rate pricing or pay-as-you-throw) refers to a fee system under which residents pay for municipal waste management services per unit of waste collected rather than through a fixed fee.

An Enterprise Fund is authorized by Chapter 44, Section 53F ½ of the Massachusetts General Laws. The establishment of an enterprise fund allows communities to seperately account for the revenues and expenses of providing a particular service. This seperate accounting demonstrates to the public how much of the costs of providing the services are recovered through user charges and how much is being subsidized through taxes. Typically, the cost of providing enterprise fund services are recovered by user charges for that service, but it is not necessary to totally recover the cost of the services through user charges to establish an enterprise fund. The accounting for enterprise funds is similar to the private sector.

This law does not alter the municipal budgetary approval process but does require communities to budget all of the revenues and costs associated with providing the service in the enterprise fund. To the extent that user charges fully recover the cost of providing the service - the retained earnings stay with the enterprise fund and may be used for increasing the services to be provided, maintained for future capital expenditure such as capping and closing a landfill or to reduce increases in future user charges to cover operations. If the user charges are not covering the costs, the amount that is being funded by taxes is calculated and allocated to keep the enterprise from running a deficit.

An enterprise fund provides improved management information to: measure performance of providing the service; analyze the impact of increasing user charges and increasing the budget; and identifies the tax subsidy, if any.

Nationwide there are approximately three thousand unit-pricing based solid waste fee programs. A large number of Massachusetts communities have initiated fee programs as a means of financing, at least in part, their solid waste programs.

II. USER FEES

Successful fee programs have been implemented in both urban areas such as the city of Worcester, and in rural areas. Almost invariably, successful fee programs are well planned, address various waste types, are equitable, and are accompanied by extensive community education programs. Landfill fees are usually part of an integrated solid waste management (ISWM) plan.

Massachusetts' fee programs vary from multi-tiered systems which provide discounted rates for elderly and low income residents to communities experimenting with a fee per pound of trash. Following is a discussion of the regulatory framework for fee programs, the types of fee systems and examples of successful systems.

A. Regulatory Framework

Massachusetts does not require communities to adopt solid waste fee programs. However, fee programs for the management of solid waste are authorized in Massachusetts General Laws Chapter 44, Section 28C, Sub-section (f) which authorizes any city or town to fix, revise, charge, and collect such fees and other charges, for any facilities or services provided as relating to the collection or disposal of solid waste.

The sub-section authorizes a city or town which has issued debt obligations to provide revenues through user fees or other charges at least sufficient to pay the current expenses of operating and maintaining such facilities and services, to pay the principal (including premium, if any,) and interest on all debt obligations issued, and to create and maintain such reserves as needed. Such fees and charges may be fixed and adjusted by each city or town to cover all or any part of the costs specified above.

III. COST RECOVERY & OTHER REVENUE

A. Cost Recovery

As part of the rate setting process, municipal officials must decide which portions of their solid waste budget they wish to recover for ISWM operations. Some options include: full cost recovery, recovery of operating costs only, recovery of some percentage of total costs, etc. This policy decision is one of the factors that will affect the landfill's net revenue requirements to be recovered through a user charge.

B. Other Revenues

Normally the revenues collected from each year's ISWM rates will not recover the total costs of the system as there are other annual revenues that will offset the cost of operating the ISWM program. In addition to a fee program, a municipality may also raise revenues through liens, federal and state grants, and interest generated from an enterprise account.

IV. ALTERNATIVE RATE STRUCTURES

There are several alternative fee systems which can be considered by municipalities for ISWM. More and more Massachusetts municipalities are turning to trash fees as an alternative revenue source to finance integrated solid waste management. October 1996 data indicate that 214 communities charge solid waste fees as broken out below:

Volume Based	77 Communities
Flat Rate - Curbside (Public Service & Subscription)	47 Communities
Flat Rate - Drop-Off	90 Communities

Note: Flat rate includes communities with publicly & privately funded MSW service

The alternative trash fee structures include flat fee and unit price fee programs. A sub-set of the unit price structure are per bag, sticker, container and card punch programs. Each of these alternative rate structures is briefly described below.

A. Flat Fee Structure

A flat fee structure is a user charge which is billed to each household periodically (monthly, quarterly, or annually). Many communities have adopted a flat fee structure. Approximately 137 communities have flat fee programs; these range in price from a $1.00 one-time fee, to $324.00 per year.

B. Unit Price Structure

A unit price fee structure, also called variable rate or pay as you throw, charges a fixed price for each unit of waste being disposed of by the customer. Thus, the larger volume user would pay more for larger volumes of trash, thereby encouraging source reduction and recycling. Some unit price systems provide reduced rates for elderly, and low income residents . Other programs charge a lower rate to households who participate in recycling and composting programs. For example, residents in the Town of Amherst subscribe for solid waste services with a town-approved hauler. The hauler is required to charge residents according to the volume of trash they discard. Residents who discard one 30-gallon barrel per week pay $169/yr; two 30-gallon barrels per week pay $195/yr; three barrels per week costs $221/yr. Households that generate small volumes of trash can subscribe to ½ barrel per week for $156/yr. Even though the large household is paying less per total volume, overall the waste disposal fee is larger.

The Town of Webster currently charges residents $2.00 per bag at the municipal transfer station. The Town credits residents who bring in a container of recyclables $1.00 (in a coupon) for future use at the transfer station. Residents who do not participate in the recycling program, or bring in more than six bags for disposal are charged $2.00 per bag. Other communities charge a unit price for waste disposal and collect recyclables at no charge. This approach also simplifies the fee system.

1. Per Bag Fee System:

In per bag programs, residents typically purchase special bags for trash disposal. These specially marked bags are usually purchased at Town/City Hall, in stores throughout the community, or in the public works department. Proceeds from the sale of these bags defer solid waste costs. Trash collectors will only collect items which are contained in these bags. This type of fee structure encourages residents to generate less solid waste and direct solid waste to recycling and composting.

2. Sticker Fee System:

Another fee system is to sell stickers, rather than bags, which are affixed to ordinary trash bags purchased by the residents. The cost of the sticker represents only the cost of the waste disposal program, and residents are free to purchase their bags based on price and convenience. Otherwise this system works the same as the per bag fee system where the customer is paying a price per unit of trash placed on the curb.

3. Per Container System:

A container system requires the community to purchase and distribute, or otherwise arrange for distribution of containers for the residents. Residents still pay per unit of trash, however, the fee is paid for on an annual basis. Thus, waste reduction decisions must be made on a longer term basis (year to year) rather than through a weekly effort.

4. Card Punch Fee System:

The card punch fee structure is a variation of the per bag system which works best at drop-off facilities. Under this system, a resident would purchase a card with a series of numbers printed on it. On each visit to the drop-off facility, the attendant punches out one number on the card for each bag or container brought into the facility. The participant is encouraged to reduce their waste volume in order to maximize the value of the card.

5. Weight-Based Systems:

Because all of the systems described above are volume based, there is a tendency to fill the containers (or bags) beyond capacity. Some type of quality control must be done by the waste handlers to limit the amount of waste stuffed into a bag or container. Generally, the fee program will attach a weight limit to the container and the waste handler will estimate whether the container exceeds that limit. A weight based program while more complex administratively, results in a more accurate fee program.

V. REVENUE PROJECTIONS

Once the rate structure is selected by a community, the community should develop fees to recover total costs. To calculate rates, the community should include all direct, indirect, overhead and landfill closure and post-closure reserve costs. The Department makes available a solid waste computer spreadsheet for use in this revenue projection analysis.

Even where fee program advocates know that their fee program will not cover the full cost of an ISWM program, it is important to know the full system cost. The fee analysis can then determine the percentage of the total cost the fee program will finance and the level of subsidy needed from the general fund. Having a full understanding of the cost of the ISWM program will aid fee program advocates in selling the program to the citizenry, and defending challenges to the program as it is implemented.

VI. WASTE REDUCTION INCENTIVES

One goal of a fee program should be the reduction of waste generated in the community. There are primarily two pricing methods which are used: 1) A one-tier system where the price residents pay covers the total costs of refuse collection and disposal or, 2) a two-tier system where only the variable costs are covered by the price of the bag and the fixed costs are covered by general revenues. Tying the fee to the variable portion of waste disposal costs is critical to realizing waste reduction.

A. The fixed costs of an ISWM program represent:

- The actual cost for hauling household trash, curbside pickup regardless of tonnage; or, in the case where curbside is not offered, the cost of hauling (tonnage) from a transfer station to the disposal point.

- The cost for hauling and disposal of municipal trash (school, town hall, etc.).

B. The variable costs of an ISWM program represent:

- The cost for disposal of tonnage generated by household units.

- The cost of the actual bag or tag for each unit of waste.

C. One-Tier System (where the price residents pay covers the total costs of refuse collected and disposed):

One of the points of the waste disposal fee is to present the true costs of solid waste collection and disposal to the waste producer. If this goal is to be accomplished then the full cost of the solid waste service should be financed by the fee. Rarely, however, is this politically feasible, at least in early stages of the fee program.

Under the one-tier pricing scheme, the amount of revenue collected by a community will decrease as people act as expected and reduce the amount of waste they generate. This presents problems, because while some costs will decrease as the quantity of waste collected decreases (i.e. tipping fees at the disposal facility), other expenses will remain the same, independent of the level of waste generation and collection. In order for a community to recover these fixed costs, it will have to increase the fees as people reduce the amount of solid waste generated, or face a short-fall of revenue. Residents will not receive any sort of "reward" for trying to reduce the amount of waste the produce. This pricing structure therefore, does not provide proper incentives for residents of the community.

D. Two-Tiered System (where only the variable costs are covered by the price of the bag and fixed costs are covered by general revenue):

Preferably, a community should set the price of their bag or tag to cover the variable costs of solid waste collection and disposal. The fixed costs should then be funded separately either out of the general fund or through a split fee system. With the general fund subsidy, the residents may not face the total cost of solid waste services, and so may not reduce to the greatest degree possible. In either case, however, the incentive for waste reduction is made evident through the cost per bag or tag system - the person producing four bags of trash pays four times as much as the person who produces one bag.

VII. IMPACT ANALYSIS

The decision by municipal officials to increase waste disposal rates or to change to a new rate structure will have a direct impact on the users of the system. It is, therefore, important to analyze the impact of rate changes in order to provide local officials and decision makers with meaningful comparative information as they examine their rate options. The rate study should include analyses that demonstrate the impact of fee system changes on the amount of waste disposed by specific customers. Impact analysis can be conducted in a number of ways, including comparing municipalities, determining an average or "mean" waste, or classifying users.
When conducting an impact analysis, the municipality can determine the full cost of waste disposal for its waste disposal system. The analysis can then be used to determine the feasibility of a "full cost" fee amount for that particular community. The more comprehensive the waste management program (collection of MSW, household hazardous waste, tires, recyclables, leaves and yardwaste) the larger the fee will need to be to support the program. Larger communities should realize lower total fees for their waste management programs, as the fixed costs are spread over more customers. An effective comparative impact analysis of fee programs requires that the analysis be made with communities which have similar population and waste management program characteristics.

VIII. ACCOUNTING SYSTEMS

Creation of the right waste management financing strategy calls for selection and implementation of the appropriate accounting system. Accounting alternatives have specific guidelines and requirements, pursuant to Massachusetts General Laws, and each has distinct advantages and disadvantages to a community depending upon the community's financial and management policies and objectives. It should be emphasized that a community's decision as to which accounting support system to utilize should be predicated upon waste management system costing and rate policy considerations. The accounting system should support these policies.

IX. POLICY CONSIDERATIONS

A. Segregation of Waste Management Costs and Revenues

Local officials may wish to segregate waste management sytem costs and revenues from other municipal costs and revenues. Generally, the segregation of these costs and revenues offers several advantages to a community by periodically providing detailed information to:

- Facilitate rate analysis and rate setting;
- Facilitate analysis of total waste management system cost, accounting and cost recovery;
- Enhance overall decision-making; and
- Provide public disclosure to taxpayers and ratepayers.

Should a community choose to make this segregation, it must utilize either a special revenue fund or an enterprise fund for its accounting purposes. Both special revenue funds and enterprise funds provide for the segregation of waste management costs and revenues in distinct funds, separate from other community finances.

Alternatively, if waste management operations are accounted for in the community's general fund, these costs and revenues will be commingled with other financial transactions in this fund. The waste management system's financial activity would still exist on the community's books, but would not be "broken out" separately.

As discussed earlier, the recovery of full costs through waste management system revenues is a policy issue made apart from the selection of an accounting support system. Full cost recovery is not required for any of the accounting options. However, for those communities which adopt a full cost recovery policy, both enterprise funds and special revenue funds support that policy through the segregation of waste management system costs and revenues from other community finances. It is important to realize that revenue generated through fee programs may be used to fund other portions of the community's budget unless a method of protecting revenue funds is created.

B. Surplus Retention

A second decision which must be made by local officials relates to the retention of any surplus that may be generated in a particular fiscal year from waste management system operations. If a community expects to have (or has) a surplus from waste management operations, does the community wish to retain the surplus separate from other community funds for future waste management operations? As more communities move toward "self-sustaining" waste management operations, and provide a "landfill closure and post-closure reserve," this issue takes on increased importance. Should local officials decide that their objective is to retain a surplus for future utility operations, certain accounting options exist. Pursuant to Massachusetts General Laws, the community may adopt a special revenue revolving fund or an enterprise fund to attain this surplus retention objective.

X. ISWM ACCOUNTING ALTERNATIVES

To account for integrated solid waste management (ISWM) revenues and expenditures, a community may utilize one of three fund accounting alternatives. These alternatives are general funds, special revenue funds, and enterprise funds.

A. General Fund

General fund accounting for ISWM operations is generally the most understood accounting support alternative. This option does not require adoption of any legislation. Essentially, waste management expenditure and revenue accounts already exist within the general fund along with other community activity. No segregation of utility costs and revenues is provided for. General fund accounting is on the budgetary (cash) basis and period-end or year-end reporting is on the modified accrual basis.

The chief advantage of this system is that it requires no change; communities can continue their current accounting practices. The main disadvantage is that it does not allow for funds to be reserved or retained for future solid waste program funding such as, landfill closure construction.

B. Special Revenue Fund (MGL Chapter 44, Section 53 E ½)

A special revenue fund is defined as a fund used to account for the proceeds of specific revenue sources that are legally restricted to expenditure for specified purposes. In Massachusetts, a departmental revolving fund may be established for ISWM under Chapter 44, Section 53E 1/2, and must be approved annually.

The key advantage of the special revenue fund is that at the end of the fiscal year surplus does not revert to the general fund. The main disadvantage is the requirement of establishing a separate fund, which does not account for capital projects.

C. Enterprise Fund (MGL Chapter 44, Section 53 F ½)

Enterprise fund accounting is relatively new to the Commonwealth and, as such, many communities are still early in the implementation process.

<u>1. An enterprise fund is defined as:</u>

- ! A fund established to account for programs financed and operated in a manner similar to private business enterprises. In this instance, the governing body intends that costs (expenses, including depreciation) of providing goods or services to the general public on a continuing basis be recovered primarily through user charges, or

- A fund established because the governing body has decided that periodic determination of revenues earned, expenses incurred and/or net income is appropriate for capital maintenance, public policy management control, accountability or other purposes.

Like special revenue funds, enterprise funds allow communities to separately account for the expenditures and revenues of their waste management operations. Similarly, this segregated accounting provides enhanced information regarding the results of operations and facilitates both rate setting and rate analyses. A community may elect to adopt an enterprise fund through city council or town meeting vote. The key advantage of the enterprise fund is the ability to segregate revenues without otherwise altering the annual budgeting process. The main disadvantage is the need to establish and maintain a fixed assets accounting system.

XI. COMBINED USER FEES AND SEGREGATED ACCOUNTING

Communities should consider establishing a self-sustaining user fees to support municipal integrated solid waste management objectives and also a segregated fund (special revenue or enterprise fund) to account for ISWM. The advantages of both these actions have been discussed throughout the chapter. There are significant advantages to establishing a segregated fund if the community's objective is to provide integrated solid waste management on a self-sustaining basis. By establishing a "fully-loaded budget" and by maintaining a segregated fund, the municipality can periodically track the results of operations during the year through budget and actual reporting. Special revenue or enterprise fund accounting combined with self-sustaining user fees present the community with a powerful fiscal management tool to meet the community's integrated solid waste management needs and for bringing ISWM issues before the public at town meetings or other forums.

Bringing either the fee system or accounting system through the local decision making process is an arduous and time consuming process. Both require extensive time commitment on the part of the program advocates to educate the public, develop public support and work the program through the political system. A main purpose of the fee program should be to provide revenue to support the ISWM system. Without the segregated accounting system, there is no assurance that this will happen. For these reasons, the Department recommends that the two are brought through the process simultaneously.

XII. ACCOUNTING FOR LANDFILL CLOSURE AND POST CLOSURE COSTS

The Governmental Accounting Standards Board (GASB) has prepared its Governmental Accounting Standards Statement No. 18 which is titled: "Accounting for Municipal Solid Waste Landfill Closure and Post-Closure Care Costs". This Statement is based on the October 9, 1991, USEPA rule, "Solid Waste Disposal Facility Criteria", which established closure requirements for all municipal solid waste landfills (MSWLFs) that receive solid waste after October 9, 1991. The effect of the EPA rule and similar Massachusetts laws and regulations is to obligate MSWLF owners and operators to perform certain closing functions and post-closure monitoring and maintenance functions as a condition for the right to operate the MSWLF.

The Statement applies to state and local government entities that are required by federal, state, or local laws or regulations to incur MSWLF closure and post-closure care costs. Some of these costs, which result in disbursements near or after the date that the MSWLF stops accepting solid waste and during the post-closure period, should be included in the estimated total current cost of MSWLF closure and post-closure care, regardless of their capital or operating nature. The estimated total current cost of MSWLF closure and post-closure care should include:

a. Cost of equipment expected to be installed and facilities expected to be constructed (based on MSWLF operating and/or closure plan) near or after the date that the MSWLF stops accepting solid waste and during the post-closure period.

b. Cost of capping expected to be applied near or after the date that the MSWLF stops accepting waste.

c. Cost of monitoring and maintaining the MSWLF area during the post-closure period.

A portion of the estimated total current cost of MSWLF closure and post-closure care is required to be recognized as an expense and as a liability in each period that the MSWLF accepts solid waste. Recognition should begin at the time the MSWLF begins accepting solid waste, continue in each period that it accepts waste, and be completed (fully funded) by the time it stops accepting waste. Estimated total current cost should be assigned to periods based on MSWLF use rather than on the passage of time.

A. Applicability

The provisions of this Statement are effective for financial statements for periods begining after June 15, 1993. Earlier applications are encouraged. For periods beginning before June 15, 1997, landfills that are reported in governmental fund types (general or special revenue funds) would report landfill closure expenditures based on this method to the extent that they normally would be paid with expendable available financial resources. Remaining amounts would be reported in the general long-term debt account group. The GASB plans to issue a future pronouncement which will provide guidance on reporting in governmental fund types for periods beginning after June 15, 1997. For enterprise funds, the EPA rule would require a community to accrue annually the liability for closure costs if the community has accepted waste after October, 1991. The amount of the liability to be accrued has not yet been defined by EPA. EPA has delegated the determination of reportable expense to the states. Post-closure expense would be accrued if a community accepts waste after October, 1993.

B. Landfill Closure and Post-Closure Reserve

Many Massachusetts municipalities are facing significant landfill closure and post-closure costs in the future, particularly if the municipal solid waste landfill accepts waste after October 1, 1993 and are subject to the above EPA rule. Massachusetts General Laws, Chapter 44, Section 28 C (f) allows communities to set aside funds for the estimated cost of closing any existing operating solid waste facility. This section of the MGL also allows communities to set aside funds to clean up or prevent pollution caused by inactive landfills. Accordingly, communities should build into their user fees an amount for a landfill closure and post-closure reserve that will build up over the active life of the landfill to minimize the impact of financing such a large capital expenditure by providing for full landfill closure and post-closures costs in future periods.

Accordingly, the municipality must consider utilizing an accounting system capable of providing a landfill closure reserve to accommodate this build-up. The enterprise fund is recommended to account for an active landfill operated by a municipality and to account for a landfill closing and post-closure reserve. To establish a landfill closure and post-closure reserve, the community provides for the reserve amount through the rate setting process. At the end of the accounting period, the Town Accountant/City Auditor would prepare a journal entry reducing the undesignated retained earnings and establishing or increasing a reserve for landfill closure and post-closure within retained earnings.

If the community is accounting for integrated solid waste management under the general fund or the special revenue revolving fund, the community should establish a landfill closure and post-closure reserve as a receipt reserved for appropriation without further town meeting or city council action. Appropriation will be required before these funds can be spent for such purposes.

XIII. CONCLUSIONS

The goal of the Department is to have all communities which maintain ISWM programs implement a unit-price based fee program and enterprise fund accounting. Under the fee system, consumers will know that they are paying for the waste they produce and will take advantage of source reduction and recycling options. The fee system will ensure that the money consumers pay for waste disposal will be used to that end.

The Department realizes the difficulty in establishing these programs. Groups working on program implementation need to develop broad support throughout the community. This will require extensive education and outreach. There are many myths to dispel, and thorough planning to be done. While it is a difficult task, there are many champions, and success stories which program advocates can use to help to establish these programs.

A unit pricing based fee program and enterprise accounting system are integral to a successful integrated solid waste management system. They are key tools which will enable the Commonwealth to reach it's goals of solid waste source reduction, improved recycling and composting programs, efficient use of disposal capacity, and resource conservation.

CHAPTER 11 PROCURING CONTRACTING SERVICE

I. INTRODUCTION

A major consideration for a municipality in assessing and/or closing a sanitary landfill is the contracting for professional services and construction activities. Contracting activities may include establishment of a selection committee to evaluate consultant qualifications and proposals, interviewing and hiring a consultant, the appropriation of funds, and the actual project oversight.

This Chapter presents some general guidelines for consideration in procuring professional services for assessment and/or closure of landfills. There is also discussion of the state's Uniform Procurement Act (Chapter 30B) and it's impact on the landfill assessment/closure process and a summary of requirements as put forth by the Office of the Inspector General.

Once a selection committee has been established, the next step is the preparation of a Request for Proposals (RFP) which describes the requirements for the contract. Appendix E presents a model RFP which may be used for contracting for assessment and closure consulting services.

II. GENERAL CONTRACTING CONSIDERATIONS

A. Pre-RFP Considerations

1. Use of In-House Expertise

Prior to developing the Request for Proposals, the responsible municipal official should determine how much, if any, of the work can be done by in-house staff. Some of the Initial Site Assessment activities such as record gathering and determining historic use of the landfill can be readily accomplished by in-house personnel. Additionally, engineering and public works staff experienced in solid waste work can be responsible for overseeing or coordinating certain design and construction activities.

2. Pre or Post-Funding

Another consideration involves whether the RFP process should begin before or after funds have been allocated. Proposals for which the local appropriation has not been made may draw a limited number of responses due to the uncertainty on the part of potential respondents as to whether the project will proceed. However, obtaining bids or proposals prior to the appropriation of funds will provide a more accurate estimate of the funding required to finance the project.

As an alternative, a community can issue a Request For Qualifications (RFQ) which would provide information on the qualifications of potential contractors, the experience of the firm and key personnel in accomplishing tasks on similar projects and may include information relative to the costs of those projects. This also reduces the amount of time which respondents will have to invest upfront in putting together a full proposal. A third option is to combine the RFP and RFQ into one RFP/Q which requires proponents to describe their ability and qualifications to perform the project as well as desribe how they would perform each task and how much it will cost to perform the tasks in the contract.

Costs estimates are outlined in Chapter 9 of this manual. These estimates may be used for planning purposes but should be updated for inflation and other economic factors. The RFP process can be initiated prior to local appropriation but the signing of a contract cannot take place until funding is available.

B. The RFP Process

Chapter 30B of the Massachusetts Code of Regulations requires that the municipality designate a Chief Procurement Officer (CPO) whose main function is to oversee preparation and implementation of contracts on behalf of the municipality. The CPO may designate another person who has the necessary expertise to be the procurement officer for the specific purpose of overseeing activities related to landfill contract(s). An individual or group within the municipal government or an outside consultant can be utilized to develop the RFP .

Publications such as those listed in the reference section of this manual provide helpful information on structuring the RFP, including interviewing and the contents of an agreement. The community's legal counsel will play an important role in structuring and/or reviewing the final contractual document.

1. The RFP

The RFP would ideally include:

- A description of services needed, including technical details;
- The amount budgeted for the proposal;
- The qualifications of personnel required for the project;
- Proposed schedule for the project;
- Format to be used in preparing a response to the RFP;

- Criteria by which the proposals will be evaluated;
- Consultant selection process.

A pre-proposal meeting can be used to clarify issues discussed in the RFP including tasks to be performed under the contract.

2. RFP Review

Consideration should be given to the following items when reviewing proposals:

- Responses to the RFP (proposals) should be reviewed by a multi-disciplinary team of individuals experienced in tasks described in the RFP.
- The qualifications of the personnel proposed to work on the project should be evaluated as well as the qualifications of the firm to perform tasks describe in the RFP;
- Tasks to be accomplished in the contract, as well as the relevant expertise to perform the tasks, should be defined to the greatest extent possible;
- Criteria (including weighting) for evaluating components of the RFP should be defined and included in a rating sheet to be used during review of proposals.
- The project manager and key personnel should be invited to make a presentation on how tasks in their proposal will be performed and answer questions raised by members of the proposal review team.

3. Contracting Considerations

The following items should be considered when structuring the contract:

- Detailed description of the scope of work ;
- Project schedule and time frame for delivering work products;
- Detailed description of coordination between the consultant, on one hand, and responsible municipal officials and/or staff on the other hand;
- Detailed description of the role and responsibilities of the project manager for the firm;

- Designated municipal person in charge;
- Define the deliverables and the schedule of payments;
- Define how information will be reported;
- Identify the number of meetings to be held between Town and Consultant and the DEP, where applicable; and
- Identify key personnel and any limitations on changes and staffing.

It is important that both the schedule and milestones be worked out between the municipality and consultant. In addition, it is useful to make DEP staff aware of the schedule. The municipal officials or representatives need to identify the tasks and responsibilities required of the consultant, and to formulate the RFP and subsequent contract around these requirements. The guidelines for assessment activities included in the appendices and technical chapters of this manual can be used to outline the tasks which need to be completed.

One of the functions of the municipal officials is to keep the consultant updated on the local issues as they affect the project. The role is reversed on technical matters.

4. Other Issues

An issue that may occur in working with consultants is a change in key personnel or the project manager. The consultant can help overcome this by identifying a backup contact who is also responsible for accomplishing the contractual requirements. Such key personnel should, therefore, participate in the RFP interviews, if possible, to enable them to become very familiar with issues raised in the RFP and selection process and prepare them to quickly replace lead personnel when necessary.

Another issue arises where the Scope of Work in the RFP does not adequately describe the particular situation presented by the landfill but reiterates the language in a model RFP and Scope. While the model RFP can be used to standardize the types of tasks which the Department defines as required to adequately assess a landfill, the Scope of Work in the RFP must be such that issues relevant to the particular landfill are addressed by tasks to be undertaken in the project .

Other circumstances which occur and result in delays in assessment activities include:

- Working from pre-existing contracts which don't contain a scope of work which is sufficient to complete the assessment process;

- Trying to adjust contracts in the midst of the assessment;
- Attempting to locate related pre-existing work;
- Sites which are in litigation;
- Trying to accomplish tasks within an unachievable time frame; and,
- Lack of coordination among boards within the municipality.

III. THE ROLE OF CHAPTER 30B

The Office of the Inspector General published a document titled, Municipal, County, District, and Local Authority Procurement of Supplies, Services and Real Property in March of 1990, to provide guidance to municipalities and public authorities in contracting for among other things, professional services. The Uniform Procurement Act which defines the procurement process for all governmental bodies in the state became effective on May 1, 1990. It was amended in 1992 to allow exemptions from the Act for certain solid waste activities.

This section describes how services should be contracted pursuant to Chapter 30B. Certain solid waste contracts are exempt from the stringent contracting procedures of c. 30B. However, contracts for professional services for the landfill assessment and design and construction of the closure are not exempt from c. 30B.

A. Chapter 30B Defined

Chapter 30B establishes comprehensive standards governing public contracts for supplies, equipment, service and real estate. It is intended to:

- Make procurement procedures consistent;
- Ensure fairness and equity for all persons seeking to provide services and supplies;
- Provide economies of scale and to maximize the purchasing value of public funds;
- Create effective competition; and
- Provide quality and integrity within the procurement system.

Ch. 30B defines uniform procedures for the awarding of government contracts. It also clarifies the rules for modifying, amending and renewing agreements and exercising options under contracts.

B. Contracts for Supplies and Services

The majority of agreements between local governments and private vendors are covered by 30B.

Ch. 30B, defines supplies and services as follows.

> Supplies: all property, other than real property, including equipment, materials, printing, and insurance and further including services incidental to the delivery, conveyance and installation of such property.
>
> Services: the furnishing of labor, time, or effort by a contractor, not involving the furnishing of a specific end product other than reports. This term shall not include employment agreements, collective bargaining agreements or grant agreements.

There are thirty (30) exceptions to the 30B requirements identified in the original legislation and subsequent amendments. The exceptions relevant to these solid waste activities are briefly described below: (note: see pp. 23-25 of the Inspector General's procurement manual for appropriate guidelines)

- Contracts for construction work and for the purchase of construction materials, subject to c. 30 § 39M;
- Contracts for design services for building projects, subject to the designer selection law at c. 7, §38A 1/2 et seq.;
- Intergovernmental agreements entered into by two or more local government units subject to the provisions of c. 40, § 4A;
- Transactions with the Commonwealth;
- Agreements between agencies, boards, commissions, authorities, departments, or public instrumentalities of a city or town;
- Contracts to purchase supplies or services from the federal government, the Commonwealth, or any of its political subdivisions;
- Contracts with designers (although the Department and the Inspector General's office recommends that

the municipality follow a competitive bid process similar to c. 7 or c. 30B to ensure a fair and equitable contract); and,

- Purchase made from a vendor pursuant to a contract with the Commonwealth for the item(s) being purchased.

C. Contract Amendments

The quantity of supplies or services called for in the contract cannot be increased by more than 10% under an existing contract. If more than this amount is required after the initial contract has been awarded, the municipality, county or local authority must re-advertise and award a new contract for the additional supplies or services. Gasoline, fuel oil and road salt are the only exceptions.

Chapter 30B contains additional requirements for quantity increases in contracts:

- The unit price of the additional supplies or services must be the same or less than the original contract price;

- The procurement officer must justify in writing that the increase is necessary and, more practical and economical than awarding a new contract; and,

- Both parties must agree to the increase in writing.

D. Record Keeping Requirements

All written documents required under 30B must be maintained for a period of six years from the date of the final payment of the contract and must be available for public inspection.

For contracts from $1000 to less than $10,000, the municipality shall keep written records which include purchase specifications, names and addresses of all persons from whom quotations were sought and the date and amount of each quotation.

For contracts of $5000 or more, there must be a file for each contract which contains all required written documents, including the executed contract and any amendments to the contract.

E. Enforcement Provisions

Chapter 30B prohibits bid splitting, i.e., the dividing of any procurement for the purpose of evading the legal requirements of c. 30B. Two enforcement provisions exist which ensure that contracts are awarded in compliance with the law:

1. No payment can be made under an invalid agreement.

2. Civil penalties can be imposed for violations of Chapter 30B.

IV. CONCLUSIONS

Subsequent to the local planning effort, the RFP is the major step in leading to a contractual arrangement between the municipality and the selected consultant. The municipality, through it's chief procurement officer and other officials involved in solid waste activities, need to draft its request and evaluate proposals to obtain the best services at a reasonable price. The person(s) or board overseeing the assessment and closure activities should understand not only the procurement process but also the tasks to be conducted and services and products to be delivered under the contract.

CHAPTER 12 PLANNING AND MANAGING LANDFILL ASSESSMENTS AND CLOSURES

I. INTRODUCTION

When conducting a landfill assessment and subsequent closure, there are ongoing planning and management activities which a municipality must go through in order to assure a successful outcome. These activities can involve large amounts of volunteer and staff time working with town officials and citizenry, DEP's Division of Solid Waste Management, and the consulting firm contracted to do the required work. Generally, a municipality which works effectively in meeting its responsibilities will receive better results and will often save money over the project life.

This Chapter focuses on two areas: 1) Working with a community and its local officials; and 2) Landfill assessment and clean-up planning and scheduling. This chapter should be particularly useful to local officials and volunteers who will be undertaking their first major municipal project.

II. WORKING WITH LOCAL GOVERNMENT

A. Municipal structure

The structure of a municipality will depend on its size and affluence. Towns with large populations and large tax revenues to draw from will have professional staff persons available to work on assessment and closure. Smaller municipalities may have few, if any, paid professional staff, and will need to find other resources to implement a landfill assessment and closure.

1. Key Players

For the large municipality with ample staff there are a number of key players. Of particular importance will be the technical role of the town engineer, Department of Public Works (DPW) superintendent or other municipal official who will have first hand knowledge of landfill operations and an understanding of what may be required for landfill assessment and closure. They will play an important role in oversight of consultants hired to conduct a landfill assessment and/or closure. In most cases, a town planner fills the coordination role, and will be knowledgeable about the project scheduling, and communications with local officials and the citizenry. The town administrator or manager will be the key financial person. He or she will be most familiar with contracting requirements, and will be the lead person in communications with the municipal body.

2. Volunteer Recruitment

In smaller municipalities lacking professional staff persons, it will be important to find regional professional staff or volunteers to fill these three key roles; technical, coordination, and administrative liaisons. In most communities sufficient expertise is available to draw from. The problem is usually one of recruiting volunteers initially and keeping them involved.

Availability of volunteer staff is not necessarily tied to a municipality's size or affluence. Larger populations do provide a bigger pool to draw volunteers from; as do communities with a large retiree population and/or many single wage earning households by providing more individuals with free time to volunteer. The biggest factor, however, is the openness of the local officials to volunteer efforts, and the effectiveness with which a local government can work with these volunteers.

New volunteers looking to give their time to an activity will quickly discover whether their help is wanted, and how much decision making authority they will have. A balance must be struck between giving volunteers sufficient quantity and quality work to keep their interest, and not giving them so much that they quickly burn out. Volunteers must be provided some level of autonomy and decision making authority or a shared decision making process. It is also important from the start to show the volunteers some structure and organization, otherwise they may drop out perceiving the project as a waste of their time.

The project organizers should be prepared to discuss goals and expected outcomes of the project, and determine the expectations of others attending meetings. This will help to maximize the use of people's available time, and help to head-off scattered agendas from being moved forward. Volunteers should leave the first meeting with an expectation of the time they will need to commit to the project, and project chairpersons should know what time and activities volunteers are committing to the project.

B. Municipal Coordination of the Committee

A formal group or committee should be established to oversee the landfill assessment and closure. The committee membership will consist of the players discussed above.

1. Establishment of the Committee

Establishment and coordination of the committee is often carried out by a town planner or Board of Health (BOH). These activities will include pulling together local officials or other key players, recruiting volunteers and setting up the guidelines for the first meeting in which the committee is established.

The committee should operate within the framework of the community's Integrated Solid Waste Management plan or program.

It should have a broad based constituency to maximize effectiveness and help in getting the project through critical stages. It should extend the coordination process through other solid waste activities (e.g. recycling, household hazardous waste collection) ongoing within the community.

In addition to recruitment through the public meeting process, other methods will be needed to recruit volunteers to the committee. Recruitment can be done through local papers, cable television, and attendance at municipal board meetings. It is very useful to have people on the committee who are either full or associate members of a local board. Again, the committee should be broad based, keeping in mind the key roles which will need to be filled, and time commitment which is available from each person.

2. Documentation

The planner or BOH official should be responsible for maintaining a paper trail which adequately documents the decision making process and the decisions which were made. This will be important should there be a turnover of committee members and is useful to document contracting procedures. It is also important to document the assignment of activities and deadlines, to make sure that all the committee members are aware of project milestones and outputs to be produced.

3. Sufficiency of Resources

It is important that an adequate number of people are available to form a "critical mass" for the committee. Prior to implementing the assessment and closure process it may be necessary to assess the project in consideration of other pending or ongoing activities to decide if the project can be successfully undertaken. This assessment should be done for the project itself and for municipal staff (volunteers and professionals) who will work on the project.

To aid in making this determination committee members need to look at other ongoing activities which they are involved in and the time requirements for each activity. (This will be critical for the key players in the assessment and closure process.) Once activities and time requirements are determined, the committee can determine whether there are sufficient resources available for the project. Project management software packages to aid in the analysis including determination of timing considerations and tracking individual activity and time commitments are available.

III. PLANNING AND SCHEDULING

A. Overview of Activities

Planning tasks begin well before the initiation of contracting or landfill site activities. The committee should remain active until the Department of Environmental Protection has signed-off on the closure and post-closure monitoring and uses of the landfill. The critical time of local involvement will be during the contracting process, but should not overshadow careful preparation leading into the RFP/RFQ process and oversight of the assessment and closure activities once a formal contractual agreement has been made between the community and consultant.

B. Need for Public Participation and Education

In cases involving municipal landfills, the community should be aware of landfill activities through board of health and selectboard or town council meetings. Since the project will require appropriations of local funds, and possibly increased solid waste charges to residents, it is important that the community understand what is going on and why. Public information meetings and educational activities will provide a means of establishing support for project funding and forums for recruitment of volunteers to serve on the assessment and closure committee. People living in proximity to the landfill should be sought out for the public participation process. This group will be most directly impacted environmentally by landfill activities.

In the Initial Site Assessment stage, long-time residents can be a valuable source of information regarding historical use of the facility. Frequently, the board members at the time a study was completed retain copies of the study. Similarly, other past public officials and volunteers may be familiar with related studies conducted for the community.

The first public meeting should occur soon after the decision is made to look into conducting the assessment and closure. Few, if any, decisions should be made prior to opening up the process to the public. Initial committee formation should be an outcome of this first public meeting.

C. Pre-Assessment Activities

1. Committee Volunteer Roles

Along with the professional and official roles discussed in Section II above, there are a number of key roles to be filled either by volunteers, municipal officials or professional staff. Many of the roles discussed here may be grouped under individual persons or may be shared by a sub-committee depending on the professionals and volunteers available to work on the project.

These are all important functions which should be delegated to committee members with the skills and inclination to carry them out.

Committee Officers

Preferably a municipal committee should be as small as possible with a chairperson (preferably co-chairs) and a recorder. The chairperson will be responsible for communications between municipal officials and the committee. The chairperson will also oversee activities undertaken by the committee and its sub-committees. The recorder's role will be to document the decision making process. If the chairperson is not a local official, the role should be closely coordinated with the municipal official in charge of the project.

Coordinator

In a busy municipality, it may be necessary to establish a project coordinator other than a local planner. This person will coordinate activities between local boards, professional staff and the citizenry. When the coordination function is not part of the planning process, the various participants may move in different directions based on their perception of the process. This problem can continue until a milestone is missed or until the project starts to fall apart.

Procurement Officer

If the municipal procurement officer is not a participant of the committee, then another person should parallel this function for the committee. The procurement officer will be the point person for contracting activities.

Meeting Facilitator

A meeting facilitator plays an important role in nearly all meetings both formal and informal. The function of the facilitator is to monitor the meeting, seeing that people who want to talk have the opportunity, and that the meeting is not usurped by one individual or topic. This function may be carried out by the committee coordinator or chairperson. However, especially in more formal settings, the function should be separated.

Public Information Spokesperson

A public information person serves the function of maintaining support for the project. This may be through news articles, talking to civic groups, municipal board meetings, school activities and phone hotlines. This function is most important near town meeting appropriation time.

Negotiator

A designated negotiator serves as spokesman for the committee when determining contractual details of the assessment and closure work. A skilled negotiator will help make the contracting process move smoothly, and the end products will better meet the committee's needs.

D. Timing and Planning Considerations

There are three major timing constraints. First, there are the regulatory constraints established by the State Solid Waste Regulations. The second set of constraints come from the local government process. The third set are related to construction work and consultant scheduling.

1. Regulatory Constraints

Landfill operators are required to notify the Department about their intention to close a landfill six (6) months before closure takes place. Operators are also required to close landfills on a schedule and in accordance with negotiated Administrative Consent Orders signed with the Department.

Final closure plans are required to have the results of an Initial Site Assessment and a Scope of Work for a Comprehensive Site Assessment submitted as a part of the closure plan. Planning for completion of the final closure plan must allow for the time it will take to complete the Initial Site Assessment and develop a Scope of Work for the Comprehensive Site Assessment so that these tasks will be completed in time to be incorporated into the final closure plan. In the case where an interim closure plan is submitted the interim closure plan must include a schedule for undertaking an ISA and developing the Scope of Work for the CSA.

2. Local Constraints

The major local constraint will be the town meeting approval process and fund allocation. Unless a Board of Health has sufficient funds in their operating budget to conduct the assessment, the Board will need to request funding through the town meeting process. This will require several months to prepare and receive approval for a warrant article, and sell the project to the public. This process will proceed more quickly in municipalities which have a Town Council form of government as there are less formalities and shorter time frames involved. It may be possible to initiate the Initial Site Assessment with existing funds while gearing up for larger appropriations to finance subsequent assessment and closure.

3. Contracting Constraints

The two constraints affecting contracting are the construction season and scheduling. Seasonal variations determine when monitoring wells can be installed and when they are sampled. Wells cannot be installed during severe winter conditions. Once installed they will need to be sampled during each season in the course of a year. In selecting a contractor to conduct the assessment, their availability to stay on schedule should be an important element of the selection criteria.

4. Scheduling

An ideal schedule would call for preparation of the warrant article at least three months prior to the spring town meeting. The committee would hold informational sessions, prepare news articles and flyers, and lobby for approval of the warrant article prior to the town meeting. Following approval, the committee would initiate the RFP/RFQ process with a July target date for contract completion and commencement of the Initial Site Assessment and development of the scope of work for the Comprehensive Site Assessment.

This will allow for approval of the Comprehensive Site Assessment Scope of Work in early fall, and completion of well installation and a first round of sampling before the end of the construction season. Corrective Action Alternative Analysis and Closure Design could be conducted the following winter once the assessment is completed and construction of the approved closure alternative could start early in the construction season. Funding for the closure design and construction would be placed on the town meeting warrant for the spring following initial approval or could be appropriated at a fall special town meeting.

Should this process begin with a fall appropriation of funds, the Initial Site Assessment would be conducted during the winter and the Comprehensive Site Assessment would start in early to mid-spring. This would set the project back three to six months but would still meet the compliance schedule of the State solid waste regulations.

IV. CONCLUSIONS

In summary, it is important that local officials initiating a landfill assessment and closure tap into expertise within the community to form their committee. Early on, the committee should begin building a base of support through public information and education. Finally, the committee should take the time needed to understand the project details and formulate a plan to carry out these activities. Time spent in planning for these activities will be saved over the course of the assessment and closure process.

CHAPTER 13 INTEGRATED SOLID WASTE MANAGEMENT

I. INTRODUCTION

This Chapter will begin with a broad discussion of the facets of integrated solid waste management (ISWM). It will then focus on how landfill assessment and closure fits into this bigger picture. The Chapter will conclude with some suggestions for successful implementation of a municipal integrated solid waste management plan.

II. INTEGRATED SOLID WASTE MANAGEMENT - As Defined by the U.S. EPA

"Integrated solid waste management involves using a combination of techniques and programs to manage the municipal waste stream. It is based on the fact that the waste stream is made up of distinct components that can be managed and disposed of separately. An integrated system is designed to address a specific set of local solid waste management problems, and its operation is based on local resources, economics, and environmental impact."

"The idea behind ISWM is that a combination of approaches can be used to handle targeted portions of the waste stream. Instead of immediately driving the development of big facilities or setting unrealistic recycling expectations, decision makers implement a series of programs each of which is designed to compliment the others. Source reduction, recycling, combustion, and landfilling can all have a positive impact on the local municipal waste management program."

"Source reduction ..... is designed to reduce both the toxic constituents in products and quantities of waste generated. Source reduction is a front-end waste management approach that may occur through the design and manufacture of products and packaging with minimum volume and toxic content, and longer useful life. It can be practised in the office and home through selective buying and material and product re-use.

"Recycling, including composting ..... can reduce the depletion of landfill space, save energy and natural resources, provide useful products and prove economically beneficial.

"Combustion (or incineration) reduces the bulk of municipal waste and can provide the added benefit of energy production. State-of-the-art technologies have greatly reduced the adverse environmental impacts associated with incineration in the past. Landfilling is necessary to manage non-recyclable and non-combustible waste and is the only actual waste 'disposal' method".

A. Resource Management

A second aspect of ISWM is efficient utilization of municipal resources including personnel and funds. Part of determining the mix of waste disposal options for the community includes development of a ISWM plan, coordination of municipal waste staff, and establishment of a funding mechanism to finance ISWM activities.

From the staff perspective ISWM involves coordination of all the individuals, paid and volunteer, working on different aspects of solid waste management within the community. The focus should be on elimination of duplicity of tasks and maintaining open communications.

By expanding these activities outside the municipal boundaries to regional and private organizations, the effectiveness of municipal ISWM can be increased. Regional collaborations can provide benefits to a municipality through economies of scale, for example, in developing markets for recycled goods. Burden sharing is another benefit, where a group of communities share the responsibility for the components of one regional ISWM system (for example, community A hosts the landfill, community B hosts the recycling center, etc).

Quasi-governmental authorities can be created to oversee regional solid waste management and implement large-scale facilities which could not be financed by a single community. These also provide some insulation from local politics. Table 13-1 presents some of the pros and cons of regional organizations.

Private/public ventures can bring alternative approaches to project implementation and may provide additional revenue for project funding. Municipalities should work closely with their private haulers, processors, secondary materials industries and local utilities in developing an ISWM plan to fully utilize existing waste management potential.

III. HOW LANDFILL ASSESSMENT AND CLOSURE FITS IN

A. Environmental Protection

A major aspect of ISWM is environmental protection. This includes protecting community public health and safety and protecting natural resources; including water supplies, wetlands and areas of critical environmental concern. Solid waste regulations require new sanitary landfills to be lined and have leachate collection systems, to prevent pollution of groundwater and surface water and control landfill gas. Environmental protection has also been the impetus for regulations requiring that inactive, mostly unlined, landfills undergo the assessment and closure process.

Environmental protection is the consideration by which commercial and industrial hazardous wastes are handled and disposed of separately from municipal waste. Likewise, household hazardous wastes, including waste motor oil and car batteries should be disposed of separately.

Under an ISWM approach, landfilling is the end point of all final solid waste disposal; incinerator ash, recycling residuals; and other non-reducible wastes. Landfill assessment and final closure are, therefore, the ultimate steps in securing the landfill and thus complete the ISWM cycle.

Failure to incorporate landfill assessment and closure into a municipal ISWM plan prolongs this inevitable event. In the interim, pollutants continue to emanate from the landfill creating greater threats to the environment. Costs to complete this work increase due to inflation and further migration of contaminants from the site. Addressing assessment and closure outside of the municipal ISWM program complicates management of both these activities.

B. Financing ISWM

In order to obtain funding for a new sanitary landfill, costs are carefully calculated for all aspects of construction and operation, including pre-construction site assessment. The solid waste regulations require that an applicant proposing a new facility determine and set aside funds to conduct final assessment and closure of the facility once it reaches its capacity.

In determining revenues to be generated by the landfill, the applicant determines the net amount of waste which will be received by the facility after subtracting estimates for source reduction, composing and recycling, and disposal at competing facilities. The operator then estimates development, operation, assessment, closure and post-closure costs. It is in this manner that a new facility operator incorporates environmental control of the landfill into the ISWM process.

Table 13-1: REGIONAL ORGANIZATIONS

This analysis and incorporation of assessment, closure and post-closure becomes more difficult for an existing landfill which no longer receives solid waste. The primary problem is that there is less incentive to initiate the assessment and closure as the facility no longer generates revenue. Regardless of the landfill status, assessment and closure should be factored into the ISWM formula, incorporating <u>all</u> present and future costs; it is the true cost of integrated solid waste management for the community.

Most municipalities have historically charged little or no fee for waste disposal. Many residents have, therefore, recently faced a dramatic rise in waste disposal costs as communities have switched over to new local or regional disposal facilities. In some instances, these increases have come at a time when water and sewer rates have also drastically increased. Hence, it becomes difficult for municipal officials to propose additional assessment related increases; yet, there really aren't any other options.

Some municipalities are operating sanitary landfills which have a few years of remaining capacity. Officials in these communities can take advantage of this capacity to raise revenues which will help to finance assessment and closure of the landfill, and implement other waste management alternatives under an ISWM plan.

IV. IMPLEMENTATION STRATEGIES

It is critical that municipal officials formulate a plan which incorporates all aspects of integrated solid waste management. It is also critical that this plan be flexible; allowing for evaluation and adjustment at regular intervals to incorporate changes as they occur. An ISWM plan should be implementation oriented, emphasizing how the different parts will work together, and how they will become operational.

Finally, the ISWM plan must be concise. Given budgetary constraints in many municipalities, any planning process will need to be done primarily by in-house staff and volunteers. Money spent on extensive analysis and characterization of local solid waste trends will be money not available for plan implementation. Where possible, municipalities should work with existing regional data estimates making adjustments as deemed appropriate.

Local ISWM plans should also be consistent with the Department's most current Solid Waste Master Plan and solid waste regulations. These will determine, in large part, the schedule for waste diversion from landfills and transfer stations.

A. Planning for the Landfill Closure

Implementation strategies for post-landfill solid waste disposal should be developed one to two years prior to ceasing disposal of waste in the sanitary landfill. In addition to the physical solid waste disposal mechanism, a community should be assessing the added cost associated with new disposal, recycling and composting and landfill assessment and closure.

The primary effect of a community losing its landfill is the loss of low or no cost disposal of community's solid waste. The driving question is how to raise funds for increased waste disposal and transportation costs. But, in order to adequately address this problem, some thought must be given to the entire solid waste management picture. Recycling and composing must be considered as means to divert as much of the waste stream as possible from the disposal site. The following breaks out some of the key questions that can help in developing an adequately funded, integrated solid waste management plan with recycling and composting as components. A brief discussion of each critical area is included as well as a list of the available options (or choices).

B. Disposal and Collection Systems:

A community has two options for solid waste collection after landfill closure. The first is to construct a transfer station for local waste collection. From there, waste is then shipped to a regional disposal facility. Money is saved by decreased trucking costs and decreased staffing for collection. However, a community intending to construct a transfer station on the existing landfill site should provide for the additional time and resources needed for the actual transfer station planning and construction and the complications which may arise in integrating the transfer station into the landfill closure plan.

The second option for waste disposal is curbside collection of solid waste. This can be contracted out in its entirety as part of a private collection/disposal contract; it can be contracted out separately from a private disposal contract; or a community can use its public works staff to manage waste collection.

Another alternative is to leave it up to the individual homeowner to contract independently with waste haulers. A community taking this approach may want to screen or otherwise license haulers who operate in their community.

Considerations connected to waste hauling include how recycling and composing will tie into the formula. A community can have multiple collections for solid waste, recyclables and yard waste. An alternative is to provide for curd-side collection of solid waste as well as provide a drop-off center for recyclable materials and yard wastes. Some communities have special seasonal collections for yard waste and special wastes (furniture and large appliances) while others provide drop-off services for solid waste materials but maintain a curbside collection of recyclable materials.

There are many options and alternative means of reaching the same results. It takes time and planning for a community to determine the best approach based on past disposal practices, available resources and citizen input. It is important to provide sufficient time and resources to make these decisions before reaching the point where alternative waste disposal is needed. The following section presents a list of choices which will help to determine the best possible waste disposal options for individual communities.

Choice of Disposal:

- Waste to energy incinerator, or
- Commercial landfill or regionally pooling waste stream with other communities with excess tonnage capacity in their contracts.

Choice of Collection:

- Curbside - municipal or contract.
- Drop-off at transfer station - municipal or contract.
- Transportation to disposal site - scheduling special waste collections.

C. Recycling and Composing

When a community's solid waste begins to be disposed of at a commercial facility, the cost/benefit of initiating recycling and composting programs change drastically. The cost of trucking materials to a regional disposal facility and the higher tip fees at the regional facility will make it worthwhile to set up composing and recycling programs or maximize the efficiency of existing programs.

If a community is planning to enter a long-term waste disposal contract the time should be taken to project the amount of solid waste which will be handled by the contract. Many long term contracts hold a community liable for maintaining a consistent level of disposal and will be charged for a minimum tonnage regardless of whether it is disposed of or not. Therefore, it is important to factor in projected tonnage that can be recycled or composted.

Choice of Recycling and Composting Collection Methods

- Drop-off,
- Selective curbside, or

- ! Full curbside.

A municipality can improve its **drop-off** programs by hiring staff to oversee and publicize the program. Attended drop-off facilities will produce better prepared recyclables and cleaner yardwaste. The more hours these facilities are open and the more locations that are offered, the higher the participation rate from the municipality. If the drop-off cannot be attended full-time, the municipality can utilize intermediate containers (barrels) to be sorted by an attendant at the end of the day.

Curbside recycling or composing collection will always increase participation and waste diversion. In order to remove many of the financial obstacles of a full curbside program, cities and towns can consider a **selective curbside** program where only one item/material is collected (e.g. newspapers only - simple and requires no special vehicles, and can be delivered to any number of waste paper dealer in the state).

A municipality can then add materials to increase to a **full curbside** program without necessarily compromising on cost. Plastic bottles, steel cans, cardboard and aluminum, along with newspaper, can be collected in an ordinary packer truck and sorted "dump and pick". Pilot programs can be used to test the curbside programs for different materials, frequencies and neighborhoods. As Materials Recycling Facilities (MRFs) are constructed across the state, full curbside recycling programs will become more affordable.

Leaf and yard waste, paper, paperboard and food waste can be composted (although paper may be more appropriately recycled). Sewage sludge can also be composted with organic solid wastes. A community may target organic wastes for collection and composting either at an appropriate municipal facility or commercial facility. Many communities already collect and compost leaf and yard waste. While leaf and yard waste composting is a relatively low cost and low level technology option, composting other organic wastes are likely to involve more sophisticated technology and higher costs and may be more appropriate on a regional scale.

D. Solid Waste Financing and Accounting

Chapters Nine and Ten of this Manual contain more detailed information on solid waste costs, financing and accounting methods. Chapter Twelve of <u>Decision-Makers Guide to Solid Waste Management</u>, published by the USEPA and listed in the reference also discusses this information. An analysis of these factors is integral to solid waste planning and decision making.

Choice of Funding

- ! Tax levy,

- Fees, or
- Leaving residents to arrange for collection and disposal themselves.

Choice of Accounting

- General fund, or
- Enterprise fund accounting.

V. CONCLUSION

The time involved in working through all of the factors discussed above should not be underestimated. They will require substantial time to formulate and work through. In planning for the assessment and closure of a landfill, it should be realized that planning and budgeting for a new solid waste management system will be as time and resource intensive an undertaking as the assessment and closure process.

PART III. APPENDICES

The Appendix has been revised again in 1996 to reflect changes in other sections of the Manual. Some changes were made in Appendix C, Outline for Solid Waste Site Assessment, in order to clarify issues raised by individuals working extensively in landfill assessment. The landfill gas screening questionaire introduced in the last version as Attachment B to Appendix C has been eliminited in this version. . Appendix E, Model Request for Proposals is almost completely new. An attempt was made to more fully describe the requirements for an RFP/Q in four separate sections. Appendix F, Municpal Fee Programs has also been revised. Appendix H has also been revised to describe the current process to obtain GIS maps directly from the GIS Unit at EOEA. In addition, a sample form to obtain GIS maps is included for copying for use to obtain maps.

APPENDIX A. COMMONLY USED CQA TESTS AND MONITORING PROCEDURES FOR SOLID WASTE LANDFILL CONSTRUCTION

Material	Parameter	Test Method	Commonly Used Reference Standard
Soils	Observation	Visual/Manual	ASTM D 2488
	Water Content	Standard Oven-drying	ASTM D 2216
		Standard Nuclear Gage	ASTM D 3017
		Calcium Carbide (Speedy)	AASHTO T217
	Unit Weight-Density (Field Methods)	Standard Sand Cone	ASTM D 1556
		Standard Water Balloon	ASTM D 2167
		Standard Nuclear Gage	ASTM D 2922
		Standard Drive Cylinder	ASTM D 2937
	Particle-size Analysis	Standard Sieve Method (+200 fraction)	ASTM D 422
		Standard Hydrometer Method (-200 fraction)	ASTM D 422
	Liquid Limit	Standard Multipoint Method	ASTM D 423
	Plastic Limit	Standard Method	ASTM D 424
	Laboratory Compaction	Standard Proctor	ASTM D 698
		Modified Proctor	ASTM D 1557
	Permeability (Laboratory)	Fixed-Wall Method	
		Flexible-Wall or Triaxial Cell Method	e.g. ACOE Triaxial cell method
	Permeability (Field)	Double Ring Infiltrometer	ASTM D 3385
		Drum Test	Federal Bentonite, 1983
	Cation Exchange Capacity	Methylene Blue Test	Federal Bentonite, 1983
Flexible Geomembranes			
CPE and CSPE (reinforced)	Thickness (overall)	---	ASTM D 751
	Breaking Strength	Grab Method A (CSPE)	ASTM D 751
	Tear Strength	Tongue Tear Method B*	ASTM D 751
	Ply Adhesion	Machine Method, Type A	ASTM

D 413			
	Dimensional Stability	212 °F, 1 hr	ASTM
D 1204			
	Bonded Seam Strength	Grab Method A*	ASTM
D 751			
	Peel Adhesion	180 degree peel, 2 inch/min	ASTM
D 413			
HDPE and PVC	Thickness	Para. 8.1.3	ASTM
D 1593			
(non-reinforced)			
	Minimum Tensile	HDPE	ASTM
D 638	Properties		
		PVC (Method A or B)	ASTM
D 882		(1 inch wide)	

Material	Parameter	Test Method	Commonly Used Reference Standard
HDPE and PVC (non-reinforced) (cont.)	Tear Resistance	Die C	ASTM D 1004
	Dimensional Stability	212 °F, 15 min	ASTM D 1204
	Bonded Seam Strength	Method A or B*	ASTM D 3083
	Peel Adhesion Peel	180 degree peel 2 inch min*	ASTM D 413
Geotextiles	Permittivity	---	ASTM D 4491
	Apparent Opening Size	---	ASTM D 4751
	Gradient Ratio	---	CW-02215
	Long-Term Flow	---	GRI-GT1
	Thickness	---	ASTM D 1777
	Tensile Properties	Grab Method	ASTM D 1682
	Tear Strength	---	ASTM D 1117 ASTM D 2263
	Burst Strength	Diaphragm	ASTM D 3786 ASTM D 774
	Puncture Resistance	Tension Machine	ASTM D 751 ASTM D 3787
Pipe	Leakage		
	non-pressure pipe	Low Pressure Air	WSDOT/APWA Sections 7-04 or 7-17
	Pressure pipe	Hydrostatic	WSDOT/APWA Section 7-11
Concrete Structures	Sampling fresh concrete	---	ASTM C 172
	Consistency	---	ASTM C 143
	Making and curing concrete test specimens	---	ASTM C 31
	Unit weight, yield and	---	ASTM C 138

	air content		
Foundation	Removal of unsuitable materials	Observation	NA
	Proof rolling of subgrade	Observation	NA
	Filling of fissures or voids	Observation	NA
	Compaction of soil backfill	(See low-permeability soil liner component)	
	Surface finishing	Observation	NA
	Sterilization	Supplier's certification and observation	NA
	Slope	Surveying	NA
	Depth of excavation	Surveying	NA
	Seepage	Observation	NA

Material	Parameter	Test Method	Commonly Used Reference Standard
Foundation (cont.)	Soil type (index properties)	Visual manual procedure	ASTM D 2488
		Particle size analysis	ASTM D 422
		Atterberg limits	ASTM D 4318
		Soil classification	ASTM D 2487
	Cohesive soil consistency (field)	Penetration tests	ASTM D 3441
		Field vane shear test	ASTM D 2573
		Hand penetrometer	Horslev, 1943
		Handheld torvane	Lanz, 1968
		Field expedient unconfirmed compression	TM 5-530 (U.S. Dept of Army, 1971)
	Strength (laboratory)	Unconfined compressive strength	ASTM D 2166
		Triaxial compression	ASTM D 2850
		Unconfined compressive strength for soil-cement	ASTM D 1633
Dikes	Dike slopes	Surveying	NA
	Dike dimensions	Surveying; observations	NA
	Compacted soil	(See low-permeability soil liner component)	
	Drainage system	(See leachate collection system component)	
	Erosion control measures	(See cover system component)	
Low-permeability soil liner	Coverage	Observation	NA
	Thickness	Surveying; measurement	NA
	Clod size	Observation	NA
	Tying together of lifts	Observation	NA
	Slope	Surveying	NA
	Installation of protective cover	Observation	NA
	Soil type (index properties)	Visual-manual procedure	ASTM D 2488
		Particle size analysis	ASTM D 422

		Atterberg limits	ASTM D 4318
		Soil classification	ASTM D 2487
	Moisture content	Oven-dry method	ASTM D 2216
		Nuclear method	ASTM D 3017
		Calcium carbide (speedy)	AASHTO T 217
		Frying pan (alcohol or gas burner)	Spigolon & Kelley (1984)
	In-place density	Nuclear methods	ASTM D 2922
		Sand cone	ASTM D 1556
		Rubber balloon	ASTM D 2167
		Drive cylinder	ASTM D 2937
	Moisture-density relations	Standard proctor	ASTM D 698
		Modified proctor	ASTM D 1557
		Soil-cement M-D test	ASTM D 558

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Material	Parameter	Commonly Used Test Method	Reference Standard
Low-permeability soil liner (cont.)	Strength (laboratory)	Unconfirmed compressive strength	ASTM D 2166
		Triaxial compression	ASTM D 2850
		Unconfirmed compressive strength for soil-cement	ASTM D 1633
	Cohesive soil consistency (field)	Penetration tests	ASTM D 3441
		Field vane shear test	ASTM D 2573
		Hand penetrometer	Horslev, 1943
		Handheld torvane	Lanz, 1968
		Field expedient unconfined compression	TM 5-530 (U.S. Dept of Army, 1971)
	Permeability (laboratory)	Fixed wall	EPA, 1983 SW-870
		Flexible wall	Daniel et al, 1984 Daniel et al, 1985 SW-846 Method 9100 (EPA, 1984)
	Permeability (field)	Large diameter single-ring infiltrometer	Day and Daniel, 1985
		Sai-Anderson infiltrometer	Anderson et al, 1984
	Susceptibility to frost damage	Susceptibility classification	Chamberlin, 1981
		Soil-cement freeze-thaw test	ASTM D 560
	Volume change	Consolidometer (undisturbed or or remolded sample)	Holtz, 1965
		Soil-cement wet-dry test	ASTM D 559
		Soil-cement freeze-thaw test	ASTM D 560
Flexible membrane liners	Thickness	Thickness of unreinforced plastic sheeting (paragraph 8.1.3, dead-weight method--specifications for nonrigid vinyl chloride plastic sheeting)	ASTM D 1593
		Thickness of reinforced plastic (testing coated fabrics)	ASTM D 751
	Tensile properties	Tensile properties of rigid thick plastic sheeting (stand-	ASTM D 638

		ard test for tensile properties of plastics)	
D 751		Tensile properties of reinforced plastic sheeting (Grab method A--testing coated fabrics)	ASTM
D 882		Tensile properties of thin plastic sheeting	ASTM
D 751	Tear strength	Tear strength of reinforced plastic sheeting (modified tongue tear method B--testing coated fabrics)	ASTM
D 1004		Tear strength of plastic sheeting (Die C--test method for initial tear resistance of plastic film and sheeting)	ASTM

Material	Parameter	Test Method	Commonly Used Reference Standard
Flexible membrane liners (cont.)	Bonding materials	Manufacturer's certification	NA
	Bonding equipment	Manufacturer's certification	NA
	Handling and storage	Observation	NA
	Seaming	Ply adhesion of reinforced synthetic membranes, bonded seam strength in peel (machine method, Type A test methods for rubber properties, adhesion to flexible substrate)	ASTM D 413 ASTM D 4437
		Bonded seam strength in shear of reinforced plastic sheeting (modified grab method A--testing coated fabrics)	ASTM D 751
		Bonded seam strength in shear of unreinforced plastic sheeting (modified)	ASTM D 3083
	Sealing around penetrations	Observation	NA
	Anchoring	Observation	NA
	Coverage	Observation	NA
	Installation of upper bedding layer	Observation	NA
Leachate collection system			
Granular drainage and filter layers	Thickness	Surveying; measurement	NA
	Coverage	Observation	NA
	Soil type	Visual-manual procedure	ASTM D 2488
		Particle size analysis	ASTM D 422
		Soil classification	ASTM D 2487
	Density	Nuclear methods	ASTM D 2922
		Sand cone	ASTM D 1556
		Rubber balloon	ASTM D 2167
	Permeability (laboratory)	Constant head	ASTM D 2434
Synthetic drainage and filter layers	Material type	Manufacturer's certification	NA
	Handling and Storage	Observation	NA

Coverage	Observation	NA
Overlap	Observation	NA
Folds and wrinkles	Observation	NA
Temporary anchoring	Observation	NA

Material	Parameter	Test Method	Commonly Used Reference Standard
Synthetic drainage and filter layers	Geotextile properties	Tensile strength	Horz (1984)
		Puncture or burst resistance	Horz (1984)
		Tear resistance	Horz (1984)
		Flexibility	Horz (1984)
		Outdoor weatherability	Horz (1984)
		Short-term chemical resistance	Horz (1984)
		Fabric permeability	Horz (1984)
		Percent open area	Horz (1984)
Pipes	Material type	Manufacturer's certification	NA
	Handling and storage	Observation	NA
	Location	Surveying	NA
	Layout	Surveying	NA
	Orientation of perforations	Observation	NA
	Jointing		
	! Solid pressure pipe	Hydrostatic pressure test	Section 4, AWWA C600
	! Perforated pipe	Observation	NA
Cast-in-place concrete structures	Sampling	Sampling fresh concrete	ASTM C 172
	Consistency	Slump of portland cement concrete	ASTM C 143
	Compressive strength	Making, curing, and testing concrete specimens	ASTM C 31
	Air content	Pressure method	ASTM C 231
	Unit weight, yield and air content	Gravimetric method	ASTM C 138
	Form work inspection	Observation	NA
Electrical and mechanical equipment	Equipment type	Manufacturer's certification	NA
	Material type	Manufacturer's certification	NA
	Operation	As per manufacturer's instructions	NA
	Electrical connections	As per manufacturer's instructions	NA

	Insulation	As per manufacturer's instructions	NA
	Grounding	As per manufacturer's instructions	NA
Cover system			
Cover foundation	Waste placement records/ waste placement process	Observation	NA
	Soil backfill	(See foundation component)	

Material	Parameter	Test Method	Commonly Used Reference Standard
Low permeability soil barrier	(See low-permeability soil liner component)		
Flexible membrane barrier	(See flexible membrane liner component)		
Bedding layer	(See flexible membrane liner component)		
Drainage and gas venting layers	(See leachate collection system component)		
Topsoil and vegetation (erosion control measures)	Thickness	Surveying	NA
	Slope	Surveying	NA
	Coverage	Observations	NA
	Nutrient content	Various procedures	Page, 1982
	Soil pH	Soil pH, lime requirement	Page, 1982
	Soil type; moisture content	(See low-permeability soil liner component)	
	Vegetation type	Supplier's certification; observations	NA
	Seeding time	Supplier's recommendations observations	NA

* Test method as modified by National Sanitation Foundation Standard Number 43, Appendix 54

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APPENDIX B. LANDFILL PLAN SUBMITTAL CHECKLISTS

I. SITE PLAN

The Site Plan shall consist of a locus and site plan providing the following information:

A) Locus Plan

_______________ 1. On USGS Topo or equivalent

_______________ 2. North arrow and other geodetic control

_______________ 3. Public water supply well w/in 15,000 feet,

_______________ (a) Zone II (or IWPA) established

4. Airport runways w/in 10,000 feet

_______________ (a) Runway length <4000 feet w/in 5,000 feet of landfill

_______________ (b) Runway length >4000 feet or known to be used by jets w/in 10,000 feet of landfill

_______________ 5. Site assigned area

_______________ 6. Identify public surface water supplies w/in 15,000 feet

_______________ 7. Areas of Critical Environmental Concern

B) Site Plan

_______________ 1. Scale 1:2400 to 1:4800 (1"=200' to 1"=400')

2. Topography for landfill and local region

_______________ (a) Contour interval < = 5 feet

_______________ 3. North arrow, bench marks and other geodetic control

_______________ 4. Boundaries and acreage of the site and the boundaries of the landfilling operation on the site

_______________ 5. Property boundary

_______________ (a) >100 feet from refuse

_______________ 6. Site assigned boundary (if different from property boundary)

_______________ (a) Property contained w/in

_______________ 7. Existing residential et al buildings

_______________ (a) >500 feet from refuse

__________ 8. Other existing buildings

__________ 9. The location and identification of adjoining and other residential, commercial and industrial property within 1000 feet of the property boundary

__________ 10. Land use map of zoning for a one-half mile radius around the landfill

__________ 11. Surface water supply

__________ (a) > 2500 feet from refuse in downgradient position

__________ (b) > 500 feet from refuse in upgradient position

__________ 12. Wetlands, flood plains, other areas protected under c.131, s.40

__________ (a) Wetlands > 100 feet from refuse

__________ (b) Filling of flood plain

__________ 13. Surface Water

__________ (a) > 250 feet from perennial watercourse

__________ (b) Does perennial watercourse draw to surface water drinking supply < 1 mile from landfill

__________ (c) > 250 feet from lake, pond or navigable river

__________ 14. Private water supply wells

__________ (a) > 500 feet from refuse

__________ (b) The location of all private drinking water wells within one-half mile of the boundaries of the landfill

__________ 15. Zone II (or IWPA)

__________ (a) Is it identified

__________ (b) Refuse w/in zone

__________ 16. Areas of Critical Environmental Concern

__________ (a) Refuse w/in area

__________ 17. Proposed buildings, roads and appurtenant works

__________ 18. Proposed leachate treatment facility

__________ 19. Proposed gas treatment facility

__________ 20. Proposed storm run-off discharges and sediment control basins

__________ 21. Proposed leachate discharge points

__________ 22. Proposed groundwater discharges

__________ 23. Hot load area

__________ 24. Fire hydrants and other sources of water for fire protection

__________ 25. The location and elevations of all existing monitoring devices or surface water monitoring locations. This includes groundwater monitoring wells, piezometers, lysimeters or other monitoring devices.

__________ 26. Sanitary facility location(s)

__________ 27. Administrative office location

__________ 28. The location of all soil borings, excavations and test pits

__________ 29. The location of all on-site borrow sources

__________ 30. The locations of all existing and proposed utilities (including power lines), structures (including fences and gates) and roads

__________ 31. Locations of permanent bench marks

__________ 32. Registered Professional Engineer stamp (Property line shall be shown on the plan and stamped by a Massachusetts Registered Professional Land Surveyor)

II. DESIGN PLAN

The design plan shall contain an engineering report, engineering drawings and plans sheets, a construction plan, a QA/QC plan and design and construction technical specifications.

A) Engineering Report

The engineering report should provide a narrative detailing the engineering basis for the proposed design. This should include site history, engineering assumptions, design calculations, and references. The report should include, but not be limited to:

__________ 1. Site description

__________ 2. Site history

__________ 3. Description of region

4. Facility description

__________ (a) Total site area

__________ (b) Assigned area

__________ (c) Refuse disposal area

_______________ (d) Average daily tonnage

_______________ (e) Peak daily tonnage

_______________ (f) Days of operation

_______________ (g) Weekly tonnage

_______________ (h) Hours of operation

_______________ (i) Service community

_______________ (j) Site owner

_______________ (k) Permittee/applicant

_______________ (l) Operator

_______________ (m) Waste types

_______________ (n) Auxiliary operations

_______________ (1) Recycling

_______________ (2) Composting

_______________ (3) Other (specify):

5. General operating procedures

_______________ (a) Sequence of operation

_______________ (b) Auxiliary activities

_______________ (c) Special wastes

_______________ 6. Construction sequence

_______________ 7. Location of water supply of fire control

_______________ 8. Specifications, operation equipment

9. Capacity and life expectancy of

_______________ (a) Each phase

_______________ (b) Entire facility

10. Leachate management

_______________ (a) Efficiency of liner

_______________ (b) Quantity of leachate

11. Gas management

_______________ (a) Types and quantity of gas generated

_______________ (b) Control strategy

12. Water management

_________________ (a) Run-off / Run-on

_________________ (b) Precipitation / Infiltration

13. Stability analysis

_________________ (a) Foundation soils

_________________ (b) Slope stability

_________________ (c) Soil-membrane-geotextile stability

B) Engineering Drawings and Plan Sheets

Schematic drawings, maps or plan sheets which delineate in plan and in detailed cross-sectional view which include:

_________________ 1. The existing conditions of the proposed landfill site showing all subsurface exploration points and results

_________________ 2. The final elevations of any excavations showing all grades of the liner and the subgrade

_________________ 3. The intermediate and final elevations of the landfill

_________________ 4. The leachate collection system showing all grades of the collection pipes, drainage layer, manhole/clean-out risers and sumps

_________________ 5. All berms, dikes, ditches, swales, or other protection devices needed to divert or collect surface water run-on or run-off

_________________ 6. The system to be utilized for venting and monitoring the gasses generated within the landfill and, if applicable, from beneath the liner

_________________ 7. The final elevations and grades of the final cover including the subgrade for the impervious cap, the drainage layer and vegetative layer

_________________ 8. All grades of the leachate treatment and disposal systems including the leachate removal pipes, treatment or pre-treatment ponds or storage facilities

_________________ 9. All proposed landscaping and screening techniques to be utilized to minimize the visual impact of the landfill

_________________ 10. North arrow bench marks and other geodetic control

_________________ 11. Existing contours

_________________ (a) 2 foot contours

_________________ 12. Existing subsurface geology

_______________ 13. Existing peak ground water table

_______________ 14. Ground water control system

_______________ 15. Access roadways

_______________ 16. Buildings, weighing scales and other appurtenant works

_______________ 17. Facility utilities

_______________ 18. Facilities for recycling, composting, etc.

_______________ 19. Facilities for "Special Wastes"

_______________ 20. Landscaping for buffer zones, etc.

_______________ 21. Site access control

_______________ 22. Special provisions to meet site assignment provisions

_______________ 23. Operating sequence plans

_______________ 24. Daily cover storage area

_______________ 25. Professional Engineer's stamp

Additional drawings or detailed diagrams on a scale of 1:40 showing the construction specifications of:

_______________ 1. The subgrade

_______________ 2. The liner and/or any cut-off wall

_______________ 3. The drainage layer

_______________ 4. The collection pipes

_______________ 5. The inlet/outlet structures

_______________ 6. Manholes, sumps, pumps and pump stations

_______________ 7. The leachate storage tanks

_______________ 8. The leachate treatment impoundments or tanks

_______________ 9. The leachate disposal systems and treatment systems, if applicable

_______________ 10. Gas vents, manifolds and pump stations

_______________ 11. Monitoring wells/devices

_______________ 12. Surface drainage and erosion controls

_______________ 13. The landfill cap and final cover

C) Construction Report

A description of the general installation methods and procedures for construction of the facility including materials required, equipment utilized and scheduling of construction events and phases. To ensure that the construction requirements of the regulations are properly implemented, the description should include a discussion of installation of the following:

________ 1. The subgrades

________ 2. Impermeable layers construction

________ (a) Materials testing requirement

________ (b) Placement requirement

________ 3. The drainage layer

________ 4. The drainage collection pipes

________ 5. The inlet/outlet structures

________ 6. Manholes, sumps, pumps and pump stations

________ 7. The leachate storage tanks

________ 8. The leachate treatment impoundments or tanks

________ 9. The leachate disposal systems, pump stations and treatment systems, if applicable

________ 10. Gas vents, manifolds and pump stations

________ 11. Monitoring wells/devices

________ 12. Surface drainage and erosion controls

________ 13. Final cover

________ 14. Construction schedule

________ 15. Structures

________ (a) Scale house

________ (b) Equipment shelter

________ (c) Other

D) QA/QC PLAN

A Quality Assurance/Quality Control (QA/QC) Plan should be included as part of the design plan. The QA/QC plan should outline the observations and tests to be used to ensure that construction of the landfill meets or exceeds all design criteria, plans and specifications. The QA/QC plan shall be the basis for the construction certification of the facility. The QA/QC Plan includes the following:

________ 1. Identity and qualifications of professional engineer responsible for construction certification

________ 2. Identity and qualifications of the person(s) responsible for overseeing the QA/QC program

_______________ 3. Identity and qualifications of installers of groundwater protection, final cover systems, or other components

_______________ 4. Testing and monitoring protocols including checklists of testing requirement for each landfill component

_______________ 5. Discussion of how construction QC inspections will be performed

_______________ 6. Location, availability, applicability and calibration of test facilities and equipment - both field and lab

_______________ 7. Procedure for observing and testing the borrow source for soil liner and membrane liner

_______________ 8. Procedures for reviewing inspection test results and laboratory field sampling and testing results

_______________ 9. Actions to be taken to repair or replace the liner or cap should deficiencies in liner or cap construction be identified, including who is to be notified and in what manner

_______________ 10. Reporting procedures for all inspection and testing data.

E) Design and Construction Technical Specifications

The Design and Construction Technical Specifications shall include the requirements for materials selection and testing and provide specific and comprehensive construction methods requirements for materials placement for all landfill components. The technical specifications shall include, but not be limited to:

_______________ 1. Groundwater protection systems

_______________ 2. Environmental monitoring systems

_______________ 3. Final cover systems

_______________ 4. Storm water control

_______________ 5. Erosion control during construction

_______________ 6. Construction worker safety and health

III. OPERATION and MAINTENANCE PLAN

The purpose of the Operation and Maintenance (O&M) Plan is to describe methods, techniques and equipment that will be necessary to properly operate the landfill in compliance with regulations. The O&M plan consists, in part, of a narrative of the methods and schedule of landfilling activities and the proposed engineering techniques and major types of equipment to be used in landfilling activities.

A) General

The narrative should include a description of the procedures and practices for operation, use and maintenance of all components of the landfill including:

________________ 1. Ditches, swales, detention basins and other drainage controls

________________ 2. Borrow pits, soil storage and handling areas and structures

________________ 3. Scales and weigh station, if required

________________ 4. Water and air pollution control facilities

________________ 5. Equipment storage and maintenance buildings, and other buildings

________________ 6. Access roads

________________ 7. Facility security

________________ 8. Groundwater, surface water and gas monitoring systems

________________ 9. Waste handling equipment

10. Waste handling and covering, which shall include:

________________ (a) Waste unloading, spreading, compacting, and covering operations

________________ (b) The frequencies of placement of daily, intermediate and final cover

________________ (c) Cover materials to be utilized, including estimated volumes required (show daily, intermediate, and final cover calculations) and their sources and availability

_________________ 11. Storm water, soil erosion, and sedimentation controls

________________ 12. Gas monitoring and control of the migration of explosive gasses

________________ 14. Control of vectors

________________ 15. The structures and procedures to be used in controlling and collecting litter

________________ 16. Dust control measures to be taken and when they would be implemented

________________ 17. Bird hazard control measures

________________ 18. Cell, lift and phase development

________________ 19. Special waste handling

B) Waste Control

________________ 1. Operating procedures for complying with wastes banned pursuant to 310 CMR 19.017, Waste Control

C) Leachate Management Plan

________________ 1. Leachate collection and transportation system clean-out and maintenance

________________ 2. Treatment facility maintenance

________________ 3. Holding tanks inspection and maintenance

________________ 4. Leachate disposal contracts

D) Staffing

A staffing plan shall be included which indicates the number of personnel required to operate the facility, taking into consideration:

________________ 1. The type of facility

________________ 2. The size of the facility

________________ 3. The safety requirements of the facility

________________ 4. The past history and present operation of the facility

________________ 5. The scope of the proposed operation

________________ 6. The number of operational days per week

________________ 7. The number of operational hours per day

________________ 8. The number of shifts per day, if applicable

________________ 9. The required number of personnel per day or shift

________________ 10. Emergency personnel coverage of operations

________________ 11. Activities which would require specially trained personnel

E) Inspection & Maintenance

An inspection and maintenance plan shall be included which shall include, at a minimum, a written schedule for regular inspection and reporting of:

________________ 1. Landfill operations

________________ 2. Environmental monitoring systems

________________ 3. Environmental control systems including operational and structural equipment such as scales, dikes, berms, pumps, leachate collection systems and on-site treatment systems

________________ 4. All slopes, elevations and remaining capacity.

F) Safety

A facility safety plan shall be included which explains the emergency procedures, hazard prevention procedures and emergency equipment to be available, and from where such aid and equipment will come in the event of a fire, explosion or release of materials to the air, water or soil of the Commonwealth that could threaten public health, safety or the environment. The facility safety plan for a landfill should include:

__________ 1. Fire control plan

__________ (a) Certified by local fire department or independent licensed fire consultant

__________ 2. Hazardous waste contingency plan

__________ (a) Inspection, detection and exclusion of hazardous waste

__________ 3. Accident prevention and safety

__________ 4. Hot loads

__________ 5. Spills of oil or other hazardous material

__________ 6. Explosions

G) Environmental monitoring

An environmental monitoring plan that includes:

__________ 1. A surface water and groundwater sampling and analysis plan, based upon the results of the hydrogeological study specified in 310 CMR 19.105(4), which will ensure the accurate representation of surface and ground water quality at the upgradient and downgradient sampling points. At a minimum, this plan shall address:

__________ (a) Sample collection

__________ (b) Sample preservation and shipment

__________ (c) Analytical procedures

__________ (d) Chain of custody control

__________ (e) Analytical QA/QC

__________ 2. An air monitoring plan which established the frequency and extent of sampling and analysis for explosive gasses and air quality

H) Recycling Plan

__________ 1. Tracking and reporting system to verify compliance with recycling requirements

IV. CONCEPTUAL CLOSURE and POST-CLOSURE PLAN

The purpose of the closure and post-closure is to indicate how the landfill, or phases of the landfill, will be closed, when each phase will close, and the schedule for post-closure maintenance and monitoring activities. The plan should also address the landfill assessment requirements and any post-closure uses planned for the facility.

A) Information concerning closure activities should include:

_______________ 1. Narrative description of activities necessary to close, cap and secure the landfill at any point during its operating life

_______________ 2. A schedule for completion and closure of each phase of the landfill where landfill development is to proceed by a phased development, or for completion and closure of the entire landfill

_______________ 3. The closure elevation of each phase of the landfill

_______________ 4. An estimate of the final closure date for the entire facility

_______________ 5. A description of how the cap on adjoining phases will be tied together

_______________ 6. Cost estimate for closure including projection of cost to proposed closure date

_______________ 7. Landfill assessment requirements. Proposed schedule and method of completing the initial site assessment, comprehensive site assessment, corrective action analysis and corrective action design (final closure plans)

_______________ 8. Post-closure inspections, monitoring and maintenance of:

_______________ (a) Final cover including erosion, settlement, and corrective action

_______________ (b) Leachate collection system

_______________ (c) Environmental monitoring system

_______________ (d) Gas control system

_______________ 9. Post closure funding

_______________ 10. Reporting requirements

(a) Minimum every two years

APPENDIX C. OUTLINE FOR SOLID WASTE SITE ASSESSMENT

OUTLINE FOR SOLID WASTE SITE ASSESSMENT

PURPOSE OF LANDFILL SITE ASSESSMENTS: Landfill assessments are necessary to determine the nature and extent of any contamination from the landfill and the potential effect of such contamination on public health, safety or the environment. Landfill assessments are required by the Solid Waste Management Facility Regulations, 310 CMR 19.000, to be completed under the following circumstances:

- Prior to final closure of the landfill
- When groundwater monitoring reveals exceedances of the MCLs
- When gas monitoring indicates that gas concentrations exceed 10% of the Lower Explosive Limit (LEL)
- Where a secondary leachate collection or leak detection system indicates that the quantity of leachate collected exceeds design leakage rates
- At other times as determined by the Department to assess potential threats to public health, safety or the environment.

USE OF THIS GUIDANCE DOCUMENT: This guidance document should be used to develop a site-specific plan to fully characterize a solid waste landfill. This guidance outlines specific technical requirements and is intended to amplify the landfill assessment regulatory requirements of the Solid Waste Management Facility Regulations at 310 CMR 19.150.

A landfill assessment must summarize site history, determine the lateral and vertical extent of refuse in the landfill and evaluate its existing and potential impact on public health, safety and the environment.

SOLID WASTE LANDFILL ASSESSMENT PROCESS

Landfill assessments are required to be conducted in three phases:

1. **Initial Site Assessment (ISA).** Existing historical and descriptive information on the site and its immediate surroundings is collected and used for preparation of a site specific scope of work for the second phase or Comprehensive Site Assessment. Two copies of an ISA summary report and scope of work for the CSA must be submitted to the applicable regional office of the Department for review and approval.

2. **Comprehensive Site Assessment (CSA).** Environmental data are collected, interpreted and evaluated to qualitatively assess the risk posed to the public health, safety and the environment. A quantitative risk assessment may be required if necessary. Two copies of the CSA report must be submitted to the applicable regional office of the Department for review and approval. Where required, following the Department's approval of the completed CSA report a scope of work for the third phase of assessment, Corrective Action Alternatives Analysis, must be developed and submitted to the applicable regional office of the Department.

3. **Corrective Action Alternatives Analysis (CAAA).** The feasibility of implementing a range of alternatives for site closure and remediation is determined. A standard cap as described in the regulations at 310 CMR 19.112 must be developed as one alternative to serve as a basis for comparison.

Application Form

An application form must be included with all report submittals:

BWP SW 12 ISA/CSA Scope,
BWP SW 23 CSA Review,
BWP SW 24 Closure Alternative Analysis,
BWP SW 25 Corrective Action Design.

Additionally, an original DEP Transmittal Form (no copies) must be included with the application form and report submittal.

SITE ASSESSMENT CHECKLISTS: To ensure the preparer that an Initial Site Assessment (ISA), Comprehensive Site Assessment Scope of Work (CSA Scope) and Comprehensive Site Assessment reports contain the basic information required for each report, checklists have been provided immediately after each outline which follow.

The Department will not accept a Comprehensive Site Assessment (CSA) report until the Initial Site Assessment (ISA) and Comprehensive Site Assessment Scope of Work (CSA Scope) have been approved.

<u>OUTLINE FOR ISA</u>

TASK 1.1 BACKGROUND INFORMATION

A) The report should include, but not be limited to, the following information:

1. Owner,

2. Operator,

3. Address of Landfill,

4. Universal Transverse Mercator (UTM) Coordinates,

5. Site Status (whether active or inactive),

6. Acreage:

   (a) Site assigned acres,
   (b) DEP permitted acres,
   (c) Footprint of the landfill,

7. Property owners and land uses or zoning (residential, commercial, industrial, other) within 500 feet of the footprint of the landfill,

   (<u>If a road abuts the landfill, list properties on both sides of the road</u>).

8. Locus on an USGS Topographic Map.

TASK 1.2 HISTORICAL RESEARCH

A) The report should include, but not be limited to:

1 Identify all towns that disposed of waste at landfill (past/present):

   (a) Industries located in these towns (include company names, type of industry, wastes generated);

2. Waste Streams and amounts (actual volumes or weights if available):

   (a) Industrial,

   (b) Commercial,

   (c) Residential,

3. Past operational practices:

   (a) Start of operations,

   (b) Method of Disposal (past/present):

      ! Residential drop-off,

- ! Municipal pickup,
- ! Private haulers; List the names of the haulers and any information on the source of the waste stream (towns, companies etc.),

(c) List violations, fines and other legal actions issued by any federal, state or local agency concerning landfill operations.

TASK 1.3 LITERATURE/DATA SEARCH

Complete a literature and data search. Typical sources of information concerning a site include DEP solid waste files in the appropriate regional office, town files, US Geological Survey (USGS), Soil Conservation Service and the Cooperative Extension Service. Past and present site workers should be interviewed to determine past operational practices.

A) Complete a literature and data search which includes, but is not limited to, the following:

1. Review Town files for available reports and data on the site and surrounding area. The following is a list of town offices and information that may be available in each office:

- ! Assessors Office
  - ! Past/present abutting properties landowners, past owners of property used for landfilling,
- ! Board of Health
  - ! Location and analytical data from private wells, public wells, industrial wells, agricultural wells, and monitoring wells.
  - ! Location of Zone IIs, violations at landfill, reported surface water, groundwater and air quality problems attributed to the landfill,
  - ! Additional sources of surface water, groundwater and air quality pollution in the town,
- ! Department of Public Works (DPW)
  - ! If the landfill is operated by the DPW of the Town, determine past/present operating procedures, location of waste oil tanks, composting/recycling areas, leachate/septage lagoons, etc...,
  - ! Utility Plans for the site.
- ! Planning Board
  - ! Zoning around the landfill, future land use or development adjacent to the landfill.
- ! Chamber of Commerce
  - ! Industries, businesses etc. located in the town past/present, and what they produce as an indication of possible wastes produced (e.g. Business name - ACME Leather Goods, Industry - Processes animal hides for

leather and produces leather goods, Wastes produced - includes but is not limited to arsenic, antimony, lead, and other metals used for treating hides; industry creates toxic sludges and liquids; inferior quality hides often discarded and are often found to contain high levels of heavy metals, resistant to degradation due to tanning process.)

- Conservation Committee
  - Location of wetlands, Areas of Critical Environmental Concern (ACEC), Habitat of Rare and Endangered Species, reported environmental problems in the municipality,

- Water and Sewer Department

  - Location of residents of the town that are connected to public water and which areas are not connected to public supplies,
  - Destination of the waste water sludge in the town,
  - Location of private, industrial, and agricultural wells,
  - Location of utility lines at or in the vicinity of the landfill that may act as conduits for groundwater, landfill gas migration,
  - Utility Plans for the site,

- Building Department

  - Utility Plans for the site,
  - Sanborn Insurance Maps,

  (These maps were published from 1800's to present and often are good sources of previous land use.)

- Fire Department

  - Past fires at landfill,
  - Location of underground storage tanks on-site (past/present) and adjacent to the landfill,

- Historical Commission (Society)

  - Location and name of past industries in the town,
  - Past use of the landfill property and adjacent properties.

2. Review Department of Environmental Protection Files in the Regions

  - Solid Waste Files
  - Facility operational records, permits, violations (non-compliance), lawsuits, other legal actions, analytical data, waste streams, etc... ,
- General Files for Town,
- Hazardous Waste Site Files
  - Review Hazardous Waste Sites that may have impacted background water quality in the landfill vicinity, and/or have contributed to the waste stream of the landfill.
- RCRA Files

3. Interview Site Workers for past and current operations.

4. Review the Department's Massachusetts Hydrogeologic Information Matrix[1], Division of Water Supply, September 1986 (or most recent), for United States Geological Survey (USGS) documents relevant to the site. The following is a list of information available in the matrix:

   - USGS Quadrangle Maps,
   - USGS Surficial quadrangle maps,
   - USGS Bedrock quadrangle maps,
   - USGS Professional Papers, Bulletins, and Open-File reports, Miscellaneous Field Studies Maps,
   - USGS Geophysical Investigations Maps,
   - USGS Water Supply Papers,
   - USGS Hydrologic Data Reports,
   - USGS Water Resources Investigations Atlas,
   - Bedrock Geologic Map of Massachusetts, (Zen, 1983)[2],

5. Review and list any other reports or data compilations.

6. Identify the presence/absence of the following potential environmental and public health sensitive receptors:

   (a) Drinking water supplies (Zone II & Zone III), Interim Wellhead Protection Zones (IWPA), Potentially Productive Aquifers (PPA), Zone A of public surface water supplies, aquifer protection zones,

   (b) Private wells,

   (c) Wetlands & vernal pools,

   (d) Ocean Sanctuaries,

   (e) Areas subject to 100 year flooding,

   (f) Sensitive terrestrial/aquatic habitats, (this should include reviewing the most recent issue of the Atlas of Estimated Habitats of Rare Wetland/Upland Wildlife[3]),

   (g) Coastal and inland water bodies (lakes, ponds, reservoirs, rivers, streams and brooks) and the recreational uses of each,

   (h) Schools,

   (i) Residential homes,

   (j) Day Care Centers,

   (k) Elderly Housing,

   (l) Farms,

   (m) Hospitals,

In the cases where any of the above are not present near the site, the ISA must make specific mention of the absence of these receptors.

6. Identify incidents of gas emissions, migration, and vegetative distress:

   (a) Evidence or reports of odors at the landfill and nearby properties,

(b) Analytical data from landfill gas probes/wells,

(c) Reports of fires at landfill from site workers, (past/present) and the local Fire Department,

(d) Location of dead or stressed vegetation.

If a direct migration route for landfill gas to a nearby receptor is identified during the ISA or CSA, the interior of the structure should be screened for explosive gases immediately.

7. Evaluate the quality of existing monitoring wells;

(a) The criteria to assess the quality of the existing monitoring well(s) should include the age of the well(s), construction specifications and geological conditions encountered. The report should include but not be limited to the following:

- ! Boring/construction logs for the well(s),
- ! Year Installed,
- ! Location of monitoring well relative to landfill (up-gradient, down-gradient, cross-gradient),
- ! Does the well serve as a conduit for vertical movement of contaminants?

(b) The criteria used to determine the quality of the monitoring well design should include, but not be limited to, the incorporation of the following design elements (Refer to the Department's guidance document #WSC-310-91: Standard References for Monitoring Wells - April, 1991)[4]:

- ! Locking Protective Pipe/road box,
- ! Vented Cap and Drain hole,
- ! Surface Seal (material and thickness),
- ! Annular Seal (type of material),
- ! Divider Seal (type of material and thickness),
- ! Well Riser (type of material and diameter),
- ! Protective Posts (in heavy traffic areas),
- ! Screened Interval,
  - ! Length of screened interval,
  - ! Filterpack (length, width and type of material),
  - ! Stratigraphy associated with screened interval (e.g. laminated fine sands with some silt),
  - ! Geological unit(s) encountered over the screened interval.

8. Summarize and Evaluate all existing groundwater, surface water, leachate, soil, sediment, air monitoring data and all existing pertinent data presented in tables:

(a) Interpret trends observed in previous analytical data;

(b) Evaluate groundwater and surface water quality on-site with respect to background quality and Massachusetts Maximum Contaminant Levels (MCLs), and Massachusetts Drinking Water Guidelines, and Federal Secondary Maximum Contaminant Levels (SMCLs),

(c) In addition to evaluating laboratory data, include all pertinent laboratory data sheets, QA/QC data (with chain of custody) from all groundwater, surface water, leachate, soil, sediment, landfill gas, and ambient air sampling rounds as appendices to the ISA report.

Task 1.4 Hydrogeological Description

A) The report should include, but not be limited to the following:

1. Description of the site (local):

(a) Surficial Geology;

- Topography (range of elevation),
- Lithology, stratigraphy, depositional environment & associated deposits,

(b) Bedrock Geology;

- Topography (elevation),
- Formation, rock classification (e.g. Rhode Island Formation, conglomerate),
- Mineralogy,
- Fault, joint and foliation frequency and orientation (dip and strike),

(c) Hydrology;

- Groundwater in surficial materials,
  - Flow direction(s),
  - Discharge/recharge areas,
  - Horizontal gradients,
  - Vertical gradients,
  - Hydraulic conductivity,
  - Tidal influence,

- Groundwater in bedrock,
  - Flow direction,
  - Discharge/recharge areas,
  - Horizontal gradients,
  - Vertical gradients,
  - Hydraulic conductivity,
  - Tidal influence,

- Surface Water,
  - Direction of surface water run-off/run-on on site,
  - Describe the condition and flow patterns associated with surface water bodies located in the immidiate area (i.e. lakes, ponds, rivers, perennial/seasonal streams, brooks, wetlands),

  - Describe the condition and flow of patterns associated with manmade structures such as swales, culverts, detention/retention ponds, fire ponds, and septage lagoons.

2. Describe the regional hydrology;

The report should include, but not be limited to:

(a) Name of drainage basin(s),
(b) Regional surface water and ground water flow patterns and direction(s),

(c) Surficial Geology;

- Describe the regional deposits in terms of lithology, stratigraphy, and depositional environment,

(d) Bedrock Geology;

- Name of formation, rock type(s),
- Structural features (e.g. basin(s), fault(s), sill(s), dyke(s), fold(s), valley(s),

(e) Submit legible copy of each of the following with the site properly located:

- USGS surficial geology map,
- USGS bedrock geology map

(refer to reference[1]).

TASK 1.5 SITE VISIT

Conduct a site visit and document field observations.

A) The narrative of the report shall include but not be limited to:

1. Condition of Landfill Surface Cap;

(a) Is the site active, describe;

(b) Is the site Inactive;

(c) Describe type of surface cap and thickness;
- Intermediate cover (describe lithology),
- Daily cover (describe lithology),
- Final cover (describe lithology),

(d) Vegetation (location, type, evidence of stress)

(e) Erosional features (e.g. gullies), and natural drainage features.

2. Direction(s) of surface water run-off/run-on;

(a) Evidence of inadequate drainage (e.g. puddles etc.);

(b) Describe the location of swales, ditches, haybales, silt fence, detention/retention basins etc...

3. Location and Condition of all monitoring devices;

Determine the condition of all the monitoring devices on site. The discussion shall include, but not be limited to the following elements:

(a) Location of groundwater monitoring wells/ piezometers and gas monitoring wells on base plan,

(b) Condition of surface seal,

(c) Locking protective pipe/road box,

(d) Working lock,

(e) Vented cap,

(f) Drain hole,

(g) Describe the condition of the inner, casing/well riser (type of material, diameter), evidence of tampering and/or vandalism, obstructions in the monitoring well,

(h) Describe the condition of the outer casing (type of material, diameter), if applicable,

(i) Protective posts,

(j) Accessibility of the monitoring well(s)

4. Evidence of leachate breakouts (locate on base plan) and indicate magnitude of flow,

5. Evidence of landfill gas emissions (visual and olfactory);

(a) Dead trees, brush of other vegetation (locate on base plan),

(b) Bubbling surface water (locate on base plan),

(c) Odors,

(d) Gas vent/flares (locate on base plan),

(e) Gas monitoring wells (locate on base plan),

(f) Reports of problems at nearby homes,

6. Location and condition of surface water and wetlands;

(a) Locate on base plan,

(b) Evidence of pollution includes iron staining, oily sheens, sediment impacts, etc...,

(c) Vegetation condition,

7. Landfill Operation Procedures,

(a) Describe how access to site is obtained and normal procedures for operation,

(b) Locate and type of scales, if present.

(c) Location and condition of active face, if applicable.

(d) Location and use of any building and utilities (manholes etc.) on site,

(e) Location of waste oil collection area,

(f) Location of special waste disposal areas such as asbestos or municipal or industrial sludges, if applicable;

8. Land use of adjacent properties (note proximity of sensitive receptors and possible sources of contamination from adjacent properties),

9. Landfill accessibility (entrance, fence(s), gates, etc.);

   (a) Evidences of any recreational use by anyone (dirt bikes, bicycles, ATVs, hikers, etc).

10. Local Geology;

    (a) Bedrock outcrops - locations, type of rock, lithology, orientation of structural features (e.g. joints, faults, foliation etc...),
    (b) Surficial soils (note lithology and stratigraphy where exposed).

TASK 1.6 MAPPING

A) An up-to-date base plan drawn at a scale between 1" to 40' and 1" to 100'shall include all, but not be limited to, the following features:

1. Site topography,
2. Property boundaries,
3. Site assigned area,
4. Extent of refuse (if unknown the extent of refuse must be determined during the CSA).
5. Locate and label all monitoring wells, test pits, surface water, soil sampling and air monitoring location,
6. Indicate direction of groundwater flow based on information available,
7. On and within 500 ft of the landfill identify:

   ! Wetlands,
   ! 100 year floodplain,
   ! Existing buildings (e.g. Guard House, residential home) and manmade structures and there use, easements, utilities, overhead wires, water pipes, sewer etc,
   ! Items identified in TASK 1.6 (B) below,

8. All plans must be signed and stamped by a Professional Engineer or Professional Licensed Surveyor registered in the Commonwealth of Massachusetts. Property lines specifically must be surveyed by a PLS.

If any of the above features are not located within 500 feet of the site the body of the report should indicate that.

B) Provide an up-to-date regional locus map, e.g. a USGS topography map with the site shown or <u>legible</u> (make sure contour lines are legible) copy. Within one mile of the site identify the following:

1. Public and private water supplies,
2. Zone II's,
3. Interim Wellhead Protection Areas (IWPAs),
4. Potentially Productive Aquifers
5. Watersheds and Drainage pattern,
6. Aquifer Protection Zones,
7. Areas of Critical Environmental Concern,
8. Surface water bodies.

If any of the above features are not located within 1 mile of the site the body of the report should indicate that.

TASK 1.7 FIELD SCREENING

The Department recommends the use of non-destructive geophysical methods and soil gas screening methods during the ISA to further characterize subsurface geologic conditions, the extent of refuse and the extent of leachate plumes. Though the Department does not require that field screening methods be conducted at all sites during the ISA, the Department does recommend that applicable screening tools be utilized to minimize field investigation costs during the subsequent CSA. Field screening is particularly useful where little baseline information exists about a site.

If field screening activities are to be performed a scope of work must be submitted to the Department for review and approval prior to implementation. The Scope of Work should address:

- Project goals,
- Field procedures,
- Instrumentation,
- Documentation of calibration methods,
- Project deliverables,
- Health and Safety Plan approvable by OSHA standards.

TASK 1.8. DEVELOPMENT OF CSA SCOPE OF WORK

Prepare a draft scope of work for the CSA <u>based on the results of the ISA</u>. Use the guidelines provided in the following section, Tasks 2.1 - 2.8 to develop the scope. This draft scope of work shall be appended to the ISA report unless field screening activities are proposed. In such a case the CSA Scope will be submitted along with the field screening report.

A project schedule must be developed for each phase of the assessment. This schedule must include estimated start and completion dates for the overall project and for each task.

<u>ISA APPROVAL</u>

Before CSA work is initiated, the DEP will review and approve (with conditions as necessary), the ISA report and the scope of work for the CSA.

A letter of approval will be issued to the landfill owner/operator.

CHECKLIST FOR SOLID WASTE SITE ASSESSMENT
INITIAL SITE ASSESSMENT

To ensure that an Initial Site Assessment (ISA) report contains the relevant information required for an ISA the following checklist is provided . The **"Outline for Solid Waste Site Assessment"** provides a more detailed description of the tasks required for each phase of the assessment.

TASK 1.1. BACKGROUND INFORMATION

Provide the following information on the site:

__________ A) Owner, address, locus on map, and UTM coordinates,

__________ B) Site status (whether active or inactive),

__________ C) Acreage, (Site assigned, DEP permitted, footprint),

__________ D) Abutting property owners and land uses.

TASK 1.2. HISTORICAL RESEARCH

__________ A) Towns and haulers that disposed waste at the landfill;

__________ 1. Industries located in these towns or serviced by the haulers.

__________ 2. Waste streams and amounts.

__________ B) Past operational practices

__________ 1. Start of operations.

__________ 2. Disposal method.

TASK 1.3. LITERATURE/DATA SEARCH

__________ A) List all existing reports and data compilations;

__________ B) File review at DEP and Town;

__________ C) Interview site workers;

__________ D) Review relevant USGS data;

__________ E) Identify potential environmental and public health sensitive receptors;

__________ F) Identify incidents of gas migration, vegetative distress;

__________ G) Evaluate the quality of the existing monitoring wells and present the criteria used to evaluate them;

__________ H) Summarize and evaluate the above and all other existing data.

TASK 1.4. HYDROGEOLOGICAL DESCRIPTION

A) Site Description - local

__________ 1. Surficial geology,

__________ 2. Bedrock geology,

__________ 3. Hydrology.

B) Site Description - regional

__________ 1. Surficial geology,

__________ 2. Bedrock geology,

__________ 3. Hydrology.

C) Submit legible copy of each of the following with the site properly located:

__________ 1. USGS surficial geology map,

__________ 2. USGS bedrock geology map.

TASK 1.5. SITE VISIT

Conduct a site visit and document field observations, which should include, but not be limited to:

__________ 1. Condition of landfill surface/cap,

__________ 2. Direction(s) of surface water run-off,

__________ 3. Location and condition of all monitoring devices,

__________ 4. Evidence of leachate breakouts,

__________ 5. Evidence of landfill gas emissions,

__________ 6. Location and condition of surface water and wetlands,

__________ 7. Landfill operation procedures,

__________ 8. Land use of adjacent properties,

__________ 9. Landfill accessibility,

__________ 10. Local geology.

TASK 1.6. MAPPING

A) Provide an up-to-date base map. The scale of the map must be between 1" to 40' and 1" to 100'. The following features must be shown:

__________ 1. Site topography,

__________ 2. Property boundaries,

__________ 3. Plan approved area,

__________ 4. Extent of refuse, (if unknown the extent of refuse must be determined during the CSA)

__________ 5. All existing locations which may include monitoring wells, test pits, surface water, soil sampling locations, sediment sampling locations, landfill gas probes/wells and vents,

6. On and within 500 feet of the landfill, identify:

__________ (a) Wetlands and floodplains,

__________ (b) Existing buildings and/or man made structures, utilities, etc.,

__________ (c) Items identified in Task 1.6(B) below.

B) Provide an up-to-date regional locus map, on a USGS topographic map or legible copy. Within one mile of the site, identify the following features:

__________ 1. Public and private water supplies,

__________ 2. Zone IIs,

__________ 3. Interim Wellhead Protection Areas (IWPAs),

__________ 4. Watersheds and their drainage patterns,

__________ 5. Aquifer protection zones,

__________ 6. Potentially Productive Aquifers,

__________ 7. Areas of Critical Environmental Concern,

__________ 8. Surface water bodies.

TASK 1.7. FIELD SCREENING (OPTIONAL)

If field screening activities are to be performed, a proposal must be submitted to the DEP for review and approval prior to implementation. The proposal must contain project goals, field procedures, instrumentation, documentation of calibration methods and project deliverables.

COMPREHENSIVE SITE ASSESSMENT SCOPE OF WORK (CSA Scope) OUTLINE

A scope of work is to be prepared for the Comprehensive Site Assessment (CSA) based on the results of the Initial Site Assessment (ISA). The CSA Scope should be appended to the ISA report.

The Department's guidance document Standard References for Monitoring Wells, contains valuable information concerning most aspects of TASK 2.3 Drilling Program, TASK 2.4 Determination of Hydraulic Conductivity, and TASK 2.5 Sampling and Analysis Plan. The Department highly recommends that preparers of Solid Waste Assessments be familiar with the contents and procedures in Standard References prior to drafting the CSA Scope.

All hydrological information required under TASK 1.4, Hydrogeological Description, of the ISA that was not determined must be addressed, if applicable to the Site, during proposed field screening activities or in the CSA Report.

The report shall include, but not be limited to, the following information:

TASK 2.1 ISA SUMMARY

A brief summary of how the prior data and/or information as well as how analyses of these data and/or information was used to develop the CSA Scope.

TASK 2.2 MAPPING

A) The CSA Scope shall specify that all features mapped in Task 1.6 of the ISA will be updated. The Scope shall also state that proposed sampling and monitoring locations will be inlcuded in the mapping. As additional data is gathered during work on the CSA more monitoring points may need to be added.

B) All sampling points are to be indicated on the site plan.

C) Wetlands delineation in accordance with state and federal laws.

TASK 2.3 DRILLING PROGRAM

310 CMR 19.118 (2)(b) requires that a groundwater monitoring system be composed of one up-gradient ***strikeout -aqt*** *and three down-gradient monitoring wells or clusters of wells.*

A) The drilling program shall be described to include, but not be limited to the following:

1. A minimum of three well clusters shall be part of the existing or proposed monitoring well network in order to provide two or more cross-sections (at right angles) with equipotential and flow lines as required in the CSA;

2. The number and location of the monitoring wells must be sufficient to adequately describe the site hydrogeology;

3. The rationale for the choice of location, depth, and number of boreholes, monitoring wells, piezometers installed and associated samples collected must be provided;

4. The proposed location of all monitoring wells, borings and piezometers shall be indicated on the base map;

5. Describe the drilling method including size of borehole, type and size of equipment used (e.g. drive and wash; 4-inch inside diameter casing, hollow stem augers; 6 5/8-inch inside diameter);

    ! If water is to be introduced to the formation during drilling indicate source of water and record amount of water used during drilling,

6. If there is the potential for cross-contamination during borehole drilling, then special drilling procedures may be necessary to prevent cross-contamination (Refer to the Department's guidance document #WSC-310-91: <u>Standard References for Monitoring Wells</u> - April, 1991);

7. A copy of a standard boring log,

8. A copy of the soil classification system,

9. Borehole abandonment procedures,

10. Drilling QA/QC plan which includes:

    (a) Well logs, both drillers and consultants,

    (b) Sample as-built monitoring wells and piezometers designs,

    (c) Equipment decontamination procedures,

    (d) Grout mix ratios.

TASK 2.4 DETERMINATION OF HYDRAULIC CONDUCTIVITY

A) The hydraulic conductivity of all major stratigraphic units must be determined. Provide the following information:

1. Detailed methods to be used to collect and interpret data,
2. Sample field data sheets,

3. Rock and/or soil type being tested.

TASK 2.5(A) SAMPLING AND ANALYSIS PLAN

A) A <u>groundwater</u> and <u>surface</u> <u>water</u> sampling plan shall include the analysis of groundwater samples for:

All parameters required for by 310 CMR 19.132(h) as specified below:

! Arsenic, barium, cadmium, chromium (total), copper, cyanide, lead, mercury, selenium, silver, and zinc,

! Manganese,

! Iron,

! Chlorides,

! Sulfate,

- Nitrate ! as Nitrogen,
- Total Dissolved Solids,
- Alkalinity,
- Chemical Oxygen Demand (COD),
- pH, specific conductance, temperature, dissolved oxygen (all measured in the field),
- Purgeable volatile organic compounds including acetone, methyl ethyl ketone, methyl isobutyl ketone and xylenes (measured using EPA Method 8260 or equivalent EPA Method(s) approved by the Department specifically for the site),

Surface water and Groundwater samples should be collected quarterly and analyzed for the parameters listed in the scope of work for one year.

B) Based on the data collected during the ISA; specifically, waste streams and previous sampling data etc.., propose collection and analyses of groundwater samples for extended parameters. If it is deemed unnecessary to test for any of the extended parameters, the rationale for such a determination must be included. The Department will review and approve the sampling before it is implemented. The extended parameters are as follows:

1. Polychlorinated Biphenyls (PCBs) and Pesticides (EPA Method 8080 or equivalent EPA method(s),
2. Total Petroleum Hydrocarbons (TPH) by infra red spectroscopy,
3. Acid-Base/Neutral Compounds (EPA Method 8270 or equivalent EPA method(s),
4. Polynuclear Aromatic Hydrocarbons (PAHs) (EPA Method 8100 or equivalent EPA method(s),
5. Halogenated Volatile Organic Compounds (EPA Method 8010 or equivalent EPA Method(s),
6. Coliform,
7. 2,3,7,8 - TCDD (for dioxins and furans) (EPA Method 613 or equivalent EPA Method(s).

The number of extended analytical parameters specified in the approved scope of work may be reduced based on the results of the previous sampling rounds. A formal request to modify the sampling and analysis plan along with supporting rationale must be submitted and approved prior to any reduction in the sampling and analysis plan.

C) First round water samples shall be analyzed for total metals. If results indicate the presence of metals above MCL the following round should be field filtered and analyzed for dissolved metals. If results are below MCL, continue with total metal analysis. Necessary variations from this format will be made on a case by case basis and must be pre-approved by the Department. Field Data Sheets must show whether samples were field-filtered or not.

D) Surface water samples should not be taken within 48 hours after a precipitation event.

E) Sample private and/or public wells within 500 feet of the landfill and/or other wells potentially impacted by landfill operations. At wells connected to a faucet or tap, samples should be collected at the tap and NOT field-filtered.

- ! When sampling for public and private well(s) substitute EPA Method 500 series for VOCs, unless significant levels of contamination is suspected.

F) All proposed sampling locations must be indicated on the base plan.

TASK 2.5(B) SOIL SAMPLING

A) The soil sampling and analysis plan shall include, but not be limited to, the following:

1. Field screening of split-spoons as described in the Department's Bureau of Waste Site Cleanup Policy #WSC-400-89 Management Procedures for Excavated Soils Contaminated with Virgin Petroleum Oils - August 7, 1990[5] or as amended.

2. Soil Samples from split-spoons should be collected for further analysis if significant ash layer(s) are encountered in a boring. Analysis in that case should include, but not be limited to, the following compounds:

   - ! VOCs, PCBs & Pesticides, TPH by IR, Cyanide, 13 Priority Pollutant metals as total metals, as well as Ba, Mn, Fe and 2,3,7,8 - TCDD.

3. Soil samples collected from split-spoons should be analyzed for the parameters listed if field screening and/or visual evidence of contamination is present. The choice of the following parameters should be determined based on ISA information (waste stream, historical data) and field screening/visual evidence. Provide rationale to support the choice of soil samples and appropriate lab analysis. The following parameters are used to establish soil and sediment quality:

   - ! Total metals,
   - ! Pesticides,
   - ! Volatile organic compounds,
   - ! Polychlorinated Biphenyls (PCBs),
   - ! Base/Neutral and Acid Extractable Compounds,
   - ! Polynuclear Aromatic Hydrocarbons (PAHs).
   - ! Halogenated Volatile Organic Compounds,
   - ! Total Petroleum Hydrocarbons (TPH),
   - ! 2,3,7,8 - TCDD (indicator for Dioxins and Furans)

4. All sampling locations must be indicated on the base plan.

5. Air within the casing of private wells within 500 feet of the landfill should be screened for VOCs, methane, % LEL, % O_2, and hydrogen sulfide).

TASK 2.5(C) SEDIMENT

A) The sediment sampling plan shall include, but not be limited to, the following considerations:

1. Are there wetlands on site and/or have off site wetlands been (or potentially) impacted by landfill? (If answered no skip next line.)

   ! Specify the number of sediment sampling locations and provide rationale why the sediment sampling plan is sufficient to characterize the impact on the wetlands.

2. Are there Rivers, Streams, Brooks on site and/or are off-site rivers, streams, brooks been (or potentially) impacted by the landfill? (If answered no skip next line.)

   ! Specify the number of sediment sampling locations and provide rationale why the sediment sampling plan is sufficient. Characterize the impact to the river, streams and brooks.

3. Are there lakes, ponds, etc... on site and/or have off- site water bodies been (or potentially) impacted by the landfill? (If answer no skip next line.)

   ! Specify the number of sediment sampling locations and provide rationale why the sediment sampling plan is sufficient to characterize the impact to the lake, pond etc.

Leachate Sampling

The leachate sampling plan shall include, but not be limited to, including the following considerations:

1. Leachate samples will be collected where seeps are evident. Leachate samples shall not be composited.

2. Leachate samples shall be analyzed, at a minimum for those indicator parameters specified in 310 CMR 19.132(h).

3. Analysis for extended parameters shall be based on ISA information, field screening and/or visual evidence. Provide rationale for including or excluding the following extended parameters during analysis of leachate samples:

   ! Pesticides, PCBs, ABNs, PAHs, Halogenated VOCs, TPH, 2,3,7,8 TCDD.

4. Unlike groundwater and surface water samples, leachate samples should be conducted shortly after a precipitation event. Leachate would be expected to be flowing at its highest volumes at this time.

5. All sampling locations must be indicated on the base plan.

TASK 2.5(D) LANDFILL GAS MONITORING

A) Monitoring Requirements

310 CMR 19.132(4) requires that landfills conduct gas monitoring during the active through post-closure periods. At a minimum, monitoring shall be conducted quarterly for explosive gases. The Department may require that Hydrogen sulfide, volatile organic compounds and additional parameters be tested.

Please refer to Chapter 4 (page 4-10) for detailed discussion of monitoring requirements.

TASK 2.5(D) FIELD QA/QC PLAN

The Department's guidance document Standard References for Monitoring Wells contains valuable information concerning field and laboratory QA/QC procedures.

A) The Field QA/QC Plan shall include, but not be limited to, the following:

1. Methodology and collection procedures (bailers, bladders pumps, submersible pumps),
2. Well purging, methodology, and volumes to be removed,
3. Decontamination procedures,
4. Chain of custody procedures, containers used, sample preservation techniques,
5. Field blanks,
6. Equipment blanks,
7. Blind Sample (minimum 1 blind per 10 samples),
8. Field log book.

TASK 2.5(E) LABORATORY QA/AC

A) A laboratory QA/QC plan shall include, but not be limited, to documentation of the following:

1. A laboratory certified by the state of Massachusetts must perform analysis,
2. Lab blanks, blind samples,
3. Allowable holding times must not be exceeded,
4. Spiked samples,
5. Chain of custody.

B) Laboratory data sheets shall contain the following information:

1. Date of sample collection, date of arrival at laboratory, date of extraction, if applicable,
2. EPA analysis method number,
3. Analytical method and detection limits,
4. Samples must be analyzed within proper holding times,
5. Data sheets for all blanks and duplicates must be submitted.
6. Signature of person who performed analyses and rationale for any necessary deviation from approved procedures.

TASK 2.6 HEALTH AND SAFETY PLAN

Although the Department does not perform a comprehensive review of Health & Safety Plans, it is required that a plan be submitted to the Department, at least, thirty (30) days before field activities are conducted. The purpose of the plan is to ensure that adequate consideration is given to protecting the safety of persons conducting the field activities and others affected by the activities in conformance with applicable Occupational Health & Safety Administration (OSHA) standards.

TASK 2.7 PROJECT SCHEDULE

A project schedule must be developed for each phase of the landfill assessment and subsequent closure. The schedule must include the estimated start and completion dates for the overall project and for each task.

TASK 2.8 CSA SUBMITTAL

Upon completion of the tasks in the approved scope of work, a report summarizing the results of the CSA activities must be prepared and submitted to the Department for review. The following is an outline of the format and contents of a CSA.

CHECKLIST FOR SOLID WASTE SITE ASSESSMENT
COMPREHENSIVE SITE ASSESSMENT SCOPE OF WORK

To ensure that a Comprehensive Site Assessment Scope of Work (CSA Scope) report contains the relevant information necessary, the following checklist is provided. The **"Outline for Solid Waste Site Assessment"** provides a more detailed description of the tasks required for each phase of an assessment.

TASK 2.1. ISA SUMMARY

__________ Provide a brief summary of prior data on the landfill. Analyses of those data used to develop the scope of work.

TASK 2.2. MAPPING

__________ All features mapped in Task 1.6 of the ISA updated during the CSA as additional data on site conditions gathered. The updated base map indicates the location of all proposed sampling points.

TASK 2.3. DRILLING PROGRAM

A) Submit a plan for a drilling program which includes:

__________ 1. The rationale for the choice of: location, depth, and number of boreholes provided. Monitoring wells, piezometers installed and associated samples collected,

__________ 2. Map indicating the proposed locations listed above,

__________ 3. Drilling method(s) and field procedures,

__________ 4. Copy of standard boring log,

__________ 5. Soil sampling method(s), soil classification system,

__________ 6. Bore hole abandonment procedures,

7. Drilling QA/QC plan, which includes:

__________ (a) Well logs, both driller's and consultant's,

__________ (b) As built monitoring well, piezometer designs,

__________ (c) Equipment decontamination procedures, grout mix ratios.

NOTE 1: The number and location of the monitoring wells must be sufficient to adequately describe the site hydrogeology.

NOTE 2: Well clusters are required.

TASK 2.4. DETERMINATION OF HYDRAULIC CONDUCTIVITY

__________ The method(s) used to collect and interpret data described in detail in the scope of work.

__________ Sample field data sheets,

__________ Rock type and/or stratigraphic unit to be tested.

TASK 2.5. SAMPLING AND ANALYSIS PLAN

___________ A) Samples of monitoring wells, public drinking water, private drinking water, surface water, leachate, soil, sediment and landfill gas:

1. Parameters required for **routine landfill monitoring**:

___________ (a) Inorganics (Arsenic, Barium, Cadmium, Chromium, Copper, Cyanide, Lead, Mercury, Selenium, Silver and Zinc),

___________ (b) Manganese,

___________ (c) Iron,

___________ (d) Chlorides,

___________ (e) Sulfate,

___________ (f) Nitrate - as Nitrogen

___________ (g) Total Dissolved Solids,

___________ (h) Alkalinity,

___________ (i) COD,

___________ (k) pH, Specific Conductance, Temperature and Dissolved Oxygen (measured in the field)

___________ (j) Purgeable volatile organic compounds including acetone, methyl ethyl ketone, methyl isobutyl ketone and xylenes (measured using EPA Method 8260).

___________ 2. Parameters **based upon results of ISA**:

___________ (a) Pesticides,

___________ (b) PCB's,

___________ (c) Base/Neutral and Acid Extractable Compounds,

___________ (d) Polynuclear Aromatic Hydrocarbons (PAHs),

___________ (e) Halogenated Volatile Organic Compounds,

___________ (f) Coliform,

___________ (g) Total Petroleum Hydrocarbons (TPH),

___________ (h) 2,3,7,8-TCDD (indicator for Dioxins and Furans)

3. Parameters used to establish soil and sediment quality **based upon results of ISA or CSA**:

___________ (a) Total metals,

___________ (b) Pesticides,

___________ (c) Volatile organic compounds,

___________ (d) PCB's,

__________ (e) Base/Neutral and Acid Extractable Compounds

__________ (f) PAH's,

__________ (g) Halogenated Volatile Organic Compounds

__________ (h) TPH

__________ (i) 2,3,7,8-TCDD (indicator for Dioxins and Furans)

4. Parameters required for perimeter landfill gas monitoring:

__________ (a) %LEL (calibrated for Methane),

__________ (b) VOCs,

__________ (c) Hydrogen Sulfide,

__________ (d) % Oxygen,

5. Parameter required for landfill gas characterization:

__________ (a) Methane,

__________ (b) Carbon Dioxide,

__________ (c) Oxygen & nitrogen,

__________ (d) Hydrogen sulfide,

__________ (e) VOCs, at a minimum will include the following compounds:

! Vinyl chloride, benzene, 1,2-dichloroethane, 1,2-Dibromethane, Dichloromethane, Tetrachloroethene, Tetrachloroethane, 1,1,1-Trichloroethene, Trichloromethane, Toluene, and Xylene.

__________ NOTE 1: Parameters (except those listed in 2.5 A) 1.) to be included in monitoring program may be modified if ISA or CSA indicate their likely presence or absence.

__________ NOTE 2: First round only - Water samples may be analyzed for total metals. If the results indicate the presence of metals above Maximum Contaminant Level (MCL), the following round should be field filtered and analyzed for dissolved metals. If results are below MCL, continue with total metals analysis.

__________ NOTE 3: Surface and Ground water samples - Quarterly samples should be collected from each monitoring well and analyzed for the parameters listed in the approved scope of work. This sampling program should continue for at least one year, to establish existing and background quality, at which time it may be amended based on the results obtained.

__________ NOTE 4: Samples collected from public and private water supply wells should be analyzed using EPA 500 series methods, unless significant levels of contamination are suspected; in which case use 8000 series method.

____________ NOTE 5: Surface water samples should not be taken within 48 hours after a precipitation event.

____________ NOTE 6: The location of all sampling points must be shown on the base map prepared in Task 2.3.(A).

____________ NOTE 7: Soil and sediment sampling may not be required if results of ISA do not indicate a concern.

____________ NOTE 8: Additional gas testing may be required if results of CSA do indicate a concern.

____________ B) Prepare a field QA/QC sampling plan to include:

____________ 1. Sample collection method(s),

____________ 2. Containers used,

____________ 3. Sample preservation techniques,

____________ 4. Equipment decontamination procedures,

____________ 5. Field blanks,

____________ 6. Equipment blanks,

____________ 7. Trip blanks,

____________ 8. Blind sample,

____________ 9. Chain of custody procedures,

____________ 10. Field log book.

____________ C) Prepare a Lab QA/QC plan to include:

____________ 1. Lab blanks,

____________ 2. Blind sample,

____________ 3. Allowable holding times,

____________ 4. Spiked samples,

____________ 5. Chain of custody procedures.

____________ NOTE 1: Laboratory data sheets must be submitted as part of the assessment report. For all samples analyzed, these data sheets must include: date of sample collection, date and time of arrival at lab, analysis to be performed, and extraction (if applicable). These data sheets must also include detection limits, analytical methods, signature of person who performed analysis and reason for any necessary deviation from approved procedures.

____________ NOTE 2: Samples must be analyzed within proper holding times.

____________ NOTE 3: A State certified lab must perform analysis.

____________ NOTE 4: Data sheets for all blanks and duplicates run must be submitted.

TASK 2.6. HEALTH AND SAFETY PLAN

__________ A) Before any field work begins, a Health and Safety Plan which complies with Occupational Safety and Health Association (OSHA) requirements must be submitted for the Department's files.

TASK 2.7. PROJECT SCHEDULE

__________ A project schedule must be developed for each phase of the assessment. This schedule must include estimated start and completion dates for the overall project and for each task.

COMPREHENSIVE SITE ASSESSMENT OUTLINE
(TASK 2.8 CSA Report Submittal)

Upon completion of the tasks in the approved scope of work, a draft report summarizing the results of the CSA activities is prepared. The report shall include, but not be limited to, the following information:

A) DATA INTERPRETATIONS AND PRESENTATIONS

1. Evaluation of groundwater and surface water quality on-site in comparison to background quality.

2. Evaluation of site hydrogeology with respect to local geology (e.g. How does local geology affect groundwater flow patterns?).

3. Identification of possible surface water flow paths.

4. Interpretation of geologic stratigraphy;

   (a) Soil type, overburden deposits, lateral and vertical continuity/discontinuity of stratigraphy, evidence of filling,

   (b) Porosity, permeability etc of overburden materials,

   (c) Bedrock type(s), structure, and hydraulic characteristics.

5. Interpretation of trends observed in piezometric and analytical data:

   (a) Groundwater range of elevation, vertical gradient, hydraulic gradient, changes or fluctuations in vertical and hydraulic gradients,

   (b) Surface water fluctuations,

   (c) Groundwater/surface water interaction (e.g. gaining/losing rivers, streams, brooks etc.,

   (d) Exceedances of Massachusetts and Federal Maximum Contaminant Levels (MCLs) and federal Secondary Maximum Contaminant Levels (SMCL) for groundwater/surface water,

   (e) Trends in contaminant concentrations,

   (f) Identification of plumes (horizontal & vertical extent), hot spots, or anomalies,

   (g) Presence & thickness of non-aqueous phase liquids,

   (h) All analytical data sheets shall be included in an appendix,

6. Calculation of mass water balance to determine potential volumes of leachate and surface water runoff.

7. Calculation of Hydraulic Conductivities (refer to **IV TASK 2.4 Determination of Hydraulic Conductivity** of the ISA checklist)

   ! Test Methodology,
   ! Data sheets,
   ! Calculations,

- ! Analysis of data.

8. Evaluation of landfill gas data.

(a) Did the landfill gas analysis meet the following objectives:

- ! Methane gas does not exceed 10% of the LEL for methane in facility structures (excluding gas control or recovery systems).
- ! Determined if landfill gas has the potential to migrate beyond the perimeter of the site.
- ! Landfill gas migration is not occurring beyond the property line of the site, as required by 310 CMR 19.132 (4).
- ! Identify locations where permanent landfill gas monitoring wells shall be installed (if applicable).
- ! Collected sufficient information to determine if the landfill will require additional testing (i.e. grid survey immediately above the solid waste disposal site and/or ambient air quality testing).

(b) Methodology and depth of sample collection. Include data sheets.

(c) Sampling locations depicted on base plan.

(d) Calibration logs for equipment.

(e) Lateral extent of landfill gas migration.

(f) Evidence of off-site migration and concentrations at site property lines.

(g) Indicate proximity of off-site migration to buildings, homes, sewers, water pipes, underground utilities (any closed systems where landfill gases could accumulate); identify areas of elevated combustible gases (5-15 % methane) or greater than 10% of the Lower Explosive Limit (LEL).

9. Identification of potential migration pathways.

10.

Please be advised that New Source Performance Standards (NSPS) for Municipal Solid Waste Landfills implements Section 111 of the Clean Air Act (CAA). Landfills which accepted waste after Novbember 8, 1987 are required to submit a design plan to the EPA as defined in the NSPS. Landfills with design capacities >2.5 million Mg (2.75 million tons) are subject to the NSPS. Section 502 of the CAA also requires any source subject to Section 111 of the CAA to obtain an Operating Permit.

Sources which are not subject to the NSPS, but whose potential emmissions of NMOCs are >55 tpy are required to obtain an Operating Permit. These sources are also subject to VOC RACT requirements.

11. Recommendations for additional CSA Work.

B) MAPS, PLANS, AND FIGURES

1. Locus map,

2. Site plan; scale between 1" to 40' and 1" to 100',

3. Bedrock contour map and/or aquitard map with the thickness of the stratigraphic units,

4. Geologic Cross-Sections; minimum of two at right angles; typically one would be parallel to the direction of groundwater flow and one perpendicular to groundwater flow (cross-sections must have vertical and horizontal scales),

5. Compile water table and piezometric data on site maps contoured to indicate equipotential and flow lines for both seasonal high and low groundwater elevations. Vertical equipotential and flow lines should be shown on geologic cross-sections for both seasonal high and seasonal low groundwater elevations,

6. Survey all new monitoring wells, test pits, and surface water, soil and air sampling locations utilized during the CSA and indicate their location on an updated site map.

C) SUMMARIES, TABLES & FORMS

The following summaries, tables and forms are required:

1. Geologic Logs of all borings and test pits,

    (a) In addition to a geologic description of materials encountered during borehole and test pit construction, provide PID screening data from split-spoons and indicate on boring/test pit logs.

2. Tabulation of all soil boring, piezometers and monitoring well construction data (e.g. well screened interval, depth of boring, etc.).

3. As-built schematic designs for all monitoring wells.

4. Tabulation of all analytical and field screening data:

    (a) Soil gas probe/gas monitoring well field measurements,

    (b) Landfill gas data of on-site structures & utilities,

    (c) Landfill gas characterization data (sampled within landfill itself)

    (d) Laboratory data from all groundwater and surface water sampling; exceedance(s) of federal and state MCLs and federal SMCLs and other applicable regulatory limits should be highlighted,

    (e) Laboratory and field screening data from soil samples (comparison with typical soil elemental concentrations),

(f) Laboratory and field screening data from sediment samples.

5. Tabulation of all watertable and piezometric elevation data,

6. Table of hydraulic conductivity test results; include the hydraulic conductivity of all units tested on the cross-sections.

7. Summary of all geophysical results. Additionally, restate goals of the geophysical investigations and indicate if they were achieved.

D) BASELINE RISK ASSESSMENT (refer to Chapter 8)

1. Identification of potential human and environmental sensitive receptors,

2. Summary of contaminants and levels of contamination (from sampling program). Any contamination exceeding Maximum Contaminant Levels (MCLs) must be highlighted. Ambient air field measurements should be compared to federal OSHA/NIOSH Permissible Exposure Limit, state Threshold Effects Exposure Limit (TEL 24 h), and state Allowable Ambient Limit(s) (AALs), as applicable to site specific conditions.

3. Summary of all pathways (in ground/surface water or air) by which existing contamination may reach identified public health or sensitive receptors,

4. A recommendation for a quantitative risk assessment, as appropriate.

FINAL CSA REPORT SUBMITTAL

Upon DEP acceptance of the CSA report, all approved recommendations for additional work should be carried out. Field investigation may utilize methodologies previously approved in the CSA scope of work. Any new methodologies to be used must be submitted to the Department for approval. Upon completion of additional recommended work a final CSA report must be prepared and submitted. The final report must include a scope of work for a Corrective Action Alternatives Analysis. Two copies of the final report must be submitted to the Department for review and approval.

CAAA SCOPE OF WORK OUTLINE

Following the completion of the baseline risk assessment and approval of the CSA report, a number of closure and corrective action options must be developed in a Corrective Action Alternatives Analysis (CAAA) process. First, appropriate technologies are listed; second, these technologies are screened. Successfully screened technologies (or combinations of technologies) are presented as closure/remediation packages. These option packages, one of which must be a standard cap, are then analyzed according to specific criteria listed below, and one is recommended. Based on this analysis and recommendation, DEP will select an option to be implemented. Before CAAA work is initiated, the DEP must review and approve (with conditions as necessary), the scope of work.

TASK 3.1 DEVELOPMENT OF CORRECTIVE ACTION ALTERNATIVES:

A) Develop a list of potential closure and corrective action technologies applicable to site-specific conditions determined during the ISA and CSA. The list should comprise all technologies which may be appropriate to address existing contamination. Technologies relevant to each affected environmental media at the site (air, ground water, surface water, leachate, wetlands, soils) must be listed.

B) Screen the list of technologies to determine which technologies are truly appropriate for the site. In screening technologies, consider these questions:

1. Will the technology address the existing level and extent of contamination in the relevant media?
2. Can the technology be combined effectively with other appropriate technologies without adverse effects?

C) Integrate successfully screened technologies into several closure and corrective action alternatives.

TASK 3.2. DETAILED ANALYSIS OF CORRECTIVE ACTION ALTERNATIVES:

For each alternative, apply these selection criteria:

A) Overall protectiveness - risk reduction,

B) Ability to comply with all state and federal environmental laws and local zoning considerations,

C) Long and short term effectiveness by evaluating:

1. Reliability
2. Permanence
3. Useful Life
4. Adverse and Beneficial Effects

D) Ability to reduce contaminant toxicity and volume,

E) Implementability by evaluating;

1. Technical feasibility,
2. Availability,
3. Demonstrated performance,
4. Support and installation requirements,
5. Time to implement,
6. Safety,
7. Operation and maintenance (including monitoring of short and long-term performance).

Once the tasks in the DEP approved scope of work are completed, a draft report summarizing the results of the CAAA activities, including a recommendation for an alternative to be implemented, must be prepared. The Department will review the CAAA draft and issue a letter of approval, with conditions as appropriate, to the landfill owner/operator. Two copies of the final CAAA report which address all DEP conditions must then be prepared and submitted for review and approval. DEP will then select a closure and corrective action option as appropriate to be implemented.

CHECKLIST FOR SOLID WASTE SITE ASSESSMENT
COMPREHENSIVE SITE ASSESSMENT

To ensure that a Comprehensive Site Assessment (CSA) report contains the relevant information the following checklist is provided.The **"Outline for Solid Waste Site Assessment"** provides a more detailed description of the tasks required for each phase of an assessment.

__________ 1. Evaluation of ground and surface water quality on-site in comparison to background quality.

__________ 2. Identification of possible surface water flow paths.

__________ 3. Evaluation of local hydrogeology :

How does local geology affect groundwater flow patterns?

__________ 4. Interpretation of geologic stratigraphy:

__________ (a) Soil type, overburden deposits, lateral and vertical continuity/discontinuity of stratigraphy, evidence of filling

__________ (b) Porosity, permeability

__________ (c) Bedrock type and hydraulic characteristics and structures

__________ 5. Interpretation of trends observed in piezometric and analytical data:

__________ (a) Groundwater range of elevation, vertical gradient, hydraulic gradient, changes or fluctuations in vertical and hydraulic gradients

__________ (b) Surface water fluctuations

__________ (c) Groundwater/surface water interaction; e.g. gaining/losing rivers, streams, brooks etc.

__________ (d) Exceedances of Massachusetts and Federal Maximum Contaminant Levels (MCLs) and Federal Secondary Maximum Contaminant Levels (SMCL) for groundwater/surface water data

__________ (e) Trends in contaminant concentrations,

__________ (f) Identification of plumes (horizontal & vertical extent), hot spots, or anomalies

__________ (g) Presence & thickness of non-aqueous phase liquids

__________ (h) All analytical data sheets included in an appendix

__________ 6. Calculation of mass water balance to determine potential volumes of leachate and surface water runoff.

__________ 7. Calculation of Hydraulic Conductivities (refer to **TASK 2.4 DETERMINATION OF HYDRAULIC CONDUCTIVITY** of the ISA checklist

- ! Methodology of test
- ! Data sheets
- ! Calculations
- ! Analysis of data

__________ 8. Evaluation of landfill gas data:

(a) Did the landfill gas data collected meet the following objectives?

- ! Ensured that methane gas does not exceed 10% of the LEL for methane in facility structures (excluding gas control or recovery systems).
- ! Determined if landfill gas has the potential to migrate beyond the perimeter of the site.
- ! Ensured landfill gas migration is not occurring beyond the property line of the site, as required by 310 CMR 19.132 (4).
- ! Identified the locations where permanent landfill gas monitoring wells shall be installed (if applicable).
- ! Collected sufficient information to determine if the landfill will require additional testing (i.e. landfill gas grid survey immediately above the solid waste disposal site and/or ambient air quality testing).

(b) The following information regarding landfill gas sampling shall be provided:

__________ ! Methodology and depth of sample collection. Include data sheets.

__________ ! Sampling locations depicted on base plan.

__________ ! Calibration logs for equipment provided.

__________ ! Lateral extent of landfill gas migration.

__________ ! Evidence of off-site migration and concentrations at site property lines.

__________ ! Indicate proximity of off-site migration to buildings, homes, sewers, water pipes, underground utilities (any closed systems where landfill gases could accumulate), identify areas of elevated combustible gases (5-15% methane) or greater than 10% of the Lower Explosive Limit (LEL).

__________ 9. Identification of potential migration pathways,

__________ 10. Recommendations for additional CSA Work.

B) MAPS, PLANS, AND FIGURES

__________ 1. Locus map

__________ 2. Site plan; scale between 1" to 40' and 1" to 100'

__________ 3. Bedrock contour map and/or aquitard map (with Departmental Approval) with the thickness of the aquitard.

_________ 4. Geologic Cross-Sections; minimum of two at right angles; typically one should be parallel to the groundwater flow and one perpendicular to groundwater flow (Cross-sections must have vertical and horizontal scales)

_________ 5. Compilation of water table and piezometric data on site maps contoured to indicate equipotential and flow lines for both seasonal high and low groundwater elevations. Vertical equipotential and flow lines should be shown on geologic cross-sections for both seasonal high and seasonal low groundwater elevations.

_________ 6. Survey all new monitoring wells, test pits, surface water, and landfill gas/probe sampling locations utilized during the CSA and indicate their location on an updated site map.

C) SUMMARIES, TABLES & FORMS

_________ 1. Geologic logs of all borings and test pits,

HNU screening data from split-spoons should be indicated on boring logs.

_________ 2. Tabulation of all soil boring, piezometers and monitoring well construction data (well screened interval, depth of boring, etc.)

_________ 3. As-built schematic designs for all monitoring wells.

_________ 4. Tabulation of all analytical and field screening data

_________ (a) Landfill gas probe/well data,

_________ (b) Landfill gas characterization data,

_________ (c) Laboratory data from all groundwater and surface water sampling (exceedance(s) of federal and state MCLs and federal SMCLs should be highlighted)

_________ (d) Laboratory and field screening data from soil samples (comparison with typical elemental soil concentrations)

_________ (e) Laboratory and field screening data from sediment samples.

_________ 5. Tabulation of all water table and piezometric elevation data.

_________ 6. Table of hydraulic conductivity test results.

Indicate on cross-section the hydraulic conductivity of all units tested.

_________ 7. Summary of all geophysical results.

Additionally, restate goals of the geophysical investigations and indicate if they were achieved.

D) BASELINE RISK ASSESSMENT

__________ 1. Identification of potential human and environmental sensitive receptors (From Initial Site Assessment).

__________ 2. Summary of contaminants and levels of contamination (from sampling program). Any contamination exceeding Maximum Contaminant Levels (MCLs) must be highlighted. Ambient air field measurements should be compared to Ambient Air Levels (AALs).

__________ 3. Summary of all pathways (e.g. groundwater, surface water, or air) by which existing contamination may reach identified public health or sensitive receptors.

__________ 4. A recommendation for a Quantitative Risk Assessment.

BUREAU OF WASTE PREVENTION
DIVISION OF SOLID WASTE MANAGEMENT
Application Checklist (Check One)

LANDFILL ASSESSMENT AND CLOSURE

____**BWP SW 12 Initial Site Assessment and Scope of Work**

____**BWP SW 23 Comprehensive Site Assessment**

____**BWP SW 24 Corrective Action Alternative Analysis**

____**BWP SW 25 Corrective Action Design**

____ **The DEP Transmittal Form is completed and payment is properly completed and is attached to the application package.**

____ **One copy of the report is attached and submitted to the appropriate office.**

____ **Certification Statement has been submitted and signed (310 CMR 19.011).**

____ **Variances requested are identified.**

To submit the application package:

____ Checklist items have been completed.

____ Send two copies of the application along with the *white* page from the DEP Transmittal form to:

Department of Environmental Protection
__________ Regional Office
Division of Solid Waste Management

Send fee of:
____ $700 for BWP SW 12;
____ $2,850 for BWP SW 23;
____ $1,800 for BWP SW 24;
____ $2,150 for BWP SW 25.

The *yellow* page of the DEP Transmittal Form is sent to the DEP, with check made payable to Commonwealth of Massachusetts. Please mail to the following address:

Department of Environmental Protection
P.O.Box 4062
Boston, MA 02211

APPENDIX D. MODEL REQUEST FOR PROPOSALS/REQUEST FOR QUALIFICATIONS (RFP/RFQ)

I. INTRODUCTION

This is a Request For Proposal/Qualifications for consultant services to perform landfill assessment and closure work for the Town of ***** solid waste landfill located at *****. Responses from qualified and interested consulting firms should be addressed to:

Responsible Authority,
Town Hall
Main Street
Town, MA, Zip Code

The work involved in the services being sought includes full characterization of the landfill including its history, present conditions, as well as contamination attributable to activities at the site. This information will be used to prepare an Initial Site Assessment as described by the Massachusetts Department of Environmental Protection in the Solid Waste Management Regulations at 310CMR19.150(4), and in the Department's document titled Landfill Technical Guidance Manual. Respondents to the RFP/Q should be knowledgable about the solid waste regulations and the manual and be experienced in landfill assessment and closure work.

Within fourteen (14) days after the award of the Contract, the successful respondent, at its own expense, shall furnish the town of ***** with a performance bond in the full amount of the contract price executed by a Surety Company acceptable to the town of *****.

The respondent, at its own expense, shall obtain and maintain, during the contract period, comprehensive liability insurance, automobile/motor vehicle liability and property damage insurance, and umbrella coverage with the town of ***** as a co-insured and with the minimum policy limits of *****.

INSTRUCTIONS FOR REQUEST FOR QUALIFICATIONS/PROPOSAL (RFQ/P) RESPONSE

1. GENERAL

This Request For Qualifications/Proposals (RFQ/P) invites qualified prospective consultants to submit proposals for the specific services described in the above referenced regulations and manual.

These instructions describe the general format and contents of the RFQ/P Response, so that prospective consultants can be evaluated on a comparative basis.

2. PREPARATION OF RFQ/P RESPONSE

The RFQ/P Response with attachments shall be in the format specified in these instructions. Each Response shall show the full legal name and business address of the prospective consultant, including street address if different from mailing address, and shall be signed and dated by the person or persons authorized to bind the prospective consultant. Proposals by a partnership or joint venture shall list the full names and addresses of all partners or joint ventures. The state of incorporation shall be stated for each corporation that is a party as a prospective consultant.

The name of each signatory shall be typed below each signature. If requested by the town, satisfactory evidence of the authority of a signatory on behalf of the prospective consultant shall be furnished.

The prime contractor will be required to assume responsibility for all services offered in the proposal whether or not the prime contractor produces them. The Town will consider the prime contractor to be the sole point of contact with regard to contractual charges resulting from the contract.

The preparation of an RFP/Q Response shall be at the expense of the prospective consultant. It is the responsibility of the prospective consultant to fully examine this RFP/Q, attachments, and referenced documents.

Bound proposals shall be submitted in accordance with the RFP/Q Response Format and Contents. All proposals submitted become the property of the Town and will be subject to applicable Public Record laws.

3.0 RFQ/P RESPONSE FORMAT AND CONTENTS

Proposed Format

All information pertaining to the prospective consultant's approach to meeting the requirements of the RFQ/P shall be organized and presented in the prospective consultant's RFQ/P Response. Proposals should be prepared in four (4) parts as described below.

Elaborate bindings and colorful displays are not to be used in the prospective consultant's RFQ/P Response. The RFQ/P Response shall be prepared simply and economically, providing a straightforward, concise delineation of the prospective consultant's commitment to satisfy the requirements of this RFQ/P.

Accuracy and completeness are essential. Omissions and ambiguous or equivocal statements will be viewed unfavorably and will be considered in the evaluation. Since all or a portion of the successful RFQ/P Response may be incorporated into any ensuing contract, all prospective consultants are cautioned not to make claims or statements that cannot be subsequently included in a legally binding agreement.

The Town may reject any RFQ/P Response that does not meet these requirements.

RFQ/P Response Contents - Part I

Banking and Financial Data

As part of its RFQ/P Response the prospective consultant shall provide reasonable evidence of its financial stability. This may include banking and/or other references.

Insurance and Risk Management

Prospective consultants must indicate methods of complying with all applicable liability and insurance requirements under law. They must also provide a brief statement as to their present standard insurance coverage or self-insurance program. Statement of Professional Liability is also required.

Conflict of Interest

Each prospective consultant is advised that its performance of work for the Town may, at any time, raise questions about real or perceived conflicts of interest because of the prospective consultant's relationship to other entities or individuals, including without limitation:

(1) private and public owners of properties that abut or may be affected by the landfill, and/or

(2) other entities with potentially conflicting interests and/or concerns.

Accordingly, the Town reserves the right to:

(1) disqualify any prospective consultant or reject any proposal at any time solely on the grounds that a real or perceived legal or policy conflict of interest is presented;

(2) require any prospective consultant to take any action or supply any information necessary to remove the conflict; or

(3) terminate any contract arising out of this solicitation if, in the opinion of the Town, any such relationship would constitute or have the potential to create a real or perceived conflict of interest that cannot be resolved to the satisfaction of the Town.

In addition, representatives and/or employees of the successful prospective consultant will be required to agree to certify from time to time, in a form approved by the Town, that in connection with work under this contract, they are in full compliance with the provisions of all applicable conflict of interest laws. The prospective consultant agrees to disclose in writing any facts the Town may seek in order to resolve questions about potential conflicts of interest occurring during the period of solicitation or performance hereunder and, upon request of the Town, supply a full and complete explanation of its relationships to other entities and individuals. In any such event, the prospective consultant shall consult with the Town's authorized representatives to learn what action must be taken to resolve such conflicts and comply with all applicable laws and policies.

Each of the prospective consultants shall submit to the Town as part of its RFQ/P Response a list of all such potential conflicts or a written certification that it has none.

Audit

Prospective consultants must include a letter verifying a recent audit and showing overhead and payroll fringe costs.

RFQ/P Response Contents - Part II, Letter of Transmittal, Proposal Format and Quality

The technical portion of its RFQ/P Response shall contain the following information in the sequence presented and under the headings given. Prospective consultants who do not comply with this restriction may be considered non-conforming and be downgraded at the discretion of the Town.

A. Letter of Transmittal

The RFQ/P Response shall include a letter of transmittal not to exceed three pages, signed by an individual, or individuals, authorized to bind the prospective consultant contractually. The letter must state that the RFQ/P Response will remain valid from the date of submission through 5:00 P.M. on DATE, the deadline for submission of the RFQ/P Response, and thereafter until the prospective consultant withdraws it; a contract is executed; or the procurement is terminated by the Town, whichever occurs first.

The transmittal letter shall include the name, title, address, and telephone number of one or more individuals who can respond to requests for additional information, and also, of one or more individuals who are authorized to negotiate and execute a contract on the prospective consultant's behalf.

B. Proposal Format and Quality

1) Understanding the Scope of Work

The proposal must describe the prospective consultant's general understanding of the scope of work and the key issues associated with performing the required consulting services in the specific disciplines involved in landfill assessment and closure. In addition, it must include statements covering the prospective consultant's familiarity with the project and describe unusual conditions or problems that may be encountered. The proposal must provide a project task list and description of each task.

2) Approach and Methodology

The proposal must describe the prospective consultant's planning and methodology and the mechanics of how each will be applied to the work. Special methods, techniques, or equipment which are required by the methodology should be covered in detail.

For tasks involving data collection (e.g. water quality sampling), the prospective consultant must describe the data collection goals, the technique, and methods proposed for the task.

3) Schedule and Progress Reports

The proposal must identify important milestones in the preparation of the reports and indicate in some detail how and when the milestones will be met.

The proposal must also briefly describe the intended method of task budget planning and progress reporting.

RFQ/P Response Contents - Part III, Qualifications of Team Personnel

The Qualifications portion of its RFQ/P Response shall contain the following information in the sequence presented and under the headings given. Prospective consultants who do not comply with this restriction may be considered non-conforming and summarily eliminated at the discretion of the Town.

A. Project Team Qualifications

The proposal must describe the prospective consultant's team composition by indicating how it intends to perform the work, i.e., as an independent company, a partnership, a joint venture, or a combination involving a prime and subconsultants. The role of each participating entity shall be fully described.

The proposal shall detail specifically the work to be done by the pricipal consultant's own forces and the work to be performed by others. A reasonable approximate percentage of jobhour effort shall be indicated for each participating entity.

The Town does not favor any one of the above-named combinations over others.

B. Key Staff Qualifications and Experience

The proposal must include summary resumes of key personnel, including the Project Manager, proposed to staff the project and descriptions of comparable projects performed by the personnel to be assigned to the work. Because of the specific nature of the work involved in the project, key personnel to be assigned to the project must include staff who demonstrate significant knowledge and experience in the fields of environmental engineering, civil engineering, geology, hydrology, water resources engineering, stormwater runoff and other drainage analyses, water chemistry, aquatic biology and other disciplines related to design, construction, operation, assessing the impacts, as well as closure of landfills.

For each key staff, indicate whether they will be assigned on a full-time or a part-time basis. If staff is to be assigned part-time, indicate what percentage of his/her time will be devoted to the work of this project.

C. Recent Projects and References

The proposal must list at least four of the prospective consultant's recent projects (no more than six) having nature and complexity of scientific, technical and management issues similar to those anticipated for this project.

Identify the key personnel to be assigned to this project who were involved in the recent projects described. Specific mention should be made of key staff member(s) experienced in projects similar to that proposed. In the case of the Project Manager, specifically describe his/her experience in managing recent projects of a nature and complexity similar to this project.

Provide the names of at least three clients for whom the prospective consultant has performed work similar to that proposed, and who may be contacted as references. At least one of these references should include governmental agencies similar to the Town for whom one of the recent projects cited have been performed.

RFQ/P Response Contents - Part IV, Office and Staffing Plan

A. Office, Equipment, and Staffing

The proposal must describe and list the field and office equipment to be used for the work tasks. It must also describe the office and field staffs' experience in the operation of the equipment.

Laboratories used to analyze water, air, and soil samples for the project must be certified by the Massachusetts Department of Environmental Protection. Therefore, the proposal must include a copy of the DEP cerification of laboratories that the prospective consultant will use for sample analyses. The Town reserves the right to inspect said laboratories as part of the consultant selection process or at any time during the period that the consultant is working on this project. In the event that the inspection(s) reveal unsatisfactory conditions at the laboratories, the Town reserves the right to require that the consultant use the services of another certified laboratory.

B. Project Organization

The proposal must provide a project organization chart which shows the relationship of project team members to each other under a manager and the relationship of the team to the Town. The chart must include the responsibilities of the project team members.

C. Staffing and Schedule Chart

The proposal must provide a staffing and schedule chart indicating the team members to be used on the project and their job titles, job description, tasks, and time allotment of each one to carry out the tasks within the time frame of the contract.

Provide a staffing and schedule chart indicating present and future staffing commitments to the prospective consultant's other ongoing or upcoming projects and how this work will be staffed.

Clarification of RFQ/P Content and Responses

Questions from prospective consultants on the RFQ/P documents will be answered by the IDENTIFY TOWN OFFICIAL at a meeting of prospective consultants and the Town. The meeting will be held at TIME, DATE & LOCATION This will be the only oppurtunity for prospective consultants to make inquires about the RFQ/P documents. Questions on the RFQ/P will not be answered over the telephone.

If clarification of the contents of any RFQ/P Response is required, the Town will request clarification by either written or in-person request to the prospective consultant. Prospective consultants must be prepared at any reasonable time to visit the Town's offices to clarify their responses or review information. Unless otherwise stated, the Town contact is:

IDENTIFY with ADDRESS & PHONE #

Submission of RFQ/P Response

The original and five copies of the prospective consultant's response to the RFQ/P shall be submitted not later than the DATE AND TIME and shall be addressed to Town's contact person identified above.

Responses received later than the specified date and time will not be considered in selecting a consultant firm to perform the work.

Review of RFQ/P Response

Upon receipt of the RFQ/P Responses, the Town will evaluate Part I (Contractual Requirements) of all respondents. For those prospective consultants deemed to be qualified under Part I, the Town will review Parts II - IV.

Oral Presentations

Following evaluation of of the proposals, at a date to be announced, each prospective consultant team found to be fully qualified and responsive **may** be invited to make an oral presentation of its RFQ/P Response to the Town. The presentation must be made by the proposed project manager and other top level team members expected to be assigned to this work. Such oral presentations shall, as a general rule, be limited to approximately 30 minutes for presentation plus 30 minutes for questions.

4.0 COST EVALUATION

The proposal will be evaluated on overall price and ranked from least costly to most costly based on the projected levels of effort and costs provided in this component. Proposals must present the cost for conducting each task required to complete the project as described both on the Department's manual and in the prospective consultants proposal. Proposals should include both direct and indirect costs.

5.0 SELECTION OF A CONTRACTOR

The results of the evaluation of each proposal will be compared by the Town and a final ranking shall be made considering management, technical merit, and capability of the consultant. The cost estimate contained in the proposal shall also be considered in the final selection of a consultant. In that regard, the Town will primarily consider the need to provide a comprehensive array of specialized services to accomplish the project including the need for detailed knowledge of the Town's solid waste program, policies and procedures. The overall goal of the evaluation process shall be to recommend award for the contract to the proposal which meets the requirements of the RFP/Q and is at the same time cost-effective.

If after completing this evaluation, the Town finds that two or more proposals are more or less equal, it reserves the right to re-evaluate said proposals placing greater emphasis on any and all of the following factors:

1. Price
2. Past performance record
3. Firm's special experience or abilities
4. Capacity of the firm to accomplish the work
5. Size and availability of firm personnel
6. Other criteria related to the firms ability.

6.0 ATTACHMENTS

ATTACHMENT A: Scope of Services Attachment A: Outline for Solid Waste Site Assessment

The Scope of Services provides a detailed outline of activities which need to be conducted for the initial site assessment process to be completed under this RFP. The Outline(s) for Solid Waste Site Assessment contained in this manual should be included as an attachment to the RFP/Q.

ATTACHMENT B: Technical Evaluation Criteria

The technical evaluation criteria is used to group consultants based on their ability to perform the required services. It provides criteria on which to rate proposals as unacceptable based on a minimum level of competence, and advantageous and highly advantageous based on experience in performing the tasks required for landfill assessment and closure. The following could be used as a guide in performing a standardised evaluation of proposals:

<u>CRITERIA</u>

- Completeness

MINIMUMS

- Complete response to RFP

COMPARATIVE ADVANTAGEOUS N/A
HIGHLY ADVANTAGEOUS N/A

<u>CRITERIA</u>

- Conformance to Technical and Scheduling Requirements

MINIMUMS

- Full Conformance

COMPARATIVE ADVANTAGEOUS N/A
HIGHLY ADVANTAGEOUS N/A

<u>CRITERIA</u>

- Proposed Service
  - Ability to provide requested service

MINIMUMS

- Proposal shows that consultant has the capacity to provide the required services.

COMPARATIVE ADVANTAGEOUS

- Proposal shows that consultant has an established relationship with all sub-contractors of at least 2 years.

HIGHLY ADVANTAGEOUS

- Proposal shows consultant has the ability to provide established services without sub-contracting and/or has an established relationship of more than three years.

<u>CRITERIA</u>

- Proposed Service
  - Experience in Assessment and Closure services

MINIMUMS

- Proposal shows consultant has satisfactorily conducted at least one landfill or waste site assessment and closure which included a groundwater and gas monitoring program.

COMPARATIVE ADVANTAGEOUS

- Proposal shows consultant has satisfactorily conducted at least one landfill or waste site assessment and closure under the DEP DSWM or BWSC guidance.

HIGHLY ADVANTAGEOUS

- Proposal shows consultant has satisfactorily completed more than three assessment and closures assessment using Department guidance.

CRITERIA

- Timing

MINIMUMS

- The consultant's proposal must fall within 3 months of the proposed schedule.

COMPARATIVE ADVANTAGEOUS N/A
HIGHLY ADVANTAGEOUS N/A

CRITERIA

- Staffing
  - Availability

MINIMUMS

- The consultant has the necessary staff to perform the required services.

COMPARATIVE ADVANTAGEOUS

- The consultant has the necessary staff dedicated to perform the required services.

HIGHLY ADVANTAGEOUS

- The consultant has the necessary staff dedicated & designated back-up staff to perform the required services.

CRITERIA

- Staffing
  - Experience

MINIMUMS

- The consultant's project manager has a minimum of 2 years of site assessment and closure experience.

COMPARATIVE ADVANTAGEOUS

- The Consultant's project manager has more than two year's site assessment and closure experience and 50% of support staff has one year's site assessment and closure experience.

HIGHLY ADVANTAGEOUS

- Project manager has a minimum of 4 years of site assessment and closure experience, and 50% of the support staff has more than 2 years assessment and closure experience.

ATTACHMENT C:

All proposals must include the completed certificate of non-collusion.

CERTIFICATE OF NON-COLLUSION

The undersigned certifies under penalties of perjury that this bid or proposal has been made and submitted in good faith and without collusion or fraud with any other person. As used in this certification, the word "person" shall mean any natural person, business, partnership, corporation, union, committee, club, or other organization, entity or group of individuals.

____
Name of person signing bid or proposal

____
Name of Business

APPENDIX E. MUNICIPAL FEE PROGRAMS

Survey information has been collected from a variety of sources, including the Massachusetts Municipal Association surveys, recycling equipment grant applications to the Department of Environmental Protection, published newspaper accounts, a Kennedy School of Government survey and anecdotal evidence. This 1993 data was still being collected and verified when the last edition of this manual was being prepared. The information in this appendix has not been updated for this edition. However, Chapter 9 has been updated with information on .

Almost half of all Massachusetts cities and towns currently charge some form of user fee for solid waste management. Based on the information collected to date, 169 of the 351 municipalities have a user fee. Of these 169 cities and towns, 84 have a flat rate for drop-off at landfills or transfer stations, and 14 have a flat rate for curbside pick-up. At least 16 communities do not provide municipal rubbish service of any type, and their residents are served through private subscription service. Finally, 55 communities currently charge for rubbish service on a volume basis, either for curbside collection or drop-off. This last group, which represents 16% of the municipalities, has chosen to do the right thing by encouraging resource conservation and recycling through the establishment of unit based user fees.

<u>Volume based user fee:</u> Resident pays per bag, barrel, or other measurable unit. In this system a residents' disposal costs reflect the amount they throw away. The DEP supports this system because it encourages waste reduction, recycling, and awareness.

<u>Flat rate user fee:</u> Residents pay an annual fee for disposal of rubbish regardless of weight or volume. There is no variation in the fee to reflect annual usage. While this system may help a community pay its solid waste disposal costs, it does not encourage reduction or recycling.

Volume based User Fees
(55 communities)

Town	Curbside/Drop-off	Unit Price
Amherst	Curbside	$105 /yr 1 barrel
		$140 /yr 2 barrel
Ashburnham	Curbside	$1.00 /15 ga. bag
		$1.50 /30 ga. bag
Ashfield	Drop-off	$1 /30 ga. bag
Athol	Curbside	$1 /bag
Belchertown	Drop-off	$30 /yr + $0.80 /bag
Boxford	Curbside	$0.70 /30 ga. bag
Brimfield	Curbside	$1 /bag
Charlemont	Drop-off	$1 /30 ga. bag
Chesterfield	Drop-off	$0.75 /15 ga. bag
		$1.50 /30 ga. bag
Chilmark	Drop-off	$2.65 /40 ga. bag/barrel
Clinton	Curbside	$0.75 /bag
Colrain	Drop-off	$1.00 /33 ga. bag
		$0.50 /16 ga. bag
Concord	Curbside	$0.90 /16 ga. bag
		$1.75 /44 ga. bag
Danvers	Drop-off	$10 /12 Transfer Station trips
Edgartown	Drop-off	$2.25 /40 ga. bag/barrel
Freetown	Curbside	$1.50 /bag
Gayhead	Drop-off	$2.65 /40 ga. bag/barrel
Gill	Curbside	$1 /bag
Gloucester	Curbside	$1 /bag
Goshen	Drop-off	$10 /yr + $2 /30 ga. bag
Halifax	Curbside	$1 /bag
Hardwick	Drop-off	$1 /bag
Hatfield	Drop-off	$25 /yr + $2 /bag
Hawley	Drop-off	$1 /30 ga. bag/barrel
Hudson	Drop-off	$10 /yr + $3 /carload
Huntington	Drop-off	$0.60 /16 ga. bag
Manchester	Curbside	$0.50 /32 ga. bag or barrel
Mendon	Curbside	$1.25 /bag
Millis	Drop-off	$50/yr + $1 /bag
		$1.00 /30 ga. bag
Milton	Curbside	One free can/wk; then
		$1.50 /can
Montague	Curbside	$1 /bag
North Adams	Drop-off	$50 /yr + $1.75 /30 ga.
		or $0.90 for 15 gals.
Norfolk	Drop-off	$1.35 /30 ga. bag
North Reading	Curbside	$0.65 /bag
Northampton	Drop-off	$1 /bag
Orange	Drop-off	$10 /yr + $1 /bag
Palmer	Drop-off	$1.00 /30 ga. bag
Petersham	Drop-off	$10 /yr + $1 /bag
Plainfield	Drop-off	$25 /punchcard (good for 50 bags
Russell	Drop-off	$20 /yr + $1 /30 ga.
		$0.60 /15 ga.
Salisbury	Drop-off	$0.80 /bag
Seekonk	Curbside	$86/year base +
		$0.31 /14-20 ga. bag or
		$0.53 /31-33 ga. bag
Shelburne	Drop-off	$1 /bag
Southbridge	Drop-off	$2 /trip to Transfer Station
Tisbury	Drop-off	$2.25 /40 ga. bag or barrel

Ware	Drop-off	$40 /yr + $1 /bag
Warwick	Drop-off	$1 /bag
Webster	Drop-off	$1 /bag if recycle $2 /bag without
Wendell	Drop-off	$0.50 /bag
Westhampton	Drop-off	$25 /yr + $1 /bag
West Tisbury	Drop-off	$2.65 /40 ga. bag or barrel
Wilbraham	Drop-off	$60 /yr + $0.60 /bag
Williamstown	Drop-off	$0.75 /15 ga. bag $1.50 /30 ga. bag
Worcester	Curbside	$0.50 /bag (to start 11/15/93)
Worthington	Drop-off	$30 /yr + $0.50 /bag

Flat Rate User Fees -- Curbside Service
(14 communities)

Town	Price
Acushnet	$ 65/yr
Attleboro	$ 83/yr
Brockton	$140/yr
Brookline	$150/yr
Chelsea	$152.50/yr
East Brookfield	$104/yr
Franklin	$160/yr
Hinsdale	$ 30/yr
Holliston	$ 75/yr
Marshfield	$ 70/yr
Medway	$150/yr
Nahant	$ 75/yr + $ 35/person/yr
Pembroke	$120/yr
Reading	$110/yr

Flat Rate User Fees -- Landfill/Transfer Station Drop-off
(84 communities)

Town	**Price**
Acton	$85/yr
Adams	$12/yr
Alford	$30/yr
Ashby	$50/yr
Ashburnham	$40/yr
Ashfield	$35/yr
Barnstable	$45/yr
Barre	$ 3/yr
Becket	$40/yr
Berlin	$50/yr
Bernardston	$25/yr
Bolton	$75/yr
Bourne	$ 7/yr
Boylston	$ 5/yr
Braintree	$10/yr
Brookfield	$50/yr
Buckland	$25/yr
Carlisle	$10/yr
Chatham	$35/yr
Charlton	$10/yr
Cohasset	$52/yr
Cummington	$100/yr
Deerfield	$35/yr
Dennis	$50/yr
Douglas	$10/yr
Dudley	$ 2/yr
Duxbury	$60/yr
Eastham	$45/yr
Egremont	$120/yr
Fairhaven	$ 5/car/yr + charge based on vehicle tonnage
Foxborough	$100/yr
Groton	$30/yr
Hadley	$30/yr
Hanson	$100/yr
Harvard	$50/yr
Heath	$25/yr
Holland	$25/yr
Hull	$50/yr
Lakeville	$50/yr ($100/yr business)
Leverett	$35/yr
Littleton	$100/yr
Ludlow	$30/yr ($60/yr business)
Lunenberg	$40/yr
Marlborough	$5/yr
Mashpee	$30/yr
Merrimac	$30 /yr
Middleborough	$ 5/yr
Middlefield	$45 /1 year dump sticker
Middleton	$10/yr
Millbury	$15/yr
Mount Washington	$50/yr
Nantucket	$50/yr
Newbury	$ 5/yr
North Brookfield	$50/yr

Northfield	$25/yr
Orleans	$75/yr
Otis	$20/yr
Palmer	$35/yr ($50/yr business)
Pepperell	$50/yr
Plymouth	$20/yr
Rockport	$75/yr
Sandwich	$35/yr
Scituate	$10/yr
Sheffield	$110/yr
South Hadley	$ 5/yr
Southboro	$100/yr
Southwick	$40/yr
Sudbury	$65/yr
Sutton	$ 5/yr
Templeton	$ 5/yr
Upton	$25/yr
Wales	$20/yr
Warren	$ 2/yr
Wellfleet	$45/yr or $3/carload
West Bridgewater	$10/yr
West Brookfield	$25/yr
Westborough	$10/yr
Weston	$130/yr
Wilbraham	$65/yr
Williamsburg	$40/yr
Williamstown	$17/yr
Winchendon	$50/yr
Windsor	$15/yr
Yarmouth	$70/yr

No municipal service -- Private subscription
Flat Rate User Fees
Curbside Service
(16 communities)

Town	Price
Auburn	$13/month
Granby	$15/month
Hadley	$18-19/month
Holden	$18-22/month
Hubbardston	$20/month
Hull	$18/month
Leicester	$20/month
New Braintree	$27/month
Northbridge	$20/month
Oxford	$16-18/month
Princeton	$19/month
Rowley	$12/month
Rutland	$18/month
Sharon	$11/month
Sturbridge	$25/month
Uxbridge	$19-24/month

APPENDIX F. SAMPLE MUNICIPAL LANDFILL BUDGET

DIRECT COSTS

COLLECTION:

Rubbish Collection	$224,000		
Recyclables Collection	33,000		
Administrative Expenditures	7,500	$264,500	

DISPOSAL:

Landfill Wages & Overtime	72,866		
Landfill Operating Expenditures	17,822		
Landfill Compactor Lease	31,700	122,388	$386,888

INDIRECT AND OVERHEAD COSTS
(See Indirect and Overhead Costs Detail)

(a)	Administration - Highway Department	17,250	
(b)	Engineering	3,000	
(c)	Administration - Town	2,642	
(d)	Treasurer	1,512	
(e)	Collector	11,824	
(f)	Data Processing	1,475	
(g)	Pension	11,535	
(h)	Health & Life Insurance	10,464	
(i)	Workers' Compensation	13,510	
(j)	General Insurance	2,000	
(k)	Medicare	267	
(l)	Payment in Lieu of Taxes	15,938	91,417

LANDFILL CLOSURE AND POST CLOSURE RESERVE	200,000
TOTAL	$678,305

INDIRECT AND OVERHEAD COST DETAIL

(a) Administration - Highway Dept. Defined by Superintendent to be 15% of Highway Administration Division Budget:		15,000	17,250
(b) Engineering Quarterly Inspections & Reporting to DEQE		750/Qtr.	3,000
(c) Administration - Town Budget (Administration, Accounting, Audit)		145,000	
Direct Cost Budget divided by	386,888		
Total Operating Budget	21,235,000 =	1.8%	2,642
(d) Treasurer Operating Budget		83,000	

Direct Cost Budget divided by	386,888			
Total Operating Budget	21,235,000	=	1.8%	1,512

(e) Collector

Operating Budget	68,500			
# Trash/Commercial Bills	7,250			
Total # Bills Sent, All Types	42,000 =		17.3%	11,824

(f) Data Processing

Hardware Maintenance (5%)	17,500	875	
Software Maintenance (1/3)	1,500	500	
Supplies (5%)	2,000	100	1,475

(g) Pension:

Pension Assessment x		710,000	
Salaries divided by	72,866		
Total Salaries (Pensionable)	4,485,000	1.6%	11,535

(h) Health & Life Insurance

2 Family Plan BC/BS	x	298/month	=	7,152	
2 Individual Plan BC/BS	x	138/month	=	3,312	10,464

(i) Workers' Compensation

Labor Wages	65,000	x	20.74 rate	=	13,481
Clerical Wages	7,866	x	00.37 rate	=	29
	72,866				13,510

(j) General Insurance
Liability/Fleet Policy (Est. by Insurance Carrier) 2,000

(k) Medicare (1.45%) Wages subject to: 1 laborer @ $18,414
267

(l) Payments in Lieu of Taxes
Property Valuation $125,000 x 12.75 tax rate = 15,938

REVENUE REQUIREMENT WORKSHEET

REVENUE REQUIREMENT TO BE RECOVERED THROUGH RATES

LESS REVENUE REQUIREMENT FROM COMMERCIAL DUMPING

Rate/Ton x number of tons
of commercial dumping

REVENUE REQUIREMENT TO BE RECOVERED FROM RESIDENTIAL USERS

Revenue to be Recovered from Residential Dumping

Sticker Fee Rate x Number of Stickers

Dumping Fee Rate x Pounds/100 Dumped

Revenue to be Recovered from Residential Curbside Pickup

Remaining Revenue to be Recovered/# Residential Pickups

CURBSIDE PICKUP FEE CALCULATION

REVENUE REQUIREMENT TO BE RECOVERED THROUGH RATES		678,305
LESS REVENUE REQUIREMENT FROM COMMERCIAL DUMPING		
Rate/Ton x number of tons of commercial dumping	$65 x 950,000	61,750
REVENUE REQUIREMENT TO BE RECOVERED FROM RESIDENTIAL USERS		616,555
Revenue to be Recovered from Residential Dumping		
Sticker Fee Rate x Number of Stickers	$10 x 400	4,000
Dumping Fee Rate x Pounds/100 Dumped	$3.25 x 31,200/100	1,014
Revenue to be Recovered from Residential Curbside Pickup		611,541
# Residential Curbside Pickups		5,500
Revenue to be Recovered per Residential Curbside Pickup		$112

REVENUE PROJECTION AT NEW RATES

I. COMMERCIAL DUMPING REVENUE

Tipping Fee	$65 per ton	
Highway Superintendent's Estimated Tonnage for FY'92	950	$61,750

II. RESIDENTIAL CURBSIDE PICKUP

Annual Flat Fee	$112/house	
Highway Superintendent & Health Agent's estimate of # of households participating	5,500	616,000

III. RESIDENTIAL NON-CURBSIDE

Landfill Sticker Fee	$10	
Est. # Residential Stickers	400	4,000
Dumping Fee per 100 pounds		
Highway Superintendent's	$3.25	
Estimate of # pounds dumped	312	1,014
		$682,764

An additional $611,541 to be recovered form 5,500 residential curbside pickups for an annual fee of $112.00.

Once the rates are computed, a revenue projection at new rates analysis is needed to verify that the new rates will produce the desired revenue. As shown below, the aggregate of the commercial dumping revenue, curbside residential pickup and residential non-curbside fees produce $682,764 slightly more than the $678,305 to be recovered through rates.

APPENDIX G. PURCHASING GIS MAPS

A party conducting a landfill assessment must submit a regional locus map of the area surrounding the landfill site. The Division of Solid Waste Management in cooperation with MassGIS has incorporated the State's permitted solid waste facilities into the MassGIS system and can produce low cost computer generated maps for use in completing a landfill assessment.

What Is GIS:

A Geographical Information System (GIS) is a computer system capable of assembling, storing, manipulating and displaying geographically referenced information. The system allows for detailed mapping of site information in one or more data layers or "overlays". The system's database contains tabular information which can be linked to the geographically referenced (mapped) features. MassGIS is the Executive Office of Environmental Affairs (EOEA) state-wide GIS. Through MassGIS, the Commonwealth has created a coordinated, statewide database of spatial information for environmental planning and management. The source scale of MassGIS data ranges from 1:5,000 to 1:250,000. Data shown on the SW Assessment map set has been developed from data with a source scale of 1:25,000 to 1:100,000.

Why Use GIS Maps:

The automated "Solid Waste Assessment" GIS map set consists of two maps at a 1:25,000 scale with your community at the center of the map. Some larger communities will plot at a smaller (more generalized) scale in order to fit both maps on one page. The Resource Map depicts Zone II's and Interim Wellhead Protection Areas, surface water supplies, non-forested wetlands, drainage basin delineations, aquifers, protected areas and permitted solid waste facilities. The Land-Use Map depicts 21 land use categories interpreted from 1985 aerial photography. The maps contain most, if not all, of the information necessary for the locus mapping required for assessment submittals. They can also be used by local officials to advocate for landfill closure and other resource protection activities.

How To Obtain These Maps:

The GIS Solid Waste Assessment Map Set costs $50 and can be ordered through MassGIS by choosing map theme "SW Assessment", Large Format Map "your town name" on the included orderform. Send completed form and check payable to Executive Office of Environmental Affairs, to: MassGIS, 20 Somerset St, 3rd floor, Boston, MA. 02108.

Order Form for Maps or Licensing of Digital Data

to be provided by the Massachusetts Executive Office of Environmental Affairs

MassGIS serves the environmental agencies of the Commonwealth of Massachusetts as a coordinated, statewide database of spatial information for environmental planning and management. Please use this order form to request ***either*** digital data from the MassGIS database (see reverse) ***or one printed map*** to be generated using MassGIS data. The MassGIS *Datalayer Descriptions and Guide to User Services* describes the available map themes and datalayers in detail; to receive a copy please check this box: ☐

a. Client Information

Organization or Individual			**Date**
Contact Name			**Check or Purchase Order #**
Address			**Telephone**
Town	**State**	**Zip Code**	**FAX**

b. To Order a Map

1. Choose a Map Theme

___ Land Use	___ Title 5	___ DEP MCP (21E) NRS Site Map
___ Open Space (OS)	___ DFA Groundwater	___ Natural Resources (DEP Regions only)
___ Water Resources	___ Wetlands Habitat	___ Water Supply Protection
___ OS/Water Resources	___________	___ Solid Waste Assessment

2. Choose a Format Provide the requested information

Large Format Map (any listed theme) Map size and scale will vary depending on the area portrayed. Maximum size is 46" x 33". Maps of towns or USGS quadrangles are printed at 1:25,000 scale. List town, quad, or region name/number Map Title	**Site Map** (21e theme only) Map will be 8½" x 11" in size and printed at 1:15,000 scale. Radii of 500 feet and ½ mile around the specified coordinates will be shown. Site Name Site Address UTM or LL Coordinates (deg, min, sec) N E/W

3. Map Production Charges

Basic fee $ 50.00	
Additional copies of the same map _____ copies @ $ 15.00	
Extra fee for printing on clear mylar _____ copies @ $ 15.00	
TOTAL Please attach a check or purchase order for this amount	

Please return this form with a purchase order or check payable to the **Executive Office of Environmental Affairs** c.

To License Digital Data First provide the client information requested on the reverse side of this form, then use this side to specify which data, format, and media you wish to receive. The MassGIS *Datalayer Descriptions and Guide to User Services* describes available datalayers and panels. Most datalayers divided into panels by town or quadrangle, etc., each priced separately. Please refer to the other side of this form to request a copy of the *Guide*.

1. List Datalayer Names Please attach additional forms if necessary	2. List Panels By number/name for each datalayer	3. Unit Price per panel	4. Data Format Fee see below*	5. Total Price
EXAMPLE Roads Datalayer 1985 Land Use Datalayer	Quads 5, 11 Town 341	100.00 100.00	50.00 25.00	250.00 125.00
TOTAL custom data request				

CD Sets Available

______ 3 CD set of Statewide Data	500.00
______ 5 CD set of Scanned USGS quads- panelled by orthoquad	250.00

d. Format and Medium for Digital Data

Format	Media
______ Arc/Info 7.x uncompressed export ______ DXF (AutoCAD)* ______ MapInfo (MIF and MID)* ______ Other*(specify: ______________) * Add $25 per file	______ CD ______ MS-DOS 3.5" diskette ______ UNIX Exabyte 4mm/8mm tape ______ Other (supplied by client, if supported)

e. License Agreement

The Massachusetts Executive Office of Environmental Affairs distributes digital cartographic data under terms and conditions published in the MassGIS *Datalayer Descriptions and Guide to User Services*. I/we acknowledge that submission of this order binds us to the terms and conditions of the agreement concerning use and distribution of this data which we have read and understand.

Authorized
Signature ______________________________ Date ______________

Please return this form with a purchase order or check
Affa

APPENDIX H. REFERENCES

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Chapter 2.

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APPENDIX I. DSWM POLICIES AND PUBLICATIONS

The following is a list of publications developed by the Division of Solid Waste Management (DSWM) of the Massachusetts Department of Environmental Protection (DEP). The documents listed can be ordered by phone on this page are available from the Department's InfoLine 617-338-2255 or 1-800-462-0444. For technical information, ask for the program contact listed in each category.

Policies
Jim Roberts (617-292-5983)

Interim Oil Ash Disposal (Feb 1983 - 2 pp)

Coal Ash Landfill Cover & Disposal (May 1983 - 5 pp)

Urea Formaldehyde Foam Insulation (UUFI) Disposal (Mar 1988 - 2 pp)

Tire Disposal and Stockpiling (June 1987 - 4 pp)

Ash Management and Disposal (Aug 1988 - 12 pp)

Ash Sampling & Analysis Guidance (July 1988 - 10 pp)

Tonnage Limits at Solid Waste Facilities (June 1989 - 4 pp)

Asbestos Guidelines (Mar 1988 - 3 pp)

Reuse & Disposal of Contaminated Soil at Landfills (Apr 1994 - 25 pp)

Policy on Approving Tonnage Increases to Facilitate Unlined Municipal landfill Closures (Dec 1996 - 5 pp)

Leachate Tank Review at Solid Waste Facilities (Dec 1994 - 3 pp)

Guidance Documents
Jim Roberts (617-292-5983)

Existing Solid Waste Management Facility Permitting Guidance (Apr 1991 - 15 pp)

Financial Assurance Requirements Guidance Document for Use with 310 CMR 19.051 (Apr 1991 - 9 pp)

Guidance on Compliance with 310 CMR 19.038(2)(d) Twenty-Five Percent Recycling Requirement (June 1991 - 27 pp)

Comprehensive Guidance to Solid Waste Disposal Facilities for Implementation of Disposal Restrictions Covering Glass, Metal and Plastic Containers, Paper, Leaves and Yard Waste, Lead-Acid Batteries, White Goods and Whole Tires (Jan 1995 - 13 pp)

Landfill Assessment & Cleanup Repermitting Guidance (Apr 1991 - 7 pp)

Landfill Technical Guidance Manual (May 1997)

Guide to the Asphalt, Brick, and Concrete (ABC) Exemption (Feb 1995 - 7 pp)

Solid Waste Facilities

Brian Holdridge (617) 292-5578

Active Ash Landfills (July 1995 - 6 pp)

Active MSW (municipal solid waste) Combustion Facilities (May 1995 - 6 pp)

Active MSW and Demolition Landfills (Dec 1995 - 19 pp)

Active Lined Solid Waste Landfills (MSW and other solid waste landfills) (August 1995 - 8 pp)

Active Stump & Demolition Landfills (May 1995 - 6 pp)

Active Transfer Stations (May 1995 - 25 pp)

General Information on Operating Solid Waste Combustion Facilities (Dec. 1993 - 27 pp)

Inactive or Closed Solid Waste Landfills (MSW and other solid waste landfills) (Dec. 1995 - 70 pp)

Tire Piles in Massachusetts

Solid Waste Management Reports

Stephen Lowe (617) 574-6873

1995 Solid Waste Master Plan Update (Dec. 1995 - 60 pp)

Presents the most up-to-date statistical and policy information on solid waste generation and disposal in the Commonwealth. Using 1994 figures, DEP calculated the amount of solid waste generated, its sources, and where it is going. The Update presents the state's policies on waste disposal capacity management with a special focus on initiatives designed to promote recycling as a means to reduce the waste stream requiring disposal and provide materials to the state's expanding recycling programs and industry. Contains charts, tables, and graphs.

1995 Solid Waste Master Plan Update - Appendices (Dec. 1995 - 55pp)

Contains technical data, methodological assumptions, and data tables, outlining analysis for both non-MSW and MSW components of the waste stream. Includes estimates of generation, diversion through recycling, and disposal.

Status Report on Cities and Town: MSW Generation and Disposal - Appendix I of Solid Waste Master Plan (Dec. 1995 - 9 pp)

Breakdown by all 351 municipalities' MSW generation rate, disposal information, and solid waste user fee programs - uses data from 1994.

Massachusetts Cities and Towns, Trash and Recycling Collection Methods, and Materials Recycled - Appendix J of Solid Waste Master Plan (Dec. 1995 - 10 pp)

Breakdown by city or town of all recyclable materials, method of trash and recycling collection and population.

Recycling

John Crisley (617) 556-1021

Apartment Building Recycling: A Manual for Apartment Owners and Managers (July, 1991 - 11pp)

Explains how municipal officials, recycling coordinators, and property managers can incorporate recycling into existing curbside collection programs. Recycling can lower an apartment building's disposal costs. It examines key elements to be considered in designing and implementing an apartment or condominium collection program.

Apartment Building Recycling Manual (May, 1988 - 56 pp)

Written for municipal DPW or Board of Health officials, Recycling Coordinators to explain how to design and implement a recycling program for medium and large size, multi-unit apartment buildings and condominiums.

Massachusetts - Buy Recycled Resource Directory (July 1995 - 18 pp)

A directory designed primarily for businesses and organizations interested in learning more about purchasing recycled products and how to set up a "buy recycled" program. Contains listings of programs that can provide technical assistance to business, sources of "how-to guides" providing information about purchasing recycled products, directories to help you locate available products made from recycled materials, and local, state, and national organizations and trade associations which can provide further information.

Commercial Recycling Basics (May 1992 - 2 pp)

Financing for Recycling Related Businesses: A Guide to MA Economic Development Agencies and Programs (May 1995 - 7 pp)

Guide covers 10 of the Commonwealth's economic development agencies and is intended as a starting point and reference for recycling related businesses seeking financial assistance. Provides agency summaries, contact names and addresses, a brief description of agency services, financing programs, types of financing available, amounts, and specific qualifications. Contains chart for each agency.

Municipal User Fees (Sept. 1993 - 8 pp)

Office Paper Recycling Guide - How your office can participate in the recycling process (1991 - 12 pp)

Step-by-step outline for starting, implementing, selecting a program coordinator, and managing an office recycling program. Provides tips on source reduction and "closing the loop" by buying recycled products. Produced by the National Office Paper Recycling Project - a consortium of private companies and public sector organizations.

Plastics Recycling Action Plan for Massachusetts (July 1988 - 108 pp)

Race-to-Recycle The MA Office Recycling Contest (1995 - 8 pp)

Contains a list of winners, and a description of recycling programs developed by owners and managers, of large to medium size office buildings. Produced jointly by DEP, WasteCap of MA, and the Building Owners and Managers Association (BOMA). Call WasteCap to obtain a copy.

Recycled Products Guide (Dec. 1990 - 79 pp)

Recycling Questions & Answers (May, 1996 - 2 pp)

Recycling Rules-Questions & Answers (March, 1995 - 4 pp)

The "Recycling Rules" formerly known as "Waste Bans," are restrictions on the disposal of certain recyclable items at solid waste landfills and incinerators in Massachusetts. The rules are located in the state's solid waste facility management regulations, 310 CMR 19.017. This document lists the restricted materials and definitions.

Recycling Services Directory and Markets Guide for Massachusetts (May, 1996 - 30 pp)

The Directory lists vendors who accept, collect or purchase recyclable materials from Massachusetts communities and businesses. This resource supplements local yellow pages by describing markets for recyclables across the state.

Scrap Tire Management in Massachusetts: Questions and Answers for Municipal Waste Management Officials (August 1991 - 9 pp)

The Solid Waste Management Resource Guide for Massachusetts Schools - 1995 update

Developed for grades K-12. It helps students realize a solid waste and resource management problem exists, makes students aware that their attitudes and actions may contribute to this problem, and seeks to foster an appreciation among students that they can play a major role in solving our solid waste problems.

Transfer Stations: A Guide for MA Municipalities (1988 - 61 pp)

Value Added by Recycling Industries in Massachusetts (July 1992 - 13 pp)

Study undertaken by Massachusetts Department of

Environmental Protection and Department of Revenue to quantify the value of recycling products in the manufacturing sector. Report examines the value added ton-for-ton of different industries and concludes that the aggregate value of these totals $588 million. Data tables included.

White Goods Management in Massachusetts (August 1991 - 9 pp)

1996 Statewide Municipal Recycling and Composting Guide (May 1996 - 124 pp)

Reference directory published by MassRecycle and sponsored by DEP. Intended for local, state, non-profit coordinators and administrators looking for names, phone numbers, hours of operation, accepted recyclables, at each of state's 351 municipal recycling locations. Includes MA Regional Recycling Districts and Associations, plus 22 national related organizations.

Turning Wastepaper Into Jobs - Increasing MA Primary Pulp and Paper Manufacturers' Competitiveness and use of Recovered Paper (February 1996 - 46 pp)

Joint study by DEP and the Industrial Services Program (ISP) to identify opportunities for increasing the competitiveness of primary pulp and paper manufacturers, and for sustaining or increasing the use of recovered paper by MA paper manufacturers. Makes recommendations and contains appendices and graphs profiling MA paper industry.

Variable Rate Pricing: A Practical Guide for Local Decisionmakers (Sept. 1995 - 120 pp)

Intended to assist municipal elected officials, administrators, solid waste managers and coordinators, recyclers, and others concerned about evaluating, planning, and implementing variable rate pricing of solid waste management services. Produced under a joint project sponsored by the Coalition of Northeastern Governors (CONEG) Source Reduction Task Force and the US Environmental Protection Agency's Office of Solid Waste.

Composting

Ann McGovern (617) 292-5834

Composting: Introductory Profiles Agricultural Sludge and Solid Waste Composting

Composting Programs in Massachusetts Cities and Towns

Composting Program Technical Assistance

Don't Trash Grass Brochure (1993 - 2 pp)

"How-to" brochure on lawn care which highlights benefits of replenishing soil nutrients by leaving clippings on the lawn. May be copied and distributed to residents.

Guidelines for Centralized Grass Composting - on the municipal scale (1993 - 7 pp)

Home Composting Bin Ordering Information for Municipalities

Home Composting Bin Design Sheets (1991 - 15 pp)

Home Composting Brochure (1993 - 1 pp)

"How-to" on home composting that can be copied and distributed to residents. Master available with blank area for insertion of distributing organization's name/address.

Home Composting Handbook: How to Promote Home Composting in your Community (1991 - 15 pp)

A guide to giving a home composting workshop, common composting questions and answers, instructions for compost testing, and bibliography.

How to Start a Christmas Tree Chipping Program (1990 - 7 pp)

Leaf and Yard Waste Composting Guidance Document (1991 - 29 pp)

Official DEP guidance for operators of municipal leaf and yard waste composting facilities. Provides detailed information and instruction on how to sit, design, equip and operate a leaf and yard waste operation. Includes appendices on environmental impact

control measures and a glossary of technical terms.

Municipal Leaf Composting: Planning for a Municipal Leaf Composting Program (1991 - 6 pp)

Notes for a Short Course on Municipal Scale Leaf and Yard Waste Composting (1991 - 41 pp)

Outlines DEP's training workshops for municipal leaf and yard waste composting operators. Provides planning and technical information on the composting process in a simple outline format. Contains tables, diagrams, & presentation outlines.

Rodent Proof Compost Bins

Table of Collection Option for Leaves

Thermometers vendor list (1995 - 1 pp)

Vermicomposting (worm composting) Information and Bin Design Sheets

Instructions for how to make and maintain an indoor earthworm composting bin. Contains updated list of local worm and worm bin suppliers.

Publications Available at the State Bookstores
Boston 617-727-2834
Springfield 413-784-1374

Note: The following publications can only be purchased through the State Bookstores, and not through the DEP.

Solid Waste Management Regulations 310CMR16.00 ($6.15) & 19.00 ($6.15)

The Solid Waste Management Resource Guide for Massachusetts, 17.00

Toward a System of Integrated Solid Waste Management, $6.15 (Solid Waste Masterplan, June 1995)(1994 Draft Master Plan available through InfoLine number listed above)

APPENDIX J.
APPENDIX J. GUIDANCE MANUAL CREDITS

Julie Bender

Ethan Bodin

Mark Dakers

William DiLibero

James Doucett

Alison Donovan

Paul Emond

Luke Fabbri

Eric Fahle

Richard Gioiosa

Sean Griffin

Daniel Hall

Joel Hartley

Ann McGovern

David Murphy

James Roberts

Michael Rostkowski

Katherine Rodden

Patricia Rodden

Abdul Turay

Roy Willey

PART IV. GLOSSARY

This Section is intended to assist municipal officials, solid waste committee members, and landfill owners and operators who may not necessarily have technical backgrounds to understand technical terms used throughout the manual. A few words have been added to this section during this revision.

GLOSSARY

mark d: add PPA & lf gas well -aqt

Applicant: the person named in the application as the owner of a property.

Adverse Impact: an injurious impact which is significant in relation to the public health, safety, or environmental interest being protected.

Aquifer: a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs.

Area of Critical Environmental Concern (ACEC): an area designated by the Secretary of the Executive Office of Environmental Affairs pursuant to 301 CMR 12.00, Areas of Critical Environmental Concern.

Aerobic Decomposition: the first phase of decomposition in a landfill that takes place in the presence of oxygen with carbon dioxide and heat produced as by products.

Anaerobic Decomposition: a decomposition process in a landfill that takes place in the absence of oxygen which results in the formation of methane and carbon dioxide.

Closure: the act or process of deactivating a facility in compliance with the approved facility final closure plan and applicable closure requirements.

Composting: a process of accelerated biodegradation and stabilization of organic material under controlled conditions yielding a product which can safely be used.

Composite Liner: a liner composed of two low permeability layers where the upper layer consists of a low permeability synthetic material direct contact with the lower layer consisting o a low permeability soil.

Construction and Demolition Waste: the waste building materials and rubble resulting from the construction, remodeling, repair or demolition of buildings, pavements, roads or other structures. Construction and demolition waste includes, but is not limited to, concrete, bricks, lumber, masonry, road paving materials, rubber and plaster.

Cover Material: soil or other materials that can be placed in one or more layers over solid waste for control of vectors, fires, odors, percolation of water into a landfill, grading, support of vegetation and related environmental or engineering purposes.

Floodplain: an area which floods from a rise in a bordering waterway or waterbody and is the maximum lateral extent of flood water which will result from the statistical 100 year frequency storm. This boundary shall be determined using the data available through the National Flood Insurance Program (NFIP) as administered by the Federal Emergency Management Agency (FEMA), except where the Department determines that more accurate information is available.

Groundwater: water below the land surface in a saturated zone.

Hazardous Waste: any waste that is defined and regulated under 310 CMR 30.00, [Hazardous Waste Regulation], as may be amended.

Interim Wellhead Protection Area (IWPA): an area extending to a one-half mile radius from a public water supply wellhead which is intended to protect the wellhead pending the delineation of its Zone II.

Landfill Gas Monitoring Well: a permanent well designed to facilitate the down-hole measurement and/or collection of landfill gas.

Landfill Gas Probe: a temporary device designed to facilitate the down-hole measurement (depth 2-5 ft) of gas and/or collection of landfill gas. Often used as a screening tool to facilitate the placement of landfill gas monitoring wells.

Landfill Gas: a mixture of gases produced by decomposition, volatilization, and by chemical reactions within solid waste. The following gases are produced; methane, carbon dioxide with trace amounts of nitrogen, oxygen, hydrogen sulfide, hydrogen, and other organic compounds. Landfill gas is typically heavier than air, explosive, corrosive and toxic.

Landfill Gas Vent: a passive landfill gas control device which relies on natural atmospheric pressure and convection to release landfill gas from the interior of the landfill to the atmosphere.

Leachate: a liquid that has passed through or emerged from solid waste and which may contain soluble or suspended material from such waste.

Liner: an engineered layer or layers of recompacted soils and/or synthetic materials designed to restrict the movement of leachate into groundwater and to facilitate the collection of leachate. "Liner" may refer to one or more low permeability layers in a groundwater protection system.

Lower Explosive Limit (LEL): the lowest percent by volume of a gas in a mixture of explosive gases that will propagate a flame at 25 degrees celsius and atmospheric pressure.

Methane: a colorless, odorless gas that is less dense than air and relatively insoluble in water. Methane is explosive at concentrations from 5 percent to 15 percent (by volume) in air and is a major constituent of landfill gas.

Monitoring Well: a well designed to facilitate the down-hole measurement of groundwater and/or gas levels and the collection of groundwater and/or gas samples.

Municipal Solid Waste: any residential or commercial solid waste.

Operator: any person who has care, charge or control of a facility subject to these regulations, including without limitation, an agent, lessee of the owner or an independent contractor.

Owner: any person who alone or in conjunction with others has legal ownership, a leasehold interest, or effective control over such property interests, the real property upon which a facility is located, or the airspace above said real property; "owner" does not mean persons holding bare legal title for the purpose of providing security for financing.

Post-Closure: a finite period of time commencing after the closure of a facility has been completed and approved by the Department, during which the Department may require site monitoring, care and maintenance.

Primary Leachate Collection System: the uppermost leachate collection system.

Recycle: to recover materials or by-products which are:

(a) reused; or
(b) used as an ingredient or a feedstock in an industrial or manufacturing process to make a marketable product; or
(c) used in a particular function or application as an effective substitute for a commercial product or commodity.

"Recycle" does not mean to recover energy from the combustion of a material.

Recycling Center (or Drop-off Center): a site where recovered manufactured materials and yard wastes are collected and sold for reprocessing.

Regional Disposal Facility: a solid waste facility that is a member of a regional disposal district established in accordance with M.G.L. c. 40, s. 44K, or a solid waste facility that receives substantial quantities of solid waste on a regular basis from two or more municipalities.

Secondary Leachate Collection System: the leachate collection system lying between the uppermost or primary liner and the secondary liner and is designed to collect leachate which has leaked through the primary liner.

Site Assignment: a determination by a board of health or by the Department as specified in M.G.L. c. 111 s. 150A that:
(a) designates an area of land for one or more solid waste uses subject to conditions with respect to the extent, character and nature of the facility that may be imposed by the assigning agency after public hearing; or
(b) establishes that an area of land was utilized as a site for the disposal onto land of solid waste or as a site for a refuse disposal incinerator prior to July 25, 1955 as provided in St. 1955, c. 310, s. 2. The area of land determined to be site assigned under this subsection shall be limited to the lateral limits of the waste deposition area (footprint) or the area occupied by the incinerator on July 25, 1955, except as approved by the Department in approved plans. Said assignment shall apply only to uninterrupted solid waste disposal activities within the footprint or plan approved area and shall have no legal force or effect at any time after the commencement of non-disposal activities.

Sludge: the accumulated solids and/or semisolids deposited or removed by the processing and/or treatment of gasses, water or other fluids.

Sole Source Aquifer: an aquifer so designated by the U.S. Environmental Protection Agency, or by the Department under the authority of a state program as may be established, that supplies 50% or more of the drinking water for the aquifer service area, and the volume of water which could be supplied by alternative sources is insufficient to replace the petitioned aquifer should it become contaminated.

Solid Waste or Waste: useless, unwanted or discarded solid, liquid or contained gaseous material resulting from industrial, commercial, mining,

agricultural, municipal or household activities that is abandoned by being disposed or incinerated or is sorted, treated or transferred pending such disposal, incineration or other treatment, but does not include:
(a) hazardous wastes as defined and regulated pursuant to 310 CMR 30.000;
(b) sludge or septage which is land applied in compliance with 310 CMR 32.00;
(c) waste water treatment facility residuals and sludge ash from either publicly or privately owned waste water treatment facilities that treat only sewage, which is treated an/or disposed at a site regulated pursuant to M.G.L. c. 83, ss. 6 & 7 and/or M.G.L. c. 21 ss. 26-53 and the regulations promulgated thereunder, unless the waste water treatment residuals and/or sludge ash are co-disposed with solid waste;
(d) septage and sewage as defined and regulated pursuant 314 CMR 5.00, as may be amended, and regulated pursuant to either M.G.L. c. 21 ss. 26-53 or 310 CMR 15.00, as may be amended, provided that these regulations do apply to solid waste management facilities which co-dispose septage and sewage with solid waste;
(e) ash produced from the combustion of coal when reused as prescribed pursuant to M.G.L. c. 111, s. 150A;
(f) solid or dissolved materials in irrigation return flows;
(g) source, special nuclear or by-product material as defined by the Atomic Energy Act of 1954, as amended;
(h) those materials and by-products generated from and reused within an original manufacturing process; and
(i) compostable or recyclable materials which composted or recycled in an operation not required to be assigned pursuant to 310 CMR 16.05(2)-(4).

Solid Waste Management: the collecting, handling, and disposal of all solid waste.

Surface Water: all bodies of water natural or artificial, inland or coastal, fresh or salt, public or private within the territorial limits of the Commonwealth of Massachusetts.

Transfer Station: a handling facility where solid wastes are brought, stored and transferred to vehicles for transport to the location of further processing, treatment or ultimate disposal.

Upper Explosive Limit (UEL): the maximum concentration of a gas or vapor above which it will not burn when exposed to an ignition source at 25 degrees celsius and atmospheric pressure.

Vector: an organism that is capable of transmitting a pathogen from one organism to another including, but not limited to, flies and other insects, rodents, birds, and vermin.

Wetlands: any land or water area subject M.G.L. c. 131. s. 40 or resource areas regulated pursuant to 310 CMR 10.00.

White Goods: an appliance employing electricity, oil, natural gas or liquified petroleum gas to supply heat or motive power to preserve or cook food, to wash or dry clothing, cooking or kitchen utensils or related items or to cool or heat air or water.

Zone II: that area of an aquifer which contributes water to a well under the most severe recharge and pumping conditions that can be realistically

anticipated (i.e. pumping at the safe yield of the well for 180 days without any natural recharge occurring); it is bounded by the groundwater divides which result from pumping the well and by contact of the edge of the aquifer with less permeable materials such as till and bedrock. At some locations, streams and lakes may form recharge boundaries. For the purposes of these regulations, a Zone II area is one which has been defined and delineated in accordance with the Department's Division of Water Supply "Guidelines for Public Water Systems", September, 1984 Supplement to the 1979 edition or the most recent version thereof.

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LANDFILL TECHNICAL GUIDANCE MANUAL

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EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
Department of Environmental Protection
Division of Solid Waste Management

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