Province of British Columbia

Landfill Criteria

For Municipal Solid Waste

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BRITISH COLUMBIA
The Best Place on Earth

Ministry of Environment

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This document is available online at:
http:www.env.gov.bc.ca/epd/mun-waste/

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These criteria were last reviewed in 1994.

1. Definitions

"**200 Year Floodplain**" means land where the chance of a flood occurring in any given year is at least one in two hundred.

"**access road**" means a road that leads from a public road to a waste disposal site.

"**active life**" means the period of operation beginning with the initial receipt of municipal solid waste and ending at completion of closure activities.

"**action plan**" means a document describing an organized, planned, technically coordinated and financially feasible course of action to be followed in identifying nonconforming landfills and to upgrade the landfill(s) to meet these criteria or to justify exemptions.

"**aerobic**" means in the presence of oxygen.

"**approved**" means authorized in writing or specified in writing with or without conditions or requirements, by the Minister of Environment, his designate, or a Manager.

"**aquifer**" includes any soil or rock formation that has sufficient porosity and water yielding ability to permit the extraction or injection of water at reasonably useful rates.

"**biomedical waste**" means a substance that is defined as biomedical waste in the *Environmental Management Act*.

"**black water**" means toilet waste

"**buffer zone**" means land used to separate a facility from other land.

"**cell**" means a compartment within a landfill isolated from other compartments by appropriate cover material and of such size so as to be considered manageable in the context of total volume and the day-to-day operating concerns including garbage placement and compaction, stability of working surfaces and slopes and the operation of landfill equipment.

"**composting**" is the aerobic biological decomposition of organic municipal solid waste under controlled circumstances to a condition sufficiently stable for nuisance-free storage and for safe use in land application.

"**contingency plan**" means a document describing an organized, planned, technically coordinated and financially feasible course of action to be followed in case of emergency or other special conditions, including, but not limited to, equipment breakdowns, fires, odours, vectors, explosions, spills, accidents, receipt or release of hazardous or toxic materials or substances, contamination of ground water, surface water or the air attributable to a solid waste management facility and other incidents that could threaten human health or safety or impair the usefulness of the environment.

"**cover material**" means soil or other material approved for use in sealing cells in landfills.

"**daily cover**" means a compacted layer of at least 0.15 metre of soil or functionally equivalent depth of other cover material that is placed on all exposed solid waste at the end of each day that municipal solid waste is discharged at the landfill.

"**design volume**" means the maximum volume of solid waste, including cover material, to be discharged at the solid waste management facility during its active life.

"**designated flood**" means a flood, which may occur in any given year, of such magnitude as to equal a flood having a 200 year recurrence interval, based on a frequency analysis of unregulated historic flood records or by regional analysis where there is inadequate stream flow data available. Where the flow of a large watercourse is controlled by a major dam, the designated flood shall be set on a site-specific basis.

"**disposal**" means the introduction of waste into the environment for the purpose of final burial, destruction or placement for future recovery.

"**fault**" means a geological fracture or zone of fractures in any material along which strata on one side have been displaced with respect to that on the other side.

"**final cover**" means a layer consisting of soil and, in some cases, other natural or synthetic materials that is placed on any surface of a landfill where no additional solid waste will be deposited and serves to restrict the infiltration of precipitation, to support vegetation, to control landfill gas, to restrict access by wildlife, and to promote surface drainage.

"**floodplain**" means a lowland area, whether dyked, floodproofed or not, which, by reasons of land elevation, is susceptible to flooding from an adjoining watercourse, ocean, lake or other body of water and for administration purposes is taken to be that area submerged by the designated flood plus freeboard.

"**floodway**" means the channel of the watercourse and those portions of the floodplains which are reasonably required to discharge the flood flow of a designated flood. A minimum required floodway shall be equal to the width of the channel within the natural boundary plus a minimum setback of thirty metres from the natural boundary on each side of the channel or channels unless otherwise approved.

"**freeboard**" means a vertical distance added to the designated flood level and is used to establish the flood construction level.

"**free liquid**" means any quantity of a liquid which is separated from a solid when subjected to the Free Liquid Test Procedure described in Part 3 of Schedule 4 of the Hazardous Waste Regulation.

"**groundwater**" means water below the ground surface in a zone of saturation.

"**hazardous waste**" means "hazardous waste" as defined in the Hazardous Waste Regulation.

" **infiltration**" is the entry into the soil or solid waste of water at the soil or solid waste surface.

"**intermediate cover**" means a compacted layer of at least 0.30 metre of soil or functionally equivalent depth of other cover material placed where no additional solid waste has been deposited or will be deposited within a period of 30 days.

"**lateral expansion**" means a horizontal expansion of the footprint of the area of landfilling beyond that which is currently authorized for waste discharge by an approved permit or operational certificate. The footprint area must not be greater than the area within the property boundaries less the areas set aside for other land uses such as buffer zones, access roads, recyclable storage areas and any other areas designated for uses other than waste discharge.

"**leachate**" means any liquid and suspended materials which it contains, which has percolated through or drained from a municipal solid waste disposal facility.

"**liner**" means a continuous layer of synthetic material or natural clay or earth materials, placed beneath and at the sides of a landfill and intended to restrict the downward or lateral escape of waste or leachate or in some cases to restrict the upward movement of ground water into the landfill.

"**lower explosive limit**" means the minimum percent concentration (by volume) of a substance in air that will explode or produce a flash of fire when an ignition source is present, measured at 25 degrees Celsius and atmospheric pressure.

"**manager**" means the "manager" as defined in the *Environmental Management Act*.

"**municipal solid waste**" means "municipal solid waste" as defined in the *Environmental Management Act*.

"**natural boundary**" means the visible high watermark of any lake, river, stream or other body of water where the presence and action of the water are so common and usual and so long continued in all ordinary years as to mark upon the soil of the bed of the lake, river, stream or other body of water a character distinct from that of the banks thereof, in respect to vegetation, as well as in respect to the nature of the soil itself (Land Act, Section 1). In addition, the natural boundary includes the best estimate of the edge of dormant or old side channels and marsh areas.

"**open burning**" means the combustion of any material or solid waste in the absence of containment and control of the combustion reaction with respect to residence time, temperature and mixing.

"**person**" includes an individual, a corporation, partnership or party, and the personal or other legal representatives of a person to whom the context can apply according to law.

"**public nuisance**" refers to an activity or action or result of such activity or action, which in the opinion of the Manager:

(a) interferes with the reasonable use and enjoyment of property surrounding the landfill;

(b) is a source of irritation to the public; or

(c) is annoying, unpleasant or obnoxious to the public.

"**putrescible**" refers to organic matter which has the potential to decompose with the formation of malodorous byproducts.

"**recovery**" means reclaiming of recyclable components and/or energy from the post-collection solid waste stream by various methods including incineration, pyrolysis, distillation, gasification or biological conversion (including composting) and includes the collection and subsequent management of methane gas generated in the landfill.

"**recyclable material**" means "recyclable material" as defined in the *Environmental Management Act.*

"**recycling**" means the collection, transportation and processing of products separated from the municipal solid waste stream which are no longer useful in their present form and the use (including composting) of their material content in the manufacture and sale of new products. Recycling refers to source-separated wastes only, when used in the context of the 3 **R** s (**R**educe, **R**euse, and **R**ecycle).

"**reduction**" means decreasing the volume, weight, and/or toxicity of discarded material and includes activities which result in greater ease or efficiency of reuse of a product or recycling of materials.

"**regional district**" means a jurisdiction created under Section 767 of the Municipal Act.

"**remediation**" means actions taken to remove, eliminate, limit, correct, counteract or mitigate the negative effects on human health or the environment of a release or threatened release of one or more contaminants into the environment.

"**reuse**" means the repeated use of a product in the same form but not necessarily for the same purpose.

"**salvaging**" means the removal of material from a solid waste facility under the control of the facility owner or operator.

"**scavenging**" means the uncontrolled removal of material from a solid waste facility.

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

"**septage**" means the pumped contents of a septic tank

"**sewage**" means effluent from a municipal sewerage system.

"**solid waste facility**" refers to a facility designed, constructed and operated for the collection, processing, transferring or disposal of the solid waste stream or components thereof, including but not limited to, transfer stations, material recycling facilities, composting facilities and disposal facilities.

"**Solid waste stream**" means the aggregate of all solid waste components, and also the process through which they move from point of generation to ultimate disposal.

"**surface water**" means lakes, bays, sounds, ponds, impounding reservoirs, perennial or ephemeral streams and springs, rivers, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of British Columbia, and all other perennial or ephemeral bodies of water, natural or artificial, inland or coastal, fresh or salt, public or private, but excludes groundwater or leachate collection channels or works.

"**unstable area**" means a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill structural components responsible for preventing releases from a landfill. Unstable areas can include poor foundation conditions, areas susceptible to mass movement, and Karst terrains.

"**vector**" means a carrier that is capable of transmitting a pathogen from one organism to another and includes, but is not limited to, flies and other insects, rodents and birds.

"**vertical expansion**" means an expansion of the vertical profile of waste deposited in a landfill or an increase in the number of lifts in a landfill beyond that which is currently authorized by an approved permit or operational certificate. The concept of vertical expansion is not applicable to those landfills for which no explicit limit on vertical height is provided in the permit or operational certificate.

"**white goods**" means stoves, refrigerators, freezers, washers, dryers, hot water heaters and dishwashers

"**waste management plan**" means "waste management plan" as defined in the *Environmental Management Act*.

2. Applicability

2.1 New Landfills and Lateral Expansions

These criteria are effective from the date of issuance and apply to all new landfills and both lateral and vertical expansions of existing landfills subsequently designed and constructed for the disposal of municipal solid waste (MSW).

2.2 Existing Landfills

During the preparation of a waste management plan, each regional district is to identify those MSW landfills, including privately owned and operated sites, that do not conform to these criteria. The Waste Management Plan is to include an action plan to upgrade nonconforming landfill(s) to meet these criteria or to justify exemptions. Where a Waste Management Plan is already in place, the holder of the plan is to identify nonconforming landfills and submit a corrective action plan to the Manager on or before December 31, 1995.

3. Landfill Classifications

For the purposes of these criteria, the following classifications of MSW disposal facilities are established:

- Sanitary Landfills
- Modified Sanitary Landfills
- Selected Waste Landfills

Separate criteria for Modified Sanitary and Selected Waste Landfills have not been established but rather exemptions from Sanitary Landfill criteria may be approved by the Manager, based on site specific environmental and public health considerations. Exemptions based on economic considerations will be contemplated only for existing landfills. The intent of these criteria is to set Sanitary Landfills as the goal for all MSW landfills while recognizing that, for some types of waste and in some areas of the province, there is a need for Modified Sanitary and Selected Waste Landfills.

3.1 Sanitary Landfills

Sanitary Landfills are defined as disposal facilities which are normally, but not necessarily, located in areas serving populations of 5,000 or more people and which may accept all types of municipal solid

wastes. Sanitary landfills are normally required to comply with all the criteria for landfill siting, design, operation and closure.

3.2 Modified Sanitary Landfills

Modified Sanitary Landfills are defined as disposal facilities which may accept all types of municipal solid wastes. These facilities are normally but not necessarily located in areas serving populations of fewer than 5,000 people where a regional or cooperative waste disposal system with neighbouring communities may not be practical or feasible.

Based on environmental considerations and economic constraints the Manager may exempt these facilities from some of the criteria except those specified in Sections 4, 5, 6.1, 6.2, 6.3, 6.5, 6.7, 7.1, 7.4, 7.7, 7.8, 7.9, 7.11 through 7.17, 8.1, 8.3, 8.4, and 8.6, all of which are considered mandatory (mandatory sections are designated by an "M" following the section heading). However, at the discretion of the Manager, the siting and operating criteria for these landfills can be made more stringent to reduce impacts on the environment. Modified Sanitary Landfills will normally not be considered acceptable for remote industrial, recreational, exploration and construction camps. MSW from these facilities should be incinerated in properly designed and permitted, auxiliary fuel fired refuse incinerators.

3.3 Selected Waste Landfills

Selected Waste Landfills are defined as disposal facilities which accept selected types of refuse, not including putrescibles. Wastes received at these landfills may include: demolition, land clearing and construction (DLC) debris; solid industrial wastes (excluding all hazardous wastes) such as foundry sands; and, where recycling options are not available or feasible and only with the approval of the Manager, bulky wastes such as large appliances ("white goods") and derelict motor vehicles. Generally, these Selected Waste Landfills will only receive a few types of waste which should each be discharged to discrete areas of the site.

Based on the waste type, leachate generation potential, location, environmental considerations and economic constraints, the Manager may exempt these landfill facilities from some of the criteria except those specified in Sections 4, 5, 6.1, 6.2, 6.3, 6.5, 6.7, 7.1, 7.4, 7.7, 7.8, 7.9, 7.11 through 7.17, 8.1, 8.3, 8.4, and 8.6, all of which are considered mandatory (mandatory sections are designated by an "M" following the section heading). Any person seeking to establish a Selected Waste Landfill must demonstrate, to the satisfaction of the Manager, the value of keeping these wastes separate from the main waste stream.

4. Performance Criteria (M)

Consistent with current trends, the design and operation of landfills should reflect the 3Rs of waste management, namely reduce, reuse and recycle. This translates to a philosophy that stresses preventing, or at least minimizing, the production of leachate and landfill gas. Initiatives to reduce the quantity of waste directed to landfills by 50% by the year 2000 will certainly result in an overall reduction in the loading of organics and other leachate/landfill gas-producing materials. For new landfills, and to a lesser extent existing landfills, design features and operating conditions can be specified that would deter the production of both leachate and landfill gas. These could include means to prevent the introduction of water to the garbage by the use of a moveable cover or structure over the working area until soil or other permanent cover material can be spread.

In recognition of the transition period that will be experienced in proceeding from the past and present to the future, the following sections address the issues of leachate and landfill gas from an environmental protection perspective.

4.1 Ground and Surface Water Quality Impairment (M)

Landfills must not be operated in a manner such that ground or surface water quality in existing or potential future water supply aquifers or surface waters decreases beyond that allowed by the Approved and Working Criteria for Water Quality prepared by the Water Management Division of the Ministry of Environment, or other appropriate criteria, at or beyond the landfill property boundary. Criteria from other jurisdictions should be used only for those contaminants which have not been dealt with in the Approved and Working Criteria by the Water Quality Branch. The appropriate water quality criteria for each site will be specified by the Manager after reviewing existing and potential future uses of the ground and surface water resources.

For new landfills, the potential for leachate generation and the estimated leachate impact must be assessed during the design stage of the landfill. If anticipated leachate quantity and quality, based on local conditions of precipitation and net water balance combined with incoming waste characteristics, indicate that leachate discharge will not cause excursions from the established criteria, consideration may be given for not installing a leachate collection/treatment system. If the assessment indicates that leachate could result in an excursion from the established criteria, provision for leachate management in the form of control of quality and quantity or collection/treatment is mandatory. In the event that leachate collection/treatment is indicated, the method of treatment shall be satisfactory to the Manager in accordance with the Ministry's policy on Best Available Control Technology (BACT).

For existing landfills, in the event that leachate discharge from the landfill results in excursions to the established criteria, the leachate shall be managed to control the impact. In the event that leachate collection/treatment is indicated, the method of treatment shall be satisfactory to the Manager in accordance with the Ministry's current policy on control technology.

4.2 Landfill Gas Management and Odour Nuisance (M)

As indicated in Section 6 addressing design criteria, an assessment of the potential for emission of landfill gas is required to determine the need for the collection and subsequent management of methane and other gases generated in the landfill. The generic grouping of gases referred to as "non-methane organic compounds" (NMOCs) has been selected as a surrogate or indicator for the purposes of assessment and subsequent management of landfill gas. This group contains many toxic and/or reactive organic gases that are normally a component of landfill gas generated in sanitary landfills. For those landfills which by virtue of their nature would not be expected to produce NMOCs in any great quantity, assessment and management of landfill gas by methane emissions directly may be appropriate. An example of this scenario would be a selected waste landfill accepting wood waste and no mixed garbage. For those landfills which by virtue of their nature would not be expected to produce landfill gas in any great quantity, management of gas may not be necessary. An assessment of the need for passive landfill gas venting will, however, still be necessary.

Notwithstanding the results of this assessment, at no time should combustible gas concentrations exceed the lower explosive limit in soils at the property boundary or 25% of the lower explosive limit in any on- site or off- site structure or facility. With regard to the construction of any on-site building and structure or the installation of services (water, sewer, electrical, etc.), due consideration must be given to the potential gas hazard.

Landfills must not be operated in a manner such that gas emissions create a public odour nuisance, or that federal, provincial or local air quality criteria are exceeded.

4.3 Public Health, Safety and Nuisance (M)

A landfill must not be operated in a manner such that a significant threat to public health or safety or a public nuisance is created with respect to: unauthorized access, roads, traffic, noise, dust, litter, vectors or wildlife attraction.

5. Siting Criteria (M)

Landfill siting requires a detailed site location investigation which addresses all the issues outlined below and on Schedule 1, Table 1 which includes water contamination, air pollution, wildlife conflicts, as well as transportation, social and economic factors. The information provided in Table 1 is intended solely as guidance for proponents in their siting activities. Concerns associated with each of the broad categories of impact are presented along with the impacted receptor and exposure pathway. The landfill design, operation and closure requirements discussed in Sections 6, 7 and 8 provide additional constraints to the siting process.

5.1 Property Boundary (M)

The buffer zone between the discharged MSW and the property boundary should be at least 50 metres of which the 15 metres closest to the property boundary must be reserved for natural or landscaped screening (berms or vegetative screens). Depending on adjacent land use and environmental factors, buffer zones of less than 50 metres but not less than 15 metres may be approved by the Manager.

5.2 Other Facilities (M)

The distance between the discharged MSW and the nearest residence, water supply well, water supply intake, hotel, restaurant, food processing facility, school, church or public park is to be a minimum of 300 metres. Greater or lesser separation distances may be approved where justified. For those landfills designed to collect and recover methane gas generated, the issue of potential on-site or off-site users of the energy should be addressed in siting the landfill, consistent with the preceding regarding public places.

5.3 Airports (M)

The distance between an airport utilized by commercial aircraft and a landfill containing food wastes which may attract birds is to be a minimum of 8.0 kilometres, unless bird control measures acceptable to Transport Canada and approved by the Manager are instituted or the potential for birds causing hazard to aircraft is minimal.

5.4 Surface Water (M)

The distance between the discharged MSW and the nearest surface water is to be a minimum of 100 metres. Greater or lesser separation distances may be approved by the Manager where justified by hydrogeological investigations or by provision of surface water diversion works to reroute the watercourse of concern.

5.5 Floodplain (M)

Landfills proposed for locations within the 200 year floodplain and the associated floodway are not to be sited without adequate protection to prevent washouts. Designs for flood protection will be referred by the Manager to the Water Management Branch of the Water Management Division of the Ministry of Environment for comment. The Manager retains the final authority for approval.

5.6 Unstable Areas (M)

Landfills are not to be located within 100 metres of an unstable area.

5.7 Other Excluded Areas (M)

Landfills are not to be located within the boundaries of those areas listed in Section 3(e) of the Hazardous Waste Regulation.

6. Design Criteria

The following clauses have been written to give guidance in designing MSW landfills. It is important to note the operational and closure provisions outlined in Sections 7 and 8.

6.1 Landfill Design Approach (M)

Landfills are to be designed to minimize environmental impact and risk and to ensure compliance with the Performance Criteria. In order to do this, the design must be based on a sound knowledge of the environmental setting including climate, surface and subsurface drainage, geology, groundwater, ecology as well as economic and social factors and must be carried out by qualified professionals.

The design criteria listed below identify two types of landfills: "natural control landfills" which utilize the attributes of the site's natural setting (e.g. low permeability soils) to control emissions such as leachate or landfill gas and "engineered landfills" which use engineered systems (e.g. leachate and gas collection systems) to compensate for inadequacies in the natural abilities of the site to restrict off-site environmental impacts.

Some landfills will not fall into these precise types but will contain components of each. The design criteria listed below are not necessarily the best achievable technology for every landfill site and merely following the criteria does not absolve the designers from taking full responsibility and liability for their design.

6.1.1 Natural Control Landfills

The following criteria apply to "natural control" landfills which do not rely on leachate containment/collection/disposal systems:

The bottom-most solid waste cell is to be 1.2 metres above the seasonal high water table. Greater or lesser separation depths may be approved based on soil permeability and the leachate renovation capability of the soil.

There is to be at least a 2 metres thick layer of low permeability soil with a hydraulic conductivity of 1 x 10-6 cm/s or less (i.e. silt or clay), below each of the bottom-most waste cells. Lesser thicknesses or no layer of low permeability soil may be approved based on the potential for leachate generation and the unsaturated depth, permeability and leachate renovation capability of the existing soil.

6.1.2 Engineered Landfills

The following criteria apply to "engineered" landfills which have leachate containment/collection/disposal systems:

The minimum liner specification for leachate containment systems is a 1 metre thick, compacted soil liner with a hydraulic conductivity of 1 x 10-7 cm/s or less. Minimum bottom slopes of the liner are to be 2 percent on controlling slopes and 0.5 percent on the remaining slopes. Natural, in- situ, low permeability soils, geomembranes, or composite liners (consisting of a geomembrane and a soil layer) which provide the same level of leachate containment are acceptable equivalents. Liners with higher hydraulic conductivities may be approved depending on the leachate generation potential and the unsaturated depth, permeability and leachate renovation capability of the existing soil.

Minimum specifications for leachate collection systems are a 0.3 metre thick sand drainage layer having a hydraulic conductivity of 1 x 10-2 cm/s or greater. Synthetic drainage nets which provide an equivalent hydraulic conductivity are an acceptable alternative.

If there is any concern for the precipitation of leachate constituents causing a plugging problem, the leachate collection system is to be designed to prevent such precipitation from occurring. The drainage layer is to be designed with appropriate grades and collection piping so that the leachate hydraulic head on the liner does not exceed 0.3 metre at any time.

6.2 Water (M)

The disposal of municipal solid waste into water is unacceptable. Surface water diversion to restrict storm water runoff from contacting the wastes is required.

6.3 Final Cover (M)

Final cover for landfill sites is to consist of a minimum of 1 metre of low permeability (<1 x 10 - 5 cm/s) compacted soil plus a minimum of 0.15 metre of topsoil with approved vegetation established. The depth of the topsoil layer should be related to the type of vegetation proposed (i.e. rooting depth). Soils of higher permeability may be approved based on leachate generation potential at the landfill site. Final cover is to be constructed with slopes between 4% and 33% with appropriate run-on/run-off drainage controls and erosion controls. An assessment of the need for gas collection and recovery systems shall be made so that, in the event such systems are required, cover can be appropriately designed and constructed. Final cover is to be installed within 90 days of landfill closure or on any areas of the landfill which will not receive any more refuse within the next year. Completed portions of the landfill are to progressively receive final cover during the active life of the landfill.

Additional layers of natural materials including earth and aggregate and/or synthetic materials may be necessary for inclusion in the final cover design due to site specific conditions and the presence of management systems for leachate and landfill gas.

6.4 Gas Venting or Recovery and Management Systems

Landfill gas recovery and management systems are not required for landfills of a total capacity not exceeding 100,000 tonnes. For landfills exceeding this total capacity, an assessment of the potential emissions of non-methane organic compounds (NMOCs), the surrogate group of gaseous compounds associated with landfill gas, shall be carried out according to the procedure appended to this document as Schedule 2. If the assessment indicates that the emission of NMOCs exceeds or is expected to exceed 150 tonnes/year, the installation and operation of landfill gas recovery and management systems are mandatory. Where a gas recovery and management system is installed, direct venting to the air of gases collected must be avoided; rather, subsequent utilization for energy recovery is recommended. Combustion, even by incineration or flaring, should be encouraged over direct venting to the atmosphere to reduce odours and greenhouse gas emissions. At no time should combustible gas concentrations be allowed that exceed or are predicted to exceed the lower explosive limit in soils at the property boundary or 25% of the lower explosive limit at or in on- site or off- site structures. Minimum recommended spacing for gas vents is two per hectare.

In the event that gas recovery and management systems are not required according to the procedure presented in Schedule 2, an assessment of the need for passive gas venting should be carried out.

6.5 Access Road (M)

An appropriately constructed and maintained access road to and a road system within the landfill site capable of supporting all vehicles hauling waste are required during the operating life of the landfill.

6.6 Fencing and Access

Fencing is required around the perimeter of the landfill. The type and extent of fencing will depend on the existing natural vegetation and topographic features and is to be approved by the Manager. All access points are to have locking gates.

6.7 Design by Qualified Persons (M)

All landfills are to be designed by persons qualified in landfill site selection, design and operation. At the discretion of the Manager, and for all sanitary landfills serving populations of 10,000 persons or greater, these landfill designs must also include both an assessment of risk from seismic activity if the site is not located on bedrock, solid glacial till or clay and an assessment of risk from fault activity.

7. Operational Criteria

7.1 Prohibited Wastes (M)

The CO-disposal of the following wastes with the rest of the MSW is prohibited unless specifically approved by the manager:

- Hazardous Wastes other than those specifically authorized in the Hazardous Waste Regulation
- Bulk liquids and semisolid sludges which contain free liquid;
- Liquid or semisolid wastes including septage, black water, sewage treatment sludge, etc.;
- Automobiles, white goods, other large metallic objects and tires (except in the case of Selected Waste Landfills approved by the Manager where recycling options are not available or feasible);
- Biomedical waste as defined in the document "Guidelines for the Management of Biomedical Waste in Canada" (CCME, February 1992); and
- Dead animals and slaughter house, fish hatchery and farming wastes or cannery wastes and byproducts.

Burial of these wastes in dedicated locations (i.e. avoiding co- disposal) at a landfill site may be approved only if there is no other viable alternative such as treatment/disposal, recycling, reprocessing or composting. Viability of alternatives is to be determined by the Manager. For those cases in which the dedicated disposal of otherwise prohibited wastes is approved, the specific on-site location of the disposal shall be recorded to allow ready access to the waste should corrective or further action pertaining to the management of these wastes be required by the Ministry at some time in the future.

7.2 Landfilling Method

The method of landfilling (e.g. trench, area, ramp) will be determined by factors including the physical site characteristics and the owner's ability to achieve compliance with these criteria.

7.3 Designated Areas

All landfill sites should be provided with and maintain, within the confines of the site or at other more appropriate locations, areas for the separation, handling and storage of recyclable, compostable or reusable materials such as bulky metallic objects and white goods, tires, batteries, and, where applicable, source separated materials such as yard wastes, glass, metal, plastic, paper, concrete, cardboard and drywall.

When a separated recyclable material is a hazardous waste it is to be stored and managed in accordance with the Hazardous Waste Regulation.

7.4 Signs (M)

All landfill sites are to have a sign posted at each entrance with the following current information:

- Site name
- Owner and operator
- Contact phone number and address for owner and operator
- Phone number in case of emergency (such as fire)
- Hours of operation (if applicable)
- Materials/wastes accepted for landfill and recycling
- Materials/wastes banned
- Tipping fees (if applicable)

Additional signs which clearly indicate the directions to the active tipping face, public disposal area, recycling and waste separation areas, etc. should also be displayed.

7.5 Supervision

All Sanitary Landfills are to have full-time, trained operators on-site during operating hours. The gates are to be locked to prevent unauthorized access during non-operating hours. Properly designed and maintained public waste disposal and/or recyclable material bins situated outside the main gate may be provided for after hours use.

7.6 Waste Measurement

The quantity of all wastes received at landfills which service a population of 5,000 or more or which receive more than 5,000 tonnes/year of waste should be measured by a method approved by the Manager. For municipal landfills serving a population greater than 10,000 or more or which receive greater than 10,000 tonnes/year and for all private landfills, weigh scales are recommended.

The federal government requires that weigh scales used to assess charges related to the weight of a commodity be accurate and sensitive to the range of weights being measured. A weigh scale accurate for measuring typical commercial waste vehicles and/or containers (loaded weight as well as tare weight) may not be accurate for measuring waste loads brought to the landfill in smaller vehicles such as pickup trucks and private automobiles. If fees are being contemplated for small loads, the accuracy of the scales for measuring these smaller weights should be confirmed with the federal department of Consumer and Corporate Affairs-Weights and Measures. Alternatively, charges for these loads could be based on typical load sizes according to type of vehicle rather than on a direct measure of weight.

7.7 Scavenging (M)

Scavenging of waste is to be prevented. The salvaging of wastes should be encouraged by providing areas and facilities for separation of recyclable or reusable materials.

7.8 Dust Control (M)

Dust created within the landfill property is to be controlled, using methods and materials acceptable to the Manager, such that it does not cause a public nuisance.

7.9 Waste Compaction and Covering (M)

Wastes are to be spread in thin layers (0.6 m or less) on the working face and compacted. Normally, 3-5 passes of the compacting equipment over the wastes are sufficient to achieve an appropriate density. The working face area should be minimized as much as possible. Cover material is to be

applied at all Sanitary Landfills at the end of each day of operation. Where a Sanitary Landfill operates continuously 24 hours per day, 0.15 m of cover material is to be applied at a frequency approved by the Manager. Under specific circumstances, such as during bear season, the Manager may specify more stringent cover requirements.

When intermediate cover is required, it is to be applied immediately after the last day of operation on areas of the landfill where disposal will not occur for a period exceeding a further 30 days.

The frequency of covering for Modified Sanitary and Selected Waste Landfills shall be specified by the Manager based on public health, environmental and economic factors. Proponents may be required to justify requests for less frequent than daily covering at these types of landfill sites

7.10 Extreme Weather Conditions

During periods of extreme weather conditions, such as those that cause the ground to freeze, an exemption to the normal cover requirements may be approved.

7.11 Litter Control (M)

Litter is to be controlled by compacting the waste, minimizing the working face area, applying cover at appropriate frequencies, providing litter control fences and instituting a regular litter pickup and general good housekeeping program or any other measures required by the Manager.

7.12 Vectors (M)

Vectors are to be controlled by the application of cover material at a specified frequency or by other control measures as required and approved by the Manager.

7.13 Wildlife (M)

Landfills are to be operated so as to minimize the attraction of wildlife such as bears and birds by applying cover at required frequencies and instituting a good housekeeping program. Further control measures, such as bear control fences and bird control devices, may be specified by the Manager.

7.14 Open Burning (M)

Open burning of typical domestic garbage, sawdust and bark at landfills is prohibited. Open burning of other combustibles is generally discouraged. Controlled burning of other wood residues such as stumps, brush and untreated wood may be allowed when approved by the Manager, subject to the following minimum provisions:

- The reuse or recycling of the wood residues is not feasible;
- The landfill services a population of 10,000 or less or receives less than 10,000 tonnes/year of waste and is a minimum of 2 km from the nearest permanently occupied residence, school, hospital or airport;
- A separate area is provided for the burning away from the fill area, complete with any fire breaks (to prevent the spread of fire to the rest of the landfill or the adjacent forest or other surrounding land use) as deemed appropriate and necessary by the Ministry of Forests or the local fire department;
- Authorization to burn in the form of a burning permit is obtained from the Ministry of Forests or any appropriate municipal authority such as the local fire department as well as authorization under the *Environmental Management Act* for the burn (unless an exempted burn) is obtained from the Ministry of Environment; (Note: *Environmental Management Act* approval may be in the form of a specific burning permit or a landfill permit or operating certificate;
- Adequate fire fighting equipment is available on-site as outlined in the issued burning permit or as required by all authorising agencies;
- Brush and wood is seasoned for at least one season and is free of rocks, soil, etc.;
- Brush and wood is stacked in a series of separate piles to facilitate fire control to the satisfaction of the Ministry of Forests or the local fire department, to enhance a hot burn for the minimization of smoke and to prevent spread to other nearby areas;
- Atmospheric conditions are suitable so that there is no threat to public health and safety and no nuisance or hazard is caused by smoke or odour; the Venting Index (VI) may be an appropriate tool for evaluating the local conditions to make the "burn/no burn" decision;
- The duration of any burning is less than 24 hours; and
- Full time supervision is provided until the burning activity is complete (i.e. until there is no smoke and until no danger of fire exists).

7.15 Monitoring (M)

A monitoring program must be submitted to and approved by the Manager addressing, as a minimum, ground and surface water, landfill gas and ambient air quality as set out pursuant to these criteria in monitoring guidelines being prepared by the Ministry. Monitoring of other environmental media such as vegetation and soils should be assessed and a program developed as the site-specific situation warrants.

7.16 Record Keeping (M)

The owner and/or operator of a landfill shall record and maintain the following information both on-site and at the legal address of the owner/operator:

- copy of the permit(s) for the site or the certificate(s) of operation;
- inspection records for inspections conducted by staff and regulatory agencies;
- training procedures;
- contingency plan and notification procedures;
- closure and post-closure care plans;
- monitoring results for gas, leachate, surface and ground water;
- volumes of gas extracted/recovered from the site (where gas collection and management are carried out);
- volumes of leachate collected from the site (where leachate collection and management are carried out);
- interpretations of monitoring results;
- financial assurance documentation if financial assurance is required; and
- copies of all annual reports.

7.17 Annual Report (M)

An annual Operations and Monitoring Report is to be submitted to the Manager in a timely fashion as specified by the Manager. These reports are to contain at least the following information:

- Total volume and/or tonnage of waste discharged into the landfill for the year;
- Approved design volume;
- Remaining site life and capacity;
- Operational plan for next 12 months;
- Operation and maintenance expenditures;
- Leachate, water quality and landfill gas monitoring data and interpretation;
- Amounts of leachate collected, treated and disposed;
- Any changes from approved reports, plans and specifications;
- An up to date contingency plan, noting any amendments made to the plan during the year;
- Amount of landfill gas collected and its disposition; and
- Review of the closure plan and associated estimated costs.

8. Closure and Post-closure Criteria

8.1 Closure Plans (M)

A closure plan for existing landfills is to be submitted to and approved by the Manager by December 31,1995. Submission of a closure plan will be a requirement for permitting any new landfill site. A closure plan for sanitary landfills will specify at least the following:

- Anticipated total waste volumes and tonnage, and life of the landfill (i.e. closure date);
- A topographic plan showing the final elevation contours of the landfill and surface water diversion and drainage controls;
- Design of the final cover including the thickness and permeability of barrier layers and drainage layers, and information on topsoil, vegetative cover and erosion prevention controls;
- Procedures for notifying the public about the closure and about alternative waste disposal facilities;
- Rodent and nuisance wildlife control procedures;
- Proposed end use of the property after closure;
- A plan for monitoring groundwater, surface water and landfill gas, erosion and settlement for a minimum post- closure period of 25 years;
- A plan and accompanying design for the collection, storage and treatment/use of landfill gas for a minimum of 25 years;
- A plan for operation of any required pollution abatement engineering works such as leachate collection and treatment systems, for a minimum post- closure period of 25 years; and
- An estimated cost, updated annually, to carry out closure and post-closure activities for a minimum period of 25 years.

The minimum contents of a closure plan may be revised as appropriate by the Manager for Modified Sanitary or Selected Waste Landfills.

8.2 Financial Security

A person that owns an existing or proposed new landfill site is to provide for the future financial security of the operations at and beyond closure by establishing a Closure Fund in a form acceptable to the Manager, such as upfront security or a fund financed on a charge per tonne of waste disposed basis. Such a fund would be analogous to the provincial Waste Management Trust Fund which the

Minister may establish under Section 136 of the *Environmental Management Act* . The ultimate amount of the financial security will meet or exceed the currently estimated closure and post- closure costs as outlined in the closure plan plus a reasonable contingency for any remediation which may be required. For municipally owned landfills, the financial security can be built up over time according to a schedule approved by the Manager.

8.3 Legal Survey (M)

All landfills sited on titled land must register a covenant that the property was used for the purpose of waste disposal as a charge against the title to the property as provided for under Section 215.1 of the Land Title Act .

8.4 Buildings and Structures (M)

The construction of buildings and other structures on landfills containing putrescible wastes is not recommended for a minimum period of 25 years after closure due to concerns about combustible gas and excessive settlement. Such activity will only be considered and /or authorized after an investigation and report by qualified persons. The report is to be submitted for approval to the Manager prior to initiating construction activities.

8.5 Operation of Gas Recovery and Management System

Where landfill gas recovery and management is required, operation of the system should be considered an integral part of overall landfill management. The system should be planned for from the early design stage of the landfill and arrangements made for its operation for a minimum 25 year life after closure.

8.6 Operation of Other Control Systems (M)

Operation of other environmental control systems for leachate and run- off as well as monitoring of leachate, groundwater and surface water must be continued during the entire post- closure period unless the early suspension of such operations or monitoring is approved by the Manager.

Schedule 1 — Table 1: Siting Concerns

	Composite	Concerns	At Risk	Pathway
A	Water Contamination	1 wells	humans (health)	ground water
		2 creeks, rivers, lakes, etc.	humans (health)	surface water
			aquatic life	surface / ground water
			plant life	surface / ground water
			animal life	surface / ground water
B	Site Air Contamination	1 odour	humans (aesth.)	atmosphere
		2 chemical	humans (health)	atmosphere
			plants	atmosphere
		3 physical	humans (explosion)	soil, rock or atmosphere
		(methane gas)	plants	soil and rock
		4 noise	humans (aesth.)	atmosphere
		5 dust	Humans (aesth.) and health	atmosphere
		6 smoke	humans (aesth.) And health	atmosphere
		7 greenhouse gases	humans (global climate)	atmosphere
C	Wildlife Conflicts	1 birds	humans (plane traffic, nuisance)	atmosphere
		2 animals	humans (human / bear conflict)	direct contact
			bears (destroyed as a nuisance)	direct contact
D	Transportation	1 accidents	humans (health)	transportation route
		2 noise	humans (aesth.)	atmosphere
		3 dust	Humans (aesth.)	atmosphere
E	Social	1 site aesthetics	adjacent land owners	reduced enjoyment of life
		2 compatible land use	adjacent land owners	reduced enjoyment of life
F	Economic	1 waste transport and transfer	taxpayers	reduced income
		2 capital cost	taxpayers	reduced income
		3 operating cost	taxpayers	reduced income

		4 life and capacity 5 land value 6 availability of cover	taxpayers adjacent land owners taxpayers	reduced income reduced net worth reduced income

Schedule 2: Procedure for Estimating the Potential Emission of Non-methane Organic Compounds (NMOCs) from Municipal Solid Waste Landfills

Introduction

The approach adopted in these criteria for the management of landfill gas emissions from municipal solid waste landfills is virtually identical to that developed and currently under review by the United States Environmental Protection Agency (USEPA). The EPA proposal would add subpart WWW to 40 CFR part 60 for the control of new sources and would propose emission guidelines and compliance schedules for existing sources under subpart C.

These criteria require municipal waste landfills emitting greater than 150 tonnes/year of non-methane organic compounds (NMOCs) to design and install gas collection systems and then combust the captured landfill gases. Energy recovery is optional. Landfills less than 100,000 tonnes total capacity would be exempt from control requirements. Landfills with design capacities greater than or equal to 100,000 tonnes would install collection and control equipment if their calculated NMOC emissions are greater than 150 tonnes/year. These larger landfills are required to calculate and report their NMOC emission rate periodically until closure or until the need for a collection and control system is indicated. Actual site-specific measurements of the calculation parameters may replace default values assumed in the estimation procedure. Alternatively, actual site-specific measurements of landfill gas generated may be used to estimate total emissions for the purpose of comparison to the 150 tonnes/year of NMOCs action level.

Calculation of Estimated NMOC Emission Rate

The estimated annual emission rate of NMOCs from municipal solid waste landfills is calculated according to the following equation:

$$M\ [NMOC] = 2LoR(1-e^{-kt})(C\ [NMOC])(3.595*10^{-9}) \quad (1)$$

where:

M [NMOC] = mass emission rate of NMOC, tonnes/year

Lo = refuse methane generation potential, m3 /tonne of refuse

R = average annual refuse acceptance rate, tonne/year

k = landfill gas/methane generation rate constant, year -1

t = age of landfill, years

C [NMOC] = concentration of NMOC in landfill gas, ppmv as Hexane

3.595*10 -9 = conversion factor

For those landfills for which the actual year-to-year acceptance rate is known, the estimated annual emission rate of NMOCs from municipal solid waste landfills is calculated according to the following equation:

QT = [Sigma] i=1,n 2kLoMi(e -kti)(C [NMOC])(3.595*10 -9) (2)

where:

QT = total NMOC emission rate from the landfill, tonnes/year

k = landfill gas generation constant, year -1

Lo = methane generation potential, m3 /tonne of refuse

Mi = mass of refuse in the i th section, tonnes

ti = age of the i th section, years

C [NMOC] = concentration of NMOC in landfill gas, ppmv as hexane

3.595*10 -9 = conversion factor

In the absence of site-specific data, the default values to be used for k, Lo and NMOC concentration are as follows:

k = 0.02 year -1

Lo = 230 m3 /tonne of refuse

C [NMOC] = 8,000 ppmv as hexane

Sample calculations of annual emission rate of NMOCs have been carried out according to Equation (1) above for a range of annual refuse acceptance rates and ages of landfill. The results, depicting the annual NMOC emission rate as a function of both annual acceptance rate and landfill age, are presented in Figures 1 and 2.

Figure 1: Annual Emission of NMOCs as a Function of Annual Refuse Charging Rate & Landfill Age (t) in Years

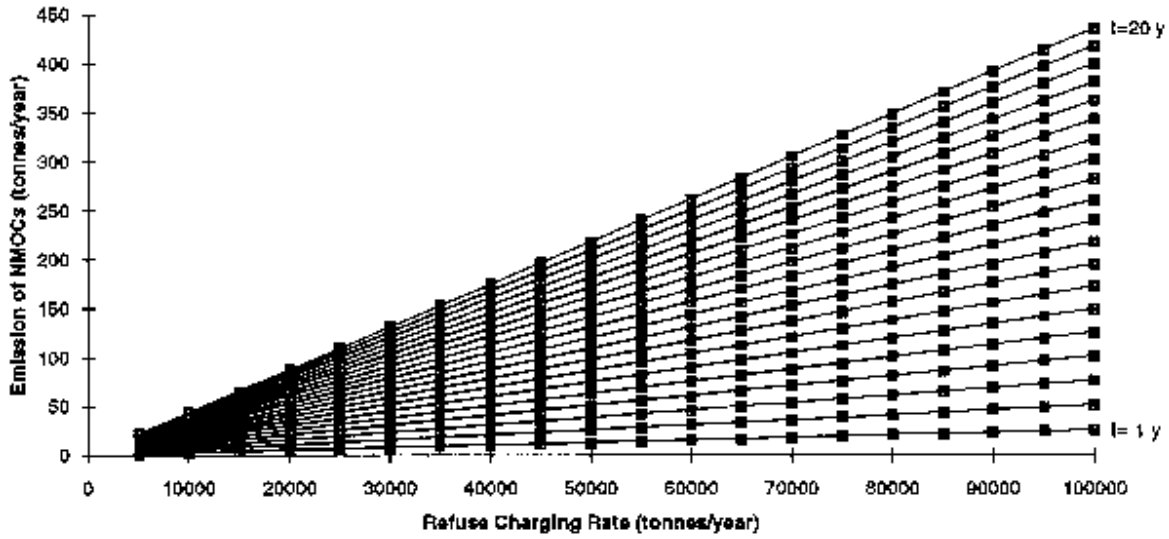

Figure 2: Annual Emission of NMOCs as a Function of Annual Refuse Charging Rate & Landfill Age (t) in Years