OPERATIONAL MANUAL

FOR THE ESTABLISHMENT OF A

COMMERCIAL COMPOSTING FACILITY

Prepared by

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IN CO-OPERATION WITH THE CITY OF BRANDON

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1 INTRODUCTION

1.1 Purpose/Intended User(s)

This composting manual was developed for use as a reference tool and guide for the City of Brandon Public Works staff. They have been composting at the Eastview Landfill Site since 1992. It is also intended for use by the Province of Manitoba for public access and distribution to potential municipalities and parties interested in establishing commercial composting operations.

1.2 Definition

Composting is a biological process that converts organic matter into a nutrient rich soil conditioner and amendment. In practice, process management in composting is based on the control of chemical and physical factors such as nutrients, moisture, oxygen concentration, and heat management to control temperature. The composting matrix is comprised of solids and water and air filled void spaces between solid particles. Composting bio-systems are dynamic. Microbial activity can use up all the oxygen, raise the temperature to lethal limits, and evaporate away the moisture, all which can negatively impact your composting process and end product. Micro-bacteria and a suitable environment for them to exist in is critical, as through their consumption of the carbon and nitrogen nutrients found in the feedstock, they build their own protein structures to multiply and create more bacteria to assist in the composting process.

1.3 Associates in Project

- City of Brandon - Wayne Kingdon, Ian Broome, Rick Bailey, Don Wood
- Darci Clark Community Consulting
- LWD Environmental Services Inc. - Curtis Navratil, P. Eng.

1.4 Information Sources

- Government of Canada Agricultural Research Station, Dr. Katherine Buckley
- Olds College, Centre for Innovation, Composting Technology Centre
- Windrow Dynamics, Ken Warner, Canby, Oregon

2 SITE ESTABLISHMENT

2.1 Compost Pad

The following factors have to be considered in the location and design of the composting pad:

1. The base has to provide a barrier to prevent the percolation of leachate and/or nutrients to the sub-soil and groundwater.
2. The surface has to accommodate equipment movement during wet weather and working conditions.
3. The surface area has to accommodate the maximum annual volume of feedstock received with sufficient room for equipment to manoeuvre and an area to establish a static pile for curing compost.
4. The surface area has to drain to a leachate collection system that can provide a source of moisture to be re-introduced into the processing windrows.

The Code of Practice for compost facilities (Alberta Environment) states that the composting pad should be constructed with a substrate that has permeability less than $5x10^{-8}$ m/s and a minimum slope of 2%.

The three most common types of composting pad surfaces are asphalt, concrete, and compacted clay. Hydrocarbon contamination from certain asphalt applications can occur from the excess heat generation in the compost windrow. The Code of Practice states that clay material must be a minimum of .5 meters thick. Another option being tried is using a 3-foot depth of ground woodchips over your existing base. (Bob McKinnon City of Bdn. 2004)

2.2 Site Environmental Compliance Monitoring

Monitoring is one of the keys to the success of your composting operation. Site Environmental Impact Monitoring needs to be performed to establish and maintain your environmental liability and impairment insurance.

Up-gradient and down-gradient surface and ground water sampling and testing needs to be done quarterly to ensure there are no negative environmental impacts resulting from the composting operation.

Incoming feed stocks need to be sampled monthly to ensure the integrity of your composting ingredients and to determine your C:N ratio.

In addition, continual monitoring for oxygen, temperature and moisture of the composting windrow needs to be done on at least a regular weekly basis, and up to three times a week minimum at the initial startup stage.

3 EQUIPMENT REQUIRED

3.1 Loader

For the composting process to begin, the feedstocks are delivered and stacked into suitable windrows using tractor mounted front-end loaders or pay loaders. Loaders are multi-functional and can be used for a number of other duties such as site maintenance, snow removal, piling the curing compost in static piles, loading compost into the trommel screen, and loading the finished compost product into trucks or trailers for market.

3.2 Windrow Turner

Loaders can be used to turn the compost windrows, however specialized compost windrow turners are much faster and do a better job of mixing the entire windrow. If space is limited at your facility site, a loader is the better option as you can make your compost windrows higher and wider (you do not have to limit the windrow size to suit the specialized compost turners). There are numerous turners available dependant upon your budget and desired windrow height and width, production capacity and desired means of operation, i.e. self-propelled, loader mounted or pull-type, and PTO driven. Typically windrows can vary from 6 to 10 feet in height and 6 to 10 feet wide at the base.

3.3 Screener

A trommel screen is desired at the end of the curing process to screen the finished compost for suitable particle size. This will remove any larger undesirable items called (overs) as well as any bulking materials such as wood chips that were used to create *Free Air Space* (FAS). This will fluff up your finished product to ensure your compost product quality is suitable for your end users.

3.4 Bagger

Whether to bag your compost or not is dependant upon having an established market. There are labour/additional costs incurred to bag compost, however the economic returns are higher if you market your compost in bags rather than in bulk. Ideally composting operations will market a portion of their product in bags for higher economic return, with the remaining portion marketed in bulk volume at a lower return in order to move all of the annual production in one year.

4 MATERIALS FOR COMPOSTING

4.1 Agricultural Manures

Agricultural manures have high levels of nitrogen and other organic nutrients such as phosphorous and potassium. They are inexpensive feedstocks that benefit from the composting process. Composting manures will convert the nutrients into a more readily available state for plant uptake and will eliminate volatizing odours found from spreading fresh manure on farm fields. These odours are actually nitrogen being lost to the atmosphere rather than being in a stable state in the soil to stay in situ until plant uptake during the growing season.

4.2 Household Yard Waste

Yard waste is available seasonally, generally spring and fall. The grass, leaves, flower and garden plants can vary from being brown and dead carbon sources delivered in the spring to wet and green nitrogen sources of composting feedstock generally delivered in the fall. Household yard waste is ideally suited for a backyard-composting bin.

4.3 Food Waste

Food waste is a very sensitive source of composting feedstock. Kitchen waste is segregated into three categories: Green, Brown and Don't Use. Sensitive wastes are meats, fats and greases, dairy products, breads and grains, pet waste, and diseased plants or plants with seed heads. The Don't Use food wastes not only negatively affect the process but also can create very foul odours and attract pests to your compost windrow.

4.4 Wood Waste

Ground wood waste fines and particles are an excellent source of carbon for the composting process. The smaller particles will disappear in the composting process while the larger particle sizes will act as bulking material for creating *Free Air Space* (FAS) for moisture and air movement within the windrow. The larger particle sizes can be screened out as "overs" using the trommel screen and can be re-introduced to the next windrow that is being constructed.

4.5 Straw

Straw is an excellent source of carbon and decomposes quite readily. It is a relatively inexpensive source of an organic carbon feed stock. Carbon sources such as straw absorb the nitrogen available in the compost windrow. Nitrogen in the farmer's soil is used to break down the carbon in the straw. If the straw is composted first, it is converted into a form that will add to the soil nutrients rather than deplete them as well as be in a form more readily available for plant uptake.

5 BULKING MATERIAL SOURCES

5.1 Wood Waste

Wood waste can provide another component to a composting operation other than as a source of carbon. Wood waste, when processed, can act as a bulking material to create F*ree Air Space* (FAS). The ground wood will provide space in the compost windrow matrix for air and moisture to flow. This assists the compost facility operator with keeping his windrow aerobic (with oxygen).

5.2 Wood Processing

Processed wood waste can be utilized as bulking material in the composting windrow. The wood is processed using a wood chipper, available in various sizes for grinding small tree branches and limbs to large tree trunks and construction and demolition lumber. When using C & D wood waste, be sure you are free of metal and other contaminants such as lead paint.

6 ANALYSIS OF THE PROCESSING STEPS

6.1 Windrow Stacking

Open windrow composting is a simple process. Organic waste is brought to an open-air facility and formed into windrows**.** The windrows are turned periodically to maintain a stable temperature and rate of decomposition, and water is added as needed to obtain the appropriate moisture content to maximize operational efficiency.

6.2 Windrow Size

The type of compost turner you use will be determined by the size of windrow it produces as well as how much of a staging area you have at your compost site. Typically windrows are 6 to 10 feet high and 6 to 10 feet wide at the base. Volume reductions between 25 to 40% (dependant upon the feedstocks) will occur during the composting process, which will reduce your end windrow sizes.

6.3 C:N Ratio

Carbon and nitrogen are required for both energy and growth of the micro-bacteria. Sufficient carbon is required to conserve and absorb the nitrogen. Ideal ratios are a 30:1 C:N ratio balance in your feed stocks at the beginning of the composting process and a 20:1 ratio balance in your finished compost product.

6.4 Moisture Content

Ideal moisture content is 55 – 60%, never lower than 55%. Your compost feed stocks should have the consistency of a wet sponge when squeezed in your hand. The moisture content for winter storage in a static pile is 45 – 50%.

6.5 Frequency of Water Addition

Water needs to be introduced to the compost windrow to initiate microbial activity and assist in reaching temperatures in excess of 65 degrees Celsius. Snow cover and rainfall amounts in excess, or the lack of, can greatly affect the moisture content of your windrow and thereby the operating efficiency of your process. It is much easier to manage windrows that are too dry rather than too wet.

6.6 Free Air Space (FAS)

Free Air Space is important to allow for the movement of air and moisture within the compost windrow. Various products can be used, but the most logical and suitable is ground wood chips. Too much air space increases porosity - moisture will be readily lost and excess air flow will be too drying, thereby preventing the windrows from reaching optimum temperature rates for pathogen reduction. A lack of sufficient FAS will cause the compost windrow to go anaerobic (without oxygen), which can cause odour and process problems.

6.7 Temperature Parameters

CCME (Canadian Council of the Ministers of Environment) states that interior compost temperatures need to reach 55 – 65 degrees Celsius for 5 consecutive days. The total windrow needs to be exposed to those temperatures for 15 days to ensure the outside layers have had a chance to be mixed into the center of the windrow to attain those temperatures for a length of time. This is to ensure thorough pathogen reduction due to exposure to that range in temperature.

6.7.1 COMPOSTING "HEAT" STAGES

- THERMOPHYLIC
  - Start quickly to activate microbiological activity
  - Requires temperatures between 55 - 65^{0}C

- MESOPHYLIC
  - Different group of bacteria take over to degrade compost
  - Temperatures cool down to ambient temps

- PSYCHROPHYLIC
  - Ambient temperature
  - Beetles and larvae move in to complete degradation process

- CURING
    - Pile into a static pile
      Avoid being too dry or cool which could produce undesirable fungal growth

Temperature can be initiated with proper C:N ratios and the introduction of moisture. Turning will typically provide a means of cooling excessive heat ranges.

6.8 Oxygen Parameters

Compost windrows require an oxygen content (greater than) >5% at all times. To ensure adequate oxygen movement in the compost windrows, a bulking agent such as processed wood chips can be used to create sufficient free air space (FAS). If there is not enough oxygen in the compost windrows, there is the potential for them to go anaerobic (without oxygen) which can lead to potential odour production and negatively affect the composting process and quality of the end product. To prevent this from occurring, add a bulking agent such as ground wood chips and turn the compost windrow to introduce oxygen. This will keep the process from going anaerobic.

6.9 Frequency of Turning

Turning the compost windrow is the means in which you can **manage excessive temperature and control oxygen content** within the windrow.

It is ideal to turn the windrow to mix in the moisture content, be it snow, water or compost tea leachate. If the feed stocks become too wet from excessive moisture, turning will help dehydrate the windrow.

The compost windrow is generally turned 3 times in the first 15 days, then once a week for the first month, once every two weeks for the second month and once an month thereafter until hauled out or piled in a static pile. This equates to approximately 10 to 12 times.

7 WINDROW MONITORING

7.1 Monitoring Equipment

A temperature probe is required to monitor the temperature in the compost windrow matrix to inform the operator of the biodegradation efficiency and pathogen destruction that is being performed in their windrow.

Oxygen probes are available to inform the operator of the presence and uniformity of oxygen throughout the windrow matrix.

This monitoring will give the operator advance notice that the compost windrow needs to be turned when the temperature gets too high or the oxygen content gets too low.

7.2 Grid System

A compost windrow has basically three zones in the windrow matrix. The small center core at the base of the windrow is the hottest spot and can overheat or go anaerobic (without oxygen) quite quickly. The second zone is the next layer of compost that forms around the center core but is beneath the outside layer, which is the third zone. These two zones tend to not to have the capacity to generate enough heat, and the outside layer tends to dry out from exposure to the elements. That is why it is critical to turn and mix the three zones together to ensure they all reach the thermophilic stage.

7.3 Frequency

In the initial start-up stages of the composting process, it is very important to probe and monitor your windrow frequently to control and assist the microbiological dynamics that are required to initiate the composting degradation. This also ensures and provides for documentation of reaching the required temperatures for the necessary length of time to destroy pathogens.

8 TIME AND TASK SCHEDULE PER WINDROW

Month	Week	Monitoring	Stacking	Turning	Moisture	Woodchips	Screen
May	1	DAILY	YES	1X	YES		
	2	DAILY	YES	2X		YES	
	3	DAILY		1X	YES		
	4	DAILY		1X			
June	5	1X		1X			
	6	1X		1X			
	7	1X					
	8	1X		1X			
July	9	1X					
	10	1X		1X			
	11	1X					
	12	1X					
Aug	13	1X					
	14	1X		1X			
	15	1X					
	16	1X					
Sept	17	1X					
	18	1X		1X			
	19	1X					
	20	1X	YES				DO
Oct							
Cost/Time							

9 COMPOST QUALITY STANDARDS

The evaluation of the quality of organic substrates is based on four categories of quality criteria that will assess whether successfulness has been achieved in producing a Class 'A' compost. The four categories are:

1.0 Maturity
2.0 Foreign matter
3.0 Trace elements
4.0 Pathogenic organisms

9.1 Maturity

"*The maturity of compost is an important characteristic to consider when evaluating the quality of the product, given the harmful effects of immature compost use on plant growth. Maturity is an inherent compost characteristic: if the product of the composting process is not mature, the term "compost" cannot be used*"[i].

The CCME position on compost maturity suggests that compost is considered mature if it meets two of the following three criteria*:*

- A C/N ratio, 25 : 1
- An oxygen uptake < 150 mg O_2/kg volatile solids per hour
- Germination of cress (Lepidium sativum) seeds and of radish (Raphanus sativus) seeds in compost must be greater than 90 percent of the germination rate of the control sample, and the growth rate of plants grown in a mixture of compost and soil must not differ more than 50 percent in comparison with the control sample.

OR

- Compost will not reheat upon standing to greater than 20C above ambient temperature
- Compost must be allowed to mature for at least 21 days after the thermophilic phase is completed.

OR

- Reduction of organic matter must be 60 percent by weight
- Compost must be allowed to mature for at least 21 days after the thermophilic phase is completed.

OR

- *If no other determination of maturity is made, the compost must be cured for a six-month period. The state of the curing pile must be conducive to aerobic biological activity. The curing stage begins when the pathogen reduction process is complete and the compost no longer reheats to thermophilic temperatures.*[ii]

"Immature composts continue to break down once they are incorporated into the soil. This can affect plant health by consuming or tying up two resources that growing roots need. The high level of microbial activity in unfinished compost requires a large intake of oxygen, and the microbes may pull this from the surrounding soil, essentially suffocating the roots."[iii]

Based on the above requirements and analytical data available at the time of this assessment, compost maturity will be evaluated based on oxygen uptake rate. Oxygen uptake rate is a measurement of "*the amount of oxygen consumed by the metabolic activity of aerobic micro-organisms in a compost sample over a period of time, which permits an estimate of the biological activity of the compost. As the biological activity of compost diminishes as the composting process nears completion, oxygen uptake decreases and may be used to provide an indication of compost maturity*."[iv] "*Compost shall be mature at the time of sale and distribution*"[v].

9.2 Foreign Matter

The CCME guideline states, "*mineral soils, sand, rocks and wood are not considered to be foreign matter. Both Category A and Category B compost must be virtually free of foreign matter that may cause nuisance, damage or injury to humans, plants or animals, during or resulting from intended use. The compost must not contain any sharp foreign matter measuring over 3 mm in any dimension or any foreign matter greater than 25 mm in any dimension"*[vi].

9.3 Trace Elements

"For the CCME, Category A trace element concentrations come from the maximum background concentrations derived from the arithmetic mean plus 3 standard deviations of rural and agricultural soils from Alberta, Ontario and Quebec, and from limits established through the British Columbia best achievable approach."[vii]

9.4 Pathogenic Organisms

"*As pathogenic organisms may be present in the compost feedstock, the compost itself may also contain pathogenic organisms and, as a result, may pose health risks. To adequately reduce these health risks, the compost shall conform to the criteria outlined in either Clause A or B below depending on the feedstock source.*

Clause A: When compost does not contain feedstock known to be high in human pathogens, the following criteria shall be met:

1. *The compost shall undergo the following treatment or other process recognized an equivalent by the relevant authority.*

   *Using the **in-vessel composting method**, the solid waste shall be maintained at operating conditions of 55ºC or greater for three days.*

> *Using the **windrow composting method**, the solid waste shall attain a temperature of 55ºC or greater for at least 15 days during the composting period. Also, during the high temperature period, the windrow shall be turned at least five times.*
>
> *Using the **aerated static pile composting method,** the solid waste will be maintained at operating conditions of 55ºC or greater for three days. The preferable practice is to cover the pile with an insulating layer of material, such as cured compost or wood chips, to ensure that all areas of the feed material are exposed to the required temperature.*

OR

Organisms shall not exceed the following:

> *faecal coliforms < 1000 most probable number (MPN)/g of total solids calculated on a dry weight basis, and*
>
> *Salmonella sp. <3 MPN/4g total solids calculated on a dry weight basis*

Clause B: When compost contains feedstock know to be high in human pathogens, the following criteria shall be met:

1. *Undergo a treatment (described in Clause A, above) or other process recognized as equivalent by the relevant province or territory.*

AND

2. *Organisms shall not exceed the following:*

   faecal coliforms < 1000 MPN/g of total solids calculated on a dry weight basis, or

   Salmonella sp. <3 MPN/4g total solids calculated on a dry weight basis."[viii]

10 SCREENING

10.1 Static Pile

When the compost has completed the process and has met all of the required parameters in regards to pathogen reduction and organic decomposition, it can be stockpiled in a large static pile for curing. After suitable curing time, compost from the static pile can be trommel screened to suit end markets.

10.2 Compost Stabilization Tests

Before you screen your compost it would be prudent to perform a compost stabilization test to determine whether your product has been processed and cured properly. A common test that can be performed is an oxygen uptake demand to determine the presence of microorganisms and their *BOD* (biological oxygen demand).

10.3 Screen Size

Screen size is determined by the potential end use. It is more imperative to screen the material through a ½ inch screen for bagging or for the home and garden market. If your compost market is wholesaling to landscape soil blenders or farmers for land application, then a larger screen size can be used to screen out any oversized and undesirable materials. It is necessary to screen your compost to remove any of the wood chips that were used as bulking material to create free air space.

11 MARKETING

With respect to marketing, and in particular marketing of a bagged product, the compost must satisfy the Federal Fertilizers Act. This includes criteria regarding quality and labelling. Any fertilizer product including compost that is publicly distributed must be registered under the fertilizer acts. The Guaranteed Analysis clause of Federal fertilizer Act is summarized below. Please refer to the Federal Fertilizer Act for complete marketing and labelling requirements.

11.1 GUARANTEED ANALYSIS[ix]

15. The guaranteed analysis of a fertilizer or a supplement shall include

(*a*) in respect of each fertilizer, the minimum amount of total nitrogen, available phosphoric acid and soluble potash expressed in per cent,

(*b*) in respect of each mixed fertilizer, other than customer-formula fertilizers and fertilizers represented for daily feeding and not for further dilution, the minimum amount of total nitrogen, available phosphoric acid and soluble potash expressed in per cent in whole numbers only,

(*c*) in respect of each fertilizer, the minimum amount of calcium, magnesium and sulphur expressed in per cent on the elemental basis,

(*d*) in respect of each fertilizer, the amount of each lesser plant nutrient, other than calcium, magnesium and sulphur, expressed in per cent on the elemental basis.

11.2 Soil Conditioner Analysis

The following table provides a detailed analysis of the three soil conditioner products produced by the City of Brandon.

TABLE 1: COMPOST QUALITY

Parameter	**units**	**Compost**		
		Keystone	Yard Waste	Airfield
Total nitrogen	%	1.14%	1.20%	1.38%
Available potassium	%	1.39%	0.84%	0.91%
Available phosphorous	%	0.23%	0.08%	0.28%
% Total carbon	%	23.28%	15.75%	22.30%
C/N ratio		11.6	11.2	13.2
Bulk density	T/cu.m	0.32	0.72	0.53
pH		8.2	7.5	7.3
Organic Matter	%	35.31%	24.03%	39.82%
% Moisture	%	38.59%	27.91%	43.47%
Calcium	%	0.015%	0.025%	0.015%
Magnesium	%	0.0089%	0.0075%	0.0064%
Sodium	%	0.31%	0.06%	0.17%
Chloride	%	0.85%	0.21%	0.44%
Sulfate	%	0.35%	0.13%	0.16%

Table 2 lists the Guaranteed Minimum Analysis as per the Federal Fertilizer Act based on the above data. However, as for each soil conditioner there is only two subsets of data, the listed "Guaranteed Minimum Analysis is not statistically valid. Additional samples of the soil conditioners are required. In addition, a complete micronutrient analysis of each product is required prior to marketing.

TABLE 2: COMPOST LABELLING

Product Name	Keystone 1-0-1	Yard Waste 1-0-0	Airfield 1-0-0
	Guaranteed Minimum Analysis		
Total Nitrogen (%)	0.9%	1.0%	1.0%
Available Phosphorous (%)	0.05%	0.00%	0.02%
Available Potassium (%)	0.9%	0.3%	0.5%
Calcium (%)	0.01%	0.02%	0.01%
Magnesium (%)	0.00%	0.00%	0.00%
Sulphur (%)	0.3%	0.1%	0.1%

12 MARKETS

12.1 Potential Local Market

Initial potential local markets are civic parks, recreation, cemeteries and public works departments. A more detailed listing of potential local markets can be found in 11.3 “Bulk Compost Markets”. Developing a local residential bag market would be advantageous as well.

12.2 Bag Compost Market Potential

Bag compost will give you the highest economic return for your compost, however you should only plan on selling a small percentage of your annual production in bags. The bags must have labels stating the minimum nutrient value, an ingredients listing and directions for use. Strict adherence to CCME Class A compost guidelines is imperative.

12.3 Bulk Compost Market Potential

Local landscapers, tree nurseries, sod farms and farmers are potential bulk compost users. Product quality and nutrient values will have an influence on the most suitable market for the compost your facility produces. Initial general market price is equivalent to that of topsoil, however once users have experience with the results from using compost, a premium over topsoil values can be realized.

12.4 Agricore

Agricore is an Agricultural Services and Support Corporation that is pioneering the use of compost on farm fields as a source of organic nutrients and as a soil conditioner for improving organic matter and the water retaining capabilities of the soil. They have established a marketing arm for sales and distribution of compost produced by various generators in Western Canada.

13 SUSTAINABLE DEVELOPMENT ASSESSMENT

13.1 Cost Benefits Analysis

Cities have departments that are annually purchasing topsoil blends for use in parks, recreation fields, cemeteries, schoolyards, street meridians and other sites. The landfills receive organics and the cost of composting those organics can be offset by the cost saving from other departments purchasing topsoil blends. Additional positive economic factors are realized when carbon credits are calculated onto the revenue side of the ledger along with the cost savings of treating leachate and methane gas venting at landfill sites.

13.2 Environmental Benefits Analysis

The environmental benefit of organics diversion from landfills to be used for composting is a large step towards minimizing climate change and global warming. The production of methane gas and leachate in landfills lend to potential negative impacts on ground and surface water.

Compost has proven positive impacts on any soils that it is incorporated into. As well as having plant-essential nutrients for growth and production, compost can improve the organic matter in your soil, which will enhance the moisture retention capacity of the soil, thereby improving the soil tilthe and humus content.

13.3 Social Benefits Analysis

The social benefits for consideration are the community pride and participation in the "greening" of your community with programs such as Communities in Bloom and local horticultural and gardening clubs. Economic Development benefits are through the jobs that will be created and spin-off businesses that will be developed from producing, distributing and utilizing the compost. There is also the public education component that will illustrate and create an understanding of how our natural eco-systems work and how humans have to learn to co-exist with nature.

14 REFERENCE SITES

- Olds College Centre for Innovation, Composting Technology Centre
- Production and Use of Compost Regulation, B.C. Reg.334/93 O.C. 1295/93
- Bureau du Normalisation du Quebec 1995 **(BNQ)**
- Canadian Council of the Ministers of the Environment **(CCME)**
- Agriculture and Agri-Food Canada **(AAFC)**
- Alberta Environmental ProtectionStandards Council of Canada **(SCC)** Code of Practice for Compost Facilities,

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[i] Section 6.1, Definition of Compost, Support Document for Compost Quality Criteria, National Standard of Canada (CAN/BNQ 0413-200), The Canadian Council of Ministers of the Environment (CCME) Guidelines, Agriculture and Agri-Food Canada (AAFC) Criteria, Page 10.

[ii] Section 6.1.2, CCME Position, Support Document for Compost Quality Criteria, National Standard of Canada (CAN/BNQ 0413-200), The Canadian Council of Ministers of the Environment (CCME) Guidelines, Agriculture and Agri-Food Canada (AAFC) Criteria, Page 11.

[iii] The Composting Process: Compost Maturity, The Composting Council of Canada, www.compost.org/sheet_4.pdf

[iv] Introduction, Organic Soil Conditioners – Composts – Determination of Oxygen Uptake – Respirometric Method, Working Draft WD 0413-220-2, BNQ, 2004, Page 1.

[v] Section 4 Definitions, Organic Soil Conditioners – Composts, Draft Standard P 0413-200-5, BNQ, 2004, page 4.

[vi] Section 6.2.2, CCME Position, Support Document for Compost Quality Criteria, National Standard of Canada (CAN/BNQ 0413-200), The Canadian Council of Ministers of the Environment (CCME) Guidelines, Agriculture and Agri-Food Canada (AAFC) Criteria, Page 15.

[vii] Section 6.3.2, CCME Position, Support Document for Compost Quality Criteria, National Standard of Canada (CAN/BNQ 0413-200), The Canadian Council of Ministers of the Environment (CCME) Guidelines, Agriculture and Agri-Food Canada (AAFC) Criteria, Page 22.

[viii] Section 6.4.2, CCME Position, Support Document for Compost Quality Criteria, National Standard of Canada (CAN/BNQ 0413-200), The Canadian Council of Ministers of the Environment (CCME) Guidelines, Agriculture and Agri-Food Canada (AAFC) Criteria, Pages 28 & 29.

[ix] Fertilizers Regulations, C.R.C., c. 666 Federal Fertilizers Act, December 31, 2003.

[ix] Section 4.0, Definition of Compost, Support Document for Compost Quality Criteria, National Standard of Canada (CAN/BNQ 0413-200), The Canadian Council of Ministers of the Environment (CCME) Guidelines, Agriculture and Agri-Food Canada (AAFC) Criteria, Page 7.

[ix] Table III: Maximum Trace Element Concentration Limits for Compost Established by the CCME, Support Document for Compost Quality Criteria, National Standard of Canada (CAN/BNQ 0413-200), The Canadian Council of Ministers of the Environment (CCME) Guidelines, Agriculture and Agri-Food Canada (AAFC) Criteria, Page 24.