625 Fisgard St.,
Victoria, BC V8W 1R7

Capital Regional District

Notice of Meeting and Meeting Agenda
Environmental Services Committee

Wednesday, February 19, 2025 | **9:30 AM** | **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, C. Plant, M. Tait, D. Thompson, A. Wickheim, C. McNeil-Smith (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. 25-0157 Minutes of the November 20, 2024 Environmental Services Committee Meeting

Recommendation: That the minutes of the Environmental Services Committee meeting of November 20, 2024 be adopted as circulated.

Attachments: Minutes - November 20, 2024

4. Chair's Remarks

5. Presentations/Delegations

The public are welcome to attend CRD 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. Presentations

5.2. Delegations

5.2.1. 25-0187 Delegation - Jim Pine; Representing Sea to Sea Greenbelt Society: Re: Agenda Item: 7.1. Motion with Notice: Model Demolition Bylaw (Director Plant)

6. Committee Business

6.1. 25-0033 2025 Environmental Services Committee Terms of Reference

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

Attachments: Staff Report: 2025 Environmental Services Committee ToR
Appendix A: 2025 Environmental Services Cmte. ToR - Approved Jan 8, 2025
Appendix B: 2025 Environmental Services Committee ToR - Redlined

6.2. 25-0149 Verbal Update on the Addition of Flexible Plastics Collection to the Blue Box Program

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

6.3. 25-0090 Options for Flexible Plastics Collection for Multi-Family Dwellings

Recommendation: The Environmental Services Committee recommends to the Capital Regional District Board:
That staff report back to committee with the results of the pilot project.

Attachments: Staff Report: Options for Flexible Plastics Collection for Multi-Family Dwellings
Appendix A: Private Waste and Recycling Collection Service Providers

6.4. 25-0146 Biosolids Literature Review Outcomes

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

Attachments: Staff Report: Biosolids Literature Review Outcomes
Appendix A: Biosolids Land Application – Updated Review

6.5. 25-0150 Previous Minutes of Other CRD Committees and Commissions for Information

Recommendation: There is no recommendation. The following minutes are for information only:
- Climate Action Inter-Municipal Task Force - December 6, 2024

Attachments: Minutes: Climate Action Task Force - December 6, 2024

7. Notice(s) of Motion

7.1. 25-0167 Motion with Notice: Model Demolition Bylaw (Director Plant)

Recommendation: [At the February 12, 2025 CRD Board meeting, the following notice of motion was read into the record by Director Plant and referred by the CRD Chair to next meeting of the Environmental Services Committee for discussion:]
The Environmental Services Committee recommends to the Capital Regional District Board:
That staff be directed to develop a model bylaw for demolition waste and deconstruction for municipalities in the capital region, and that the attached City of Victoria bylaw be used as a starting point.

Attachments: Memo: Notice of Motion

8. New Business

9. Motion to Close the Meeting

9.1. 25-0161 Motion to Close the Meeting

Recommendation: That the meeting be closed for Contract Negotiations in accordance with Section 90(1)(k) of the Community Charter. [1 item]

10. Adjournment

The next meeting is March 19, 2025.

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

Capital Regional District

625 Fisgard St.,
Victoria, BC V8W 1R7

Meeting Minutes

Environmental Services Committee

Wednesday, November 20, 2024 **1:30 PM** **6th Floor Boardroom**
625 Fisgard St.
Victoria, BC V8W 1R7

PRESENT:
Directors: B. Desjardins (Chair) (EP), S. Tobias (Vice Chair), J. Bateman (for M. Tait) (EP), J. Brownoff (EP), J. Caradonna, G. Holman (EP), D. Kobayashi (EP), D. Murdock (EP), D. Thompson, A. Wickheim (EP), C. McNeil-Smith (Board Chair, ex-officio)

Staff: T. Robbins, Chief Administrative Officer; G. Harris, Acting General Manager, Parks, Recreation and Environmental Services; T. Watkins, Acting Senior Manager, Environmental Resource Management; N. Elliott, Manager, Climate Action Programs; M. Lagoa, Deputy Corporate Officer; J. Dorman, Committee Clerk (Recorder)

EP – Electronic Participation

Guests: Director Little & P. Ross, Raincoast Conservation Foundation

Regrets: Director M. Tait

The meeting was called to order at 1:32 pm.

1. Territorial Acknowledgement

Director Caradonna provided a Territorial Acknowledgement.

MOVED by Director Caradonna, SECONDED by Director McNeil-Smith,
That Director Little be permitted to participate (without vote) in the November 20, 2024 session of the Environmental Services Committee.
CARRIED

2. Approval of Agenda

MOVED by Director Thompson, SECONDED by Director Caradonna,
That the agenda for theNovember 20, 2024 Environmental Services Committee meeting be approved.
CARRIED

3. Adoption of Minutes

3.1. 24-1184 Minutes of the October 16, 2024 Environmental Services Committee Meeting

MOVED by Director Thompson, SECONDED by Director Caradonna,
That the minutes of the Environmental Services Committee meeting of October 16, 2024 be adopted as circulated.
CARRIED

4. Chair's Remarks

There were no Chair's remarks.

5. Presentations/Delegations

5.1. Presentations

5.1.1. 24-1154 Presentation: Healthy Waters in the Tod Creek Watershed (2023-25): A Preliminary Report - Peter Ross, Raincoast Conservation Foundation

P. Ross presented on Healthy Waters in the Tod Creek Watershed (2023-25): A Preliminary Report.

Discussion ensued on the following:
- sampling sources, sites and analysis
- sources of contaminants and forever chemicals
- land application of biosolids
- study results and datasets
- first nations partnerships

5.2. Delegations

5.2.1. 24-1242 Delegation - Philippe Lucas; Representing Biosolid Free BC: Re: Agenda Item 6.1. Healthy Waters Project for Tod Creek on the Saanich Peninsula - November Update

P. Lucas spoke to Item 6.1.

6. Committee Business

6.1. 24-1153 Healthy Waters Project for Tod Creek on the Saanich Peninsula - November Update

G. Harris presented Item 6.1. for information.

Discussion ensued on the following:
- media and public interest plan and educational opportunities
- water quality guidelines and regulatory meetings
- ministry of environment awareness and provincial data collection

6.2. 24-1180 Solid Waste Market Research and Engagement Study

T. Watkins presented Item 6.2. for information.

6.3. 24-1185 Solid Waste Management Plan - Three-Year Cycle

T. Watkins presented Item 6.3. for information.

6.4. 24-1181 Hartland Landfill Tipping Fee and Regulation Bylaw No. 3881 Amendment and Adoption of Bylaw Nos. 4636 and 4646

T. Watkins spoke to Item 6.4.

Discussion ensued on the following:
- geographical and disposal studies
- regional identification and differentiation tools
- overall acceptance of new rates

MOVED by Director Caradonna, SECONDED by Director Wickheim,
The Environmental Services Committee recommends to the Capital Regional District Board:
1. That Bylaw No. 4636, "Hartland Landfill Tipping Fee and Regulation Bylaw No. 6, 2013, Amendment Bylaw No. 6, 2024", be read a first, second and third time; and
2. That Bylaw No. 4636 be adopted.
3. That Bylaw No. 4646, "Capital Regional District Ticket Information Authorization Bylaw, 1990, Amendment Bylaw No. 80, 2024", be read a first, second and third time; and
4. That Bylaw No. 4646 be adopted.
CARRIED

6.5. 24-1189 Award of Contract ERM2024-007 - Hauling and Processing of Kitchen Scraps

T. Watkins spoke to Item 6.5.

Discussion ensued on material separation and back hauling versus dedicated loads.

MOVED by Director Caradonna, SECONDED by Director Desjardins,
The Environmental Services Committee recommends to the Capital Regional District Board:
That Contract ERM2024-007, Hauling and Processing of Kitchen Scraps, be awarded to Convertus Canada Ltd. from March 1, 2025 to February 28, 2030, at the rate of $130 per tonne and an estimated cost of $1,560,000 per year, plus GST.
CARRIED

6.6. 24-1152 Vancouver Island and Coastal Communities Climate Summit - Summary Report

N. Elliott presented Item 6.6. for information.

Discussion ensued on intermunicipal and interregional staff networking.

7. Notice(s) of Motion

There were no notice(s) of motion.

8. New Business

There was no new business.

9. Adjournment

MOVED by Director Thompson, SECONDED by Director Caradonna,
That the November 20, 2024 Environmental Services Committee meeting be adjourned at 2:55 pm.
CARRIED

____
CHAIR

____
RECORDER

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REPORT TO ENVIRONMENTAL SERVICES COMMITTEE
MEETING OF WEDNESDAY, FEBRUARY 19, 2025

SUBJECT **2025 Environmental Services Committee Terms of Reference**

ISSUE SUMMARY

To provide the 2025 Environmental Services Committee Terms of Reference for information.

BACKGROUND

Under the *Local Government Act* and the CRD Board Procedures Bylaw, the CRD Board Chair has the authority to establish standing committees and appoint members to provide advice and recommendations to the Board.

On January 8, 2025, the CRD Board approved the 2025 Terms of Reference for standing committees. Terms of Reference (TOR) serve to clarify the mandate, responsibilities and procedures of standing committees and provide a point of reference and guidance for the committees and members.

The Environmental Services Committee TOR was updated to remove the overly prescriptive timing for the schedule of committee meetings by removing the words “except August and December”. In addition, the General Manager title has been updated to reflect recent changes with CRD Evolves. The mandate around climate action was clarified by deleting the word “community” as the Committee considers both corporate and community climate action matters.

The approved 2025 Environmental Services Committee TOR is attached as Appendix A, and a redlined copy is attached as Appendix B.

The TOR are being provided for information to the Committee. Any proposed revisions to the TOR will require ratification by the Board.

CONCLUSION

Terms of Reference serve to clarify the mandate, responsibilities and procedures of committees and provide a point of reference and guidance for the committees and their members. Any future revisions to the TOR will require ratification by the Board.

RECOMMENDATION

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

Submitted by:	Marlene Lagoa, MPA, Manager, Legislative Services & Deputy Corporate Officer
Concurrence:	Luisa Jones, General Manager, Recreation, Parks & Environmental Services
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Ted Robbins, B. Sc., C. Tech., Chief Administrative Officer

ATTACHMENT(S)

Appendix A: 2025 Environmental Services Committee Terms of Reference – Approved
Appendix B: 2025 Environmental Services Committee Terms of Reference – Redlined

Terms of Reference

ENVIRONMENTAL SERVICES COMMITTEE

PREAMBLE

The Capital Regional District (CRD) Environmental Services Committee is a standing committee established by the CRD Board and will oversee and make recommendations to the Board regarding waste management, resource recovery, climate change and other environmental matters.

The Committee's official name is to be:

Environmental Services Committee

1.0 PURPOSE

a) The mandate of the Committee includes overseeing and making recommendations to the Board regarding the following functions:

i. Regional solid waste function, including the Solid Waste Management Plan
ii. Environmental protection, monitoring and compliance
iii. Climate action
iv. Resource recovery opportunities, including the Long-term Biosolids Management Plan

b) The Committee will also:

i. Serve as the Plan Monitoring Advisory Committee for the current Solid Waste Management Plan (SWMP)
ii. Stand as the steering committee for the revised SWMP

c) The following committees will report through the Environmental Services Committee:

i. Climate Action Inter-Municipal Task Force
ii. Solid Waste Advisory Committee (SWAC)
iii. Technical and Community Advisory Committee (TCAC)

2.0 ESTABLISHMENT AND AUTHORITY

a) The Committee will make recommendations to the Board for consideration; and

b) The Board Chair will appoint the Committee Chair, Vice Chair and Committee members annually.

3.0 COMPOSITION

a) Committee members will be appointed CRD Board Members;

b) All Board members are permitted to participate in standing committee meetings, but not vote, in accordance with the CRD Board Procedures Bylaw; and

c) First Nation members are permitted to participate in standing committee meetings at their pleasure, in accordance with the CRD Procedures Bylaw, where the Nation has an interest in matters being considered by the committee.

4.0 PROCEDURES

a) The Committee shall meet on a monthly basis and have special meetings, as required

b) The agenda will be finalized in consultation between staff and the Committee Chair and any Committee member may make a request to the Chair to place a matter on the agenda through the Notice of Motion process;

c) With the approval of the Committee Chair and the Board Chair, Committee matters of an urgent or time sensitive nature may be forwarded directly to the Board for consideration; and

d) A quorum is a majority of the Committee membership and is required to conduct Committee business.

5.0 RESOURCES AND SUPPORT

a) The General Manager of Parks, Recreation and Environmental Services will act as liaison to the Committee; and

b) Minutes and agendas are prepared and distributed by the Corporate Services Department.

Approved by CRD Board January 8, 2025

Terms of Reference

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Approved by CRD Board ____________________

REPORT TO ENVIRONMENTAL SERVICES COMMITTEE
MEETING OF WEDNESDAY, FEBRUARY 19, 2025

SUBJECT **Options for Flexible Plastics Collection for Multi-Family Dwellings**

ISSUE SUMMARY

To provide information on options for flexible plastic packaging collection from multi-family dwellings in the capital region.

BACKGROUND

At its October 16, 2024 meeting, the Environmental Services Committee approved a motion directing staff to provide a report regarding options for the collection of soft plastics from multi-family dwellings. Recycle BC is the Extended Producer Responsibility (EPR) stewardship agency responsible for collecting and recycling residential packaging and paper products (PPP) in BC under the BC Recycling Regulation. Residential PPP includes paper and cardboard, mixed containers, glass bottles and jars, flexible plastics and foam packaging generated from single family and multi-family dwellings (MFDs).

Rather than providing direct collection of PPP from MFDs in the capital region, Recycle BC instead offers financial incentives to private waste management firms to collect selected PPP material streams from MFD on its behalf. In turn, these private waste management firms offer a variety of waste management services for MFDs in the capital region, including recyclables collection, on a fee-for-service basis. Each MFD is free to contract for the collection services that best meet their needs. The array of collection services offered by these firms is outlined in Appendix A for information. The recycling services being offered by these private waste management companies typically only includes paper, cardboard and mixed container collection. Other materials, such as soft/film/flexible (flexible) plastics that residents may wish to recycle, must be dropped off at a participating recycling depot. However, a few companies offer on-site collection of flexible plastics, often as an add-on service to other recycling services.

The table below lists private companies in the capital region that offer flexible plastics collection services. Of the ten private companies offering recycling services to MFDs in the capital region, five indicated that their services include a flexible plastics option.

While most private companies offer collection services outside of Recycle BC's program, The Bottle Depot is currently partnering with Recycle BC on a pilot project to assess the feasibility of a flexible plastics collection program for MFDs in the capital region. The pilot began in August 2024 and is expected to continue until spring 2025. Results will inform next steps and any implications for the Capital Regional District.

Private Companies Offering Flexible Plastics Collection to MFD in the capital region:

Company	Service Description
The Bottle Depot	Offered as an add-on service.
Capital City Recycling	Offered as an add-on service.
reFUSE (Emterra)	On-call or scheduled pick-ups available.
Cascades Recovery	Service available on case-by-case basis.
Pacific Mobile Depot (PMD)	Rates based on bag size.

Recycling depot drop-off locations for flexible plastics are spread throughout the capital region and include the Hartland Recycling Depot, two Island Return-It depots, three Bottle Depot locations, as well as multiple grocery store and London Drugs locations. Facilities collecting flexible plastics on behalf of Recycle BC do not charge for this service, but those providing the service directly charge a fee for flexible plastics drop-off. There are also mobile 'pop-up' drop-off points offered by private companies like Pacific Mobile Depot, on a fee for service basis.

ALTERNATIVES

Alternative 1
The Environmental Services Committee recommends to the Capital Regional District Board:
That staff report back to committee with the results of the pilot project.

Alternative 2
The Environmental Services Committee recommends to the Capital Regional District Board:
That this report be referred back to staff for additional information

CONCLUSION

Recycle BC is responsible for the management of residential packaging and paper products, including flexible plastics in BC. While flexible plastic packaging from multi-family dwellings is typically collected through a drop-off depot system, there are five private waste management companies that offer onsite collection, often as an add-on to existing services. The Bottle Depot is offering collection of flexible plastics in multi-family dwellings through a pilot project, in collaboration with Recycle BC, which is anticipated to run through spring 2025.

RECOMMENDATION

The Environmental Services Committee recommends to the Capital Regional District Board:
That staff report back to committee with the results of the pilot project.

Submitted by:	Russ Smith, Senior Manager, Environmental Resource Management
Concurrence:	Glenn Harris, Ph.D., R.P.Bio., Acting General Manager, Parks, Recreation & Environmental Services
Concurrence:	Ted Robbins, B. Sc., C. Tech., Chief Administrative Officer

ATTACHMENT

Appendix A: Private Waste and Recycling Collection Service Providers in the Capital Region

PRIVATE WASTE AND RECYCLING COLLECTION SERVICE PROVIDERS IN THE CAPITAL REGION

There are a number of companies in the capital region that provide subscription collection services for garbage, kitchen scraps and recycling. Please contact companies directly for information regarding their services and fees.

Company	Sector[1]	Services				
		Garbage	Kitchen Scraps	Recycling[2]	Glass Bottles & Jars	Flexible Plastic Packaging
Capital City Recycling info@ccrvictoria.com 250.652.5008	All	✓	✓	✓	✓	✓
Cascades Recovery+ Victoria 250.480.1274	ICI	✓	✓	✓	x	✓
GFL Environmental 250.474.5145	All	✓	✓	✓	✓	x
Pan-insula Disposal[3] paninsuladisposal@telus.net 250.544.1466	All	✓	✓	x	x	x
Emterra Ar.west@emterra.ca 250.385.4399	All	✓	✓ (residential only)	✓ (commercial paper/ cardboard only)	x	x
ReFUSE info@refuse.ca 250.381.6007 ext. 3708	All	✓	✓	✓	x	✓
Sooke Disposal Ltd. sookedisposal@shaw.ca 250.642.3646	SFD	✓	✓	x	x	x
Super Save 1.800.665.2800	MFD	✓	✓	✓	x	x
Waste Connections of Canada customerservice7310@wcnx.org 250.652.4414	All	✓	✓	✓	✓	x
Waste Management 250.544.2330	All	✓	✓	✓	x	x
The Bottle Depot Info@BottleDepot.ca 250.727.7480	MFD, ICI	x	x	Refundable Beverage Containers		✓
Pacific Mobile Depot info@pmdrecycling.com 250.893.8383	All	x	x	✓	✓	✓

Note: Published details are for information only, the CRD does not endorse any of the companies listed.

1 SFD - Single family dwellings
MFD - Multi-family dwellings
ICI - Industrial, Commercial, Institutional
Al - SFD, MFD, ICI

2 Recycling = paper, cardboard, plastic, metal containers

3 Saanich Peninsula locations only

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EIS 25-05

REPORT TO ENVIRONMENTAL SERVICES COMMITTEE
MEETING OF WEDNESDAY, FEBRUARY 19, 2025

SUBJECT **Biosolids Literature Review Outcomes**

ISSUE SUMMARY

To present the Environmental Services Committee with the results of the independent academic literature review on the risks and benefits of biosolids land application.

BACKGROUND

At the August 9, 2023 Capital Regional District (CRD) Board meeting, staff were directed to *report back with a proposal that CRD Environment Service fund University of Victoria or other suitable independent academic institution to prepare a review: a) of available literature, to determine whether there are validated examples and/or peer reviewed papers assessing the risks and benefits of the application of biosolids on environmental and human health, and b) based on this and on The Precautionary Principle, whether CRD may have a legal liability for such application.*

At the October 18, 2023, Environmental Services Committee meeting, staff presented a proposal for an academic institution to conduct a literature review. At that time, the provincial government's Technical Working Group (TWG) was expected to issue a report on its review of the Organic Matter Recycling Regulation in late 2023. Given the upcoming report, the committee passed the following motion: *That the committee postpone discussion on this item until the January 2024 committee meeting.*

After delays to the release of the TWG report, the CRD Board directed staff to reinitiate the process of authorizing the literature review by the following motion at the March 13, 2024 Board meeting: *Given delays to provincial reporting on Organic Matter Recycling Regulation, and the Board's previous direction to initiate an academic analysis, that the Board direct staff to move forward with a third-party academic review of the scientific literature on the uses and impacts of biosolids*.

At the June 19, 2024 Environmental Services Committee meeting, staff presented qualification criteria for a suitable academic researcher. The Committee directed staff to 1. *Secure a tenured professor that fulfills the qualification criteria outlined in this report, to undertake the independent literature review, as per the terms of reference previously approved for this work, with a budget not to exceed $40,000*; and 2. *That staff be directed to procure a legal review in alignment with the selection criteria and scope of work presented in this report, with a budget not to exceed $25,000.*

Dr. Chris Kennedy, a Professor of Aquatic Toxicology at Simon Fraser University was selected to author the literature review. The report (Appendix A), focused on relevant literature published in 2023 and 2024; the work was completed in late 2024.

The law firm Borden Ladner and Gervais is completing the review of legal liability associated with land application of biosolids. The review is in the late stage of drafting, and staff anticipate providing the report to the ESC in March.

The objectives of the literature review were to provide up to date information on the following:

1. The human health and environmental risks of both legacy contaminants and Contaminants of Emerging Concern (COECs), with consideration of environmental conditions typical of the BC south coast.
2. Contaminant concentrations in biosolids relative to levels of exposure in general society.
3. The limitations of extrapolating lab-based toxicity testing to observations in the environment.
4. A summary of the areas of uncertainty in biosolids land application risk, including a summary of relevant techniques for evaluating and addressing uncertainty.
5. A summary of biosolids land application techniques that can reduce risk and/or address uncertainty.
6. A summary of the risks and concerns that have resulted in land application bans elsewhere.
7. An assessment of the overall risks of biosolids land application considering the intent of the Precautionary Principle (Rio Declaration, 1992 and subsequent derivations).

The literature review considered a broad suite of COECs including per and polyfluoroalkyl substances (PFAS), pharmaceuticals and personal care products and microplastics.

IMPLICATIONS

Environmental Implications

The author concluded that the low concentration of COECs in CRD biosolids coupled with existing toxicity data suggests that the COECs in CRD biosolids represent a negligible to low risk to human health and the environment. However, the report also highlighted significant sources of uncertainty in this conclusion, which should be reviewed regularly as the science evolves.

An adaptive management framework is recommended to mitigate uncertainty by regularly reviewing available updates to the scientific literature. Under such a framework, decision makers keep pace with evolving science and regularly weigh the risks and benefits in biosolids management. In the context of biosolids land application, this means enhanced monitoring of COECs in biosolids, careful site selection, and the adoption of advanced treatment technologies as they become available.

Alignment with Existing Plans & Strategies

The conclusions of the literature review align with the CRD's proposed Long-term Biosolids Management Strategy (long-term strategy), as Tier 1 of the long-term strategy includes investigation and development of emerging technology (advanced thermal demonstration facility) for biosolids management. The long-term strategy also exercises a precautionary approach by excluding agricultural land application options. Staff have also begun testing biosolids biannually for a greater range of contaminants, including PFAS and pharmaceuticals, which can inform an adaptive management framework where staff will continue to monitor the evolving science to inform decision-making.

CONCLUSION

A literature review commissioned by the CRD examined the human health and environmental risks and benefits of biosolids land application. Based on recent research, the review concluded that contaminants of emerging concern (COECs) present in CRD biosolids pose a negligible to low risk to human health and the environment. However, it also identified significant sources of uncertainty in this risk assessment. To address this uncertainty, the review recommended an adaptive management framework that includes exercising caution and exploring emerging technologies. The CRD's proposed long-term strategy aligns with these conclusions by prioritizing the development of an advanced thermal demonstration facility and excluding agricultural land application from consideration. Staff will continue to monitor evolving science and have initiated enhanced monitoring of COECs in biosolids to inform future decision-making.

RECOMMENDATION

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

Submitted by:	Peter Kickham, M.E.T., R.P.Bio., Acting Senior Manager, Environmental Innovation & Strategy
Concurrence:	Luisa Jones, MBA, General Manager, Parks, Recreation & Environmental Services
Concurrence:	Ted Robbins, B. Sc., C. Tech., Chief Administrative Officer

ATTACHMENT

Appendix A: Biosolids Land Application – An Updated Review of Human Health and Environmental Risks

APPENDIX A

FINAL REPORT

Biosolids Land Application – An Updated Review of Human Health and Environmental Risks

Version 2.0

December 12, 2024

Prepared for:

Capital Regional District

Prepared by:

Biowest Environmental Research Consultants

Dr. Christopher J. Kennedy

Table of Contents

1 Introduction

Municipal wastewater treatment yields two primary byproducts: treated wastewater and solid residue, or biosolids. Soil application of biosolids as an organic fertilizer is economic way to beneficially use the carbon and nutrient contents in biosolids to promote soil fertility. A substantial body of research has explored the risks and benefits associated with the land application of biosolids, including numerous studies focused on contaminants, including heavy metals, pathogens, and contaminants of emerging concern (COECs) (Hydromantis Inc., 2010; McCarthy et al., 2015; LRCS Land Resource Consulting Services, 2016; Pozzebon and Seifert, 2023; BC ENV 2024).

There are many benefits associated with the land application of biosolids. Benefits include the addition or organic matter to soil and the associated increase in soil water retention and reduction in soil erosion, as well as the addition of essential nutrients for plant growth. Biosolids can provide a natural alternative to synthetic fertilizers and can store carbon in soil and reduce greenhouse gas emissions (LRCS Land Resource Consulting Services, 2016' BC ENV, 2024). These benefits have been well documented by others and are not the focus of this review. The objective of this report is to build on previous literature reviews assessing potential human health and environmental risks through a comprehensive scan of the recent primary scientific literature and other relevant studies.

As background, the British Columbia Organic Matter Recycling Regulation (OMRR) (available at https://www.bclaws.gov.bc.ca/OMRR) provides a regulatory framework for the production, quality, and application of organic matter products, including biosolids. Its purpose is to ensure that biosolids and other organic materials are used in a way that protects human health and the environment while promoting sustainable resource use. The OMRR was developed based on a review of the available scientific literature in the late 1990s and implemented in 2002. The OMRR has undergone several regulatory reviews, with additional amendments proposed which are noted to include provisions to enable the BC Ministry of Environment and Climate Change Strategy to require sampling and analysis for COECs (BC ENV, 2024). Currently, while the OMRR includes requirements for vector (i.e., rodents, birds and insects) attraction reduction processes, and limits for pathogens and heavy metals, the regulation does not include limits for several key COECs including per- and polyfluroalkyl substances (PFAS), pharmaceuticals and personal care products (PPCPs), and microplastics. While it is acknowledged that the derivation of limits for some of the COECs is complicated by the limited available toxicological data, the importance of recommending limits based on the best available science is essential for the protection of human health and the environment.

In response to concerns over the land application of biosolids, the BC government has convened two technical working groups (TWGs), one in 2015 and a second in 2022, to review scientific information on biosolids production and waste management practices. A summary of the findings of the reports produced by the two TWGs follows.

The findings of the 2015 Technical Working Group were presented in the report titled *A literature review of risks relevant to the use of biosolids and compost from biosolids with relevance to the Nicola Valley, BC* (LRCS Land Resource Consulting Services, 2016). The review focused on risks not addressed by the existing regulatory framework for biosolids management in Canada, including the issue of COECs. Primary environmental and human health risks identified included the potential contamination of ground and surface water by COECs, seasonal risks due to groundwater recharge and runoff following biosolids application, and the potential for livestock and wildlife to be directly exposed to contaminants in biosolids via ingestion of biosolids during foraging, as well as the ingestion of plants that have accumulated the contaminants. Several knowledge gaps were identified, including:

- Insufficient empirical data to conduct detailed human health and ecological risk assessments.

- Lack of data on the ever-expanding list of emerging contaminants of concern present in biosolids.
- Lack of research on the potential synergistic effects of contaminants present in biosolids.
- Limited field studies on biosolid impacts on ground and surface water and subsequent effects in aquatic receiving environments.
- Limited studies assessing the effects of the land application of biosolids on wildlife at all trophic levels.
- Gaps in the understanding of the ability of treatment processes to reduce toxic loading to environmental media and biota.

The report presented several recommendations, including implementing routine public reporting on biosolid composition, focusing on contaminants, including COECs, conducting quantitative risk assessments to address area-specific exposures and associated risks, revising regulations to increase setback distances from watercourses for Class B biosolids and enhanced monitoring programs, to further evaluate the effectiveness of composting and thermal treatment to reduce COECs and to develop public education and source reduction programs to reduce the introduction of contaminants into wastewater systems.

The 2022 TWG provided recommendations in a report titled Organic Matter Recycling Regulation, Technical Working Group Report 2024. The scope of the 2022 TWG was limited and focused on identifying new scientific information on biosolids and compost constituents and management, and on new information on COECS in biosolids and compost since the 2015 TWG. BC ENV (2024) provides the following key messages derived from the TWG findings:

- Each compost and biosolids product is unique to their origin. For example, wastewater treatment plants vary in their input sources (e.g., industrial vs. residential) and may use different treatment processes. Further, the land to which the biosolids (and compost) are applied have unique characteristics. As such, an OMRR application plan specific to the source and the application site should be prepared.
- The importance of source control as the quality of the biosolids (and compost) is directly related to their inputs. The 2022 TWG therefore advocated for regulations that focus on preventing contamination at the source.
- Our understanding is constantly evolving as science advances, and it is challenging to keep pace with evolving science. The 2022 TWG therefore recommended that the ministry devote resources to monitoring the scientific literature and be transparent regarding the research that is used to inform policy.
- To identify and manage COECs it was recommended that the BC ENV develop a comprehensive and transparent strategy that should include not only the presence of COECs, but associated risk. The TWG recommended that the ENV focus on the results of field-based, vs. laboratory-based, studies.
- Provision of context for clear, factual and easily understood information, including providing plain language information on the BC ENV website for why we compost and use biosolids.

Given the large body of scientific literature on the benefits and risks of biosolids that exists, as well as the work conducted by the TWGs convened by the BC ENV, this review is focused on the scientific literature and other relevant reports that have been produced over the last two years (2023 and 2024), with the objective to provide up to date information on the following:

- The human health and environmental risks of both legacy contaminants and COECs, with consideration of environmental conditions typical of the BC south coast.
- Contaminant concentrations in biosolids relative to levels of exposure in general society.
- The limitations of extrapolating lab-based toxicity testing to observations in the environment.
- A summary of the areas of uncertainty in biosolids land application risk, including a summary of relevant techniques for evaluating and addressing uncertainty.
- A summary of biosolids land application techniques that can reduce risk and/or address uncertainty.
- A summary of the risks and concerns that have resulted in land application bans elsewhere.
- An assessment of the overall risks of biosolids land application considering the intent of the Precautionary Principle (Rio Declaration, 1992 and subsequent derivations).

2 Contaminants Present in Biosolids and Associated Risks

Previous studies have identified the presence of numerous contaminants in biosolids. These include legacy contaminants such as heavy metals (Sloan et al., 1997; Evanylo et al., 2006; LRCS Land Resource Consulting Services, 2016; Marchuk et al., 2023) and persistent organic pollutants like polychlorinated biphenyls (PCBs), dioxins and furans (PCDD/Fs) and polycyclic aromatic hydrocarbons (PAHs) (Furr et al., 1976; Bergh and Peoples, 1977). In addition, several COECs have been identified in biosolids, including PFAS (LRCS Land Resource Consulting Services, 2016; Wang et al., 2020; Moodie et al., 2021), microplastics (Crossman et al., 2020; Mohajerani and Karabatak, 2020), PPCPs (LRCS Land Resource Consulting Services, 2016; Mohajerani and Karabatak, 2020; Kinney and Heuvel, 2020) and industrial contaminants such as plasticizers, surfactants and brominated flame retardants. The USEPA (https://www.epa.gov/biosolids/basic-information-about-biosolids) reports that more than 700 contaminants have been identified in biosolids (in at least one instance) since 1993, with the contaminants present in biosolids varying between wastewater treatment plants (WWTPs) depending on inputs to the facilities.

Regulatory agencies, including the BC ENV, have established limits for metals in biosolids, as well as for pathogens. These contaminants are routinely monitored in biosolids prior to land application. Further, as the toxicity of the legacy organic pollutants (e.g., PCBs, PCDD/F, PAHs) is well understood, many of them have existing standards or criteria in Canada and internationally. A sampling program conducted by the BC ENV (2019) indicated that the concentrations of metals, pathogens and legacy organic pollutants were less than the applicable standards/guidelines for biosolids in samples collected from two WWTPs in the province. Further, previous assessments (Smith, 2009; Eriksen et al., 2009; Jensen et al., 2012; WEAO 2001 and 2010; Higgin et al., 2010) have evaluated risks associated with these contaminants in biosolids. These previous studies have indicated a negligible to low potential for risk to human health and the environment. As the use of some of these chemicals have been phased out overtime, concentrations of these contaminants in wastewater (and biosolids) have also decreased overtime. Despite having a good understanding of the potential risks associated with legacy contaminants in biosolids on an individual level, many of the uncertainties discussed throughout this report, including the lack of understanding of the potential for additive and synergistic effects of contaminants in biosolids, also apply to legacy contaminants.

Contaminants of emerging concern are those that have been identified in recent years, primarily due to advancements in laboratory methodologies and the associated reduction in laboratory detection limits. As they are relatively new contaminants, with limited toxicological data, regulatory agencies typically have not derived environmental quality standards for COECs. Further, due to the same limitation as well as a lack of understanding of the fate of these contaminants following land application of biosolids, a limited number of risk assessments have been conducted to assess the potential for COECs in biosolids to adversely impact human health and the environment. Those available (Eriksen, 2009; Smith, 2009; Jensen et al., 2012; Higgens et al., 2010; Kennedy/Jenks, 2017) have concluded that the contaminants generally represent a low risk to human and environmental health based on the low concentrations of most of the COECs identified in biosolids. Further studies (Higgins et al., 2010; Clarke and Smith, 2011; TCEQ , 2021; Warke and McAvoy, 2024) have attempted to prioritize or rank COECs in biosolids, but have encountered similar challenges due to the paucity of toxicity data for many of the COECs.

A review of the recent (2023-2024) literature pertaining to COECs in biosolids indicates that the scientific understanding of select COECs in biosolids is evolving at a rapid rate, with many recent studies focused on PFAS, microplastics and PPCPs. Research focused on the prevalence of these and other COECs in biosolids, their fate following land application, and their toxicities is being undertaken across the globe, including in Canada. This research has highlighted the existing data gaps and uncertainties in our understanding of COECs in biosolids owing to the complex mixture of contaminants present in biosolids, the variability in the contaminant profile observed between sources depending on inputs, and the potential for these contaminants to act additively or synergistically.

With the objective of this report to update previous studies regarding human health and ecological risks from the land application of biosolids, a summary of the recent literature and other information (e.g., regulatory decisions) pertaining to PFAS, microplastics and PPCPs follows. Recent data on the concentrations of PFAS in Canadian biosolids was identified, including from the Capital Regional District (CRD), and has been used to conduct a screening level human health and ecological risk assessment of select PFAS with available toxicological data (Section 2.1.1), as well as a comparison of exposures of PFOA and PFOS in CRD biosolids relative to typical daily exposures intakes of PFOA and PFOS (Section 2.1.2). Additionally, a summary of a 2024 study conducted to rank unregulated organic compounds (UOCs) identified in biosolids is also provided (Warke and McAvoy, 2024) (Section 2.4).

2.1 PFAS

Per- and polyfluorinated alkyl substances (PFAS) are a group of over 4700 aliphatic compounds containing at least one carbon-fluorine (C-F) bond. Due to environmental concerns, North America, Europe, and Australia voluntarily phased out long-chain PFAS (≥8 carbons) in the early 2000s, replacing them with shorter-chain versions. These shorter-chain PFAS are less prone to soil absorption and bioaccumulation, yet they are more environmentally mobile. Despite their reduced bioaccumulation, short-chain PFAS still persist in the environment and can pose risks to human health and the environment (Pozzebon and Siefert, 2023).

Although toxicity and effects data only exist for a small number of PFAS, the health effects of this class of chemicals are well documented. Exposure to PFAS, even at low concentrations, can have significant adverse health effects and effect multiple organs and systems, including liver, kidney and thyroid function, as well as the immune, nervous and reproductive systems (https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/water-talk-per-polyfluoroalkyl-substances-drinking-water.html). Additionally, in the environment, PFAS exposures have been linked to negative impacts on the immune and nervous systems of wildlife, as well as effects on growth, reproduction, and development (ECCC, 2023 and 2024).

In May 2023, Environment and Climate Change Canada and Health Canada published the Draft State of PFAS Report (Government of Canada, 2023), providing a qualitative assessment of the fate, sources, occurrence, and potential impacts of PFAS on the environment and human health. The report highlights the extreme stability of PFAS in the environment, often referred to as "forever chemicals". The report also emphasizes the potential for cumulative effects from co-exposure to multiple PFAS, which may lead to adverse environmental and health outcomes. In July 2024, an updated draft report (Government of Canada, 2024) was issued which incorporated new information and public comments. The updated report continues to underscore the environmental persistence and potential human health and environmental risks associated with PFAS, and reinforces the need for comprehensive management strategies to mitigate their impact. Additionally, in alignment with the Government of Canada's 2021 notice of intent to address PFAS as a class of chemicals (https://www.canada.ca/en/health-canada/services/chemical-substances/other-chemical-substances-interest/per-polyfluoroalkyl-substances.html), in August 2024, Health Canada published an objective for Canadian Drinking Water Quality for PFAS of 30 nanograms/L (ng/L) for the sum of 25 PFAS (Health Canada, 2024a).

PFAS have been identified in biosolids globally, and while concentrations of PFAS in biosolids are influenced by inputs to WWTPs, treatment methods, and sludge stabilization techniques, studies have confirmed their presence in biosolids in Canada nationwide (McCarthy, 2015; Letcher et al., 2020; Lakshminarasimman et al., 2021 and Gewurtz et al., 2024).

In response to growing concerns over PFAS in biosolids, in June 2024 the Canadian Food Inspection Agency (CFIA) recommended an interim standard for PFAS in commercial biosolids of 50 part per billion (ppb) of perfluorooctane sulfonate (PFOS) on a dry weight basis (Canada Food Inspection Agency trade memoranda T-4-132 available at https://inspection.canada.ca/en/plant-health/fertilizers/trade-memoranda/t-4-132-commercial-biosolids), with enforcement of the standard to begin as of October 18, 2024. CFIA (2024) indicates that the available data suggest that approximately 92% of Canadian biosolids contain PFOS at concentrations below 50 ppb (ng/g). Data provided by the Capital Regional District (CRD) indicates that the average concentration of PFOS in biosolids from the region is 5.4 ppb (ng/g) and is nearly an order of magnitude below the CFIA limit (see data in Table 1).

The US EPA has prioritized research, restriction, and remediation of PFAS in the environment, including in biosolids, and has defined a PFAS Strategic Roadmap which includes a risk assessment for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) in biosolids. The assessment is currently underway and is anticipated to be completed by the end of 2024 (https://www.epa.gov/biosolids/and-polyfluoroalkyl-substances-pfas-biosolids). During the completion of the assessment, the US EPA has advised states to monitor biosolids for PFAS contamination, identify suspected industrial discharges and implement pre-treatment requirements where appropriate to reduce concentrations of PFAS in biosolids. The US EPA has indicated that if the risk assessment determines that PFOA or PFOS in biosolids may adversely affect public health or the environment, that risk managers will consider options for numerical limitations and best management practices for these compounds.

Additionally in the USA, several states have responded to concerns regarding PFAS in biosolids by enacting rules that limit the concentration of PFAS in biosolids, with Maine (in 2022) and Connecticut (in 2024) implementing bans on the use or sale of PFAS-containing biosolids.

Key findings of recent scientific studies that have evaluated PFAS in biosolids include the following:

1. As the quality of biosolids is dependent on the contaminants present in raw wastewater, it is important to consider upstream controls and monitoring to minimize the input of PFAS-containing wastes into wastewater treatment systems (BC ENV, 2024; Tansel et al., 2024; Gewurtz et al., 2024). In their review of PFAS concentrations in influent, effluent and biosolids samples collected from 27 wastewater treatment plants (WWTPs) across Canada, Gewurtz et al. (2024) identified that PFAS concentrations are the highest in samples from plants that receive landfill leachate.
2. PFAS concentrations in biosolids in the US have not decreased despite the phasing out of the longer chain PFAS in the early 2000s (Pozzebon and Siefert, 2023; Borthakur et al., 2022; Gewurtz et al., 2024). In a study of biosolids sourced from Canadian WWTPs, Gewurtz et al. (2024) reported that except PFOS, the concentrations of long-chain PFAS have generally decreased overtime; however, they remain at measurable concentrations. Further, Gewurtz et al. (2024) found that the replacement of long-chained PFAS with short-chain PFAS has resulted in concentrations of short-chain PFCAs in wastewater influent and effluent increasing over the period of 2009 and 2021, with the short-chain PFAS less frequently detected in biosolids.
3. Recent evidence suggests that PFAS are transformed during the wastewater treatment process. Studies (Helmer et al., 2022; Tansel et al., 2024; Behnami et al., 2024) indicate that some PFAS precursors transform during treatments like anaerobic digestion, potentially altering contaminant profiles and increasing certain PFAS concentrations post-treatment. PFAS not degraded during aerobic and anaerobic digestion will instead become concentrated during treatment (Lakshminarasimman et al., 2021; Gewurtz et al., 2024; Tansel et al., 2024). Carbon chain length significantly affects PFAS partitioning, with longer chain PFAS adsorbed to sludge, and shorter chain PFAS partitioning to the wastewater (Behnami et al., 2024; Gewurtz et al., 2024).

2.1.1 Screening Level Human Health and Ecological Risk Assessment for PFAS in Biosolids

Data collected from 29 Canadian wastewater treatment plants, as summarized in Zhou et al. (2024) from

Letcher et al. (2020) and Lakshminarasimman et al. (2021) indicate that PFOS was the most prevalent PFAS (<0.49–50.4 ng/g dw) in collected biosolids, followed by PFDA (0.11–53 ng/g dw) and PFOA (<0.07–23 ng/g dw) (Zhou et al., 2024; Letcher et al., 2020; Lakshminarasimman et al., 2021).

Gewurtz et al. (2024) summarized data for 42 PFAS in samples collected in 2021 from 27 WWTP across Canada, and reviewed trends in concentrations overtime. The 2021 results were consistent with the previous studies, indicating PFOS is the most prevalent, with concentrations ranging from <0.32 to 96 ng/g dw.

Gerwurtz et al. (2024) reported that the PFAS with the highest concentrations in Canadian biosolids (2018 to 2021) were PFOS, PFBA and the short-chain precursor 5:3 FTCA. Long-chain PFCAs, PFOS, FOSA, the long-chain intermediate transformation products *N*-methylperfluorooctanesulfonamidoacetic acid (MeFOSAA) and N-ethylperfluorooctanesulfonamidoacetic acid (EtFOSAA), PFHxA, and 5:3 FTCA were frequently (in >60 % of the samples) over this period, with the long-chain PFAS likely detected more frequently due to their greater tendency to sorb to solids (Gewurtz et al., 2024; Helmer et al., 2022).

The below table summarizes the concentrations of select PFAS identified in Canadian biosolids (from Letcher et al., 2020; Lakshminarasimman et al., 2021 and Gewurtz et al., 2024). In addition, average PFAS concentrations measured in CRD biosolids (n=3) have been provided for comparative purposes.

PFBA (C4)	**PFPeA (C5)**	**PFHxA (C6)**	**PFHpA (C7)**	**PFOA (C8)**	**PFNA (C9)**	**PFDA (C10)**	**PFUnA (C11)**	**PFDoA (C12)**	**PFBS (C4)**	**PFHxS (C6)**	**PFOS (C8)**
Letcher et al., 2020											
<0.48-3.0	<0.28-6.0	0.17-4.65	<0.08-1.53	<0.07-11.5	0.09-4.72	0.11-23.4	0.19-7.49	0.19-6.09	<0.14-3.48	<0.06-2.43	0.49-**50.4**
Lakshminarasimman et al., 2021											
<2.06	<2.06-14	<2.06-8.3	<2.06-5.2	<2.06-23	<2.06-20	<2.06-53	<2.06-7	<2.06-10	<4.11-11	<**4.11**	<4.11-**27**
Gewurtz et al., 2024 (2021 data)											
<1.3-200	<0.64-12	<0.32-7.9	<0.32-2.6	<0.32-42	<0.31-8.8	<0.31-27	<0.31-3.5	<0.31-7.6	<0.32-7.5	<0.32-**5.4**	<0.32-**96**
Capital Regional District Biosolids											
<1.50	1.28	2.02	0.96	1.11	0.37	1.80	0.738	1.34	0.474	2.2	5.35
Health Canada SSVs (HC, 2019), BC CSR Standards and CCME Soil Quality Guidelines, Residential/Agricultural Land Use, Human Health Protection											
114,000[a]	800[a]	800[a]	800[a]	700[a]	800[a]	NA	NA	NA	61,000[a] 300,000[b]	2,300[a]	2,100[a] 1000[b] 2,000[c]
Grippo et al., (2021), BC CSR Standards and CCME Soil Quality Guidelines, Residential/Agricultural Land Use, Ecological Protection											
2,980[d]	NA	6,200[d]	NA	3,840[d]	24.2[d]	67.7[d]	NA	NA	817[d]	2.8[d]	70,000[b] 10[c] 8.7[d]

Table 1: Concentrations of PFAS reported in biosolids from WWTPs in Canada (in ng/g) (from Letcher et al., 2020; Lakshminarasimman et al., 2021 and Gewurtz et al., 2024) compared to Health Canada SSVs (2019) and BC CSR soil standards for residential and agricultural land use. NA: Not Applicable, [a] Health Canada SSV, [b] BC CSR soil standard, [c] CCME soil quality guideline, [d] Grippo et al. (2021) ESV, **Bold** – concentration exceeds ecological protection guidelines/standards.

Following the land application of biosolids, there is the potential for human and ecological receptors to be exposed to the biosolids, and thus the contaminants, including PFAS, present in the biosolids. Depending on the land application technique used (e.g., injection, incorporation into surface soils, amendments), the biosolids and COECs may be 'diluted'. For this screening exercise, it has been conservatively assumed that there is the potential for human and ecological receptors to be exposed directly to the PFAS concentrations measured in Canadian biosolids. In practice, biosolids are mixed with other materials prior to land application; for example the CRD uses a mixing ratio of 18:1 (5 parts sand, 13 parts wood and 1 part biosolids, or approximately 6% biosolids by volume).

Per standard risk assessment methodologies, including those recommended in guidance from the BC ENV

(2023a), Health Canada (2024b) and the CCME (2020), the concentrations of PFAS presented in Table 1 have been compared to guidelines/standards derived to be protective of human health and ecological direct contact exposures, including for human health, incidental ingestion of soil, and for ecological receptors, direct contact, and for wildlife, soil and food ingestion.

Soil guidelines/standards derived to be protective of human health are available for select PFAS from Health Canada (2019), the BC Contaminated Sites Regulation (CSR) (BC, 2023b) and the CCME (2021). Health Canada recommends human health protective soil screening values (SSVs) for 11 select PFAS including PFOS, PFOA, PFBA, PFBS, PFHxS, PFPeA, PFHxA, PFHpA, PFNA and two fluorotelomer sulfonates (6:2 FTS and 8:2 FTS). The SSVs also consider the potential for PFOS and PFOA to act additively, with an SSV of < 1 for the sum of the ratio of the [PFOS]/SSV_{PFOS} and the [PFOA]/SSV_{PFOA}. Using the maximum concentration of PFOS and PFOA reported in Table 1 (PFOS = 96 ng/g and PFOA = 42 ng/g), the ratio is < 1 and thus meets the SSV. In addition, the BC CSR provides human health protective soil standards for PFOS and PFBS, and the CCME provides a human health soil quality guideline for PFOS. A comparison of the maximum concentrations of the PFAS measured in Canadian biosolids to the Health Canada SSVs, as well as the BC CSR and CCME human health protective soil standards (See Table 1) indicates that the measured concentrations are well below the SSVs, standards and guidelines, with the average concentrations of PFAS measured in CRD biosolids (n=3) well below the Canadian maximum concentrations and all available SSVs, standards and guidelines. As noted, the direct comparison of measured concentrations in biosolids to the standards and guidelines is highly conservative given the mixing that occurs prior to land application. For example, applying the 18:1 mixing ratio used by the CRD, the concentrations of PFAS in Table 1 would be divided by a factor of 18 to provide a resulting exposure concentration. Applying this ratio, the maximum exposure concentration of PFOS (the PFAS measured at the highest concentration) in CRD biosolids would be 0.3 ng/g compared to the lowest standard for human health protection of 1000 ng/g and the lowest standard for ecological health protection of 8.7 ng/g (protective of food chain exposures).

Soil guidelines and standards in BC and available from the CCME for the protection of the environment, are limited to PFOS only. On behalf of the US Department of Energy, Grippo et al. (2021) developed ecological screening values (ESVs) to support screening-level ecological risk assessments at U.S. Air Force (Air Force), Navy, Army, and other U.S. Department of Defense (DOD) sites PFAS have been detected in soils and surface waters. A comparison of the maximum concentrations of PFAS measured in Canadian biosolids to the ESVs and CSR/CCME guidelines/standards for PFOS is provided in Table 1. As presented, concentrations of select PFAS, including PFOS and PFHxS exceed the guidelines for environmental protection, and specifically the CCME soil quality guideline and the Grippo et al. (2021) EVS for soil and food ingestion. Concerning the Grippo et al. (2021) ESV that is exceeded, it is specific to soil and food ingestion of mammalian ground insectivores. Further, concentrations of PFOS exceed the CCME guidelines protective of soil leaching to groundwater for the protection of potable groundwater (10 ng/g) and aquatic life (10 ng/g).

The below discussion considers screening quotients (SQs) for select PFAS; SQs were calculated as the [PFAS] / guideline (or standard or screening value).

The above screening exercise indicates that the concentrations of individual PFAS in both Canadian biosolids, including those from the CRD, for which there is available toxicity data to derive soil guidelines are less than the guidelines derived to be protective of human health (maximum SQ of 0.06 for PFOA), and thus, exposure to these individual PFAS in biosolids, as well as combined exposures to PFOS and PFOA, are not anticipated be associated with risks to human health. As noted the comparison of measured concentrations is highly conservative as amendment would occur prior to application.

The comparison of the PFAS concentrations measured in Canadian biosolids, as reported by Letcher et al., 2020; Lakshminarasimman et al., 2021 and Gewurtz et al., 2024 exceed ecological health guidelines for select individual PFAS including PFOS (maximum SQ =11) and PFHxS (maximum SQ = 1.9). On this basis, there is the potential for the highest concentrations of these PFAS measured in Canadian biosolids to pose a risk to ecological receptors and specifically wildlife exposed via soil and food ingestion. Further, as the maximum PFOS concentrations exceed of soil guidelines protective of drinking water and aquatic life (maximum screening quotient of 9.6), there are potential for risks to both human health and the environment associated with soil leaching to groundwater. The average concentrations of PFAS in the CRD biosolids were all below the available SSVs, ESVs, as well as the CCME guideline and CSR standard for PFOS (i.e., all SQs are well below 1).

The findings of the above screening exercise must be interpreted in the context that guidelines are only available for a small number of the 4700 PFAS known to exist, and that the individual guidelines may not consider the combined toxicity of the PFAS mixture present in biosolids. Further, as PFAS are persistent and accumulate in soils, following the repeated application of biosolids to land, the concentrations of PFAS have the potential to increase overtime.

2.1.2 Estimated Daily Intakes of PFOS and PFOA

As PFAS are ubiquitous in the environment, humans are exposed daily to PFAS from a variety of sources (i.e., consumer products, diet, air, water and soil). Limited data exists on Canadian's exposure to PFAS; however, biomonitoring data indicates that PFAS are present at measurable concentrations in the blood of most Canadians (Government of Canada, 2024).

Using summary statistics from secondary sources for concentrations of PFOA and PFOS in indoor and outdoor air, water and dust in the US, as well as European dietary intake estimates to estimate exposures from food, East et al. (2023) estimated exposure to adults and children over the period of 2011 to 2017. Daily intake estimates for adults were estimated to be 40 ng/day PFOA and 40 ng/day PFOS, and rates for young children (toddlers) were estimated to be 14 ng/day PFOA and 17 ng/day PFOS. A comparison of these estimates using a first-order pharmacokinetic model indicated that the results were aligned with serum concentration measurements from the National Health and Nutrition Examination Survey over the same time period (East et al., 2023), providing evidence that the modeled daily intakes are reasonable. It is noted that although not discussed by East et al. (2023), it is assumed that exposures to PFAS in biosolids would be accounted for in the measured serum contributions in areas where biosolids are applied and represent a potential source.

As measured levels of PFAS in blood in Canada and the US are reportedly similar (Public Health Ontario, 2023), the results of East et al. (2023) have been considered here in an assessment of potential PFAS exposures for Canadians, and a comparison to potential exposures to PFOS and PFOA measured in Canadian biosolids.

Using Health Canada (2024b) exposure equations for the direct soil exposure pathways (i.e., incidental ingestion, dermal contact and inhalation of soil particulate) and receptor characteristics for an adult and a toddler, with the average PFOS and PFOA concentrations in CRD biosolids from Table 1 used as exposure point concentrations, exposure intakes associated with exposures to PFOA and PFOS in CRD biosolids were estimated. A summary of the results summed with the estimates from East et al. (2023) and compared to the Health Canada tolerable daily intakes (TDIs) for PFOA and PFOS are presented in Table 2.

PFAS	**Background EDI (East et al., 2023) (ng/day)**		**EDI from CRD biosolids (ng/day)**		**Total Exposure Estimate (ng/day)**		**Total Exposure Estimate (ng/kg-bw/day)**		**Health Canada Tolerable Daily Intakes (ng/kg-bw-day)**
	Toddler	Adult	Toddler	Adult	Toddler	Adult	Toddler	Adult	
PFOA	14	40	0.09	0.03	14.09	40.03	0.85	0.57	60
PFOS	17	40	0.44	0.14	17.44	40.14	1.06	0.57	21

Table 2. Estimated daily intakes for PFOA and PFOS (from East et al., 2023) and from exposures to PFOA and PFOS in biosolids using the maximum PFOA and PFOS concentrations in Table 1. Total exposure estimates are the sum of the EDIs from East et al., 2023 and the EDIs from biosolids.

The total exposure estimates (the sum of the estimated daily intakes from East et al., 2023 and those from CRD biosolids) in ng/kg-bw-day are well below the Health Canada (2021) tolerable daily intakes (TDIs), suggesting that exposures for PFOA and PFOS in biosolids in the CRD, combined with background exposures, are unlikely to represent a health risk. The estimated exposures from the CRD biosolids are conservative as they are based on concentrations measured in the CRD biosolids, which as noted, would be reduced by a factor of 18 following the amendment of the biosolids prior to application.

As with the results of the screening assessment presented in Section 2.1.1, the above evaluation does not consider exposures to the mixture of PFAS in biosolids, which has the potential to act additively with one another as well as with other contaminants in biosolids, and thus is likely an underestimate of total risks associated with PFAS exposures. Despite this, the potential contribution of exposures to PFOS and PFOA from biosolids from the CRD to overall exposures of these PFAS is low, and when amendment of the biosolids is considered, is likely to be negligible.

2.2 Microplastics

Microplastics are pieces of plastic less than five millimeters in diameter and while some microplastics are intentionally manufactured (e.g., microbeads in beauty products), they generally result from the degradation of plastic debris. Microplastics have been identified to be present in biosolids around the globe, including in Canada (Crossman et al., 2020; Gies et al., 2018; Lavoy and Crossman, 2021; Savarajah et al.; 2023). Further, biosolids have been identified as an important pathway for microplastics to enter the environment (Crossman et al., 2020) and agricultural lands where biosolids have been applied are one of the largest reservoirs of microplastics (Pozzebon and Siefert, 2023). Due to their emerging nature, there are no regulations pertaining to microplastics in biosolids (or from other sources) in Canada.

While the studies assessing the prevalence of microplastic in biosolids in Canada were previously limited, Sivarajah et al., (2023) quantified microplastics in biosolids from 22 WWTPs located in nine Canadian provinces. Microplastics were identified in all samples, at concentrations ranging from 228 to 1353 particles per gram dry weight (dw) (median = 636 particles per gram dw). These concentrations are orders of magnitude greater than those reported from previous investigations of microplastics in biosolids in 4 other WWTP in Canada, as well as in other countries (Sivarajah et al., 2023). Importantly, despite the large variation in the concentrations of microplastics observed across the samples from the 22 WWTPs, the investigators did not find a significant difference in the concentrations based on region, the type of WWTP or the sludge treatment type. The results for the Pacific region (n=4) were the highest, with a median concentration of 914 particles per gram dw.

The effects of microplastics on humans and the environment remain largely uninvestigated. In recognition of this, in January 2024 the Government of Canada announced funding of $2.1 million over four years to three academic institutions for the research of microplastics and their potential to impact human health (https://www.canada.ca/en/health-canada/news/2024/01/government-of-canada-funding-research-on-the-health-risks-of-microplastics.html). While there is limited data on health effects, the inhalation of microplastics has been identified as a concern, with the inhalation of microplastics associated with oxidative stress in lung tissues and general inflammation responses in airways (Pozzebon and Siefert, 2023).

Microplastics are highly persistent, resistant to degradation and can accumulate in soils (Xu et al., 2019; Pozzebon and Siefert, 2023). This is of specific concern in areas where there is repeated land application of biosolids. Contrary to the benefits of the land application of biosolids, microplastics from biosolids and their accumulation in soil compromises soil structure and affects nutrient availability, water retention and aeration (Xu et al., 2019). They can also be toxic to soil organisms and thus reduce the beneficial effects these organisms have on soil fertility and structure (Xu et al., 2019). Evidence also suggests the potential for the chemical constituents in mircroplastics to leach into soil and groundwater, and for plants to absorb microplastic particles, serving as a pathway for microplastics to enter the food chain (Xu et al., 2019; Pozzebon and Siefert, 2023).

A recent study (Wang and Good, 2024) identified that microplastics in biosolids can act as vectors for the long-range transport of PFAS, including atmospheric deposition in aquatic systems. The authors indicate that microplastics enriched with PFAS are an important concern due to the ubiquitous nature of both microplastics and PFAS globally, but also their co-occurrence in biosolids and the potential for combined toxicity (Wang and Good, 2024).

The presence of microplastics in biosolids, and the early evidence of effects to both human health and the environment, highlights the need for further research and the implementation of measures to prevent the further introduction of microplastics to the environment. Recent policies limiting single use plastics, along with existing regulations banning use of polymeric microbeads in cosmetics and personal care products, are likely to have resulted in a reduction in microplastics entering WWTPs. Despite this, the laundry of synthetic clothing will continue to contribute to the load of microplastics in biosolids (Crossman et al., 2020); however, the use of microfibre filters in washing machines would reduce microplastics sourced from laundering clothing.

2.3 Pharmaceuticals and personal care products

Pharmaceutical and personal care products (PPCPs) include prescription and over the counter medications and supplements, as well as pharmaceuticals used in agriculture to promote growth and health of livestock (Pozzebon and Siefert, 2023; Hydromantis Inc., 2010; McCarthy, 2015). PPCPs also include other products used for health and cosmetic purposes (e.g,, fragrances). Sub-categories of PPCPs include antibiotics, antimicrobials, steroidal chemicals, fragrances, alkylphenolics, and other PPCPs such as analgesics, antidepressants, antifugals, anti-inflammatories and diuretics, to name a few.

Traditional WWTPs are generally ineffective at removing PPCPs, which often persist through the treatment process. The land application of biosolids has been identified as the primary way that PPCPs enter the environment (Brown et al., 2019; Kinney and Vanden Heuvel, 2020; Pozzebon and Siefert, 2023).

Data indicate that most PPCPs degrade within months after being introduced to the environment; however, some studies indicate that select PPCPs can persist (Garcia-Santiago et al., 2016; McCarthy, 2015; Kinney and Vanden Heuvel, 2020). Further, many PPCPs are considered "pseudo-persistent" as they are continuously introduced to the environment (Pozzebon and Siefert, 2023). The potential for PPCPs to accumulate in soil and transfer to soil invertebrates and plants, as well as to leach to groundwater has been demonstrated (Garcia-Santiago, 2016), although limited data exists on the ecotoxicity of PPCPs, especially in terrestrial systems (Pozzebon and Siefert, 2023). Given the low doses of many PPCPs required to elicit a response in humans, PPCPs are likely to cause a variety of effects on biota if they accumulate in the environment. PPCPs contain endocrine disruptors which have the potential to interfere with human and animal hormonal systems even at low concentrations. Reproductive failure associated with exposure to endocrine disrupting contaminants has been well documented in aquatic systems (Pozzebon and Siefert, 2023).

Further, some antibiotics persist in the environment after land application, affecting soil microbial communities and potentially altering ecosystem functions. They can promote the growth of antibiotic-resistant bacteria, and may disrupt the balance of beneficial soil microorganisms, affecting nutrient cycling and soil health (Black et al., 2019; Pozzebon and Siefert, 2023). Antibiotic resistance has been defined by the World Health Organization as a global threat to health and food security. The promotion of antibiotic-resistant bacteria by PPCPs will contribute to this threat and is specifically concerning given the co-occurrence of antibiotic-resistant bacteria and pathogens in biosolids (Pozzebon and Siefert, 2023). Hung et al. (2022) found that biosolid samples contained significantly higher concentrations of antibiotic-resistant genes when compared to raw agricultural soils, as well as the potential for the airborne spread of the genes. The authors emphasized the importance of their findings to the global concerns regarding antibiotic resistance.

Previous studies (Garcia-Santiago et al., 2016; Kennedy/Jenks, 2017) have conducted preliminary evaluations of the potential effects and risks associated with PPCPs. Additionally, McCarthy (2015) summarized the results of previous risk assessments including those for PPCPs. Overall, the assessments suggest that the potential for human health risks from exposure to individual PPCPs in biosolids is likely low, however, there are limitations and uncertainties in the previous assessments, including the consideration of a small number of PPCPs and the lack of accounting for potential additive and synergistic effects.

Garcia-Santiago et al. (2016) conducted a screening level risk assessment to assess the potential for human exposure to PPCPs measured in biosolids to exceed one therapeutic dose. The study focused on PPCPs shown to persist in WWTPs including carbamazepine, fluoxetine, triclosan, miconazole and ciprofloxacin, and Naproxen. Total exposures via the direct soil exposure pathways, as well dietary exposures, were evaluated. The results of the assessment indicated total hazard quotients (HQs) were less than an HQ of 1.0 (i.e., total exposures were less than one therapeutic dose), with most PCPPs having HQ values of less than 0.1, except for triclosan which has been shown to bioaccumulate, which had an average HQ of 0.28 and a 95% UCLM HQ of 0.95, indicating a potential risk to human health. The mean triclosan concentration reported by Garcia-Santiago et al. (2016) was 5,890 (SD = 3,870) ng/g, while the concentration of triclosan measured in CRD biosolids (n=1) is 1,870 ng/g.

Kennedy/Jenks Consultants (Kennedy/Jenks, 2017) completed a biosolids risk assessment on behalf of Metro Vancouver. A quantitative human health risk assessment was conducted for a small group of COECs detected in biosolids including over the counter pain medications (analgesics) and non-steroidal anti-inflammatory drugs, antidepressants, antibiotics, antimicrobials, plasticizers, and flame retardants. The results of the risk assessment suggested that the concentrations of the COECs in biosolids from the Metro Vancouver region were unlikely to result in adverse health effects to exposed individuals, including children. The assessment further demonstrated that it would take a minimum of a decade and up to one billion years of exposures to the COECs in biosolids to equal a single therapeutic dose of the PPCPs.

The number of PPCPs identified in biosolids continues to grow and there is a general lack of data on the effects of these chemicals in the environment. Given that many of them act via the same mode of action (e.g., endocrine disruptors) and/or belong to the same classes (e.g., antibiotics, SSRIs) it is essential that future assessments consider the combined effect of the mixture of these PPCPs on human health and the environment.

2.4 Prioritization of Unregulated Organic Chemicals in Biosolids (Warke and McAvoy, 2024)

While acknowledging the benefits of the land application of biosolids, Warke and McAvoy (2024) conducted a literature review to compile a database of all reported unregulated organic chemicals (UOCs) present in biosolids. Where data gaps were identified, predictive modelling and an extensive literature search were conducted to determine values for persistence, mobility, bioaccumulation, and toxicity. The prioritization process used these characteristics to rank the UOCs according to their potential impact on human health.

Of 906 chemicals identified in biosolids, 124 were categorized as either high or low priority. Among these, 13 chemicals were classified as carcinogenic, and 22 as endocrine disruptors. Notable examples of endocrine-disrupting chemicals included N-nitrosodimethylamine, cashmeran, nonylphenol, bisphenol A, and several PBDEs. Potential carcinogens identified included 1,2-dichloropropane, 1,4-dioxane, di(2-ethylhexyl)-phthalate, and trichloroethylene.

The priority UOCs were further ranked using scoring based on combinations of mobility, persistence, bioaccumulation, and toxicity. This analysis added eight additional compounds to the high-priority list, resulting in a total of 46 high-priority compounds, with the remaining 78 classified as low priority. The high priority UOCs included several carcinogens (e.g., N-nitrosodiethylamine), endocrine disruptors (e.g., BDE 99, estrone), PPCPs (e.g., fluoxetine, bisphenol-A, carbamazepine, triclosan) and industrial solvents (e.g., trichloroethylene)

Comparison of the Warke and McAvoy (2024) results to those from other studies ranking UOCs in biosolids identified similarities. Of the 46 high-priority UOCs identified by Warke and McAvoy (2024), 38 were also present in other priority lists, including 20 in from Higgins et al. (2010), 14 in a study conducted on behalf of Scottish EPA (WCA, 2019), and 12 in a study conducted by the Texas Commission on Environmental Quality (TCEQ, 2021).

Of the high-priority UOCs identified, several including: bisphenol-A, triclosan, nonylphenol, N-nitrosodimethylamine, 4-chloraniline, triphenyltin (TPhT), and several polybrominated diphenyl ethers (PBDEs) such as BDE 209, BDE 47, and BDE 99, have been associated with effects ranging from endocrine disruption to carcinogenic effects (Warke and McAvoy, 2024). Additionally, triclosan, is known to disrupt thyroid function, may cause reproductive and developmental toxicity and N- nitrosodimethylamine has been linked to neurological, gastrointestinal, and developmental disorders (Warke and McAvoy, 2024).

As noted, previous risk assessments for biosolids-amended soil indicate that most UOCs are below threshold levels for human exposure pathways (HQ < 1). However, Warke and McAvoy (2024) emphasized that preliminary data for pathways involving soil organisms and aquatic systems suggest the potential for HQ values exceeding 1 for certain UOCs including triclocarban, ciprofloxacin, and azithromycin, and that further study is needed for these pathways. Further, while some compounds like caffeine pose minimal risks to humans, they can significantly impact aquatic and soil organisms and antibiotics like ciprofloxacin and azithromycin, as well as fluoroquinolones, have been identified as photosynthetic inhibitors in plants and present potential risks to soil and aquatic ecosystems (Warke and McAvoy, 2024).

While the available data generally support that the measured concentrations of PCPPs in biosolids are low and for the most part do not represent a risk to human health and the environment, the results of Warke and McAvoy (2024) further highlight the number of contaminants in biosolids, and gaps where further research is required to understand potential risks to human health and the environment.

3 Fate and Transport of Contaminants in Biosolids and Considerations of Conditions Typical of the BC South Coast

In sensitive coastal environments, like those present in southern BC, the fate and transport of contaminants, is complex. As discussed throughout this report, land application of biosolids can result in the introduction of a range of contaminants, which may disperse in the environment through soil leaching, erosion, and runoff. This issue is exacerbated by heavy precipitation which can enhance the mobilization of contaminants. Precipitation infiltrates the soil and can leach soluble contaminants into groundwater. In agricultural and rural areas, where biosolids are most likely to be applied, the use of groundwater as a source of drinking water, irrigation water or livestock water, is more likely. Thus, the contamination of groundwater has the potential to result in human health exposures via potable water, as well as livestock and crop exposure. Further, groundwater impacted with contaminants from biosolids can migrate to nearby aquatic systems and result in effects to aquatic ecosystems, as well as entry into the human food chain via seafood consumption.

Heavy rainfall or snowmelt can also create surface runoff, which has the potential to mobilize contaminants from application areas, resulting in impacts to adjacent lands, or migration to nearby water bodies. For example, Crossman et al. (2020) suggested that heavy rainfall may result in the mobilization of microplastics from agricultural soils. The risk of contaminant mobilization via surface runoff is especially high prior to the incorporation of applied biosolids into the soil matrix (LRCS Land Resource Consulting Services, 2016).

Further, prolonged or intense precipitation can saturate soils, resulting in decreased soil adsorption of contaminants and subsequent leaching, as well as soil erosion. Eroded soils carrying adsorbed contaminants may be redistributed across the landscape onto adjacent lands or to nearby waterbodies. Additionally, natural processes such as freeze-thaw and drying cycles can release fine particles from biosolids, facilitating the movement of contaminants into subsurface soils and groundwater.

Tansel et al. (2024) discussed that PFAS persistence and mobility are dependent on soil interactions and precipitation events. Leaching, which is influenced by soil type and water infiltration rates, with higher infiltration rates in areas with high precipitation levels, facilitates PFAS migration to groundwater and surface water. PFAS compounds with long fluoroalkyl chains tend to bind more strongly to solid phases, while shorter-chain PFAS are soluble and prone to leaching and transport. Consistent with other studies (Blake and Fenton, 2020; Drew et al., 2021), Tansel et al. (2024) identified the potential for plant uptake of PFAS from biosolid-amended soils, raising concerns about bioaccumulation in food chains and ecosystems.

PCPPs in biosolids can similarly migrate, with pharmaceuticals showing potential to leach into groundwater (Santiago et al., 2016; Kinney et al., 2006). Gottschall et al., (2012) detected pharmaceuticals and personal care products (PPCPs) in groundwater following biosolids land application. While many PPCPs dissipate within a few months, others, particularly those embedded in biosolid aggregates, can persist for over a year (Kinney and Heuvel, 2020).

Some COECs, due to their persistence and bioaccumulation potential, can be transported long distances. For example, microplastics in biosolids exhibit hydrophobic characteristics, allowing them to adsorb other contaminants. These particles may then be subject to long-range transport (Carbery et al., 2018). Studies (Wang et al., 2024, Strynar et al., 2011) indicate that long-chain PFAS can attach to microplastics or dust and become airborne. These findings raise concerns regarding the multiple contaminant types present in biosolids and their influence not only on the fate and transport of such contaminants, but also on their combined toxicities.

While the science on the fate and transport of COECs in biosolids in advancing, further research is required to fully understand the behaviour of these contaminants in the environment. Field studies in BC that evaluate seasonal influences, such a precipitation levels, on the environmental fate and transport of COECs in biosolids would provide valuable insight, including how the co-occurrence of numerous contaminants impact migration patterns and ultimately exposure pathways for human and ecological receptors.

4 Techniques to Reduce Risks in Biosolids Land Application

Numerous studies have emphasized the importance of government oversight and regulation to limit the risks associated with the land application of biosolids; however, as discussed, available regulations are limited due to the paucity of toxicity data for COECs. This gap, and the uncertainties discussed in Section 6, highlight the critical need for further research, source control to limit the entry of COECs into WWTPs, the development of treatment technologies that degrade COECs in biosolids, and standardized requirements for monitoring COECs in biosolids.

4.1 Recent Research on Treatment Technologies

Recognizing the critical problem that contaminants, and specifically COECs, in biosolids present, recent research has focused on treatment technologies that remove COECs. As noted, conventional WWTPs were not designed to remove COECs and thus, these contaminants will continue to persist in inputs to WWTPs.

Much recent research has been focused on technologies that destroy PFAS. An PFAS Innovative Treatment Team was formed by the USEPA is 2020 to investigate and develop innovative tools and methods to break the carbon fluorine (C-F) bonds in PFAS-containing waste. Four emerging technologies were identified by the team with a technology's suitability dependent on waste characteristics, processing requirements, and potential byproducts, as well as considerations for energy consumption, costs, and system mobility (Berg et al., 2022). Berg et al. (2022) also indicated that additional pretreatment and post-treatment steps may be necessary to enhance effectiveness and manage byproducts, such as volatile PFAS emissions.

The four emerging technologies were summarized by Berg et al. (2022) and include:

- Mechanochemical destruction (MCD), which has been shown to result in over 99% PFAS destruction in laboratory settings. The authors note that this technology requires further study for commercial-scale application.
- Electrochemical oxidation (EO), which uses electrical currents to break C-F bonds in PFAS, has shown successful bench and pilot-scale results, but faces challenges in scaling up.
- Supercritical water oxidation (SCWO) treats waste at high temperatures and pressures, producing heat that can sustain the process, but requires managing acidic byproducts and salt precipitation.
- Pyrolysis and gasification decompose materials at high temperatures, potentially destroying PFAS, and produce useful byproducts like char and syngas. Further research on this technology was noted to be required.

Research briefs on these technologies are available on the PITT's website, providing detailed information on benefits and areas needing further research available at https://www.epa.gov/chemical-research/pfas-innovative-treatment-team-pitt. Each of these technologies were noted by US EPA to be under evaluation, with further pilot-testing and reporting of the results planned for 2021; however, no further updates on these technologies were identified on the above webpage. While showing promise, the technologies are not yet commercially available.

Keller et al. (2024) pyrolyzed biosolid samples from a WWTP in Southern California at temperatures ranging from 400 to 700 °C for two hours. The study evaluated contaminant removal, with most contaminants being eliminated entirely and only minimal residuals detected. Notably, no PFAS were detectable at the lowest temperature tested (400 °C), and overall removal of PPCPs exceeded 99.9%. Microplastic removal ranged from 91 to 97% depending on conditions. Additionally, the resulting biochar was rich in iron and phosphorus, making it a valuable fertilizer additive. The authors of the study indicated that a techno-economic analysis showed that pyrolysis could lead to significant cost savings, with revenue from biochar sales having the potential to offset the capital and operational costs of the drying and pyrolysis systems.

Vo et al. (2024) assessed treatment technologies for microplastics and organic contaminants in biosolids. Their multi-criteria analysis identified anaerobic digestion as the most established and practical approach, indicating that while thermal treatment shows potential, the application requires further advancements in infrastructure, regulatory frameworks, and public acceptance to become widely viable.

Recent studies have explored advanced oxidation treatment methods which are reportedly effective at degrading COECs including PPCPs and PFAS. Booton et al. (2024) indicate that chemical oxidation offers a promising alternative and eliminates persistent contaminants. Compared to biological systems, it is potentially simpler to operate and maintain, while requiring less space for efficient treatment. Key advantages of chemical oxidation are reported by the authors to include its ability to address COECs, its rapid start-up and shutdown capabilities, and its ability to avoid common challenges in biological treatment, such as toxic load management, biomass washout, sludge settling issues, and the complexities of sludge handling and disposal.

The recent research illustrates the potential for available technologies to destroy COECs, demonstrating that with further testing and implementation, that the risks association with the land application of biosolids could be greatly reduced.

4.2 Application Techniques and Site-Specific Application Considerations

Specific application techniques, such as injection, surface incorporation and amendment/mixing of biosolids to produce a biosolids growing media, have been demonstrated to reduce risks associated with biosolids land application. Injecting biosolids below the soil surface reduces bioaerosol dispersion, wind and water erosion, and prevents exposure to contaminants by reducing dust generation and the potential for surface contact. Injection also reduces adherence to plant tissues, and therefore exposures to livestock and wildlife. Similar results may be achieved by mixing biosolids into soil immediately after application (LRCS Land Resource Consulting Services, 2016).

BC ENV (2008), LRCS Land Resource Consulting Services (2016) and others have provided recommendations for reducing risks associated with the land application of biosolids. The recommendations include risk-based planning to reduce exposures, including avoiding sensitive ecosystems and proximity to water bodies, as well as areas with shallow groundwater where leaching of contaminants is more likely. Further, the use of personal protective equipment for workers, adhering to buffer zones required in the OMRR and avoiding application during heavy rainfall and snowmelt will further reduce exposures and the potential for contamination of groundwater and surface water. Implementing waiting periods between application and livestock (and wildlife) exposures is also recommended.

The amendment of biosolids with biochar or wood chips, as done in the CRD, has also been demonstrated to enhance the degradation and/or retention of leachable PPCPs (Pozzebon and Siefert, 2023).

5 Limitations of Extrapolating Lab-Based Testing to the Environment

The limitations in extrapolating lab-based toxicity testing results to real-world environmental scenarios are generally recognized and have been well documented by others (Cairns, 1983; Smith and Cairns, 1993; Hill et al., 1994). These limitations are exacerbated when considering the land application of biosolids owing to the large number of contaminants, including COECs, present in biosolids, and as the fate and toxicity of these contaminants which will vary depending on the mixture present and the application site characteristics. Controlled laboratory conditions cannot replicate the complex, variable nature of these environments.

The key limitations that arise during this extrapolation process include:

1. Laboratory tests are conducted under highly controlled conditions, which typically include simplified systems that do not reflect the complexity of the natural environment. Factors such as contaminant mixtures, environmental conditions (e.g., soil type, pH), and contaminant exposure pathways cannot be replicated in a lab setting.
2. Lab tests typical assess the effects of a single chemical or a small group of related chemicals. In the environment, specifically in the case of biosolids, organisms are exposed to complex mixtures with potential additive, synergistic, or antagonistic effects.
3. Lab studies typically expose test organisms to high concentrations of a single contaminant over short durations in confined spaces, with even chronic tests typically limited in duration. This does not reflect environmental exposures which often involve chronic exposures to low levels of contaminants over large areas. The effects of chronic, low dose exposures are typically underestimated in lab settings, leading to potential inaccuracies when predicting chronic toxicity in the natural environment.
4. In toxicity testing, exposures are usually simplified and typically limited to immersion in a contaminated medium or direct ingestion or inhalation. In natural environments contaminants exposure pathways are more complex and may include cross-media exposures, including food chain exposures. This oversimplification has the potential to underestimate exposures and associated effects.
5. Lab toxicity test methods have been developed for a limited number of species, focusing on model organisms that may not be representative species that are most sensitive to a specific contaminant. Further, lab tests may not include life stages (e.g., juveniles, larvae) most sensitive to the contaminants tested.
6. Laboratory organisms are often maintained in stable environments and lack the physiological adaptations that organisms may develop in response to natural stressors. Additionally, organisms may behave differently in the lab setting compared to in their natural environment, potentially influencing their exposure and response to contaminants.
7. In natural environments, interactions with abiotic factors (e.g., soil composition) and biotic factors (e.g., predation) may influence toxicity. These factors cannot be accounted for in a laboratory.

The above limitations of laboratory-based toxicity studies highlight the need for caution when extrapolating laboratory testing results to the environment. As noted, given the complex contaminant mixtures known to be present in biosolids, the likely potential for synergistic or additive effects, as well as the influence of the characteristics of the application area on fate and toxicity, the importance of field studies in the assessment of potential risks from the land application of biosolids cannot be understated. Field observations, together with laboratory toxicity testing, are essential to understanding risks. The collective results of both, once available, should be considered in the establishment of a risk-based, adaptive management strategy for the land application of biosolids.

6 Uncertainties in the Risks Associated with the Land Application of Biosolids

Numerous uncertainties exist in the assessment of risks associated with the land application of biosolids. Many of these uncertainties have been documented by others (McCarthy, 2015; Pozzebon and Siefert, 2023; Garcia-Santiago et al., 2020; Schoof and Houkal, 2005; LRCS, 2016), including those summarized below and discussed in previous sections of this report. The rapidly evolving science on COECs in biosolids and their fate and effects following land application, as well as the very recent government policies and regulations pertaining to COECs in biosolids in Canada and elsewhere (e.g., CFIA October 2024 limit for PFAS in biosolids; Government of Canada July 2024 draft report of PFAS; Government of Canada 2023 funding for research on microplastics), underscore that the science on COECs is “emerging”.

Some of the key scientific gaps and uncertainties related to the land application of biosolids are summarized below:

1. Regulatory agencies have not derived limits for most COECs in biosolids, and further, given the paucity of toxicity (including ecotoxicity and specifically for wildlife at all trophic levels) and fate data for COECs, have not derived environmental quality standards. For the same reason, risk assessments evaluating the potential human health and environmental risks associated with exposures to COECs in biosolids, are limited and have generally focused on only a few of the more common COECs.
2. Due to advances in analytical chemistry methodologies, new COECs present in biosolids continue to be identified. The fate and effects of these contaminants are not well understood and thus, it is not possible to assess the potential for risks to human health and the environment.
3. Existing risk assessments and other evaluations of COECs in biosolids are focused on individual contaminants and are based on toxicity data from laboratory toxicity tests. These risk assessments do not consider that exposures to biosolids would result in the simultaneous exposure to numerous contaminants, and the potential for the contaminants to act additively or synergistically and thus are likely to have underestimated the potential for risks.
4. Similarly, the coexistence of numerous contaminants in biosolids may affect their fate, transport and distribution and therefore potential exposure pathways for human and ecological receptors. As an example, Wang and Good, (2024) identified that microplastics in biosolids can act as vectors for the long-range transport of PFAS. Field studies evaluated the influence of the contaminant mixtures present in biosolids on their environmental fate and transport are required to address this uncertainty.
5. The limited available toxicity data for most COECs is based on laboratory toxicity testing. The limitations and uncertainties associated with lab studies, and the need for field studies to be considered in the interpretation of risks, is highlighted in Section 5.
6. The long-term impacts of COECs in biosolids after land application, including their potential to accumulate overtime, leach into groundwater, enter the food chain, or impact human health or wildlife, are not fully understood. Further research in these areas is essential for the assessment and management of risks.
7. Efficient technologies for detecting and measuring COECs in biosolids and the environment are underdeveloped. Without reliable monitoring, it is challenging to assess or mitigate potential risks associated with contaminants in biosolids.

The rate at which our understanding of COECs in biosolids is advancing, with new data on the fate and effects of COECs being published continuously, underscores the importance an adaptive management framework for the land application of biosolids. . With time, it is anticipated that the uncertainties and data gaps identified here and elsewhere will be addressed, and thus regulators must keep pace with the evolving science and regularly weigh the risks and benefits of the practice in an informed and transparent manner.

7 Biosolid Land Application Bans

Several countries have restricted or banned the land application of biosolids due to concerns about environmental contamination, health risks, and public opposition primarily related to the presence of PFAS in biosolids, and their associated entry into the environment, specifically the human food chain.

In Canada, the land application of biosolids has been banned in specific regions due to environmental and public health concerns. In British Columbia, the Capital Regional District implemented a ban on the land application of biosolids in 2011. The ban was implemented due to concerns regarding COECs in biosolids, and to protect local drinking water sources, the environment, and public health. In March 2023, Quebec announced a temporary ban on the import and land application of biosolids originating from the United States due to concerns over PFAS contamination in imported biosolids. The province is working towards establishing standards for PFAS in biosolids to ensure environmental safety.

The following is a summary of the various countries that have banned or implemented strict regulations on the land application of biosolids.

7.1 United States of America

In the U.S.A., some states and municipalities have imposed restrictions or moratoriums on the land application of biosolids. In 2022, Maine became the first state to ban the land application of biosolids after it found PFAS had contaminated crops or water on over 50 farms throughout the state where sludge had been spread (Carey, 2023). Other states are starting to implement limits and bans. As of October 1, 2024, Connecticut prohibited the sale of PFAS-containing biosolids or wastewater sludge. Further, Michigan, New York, and Wisconsin have implemented interim strategies that limit the PFAS concentrations allowed in land-applied biosolids, and Colorado's interim strategy requires Source Control Programs to evaluate potential PFAS sources if concentrations in biosolids exceed a determined level.

Several more states have pending legislation that would enforce similar restrictions. As an example, Massachusetts is developing legislation that would set maximum levels for the amount of PFAS allowed in any fertilizer sold in the retail market, and proposed legislation in Oklahoma would require a warning label on any product derived from biosolids or sewage sludge.

7.2 Europe

In Europe, several countries have adopted a precautionary approach in banning the land application of biosolids, emphasizing soil and food safety. Switzerland has had a ban on agricultural use in place since 2006 with their current regulation requiring sewage sludge to be combusted, while the Netherlands has imposed stringent limits on several contaminants commonly identified in biosolids, resulting in very limited use. Due to concerns over COECs, including PFAS, pharmaceuticals and microplastics, Sweden, Germany and Austria (Vienna region) have banned the application of biosolids on agricultural land. The ban in Germany was implemented with the amendment of the German Sewage Sludge Ordinance in 2017, and by 2029 biosolids land application will be phased out. Germany is reportedly shifting towards incineration of sewage sludge and phosphorus recovery.

8 Discussion and Conclusion

In British Columbia, approximately 38,000 tonnes of biosolids are produced annually, with approximately 72% of biosolids and biosolids-derived products applied to land (BC ENV, 2019). As discussed throughout, while there are many benefits associated with the land application of biosolids, biosolids contain a complex mixture of contaminants, including COECs. Data on the fate and effects of these COECs is limited, and our understanding of the risks that these contaminants present to human health and the environment is rapidly evolving.

When weighed collectively, the available information on the land application of biosolids, including the information presented by others (e.g., Pozzebon and Siefert, 2023; LRCS Land Resource Consulting Service, 2016; McCarthy, 2015; BC ENV, 2024) and herein, supports the assessment of the practice in the context of the Precautionary Principle. The Precautionary Principle guides decision-makers to take action to protect the environment and public health in the face of environmental or health uncertainties (Goldstein, 2001).

Given the significant data gaps and uncertainties in the land application of biosolids, as well as the rapidly advancing science, previous studies that have concluded a low risk to human health and the environment must be interpreted in the context of the uncertainties. Risk assessments are conducted using the best scientific evidence available at the time of the assessment but must consider the unknowns in the overall interpretation of risks and in management decisions (Yoe, 2019, CSAP, 2016). Based on the data gaps and uncertainties summarized in Section 6, the uncertainty in the risk conclusions made to date, and specifically the potential for the assessments to have underestimated risks to human health and the environment, is categorized as moderate to high, and thus, is not supportive of a conclusion of low risk (CSAP, 2016). Rather, based on the uncertainties and the potential for the assessments to have underestimated risk, the risk conclusions are also uncertain, and cannot be further understood until the data gaps are resolved and the uncertainties are decreased.

In the context of biosolids from the CRD, with the data for PFAS and triclosan discussed herein, a review of the data indicates that the concentrations of the COECs are lower than measured in other Canadian biosolids. As noted, the comparison of the low concentrations of COECs with existing toxicity data suggests that the COECs in CRD biosolids represent a negligible to low risk to human health and the environment. Despite this, given the uncertainties discussed in Section 6, the uncertainty in this conclusion is moderate to high and should be reviewed regularly as the science on biosolids evolves.

Oberg and Mason-Renton (2018) examined how uncertainties and gaps in scientific knowledge were addressed and communicated in British Columbia, compared to Sweden, during their jurisdictional review of regulations on the land application of biosolids. The study highlighted how the jurisdictions had approached the uncertainty in the land application of biosolids differently; with BC taking the position that the absence of evidence of risk implies the practice is safe. Sweden, however, prioritized a precautionary approach, operating under the assumption that the absence of evidence or risk is not equivalent to evidence of absence (Oberg and Mason-Renton, 2018).Given the benefits of the land application of biosolids, the Canada-wide approach (CCME, 2012) encouraging the beneficial use of biosolids versus disposal, and as the scientific evidence available to date suggests that the land application of biosolids represents a negligible to low risk, Sweden's approach is likely overly restrictive.

Applying the Precautionary Principle aligns with using an adaptive management framework for the land application of biosolids. As noted, with time, it is anticipated that the uncertainties and data gaps identified in this report and elsewhere will be addressed, and thus regulators must keep pace with the evolving science and regularly weigh the risks and benefits of the practice in an informed and transparent manner. In the interim actions such as source control to limit the introduction of COECs to WWTPs, adopting advanced treatment technologies as they become available, careful site selection through the application of risk-based principles, and ongoing monitoring to minimize risks, are essential for the protection of human health and the environment. Such strategies are increasingly emphasized in regulatory guidelines around the globe to ensure biosolids use does not compromise human health and the environment. This approach addresses both the potential risks and the benefits of nutrient recycling while minimizing ecological and human health hazards (Schoof & Houkal, 2005; Gianico et al., 2021).

9 Limitations

This report has been prepared and the work referred to in this report has been undertaken by Dr. Chris Kennedy for the Capital Regional District (CRD). Dr. Chris Kennedy makes no representation or warranty to any other person with regard to this report and the work referred to in this report and he accepts no duty of care to any other person or any liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm that may be suffered or incurred by any other person as a result of the use of, reliance on, any decision made or any action taken based on this report or the work referred to in this report.

This report has been prepared based on the CRD Terms of Reference and the literature identified during the review. Dr. Chris Kennedy expresses no warranty with respect to the accuracy of the data reported in the literature.

The evaluation and conclusions reported herein do not preclude the identification of additional literature pertinent to the contaminants discussed in this report. If new literature/studies become available, modifications to the findings, conclusions and recommendations in this report may be necessary.

Where information obtained from reference sources is included in the report, no attempt to verify the reference material was made. Dr. Chris Kennedy expresses no warranty with respect to the toxicity data presented in various references or the validity of the toxicity studies on which it was based. Scientific models employed in the evaluations were selected based on accepted scientific methodologies and practices in common use at the time and are subject to the uncertainties on which they are based.

Nothing in this report is intended to constitute or provide a legal opinion. Dr. Chris Kennedy makes no representation as to the requirements of or compliance with environmental laws, rules, regulations or policies established by federal, provincial or local government bodies. Revisions to the regulatory guidelines and standards referred to in this report may be expected over time, especially considering the evolving nature of the science for many of the contaminants evaluated. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary.

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File: 0360-20
Climate Action Task Force

Capital Regional District

Meeting Minutes
Climate Action Inter-Municipal Task Force (IMTF)

Friday, December 6, 2024	**9:30 AM**	**MS Teams**

Present: Councillor A. Baird (Highlands), Councillor J. Brownoff (Saanich), Councillor D. Cavens (Esquimalt), Councillor S. Duck (Sidney), Councillor M. Gardiner (Victoria), Councillor S. Gray (Metchosin), Councillor D. Grove (Colwood), Director G. Holman (SSI EA), Councillor S. Riddell (Central Saanich), Councillor C. Smart (Oak Bay), Councillor T. St-Pierre (Sooke), Councillor M. Wagner (Langford), Director A. Wickheim (JdF EA)

Staff: N. Elliott (Manager, Climate Action Programs), M. Greeno (Community Energy Specialist), M. Rowe (Climate Action Program Assistant, Recorder)

Regrets: Director P. Brent (SGI EA), Mayor P. Jones (North Saanich), A. MacKenzie (View Royal)

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

1. Welcome and Introductions

- A round of introductions was made by Task Force members, and CRD staff.

2. Territorial Acknowledgement

- N. Elliott provided a Territorial Acknowledgment.

3. Approval of Agenda

- Agenda for the December 6, 2024 Climate Action Inter-Municipal Task Force meeting.

4. Adoption of Minutes

- Minutes from the September 27, 2024 Climate Action Inter-Municipal Task Force meeting.

  MOVED by Councillor D. Grove, SECONDED by Councillor T. St-Pierre
  That the minutes of the September 27, 2024 Climate Action Inter-Municipal Task Force meeting be adopted as circulated.
  CARRIED

5. Climate Action Program Updates

- N. Elliott provided background information and updates for the CRD Climate Action Service, including:
  - Climate Action Strategy renewal timelines, CRD 2025 Provisional Budget

approval, forthcoming CRD services going through AAP processes (Foodlands Access Service, Biodiversity & Environmental Stewardship service, Transportation Governance service), climate adaptation capacity building grant application, climate adaptation backgrounder report, CRD Public EV Charging Network, Zero Carbon Step Code, Home Energy Navigator regional building retrofit program, energy benchmarking/Energy and Carbon Emissions Reporting, additional policy analysis, and the launch of new thermal imaging kits with local libraries.

- Members advised that the CRD consider:
    - A member requested staff reassess the Task Force's role and purpose, with other members affirming the value of the meetings for collaboration and information sharing. It was agreed to revisit this topic in the new year through future meetings and as it pertains to the Climate Action Strategy renewal.
    - Evaluating the costs related to climate action and inaction.
    - Opportunities to share key information with local governments (staff and Councils) to avoid redundancy, ensure alignment and build capacity across the region.
    - Opportunities to advocate more effectively to the province with respect to climate considerations.

Action:

a) CRD staff to engage Task Force on CRD Climate Action Strategy renewal beginning in March 2025.

6. Municipal Roundtable – Open Discussion

- Attendees provided brief updates regarding current projects and areas of interest in their respective municipalities and electoral areas. Discussion related to staff capacity changes, managing competing priorities and budget considerations, communicating climate action costs in budget, public education and awareness building about local government climate action, multi-residential stakeholder engagement, waste disposal services, in-vessel composting, green fleet plans, building retrofits, corporate risk assessments, tree planting, energy benchmarking, FireSmart work, active transportation and EV infrastructure, climate plan and bylaw updates, infrastructure project implementation challenges and public feedback.

Action:

b) CRD staff to include a link to UBC study of Saanich E-Bike Incentive Program Pilot with meeting minutes.

7. Community Mobilization Discussion & Feedback

- CRD staff provided an update on research completed related to the community mobilization initiative. Members provided feedback for consideration on proposed recommendations, including:
    - Hosting a climate calculator on the CRD website like Saanich's.
    - Hosting a municipal/EA competition to encourage climate action. Councillor A. Baird created "Municipal Survivor Climate Challenge" a few years ago.
    - Sustainable operational funding for climate action for local non-profits.
    - Coordinating with CRD Arts & Culture Support Service for grant opportunities.

- Supporting youth climate action involvement, particularly through the arts.
- Focus on inspiration, hope, envisioning the future that we want.
- Support non-profit coordination.
- Look at investments through a climate lens.

8. Meeting Admin for 2025

- Confirmed that Friday mornings still work best for majority.

Actions:

c) CRD staff to send out calendar holds for the 2025 quarterly Task Force meetings.
d) CRD staff to work with IT to solve issues with SharePoint Collaboration Site access.

9. Adjournment

- Meeting adjourned at 11:30 am.

New Actions	Responsibility	Timeline
CRD staff to engage Task Force on CRD Climate Action Strategy renewal beginning in March 2025.	Staff	Next meeting
CRD staff to include a link to UBC study of Saanich E-Bike Incentive Program Pilot with meeting minutes.	Staff	ASAP
CRD staff to send out holds for the 2025 quarterly Task Force meetings.	Staff	Early 2025
CRD staff to work with IT to solve issues with SharePoint access.	Staff	ASAP
Past Actions	**Responsibility**	**Timeline**
Members to utilize Task Force SharePoint site to share key documents and resources between members. If you need assistance accessing the collaborative site, please contact staff.	IMTF	Ongoing
Members to provide future meeting topic requests to Manager, Climate Action Programs.	IMTF	Ongoing
CRD staff to attach the minutes from the previous meeting with future meeting invites, in addition to linking to the SharePoint collaboration site.	Staff	Ongoing

From:	Colin Plant
To:	CRD Chair; Barbara Desjardins
Cc:	Ted Robbins; Marlene Lagoa
Subject:	Motion with Notice "heads up"
Date:	Friday, January 31, 2025 9:02:22 AM

Hello Cliff, Barb, Ted and Marlene,

I am sending this email in the spirit of 'no surprises'.

As Ted will know I have been corresponding with staff about a potential demolition waste and deconstruction model bylaw the CRD could help develop and then share with regional partners. Staff were so kind to help even provide the draft language below.

"That staff be directed to develop a model bylaw for demolition waste and deconstruction for municipalities in the capital region, and that the attached City of Victoria bylaw ***be used as a starting point."***

I am writing because it is my intention (and I understand staff to be supportive of this direction) that I will serve this Motion with Notice on February 12th at our Board meeting and request you direct it to the Environmental Services Committee on February 19th for consideration.

I am not asking you to weigh in today on the merits or value of the bylaw but would welcome any concerns or comments you may have about my proposed process noted in this email.

All the best. Stay warm!

C.

NO. 22-062

DEMOLITION WASTE AND DECONSTRUCTION BYLAW

A BYLAW OF THE CITY OF VICTORIA

The purposes of this Bylaw are to regulate, prohibit, and impose requirements to ensure that waste and reusable materials resulting from demolition work are managed in a manner that enhances and protects the well-being of the community and to ensure the efficient use of waste disposal and recycling services.

Contents

Under its statutory powers, including sections 8(3)(g), 8(4), 16, 64, 65, and 194 of the *Community Charter*, the Council of the Corporation of the City of Victoria in an open meeting assembled enacts the following provisions:

PART 1 - INTERPRETATION

Title

1 This Bylaw may be cited as the "Demolition Waste and Deconstruction Bylaw".

Definitions

2 In this bylaw:

The following words have the same meaning ascribed to these terms in Division A, section 1.4 of the BC Building Code: basement, first storey, floor area, storey;

"above-ground floor area" means the sum of the floor area of each storey including the first storey and any upper storeys, but excluding the basement;

"Building Bylaw" means the *Building and Plumbing Regulation Bylaw* No. 08-058;

“building official” has the same meaning ascribed to this term in the Building Bylaw;

“Bylaw Notice Adjudication Bylaw” means the *Bylaw Notice Adjudication Bylaw* No. 16-017;

“Director” means the City’s Director of Engineering and Public Works or their designated representative;

“rate adjustment” means a formula to calculate the reduced salvaging rate under section 3(4), as follows: salvaging rate minus kilograms of damaged or post-1960 wood divided by above-ground floor area, using a conversion of 1.33 kilograms per board foot;

“recycling” means the process of collecting, sorting, cleaning, treating and reconstituting materials that would otherwise be waste, and converting them into material that can be used for new products, and includes storage for such purpose;

“reuse” means further or repeated use of wood originating from work, and includes storage for such purpose but does not include recycling;

“salvaging” or “salvaged” means the removal of wood originating from work such that the materials are protected from damage and kept intact for:

i. reuse;

ii. sale or donation to a business or organization that resells or builds products using salvaged wood; or

iii. donation to a charitable organization that reuses or sells for reuse salvaged wood and is registered under the *Income Tax Act* (Canada) or a non-profit organization to which section 149 of the *Income Tax Act* applies;

“salvaging rate” means the amount of wood required to be salvaged, as specified in Column 1, Table 1, Schedule C, in order to be eligible for a waste management fee refund;

“single family dwelling” has the same meaning ascribed to this term in the Zoning Bylaw;

“two family dwelling” has the same meaning ascribed to this term in the Zoning Bylaw;

“waste management fee” means the fee amount specified in section 3(1)(b);

“waste management fee refund” means the partial or complete refund of a waste management fee calculated in accordance with Schedules A and C;

"wood" includes dimensional lumber from studs, joists, beams, posts, blocking, headers, sheathing, rafters and flooring with a moisture content of 20% or less and suitable for salvaging, but excludes particle board and medium-density fibreboard material;

"work" means activities that require a building permit under the Building Bylaw that includes the complete or near-complete removal of a structure through demolition, deconstruction, disassembly, or relocation of a:

i. single family dwelling constructed prior to 1960; or

ii. two family dwelling constructed prior to 1960;

"Ticket Bylaw" means the *Ticket Bylaw* No. 10-074; and

"Zoning Bylaw" means the *Zoning Regulation Bylaw* No. 80-0159.

PART 2 - REGULATIONS

Waste Management Fee and Fee Refund

3 (1) A person who carries out or causes to carry out work must submit to the City:

(a) a non-refundable administration fee of $500 at the time of submitting an application for a building permit for work;

(b) a waste management fee of $19,500 at the time of submitting an application for a building permit for work;

(c) a report within 90 days of completion of the work in the form prescribed in Schedule A; and

(d) supporting documentation listed in Schedule B attached with the report in subsection (c).

(2) Notwithstanding section 19(1) of the Building Bylaw, a person is not required to submit a separate building permit application fee for the work in addition to the fee under subsection (1) of this bylaw.

(3) The holder of the building permit for work who has fulfilled the requirements under subsection (1) and met the salvaging rates to the satisfaction of the Director, is eligible for a waste management fee refund.

(4) Where, prior to submitting a building permit application for the work, the amount of wood available for salvaging was damaged by natural disaster, fire, water, insect infestation, or other causes or was added to a structure after 1960, then:

(a) the person may apply for a reduced salvaging rate by submitting supporting documentation listed in section iii., Schedule B, to the satisfaction of the Director; and

(b) the Director shall reduce the salvaging rate by applying the rate adjustment where, in the opinion of the Director, the criteria in this subsection (4) have been met.

(5) No fee refund shall be issued under this part where the building permit for the work has expired pursuant to the Building Bylaw.

Signage

4 A person who carries out or causes to carry out work must post signage on the site of the work in accordance with Schedule D of this bylaw within 10 days of receiving a building permit for the work and maintain such signage on site for a period of 90 days.

Prohibition

5 No person shall knowingly submit false or misleading information to a building official in relation to any waste management fee refund application or related documentation pursuant to this bylaw.

PART 3 – GENERAL

Inspections

6 (1) The Director, a City employee authorized by the Director, or bylaw officer may enter on or into property in accordance with section 16, *Community Charter*, to inspect and determine whether all regulations, prohibitions, and requirements of this bylaw are being met.

(2) A person must not prevent, obstruct, or attempt to prevent or obstruct, an entry authorized under subsection (1).

Offences

7 (1) A person commits an offence and is subject to the penalties imposed by this bylaw, the Ticket Bylaw, the Bylaw Notice Adjudication Bylaw, and the *Offence Act* if that person:

(a) contravenes a provision of this bylaw,

(b) consents to, allows, or permits an act or thing to be done contrary to this bylaw, or

(c) neglects or refrains from doing anything required by a provision of this bylaw.

(2) Each day that a contravention of a provision of this bylaw continues is a separate offence.

Penalties

8 A person found guilty of an offence under this bylaw is subject to a fine of not less than $100.00 and not more than $50,000.00 for every instance that an offence occurs or each day that it continues.

Severability

9 If any provision or part of this Bylaw is declared by any court or tribunal of competent jurisdiction to be illegal or inoperative, in whole or in part, or inoperative in particular circumstances, it shall be severed from the bylaw and the balance of the bylaw, or its application in any circumstances, shall not be affected and shall continue to be in full force and effect.

Consequential Amendments to Ticket Bylaw and Bylaw Notice Adjudication Bylaw

10 (1) The Ticket Bylaw is amended as follows:

(a) in the table of contents, by inserting the following immediately after "Schedule K – Dance (Club) Bylaw Offences and Fines":

"Schedule K.1 – Demolition Waste and Deconstruction Bylaw Offences and Fines"

(b) In Schedule A, Bylaws & Enforcement Officers, by adding the following row immediately after item number 11, and renumbering each subsequent row accordingly:

12	Demolition Waste and Deconstruction Bylaw	Bylaw Officer

(c) by inserting immediately after Schedule K, Schedule K.1 attached to this bylaw as Appendix 1.

(2) The Bylaw Notice Adjudication Bylaw is amended as follows:

(a) in section 8(2) by adding "Bylaw Officer" immediately before the words "Customer Service Ambassador";

(b) in section 8(3), by adding "Bylaw Officer" immediately before the words "Manager – Parking Services";

(c) in Schedule A, by adding the following rows immediately after the last offence listed under the Streets and Traffic Bylaw:

Demolition Waste and Deconstruction Bylaw No. 22-062			
4	Fail to post sign as required	$150.00	$125.00

5	Give false/misleading information	$300.00	$250.00
6(2)	Prevent/obstruct inspection	$500.00	$500.00

PART 4 - TRANSITION, REPEAL, COMMENCEMENT

Definitions in Relation to this Part

11 In this Part:

"development permit" means a permit issued under section 490 of the *Local Government Act*;

"multiple dwelling" has the same meaning ascribed to this term in the Zoning Regulation Bylaw No. 80-0159.

Transition Provision

12 Section 3(1) does not apply if the person has an approved development permit to construct a multiple dwelling on the same site as an existing single family dwelling or two family dwelling.

Repeal of Transition Provision

13 Sections 11 and 12 of this bylaw are repealed.

Commencement

14 This bylaw comes into force on September 12, 2022, except:

(a) section 3(1)(b), which comes into force on September 12, 2023;

(b) section 13, which comes into force on May 12, 2025.

READ A FIRST TIME the	**16th**	day of	**June**	2022
READ A SECOND TIME the	**16th**	day of	**June**	2022
READ A THIRD TIME the	**16th**	day of	**June**	2022
ADOPTED on the	**23rd**	day of	**June**	2022

"CURT KINGSLEY" CITY CLERK	**"LISA HELPS"** MAYOR

Schedule A
Material Salvage and Disposal Report

Table 1: Project Information

Project address	
Building permit number	
Person or contractor who carried out the salvage	
Demolition or deconstruction completion date	

Table 2: Wood Salvaged for Reuse, Sale or Donation

Load of wood	Identify which entity is receiving the material or describe how material is being reused*	Date on scale receipt	Scale location	Net weight (tonnes)
1				
2				
3				
…				
			Total	
Salvage rate achieved $\frac{Total\ tonnes\ salvaged\ for\ reuse,\ sale\ or\ donation}{above-ground\ square\ metres} \times \frac{1000\ kg}{1\ tonne} = \_\_\_\_\_\_ \frac{kg}{square\ metre}$				
___ House relocated for use at another location (check if applicable)				

[*See definitions of “wood”, “reuse” and “salvaging” for acceptable wood, reuse activities or sale or donation entities*]

Table 3: Description of Salvaged Wood

Species	Wood Dimension or Description	Board feet
	1 x 4, 6, 8, 10, 12	
	2 x 4, 6, 8, 10, 12	
	4 x 4, 6, 8, 10, 12	
	Other	
	Solid wood flooring	
	Total board feet:	
	Number of solid wood doors: ___________	

Table 4: Materials Sent to Disposal

Load of mixed waste or other material sent to disposal	Material Disposed		
	Date	Facility Name	Metric tonnes or kilograms
1			
2			
3			
…			
		Total:	

Schedule B
Supporting Documentation

i. Wood salvaged for reuse, sale, or donation:

- Receipts for sale/donation of wood salvaged for reuse indicating business or organization name, quantity of wood and date*, or
- For wood stored for future reuse: address(es) of storage location(s) and contact information for site manager(s) at storage location(s), and
- Scale receipts for each load of wood sold, donated, or stored, indicating scale location, quantity of wood in kilograms or metric tonnes, and date

OR, for quantities less than 500 kg:

- Photos of salvaged wood at location of work before reuse (location must be recognizable), and
- For each type of reuse: quantities in board feet, photo(s) of reuse, description(s) of reuse, address(es) of reuse, and contact information for site manager(s) at location(s) of reuse*

OR, if the house as constructed was relocated for reuse:

- Documentation to demonstrate the move and the site to which the house was relocated

[**See definition of "reuse" and "salvaging" for acceptable reuse activities or sale or donation entities*]

ii. Mixed waste or other material sent to disposal:

- Disposal facility tipping receipts indicating facility name, date, material type and quantity by load

iii. Evidence of damage to salvageable wood, or additions or alterations after 1960, if applicable:

- Quantity in board feet of wood that is damaged or was added after 1960
- Written description of the cause of damage (e.g., fire, water, insect infestation), or additions or alterations made after 1960)
- Building plans with dimensions indicating impacted area(s)
- Building permits for alterations and additions made after 1960 if applicable
- Photos clearly showing damaged wood in situ and the impacted area(s) within the structure, or areas that were added or altered after 1960, prior to demolition or deconstruction;
- Other information that in the Director's opinion, is reasonably necessary for assessing the scope of damage, or additions after 1960.

Schedule C

Waste Management Fee Refund

Table 1: Fee Refund

Column 1 – Salvaging rate: Amount of wood salvaged per unit of above-ground floor area	**Column 2 - Amount of waste management fee refund**
More than or equal to 40 kg per square metre	100%
30 kg to 39 kg per square metre	75%
Less than 30 kg per square metre	0%

Schedule D
Sign Posting Procedures

1. The owner or owner’s agent shall post the sign or signs in a prominent location, clearly visible from the street, and on the site that is subject to the work.

2. The City shall determine the specifications, format and content of the sign or signs and provide the specifications to the owner or their agent.

3. The owner or owner’s agent shall, at its sole expense, prepare the signs in accordance with the specifications provided by the City.

Appendix 1

Schedule K.1

Demolition Waste and Deconstruction Bylaw Offences and Fines

Column 1 – Offence	Column 2 – Section	Column 3 – Set Fine	Column 4 – Fine if paid within 30 days
Fail to post sign as required	4	$150.00	$125.00
Give false/misleading information	5	$300.00	$250.00
Prevent/obstruct inspection	6(2)	$500.00	$500.00