

Guideline for the Production of Compost in Ontario

July 25, 2012

This document is a companion to the "Ontario Compost Quality Standards" ("Standards").

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Waste Management Policy Branch

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Guideline for the Production of Compost in Ontario

SUMMARY.....	6
PART I – INTRODUCTION AND OVERVIEW.....	8
1.0 INTRODUCTION.....	8
1.1 PURPOSE.....	8
1.2 OBJECTIVES.....	8
1.3 SCOPE.....	8
2.0 LEGISLATION, APPROVALS AND STANDARDS.....	9
2.1 APPLICATION FOR ENVIRONMENTAL COMPLIANCE APPROVAL.....	10
2.2 OTHER JURISDICTIONS.....	10
PART II – COMPOST FACILITY APPROVAL CONSIDERATIONS.....	12
3.0 SITE SELECTION CONSIDERATIONS.....	12
3.1 ECOSYSTEM APPROACH.....	13
3.2 OFFICIAL PLANS, LOCAL ZONING AND BY-LAWS.....	13
3.3 MINIMUM SEPARATION DISTANCES AND BUFFER ZONES.....	14
3.3.1 <i>Siting Considerations</i>	15
3.3.2 <i>Separation Distances for Water Protection</i>	17
3.4 WATERSHED PLANNING.....	17
3.5 WATER (SEWAGE) MANAGEMENT.....	18
3.6 OFF-SITE TRAFFIC.....	19
4.0 SITE DESIGN AND OPERATING CONSIDERATIONS.....	19
4.1 SITE DESIGN AND OPERATING PROCEDURES BY PROCESS UNIT OPERATION.....	20
4.1.1 <i>Receiving</i>	21
4.1.2 <i>Pre-Processing</i>	23
4.1.2.1 <i>Pre-processing Procedures</i>	24
4.1.2.1.1 <i>Pre-processing and Contaminant Removal</i>	24
4.1.2.1.2 <i>Size Reduction</i>	25
4.1.2.1.3 <i>Recipe Development</i>	25
4.1.3 <i>Processing</i>	26
4.1.3.1 <i>Processing Procedures</i>	28
4.1.3.1.1 <i>Pile Formation and Loading</i>	28
4.1.3.1.2 <i>Turning</i>	28
4.1.3.1.3 <i>Aeration</i>	28
4.1.3.1.4 <i>Temperature Control</i>	28
4.1.3.1.5 <i>Compost Monitoring</i>	28
4.1.4 <i>Curing and Finishing</i>	29
4.1.4.1 <i>Curing Procedures</i>	30
4.1.4.1.1 <i>Discharge from Enclosed Systems</i>	30
4.1.4.1.2 <i>Turning</i>	30
4.1.4.1.3 <i>Finishing</i>	30
4.1.4.1.4 <i>Compost Analysis</i>	31
4.2 SEPARATION TO MAINTAIN HYGIENIC CONDITIONS.....	31

4.3	OPERATIONAL FLEXIBILITY AND REDUNDANCY.....	31
4.4	SITE CAPACITY.....	32
4.5	COMPOSTING PAD DESIGN.....	32
4.5.1	<i>Working Surface</i>	33
4.5.2	<i>Drainage</i>	33
4.6	LEACHATE MANAGEMENT PLAN.....	34
4.6.1	<i>Assessment of Physical and Water Use Conditions</i>	34
4.6.2	<i>Site Water Balance</i>	35
4.6.2.1	<i>Leachate Collection</i>	37
4.6.2.2	<i>Leachate Collection Lagoon and Run-off Retention Pond</i>	37
4.6.3	<i>Leachate Monitoring</i>	37
4.6.4	<i>Leachate Treatment and Disposal</i>	38
4.6.4.1	<i>Rehydration of Compost</i>	38
4.6.4.2	<i>Off-site Treatment of Leachate</i>	39
4.6.4.3	<i>Discharge to Municipal Sanitary Sewer System</i>	39
4.6.4.4	<i>Direct Discharge to Receiving Waters</i>	39
4.6.4.5	<i>Land Application/Spray Irrigation of Combined Leachate and Contaminated Run-off</i>	40
4.6.4.6	<i>Infiltration</i>	40
4.7	PREVENTION AND CONTROL OF POTENTIAL ADVERSE EFFECTS.....	41
4.8	BUILDING STRUCTURES.....	42
4.9	SITE SERVICES.....	42
4.10	OTHER SITE DESIGN CONSIDERATIONS.....	43
4.11	SITE SECURITY AND ACCESS.....	43
4.12	SITE CONSTRUCTION PRACTICES.....	43
PART III – OPERATING GUIDELINES.....		44
5.0	INTRODUCTION.....	44
5.1	FEEDSTOCK QUALITY.....	44
5.1.1	<i>Changes in Feedstock</i>	46
5.2	ORGANICS COLLECTION.....	46
5.2.1	<i>Plastic Bags and Compostable Plastic Bags</i>	46
5.2.2	<i>Other Quality Considerations</i>	47
5.3	PROCESS CONTROL REQUIREMENTS.....	47
5.3.1	<i>Aerobic Conditions</i>	48
5.3.2	<i>Temperature Control and Pathogen Reduction</i>	48
5.4	PREVENTION AND CONTROL OF ADVERSE EFFECTS.....	48
5.4.1	<i>Odours</i>	48
5.4.2	<i>Noise</i>	49
5.4.3	<i>Litter</i>	49
5.4.4	<i>Dust</i>	49
5.4.5	<i>Vermin and Vectors</i>	50
5.4.6	<i>Fire</i>	50
5.4.7	<i>Traffic</i>	51
5.5	COMPLAINT RESPONSE PROCEDURES.....	51
5.6	CONTINGENCY PLANS.....	51
5.7	REPORTING AND RECORD KEEPING.....	52
PART IV – ODOUR PREVENTION AND CONTROL.....		53
6.0	REGULATION OF ODOUR.....	54
6.1	FACILITY SITING AND DESIGN FOR ODOUR CONTROL.....	55
6.2	ODOUR IMPACT ASSESSMENTS (OIA).....	57
6.3	ODOUR CONTROL SYSTEM.....	57
6.3.1	<i>Odour Containment and Collection</i>	58

6.3.2	<i>Odour Treatment</i>	58
6.3.3	<i>Dilution and Enhanced Dispersion</i>	60
6.4	FACILITY MANAGEMENT FOR ODOUR CONTROL	61
6.4.1	<i>Odour Sources</i>	61
6.4.2	<i>Assessing Feedstock Odour Potential</i>	63
6.4.3	<i>Odour Source Identification</i>	64
6.4.4	<i>Nutrients and Moisture</i>	64
6.4.5	<i>Site Management</i>	65
6.4.6	<i>Operational Controls</i>	65
6.4.7	<i>Monitoring Meteorological Conditions</i>	66
6.4.8	<i>On and Off-Site Odour Monitoring</i>	66
APPENDIX 1: GLOSSARY		67
APPENDIX 2: KEY ENVIRONMENTAL LAWS THAT MAY RELATE TO COMPOSTING		73
A2.0	ENVIRONMENTAL PROTECTION ACT.....	73
A2.1	ONTARIO WATER RESOURCES ACT (OWRA).....	74
A2.2	NUTRIENT MANAGEMENT ACT, 2002 (NMA).....	74
A2.3	CLEAN WATER ACT, 2006 (CWA).....	74
A2.4	ENVIRONMENTAL ASSESSMENT ACT (EAA).....	75
A2.5	ENVIRONMENTAL BILL OF RIGHTS, 1993 (EBR).....	75
APPENDIX 3: OTHER RELEVANT REGULATIONS AND STANDARDS		77
APPENDIX 4: SELECTED REFERENCES		79
APPENDIX 5: SAMPLE COMPLAINT FORM		83

SUMMARY

The Ontario Ministry of the Environment (the ministry) has prepared this revised Guideline for aerobic composting of waste materials: *Guideline for the Production of Compost in Ontario* (Guideline). In conjunction with the recently published *Ontario Compost Quality Standards* (Standards), the Guideline updates and replaces the *Interim Guidelines for the Production and Use of Aerobic Compost in Ontario* (Interim Guidelines) first released in November 1991, and last updated in 2004.

There have been many changes in Ontario's composting industry since the *Interim Guidelines* were released. The updated Guideline was needed to reflect current legislation, describe new industry standards and good management practices, and reflect advances in technology and science.

The Guideline has been prepared to assist proponents of composting facilities, ministry staff and others in the siting, design, and approval of composting facilities. It also provides guidance on the production of compost based on engineering principles, practical experience, and current legislation, to protect public health and the environment.

The ministry Director, under the authority provided in section 20.3 of the Environmental Protection Act (EPA), will refer to this document when considering an application for an environmental compliance approval (ECA). Inclusion of the language from this document (or variation thereof) as a condition of an ECA, will make the language legally binding on the operator of the composting site.

In general, this Guideline applies only to composting of non-hazardous organic materials for the purpose of producing a humus-like material intended for use as a soil conditioner. Some composting operations (such as backyard composters and on-farm composting of agricultural wastes) are beyond the scope of the Guideline.

In addition, this Guideline does not address:

- processes that are not aerobic (such as anaerobic digestion and fermentation),
- biological treatment of hazardous wastes, and
- processes to produce products that are not intended for use as a soil conditioner (such as the production of animal feed).

In the event that the information in this document differs from legislation, then the legislation prevails. To ascertain relevant legal obligations, the interested party should consult a lawyer.

The Guideline consists of four parts, as follows:

Part I provides introductory information and an overview of the legislative framework.

Part II provides guidance on planning for and developing a composting facility in the following areas:

- site selection and site design
- composting facility unit operations

- water management
- prevention and control of contaminants and adverse effects

The considerations in this Part must be addressed at the planning and development stage. Plans and reports containing descriptions of how these issues are being considered and managed are typically required as part of the ECA application process.

Part III outlines currently accepted best management practices for composting facilities. Operators of composting facilities will typically be required to operate in conformity with the guidance provided in this Part through conditions outlined in their ECA.

Part IV outlines issues related to odour prevention and control.

IMPORTANT NOTE: This document is a companion to the “Ontario Compost Quality Standards” (“Standards”), which is available on the ministry’s website. There are numerous references to the Standards in this Guideline.

The Standards set out three categories of compost quality (AA, A and B), and set out the standards for feedstock and compost that must be met if:

- the use and transport of the compost is to be exempt from Part V of the EPA and Regulation 347 (see section 3(2)25, 26 of Regulation 347),
- the compost (Categories AA and A) is to be exempt from the definitions of (and requirements for) "agricultural source material" (ASM) and "non-agricultural source material" (NASM) (under O. Reg. 267/03, made under the Nutrient Management Act, 2002 (NMA)), and
- the compost (Category B) is to be used as a NASM under O. Reg. 267/03.

These provisions are incorporated into Regulation 347 and O. Reg. 267/03 and, as such, are law.

PART I – INTRODUCTION AND OVERVIEW

1.0 INTRODUCTION

1.1 PURPOSE

Composting provides many benefits. Composting not only diverts organic materials from disposal in landfills, it also helps to return nutrients and organic matter to the soil, providing a valuable material for agriculture, horticulture and landscaping.

The purpose of this Guideline is to protect the environment by recommending planning, design and operational practices for composting facilities.

1.2 OBJECTIVES

The ministry's objectives in developing this Guideline are to:

- help Ontario increase diversion of waste from disposal by increasing the composting of organic waste
- assist in the development of composting as a significant waste management option in Ontario
- prevent negative impacts on the environment by ensuring that compost facilities in Ontario meet high standards
- provide a reference document for the design, approval, and operation of safe, efficient composting facilities

1.3 SCOPE

The Guideline applies to the composting of non-hazardous organic materials – including food waste, wood, pulp and paper mill biosolids, sewage biosolids and de-watered domestic septage. **Composting should be undertaken by those with significant practical experience in the handling of compostable wastes, the composting process, and the marketing of the end product.**

The Guideline does not necessarily apply to the following activities:

- composting under Ontario Regulation 101/94 (EPA)
- composting of “regulated dead animals” and “dead farm animals” under the Food Safety and Quality Act, 2001 and the Nutrient Management Act, 2002 (NMA)
- composting of “specified risk material” (SRM), which is subject to Canadian Food Inspection Agency permitting requirements
- residential backyard composting
- production of a product that is not intended for application to land or for use as a soil

- conditioner (e.g., production of a waste-derived animal feed)
- biological treatment of hazardous wastes
- management of excess soils from construction activities
- other waste stabilization methods (such as lime stabilization, fermentation, pasteurization)
- remediation of contaminated soils (information on requirements for remediated sites is contained in Ontario Regulation 153/04 - Record of Site Condition, made under the EPA)

Compost produced at facilities to which this Guideline applies must meet the requirements presented in Part II of the Standards (which include pathogen reduction criteria) to qualify for transport and use approval exemptions.

Anaerobic digestion (AD) facilities and vermicomposting are excluded from this Guideline. Applications for approval for vermicomposting will be considered on a case-by-case basis.

Although this Guideline does not apply to the operation of AD facilities or the use of digestate, guidance and ‘best management practices’ in this Guideline should be adopted (where applicable) if similar waste types are accepted and handled at the AD facility and the digestate is to be composted.

This Guideline is not intended to restrict process or equipment development. However, for approval to be considered, proponents of innovative composting techniques or new or updated technology differing significantly from currently accepted practices and processes, must ensure that the technology can produce compost that meets Ontario’s quality Standards and that the site can operate in compliance with the ministry’s emission restrictions. Such proponents are encouraged to contact the appropriate ministry regional, district or area, early in the planning stages.

2.0 LEGISLATION, APPROVALS AND STANDARDS

The Ministry of the Environment is responsible for protecting clean and safe air, land and water to ensure healthy communities, ecological protection and sustainable development for present and future generations of Ontarians. Numerous acts and regulations exist to help the ministry fulfill this mandate. This section provides a brief overview of the key environmental laws that may relate to composting (additional information is provided in Appendix 2):

- The Environmental Protection Act, R.S.O. 1990, c. E.19 (EPA), and Regulation 347 (General – Waste Management) – regulate waste management activities, including the receiving and processing of organic waste materials by compost facilities, as well as the transportation, application and use of compost in non-agricultural applications.
- The Ontario Water Resources Act, R.S.O. 1990, c. O.40 (OWRA) – regulates discharges to surface and groundwater, including stormwater and leachate from composting facilities, to ensure that water resources are protected. The OWRA also regulates water takings from surface water and groundwater in excess of 50,000 litres on any day.
- The Nutrient Management Act, 2002, S.O. 2002, c. 4 (NMA), and Ontario Regulation 267/03 – regulate the application and storage of nutrients, including compost, on agricultural lands.

- The Clean Water Act, 2006, S.O. 2006, c. 22 (CWA) – ensures that communities can identify potential risks to their drinking water supplies, and take actions to reduce these risks.
- The Environmental Assessment Act, R.S.O. 1990, c. E.18, (EAA) – provides for the protection and conservation of the natural environment.
- The Environmental Bill of Rights 1993, S.O. c. 28 (EBR) – protects, conserves and, where reasonable, restores the integrity of the environment, provides sustainability of the environment and protects the right to a healthful environment.

This document is intended only as a general guide to applicable environmental laws administered by the ministry. Composting facilities may be subject to other federal, provincial, or municipal laws and policies (e.g. Ontario’s Greenbelt Plan) and may require additional permits or approvals from other agencies.

2.1 APPLICATION FOR ENVIRONMENTAL COMPLIANCE APPROVAL

Unless specifically exempted by regulation, every compost facility will require an ECA, pursuant to section 9 of the EPA, since they may discharge contaminants, including odours, into the natural environment (i.e., atmosphere). For the Director to evaluate a proposed composting operation, the proponent must provide the Director with information that adequately describes the proposed facility in its ECA application.

Part III of this Guideline includes information that is usually required for the Director to make approval decisions about a proposed facility. This list may be modified by the Director, depending on the nature or location of the proposed facility. The proponent must provide the Director with requested information, as part of the ECA application.

Part II of this Guideline includes considerations for conditions in an ECA for a Waste Disposal Site (Processing). When these requirements are in an ECA issued by the Director, they become legally binding on the site operator.

Applications for ECAs can be obtained from the nearest ministry regional or district office or from the ministry’s website. Other documents are available on the ministry’s website that may be of assistance when completing an application, for example:

- *Introductory Guide to Applying for an Environmental Compliance Approval (ECA)*, December 2011, PIBS 8579e (as amended).

Applicants are encouraged to visit the ministry’s website for additional or updated guidance material, as changes may have occurred after this Guideline was produced.

2.2 OTHER JURISDICTIONS

The ministry is not the only agency with the ability to direct or influence the production and use

of compost. Several regulatory and voluntary standards for compost production and use have been developed in recent years. In particular, site operators should be aware of the following compost quality initiatives that are briefly described in Appendix 3:

- The Canadian Food Inspection Agency (CFIA) regulates the **sale** and **import** of compost under the federal Fertilizers Act
- The Canadian Council of Ministers of the Environment (CCME) has developed a national guideline for compost quality
- The Bureau de Normalization du Quebec (BNQ), on behalf of the Standards Council of Canada, has published a national voluntary industry standard for compost

PART II – COMPOST FACILITY APPROVAL CONSIDERATIONS

Part II suggests approaches and methods to ensure proper siting and design of composting facilities. This guidance reflects the following objectives for composting facility management:

- prevention and control of off-site environmental impacts, especially odour, water contamination, dust, noise and vermin and vectors
- protection of public health
- prevention of emergency situations
- anticipation of seasonal effects that may impact the composting process
- production of compost that meets the Standards

The considerations suggested in this Part would be included in documents submitted as part of an ECA application, e.g., as part of a design and operations plan, contingency plan or Odour Impact Assessment. This information would be considered in the review of the application. This assures the ministry that necessary planning has taken place, and that suitable zoning and siting has been arranged. Plans and reports submitted as part of the application process would constitute part of the ECA, upon approval.

ECA applicants should consult with their district ministry office early in the application process to confirm what supporting information will be required. All information required by the Director must be submitted by the applicant (pursuant to section 20.8 of the EPA).

Additional information regarding ECA application requirements can also be found on the Environmental Approvals page of the ministry's website.

3.0 SITE SELECTION CONSIDERATIONS

This section provides guidance on the selection of a site for a composting facility. **Proper site selection can affect the success of any composting project by avoiding the potential for adverse effect.** Many potential problems can be avoided by careful planning at this stage. Several technical, social, environmental and economic factors will help to shape decisions on site selection. Among the more important considerations are:

- provision of adequate separation between the facility, adjacent land uses, especially sensitive land uses, and sensitive environmental features
- compliance and conformity with the municipal official plan and local zoning by-laws
- selection of a site with sufficient space
- watershed planning and protection of surface and groundwater
- ensuring convenient access to transportation routes

General considerations for selecting an appropriate site are discussed in this section. Specific site design criteria are presented in section 4.0.

It is important that the site selected is large enough to allow for the design of the facility and all operational requirements discussed in this Guideline. Proponents should be familiar with regulatory requirements, including land use planning and environmental approval considerations, prior to selecting and purchasing a site.

Proponents are strongly advised to consult with their local municipality early in the planning process to identify the required land use planning processes and approvals that need to be obtained to ensure the facility is appropriately sited within a given community. Municipal official plans and zoning by-laws, as well as *MOE Guideline D-1 “Land Use and Compatibility”*, *MOE Procedure D-1-1 “Land Use Compatibility: Procedure for Implementation”*, *MOE Procedure D-1-2 “Land Use Compatibility: Specific Applications”* and *MOE Procedure D-1-3 “Land Use Compatibility: Definitions”*, contain useful information to assist in suitable site selection.

There are also provincial laws and policies that govern land use planning that proponents may be obligated to comply with. Information about provincial land use planning policies is available from the Ministry of Municipal Affairs and Housing.

There are public notice and consultation requirements associated with land use planning approval processes and the ECA process. Proponents should meet with the municipality and resolve municipal issues prior to submitting an application for an ECA. This includes confirming with the municipality that the zoning in place is consistent with the proposed use of the land. Proponents should ensure that any required public notice and consultation includes the entire area surrounding the composting site that has the potential to be adversely affected by odours from the site.

3.1 ECOSYSTEM APPROACH

Through its Statement of Environmental Values, the ministry encourages proponents to adopt an ecosystem approach when planning projects such as composting facilities. It is recommended that projects should be based on an approach that focuses on the prevention of impacts, protection of the existing environment, and opportunities for rehabilitation and enhancement of impacted environments.

3.2 OFFICIAL PLANS, LOCAL ZONING AND BY-LAWS

Official plans are prepared by municipal councils to control the physical development of the municipality, including land use, infrastructure, future development, and erection of buildings and structures. If a proposed land use conflicts with the official plan, an amendment to the plan may be needed.

Zoning by-laws outline the details of specific uses allowed in specific locations. A zoning by-law amendment or rezoning may be required if a proposed land use does not conform to the zoning by-law.

Proponents are responsible for consulting the municipality and ensuring that their proposed composting facility meets all zoning by-laws. It should be noted that most of Northern Ontario remains unorganized, and as a result, the Ministry of Municipal Affairs and Housing (MMAH) is the land use planning authority and has the responsibility for determining zoning. Consult the local MMAH Municipal Service Office for zoning issues.

3.3 MINIMUM SEPARATION DISTANCES AND BUFFER ZONES

Composting facilities should be physically separated as far from other land uses as possible to help mitigate potential adverse effects such as odours, dust, litter, noise and potential impacts on surface water and groundwater. This is usually accomplished by setting the composting operation back from the property line and by using visual screens, such as berms, fences, or landscaping.

Adjacent land uses of particular concern regarding odours and bioaerosols include:

- residential developments
- schools
- places of worship
- cemeteries
- hospitals
- long term care facilities
- nursing homes or other public institutions
- environmentally sensitive areas
- major retail or office establishments
- day care operations

In addition to separating or visually screening a facility from its neighbours, compost operators may need much larger separation distances to allow odours generated at the site to dissipate before they reach a neighbour's property. Historically, odour emissions have been the most common challenge facing composting facilities. Additional guidance on separation distances for odour control is provided in Part IV, section 6.1 of this Guideline.

Separation distance is also important for reducing health and safety risks associated with bioaerosols. Bioaerosols are particles that can become airborne during some composting operations (such as turning a pile). Bioaerosols associated with composting can include fungi, bacteria, actinomycetes, endotoxins, microbial enzymes, glucans and mycotoxins. These compounds are present in feedstocks and may also be produced at sites with an abundance of decaying organic matter.

Studies have investigated background concentrations of bioaerosols in indoor and outdoor environments, including composting facilities, and generally conclude that bioaerosols (particularly the fungus *Aspergillus fumigatus*) are commonly present in the environment. Background concentrations of bioaerosols are highly variable, with highest concentrations typically in the spring and summer. Concentrations off-site vary depending on wind conditions and other factors. Literature indicates that bioaerosol concentrations found off-site are typically below levels believed to cause health effects.

The health risk of public exposure to bioaerosols can be reduced through careful siting of facilities, including providing the maximum possible distance to sensitive receptors, as well as implementing design and operational control measures.

Operational controls to reduce bioaerosols include:

1. Maintain a proper composting environment. Regular and thorough mixing of compost piles will aid proper composting and minimize the presence of *Aspergillus fumigatus*.

2. Reduce dust concentrations by maintaining optimal moisture concentrations in composting materials (>45%).
3. Maintain a clean site and practice good housekeeping to reduce dust generation.
4. Wet down dry and dusty surfaces.
5. Ensure all facility operators and compost workers are trained in methods of dust and bioaerosol control.

3.3.1 Siting Considerations

All components of the composting operation (including curing pads) should be located as far as possible from “sensitive receptors” or from areas where sensitive receptors would reasonably be expected to locate in the future.

It may not be possible to select a separation distance that would eliminate the risk of off-site odour impacts that would be practical and economical within a reasonable proximity to urban areas. Other odour control measures are therefore essential (further discussed in Part IV, section 6 of this Guideline).

Furthermore, it is not possible to recommend separation distances that would be suitable for all sites, as each site has unique circumstances such as topography, vegetation, elevation, prevailing wind speed and direction.

In most cases, the distance likely to be required for facility approval would be a minimum of 250 metres up to 1000 metres, depending on site-specific factors.

Facility proponents are strongly encouraged to consult with their local ministry office early in the facility planning stages, prior to site selection, to identify site-specific separation distance considerations. Proponents will be required to demonstrate that they will not cause adverse effect, as part of the application for approval or amendment to existing approval.

Generally, it should be expected that the minimum required separation distances will increase as follows, for different types and sizes of operation:

Table 3.0 Separation Distance Requirements Relative to Facility Size and Type

Type of Facility	Distance to Nearest Sensitive Receptor
Outdoor leaf and yard waste only facilities	Shortest Distance
Enclosed facilities (defined in Appendix 1) < 40,000 tonnes/year	
Outdoor facilities with less than 1000 tonnes/year of non-leaf and yard waste feedstock (maximum 25% non-leaf and yard waste feedstock); Semi-enclosed facilities (defined in Appendix 1) < 40,000 tonnes/year; Enclosed facilities 40,000 – 80,000 tonnes/year	
Outdoor facilities with greater than 1000 tonnes/year of non-leaf and yard waste feedstock (maximum 25% non-leaf and yard waste feedstock); Semi-enclosed facilities 40,000 – 80,000 tonnes/year; Enclosed facilities > 80,000 tonnes/year	Longest Distance
Semi-enclosed facilities > 80,000 tonnes/year	

In addition to the facility size and type, the factors in Table 3.1 will be considered in determining suitable separation distances as part of the approval process. These factors are normally accounted for in the facility's Odour Impact Assessment, as well as the results of the Emission Summary and Dispersion Modelling.

Table 3.1 Additional Factors that Affect Required Separation Distance

Factors that Reduce the Need for Separation Distance	Factors that Increase the Need for Separation Distance
Sensitive receptors located upwind from facility, relative to prevailing winds	Sensitive receptors located downwind from facility, relative to prevailing winds
Favourable topography and vegetative buffer	Unfavourable topography and vegetation
Receipt of lower-odour feedstock (e.g., higher carbon materials like leaf and yard waste)	Receipt of feedstock with greater odour-generating potential (e.g., higher nitrogen materials like diapers, green grass) or material that has undergone longer storage and shipping times
High degree of odour containment and control (from receipt to finished product)	Low degree of odour containment and control (from receipt to finished product)
Effective odour treatment	Lack of effective odour treatment
Facility design and odour control system well-demonstrated as successful	Facility design and odour control system innovative and unproven
Flexibility and redundancy in facility design and operations to account for operational upsets and changing feedstocks or conditions	Limited design and/or operations flexibility
Low population density, and no particularly sensitive receptors such as hospitals nearby	High population density or close proximity to particularly sensitive receptors such as hospitals

The compost site operator usually does not have control over future development on neighbouring properties. Therefore, facilities should be sited with a maximum possible buffer zone to the property line – a minimum of 30 metres. This will ensure that, regardless of any future development on adjacent lands, minimum separation distances can be maintained.

Facility proponents and operators should always familiarize themselves with municipal planning requirements and discuss proposals with municipal planning staff to ensure that current and future adjacent land uses are compatible with a composting operation. This will minimize future off-site impacts (e.g., odour complaints) related to encroachment. This could be accomplished by council limiting incompatible adjacent development through the official plan or other planning tools, as described above.

Proponents of facilities to be located near an airport should contact Transport Canada for guidance. Additional information is available in TP-1247-Aviation "*Land Use in the Vicinity of Airports, 8th Ed.*", Transport Canada, May 2005.

3.3.2 Separation Distances for Water Protection

In addition, any outdoor operations (including curing piles) should be located at least a minimum distance from surface and groundwater to avoid potential contamination, including:

- 100 metres from any municipal well or surface water body
- 15 metres from any drilled well that has a depth of at least 15 metres and a watertight casing to a depth of at least six metres below ground level
- 90 metres from any other well

Outdoor composting facilities should not be located in areas where the high water table is less than one metre from the surface, or where the minimal depth to bedrock is less than 1.5 metres. Where outdoor facilities are constructed on a contained pad, the bottom of the pad should be at least 30 cm above the high water table.

See the ministry's "*Guide to Applying for Approval of Waste Disposal Sites*" for more information about separation distances and buffer zones.

3.4 WATERSHED PLANNING

Local municipalities and conservation authorities should be consulted to determine whether the proposed work conforms to the Official Plan, Watershed, Subwatershed, or Master Drainage Plans and other related requirements for the area.

Conservation Authorities comment on proposals submitted to municipalities for review under the Planning Act. They indirectly impose requirements such as facilities for erosion and stormwater control, and for sediment control during construction. As a result, a Stormwater Management Plan and sediment control measures may be required as part of a composting site plan submission for approval.

Local conservation authorities may also restrict new development within regulatory floodplains. While these restrictions might not specifically include composting facilities, they may effectively do so by restricting the construction of composting pads, drainage facilities, buildings and parking lots.

Assessment reports and source protection plans developed under the Clean Water Act, 2006 will need to be considered when selecting a proposed composting site. The assessment report will identify areas where activities associated with compost facilities may pose a significant risk to sources of drinking water, and the source protection plan will set policies to ensure existing and future activities identified as a significant risk are managed. These policies are mandatory where an activity is, or would be, a significant risk to drinking water.

Proposed composting facility sites may include existing drainage infrastructure, which may require modifications. The following are possible drainage infrastructure scenarios:

- Private drains are drainage systems that have been constructed by the current or former property owner (e.g., an agricultural tile drainage system, ditches, swales or grassed

- waterways). Generally, no ECA is required to move private drains.
- Municipal drains are communal drainage systems constructed by municipalities under the Drainage Act. To find out if a municipal drain exists on the site, contact the municipality where the site is located. To relocate a municipal drain, a request must be filed with the municipal council. More information on municipal drains is available from the Ministry of Agriculture, Food and Rural Affairs website: www.omafra.gov.on.ca/english/landuse/drainage.htm
 - Mutual agreement drains are shared drainage systems built through a contract or agreement with other property owners. Typically, this type of agreement is registered on the property title. To find out if a mutual agreement drain exists on a site, proponents should consult with the local registry office, or neighbours of the site. Support from the other participants in the agreement would be required to relocate a mutual agreement drain.

3.5 WATER (SEWAGE) MANAGEMENT

Water that has come into contact with waste or compost, that has percolated through the compost pile, or that has seeped from the compost or waste materials may possess characteristics and contain compounds that can degrade the quality of surface and groundwater if discharged without treatment. The term "leachate" is used throughout this document to refer to any water that has come into contact with waste or compost. Stormwater which comes into contact with waste, compost, or leachate is considered to be leachate, and may require treatment prior to discharge from the site. Composting facilities can generate significant amounts of leachate.

If leachate (sewage) is directly discharged to a receiving water body, directly to the ground, or into the subsurface, approval under section 53 of the OWRA is required.

Facility proponents should also be familiar and comply with municipal sewer use by-laws and other applicable conservation authority, provincial and federal requirements.

As part of the composting facility approval process, proponents may be required to conduct a study of the physical, geological, hydrologic and hydrogeological conditions at their proposed composting site, especially for larger, outdoor sites. Such a study would identify site and local conditions and the qualities and quantities of run-off and leachate to be managed, and should identify appropriate options for managing it. If the study identifies infiltration as a preferred treatment option, a detailed hydrogeological study may also be required.

Proponents who are not required to conduct a detailed study would typically be required to meet minimum requirements for leachate and stormwater management (see section 4.5 for examples).

Composting facilities must be designed, constructed, and operated in a manner that prevents contamination of local surface and groundwater, or other adverse effects. The potential impacts of discharging sewage from a composting site to surface and groundwater must be evaluated on a site-specific basis. The potential impact of a windrow facility is quite different from the potential impact of an enclosed or in-vessel facility.

An in-vessel process will tend to generate smaller quantities of leachate, and many in-vessel systems provide for the recirculation of this leachate within the vessel, limiting or eliminating the need for leachate treatment and disposal. Outdoor sites, however, tend to generate significant quantities of both leachate and stormwater runoff, that must usually be collected, treated and

released. Since the treatment and disposal requirements for stormwater will generally be less onerous than the requirements for the treatment of leachate, proper site design should ensure that the two are kept separate to the greatest extent possible.

For further information on the assessment of waste disposal sites and groundwater protection and management please refer to the following documents, available on the ministry's website:

- Guideline B-7 "*Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities*"
- Procedure B-7-1 "*Determination of Contaminant Limits and Attenuation Zones*"

Information on the assessment of waste disposal sites and surface water protection can be found in *Water Management – Policies Guidelines Provincial Water Quality Objectives of the Ministry of the Environment and Energy, July, 1994*, available on the ministry's website.

3.6 OFF-SITE TRAFFIC

Proponents should investigate seasonal load restrictions on local roads through their local municipality. Proponents should also investigate the haul routes that will be used to transport the feedstock and amendment materials to the composting facility, and the compost and residual waste from the facility, and consider the most appropriate transport routes to be used. Entrance and exit roads should be designed to adequately accommodate expected traffic flow (e.g., a left-turn lane may be required at the entrance).

Consideration should be given to minimizing dust, noise, and odour from truck traffic, especially in residential areas.

4.0 SITE DESIGN AND OPERATING CONSIDERATIONS

This section introduces important considerations for the physical design of composting facilities - considerations that will normally be incorporated into applications for a composting facility's ECA (i.e., for waste disposal site, air, and sewage). In addition to the ministry's standard application forms, a number of supporting documents are typically required. For example:

- Design and Operations Report, including:
 - Site description: location, zoning designations and adjacent land uses, physical site setting and geology, drainage and hydrogeology, local wind patterns
 - Facility design and layout: sources, types and estimated quantities of feedstock and amendment material, facility design, capacity, equipment, site access, security
 - Facility operations: operating parameters, processing description, process monitoring
 - Quality assurance: feedstock quality, cross-contamination prevention, final product sampling and analysis
 - Maintenance program
 - Nuisance control programs for odour, litter, vectors and vermin, dust, noise and traffic
 - Contingency plans: feedstock shortages, market disruptions, labour disruptions, equipment malfunction, power failures
 - Emergency response plans: fire, spills, flooding
 - Documentation: record keeping and reporting

- Site closure plan
- Odour Impact Assessment
- Emission Summary and Dispersion Modelling (ESDM) Report
- Hydrogeological Assessment Report
- Acoustic Assessment Report
- Drainage Study
- Odour Management and Control Plan

These will apply to the composting facility if they are incorporated into an ECA by the Director.

For more information about ECA application requirements, please refer to the ministry's Environmental Approvals webpage.

The information presented in this section is a sample of best management practices. Not all considerations are applicable to all facilities. This section should not be considered a comprehensive treatment of the subject.

Typically a composting site provides for a number of different functions including:

- employing the unit operations of composting to convert feedstock into compost
- ancillary systems for stormwater and leachate management and prevention of off-site noise, odour and dust impacts
- facilities for site administration and staff
- separation distance from adjacent land uses
- controlled access and site security

The specific design requirements for each function are typically determined by the:

- overall objectives for the composting site, expressed in terms of quantities and types of feedstock and amendment materials
- types of product to be marketed
- desired degree of technological sophistication

Site design is often constrained by available area or the requirements of local zoning by-laws, which may specify minimum property line setbacks, limit the portion of the site that can be covered, or impose other requirements depending on the zoning designation.

Investment in good design provides long term value by minimizing operational challenges, and maximizing the sustainability of the operation.

4.1 SITE DESIGN AND OPERATING PROCEDURES BY PROCESS UNIT OPERATION

The composting process, from receipt of raw feedstock material through to the production of mature compost, typically takes between 4 and 12 months to complete. This should be considered in all aspects of site design to ensure there is adequate capacity for the quantity of material that will be processed.

The production of compost can be viewed as a series of discrete, but interrelated processing steps,

or "unit operations". Each unit operation has specific inputs and outputs that subject the composting mass to physical, chemical, or biological processes. Each unit operation may include several activities.

Four unit operations - receiving, pre-processing, processing and curing (including finishing) - are common to all composting facilities, although there will be variations between facilities. The greatest differences are between processes which occur within an enclosed composting structure and outdoor processes such as windrows and static piles. In some cases, the composting operation is semi-enclosed. (See Appendix 1 for definitions of "enclosed composting" and "semi-enclosed composting".)

Each of these unit operations can be a continuous process or a batch process. For example, material may be received and processed at the site continuously throughout the year, but some finishing activities, such as screening cured compost, may only be performed on a batch basis.

Unit operations should not be confused with references to the stages of composting. Many documents will refer to the high-rate and curing stages of composting. These stages refer to the state of biological activity within the compost substrate and not to unit operations.

Viewing the composting process in terms of discrete unit operations has several benefits. For example, it:

- assists in the identification of specific potential problem areas so that solutions that focus on the source of the problem can then be developed more logically
- allows the operator to identify and control the rate of each of the operations on the site and ensure that the entire system is balanced, thus avoiding "bottlenecks" in the process
- helps to identify opportunities for efficient materials handling, which can help to minimize the overall cost of the total operation

The following sub-sections introduce design considerations and procedures for the specific area of the composting site devoted to each unit operation.

4.1.1 Receiving

The objectives of the receiving operation are to:

- receive feedstock material in a timely and orderly manner
- provide for temporary storage of feedstock and amendment materials
- document the arrival of materials at the site
- inspect for and manage contamination
- manage potential odours
- segregate materials
 - by material characteristics (e.g., C:N ratio)
 - by process requirements.

Specific activities in the receiving operation include:

- waste acceptance
- weighing

- documentation
- tipping

Note: Operators of compost facilities are responsible for clearly identifying and tracking wastes that will result in the production of different categories of compost (i.e., Category AA, A and B), as described in the Standards.

Site design considerations for the receiving operation include:

- providing an on-site area for truck queuing to keep trucks off public roadways
- providing adequate space for unloading, including overhead clearance, based on the types of delivery vehicles expected
- enclosed receiving areas to minimize potential for fugitive odour emissions by providing fast acting doors, or air-lock systems
- providing a minimum of three days feedstock retention to buffer effects of unscheduled process shutdowns (as a contingency measure)
- ensuring proper receiving area drainage and adequate and appropriate containment infrastructure (e.g., tank or pit) for leachate from high moisture content loads
- providing space and systems for truck rinsing and collection of wash water
- providing longer-term storage for amendment materials if required, to buffer the effects of seasonal variation in supply

4.1.1.1 Receiving Procedures

Quality control at the receiving stage is a very important step to ensure the production of compost that meets regulatory and market requirements. Proper quality control depends on clear, documented and enforceable procedures for waste acceptance or rejection. Waste acceptance procedures should begin prior to receipt of wastes. The operator should evaluate all new incoming wastes before receiving them, characterizing:

- C:N ratio
- moisture content
- physical structure of the waste
- heavy metal content
- potential for toxic contaminants (particularly from industrial sources)
- non-biodegradable particulate matter (e.g. plastic, metal and glass)
- odour generation potential

It is also prudent to visit the site of waste generation and inspect the waste. Feedstock sampling is discussed in the Standards.

When waste arrives at the site, waste acceptance procedures should confirm that only wastes that have been characterized by the operator are received. Waste acceptance procedures should include a physical inspection of incoming material, for evidence of contamination and offensive odours. Wastes that do not reflect the characterization, due to contamination or other reasons, should be rejected upon arrival and re-directed to an appropriate disposal facility.

Records should be kept of each load of material (waste and bulking agents) received at the site. The records should include:

- a description of the material
- the date the material was received
- the source of the material
- the weight or volume of the load

Records should also be kept of any rejected loads including the source of the material and the reason for rejecting the load.

It is important to direct incoming wastes for prompt pre-processing and incorporation into the composting process.

4.1.2 Pre-Processing

The objectives of the pre-processing operation are:

- to create a good “recipe”
- to promote microbial growth by adjusting:
 - moisture content
 - nutrient balance
 - particle size and structure
- to prevent on-site and off-site nuisances (e.g., odour, noise, dust, litter, birds and vermin)

Specific activities in the pre-processing operation can include:

- debugging/contaminant removal
- size reduction by grinding or shredding
- mixing and blending (with a bulking agent if needed) to create a good recipe, to achieve:
 - nutrient balance (e.g., C:N ratio)
 - moisture balance
 - suitable particle size and structure

Pre-processing operations will influence the rate of degradation, the nature of process by-products such as leachate and odour, and the quality of the compost.

Feedstock should be incorporated into the composting process as soon as possible. Wet or odorous material should only be accepted at the site if it can be incorporated into the process promptly and processed by the system without the release of offensive odours. If the waste cannot be processed immediately, adding bulking or drying agents or covering the wet or odorous material with compost may help to reduce odours.

Highly putrescible wastes, including food wastes, biosolids and manures, should be blended with bulking materials as soon as possible and incorporated into the composting process within 24 hours of receipt.

Less putrescible wastes, such as leaf and yard wastes, should be on site for a maximum of four days before entering the active composting process. However, some yard wastes, such as brush, brown leaves and wood that are to be used as a bulking agent and amendment material, may be stored longer.

In both cases, storage duration depends on the type of material, the storage area design, and the location of the facility. Variations in storage time limits may be considered on a site-specific basis, if the facility can demonstrate to the satisfaction of the Director that:

- adequate odour prevention measures have been implemented, and
- the proposed activity is not expected to result in odour complaints from the public.

To reduce the potential for odours, care should be taken when developing the compost “recipe” to not overburden the mixture with highly putrescible wastes.

Site design considerations for the pre-processing operation include:

- allocating space for efficient arrangement of required pre-processing operations
- allocating space for effective handling and temporary storage of contaminant materials
- providing temporary storage between pre-processing and processing area operations to buffer batch vs. continuous or batch vs. batch operations
- noise attenuation and prevention of off-site odours and dust

4.1.2.1 Pre-processing Procedures

4.1.2.1.1 Pre-processing and Contaminant Removal

If the feedstock arrives in bags of any kind, it will need to be processed to remove the compostable material from the bags, to ensure that the material can be properly blended.

Experience at compost facilities that accept organic materials in non-compostable plastic bags has demonstrated that non-compostable plastic bags are difficult to remove. Depending on the processing equipment, it can be challenging to fully remove the organic material from the bags. If the bags are screened out prior to processing, then desirable organic materials can remain trapped in the bags and sent to landfill as residual waste. Also, non-compostable plastic bags can remain in the compost as a contaminant, even if there is a pre-processing screening step.

The use of plastic bags for organics collection, and the acceptance of material collected in plastic bags at composting facilities, should only be considered where appropriate provisions have been incorporated into the facility design (see Part III, section 5.2 of this Guideline for additional guidance on plastic bag use).

The pre-processing stage is an appropriate time to remove other contaminants (e.g., larger non-compostable items and metals). Contaminants are any items that might cause mechanical problems, pose a threat to the safety of workers or the public, or affect the aesthetics or quality of the compost. Contaminant removal can be achieved by direct removal from an incoming load of waste, or a dedicated picking line over which incoming wastes are directed for manual removal and/or mechanical (e.g., magnetic) separation. Any contaminant removed from the incoming feedstock must be properly stored on the site and removed from the facility to an appropriate waste disposal facility in a timely manner.

4.1.2.1.2 Size Reduction

Some feedstocks, such as leaf and yard waste, brush, and wood may require size reduction prior to composting.

Size reduction of incoming feedstock may be required to meet market requirements (e.g., for use as a mulch), or to meet process requirements (e.g., for use as bulking agent). Size reduction will improve the mixing of materials, and will provide greater surface area for microbial action. However, this may lead to faster composting and higher oxygen demands. It may also impede air flow in the compost due to a lack of porosity, which may lead to the need for more frequent turning of the compost.

4.1.2.1.3 Recipe Development

Prior to composting, wastes need to be mixed and blended in an appropriate recipe to facilitate composting.

Few feedstocks have, on their own, the properties necessary to create ideal conditions for composting. To approximate ideal conditions, it is usually necessary to blend feedstocks or add a bulking agent, a nutrient amendment, or water.

The moisture content can be changed by adding water directly to the composting material, by blending dry or absorbent materials with wet materials, or by turning compost to increase evaporation. The nutrient balance of the substrate can be adjusted by blending feedstocks with different carbon to nitrogen ratios. For example, leaves with a high C:N ratio are often mixed with grass, which has a low C:N ratio. The physical structure of the compost can be altered by shredding or by adding a bulking agent (such as wood chips). In some cases, all three objectives can be met by careful selection of bulking agents. For example, adding dry wood chips to a wet incoming material affects the moisture content, the C:N ratio, and the physical structure of the mixture.

Blending of yard wastes is often based on experience or common practice. However, the blending of other feedstocks should be calculated based on laboratory analysis of the nutrients in the feedstock or on published information.

The aerobic microbes involved in composting require carbon (C) and nitrogen (N) for cell growth and reproduction. Oxidation of organic carbon provides energy, while both carbon and nitrogen are required to construct the molecules comprising the body of the microbe.

On average, the variety of microbes involved in composting require approximately 30 parts carbon to one part nitrogen. Therefore, the theoretical optimum carbon to nitrogen ratio for composting is approximately C:N 30:1. However, 25:1 – 30:1 is acceptable if an ideal C:N of 30:1 cannot be achieved. It is important to note that not all organic carbon in a feedstock is equally available to the microbes. Although high in total carbon, wastes with high lignin content (such as paper fibres or wood chips) have a relatively low percentage of available carbon. This should be considered when determining feedstock blending requirements.

When the C:N is less than 25:1, microbes can readily convert excess nitrogen to ammonia that, if the pH is basic, will be volatilized and create odours. When the C:N is greater than 30:1, the

lower level nitrogen will reduce the rate of degradation and result in the generation of fewer odours.

In the case of leaf and yard wastes, mixing may be undertaken to ensure that the incoming feedstocks are evenly blended prior to composting. In simpler facilities, mixing may be accomplished during the composting process.

In the case of nutrient and/or moisture-rich feedstocks (e.g., food wastes, biosolids and manures), blending with complementary materials is necessary to develop a recipe that helps balance the nutrients and moisture, and ensure an appropriate physical structure of the feedstock mix (i.e., porosity). The physical structure can be assessed by measuring the “bulk density”. Composting of these wastes typically includes blending them with carbonaceous amendment materials such as wood chips, leaves and sawdust. A desired bulk density range for the resulting mix is 0.5 – 0.65 g/cm³.

4.1.3 Processing

The objectives of the processing operation are to:

- maintain aerobic conditions
- maintain a high rate of decomposition
- meet time and temperature requirements
- inactivate pathogenic organisms
- prevent on-site and off-site nuisances (e.g., odour, noise, dust, litter, birds and vermin)

These objectives are achieved by regulating microbial activity through aeration, mixing, the addition of water and amendments, and by monitoring process variables such as temperature and oxygen content.

Specific activities in the processing operation can include:

- pile formation or vessel loading
- turning
- aeration
- monitoring

The primary difference between outdoor, semi-enclosed, and enclosed composting systems is the degree of control that the operator has over the process. Enclosed systems typically involve the use of forced aeration, may involve mechanical turning or mixing, and generally provide greater direct control over the composting process.

Facilities may have one or more stages of processing, depending on their design. For example, a facility might have:

- one very actively managed phase (where much of the thermophilic - or heat generating - decomposition takes place and oxygen and moisture control demands are highest); and
- one less actively managed phase (where decomposition slows, and the compost undergoes further processing before the curing phase).

Regardless of the facility design, total processing retention time is an important consideration. Retention time in the processing operation typically exceeds the time required to satisfy the time and temperature requirements for pathogen reduction (i.e., a minimum of 55°C for a certain number of days depending on the composting process). The total retention time should be sufficient to ensure the material is adequately processed prior to curing, to reduce the risk of off-site adverse effects, such as odour, and to ensure that mature compost is produced within the proposed time frame for curing. Typical retention time in the processing operation is a minimum of three weeks, up to eight weeks, to achieve the desired outcomes.

At the completion of the processing operation the compost should have reduced biological activity. The length of time required to achieve this depends on the processing technology used, the nature of the feedstock materials, the degree of process control, and the solids reduction objectives of the processing operation.

In all cases, blended feedstock should be fully processed before being moved from the processing operation to the curing operation (if outdoors), to minimize the risk of off-site odour impacts.

Compost that is ready for curing has a slower rate of decomposition, and lower biological activity and oxygen demand. This phase of the process is characterized by:

- reduced temperatures
- lower moisture content
- lower odour generation than previous phases of the operation

As part of the ECA application process, the facility's proponents will typically be required to demonstrate that their indoor process is adequately designed to produce compost with these characteristics. This may include a requirement for laboratory testing.

Details of the processing operation are generally specific to the technology employed, and a complete description of processing techniques is beyond the scope of this Guideline. However, several published guides that may be of use to operators are included in Appendix 4: Selected References.

Process control information for enclosed systems is also available from equipment suppliers.

Design considerations for the processing operation include:

- providing sufficient retention time to satisfy pathogen reduction and volatile solids reduction requirements
- providing adequate space for equipment operation
- ensuring adequate ventilation (forced or passive), to maintain aerobic conditions throughout the composting materials, and to remove heat as required
- rehydrating the composting material to maintain adequate moisture content
- combining composting material streams to compensate for volume reduction
- providing adequate containment and control to prevent off-site odour or dust impacts
- providing adequate space for emergency vehicles

4.1.3.1 Processing Procedures

4.1.3.1.1 Pile Formation and Loading

Once the recipe development is complete, the mixed or blended feedstock is ready for composting. If a non-enclosed composting system is being used, the material is formed into a windrow or aerated static pile. If an enclosed composting system is being used, then feedstock will need to be loaded into the vessel, drum or channel etc.

4.1.3.1.2 Turning

Outdoor piles (i.e., windrows) require regular turning to provide aeration and further mixing. Regular turning is also part of the pathogen reduction requirements in Part II of the Standards.

A loader, excavator or specialized windrow turner can be used. Outdoor turning should only take place during favourable wind conditions, to minimize potential off-site odour impacts.

Enclosed systems, such as channel systems, typically use a specialized turner that mixes and moves composting material.

4.1.3.1.3 Aeration

Enclosed systems and aerated static piles have an aeration system that mechanically aerates the composting mass. This helps maintain and optimize aerobic conditions during composting.

4.1.3.1.4 Temperature Control

In addition to controlling and monitoring temperatures in the composting mass to ensure pathogen reduction, temperature control and monitoring is also important for maintaining a high rate of decomposition. Hotter is not better; generally, microbial activity is maximized around 45°C, the temperature where the mesophilic and thermophilic micro-organisms thrive. Microbial activity becomes more limited as temperatures rises, and may become severely limited above 70°C and result in slower decomposition.

After the pathogen reduction time and temperature criteria in Part II of the Standards have been met, care should be taken to manage the process to maintain temperatures as close to 45°C as possible to optimize decomposition.

4.1.3.1.5 Compost Monitoring

It is important to monitor the composting mass throughout the process, to ensure that aerobic conditions and desired temperature ranges are maintained, that temperatures required for pathogen inactivation have been achieved, and that anaerobic and odour generating conditions do not develop.

The most common way to monitor conditions is by collecting temperature data from the composting mass. This data needs to be collected and documented to ensure that time and temperature requirements are met.

Temperature of the active composting mass during the high temperature phase should be measured at a sufficient number of points (typically six or more) in the mass to ensure an accurate temperature profile. Temperatures should be measured at a depth of one metre from the surface of the composting mass, or as required in the facility's ECA. Where continuous automated temperature monitoring is used, the requirement may be based on daily averages using all data points acquired over a 24 hour period.

Other monitoring can include measuring the oxygen content in the composting mass. A good target range for aerobic conditions is 12-18% oxygen concentration, with a minimum of 10%.

4.1.4 Curing and Finishing

The objectives of the curing and finishing operation are to:

- ensure the production of mature compost
- meet regulatory compost Standards
- meet end market requirements
- prevent on-site and off-site nuisances (e.g., odour, noise, dust, litter, birds and vermin)

Specific activities in the curing and finishing operation can include:

- discharge from enclosed systems
- turning
- screening
- analyzing

After the time and temperature requirements for pathogen reduction in the Standards have been satisfied, and the compost has completed the processing phase, the compost must be cured until mature (as described the Standards). Typical retention times for compost curing range from one to six months (minimum curing time may be required). However, curing can take longer, depending on the degree of volatile solids reduction achieved in the processing operation, the degree of process control, and the maturity and other quality objectives for the compost.

It is important to note that the presence of offensive odours is a good indicator that compost is not yet mature. Mature compost produces an “earthy” smell. Regulatory requirements for compost quality, including maturity, are discussed in Part II of the Standards.

Design considerations for the curing and finishing operation include:

- providing sufficient retention time to satisfy compost maturity requirements
- ensuring adequate ventilation, forced or passive, to maintain aerobic conditions throughout the composting materials and to remove heat as required
- allocating space for the efficient arrangement of product finishing activities such as

- screening, blending or bagging
- allocating sufficient space for up to six months of compost curing
- allocating sufficient space to store compost when market demand is slow
- providing adequate containment and control, to prevent off-site odour or dust impacts

In windrow facilities, curing may take place on the same pad as composting.

4.1.4.1 Curing Procedures

4.1.4.1.1 Discharge from Enclosed Systems

After processing is completed, the compost is moved (typically with a loader) to a curing area and formed into windrows. Curing areas can be outdoors if proponents can demonstrate that there will be no off-site odour impacts. However, indoor or covered curing (with aeration) is encouraged where possible, to reduce process and stormwater management demands, and off-site odour risks.

Curing and storage areas should be properly graded and drained to avoid the collection of stagnant water or leachate at the bottom of curing piles. Although curing piles are often larger than active windrows, they should be sized such that they can be turned adequately by the equipment available on the site.

4.1.4.1.2 Turning

During curing, a composting mass should be turned at least once per month, or more frequently if required, to maintain aerobic conditions. This is done using a loader or specialized turner.

The temperature of a curing pile should be measured and recorded at least weekly. Optimal moisture levels should be maintained (40-55%). To minimize potential off-site odour impacts, turning should only take place during favourable wind conditions.

In circumstances where it is not feasible to turn monthly (e.g., extreme cold causing frozen material), turning frequency may need to be decreased to maintain desired conditions. In such cases, the minimum curing period should be as long as it takes to turn the material once for each month of required curing, with at least one month between turns.

4.1.4.1.3 Finishing

One of the final activities on a composting site is the preparation of the compost for delivery to market. The extent of the activity will depend on the end market requirements, and may include screening, blending, bagging, and loading material for shipment. To minimize potential off-site dust impacts, these activities should be undertaken during favourable wind conditions. Wetting Moistening dry compost may be required to prevent off-site dust impacts. If the feedstock was collected in plastic bags, care must be taken to ensure that the screening operations do not generate litter.

4.1.4.1.4 Compost Analysis

Compost must be sampled and analyzed to demonstrate that it meets the requirements in Part II of the Standards (e.g., metals, foreign matter and pathogens). It is also prudent to analyze for other quality parameters to ensure that compost meets desired end market requirements. Regulatory requirements for compost quality are discussed in Part II of the Standards. Compost Sampling and Laboratory Analysis are discussed in Part IV sections 6 and 7 of the Standards.

4.2 SEPARATION TO MAINTAIN HYGIENIC CONDITIONS

Compost that has been processed according to this Guideline will have undergone extensive pathogen reduction (which is necessary to meet the pathogen requirements in Part II of the Standards). Pathogen inactivation is achieved during the processing operation, which subjects the composting mass to extended periods of elevated temperatures. The processing operation also ensures that the readily decomposable portion of the composting material is sufficiently reduced and that continued decomposition of the composting mass is unlikely to create conditions favourable to the re-growth of pathogens.

The composting facility's site design should provide an effective barrier that serves to prevent the reintroduction of pathogenic organisms into composting material that has satisfied the requirements for pathogen inactivation. Direct or indirect contact between processed compost material and feedstock or leachate must be avoided to avoid cross-contamination. Receiving and pre-processing operations, the entrance to the processing operation, and all associated mobile equipment, should be separate from the 'clean' area of the site. The 'clean' area should incorporate the outlet of the processing operation, the curing and finishing operation, as well as associated mobile equipment.

Transfer of equipment or material between the separate areas of the site should be prohibited, other than for compost material passing through the processing operation. If equipment transfer cannot be avoided, equipment must be properly cleaned prior to use with processed material.

Leachate should not be used for rehydration after the composting material has satisfied the time and temperature requirements for pathogen inactivation.

4.3 OPERATIONAL FLEXIBILITY AND REDUNDANCY

Operational flexibility enables a facility to accommodate changes in quantity and composition of feedstock materials, and operational upsets.

Design features that contribute to operational flexibility include:

- the ability to bypass unnecessary or failed operations
- material buffers, i.e., temporary storage areas, especially between batch and continuous operations
- the ability to temporarily increase the material throughput capacity of specific operations (without jeopardizing process control requirements)

Redundancy and operational contingencies should be provided for essential operations (e.g., moving material from the tipping floor to pre-processing, compost turning and aeration).

Facilities should be designed with enough capacity to allow for routine maintenance of all equipment, equipment breakdowns, and operational anomalies, without compromising process conditions, the environmental controls of the facility, or the compost quality.

4.4 SITE CAPACITY

Determination of the maximum capacity of a composting facility is important because of the need to balance several different site operations, and to ensure that waste received at the site can be processed promptly.

Proponents will be asked to specify the maximum annual and daily incoming amounts, by type of feedstock, as well as the total amount of material (including compost) on the site at any one time. For seasonal operations, proponents should specify daily maximum and minimum amounts by type of feedstock. This maximum site capacity is typically included as a condition in the ECA for the site. The purpose of these restrictions is to ensure that the material on site can be physically processed by the proposed facility.

To assist the ministry in determining appropriate limits, proponents need to clearly present calculations of the maximum capacity of the site. These calculations should include a plan for dealing with seasonal variations in feedstock delivered to the site, downtime for maintenance activities and other operational requirements, and for the removal of compost from the site.

At outdoor sites, the site capacity depends on the size of the composting pad, the size and spacing of piles or windrows, and the time taken to complete the composting process. The size of a windrow usually depends on the type of equipment used for turning. In general, windrows must be physically sized to be manageable by the proposed equipment (to meet the pathogen reduction requirements in Part II of the Standards). An easily-manageable windrow height for a typical front end loader is about three metres. Pile height may vary, if proponents can demonstrate the pile is manageable, to the satisfaction of the Director.

At enclosed sites, the site capacity depends on the vessel size and retention time, as well as the time and space required for curing.

Regardless of the type of facility, the design should allow for adequate retention time for all operations, to reduce the risk of off-site impacts, and ensure the production of compost that meets minimum maturity requirements.

4.5 COMPOSTING PAD DESIGN

Most composting facilities make some use of outdoor areas for material handling, processing or storage operations. For the purpose of this section, "composting pad" refers to all engineered surfaces underlying these outdoor areas.

Composting pads are employed in a variety of operations. Regardless of the operation, the

functional requirements of the pad area are similar and include:

- providing a year-round working surface capable of withstanding regular heavy equipment use and material movement
- preventing infiltration of leachate
- providing adequate containment and drainage to prevent accumulation of leachate or run-off (i.e., ponding)

Compost pads should be designed to account for movement and management of materials, including receipt, turning, and storage. Adequate space should be allocated between and around the perimeter of operations to allow for vehicle and heavy equipment operation.

The following features should be incorporated into the composting pad design for leachate and stormwater management:

- any areas of the site used for receiving, processing, composting, finishing, or storing waste or compost must be located on surfaces which minimize the release of leachate or storm water run-off to groundwater
- surfaces must have a permeability not greater than 10^{-7} centimetres per second;
- the site must be graded such that any leachate or stormwater contaminated with leachate, compost, or waste is directed to a retention pond
- the retention pond must be sized such that it can safely store 110% of the stormwater run-off from all active areas of the site for a precipitation event based on the intensity of a 24 hour duration event with a 25 year return period
- the contents of the retention pond must be treated according to one of the methods outlined in section 4.6.4 of this Guideline, or by other means acceptable to the ministry

4.5.1 Working Surface

Subsurface conditions may require that the base of uncovered active composting areas be designed to limit infiltration. In such cases, all uncovered active areas of the site should be located on a natural or artificial base of low permeability (such as clay, concrete or asphalt), and should be sloped toward the leachate storage and/or treatment and disposal facilities, to eliminate standing water. For sites at existing landfills, slope should direct run-off towards the existing leachate collection system. Windrows of compost should be oriented parallel to the direction of drainage to prevent ponding.

4.5.2 Drainage

The choice of pad material will have a direct impact on the volume of run-off generated at the site, and on the volume of water that infiltrates into the groundwater. For example, pads constructed from relatively impermeable materials, such as concrete or asphalt, will have run-off coefficients on the order of 0.75 to 1.0, meaning that 75% to 100% of the precipitation on the site would end up as run-off. In this case, a retention pond to store run-off and leachate, or a treatment system that improves water quality prior to discharge, would likely be required.

Drainage of water from a composting pad is typically achieved by sloping the pad towards a

retention pond or other water collection or treatment facility, and by aligning windrows parallel to the direction of the slope. A porous pad could also be drained by locating drainage tiles under the pad, but this is rare in practice.

Many compost pads are graded to a slope of approximately 2% to 4%. Experience has shown that slopes in this range tend to result in relatively good drainage. Steeper pads tend to encourage water to run off, while flatter pads tend to hold water, encouraging percolation. The slope of the pad can also have an impact on site operations and the quality of run-off from the site. A flat pad (<1%) may encourage the accumulation of leachate or ponded water that can lead to odour and insect problems. Too steep a slope can lead to problems with erosion of the pad or soil adjacent to the pad, which further increases the load of suspended solids in the run-off.

Site topography may be such that precipitation tends to run onto the active composting area. In such cases, drainage works such as berms, swales, and ditches should be used to redirect stormwater around and away from the active area.

4.6 LEACHATE MANAGEMENT PLAN

Good compost site management requires the development and implementation of a Leachate Management Plan, unless the site is fully contained. A Leachate Management Plan is essential for outdoor composting facilities and may be required for enclosed or semi-enclosed composting facilities. Components of a Leachate Management Plan should include:

- assessment of local physical and water use conditions
- completion of a site water balance
- determination of appropriate leachate collection, treatment, and disposal methods
- development of monitoring and contingency plans

This section provides general information and guidance about leachate management considerations. For more detailed technical guidance, proponents should consult additional resources. For example:

- *Design Guidelines for Sewage Works, 2008*, MOEE, ISBN 978-1-4249-8438-1 PIBS 6879

4.6.1 Assessment of Physical and Water Use Conditions

The first step in the development of a Leachate Management Plan is the investigation of physiographic, hydraulic and water use conditions at and in the vicinity of the site. The scope of such investigations will depend on the scale of the proposed composting operation, the local conditions, and on the specific leachate management options selected for the site.

In general, a proponent should compile the following information on local conditions:

- surface water hydrology (e.g. existing topography, natural versus artificial surfaces, drainage patterns, proximity to surface waters, extent of local floodplains, local precipitation patterns)

- local geology, including soil composition and stratigraphy
- local hydrogeology, such as the depth to the water table, current groundwater quality, and direction of groundwater flow
- identification of wells, water takings and other water uses
- local regulatory requirements, primarily municipal zoning and by-laws, and regional conservation authority requirements

This information can be compiled from a number of sources including the following:

- regional mapping (topographic maps, MNR regional soil and bedrock maps)
- regional conservation authorities
- Environment Canada
- regional and municipal governments
- legal site and engineering surveys
- existing well records (ministry and local)
- site visits
- test pits or boreholes

This understanding of the site and local conditions and local water use should be used in the facility siting, and development of the site design and operations report. Key outcomes from this assessment include:

- the identification of potential impacts on groundwater, surface water and water users, from the specific type of facility being proposed
- monitoring and contingency plans where deemed appropriate, to detect, and if necessary, mitigate impacts

4.6.2 Site Water Balance

Development of a Leachate Management Plan for a compost facility requires an understanding of the balance of water inputs and outputs at the site once the facility is operational, including combination of the natural water inputs and outputs at the site and those introduced through the composting process. The purpose of the site water balance assessment is to determine expected quantities of stormwater and leachate, and the timing of the peak generation for each. The site water balance will also determine the need for active treatment and disposal of collected leachate. Typically, the need for active water management is greatest in the spring and fall.

The specific details of a site water balance will be different for outdoor versus enclosed composting facilities. However, even enclosed facilities may have large uncovered outdoor areas such as receiving, tipping or mixing areas, and curing and storage areas.

Water inputs at a composting facility include:

- precipitation
- moisture in incoming material
- process water added directly to the composting material
- wash water for trucks or surfaces

Water is also a natural by-product of the aerobic composting process. Water leaves the site

through infiltration into the subsurface, evaporation, as moisture in outgoing materials, or through water treatment, disposal or discharge.

Composting facilities should be designed and operated with the objective of minimizing the production of leachate, and preventing its release to the environment. Leachate production can be controlled by reducing contact between precipitation and feedstock or compost. Even enclosed or semi-enclosed composting systems may have uncovered active areas such as receiving areas, pre-processing areas, and storage and curing areas. Covering some or all of these areas will reduce the amount of leachate produced at the facility. Covering receiving areas should be feasible for most facilities because of the relatively small space requirement. This also contributes to achieving odour and vector control objectives.

Below are a list of characteristics and compounds in compost leachate that are of particular concern:

Biochemical Oxygen Demand (BOD):

Compost leachate often exhibits high BOD due to the decomposition of organic materials. High BOD reduces the oxygen available for fish and aquatic life in receiving water.

Phenols:

Some phenols are natural by-products of the decomposition process. Phenols can affect the taste and odour of water, and are an indicator of fish flesh tainting compounds.

Nutrients:

Several nutrients, such as nitrogen and phosphorus, are essential to the composting process. However, nutrients in leachate can contribute to algal growth and eutrophication if released to receiving waters. Some nutrient based compounds, such as un-ionized ammonia, can be acutely toxic to aquatic life.

Pathogens:

Leachate that leaves the compost pile during the active composting process stages may contain waterborne micro-organisms, some of which may be disease-causing agents (pathogenic), like *Salmonella*.

Metals:

Metals may be toxic to organisms, and may bio-accumulate in aquatic environments.

Other Trace Organic Chemicals:

Compost feedstocks may also contain trace organic compounds that may be toxic to fish and other freshwater organisms. These may include endocrine disrupting compounds, pharmaceutical and personal care products, and chlorinated and brominated compounds such as brominated flame retardants, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs), and fluorinated defoaming agents (e.g., perfluorooctane sulfonate).

Other:

Limited testing of compost leachate quality has indicated that concentrations of conventional pollutants, such as Total Phosphorus (TP) and un-ionized ammonia, can often exceed the Provincial Water Quality Objectives (PWQO). Concentrations of phenols and metals may also exceed PWQO.

Also of concern are leachates that have a high Total Suspended Solids (TSS) content, a pH that could affect the receiving water, or a high salt content.

4.6.2.1 Leachate Collection

A leachate collection system may be required to ensure protection of ground and surface waters, to provide year round site accessibility, and to prevent odour and vector problems associated with standing water. A composting site leachate collection system may include drains, berms, ditches and a storage pond.

4.6.2.2 Leachate Collection Lagoon and Run-off Retention Pond

Sites with uncovered active areas, and without direct connection to municipal sanitary sewers, will typically require a lagoon to contain and stabilize, and provide adequate treatment to leachate prior to disposal. Proponents must ensure that the leachate collection lagoon can accommodate the leachate that can reasonably be expected at the site. Where subsurface conditions permit infiltration, the leachate collection lagoon must be equipped with a natural or artificial liner of low permeability.

As noted in section 4.5.2, the site must be graded such that any leachate or stormwater contaminated with leachate, compost, or waste, is directed into an adequately-sized retention pond.

Stormwater that does not come into contact with waste, compost or leachate should be directed away from the leachate collection lagoon.

Leachate collection lagoons require active management, including monitoring the quantity of leachate, and checking for odours. Lagoons may need to be aerated, through natural or mechanical means, to ensure that the high BOD of the leachate does not lead to anaerobic conditions and odours. Leachate lagoons have to be designed properly and approved under section 53 OWRA for discharges to surface water receivers and infiltration.

4.6.3 Leachate Monitoring

Leachate quality monitoring is important for sites where leachate is discharged to surface water or where infiltration is used to dispose of leachate. Leachate monitoring will typically be required as part of an OWRA section 53 waste water disposal ECA and may be required as part of the EPA Part V waste disposal ECA.

For sites where the potential for groundwater or surface water impacts is a concern, monitoring of the receptor(s) of concern is advised, and may be required as part of the EPA or OWRA ECA.

For additional information on these requirements and their applicability to a compost facility and site, please contact the ministry's district office.

4.6.4 Leachate Treatment and Disposal

The purpose of this section is to outline several options for the treatment of leachate and disposal of the treated effluent from a composting site. If treatment of leachate is required, the Leachate Management Plan must include details of the treatment and disposal methods. Leachate treatment options include:

- rehydration of compost with leachate
- on or off-site treatment
- discharge to a naturally occurring or engineered marsh¹
- spray irrigation
- discharge to municipal sanitary sewer system

Disposal of effluent from leachate treatment includes:

- infiltration
- discharge to surface water
- subsurface discharge
- reuse

It should be noted that wetlands are approved only as a final polishing system in the treatment of sewage. As such, there is no reliable performance data to suggest that they can be used as a stand-alone treatment system.

4.6.4.1 Rehydration of Compost

Water is often added to compost during processing to maintain optimum composting conditions. In some operations, this process water is obtained from a leachate collection pond, allowing the site operator to both reduce water costs, and to provide a simple method of leachate treatment.

Leachate should only be used to rehydrate the composting material prior to the thermophilic temperature period to ensure inactivation of any pathogens present in the leachate. Use of leachate as a water source on compost that has completed the thermophilic stage may re-inoculate the compost with pathogens.

Operators should also be aware that extensive use of this practice may lead to the accumulation of contaminants such as metals, salts, or nutrients in the compost, potentially rendering the compost un-marketable or adversely affecting the composting process. Analytical results from compost should be monitored closely, to ensure there is no build-up of levels beyond those specified as acceptable.

¹ This option should be fully discussed with MOE regional staff at the outset.

4.6.4.2 Off-site Treatment of Leachate

Transporting leachate or combined run-off to a wastewater treatment plant may be a viable treatment option. Water requiring disposal can also be transported via a direct connection to a sanitary sewer (through a gravity or force main), or may be hauled to the plant by a licensed liquid waste hauler.

4.6.4.3 Discharge to Municipal Sanitary Sewer System

Proponents should be aware that municipal by-laws and policies may restrict direct connections to sanitary sewer systems. In particular, local sewer use by-laws should be consulted to determine any restrictions on the quantity and quality of any discharges. While combined run-off could meet the quality restrictions on sewer use, municipalities may discourage or forbid connections that drain large outdoor areas.

4.6.4.4 Direct Discharge to Receiving Waters

The Provincial goal for surface water quality management is to ensure that the surface waters of the Province are of a satisfactory quality for aquatic life and recreation. The Provincial Water Quality Objectives (PWQO) includes numerical and descriptive criteria for chemical and physical indicators, which represent a satisfactory level of surface water quality.

Discharging leachate to a surface receiving water such as a river, stream or dry ditch may be a viable alternative method for disposal of all or a portion of the leachate generated by the composting site. However, the necessary sewage treatment works, which may include biological and/or physical-chemical treatment, requires an ECA under the OWRA.

An important first step is the characterization of the compost leachate quality to identify potential pollutants. Some effluent quality guidelines for discharge to surface waters are outlined in ministry guideline “*F-5 Levels of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters*”, which typically address TSS, CBOD₅² and TP. Additional information on the derivation of receiving water based effluent requirements are outlined in Chapter 4 of “*B-1-5 Deriving Receiving Water Based, Point Source Effluent Requirements for Ontario Waters*” available on the ministry website.

Effluent loading requirements consider the compost leachate quality, any treatment, and the flow and assimilative capacity of the receiving water body. The proponent is responsible for completing a receiving water assessment, which will be considered in the development of specific effluent requirements.

Annual variations in stream flow will be considered in determining whether discharge will be permitted on a continuous, non-continuous or flow proportional basis. Discharges to dry ditches (watercourses that go dry seasonally) may be permitted in some instances, provided it can be shown that continuously flowing watercourses downstream will not be negatively affected.

² Five day Carbonaceous Biochemical Oxygen Demand measured in an unfiltered sample.

Effluent contaminant loadings and concentrations are based on a parameter by parameter comparison of the quality of the receiving water to the PWQO, and known variations of the receiving water quality and quantity over time, and at different locations in the watercourse.

Proponents are advised to arrange a pre-consultation meeting with ministry District or Region staff prior to submitting an application under the OWRA. Ministry staff will review the proponents receiving water assessment and prescribe effluent requirements.

Monitoring requirements for surface water and groundwater, such as those provided in section 4.6.4, may be required where discharge to surface, ground or groundwater occurs.

4.6.4.5 Land Application/Spray Irrigation of Combined Leachate and Contaminated Run-off

If approved to do so, some composting facilities treat a portion of the leachate from the site by spray irrigation or other land application methods. Spray irrigation systems apply leachate intermittently to a field and rely on interactions with the soil and vegetation to treat contaminants in the leachate.

In accordance with O. Reg. 267/03, under the Nutrient Management Act, 2002, the leachate can be applied to agricultural land if it meets the NASM beneficial use and quality standards set out in the Regulation.

If the leachate cannot meet these standards or it is to be applied on non-agricultural land, then an ECA (issued under the EPA) would be required.

4.6.4.6 Infiltration

Allowing leachate and stormwater to infiltrate through surface soils into the groundwater is one method of treating and disposing of leachate and contaminated run-off from composting facilities that may be appropriate in some circumstances. Infiltration relies on natural processes in the soil and groundwater to attenuate and degrade contaminants in the leachate. Infiltration will likely only be approved when it is in accordance with good groundwater management practices.

Ministry approval for infiltration will generally be required under section 53 of the OWRA. A Hydrogeological Assessment Report is required for the ministry to evaluate a proposal to treat leachate and contaminated run-off by infiltration, including:

- a detailed assessment of the site, local hydrogeological, and water use conditions
- a reasonable use assessment

The scope of the Hydrogeological Assessment Report may vary depending on the scale of the proposed facility, and the importance of the local groundwater resource. Proponents should discuss the scope of any hydrogeological investigations with the local ministry district or regional office prior to proceeding with any investigations.

Significant discharges of leachate and contaminated run-off to groundwater by infiltration are assessed for ECA applications using ministry Guideline B-7 "*Incorporation of the Reasonable*

Use Concept into MOEE Groundwater Management Activities". This document:

- explains the "reasonable use" approach used in the ministry's protection of groundwater quality
- establishes procedures for determining what constitutes the reasonable use of groundwater on property adjacent to sources of contaminants
- provides guidance for establishing limits on the discharge of contaminants from facilities that are used for the disposal of leachate into the shallow subsurface

The ministry may not support proposals for subsurface disposal of combined leachate by infiltration in the following environments:

- no appreciable attenuation can be provided
- natural attenuation capacity is weak
- subsurface is suited for better use
- consequences of failure are unacceptable

4.7 PREVENTION AND CONTROL OF POTENTIAL ADVERSE EFFECTS

Many potential off-site impacts from composting facilities can be minimized or eliminated through proper planning at the design stage. Potential adverse effects include:

- noise
- litter
- dust
- vermin and vectors
- fire
- traffic

Please note: odour prevention and control measures are discussed separately in Part IV of this Guideline.

Considering the prevailing wind direction, and the downwind land use, is critical when planning the location of a composting facility, particularly receiving and processing areas. Buffer zones (together with the use of existing trees, natural features, berms, screens, and fences) should be planned to both visually screen the site from neighbours, and to minimize the potential for adverse effects.

In addition, facility design should include the following features:

- constructed composting pad and road surfaces (concrete, asphalt, gravel, etc.)
- proper grading and construction of outdoor composting pads and indoor receiving areas to eliminate standing water
- adequate space for composting, curing and product storage
- installation of:
 - shields around high litter generation points (e.g., conveyors)
 - litter fences or other infrastructure to minimize movement of litter at an outdoor facility

- screening vegetation or other windbreaks
- a wheel wash for vehicles leaving the site
- compliance with appropriate building and fire codes
- access to water to be used for fire suppression
- rapid unloading and processing of vehicles

Enclosing operations where possible, and the use of dust collection equipment such as collection hoods, negative air pressure at dust collection points, wet scrubbers, and bag houses is also recommended.

For more information on best management practices for dust control, please refer to Appendix F of the Ministry's "*Procedure for Preparing an ESDM Report*".

4.8 BUILDING STRUCTURES

The Director will typically require that higher odour-generating potential feedstocks (e.g., biosolids, food wastes) be pre-processed in an enclosed composting system, and composted in an enclosed or semi-enclosed composting system.

Structures built to house composting operations should be designed to withstand the moist, corrosive, and biologically active conditions prevalent at a composting site. Materials used for construction should be chosen with these conditions in mind.

If an existing building is to be used for a composting operation, care must be taken to ensure that the building is structurally sound and properly sealed to prevent fugitive odour emissions. The structural integrity should be tested to ensure effective containment.

Proper ventilation of buildings is essential for both worker health and safety and for long term maintenance of the building. Proper ventilation will minimize worker exposure to the volatile compounds present in organic materials, such as ammonia and hydrogen sulphide, and also exposure to odour and dust. Typically, building ventilation is combined with the odour containment and control system (see Part IV, section 6.3 of this Guideline).

4.9 SITE SERVICES

Most composting facilities need a source of process water to be able to adjust the moisture content of the compost mass when needed. The use of leachate for this purpose is discussed in section 4.6.4.1 of this Guideline. Other alternatives include:

- municipal water supplies
- local surface water bodies or wells
- collected rainwater
- the use of trucked water supplies

The use of local surface or groundwater supplies may require ministry approval under the OWRA.

Water will also be required for washing equipment and for domestic purposes, such as drinking and hand washing. At larger facilities with daily operations, facilities such as toilets, showers, and change rooms may be appropriate.

If a site is serviced by a sanitary sewer, it may be possible to use the sanitary sewer system as a treatment mechanism for leachate from the site. Water management issues are discussed in sections 4.6 of this Guideline.

4.10 OTHER SITE DESIGN CONSIDERATIONS

Composting facilities must include functions ancillary to the unit operations of the composting process. Key ancillary systems are odour prevention and control, leachate management, and the prevention of adverse effects that are addressed in Part IV, section 6 of this Guideline. Additional ancillary functions can include, but are not limited to, the following:

- providing public access to drop-off depots or compost pickup areas
- site administrative functions, e.g., site office and facilities for management and administrative staff, and staff parking
- process and quality control functions, e.g., automated monitoring systems, feedstock and compost analysis
- providing worker amenities, e.g., showers, change room, lunchroom and first aid
- equipment maintenance and repair (including repair shop and materials and parts storage)
- separation and visual barrier between composting site and adjacent land uses, e.g., berms or tree lines in the property line setback area
- covered or enclosed vehicle and equipment storage

4.11 SITE SECURITY AND ACCESS

Reasonable care should be taken to ensure that unauthorized persons are kept out of any areas where waste is handled, processed or stored. This can be accomplished by erecting fences and gates, making use of natural features that make access difficult, or by conducting activities inside a building. Signs that are a sufficient size to be readable from a public roadway should be posted at the facility and list the:

- address of the site
- name of the owner of the facility and the name and telephone number of a person to contact in an emergency or to report complaints
- hours of operation
- categories of waste that will be accepted at the facility and any rules that relate to the acceptance of such waste

4.12 SITE CONSTRUCTION PRACTICES

The construction of a composting facility can involve several activities that have the potential to lead to erosion of soil or the deposition of sediments in local waters. Activities such as removing topsoil, grading the site, or changing natural drainage patterns should be carefully planned to control erosion both during and after the construction period. Additional sources of information regarding erosion and sediment control during construction are listed in Appendix 4.

PART III – OPERATING GUIDELINES

5.0 INTRODUCTION

This section presents operating parameters and other recommended best management practices for composting facilities in Ontario. When these requirements are included in an ECA for a Waste Disposal Site (Processing) issued by the Director, they become legally binding on the site operator. Best management practices in this Guideline that are not included in an ECA, should also be followed. Circumstances at each facility are unique, so variations on these guidelines are at the discretion of the Director in issuing an ECA. Additional provisions may be required, beyond what is discussed in this Guideline.

Generally, there are requirements in a composting facility ECA relevant to the following areas:

- feedstock quality
- process control
- sewage (leachate and stormwater) management
- adverse effects such as odour , noise, fire, litter and dust management
- reporting and record keeping

Feedstock and compost sampling and laboratory analysis requirements are also typically included in a composting facility ECA. Information on feedstock and compost sampling and laboratory analysis is included in the Standards.

5.1 FEEDSTOCK QUALITY

The most important quality control steps in the production of compost are the selection, collection, and handling of feedstock. Clean, source-separated wastes are much more likely to produce compost that meets both regulatory and end market quality requirements. Therefore, composting facility operators should take reasonable steps to ensure that they accept feedstock materials that:

- meet the maximum concentration for metals in feedstock (see Part II, section 3.3 of the Standards)
- can reasonably be expected to produce compost that will meet the compost Standards for Category AA, A or B (see Part II of the Standards for information on the compost Standards for each of these categories of compost)
- they have the appropriate technology to manage, including for odour control and treatment

A facility's ECA will prescribe which feedstocks are acceptable for each facility. The acceptability of certain feedstocks may vary by facility, based on site-specific circumstances. To ensure compliance with the facility's ECA and the compost quality Standards, facility operators should impose feedstock quality requirements on organic waste generators and/or haulers, and include minimum quality requirements in processing contracts.

In general, acceptable feedstocks are:

- organic
- biodegradable
- non-hazardous solid
- non-hazardous liquid (at facilities designed to handle these wastes)
- those that can be processed into compost that meets compost Standards for Category AA, A or B

Facilities will be granted approval to accept certain materials, on a site-specific basis, depending on the capabilities of the processing and odour control technology. Examples of feedstocks that may be acceptable include:

- leaf and yard wastes
- food wastes
- food processing wastes
- non-recyclable paper wastes
- wood (natural wood only - excluding pressure treated, painted, or composite wood)
- pulp and paper biosolids *
- domestic septage *
- sewage biosolids *
- agricultural manures
- crop residues
- pet waste
- soiled paper such as tissues and paper towels
- diapers and sanitary products

* Domestic septage, sewage biosolids and pulp and paper biosolids are not acceptable feedstocks for the production of Category AA compost.

Examples of unacceptable feedstocks include:

- predominantly inorganic materials
- hazardous or liquid industrial waste including biomedical, PCB and radioactive waste
- Specified Risk Material (SRM) or animals infected with bovine spongiform encephalopathy (BSE) or potentially BSE contaminated wastes
- materials that are not readily biodegradable within the facility process time
- materials that contain contaminants or foreign matter in concentrations so high that they cannot reasonably be expected to produce compost that meets the compost quality Standards
- materials that contain metals in concentrations that exceed the allowed feedstock concentrations set out in the Standards

Note: Operators of compost facilities are responsible for clearly identifying and tracking wastes that will result in the production of different categories of compost (i.e., Category AA, A and B), as described in the Standards.

Procedures for sampling feedstock materials and methods suitable for the analysis of samples are presented in the Standards.

Some wastes received at a composting facility may contain micro-organisms that are human pathogens. These wastes include food wastes, diapers, domestic septage, manure, and biosolids. Workers should take precautions (e.g., practice good hygiene) to ensure that they are not exposed to pathogens.

5.1.1 Changes in Feedstock

The addition of new feedstocks (e.g., sewage biosolids, pulp or paper biosolids or domestic septage) to a process would require an amendment to an ECA (pursuant to section 27 of the EPA), if they are not permitted under the existing ECA.

5.2 ORGANICS COLLECTION

There are a number of ways to source-separate and collect organic materials from a variety of sources. Regardless of the collection method used, decisions made at the collection stage impact the quality of the feedstock delivered to the composting facility and the production of high quality compost.

5.2.1 Plastic Bags and Compostable Plastic Bags

An important consideration for collection programs, in particular municipal "green bin" programs, is whether plastic or compostable plastic bags will be used. Where bags are used, it is necessary for the receiving composting facility to have the proper processing technology in place to handle this material.

As noted above, inorganic materials, such as plastic bags, are undesirable in the compost feedstock. Organic material collected in plastic bags can be challenging to manage. The degree of difficulty varies, depending on the number and types of bags used, and the transport and storage times.

Generally, while plastic bag use should be limited, it may be suitable in some situations. The acceptance of materials collected in plastic and/or compostable plastic bags would be discussed as part of the facility's approval process. Proponents would need to demonstrate to the ministry that the facility has been designed to adequately manage these materials, including providing sufficient odour control measures to manage the higher odour-generating potential of the feedstock.

The use of certified compostable bags and paper bags may be suitable, but should also be thoughtfully considered with regard to processing capabilities. For example, the facility should be equipped with adequate processing technology (e.g., to break apart the bags) and adequate composting conditions and material retention time so that the bags, and their contents, fully decompose.

5.2.2 Other Quality Considerations

The sorting of organic waste from other materials at the source is also an important consideration. The presence of "contaminants" (other types of waste that are inorganic) affects the quality of the compost. Collection programs should be designed and operated in such a way that contamination is minimized (and mitigated if necessary) to ensure a "clean" feedstock is delivered to the composting facility. Ongoing education of program participants (e.g., residents participating in green bin programs), and quality control at collection points (e.g., collection truck drivers rejecting contaminated material), is essential to ensure the material is properly sorted.

Composting facilities should not accept diapers or sanitary products as feedstock, unless the facility has implemented special management techniques, odour control systems and processing technologies capable of dealing with these materials (e.g., feedstock preparation and adequate screening for compost quality). Without appropriate mechanical processes, diapers and sanitary products often remain mostly intact in the compost, and the uncomposted fibre portion and residual plastic need to be removed and disposed as waste.

Careful consideration should be given to the acceptance of compostable products or packaging. If accepted, preference should be given to "certified compostable" items or paper products. Not all biodegradable or compostable materials decompose under typical composting conditions. However, certified compostables are required to meet specific performance criteria. Other factors to consider include:

- the compatibility of the product or packaging with the facility's equipment
- the duration of the active composting process relative to the criteria for certification
- the means to educate waste generators on the compostability of the material and the collection method

The best way to ensure high quality compost is to ensure high quality feedstock. Although composting facilities include process features designed to screen out contaminants, this approach has limitations.

Transportation time is also an important consideration related to the quality of the feedstock and odour issues at facilities. The closer the collection route is to the facility, the more likely that transport and storage (i.e., transfer station storage) times will be shorter and the less odorous the material is likely to be upon arrival at the facility. Repeated handling, long shipping distances, and long delivery wait times should be minimized.

5.3 PROCESS CONTROL REQUIREMENTS

Highly putrescible wastes, including food wastes, biosolids and manures, should be blended with bulking materials as soon as possible, and incorporated into the active composting process within 24 hours of receipt.

Less putrescible wastes, such as most leaf and yard wastes (other than brush and brown leaves), should not be on-site for more than four days before entering the active composting process.

Food waste and other odour generating feedstocks (e.g., biosolids and manures) should be

processed in a building or enclosed or semi-enclosed structure, which has technology to collect and treat the odorous air before discharging the air to the atmosphere, particularly in urban areas.

5.3.1 Aerobic Conditions

During composting, the composting mass must be provided with adequate aeration to ensure that aerobic conditions are maintained (see Appendix 1 for a definition of aerobic). Aeration is achieved by turning as required to meet pathogen reduction requirements in the Standards, as well as other forms of passive or mechanical aeration.

5.3.2 Temperature Control and Pathogen Reduction

Compost feedstocks may contain pathogenic organisms. To reduce the risk of adverse health effects from pathogens in compost, **all** composted wastes (other than pure leaf and yard waste) must meet the time and temperature and pathogen criteria specified in Part II of the Standards. Leaf and yard waste is required to meet the time and temperature criteria **or** the pathogen criteria specified in the Standards.

5.4 PREVENTION AND CONTROL OF ADVERSE EFFECTS

Adverse effects, including uncontrolled odours, can cause major problems for a composting facility. Owners and operators are responsible for ensuring that adverse effects are avoided. Several potential adverse effects and some suggested methods of control are presented below.

5.4.1 Odours

As part of the ECA application process, all composting facilities will typically be required to develop an odour prevention and control plan, and conduct an Odour Impact Assessment. Follow-up assessments will also likely be required, to reflect actual operating conditions and assess odour issues that may arise. Detailed information on odour prevention and control is presented in Part IV of this Guideline.

Odour Prevention and Control Plans include the following elements to reduce or eliminate odour problems:

- assessment of feedstock odour potential
- odour source identification, including both point and fugitive sources
- nutrient and moisture balance
- site management
- process control
- monitoring of meteorological conditions
- on and off-site odour monitoring
- complaint response procedures

The components of an Odour Prevention and Control Plan are described in Part IV, section 6.

Other useful information on odour prevention and control can also be found in Part II, section 4 of this Guideline.

5.4.2 Noise

Noise can be generated by vehicles entering, leaving, or operating at the composting facility, and by equipment used in the compost processing operations. An acoustic assessment report is typically required as part of the facility approval process.

Proponents should check with their local municipality to ensure that they are complying with any local noise control by-laws.

Measures that can be used to reduce noises from a facility include:

- Limit hours of operation or coordinate operations with adjacent activities.
- Limit traffic to and from the facility.
- Properly maintain all equipment.
- Specify equipment with noise reduction design features (such as mufflers and sound enclosures).

5.4.3 Litter

Litter, primarily in the form of plastic and paper, can be present in loads of waste. It can also be tracked through and off-site by vehicles leaving the facility.

Measures that can be used to reduce litter from a facility include:

- Minimize receipt of wastes with a high percentage of foreign matter.
- Refuse to accept loads from uncovered vehicles.
- Receive and process feedstock in an enclosed area.
- Exercise care during processing and screening of organic waste, particularly during windy days.
- Collect on-site and off-site litter promptly (e.g., by conducting a daily manual pickup).
- Ensure that litter and other waste materials at the site are stored in proper containers and disposed of on a regular basis.

5.4.4 Dust

Dust is generated from dry composts and potentially from roads muddied by vehicles leaving the site.

Measures that can be used to control dust from a site include:

- Maintain adequate moisture content in all active composting piles (> 45%).
- Wet dry dusty site roads.
- Ensure vehicles leaving the site use a wheel wash to minimize dried mud on roads.
- Conduct general site housekeeping.

- Limit screening and turning activities in high winds and moisten dry compost as necessary.

5.4.5 Vermin and Vectors

Raw organic and composting organic wastes attract a variety of vermin and vectors including insects, rodents, birds and other wildlife. Once established, vermin and vectors can be very difficult to remove, and may pose a public health problem.

Wildlife may be attracted by the food and shelter available at a composting site. Flies are attracted to decomposing material, and mosquitoes may breed in pools of water on the site.

Possible trouble areas at a composting facility include:

- receiving areas
- processing areas
- run-off and leachate ponds
- low lying areas on composting pads that hold standing water
- site perimeters
- roadways

Measures that can be used to control vermin and vectors at a site include:

- Promptly incorporate wastes (particularly food wastes) into active processing.
- Cover fresh organic wastes (e.g., food wastes) with a layer of carbonaceous material (e.g., leaves or wood chips) or compost.
- Maintain aerobic composting conditions at all times.
- Control ammonia production (which can attract flies) by maintaining a C:N ratio of 25:1 – 30:1.
- Ensure:
 - regular turning of windrows to discourage nesting of rodents and birds, and to minimize fly populations,
 - active management of run-off and leachate collection ponds, and
 - regular cleaning of receiving areas.
- Use pest control and traps for vermin as required.
- Use an electric fence enclosure at sites likely to attract bears.

5.4.6 Fire

Fire can have an impact on an area surrounding a composting facility through the generation of smoke and odour.

Measures that can be used to minimize the likelihood of a fire developing include:

- Prohibit smoking at the facility.
- Exercise appropriate care when using equipment such as welders.
- Ensure windrows/piles are not built higher than can be managed with available equipment.
- Ensure windrows have a moisture content of greater than 45%.
- Turn stockpiles of amendment material to cool the interior.

5.4.7 Traffic

Traffic can have an impact on an area surrounding a composting facility. Trucks can generate noise, track mud, create dust, deposit litter onto roadways and possibly be a source of odour. In addition, area roads may be subject to load restrictions.

Measures that can be used to reduce traffic impact noises from a site include:

- Limit traffic to and from the facility.
- Limit speed of on-site traffic.
- Maintain clean site roads.
- Ensure vehicles leaving the site use the wheel wash.
- Provide sufficient space for truck traffic and queuing.

5.5 COMPLAINT RESPONSE PROCEDURES

The importance of initiating and maintaining good relations with the local community cannot be overstated. Public goodwill toward a facility and its management can be facilitated by quick completion of voluntary abatement plans. Public opposition on the other hand, can make an abatement process more onerous and adversarial.

Creating goodwill is the responsibility of the facility's management. Experience has shown that communities respond well when they are given the opportunity to become familiar with the operation, and when they are given clear and accurate information. Successful methods for creating public goodwill include: open houses, presentations to schools and local groups, newsletters, websites and other communications tools.

To maintain goodwill it is essential that facility management respond quickly to odour and other complaints. The response should be designed to achieve the following objectives:

- record the complaint for follow-up and evaluation
- identify the cause of the complaint
- confirm that the facility is, or is not, the source of the odour or other adverse effect
- implement remedial measures
- respond to the complaint and reassure residents that the situation can and is being resolved
- follow up regularly with residents and the local ministry representative

Facilities are typically required to track and respond to complaints received, including complaints related to odour or other adverse impacts. Appendix 5 is a sample Complaint Response form, which can be used to monitor and record complaints and remedial actions.

5.6 CONTINGENCY PLANS

Site operators are typically required to develop and maintain plans for preventing and dealing with leachate, noise, dust, litter, fire, power outages, emergency and non-routine situations at the

composting facility. A copy of these contingency plans would be required to be kept at the site. Operations staff should be well-acquainted with the contents of the plans. The plan would normally be required to be implemented as soon as a problem is discovered.

Site operators are also required to conform to the Ontario Fire Protection and Prevention Act, administered by the Office of the Fire Marshal, Ministry of Community Safety and Correctional Services. The specific requirements that a Director may require for contingency plans are outlined in the "*Guide to Applying for Approval of Waste Disposal Sites*".

5.7 REPORTING AND RECORD KEEPING

The facility operator will typically be required to establish and maintain records of the daily operations at the facility, including public complaints and to produce monthly and annual reports from this information.

The conditions of the ECA will typically list the type of information, preferably in an electronic format, that will be required to be kept on-site for at least five years and will require the information to be organized in a form of an annual report. The Director may require through a condition in the ECA, that this annual report be submitted each year, to the ministry and to the Public Liaison Committee if one exists. In any case, all reports must be made available to ministry staff on request.

The information that could be required includes but is not limited to the following:

- source, type, quality, and quantity of feedstock and amendment materials received.
- if more than one category of compost is being produced, operational procedures clearly demonstrating that the materials are kept separate at each stage of the process, and daily tracking of each batch or stream.
- process operating information (such as temperatures and retention times required under Part II of the Standards).
- quantity of compost and residues produced, and the quantity and destination of compost and residue removed from the facility.
- a log of all feedstock and compost sampling events, with sufficient detail to clearly identify the source of all samples taken.
- all results of analytical testing, as described in Part II of the Standards, from laboratory reports/certificates of analysis of compost and feedstock.
- a log of all complaints received and corrective action taken to abate problems.

PART IV – ODOUR PREVENTION AND CONTROL

Odour control must be a primary goal of the planning, siting, design and management of all composting facilities. **Historically, failure to control odours has been the most common cause of composting facility challenges.**

Odour control is of critical importance to the success of a composting facility for the following reasons:

- All composting feedstocks contain some amount of odorous compounds when they are received at the facility; some material (e.g., residential food waste and diapers) is more odorous than others (e.g., leaf and yard materials). Normal composting operations, such as handling and aeration, tend to promote the volatilization of odorous compounds.
- Odour is a contaminant regulated under the EPA. The ministry has the authority to inspect and require facilities to take measures to abate the release of odours. Facilities can be required to implement potentially costly corrective measures. If abatement is unsuccessful, facility scale-backs, processing reductions, changes to the operation (i.e., equipment, procedures), closure and, prosecution may follow.
- Ontario Regulation 419/05, Air Pollution – Local Air Quality, made under the EPA, establishes contaminant-specific concentration limits for some odorous contaminants.
- Worker exposure to some odorous compounds normally associated with composting, such as ammonia (NH₃) and hydrogen sulphide (H₂S), is regulated under the Occupational Health and Safety Act.
- Certain recognizable odorous compounds can indicate a nutrient imbalance (e.g., ammonia may indicate a low C:N ratio), or the presence of anaerobic conditions, indicating that the supply of oxygen needs to be increased.
- Insects and vermin can be attracted by the odour of decomposing organic matter, particularly odours generated by anaerobic decomposition.

A number of factors contribute to the likelihood of a facility experiencing odour problems, with no single factor being determinative of the success or failure of a facility in abating odours. It is recommended that serious consideration be given to all of the factors discussed in this section when planning a new compost facility or reviewing existing operations.

Key factors that *minimize* the risk of odours at composting facilities:

- proper facility design (including enclosed structures and odour control technologies)
- minimizing transportation and storage times of feedstock materials
- incorporating materials into the composting process as soon as possible (in accordance with the timelines set out in Part II, section 4.1.2 of this Guideline)
- avoiding or reducing receipt of highly-odorous feedstock material
- proper maintenance, operation and repair of air handling and process equipment
- operator training
- good site management, including good housekeeping
- contingency plans
- feedstock selection

Adequate separation distances from nearest receptors are important to reduce off-site odour

impacts, as described in Part II, section 3.3. Outdoor operations will require greater separation distances than fully-enclosed operations with odour control systems.

Key factors that *increase* the risk of odours at composting facilities:

- accepting materials with higher potential for odours, such as food waste, animal feces and materials that are not delivered the same day as they are collected from the source and/or are in an anaerobic condition
- allowing excessive transit or storage times for feedstock materials
- inadequate or poorly maintained equipment, or improper operation of systems
- inadequate control of the process (e.g. anaerobic conditions, immature compost)
- receiving and processing materials outdoors
- poor housekeeping practices

Siting a facility too close to residential communities and other “sensitive receptors” (defined in Appendix 1) can increase off-site odour impacts.

The objective of this section is to provide guidance on odour control measures applicable to siting, design and management of composting facilities.

6.0 REGULATION OF ODOUR

The EPA defines ‘contaminants’ as solids, liquids, gases, odour, noise, radiation and vibration produced by human activities that cause or may cause an adverse effect. Adverse effects, under the EPA, essentially involve negative impacts to people, property, businesses, or any part of the natural environment.

The Ministry of the Environment has the responsibility to take appropriate measures to address public complaints, and the authority to order the offending facility to take corrective action. A discharge of an odour that causes an adverse effect could result in a request from the ministry for voluntary abatement action, a ministry order, a referral for investigation and prosecution, or any combination of these approaches.

Although the odours generated from the composting process are not a physical health risk at the concentrations normally encountered, it is important to remember that the public often has a low tolerance for odours, and it is the facility owner and operator’s responsibility to ensure that any odour problems that arise are abated quickly and effectively. To maintain positive neighbourhood relations, facility operators are encouraged to voluntarily address odour concerns that arise, including temporary scale-back or discontinuation of material receipt, if necessary.

As noted in Part I, section 2.1 of this Guideline, composting facilities, unless otherwise exempt, require an ECA pursuant to section 9 of the EPA, since they may discharge contaminants, including odours, into the natural environment (i.e., the atmosphere). Ontario Regulation 419/05, Air Pollution – Local Air Quality, made under the EPA, establishes contaminant-specific concentration limits (or air standards) that are used in the assessment of environmental impacts and the approval of the ECA.

Demonstration of compliance with O. Reg. 419/05 begins with the development of an Emission

Summary and Dispersion Modelling (ESDM) Report that includes a summary of total air emissions for individual contaminants from a property. Air emissions are then converted to off-property concentrations using mathematical air dispersion models.

Contaminant-specific air standards serve to protect against adverse health and environmental effects. However, odour can cause an adverse effect even when individual contaminant standards are met, and the prohibition under section 14 of the EPA against discharges that may or do cause an adverse effect can be invoked when odours are discharged. As such, the odour emission rates from all the odour sources in a composting facility should be estimated and used in an air dispersion model to calculate the odour levels at nearby sensitive receptors. Results of this calculation will be used to assess whether an adverse effect is likely to occur. Odour concentrations that are greater than one Odour Unit at a sensitive receptor, based on a 10 minute average concentration, have the potential to cause an adverse effect and can result in public complaints.

Source Testing requirements and Technology Benchmarking Reports are examples of other ministry odour prevention tools that may be incorporated as ECA requirements or odour abatement strategies. Supporting documentation for these tools can be found on the ministry's website.

Proponents of facilities that are not required to obtain an ECA under section 9 of the EPA, will likely be required to submit documentation normally required for section 9 approval, such as an Odour Impact Assessment and ESDM report (with their disposal site ECA application).

Proponents are strongly encouraged to consult with the ministry's district office to confirm which supporting documentation will be required when applying for site approval.

6.1 FACILITY SITING AND DESIGN FOR ODOUR CONTROL

The Director will typically require that odour control be considered in the early stages of facility planning since it influences site selection and facility design. For odour control, good management practice cannot compensate for inappropriate siting and poor design. Nor can appropriate siting and design compensate for poor management practices. All aspects of the operation must be optimized to minimize the odour potential.

This section identifies several opportunities to incorporate odour control into site selection and facility design. In the planning and design stage, an Odour Impact Assessment (OIA) can be used to identify the need for odour containment, collection and treatment. Odour Impact Assessments are discussed in section 6.2 of this Guideline. It is strongly recommended that all compost facilities conduct OIAs **before siting** the proposed facility, or determining the appropriate separation distances from the nearest sensitive receptors.

Siting:

- The greater the separation distance between the facility and its nearest neighbours, the greater the natural dispersion of odours released. With sufficient dispersion, odours can be diluted to below the concentration at which they can be detected.
- However, natural dispersion alone cannot be relied upon to sufficiently dilute odours from any but small-scale facilities processing only leaf and yard materials or other low odour

- potential feedstock.
- Separation distances may be based on:
 - Odour Impact Assessments
 - Odour Prevention and Control Plans
 - considerations of facility size and design
 - equipment and process technologies
 - types of feedstock materials accepted
 - location and topography
 - operational procedures
 - The types of neighbouring land uses should be carefully considered. Future uses of land within the separation distances must also be considered. As mentioned earlier, **facility developers should seek support from municipal councils and planning staff to minimize future off-site odour impacts**. This could be achieved by limiting incompatible adjacent development through the official plan or other planning tools.
 - Other considerations in the Separation Distances and Buffer Zones section should also be followed (see Part II, section 3.3 of this Guideline).
 - Generally, the smaller the separation distance, the more odour controls required to minimize the potential for adverse effect. Facilities processing materials other than leaf and yard waste that are sited near populated areas (which would include most of Southern Ontario) would normally require enclosed composting including full containment, control and treatment of odours.

Design:

- Open windrow composting is generally not considered appropriate for most composting operations other than small leaf and yard waste operations or very remote facilities, due to the higher potential for odour emissions. Where open windrow composting is used, facilities are strongly encouraged to use odour control systems, such as compost covers.
- As a general rule, for facilities processing materials other than leaf and yard waste, the facility design should include enclosed areas (building or other structure that is completely enclosed) for receiving and pre-processing operations, and in most cases, for the initial stages of the composting process.
- Facilities should be designed to:
 - collect and treat the odorous air inside the buildings or structures (e.g., with a biofilter or equivalent technology) before discharging to the atmosphere
 - enclose significant odour sources within the smallest possible enclosure to minimize the quantity of odorous air requiring treatment, and to minimize the release of odours directly into the building air
 - create partitions to prevent airflow through buildings
 - maintain enclosed areas under sufficient negative atmospheric pressure at all times to minimize the release of fugitive emissions
- Facility design should consider the use of a double door air-lock system for truck doors at the feedstock receiving area, as well as fast-acting doors. Doors should remain closed at all times, except to allow vehicle and personnel entry or exit.
- Odour control systems must be carefully designed to handle the anticipated characteristics of the process air requiring treatment.
 - Flexibility should be incorporated in the design to allow for adjustments to be made in response to unexpected conditions, once the facility is operational.
 - Preference should be given to technology with demonstrated effectiveness in the field.

6.2 ODOUR IMPACT ASSESSMENTS (OIA)

The purpose of an OIA is to estimate the emission of odours from the site and assess whether the proposed facility siting and design can adequately control odours such that odour complaints are likely to be avoided. Such assessments typically use air dispersion modelling (described below) to predict the resulting odour concentrations at sensitive receptors under worst-case meteorological conditions, given the local topography and prevailing wind direction. Odour Impact Assessments may be used to identify the need for additional odour controls, such as odour containment, collection and treatment, when natural dispersion does not dilute odours to below detection threshold concentrations.

Odour Impact Assessments can also be used to identify effective odour abatement measures at facilities that are causing off-site odour impacts. It should be noted that, even where an ECA has been issued, if the situation warrants, the ministry has authority to order completion of an OIA and follow-up re-assessment.

Odour dispersion modelling estimates the atmospheric dispersion of released odours under meteorological and topographical conditions specific to the site. Successful modelling requires familiarity with atmospheric modelling techniques and should be undertaken by a qualified professional.

Dispersion modelling must be carried out using an approved dispersion model with an emission rate and operating scenario as described in Ontario Regulation 419/05. Dispersion modelling can be used in conjunction with measured or estimated odour concentrations for the purpose of assessing the potential off-property odour impact. Models accepted for use in Ontario, and instructions for their use, are provided in the guidance document titled "[*Guideline A-11: Air Dispersion Modelling Guideline for Ontario*](#)".

Measurement of odour concentration requires specialized sample collection and analysis techniques, which should be undertaken by qualified professionals. In some cases it may be possible to identify a specific odorous compound, or family of compounds, that can be used as an indicator of odour concentration. In these cases, it may be possible to use the indicator compound to enable frequent on-site monitoring of both the odour sources and the performance of the odour control system.

The dispersion model will estimate the facility's off-property odour concentration. An odour detection threshold concentration of one odour unit (OU) is defined as the concentration at which 50% of a population can detect the odour. A 10-minute average concentration at sensitive receptors at this level should minimize the potential for an adverse effect. A 10-minute concentration greater than this level may be acceptable, depending on the frequency of occurrence and the magnitude of the concentration.

Additional guidance on OIAs is available from the ministry upon request.

6.3 ODOUR CONTROL SYSTEM

Enclosed and semi-enclosed composting facilities will typically be required to provide an odour

control system for some or all of their composting operations. An Odour Impact Assessment can help to determine the specific requirements for odour control at a composting facility. This section describes each element of an odour control system: containment, collection, treatment, and dilution and enhanced dispersion.

This section also describes the use of masking and neutralizing agents, which should be considered contingency measures and not elements of an odour control system.

6.3.1 Odour Containment and Collection

Containment involves establishing a barrier to prevent the release of odorous compounds into the atmosphere. Containment can be achieved by:

- enclosing composting operations within a building
- using smaller enclosures for specific composting operations
- the use of partitions (such as plastic curtains)
- by creating zones of negative atmospheric pressure to draw odorous air into the collection system

Odour containment may also be achieved using a cover system, provided proponents can demonstrate odour control effectiveness.

Collection conveys the odorous air from the containment areas to the treatment, dilution or enhanced dispersion systems. Collection systems are normally comprised of corrosion resistant ducting connecting each containment area to the intake of a fan. The fan should have sufficient power to maintain containment areas under negative atmospheric pressure at all times to prevent fugitive releases of odorous air. Negative pressure conditions should be closely monitored.

For composting facilities where all or some of the composting operations are enclosed within a building, the mechanical odour collection system is usually connected to the mechanical building ventilation system.

6.3.2 Odour Treatment

All odour treatment systems involve absorption or adsorption with thermal, chemical or biological oxidation, to remove odorous compounds from gas. No treatment system can guarantee continuous removal of all odorous compounds. Removal efficiencies (output/input odour concentrations) vary according to the loading rates, concentration, and types of compounds in the odorous air. The odour removal efficiency can be determined by measuring the odour concentration at both the inlet and outlet of the air pollution control device. Selecting a specific odour treatment system for a facility should be undertaken with the aid of a qualified professional.

Odour treatment systems used at composting facilities include:

Biofiltration

Biofiltration is a proven method of treating odorous emissions from composting facilities. Biofilters are well-suited to treatment of high volume-low concentration mixtures of odorous

compounds.

Biofiltration involves passing odorous gas through a biologically active medium. Within the medium, two mechanisms (absorption/adsorption and biological oxidation) remove and degrade odorous compounds. Micro-organisms live in the aqueous film surrounding the particles. Water soluble compounds are absorbed into the water film, where they are degraded by the micro-organisms, thus regenerating the absorptive capacity of the medium. Odorous compounds can also be directly adsorbed onto the surface of the medium particles.

Biofilter media can be organic (typically mixtures of ground root-wood, compost and other materials), inorganic (such as an expanded clay), or a combination of the two. Biofilters should be designed by professional engineers. Properly designed and maintained biofilters, regardless of the choice of medium, can achieve odour removal efficiencies in excess of 90%. However, unlike other treatment systems, conditions within the biofilter are continuously changing due to ongoing microbial action, climatic conditions and changes in the composition of the odorous air. Maintaining high odour removal efficiency requires that the biofilter be routinely monitored. **Any performance deficiencies identified should be immediately corrected.**

Biofiltration alone may not be sufficient to treat gases with high concentrations of ammonia, or reduced sulphur compounds, which are relatively insoluble. Technical literature suggests that ammonia removal efficiencies of biofilters are reduced with higher ammonia concentrations in the incoming gas stream. This may be attributed to toxification of the filter media due to a build-up of ammonia. As well, a significant acclimatization period may be required to develop a population of nitrifying bacteria. Chemical scrubbing to remove ammonia may be a required pre-treatment.

Chemical Scrubbing:

Odorous air is passed through either mist or packed towers, where one or more soluble compounds in a gas mixture are absorbed into a scrubbing liquid. Typically dissolution is followed by chemical reactions that may neutralize odorous compounds. However, it should be noted that chemicals in scrubbers can potentially increase odour emissions on low concentration sources.

Bioscrubbing:

Odorous air is bubbled through a biologically active slurry where odorous compounds are biologically oxidized into non-odorous forms. An example of bioscrubbing is the use of compost exhaust air for aeration at a wastewater treatment plant.

Thermal Destruction:

Incineration, or thermal oxidation, has been shown to eliminate nearly 100% of the odorous compounds present in odorous air. The main drawback with incineration is the energy requirement and cost. Variations of incineration technology include recuperative incinerators and catalytic incinerators. Recuperative incinerators use heat exchangers to preheat the odorous air or to recover energy for other uses. Catalytic incinerators have a bed of catalyst material immediately following the flame area. The catalyst increases the oxidation reaction rate and enables conversion at lower reaction temperatures than in thermal incinerator units. Typical catalyst materials include platinum and palladium.

Masking and Neutralization:

There are several commercially available formulations marketed as odour treatments. These compounds are one of two basic types:

- counteractants that chemically neutralize odorous compounds
- masking agents (perfumes), to cover compost odours with what is considered to be a more pleasant scent

Counteractants can potentially reduce odour concentrations to a minimum of approximately 100 - 150 OU, due to the odour of the residual compounds. However, because of the complex mix of emissions from composting, there is no guarantee that counteractants will be effective. Counteractants should only be used as a temporary abatement measure to address acute odour incidents while longer term solutions are being developed; ongoing reliance on counteractants should not be considered as a replacement for an odour treatment system.

Masking agents attempt to mitigate the impact of an odour by changing its hedonic tone (a measure of pleasantness). However, masking agents add to the overall odour generation rate, and the effect on nearby receptors can be unpredictable. Use of masking agents should not be considered to be part of an odour treatment system, and care should be taken to not exacerbate odour problems.

Other odour treatment systems may also be available.

6.3.3 Dilution and Enhanced Dispersion

Pre-dilution and enhanced dispersion are techniques to alter the dispersive characteristics of emissions from the composting facility, thereby potentially reducing the concentration of odours off-site. However, these techniques do not change the odour emission rate and are not a solution for serious odour problems.

Pre-dilution involves adding non-odorous air to the compost facility air immediately prior to the emission point.

Enhanced dispersion techniques are applicable to point sources of odours (e.g., the outlet of a building ventilation system or odour treatment device). Dispersion can be enhanced by increasing stack height, increasing exit velocity, providing reheat to increase thermal buoyancy and providing forced dilution with ambient air.

Things to avoid:

- locating the plume within the zone of building or stack downwash
- low velocity discharges from the sides or roofs of buildings
- using rain caps on roof ventilators
- low stack velocity
- nearby topographical influences such as hills and valleys
- relocation of an odour impact by altering the stack design

6.4 FACILITY MANAGEMENT FOR ODOUR CONTROL

6.4.1 Odour Sources

For the purpose of odour control, it is useful to consider odour sources to be all areas of the facility where odorous compounds are potentially generated. This includes both release within an enclosure such as a building or vessel, and release to the atmosphere, and applies to all components of the operation from receipt of feedstock and amendment material to emissions from an air treatment system.

Successful odour control requires:

- a complete inventory of all potential odour sources at the facility
- an understanding of the nature of odours generated by each source
- an understanding how different odours interact and contribute to overall facility odour
- operational measures to minimize the odour source where possible and necessary
- application of an effective control system for the odour source

Table 6.0 lists important odour sources common to many composting facilities. A facility may have additional odour sources.

TABLE 6.0 - Potential Odour Sources (there may be other odour sources not listed here)

Source	Description	Corresponding Emission Control
OUTDOORS		
Access Roads and Pad Areas	<ul style="list-style-type: none"> Odours released by waste on roadways from truck spills and carry over from tipping floor 	<ul style="list-style-type: none"> Frequent cleaning of roadways and surfaces
Inbound/Outbound Trucks	<ul style="list-style-type: none"> Odours released by trucks in queue on the tipping floor 	<ul style="list-style-type: none"> Keep trucks clean Loads should be secure and fully covered and contained
Receiving Area	<ul style="list-style-type: none"> Odours released as materials dumped out of trucks 	<ul style="list-style-type: none"> Limit highly odorous feedstocks Minimize shipping distances and wait times
Pre-processing Area	<ul style="list-style-type: none"> Odours released by debugging and grinding operations etc. 	<ul style="list-style-type: none"> Limit activities to periods with favourable wind conditions, if possible, and ensure quick incorporation of odorous feedstocks
Active Composting Area	<ul style="list-style-type: none"> Odours released during handling Odours from active or passive ventilation of compost 	<ul style="list-style-type: none"> Limit activities to periods with favourable wind conditions Ensure the composting process is properly managed
Curing Pad	<ul style="list-style-type: none"> Odours released during handling Odours from passive ventilation of compost 	<ul style="list-style-type: none"> Limit activities to periods with favourable wind conditions Cover the pile with woodchips or compost
Product Finishing and Storage Pad	<ul style="list-style-type: none"> Odours released during screening Odours released during product loading Odours released from passive aeration 	<ul style="list-style-type: none"> Limit activities to periods with favourable wind conditions Cover the pile with woodchips or compost
Stormwater Pond	<ul style="list-style-type: none"> Odours from decomposition of dissolved and suspended organic material 	<ul style="list-style-type: none"> Aeration
Odour Control System Outlet	<ul style="list-style-type: none"> Odours may pass through untreated, or the system itself may generate odours (e.g. biofilter media) 	<ul style="list-style-type: none"> Ongoing monitoring and maintenance
INDOORS		
Receiving Area (tipping floor)	<ul style="list-style-type: none"> Odours released as materials dumped out of trucks 	<ul style="list-style-type: none"> Limit highly odorous feedstocks Minimize shipping distances and wait times Control process air via odour control technology (e.g., biofilter) Control fugitive emissions via closed doors and negative pressure
Pre-processing Area	<ul style="list-style-type: none"> Odours released during handling 	<ul style="list-style-type: none"> Control process air via odour control technology (e.g., biofilter)
Composting Vessel	<ul style="list-style-type: none"> Odours released from process air from compost bed Odours released during mechanical agitation of compost 	<ul style="list-style-type: none"> Control fugitive emissions via closed doors and negative pressure
Load Out Area	<ul style="list-style-type: none"> Odours released from mechanical unloading of vessel 	
Curing Pad	<ul style="list-style-type: none"> Odours released during handling and passive ventilation 	

6.4.2 Assessing Feedstock Odour Potential

Odours released during feedstock receiving and pre-processing operations can be stronger and more offensive than odours released during the composting process.

Feedstock materials received in plastic bags, or in certified compostable bags, can be a particularly troublesome source of odours at compost facilities. The collection of organic wastes in plastic bags or sealed bins or carts may interfere with oxygen flow and create uncontrolled anaerobic digestion of the materials, which can create significant odours, often before the materials even arrive at the facility. The potential for odours is especially great where there is a long travel time between the collection point and the composting facility. It is essential that materials are collected and delivered to the composting facility in a timely manner.

Facilities that receive materials with a high potential for odours (e.g., food waste, animal waste and organic materials that are not delivered the same day they are collected and/or are in an anaerobic condition) require suitable management techniques and/or odour control systems to minimize the risk of off-site odour impacts

Upon application for approval, proponents will typically be required to demonstrate to the Director that the design and operation of the facility is adequate to deal with the expected feedstock odour potential.

Management of feedstock:

1. All wastes should be incorporated into the composting process as soon as possible.
 - a. Highly putrescible wastes including food wastes, biosolids and manures should be incorporated into the active composting process within 24 hours of receipt.
 - b. Less putrescible wastes such as most leaf and yard wastes should be on site for no more than **four days** before entering the active composting process.
 - c. Brush, brown leaves, and wood may be stored on site longer, to allow them to be used as a bulking agent and amendment material as needed.
2. Wet or odorous material should only be accepted at the site if it can be incorporated into the process promptly and processed by the system without the release of offensive odours.
3. If the waste cannot be processed immediately, then immediately adding bulking or drying agents, or covering wet or odorous material with compost or high-carbon absorbent materials (such as woodchips, sawdust or shredded paper) may help to reduce odours.
4. To reduce the potential for odours, care should be taken when developing the compost “recipe” to not overburden the mixture with highly putrescible wastes.
5. Operational procedures should be developed to minimize the release and impact of odours at all stages of handling and processing.
6. Operational and maintenance procedures should be developed, consistent with manufacturer or supplier recommendations, to ensure effective and consistent operation of odour control equipment; operation and/or maintenance contracts with equipment suppliers, if available, are recommended, versus in-house operation and maintenance.

Odour Precursors

Knowledge of the presence of chemical precursors for the formation of odorous compounds can

be used to assess the odour potential of a feedstock. Odour precursors include:

- Nitrogen, which is the precursor for the formation of ammonia, amines and indole, and which is in high proportion in materials such as grass clippings, manure, biosolids, fish, meat, mixed food waste and many food processing wastes.
- Sulphur, which is the precursor for the formation of organic sulphides, mercaptans and hydrogen sulphide, and which is contained in materials such as manure, in particular poultry manure, biosolids and mixed food waste.
- Rapidly degrading carbohydrates and fats, which are the precursors for the formation of volatile fatty acids.

Knowledge of the degradability of a feedstock can also be applied to assess its odour potential. The oxygen demand of an abundance of rapidly decomposing material may outpace the rate at which oxygen can be replaced by aeration, leading to anaerobic conditions and the formation of new odorous compounds.

6.4.3 Odour Source Identification

The Odour Prevention and Control Plan should include a complete inventory of potential odour sources. Potential odour sources common to many composting facilities are presented in Table 6.0. The potential odour source inventory can be used as a guide to focus odour reduction efforts.

6.4.4 Nutrients and Moisture

The importance of nutrient balance in odour avoidance is discussed in Part II, section 4.1.2.1.3 of this Guideline.

Feedstocks vary in their potential as a source of odours. Knowledge of the physical and chemical characteristics of the feedstock can help identify materials requiring special handling.

Special attention should be paid to the following feedstock characteristics:

Carbon to Nitrogen Ratio:

An abundance of nitrogen relative to degradable carbon will promote the formation of volatile forms of nitrogen, such as ammonia. Total nitrogen content, not specific nitrogen compounds, is significant because the nitrogen is readily available. Ammonia (NH_3) is volatile, while ammonium (NH_4^+) is not. $\text{NH}_3/\text{NH}_4^+$ equilibrium is determined by pH and temperature. The equilibrium point is close to neutrality. A pH below neutral results in high ammonium while a pH above neutral results in high ammonia and ammonia volatilization. To reduce formation of volatile nitrogen compounds, it is necessary to ensure that the C:N ratio of the blended feedstock is not less than 25:1, as described in Part II, section 4.1.2.1.3 of this Guideline.

Carbon to Sulphur Ratio:

An abundance of sulphur relative to degradable carbon will promote the formation of volatile reduced sulphur compounds, such as hydrogen sulphide. Sulphur is primarily contained in amino

acids and to a lesser extent in other organic molecules. Reduced sulphur compounds, resulting from anaerobic processes, have been linked to odour problems at many composting facilities. To reduce the formation of volatile sulphur compounds, the C:S ratio of the blended feedstock should be greater than 100:1.

High Moisture Content:

Some organic wastes can have moisture contents in excess of 80%. These wastes present special management problems as they:

- tend to compact under their own weight making them less porous and difficult to aerate
- generate leachate
- can be difficult to handle
- require drying or addition of dry amendments

For example, cafeteria food wastes or grocery store wastes often have a very high moisture content.

6.4.5 Site Management

Odour prevention principles must be incorporated into overall site management practices. Management activities must ensure that the facility is maintained in a clean and orderly state. Suggested management activities include:

- inspection and rejection of loads with strong, offensive odours, at facilities with outdoor receiving or tipping areas
- developing operational procedures to manage rejected loads
- minimizing on-site storage of feedstocks
- washing equipment and surfaces that contact waste with detergent (preferably biodegradable)
- preventing ponding of leachate
- maintaining aerobic conditions in a run-off storage pond
- removing residual wastes from the site promptly

6.4.6 Operational Controls

Managing odour is a function of maintaining the composting mass in an aerobic state. At an outdoor facility, it is critical to understand a site's ability to disperse odour. This will ultimately dictate the intensity of processing activities.

For enclosed facilities it is important to ensure that odour abatement equipment, such as biofilters, are in good working order. As well, it is important to minimize "fugitive emissions" (i.e., those emissions not captured by odour abatement equipment). These types of emissions can occur from opening doors for incoming/outgoing vehicles, and other similar activities. Their impact can be minimized by ensuring that a building's aeration system is under sufficient negative pressure to prevent the outflow of odorous air, and by installing an air-locked vehicle receiving area.

6.4.7 Monitoring Meteorological Conditions

Potential odour releasing activities, such as windrow turning, should be avoided during unfavourable meteorological conditions that minimize natural dispersion. Often, meteorological conditions during the early morning and early evening are most stable and can tend to concentrate odours at ground level. Therefore, it may be advantageous to conduct turning operations at mid-day when the atmosphere tends to be more turbulent and provides better odour dispersion.

When all odour generating sources are assessed, odour dispersion modelling can be used to identify unfavourable, or 'worst case' meteorological conditions. An on-site weather station can be useful for day-to-day operations to identify unfavourable and favourable meteorological conditions.

6.4.8 On and Off-Site Odour Monitoring

On-site monitoring should include both routine monitoring by facility staff to identify odorous situations on a daily basis (although it is important to note that employees that are regularly exposed to odours can become de-sensitized). On-site monitoring can provide useful feedback on the effectiveness of site management activities and process control measures. Odorous situations should be noted in the daily site log, and the causes analyzed to prevent repeat occurrences.

A program of periodic sampling and analysis of the treatment system emissions is strongly recommended.

If odour problems have been identified (e.g., through public complaints), it may become necessary to increase the monitoring frequency and determine the odour concentration of the input air, to determine whether the removal efficiency of the treatment system is within an acceptable range.

Ambient sampling and analysis of odour to determine specific ambient odour concentrations is impractical. However, ambient odour monitoring can be used to estimate the off-site odour impact. This can also be verified by the frequency and number of complaints received from nearby residents. Residents should be provided with a contact phone number at the facility should they detect odour attributed to the composting operations. **Facility management should be prepared to respond quickly to odour complaints.**

APPENDIX 1: GLOSSARY

Active Composting - The phase of the composting process in which the blended feedstock is subjected to controlled conditions to facilitate thermophilic aerobic decomposition.

Adverse Effect - Under EPA section 1 "adverse effect" means one or more of:

- (a) impairment of the quality of the natural environment for any use that can be made of it,
- (b) injury or damage to property or to plant or animal life,
- (c) harm or material discomfort to any person,
- (d) an adverse affect on the health of any person,
- (e) impairment of the safety of any person,
- (f) rendering any property or plant or animal life unfit for use by man,
- (g) loss of enjoyment of normal use of property, and
- (h) interference with the normal conduct of business.

Aerated Static Pile - A composting method whereby a static compost pile or windrow is constructed over a grid of perforated piping and a layer of bulking agent (such as wood chips) and/or compost. Fans are used to force (inject) or draw (induct) air into the pile and support aerobic decomposition. The pile may be topped with a layer of compost and/or wood chips to filter odorous compounds and to provide insulation thereby maintaining a temperature adequate to destroy pathogens.

Aerobic - Composting conditions characterized by the predominance of micro-organisms that require the presence of oxygen.

Agricultural Waste - In Regulation 347, section 1, under the EPA, "agricultural waste" means waste generated by a farm operation activity, but does not include:

- (a) domestic waste that is human body waste, toilet or other bathroom waste, waste from other showers or tubs, liquid or water borne culinary waste,
- (b) waste from a sewage works to which section 53 of the Ontario Water Resources Act applies,
- (c) a dead farm animal within the meaning of Ontario Regulation 106/09 (Disposal of Dead Farm Animals) made under the Nutrient Management Act, 2002 or a regulated dead animal within the meaning of Ontario Regulation 105/09 (Disposal of Deadstock) made under the Food Safety and Quality Act, 2001,
- (d) inedible material within the meaning of Ontario Regulation 31/05 (Meat) made under the Food Safety and Quality Act, 2001, or
- (e) any material that is condemned or derived from a carcass at a registered establishment within the meaning of the Meat Inspection Act (Canada);

A "farm operation" activity means:

1. Growing, producing or raising farm animals.
2. The production of agricultural crops, including greenhouse crops, maple syrup, mushrooms, nursery stock, tobacco, trees and turf grass.
3. The processing, by the operator of the farm operation, of anything mentioned in paragraphs 1 and 2, where the processing is primarily in relation to products produced from the agricultural, aquacultural or horticultural operation.

4. The use of transport vehicles by the operator of the farm operation, to transport anything mentioned in paragraphs 1 and 2, where the use of transport vehicles is primarily in relation to products produced from the agricultural, aquacultural or horticultural operation;

Amendment - Amendment, when referring to compost, means supplemental material added during composting or to compost to provide attributes required by certain customers, such as product bulk, product nutrient value, product pH, and blends of soil materials. Amendment also means, any material, such as compost, lime, gypsum, sawdust, or synthetic conditioners that is worked into the soil to make it more productive.

Anaerobic - Conditions characterized by the predominance of micro-organisms that thrive in the absence of oxygen.

Anaerobic Digestion Facility - An organic waste processing facility that involves a process of microbial decomposition of organic waste, in the absence of oxygen, that produces liquid and solid “digestate”, and biogas.

Biodegradable Material - Organic materials that can be broken down by naturally-occurring bacteria and other micro-organisms, usually in the presence of moisture and oxygen, into simple, stable compounds.

Biosolids - includes:

Sewage Biosolids - Solid or semi-solid residue from a sewage treatment works (licensed under the OWRA) following treatment of sewage and removal of effluent.

Pulp and Paper Biosolids - Solid or semi-solid residue from the primary and secondary treatment of wastewater from the manufacture of pulp and paper, recycled paper or products such as corrugated cardboard.

Bulk Density - A characteristic of feedstock mix or compost, measured by dividing the mass of the material by the volume of the material.

Bulking Agent - Bulking agent means material, usually carbonaceous, such as wood chips or shredded yard trimmings, added to a compost system to maintain airflow by reducing settling and compaction.

Certified Compostable - A product, package or bag that has been officially endorsed as compostable under a third party operated accredited certification program, in accordance with specified criteria.

Compost - Compost is a stabilized humus that is a solid, mature product produced by an aerobic composting process that meets the Standards.

Composting - In Regulation 347 of the EPA “composting” means the treatment of waste by aerobic decomposition of organic matter by bacterial action for the production of stabilized humus.

Contaminant - Under EPA section 1 "contaminant" means any solid, liquid, gas, odour, heat,

sound, vibration, radiation or combination of any of them resulting directly or indirectly from human activities that may cause an adverse effect. "Contaminant" is also used in this Guideline to refer to foreign materials (such as dirt, heavy metals, plastic scraps etc.) that make it more difficult to compost a feedstock, or reduce the value of the final compost.

Director - Within the meaning of section 20.3 of the Environmental Protection Act, R.S.O. 1990.

Domestic Septage - Domestic sewage from a holding tank or septic tank that is only human body waste, toilet or other bathroom waste, waste from showers or tubs, liquid or water borne culinary or sink waste or laundry waste.

Enclosed Composting - A diverse group of composting methods in which composting materials are completely contained in a vessel, building or enclosed structure at all times, designed to be operated under negative pressure at all times, from receipt of feedstock until the compost is ready for curing. The purpose of the enclosure is to help maintain optimal conditions for composting, and to contain and control odorous process air emissions, and treat the air to remove odours before release.

Endotoxin - A toxin that forms an integral part of the cell wall of gram-negative bacteria that is only released upon destruction of the bacterial cell, that may cause acute illness such as flu-like symptoms and chronic illness such as chronic bronchitis, depending on the bacterial species and the health of the infected person.

Feedstock - Feedstock means waste that contains the primary biologically decomposable organic materials used for the production of compost. Supplements including additives, amendments and bulking agents are not feedstock.

Fertilizer - Natural or synthetic material used to add nutrients to soil. Most chemical fertilizers contain a defined mixture of nitrogen (N), phosphorus (P) and potassium (K).

Foreign Matter - Any matter resulting from human intervention and made up of organic or inorganic components such as metal, glass, or plastic that may be present in compost. Foreign matter does not include mineral soils, woody material, and rocks.

Sharp Foreign Matter - Any foreign matter that may cause damage or injury to humans and animals during or resulting from its intended use. Sharp foreign matter may consist of, but is not limited to, the following: metallic objects or pieces of metallic objects (for example utensils, fixtures, electrical wiring, pins, needles, staples, nails, bottle caps), glass and porcelain or pieces of glass and porcelain (for example, containers, dishes, glass panes, electric light bulbs and tubes, mirrors).

Leachate - The liquid which passes through (and, on occasion, out of) a compost pile as the result of rain and other water percolating through the composting material.

Leaf and Yard Waste - Includes waste consisting of natural Christmas trees and other plant materials, but not tree limbs or other woody materials in excess of seven centimetres in diameter.

Maturity - A condition of compost that results from the thorough decomposition of the feedstock materials, and as a result exhibits very limited biological activity, which enables the compost to be stored and handled without adverse effect, including offensive odours, and can be used

without risk to plants from residual phytotoxic compounds.

Mesophilic Phase - A period in the composting process, following the thermophilic phase, characterized by the predominance of micro-organisms that thrive at a temperature range of 20°C to 45°C.

Municipal Waste (in Reg. 347 under the EPA) - means:

- (a) any waste, whether or not it is owned, controlled or managed by a municipality, except,
 - (i) hazardous waste,
 - (ii) liquid industrial waste, or
 - (iii) gaseous waste, and
- (b) solid fuel, whether or not it is waste, that is derived in whole or in part from the waste included in clause (a).

Organic Soil Conditioning - In section 1 of Regulation 347 made under the EPA “organic soil conditioning” means the incorporation of “processed organic waste” (as defined in Regulation 347 made under the EPA) in the soil to improve its characteristics for crop or ground cover growth.

Organic Soil Conditioning Site - A site which has an ECA authorizing the incorporation of processed organic waste in the soil.

Organic Waste - Waste containing carbon-based compounds. In the context of composting, the term is often used in a more restrictive sense to refer specifically to biodegradable, compostable wastes of plant or animal origin, such as food scraps, grass clippings, yard wastes, etc. but excluding lumber, plastic, rubber, oils and other hydrocarbons, and other organic chemicals.

Pathogens - Organisms, including some bacteria, viruses, fungi, and parasites, that are capable of producing an infection or disease in a susceptible human, animal, or plant host.

Quality Assurance (QA) - A system of activities and procedures that allows the producer of a product (i.e., data) to demonstrate that it is constantly producing a product of definable quality. QA consists of those activities that assure that all necessary quality control activities were defined and carried out according to protocol. QA is primarily a supervisory responsibility.

Quality Control (QC) - A description of specific activities conducted for the purpose of maintaining quality in sample collection, analysis, and recording. QC is primarily a scientific or technical function performed by research or technical staff.

Quality Management (QM) - The process of ensuring that a full and complete QA and QC program is established, that proper evaluation of the total program occurs, and that appropriate actions are taken when satisfactory quality is not being achieved. QM involves the specification of what constitutes acceptable quality, the detailing of the means by which it is determined that the specified quality has been achieved, and the defining of what actions will be taken when the desired quality is not met. QM is normally the responsibility of project management.

Semi-enclosed Composting - Composting methods in which composting materials are contained in a vessel or other enclosure (such as a textile cover) for most of the processing time, from receipt of feedstock until the compost is ready for curing. The purpose of the enclosure is to help maintain optimal conditions for composting, and to contain and control odorous process air

emissions, and treat the air to remove odours before release.

Sensitive Receptor - Any location where routine or normal activities occurring at reasonably expected times would experience adverse effect(s) from odour (or other) discharges from the facility, including one or a combination of:

- (a) private residences or public facilities where people sleep (e.g., single and multi-unit dwellings, nursing homes, hospitals, trailer parks, camping grounds);
- (b) institutional facilities (e.g., schools, churches, community centres, day care centres, recreational centres);
- (c) outdoor public recreational areas (e.g. trailer parks, play grounds, picnic areas); and
- (d) other outdoor public areas where there are continuous human activities (e.g., commercial plazas, office buildings).

Sewage - Under the OWRA, “sewage” includes drainage, stormwater, commercial wastes and industrial wastes, and such other matter or substance as is specified by the regulations.

Sludge - An untreated semi-solid substance consisting of settled sewage solids combined with varying amounts of water and dissolved materials generated from municipal or industrial wastewater treatment plants.

Soil Conditioner - Any material added to the soil to beneficially enhance the soil's physical or chemical properties or biological activity.

Source Separation - Use of this term in this document refers to the segregation of used organic materials from municipal waste at the point of generation to facilitate composting.

Specified Risk Material - In Regulations Respecting the Regulation and Control of Agricultural Fertilizers made under the federal Fertilizers Act “specified risk material” means the skull, brain, trigeminal ganglia, eyes, tonsils, spinal cord and dorsal root ganglia of cattle aged 30 months or older, and the distal ileum of cattle of all ages, but does not include material from a country of origin as defined in section 2 of the Health of Animals Regulations, or a part of a country of origin, that is designated under section 7 of those Regulations as posing a negligible risk for Bovine Spongiform Encephalopathy.

Stability - The term ‘stability’ is sometimes used interchangeably with ‘maturity’. However in it’s generally accepted meaning, ‘stability’ refers only to reduced biological activity. It is a subset of maturity. Compost could appear stable as a result of a nutrient imbalance or lack of moisture, and not extensive decomposition, and could become ‘unstable’ if any of the limiting conditions are removed. All mature compost is stable, but not all stable compost is mature.

Substrate - A blend of feedstocks in the active composting stage and not yet compost.

Thermophilic Phase - A period in the composting process characterized by the predominance of active micro-organisms that thrive at a temperature range of 45°C to 75°C.

Waste - Under the EPA Part V section 25 “waste” includes ashes, garbage, refuse, domestic waste, industrial waste, or municipal refuse and other such wastes as are designated in the regulations.

Windrow Composting - A composting method whereby the material to be composted is stacked

into elongated piles with a triangular cross-section. Both turned and static windrow systems are used for composting. In the former, the windrows are periodically torn down and reconstructed or turned mechanically (the outside layer of the original windrow becoming the interior of the rebuilt windrow) to aerate and mix the organic wastes, speed the decomposition process, and reduce odours.

Wood - Wood suitable for composting generally includes lumber, tree trunks, tree branches or other similar woody material. Wood does not include material that is contaminated by glue, paint, preservatives or other materials or attached to non-wood material (e.g., particle board, chip board, plywood).

APPENDIX 2: KEY ENVIRONMENTAL LAWS THAT MAY RELATE TO COMPOSTING

A2.0 ENVIRONMENTAL PROTECTION ACT

Part V of the EPA and Regulation 347 set out requirements for handling, storing, managing, and disposing of waste. Feedstock in a composting process is waste as defined under this legislation. Unless otherwise exempt, a composting facility will require an environmental compliance approval (ECA) for a Waste Disposal Site (Processing) under section 27 (1) (b) of the EPA.

section 9 of the EPA regulates the discharge of a contaminant into any part of the natural environment other than water. Unless otherwise exempt, composting facilities will also require a ECA (Air) under section 9 of the EPA where there is a direct discharge of contaminants into the natural environment.

In addition, an ECA for a Waste Management System under section 27 (1) (a) of the EPA is required by the owner of vehicles transporting waste materials. This includes transporting wastes from a source to a licensed composting facility with an ECA, and from a licensed composting facility with an ECA to another location.

Some composting operations are exempt from some aspects of the EPA and Regulation 347. For example, O. Reg. 101/94 – *Recycling and Composting of Municipal Waste* – made under the EPA, provides an exemption from the requirement to obtain a waste ECA when composting only leaf and yard waste, if certain conditions are met. Facilities that are exempt from Regulation 347 or from section 27 approval requirements under the EPA are still subject to the general provisions of the EPA. Therefore, even if the site is exempt, operators are strongly encouraged to manage their sites in accordance with good practices as described in this document.

“Agricultural wastes” as defined in Regulation 347 are generally exempt from Part V of the EPA and Regulation 347. On-farm composting of agricultural wastes does not require approval from the ministry.

Under Regulation 347, dead farm animals are not included in the definition of agricultural waste and are therefore not generally exempt; however, the following activities are exempt from approval requirements under the EPA

- on-farm composting of dead farm animals, regulated by O. Reg. 106/09 (Disposal of Dead Farm Animals) under the NMA, and
- off-farm composting of dead animals by a licensed compost facility operating under O. Reg. 105/09 (Disposal of Deadstock Regulation) under the Food Safety and Quality Act, 2001.

Where agricultural waste is received by a compost facility with an ECA under the EPA, it must be managed according to the requirements of the ECA.

The framework under Regulation 347 provides exemptions for the transport and use of compost that meets certain criteria. More information about compost categories and exemption criteria is included in Part II of the Standards.

Questions about ECAs can be directed to the appropriate ministry's regional, district or area office, or the Environmental Approvals Access and Service Integration Branch.

A2.1 ONTARIO WATER RESOURCES ACT (OWRA)

Composting facilities (especially those that are not enclosed in a building), often generate stormwater and leachate (sewage), which must be properly managed.

'Sewage', as defined under OWRA section 1, includes drainage, storm water, commercial wastes and industrial wastes and such other matter or substance as is specified by regulations. Approval under section 53 of the OWRA is generally required for any sewage works established, altered, extended or replaced. Sewage works would normally be necessary for any facility that directly discharges sewage to a receiving water body, directly to the ground, or into the subsurface. A permit to take water may also be required if the site is not serviced. The ministry's district staff should be consulted for further information on the OWRA.

A2.2 NUTRIENT MANAGEMENT ACT, 2002 (NMA)

The NMA protects Ontario's natural environment through the regulation and management of livestock manure and other nutrients that are stored on farm properties or applied to agricultural land. The General Nutrient Management Regulation O. Reg. 267/03 provides clear requirements for environmental protection by Ontario's agricultural industry, municipalities and other generators and receivers of materials that contain nutrients.

O. Reg. 267/03 establishes standards for the management of materials containing nutrients. The preparation of Non-agricultural Source Material (NASM) Plans, Nutrient Management Plans (NMP) and Nutrient Management Strategies (NMS) are key requirements of the regulation. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and the Ministry of the Environment are jointly responsible for overseeing the NMA. OMAFRA works closely with farmers, and is responsible for training, education and approvals. The Ministry of the Environment is responsible for compliance and enforcement activities.

A2.3 CLEAN WATER ACT, 2006 (CWA)

The purpose of this Act and its regulations is to protect existing and future drinking water sources through a collaborative and locally driven multi-stakeholder process. Under the CWA, Source Protection Committees (SPCs) including municipalities, conservation authorities and other key stakeholders, identify and assess risks to the quality and quantity of drinking water sources, and develop plans to manage those risks.

For each source protection area, the SPC completes an assessment report that identifies vulnerable areas in the watershed and identifies activities within these areas that pose risks to sources of drinking water. Vulnerable areas include:

- wellhead protection areas (areas around groundwater wells),
- intake protection zones (areas around surface water intakes),

- areas of significant groundwater recharge, and
- highly vulnerable aquifers.

A determination of whether an activity poses a significant risk will be dependent on whether the activity:

- is located within a vulnerable area,
- uses, stores, or produces chemicals or pathogens, or
- impacts the quantity of water available within an aquifer or surface water body.

If the scientific assessment shows that an activity is located in one of the above vulnerable areas and poses a significant risk to a drinking water source, then the SPC and local community must develop policies to manage each of those significant risks. Policies may range from planning policies, to education and outreach policies, to developing a risk management plan. Existing measures that manage the risks would be taken into account when setting or implementing these policies.

A2.4 ENVIRONMENTAL ASSESSMENT ACT (EAA)

The EAA sets out a planning and decision-making process to evaluate the potential environmental effects of a proposed undertaking. Proponents wishing to proceed with an undertaking must document their planning and decision-making process and submit the results of their environmental assessment (EA) to the Minister of the Environment for approval.

The purpose of the EAA is to provide for the protection, conservation and wise management of Ontario's environment. To achieve this purpose, the EAA promotes responsible environmental decision-making and ensures that interested parties have an opportunity to comment on undertakings that may affect them. The EAA defines the 'environment' broadly to include the natural, social, cultural, economic and built environments.

O. Reg. 101/07, Waste Management Projects, prescribes the EA requirements for different types of waste management projects. The regulation, with its companion guide streamlines the EA process for waste management undertakings that have predictable environmental impacts that can be readily mitigated. Waste processing facilities (which include composting sites) that transfer for final disposal, an annual average of 1,000 tonnes of residual waste per day or less, do not require an EA under this regulation.

For further information on the EA process, staff at the ministry's Environmental Approvals Access and Service Integration Branch should be consulted.

A2.5 ENVIRONMENTAL BILL OF RIGHTS, 1993 (EBR)

The EBR requires that the ministry, on behalf of the Government of Ontario, maintain a registry of proposals, decisions, and other activities that could affect the environment. The purpose of the "Environmental Registry" is to allow the public to participate in the making of environmentally significant decisions by prescribed ministries.

Under the EBR, proposals to issue certain instruments (e.g., environmental compliance approval,

unless otherwise exempt) must be posted on the registry for public review and comment for a minimum of 30 days before issuance, if implementation could have a significant effect on the environment. Instruments that are issued to implement a project that is approved or exempted under the EAA are not subject to the consultation requirements under the EBR.

Where a proposal is posted on the Environmental Registry, the ministry must consider all comments received when making decisions and include a summary of its considerations of those comments when posting a Notice of Decision.

A proposal for a compost facility approval is considered a Class II proposal under the EBR. Class II proposals may have additional notice and public participation requirements beyond the Environmental Registry posting. Proponents are encouraged to consult with their district office on this matter

APPENDIX 3: OTHER RELEVANT REGULATIONS AND STANDARDS

Federal Fertilizers Act

The Fertilizers Act is the legislative authority under which the Canadian Food Inspection Agency regulates and monitors fertilizers and supplements sold or imported into Canada. This protects the farmer and the general public against potential health hazards and fraud in marketing as well as ensuring a fair marketplace. It therefore regulates compost when sold either as an amendment to soil, or as a fertilizer with plant nutrient claims.

Some fertilizers and supplements are exempt from the Act and its Regulations, such as animal and vegetable manures sold in their natural condition, fertilizers and supplements intended and labelled for export, potting soils (unless they claim a nutrient/supplement value) and supplements intended for experimental purposes.

BNQ Industry Compost Quality Standards

The *Bureau de Normalisation du Québec (BNQ)*, acting on behalf of the Standards Council of Canada (SCC), establishes industry standards for adoption by the SCC and allows products that meet their standards to bear seals reflecting high quality. Within the SCC, the BNQ is recognized as having primary responsibility for organic fertilizers and soil supplements. As such, the BNQ is the only standards-writing organization of the SCC accredited to write industry standards for compost.

The BNQ's voluntary compost quality standard is supported by a BNQ certification program to verify the conformance to requirements with the help of independent laboratories accredited by the BNQ. The conformance does not necessarily mean that a product will meet additional requirements of some regulating authorities. It is up to compost producers to verify that their product conforms to existing requirements of regulating authorities.

Canadian Council of Ministers of the Environment (CCME) Guidelines for Compost Quality

The specific goals of the *CCME Guideline* are to:

- protect public health and the environment across Canada;
- encourage source separation of municipal solid waste (MSW) to produce a high quality product;
- produce harmonized compost standards across Canada, while accommodating different groups and interests; and
- ensure consumer confidence through consistent nation-wide product quality standards; and
- ensure that composting is allowed to develop as an important waste/resource management solution, and an environmentally sound industry that diverts valuable organic materials from landfill and incineration.

The *CCME Guideline* applies to compost produced by municipal solid waste or other feedstock as determined by regulatory agencies. It applies to compost that is sold or given away, excluding residential backyard composting and on-farm composting of materials generated on property, under the property owner's control, and for use on property under their control. Compost-based products are not directly targeted by the *CCME Guideline*.

The *CCME Guideline* includes four criteria for product safety and quality: foreign matter; maturity; pathogens; and metals. These standards integrate the concept that exposure is an integral part of risk, by establishing different categories of material (i.e., A and B), on the basis of their safety and quality. The *CCME Guideline* is designed to allow the flexibility necessary for different regulatory agencies to respond to specific local needs and environments.

APPENDIX 4: SELECTED REFERENCES

GENERAL COMPOSTING REFERENCES

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United States Environmental Protection Agency. 1994. *Composting Yard Trimmings and Municipal Solid Waste*, EPA530-R-94-003. (Economic information is outdated.)

The U.S. Composting Council. 1994. *Compost Facility Operating Guide: a reference guide for composting facility and process management*, Alexandria, Virginia.

APPROVALS FOR COMPOSTING FACILITIES

Relevant Legislation – Copies of relevant provincial legislation may be obtained electronically from e-laws at <http://www.e-laws.gov.on.ca/index.html>. Hard copies of Ontario Government publications may be obtained from ServiceOntario for a nominal fee. Please visit their website at <https://www.serviceontario.ca/publications> or contact the ServiceOntario centre at 416-326-5300; 416-325-3408 TTY or 1-800-668-9938; 1-800-268-7095 TTY. **Electronic copies of Ontario legislation and guideline documents (including those listed in the following pages) can be obtained from the ministry's website at www.ene.gov.on.ca.**

RELATED GUIDELINES AND STANDARDS

BNQ. 2005. *Organic Soil Conditioners - Compost*, Bureau de Normalisation du Quebec, CAN/BNQ 0413-200/2005.

CCME. 2005. *Guidelines for Compost Quality*, Canadian Council of Ministers of the Environment, ISBN 1-896997-60-0.

NB. *Guidelines for the Site Selection, Operation and Approval of Composting Facilities in New Brunswick*, New Brunswick Department of Environment.

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Record of Site Condition and its amending regulation (Ontario Regulation 511/09), Ontario Regulation 153/04 made under the Environmental Protection Act.

Recycling and Composting of Municipal Waste, Ontario Regulation 101/94 made under the Environmental Protection Act.

General Nutrient Management Regulation, Ontario Regulation 267/03 made under the Nutrient Management Act, 2002.

SITE SELECTION & DESIGN

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MOE. 1994. *Towards an Ecosystem Approach to Land-use Planning*, Ontario Ministry of the Environment, Environmental Planning and Analysis Branch.

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MOE. 1987. *Guidelines on Erosion and Sediment Control for Urban Construction Sites*, Ontario Ministry of the Environment, PIBS 490.

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The Great Lakes Center for Occupational & Environmental Safety and Health. 1996. *Environmental Characterization of Bio-Aerosol Emissions from the DK Recycling Systems Inc., Composting Facility in Lake Forest Illinois, June 14, 1996*, University of Chicago School of Public Health, Health Hazard Evaluation Report 96-001.

Green Lane Environmental Group Ltd. 1995. *Sarnia Leaf and Yard Composting Site Bioaerosol Control Study*, unpublished.

WATER MANAGEMENT

MOE/MNR. 1993. *Water Management on a Watershed Basis: Implementing an Ecosystem Approach*, Ontario Ministries of the Environment and Natural Resources, ISBN 0-7778-2920-7.

MOE/MNR. 1993. *Subwatershed Planning*, Ontario Ministries of the Environment and Natural Resources, ISBN 0-7778-1518-4.

MOE. 1991. *Stormwater Quality Best Management Practices*, Ontario Ministry of the Environment, J, PIBS 1599.

MOE. 1994. *Stormwater Management Practices Planning and Design Manual*, Ontario Ministry of the Environment, PIBS 3150.

ODOUR PREVENTION AND CONTROL

Biocycle Editorial Staff. 2006. *Odour Management at Composting Facilities*, Biocycle. J.G. Press Inc., Emmaus, PA.

CIWMB. 2007. *Comprehensive Compost Odor Response Project*, Sacramento, CA: Integrated Waste Management Board.

MOE. 2008. *Methodology for Modelling Assessments of Contaminants with 10 Minute Average Standards and Guidelines Under O. Reg. 419/05*, Ontario Ministry of the Environment, PIBS 6700e.

MOE. 2009. *Procedure for Preparing an Emission Summary and Dispersion Modelling Report, Version 3.0 - Guidance for Demonstrating Compliance with Ontario Regulation 419/05 Air Pollution – Local Air Quality, made under the Environmental Protection Act*, PIBS 3614e03.

MARKETING

Alexander, R. 2003. *The Practical Guide to Compost Marketing and Sales*, North Carolina: R. Alexander Associates, Apex.

Tyler, R.W. 1996. *Winning The Organics Game: The Compost Marketer's Handbook*, Alexandria, Virginia: ASHS Press.

COMPOSTING RESOURCES ON THE INTERNET:

The Compost Council of Canada: www.compost.org

Cornell University – Composting (managed by the Cornell Waste Management Institute):
www.css.cals.cornell.edu

APPENDIX 5: SAMPLE COMPLAINT FORM

COMPLAINT RECEIPT

Complaint Received		Complainant	
Date:		Name:	
Time of incident:		Address:	
Time reported to facility:		Phone:	
Date and time reported to MOE (if applicable):			
<p>Details (e.g., type of complaint; for an odour complaint, description of the odour, including odour intensity based on a scale of 1-10, with 10 being the strongest):</p>			
Meteorological Conditions			
Temperature:		Cloud Cover:	
Wind Speed:		Full Partial None	
Wind Direction:		Precipitation:	
<p>Site Activities (windrow turning, waste receipt, screening etc.):</p>			
Response			
Actions taken to remediate cause of complaint:		Follow Up Call:	
Action to prevent recurrence:			

