APPENDIX A

Long-Term Biosolids Beneficial Use Option Analysis

Capital Regional District

05 July 2023

→ **The Power of Commitment**

<table>
<tr><th colspan="2">Project name</th><td colspan="6">TA - Biosolids and Resource Recovery</td></tr>
<tr><th colspan="2">Document title</th><td colspan="6">Long-Term Biosolids Beneficial Use Option Analysis</td></tr>
<tr><th colspan="2">Project number</th><td colspan="6">12590255</td></tr>
<tr><th colspan="2">File name</th><td colspan="6">12590255 - Task 2 - Long-Term Biosolids Beneficial Use Strategy Report - Working Draft (May 31 2023).docx - Long-Term Biosolids Beneficial Option Analysis</td></tr>
<tr><th rowspan="2">Status Code</th><th rowspan="2">Revision</th><th rowspan="2">Author</th><th colspan="2">Reviewer</th><th colspan="3">Approved for issue</th></tr>
<tr><th>Name</th><th>Signature</th><th>Name</th><th>Signature</th><th>Date</th></tr>
<tr><td>S3</td><td>01</td><td>Abram Robiso, Parvin Donyanavard</td><td>Jason Wilson</td><td></td><td>Deacon Liddy</td><td></td><td>June 23, 2023</td></tr>
<tr><td>S4</td><td>00</td><td>Abram Robiso, Parvin Donyanavard</td><td>Jason Wilson</td><td></td><td>Deacon Liddy</td><td></td><td>July 5, 2023</td></tr>
</table>

GHD

138 East 7th Avenue, Suite 100

Vancouver, British Columbia V5T 1M6, Canada

T +1 604 214 0510 | **F** +1 604 214 0525 | **E** info-northamerica@ghd.com | **ghd.com**

Executive Summary

GHD has prepared this Long-Term Biosolids Beneficial Use Strategy report for the Capital Regional District (CRD) to support public and First Nations consultation regarding the beneficial long-term use of Class A biosolids produced by the Residual Treatment Facility (RTF) located adjacent to the Hartland Landfill.

The main purpose of this report is to identify and evaluate the full spectrum of beneficial biosolids management options potentially available to the CRD in preparation for consultation with the public and First Nations groups. To accomplish this, GHD evaluated land-application and thermal biosolids management options, conducted a jurisdictional scan of options used worldwide, evaluated ongoing CRD thermal technology pilot trials, as well as identified, screened, and evaluated all long-term options currently available to the CRD. With this information, GHD then generated long-term strategy portfolios for CRD's consideration which are recommended to provide necessary resilience and redundancy to ensure long term consistent biosolids beneficial use. This report also proposes an evaluation criteria and risk matrix to assist the CRD in implementing a step-by step long-term biosolids beneficial use strategy following the reception of feedback from public and First Nations engagement.

This report concluded the following:

Development and Evaluation of Land Application Options – There are various beneficial use land application methods which meet the Canadian Council Ministers of the Environment (CCME) beneficial use criteria in the form of mine/quarry reclamation, forest fertilization, land improvement, direct land application, biosolids growing medium (BGM), compost, and soil product production. There are various out-of-region land application programs available. There are currently no in-region land application options available at this time due to the long standing CRD policy banning land application. However, this policy was recently expanded to allow for non-agricultural land application as a contingency or emergency option. As such, a number of in-region land application options could be investigated for inclusion in potential long term management portfolios.

Evaluation of Thermal Options – Thermal biosolids management technologies are generally classified as pyrolysis, gasification, or incineration. Among the thermal technologies, incineration is the most commercially proven and widely used thermal treatment process for biosolids. However, incineration is energy intensive and does not result in the beneficial use of ash and as such may not be considered a beneficial use option by the CCME. Pyrolysis and gasification technologies are both still emerging in the biosolids processing space with slightly more pyrolysis facilities anticipated to move into operations in North America over the next few years.

Thermal technologies have the added benefits of generating potential revenue through biochar, syngas, heat recovery as well as the potential to co-process other mixed waste streams. However, there are challenges in thermal co-processing technologies, as mixing biosolids with other waste streams may increase maintenance and operational costs due to the added complexity of handling/treating mixed waste streams. Co-processing also presents challenges in meeting CCME criteria for the beneficial re-use of 25% of ash.

Contaminants of Emerging Concern - Community concerns around the land application of biosolids and its potential impacts to soil quality, surface water, and groundwater are largely based on the presence, or suspected presence, of unregulated CEC's. These potential impacts are the subject of ongoing scientific research. CCME's guidelines note that many CECs are found in low concentrations in biosolids, and that detection does not necessarily mean there is a risk to human health or the environment. Generally, risk assessments for each individual CEC have not been completed, but ecotoxicological testing, used to assess the toxicology of residuals holistically, did not detect significant negative impacts. The CCME is supportive of source control measures as an effective way to improve the quality of biosolids. CRD's biosolids have been treated to Class A standards as per the Organic Matter Recycling Regulation (OMRR).

The Canadian Food Inspection Agency (CFIA) proposed an interim standard for per - and polyfluoroalkyl substances (PFAS) in biosolids used in Canada as fertilizers at 50 ppb PFOS (one type of PFAS). The proposed standard aims to protect human health by preventing the small proportion of biosolids products that are heavily impacted by industrial inputs from being applied to agricultural land in Canada. The concentration of PFOS in CRD's biosolids is under the proposed standard at approximately 6 ppb (based on two samples).

The fate of CECs in advanced thermal processing of biosolids is still under investigation. While CECs appear to be reduced in biochar products, some can still be found in syngas and bio-oil products, but the concentrations and environmental fate still need to be confirmed.

Jurisdictional Scan – Globally, biosolids, are beneficially used primarily through land application or thermal treatment methods. The majority of countries assessed in the jurisdictional scan primarily land-apply their biosolids for beneficial use, except for Japan, who relies on incineration due to its high population density and limited areas for land application.

Across the world, the decision to beneficially use biosolids through land application or thermal processes is influenced by a range of factors: regulatory requirements, local infrastructure/resources, public perception, as well as the goals and priorities of local municipalities. Identifying and evaluating these factors are key to the implementation of an effective, long-term biosolids management strategy.

Evaluation of Thermal Pilots – In the evaluation of the Biosolids Thermal Pilot technologies/studies explored by the CRD, valuable insight was gained into the discrete operation of each of these technologies. However, the current pilot results alone may not be sufficient to confirm the feasibility of on-site thermal processing of CRD biosolids nor the potential for integration/beneficial use of by-products into other systems at Hartland at this time.

For the upcoming on-site thermal trial, GHD suggests that the CRD capture key operational criteria such as process reliability, operational costs, maintenance requirements, co-processing feasibility, residual product quality, biochar markets, carbon sequestration benefits, and long-term synergies at Hartland.

Long-Term Options & Portfolio Generation – A long-list of biosolids management options available to the CRD was identified and screened against CCME beneficial use criteria.

GHD recommends that the CRD develop of a combination of multiple options within a diverse portfolio to ensure resiliency in the form of strategy redundancy. In the unexpected event that a biosolids management option is interrupted, the inclusion of additional options within a portfolio will allow CRD's biosolids to still be beneficially used in the interim until the interruption is resolved.

General portfolios were generated using the long-list of options available to the CRD. A risk evaluation identified notable potential risk of interruption factors such as contingency option availability and facility ownership changes to consider in the development of the long-term biosolids beneficial use strategy. The risk evaluation also indicated that some form of land-application is likely required in all proposed portfolios to ensure resiliency.

Next Steps – Following public and First Nations consultation, the CRD may further refine the general portfolios outlined in this report. From the list of options approved by the public and First Nations groups, the CRD may develop portfolios using specific options and vendors and future test these portfolios for resiliency using the risk matrix outlined in Section 7. The risk analysis will help inform the selection of a resilient long-term portfolio for the long-term beneficial use of CRD's biosolids.

Contents

Table Index

Figure Index

Appendices

1. Introduction

The Capital Regional District's (CRD) Core Area Wastewater Treatment Project included construction of a Residuals Treatment Facility (RTF) located north of Hartland landfill, which processes wastewater residual solids into approximately 3,650 tonnes of dried pelletized Class A biosolids per year using mesophilic anaerobic digestion and a fluidized bed dryer. The CRD has a provincially approved short-term (2021-2025) Biosolids Beneficial Use Strategy (Definitive Plan) that involves the transport of biosolids to the Lafarge cement manufacturing facility (Lafarge) in Richmond, BC where the biosolids are used as an alternative fuel in the plant's combustion processes. The CRD also has an approved Contingency Plan to manage biosolids when Lafarge has planned or unplanned shutdowns and cannot receive the biosolids, which was anticipated to be approximately 35-days per year. That plan involves the production of Biosolids Growing Medium (BGM), which is then beneficially used in final cover materials at the Hartland Landfill.

Over the course of 2022, disposal of biosolids at Lafarge was unavailable for approximately 10-months, due to both planned shutdowns and unplanned operational issues. As a result, CRD managed approximately 2,700 tonnes of biosolids at Hartland Landfill, 600 tonnes of which were used to produce BGM under the Contingency Plan and the remainder were landfilled. In 2022 the biosolids contingency management consumed more than two-years of the five-year Contingency Plan for beneficial use at Hartland Landfill as BGM, and a significant volume of landfill airspace that should be utilized for non-divertible solid waste. The Contingency Plan must also be aligned with landfill operations such as receiving and storing. Producing future biosolids needs to consider space constraints for temporary storage and application of BGM until final cover areas are ready. This constrains how much material can be used for BGM production in any given year. Given the challenges with biosolids management under the Definitive and Contingency Plans, the CRD is interested in investigating and developing alternative strategies for the short-term and long-term beneficial use of Class A biosolids generated through the RTF.

Under a separate cover 'Alternative Short-Term Contingency Biosolids Beneficial Use Options', GHD assessed responses from industry which were obtained during a previous RFEOI (No.40.20.01-02) issued by the CRD and followed up with various vendors to assess their interest, and ability to manage CRD biosolids in accordance with provincial requirements. GHD also assessed information obtained by CRD in their 2022 outreach to industry to identify additional Short-Term contingency options.

Following this report, the CRD will engage with the public and First Nations groups with regards to the biosolids beneficial use options available to the CRD and outlined in this report. Based on feedback from this consultation, the CRD will develop a strategy which will outline the steps required to implement a resilient portfolio for the beneficial use of biosolids.

1.1 Purpose of this Report

The purpose of this report is to identify and evaluate options to support consultation efforts for the beneficial long-term use of Class A biosolids produced by the RTF at the Hartland Landfill. The key objectives are to:

– Assess potential land application and thermal technology options.
– Conduct a jurisdictional scan of biosolids management options currently used worldwide.
– Evaluate and summarize the results from thermal technology pilots commissioned by the CRD.
– Evaluate the full spectrum of long-term options known to be available to the CRD that are permitted by Provincial regulations.
– Present proposed screening, evaluation, and resiliency criteria as well as methodology to be used to evaluate options and portfolios following the results of public and First Nations consultation.

1.2 Scope and Limitations

This technical memorandum has been prepared by GHD for the Capital Regional District. It is not prepared as, and is not represented to be, a deliverable suitable for reliance by any person for any purpose. It is not intended for circulation or incorporation into other documents. The matters discussed in this memorandum are limited to those specifically detailed in the memorandum and are subject to any limitations or assumptions specially set out.

2. Background

The CRD submitted Amendment No.11 to their Core Area Liquid Waste Management Plan (CALWMP) to the BC Ministry of Environment and Climate Change Strategy (ENV) in September 2016, committing to the determination of a long-term management option for the beneficial use of biosolids generated at the RTF. On November 18, 2016, ENV conditionally approved Amendment No.11, with the stipulation that the CRD must first develop a short-term Definitive Plan for utilization of CRD's biosolids which was to be submitted by June 30th, 2019. The Definitive Plan was also required to not include disposal or multi-year storage options at Hartland landfill. Additionally, ENV stipulated that the CRD develop a long-term management beneficial use strategy plan which considers and evaluates the entire spectrum of potential management options with a jurisdictional review of how different municipalities manage their biosolids. This letter of conditional approval can be found in Appendix A.

As of 2023, the RTF produces approximately 10 tonnes of dried biosolids per day, or 3,650 tonnes per year. Biosolids produced by the RTF are currently managed through the following options:

1. Transport to LaFarge for use as alternative cement kiln fuel under the approved Definitive Plan
2. Mix with sand and ground wood to produce BGM for use as a final cover at Hartland Landfill under the approved Contingency Plan
3. Blend with soil and directly landfill (not approved)

As indicated above, these biosolids are primarily transported to Lafarge under the approved Definitive Plan. When Lafarge is unable to accept biosolids, the biosolids are blended with sand and ground wood at a volumetric ratio of 1:5:13 to produce 38 m^3 of BGM for each tonne of biosolids, using up to an approved 350 tonnes of biosolids per year under the Contingency Plan. If the 350 tonnes of biosolids per year used to produce BGM has been exhausted and Lafarge is still unable to take biosolids, the CRD currently has only one remaining emergency option available, which is to blend the biosolids with soil and directly landfill. This process has no beneficial use, is not an approved Canadian Council of Ministers of the Environment (CCME) option and consumes landfill airspace.

The biosolids from the RTF are characterized as Class A, under the BC Organic Matter Recycling Regulation (OMMR). Accordingly, Class A biosolids must have undergone pathogen reduction treatment, vector attraction reduction, and specific sampling protocols. Class A biosolids also have specific limits on their heavy metal and coliform concentrations. The criteria and treatment protocols for Class A designation are outlined in Section 3.2.6. of the OMMR, which regulates the production and land application of compost and biosolids.

BGM must adhere to certain quality criteria outlined in Section 3.4.10 of the OMRR. Schedule 11 of the OMRR stipulates that BGM must be derived from either Class A or Class B biosolids.

The CCME provides guidelines on the beneficial management of biosolids from wastewater treatment plants.

In addition to the above, the CRD's Board currently restricts the land application of biosolids beyond contingency/emergency use at the Hartland Landfill and, more recently, for non-agricultural land application.

Additional information on OMRR requirements, CCME guidelines, CRD Board direction, CRD biosolid characteristics, and thermal processing pilot trials are described in more detail below.

2.1 OMRR Requirements

The production, distribution, storage, sale, and usage of biosolids are regulated under OMRR. OMRR also sets the minimum standards for biosolid product quality criteria in terms of pathogen reduction, vector attraction reduction, pathogen limits, and heavy metals limits.

An official plan must be prepared by a qualified professional for the land application of biosolids. Section 3.1.5 of the OMRR outlines all the requirements for a land application plan. The plan must designate each site where organic matter will be applied, and each scheduled occurrence of application. After each occurrence, the discharger must obtain written certification from a qualified professional that the application was done in accordance with the land application plan.

In terms of distribution requirements, Class A biosolids may only be distributed as follows:

a. In volumes that do not exceed 5 m^3 per vehicle per day.
b. In sealed bags for retail purposes, each not to exceed 5 m^3, with no restrictions on the number of bags distributed per vehicle per day.
c. In volumes greater than 5 m^3 to composting facilities or biosolids growing medium (BGM) facilities.

BGM application does not require a land application plan and may be distributed without volume restrictions as it is considered retail-grade organic matter.

2.2 CCME Beneficial Use Criteria Application

One of ENV's conditions of approval to the CRD's CALWMP was that the proposed long-term management plan for the biosolids generated at the RTF must comply with the requirements for beneficial use specified in the *Canada-Wide Approach for the Management of Wastewater Biosolids* (2012) by the CCME.

According to the CCME, beneficial use of biosolids is based on sound management that includes:

– Consideration of the utility and resource value (product performance).
– Strategies to minimize potential risks to the environment and health.
– Strategies to minimize greenhouse gas emissions and.
– Adherence to federal, provincial, territorial, and municipal standards and regulations.

The policy stated above is upheld by the following principles:

1. Municipal biosolids contain valuable nutrients and organic matter that can be recycled or recovered as energy.
2. Adequate source reduction and treatment of municipal sludge and septage should effectively reduce pathogens, trace metals, vector attraction, odours, and other substances of concern.
3. The beneficial use of municipal biosolids, municipal sludge, and treated septage should minimize the net GHG emissions.
4. Beneficial uses and sound management practices of municipal biosolids, municipal sludge, and treated septage must adhere to all applicable safety, quality, and management standards, requirements, and guidelines.

More details and examples of the beneficial use of biosolids are provided in the CCME supporting document, *Guidance Document for the Beneficial Use of Municipal Biosolids, Municipal Sludge and Treated Septage* (2012). There are opportunities for the beneficial use of biosolids through land application, value-added product development, energy recovery, and combustion. Landfilling is not considered a beneficial use option by the CCME since it results in the loss of nutrients and emits greenhouse gases. Any biosolids management option must be evaluated in accordance with the regulations stated in the OMRR, as well as supported by CCME guidelines and principles.

The CCME guidance document promotes the land application of Class A biosolids in support of its beneficial use guiding principles. In alignment with principle 1, the nutrient-rich concentration of biosolids allows direct land application to be a beneficial use option when properly managed as it enhances soil fertility, soil structure, and plant growth. Furthermore, land application supports principle 3 by reducing the need for energy intensive synthetic fertilizer production as well as increasing carbon storage into the soil, hence minimizing net GHG emissions.

Biosolids may also be thermally treated and pelletized to be used for land application or as a biofuel feedstock for combustion. However, for biofuel combustion to be considered as a beneficial use, per the CCME guidance document there are three requirements:

1. The net energy balance must show that the energy recovered exceeds the energy required to combust with dry matter composing >30% of the biosolids to allow for auto combustion and exothermic reaction.
2. >25% of ash or phosphorus generated from the combustion of biosolids must be recovered.
3. The process must emit low levels of nitrous oxides through continuous temperature monitoring with a minimal combustion temperature >880°C.

2.3 CRD Board Resolution on Land Application of Biosolids

On July 13, 2011 the CRD's Board moved to restrict the land application of biosolids within the CRD. These minutes can be found in Appendix B and the motion referenced below.

"*Be it so moved that the CRD will harmonize current and long-term practices at all CRD-owned regional facilities and parks with the approved policies of the regional treatment strategy, including ending the production, storage, and distribution of biosolids for land application at all CRD facilities and parks; and*

Be it further moved that the CRD does not support the application of biosolids on farmland in the CRD under any circumstances, and let this policy be reflected in the upcoming Regional Sustainability Strategy."

The provincial government conditionally approved the Definitive Plan with the condition that the CRD prepare beneficial use options, for use during Lafarge shutdowns, that did not include landfilling or long-term storage. To comply with these regulatory requirements, the CRD Board moved to partially rescind its land application restriction on February 12, 2020. The motion is referenced below.

"*That the Capital Regional District Board partially rescind its policy to prohibit land application as a beneficial use of biosolids at Hartland landfill only; and 2. That land application of biosolids be approved as a contingency plan for beneficial use at Hartland landfill."*

On February 8, 2023, the CRD board amended its policy to allow non-agricultural land application of biosolids as a short-term contingency alternative. These minutes can be found in Appendix C and the motion referenced below.

"*That the Capital Regional District (CRD) Board amend its policy to allow non-agricultural land application of biosolids as a short-term contingency alternative; and 2. That staff be directed to update the CRD's short-term biosolids contingency plan correspondingly*."

2.4 Short Term Memorandum

A short-term alternative contingency plan was developed to address the immediate challenges with biosolids management under the current Definitive and Contingency Plans.

In 2022, GHD prepared a memorandum which identified and evaluated additional contingency options for the beneficial short-term use of Class A biosolids produced by the RTF. These options included both non-land application and land application options which have the potential to be implemented within two-years. The memorandum concluded the following:

- There is no option currently available that meets the CCME criteria for beneficial use, meets OMRR criteria and meets the CRD Board restriction on land application other than Lafarge and BGM.
- Non-land application options could be developed in 24-months or greater that could partially meet the CCME criteria for beneficial use and CRD Board restriction on land application are presented below:
  - Off-Site Thermal Options – Thermal options in addition to Lafarge are possible in 24-months or greater working with existing facilities such as Envirogreen in Princeton, Lehigh Cement Plant, or the Metro Vancouver WTEF. Changes to ENV permits/approvals, consultation with stakeholders may be needed and biosolids receiving, handling and dust mitigation procedures and potentially equipment would need to be developed. The off-Site thermal options do not beneficially use the ash from the biosolids, and as such may not meet CCME guidelines.
  - On-Site Thermal Options – A pilot pyrolysis or gasification facility could be established at Hartland. This would require construction of the pilot facility, and an approval from ENV to operate the facility, which would require 24-months or greater to develop. During the pilot stage the syngas would be flared, and the pilot would be used to characterize the quantity and quality of the syngas to provide information towards the long-term beneficial use (e.g., as a fuel). The quality of the biochar produced would be evaluated and ultimately marketed as a biochar product if feasible. Fulsome GHG implications would also be determined.
- Land application options exist that meet CCME criteria and are used by other jurisdictions in many cases to cost effectively manage biosolids. If the CRD Board limitation on the land application of biosolids was beyond contingency use at the land fill and for non-agricultural land application, then these options could likely be implemented within 1 to 2-years, with some options being available immediately, and without additional infrastructure.

2.5 Biosolids Characteristics

A Safety Data Sheet (SDS) for the CRD's Class A biosolids can be found in Appendix E.

2.6 Thermal Processing Pilot Trials

In July 2020 the CRD issued a Request for Expressions of Interest (RFEOI) (No.40.20.01-02) as part of the CRD's long term plan to determine avenues for the beneficial use of Class A biosolids produced by the RTF. The intent of the RFEOI was twofold:

a. Understanding what technologies were available to beneficially use biosolids
b. Determine interest from proponents willing to undertake pilot trials

An evaluation of the results from the selected pilot trials has been summarized in Section 5.

Following the pilot trials, on March 29, 2023, the CRD board moved to initiate a Request for Proposals (RFP) for the development of a thermal processing trial on-site. These minutes can be found in Appendix D and the motion referenced below:

"Staff concurrently initiate a Request for Proposals process for a biosolids advanced thermal site trial; and that the RFP be scoped broadly to include potential for co-processing of municipal solids waste streams, and that submission be welcomed from both domestic and international vendors."

The RFP process was initiated June 16, 2023, with a response closing date of July 14, 2023.

3. Biosolids Management Options

The beneficial use of biosolids includes various methods of both land application and thermal treatment, which are discussed in further detail below.

3.1 Land Application Options

Biosolids are rich in nutrients such as phosphorus and nitrogen and as a result can be directly applied to lands at an agronomic rate to promote vegetation growth. The land application of biosolids involves spreading biosolids on the soil surface or incorporating biosolids into the soil as soil amendment and fertilizer. Land application is the most common and cost-effective way to beneficially use biosolids and has been widely practiced for decades. Prior to land application, wastewater solids are required to undergo a stabilization process to minimize odour generation, destroy pathogens (disease causing organisms), and reduce vector attraction potential (potential to attract organisms capable of spreading the material) . Wastewater solids can be converted to stabilized biosolids through several methods including adjustment of pH (lime or alkaline stabilization), aerobic digestion, anaerobic digestion, composting, and heat drying.

The following sections outline the most common land application options for biosolids.

3.1.1 BGM, Compost, and Soil Products

Biosolids can be mixed with mineral feedstocks (typically sand or topsoil) to produce BGM, a nutrient rich soil with similar properties to other fabricated soils with respects to aesthetics, odour, consistency, and performance. BGM can promote vegetation growth when applied to lands. Currently, CRD's Class A biosolids are used to produce BGM under the approved Contingency Plan for use as final cover at Hartland Landfill.

Biosolids are a commonly used feedstock at many compost facilities. Biosolids can be combined with wood chips or green materials as bulk agents to produce a high-quality compost suitable for various land applications. However, composting generally requires a long residence time resulting in increased costs for this option. Wood waste can be mixed with biosolids and cured over time to create a Class A Compost, a nutrient-rich soil amendment which can be regularly tested to ensure it meets both OMRR and the Canadian Food Inspection Agency (CFIA) requirements for land application.

3.1.2 Agricultural Land

Biosolids can be recycled and used as a soil amendment or fertilizer on agricultural land to improve soil productivity, stimulate plant growth, and potentially reduce chemical fertilizer application. Biosolids have been widely applied on agricultural lands due to the cost-effectiveness of this option and its ease of use. Using biosolids on agricultural land has the potential for significant benefits in both the environment and the farming industry.

3.1.3 Forest Fertilization

Forest fertilization is another cost-effective and environmentally safe way to recycle biosolids. Forest soil is usually acidic and deficient in nutrients, thereby applying biosolids can significantly increase the forest lands fertility, total tree production, and build soil foundation for productive forest ecosystems, including wildlife habitat. Furthermore, forestry application can increase vegetation and result in healthier forest soils to improve soil tilth and reduce soil erosion into lakes and streams.

3.1.4 Mine/Quarry Reclamation

Damaged soils impacted by activities such as mining or quarrying can be reclaimed by applying biosolids. Mine/quarry reclamation involves the application of large quantities of biosolids at singular to infrequent periods. Biosolids are often mixed with other materials like wood waste and sand or mixed with stockpiled soil removed from a site prior to disturbance.

Biosolids can be effective in restoring former mines by improving soil conditions, revegetating extensive areas of piled rock and mine tailings and stabilizing slopes. Following biosolids application, the soil is more aerated and lighter, which increases the water infiltration to reduce soil erosion. Unlike nutrients in commercial fertilizers, nutrients added in the biosolids will stay in the topsoil over time and the restored ecosystem will continue to prosper.

The process of mine/quarry reclamation and closure is often required by government to ensure sustainable practices and minimize the long-term effects of mining/quarry operations on the surrounding ecosystems and communities. Ongoing monitoring and maintenance may be required to ensure the success of the reclamation efforts and the long-term stability of the reclaimed site.

3.1.5 Landfill Cover

Biosolids can be beneficially used as an amendment to final cover at landfills acting as a biofilter and mitigating greenhouse gas emissions. Landfills can also benefit from the application of BGM as a topsoil to improve vegetation and prevent erosion on temporarily or permanent closed landfill cells.

3.1.6 Biodiesel and Fuel Crop Production

Biodiesel is an environmentally friendly diesel fuel and renewable alternative to fossil fuels. It is produced from vegetable oils or animal fats through an esterification reaction. High oil seed crops (fuel crops) such as soy and canola and high biomass plants such as willow are considered as suitable feedstock for biodiesel production. Biosolids can be used as fertilizer in growing biodiesel crops and willow plants, in which the biodiesel produced can be beneficially used as fuel for vehicle fleets and farming equipment.

3.2 Knowledge Gaps and Limitations in Land Application

When considering the land application of Class A biosolids, it is important to recognize that knowledge gaps, as well as limitations and barriers to implementation exist. Some of these knowledge gaps and limitations are outlined below.

Nutrient Management: Effective nutrient management is crucial to prevent overapplication or imbalances in soil nutrient levels. Understanding the nutrient content and availability of biosolids is important for determining appropriate application rates and timing. Research can help optimize nutrient management strategies and guidelines specific to biosolids with consideration for the application site soil conditions.

Pathogen and Contaminant Monitoring: Assessing and monitoring the presence of pathogens, heavy metals, pharmaceuticals, and other contaminants of concern in biosolids is essential for reducing risks to public and environmental safety. The presence of ‘per’ and polyfluoroalkyl substances (PFAS) within biosolids has led to public concern regarding land application methods. The potential for groundwater contamination following land application of biosolids and subsequent leaching of PFAS through soil is one of several potential impacts that have generated discussions on banning land application methods. This risk is attributed to how PFAS does not easily decompose. Thermal treatment and destruction technologies at commercial scales are currently limited. Adhering to land application plans can reduce risk of broad environmental contamination.

Public Perception and Acceptance: Public acceptance and understanding of the land application of biosolids play a significant role in its successful implementation. Addressing concerns related to odour, visual appearance, and potential health risks through educational initiatives and public outreach can help foster acceptance and support for this practice.

Logistics and Operational Considerations: Conducting pilot programs and field trials can provide valuable insights into the logistical aspects of land application, such as transportation, storage, application methods, and equipment requirements. These pilot programs can help identify any challenges, evaluate the feasibility of large-scale implementation, and assess the associated costs.

Regulatory Framework and Compliance: Understanding and complying with the existing regulatory framework governing the land application of biosolids is crucial. Identifying any regulatory gaps or barriers can help inform policy development and ensure that appropriate guidelines and standards are in place to regulate the practice effectively.

3.3 Thermal Options

With an increasingly global focus on environmental responsibility, and contaminants of emerging concern (such as microplastics and PFAS), interest in the efficient, safe, and effective thermal processing of biosolids is growing. Employing thermal treatment technologies can produce renewable energy, reduce emissions associated with the transport of biosolids, and result in a higher-value final product.

The thermal management of biosolids refers to application of heat to reduce the volume, reduce contaminants, and utilize the calorific energy of biosolids as heat, steam, electrical power, or combustible material. There are many types of thermal conversion technologies available from many technology providers, however they generally fall into three broad categories: gasification, pyrolysis, and combustion/incineration. Combustion/incineration is the most widely used and commercially proven thermal treatment process for biosolids. Gasification and pyrolysis are innovative technologies gaining interest due to the potential of producing value added products such as syngas and biochar, however, they have limited commercial experience with biosolids as a sole feedstock.

3.3.1 Gasification

Gasification is a thermal treatment technology where any carbon-containing raw material, such as biosolids, can be converted into fuel gas (also known as synthesis gas or syngas) under conditions of high temperature and a highly controlled supply of partial oxygen and/or steam. Gasification can be used to significantly reduce the biosolids volume and produce syngas as a renewable source of energy. Gasification by-products (ash and biochar) can be applied as soil amendments or landfilled. Contaminant reduction also takes place, although the ultimate fate and level of reduction of various classes of organic contaminants is still under investigation.

Syngas can either be utilized as a low calorific gaseous fuel such as in an internal combustion engine (ICE) for cogeneration or can be thermally oxidized to produce heat for beneficial use. Gasification of biosolids typically requires dried biosolids (80% to 90%) as feed, which the RTF already produces. The thermal oxidation of syngas produces heat which can be used to dry biosolids and pre-condition them for gasification.

Close coupled drying with gasification, as shown in Figure 3.1, is an emerging commercial trend for biosolids thermal treatment. Conditioning of syngas for use as fuel in a cogeneration system such as an ICE is still under development. Cleaning of syngas to produce Renewable Natural Gas (RNG) is another avenue of energy recovery which is being explored, however the feasibility of this is still under development.

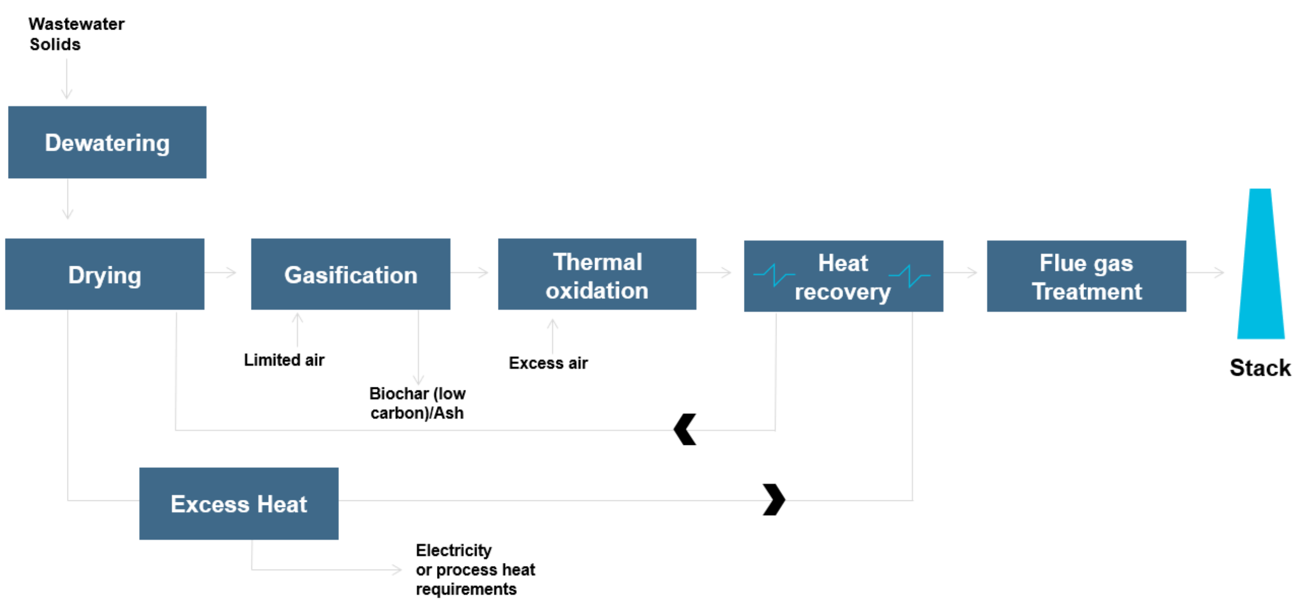


Figure 3.1 Close-Coupled Gasification Process Flow Diagram

3.3.2 Pyrolysis

Pyrolysis is a similar thermal treatment technology to gasification; however, it requires a lower temperature and is carried out without the presence of oxygen under an inert atmosphere (e.g., nitrogen or argon). Like gasification, pyrolysis can decompose and covert biosolids to useful products (syngas, bio-oil, and biochar) while minimizing air emissions and reducing pathogens/contaminants. Like gasification, some contaminant reduction does occur during pyrolysis. However, the contaminant partitioning between the biosolids feedstock and the residual pyrolysis products is yet to be fully understood, and more research is ongoing.

Depending on the temperature and heating rate, pyrolysis can be classified into slow and fast pyrolysis. In slow pyrolysis, known as carbonization, material is pyrolyzed at low to moderate temperatures (around 300 °C) and low heating rates or long reaction times (several hours). The goal of carbonization is to maximize charcoal product (biochar) and generate lower yields of bio-oil and syngas. Fast pyrolysis, carried out at intermediate temperatures (around 500 °C) and short reaction times (a few seconds), produces higher yields of bio-oil in addition to biochar and syngas.

The majority of pyrolysis technologies utilize a close-coupled configuration as shown in Figure 3.2. Syngas produced during pyrolysis is oxidized (combusted) in a thermal oxidizer, and the heat released from thermal oxidation of syngas is recovered and used for biosolids drying. Pyrolysis of biosolids typically requires dried biosolids (80%-90%) as feedstock, which the RTF already produces. A portion of thermal energy is recycled to the pyrolyzer to sustain pyrolysis, and the rest can be recycled to the dryer for beneficial use. Some of the newer pyrolysis technologies do not require continuous heat for their bio-drying process.

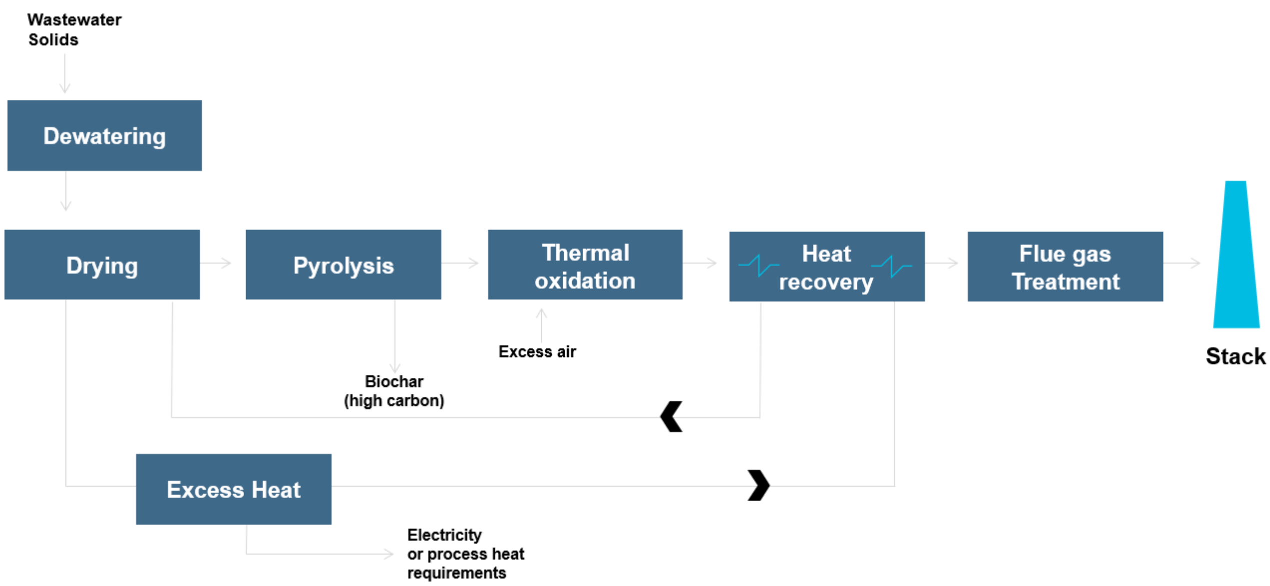


Figure 3.2 Closed Coupled Pyrolysis Process Flow Diagram

3.3.3 Combustion/Incineration

Combustion is a controlled reaction under high temperatures between a fuel and an oxidant that generates carbon dioxide, heat, and water. Incineration is another form of combustion which uses waste as the feedstock fuel material. The primary objective of incineration is feedstock volume reduction and energy recovery. Combustion/incineration residues generally consist of small quantities of HCl, S, volatile compounds, and ash which are typically landfilled. Some biosolids management options utilize biosolids as an alternative fuel for combustion in manufacturing processes such as cement kilns.

Using biosolids as a renewable fuel for combustion/incineration can offset the use of non-renewable fuels and reduce overall GHG emissions. Combustion/incineration without the production of value derived products or energy recovery is commonly not considered an environmentally friendly technology as it is energy intensive and generates a significant amount of greenhouse gas emissions. However, there is ongoing research and development in modern engineering and advanced air pollution control technologies to mitigate the environmental impacts and increase the energy efficiency of the process.

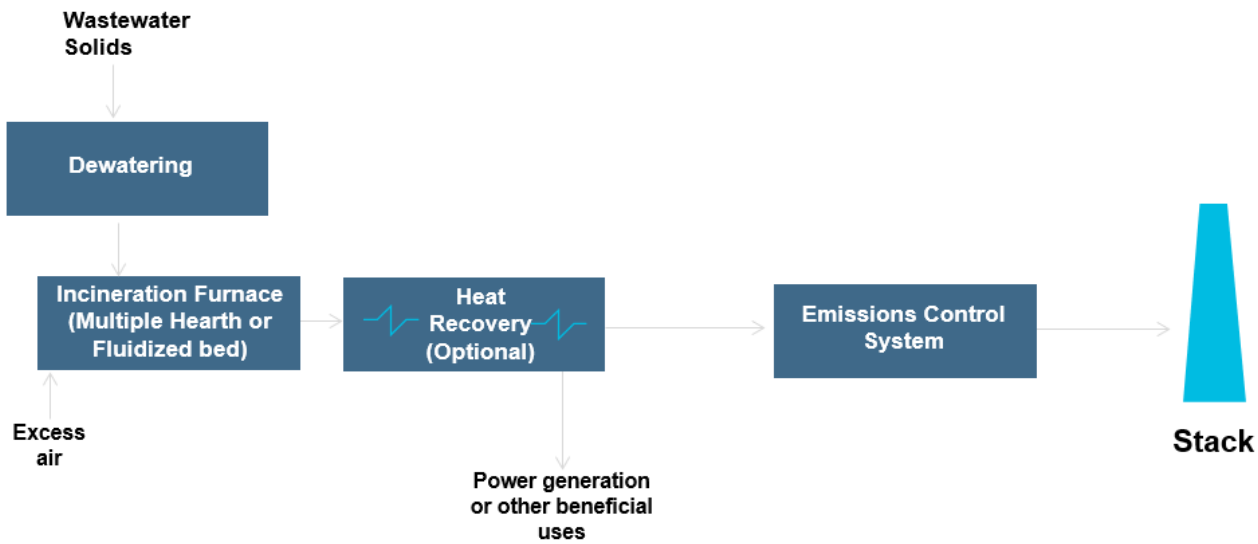


Figure 3.3 Incineration Process Flow Diagram

3.4 Thermal Processing Technologies Summary

Table 3.1 below highlights a few of the key characteristics of the three thermal processing technologies discussed above.

Table 3.1 Thermal Processing Technologies

Technology	Technology Description / Major Differentiators	Benefits	Challenges	End-Products & Utilization
Gasification	– Limited/controlled quantity of oxygen/air required – Temperature Range: 600-1000 °C	– Simplicity – Efficient process – Biochar production to be used as contaminant adsorbent or soil amendment – Can be autogenous – Significant volume reduction	– Syngas refinement for fuel generation is challenging – Gas treatment system usually involves scrubbing, which typically requires media that needs to be disposed of as hazardous waste – GHGs are emitted as part of process – Presence of particulate and tars in the produced gas – Low fixed carbon, high ash – Contaminant fate and destruction effectiveness still not fully understood	– Steam which can be converted to electricity – Syngas which can be used in boilers, gas turbines, internal combustion engines to generate electricity – Fly ash which would be disposed as hazardous waste residue – Biochar which may be beneficially used as a soil amendment, compost, biofilter, or as livestock bedding – Slag which may have to be disposed as hazardous waste residue
Pyrolysis	– Complete absence of oxygen required – Temperature Range: 600-1000 °C	– More energy placed into creating final char product – Lower temperature required than other thermal treatments – High fixed carbon, low ash – Significant volume reduction – Low operation energy consumption – Biochar production to be used as contaminant adsorbent or soil amendment	– Technical difficulties ranging from an inability to scale up to largescale production, and relatively poor heat transfer – Requires a constant supply of fuel – Gas treatment system usually involves scrubbing, which typically requires media that needs to be disposed of as hazardous waste – GHGs are emitted as part of process – Contaminant fate and destruction effectiveness still not fully understood	– Syngas which can be used in boilers, gas turbines, internal combustion engines to generate electricity – Biochar which may be beneficially used as a soil amendment, compost, biofilter, or as livestock bedding – Pyrolysis oil (bio-Oil) which can be used as fuel for engines and boilers, or used to produce electricity/heat via combined heat and power plants – Ash which will be disposed as residue, potentially as hazardous waste
Combustion/ Incineration	– Excess oxygen/air required for combustion of waste	– Significant volume reduction – Proven technology at commercial scale	– Poor public perception from historical plants (strict environmental regulations for	– Steam which can be converted to electricity – Heat which can be used for general heating, hot water supply, etc.

Technology	Technology Description / Major Differentiators	Benefits	Challenges	End-Products & Utilization
	– Temperature Range: 800-1200 °C	– Greater contaminant reduction at higher temperatures	emissions and combustion control) – Energy-intensive if process does not recover/recycle energy – Gas treatment system usually involves scrubbing, which typically requires media that needs to be disposed of as hazardous waste – GHGs are emitted as part of process – Mixing biosolids with wood chips was found to be necessary to prevent fouling and meet emission requirements – Requires emissions treatment systems to capture pollutants	– Bottom ash which will be disposed as hazardous waste residue

3.5 Thermal Co-Processing

Co-processing biosolids with other types of waste through thermal treatment, particularly in municipal waste-to-energy facilities has potential added benefits of reduced capital costs and increased efficiency in resource recovery. However mixing biosolids with other waste streams may also increase maintenance and operational costs due to the complexity of handling and treating mixed waste streams and their end products. In addition, co-processing presents challenges in meeting the requirement set by CCME for the beneficial re-use of 25% of ash.

A few examples of facilities that process, or have processed, biosolids with other types of waste are noted below:

– The Anaergia's Rialto Bioenergy Facility in California will use pyrolysis to process combination of food waste extracted from municipal waste streams, liquid waste, and municipal biosolids to produce carbon-negative RNG. The facility is currently under construction[1].
– The Covanta Huntsville WTE Facility in Huntsville, Alabama, uses incineration to process solid waste and sewage sludge, producing steam and ash. The facility is currently operational.
– The City of Lebanon, Tennessee, operates a gasification plant that utilized biosolids and wood waste as feedstock to produce syngas and biochar in the past. The facility is operational, however, currently only utilizes wood waste as feedstock.

3.6 Biochar Beneficial Use

Biochar is a type of charcoal produced from the pyrolysis or thermal decomposition of organic biomass materials, such as biosolids, agricultural waste, wood chips, or crop residues. Biochar has demonstrated potential to be used as a soil amendment to improve soil fertility, sequester carbon, and mitigate soil erosion.

Below is a summary of the potential beneficial use options for biochar:

– **Soil Amendment**: Biochar may be directly incorporated into the soil to improve its physical, chemical, and biological properties. Some cases have shown to enhance soil water retention, increase nutrient availability, and promote microbial activity, and consequently improve crop productivity.
– **Carbon Sequestration:** Research demonstrates that the use of biochar as a soil amendment has the added benefit of sequestering carbon for up to a mean residence time of 2,000 years. Biochar sequestration can remove carbon dioxide directly from the atmosphere through carbon uptake by plants, allowing, in principle, a reduction of atmospheric carbon dioxide levels[2].
– **Composting**: Biochar can be mixed with organic waste materials for composting. This can enhance the compost's nutrient content, reduce greenhouse gas emissions, and improve its stability. The resulting compost enriched with biochar can be used as a soil amendment or a growing medium in horticulture and landscaping.
– **Livestock Bedding**: Biochar can be used as bedding material in livestock operations. Its high absorbency helps in moisture management, odour control, and the reduction of pathogen build-up. Used biochar bedding can be further recycled as a soil amendment or added to composting systems.
– **Erosion Control**: Biochar can be applied to erosion-prone areas, such as slopes or mine reclamation sites, to stabilize the soil and prevent erosion. Its porous structure and high water-holding capacity can help retain moisture and promote plant establishment, making it beneficial for land reclamation projects.
– **Stormwater Filtration:** Biochar can be used in permeable reactive barriers or biofiltration systems to treat stormwater runoff. It can act as a filter medium, adsorbing and retaining contaminants such as heavy metals and organic pollutants, thereby improving water quality.

1 Rialto Bioenergy Facility | Anaergia
2 Biochar is carbon negative | Nature Geoscience

– **Activated Carbon Production**: Biochar can be upgraded to produce activated carbon via physical and chemical alteration. Biochar can be physically activated through heating under an oxidant environment in the temperature range of 700–900 °C. To chemically activate, biochar is subjected to activating agents such as $ZnCl_2$, H_3PO_4, NaOH, KOH and treated with heat between 300–500 °C.[3] Activated carbon can be utilized as an adsorbent, as it acts as a porous material to capture and retain various pollutants/contaminants in its structure. Its high surface area and porosity make it effective for adsorbing contaminants from water, air, and soil, offering potential environmental remediation, odour control, and purification applications. It is also intended for adsorption applications like gas masks and fixed-bed adsorbers.

Despite the many potential benefits of biochar, research related to the adverse effects of biochar on soil ecosystems and chemistry is still under investigation. There are growing concerns related to the effects of applied biochar soil physiochemical properties, interactions between biochar and other chemicals within the soil, contaminant accumulation, and its potential impact on soil organisms. A 2021 review of 259 studies related to biochar application to soil concluded that the findings on the effects of biochar soil application are often mixed[4]. Studies indicate that these effects, whether net negative, neutral, or beneficial, are dependent on factors such as feedstock, production process, application rate, soil type, environmental/climactic conditions, and therefore cannot be generalised.

Site-specific assessments and research are essential to determine the appropriate application methods and optimize the benefits of biochar in different contexts. It is crucial to assess the quality and safety of the biochar as well as its effect on the soil's microbiological properties and biota prior to application. Adequate testing and quality standards are important to verify that the biochar is free from contaminants (particularly metals) and meets the desired criteria for its intended use. Research and knowledge sharing in this field is currently ongoing to better understand biochar's potential and optimize its use in diverse agricultural and environmental settings.

3.7 Knowledge Gaps and Limitations in Thermal Treatment Technologies

Similar to the land application of biosolids, it is important to recognize that knowledge gaps and limitations exist in regards to biosolids thermal treatment technologies. Some of these gaps/limitations are outlined below:

Technical Limitations: Specific technical limitations can vary depending on the thermal treatment method employed. For example, incineration may have limitations related to the control of emissions and the need for air pollution control equipment. Pyrolysis and gasification may have limitations related to process efficiency, feedstock characteristics, and the quality of the end products.

Environmental Impacts: While thermal treatment can help reduce the volume of biosolids and recover energy, there may be environmental concerns associated with the process. These can include emissions of greenhouse gases, air pollutants, and the potential for the release of harmful compounds during the treatment process. An environmental impact assessment of any employed thermal treatment method is crucial.

Residuals Management: Thermal treatment processes typically generate residues such as ash or char. The management of these residuals can present challenges in regard to their safe disposal or beneficial reuse. Depending on the residue characteristics, there may be potential for contaminant leaching into the environment. Robust handling and storage protocols need to be established in consideration of the end-use of the residues.

Energy Efficiency: While thermal treatment can produce energy in the form of heat or electricity, the overall energy efficiency of the process is an important consideration. Achieving optimal energy recovery and maximizing the net energy output from the treatment process is a crucial consideration for its economic viability and environmental sustainability. Ensuring there is an end-user of the energy output is also critical to ensure beneficial reuse expectations are achieved.

3 Process Intensification: Activated Carbon Production from Biochar Produced by Gasification - technology.matthey.com
4 https://www.sciencedirect.com/science/article/pii/S0048969721038286

Impact on Nutrient Content: Thermal treatment methods can alter the chemical composition of biosolids, potentially affecting the availability and quality of nutrients. For example, high-temperature processes like incineration can result in the loss of certain nutrients, limiting their potential for use as fertilizer or soil amendment.

Cost Considerations: The economics of thermal treatment processes, including capital costs, operational costs, maintenance costs, and residual disposal costs can significantly impact their feasibility and implementation. Understanding the financial implications and comparing them to alternative treatment methods is important for the decision to invest in thermal treatment processes.

3.8 Contaminants of Emerging Concern

The CRD introduced a ban on the land application of biosolids produced at CRD facilities in 2011 based on the precautionary principle and concerns from the community. Community concerns around the land application of biosolids are largely based on the presence, or suspected presence, of unregulated organic chemical compounds, commonly referred to as "contaminants of emerging concern" (CEC's), or persistent organic pollutants" (POPs). CECs include Volatile and Semi-Volatile Organic Compounds (VOCs & SVOCs), PFAS, polybrominated flame retardants (PBDE), dioxins, pharmaceuticals and personal care products (PPCPs) and microplastics. There is concern that biosolids with detectable levels of unregulated CEC's could impact soil quality, surface water or groundwater.

In 2011, the CRD retained Stantec to undertake a literature review titled *Land Application of Wastewater Bio-solids, Concise Literature Review of Issues for CRD* on the risks of the land application of biosolids. The literature review assessed heavy metals, pathogens, and legal liability arising from the land application of biosolids. The review concluded "there is no scientific evidence indicating that the risks of environmental damage or public health concerns for either Class A or B bio-solids land application would be high".

This risk assessment was updated by Golder in 2014 in their report *Biosolids Risk Assessment and Literature Review Update*. The intent of the report was to re-evaluate the previous analysis using recent information and case studies. The review found that Stantec "oversimplifies the risk and concerns associated with the land application of biosolids" and found that the current state of scientific knowledge does not allow us to fully quantify all risks. Despite this finding, the authors conclude that "no risks have been identified for emerging substances that presently warrant imposition of a land application ban".

The CCME considered CEC's when developing the beneficial use guidelines. The document notes that many CECs are found in low concentrations in biosolids, and that detection does not necessarily mean there is a risk to human health or the environment. Generally, risk assessments for each individual compound have not been completed, but ecotoxicological testing, used to assess the toxicology of residuals holistically, did not detect significant negative impacts. The CCME is supportive of source control measures as an effective way to improve the quality of biosolids.

In 2017, Metro Vancouver commissioned a risk assessment for their land application based biosolids management plans in a report titled *Biosolids Risk Assessment for Metro Vancouver*. The report looked at 11 different types of pharmaceuticals or organic compounds and concluded "the results of this risk assessment indicate that the presence of these eleven CECs in biosolids is highly unlikely to result in adverse health effects for the four Metro Vancouver biosolids use exposure scenarios evaluated."

In recent years, there has been an increased interest in PFAS and their effects on human and environmental health. PFAS are a class of over 4,700 substances that do not occur naturally. PFAS make products non-stick, water repellent and fire resistant, and are found in a wide range of consumer and industrial products, including cookware, food packaging, clothing, and firefighting foams. PFAS are sometimes referred to as "forever chemicals" because the molecules are characterized by a chain of strong fluorine-carbon bonds which result in highly stable and long persisting chemicals. Exposure to PFAS is associated with an increased risk of cancer, increased cholesterol levels, and can affect the immune system.

In June 2022, the ENV released the *Organic Matter Recycling Regulation Project Update*, which contained some discussion of CECs. "Due to advances in analytical chemistry, the ability to measure CECs has generally outpaced the ability to understand the impacts of CECs on human health and the environment. For this reason, the impacts of CECs in biosolids and wastewater treatment discharges is the subject of on-going scientific research." The ENV intends to add the authority for a director to require the testing of biosolids for CECs but does not intend to regulate the concentration of CEC's in biosolids. The ENV advocates for a prevention first approach to reducing CECs in biosolids, by implementing source control measures to discourage the discharge of certain wastes to the system. Regulatory amendments are targeted for 2023.

On May 19, 2023, The Canadian Food Inspection Agency (CFIA) proposed an interim standard for PFAS in biosolids used in Canada as fertilizers. The CFIA worked with Environment and Climate Change Canada, Health Canada and provincial partners to assess an appropriate standard for PFAS. The proposed standard will protect human health by preventing the small proportion of biosolids products that are heavily impacted by industrial inputs from being applied to agricultural land in Canada. The proposed standard is 50 ppb PFOS (one type of PFAS). The concentration of PFOS in CRD biosolids is under the proposed standard at approximately 6 ppb (based on two samples). For comparison, a 2020 study, found that the PFOS concentration in household dust was 100 ppb (100ng/g).[5]

3.9 Land Application vs Thermal Process Trends

Land application is a well-established practice in British Columbia and many other parts of the world. However, there has been a varied perception and increased regulation towards this practice due to growing concerns over potential environmental and public health risks, including the risk of pathogen regrowth, odours, heavy metals, and CEC's. Scientific literature indicates that when biosolids are properly treated, monitored, and applied in accordance with regulations, the risks associated with contaminants and pathogens are typically low[6]. Land application remains a widely used and accepted approach in many jurisdictions, particularly in areas with access to agricultural land and a demand for fertilizer. Research indicates an increasing trend in the use of biosolids as a soil amendment to support sustainable agriculture and carbon sequestration goals.

Since 2017, there has been a trend towards increased use of thermal processes for biosolids management, particularly in areas where land application is restricted, challenging, or cost prohibitive. However, further research and investment are needed to optimize these technologies and ensure their long-term sustainability.

Overall, the choice between land application and thermal processes for biosolids management will depend on a range of factors, including regulatory requirements, local infrastructure and resources, public perception and acceptance, the need for end-use redundancy, and the specific goals and priorities of the community or organization managing the biosolids.

4. Biosolids Jurisdictional Review Update

Globally, biosolids are primarily managed in three ways, land application, incineration or landfilling. The decision to landfill biosolids rather than using them for beneficial purposes is influenced by several factors, such as:

- **Regulatory Constraints**: Some governments impose restrictions to the land application of biosolids due to concerns over potential environmental and public health risk.
- **Public Perception:** The acceptance of biosolid management options varies widely. In some communities, there persists public resistance to the beneficial use of biosolids based on concerns primarily regarding potential health, environment, and nuisance impacts.
- **Costs and Logistics:** Local circumstances such as land availability, transportation distances, regulatory compliance, and the proximity of technology providers may make landfilling a more logistical and cost-effective option as compared to beneficial reuse.

5 Per- and polyfluoroalkyl substances (PFAS) in dust collected from residential homes and fire stations in North America - PMC (nih.gov)
6 https://www.academia.edu/34682659/Chapter_6_The_environmental_impact_of_biosolids_land_application

The section below presents findings from literature on the reported biosolids management options used in jurisdictions across the globe. It should be noted that the examples presented are not an exhaustive list of all global biosolids management cases as the review is limited to data that is readily available.

4.1 Literature Review

4.1.1 Canada

In Canada, more than 660,000 dry tonnes of stabilized biosolids are produced annually. According to the CCME, land application and landfilling are the most common methods of biosolids management in Canada where approximately 50% of biosolids are applied to land, 41% landfilled and the remainder incinerated (9%) (CCME, 2012a).

In British Columbia, 38,000 dry tonnes of biosolids are produced every year, of which around 94% is beneficially applied to land to support forestry, agriculture, land reclamation and landfill cover, and approximately 6% is landfilled.[7]

In Quebec 49% and 34% of biosolids are incinerated and land applied respectively annually. In Ontario, 44% and 48% of biosolids are incinerated and land applied respectively annually. Both provinces are among the leading provinces in the beneficial use of biosolids[8].

Table 4.1 below summarizes biosolids management in some Canadian provinces in the year 2016. Since then, there has been a lack of available information regarding the current status of Canada's involvement in biosolids beneficial use.

Table 4.1 Biosolids Management in Canada (2016)[2]

Jurisdiction	Land Application	Incineration	Landfill	Percent Beneficial use
British Columbia	94%	0%	6%	94%
Manitoba	75%	0%	25%	75%
Ontario	48%	44%	8%	92%
Alberta	95%	0%	5%	95%
Quebec	34%	49%	17%	83%
Newfoundland/Labrador	0%	0%	100%	0%

4.1.1.1 Examples of Land Application Options in Canada

The CCME Guidance document provides several instances of municipalities across Canada that have beneficially used biosolids through land application. Some examples are:

– The JAMES wastewater plant in Abbotsford, British Columbia, holds a contract with a third party to use municipal biosolids resulting from wastewater treatment as a feedstock addition in the production of fabricated topsoil. The end product is marketed as Val-E-Gro™ and is used as a fertilizer for land application.

– The Lansdowne Wastewater Treatment Plant in Prince George, British Columbia and various treatment plants in the Regional District of Nanaimo, BC have used their biosolids for the fertilization of forests. The fertilization of forests through biosolids is of significant interest to the forest industry, as biosolids allow a slower release of nutrients (>5-years) as compared to the fast action of chemical alternatives (2-3-years). Further, biosolids applied to temporary roads and landings within forests can return these degraded areas into productive land bases quickly, thus resulting in a larger growing area and greater cutting allowance.

7 Biosolids-10 (gov.bc.ca)
8 biosolid_world_map.pdf (gov.bc.ca)

- The Halifax Regional Municipality has treated municipal biosolids with an alkaline stabilization process named N-ViroTM to produce class A biosolids for land application since 2008. The process recycles cement kiln dust as a second residual stream to provide alkalinity for the process. 100% of the biosolids produced have been beneficially used to fertilize sod and agricultural crops such as corn, soybeans, cereals, and forages.
- Locally generated municipal biosolids in Sechelt, British Columbia have been directly applied to barren soils at the Lehigh Materials mine. The community has been supportive of the successful program, and the mine was awarded for its achievements with the 2010 British Columbia Jake McDonald Mine Reclamation Award.

Table 4.2 below summarizes cases of land application of biosolids across Canada:

Table 4.2 Summary of Land Application in Biosolids Management in Canada

Jurisdiction	Product Name	Technology	Program Initiation	Beneficial Reuse of Biosolids
City of Kelowna, BC	Natures Gold	Aerobic composting	Undisclosed	Gardens and lawns fertilization, commercial landscaping and gardening (as mulch)
Metro Vancouver Regional District	Nutrifor	Thermophilic anaerobic digestion	1991	Mine reclamation, landfill closure and reclamation, regional reclamation projects, regional landscaping projects, forest fertilization, and ranch land fertilization
City of Kelowna/City of Vernon	Ogogrow	Aerated static pile composting	1995- 2006	Commercial landscaping, residential gardening, nurseries, orchards, and landfill closure.
Comox/Strathcona Regional District	SkyRocket	Aerated static pile composting	2007	Commercial landscaping, residential, gardening, nurseries and orchards, slope stabilization project, and local reclamation projects.
Regional District of Nanaimo	N/A	Mesophilic and Thermophilic anaerobic digestion	1991	Forest fertilization.
CRD	PenGrow	RDF lime- Pasteurization	2008-2011	Residential gardening and landscaping.
City of Edmonton, AB	N/A	Co-composting with residential organic waste	2002	Horticulture, agriculture, nurseries, commercial landscaping, residential gardening, city reclamation and enhancement projects.
Niagara Region, ON	Niagara N-Rich	N-Viro alkaline stabilization	2007	Agricultural fertilizer.
City of Toronto, ON	N/A	Thermal drying N-Viro alkaline stabilization	2007	Agricultural fertilizer, and mine reclamation.
Greater Moncton, NB	Gardener’s Gold	Composting- Gore Cover system	2008	Commercial landscaping, municipal parks and horticultural activities, and residential gardening.
City of Halifax, NS	Halifax N-Rich	N-Viro alkaline stabilization	2007	Agricultural fertilizer, and municipal horticultural activities.

4.1.2 United States

In the US, based on 2018 data, approximately 54% of all biosolids were land applied, 15% were incinerated and 30% disposed of in landfills (excluding the use as daily cover which is considered a beneficial use option)[9]. According to reports from the US EPA in 2021, about 4.5 million dry metric tons of biosolids generated in the United States, of which approximately 43% were land applied, 14% incinerated, and 42% landfilled, which suggests a trend of decreasing land application and increasing landfilling in US over the past few years. This percentage may vary between state and region. For example, land application of biosolids is more common in the Mid-Atlantic and Northeast regions than in other parts of the country[10]. Figure 4.1 shows the latest status of biosolids management in the US.

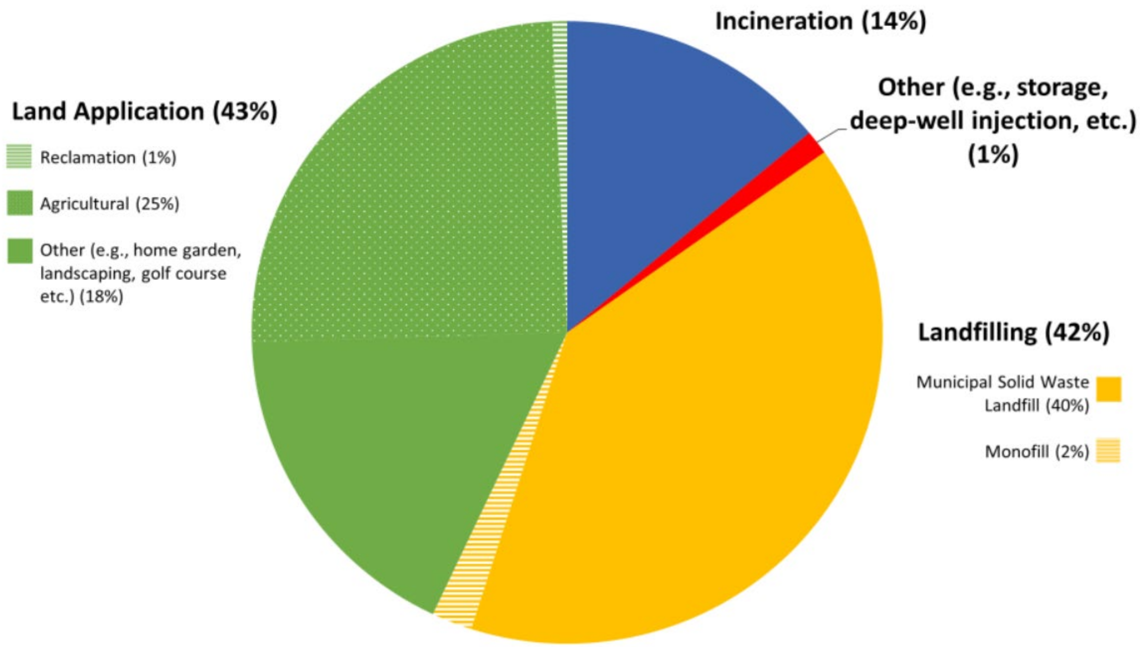


Figure 4.1 2021 Biosolids Management in the US[4]

4.1.3 Europe

In Europe there are rules around the use of sewage sludge as a fertilizer, the sampling and analysis of the sludge, record keeping and the type of treatments and end usages, similar to OMRR in BC. The European Union (EU) developed a Sewage Sludge Directive which aimed to increase the sewage sludge used in agriculture while ensuring heavy metals in soils and sewage sludge did not exceed set limits (also developed as part of the Directive). The Directive would ban the use of sewage sludge on agricultural soils if the concentration of metals in the soil exceeded pre-approved limits. In 2014, it was found that the Directive achieved is objective by increasing the amount of sewage sludge used in agriculture while reducing environmental harm. However, since then, a study was launched in 2020 to evaluate the effectiveness, efficiency, relevance, and coherence of the Directive in all EU countries. The study aimed to complement the results of the initial Directive and better understand the areas where the Directive was successful or challenged[11].

Figure 4.2 below illustrates the proportions of sewage sludge management technologies used by various EU countries:

9 National Summary — National Biosolids Data Project
10 Basic Information about Biosolids | US EPA
11 https://environment.ec.europa.eu/topics/waste-and-recycling/sewage-sludge_en

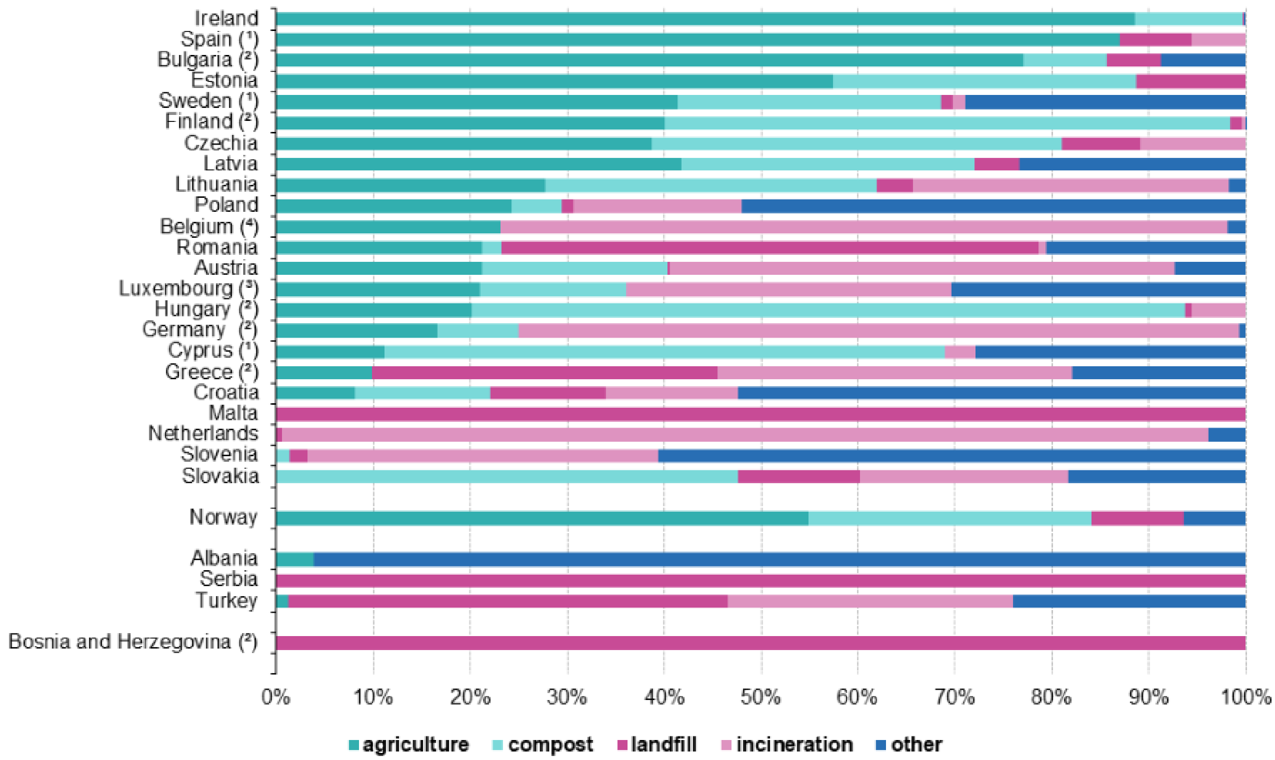


Figure 4.2 *2020 European Sewage Sludge Disposal*[7]

In Europe, land application of biosolids still constitutes the main method for biosolids management for many countries. In general, 50% of biosolids are land applied on agricultural land (marking an increase from 37% in 2017), 28% incinerated, and 18% landfilled. The remaining fraction is disposed through other methods such as pyrolysis, storage, reuse in green areas and forestry, and landfill cover. The percentage of biosolids managed through each practice may vary depending on factors such as location, available infrastructure, and local regulations. In countries such as Netherlands and Germany, incineration is the primary beneficial use for biosolids due to the low availability of land available for biosolids application. In the Netherlands (96%), Belgium (75%), Germany (74%) [12,13] the majority of biosolids are incinerated.

In France, 44% of biosolids are directly land applied, 29% are composted, 18% are incinerated and 9% are landfilled. In the United Kingdom (UK), approximately 3.6 million tonnes of biosolids are land applied for agricultural use annually and the UK has developed an Biosolids Assurance Scheme (BAS) to provide reassurance that certified biosolids can be safely used in agriculture. According to the UK's BAS, around 3-4 million tonnes of biosolids are applied annually to agricultural land in the UK, representing around 75% of sewage sludge production[14]. In Denmark, based on the 2010 data, 64% of biosolids were land applied, 29% incinerated and 2% of biosolids ended up in landfills. In Portugal, as per 2016 data, 5% of biosolids were disposed in landfills while the rest were used for land application and other uses including agriculture and composting. In Italy (2010), from all the biosolids produced, 34% are land applied, 4% are incinerated, and 49% are landfilled[6].

Europe has been at the forefront of research and development of new thermal technologies for biosolids treatment, such as pyrolysis and gasification. Despite this, many European countries still primarily use land application as the most beneficial method for biosolids utilization. It is noteworthy that there are various approaches to managing PFAS across Europe, both in terms of the presence of regulations and how these regulations are established. Denmark, Germany, the Netherlands, and Sweden established national limits for PFAS in soil, while Germany also set a limit for PFAS in fertilizer, which also applies to biosolids used as fertilizer. As of September 2020, no European countries,

12 https://www.mdpi.com/2071-1050/11/21/6015/htm
13 Water statistics - Statistics Explained (europa.eu)
14 Biosolids-Agric-Good-Practice-Guidance-January-2019.pdf (assuredbiosolids.co.uk)

except for several German states, had implemented specific rules or limitations regarding PFAS concentrations in biosolids for land application [15].

The EU has long been promoting the use of thermal technologies for waste management, including biosolids. The Waste Framework Directive (2008) recommends thermal treatment as a preferred method for waste management. While there are gasification and pyrolysis plants in Europe, they mainly process municipal solid waste. The Netherlands and Germany have the largest sewage sludge incineration capacity among European countries. In Finland, the Helsinki Regional Environmental Services Authority (HSY) implemented a sludge pyrolysis pilot plant with the capacity equivalent to treating wastewater sludge generated by a population of approximately 30,000 people during 2020. In August 2004, a fluidized-bed gasification plant, manufactured by Kopf was constructed at a WWTP in Balingen Germany for processing the digested biosolids and recovering energy. The Balingen plant processes about 230 kg of sewage sludge per hour[16].

4.1.4 Australia

In Australia, approximately 83% of biosolids were beneficially applied to land in 2021, with 72% of that being on agricultural land, which represents an 8% increase compared to the data from 2017. The remaining fraction was disposed of in landfills. Australia is making significant efforts to combat carbon emissions by pledging to reduce them by 43% from 2005 levels by 2030. A step towards this goal has been taken with the opening of Australia's first biosolids gasification plant at the Loganholme Wastewater Treatment Plant in Logan City, Queensland. To further explore the potential applications of the biochar product, the Logan City Council is collaborating with scientists from the Queensland University of Technology to uncover future possibilities for utilizing the biochar product in various ways[17].

4.1.5 New Zealand

In New Zealand, the total percentage of biosolids sent to landfill was 33% in 2021 (down from 38% in 2019). 43% of biosolids were used for land reclamation, 3% of biosolids were used for agricultural purposes, and 2% of biosolids were incinerated. The remaining fraction of biosolids were land applied for forestry, vermicomposting, landfill capping, stockpiling, and other uses.

4.1.6 Japan

Japan heavily relies on thermal processing methods for the management of biosolids. In particular, incineration is commonly used in Japan due to its high population density and limited opportunities for biosolids land application. Sewage sludge in Japan is treated according to regulations that require the removal of harmful substances and pathogens. The treated sludge or biosolids are then typically incinerated or applied to farmland as fertilizer. In 2016, 68% of were biosolids incinerated, 11% were land applied and the rest landfilled[18].

Literature also indicates an increasing trend in the gasification of biosolids in Japan as a means to reduce landfilling. The Kiyose Water Reclamation Center started using a gasification system in 2010 to treat 100 tonnes of dewatered sewage sludge each day[19]. A waste-to-hydrogen facility, located at the Sunamachi Water Reclamation Center near Tokyo Bay, is capable of processing 1 tonne of dried sewage sludge per day to generate 40-50 kg of hydrogen per day[20]. Japan Blue Energy Co., Ltd. (JBEC) has developed an Advanced Gasification Module (AGM), which is a small-scale 1 dry ton per day plant with a goal of producing between 20 and 50 kg of hydrogen per day depending on the system configuration and feedstock quality[21].

15 PFAS in biosolids: A review of international regulations (awa.asn.au)
16 Technology Assessment Report Aqueous Sludge Gasification Technologies (epa.gov)
17 Logan City Biosolids Gasification Project - Australian Renewable Energy Agency (ARENA)
18 biosolid_world_map.pdf (gov.bc.ca)
19 Kiyose Water Reclamation Center Starts Using Gasification System to Treat Sewage Sludge - Bureau of Sewerage Tokyo Metropolitan Government
20 Ways2H Shareholder Japan Blue Energy Launches Tokyo Waste-to-Hydrogen Facility - Hydrogen Central (hydrogen-central.com)
21 Japan Blue Energy – Renewable Hydrogen Production Technology (wipo.int)

4.2 Thermal Processing Facilities Scan

Table 4.3 below outlines some of the biosolids thermal processing facilities globally, the technology implemented, and the stage of the project.

Table 4.3 Thermal Processing Facilities

Location	Facility Name	Technology	End Products	Project Stage
Linden, New Jersey, USA	Aries Linden Biosolids Gasification Facility	Gasification	Syngas, Biochar	Commissioning
Sanford, Florida, USA	Fluidized Bed Biosolids Disposal Gasification Facility	Gasification	Thermal energy	Decommissioned
Kearny, New Jersey, USA	Aries Kearny Biochar Production Facility	Gasification	Biochar	Development
Taunton, Massachusetts, USA	Aries Taunton Biosolids Gasification Facility	Gasification	Biochar	Development
Edmonds, Washington, USA	Edmonds Wastewater Treatment Plant	Gasification	Ash Slurry[22]	Commissioning
Morrisville, Pennsylvania, USA	Ecoremedy Sludge Gasification Pilot Plant	Gasification	Biochar	a three-year pilot project (Decommissioned)
Derry Township, Pennsylvania, USA	Clearwater Road Wastewater Treatment Facility	Gasification	Renewable Thermal Energy, Biochar	Development
Silicon Valley Clean Water (SVCW), California, USA	SVCW Plant	Pyrolysis	Biochar	Operational
Rialto, California, USA	Rialto Bioenergy Facility	Pyrolysis	Biochar	Under construction
Ephrata, Pennsylvania, USA	Ephrata Bioforcetech Pyrolysis Facility	Pyrolysis	Energy, Biochar	Under construction
Niagara Falls, Ontario, Canada	CHAR Technologies' high temperature pyrolysis plant	High Temperature Pyrolysis (HTP)	Syngas, Biocarbon	Development (relocation from London Ontario)
Saint-Félicien, Quebec, Canada	Biomass Power Plant	High Temperature Pyrolysis (HTP)	RNG, Biocarbon	Development
Cuyahoga Heights, Ohio, USA	Southerly Wastewater Treatment Plant (WWTP)	Incineration	Heat and Steam to Energy, Ash	Operational
Los Angeles, California, USA	Biosolids Recovery Plant	Incineration	Steam, Ash	Operational
Pickering, Ontario, Canada	Duffin Creek Water Pollution Control Plant	Fluidized bed incineration	Heat and Steam to Energy, Ash	Operational
London, Ontario, Canada	Greenway Wastewater Treatment plant	Fluidized bed incineration	Heat to energy, Ash	Operational
Mississauga, Ontario, Canada	G.E. Boot Wastewater Treatment Plant	Incineration	Steam, Ash	Operational

22 FlexChar™ has properties similar to activated carbon and can be used as an alternative renewable fuel or a soil amendment.

Location	Facility Name	Technology	End Products	Project Stage
Pickering, Ontario, Canada	Duffin Creek Water Pollution Control Plant	Fluidized bed incineration	Steam, Ash	Development
Espoo, Finland	Pyrolysis Pilot Plant	Pyrolysis	Biochar	Pilot Program
Balingen, Germany	Kopf fluidized-bed Gasification Plant	Gasification	Syngas	Operational
Logan City, Australia	Loganholme Wastewater Treatment Plant	Gasification	Biochar	Operational
Tokyo, Japan	The Kiyose Water Reclamation Center	Gasification	Heat and Electricity	Operational
Tokyo, Japan	Sunamachi Water Reclamation Center	Gasification	Hydrogen	Operational
Japan	Blue Energy Advanced Gasification Module	Gasification	Hydrogen	Operational
Lesna, Poland	Budimex Drying and Incineration Plant	Incineration	Thermal Energy, Ash	Operational

It is important to note that information about advanced thermal facilities in Europe and Asia is limited. There is a lack of available data regarding the status of these facilities, technology providers, and if these providers sell their technology in North America.

In North America, pyrolysis is slightly ahead of gasification in terms of technological readiness with slightly more pyrolysis facilities in operation. Both technologies however are considered innovative and are still emerging in the biosolids processing space.

4.3 Global Trend Summary

Since 2017, the choice of biosolids beneficial reuse has varied across different countries and regions. In Canada, there has been a gradual increase in beneficial reuse, with a focus on land application, composting, and energy recovery. The United States has demonstrated a decrease in land application and an increase in landfilling over the since 2017. However, this trend may vary by state and region. Europe has established well-regulated and advanced biosolids management systems, utilizing land application, composting, and incineration. Australia and New Zealand have actively promoted land application, especially in agriculture, while complying with environmental regulations. In Japan, thermal processing methods such as incineration have been relied upon due to limited land availability stemming from high population density, although efforts are being made to explore alternative reuse options.

The most prevalent biosolid management option in many regions of the world, including North America, is land application (BCWWA 2016, EPA 2017).

The CCME has developed a comprehensive framework for managing wastewater biosolids, including the *Canada-Wide Approach for the Management of Wastewater Biosolids* (CCME, 2012a) and *Guidance Document for the Beneficial Use of Municipal Biosolids, Municipal Sludge and Treated Septage* (CCME, 2012b). This guidance covers biosolids quality, application rates, methods, setbacks, and monitoring. Quality standards are in place to ensure biosolids meet specific criteria, including limits on contaminants like heavy metals and pathogens to protect the environment and human health. Risk assessments are conducted before application to evaluate potential impacts on soil, water, and crops, determining appropriate rates and precautions. Biosolids are recognized for their benefits in improving soil fertility, organic matter, and crop productivity. Best management practices, such as proper storage, transportation, and application methods, are encouraged to ensure safe and effective land application. Compliance with setback distances from sensitive areas is also emphasized. Regular monitoring and reporting are required to assess the efficacy of biosolids management, including soil and crop testing, tracking application rates, and locations. These measures aim to ensure compliance with regulations and promote responsible biosolids land application.

Regulations for wastewater residuals, including biosolids, are implemented at the provincial and territorial levels with varying mechanisms to ensure environmental and public health protection. In Newfoundland and Labrador, the land application of biosolids is not permitted. In New Brunswick, only biosolids meeting Category A requirements outlined in the *Guidelines for Compost Quality* (2005) can be applied to land. Quebec prohibits the land application of biosolids for fruit, vegetables, pastureland, and home gardens unless certified by the Bureau de normalization du Quebec (BNQ). Alberta, British Columbia, Ontario, and Nova Scotia permit the land application of Class A and B biosolids and compost in accordance with regulations. Quebec imposes a green tax on sewage sludge/biosolids landfilled or incinerated, while Nova Scotia prohibits landfilling of organic material. Increasing landfill fees and recognition of the resource value in biosolids are reducing the acceptance of biosolids landfill disposal in Canada (CCME, 2012b).

The EPA and the National Academy of Sciences recognize the value of biosolids as a safe resource for soil conditioning and land reclamation. The EPA regulates biosolids under the Part 503 Biosolids Rule. In the US, approximately 43% of biosolids are land applied, 14% are incinerated and 42% are disposed of in landfills. Land application is supported at the federal level but faces restrictions in some counties. In Northern California, a significant portion of biosolids is used as alternative daily cover or disposed of in landfills due to local weather conditions and waste diversion requirements. Legal cases have upheld state regulations allowing land application over local regulations that try to limit land application in states such as California, Pennsylvania, Virginia, North Carolina, and Maryland. Legal cases in California, Pennsylvania, and Virginia have reinforced the safety and acceptance of land application of biosolids as a crucial recycling practice. In Kern County, California, a court ruling deemed the county's biosolids ban unconstitutional after a two-week trial which provided valuable resources for defending land application practices. The Pennsylvania Supreme Court also upheld the protection of biosolids farming under the state's Right to Farm Act, dismissing claims brought by plaintiffs in a long-running litigation. Additionally, the Richmond, Virginia, Circuit Court upheld regulations for land application, rejecting claims of insufficient protection and excessive phosphorus loading. (USEPA, 2017 and Slaughter, 2017)[23].

In Europe, the main method of reusing biosolids in recent years has been application on agricultural land. According to the European Commission, biosolids can be safely used as fertilizer on agricultural soils if they do not pose any environmental or health risks. However, there are variations in the regulations across member states, deviating from the European Commission directive. To improve policy decisions, actions such as sludge minimization, enhancing biosolids reuse, comprehensive monitoring, proper sludge characterization, and effective planning have been recommended. These measures will help ensure the quality of biosolids, protect the environment, and safeguard public health in sludge management practices.

Currently, within the 28 countries which form the European Union, the primary method of sewage sludge recovery is through land application. Approximately 50% of sewage sludge are spread on agricultural soils, 28% are incinerated, and 18% are disposed of in landfills. The decision-making regarding the alternative routes of sludge recovery/disposal, particularly land spreading, is greatly influenced by population density and the availability of agricultural lands. In regions with limited available land for biosolid spreading, northern European countries like the Netherlands and Germany have opted for incineration as the main recovery method. Additionally, despite the potential to apply all produced sludge to less than 5% of agricultural areas in most European Union Member States, the restricted use of biosolids in agriculture is attributed to low acceptance by farmers and the public. This factor also impacts policy decisions regarding sludge management, resulting in the implementation of national regulations by each Member State.

In Australia, approximately 83% of biosolids were beneficially applied to land in 2021, with 72% of that amount being utilized on agricultural land. In New Zealand, land reclamation accounted for 43% of biosolids utilization, while agricultural purposes comprised 3% of usage. Additionally, 2% of biosolids were subjected to incineration. The remaining portion of biosolids was allocated for forestry, vermicomposting, landfill capping, stockpiling, and various other applications.

On the other hand, Japan heavily relies on thermal processing methods, particularly incineration, for biosolids management. In 2016, 68% of were biosolids incinerated, 11% were land applied and the rest landfilled. Due to its

23 https://www.accesswater.org/publications/proceedings/-279639/biosolids-on-trial---recent-litigation-wins-for-land-application

dense population and limited opportunities for land application, Japan has prioritized the generation of energy as a beneficial use of biosolids processing.

5. Evaluation of Biosolids Thermal Pilots

In July 2020, the CRD issued a RFEOI to understand the advanced thermal technologies available and determine interest from the market to undertake pilot trials. The CRD evaluated the proponent submissions on the basis of adherence to CRD policy, beneficial use, project synergies, reputation/track-record, scalability, and the completeness of information in the proponents' responses. The CRD opted to select one pilot from each type of advanced thermal technology to better understand the respective process and by-product characteristics.

A description and the results to date of each selected pilot trial are outlined below.

5.1 Waste Management

Waste Management (WM) collaborated with the CRD to explore the management of CRD biosolids using pyrolysis technology. WM, through their partner BioForceTech (BFT) have a pyrolysis facility located at the Silicon Valley Clean Water Authority in Redwood, California. The BFT pyrolysis system includes three bio-dryers, a pyrolysis kiln, and a thermal oxidizer. This system dries biosolids, pyrolyzes into a pyrolysis gas and biochar, and oxidizes the pyrolysis gas, recovering heat for use in the pyrolysis kiln and biodryers.

The initial step in this pilot program was a desktop data review, to take advantage of results from previous trials at the facility, as well as other published research. WM engaged two external consultants, Northern Tilth and Brown & Caldwell to assist in this work. Northern Tilth gathered and analyzed relevant data sets from previously pyrolyzed biosolids and compared the quality characteristics to CRD biosolids. Brown & Caldwell conducted a literature review on biosolids pyrolysis air emissions, and reviewed air emission data available from the BFT facility.

Based on the review, which compared CRD biosolids against two North American biosolids samples, WM concluded the following:

- CRD biosolids are similar in quality to other anaerobically digested and thermally dried biosolids from similarly sized municipal wastewater treatment facilities in terms of commonly tested parameters such as nutrients and metals. Thus, the resulting biochar from CRD biosolids is also expected to be similar.
- CRD lacks baseline data on non-regulated compounds of concern, including PFAS, VOCs, SVOCs, pharmaceuticals, and personal care products. WM recommended that the CRD test its dried biosolids for these parameters, so that they can be compared to other biosolids. Samples were submitted to an analytical lab, and the analysis will be updated when results are received.
- A WM pyrolysis trial in 2019, and data from other trials globally, found that the concentration of compounds of concern, including PFAS, within the biosolids used in the trial (of similar quality to CRD biosolids) were significantly reduced in the biochar produced from pyrolysis.
- There is limited data on the fate of PFAS in pyrolysis gas before and after combustion. Bench scale testing has demonstrated that pyrolysis can remove specific PFAS compounds to below detection limits in pyrolysis gas, however, the transformation of PFOS (one type of PFAS) into a different type of PFAS was observed. More research, and the confirmation of bench-scale results in a commercial system is needed.
- The BFT Pyrolysis facility meets the requirements of its air permit. Available data suggests that coupling pyrolysis with appropriate emissions technology can lead to air emissions that comply with BC regulations.
- Currently, there is only one full-scale pyrolysis facility for dried biosolids operating in North America, and available air emissions data from that facility is limited to a few regulated parameters of concern, including NO_X and metals. Full-scale air emissions testing at an operational facility is needed to comprehensively understand the fate of both regulated parameters and compounds of concern, such as PFAS, in air emissions.

The second stage of this pilot project was to conduct additional testing, based on knowledge gaps identified during the first stage. The planned testing included participation in a comprehensive study backed by Water Environment Federation which aims to quantify the extent to which PFAS compounds are destroyed pyrolysis by analysing all inputs and outputs to the system, including the pyrolysis gas. All additional testing has been postponed until mid-2024, while the pyrolysis kiln is upgraded.

5.2 Char Technology

In February 2022, CHAR Technologies (CHAR) completed bench-scale laboratory testing of CRD biosolids. Afterward, they collaborated with the CRD to carry out a pilot-scale high temperature pyrolysis (HTP) test of 800 kilograms of CRD biosolids at CHAR's pilot facility in London, Ontario over two days in October 2022. The results of the pilot test were reported to CRD on March 3, 2023.

CRD provided biosolids for the pilot that had a moisture content of 5.3%, total solids (TS) content of 94.7%, and a particle size of approximately 1 mm. Two tests were performed using 398 kg of biosolids with identical operating conditions, in a HTP pilot test, at 850°C. The feed rate was 50 kg/h and the solids residence time was 1-hour, aimed at optimizing the destruction of PFAS components. Biochar was collected 1-hour after the first batch of biosolids entered the kiln.

CHAR used internally developed and proprietary modelling to predict HTP product yields based on previous test results. According to the results, HTP of biosolids at 850°C yielded 28% biochar, 60% syngas, and 12% condensate, a total solids mass reduction of 72%. The CRD biosolids had a carbon content of 8.26%, volatile matter of 62.35%, and ash of 19.55%. After HTP, volatile matter decreased and fixed carbon and ash increased, resulting in biochar with a fixed carbon content of 23.60%. This high fixed carbon content made the biochar eligible for carbon credits, with each tonne generating 0.7 credits according to Puro.earth, a voluntary market which determined carbon credits that can be allocated per tonne of biochar.

Pyrolysis typically increases the concentration of inorganic matter (including metals) due to the loss of volatile matter at high temperatures. As a result, concentrations of Molybdenum and Zinc in the resulting biochar exceeded limits set by the Fertilizer Act of Canada and BC Class A Biosolids standards. Further analysis is needed to determine how the biochar can be used, which may involve methods such as ash washing or compost blending. Phosphorous and potassium were present in the produced biochar in high concentrations of 54,000 mg/kg and 1,910 mg/kg respectively, making it a potentially valuable fertilizer. Nitrogen was detected in the form of nitrate and nitrite in the feedstock. This was an expected result, as volatile forms of nitrogen were lost during the pyrolysis process while phosphorous and potassium were concentrated in the resulting biochar.

Tests and analysis demonstrated that CHAR's HTP Technology was successful in removing PFAS components from the solid phase of CRD's biosolids feedstock at 850°C. The resulting biochar had PFAS components that were below detection limits and met Canada’s Agricultural Use standards.

However, PFAS was detected in the dirty syngas, both pre- and post- oxidizer. The samples were not taken simultaneously, thus leading to non-identical process conditions. The oxidizer operated at 850°C with a minimum residence time of 2-seconds. Volumetric flow rates of syngas could not be measured at the sampling locations, so only concentration data was provided. PFAS tests were conducted on the syngas and gas results for O_2, CO_2, CO, CH_4, N2, and H2 were provided for both pre- and post- oxidizer/combustor. The presence of oxygen in both pre- and post-oxidizer gas was identified and indicated air intrusion. Analysis of the syngas particulate matter suggested that more attention is needed when designing the oxidizer to ensure that the particulate matter emissions do not exceed the stack limits and sufficient destruction of any contaminants that are partitioned to the syngas like PFAS. Higher oxidizing temperatures may be necessary. Based on the presence of sulfur and nitrogen in the dirty syngas, the formation of NOx and SO_2 was anticipated.

The process of contaminant partitioning from biosolids feedstock to end products including biochar and syngas (post-oxidizer) is currently under investigation for a variety of organic and inorganic contaminants of concern. While the conversion process may lead to a reduction in contaminant levels, complete destruction of contaminants is still under investigation. Furthermore, careful consideration of the end-use of syngas is necessary to ensure potential risks are mitigated.

Overall, additional analysis is necessary to fully comprehend the properties of the syngas generated, as there were concerns that air intrusion may have adversely affected results. To obtain precise gas data and establish reliable emissions control for a commercial-scale system, CharTech suggested installation of an on-site HTP demonstration system with syngas cleaning at a CRD location for further testing.

5.3 CEM

The CRD discussed the opportunity to pelletize and combust biosolids with CEM. The objective was to have CEM complete a lab analysis on a sample of biosolids and provide a professional opinion of the combustion proprieties of the biosolids and comment on the opportunity to bind biosolids with wood waste for use as fuel in a boiler.

CEM retained a lab in Europe to test different mixtures of dried biosolids and wet Hartland Landfill woodchips at four different ratios:

– 100% biosolids
– 20% biosolids and 80% wood chips
– 10% biosolids and 90% wood chips
– 5% biosolids and 95% woodchips

The lab conducted a “BASIC” analysis on all four samples.

Results showed that the in the 100% biosolids test, the Ash Deformation Temperature (ADT) was at 1,000-1,100 ˚C, which was significantly higher than the minimum requirement of 800 ˚C based on the Best Demonstrated Practice (BDP). ADT refers to the temperature at which ash in a combustion chamber begins to soften and deform. This temperature is a critical parameter for combustion operations, as a low ADT can lead to slagging and fouling in the combustion chamber, reducing the efficiency and reliability of the process.

Since the biosolids had high ADT, they may be burned in a biomass boiler as-is using a fines burner or travelling grate. However, the biosolids contained a considerable amount of ash, approximately 24% on a dry basis. Also, burning biosolids produces high levels of NO_X, SO_X, and strong acids such as HCl and HF. NO_X and SO_X emissions may be reduced with Best Available Control Technology (BACT). Burning biosolids can also cause corrosion due to the production of strong acids, but this may be prevented by maintaining a flue gas temperature above 150°C. As per BACT, mixing biosolids with wood chips was found to be necessary to prevent fouling and meet emission requirements. A mixture of 85% wood chips and 15% biosolids was recommended by CEM to avoid fouling and reduce NOX/SOX emissions significantly, and to meet the BACT emission levels. CEM believed that this was an inefficient utilization of the biosolids. Additionally, the pellets produced would not be appropriate for pellet boilers intended for commercial or residential use as they would contain elevated levels of sulphur and chlorine.

The pelletization of biosolids was found to be unnecessary for their combustion due to their high ADT. The biosolids could be burned directly in a dedicated "fines" burner with wood chips or above the travelling grate along with the wood chips. This was a positive result because it simplified the combustion process and reduced the cost and complexity of preparing the fuel for combustion.

If 15% of the mix is biosolids at a rate of 3,600 tonnes per year and 85% is wood at 20,400 tonnes per year, the weighted average calorific value of the biosolids wood chip mixture would be 4,800 Btu/lb. The as-is calorific value of the biosolids is 17,250 kJ/kg and the as-is calorific value of the wood is 10,080 kJ/kg. The combustion of approximately 24,000 tonnes of the 15%/85% biosolids wood chip mixture would produce around 2,600 tonnes of ash per year, which could then be collected and utilized either in asphalt or land application.

CEM recommended that the CRD perform further proximate and ultimate analyses on their different types of wood chips, including the coastal-like, dirty, and Construction/Demolition (C&D) Waste wood chips, as well as any other sources of biomass they may have. It was recommended that the CRD prioritized assessing the ash content, chlorine, and fluorine levels in their wood chips to establish a hierarchy of fuel types based on their cleanliness, with the least contaminants of concern being the most favourable option.

CRD was advised to initiate discussions with Natural Resources Canada through their CanmetENERGY laboratory to explore the feasibility of conducting preliminary tests/work on pelletizing a fraction of their biosolids. In addition, it was suggested that CRD conduct an incremental cost/benefit analysis of pelletizing their biosolids (and wood chips) to assess if the additional CAPEX and OPEX involved in this process are worthwhile, considering that alternative, less expensive options may also be available.

Due to the ash content of the fines, CEM recommended the CRD seek out burner OEMs who have the capacity to burn biosolid fines. The OEMs should provide a summary of the advantages and disadvantages of the fines burner option compared to mixing the biosolids and wood chips together and burning them on a grate.

CEM suggested that the ideal location for a biosolids/wood chip combustor would be a thermal-intensive customer within CRD who has a consistent demand for steam, hot water, or hot oil and is interested in reducing their carbon footprint. A biomass combustion system can operate for 8,000-hours per year on 3 tonnes/hour of biosolids/wood chip mixture, resulting in 31.7 mmBtu per hour of heat and 27 mmBtu per hour of useful energy. Assuming an 85% high heat value (HHV) efficiency, this could result in a CO_2 savings of 11,000 tonnes CO_2 equivalent per year. Based on the amount of biosolids available and the recommended blend ratio of 15% biosolids to 85% wood chips, the host site/customer should have a thermal load of around 250,000 mmBtu per year (i.e., equivalent to 10,000 - 11,000 tonnes per year of CO_2 equivalent).

CEM identified at least five fossil fuel users on Vancouver Island with over 10,000 tonnes of CO2 emissions per year who could potentially use all of CRD's biosolids for heat and/or power. It is likely that these operations would require modifications to their systems before pelletized biosolids could be used.

5.4 Aries Clean Technologies

Aries Clean Technologies (Aries) is a US based company which uses Fluidized Bed Gasification technology and is commissioning a new facility in Linden, New Jersey which will operate solely on biosolids. CRD intended to collaborate with Aries to conduct a pilot gasification program of biosolids. However, due to commissioning issues at this new facility, Aries indicated that their facility will not be operational and unable to undergo performance testing until the last quarter of 2023. As such, the pilot trial has been delayed. Staff are currently maintaining communication with Aries Clean Technologies and will make efforts to carry out the pilot study when the facility becomes operational.

5.5 Summary of Thermal Pilot Results

The advanced thermal pilot outcomes/results to date have provided valuable insights into the discrete operation of these technologies and the quality of products that can be obtained from CRD's biosolids. However, the pilots were all completed over a discrete period of time and therefore may not be representative of the long-term day to day operating conditions of the various systems/technologies. In addition, the trials only allowed for limited data to be collected on the characteristics of by-products such as biochar, syngas and wastewater. As such, the current pilot results alone are insufficient to confirm the feasibility of on-site advanced thermal processing of CRD biosolids and the potential for integration/beneficial use of by-products into other systems at Hartland.

5.6 Thermal Pilot Next Steps

Following the pilot trials, on March 29, 2023, the CRD board moved to initiate a request for proposals (RFP) process for an advanced thermal processing trial on-site at Hartland.

GHD recommends the following key objectives for consideration as part of the on-site thermal processing trial:

– Confirm equipment/process reliability
– Determine operating costs and short- and long-term maintenance requirements

- Evaluating the magnitude and quality of flue gases from the process
- Confirm the quantity and quality of syngas, biochar, and liquids
- Identify opportunities for process optimization
- Evaluate the potential for co-processing of other materials arriving at the landfill and assess the effects of co-processing on the quantity and quality of products and waste streams
- Identify and develop local markets for biochar
- Assess carbon sequestration benefits
- Evaluate contaminant partitioning and fate
- Evaluate GHG implications of any oxidized syngas
- Assess potential long-term synergies at Hartland

As noted above, the RFP process was initiated June 16, 2023, with a response closing date of July 14, 2023.

6. Long Term Options

The following section outlines the long-term biosolids beneficial use management options currently available to the CRD at the time this report was developed, along with proposed screening and evaluation criteria used to differentiate between the various options.

6.1 Long-Term Options

As per provincial regulatory direction from ENV, the proposed long-term management plan for biosolids generated at the RTF must comply with the requirements for beneficial use specified by the CCME.

In the context of the CCME beneficial use criteria, the below Table 6.1 screens all known biosolids long-term options available to the CRD:

Table 6.1 Potential Biosolid Options available to the CRD

Type of Operation	Potential Options	Adheres to CCME Beneficial Use?
Land Application		
Mine/Quarry Reclamation	Three potential options: – Two options for quarry reclamation near Nanaimo, BC. – An option for mine reclamation on the mainland.	Yes
Forest Fertilization	Three potential options: – Options for forest fertilization within the CRD and near Nanaimo, BC.	Yes
Land Improvement	One potential option: – An option to land apply biosolids to promote grass growth, help manage invasive species, and develop the potential for land grazing near Courtenay, BC.	Yes

Type of Operation	Potential Options	Adheres to CCME Beneficial Use?
Land Application		
Direct Land Application	One potential option: – Biosolids could be bagged and distributed as a fertilizer product in packages of less than 5 m^3. A pilot project would be required to assess feasibility.	Yes
BGM/Composting/Soil-Product	Multiple potential options with several vendors: – Biosolids could be mixed into BGM and land applied. – Biosolids could be composted with other municipal organic waste and land applied.	Yes
Thermal		
Fuel for Combustion/Incineration	Four potential options: – Co-combustion at two lower mainland cement kilns – As fuel in biomass boilers, either directly or mixed/pelletized with wood. Although possible, a market does not currently exist for use of biosolids as fuel. Changes to air permits would be required, potentially with additional stack testing requirements. Use in traditional residential/commercial units is not recommended as per results of thermal pilot trials. A specially designed “fines” boiler, with emissions control technology, would be required. – Incineration at an off-site waste-to-energy facility. Material handling at the facility would need to be developed.	Potentially – not all options beneficially re-use ash.
Pyrolysis	Two potential options: – On-Site pilot facility - Pyrolysis gas would not be beneficially used in the pilot. – On-Site long-term facility	Partial – Pilot option may not capture energy. Biochar and bio-oil from pyrolysis may not be suitable for land application or combustion, respectively.
Gasification	Two potential options: – On-Site pilot facility - Syngas would not be beneficially used in the pilot. – On-Site long-term facility	Partial – Pilot option may not capture energy. Biochar from gasification may not be suitable for land application.

Options outlined in Table 6.1 may also benefit from the development of additional material handling and storage procedures which may result in increased flexibility for transportation and transportation logistics. Table 6.2 illustrates available materials handling and storage options which could be coupled with options in Table 6.1 above to provide increased flexibility for the CRD.

Table 6.2 Materials, Handling, and Storage Options

Material Handling & Storage	
Materials Handling	Two potential options: – Manually bag biosolids into bulk bags with bag liners for storage and transport. – Bagging for distribution- Class A biosolids can be distributed freely bagged in quantities of less than 5 m^3.
Storage	Two potential options: – Hartland Silo – construct additional silo(s) at Hartland. – Stockpile - stockpiling of biosolids will require blending 1:1 with sand to safely store. Blended biosolids will no longer be suitable for combustion. Stockpiled biosolids must meet OMRR storage requirements. Biosolids could be stockpiled at Hartland landfill or at land application site.

6.2 Proposed Evaluation Criteria

The following table describes a proposed evaluation criteria which could be used to distinguish and identify the benefits and challenges with each of the biosolid beneficial use options outlined above.

Table 6.3 Proposed Evaluation Criteria

Evaluation Criteria	Description
Economic	– Estimated CAPEX and OPEX e.g., cost of capital investment for additional infrastructure and cost of processing – Potential for revenue generation e.g., biochar, biofuel – Estimated cost per tonne e.g., CAPEX and OPEX to process tonne of biosolids; estimated based on information available at the time of this report
Environmental Impacts	– Odour – Noise – Truck Traffic – Air emissions and dust – Contaminant mass balance
Environmental Sustainability	– Production of value derived products e.g., biochar, biocrude, etc. Diversified beneficial use and marketability of products recovered – GHG Emission Implications – Potential to recover energy and reduce dependence on electric grid and natural gas – Potential to co-process additional waste streams – Soil/groundwater impacts
CRD Owned	Yes or no
Reputation	Type of application (thermal treatment, land reclamation, agricultural fertilizer etc.)
Regulatory	New permit requirements and impacts to existing operating permits

6.3 Options Evaluation

The results of the options evaluations using the proposed evaluation criteria are summarized in Table 6.4 below:

Table 6.4 General Option Pathway Evaluation Results

Evaluation Criteria	Description	Mine/Quarry Reclamation	Forest Fertilization	Land Improvement	Direct Land Application	BGM/Composting/Soil-Product	Fuel for Combustion/Incineration (Off-Site)	Pyrolysis (On-Site)	Gasification (On-Site)
Economic	CAPEX and OPEX	Low CAPEX given no investment for additional infrastructure. Medium OPEX due to labour, transport, materials handling, maintenance, storage, public outreach, etc.			Low CAPEX given no investment for additional infrastructure. Higher OPEX due to increased costs from bagging protocol and materials.	Low CAPEX given no investment for additional infrastructure. Medium OPEX due to labour, transport, materials handling, maintenance, storage, public outreach, etc.	Low to medium CAPEX depending on contract agreement. Some vendors may require investment for additional feedstock storage infrastructure. Medium OPEX due to labour, transport, materials handling, maintenance, storage, etc.	High CAPEX due to capital investment for on-site facility. OPEX induced from labour, utility demands (natural gas, electricity, and water), and the transport of biochar. In comparison to off-site alternatives, OPEX will be low in the long-term due to lack of tip-fees for biosolids. However, OPEX may be higher during the early commercial facility commissioning stage until the process becomes optimized.	
	Potential for revenue generation	Low potential for revenue generation as there are no residual products from this process.			Potential for revenue generation through the distribution of bagged biosolids fertilizer product to partially offset processing costs.	Low potential for revenue generation as CRD may not own the rights to the BGM/composting/soil-products.	Low potential for revenue generation as CRD may not own the rights to the value derived products (electricity, cement, heat, etc.).	Potential for revenue from value derived products (biochar, bio-oil) to partially off-set processing costs.	Potential for revenue from value derived product (biochar) to partially off-set processing costs.
	Estimated cost per tonne (CAPEX and OPEX estimate based on information available at the time of this report)	<$250/tonne	<$400/tonne	<$500/tonne	<$500/tonne	<$500/tonne	<$500/tonne	$500-4,500/tonne[1]	
Environmental Impacts	Odour	Potential for nuisance odour emissions at application site(s). May be mitigated via biosolids stabilization and mixing with soil. Application sites are generally far from population centres.					Minimal odour due to installation of an odour abatement system at the facility.		
	Noise	Noise emitted from land application equipment. However, mines/quarries are generally located far from population centres.			Noise potentially emitted from bagging equipment. However, site is located far from population centres	Noise emitted from land application equipment. However, application sites are generally	Minimal noise due to installation of noise abatement system at the facility.		

Evaluation Criteria	Description	Mine/Quarry Reclamation	Forest Fertilization	Land Improvement	Direct Land Application	BGM/Composting/Soil-Product	Fuel for Combustion/Incineration (Off-Site)	Pyrolysis (On-Site)	Gasification (On-Site)
Environmental Sustainability					and a noise abatement system would be designed as the bagging protocol is developed.	located far from population centres.			
	Estimated Truck Traffic	Truck traffic associated with transport of biosolids from site: Approximately one truck every three days (122 trucks each year)						Truck traffic associated with transport of biochar from site: – Approximately one truck every nine days (41 trucks each year)	
	Air Emissions and Dust	Generally low potential for particulate air emissions/dust.					Minimal air emissions/dust due to installation of advanced capture and treatment systems at facility, though residues from these capture and treatment systems need to be disposed of.		
	Contaminant mass balance	Potential accumulation of contaminants. However, class A biosolids have undergone contaminant reduction processes as per OMRR quality standards.					Contaminants have shown to be reduced through thermal processing. However, the level of reduction and ultimate environmental fate are still under investigation.		
	Production of value derived products e.g., biochar, biocrude, etc.	Biosolids may be considered a fertilizer product derived from a waste stream in the context of land-application, with the added benefit of reducing the need for energy-intensive synthetic fertilizer production.				Produces BGM, compost, soil-products which may be beneficially re-used in various applications and reduces the need for energy-intensive synthetic fertilizer production.	Produces energy which may be beneficially re-used for electricity/heating applications assuming nearby end-users.	Produces steam, syngas, , and bio-oil, which can be beneficially re-used in various applications such as heating, electricity, etc. Also produces biochar, however the potential beneficial applications of this product as a soil amendment are still under investigation.	Produces steam, syngas, and which can be beneficially re-used in various applications such as heating, electricity, etc. Also produces biochar, however the potential beneficial applications of this product as a soil amendment are still under investigation.
	GHG Emission Implications[2]	In comparison to landfilling, GHG emissions are significantly reduced due to lesser methane/nitrous-oxide emissions, carbon sequestration into soil, and an offset usage of synthetic fertilizers. In comparison to alternative beneficial use options, biosolids application to degraded areas (mines, quarries, forests, lands, etc.) presents the lowest potential for GHG emission reduction. Any off-site option will have higher GHG emission implications due to the transport distances and trucking frequency associated with the transport of			In comparison to landfilling, GHG emissions are significantly reduced due to lesser methane/nitrous-oxide emissions, carbon sequestration into soil, and offset usage of synthetic fertilizers. In comparison to alternative beneficial use options, the production and sale of biosolids as a soil fertilizer product through bagging, compost, or BGM, presents medium potential for GHG emission reduction, assuming it has greater potential to offset the usage of synthetic fertilizers.		In comparison to landfilling, GHG emissions are significantly reduced (lesser methane/nitrous-oxide emissions, non-renewable fuel usage offsets). Thermal processing options will have increased GHG implications from the oxidization of any gases produced.	In comparison to landfilling, GHG emissions are significantly reduced (lesser methane/nitrous-oxide emissions, non-renewable fuel usage offsets). Advanced thermal processing options will have increased GHG implications from the oxidization of any gases produced. Like combustion/incineration, pyrolysis and gasification present high potential for GHG emission reduction, if biosolids-derived energy (heat, syngas, or bio-oil from	

Evaluation Criteria	Description	Mine/Quarry Reclamation	Forest Fertilization	Land Improvement	Direct Land Application	BGM/Composting/Soil-Product	Fuel for Combustion/Incineration (Off-Site)	Pyrolysis (On-Site)	Gasification (On-Site)
		biosolids, resulting in increased non-renewable fuel usage.			Any off-site option will have higher GHG emission implications due to the transport distances and trucking frequency associated with the transport of biosolids, resulting in increased non-renewable fuel usage.		In comparison to land application options, utilizing biosolids as renewable fuel for cement combustion or energy production via incineration presents high potential for GHG emission reduction, assuming it offsets the usage of non-renewable fuel sources. Any off-site option will have higher GHG emission implications due to the transport distances and trucking frequency associated with the transport of biosolids, resulting in increased fuel usage.	pyrolysis) is beneficially used to offset the usage of non-renewable fuel sources. Depending on process design, this derived energy may not be reused or recycled, and may result in lower GHG emission reductions. On-site options will have lesser GHG emissions associated with transport, as the trucking frequency of hauling biochar will be less than that required of biosolids.	
	Potential to recover energy and reduce dependence on electric grid and natural gas	No potential to recover energy.					High potential to recover energy from products (steam, heat) to offset dependence on electric grid and natural gas. Fulsome energy recovery would depend on presence of nearby end-users.	High potential to recover energy from products (syngas, steam, heat) to offset dependence on electric grid and natural gas onsite. Fulsome energy recovery would depend on presence of nearby end-users.	
	Potential to co-process additional waste streams	No potential for co-processing.				Potential for co-processing via blending of biosolids with compost generated from organic waste streams.	Low potential to co-process mixed waste streams as CRD would not have control over off-site facility operations.	Potential to co-process mixed waste streams. However, co-processing may increase maintenance/operational costs due to added complexity of feedstock.	
	Soil/groundwater impacts	Supplementing soil cover and improving soil health via biosolids application reduces erosion into lakes and streams. Potential negative impact to soil/groundwater if application plan is not followed correctly as per OMRR.			Bagging process presents minimal impacts to soil/groundwater. End-use of the bagged product may present potential negative impact to soil/groundwater if applied in quantities greater than one bag ($5m^3$) per parcel of land. OMRR does not require a land application plan for application quantities less than or equal to $5m^3$ per parcel of land.	End-use of the products may present potential negative impact to soil/groundwater if application plan is not followed correctly as per OMRR.	Process presents minimal impact to soil/groundwater. End-use of the products (biochar, bio-oil, ash) may present potential negative impact to air/soil/groundwater if proper consideration not taken.		

Evaluation Criteria	Description	Mine/Quarry Reclamation	Forest Fertilization	Land Improvement	Direct Land Application	BGM/Composting/Soil-Product	Fuel for Combustion/Incineration (Off-Site)	Pyrolysis (On-Site)	Gasification (On-Site)
CRD Owned	Yes or no	No. Biosolids would be sent to vendors who would own risk and land application responsibility.			Yes.	No. Biosolids would be sent to vendors who would own risk and responsibility.	No. Biosolids would be sent to off-site facility.	Yes.	
Experience and Reputation	Type of application	Mines/quarries are required by the government to eventually reclaim and close to minimize the long-term environmental effects of operations. Biosolids have shown to be an effective measure in the restoration of former mines/quarries by adding nutrients to promote vegetation growth in their barren soils. However, general public acceptance regarding land application varies due to concerns on noise, odour, contaminants, etc.	Biosolids have shown to be an effective measure in the fertilization of forests to increase tree production, reduce soil erosion, and improve soil health. However, general public acceptance regarding land application varies due to concerns on noise, odour, contaminants, etc.	Land application has demonstrated commercial success and is one of the commonly used management options worldwide. However, general public acceptance regarding land application varies due to concerns on noise, odour, contaminants, etc.	It is unclear if there is a local market for bagged biosolids fertilizer product. A pilot trial would be required to assess demand and feasibility. Biosolids as a bagged product is allowed under OMRR in packages of <5m^3. However, general public acceptance regarding land application varies due to concerns on noise, odour, contaminants, etc.	Land application has demonstrated commercial success and is one of the commonly used management options worldwide. However, general public acceptance regarding land application varies due to concerns on noise, odour, contaminants, etc.	High technological readiness as combustion/incineration is a commercially proven and widely used biosolids management process. However, the market for biosolids as fuel does not currently exist. Additionally, public acceptance of waste incinerators varies due to concerns regarding intensive energy usage and potential for air pollutant emissions.	Reputation of pyrolysis is gaining interest as an innovative technology which produces value added products from waste streams, however it has demonstrated low technological readiness as there are a limited number of operational facilities which use biosolids as a sole feedstock. In North America, pyrolysis is ahead of gasification with regards to technological readiness based on the number of operational facilities.	Reputation of gasification is gaining interest as an innovative technology which produces value added products from waste streams, however it has demonstrated low technological readiness as there are a limited number of operational facilities which use biosolids as a sole feedstock. In North America, gasification is below pyrolysis with regards to technological readiness based on the number of operational facilities.

Evaluation Criteria	Description	Mine/Quarry Reclamation	Forest Fertilization	Land Improvement	Direct Land Application	BGM/Composting/Soil-Product	Fuel for Combustion/Incineration (Off-Site)	Pyrolysis (On-Site)	Gasification (On-Site)
Regulatory	New permitting requirements and impacts to existing permits	May require approvals from: - ENV to ensure land application is carried out safely and does not pose a risk to human health or the environment.					Changes to boiler air mass permits may be required. May require approval from Environmental Management Act Air Quality Permit for any emissions associated with thermal process.	May require approval from Environmental Management Act Air Quality Permit for any emissions associated with thermal process.	

1. Due to pyrolysis and gasification being considered emerging technologies in the biosolids industry there are a number of unknown risks associated with these technologies which have the potential of increasing both CPAEX and OPEX associated these types of projects.
2. GHG Emission Implications are based on the 2022 BEAM Model developed by the Northeast Biosolids and Residuals Association, Northwest Biosolids, Northern Tilth LLC.

6.4 General Option Pathways

The available option types outlined in Table 6.4 fall under four general pathways for CRD's consideration in the long-term:

- **On-Site Thermal:** The CRD invests in an on-site advanced thermal technology to process their biosolids. These processes would yield value-added products such as syngas, biochar, bio-oil, or energy that can be converted into heat/electricity. There is also potential to co-process other waste streams in addition to biosolids, such as municipal solid waste.
- **Off-Site Thermal:** Similar to on-site thermal, the CRD transports biosolids from Hartland to a different facility to process the biosolids via an advanced thermal technology. However, in this scenario there is no need to invest in additional infrastructure.
- **Cement Manufacturing:** The CRD transports biosolids from Hartland to off-site facilities for beneficial use as alternative fuel in cement kilns.
- **Land Application:** The CRD would utilize the biosolids for non-agricultural land-application purposes such as mine/quarry reclamation, forest fertilization, land improvement, direct land application, or the production of BGM/compost/soil-product.

7. Long-Term Portfolios

Irrespective of the type of management option selected for the long-term strategy, GHD recommends that the CRD develop a combination of multiple options within a diverse strategy portfolio to ensure resiliency and further protect the CRD against risks of interruption such as future market forces, regulatory changes, facility shutdowns, or other unplanned circumstances. In the unexpected event that a management option is interrupted due to these risks, the added benefit of strategy diversification in following the portfolio approach will allow CRD's biosolids to still be beneficially used in the interim until the interruption is resolved.

The following sections outline the process for developing biosolids beneficial use portfolios and provide a few general portfolios based on the four general pathways described in the previous section.

A portfolio may be made up of three of more biosolids beneficial use options in order to increase resiliency. These three options may be categorized as follows:

1. **Preferred Option** – This refers to the primary management option. For an option to be categorized as preferred, it should be able to accommodate all biosolids produced by the RTF. A preferred option may be made up of several smaller preferred options in order to meet this requirement.
2. **Support Option** – This refers to a secondary option which would be available to beneficial use biosolids if one or all the preferred options were not available. This option does not have to be capable of accommodating all biosolids produced by the RTF and as such may be seasonal and/or have minimum tonnages associated with it.
3. **Contingency Options** – This refers to options which would serve as back-up options for the beneficial use of biosolids in the unexpected event that the preferred and support options are not available. Contingency may not be as economically or environmentally attractive as the preferred of support options however would be available to accept biosolids on short notice.

7.1 General Portfolios

As noted above, portfolios made consist of the following general biosolids beneficial use option pathways:

- **On-Site Thermal**
- **Off-Site Thermal**

– **Cement Manufacturing**
– **Land Application**

Table 7.1 below outlines a few potential general portfolios. It is important to note that this is not an exhaustive list of all potential portfolios and that there may be additional possible combinations. Following consultation, the portfolios may be further refined to include the specific options approved by the public and First Nations groups.

Table 7.1 General Portfolios

Option Categories	Existing Scenario Portfolio	Short-Term Portfolio	On-Site Thermal Portfolio	Off-Site Thermal Portfolio	Land Application Portfolio
Preferred Option	Cement Manufacturing	Cement Manufacturing	Thermal/Fuel (on-site)	Thermal/Fuel (off-site)	Land Application
Support Option	N/A	Land Application	Land Application	Land Application	Land Application
Contingency Option	On-Site BGM	On-Site BGM	Cement Manufacturing (off-site)	Cement Manufacturing (off-site)	Cement Manufacturing (off-site)

7.1.1 General Portfolio Narratives

Existing Scenario Portfolio:

– This portfolio illustrates CRD's existing biosolids management strategy, in which the biosolids are transported off-site for use alternative fuel in cement manufacturing. As a contingency, 350 tonnes of biosolids are used to produce BGM under the Definitive Plan. This portfolio lacks a support option, and consequently does not have appropriate redundancy. This has led to significant operational challenges as off-site cement manufacturing has been interrupted. Although temporary, this portfolio is included as a comparison to the proposed portfolios.

Short-Term Portfolio:

– This portfolio depicts CRD's current short-term strategy, in which potential land-application options are being investigated to serve as additional support to the existing scenario for added resiliency.

On-Site Thermal Portfolio:

– This portfolio includes the investment and construction of an advanced thermal facility at Hartland Landfill. The potential to construct an on-site pilot facility is currently being investigated with pyrolysis and gasification technologies. Depending on the results and operations of the pilot, the on-site facility may be able to process and beneficially use CRD's biosolids for the long-term.
– During periods of planned shutdown, a portion of the biosolids could be transported to various land application programs. There are several potential land application options being explored by the CRD in the areas of mine/quarry reclamation, forest fertilization, land improvement, and BGM/composting/soil-product.
– In the unlikely event that both preferred and support options are interrupted, the CRD may send biosolids for use as alternative fuel in cement manufacturing. There are two off-site cement manufacturing options known to be available to the CRD which meet beneficial use criteria.

Off-Site Thermal Portfolio:

- This portfolio also considers the processing of biosolids via an advanced thermal treatment technology. However, in this scenario the biosolids would be transported to an off-site facility rather than investing in the construction of an on-site facility. Currently, there is one potential off-site thermal option available to the CRD in the form of incineration at a waste-to-energy facility.
- During periods of planned shutdown, a portion of the biosolids could be transported to various land application programs. There are multiple potential land application options being explored by the CRD.
- In the unlikely event that both preferred and support options are interrupted, the CRD may send biosolids for use as alternative fuel in cement manufacturing. There are two off-site cement manufacturing options known to be available to the CRD which meet beneficial use criteria.

Land Application Portfolio:

- This portfolio considers the transport of biosolids to one of the various potentially available land application programs.
- In the unlikely event that both preferred and support options are interrupted, the CRD may send biosolids for use as alternative fuel in cement manufacturing. There are two off-site cement manufacturing options known to be available to the CRD which meet beneficial use criteria.

7.2 Resiliency Evaluation

The following criteria in Table 7.2 was prepared to identify and evaluate the risk of interruption of potential portfolios:

Table 7.2 Resiliency Criteria and Factors

Resiliency Criteria	Factors
Preferred Option Sufficient Capital for Start-Up/ Operating/Refurbishment	Insufficient capital leading to potential shutdown or service interruptions.
Preferred Option Change in Ownership	New owner does not honour existing contracts (increase in tipping fees exponentially over short period of time).
Preferred Option Market for End-Product	Lack of market for end-product causes facility to turn away biosolids.
Preferred Option New OMRR Requirements	Updated OMRR with standards that current facility does not meet.
Preferred Option Short-term Shutdown	Short term shutdowns for various reasons - feedstock interruption, highway closure, wildfire, etc.
Preferred Option Facility Reputation	CRD being associated with a facility a causing a nuisance (haul route, odour, noise, etc.)
Preferred Option Facility Non-Compliance	Facility is not in compliance with permits or regulations.
Support Option Seasonality	Support option cannot accept biosolids on-demand due to winter, rain, etc.
Support Option Minimum Tonnage	CRD cannot produce/store enough biosolids to meet support or contingency option minimum tonnage requirements during periods of interruption of preferred option.
Contingency Option Unavailable	Support/Contingency option is unavailable (no longer open, at maximum capacity, etc.).

Each proposed portfolio was evaluated against the criteria noted in Table 7.2 using a risk-matrix per the following steps:

1. The probability of each criteria factor occurring was evaluated on a scale of rare (<3%), unlikely (3-10%), moderate (11-50%), likely (51-90%), to certain (>90%).
2. The consequence severity of the criteria factor occurring was evaluated on a scale of insignificant (easily mitigated by day-to-day process), minor (schedule delays up to 10% and CAPEX/OPEX increase up to 10%), moderate (schedule delays up to 50% and CAPEX/OPEX increase up to 50%), major (schedule delays up to 100% and CAPEX/OPEX increase up to 100%), to catastrophic (need to abandon the project).
3. The probability and consequence severity ratings for each criteria factor were correlated to find a risk of interruption value on a scale of negligible (level 1), low (levels 2-4), moderate (levels 5-10), high (levels 11-24), to extreme (level 25) using the risk matrix depicted in Table 7.3 below.
4. The resulting risk of interruption values for each criteria factor were averaged to generate a weighted risk of interruption rating and risk level for the overall portfolio.

Table 7.3 Risk Matrix

Consequence Severity	Probability				
	Rare (<3%)	Unlikely (3-10%)	Moderate (11-50%)	Likely (51-90%)	Certain (>90%)
Insignificant	Negligible (1)	Low (2)	Low (3)	Low (4)	Moderate (5)
Minor	Low (2)	Low (4)	Moderate (6)	Moderate (8)	Moderate (10)
Moderate	Low (3)	Moderate (6)	Moderate (9)	High (12)	High (15)
Major	Low (4)	Moderate (8)	High (12)	High (16)	High (20)
Catastrophic	Moderate (5)	Moderate (10)	High (15)	High (20)	Extreme (25)

The resulting risk of interruption and risk level for each portfolio is summarized in Table 7.4 below:

Table 7.4 Risk Resiliency Evaluation

General Portfolio	Average Portfolio Risk of Interruption Value Rating	Average Portfolio Risk Level	Comments
Existing Scenario	High	11	– Results in a high average portfolio risk of interruption rating (11) as the existing scenario portfolio does not include a support option for redundancy. – Preferred option availability (cement manufacturing) identified as a notable potential risk factor as this option has historically demonstrated operational challenges. – Contingency option availability (on-site BGM) identified as a notable potential risk factor as space for BGM cover at Hartland is limited and may eventually reach maximum capacity.
Short-Term	Moderate	9	– CRD is exploring land-application programs in the short-term to serve as a support option to the existing scenario. This has decreased the average portfolio risk of interruption rating from high (11) to low (9). – Contingency option availability (on-site BGM) identified as a notable potential risk factor as space for BGM cover at Hartland is limited and may eventually reach maximum capacity.

General Portfolio	Average Portfolio Risk of Interruption Value Rating	Average Portfolio Risk Level	Comments
On-Site Thermal	Moderate	7	– CRD ownership of preferred option (on-site thermal facility) decreases potential risk in multiple criteria factors: change in ownership, market for biosolids in-take, facility reputation, and facility non-compliance. – Contingency option availability (cement manufacturing) identified as a notable potential risk factor as this option has historically demonstrated operational challenges.
Off-Site Thermal	Moderate	8	– Contingency option availability (cement manufacturing) identified as a notable potential risk factor as this option has historically demonstrated operational challenges.
Land Application	Moderate	8	– Contingency option availability (cement manufacturing) identified as a notable potential risk factor as this option has historically demonstrated operational challenges.

It was found that the inclusion of some form of land-application reduced the overall risk of interruption within the generated portfolios due to the diversification of option types resulting in increased resiliency.

Based on feedback from the public and First Nations groups, the CRD may further refine the portfolios and conduct a similar risk matrix exercise on alternative portfolios. This will help the CRD identify notable potential risks of interruption and incorporate mitigation plans accordingly. Further, the risk evaluation will assist the CRD in selecting a single, resilient portfolio for the long-term beneficial use of biosolids.

8. Conclusions & Next Steps

8.1 Conclusions

Development and Evaluation of Land Application Options – There are various beneficial use land application methods which meet CCME beneficial use criteria in the form of mine/quarry reclamation, forest fertilization, land improvement, direct land application, BGM, compost, and soil product production. There are various out-of-region land application programs available. There are currently no in-region land application options available at this time due to the long standing CRD policy banning land application. However, this policy was recently expanded to allow for non-agricultural land application as a contingency or emergency option. As such, a number of in-region land application options could be investigated for inclusion in potential long term management portfolios.

Evaluation of Thermal Options – Thermal biosolids management technologies are generally classified as pyrolysis, gasification, or incineration. Among the thermal technologies, incineration is the most commercially proven and widely used thermal treatment process for biosolids. However, incineration is energy intensive and does not result in the beneficial use of ash and as such may not be considered a beneficial use option by the CCME. Pyrolysis and gasification technologies are both still emerging in the biosolids processing space with slightly more pyrolysis facilities anticipated to move into operations in North America over the next few years.

Thermal technologies have the added benefits of generating potential revenue through biochar, syngas, heat recovery as well as the potential to co-process other mixed waste streams. However, there are challenges in thermal co-processing technologies, as mixing biosolids with other waste streams may increase maintenance and operational costs due to the added complexity of handling/treating mixed waste streams. Co-processing also presents challenges in meeting CCME criteria for the beneficial re-use of 25% of ash.

Contaminants of Emerging Concern - Community concerns around the land application of biosolids and its potential impacts to soil quality, surface water, and groundwater are largely based on the presence, or suspected presence, of unregulated CEC's. These potential impacts are the subject of ongoing scientific research. CCME's guidelines note that many CECs are found in low concentrations in biosolids, and that detection does not necessarily mean there is a risk to human health or the environment. Generally, risk assessments for each individual CEC have not been completed, but ecotoxicological testing, used to assess the toxicology of residuals holistically, did not detect significant negative impacts. The CCME is supportive of source control measures as an effective way to improve the quality of biosolids. CRD's biosolids have been treated to Class A standards as per OMRR.

The CFIA proposed an interim standard for PFAS in biosolids used in Canada as fertilizers at 50 ppb PFOS (one type of PFAS). The proposed standard aims to protect human health by preventing the small proportion of biosolids products that are heavily impacted by industrial inputs from being applied to agricultural land in Canada. The concentration of PFOS in CRD's biosolids is under the proposed standard at approximately 6 ppb (based on two samples).

The fate of CECs in advanced thermal processing of biosolids is still under investigation. While CECs appear to be reduced in biochar products, some can still be found in syngas and bio-oil products, but the concentrations and environmental fate still need to be confirmed.

Jurisdictional Scan – Globally, biosolids, are beneficially used primarily through land application or thermal treatment methods. The majority of countries assessed in the jurisdictional scan primarily land-apply their biosolids for beneficial use, except for Japan, who relies on incineration due to its high population density and limited areas for land application.

Across the world, the decision to beneficially use biosolids through land application or thermal processes is influenced by a range of factors: regulatory requirements, local infrastructure/resources, public perception, as well as the goals and priorities of local municipalities. Identifying and evaluating these factors are key to the implementation of an effective, long-term biosolids management strategy.

Evaluation of Thermal Pilots – In the evaluation of the Biosolids Thermal Pilot technologies/studies explored by the CRD, valuable insight was gained into the discrete operation of each of these technologies. However, the current pilot results alone may not be sufficient to confirm the feasibility of on-site thermal processing of CRD biosolids or the potential for integration/beneficial use of by-products into other systems at Hartland at this time.

For the upcoming on-site thermal trial, GHD suggests that the CRD capture key operational criteria such as process reliability, operational costs, maintenance requirements, co-processing feasibility, residual product quality, biochar markets, carbon sequestration benefits, and long-term synergies at Hartland.

Long-Term Options & Portfolio Generation – A long-list of biosolids management options available to the CRD was identified and screened against CCME beneficial use criteria.

GHD recommends that the CRD develop of a combination of multiple options within a diverse portfolio to ensure resiliency in the form of strategy redundancy. In the unexpected event that a biosolids management option is interrupted, the inclusion of additional options within a portfolio will allow CRD's biosolids to still be beneficially used in the interim until the interruption is resolved.

General portfolios were generated using the long-list of options available to the CRD. A risk evaluation identified notable potential risk of interruption factors such as contingency option availability and facility ownership changes to consider in the development of the long-term biosolids beneficial use strategy. The risk evaluation also indicated that some form of land-application is likely required in all proposed portfolios to ensure resiliency.

8.2 Next Steps

Following public and First Nations consultation, the CRD may further refine the general portfolios outlined in this report. From the list of options approved by the public and First Nations groups, the CRD may develop portfolios using specific options and vendors and future test these portfolios for resiliency using the risk matrix outlined in Section 7. The risk analysis will help inform the selection of a resilient long-term portfolio for the long-term beneficial use of CRD's biosolids.

Appendices

Appendix A

Provincial Conditional Approval Letter

BRITISH COLUMBIA

Reference: 305517

November 18, 2016

Jane Bird
Chair, Core Area Wastewater Treatment Project Board
Capital Regional District
PO Box 1000, 625 Fisgard Street
Victoria BC V8W 2S6

Dear Ms. Bird:

Thank you for your letter of November 17, 2016, regarding my conditional approval of Amendment No. 11 to the Core Area Liquid Waste Management Plan (CALWMP). As requested in your letter, I will clarify my conditional approval of Amendment No. 11 to the CALWMP and have also considered your request to modify my condition for Integrated Resource Management.

To address your concerns, I am revising my September 30, 2016, Conditional Approval of Amendment No. 11. This revised Conditional Approval of Amendment No.11 supersedes my September 30, 2016, decision.

To clarify, Amendment No. 11 includes, but is not limited to, the following:

1. A single 108 megalitre/day wastewater treatment plant located at McLoughlin Point within the Township of Esquimalt capable of tertiary treatment for flows up to 2 times Average Dry Weather Flow (ADWF) for the Core Area up to 2040. For flows that are greater than 2 times ADWF but not more than 3 times ADWF for the Clover Point catchment and up to 4 times ADWF for the Macaulay catchment, primary treatment will be guaranteed. Construction of the wastewater treatment plant will be completed by December 31, 2020.
2. Commitment to advance studies for a wastewater treatment proposal in Colwood, including up to $2 million to complete the required technical studies and environmental impact assessments.
3. Conveyance of sewage sludge to the Hartland landfill for processing into Class A biosolids, as defined under the Organic Matter Recycling Regulation, for beneficial use and optimization for potential opportunities for integrated resource management.

...2

Ministry of Environment
Office of the Minister
Mailing Address: Parliament Buildings Victoria BC V8V 1X4
Telephone: 250 387-1187
Facsimile: 250 387-1356

As a condition of my approval and in accordance with Section 24 (5) of the *Environmental Management Act*, I require the Capital Regional District (CRD) develop a definitive plan for the beneficial reuse of biosolids that does not incorporate multi-year storage of biosolids within a biocell. The Ministry of Environment understands that the plan may need to include short-term storage and/or management options as part of implementing the beneficial reuse plan, but the CRD is strongly encouraged to minimize the need for this. Further, I am amending the deadline for submission of the plan from December 31, 2017, to June 30, 2019, under the condition that the CRD submit, by May 31, 2017, a plan that outlines the procedural steps and schedule it will implement to achieve the definitive plan.

The CRD must ensure that the definitive plan for beneficial reuse of biosolids is supported by an assessment of the full spectrum of beneficial uses and integrated resource management options available for the proposed Class A biosolids produced at the Hartland Landfill, and incorporates a jurisdictional review of how similar-sized and larger municipalities within British Columbia, North America and further abroad, successfully and beneficially reuse biosolids. Ministry staff will assist as necessary and can share the ministry's jurisdictional review of how other similar-sized and larger municipalities reuse biosolids.

The beneficial reuse option selected for treated biosolids must meet the requirements for beneficial use specified in the Canadian Council of Ministers of the Environment *Canada-Wide Approach for the Management of Wastewater Biosolids* (October 11, 2012) and be based on scientific evidence. This definitive plan for the beneficial reuse of biosolids will replace the current proposal to use a biocell for storage.

Please continue to work with staff in the Environmental Protection Division of the Ministry of Environment to ensure that the proposed wastewater treatment facility is registered under the Municipal Wastewater Regulation prior to operation of the plant. Please also inform ministry staff of all beneficial uses of biosolids being considered, in order to ensure all necessary forms of authorization are obtained in advance of discharge.

Additionally, the CRD should continue to engage First Nations and the public on all aspects of the CALWMP.

Be advised that the ministry intends to publically post any reports or other documents received by the CRD on the ministry website related to this conditional approval, the CALWMP and this activity regulated under the *Environmental Management Act*.

...3

Approval of Amendment No.11 to the CALWMP does not authorize entry upon, crossing over or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority shall rest with the local government. This amendment is approved pursuant to the provisions of the *Environmental Management Act*, which asserts it is an offence to discharge waste without proper authorization. It is also the regional district's responsibility to ensure that all activities conducted under this plan amendment are carried out with regard to the rights of third parties and comply with other applicable legislation that may be in force.

Sincerely,

Mary Polak
Minister

cc: Honourable Peter Fassbender, Minister of Community, Sport and Cultural Development
AJ Downie, Director, Environmental Protection Division, Ministry of Environment
Robert Lapham, Chief Administrative Officer, Capital Regional District
Larisa Hutcheson, Interim Project Director, Core Area Wastewater Treatment Project, Capital Regional District
Sharon Singh, Associate, Bennett Jones Vancouver

Appendix B

CRD Board Minutes Land Application Restrictions July 13, 2011

Making a difference...together

MINUTES OF THE MEETING OF THE CAPITAL REGIONAL DISTRICT BOARD,
held Wednesday, July 13, 2011 in the Board Room, 625 Fisgard Street, Victoria, BC

PRESENT: **Directors:** G. Young (Chair), S. Brice, J. Brownoff, C. Causton, L. Cross, V. Derman, B. Desjardins, J. Evans, D. Fortin, C. Green (for A. Finall), K. Hancock, G. Hendren, M. Hicks (3:30 p.m.), G. Hill, P. Lucas, F. Leonard (2:37 p.m.), J. Mar, J. Mendum, J. Ranns (2:37 p.m.), D. Saunders, L. Seaton (for D. Blackwell), C. Thornton-Joe and L. Wergeland
Staff: K. Daniels, J. Hull, L. Hutcheson, B. Lapham, L. Rushton, S. Santarossa and N. More (Recorder)
Also Present: Kathryn Stuart, Staples McDannold Stewart, Board Solicitor

ABSENT: J. Brownoff, L. Cross and B. Desjardins,

The Chair called the meeting to order at 2:34 p.m.

1 APPROVAL OF THE AGENDA

MOVED by Director Lucas, **SECONDED** by Director Derman,
That the agenda and supplementary agenda be approved; and

That a Notice of Motion to be presented by Director Derman be added to the agenda under item 8 (New Business).

CARRIED

MOVED by Director Derman, **SECONDED** by Alternate Director Green,
That the late request to speak by C. Bannister (#19) be approved.

DEFEATED
Evans OPPOSED

2 ADOPTION OF MINUTES OF THE MEETING OF JUNE 15, 2011

MOVED by Lucas, **SECONDED** by Director Hancock,
That the minutes of the meeting of June 15, 2011 be adopted.

CARRIED

3 REPORT OF THE CHAIR

Chair Young acknowledged the passing of former Capital Regional District (CRD) Alternate Director Allan Cassidy, highlighting his service to the CRD Board from 1999–2002 and 2007, his role as a Royal and McPherson Theatre Society Board member, 2000–2004, and his involvement with the restoration of the Royal Theatre.

Directors Leonard and Ranns entered the meeting at 2:37 p.m.

4 PRESENTATIONS/DELEGATIONS

a) Canadian Association of Municipal Administrators (CAMA) 2011 Education Award – Bill Holtby

Bill Holtby, CAMA Board representative, recognized the CRD for its leadership in the education of its municipal employees because of the custom training program called iLead, developed in association with Royal Roads University (RRU), and presented the CRD with the 2011 National Municipal Education Award in the form of a plaque. Chair Young expressed appreciation on behalf of the CRD Board and thanked RRU for assisting in designing and implementing the iLead program.

b) Victoria Airport Authority 2010 Report to Nominators – Colin Smith, CRD Nominee and Geoff Dickson, President & CEO

Mr. Smith reported on the 2010 activities of the Victoria Airport Authority, using a PowerPoint presentation to illustrate main points, with the assistance of Mr. Dickson. He also provided an overview of the 2011 Capital Program.

c) Supplementary delegates

1. Ruby Commandeur re Item 5.3.1 – Director Lucas Motion re Biosolids—spoke in favour of the motion because of the toxicity of contaminants in biosolids, the pressures on the food supply due to climate change, how farmland is managed and the difficulty in regulating the use of biosolids on farmland. She urged the Board to think carefully on decisions about land use application of biosolids.
2. Marcie Zemluk re Item 5.3.1 – Director Lucas Motion re Biosolids—spoke about the legal liabilities in American case law and current cases before the Canadian courts on the issue of biosolids land application. She noted the importance of understanding the potential for contaminated sites, ongoing regulatory responsibility and liability for the Province and the CRD, and the hardship that an error in regulation or monitoring can have on farmland in the region.
3. Chloe Donatelli re Item 5.3.1 – Director Lucas Motion re Biosolids—Did not appear to speak when called.

Directors Cross and Mendum left the meeting at 3:10 p.m.

Director Mar excused himself from the meeting at 3:13 p.m., noting that he cannot be present to receive further input on the Peninsula Co-op development proposal as the public hearing has been held.

4. David Lawson re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—spoke in favour of the response because the development proposal is inconsistent with the Central Saanich Official Community Plan (OCP) and the Regional Growth Strategy (RGS).

Director Desjardins left the meeting at 3:15 p.m.

5. Mike Achtem re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—spoke in favour of the response because of economic impacts of concern related to the development proposal.
6. Jennifer Kay re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—spoke in favour of the response because the development proposal is inconsistent with the OCP and the RGS.
7. Don & Shelly Bottrell re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—spoke in favour of the response because the development proposal is inconsistent with the OCP.
8. Alexander Marr re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—spoke in favour of the response because the development proposal is inconsistent with the RGS.

Director Hicks entered the meeting at 3:30 p.m.

9. David Wilson re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—spoke in favour of the response because the development proposal is inconsistent with the OCP.
10. Tom Hall re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—Did not appear to speak when called.
11. Michelle Passmore re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—Did not appear to speak when called.
12. Hanne Kohout re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—spoke in favour of the response because the development proposal is inconsistent with the RGS.
13. Carol Pickup re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—withdrawn from agenda prior to the meeting.
14. Constance Christiansen re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—Did not appear to speak when called.
15. Ryan Windsor re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—spoke in favour of the response because the development proposal is inconsistent with the OCP and the RGS, and due to the importance of maintaining the integrity of the OCP and RGS.
16. Frances Pugh re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—spoke in appreciation of the RGS and the response.
17. Jack Thornburg re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—spoke of the interests of the larger community and the legacy to future generations in the thoughtful stewardship of land, air and water.
18. John Hannam re Item 5.8.1 – Response to Central Saanich Referral re Peninsula Co-op—spoke of stormwater management issues and inconsistencies with the OCP and the RGS.

Director Mar returned to the meeting at 3:45 p.m.
Directors Brownoff and Mendum left the meeting at 3:45 p.m.

5 REPORTS OF COMMITTEES

5.1 CORE AREA LIQUID WASTE MANAGEMENT COMMITTEE – June 29, 2011

1. **Core Area Infrastructure Upgrade Projects for 2011**

MOVED by Director Brice, **SECONDED** by Director Leonard,
That the CRD Board authorize proceeding with the infrastructure upgrading projects identified in Appendix A of the staff report, that costs be shared as outlined in Appendix B of the staff report, and that funding be provided by the trunk sewer reserve fund in the amount of $530,000.

CARRIED

5.2 ELECTORAL AREA SERVICES COMMITTEE – June 1, 2011

1. **Galiano Island Community Use Building Service Establishment And Loan Authorization Bylaws**

MOVED by Director Hancock, **SECONDED** by Director Hicks,
That a second referendum be held concurrently with the November 2011 BC civic election in order to confirm the proposed service area's position regarding the updated service establishment and loan authorization bylaws.

CARRIED

MOVED by Director Hancock, **SECONDED** by Director Hicks,
That Bylaw No. 3792, cited as "Galiano Island Community Use Building Service Establishment Bylaw No. 2, 2011", be introduced and read a first time and second time.

CARRIED

MOVED by Director Hancock, **SECONDED** by Director Hicks,
That Bylaw No. 3792 be read a third time.

CARRIED

Director Mendum returned to the meeting at 3:47 p.m.

MOVED by Director Hancock, **SECONDED** by Director Hicks,
That Bylaw No. 3793, cited as "Galiano Island Community Use Building Loan Authorization Bylaw No. 2, 2011", be introduced and read a first and second time.

CARRIED

MOVED by Director Hancock, **SECONDED** by Director Hicks,
That Bylaw No. 3793 be read a third time.

CARRIED

2. Grants-In-Aid

MOVED by Director Hancock, **SECONDED** by Director Hicks,
That the following grants-in-aid applications be approved for payment:

1. Juan de Fuca Grants-in-Aid as approved by Director Hicks
   a) Shirley Community Association $4,800
2. Salt Spring Island Grants-in-Aid as approved by Director Hendren
   a) Canadian Red Cross $5,014
3. Southern Gulf Islands Grants-in-Aid as approved by Director Hancock
   a) Mayne Island Integrated Water Systems Society $3,607
   b) Pender Community Transition Society $2,000
   c) Saturna Heritage Committee $2,000

CARRIED

5.3 ENVIRONMENTAL SUSTAINABILITY COMMITTEE – May 25, 2011

1. Motion to Protect Local Farmland and to Harmonize Sewage Treatment Strategies within the CRD – Director Lucas

MOVED by Director Lucas, **SECONDED** by Director Derman,
Whereas the CRD is committed to developing regional sewage treatment strategies that have the lowest impact on both the environment and public health, and the highest resource recovery potential;

And Whereas the Core Area Liquid Waste Management Committee has passed a motion banning the land application of biosolids in order to address legitimate public health and environmental concerns about the accumulation and dispersal of Polycyclic Aromatic Hydrocarbons, heavy metals, pharmaceuticals, and other Emerging Compounds of Concern (ECCs) on our land, in our food, and in the regional water table;

And Whereas protecting the “integrity of rural communities” and “regional green and blue spaces”, and managing “natural resources and environmental sustainability” are important and explicit goals and responsibilities of the CRD as outlined in the Regional Growth Strategy (http://tinyurl.com/65wdd8p), and “improving population health and regional food security” are noted as Priority Actions in the Capital Region Food and Health Action Plan (http://tinyurl.com/4xetqbz);

Be it so moved that the CRD will harmonize current and long-term practices at all CRD-owned regional facilities and parks with the approved policies of the regional treatment strategy, including ending the production, storage and distribution of biosolids for land application at all CRD facilities and parks; and

Be it further moved that the CRD does not support the application of biosolids on farmland in the CRD under any circumstances, and let this policy be reflected in the upcoming Regional Sustainability Strategy.

MOVED by Director Hendren, **SECONDED** by Director Hancock,
That the motion **be amended** by adding the following:
"That it be further moved that the pasteurized, lime-stabilized Class A biosolids material produced at the Saanich Peninsula Wastewater Treatment Plant may be beneficially used by Hartland Landfill operations to replace chemical fertilizers as the soil amendment blended with soil and compost for use as the final cover material in the closure of Phase 2 Cell 1, in full compliance with all environmental and health regulations."

Concerns were raised that the amendment creates an exception and that other exemptions may need to be considered.

MOVED by Director Evans, **SECONDED** by Director Hill,
That the **amendment be referred** to the Environmental Sustainability Committee for consideration.

CARRIED

MOVED by Director Hendren, **SECONDED** by Director Hill,
That consideration of the main motion be postponed until the Environmental Sustainability Committee reports on exemptions.

DEFEATED
Hicks, Ranns, Evans, Seaton, Young, Brice, Causton and Wergeland IN FAVOUR

The question on the main motion was called. **CARRIED**
Evans, Seaton, Causton OPPOSED

Director Saunders left the meeting at 4:17 p.m.

5.4 ENVIRONMENTAL SUSTAINABILITY COMMITTEE – June 22, 2011

1. #EEP 11-44 Millstream Meadows 2011 Work Plan – Award of Project Management Consulting Contract

Director Causton and Alternate Director Green left the meeting at 4:19 p.m.

MOVED by Director Ranns, **SECONDED** by Director Derman,
That staff be directed to:
1) award a project management consulting contract to Golder Associates Ltd. at a cost of $265,000 excluding HST to implement the Stage 1 work;
2) undertake the design and tendering for the Stage 1 work; and
3) report to the Committee following completion of Stage 1 work.

CARRIED
Director Evans OPPOSED

5.5 FINANCE AND CORPORATE SERVICES COMMITTEE – July 6, 2011

1. Recreation Services and Facilities Fees and Charges 2011/2012

Director Causton and Alternate Director Green returned to the meeting at 4:20 p.m.

MOVED by Director Mar, **SECONDED** by Director Evans,
That Bylaw No. 3794, cited as "Capital Regional District Recreation Services and Facilities Fees and Charges Bylaw No. 1, 2009, Amendment Bylaw No. 2, 2011", be introduced and read a first and second time.

MOVED by Director Evans, **SECONDED** by Director Mar,
That consideration of Bylaw No. 3794, cited as "Capital Regional District Recreation Services and Facilities Fees and Charges Bylaw No. 1, 2009, Amendment Bylaw No. 2, 2011", **be postponed** until the SEAPARC Recreation Commission has reviewed the proposed fee changes.

CARRIED

2. Budget Direction for the Year 2012

MOVED by Director Causton, **SECONDED** by Director Evans,
That staff prepare the draft 2012 financial plan within the following guidelines:
1) no increase in service levels for existing services
2) new services only as previously approved by the Board
3) staff continue to explore innovative practices to absorb inflationary costs, benefits and utility/fuel costs within existing budgets as much as possible
4) the draft budget recognize provisions for new initiatives directly related to the Board's strategic priorities.

Staff noted that an interim budget report will be forwarded to the committee in October.

The question on the motion was called. **CARRIED**

5.6 JUAN DE FUCA LAND USE COMMITTEE – VOTING BLOCK A – June 21, 2011

1. Development Permit with Variance – DP-09-11 – Lot A, Section 74, Renfrew District, Plan VIP71883 (Lynge – 11237 West Coast Road)

MOVED by Director Hicks, **SECONDED** by Director Evans,
That the steep slopes, foreshore and marine shoreline and watercourses, wetlands and riparian areas development permit (DP-09-11) for Lot A, Section 74, Renfrew District, Plan VIP71883 and the request for:

a. Relaxation of the rear yard setback from 15m to 7.5m for the existing deck; and
b. Exemption from floodplain setback regulations of Part 5 of Bylaw No. 2040, as shown in Appendices 1 and 2, be approved subject to the following conditions:
    i. that the proposed development comply with the Steep Slope, Foreshore and Marine Shoreline and Watercourses, Wetlands and Riparian Areas Development Permit Guidelines outlined in the Shirley/Jordan River Official Community Plan, Bylaw No. 3352;

ii. that the driveway proposed to be constructed prior to subdivision comply with CRD Residential Driveway standards;
iii. that the proposed development comply with the recommendations outlined in the environmental report prepared by Brian Wilkes & Associates dated November 18, 2010; and
iv. that the geotechnical report prepared by Ryzuk Geotechnical dated December 15, 2010, as shown in Appendix 4, be recommended to be secured by the Approving Officer as a restrictive covenant as part of the subdivision process.

CARRIED

5.7 JUAN DE FUCA LAND USE COMMITTEE – VOTING BLOCK B – June 21, 2011

1. Development Permit with Variance – DP-08-11 – Block 352, Malahat District, Except Part in VIP84067 and Block 399 Malahat District (Isis Land Corporation/Hawes)

MOVED by Director Hicks, **SECONDED** by Director Mar,
That the steep slope and foreshore, wetland and riparian development permit (DP-08-11) for Block 352, Malahat District, Except Part in VIP84067 and Block 399 Malahat District District, and the request for an exemption of Section 944 of the Local Government Act to relax the requirement that the minimum frontage of a lot shall be one tenth of the perimeter of the lot that fronts on the highway, for the purposes of permitting a 86-lot subdivision, be approved subject to the following conditions:

a. That the proposed subdivision and development comply with the Development Permit Guidelines in the Malahat Official Community Plan, Bylaw No. 3228; and
b. That the geological reports prepared by Thurber Engineering Ltd. dated October 18, 2010, and April 18, 2011 as shown in Appendix 3, be secured by restrictive covenant as part of the building permit process; and
c. That the report prepared by PA Harder and Associates Ltd. dated March 31, 2011, be secured by restrictive covenant as part of the building permit process; and
d. That the applicant register a Statutory Right of Way to provide access to Regional Parks for access to and construction of the portion Trans Canada Trail through the property as shown on Appendix 2.

CARRIED
Leonard and Mendum OPPOSED

5.8 PLANNING, TRANSPORTATION AND PROTECTIVE SERVICES COMMITTEE – June 22, 2011

Director Hicks left the meeting at 4:45 p.m.

Staff reported on legal opinion about the potential for conflict of interest in regard to Directors and Co-op membership. Upon advice to Directors to seek legal advice or make their own decision on whether they have a conflict, it was determined there would not be quorum to hear the item.

MOVED by Director Fortin, **SECONDED** by Director Lucas,
That consideration of the agenda item "Response to Central Saanich Referral re Peninsula Co-op" be postponed until the next meeting to give Directors that are members of the Peninsula Co-op an opportunity to determine whether they have a conflict of interest.

CARRIED

Staff was requested to circulate the legal opinion prepared by Staples McDannold Stewart.

Staff was asked to close the item to further delegations, since it was a postponement on procedural grounds rather than for the addition of new information.

5.9 REGIONAL PARKS COMMITTEE – June 15, 2011

1. E&N Rail Trail Project – Intersection Improvements Esquimalt Road to Admirals/Colville

MOVED by Director Causton, **SECONDED** by Director Hill,
That the single source procurement of rail infrastructure improvements be approved for five intersections and one pedestrian crossing in the amount of $1,672,200 (not including HST) as per the letters from SVI dated May 17, 2011.

CARRIED

MOVED by Director Causton, **SECONDED** by Director Mar,
That commencement of the expenditure is conditional upon confirmation by the provincial and federal governments that they will financially support active use of the E&N rail line.

CARRIED

MOVED by Director Causton, **SECONDED** by Director Evans,
That this motion be included in the Board Chair's letters to the Minister of Transportation and Infrastructure and the federal government regarding rail investment.

CARRIED

2. Elk/Beaver Lake Recreational Use Advisory Group Revised Terms of Reference

MOVED by Director Evans, **SECONDED** by Director Lucas,
That the revised Terms of Reference for the Elk/Beaver Lake Recreational Use Advisory Group be approved.

CARRIED

6 ADMINISTRATION REPORTS

6.1 2011 GENERAL LOCAL ELECTION – APPOINTMENT OF CHIEF ELECTION OFFICER AND DEPUTY CHIEF ELECTION OFFICER – ELECTORAL AREA DIRECTORS

MOVED by Director Evans, **SECONDED** by Director Lucas,

1) That pursuant to Section 41 of the Local Government Act, Thomas F. Moore be appointed Chief Election Officer with the power to appoint such other assistance as may be required for the administration and conduct of the 2011 General Local Election of the Capital Regional District Electoral Area Directors; and

2) That Sonia Santarossa, Sheila Norton, Kerry Fedosenko, Mary Cooper and Anthony Kennedy be appointed Deputy Chief Election Officers

CARRIED

6.2 EXTENSION TO THE CONTRACT WITH LANGFORD FOR CALL RELAY SERVICES

MOVED by Director Seaton, **SECONDED** by Director Evans,
That an extension of the Call Relay Contract with the City of Langford from August 1, 2011 to May 31, 2012 in the amount of $364,574 be approved.

CARRIED

7 BYLAWS AND RESOLUTIONS

7.1 BYLAW NO. 3784, "SOUTHERN GULF ISLANDS ELECTORAL AREA FALSE ALARM REDUCTION BYLAW NO. 1, 2011"

MOVED by Director Hancock, **SECONDED** by Director Evans,
That Bylaw No. 3784 "Southern Gulf Islands Electoral Area False Alarm Reduction Bylaw No. 1, 2011" be adopted.

CARRIED

7.2 BYLAW NO. 3785, "ANIMAL REGULATION AND IMPOUNDING BYLAW NO. 1, 1986, AMENDMENT BYLAW NO. 8, 2011"

MOVED by Director Hancock, **SECONDED** by Director Evans,
That Bylaw No. 3785 "Animal Regulation and Impounding Bylaw No. 1, 1986, Amendment Bylaw No. 8, 2011" be adopted.

CARRIED

8 NEW BUSINESS

8.1 2011 GENERAL LOCAL ELECTION – APPOINTMENT OF CHIEF ELECTION OFFICER AND DEPUTY CHIEF ELECTION OFFICER (ISLANDS TRUST) & ISLANDS TRUST 2011 ELECTION SERVICES AGREEMENT

MOVED by Director Evans, **SECONDED** by Director Leonard,

a) That the Islands Trust 2011 Election Services Agreement between the CRD and the Islands Trust Council be approved and authorized for execution; and
b) That pursuant to Section 41 of the Local Government Act, Thomas F. Moore be appointed Chief Election Officer with the power to appoint such other assistance as may be required for the administration and conduct of the 2011 General Local Election of Island Trustees; and
c) That Sonia Santarossa, Sheila Norton, Kerry Fedosenko, Mary Cooper and Anthony Kennedy be appointed Deputy Chief Election Officers.

CARRIED

8.2 NOTICE OF MOTION – VIC DERMAN – MARINE TRAIL HOLDINGS

Director Derman gave notice of his intention to propose the following motion at the August Board meeting:

That the Board of the Capital Regional District determines that the Marine Trail Holdings Ltd. Rezoning application to build 257cabins, 6 caretaker residences, a resort lodge and two recreation centres in the Juan de Fuca Rural Resource lands is inconsistent with the Regional Growth Strategy and therefore shall not be permitted to proceed.

9 MOTION TO MOVE IN CAMERA

MOVED by Director Hill, **SECONDED** by Director Derman,
That the Board close the meeting and move in camera in accordance with the Community Charter, Part 4, Division 3, 90(1)(a) personal information about an identifiable individual who is being considered for a position appointed by the Board; (i) the receipt of advice that is subject to solicitor-client privilege, including communications necessary for that purpose.

CARRIED

The Board convened the in camera portion of the meeting at 5:00 p.m. and resumed in open meeting at 5:32 p.m. to rise and report.

10 RISE AND REPORT

- **Water Treatment Upgrade Project**
  That payment is authorized to Ridgeline Mechanical Ltd. in the amount of $190,000 from the Highland and Fernwood Water Treatment Upgrade Project funds to settle a claim related to CRD Contract No. 09-1645.

- **Appointment to Juan de Fuca Economic Development Commission**
  Ken Douch was appointed.

- **Appointment to Port Renfrew Utility Services Committee**
  Dorothy Hunt was appointed.

11 ADJOURNMENT

MOVED by Director Hill, **SECONDED** by Director Derman,
That the meeting be adjourned at 5:35 p.m.

CARRIED

CERTIFIED CORRECT:

____________________________ ____________________________

CHAIR **CORPORATE OFFICER**

Appendix C

CRD Board Minutes Land Application

February 15, 2023

Capital Regional District

625 Fisgard St.,
Victoria, BC V8W 1R7

Notice of Meeting and Meeting Agenda
Environmental Services Committee

Wednesday, February 15, 2023 | **1:30 PM** | **6th Floor Boardroom, 625 Fisgard St., Victoria, BC V8W 1R7**

B. Desjardins (Chair), S. Tobias (Vice Chair), J. Brownoff, J. Caradonna, G. Holman, D. Kobayashi, D. Murdock, M. Tait, D. Thompson, A. Wickheim, C. Plant (Board Chair, ex-officio)

The Capital Regional District strives to be a place where inclusion is paramount and all people are treated with dignity. We pledge to make our meetings a place where all feel welcome and respected.

1. Territorial Acknowledgement

2. Approval of Agenda

3. Adoption of Minutes

3.1. 23-156 Minutes of the January 18, 2023 Environmental Services Committee Meeting

Recommendation: That the minutes of the Environmental Services Committee meeting of January 18, 2023 be adopted as circulated.

Attachments: Minutes - January 18, 2023

4. Chair's Remarks

5. Presentations/Delegations

The public are welcome to attend CRD Board meetings in-person.

Delegations will have the option to participate electronically. Please complete the online application at www.crd.bc.ca/address no later than 4:30 pm two days before the meeting and staff will respond with details.

Alternatively, you may email your comments on an agenda item to the CRD Board at crdboard@crd.bc.ca.

5.1. 23-166 Delegation - Dave Cowen; Representing Peninsula Biosolids Coalition: Re: Agenda Item 7.1.: Motion with Notice: Healthy Waters Project for Tod Creek on the Saanich Peninsula (Director Caradonna)

6. Committee Business

6.1. 23-103 2022 Solid Waste Stream Composition Study Results

Recommendation: There is no recommendation. This report is for information only.

Attachments: Staff Report: 2022 Solid Waste Stream Composition Study Results

Appendix A: CRD 2022 Solid Waste Stream Composition Study - Tetra Tech

6.2. 23-130 Recycle BC - Packaging and Printed Paper Product, Extended Producer Responsibility - Draft Program Plan

Recommendation: There is no recommendation. This report is for information only.

Attachments: Staff Report: Recycle BC - Packaging & Paper, EPR - Draft Program Plan

Appendix A: Cont'd Participation in EA Depot Recycling - SR - Feb 7/18

Appendix B: Depot Impacts Analysis

Appendix C: Consultation Feedback Ltr to Recycle BC from CRD (Jan 3/23)

6.3. 23-131 Central Saanich Request for CRD Carbon-based Budget Policy

Recommendation: The Environmental Services Committee recommends to the Capital Regional District Board:
That the CRD not adopt a policy of carbon budgeting as part of its budget cycle but continue to monitor progress in carbon budget methodologies and implications on CRD financial planning processes and share learnings with local governments through the CRD Inter-Municipal Working Group and Task Force, as appropriate.

Attachments: Staff Report: Central Saanich Request for CRD Carbon-based Budget Policy

Appendix A: Central Saanich Letter to CRD Board - November 8, 2022

Appendix B: Summary and History of Carbon Budgeting

6.4. 23-138 Bylaw No. 2922 - Sewer Use Bylaw Amendments

Recommendation: The Environmental Services Committee recommends to the Capital Regional District Board:
1. That Bylaw No. 4530, "Capital Regional District Sewer Use Bylaw No. 5, 2001, Amendment Bylaw No. 7, 2023", be introduced and read a first, second, and third time; and
2. That Bylaw No. 4530 be adopted.
3. That Bylaw No. 4531, "Capital Regional District Ticket Information Authorization Bylaw 1990, Amendment Bylaw No. 75, 2023", be introduced and read a first, second, and third time; and
4. That Bylaw No. 4531 be adopted.

Attachments: Staff Report: Bylaw No. 2922 - Sewer Use Bylaw Amendments

Appendix A: Bylaw No. 2922 - Unofficial Consolidated Bylaw with Amendments

Appendix B: Bylaw No. 4530

Appendix C: Bylaw No. 4531

7. Motions with Notice

7.1. 23-154 Motion with Notice: Healthy Waters Project for Tod Creek on the Saanich Peninsula (Director Caradonna)

Recommendation: That the Healthy Waters project proposal for Tod Creek watershed be referred to staff to report back, by end of March or within the span of two committee meetings, on project implications including resources, service mandate, and regulatory framework.

Attachments: Motion with Notice: Healthy Waters Project for Tod Creek

8. New Business

9. Adjournment

The next meeting is March 29, 2023 at 9:30 am (Special).

To ensure quorum, please advise Jessica Dorman (jdorman@crd.bc.ca) if you or your alternate cannot attend.

Meeting Minutes

Environmental Services Committee

Wednesday, January 18, 2023 **1:30 PM** **6th Floor Boardroom 625 Fisgard St. Victoria, BC V8W 1R7**

PRESENT
Directors: B. Desjardins (Chair), S. Tobias (Vice Chair), J. Brownoff, J. Caradonna, G. Holman (EP), D. Kobayashi, D. Murdock, M. Tait, D. Thompson

Staff: T. Robbins, Chief Administrative Officer; L. Hutcheson, General Manager, Parks and Environmental Services; G. Harris, Senior Manager, Environmental Protection; S. May, Senior Manager, Environmental Engineering; M. Lagoa, Deputy Corporate Officer; J. Dorman, Committee Clerk (Recorder)

EP - Electronic Participation

Regrets: Director(s) C. Plant, A. Wickheim

The meeting was called to order at 1:30 pm.

1. Territorial Acknowledgement

Vice Chair Tobias provided a Territorial Acknowledgement.

2. Approval of Agenda

MOVED by Director Caradonna, SECONDED by Director Kobayashi,
That the agenda for the January 18, 2023 Environmental Services Committee meeting be approved.
CARRIED

3. Adoption of Minutes

3.1. 23-065 Minutes of the June 15, 2022 and the minutes of the September 28, 2022 Environmental Services Committee Meeting.

MOVED by Director Tait, SECONDED by Director Murdock,
That the minutes of the Environmental Services Committee meeting of June 15, 2022 and September 28, 2022 be adopted as circulated.
CARRIED

4. Chair's Remarks

I am pleased to continue as the Chair of the Environmental Services Committee and looking forward to working with all of the committee members. We are in exciting times within the mandate and work of the Environmental Services Committee, we are on critical paths towards solutions for solid resources whether they be biosolids, wood solid, or organic resources. We are also coming through the pandemic time, where Hartland received a significant per capita increase, and that adds more pressure to make good decisions and set direction going forward. We need some good decision making for critical movement forward for our climate and solid waste targets.

5. Presentations/Delegations

There were no presentations.

5.1. 23-068 Delegation - Daniel Kenway; Representing Willis Point Community Association: Re: Agenda Item 6.3.: Evaluation of Passing Lane on Willis Point Road

D. Kenway spoke to item 6.3.

5.2. 23-071 Delegation - Philippe Lucas; Representing Biosolid Free BC: Re: Agenda Item 6.2.: Biosolids Short-term Contingency Beneficial Use Plan

P. Lucas spoke to Item 6.2.

5.3. 23-072 Delegation - Hugh Stephens; Representing Peninsula Biosolids Coalition: Re: Agenda Item 6.2.: Biosolids Short-term Contingency Beneficial Use Plan

H. Stephens spoke to Item 6.2.

6. Committee Business

6.1. 23-044 2023 Environmental Services Committee Terms of Reference

L. Hutcheson presented 6.1. for information.

Discussion ensued on clarification of corporate and community climate action.

There is no recommendation. This report is for information only.

6.2. **23-052** Biosolids Short-term Contingency Beneficial Use Plan

G. Harris spoke to Item 6.2.

Discussion ensued on the following:
- water quality testing and monitoring
- thermal process pilot studies and established programs
- consultation and engagement processes
- chemicals and contaminants testing
- contingency planning related to operational changes
- shipping and additional costs
- associated risks of the service
- land application in other jurisdictions
- regulatory process
- gasification or composting possibilities

MOVED by Director Holman, SECONDED by Director Tait,
That the Environmental Services Committee recommends to the Capital Regional District Board:
1. That the Capital Regional District (CRD) Board amend its policy to allow non-agricultural land application of biosolids as a short-term contingency alternative;
and
2. That staff be directed to update the CRD's short-term biosolids contingency plan correspondingly.
DEFEATED
OPPOSED: Caradonna, Desjardins, Kobayashi, Thompson, Tobias

MOVED by Director Caradonna, SECONDED by Director Thompson,
That we move to direct staff to look at alternative options and maintain the status quo for now.
CARRIED
OPPOSED: Brownoff, Holman, Murdock, Tait

6.3. 23-009 Evaluation of Passing Lane on Willis Point Road

S. May presented Item 6.3. for information.

Discussion ensued on the following:
- existing turn lanes off of Willis Point road
- jurisdiction and authority of road
- cost of passing lane

There is no recommendation. This report is for information only.

7. Notice(s) of Motion

Appendix D

CRD Board Minutes On-Site Thermal RFP

March 29, 2023

Meeting Minutes

Environmental Services Committee

Wednesday, March 29, 2023 **9:30 AM** **6th Floor Boardroom**
625 Fisgard St.
Victoria, BC V8W 1R7

Special Meeting

PRESENT
Directors: B. Desjardins (Chair), S. Tobias (Vice Chair), J. Brownoff, J. Caradonna, G. Holman (9:33 am) (EP), D. Kobayashi (EP), D. Murdock, M. Tait (9:43 am) (EP), D. Thompson (9:51 am) (EP), A. Wickheim, C. Plant (Board Chair, ex-officio)

Staff: T. Robbins, Chief Administrative Officer; L. Hutcheson, General Manager, Parks and Environmental Services; G. Harris, Senior Manager, Environmental Protection; R. Smith, Senior Manager, Environmental Resource Management; N. Elliott, Climate Action Program Coordinator, Environmental Protection; L. Ferris, Manager, Policy & Planning, Environmental Resource Management; M. Lagoa, Deputy Corporate Officer; J. Dorman, Committee Clerk (Recorder)

EP - Electronic Participation

The meeting was called to order at 9:30 am.

1. Territorial Acknowledgement

Vice Chair Tobias provided a Territorial Acknowledgement.

2. Approval of Agenda

MOVED by Director Caradonna, SECONDED by Director Wickheim,
That the agenda for the March 29, 2023 Environmental Services Committee meeting be approved.
CARRIED

3. Presentations/Delegations

3.1. 23-258 Delegation - Philippe Lucas; Representing Biosolid Free BC: Re: Agenda Item 4.1.: Long-term Biosolids Planning and Biosolids Thermal Plan Updates

P. Lucas spoke to Item 4.1.

3.2. 23-259 Delegation - Jonathan O'Riordan; Representing Peninsula Biosolids Coalition: Re: Agenda Item 4.1.: Long-term Biosolids Planning and Biosolids Thermal Plan Updates

J. O'Riordan spoke to Item 4.1.

4. Special Meeting Matters

4.1. 23-253 Long-term Biosolids Planning and Biosolids Thermal Plan Updates

L. Hutcheson spoke to Item 4.1.

Discussion ensued on the following:
- gasification and thermal processing of biosolids in North America
- international participation in RFP
- co-processing of municipal waste streams
- pyrolysis pilot study in Kelowna and pilot study in Esquimalt
- resource recovery and potential innovation grants
- funding for thermal processing pilot studies
- potential collaboration with other regional districts
- air quality and differentiating technologies
- timelines for consolidation, proposal call, and long term plan

Director Tait joined the meeting at 9:43 am.

Director Thompson joined the meeting at 9:51 am.

Director Murdock left the meeting at 9:53 am.

MOVED by Director Caradonna, SECONDED by Director Tobias,
The Environmental Services Committee recommends to the Capital Regional District Board:

1. That staff develop a consultation plan for long-term biosolids management for the July Environmental Services Committee meeting, to be implemented in the fall of 2023; and
2. That staff concurrently initiate a Request for Proposals process for a biosolids advanced thermal site trial.

Director Murdock returned to the meeting at 10:05 am.

Director Tait left the meeting at 10:16 am.

MOVED by Director Caradonna, SECONDED by Director Plant,
That the following words be added following" site trial"; "and that the RFP be scoped broadly to include potential for co-processing of municipal solid waste streams, and that submissions be welcomed from both domestic and international vendors".
CARRIED

The question was called on the main motion as amended.
The Environmental Services Committee recommends to the Capital Regional District Board:
1. That staff develop a consultation plan for long-term biosolids management for the July Environmental Services Committee meeting, to be implemented in the fall of 2023; and
2. That staff concurrently initiate a Request for Proposals process for a biosolids advanced thermal site trial; and that the RFP be scoped broadly to include potential for co-processing of municipal solid waste streams, and that submissions be welcomed from both domestic and international vendors.
CARRIED

4.2. [23-239] Capital Regional District Climate Action Inter-Municipal Task Force

N. Elliott spoke to Item 4.2.

MOVED by Director Brownoff, SECONDED by Director Caradonna,
The Environmental Services Committee recommends to the Capital Regional District Board:
That the Terms of Reference for the Climate Action Inter-Municipal Task force, attached as Appendix A, be approved.
CARRIED

4.3. [23-131] Central Saanich Request for CRD Carbon-based Budget Policy

N. Elliott spoke to Item 4.3

Discussion ensued on the participants and outcomes of the workshop.

Motion Arising:
MOVED by Director Caradonna, SECONDED by Director Plant,
The Environmental Services Committee recommends to the Capital Regional District Board:
That CRD staff host a workshop on the concept of carbon budgeting with municipal and electoral area staff and elected officials.
CARRIED
OPPOSED: Holman

4.4. [23-236] Solid Waste Advisory Committee Motions of March 3, 2023

R. Smith presented Item 4.4. for information.

Discussion ensued on the following:
- organics processing and composting within the region
- current mandates on collection
- waste composition study
- Compost Education Centre

MOVED by Director Plant, SECONDED by Director Caradonna,
The Environmental Services Committee recommends to the Capital Regional District Board:
That staff be directed to explore mandatory curbside organics collection from the municipalities around the region.
CARRIED

4.5. [23-241] Previous Minutes of Other CRD Committees and Commissions for Information

The following minutes were received for information:
a) Climate Action Inter-Municipal Task Force - March 2, 2023
b) Solid Waste Advisory Committee Minutes - February 3 and March 3, 2023

5. Adjournment

MOVED by Director Murdock, SECONDED by Director Tobias,
That the March 29, 2023 Environmental Services Committee meeting be adjourned at 10:58 am.
CARRIED

____
CHAIR

____
RECORDER

Appendix E

CRD Class A Biosolids SDS

SAFETY DATA SHEET
Dried, Pelletized, Class A biosolids
(From the CRD Residuals Treatment Facility)

SECTION 1 – IDENTIFICATION

Material Name:	Biosolids from wastewater treatment
Other Designations:	RTF Biosolids, Class A Biosolids
Source:	CRD Residuals Treatment Facility, Saanich, BC
Product Use:	RTF biosolids are currently used at Hartland as a soil amendment (fertilizer) product after mixing with other carbon and nitrogen sources (wood waste/sand/soil). Off site, biosolids are used as an alternative fuel.

SECTION 2 – HAZARD IDENTIFICATION

DANGER: Biosolids may pose a flammability/explosion risk if handled contrary to safety procedures. See Section 16.

Hazard Statements:	Combustible solid – do not expose to moisture/precipitation (exothermic reaction) Combustible dust – dust dispersed in sufficient concentrations in confined spaces, or enclosed areas, may create an explosion hazard in the presence of ignition sources May cause respiratory irritation (dust) May cause eye irritation (dust) Symptoms may be delayed
Precautionary Statements:	No smoking, open flame, sources of heat or ignition. Do not expose to water/moisture unless the material is being blended/mixed with inert material. Do not store as a raw product in large piles for longer than 24 hours. Prompt mixing with inert material recommended.
Other Hazards:	Lung/eye irritant (dust)

SECTION 3 – COMPOSITION

Wastewater biosolids are regulated for use under the BC Organic Matter Recycling Regulation. At Hartland, biosolids are blended with sand, soil and wood waste into a biosolids growing medium (BGM) product and applied as a soil amendment for closure areas, or further blended and applied to open areas for landfill gas mitigation.

Biosolids are a brown/grey granular solids consisting of dried wastewater residuals from the CRD's tertiary wastewater treatment plant (McLoughlin Point). Please refer to Appendix 1 for lab results.

SECTION 4 – FIRST AID MEASURES

Inhalation:	Remove to fresh air. Check for clear airway, breathing, and presence of pulse. Provide cardiopulmonary resuscitation for person without pulse or respirations. Remove victim to fresh air, if safe to do so. Keep at rest and comfortably warm. Seek medical attention.
Skin Contact:	Wash with soap and water
Eye Contact:	Dust may cause eye irritation. Relocate to fresh air and flush with clean water.
Ingestion:	Not an expected route of exposure. If necessary, consult with a physician.

SECTION 5 – FIRE FIGHTING MEASURES

Call fire department immediately and follow site-specific fire safety/response procedures. Do not attempt to extinguish fire.

SECTION 6 – ACCIDENTAL RELEASE MEASURES

Avoid exposure to dust. Reload material into containment vessel/bin. Do not allow product to enter surface watercourses.

SECTION 7 – HANDLING AND STORAGE

Safe Storage:	Short-term (<24 hours) Store in cool, well-ventilated place. Do not store raw biosolids in ambient air, or expose to precipitation for more than 24 hours. For longer-term storage, store under controlled conditions in oxygen- reduced/free environment with inert gas (e.g. nitrogen or carbon dioxide blanket).
Safe Handling:	Wear full- or half-face respiratory (P100) protection when disturbing material. Avoid dust generation in enclosed areas/buildings.

SECTION 8 – EXPOSURE CONTROLS AND PERSONAL PROTECTION

Permissible Exposure Limits:	WorkSafeBC limit for Particles (Insoluble or Poorly Soluble) Not Otherwise Classified (PNOC) – 10 mg/m^3 8-hour average for total dust; and 3 mg/m^3 8-hour average for the respirable portion.
PPE:	Always wear chemical-/liquid-resistant gloves (butyl rubber, natural latex, nitrile rubber) and protective eyewear (goggles) when working around biosolids. Standard protective clothing is required at the landfill (follow all site PPE requirements – high visibility gear, steel-toed boots).
Respiratory Protection:	Use half- or full-face respirator equipped with P100 particulate filter when working in areas that have the potential to exceed WorkSafeBC thresholds.

Ensure adequate ventilation when disturbing the material.

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Physical State	solid (<10% total moisture)
Appearance	granular/pelletized, soil-like
Colour	brown
Odour	earthy, musty, compost
Odour Threshold	not applicable
Combustion/Explosion	See Section 10

SECTION 10 – STABILITY AND REACTIVITY

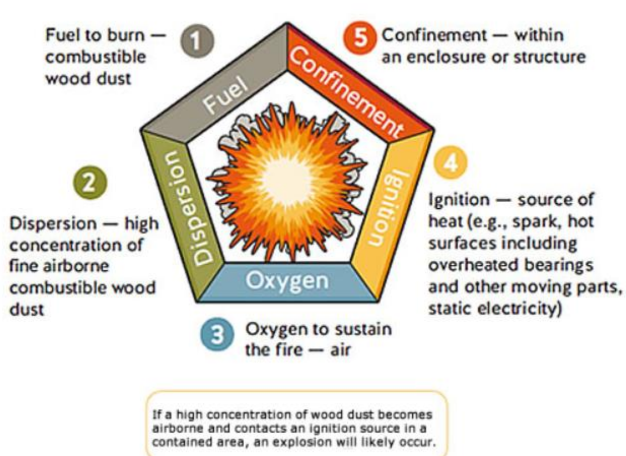
Combustion:	Dried biosolids undergo slow exothermic oxidation in the presence of oxygen and water/moisture and can undergo combustion. Avoid prolonged exposure to ambient air and moisture in raw form.
Explosivity:	Explosibility testing was completed for the biosolids and results are provided below. At moisture contents less than 10%, the material is explosive as a dust cloud. This is similar to other operations that manage materials that create dust (e.g., flour/grain processing, sawmills, etc.).

Sample	Moisture content (wt.%)	Concentration (g/m^3)	Explosible
Biosolid dust	5.0	1000	Yes
Biosolid dust	10.0	1000	Yes
Biosolid dust	15.0	2000	No
Biosolid dust	20.0	2000	No

WorkSafeBC indicates: “many dusts are combustible, which means they can catch fire and burn. When fine dust particles catch fire while they’re suspended in the air, known as deflagration, fire can spread rapidly and sometimes leads to an explosion”.

When dust is exposed to enough heat or even a spark, it can ignite. When airborne dust is near a fire, it often results in an explosion. For an explosion to occur, the following five factors must be present.

Dust explosion pentagon



SECTION 11 – TOXILOGICAL INFORMATION

Routes Of Exposure:	Inhalation, ingestion, skin and eye contact
Immediate Effects:	May cause irritation to skin or mucous membranes
Toxicity:	No acute toxicity

SECTION 12 – ECOLOGICAL INFORMATION

Aquatic Toxicity:	No additional information on aquatic toxicity available.
Additional Ecological Information:	Do not allow biosolids to enter watercourses. Product will cause harm to aquatic organisms (suspended solids/asphyxiation).

SECTION 13 – DISPOSAL CONSIDERATIONS

Do not landfill material (prohibited under provincially approved management plan).

SECTION 14 – TRANSPORT INFORMATION

UN Classification:	Non-regulated material
Other Transport Considerations:	Loads transported long distances (outside of Hartland) require a nitrogen or non-reactive gas blanket (oxygen free).

SECTION 15 – REGULATORY INFORMATION

BC Hazardous Waste Regulation:	Not a Hazardous Waste
Other Regulations:	Management and use of product is regulated under the BC Organic Matter Recycling Regulation.

SECTION 16 – OTHER INFORMATION

None.

APPENDIX 1 – BIOSOLIDS LAB DATA

Summary statistics: RTF biosolids, February 3 to April 26, 2021.

Substance	OMRR Limit * (mg/kg)	Biosolids Samples **		
		Avg ***	Min	Max
Arsenic (As)	75	2.4	1.7	3.7
Cadmium (Cd)	20	1.4	1.1	1.9
Chromium (Cr)	1060	33.2	26.4	45.2
Cobalt (Co)	151	3.0	2.3	3.9
Copper (Cu)	757	744	591	880
Mercury (Hg)	5	0.6	0.4	1.0
Molybdenum (Mo)	20	6.2	4.8	7.7
Nickel (Ni)	181	17.6	13.0	28.7
Lead (Pb)	505	31.5	25.0	39.0
Selenium (Se)	14	3.6	2.0	4.6
Thallium (Tl)	5	0.08	0.0	<0.5
Vanadium (V)	656	20.7	13.3	33.0
Zinc (Zn)	1868	713	576	826

Solids	n/a	96.9%	94.4%	98.4%
Chlorine	n/a	0.066%	0.061%	0.072%
Iron (Fe)	n/a	29363	23000	35100
Fecal Coliforms	n/a	1.9 MPN/g	<3.0 MPN/g	3.5 MPN/g
Acidity	n/a	5.7 pH	5.6 pH	5.8 pH

Note:
- Mercury: 11 samples.
- Arsenic, Cadmium, Chromium, Cobalt, Copper, Molybdenum, Nickel, Lead, Selenium, Thallium, Vanadium and Zinc: 10 samples.
- Solids and Iron: 8 samples.
- Fecal coliforms: 5 samples.
- Chlorine and pH: 2 samples.
** Based on a 4,400 kg/ha/year application rate.*
*** Values in mg/kg unless otherwise noted. Samples taken from February 3 to April 26, 2021.*
**** Values below the detection limit were replaced with values half the detection limit.*

ghd.com

→ The Power of Commitment