1 INTRODUCTION

The BC Ministry of Environment (MOE) consulted with Sylvis Environmental Services Inc. to create a list of “frequently asked questions” (FAQ) and case studies in order to provide information to the public on the beneficial use of biosolids. This document provides answers to common questions that have been raised and provides three case studies for consideration.

2 FREQUENTLY ASKED QUESTIONS

2.1 WHAT ARE BIOSOLIDS?

The term “biosolids” means different things in different places.

In British Columbia, “biosolids” and “sludge” do not mean the same thing. In BC, sludge means the solid, semi-solid or liquid material that is generated during the wastewater treatment process and before the criteria for beneficial use have been met.

In BC, the term “biosolids” has a very specific definition that is provided in the BC Organic Matter Recycling Regulation (OMRR). The OMRR says that biosolids “means stabilized municipal sewage sludge resulting from a municipal wastewater treatment process or septage treatment process which has been sufficiently treated to reduce pathogen densities and vector attraction to allow the sludge to be beneficially recycled in accordance with the requirements of this regulation.”

To summarize, municipal wastewater treatment generates sludge which is further processed into biosolids – biosolids are sludge that has been treated to reduce pathogens and odours, stabilized, and tested to ensure that treatment requirements and quality criteria are met.

The OMRR does not allow the land application of sludge.

- Photograph 1 depicts biosolids generated through different wastewater treatment processes.
2.2 **How are biosolids regulated in BC?**

In BC, biosolids are regulated under the BC Organic Matter Recycling Regulation (OMRR) which is administered by the BC Ministry of Environment and falls under the umbrella of both the BC *Environmental Management Act* and BC *Public Health Act*. The OMRR was developed through public consultation and was promulgated (signed into law) in 2002.

The OMRR divides biosolids into 2 categories:

1. Class A biosolids and,
2. Class B biosolids

The categories differ in the requirements for treatment, quality, management and distribution and are dependent on the quality of the material produced.

Specific biosolids management practices have been put into place to protect human health and the environment. One of the management practices is a Land Application Plan (LAP). A LAP is a document that is authored and signed by a qualified professional that provides details on the quality of the biosolids and the soil where the biosolids will be applied, outlines how the land application will take place including where and when, and provides monitoring requirements. The BC Ministry of Environment is notified of all land application plans.

According to the Regulation, public notification of land application is not required; however, some companies provide public notification and information on a voluntary basis. Depending on the quality and class of biosolids, having visible signage after land application that explains the land application and the required restrictions is mandatory under the regulation.

The OMRR, supporting Guidelines for best management practice, and a summary of the most recent public engagement process are available for viewing on the Ministry’s website: [http://www2.gov.bc.ca/gov/topic.page?id=2C130233751D44AEBC77A7ACE4A014A8](http://www2.gov.bc.ca/gov/topic.page?id=2C130233751D44AEBC77A7ACE4A014A8)

- Photograph 2 aims to depict qualified professional involvement in a biosolids beneficial use project.

2.3 **How are biosolids produced?**

Biosolids are produced through municipal wastewater treatment– In BC the term “biosolids” does not include material generated by industrial wastewater treatment. Municipal wastewater treatment plants are designed to take the incoming material (called “influent”) and produce two products: water (called “effluent”) and biosolids. Influent quality is also protected by source control bylaws (local/regional laws that describe what can and cannot be put into the local/regional wastewater treatment system) and in some cases, pre-treatment of the wastewater. It is against the law (specifically the Hazardous Waste Regulation) to dispose of hazardous materials into the sewer system.

Many people think that biosolids are the solids that are flushed down your toilet; they are not. Once the influent enters the wastewater treatment plant it is treated in a series of steps that may include any combination of physical, biological and chemical processes depending on the type
of treatment facility and the level of treatment. These processes generate sludge. The sludge is then further treated to meet the requirements of the BC Organic Matter Recycling Regulation (OMRR). Only once the OMRR requirements are met can the term “biosolids” be used.

Many municipalities offer tours of their wastewater treatment facilities, we encourage you to contact your local wastewater treatment plant if you would like to learn more about how wastewater is treated and biosolids are produced in your area.

- Photograph 3 depicts a wastewater treatment plant.

### 2.4 What is in biosolids?

Biosolids are made up primarily of water, organic matter and nutrients. These properties allow the biosolids to be used as a soil amendment and/or fertilizer.

Adding organic matter to the soil allows air, water and nutrients to move more easily in the soil which is beneficial for plant establishment and growth. The increase in soil organic matter also increases the amount of water the soil can hold which helps to prevent soil erosion, reduces run-off and supports plants.

Biosolids contain nutrients that are needed for plant growth. These nutrients include nitrogen, phosphorus and potassium (these are referred to as “macro nutrients”) and smaller amounts of zinc, copper and iron (these are referred to as “micro-nutrients”). The combination of organic matter and nutrients allows the biosolids to act like a slow release fertilizer when applied to the soil.

Similar to animal manures, biosolids contain micro-organisms some of which are pathogens (organisms that have the potential to cause disease); dissimilar to animal manure, the amount of pathogens in the biosolids is controlled (the OMRR provides maximum limits) and has been reduced in the wastewater treatment process. Not all microorganisms contained in biosolids are pathogenic (capable of causing disease).

Biosolids contain trace elements some of which are beneficial to plant growth and others which are not and must be controlled. The OMRR specifies the maximum concentrations of trace elements that may be present in the biosolids, as well as maximum limits for soils post application which are protective of soils in a wide variety of situations. It is important to understand that soils naturally have background levels of all trace elements, and that all soil amendments, including manures, fertilizers and composts provide trace element addition to the soil. Biosolids are the only soil amendment where post application trace element limits are controlled through regulation.

Biosolids can also contain ultra-trace amounts of other materials that enter the wastewater treatment system. These constituents can include personal care products, pharmaceuticals, flame retardants, antibiotics, and hormone mimics. We use or are exposed to these compounds on a regular basis in our daily lives, and as a result they are found in dilute quantities in biosolids. These compounds are generally found in the parts per billion to parts per trillion range in biosolids, To understand how small these concentrations are, a part per billion is
roughly equivalent to a few drops diluted in an Olympic sized swimming pool, while a part per trillion is analogous to trying to find a loonie within an area the size of Canada. Research shows that some of these compounds are reduced or eliminated in the wastewater treatment process and others degrade rapidly in sunlight, or when they contact the soil once the biosolids are land applied. The presence of these compounds in biosolids has not been determined to cause any risk to people or the environment through biosolids application, and it is important to consider that they are used in much greater quantities in our everyday activities.

The best way to protect biosolids quality is to consider what you put 'down the drain', which empties into the wastewater treatment system. For example return unused medication to your local pharmacy, and recycle oil and paint at appropriate recycling facilities rather than disposing of it in the toilet or drain. We all contribute to biosolids production and we all play a role in protecting biosolids quality.

- Photograph 4 depicts a biosolids sampling event.

### 2.5 Are there any quality requirements for biosolids?

The OMRR provides quality criteria for biosolids, compost and biosolids growing media (BGM). These criteria include:

- maximum trace element concentrations in the biosolids and in the soil after the biosolids have been applied;
- maximum concentration of fecal coliforms in the biosolids, compost or BGM (fecal coliforms are a group of bacteria found in human and animal intestines, \( E. coli \) is an example of a type of fecal coliform);
- maximum concentration of foreign matter (materials not normally found in the soil) in the biosolids, compost and BGM; and,
- requirements for pathogen reduction and vector attraction reduction (odour control).

The biosolids trace element criteria used in BC are based on the extensive risk assessments completed by the United States Environmental Protection Agency (US EPA) and are more restrictive than the criteria used in the US. A Guide to the Biosolids Risk Assessments has been prepared by the USEPA which outlines the scientific process that was completed in setting safe limits for biosolids.

Trace element concentrations in the soil receiving biosolids must comply with soil quality standards. The soil standards are based on the criteria provided in the BC Contaminated Sites Regulation. These standards take into consideration site-specific factors such as land use, water resources and soil pH.

- Photograph 5 depicts a soil sampling event prior to land application of biosolids.
2.6 HOW ARE BIOSOLIDS MANAGED?

In 2012, the Canadian Council of Ministers of Environment (CCME) developed a Canada-Wide Approach for Biosolids Management (CCME, 2012) that “promotes the beneficial use of valuable resources such as nutrients, organic matter and energy contained within municipal biosolids…” CCME is made up of the environment ministers from the federal, provincial and territorial governments that work together to address environmental issues of national importance.

Biosolids are managed in a variety of ways in British Columbia including land application and as an ingredient in creating compost and fabricated soil. The BC Ministry of Environment, through the OMRR, promotes the beneficial use of biosolids rather than disposal – this is in line with the direction provided by CCME in their Canada-Wide Approach for Biosolids Management.

Beneficial use of biosolids as a fertilizer and soil amendment returns necessary nutrients to the soil, decreases the need for chemical fertilizer and adds organic matter that helps reduce soil erosion and run-off.

In BC, biosolids are used for:

- soil fabrication;
- compost production;
- land restoration;
- mine reclamation;
- agricultural land fertilization;
- forest fertilization;
- erosion control;
- horticulture;
- slope stabilization; and
- roadside aesthetic improvements.

- Photograph 6 depicts land application of biosolids.

2.7 WHAT MECHANISMS ARE IN PLACE TO PROTECT THE ENVIRONMENT?

In BC, biosolids land application must be beneficial (biosolids cannot be land applied as a method of disposal) and the biosolids application rate selected to match the desired beneficial use. For example, if the biosolids are being land applied as a nitrogen fertilizer the application rate should meet the nitrogen requirements of the intended crop, without providing more nitrogen than the crops needs. This protects water resources by reducing the possibility of nitrogen movement, or ‘runoff’ to surface water, or leaching to groundwater.

Before they are land applied, biosolids must meet the quality criteria provided in the BC Organic Matter Recycling Regulation. A qualified professional must specify the biosolids application rate and select the most appropriate time for application.
Biosolids land application must also adhere to a variety of management practices such as:

- Set-backs from roads, occupied dwellings or boundaries of property zoned for residences or recreation;
- Buffers zones (areas where biosolids applications are prohibited) from water resources including groundwater wells;
- Domestic animal grazing restrictions;
- Signage indicating biosolids have been applied; and,
- Waiting periods before consuming food crops.

In comparison to manure and chemical fertilizers, the land application of biosolids as a fertilizer or soil amendment is much more highly regulated.

- Photograph 7 depicts a demarcated setback distance line along which a biosolids land application has taken place.

2.8 ARE THERE HUMAN HEALTH CONSIDERATIONS WHEN USING BIOSOLIDS?

Health considerations when using biosolids are the same as those when working in your garden, or when using any other organic amendment, like manure. Practice good hygiene such as washing your hands after touching the biosolids and before eating or before using the bathroom. If you have open wounds on your hands, they should be protected from biosolids.

- Photograph 8 depicts the handling of biosolids using gloves as protection.

2.9 WHO IS RESPONSIBLE FOR BIOSOLIDS MANAGEMENT?

Owners of wastewater treatment plants are responsible for treating wastewater and for managing the biosolids that are produced. The Ministry of Environment, through the BC Organic Matter Recycling Regulation, provides criteria for biosolids use. The Ministry of Environment also provides best management practice guidelines to assist users in complying with the requirements of the OMRR.

The OMRR specifies that Land Application Plans (LAP), authored by qualified professionals, must be prepared in advance of land application of managed organic matter (Class A biosolids, Class B biosolids and Class B compost). Following land application, the qualified professional is required to certify that the biosolids application occurred as per the LAP. A qualified professional is defined in the OMRR as a person that:

- “(a) is registered in British Columbia with his or her appropriate professional association, acts under that professional association’s code of ethics, and is subject to disciplinary action by that professional association, and
- (b) through suitable education, experience, accreditation and knowledge may be reasonably relied on to provide advice within his or her area of expertise as it relates to this regulation.”
The Ministry of Environment, and in specific cases the regional Medical Health Officer and Agricultural Land Reserve Commission, review the land application plans and request additional information if required. The Ministry of Environment can also require additional management practices if necessary to protect human health and the environment.

All biosolids generators, users and qualified professionals must act according to the OMRR and best management practices.

### 2.10 Where can I find out more about biosolids?

There is a wealth of information and a large body of scientific knowledge supporting beneficial use of biosolids.

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<tr>
<th>Description</th>
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<tr>
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<td><a href="http://www.wef.org/biosolids/">http://www.wef.org/biosolids/</a></td>
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For additional information on how the BC Ministry of Environment manages the beneficial use of biosolids, please contact the Environmental Protection Division at [envprotdiv@Victoria1.gov.bc.ca](mailto:envprotdiv@Victoria1.gov.bc.ca).

- Photograph 9 depicts a tour group at a biosolids land application project.
3 CASE STUDIES

Case studies on beneficial biosolids use in the agricultural, forestry, and mine reclamation sectors are presented in the following sections.

3.1 CASE STUDY 1: FORESTRY

More than 40% of BC’s regional economies are forestry-based, and forestry supports over 55,000 direct jobs in more than 7,300 businesses. A lack of plant essential nutrients, especially nitrogen, limits the productivity of many BC forest ecosystems. For over 25 years, municipalities in British Columbia and throughout the Pacific Northwest of Canada and the United States have been applying biosolids to improve the productivity of forestland.

Extensive biosolids forest fertilization research conducted in local forest ecosystems in the Pacific Northwest has shown that biosolids applications in forestry:

- improve the quality of the soil;
- increase the growth rate of the trees and therefore the rate of timber production; and
- promote the growth of understory plants.

Biosolids can be beneficially used in traditional forests, short-rotation intensive culture of fast growing trees such as hybrid poplar, and Christmas tree plantations.

When land applied, biosolids provide organic matter and nutrients such as nitrogen that are often lacking in forest soils. The addition of organic matter increases the ability of the soil to retain nutrients and water. The increased water-holding capacity of the soil is beneficial as many second-growth forests grow in rocky, nutrient-poor soils where water shortages occur, especially during dry summer months.

The high organic matter content of the biosolids also allows it to act as a slow-release fertilizer. Trees fertilized with biosolids generally show an increased growth rate for five to eight years following biosolids application. Some tree species such as Douglas fir show a consistent and significant growth response to biosolids fertilization, increasing the rate of timber production by up to 75%. Biosolids are also especially well-suited to the fertilization of short-rotation plantations. For example, hybrid poplar trees grown in short rotation as a biomass crop have a high nutrient demand and can capitalize on the nutrients provided by the biosolids. In addition to promoting tree growth, biosolids application also benefits the understory vegetation. Understory plants grow faster and typically have a higher nutrient content therefore providing habitat and food for wildlife.

- Photograph 10 depicts growth response in a coniferous tree following biosolids fertilization.
- Photograph 11 depicts land application of dewatered biosolids to a short-rotation hybrid poplar plantation.
- Photograph 12 depicts application of dewatered biosolids to traditional forest stand.
3.2 **Case Study 2: Agriculture**

Throughout BC and the rest of Canada there are many active agricultural land application programs using biosolids as a fertilizer and soil amendment. Ongoing research programs, particularly in the Pacific Northwest, continually add to our knowledge about the application of biosolids to agricultural land.

Biosolids applications to agricultural land provide a number of benefits such as:

- improved soil structure including increased water holding capacity and decreased soil erosion;
- fertilization and replenishing of the nutrients in the soil that are removed through intensive agriculture;
- increased yield; and,
- pH adjustment of the soil.

These benefits are a result of the unique characteristics of biosolids. Biosolids contain a high concentration of organic matter which when land applied improves the quality of the soil. Soil quality improvements include increased water retention, tilth, erosion resistance and nutrient holding capacity.

As a fertilizer, biosolids provide a unique blend of macro-nutrients such as nitrogen and phosphorus and micro-nutrients such as calcium, iron, magnesium, copper, and zinc. The nutrients contained in the biosolids are released slowly over time as they are found in both plant-available and organically-bound forms. Plant-available nutrients can be immediately used by plants; organically bound nutrients are released slowly as the organic matter breaks down over a three to five-year period following biosolids fertilization. This slow release not only provides sustained fertilization benefits for the farmer for multiple years following a single application it also protects water resources in comparison to traditional chemical fertilizers that release nutrients quickly and are more prone to leaching.

When determining biosolids application rates for agricultural land the qualified professional takes into consideration the nutrient requirements of the crop, the nutrient concentration in the biosolids and the soil and the nutrient release rates. The application rate is selected so that the amount of plant-available nutrient released in the first year is equal to the crop demand. In this way, there is no excess nutrient left over after the growing season, reducing the potential for nutrient leaching. Biosolids fertilization results in crop yield increases that are similar and often more significant than those provided by chemical fertilization.

Depending on the characteristics of the biosolids they can also be used for pH adjustment of the soil. Some municipalities use lime in their treatment processes resulting in biosolids that have a high pH. These biosolids can be land applied to improve plant growth and soil productivity by increasing the pH of acidic soils.

- Photograph 13 depicts land application of dewatered biosolids.
- Photograph 14 depicts an example of vegetation response (i.e., a deeper green lushness) of biosolids-fertilized grasses.
• Photograph 15 depicts a method for ensuring that the target biosolids application rate is achieved.

3.3 **Case Study 3: Mine Reclamation**

Mine reclamation is required as a normal part of mining activities in BC. Surface mining operations remove topsoil and stockpile it in preparation for future reclamation activities while they conduct mining operations. Following mining activities the resulting soil is typically low in nutrients and organic matter and there is insufficient topsoil to complete the reclamation activities. Although the original topsoil is stockpiled, it often loses organic matter through decomposition, so that by the time reclamation activities begin, the topsoil is no longer suitable for re-vegetating and reclaiming an area.

In British Columbia, biosolids have been used for:

- soil development;
- slope stabilization;
- aesthetic improvement through vegetation establishment;
- wildlife habitat creation including the creation of an artificial wetland on a former quarry sedimentation pond; and,
- reduction of acid mine drainage.

In reclamation projects, biosolids are typically applied either only once or infrequently and at a higher application rate than would be used for agricultural or forestry applications. As mine soils often lack nutrients and organic matter, the biosolids application can be higher and the higher rate initiates the nutrient cycling process in the soil. Biosolids contain plant-essential nutrients and organic matter, which helps build the soil and improve its tilth, moisture retention, and nutrient-holding capacity.

In addition to soil development, biosolids act as a fertilizer by the providing macro and micro-nutrients needed to establish and sustain vegetation. The vegetation improves the aesthetics of the mine, suppresses dust generation, creates wildlife habitat and improves slope stability. Depending on the characteristics of the biosolids they can also be used for reduction of acid mine drainage. Some municipalities use lime in their treatment processes resulting in biosolids that have a high pH. These biosolids can be land applied to prevent the generation of acid mine drainage by increasing the pH of the soil.

Biosolids have been used in mine reclamation in British Columbia for over 20 years and have been recognized as a key innovation in award-winning mine reclamation programs.

- Photograph 16 depicts a dry former tailings pond on a windy day where dust is being generated.
- Photograph 17 depicts land application of biosolids to a dry former sedimentation pond as a first step in reclamation leading from soil development to establishment of vegetation.
• Photograph 18 depicts the development of a soil layer rich in organic matter as a result of land application of biosolids in a mine reclamation project.
PHOTOGRAPHS

Photograph 1: Examples of biosolids resulting from different treatment processes. The biosolids on the left result from lime treatment and the biosolids on the right from treatment by anaerobic digestion.

Photograph 2: Biosolids management must involve a qualified professional, who takes responsibility for the specific biosolids beneficial use project.

Photograph 3: Biosolids are produced at a wastewater treatment plant.
Photograph 4: Biosolids are sampled prior to use to ensure quality parameters comply with criteria listed in the BC Organic Matter Recycling Regulation.

Photograph 5: Soil samples are taken from a biosolids land application site to ensure that post-application soil concentrations of trace elements do not exceed the relevant soil quality limits.

Photograph 6: Land application of biosolids can aid in soil development and subsequent establishment of vegetation in land reclamation projects.
Photograph 7: Biosolids land applications must respect a 30-meter setback distance, demarcated with stakes in this photo, from surface water.

Photograph 8: When handling biosolids, as with other animal manures, basic hygiene should be followed and protection such as gloves should be worn.

Photograph 9: Participants in a biosolids land application project tour learn about biosolids beneficial use.
Photograph 90: The effects of biosolids fertilization on a Douglas Fir tree are readily visible when comparing the current year’s to the previous year’s growth.

Photograph 101: Dewatered biosolids are applied to a short-rotation hybrid poplar plantation.

Photograph 112: Depending on the terrain and access, specialized rather than traditional agricultural equipment must be used. Here, biosolids are applied using a side-discharge manure spreader in a forest stand.
Photograph 123: Biosolids are land-applied to a hayfield in the BC Interior using traditional agricultural equipment.

Photograph 134: The beneficial effects of biosolids fertilization can be seen in the lushness of the grasses in the center portion of the photo.

Photograph 145: Biosolids application rates, which are tailored to site vegetation requirements, are calibrated by measuring the amount of biosolids applied to a specific area (the “tarp method”).
Photograph 156: Mining areas such as former tailings ponds are characterized by soils low in nutrients and organic matter. Such soils are prone to water and wind erosion, and can realize numerous benefits associated with biosolids land application.

Photograph 167: Biosolids are land-applied to a dry former tailings pond in order to aid in soil development and eventual establishment of a self-sustaining vegetation community.

Photograph 178: The beneficial effects of land application of biosolids on soil development, soil fertility, and vegetation establishment make it an effective method of mine reclamation. Here, a deer browses on grass in a poplar plantation established on biosolids-amended soil.