TOWARDS A CANADA-WIDE APPROACH TO THE MANAGEMENT OF WASTEWATER BIOSOLIDS

CONSULTATION BACKGROUND DOCUMENT

1. Introduction

Canadian wastewater treatment plants produce more than 660,000 dry tonnes of biosolids per year. Biosolids contain valuable nutrients and organic matter, as well as some substances of concern. Currently, biosolids are beneficially managed in a number of ways, including composting, use in fabricated growing media, land application in agriculture, forestry, silviculture, mines and other disturbed areas, and incineration with energy capture/ash recycling. Disposal options include incineration without energy capture and burial in landfills.

An ongoing challenge to managing biosolids is that, irrespective of end use, there are benefits, risks, and specific considerations for every biosolids management option.

Biosolids are managed in a manner that is protective of human health and the environment. To facilitate beneficial biosolids management, the Canadian Council of Ministers of the Environment (CCME), has established a Biosolids Task Group (BTG) composed of federal, provincial and territorial representatives. The role of BTG is to work towards the development of a Canada-wide approach for the management of municipal wastewater biosolids.

The development of the Canada-wide approach for biosolids management includes: legislative review, investigation of emerging issues, preparation of a draft policy statement and supporting principles, consultation, and development of a Guidance Document.

In this stage of the process, BTG is consulting with key stakeholders on the draft policy statement and principles by which the policy will be developed and implemented. Development of the policy statement and principles was guided by work completed by BTG on the investigation of two emerging areas: greenhouse gas (GHG) emissions related to biosolids management and emerging substances of concern in biosolids, and by the experiences of jurisdictions in regulating biosolids. Work completed by BTG is summarized in Appendix 1.

1.1 Consultation Background Document Objectives

The purpose of this document is to provide background information to facilitate participation of interested stakeholders in the consultation process. The consultation has been designed to enable stakeholders to have meaningful input into the development of a Canada-wide biosolids management policy and ultimately the Guidance Document that supports the policy.

Information provided in this document includes:

- biosolids use, management options and considerations
- benefits of developing a Canada-wide approach

- draft policy statement and principles developed by BTG to facilitate a Canada-wide approach to biosolids management

1.2 Definitions

Wastewater solids are typically referred to as biosolids, septage and sludge. The definitions of biosolids, septage and sludge vary across Canada. To promote consistency across the country, the BTG has developed definitions for use in developing the Canada-wide approach.

> ***Municipal wastewater biosolids*** are organic-based products produced from the treatment of wastewater sewage sludge and septage to reduce pathogens and vector attraction (odours). Municipal wastewater biosolids may be solids, semi-solid or liquid and are generated primarily from the treatment of domestic wastewater and municipal sludge, although municipal wastewater treatment plants can also treat industrial, commercial and institutional wastewater.
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> ***Septage*** is the biodegradable waste from septic tanks and similar on-site treatment units. Septage includes sediments, water, grease, and scum pumped from a septic tank.
>
> ***Sludge*** is a mixture of water and solids separated from various types of wastewater as a result of natural or artificial processes.

Additional definitions for terminology used in this Consultation Background Document are provided in the Glossary in Appendix 3.

1.3 Document Organization

The subsequent Sections of this document are organized as follows:

- Section 2.0 Biosolids Production, Management and Current Regulatory Framework
- Section 3.0 Opportunities for Developing a Canada-wide Approach for the Management of Wastewater Biosolids
- Section 4.0 Draft Policy Statement and Supporting Principles
- Section 5.0 Stakeholder Consultation
- Appendix 1: Summary of Work Completed by the CCME Biosolids Task Group
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- Appendix 3: Glossary of Terms

1.4 Obtaining Additional Copies

Additional copies of this document may be obtained from Liz Dykman, CCME Secretariat, ldykman@ccme.ca.

2.0 Biosolids Production, Management and Current Regulatory Framework

2.1 Biosolids Production

Biosolids are the treated and stabilized organic product of municipal wastewater treatment. Canadians currently generate greater than 660,000 dry tonnes of biosolids per year. The amount of biosolids generated in Canada is expected to increase in the future due to increasingly stringent requirements for wastewater treatment. Biosolids are continually produced at wastewater treatment plants across the country and require ongoing management to ensure protection of human health and the environment.

2.2 Biosolids Management

Biosolids management options are dependent on the quality of the biosolids, the level of treatment used to produce the biosolids, and the regulatory framework of each province or territory. The regulatory framework will be discussed in greater detail in Section 2.3.

Biosolids management options can be classified into two broad categories: disposal and beneficial use. Disposal options include burying of the biosolids in a landfill or incinerating the biosolids in a manner that does not result in energy recovery. In moving forward with development of the Canada-wide biosolids management approach, BTG is focusing on beneficial use options for biosolids.

Beneficial use options capitalize on the nutrient and organic matter value of the biosolids for use in: agricultural land fertilization or soil amendment, forest fertilization, land reclamation, composting, development of soil products and energy production. The benefits of biosolids use associated with each of the management options are summarized in Table 1.

There are several considerations in developing a beneficial biosolids use option. Similar to the management options, the management considerations are dependent on the quality of the biosolids, the treatment process, and the jurisdiction where the biosolids are to be used. Factors that need to be considered in the effective management of biosolids include:

- odour management
- biosolids quality – trace elements, nutrients, pathogens, emerging substances of concern
- suitability of the land applications site (e.g., soil quality prior to biosolids applications and proximity to sensitive water resources)

- transportation logistics – number of transport vehicles required, availability of access roads
- buffer distances (e.g., distance of the proposed land application of biosolids from specified features such as water resources, roads and neighbouring landowners)
- social considerations (e.g. for example, proximity of proposed land applications to residences and community facilities, and marketability of some biosolids products).

Table 1: Beneficial Management Options for Biosolids Use

Beneficial Biosolids Management Option	Opportunity for Biosolids Use
Compost and soil products (e.g. topsoil and growing media)	• Biosolids, used as an ingredient in topsoil and compost, provide a source of nutrients and organic matter which supports plant establishment and growth. • Biosolids can be used in development of biocover for placement on landfills to mitigate fugitive methane (CH_4) emissions.
Agricultural land fertilization	• Biosolids provide macronutrients (e.g., nitrogen and phosphorus) and micronutrients (e.g., calcium, magnesium and sulphur). • Biosolids reduce the requirement for chemical fertilizer. • Biosolids provide organic matter that improves soil physical properties including porosity, bulk density and water holding capacity.
Forest fertilization	
Land reclamation	• Biosolids provides a source of nutrients and organic matter to promote soil development and vegetation establishment on degraded sites. Biosolids can be managed at mines to assist in achieving multiple reclamation objectives.
Energy capture	• Biogas generated during the wastewater treatment process can be captured and used for heating or to generate electricity. • Energy capture in the form of heat from incineration of biosolids can be used to generate electricity.

2.3 Current Canadian Regulatory Framework for Biosolids

In Canada, the framework for biosolids management varies among the provinces and territories, however the Canadian Food Inspection Agency regulates biosolids on a national level if they are imported or sold as a fertilizer or soil supplement. In general, biosolids are managed similarly in that they are required to meet certain process and quality criteria in order to be used for specific purposes. Each of the provinces or territories is responsible for setting their own policy either through their own policy development or reference to policies created in other jurisdictions. The goal of developing a Canada-wide approach is to harmonize biosolids management policies across jurisdictions in areas where it makes sense to do so. To aid in the development of the approach, BTG completed a review of the existing legislative framework for biosolids. *A Review of the Current Canadian Legislative Framework for Wastewater Biosolids* is available on the CCME website at http://www.ccme.ca/assets/pdf/pn_1446_biosolids_leg_review_eng.pdf

3.0 Opportunities for Developing a Canada-wide Approach for the Management of Wastewater Biosolids

BTG has identified opportunities for the development of a Canada-wide approach which will address the challenges identified in Section 2. Opportunities include:

- harmonizing communication and policy among different governments within Canada
- establishing consistent terminology (e.g., the definition of municipal biosolids)
- facilitating identification and investigation of emerging issues

4.0 Draft Policy Statement and Supporting Principles

4.1 Draft Policy Statement

In moving forward with the Canada-wide approach, BTG has prepared a draft policy statement for consultation that defines and addresses the challenges surrounding beneficial biosolids management. The purpose of the draft policy statement is to promote a Canada-wide approach for the management of municipal wastewater biosolids, sludge and treated septage that focuses on beneficial use.

Draft Policy Statement

The Canadian Council of Ministers of Environment (CCME) promotes the "beneficial use" of the nutrients, organic matter and energy contained within municipal wastewater biosolids, sewage sludge and treated septage, rather than wasting these valuable resources.

A beneficial use must:

- demonstrate product efficacy

- minimize potential risks to the environment and human health

- minimize GHG emissions.

Beneficial use includes the land application of municipal wastewater biosolids and treated septage to establish vegetation when conducted in accordance with current regulations, guidelines or approvals. Anaerobic digestion of sludge where biosolids are produced and methane is captured and utilized to generate energy is considered beneficial use. Methane recovery and energy production is an additional benefit as it can reduce GHG emissions from the wastewater treatment process.

Landfilling is not considered a beneficial use, regardless of whether it meets provincial and territorial regulations or standards and landfill gas is collected and used for energy. Landfilling does not capitalize on the nutrient value of the biosolids and significant GHG emissions can still occur due to fugitive CH_4 emissions resulting from inefficiencies in landfill gas collection. Incineration of municipal wastewater biosolids that does not result in a positive energy balance or that emits significant nitrous oxide (N_2O), a potent GHG, is not considered beneficial use.

4.2 Principles Supporting the Draft Policy Statement

BTG has drafted the following six principles to support the draft policy statement:

1. Land application of municipal wastewater biosolids and treated septage is a beneficial use that can partially replace non-renewable chemical fertilizers to enhance plant growth, soil fertility and soil properties, including carbon sequestration (*LeBlanc et al., 2008; SYLVIS, 2009*). Safety is achieved through regulatory standards and guidelines.

2. While municipal wastewater biosolids consist primarily of non-fossil fuel-derived organic matter and nutrients, it is recognized that applicable quality and management standards must be adhered to and that all jurisdictions should encourage and support the continuous improvement of biosolids in order to maximize their inherent benefit to the environment.

3. Landfilling of municipal wastewater biosolids and sludge is not considered a beneficial use because organic matter decomposition contributes to GHG emissions, (even if landfill gas is collected and used for energy (*SYLVIS, 2009*)), and landfilling results in the loss of useful nutrients, such as nitrogen and phosphorus.

4. Anaerobic digestion/methanization of municipal wastewater sludge produces renewable, carbon neutral energy. The biosolids that are produced are of enhanced quality and may then be used for land application.

5. Composting is a sludge treatment process that produces biosolids of enhanced quality that may then be used for land application.

6. Incineration that does not result in a positive energy balance or that emits significant amounts of N_2O or that does not recover a significant portion of ash, is not considered as “beneficial use”.

4.3 Guidance Document

BTG is preparing a Guidance Document which will assist jurisdictions in meeting the proposed policy statement and principles. The Guidance Document will be developed, and input on the draft Guidance Document will be sought through consultation. Previous work completed by the BTG (summarized in Appendix 1 and the legislative review) will be used to develop the Guidance Document along with input from stakeholders participating in the consultation process on the draft policy statement and principles and draft table of contents for the Guidance Document. The draft table of contents for the Guidance Document is included in Appendix 2. The Guidance Document is intended to provide harmonized, Canada-wide recommendations, best management practices and considerations for regulators regarding beneficial use of municipal wastewater biosolids, sludge and treated septage. Recommendations will be designed to assist regulators in managing wastewater biosolids, sludge and treated septage according to the beneficial use draft policy statement.

5.0 Stakeholder Consultation

The purpose of this consultation is to enable stakeholders to have meaningful input into the development of a Canada-wide biosolids management policy statement and principles and to help shape the development of a guidance document for beneficial use of biosolids.

Through the consultation process, BTG will:

- provide stakeholders and interested Canadians with information on the activities and work completed by BTG
- build a shared understanding of the opportunity to develop a Canada-wide approach to biosolids management
- solicit input that will be used to inform and refine the draft policy statement and principles and support development of a Canada-wide approach to biosolids management.

To promote participation and encourage feedback on the draft policy statement and principles, BTG has developed a series of consultation questions in the attached comment form.

5.1 Stakeholder Consultation Questionnaire and Response Submission

BTG will be accepting responses to the consultation questions until October 29, 2010. Your response to the consultation questions can be submitted to BTG using the attached form.

5.2 Next Steps

BTG will be consulting with key stakeholders across the country on the draft policy statement and principles through the fall of 2010. Comments from stakeholders will be compiled and used to refine the draft policy statement and principles and develop the Guidance Document.

A second public consultation phase will be completed in early 2011. This phase of the consultation process will allow Canadians to review and provide comment on the draft Guidance Document. Following the second phase of consultation, comments will be compiled and used to develop a draft Canada-wide Approach to the Management of Municipal Wastewater Biosolids.

Completion of the Approach is targeted for the summer of 2011.

Appendix 1: Summary of Work Completed by the CCME Biosolids Task Group

The draft policy statement and principles were developed, in part, by reviewing work previously completed by BTG pertaining to GHG emissions and emerging substances of concern (ESOC). This work is summarized below. The final reports for these projects and the Biosolids Emissions Assessment Model are available on CCME's website at http://www.ccme.ca/ourwork/waste.html?category_id=137.

I. Emerging Substances of Concern

BTG identified emerging substances of concern (ESOC) in biosolids as an area for further research. Specifically this research was designed to identify and inventory ESOC that may be present in Canadian biosolids. ESOC are compounds such as pharmaceuticals and personal care products. Sound scientifically-based knowledge on the presence or absence of these compounds in Canadian biosolids is important in evaluating risks and ensuring health and environmental protection in the beneficial use of biosolids.

In 2008, BTG commissioned a project to:

- review the state of the knowledge with respect to biosolids science and research
- complete a field sampling program to identify and quantify the presence/absence of ESOC in Canadian biosolids
- determine the effect of wastewater treatment on ESOC
- identify those ESOC that that may pose a risk to the environment if land applied
- recommend best management practices and research requirements for ESOC.

This project was completed by Hydromantis Inc., the University of Waterloo and Trent University under contract to CCME. In carrying out the ESOC study the following activities were completed:

- Literature Review and Survey:
  - The literature review and survey included a review of academic and government research and correspondence with experts in the field of ESOC. The literature review is available on CCME's website: http://www.ccme.ca/assets/pdf/pn_1440_contam_invt_rvw.pdf

- Selection of ESOC for Analysis:
  - The specific ESOC included in this study were selected based on potential importance with respect to the environment and human health, likelihood of finding detectable concentrations, the presence of good laboratory methods and the project budget. The list of ESOC selected for analysis included 57 pharmaceutical compounds, three alkylphenolic compounds (Bisphenol A for example) and 11 synthetic musk fragrances. In addition the sludge/biosolids were analyzed for nutrients and 11 trace elements which are commonly regulated in Canadian biosolids.

- Sampling and Analysis:
  - Sludge/biosolids samples were collected from 11 municipalities across Canada representing seven different biosolids and sludge treatment processes. The samples were collected before and after the sludge treatment process to determine the effect of the treatment process on the form and concentration of the ESOC.

- Effectiveness of Wastewater Treatment Methods, Identification of Alternatives and Recommendations for Best Management Practices:
  - From the data collected and literature reviewed, the study identifies knowledge gaps and research needs, makes conclusions regarding the presence of ESOC and effect of treatment processes on ESOC and provides recommendations for further investigation and research.

This study revealed that some ESOC were never detected in Canadian biosolids, some detected ESOC showed a decrease in concentration after treatment to the extent they were no longer detectable, and a limited number increased after treatment possibly due to transformation from other compounds. Lab methods currently allow ESOC to be detected at concentrations in the range of nanograms per litre (10^{-9} g/L) or nanograms per gram (10^{-9} g/g). It is currently unknown what risk if any is posed by ESOC detected at these low levels; detection does not immediately imply a risk associated with proper biosolids management. Of the treatment processes identified, composting was identified to efficiently remove a large number of pharmaceuticals and fragrances (*Hydromantis et al, 2010*).

The ESOC literature review and study were used to inform the draft policy statement and principles. The report discussing the results of the sampling and analysis is available on the CCME website at http://www.ccme.ca/assets/pdf/pn_1445_biosolids_esoc_final_e.pdf.

II. Greenhouse Gas Emissions

Knowledge of GHG emissions is an important consideration in assessing the sustainability of a biosolids management option. Although methodologies had been developed for other organic materials generated by municipalities, the methodologies and documentation for biosolids were limited.

To address these issues, BTG initiated the development of a tool which allows for the calculation of GHG emissions from biosolids management options currently in use in Canada. This tool was developed by SYLVIS Environmental with project partners at the University of Washington, the North East Biosolids and Residuals Association and Northern Tilth under contract to CCME.

Biosolids Emissions Assessment Model (BEAM) is the name of the tool developed for quantification of GHG emissions from Canadian biosolids management options. The BEAM and supporting user guide are publicly available and can be accessed on CCME's website at http://www.ccme.ca/ourwork/waste.html?category_id=137

The BEAM model can be used to:

- estimate the GHG emissions from a biosolids management program, including establishing a baseline

- compare emissions from different biosolids management options
- estimate the impacts on GHG emissions resulting from changes in a biosolids management program
- understand the factors that have the greatest impact on increasing or reducing GHG emissions associated with biosolids management.

Development of the BEAM included:

- Background and Literature Review:
  - The background and literature review consisted of a review of the biosolids management options used in Canada including land application and incineration and a review of current methods of quantifying GHG emissions. The type of biosolids management options used in Canada was determined by surveying wastewater treatment plants across the country.

- Method Development:
  - The goal in developing the BEAM was to allow Canadians to easily calculate GHG emissions related to biosolids management, to identify opportunities in the management process for GHG reduction, and to identify sustainable management options.

  - Considerations in method development included identification of the biosolids management options in use in Canada and sources of GHG emissions and reductions associated with each option.

- Development of Examples:
  - The BEAM model was tested using real-world Canadian examples. GHG emissions were calculated for biosolids management programs from nine Canadian municipalities. The municipalities were selected to ensure Canada-wide representation and variations in biosolids management options. Data provided by the municipalities and literature-based emission factors were used in the BEAM to calculate the GHG emissions associated with the management options and to provide recommendations for reducing the emissions. Ideally the amount of GHG emitted would be less than the amount of GHG avoided or sequestered (i.e., in a form that is not available for release to the atmosphere).

The results of the BEAM and testing with Canadian municipalities demonstrated opportunities for carbon sequestration and reduction in the overall GHG emissions when biosolids were beneficially used. The information obtained through this project was considered in the development of the draft policy statement and principles.

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CCME GUIDANCE DOCUMENT FOR THE BENEFICIAL USE OF BIOSOLIDS, SLUDGE AND TREATED SEPTAGE

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Anaerobic Digestion
Anaerobic (without oxygen) digestion is a sludge treatment process which results in the production of biogas and biosolids.

Beneficial Use
The draft policy statement defines a beneficial use of biosolids as one that demonstrates product efficacy, minimizes potential risks to the environment and human health, and minimizes emissions of GHGs.

BEAM
The Biosolids Emissions Assessment Model (BEAM) is a calculator tool and guidance document. The BEAM is designed to assist users in determining GHG emissions associated with various biosolids management options and to demonstrate how changes to wastewater treatment processes or biosolids management practices can impact GHG emissions.

Biosolids
Refer to the definition of **municipal wastewater biosolids**.

Biosolids Task Group (BTG)
BTG was established by CCME to develop a Canada-wide approach for the management of wastewater biosolids. The work of BTG includes developing an inventory of ESOC in Canadian biosolids, reviewing current Canadian legislative frameworks for biosolids, and developing a calculator tool (BEAM) for determining GHG emissions from various biosolids management practices.

Canada-wide Approach
The Canada-wide Approach is the process by which CCME looks to harmonize biosolids management in Canada. The Approach will include a Draft Policy Statement, six Guiding Principles and supporting Guidance Document.

Carbon Sequestration
Carbon sequestration refers to the removal of carbon from the atmosphere (by plants for example) or the storage of carbon which prevents its release to the atmosphere. Land application of biosolids can result in the sequestration of carbon in the soil and above and below ground biomass, preventing carbon release to the atmosphere.

CCME
The Canadian Council of Ministers of the Environment (CCME) is a council composed of environment ministers from the federal, provincial and territorial governments. The role of CCME is to work together to protect Canada's environment by developing national strategies and guidance that each environment ministry across the country can use.

Composting
Composting is a method of stabilizing organic matter under aerobic conditions (i.e., in the presence of oxygen).

Digestate
Digestate is the material that results from anaerobic (without oxygen) digestion of organic matter such as sludge. In municipal wastewater treatment, the digestate produced is biosolids.

Draft Policy Statement
The draft policy statement is a statement developed by BTG that promotes the beneficial use of biosolids and clarifies what is considered to be a beneficial use. The draft policy statement is the vision which guides the Canada-wide approach to the management of municipal wastewater biosolids, sludge and treated septage that focuses on beneficial use. It is proposed that the policy statement will be implemented in the form of a Guidance Document. Once finalized, the policy statement will apply to all municipal wastewater biosolids and septage produced in Canada from municipal / domestic wastewater treatment.

Greenhouse Gases (GHG)
GHGs are gases in the atmosphere that absorb and emit radiation. Examples of GHGs are carbon dioxide, methane and N_2O.

Guidance Document
The Guidance Document is a mechanism of implementing the draft policy statement proposed by BTG to promote a Canada-wide approach to management of municipal wastewater biosolids, septage and treated sludge. The Guidance Document is supported by the proposed draft policy statement and principles. It is proposed that the Guidance Document contain best management practises pertaining to beneficial use of biosolids. Adoption of the Guidance Document is voluntary; however, individual provinces and territories may choose to adopt the Guidance Document into their regulatory framework.

Methane
Methane is a GHG that is approximately 23 times as potent a GHG as carbon dioxide. Methane can be generated and utilized from wastewater treatment processes and biosolids management.

Municipal Wastewater Biosolids
Municipal wastewater biosolids are organic-based products produced from the treatment of wastewater sewage sludge and septage to reduce pathogens and vector attraction (odours). Municipal wastewater biosolids may be solids, semi-solid or liquid and come primarily from the treatment of domestic wastewater and municipal sludge, although municipal wastewater treatment plants may also treat some commercial and industrial sewer effluents.

Nitrous Oxide (N_2O)
Nitrous oxide is a GHG that is approximately 300 times as potent a GHG as carbon dioxide. Nitrous oxide can be generated from wastewater treatment processes and biosolids management.

Nutrients
Nutrients are necessary substances that are required for growth and to support life. Nutrients such as nitrogen and phosphorus are required for plant growth.

Principles
The draft principles developed by BTG provide guidance on the draft policy statement. There are six proposed principles.

Septage
Septage is the biodegradable waste from septic tanks and similar on-site treatment units. Septage includes sediments, water, grease, and scum pumped from a septic tank.

Sludge
Sludge is a mixture of water and solids separated from various types of wastewater as a result of natural or artificial processes.