Ontario Compost Quality Standards

July 25, 2012

Ontario

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Last Revision Date: July 25, 2012

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PIBS 8412

Ministry of the Environment

Ontario Compost Quality Standards

SUMMARY

The Ontario Ministry of the Environment (ministry or MOE) has prepared revised standards for aerobic composting of organic waste materials, supported by regulatory amendments. *Ontario Compost Quality Standards* (Standards) updates and replaces, except as explained below, 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.

Some environmental compliance approvals (ECAs) issued under Part II.1 of the Environmental Protection Act (EPA) before January 1, 2013 incorporate the Interim Guidelines in whole or in part. Where a facility's ECA was issued before January 1, 2013, and the facility operator wishes to take advantage of the new compost categories, the standards for metals in compost, the quality of feedstock and pathogens in the Standards must be met. This means conditions in the ECA that deal with standards for metals in compost, the quality of feedstock and pathogens, including those that incorporate the Interim Guidelines, would no longer apply. Conditions in the ECA, relating to foreign matter (non-biodegradable particulate matters) and maturity (stability), including those that incorporate the Interim Guidelines, remain in effect until July 1, 2015. After this date, all the requirements in Part II of this document apply.

The Standards set out three categories of compost quality (AA, A and B).

In general, the Standards apply only to aerobic 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, on-site composters, and on-farm composting of agricultural wastes) are beyond the scope of the Standards.

In addition, the Standards do 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).

The standards in this document are referred to in Regulation 347 (General – Waste Management), made under the EPA, and are part of that regulation.

In the event that any information in this document differs from the legislation, the legislation prevails. Anyone relying on this document should ensure that they have the most recent version of Regulation 347 and this document. To ascertain relevant legal obligations beyond those dealt with in this document, or with respect to any other legal question, the interested party should consult a lawyer.

The provisions in Part II are incorporated into Regulation 347 and O. Reg. 267/03 General Regulation made under the NMA, 2002 and, as such, are law. Mandatory language such as "must" and "shall" is therefore used in these provisions.

This document consists of four parts:

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

Part II sets out standards for feedstock and compost, which are implemented through regulation.

Part III includes compost use requirements and considerations.

Part IV includes guidance for feedstock and compost sampling, and laboratory analysis.

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 return nutrients and organic matter to the soil, providing a valuable material for agriculture, horticulture and landscaping.

The purpose of this document is to set environmentally protective standards for the production of compost for beneficial uses.

This document also provides details on the regulatory framework under Regulation 347, which would exempt compost that meets certain compost quality standards from the need for an ECA for use and transport.

1.2 OBJECTIVES

The objectives of the Standards are to:

- set a framework that will increase diversion of waste from disposal by increasing the composting of organic waste,
- prevent negative impacts on the environment by ensuring that compost produced in Ontario meets high standards for quality.

1.3 SCOPE

The Standards apply to compost produced by aerobic composting of non-hazardous organic materials – including food waste, wood, pulp and paper mill biosolids, sewage biosolids and de-watered domestic septage. Compost should be produced with good judgment and significant practical experience in the handling of compostable wastes, the composting process, and marketing of the end product.

Compost to which the Standards apply must meet the compost standards presented in Part II of this document.

The Standards do not apply to compost produced under the following circumstances:

- if the compost is produced from:
  - leaf and yard waste and regulated by O. Reg. 101/94 made under the EPA
  - "regulated dead animals" and "dead farm animals" under the Food Safety and Quality Act, 2001 and the NMA;
  - "specified risk material" (SRM) which is subject to Canadian Food Inspection Agency permitting requirements;

  - residential backyard composting;
- products 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;
- remediation of contaminated soils; information on remediation procedures is contained in Ontario Regulation 153/04 - Record of Site Condition made under the EPA.

The Standards also do not apply to other processes for the treatment of organic wastes such as anaerobic digestion and vermicomposting, or other waste stabilization methods (such as lime stabilization, fermentation, pasteurization), as the pathogen reduction requirements in the Standards are not typically applicable to these processes. Applications for approval for these types of organics processing will be considered on a case-by-case basis.

This document provides some general information on the use of compost on both agricultural and non-agricultural lands. However, a detailed discussion of practices for the use of compost in home and garden, horticultural and agricultural and non-agricultural applications is beyond the scope of this document. Additional information on the application of compost on agricultural lands is available from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) www.ontario.ca/nasm-omafra. Additional information on the application of compost on non-agricultural lands is available from the ministry.

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 legislation that may relate to composting:

- 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 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 Nutrient Management Act, 2002, S.O. 2002, c. 4 (NMA), and Ontario Regulation 267/03 – regulates the application and storage of nutrients, including compost, on agricultural lands.

- The Clean Water Act, 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 some of the environmental legislation administered by the ministry. Composting facilities may be subject to other federal, provincial, or municipal laws, and may require permits or approvals from agencies other than the MOE.

2.1 APPLICATION FOR AN ENVIRONMENTAL COMPLIANCE APPROVAL

Unless otherwise exempt, a composting facility will require one or more environmental compliance approvals (ECAs) to operate.

The ministry requires certain information in order for the Director to process an application and make approval decisions about a proposed facility. The proponent must provide the Director with all requested information, as part of the ECA application. Documentation submitted in support of an ECA application, as well as conditions contained in the ECA issued by the Director, become legally binding on the facility operator.

Information requirements may be modified by the Director, depending on the nature or location of the proposed facility.

Applications for ministry approvals can be obtained from the nearest ministry regional or district office or from the ministry 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 document was produced.

2.2 OTHER JURISDICTIONS

The ministry is not the only agency concerned with the production and use of compost. Several regulatory and voluntary standards for compost production and use have been developed in recent years. In particular, facility operators should be aware of the following compost quality initiatives which are briefly described in Appendix 4:

- 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 STANDARDS

3.0 INTRODUCTION

This Part of the Standards contains mandatory standards for compost including:

- metals in compost,
- quality of feedstock,
- pathogens,
- foreign matter content,
- compost maturity, and
- compost labelling.

The standards for compost quality presented here take into consideration protection of both the environment and human health for long term compost application. As such, it is important that compost always be used in accordance with label limits provided for end users. It is beyond the scope of this document to present any discussion of compost handling and potential adverse human health effects related to compost handling by workers or end users.

These compost standards are used to identify whether compost may be categorized as Category AA, A or B compost. Compost that meets the requirements in this Part for Categories AA and A is exempt from Regulation 347 and Part V of the EPA. See section 3 (2) 25 of Regulation 347[1]. Compost that meets the requirements for Category B in this Part is not exempt from Regulation 347 and Part V of the EPA except where it is applied to agricultural land as a nutrient and satisfies the requirements of O. Reg. 267/03 General Regulation made under the NMA. See section 5.0.2 of Regulation 347.

The compost standards in this part are based on the need to protect the environment, and may not include quality parameters of importance to specific end users of compost. Quality requirements for specific market applications may be more stringent than those indicated in this document. Therefore, meeting the standards in this document does not ensure that compost will meet the needs of specific end users (e.g. nurseries). Part III contains more information on compost use including additional compost quality recommendations (see section 5.0).

Additional recommended criteria (such as nutrient content, pH and salinity) can be found in the BNQ Industry Standard, CAN/BNQ 0413-200/2005, *Organic Soil Conditioners - Compost*.

The Compost Quality Alliance, a voluntary industry program managed by the Compost Council of Canada, may also be able to assist with confirming product quality with respect to specific end uses.

3.1 COMPOST TESTING FOR COMPOST CATEGORIES AA, A AND B

Compost must be tested after the maturation period is complete and prior to release into the marketplace. All analyses for mandatory standards shall be conducted by an accredited laboratory using accredited analytical methods (more information on sampling and analysis can

[1] Note: The first posting of this document on the Ministry's website incorrectly referred to s. 3 (2) 24. The correct reference is s. 3 (2) 25.

be found in Part IV, sections 6 and 7 and appendices 1 and 2). If the compost fails to meet *any one* of the standards set out in Part II of the Standards for a specific category, then the compost will fail to qualify for that category.

See Appendix 1 section A1.1.4, Sample Failure Policy (Re-Testing), for information about re-testing for compost samples that fail to meet the compost standards.

3.2 STANDARDS FOR METALS IN COMPOST

Although low concentrations of some metals can be beneficial to or even necessary for plant growth and development, maximum metal limits are necessary to prevent metal accumulation in soils. Therefore, this document sets out limits on the concentration of regulated metals in compost.

Compost shall be tested for those parameters listed in Table 3.1 and shall be categorized according to the concentrations listed for each metal, as calculated on a dry weight basis:

- Category AA compost must not contain regulated metals in a concentration that exceeds any of the limits set out in Column 2 of Table 3.1;
- Category A compost must not contain regulated metals in a concentration that exceeds any of the limits set out in Column 3 of Table 3.1; and
- Category B compost must not contain regulated metals in a concentration that exceeds any of the limits set out in Column 4 of Table 3.1.

The requirements for sampling and analysis of compost will be set out in the conditions of the facility's ECA. The conditions will generally reflect the guidance provided in Part IV, sections 6 and 7 of this document.

TABLE 3.1 - Maximum Concentration for Metals in Compost

Item	Column 1	Column 2	Column 3	Column 4
	Metal	**Category AA Compost**	**Category A Compost**	**Category B Compost**
		mg/kg dry weight		
1.	**Arsenic**	13	13	75
2.	**Cadmium**	3	3	20
3.	**Chromium**	210	210	1060
4.	**Cobalt**	34	34	150
5.	**Copper**	100	400	760
6.	**Lead**	150	150	500
7.	**Mercury**	0.8	0.8	5
8.	**Molybdenum**	5	5	20
9.	**Nickel**	62	62	180
10.	**Selenium**	2	2	14
11.	**Zinc**	500	700	1850

3.3 QUALITY OF FEEDSTOCK

Table 3.2 identifies limits for the eleven regulated metals in compost feedstock. For Category AA compost, the feedstock must not contain regulated metals in a concentration that exceeds the limits set out in Column 2 of Table 3.2, as calculated on a dry weight basis.

In addition, sewage biosolids, pulp and paper biosolids and domestic septage are not permitted to be used as feedstock material for the production of Category AA compost.

For Category A and B compost, feedstock must not contain metals in a concentration that exceeds Column 3, as calculated on a dry weight basis.

Sewage biosolids, pulp and paper biosolids and domestic septage may be used as feedstock materials for the production of Category A and B compost. In the case of Category A compost production, sewage biosolids, pulp and paper biosolids and domestic septage shall be limited to a maximum of 25% of the feedstock blend (on a dry weight basis).

Information on feedstock and compost sampling and analysis is provided in Part IV, sections 6 and 7.

TABLE 3.2 - Maximum Concentration for Metals in Feedstock

Item	Column 1	Column 2	Column 3
	Metal	Feed for Category AA Compost	Feed for Categories A & B Compost
		mg/kg dry weight	
1.	**Arsenic**	75	170
2.	**Cadmium**	20	34
3.	**Chromium**	1060	2800
4.	**Cobalt**	150	340
5.	**Copper**	760	1700
6.	**Lead**	500	1100
7.	**Mercury**	5	11
8.	**Molybdenum**	20	94
9.	**Nickel**	180	420
10.	**Selenium**	14	34
11.	**Zinc**	1850	4200

3.4 PATHOGENS

In order to reduce the risk of adverse health effects from pathogens, Category AA, A and B compost must meet the criteria specified below, depending on the feedstock source:

1. **For leaf and yard waste only:**

a. The compost shall meet temperature requirements as specified below,

- Using the in-vessel composting method, the material shall be maintained at a minimum temperature of 55 degrees Celsius for at least 3 (three) consecutive days.
- Using the windrow composting method, the material shall be maintained at a minimum temperature of 55 degrees Celsius for at least 15 (fifteen) days. Also, during the high temperature period, the windrow shall be turned at least five times.
- Using the aerated static pile composting method, the material shall be maintained at a minimum temperature of 55 degrees Celsius for at least 3 (three) consecutive days. The pile shall be covered with an insulating layer of material, such as cured compost or wood chips, to ensure that all areas of the feed material are maintained at the required temperature.

OR

b. The compost shall meet the following pathogen reduction requirements:
   - must not exceed 1000 colony forming units (CFU) *E. coli* or most probable number (MPN)/gram total solids (on a dry weight basis), and
   - must not exceed 3 MPN *Salmonella*/4 grams total solids (on a dry weight basis, based on an analysis of the entire 4g sample).

   This requirement applies to each individual sample tested. If one sample fails, re-testing is permitted as described in Appendix 1, section A1.1.4. More information on sampling and analysis is provided in Part IV, sections 6 and 7.

2. For all other materials:

- The compost shall meet BOTH the temperature and pathogen requirements set out in 1.a. and b. above.

The temperature of each composting mass shall be measured **daily** until the requirements above have been satisfied. The days during which the compost, using the windrow composting method, are required to meet the prescribed temperature do not have to be consecutive.

Once these requirements have been met, the temperature shall be measured at least once **weekly** until the compost is cured.

If temperature monitoring shows that the specified minimum time and temperature relationship has not been achieved, the material from the composting process shall be incorporated back into the composting process at the pre-processing stage, or disposed of at a waste disposal site.

Additional requirements for temperature monitoring of compost may be set out in the conditions of the facility's ECA if applicable.

3.5 FOREIGN MATTER

Compost should be virtually free of foreign matter of a size or shape that could reasonably be expected to cause human or animal injury, or damage to equipment. The total foreign matter content and sharp foreign matter content of compost must not exceed the concentrations listed in Table 3.3, as calculated on a dry weight basis.

TABLE 3.3 - Maximum Concentration of Foreign Matter in Compost

Parameter	Category AA	Category A	Category B
Foreign matter	Total foreign matter greater than 3 mm shall not exceed 1.0%, calculated on a dry weight basis, and plastic cannot exceed 0.5%; **and** Compost shall not contain any foreign matter greater than 25 mm per 500 ml.	Total foreign matter greater than 3 mm shall not exceed 1.0%, calculated on a dry weight basis, and plastic cannot exceed 0.5%; **and** Compost shall not contain any foreign matter greater than 25 mm per 500 ml.	Total foreign matter greater than 3 mm shall not exceed 2.0%, calculated on a dry weight basis, and plastic cannot exceed 0.5%; **and** Compost shall not contain any foreign matter greater than 25 mm per 500 ml.
Sharp foreign matter	Compost shall contain no material of a size or shape that can reasonably cause human or animal injury.	Compost shall contain no material of a size or shape that can reasonably cause human or animal injury.	Compost shall have a maximum of 3 pieces of sharp foreign matter per 500 ml; **and** The maximum dimension of any sharp foreign matter shall be 12.5 mm.

More information on sampling and analysis is provided in Part IV, sections 6 and 7.

3.6 MATURITY

Generally, the term "mature" is used in reference to compost that exhibits limited biological activity, and which has degraded to the point where it can be stored and used without risk of odour and adverse effects, such as risk to plants from residual phytotoxic compounds.

'Stability' is different from 'maturity'. 'Stability' generally refers only to reduced biological activity. Compost becomes more stable when it has completed the thermophilic phase of microbial decomposition. However, compost could also appear to be stable as a result of a nutrient imbalance or a lack of moisture, and therefore might not demonstrate extensive decomposition at the time of testing. It could become 'unstable' again if any of the limiting conditions are removed. All mature compost is stable, but not all stable compost is mature.

In order for compost to meet Categories AA, A and B standards for maturity, it must be cured in accordance with the maturity criteria described below. The curing process is considered to have commenced immediately after the final quantity of compost has been discharged from the processing operation and added to the lot of compost to be cured.

The compost shall be maintained at ≥ 40% moisture during curing.

Compost is mature if it:

1. has been cured for a minimum period of 21 days from the day the last portion of material went into the batch, and the respiration rate is:

- less than, or equal to, 400 milligrams of oxygen per kilogram of volatile solids (on a dry weight basis) per hour; or,
- less than, or equal to, 4 milligrams of carbon in the form of carbon dioxide per gram of organic matter (on a dry weight basis) per day.

OR

2. is made from leaf and yard waste only, and has been cured for a minimum period of 6 months.

This standard is a minimum. The Director may require a longer curing period in the ECA, determined on a site-specific basis. Additionally, the Director may require a specific test procedure for measuring respiration.

Part III, section 5.1 provides information on additional maturity indicators that can be used in the field to inform operational decisions.

3.7 LABELLING REQUIREMENTS

Category A compost that is exempt from Part V of the EPA and Regulation 347 does not require an ECA for the use or transport of that material. However, Category A compost should be restricted in its use to minimize accumulation of metals in soil. **All Category A compost that is sold or distributed shall be labelled with the following information:**

- A concise statement on the front of the bag, or in large print on a shipping bill or statement accompanying the shipment where the compost is sold or distributed in bulk, that the product contains domestic septage, and/or municipal sewage biosolids and/or pulp and paper biosolids used as feedstock for the compost, if the feedstock contained any of these materials;

- A statement that sets out the following:

  - the recommended application rate is less than the equivalent of 8 tonnes per hectare (80 kg/100 m^2) per year, on a dry weight basis, or a total of the equivalent of less than 40 tonnes dry weight per hectare (400 kg/100 m^2) over any 5 year period, should the application not occur on an annual basis.

OR

  - the recommended application rate is less than the equivalent of X tonnes per hectare per year, on a dry weight basis, or a total of the equivalent of less than Y tonnes dry weight per hectare over any 5 year period, should the application not occur on an annual basis.
    - X and Y must be determined by the method described in Appendix 7.

  This statement must be expressed in clear language using units of measurement appropriate to the quantity being distributed, and calculated on a dry weight basis of the final product such as in the examples provided below:

General example:

- Apply no more than 1 kg of compost for every square metre in a year or 5 kg for every square metre for any 5 year period

Examples for a 5 kg bag (30 L) bag:

- It is recommended the contents of this bag may be spread annually over an area no smaller than 3 m^2.

- It is recommended the contents of this bag may be spread annually to a maximum depth of 1 cm or a maximum depth of 5 cm over any 5 year period.

- A statement that failure by the user to comply with the above recommendation could, under some circumstances, result in the accumulation of metals in the receiving soil to concentrations beyond those that are considered acceptable.

- A statement that the product should not be used on soils with elevated copper or zinc concentrations.

Where the compost is sold or distributed in bags, **the required information must be clearly written on the bag in letters that are a minimum of 5 mm high**. This size may be reduced to 3 mm in height for bags that are 10 L or less.

The federal Fertilizers Act and its regulations also set out labelling and application rate requirements for compost that is **sold**.

PART III – USE OF COMPOST

This section describes the permitted uses for all compost types, and relevant compost quality factors, in addition to those described in Part II.

4.0 DETERMINING APPROPRIATE USE

Compost has many benefits. It:

- returns nutrients to the soil
- improves soil structure
- helps soil retain moisture
- can suppress some plant diseases
- contributes to healthy soil ecosystems

Using compost can reduce the need for fertilizers and pesticides, and helps conserve water. However, compost users should be aware that compost is to be used as a soil supplement, rather than a soil replacement. Frequent and high application rates of compost could, in some circumstances, result in accumulation of metals and other trace contaminants in soil, over time.

NOTE: In addition to satisfying the Ontario quality standards and restrictions on use, all compost products sold in the Canadian marketplace must also meet the safety, microbial quality, efficacy, and labelling requirements in the federal Fertilizers Act and regulations, administered by the Canadian Food Inspection Agency.

4.1 CATEGORY AA AND A COMPOST

Although Categories AA and A compost are exempt from transport and use approvals, all compost is considered a nutrient under the NMA. When applied as a nutrient on agricultural land that is required to have a Nutrient Management Plan (NMP) and/or NASM Plan, the compost must be applied in accordance with the NMP or NASM Plan and O. Reg. 267/03.

4.2 CATEGORY B AND OTHER COMPOSTED MATERIAL

4.2.1 Category B Compost

Unlike Categories AA and A compost, Category B compost is not an exempt waste and is therefore subject to Part V of the EPA and Regulation 347, including approvals for transportation and management. However, where Category B compost is applied to agricultural land as a nutrient and satisfies the requirements of O. Reg. 267/03 under the NMA, it is exempt from Part V of the EPA and Regulation 347 for use (it still requires approval for transportation).

Use of Category B compost typically would not be permitted for areas with regular human

contact, such as parks or residential areas. However, Category B compost may be put to beneficial use through the following applications:

- **Organic soil conditioning** – Category B compost may be used as an organic soil conditioner in a variety of non-agricultural applications (e.g. land reclamation, mining rehabilitation, reforestation, etc.), subject to an ECA for an organic soil conditioning site that permits the spreading or application of Category B compost.

- **Agricultural land use** – Category B compost may be used on agricultural land as a nutrient subject to the requirements of O. Reg. 267/03, made under the NMA.

  For more information on the agricultural land-application of Category B compost please see:

  - the NMA,
  - O. Reg. 267/03, made under the NMA,
  - the Nutrient Management Protocol,
  - the NASM Odour Guide,
  - the Nutrient Management Tables Document, and
  - the Sampling and Analysis Protocol.

  Additional information on nutrient use on agricultural land is available from OMAFRA at www.ontario.ca/nasm-omafra.

- **Landfill cover** – Category B compost may be used as daily, intermediate cover at a landfill that has an ECA (waste disposal site) that permits the use of Category B compost as cover.

4.2.2 Other Processed Organics

Processed organic material that does not meet the requirements for Category AA, A or B set out in Part II of the Standards is subject to all of the ministry approval requirements for transportation, use and disposal. Contact your local District or Area ministry Office for more information.

5.0 ADDITIONAL COMPOST CHARACTERISTICS

In addition to the compost standards outlined in Part II of the Standards, a number of other characteristics should be considered by compost producers and end users regarding the impact of compost on plant growth. These considerations are not regulatory standards. They are presented for additional information only.

The following are some examples of compost characteristics, with typical desired ranges. Depending on the intended use, some parameters may be acceptable, or even preferred, outside of these ranges. Compost producers are encouraged to communicate with end users to ensure that compost is used in the most beneficial way.

Particle Size:	<25 mm
Moisture:	40% - 50%
Total Organic Matter:	> 30% on a dry weight basis
C/N Ratio:	< 22
pH:	5.5 – 8.5
Sodium (Na):	<2% on a dry weight basis
Soluble Salts (of a saturated paste):	<4 mS/cm

Salts in the form of mineral ions are naturally present in all composts, and normally concentrate somewhat during composting. Salt may pose limitations for soil application, since plants have varying sensitivities. End use will determine what, if any, limitations may exist regarding the salt content of the compost. For example, material that is to be used as a medium for the germination of seeds should have a soluble salts content of < 2 mS/cm. Laboratory service providers can assist with salt and/or sodium content analysis.

Category B compost applied on agricultural land as a NASM under the NMA is restricted to a maximum annual sodium loading limit to maintain soil health. Please refer to the current version of O. Reg. 267/03.

The Compost Quality Alliance (CQA) may be a useful resource for determining suitable salt content for various intended uses. The CQA is a voluntary program established by the Compost Council of Canada and the compost producers using standardized testing methodologies and uniform operating protocols, to improve customer confidence in compost selection and utilization.

Some feedstocks could contain chemical compounds (in addition to the metals listed in Part II, Table 3.2), which may have an adverse effect on the environment and human health. Organic chemicals such as polycyclic aromatic hydrocarbons can enter the waste stream from a number of industrial and domestic sources.

In cases where there is a site-specific concern that these organic chemicals may be present in the feedstock, the ministry Director may require, through a facility's ECA, that the feedstock and compost be monitored at the facility for particular chemicals in addition to those listed in Part II, Table 3.2. The requirement for additional monitoring of compost may be discontinued by the Director when and if acceptable quality is consistently demonstrated. Resumption of monitoring may be required when the organic waste source or processing conditions are changed.

5.1 ADDITIONAL MATURITY INDICATORS

In addition to the compost maturity standards described in Part II, section 3.6, the list below includes other tests and characteristics that can be used to gauge compost maturity. While these tests are not acceptable for demonstrating compliance with Ontario's regulated maturity standards, they can assist with operational decision making:

1. A significant reduction in odour – foul odours are an indication of improper process controls and incomplete decomposition
2. A reduction in volatile solids (i.e. organic matter) during composting - typically by about 60% compared with the feedstock material
3. Carbon to nitrogen ratio is less than 22:1
4. Phytotoxicity:
    - seed germination – germination rates should not be adversely affected, and the harvested weight of plants (e.g. cress) grown in a compost amended medium is at least 90% of the harvested weight of the control sample, after 6 days, or
    - plant growth in comparison to growth in a typical greenhouse or nursery growing medium, for a particular plant species, over a longer period of time.
5. Reduced biological activity as demonstrated by spontaneous heating, with a temperature rise in the compost of less than 8 degrees Celsius above ambient temperature:
    - measured in situ over three days
    - 0.5 metres into the pile
    - under aerobic conditions (within the same day as turning)

In the case of maturity testing using spontaneous temperature rise, the size of the sample should be large enough to provide a reasonable simulation of conditions in a properly operated compost pile. A minimum size of 2 metres in diameter and 1.5 metres high is large enough to provide for air diffusion into the pile, and to provide sufficient self-insulation to allow for retention of heat generated in the pile.

In addition to these indicators, numerous commercial test kits are available for field testing purposes, to gauge maturation of compost over time. These field tests can serve as effective preliminary tests prior to running the required standard tests.

To increase accuracy, compost maturity testing should be conducted under the following conditions:

- Compost:
    - 40-55% moisture
    - pH 5.5-8.5.
- Ambient temperature :
    - above 8 degrees Celsius

5.2 ODOUR MANAGEMENT

In addition to producing high quality compost, odour reduction is an important objective of composting facility operation. Compost facility owners/operators are responsible for ensuring that their process is designed and operated to minimize odour generation at every stage of handling. Demonstration of an effective odour management plan is a critical part of facility approval considerations.

Compost that has been effectively processed and is ready for use should not generate foul odours. It should have an “earthy” aroma.

PART IV – SAMPLING AND ANALYSIS

This Part sets out typical requirements for sampling feedstock and compost, and provides guidance on laboratory analyses.

All sampling and analysis required in an ECA is the responsibility of the facility owner/operator.

For detailed guidance on feedstock and compost sampling, please see Appendix 1. The sampling procedures in this document are mandatory for the composting facility if they are incorporated into an ECA by the Director.

6.0 FEEDSTOCK AND COMPOST SAMPLING

Facility operators should contact their laboratory service provider for preferred sample preparation methods, sample containers, and other materials which may differ from those described in this document (see detailed instructions in Appendix 1).

6.1 GENERAL

Composting facilities are required to sample and analyse the parameters set out in Part II of the Standards, to meet the regulatory exemption criteria described in Regulation 347. In certain circumstances, however, (depending on the waste stream, processing method, or the suspected presence of toxic substances), the ministry may require additional parameters to be measured, or vary the frequency of analysis requirements in the compost facility's ECA.

Collecting a representative sample is the first step in the process of analysing the physical and chemical characteristics of the feedstock or compost. Poor sample collection or handling practices can render the most careful laboratory analyses useless.

Samples submitted for laboratory analysis are composite samples formed by mixing a number of grab samples taken from each lot of compost. The composite sample is then reduced in volume for submission to the laboratory. Composite sampling is described in Appendix 1 section A1.1.8.

Recommended procedures for sampling compost are presented in Appendix 1, section A1.1, while recommended procedures for sampling feedstocks and compost in process are presented in Appendix 1, section A1.2. Sample preparation methodology is presented in Appendix 1, section A1.4. Compost sampling frequency recommendations are presented in Appendix 1, section A1.1.2, and are based on the annual production rate and compost feedstocks used.

All sampling should be conducted according to a site-specific, well-documented sampling plan and Standard Operating Procedures (SOPs). The sampling plan should clearly specify the field collection and laboratory submission procedures to be used. A written sampling plan is needed to help ensure that:

- field samples are representative of the material being sampled,
- the results are reproducible, and
- that samples are collected, handled, and stored in a manner that minimizes any potential

sources of contamination, bias or error.

The sampling plan should also list procedures to be followed to ensure that the quality of the samples collected is acceptable. Throughout all sample collection and sample handling procedures, care must be taken to prevent cross-contamination of samples. Sampling equipment should be cleaned carefully, and clean sample containers should be used.

The sampling plan should provide specific sampling instructions for each feedstock material and the compost, including sampling frequency and the number of laboratory submission samples required. The laboratory conducting the analysis can assist in developing the sampling plan for the use of quality control samples (such as field replicates).

The plan should reflect the specifics of an individual facility. Additional information on sampling can be found in the BNQ Industry Standard, CAN/BNQ 0413-200/2005, *Organic Soil Conditioners – Compost.*

7.0 LABORATORY ANALYSIS

Few if any composting facilities are large enough to justify an in-house laboratory with accreditation. Appendix 2 of this document is intended to assist compost facility operators with the selection of analytical methods and accredited laboratories to conduct the required analytical testing.

The methodologies used, and the final results obtained for these analyses, should be made readily available to the ministry and all end users upon request. For the agricultural land-application of NASM, generators are required under O. Reg. 267/03 to submit the results of analysis to the person receiving the NASM. Without these results NASM cannot be received at an agricultural operation under O. Reg. 267/03.

See Appendix 2 for guidance on laboratory selection and analytical methods. The laboratory procedures in this document are mandatory for the composting facility if they are incorporated into an ECA by the Director.

APPENDIX 1: FEEDSTOCK AND COMPOST SAMPLING

A1.0 SAMPLING PREPARATION

The following equipment is recommended for compost and feedstock sampling:

- clean hand shovel
- clean plastic bag, bucket or pail large enough to contain 10 grab samples of 1-3 litres each
- clean tarp at least 2m x 3m
- implement handle that can be cleaned and disinfected between samples to split sample on tarp
- clean sample containers (new plastic bags)
- marker to uniquely identify sample (e.g. date, location, lot#, etc.)
- shovel to remove rejected materials from tarp

A clean area where the tarp can be laid out such that the compost can be mixed and handled, is essential to maintain the quality of the sample. This may be a paved area, an area of a building, or a sheet of plywood.

A1.1 SAMPLING COMPOST FOR QUALITY DETERMINATION

A1.1.1 General Considerations

To meet the compost standards in Part II, compost must be analyzed for all mandatory parameters before it leaves the composting facility. The results of this analysis should be made readily available to all end users upon request. For the agricultural land-application of Category B compost as a NASM, generators are required by O. Reg. 267/03 to submit the results of analysis to the person receiving the NASM.

As required by Part II, samples of compost must be taken from compost that is assumed to satisfy the maturity requirements presented in section 3.6. Samples submitted for laboratory analysis should be representative of the form in which the compost will be shipped or sold. For example, if compost is to be screened prior to being shipped or sold, then the laboratory sample should also be screened prior to analysis. The testing for metals and pathogens must only be completed if and when the material has passed the maturity test required under Part II, section 3.6.

Those wishing to land apply Category B compost as a NASM under O. Reg. 267/03 should refer to that regulation and:

- NASM Odour Guide,
- Nutrient Management Tables Document,
- Nutrient Management Protocol, and
- Sampling and Analysis Protocol.

A1.1.2 Sample Frequency

The minimum number of composite samples typically required is described in the Table A1, based on a facility's annual production during the production period. Composite samples should

be formed from independent sets of grab samples, and all samples should be submitted to a laboratory for analysis.

Sampling frequency can consist of more than one individual batch or lot of compost, provided that the characteristics of each of the batches are similar. Composite samples should be formed from batches of compost that have similar characteristics. In the case where batches are derived from significantly different feedstocks, separate samples need to be collected and analyzed, unless previous analysis shows that the concentration of mandatory parameters in each of the finished products is similar.

Additional sampling may be required by the Director for materials where feedstocks that have not been well-characterized are used.

Table A1: Baseline Sampling Frequency of Compost (Metals, Pathogens, Maturity and Foreign Matter)

Compost Produced Annually (wet tonnes)	**Baseline Number of Samples (per year)[1]**	**Minimum Additional Samples for Compost Containing Human Body Waste Feedstock[2] (per year)**
<5000	4	+2
5000-15000	6	+2
15000-50000	12	+4
>50000	+ 2 more samples for every additional 10,000 tonnes above the 12 Baseline samples.	+ 4 additional samples above the Baseline Number of Samples

1. Samples should be distributed throughout the production year to capture seasonal variability.
2. By weight, on a dry weight basis. See Glossary for a definition of "Human Body Waste Feedstock".

Note: Category B compost which is to be land-applied as a NASM on agricultural land must also meet the sampling requirements specified in O. Reg. 267/03.

A1.1.3 Sampling Frequency Adjustment

If the feedstock remains consistent, and the compost characteristics and analytical results are consistent, the operator can request, through an application for an amendment to the facility's ECA, a reduction in the number of samples required.

Baseline sampling frequency (Table A1) can be reduced when the monitoring results over a two year period (or 12 consecutive samples) demonstrate consistent and acceptable compost quality (i.e., when test results for each sample are <80% of the metals standards in Table 3.1). Once acceptable consistency is demonstrated, sampling frequency can be reduced by 50%. However, if any individual sample fails to meet any one of the quality standards, Baseline sampling frequency in Table A1 should be resumed until all results for six consecutive samples are below 80% of all quality standards in Table 3.1.

In the case of pathogen standards in Part II, section 3.4, samples are considered consistent, and Baseline frequency of sampling can be reduced (as above), when test results are within the same

order of magnitude and there are no failures after 2 years of monitoring (or 12 consecutive samples).

Where there is a change in compost characteristics, including feedstock, sampling should return to Baseline frequencies until such time as consistent and acceptable compost quality can be demonstrated again according to the requirements above.

A facility should document the test results that demonstrate consistent and acceptable compost quality that complies with the mandatory quality standards (Part II). Such documentation is usually required to be retained by the facility for five years, or as otherwise specified in the facility ECA, and made available to the ministry upon request.

A1.1.4 Sample Failure Policy (Re-Testing)

If the result from any compost sample fails to meet the compost standards for metals and pathogens set out in Part II, Table 3.1 and section 3.4, in the category of compost being produced, additional samples should be taken until a minimum of 4 consecutive samples from the batch in question meet the criteria, and the arithmetic mean of all samples meets the standard in Table 3.1. If these conditions are not met within 12 additional samples, the batch fails.

Documentation of the test results should be maintained and made available to the ministry upon request.

A1.1.5 Sample Size

Each composite sample should be comprised of a minimum of 10 randomly selected grab samples of the same volume, approximately 1 to 3 litres each. Two composite samples should be formed from independent sets of grab samples taken from different locations within the lot of compost. One sample should be prepared for sending to the laboratory, and the other one should be stored on site for a minimum of six months for duplicate analysis, if required. The Ministry may require additional testing to be performed with this duplicate sample and therefore, this sample must be handled and stored appropriately. It is important that grab samples be small enough to allow the composite samples to be mixed easily.

A1.1.6 Sample Locations

Proper selection of grab sample locations is necessary to ensure that the laboratory submission samples are representative of the lot of compost. Sampling locations that may not be representative of the lot of compost, such as the surface or base of compost piles, should be avoided.

Operator bias must be avoided in the selection of sampling locations. Grab sample locations should be determined by random selection of subdivided areas from a sketch of the lot to be sampled, or by sampling at regular intervals from a randomly selected starting point. Random selection of sampling locations is not equivalent to a haphazard selection process. A systematic method of selecting random, unbiased locations should be used.

A1.1.7 How to Take Random Grab Samples From a Lot of Compost

Grab sample locations should be randomly selected from a lot of compost following these steps:

1. Select a starting point (such as the head of a windrow).
2. Measure the perimeter of the lot of compost (this can be done by pacing).
3. Divide the total perimeter into 10 parts, i.e. the number of grab samples to be collected, to give the length of 1 distance interval.
4. Generate a two digit random number[2] between 0 and 1, and multiply that number by the distance interval, rounding up or down as required.
5. Pace off this distance from the starting point to find the first sampling location.
6. At the midpoint between the top and bottom of the lot, dig approximately 1 metre into the compost using a small shovel or similar tool.
7. Collect a 1-3 litre grab sample and place the grab sample in a plastic bucket or pail.
8. Walk a distance equal to the distance interval and collect a second grab sample of equal volume to the first, and combine with the first grab sample in the plastic bucket or pail.

Repeat until all 10 grab samples have been collected.

A1.1.8 Creating a Composite Sample

Proper mixing of composite samples ensures that all material collected in the grab samples has an equal likelihood of being selected for the laboratory submission sample. Several tools and techniques can be used, including:

- placing the composite sample on a small tarp and then "rolling" the tarp in different directions
- tumbling the composite sample in a plastic barrel or drum with a closable lid
- placing the composite sample on a clean surface and repeatedly shovelling material from the outside to the inside of the pile and then flattening the pile
- coning and quartering (see A1.4)

A1.2 SAMPLING FOR FEEDSTOCK CHARACTERIZATION

A1.2.1 General Considerations

The purpose of sampling feedstocks, amendments, and compost in process is to obtain the information necessary to improve or control the composting process, or to confirm compliance with regulatory requirements. The information required depends on the types and sources of feedstock materials. Sampling plans address the sampling requirements of each feedstock material accepted for composting at the facility, and include measures to deal with wastes that could have elevated levels of metals or other contaminants.

When accepting feedstock materials, operators must take reasonable steps to ensure that the resulting compost will satisfy the requirements for Categories AA, A or B compost. This would include only accepting feedstocks where characteristics, particularly with respect to metal

[2] Spreadsheet software programs and many calculators have functions to generate random numbers. In Excel, two digit random numbers between 0 and 1 can be generated from the following formula: =round(rand(),2)

concentrations, are known.

Many feedstock materials are heterogeneous mixtures of large particle size and cannot be sampled effectively without prior size reduction and mixing.

A1.2.2 Sample Frequency

Operators are responsible for ensuring that feedstocks are characterized according to basic physical and chemical parameters of importance to the composting process, such as carbon content, nutrient content, moisture content, physical structure, metal content, etc. To ensure the feedstock quality standards in Part II are met, characterization should occur prior to receipt of the waste (feedstock or bulking agent) at the composting facility, and should be repeated whenever changes in the generation, handling, or storage of the waste affect any of its characteristics.

Sampling and analysis can be undertaken by the operator, or the generator of the feedstock.

In some cases, operators may choose to rely on published information for wastes that have been well-studied (e.g. leaf and yard wastes, food wastes, wood etc.).

The Director may require that feedstocks which have not been well-characterized, and exhibit variability in C:N ratio, moisture content, bulk density, heavy metals or other contaminants, be subjected to a program of laboratory testing. This includes wastes such as biosolids (from sewage or pulp and paper mill processing), domestic septage, and industrial, commercial and institutional (IC&I) sludges. The Director may require that the operator establish a more detailed program of laboratory testing for these wastes.

In general, feedstocks which have not been well-characterized should be analyzed:

- prior to receipt,
- every 1-2 months in the first year of receipt, and
- if characteristics have changed.

If the waste characterization is relatively consistent, the operator can request a reduction of testing requirements from the ministry.

The Director may require that sampling frequency be increased if:

- the average concentration of any regulated metal is greater than 80% of the concentration limit for the feedstock of the category of compost being produced (see Part II, section 3.3); and
- the quantity of the particular feedstock is greater than 50% by weight of all materials accepted for composting; or
- a change in characteristics of the feedstock is expected due to changes at the generating facility or in the collection, handling, and storage of the material.

Where increased sampling frequency is warranted, sampling should be frequent enough to demonstrate the operator's diligence in managing the composting process, and in ensuring that the resulting compost satisfies the requirements to produce Category AA, A or B compost.

A1.2.3 Sample Size

Feedstock samples should be composite samples consisting of at least 10 grab samples of the same volume, approximately 1 to 3 litres each, as described in section A1.1.5.

A1.2.4 Sample Locations

Where possible, feedstock materials should be sampled from the output of size reduction or mixing operations rather than piles. In particular heterogeneous, large particle size feedstock materials should be size reduced and mixed prior to sampling. Two composite samples should be formed from independent sets of grab samples.

When sampling from the output of processing operations, it is necessary to use a randomization process to avoid bias in the selection of times of grab sample collection. Two approaches can be used:

- the timing of each grab sample selection can be randomized; or
- a starting time can be selected randomly with grab sample collections following at uniform time intervals.

In some instances, collecting grab samples from conveyor discharges may not be possible. For piles of feedstock material, follow the directions for random selection of grab sample locations provided in section A1.1.7.

A1.2.5 How to take Grab Samples from Incoming Feedstock Materials

Unbiased sampling of feedstock materials that are received throughout the year requires random selection of the time of sampling. To randomly select sample times from a continuous stream of material, e.g. the output material from a size reduction or screening operation, follow these steps:

1. Define the period for which a laboratory submission sample is required and express in appropriate units, e.g. number of truckloads expected within a defined period of time, or required to deliver a predetermined quantity of material.
2. Divide the period into 10 equal intervals, i.e. the number of grab samples to be collected, to give the length of one grab sampling interval.
3. Generate a two-digit random number and multiply by the grab sampling interval, rounding up or down as required, to identify the starting interval.
4. At the starting interval, collect a 1-3 litre grab sample, and place in a plastic bucket or pail.
5. Wait one sampling interval and collect the second grab sample, combining the second grab sample of equal volume with the first grab sample in the plastic bucket or pail.
6. Repeat until all 10 grab samples have been collected.

Creating a composite sample of feedstock material is the same procedure as creating a composite sample of compost (see section A1.1.8).

A1.3 RECORDS

Plant owners or operators will normally be required to keep a log book which records all sampling events. Typically, records of analyses are required to be kept for at least five years past the disposition of the compost or for such other period as specified in a regulation or in a condition of an ECA. This information must be made available to the ministry upon request.

Sampling plans should detail the types of field observations that are to be made during the sampling. Field staff should be diligent in taking field notes of sampling locations, sample depths, any unusual odours observed, or any other observations that could be of potential assistance in interpreting analytical results. These records should also be retained for five years or more after disposition of the compost.

A1.4 PREPARING A LABORATORY SUBMISSION SAMPLE

Preparation of a laboratory submission sample involves the methodical reduction of the volume of the composite sample (10-30 litres) until only the amount required for the laboratory submission sample remains (approximately 1-3 litres). A proper size reduction methodology is required to ensure that all of the material in the composite sample has an equal likelihood of being selected for the laboratory submission sample.

Coning and quartering is one of the easiest methods to reduce the volume of samples. Coning and quartering involves mixing grab samples and forming the mixture into a pile or cone. The cone is then flattened and divided into four quarters, the quarters separated, and the opposite quarters combined to form the reduced volume sample. This coning and quartering procedure is repeated until the desired volume of sample is achieved.

Coning and quartering includes the following steps:

1. Form a "cone" in the centre of the tarp, and split into four "quarters" by slipping a stick (such as a broom or shovel handle) under the tarp and lifting it up to split the cone in half, then split the cone the other way into quarters.
2. Flip a coin to decide which two diagonal quarters to accept and which to reject.
3. Use a shovel to remove the two rejected quarters from the tarp, and combine the remaining two quarters.
4. Repeat the process until you are down to 5 to 10 kg, or twice what the lab requires, and split in half once more.
5. Reject one half (or store as a duplicate sample), and place the other half into a clean new plastic bag to send to the lab for analysis.
6. The other half of the composite sample can be stored and used to confirm analytical results, or sent to a different laboratory for analysis.

A laboratory submission sample of one to two kilograms should provide sufficient material to allow for a wide range of physical and chemical analyses, and provide a residual amount for re-testing if necessary.

A1.4.1 Sample Containers

Plastic "zip-lock" bags or other clean plastic or glass containers with no metal contact should suffice for most compost sampling activities.

Analysis for some parameters may require containers other than clean plastic bags. For example pre-sterilized and sealed containers may be required for pathogen analyses, and glass sample containers with specially lined lids may be required for selected chemicals, such as mercury. Operators should confirm container requirements with the intended analytical laboratory prior to sample collection.

A1.4.2 Sample Handling and Submission

Proper sample handling requires that a chain of custody form be completed and submitted with the Laboratory Submission sample. This includes a description of the sample as well as analytical requirements. Chain of custody forms are provided by the laboratory.

Laboratory submission samples should normally be in a cooler with an icepack(s), and arrangements should be made to have them delivered to the laboratory the same or next day. Laboratory submission samples should not be kept on-site.

Samples for analysis of volatile components (e.g. mercury or organic chemicals) may require separate handling to ensure that the analytical sample is representative of the source. The analyzing laboratory should be consulted for specific handling procedures.

Samples for *E. coli* and *Salmonella* testing should be received by the laboratory and the analysis initiated within 30 hours of sample collection.

APPENDIX 2: LABORATORY ANALYSIS

A2.0 SELECTING LABORATORIES FOR COMPOST ANALYSIS

To meet the mandatory standards for compost in Part II (for metals, pathogens, foreign and sharp foreign matter, and compost maturity), facility owners or operators should select laboratories that are accredited by an internationally recognized accreditation body which accredits laboratories under ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*, as amended from time to time, including the Standards Council of Canada or the Canadian Association for Laboratory Accreditation. Directories of accredited laboratories are available on these organizations' websites at www.scc.ca and www.cala.ca. Accreditation does not preclude the possibility of an inspection by the ministry to evaluate laboratory data.

Use of accredited laboratory analytical methods is also normally required for the mandatory parameters in Part II, section 3, as noted above. Analytical methodologies are recommended in section A2.1 below.

Additional information regarding analytical method performance requirements (for the analysis of eleven regulated metals and the pathogen testing) is provided in the OMAFRA/MOE Sampling and Analysis Protocol of General Nutrient Management Regulation, O. Reg. 267/03, as amended (see reference in Appendix 5).

For in-house laboratory analyses, when analyzing compost for routine testing parameters, such as moisture content, temperature, organic matter, and stage of maturity (as discussed in Part III, section 5.1), the laboratory may be required to have documented standard operating procedures (SOPs) for each measurement or test performed. This would allow the facility to maintain consistency of the operation.

All facility laboratories should have a formal written method for all analyses that are conducted on their samples, including those analyses performed in-house and by accredited laboratories. Consult the laboratory service provider for detailed methods information on the contracted analytical tests performed.

The results of laboratory analyses are used to determine compliance with the Standards. Therefore, is it essential that all analytical methods are well-documented, controlled, and consistently applied, and that appropriate quality assurance and quality control procedures are carried out.

A2.1 ANALYTICAL METHODOLOGIES

Analytical methods acceptable for the eleven regulated metals and the pathogen testing are described in the Sampling and Analysis Protocol of O. Reg. 267/03. Note that analyses for *E. coli* and *Salmonella* should be initiated within 30 hours of sample collection.

Analysis of mature compost respiration rate should be conducted in accordance with the

procedure(s) outlined in the BNQ Industry Standard, CAN/BNQ 0413-200/2005 *Organic soil conditioners - Composts*. The BNQ Standard document also contains acceptable methods for analyzing additional parameters, such as moisture content, organic matter, foreign and sharp foreign matter content.

Those wishing to apply Category B compost to agricultural land as a NASM under O. Reg. 267/03 should refer to that regulation and its supporting documents. Testing of additional parameters, such as nutrients, will be required.

A2.2 RECORDING AND REPORTING OF RESULTS

The results of all laboratory analyses are used to determine compliance with the Standards. Typically, records of analyses are required to be kept for at least five years past the disposition of the compost, as described in Appendix 1, section A1.3. As noted in Appendix 1, section A1.1.1, when Category B compost is to be applied on agricultural lands as a NASM, the analytical results must be provided to the person receiving the NASM material.

APPENDIX 3: GLOSSARY

Adverse Effect - Under EPA section 1 "adverse effect" means one of 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 effect 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 human use, (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 which thrive in the absence of oxygen.

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 the treatment of sewage at a treatment facility licensed under the OWRA.

Pulp and paper biosolids - solid or semi-solid residue from the treatment of wastewater from a manufacturer 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.

Compost - Compost is a stabilized humus that is a solid, mature product produced by an aerobic composting process that meets the compost standards of this document.

Composting - In Regulation 347, section 1, under 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 document 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 EPA.

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

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.

Human Body Waste Feedstock - Human body waste feedstock means feedstock materials derived from or containing wastes from the human body, including sewage biosolids, domestic septage and diapers.

In-Vessel Composting - A diverse group of composting methods in which composting materials are contained in a vessel. The purpose of the vessel is to help maintain optimal conditions for composting. Types of in-vessel systems include: rotating drum systems; horizontal channels either fully or partially enclosed; vertical (silo) configurations; or batch container systems.

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 7 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 used without risk to plants from residual phytotoxic compounds.

Municipal Waste (in Reg. 347, section 1, 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, section 1, 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 QC 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.

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 - A 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.

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 sub-set 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.

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 4: 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 farmers and the general public against potential health hazards and fraud in marketing, as well as ensuring a fair marketplace. It 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 Quebec (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 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;
- 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 5: SELECTED REFERENCES

GENERAL COMPOSTING REFERENCES (available at the time of publishing)

Goldstein. 2005. *Modern Composting Technologies*, The J.G. Press Inc. Emmaus, PA.

The Compost Council of Canada. 1995. *Composting Technologies and Practices: A Guide for Decision Makers*, Ontario, Canada: Compost Council of Canada (ISBN1-896471-03-X).

The Compost Council of Canada. 2006. *Composting Processing Technologies*. Ontario, Canada: Compost Council of Canada. Available at: http://www.compost.org/pdf/compost_proc_tech_eng.pdf.

Forgie, David., Larry Sasser, and Manjit Neger. 2004. *Compost Facility Requirements Guideline: How to Comply with Part 5 of the Organic Matter Recycling Regulation*. British Columbia, Canada: Ministry of Water Land and Air Protection.

Geesing, Dieter and Paul, John. 2009. *Compost Facility Operator Manual*. Abbotsford, BC. Transform Compost Systems Ltd.

Haug, R.T. 1993. *The Practical Handbook of Compost Engineering*, Lewis Publishers, Florida.

Northeast Regional Agricultural Engineering Service. 1992. *Field Guide to On-Farm Composting*. Ithaca, NY: Northeast Regional Agricultural Engineering Service (NRAES-114).

Northeast Regional Agricultural Engineering Service. 1994. *Composting for Municipalities-Planning and Design Considerations.* Ithaca, NY: Northeast Regional Agricultural Engineering Service (NRAES-94).

Northeast Regional Agricultural Engineering Service. 1992. *On-Farm Composting Handbook.* Ithaca, NY: Northeast Regional Agricultural Engineering Service (NRAES-54).

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

The 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.

MOE. 1996. *Guidelines for the Utilization of Biosolids and Other Wastes on Agricultural Land*, Ontario Ministries of the Environment and Agriculture, Food and Rural Affairs.

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.

FIELD SAMPLING AND LABORATORY ANALYSIS

MOE. 1994. *Municipal/Industrial Strategy for Abatement (MISA) - Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater*, Ontario Ministry of the Environment.

MOE. 1994. *Estimation of Analytical Method Detection Limits*, Ontario Ministry of Environment, PIBS 299.

OMAFRA/MOE. Sampling and Analysis Protocol for Ontario Regulation 267/03 made under the Nutrient Management Act, *2002* - September 14, 2009.

OMAFRA/MOE. NASM Odour Guide for Ontario Regulation 267/03 made under the Nutrient Management Act, 2002 - September 2009.

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): http://cwmi.css.**cornell**.edu/**composting**.htm

APPENDIX 6: EXCERPTS FROM THE 2004 INTERIM GUIDELINES FOR THE PRODUCTION AND USE OF AEROBIC COMPOST IN ONTARIO (INTERIM GUIDELINES)

Regarding: Foreign Matter (Non-biodegradable Particulate Matter) and Maturity (Stability)

The following are sections from the previous (2004) compost guideline for Ontario. Some environmental compliance approvals (issued as "certificates of approval") issued prior to January 1, 2013 refer to the Interim Guidelines in whole or in part. In some cases, facility operators with these certificates of approval will continue to be governed by the Interim Guidelines for foreign matter and maturity criteria, until July 1, 2015.

This appendix has been included as a quick reference. The full document is available on the ministry's website, or from the ministry's regional, district or area offices.

Foreign Matter Section (referred to here as non-biodegradable particulate matter):

7.4 Non-Biodegradable Particulate Matter

The compost must contain no material of a size or shape that reasonably can cause human or animal injury, or damage to equipment.

The non-biodegradable particulate content of the compost greater than 8 mesh screen size shall not exceed the following:

Parameter	**Concentration (% dry wt)**
Plastic	1.0
Other (total)	2.0

Maturity Section (referred to here as stability):

7.5 Stability

Various means for determining stability are suggested in Appendix 3. Any of the methods alone or in combination may be used. If no determination of stability is made, the compost must be cured for a six month period.

Excerpt from Appendix 3:

Stability

There is no exact definition of biological stability with respect to composting. Stability is proportional to retention time, under proper operating conditions, and waste characteristics. The degree of stability required may depend on the end use of the compost. Complete stability is not readily attainable and not likely desirable as there would be no soil amendment value due to low or non-existent organic content.

On the other hand, compost with a high potential for continuing decomposition can adversely affect crop growth due to toxic effects and nitrogen depletions. There is, therefore, a level of stability which must be met based on end-use of product, and the ability of the compost to be stored or handled with no nuisance effects or conditions occurring.

The relative stability can be determined using indicators such as volatile solids destruction, spontaneous heating, oxygen uptake rates, toxin production, carbon to nitrogen ratio, seed germination and growth test and redox potential. These tests are not necessarily conclusive or definitive, but do indicate relative stability of compost, compared with the raw feed.

APPENDIX 7: METHOD FOR DETERMINING ALTERNATIVE APPLICATION RATE FOR CATEGORY A COMPOST

Part II of this document sets out the requirements for the labelling of Category A compost. The labelling must set out a recommended application rate of less than 8 tonnes/ha/year (or equivalent) or a recommended application rate of less than a rate as determined in accordance with the method set out here.

The use of this method is recommended for Category A compost where metal concentrations are significantly lower than the allowable metal concentrations in Column 3 of Table 3.1 in Part II.

For this method to be used to establish an alternative application rate, there must be a minimum of 6 samples for each batch of compost that uses the same feedstock, feedstock mixing ratio and processing method. Should the batch exceed 5,000 tonnes, there must be at least 2 additional samples taken and used in the calculation for each additional 5,000 tonnes. These are minimum sampling requirements; however, more samples can reduce the standard deviation and therefore result in increasing the application rate. If more samples have been taken, however, then all the available metals data must be included in calculating the mean, in order to achieve non-biased results. Sampling frequency can be reduced by 50% if, after three batches of compost, the calculated application rate has not varied by more than 10% between any two batches.

Method:

1. Determine the arithmetic mean of the sample concentrations for each of the 11 metals listed in Column 1 of Table 3.1 of Part II ("regulated metals") as follows:

   mean = sum of concentrations / number of samples, which is:

   $$m = [\Sigma(x_i)]/ n$$

   Where:
   m = mean
   n = number of sample results
   x_i = the value (metal concentration) of the i^{th} sample

2. Determine the standard deviation of the samples for each of the 11 regulated metals. The standard deviation is the square root of the sum of all the differences between the mean value and the sample value after squaring them, divided by the total number of samples minus one.

   $$s = [\Sigma((x_i-m)^2) / (n-1)]^{1/2}$$

   Where:
   s = standard deviation

3. Add the mean and two standard deviations to get the reasonable estimate of the maximum (REM) concentration for each of the 11 regulated metals.

   $$REM = m +2s$$

4. The maximum application rate (MAR) for each metal can then be determined as 8 tonnes/ha/year times the allowable metal concentration in Column 3 of Table 3.1 in Part II (AMC), divided by the REM:

    i.e., MAR = 8 (AMC/REM) tonnes/ha/year

The above method must be followed for each of the 11 regulated metals. The recommended application rate to be set out on the Category A compost label will be less than the lowest of the 11 maximum application rates calculated above or 8 tonnes/ha/year, as set out in Part II.

Notes:

1) Where more than 50% of the sample results are below the detection limit, ½ detection limit can be used for those results that are below the detection limit.
2) The method can be done using standard spreadsheets such as Open Office, Excel etc.
3) This method was developed as a simple method for estimating a reasonable application rate where metal concentrations are lower than the allowable metal concentrations. While using basic statistical principles, it deliberately avoids requiring the use of more complicated statistics such as estimation of distributions and confidence limits.