Capital Regional District

625 Fisgard St.,
Victoria, BC V8W 1R7

Notice of Meeting and Meeting Agenda
Capital Regional District Board

Wednesday, February 9, 2022 | **1:00 PM** | **6th Floor Boardroom, 625 Fisgard Street, Victoria, BC**

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 THE AGENDA

3. ADOPTION OF MINUTES

3.1. 22-099 Minutes of the January 12, 2022 Capital Regional District Board Meeting

Recommendation: That the minutes of the Capital Regional District Board meeting of January 12, 2022 be adopted as circulated.

Attachments: Minutes - January 12, 2022

4. REPORT OF THE CHAIR

5. PRESENTATIONS/DELEGATIONS

In keeping with directives from the Province of BC, there is limited space for the public to attend CRD Board meetings in-person at this time. However, the public may continue to view meeting materials and Live Webcasts online. If you wish to attend a meeting in-person, please email legserv@crd.bc.ca.

CRD encourages delegations to participate electronically. Please complete the online application for "Addressing the Board" on our website 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. 22-132 Delegation - Marcie McLean; Resident of Highlands: Re: Agenda Item 8.4.: Bylaw No. 4453 - Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2022

5.2.2. 22-133 Delegation - Josh Nobleman; Representing Vancouver Island Slacklining Association: Re: Agenda Item 8.7.: Regional Parks - Strategic Plan Update

5.2.3. 22-134 Delegation - Alison Spriggs; Resident of Victoria: Re: Agenda Item 8.7.: Regional Parks - Strategic Plan Update

5.2.4. 22-135 Delegation - Vicky Husband; Resident of Highlands: Re: Agenda Item 8.7.: Regional Parks - Strategic Plan Update

6. CONSENT AGENDA

6.1. 22-084 Grant Application for Anderson Cove (East Sooke) Water Service Extension

Recommendation: The Juan de Fuca Water Distribution Commission recommends the Electoral Areas Committee recommend to the Capital Regional District Board:
That staff be directed to prepare and submit an application for an Investing in Canada Infrastructure Program - British Columbia - Green Infrastructure - Environmental Quality grant for the water service extension to the Anderson Cove area of the Juan de Fuca Water Distribution service area.
(NWA)

Attachments:
Staff Report: Grant Application for Anderson Cove (E.Sooke) Water Svc. Ext.
Attachment 1: Water Main Extension Map
Attachment 2: JDF Electoral Area Director Letter to Residents
Attachment 3: RGS Map 5 – JDF Water Svc. Area (East Sooke & Otter Point)

6.2. 22-098 Cedars of Tuam Water New Well Grant Application, Loan Authorization and Water Conservation Plan

Recommendation: The Cedars of Tuam Water Service Commission recommends the Electoral Areas Committee recommends to the Capital Regional District Board:
1. That the Board supports an application for grant funding for the SSI: Cedars of Tuam - New Well and Water Treatment Plant Project through the Investing in Canada Infrastructure Program - Green Infrastructure - Environmental Quality Program; and that the Board supports the project and commits to any associated ineligible costs and cost overruns.
2. That the Board review, accept and endorse the Cedars of Tuam Water Conservation Plan, Revised January 2022.
3. That staff be directed to proceed with preparing the Loan Authorization Bylaw, authorizing the borrowing up to $600,000 with the amortization term of 30 years.
4. That staff be directed to present the project and funding option to the ratepayers; and bring forward a report to the Commission on the results of the public engagement, and ratepayer's preferred electoral assent process.
(NWA)

Attachments:
Staff Report: Cedars of Tuam Water Commission New Well Grant Application
Appendix A: Cedars Of Tuam Water Conservation Plan - Revised Jan 2022

6.3. 22-093 Investing in Canada Infrastructure Program - Green Infrastructure - Environment Quality Grant Application for the Skana Water System Storage Tank Replacement

Recommendation: The Skana Water Service Committee recommends the Electoral Areas Committee recommend to the Capital Regional District Board:
That staff be directed to submit an application for an Investing in Canada Infrastructure Program - British Columbia - Green Infrastructure - Environmental Quality grant for the project's grant-eligible costs for the Skana Water System Storage Tank Replacement.
(NWA)

Attachments: Staff Report: Green Infra. Env. Quality Appl. for Skana Tank Replacement

6.4. 22-111 Request for Governance Study by the Magic Lake Property Owners' Society, North Pender Island

Recommendation: That the Electoral Areas Committee recommend to the Capital Regional District Board:
That the Board advance the request of the Magic Lake Property Owners' Society to the Ministry of Municipal Affairs to evaluate the local context of the Magic Lake Estates neighborhood on North Pender Island and request the Ministry consider funding a Governance and Services Study to examine governance concerns within the community and provide options and alternatives to address those concerns.
(NWA)

Attachments: Staff Report: Request for Governance Study by the MLPOS North Pender Isl.

Appendix A: Letter from Magic Lake Property Owners Association

6.5. 22-125 Regulation of Vacation Rentals on the Southern Gulf Islands and Salt Spring Island

Recommendation: That the Electoral Areas Committee recommends to the Capital Regional District Board:
That the Regulation of Vacation Rentals on the Southern Gulf Islands and Salt Spring Island report be received for information.
(NWA)

Attachments: Staff Report: Regulation of Vacation Rentals on the SGIs and SSI

Appendix A: Letter from Islands Trust, Nov. 9, 2021

Appendix B: UBCM Priorities for Action on Short-Term Rentals

6.6. 22-039 2020 Regional Greenhouse Gas Inventory

Recommendation: The Environmental Services Committee recommends to the Capital Regional District Board:
That the 2020 Regional Greenhouse Gas Inventory report be received for information.
(NWA)

Attachments: Staff Report: 2020 Regional Greenhouse Gas Inventory

Appendix A: 2020 GPC BASIC & Community GHG Inventory - Stantec

Appendix B: 2007 Base Year & 2020 Reporting Year - Stantec

Appendix C: Capital Region CO2E Emissions Per Capita

6.7. 22-034 Zero-Emissions Fleet Initiative - Final Study Report

Recommendation: The Environmental Services Committee recommends to the Capital Regional District Board:
That the Zero-Emissions Fleet Initiative Final Study Report be received for information.
(NWA)

Attachments: Staff Report: Zero-Emissions Fleet Initiative - Final Study Report

Appendix A: Zero-Emissions Fleet Initiative - Final Study Report

6.8. 22-074 First Nations Relations Operational Update

Recommendation: The First Nations Relations Committee recommends to the Capital Regional District Board:
That the First Nations Relations Operational Update report be received for information.
(NWA)

Attachments: Staff Report: First Nations Relations Operational Update

6.9. 21-642 Capital Regional District Board Policy on Regional Grants-in-Aid

Recommendation: The Governance Committee recommends to the Capital Regional District Board:
1. That the Capital Regional District Board Policy on Regional Grants-in-Aid report be received for information.
(NWA)

[At the February 2, 2022 Governance Committee meeting, the following motion arising was carried:]
The Governance Committee recommends to the Capital Regional District Board:
2. That the policy of Grants-in-Aid levied only against the taxpayers of an individual municipality be removed, and the option of the Grants-in-Aid for individual electoral areas be retained.
(NWA)

Attachments: Staff Report: CRD Board Policy Regional Grants-in-Aid

Appendix A: CRD Board Minutes from February 23, 1994

Appendix B: History of Past Regional GIA Requests

6.10. 22-042 2022 Performing Arts Facilities Select Committee Terms of Reference

Recommendation: The Performing Arts Facilities Select Committee recommends to the Capital Regional District Board:
That the 2022 Performing Arts Facilities Select Committee Terms of Reference attached at Appendix A be approved.
(NWA)

Attachments: Staff Report: 2022 PAF Select Committee TOR

Appendix A: 2022 PAFSC TOR

6.11. 22-048 2022 Regional Parks Committee Terms of Reference

Recommendation: [At the January 26, 2022 Regional Parks Committee, the motion to receive the 2022 Terms of Reference was defeated and the following motion arising was carried:]
That the Terms of Reference be referred back to the Board Chair to work with staff, the Chair and Vice Chair of the Regional Parks Committee, and Chair of the Transportation Committee to bring back a Terms of Reference to reflect the intersectionality of regional trails between Parks and Transportation.
(NWA)

Attachments: Staff Report: 2022 Regional Parks Committee Terms of Reference

Appendix A: RPC Terms of Reference

Appendix B: RPC Terms of Reference (redlined)

7. ADMINISTRATION REPORTS

7.1. 22-115 Bylaw No. 4478: Cedars of Tuam Loan Authorization Bylaw No. 2, 2022

Recommendation: 1. That Bylaw No. 4478, "Cedars of Tuam Loan Authorization Bylaw No. 2, 2022", be introduced and read a first, second and third time; and
(WA)
2. That the referral of Bylaw No. 4478 to the Inspector of Municipalities for approval be withheld until staff report back on the result of the grant application.
(NWA)

Attachments: Staff Report: Bylaw No. 4478 Cedars of Tuam Loan Authorization Bylaw No. 2,

Appendix A: Bylaw 4478

8. REPORTS OF COMMITTEES

Electoral Areas Committee

8.1. 22-090 Bylaw No. 4480 - Building Permit Information Reports - Fee Increase

Recommendation: The Electoral Areas Committee recommends to the Capital Regional District Board:
1) That Bylaw No. 4480, "Building Regulation Bylaw No. 5, 2010, Amendment Bylaw No. 3, 2022" be introduced and read a first, second, and third time; and
2) That Bylaw No. 4480 be adopted.
(NWA, 2/3 on adoption)

Attachments: Staff Report: Bylaw No. 4480 Bldg Permit Info Rpts. Fee Increase

Appendix A: Bylaw No. 4480

Governance Committee

8.2. 22-094 Cost Recovery Options and Cost Allocations for Freedom of Information (FOI) Requests

Recommendation: [At the February 2, 2022 Governance Committee meeting, the Committee defeated Recommendation 1 to include a $10 application fee for general FOI requests and carried Recommendations 2 and 3 as presented:]
The Governance Committee recommends to the Capital Regional District Board:
2. That staff be directed to further investigate and establish appropriate categories of building and property records which are available to the public without a FOI request in accordance with section 71 of the Freedom of Information and Protection of Privacy Act and the Copyright Act, including setting prescribed fees for providing copies of available records; and,
3. That staff report back with proposed amendments to Bylaw No. 3741, "Building Regulation Bylaw No. 5, 2010" to include a list of routinely available records and their associated fees.
(NWA)

Attachments: Staff Report: Cost Recovery Options and Cost Allocations for FOI Requests

Appendix A: Bylaw No. 3945

8.3. 22-095 Bylaw No. 4479 - “Delegations Amendment to Board Procedures Bylaw”

Recommendation: The Governance Committee recommends to the Capital Regional District Board:
1. That Bylaw No. 4479, "Capital Regional District Board Procedures Bylaw, 2012, Amendment Bylaw No. 12, 2022" be introduced and read a first, second and third time.
2. That Bylaw No. 4479 be adopted.
(NWA, 2/3 on adoption)

Attachments: Staff Report: Delegations Amendment Procedures Bylaw

Appendix A: Bylaw 4479

Appendix B: Bylaw 3828 Consolidated (redlined)

Appendix C: Delegation Procedures – Electronic Presentations

8.4. 22-097 Bylaw No. 4453 - “Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2022”

Recommendation: The Governance Committee recommends to the Capital Regional District Board:
1. That Bylaw No. 4453, "Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2022", be introduced and read a first, second, and third time.
(WP - All except SGI & SSI, and 2/3 vote)
2. That Bylaw No. 4453 be adopted.
(WP - All except SGI & SSI, and 2/3 vote)
3. That staff be directed to advise service participants of Bylaw No. 4453.
(NWA)

Attachments: Staff Report: Bylaw 4453, “VFC and YJC Commission Bylaw No. 1, 2022”

Appendix A: Correspondence with VFC&YJC and its recommendations

Appendix B: Oct. 2021 Ltr. to VFC&YJC from A/ADM Paul Craven

Appendix C: Jan.10, 2022 Ltr. from C. Day encl adopted motions & AGM

Appendix D: Redlined Draft Bylaw No. 4453, showing modifications

Appendix E: Bylaw No. 4453

Juan de Fuca Land Use Committee

8.5. 22-016 Zoning Amendment for Lot 28, Section 15, Otter District, Plan VIP87643 - 3312 Otter Point Road

Recommendation: The Land Use Committee recommends to the Capital Regional District (CRD) Board:
1. That the referral of proposed Bylaw No. 4454, "Juan de Fuca Land Use Bylaw, 1992, Amendment Bylaw No. 154, 2021", to the Otter Point Advisory Planning Commission, appropriate CRD departments, BC Hydro, District of Sooke, FLNR - Archaeology Branch, FLNR - Ministry of Forests, Lands, Natural Resource Operations and Rural Development, FLNR - Water Protection, Island Health, Ministry of Environment & Climate Change Strategy - Environmental Protection and Sustainability, Ministry of Transportation & Infrastructure, Otter Point Fire Department, RCMP, Sc'ianew First Nation, and T'Sou-ke First Nation be approved and the comments received;
2. That proposed Bylaw No. 4454 be introduced and read a first time and read a second time; and
3. That in accordance with the provisions of section 469 of the Local Government Act, the Director for the Juan de Fuca Electoral Area, or Alternate Director, be delegated authority to hold a Public Hearing with respect to Bylaw No. 4454.
(NWP - Voting Block A: JDF EA, Colwood, Langford (Blackwell), Metchosin, Sooke)

Attachments:
- Staff Report: Zoning Amendment for 3312 Otter Point Road
- Appendix A: Subject Property
- Appendix B: Site Plan
- Appendix C: Bylaw No. 4454
- Appendix D: Referral Comments

Performing Arts Facilities Select Committee

8.6. 22-040 Costs and Timeline Associated with a Region-Wide Referendum on a Full Regional Performing Arts Facilities Service

Recommendation: [At the January 19, 2022 Performing Arts Select Committee meeting, the Select Committee defeated the Recommendation and referred the report to the February CRD Board meeting without a recommendation.

The defeated staff recommendation is provided below for information:
That the Costs and Timeline Associated with a Region-Wide Referendum on a Full Regional Performing Arts Facilities Service report be received for information and policy options for sub-regional performing arts facilities services be considered.]

Attachments:
- Staff Report: Costs Timeline Referendum - Regional PAF Service
- Appendix A: Cost Estimate for Region-Wide Referendum
- Appendix B: Amended Bylaw No. 4445, Arts Facilities Service
- Appendix C: Communications Plan For Public Awareness
- Appendix D: Updated Service Plan for Regional Service

Regional Parks Committee

8.7. 22-056 Regional Parks - Strategic Plan Update

Recommendation: [At the January 26, 2022 Regional Parks Committee meeting, the following motion was carried "That the items in the missions, and values and principles be revised prior to the Board meeting so that they appear in alphabetical order." An Updated Appendix B: Presentation (February 9, 2022) is attached. The recommendation was amended to remove "vision" and carried as follows:]
The Regional Parks Committee recommends to the Capital Regional District Board:
1. That the proposed values and mission statements and proposed priorities be accepted for stakeholder, First Nations and public input.
(NWA)

[The following motion arising asking that staff give consideration to including additional stakeholder groups was carried:]
That the Regional Parks Committee recommends to the Capital Regional District Board:
2. That the following stakeholder groups be considered:
a) That the following parties that deliver key services throughout Sooke and JDF Region, be invited to participate as key stakeholders in the strategic planning process: Sooke Region Historical Society (Museum and Visitor Info Centre), Wildwise Sooke and the Sooke Region Community Health Network (SRCHN),
b) Our Earth Our Future, Climate Justice Victoria, Salt Spring Island Trail and Nature Club, Victoria Community Association Network, Saanich Community Association Network, and community associations in Colwood, Oak Bay, Highlands and elsewhere in the region.
(NWA)

[The following motion arising directing staff to consult with a stakeholder group was carried:]
That the Regional Parks Committee recommends to the Capital Regional District Board:
3. That the South Island Disc Golf Society be added to the list of stakeholders.
(NWA)

[Following the removal of "vision" from the main recommendation, the following motion arising was carried "That we refer the vision statement back to staff for further revision and have it presented as an option at the February Board meeting with this report." A supplemental report with vision statement options is attached with the following recommendation:]
4. That the following proposed vision statement be accepted for the new CRD Regional Parks Strategic Plan prior to seeking input from stakeholders, First Nations and the public:
We work cooperatively and respectfully to steward and expand an exceptional system of regional parks and trails that is rich in biodiversity and cultural heritage, resilient to change, connects people to nature and provides healthy outdoor experiences for all.
(NWA)

Attachments: Staff Report: Regional Parks – Strategic Plan Update
Appendix A: Status Review
Appendix B: Presentation
Updated Appendix B: Presentation (Feb 9, 2022)
Appendix C: Key Priority Statements
Appendix D: Stakeholder Engagement
Supplemental Staff Report: Regional Parks - Strategic Plan Vision Statement

9. BYLAWS

9.1. 22-109 Bylaw 4085 - "SSI Liquid Waste Disposal Additional Local Service Establishment Bylaw No. 1, 1993, Amendment Bylaw No. 3, 2021"

Recommendation: That Bylaw 4085 - "SSI Liquid Waste Disposal Additional Local Service Establishment Bylaw No. 1, 1993, Amendment Bylaw No. 3, 2021" be adopted.
(NWA)

Attachments: Bylaw No. 4085

9.2. 22-105 Bylaw 4468 - "Capital Regional District Climate Action and Adaptation Service Establishment Bylaw, 2008, Amendment Bylaw No. 2, 2021"

Recommendation: That Bylaw 4468 - "Capital Regional District Climate Action and Adaptation Service Establishment Bylaw, 2008, Amendment Bylaw No. 2, 2021" be adopted.
(NWA)

Attachments: Bylaw No. 4468

10. NOTICE(S) OF MOTION

11. NEW BUSINESS

12. MOTION TO CLOSE THE MEETING

12.1. **22-100** Motion to Close the Meeting

Recommendation: 1. That the meeting be closed for Appointments in accordance with Section 90(1)(a) of the Community Charter. [1 item]
2. That the meeting be closed for Labour Relations under Section (90)(1)(c) of the Community Charter. [4 items]
3. That the meeting be closed for Land Acquisition in accordance with Section 90(1)(e) of the Community Charter. [1 items]
4. That such disclosures could reasonably be expected to harm the interests of the Regional District. [1 items]
5. That the meeting be closed for Intergovernmental Negotiations in accordance with Section 90(2)(b) of the Community Charter. [3 items]

13. RISE AND REPORT

14. ADJOURNMENT

Votinq Key:
NWA - Non-weighted vote of all Directors
NWP - Non-weighted vote of participants (as listed)
WA - Weighted vote of all Directors
WP - Weighted vote of participants (as listed)

Making a difference...together

625 Fisgard St.,
Victoria, BC V8W 1R7

Capital Regional District

Meeting Minutes

Capital Regional District Board

Wednesday, January 12, 2022 **1:10 PM** **6th Floor Boardroom**
625 Fisgard Street
Victoria, BC

PRESENT:
C. Plant (Chair), R. Mersereau (Vice Chair) (EP), D. Blackwell, P. Brent (for D. Howe) (EP), S. Brice (EP), B. Desjardins (EP), L. Helps (EP), F. Haynes (EP), M. Hicks (EP), G. Holman (EP), B. Isitt (EP), J. Loveday, R. Martin (EP), C. McNeil-Smith (EP), K. Murdoch (EP), G. Orr (EP), J. Ranns (EP), D. Screech, L. Seaton (EP), M. Tait (EP), N. Taylor (EP), K. Williams (EP), R. Windsor (EP), G. Young (EP)

Staff: R. Lapham, Chief Administrative Officer; N. Chan, Chief Financial Officer; L. Hutcheson, General Manager, Parks and Environmental Services; K. Lorette, General Manager, Planning and Protective Services; K. Morley, General Manager, Corporate Services; T. Robbins, General Manager, Integrated Water Services; M. Lagoa, Deputy Corporate Officer; S. Orr, Senior Committee Clerk (Recorder)

EP - Electronic Participation

Regrets: D. Howe

The meeting was called to order at 1:29 pm.

1. TERRITORIAL ACKNOWLEDGEMENT

A Territorial Acknowledgement was provided in the preceding meeting.

2. APPROVAL OF THE AGENDA

MOVED by Director Blackwell, SECONDED by Director Loveday,
That the agenda for the January 12, 2022 Session of the Capital Regional District Board be approved.
CARRIED

3. ADOPTION OF MINUTES

3.1. 21-904 Minutes of the December 8, 2021 Capital Regional District Board Meeting

MOVED by Director Blackwell, SECONDED by Director Screech,
That the minutes of the Capital Regional District Board meeting of December 8, 2021 be adopted as circulated.
CARRIED

3.2. 22-032 Minutes of Previous Committee and Commission Meetings

MOVED by Director Screech, SECONDED by Director Loveday,

That the minutes of the Regional Arts Facilities Select Committee meeting of March 3, 2021 be adopted as circulated
CARRIED

4. REPORT OF THE CHAIR

I want to wish everyone a happy new year. This is certainly not the year we were hoping to have but it is nice to know that at least all of us continue to participate in the activities of the Board. Please let's do our best to be patient because I recognize if this meeting does become a meeting where there is a lot of debate, it could be challenging to manage and I suspect that many of you who are mayors are experiencing that yourself with your own meetings; I am sure you will have empathy. It's great to see us all here and let's hope that 2022 becomes the year we really see a change in how our communities are able to respond to the pandemic.

5. PRESENTATIONS/DELEGATIONS

There were no presentations or delegations.

6. CONSENT AGENDA

Item 6.6 was moved to be considered as agenda item 7.3.

MOVED by Director Blackwell, SECONDED by Director Loveday,
That consent agenda items 6.1. through 6.5. be approved.
CARRIED

6.1. 22-004 Royal and McPherson Theatres Services Advisory Committee 2022 Terms of Reference

That the 2022 Royal and McPherson Theatres Services Advisory Committee Terms of Reference attached at Appendix A be approved.
CARRIED

6.2. 22-003 Capital Regional District 2021 Audit Planning Discussion

That the Capital Regional District 2021 Audit Plan developed by KPMG be approved.
CARRIED

6.3. 21-676 Municipal Finance Authority - Debt Issuance Terms

That this item be referred back to staff to bring an information report back through the Finance Committee.
CARRIED

6.4. 22-007 Update on the Municipal Finance Authority Product Offerings

That the Update on the Municipal Finance Authority Product Offerings report be received for information.
CARRIED

6.5. 22-006 Capital Regional District External Grants Update

That the Capital Regional District External Grants Update be received for information.
CARRIED

7. ADMINISTRATION REPORTS

7.1. 22-012 CAO Quarterly Progress Report No. 4 - 2021

R. Lapham spoke to Item 7.1.

Discussion ensued regarding:
- Director Desjardins stated that she was not in attendance at the ribbon cutting ceremony for Esquimalt's Urgent Primary Care Centre
- Grants update
- Mountain biking areas
- Extreme weather impacts to parks, water supply area and overall operations
- Slope failure potential
- Work from home

MOVED by Director Screech, SECONDED by Director Loveday,
That the CAO Quarterly Progress Report No. 4 - 2021 be received for information.
CARRIED

7.2. 22-022 Community Emergency Preparedness Fund: Evacuation Route Planning Grant - Motion of Support

K. Lorette spoke to Item 7.2.

Discussion ensued regarding grants.

MOVED by Director Tait, SECONDED by Director Blackwell,
That the Capital Regional District Board support an application to the Union of British Columbia Municipalities Community Emergency Preparedness Fund for the Evacuation Route Planning grant and direct staff to provide overall grant management.
CARRIED

7.3. 22-030 2022 Committee and External Membership Appointments - Update #1

Discussion ensued regarding:
- Sooke and Electoral Area Parks and Recreation Commission
- First Nations Relations Committee
- Acting Chair of Capital Regional Hospital District Board

MOVED by Director Tait, SECONDED by Director Blackwell,
That the Board receive for information the updated 2022 Committee and External Membership Appointments as amended:
1. Add the Sooke CRD Director to the Sooke and Electoral Area Parks and Recreation Commission
2. Add Director Murdoch to the First Nations Relations Committee
3. Revise Capital Regional Hospital District Board Acting Chair to Director Mersereau.
CARRIED

8. REPORTS OF COMMITTEES

Finance Committee

8.1. 22-008 Bylaw No. 4476: Security Issuing Bylaw, Spring 2022

MOVED by Director Brice, SECONDED by Director Williams,
1. That Bylaw No. 4476, "Security Issuing Bylaw No. 1, 2022", be introduced and read a first, second, and third time.
CARRIED

MOVED by Director Brice, SECONDED by Director Williams,
2. That Bylaw No. 4476 be adopted.
CARRIED

8.2. 22-010 Motion with Notice: Socially and Environmentally Responsible Investing (Directors Taylor and Loveday)

Discussion ensued regarding:
- Investment funds options
- Alignment of investments with climate change
- MFA guidelines, restrictions and product offerings

MOVED by Director Brice, SECONDED by Director Williams,
1. That staff be directed to report back with options to move investments further into alignment with the CRD's stated social and environmental values, including the declaration of a climate emergency.
CARRIED
Opposed: Blackwell, Brice, Screech, Seaton

MOVED by Director Murdoch, SECONDED by Director Screech
That Recommendation #2 "And that staff be directed to develop a draft policy regarding socially and environmentally responsible investing that could be considered by member local governments." be referred back to the Finance Committee until the report that is referenced in Recommendation #1 has been received from staff.
CARRIED

9. BYLAWS

There were no bylaws for consideration.

10. NOTICE(S) OF MOTION

There were no Notice(s) of Motion.

11. NEW BUSINESS

There was no new business.

12. MOTION TO CLOSE THE MEETING

12.1. 22-029 Motion to Close the Meeting

MOVED by Director Loveday, SECONDED by Director Blackwell,
1. That the meeting be closed for Appointments in accordance with Section 90(1) (a) of the Community Charter.
CARRIED

MOVED by Director Loveday, SECONDED by Director Blackwell,
2. That the meeting be closed for Labour Relations under Section (90)(1)(c) of the Community Charter.
CARRIED

MOVED by Director Loveday, SECONDED by Director Blackwell,
3. That the meeting be closed for Legal Advice under Section 90 (1)(i) of the Community Charter.
CARRIED

MOVED by Director Loveday, SECONDED by Director Blackwell,
4. That the meeting be closed for Intergovernmental Negotiations in accordance with Section 90(2)(b) of the Community Charter.
CARRIED

The Capital Regional District Board moved to the closed session at 2:42 pm.

13. RISE AND REPORT

The Capital Regional District Board rose from the closed session at 2:29 pm. and reported on the following items:

In accordance with Bylaw No. 2339, that the following be appointed to the Magic Lake Estates Water and Sewer Committee for a term expiring October 31, 2023: Richard Sullivan

In accordance with Bylaw No. 3561 that the following be appointed to the Pender Islands Community Parks and Recreation Commission for a term to expire December 31, 2022: Andrea Mills

In accordance with Bylaw No. 3561 that the following be appointed to the Pender Islands Community Parks and Recreation Commission for a term to expire December 31, 2023: Larry Colcy

In accordance with Bylaw No. 3654 that the following be appointed to the Port Renfrew Fire Protection and Emergency Response Service Commission for a term to expire December 31, 2022: Dan Kuzman, Roy McIntyre, Dan Quigley

In accordance with Bylaw No. 3654 that the following be appointed to the Port Renfrew Fire Protection and Emergency Response Service Commission for a term to expire December 31, 2023: Matthew Cottrell, Kevin Neish

In accordance with Letters Patent that the following be appointed to the Saanich Peninsula Water Commission for a term to expire December 31, 2022: Wayne Helgason

In accordance with Bylaw No. 3654 that the following be appointed to the Shirley Fire Protection and Emergency Response Service Commission for a term to

expire December 31, 2022: Roy McIntyre, James Powell, Sean Rafferty

In accordance with Bylaw No. 3654 that the following be appointed to the Shirley Fire Protection and Emergency Response Service Commission for a term to expire December 31, 2023: Brian Einarson, Ron Ramsay, Howard Williams, Malcolm Taylor

In accordance with Solid Waste Advisory Committee Terms of Reference that the following person be appointed to the Solid Waste Advisory Committee for a term to expire December 31, 2024: Michael Bodman

That the following appointment to the Surfside Park Estates Water Service Committee be revised from a term to start January 1, 2022 and expire December 31, 2023 to a term to start January 12, 2022 and expire June 30, 2022: Ken Wall

14. ADJOURNMENT

MOVED by Director Screech, SECONDED by Director Loveday,
That the meeting be adjourned at 3:30 pm.
CARRIED

_____

CHAIR

CERTIFIED CORRECT:

_____

CORPORATE OFFICER

Making a difference...together

JWDC 22-01

REPORT TO JUAN DE FUCA WATER DISTRIBUTION COMMISSION
MEETING OF TUESDAY, FEBRUARY 1, 2022

SUBJECT **Grant Application for Anderson Cove (East Sooke) Water Service Extension**

ISSUE SUMMARY

The Juan de Fuca Electoral Area Director has requested that a grant application be submitted for the proposed Anderson Cove water service extension to provide project funding. The grant program is *Investing in Canada Infrastructure Program - British Columbia - Green Infrastructure - Environmental Quality* which has an application deadline of February 23, 2022.

BACKGROUND

The Anderson Cove area of East Sooke, which represents approximately 30 single family residential properties, relies on ground water sources for domestic water supply. To date, the Juan de Fuca Water Distribution system has not been extended to the area to allow connection.

In January, 2020, the Juan de Fuca Water Distribution Commission (the Commission), and subsequently the Capital Regional District (CRD) Board, approved a grant application under the *Investing in Canada Infrastructure Program - British Columbia - Green Infrastructure - Environmental Quality*, requesting project funding to extend the Juan de Fuca water distribution system to the Anderson Cove area. The project budget was set at $2.055 million with grant program funding of up to 73.33% of the project costs. The remaining 26.67% would have been funded by the benefitting property owners. While the grant application was unsuccessful, there is now another funding stream available in the same grant program and the Juan de Fuca Electoral Area Director is requesting that another application be submitted for the Anderson Cove project.

The latest intake of the grant program, *Investing in Canada Infrastructure Program - British Columbia - Green Infrastructure - Environmental Quality* (the Grant), will continue to fund up to 73.33% of eligible costs with the 30 benefitting property owners funding the remaining eligible costs of 26.67% plus any ineligible project costs. The 2022 intake is the third intake under this program and is to support cost-sharing of infrastructure projects in communities across the province. In particular, the Grant program requires that certain outcomes be met, one of which is “increased access to potable water”. The project scope remains the same as in 2020 but the project budget has been updated to reflect cost escalation and is now $2.484 million.

Project Overview

In order to extend the Juan de Fuca water distribution system to Anderson Cove, the project would encompass the following:

- 1,855 metres of 250 millimetre (mm) diameter and 150mm diameter water main and appurtenances. (See Attachment 1 for location).

The project scope remains the same as the 2020 grant request for the following reasons referenced on Attachment 1:

- 500 metres of water main was twinned on East Sooke Road in 2019 at a cost of $530,000 and funded by the "Mine Road Utilities Deferred Capacity Trust Fund".
- As a result of the twinning work on East Sooke Road, another project to connect the pressure zones on East Sooke Road became viable which requires 430 metres of water main at an estimated cost of $500,000 including engineering and contingency. Regardless of the success of the Anderson Cove grant application, this project was approved by the Commission in the 2022 capital program as an enhancement to the Juan de Fuca water distribution system to connect pressure zones and increase fire and domestic storage in the area.

Project Costing

- Total eligible costs are estimated at $2.41 million including engineering and contingency amounts.
- Reimbursable costs are estimated at $1.767 million (73.33% of $2.41 million).
- Ineligible costs are estimated at $74,000.
- Total costs to be borne by the benefitting property owners are estimated at $643,000 (26.67% of $2.41 million) plus ineligible costs of $74,000 which totals $717,000.

Project Funding

As noted, the grant program would provide up to $1.767 million in funding and the benefitting property owners would provide up to $717,000 in funding. If the grant application is successful, in order to finance the benefiting property owners' share, subject to CRD Board approval, a CRD local service area would be established for the purpose of funding a CRD loan. (See Attachment 2 for service area boundary).

To reaffirm the property owners' support for the project and their funding contribution, the Juan de Fuca Electoral Area Director has carried out the following tasks:

- Sent a letter to all affected residents to ask them to confirm that they would be willing to pay up to $25,000 per property to fund their part of the project (see Attachment 3).
- Received 100% support to his request for funding from all 30 property owners.

As a result of the property owners' support, if the grant is approved, the project is anticipated to have full funding.

ALTERNATIVES

Alternative 1
The Juan de Fuca Water Distribution Commission recommends the Electoral Areas Committee recommend to the Capital Regional District Board:

That staff be directed to prepare and submit an application for an *Investing in Canada Infrastructure Program - British Columbia – Green Infrastructure - Environmental Quality* grant for the water service extension to the Anderson Cove area of the Juan de Fuca Water Distribution service area.

Alternative 2
The Juan de Fuca Water Distribution Commission directs staff not to proceed with a grant application to the *Investing in Canada Infrastructure Program-British Columbia-Green Infrastructure-Environmental Quality* program.

FINANCIAL IMPLICATIONS

The grant application nor the project as a whole will result in any capital costs for the Juan de Fuca Water Distribution Service. If the project is completed, on-going infrastructure operating costs will be funded through the water rate revenue.

LAND USE POLICY IMPLICATIONS

Leading up to the 2016 grant application, at its October 12, 2016 meeting, the CRD Board resolved to permit the extension of water service to the Anderson Cove area, deeming the extension in accordance with Action 1.1 (5) of the 2003 Regional Growth Strategy (RGS). The RGS has since been updated (January 2018). The proposed Anderson Cove water service extension aligns with RGS Objective 2.2 (Manage Regional Infrastructure Services Sustainably) and the principles and policies set out thereunder, namely:

- The service extension will service existing dwellings/lots only, replacing ground water wells for domestic water supply;
- The negative financial impacts to those currently serviced will be minimized as the benefitting property owners will be funding the initial capital (in excess of grant funding) and on-going operating costs; and,
- The proposed service extension falls within the Juan de Fuca Electoral Area outside the Urban Containment Policy Area, but within the East Sooke water service area referenced under RGS Objective 2.2, Policy 2.b (See Attachment 3 – RGS Map 5).

CONCLUSION

At the request of the Juan de Fuca Electoral Area Director, approval for a grant application to install water service to the Anderson Cove area of East Sooke is required. The grant program, *Investing in Canada Infrastructure Program - British Columbia - Green Infrastructure - Environmental Quality*, provides up to 73.33% funding with 26.67% funding coming from 30 benefitting property owners. The total project budget has been set at $2.484 million. If the CRD receives the grant, the project would be funded through $1.767 million in grant funds and $717,000 in funding from the benefitting property owners. Project and funding support was sought from the property owners and all of the owners have agreed through an informal petition process, to pay their portion (estimated at up to $25,000 per property). Other than grant funds, the full capital cost of the project will be borne by the benefitting property owners and the on-going operating costs will be funded through the water rate revenue. The deadline for submitting the grant application is February 23, 2022.

RECOMMENDATION

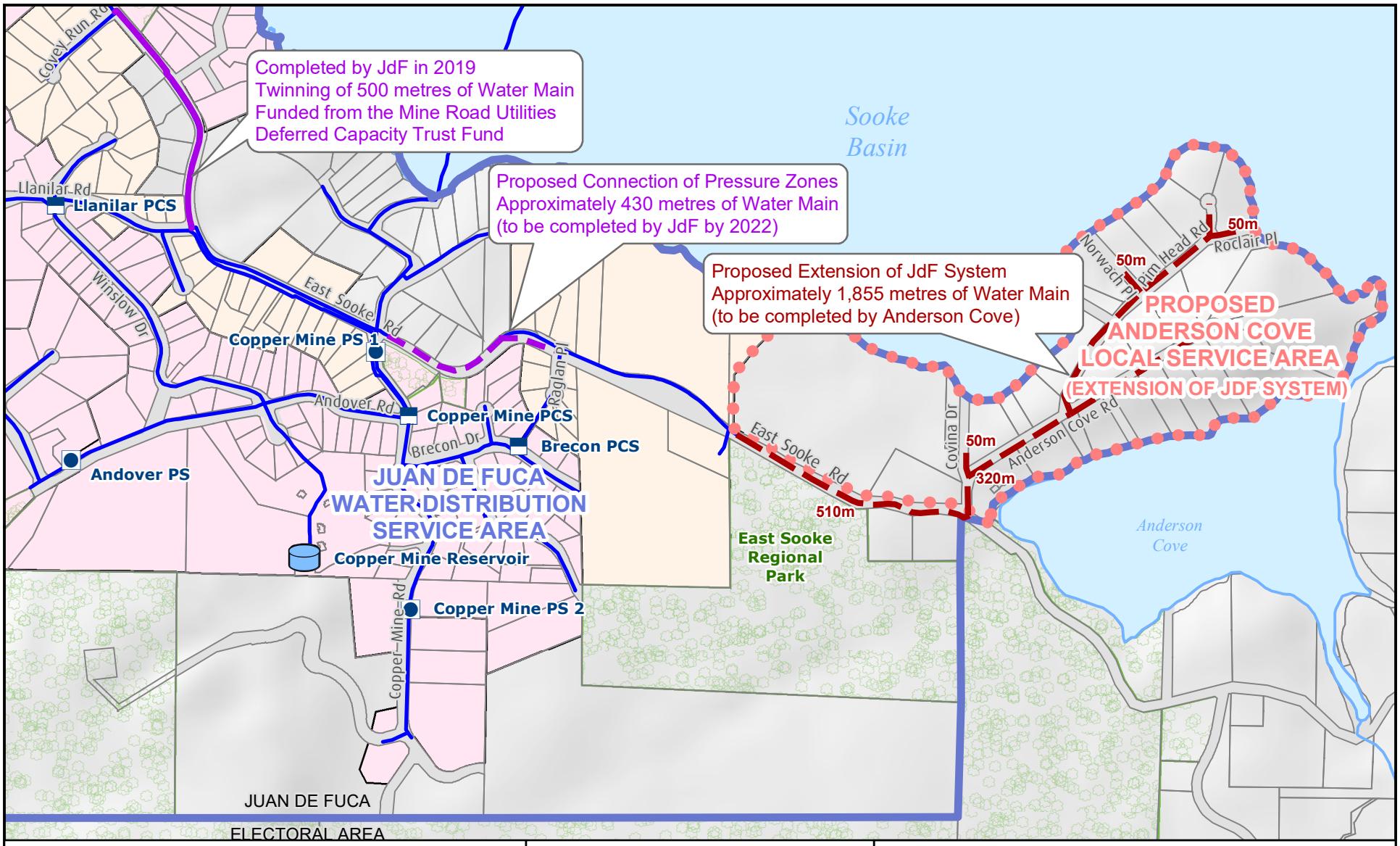
The Juan de Fuca Water Distribution Commission recommends the Electoral Areas Committee recommend to the Capital Regional District Board:

That staff be directed to prepare and submit an application for an *Investing in Canada Infrastructure Program - British Columbia – Green Infrastructure - Environmental Quality* grant for the water service extension to the Anderson Cove area of the Juan de Fuca Water Distribution service area.

Submitted by:	Ian Jesney, P.Eng., Senior Manager, Infrastructure Engineering
Concurrence:	Ted Robbins, B. Sc., C. Tech., General Manager, Integrated Water Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENTS

Attachment 1: Water Main Extension Map
Attachment 2: Juan de Fuca Electoral Area Director Letter to Residents
Attachment 3: Regional Growth Strategy Map 5 – Juan de Fuca Water Service Area (East Sooke & Otter Point)



1:11,000

Metres

0 100 200 400

N W E S

UTM Zone 10N NAD 1983

Juan de Fuca Water Distribution Service Area

Proposed Anderson Cove Local Service Area

Existing JdF Water Main

Completed JdF Twinning of Main

Proposed JdF Connection

Proposed Anderson Cove Extension

Anderson Cove - East Sooke - JdFEA Water Mains Required for Extension

December 2019

Attachment 1

Making a difference...together

DISCLAIMER
Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

December 2019 | EastSookeAndersonCove_11x17.mxd | helpdesk@crd.bc.ca

ATTACHMENT 2

Making a difference...together

Mike Hicks
Regional Director
Juan de Fuca Electoral Area
#3 – 7450 Butler Road
Sooke, BC V9Z 1N1
250 216 5802
directorjdf@crd.bc.ca

November 19, 2019

Dear Anderson Cove resident,

We have another chance to apply for a Federal Government grant to extend water from the East Sooke Fire Department to the Anderson Cove area. Before submitting the application we must complete the engineering and cost analysis and get approval from the JDF Water Commission and CRD Board. As they only meet once a month and with Xmas holidays coming soon, I need your immediate reply to my letter if possible.

If successful the grant Federal Government will cover 70% of the costs leaving 30% to the Anderson Cove area property owners. The cost to extend the water will be somewhere between $ 20,000 and $ 25,000 per property. Family owning 2 properties will have to pay 2 parcel taxes or $ 40-50,000. There are 30 properties affected. The project would not happen for at least a year and financing options would be available.

At this time, I need to know if you want us to proceed with the grant application. I need to know if you are willing to contribute your share. This is not legally binding but there are many folks needing water in the Juan de Fuca Electoral Area and as we only have one application, I must feel comfortable that most if not all of Anderson Cove want to proceed.

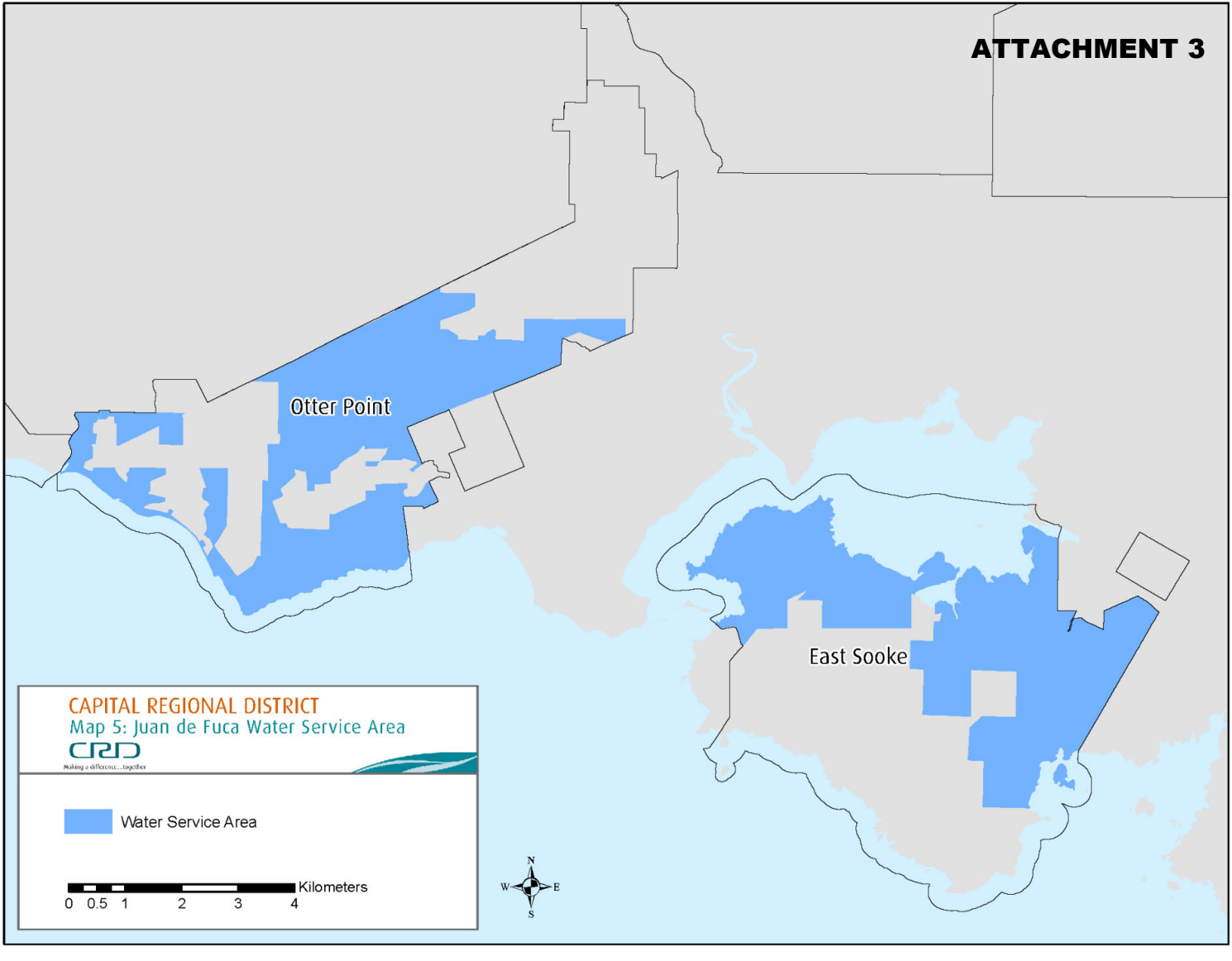
Please send me an e-mail to: directorjdf@crd.bc.ca with your name, phone number and Yes or No to proceed. Give me a call if you have questions please 250 216 5802

Sincerely,

Mike Hicks
Regional Director
Juan de Fuca Electoral Area

COPY

ATTACHMENT 3



Making a difference...together

REPORT TO CEDARS OF TUAM WATER SERVICE COMMISSION
MEETING OF, FEBRUARY 4th, 2022

SUBJECT **Cedars of Tuam Water New Well Grant Application, Loan Authorization and Water Conservation Plan**

ISSUE SUMMARY

To seek approval to proceed with preparing the Loan Authorization Bylaw, community consultation, and electoral assent process to advance the Cedars of Tuam Investing in Canada Infrastructure Program grant application (ICIP). A Capital Regional District (CRD) Board resolution is required for the grant application. The ICIP application also requires Service Commission and CRD Board endorsement of a current Water Conservation Plan.

BACKGROUND

The CRD is submitting an ICIP grant under the Green Infrastructure – Environmental Quality Sub-Stream. The ICIP-EQ program targets capital infrastructure projects in communities that will protect public health and environment, promote climate change resilience and support broad public benefits and service sustainability. The Cedars of Tuam new well and water treatment plant (WTP) meets one of the federal outcomes for green infrastructure – environmental quality that will support increased access to potable water. Projects must start within 2 years of the date of application and be completed by December 31st, 2026. The ICIP deadline for submission is **February 23, 2022**.

As a requirement of the ICIP application, a Board resolution supporting the project and commitment to its share of the project is required together with endorsement of a current Water Conservation Plan. The Cedars of Tuam had developed a Water Conservation Plan in October of 2011. Although the underlying strategies for water conservation have remained unchanged, it has been revised with new information and data added to bring it forward to 2022 as the Plan must be endorsed within the last five (5) years. Further, "A Manual for Owners and Residents of the Cedars of Tuam Water System", developed in January of 2010 will be submitted with the ICIP application. The Water Conservation Plan is attached as Appendix A to this report.

The funding provided towards infrastructure projects is a three-way cost share between federal and provincial partners and the local government. Applicants must be prepared to finance project construction and their cost-share of the project, as well as cover any cost over-runs. The funding split is as follows:

Table 1: Program Funding Splits

Ultimate Recipient	*Federal*	*Provincial*	*Total Senior Gov't Contribution (up to)*	*Ultimate Recipient Contribution (up to)*
Local government	40%	33.33%	73.33%	26.67%

One of the requirements of the ICIP is a resolution/bylaw identifying the source of the proponent's share of the project costs including sufficient funds for cost overruns. The resolution is to be submitted as part of the application package, or within **one month** after the submission deadline

due to timing of CRD Board meetings.

The CRD must also submit evidence that their full share of funding has been or will be secured. This evidence may be in the form of staff reports and/or resolutions of board/council directing the use of reserve funds, or a loan authorization bylaw that has **received third reading**, and/or a date that borrowing has been approved through a formal public approval process and a copy of the related bylaw.

The Cedars of Tuam new well and WTP conceptual designs have a construction cost of approximately $1,743,500 (Class D cost estimate with up to ±40%). If the grant is awarded and the project budget is approved, staff will proceed with detailed design and Class A cost estimate of ±10%-15% will be provided from final drawings and specifications for a tender ready project.

To fund the local government's share of the ICIP is as follows:

Cedars of Tuam Well and WTP Project Cost Estimate	
WTP Construction (Labour and Materials)[1 and 3]	$1,054,010
Engineering, Quality Assurance and Project Management	$193,990
Contingency (25%) [2]	$312,000
CRD Project Management, Internal Costs and Legal Costs	$183,500
Total Estimated Cost	**$1,743,500**

1. Cost Estimation is based on conceptual/preliminary design as of September 2019 (Class D, ±40%)
2. 25% contingency is allowed due to uncertainties and risks associated with regulatory approval as well as preliminary analysis and design from conceptual/preliminary design project.
3. To allow for cost increases from the 2019 estimate until current date a factor of 20% was added.

There are currently insufficient funds in the Capital Reserve ($18,697 as of December 31, 2021) to fund the proposed work; therefore, it is recommended to fund the project through a loan authorization bylaw as follows:

Cedars of Tuam Well and WTP Loan Authorization Amount	
Total Eligible Costs	$1,560,000
ICIP Portion of Eligible Costs (73.33%)	<$1,143,948>
CRD Project Management and Internal Costs	$183,500
Total Loan Authorization Amount (Rounded from $599,552)	**$600,000**

Recipients of grant funding will be responsible for ineligible costs, managing project risks, including cost increases, as the ICIP is not designed to deal with cost overruns. Any project cost increases will be the responsibility of the Ultimate Recipient.

Where applicants plan to use or have applied for funds from other federal or provincial programs, the source of these funds must be disclosed. Applicants who have confirmed or identified potential sources of other senior government funding for their project should note that the ICIP program is subject to federal stacking rules. Federal funding towards the project is limited to the Government of Canada contribution in Table 1, from all federal sources. Community Works Funds cannot be utilized for the Ultimate Recipient's funding contribution to the project.

ALTERNATIVES

Alternative 1

The Cedars of Tuam Water Service Commission recommends the Electoral Areas Committee recommends to the Capital Regional District Board:

1. That the Board supports an application for grant funding for the SSI: Cedars of Tuam – New Well and Water Treatment Plant Project through the Investing in Canada Infrastructure Program – Green Infrastructure – Environmental Quality Program; and that the Board supports the project and commits to any associated ineligible costs and cost overruns.

2. That the Board review, accept and endorse the Cedars of Tuam Water Conservation Plan, Revised January 2022.

3. That staff be directed to proceed with preparing the Loan Authorization Bylaw, authorizing the borrowing up to $600,000 with the amortization term of 30 years.

4. That staff be directed to present the project and funding option to the ratepayers; and bring forward a report to the Commission on the results of the public engagement, and ratepayer's preferred electoral assent process.

Alternative 2

That this report be referred back to staff for additional information.

IMPLICATIONS

Financial Implications

Currently there is no parcel tax within the Cedars of Tuam water service area, the service budget is funded by user charge only from the properties connected to the system. The estimated new debt servicing cost is proposed to be funded by a new parcel tax requisition from all the taxable folios in the service area (16 taxable folios and 17 SFEs as of December 2021 (one lot has a home and a cottage)).

Long-term debt for all BC municipalities, including regional districts, must be arranged through the Municipal Finance Authority (MFA). MFA issues debenture debt for different terms from 5 years to a maximum 30 years.

For analytic purposes only, the estimated debt servicing cost alternatives under four different amortization term scenarios are simulated and shown below based on the indicative interest rates published on MFA website as of January 27, 2022.

Loan	**Amortization Term**			
Loan Authorization **$600,000**	**15 year**	**20 year**	**25 year**	**30 year**

Indicative Interest Rate	2.86%	2.99%	2.99%	2.99%
Cost of Borrowing $	**168,497**	**240,505**	**302,040**	**364,788**
Annual Debt Payment $	**51,233**	**42,025**	**36,082**	**32,160**
Annual Parcel Tax per taxable folio $	**3,202**	**2,627**	**2,255**	**2,010**

The longer amortization term will minimize the annual debt payments, but results in higher total cost of borrowing and higher future interest risk exposure. A debt term of 15 years mitigates interest rate risk to only one subsequent renewal period. CRD staff consider multiple guidelines on each issue with respect to term maturity, including the interest risk exposure, estimated useful life of the infrastructure and the overall impact of both the annual debt payment costs and total cost of borrowing when bringing forward recommendations.

Service Establishment

The Cedars of Tuam system was established as a specified area in 2002 to operate a water supply system (the CRD took over the service which was originally installed in ~ 1970). The existing Cedars of Tuam well and water treatment plant are at the end of their useful life and the well itself has been failing to produce enough water to meet demand, particularly over the drought in the summer of 2021. Water had to be trucked in to meet the demand of the residents. The CRD may levy a tax requisition on the ratepayers in the Cedars of Tuam service area to fund the annual operating costs and transfers to reserves for the service. The current maximum tax levy is the greater of $25,425 or $6.75/$1,000 on actual assessed value of land and improvements to a maximum of $81,899 based on 2021 assessment. The Cedars of Tuam service has sufficient room in the tax levy to meet the debt servicing costs for the proposed $600,000 loan authorization.

Water Conservation Plan

One of the requirements of the ICIP grant program is Board endorsement of a water conservation plan for any drinking water and wastewater projects. In order to meet the grant application requirements, the Board endorsement for the Water Conservation Plan must be submitted with the application.

The Cedars of Tuam Water Conservation Plan contemplates population and potential growth, current water demand, water supply capacity and climate change adaptation and mitigation and in this context sets out water demand reduction targets as well as measures for current and planned water conservation. Measures include universal metering, reporting usage on water bills, consumption based billing as well as community awareness and education. Further, the Plan is periodically reviewed. The benefit of having a Plan is that it creates a sense of community responsibility, accountability, awareness and to a certain extent creates peer pressure for water conservation. Water, particularly on Salt Spring Island, is a precious resource and a formal Water Conservation Plan, when implemented and followed ensures it will always be available.

Alternative 1

It is recommended the Commission proceed with Alternative 1 and seek electoral assent for borrowing the total of the amount not covered by the ICIP grant (26.67% of eligible costs) plus all of the ineligible costs with a thirty (30) year amortization and adopt the Cedars of Tuam Water Conservation Plan.

1. The grant is not guaranteed and will be very competitive.

2. If the grant is not awarded some other solution must be developed to provide an adequate supply of water to the community.

3. ICIP requires a secured funding plan for the replacement within the application to support the cost of the project. The funding plan is to include sufficient funds to cover all eligible costs, cost overruns beyond budget contingencies, ongoing operational costs associated with the project.

4. ICIP may not consider applications if the project represents a risk to the program funder, including, but not limited to, if there is a potential for the project not to proceed should there be applicant funding difficulties; the project does not have public support; and the applicant does not demonstrate they are able to manage, maintain, and finance the project over the long term.

5. The loan authorization bylaw can be held at third reading until grant award.

Alternative 2

Alternative 2 will require the further development of options to provide an adequate supply of water. Options other than trucking water, an extension of the pipeline from the Fulford Water Service or dissolution of the Water Service with taxpayers drilling their own wells all will still require further development and exploration.

Funding Approval Options

There are three options for approval of a loan authorization bylaw under the LGA to undertake this project:

1. Electoral Participating Area Petition Process
2. Alternative Approval Process
3. Referendum Process

Electoral Participating Area Petition Process

The owners of parcels within the service can sign and submit a petition under section 408 of the LGA to give their consent to borrowing and maximum term for the debt in relation to the infrastructure works. This is used for services where there are a small number of parcels. The petition must be signed by the owners of at least 50% of the parcels liable to be charged in relation to the proposed borrowing, and the persons signing must be the owners of parcels that in total represent 50% of the net taxable value of all land and improvements within the participating area.

An Electoral Participating Area Petition and would cost approximately $1,000.

Alternative Approval Process (AAP)

Local/regional governments can use the Alternative Approval Process under Section 345 of the LGA to obtain participating area approval of a loan authorization bylaw. It is most commonly used in relation to long-term borrowing bylaws as it is a less expensive option than using a referendum.

If more than 10% of the affected electors sign a counter-petition opposing the bylaw, a referendum must be held if the Committee still wishes to adopt it. Proceeding to referendum voting must occur no later than 80 days after the deadline established for submitting elector response forms during the AAP.

An AAP would take approximately six (6) months, and would cost approximately $5,000.

Referendum Process

The referendum process is typically used to seek approval by assent of the electors, Section 407 of the LGA, where for a participating area, a majority of the valid votes are counted in favour of the bylaw to fund a project. Typically, a referendum question is developed and then reviewed by the Inspector of Municipalities at the province, requesting the electors to approve the borrowing of a specified amount of funds for the project. If electoral assent is not received, local government must wait at least six (6) months before seeking elector assent on another bylaw for the same purpose in a referendum. In special circumstances, the local government may request approval from the Minister to hold another assent voting opportunity sooner.

Based on the above tentative schedule, the referendum would take approximately seven (7) months and cost approximately $10,000.

Public Engagement

Due to the financial impact of the alternatives on the taxpayers, there is a need for public engagement to inform the stakeholders of the issues, alternatives, impacts and timeline for the process. The exact form and extent of this process will be developed once the Commission decides on the preferred borrowing alternative.

The CRD follows the Public Participation Spectrum developed by the International Association for Public Participation (IAP2) as a model for developing our public engagement strategy. The Spectrum outlines varying levels of public participation: inform, consult, involve, collaborate and empower. Even though the taxpayers are empowered by default through an electoral assent process, at this point in the public engagement process, staff advise focusing on informing and consulting with the ratepayers to provide them with information needed to assist them in making an informed decision. During the process, a method of obtaining public feedback will be an important factor in order to determine the community understanding of the project, gauge their support for borrowing, and their preference for the method to seek electoral assent.

CONCLUSION

The Cedars of Tuam well and WTP was originally constructed in the early 1970s. Since its original construction, there were modifications and upgrades to the system to address performance issues. The well has been failing to produce enough water to meet the demand of the residents, particularly this past summer (2021) where water had to be trucked in from both Vancouver Island and locally from Salt Spring Island. The total cost of the project is estimated at $1,743,500 and staff will be submitting an application for up to 73.33% ICIP grant funding towards the cost of the project that is intended to provide an adequate, safe and secure supply of quality potable water. Should the CRD be successful in an ICIP grant award it will allow the project to proceed. The

Cedars of Tuam Water Service Water Conservation Plan is an important and integral component of the ICIP application and its timely endorsement will fulfill the requirement in the application.

RECOMMENDATION

The Cedars of Tuam Water Service Commission recommends the Electoral Areas Committee recommends to the Capital Regional District Board:

1. That the Board supports an application for grant funding for the SSI: Cedars of Tuam – New Well and Water Treatment Plant Project through the Investing in Canada Infrastructure Program – Green Infrastructure – Environmental Quality Program; and that the Board supports the project and commits to any associated ineligible costs and cost overruns.

2. That the Board review, accept and endorse the Cedars of Tuam Water Conservation Plan, Revised January 2022.

3. That staff be directed to proceed with preparing the Loan Authorization Bylaw, authorizing the borrowing up to $600,000 with the amortization term of 30 years.

4. That staff be directed to present the project and funding option to the ratepayers; and bring forward a report to the Commission on the results of the public engagement, and ratepayer's preferred electoral assent process.

Submitted by:	Karla Campbell, BPA, Senior Manager, Salt Spring Electoral Area
Concurrence:	Nelson Chan, MBA, CPA, CMA, Chief Financial Officer
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT(S)

Appendix A: Cedars of Tuam Water Service Water Conservation Plan, Revised January 2022

Making a difference...together

Cedars of Tuam Water Service
WATER CONSERVATION PLAN

C. Sunderland
October 2011

Updated: Dean Olafson, January 2022

As a condition of the British Columbia Community Water Improvement Program grant awarded for upgrades to the Cedars of Tuam water system, this Water Conservation Plan identifies targets and opportunities for sustainable water use in the Cedars of Tuam community.

2022 Update - *As a requirement for the Canada - British Columbia, Investing in Canada Infrastructure Program grant application for the Cedars of Tuam new water well and water treatment plant, this Water Conservation Plan has been reviewed and updated. Since the original date of this plan in 2011, there are very few changes to the plan, strategy, well performance, number of users, demand, supply, conservation measures and targets however this summer's past drought conditions, which necessitated the trucking of water to meet demand, has highlighted the need for a new well and water treatment plant. A new section, "**Water Production and Demand – 2022 Update**" (below) has been added to update the plan with currently available information.*

This plan supplements the *Manual for Owners and Residents of the Cedars of Tuam Water System* (Bain et. al., 2010), which was adopted by the Cedars of Tuam Water Service Commission at its Annual General Meeting of September 27, 2010.

Population and Potential Growth

The Cedars of Tuam Water Service Area includes 16 taxable folios, all of which are connected to the water system. Each connection serves a single-family dwelling. Population fluctuates seasonally. For the purpose of this analysis, the population is assumed to average 24 residents (Bain et. al., 2010).

There is limited potential for population growth in the Cedars of Tuam Water Service Area. There are no undeveloped folios in the area, and based on the relatively small lot sizes, steep topography and lack of a sewer system, subdivision is extremely unlikely. Secondary dwellings are allowed on residential parcels on Salt Spring Island; however, the Islands Trust (which has jurisdiction for land use) restricts the approval of secondary dwellings where drinking water supply capacity or wastewater facilities are constrained. Thus it is estimated that the area has already achieved its maximum number of households.

Expansion of the service area is subject to the approval of the Capital Regional District Board (normally following a recommendation by the local service commission). There are several dwellings in immediate proximity to the Cedars of Tuam water system, served by individual private wells. It is possible that the owners of some of those dwellings may seek inclusion in the Cedars of Tuam water service area in the future. Inclusion of additional properties in the service area would be contingent upon sufficient water supply capacity, which does not currently exist.

There is potential for an increase in average household size, although there are no apparent drivers for such an increase in order to predict a significant change. For the purpose of this study, it is assumed that the maximum population of the service area is 32, or two residents per existing dwelling.

Current Water Demand (2011)

Water treated and supplied to the distribution system is measured monthly. Total annual water production and water production per capita for the years 2006-2010 is shown in Figure 1. Customer water meters were read March 31, June 30, September 30 and December 31, 2010. Quarterly water production, retail demand and non-revenue water for April-December 2010 are shown in Figure 2 (total cubic metres) and Figure 3 (litres per capita per day).

The annual average retail water demand in the Cedars of Tuam Water Service Area in 2010 is estimated to have been 192 litres per capita per day (l/c/d). Seasonal variation in water demand is primarily the result of the changes in occupancy of part-time dwellings. Landscape irrigation also accounts for a portion of summer demand.

Figure 1. Water Production

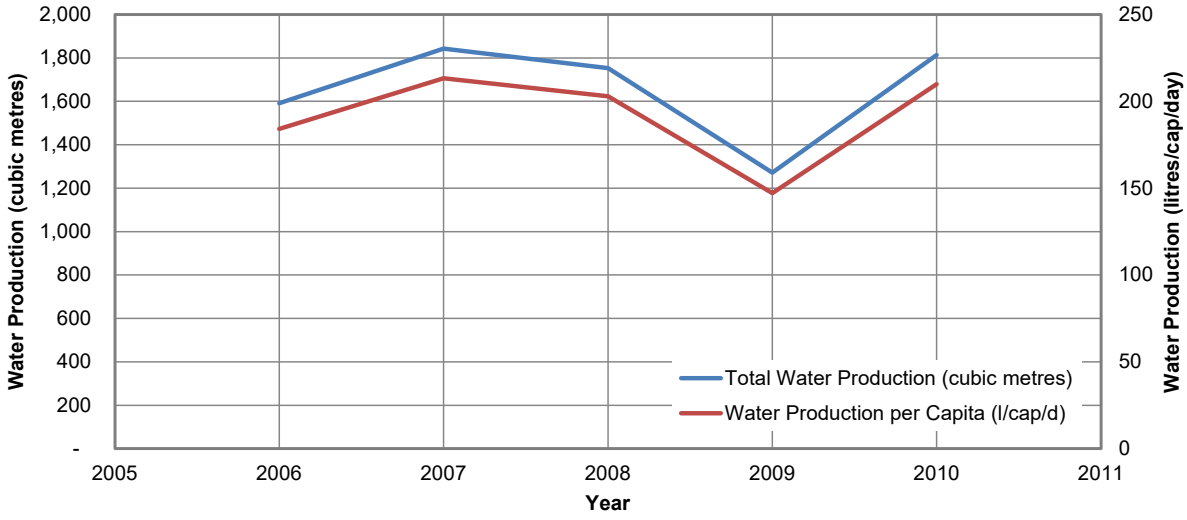


Figure 2. Quarterly Water Production, Retail Use and Non-Revenue Water (2010)

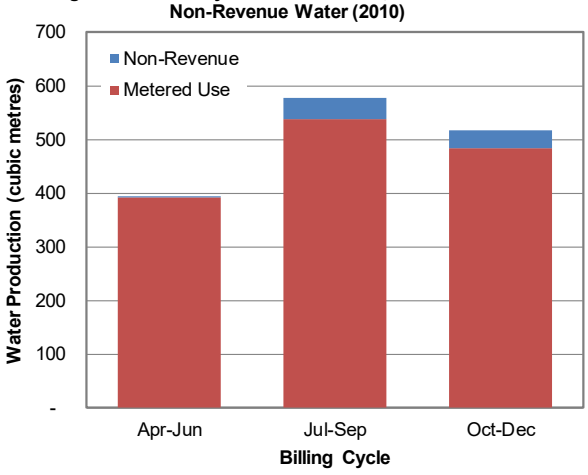


Figure 3. Water Production, Retail Use and Non-Revenue Water Per Capita (2010)

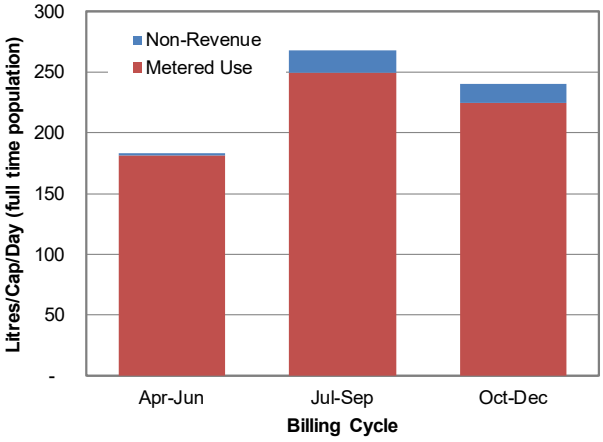
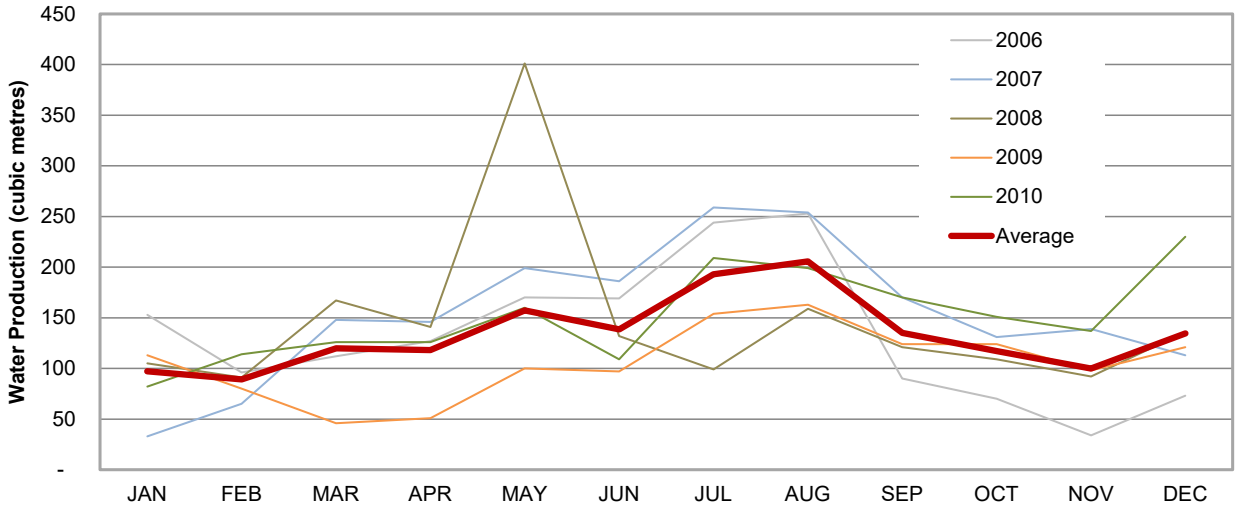


Figure 4. Monthly Average Water production



Water Supply Capacity

Well drawdown test records are not available; however, operational experience indicates that the Cedars of Tuam well currently operating is able to sustain demands typically in excess of 7 m^3/day (1 lgpm) in late summer and early fall in an average year although shortfalls have been experienced in dry years and under unusually high demands (e.g. significant leak or irrigation system malfunction). The seasonal period of lowest well yield (and lowest groundwater level) corresponds with maximum seasonal demand. Well yield is greater at other times of year; however, storing a sufficient volume of water to significantly increase water supply capacity during the period of low well yield is impracticable.

For the purpose of this analysis, it is assumed that the seasonal minimum yield of the existing well is 10 m^3/day (1.5 lgpm) in an average year. Based on historical climate data for Mayne Island, precipitation in the driest year on record was 69% of average. Assuming well yield is directly related to annual precipitation (likely worst-case scenario), the seasonal minimum well yield in a drought is assumed to be 7 m^3/day (1.0 lgpm).

The community has developed and secured access to a new well near the service area that will provide a sufficient quantity and quality of water to meet the long term needs of the community; however, the cost to develop a pump house and pipeline to connect the new well to the service area will be substantial, and it will benefit the community do defer this project as long as possible.

Water Production and Demand – 2022 Update

Referring to Figure 5, the amount of water extracted (water production) from the ground water in 2020 is unfortunately unknown. This is the result of inaccurate water meter readings due to sand intrusion from the ground water source. Sand builds up in the meter creating a false low reading. Water demand (customer water billing) for the service totaled 1,476 m3 of water; a 2% decrease from the previous year and an 18% increase from the 5 year rolling average.

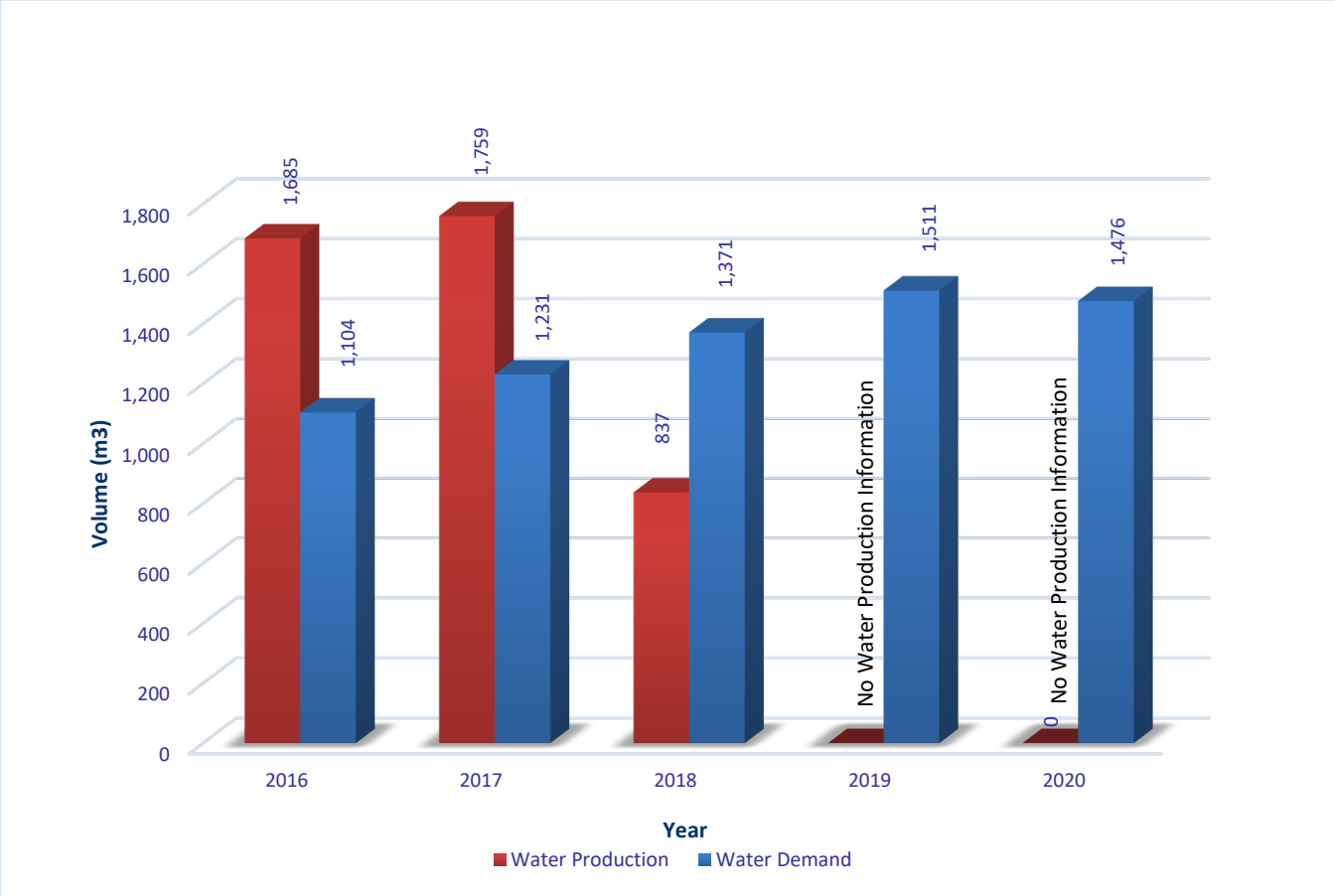


Figure 5: Cedars of Tuam Water Service Annual Water Production and Demand

The Cedars of Tuam Water System is fully metered, and water meters are read quarterly. Water meter information enables water production and consumption to be compared in order to estimate leakage losses in the distribution system. The difference between water produced and water demand (total metered consumption) is called non-revenue water and includes distribution leaks, meter error, and unmetered uses such as standpipe usage, distribution system maintenance and process water for the treatment plant. For 2020, the non-revenue water cannot be calculated due to the erroneous raw water meter production information. This inaccurate water production information will need to be resolved by either replacing the water meter with a different technology that is not influenced by sand or grit in the raw water source or investigating and eliminating the sand intrusion into the well. Capital improvements are planned in 2022 to address this issue.

Climate Change Adaptation and Mitigation

Precipitation patterns are expected to change in coming decades. For the CRD region, by the 2050s, annual precipitation is likely to increase, but probable scenarios based on Global Climate Model projections range from a decrease of 3 percent to an increase of 12 percent (Pacific Climate Impacts Consortium). For the purpose of this analysis, it is assumed that the worst case annual precipitation would be 3% less than the driest year on historical record. Again, assuming well yield is proportional to annual precipitation, climate change within the next 50 years may further reduce the seasonal minimum yield to 6.7 m^3/day.

The Cedars of Tuam water system has a relatively low carbon footprint due to its elevated source. However, reducing water use per capita will benefit the community and the environment by:

- reducing the costs and carbon emissions of expanding the infrastructure to accommodate growth (e.g. manufacturing, transporting and installing larger water mains)
- reducing the carbon emissions associated with trucking in water to overcome supply shortfalls in drought years
- maintaining more water storage in reserve for emergencies such as wildfires or extreme drought, which may increase due to climate change

Water Demand Reduction Target

Peak monthly water demand in the Cedars of Tuam Water Service Area occurs in August, coinciding with the seasonal minimum well yield. The average daily water production for August between 2006 and 2010 was 6.6 m^3/day. If the population of the area increases to 32 without corresponding changes in usage per capita, water demand in August would increase to 8.8 m^3/day, possibly exceeding available supply in the worst case drought year by up to 2.1 m^3/day. Peak month water demand would need to decrease to 207 l/c/d (72% of the 2006-2010 average) to avoid a water supply shortfall under the worst case scenario.

In order to minimize the risk of a supply shortfall in a drought year and to defer the need to develop and connect the new well, the following water conservation targets are proposed:

- Maintain total annual water supply and peak month water supply flows at or below the 2006-2010 averages of 1,650 m^3 and 206 m^3, respectively
- By 2020, reduce annual average water demand to 147 l/c/d
- By 2020, reduce peak month (August) water demand to 206 l/c/d

These targets can be achieved if the following occur by 2020:

- High efficiency toilets and front loading washing machines replace most existing fixtures and appliances.
- Leaks are found and repaired promptly in the distribution system and customer plumbing systems.
- Rainwater is harvested and stored by customers for non-potable uses, including all irrigation uses.

Current and Planned Water Conservation Measures

A planned adaptive strategy for water conservation is proposed for Cedars of Tuam, enabling conservation measures to be tailored to meet the changing needs of the community over time. This approach has proven successful for the CRD Greater Victoria water system. The following conservation measures are proposed as elements of a water conservation plan for Cedars of Tuam:

1. **Universal metering** (current) – Each customer connection to the water system is fitted with a water meter, which is read quarterly.

   The meters are estimated to be approaching the end of their service lives. The ongoing annual cost to read the meters and to replace them every 15 years is estimated to be $1,000, of which $500 (meter reading cost) is currently budgeted. Recovery of the replacement cost is expected to be addressed as an outcome of a Strategic Asset Management Plan for the service, scheduled to be completed in 2011.

2. **Reporting usage and water budgets on water bills** (current) – Information about water use has been displayed on water bills since January 2011, raising customer awareness about their water use. Further information is presented at annual general meetings and in community newsletters, enabling customers to compare their own usage with the range and average in their community and others. The following annual water budget target could be displayed on water bills:

Billing Period	Water Budget (cubic metres)
January-March (Q1)	20
April-June (Q2)	25
July-September (Q3)	33
October-December (Q4)	22
Annual Total	100

The cost of reporting usage and providing conservation messages on the water bills is currently budgeted.

3. **Consumption based water billing** (current) – Water is billed using a two-tier inclining block structure. Water for basic household needs (up to 75 m^3 every three months) is billed at \$0.90/m^3, and water use in excess of 75 m^3 every three months is billed at \$7.70/m^3. The upper tier rate is approximately equivalent to the cost of trucking in water, ensuring that the cost of very high usage is not passed on to careful water users. Customers very seldom use more than the quarterly water budget of 75 m^3. The consumption charges recover about 5% of the cost of water service, and the remaining 95% is recovered through a fixed annual charge.

   This structure maintains stable revenue for fixed costs (almost all costs unless trucked water is required), provides a sufficient quantity of water at an affordable cost for essential customer needs, and provides a strong price signal to reduce excessive usage in any of the four billing cycles. This structure has proven well suited to Gulf Island communities with a large proportion of seasonal or occasional users. Based on recent implementation of this structure in other CRD water services, an overall demand reduction of 5-10% may be reasonably expected. A third (middle) tier could be added to the consumption charge structure to provide a financial incentive to maintain water use below 25 cubic metres per quarter.

   The cost of consumption based billing is currently budgeted.

4. **Community Awareness and Education** (current; expand as needed to meet target) – Information about water use and conservation is provided in community newsletters and at typically well attended annual general meetings. Members of the community have prepared a *Manual for Owners and Residents of the Cedars of Tuam Water System* (attached) that includes water conservation advice. The manual has been endorsed by the Cedars of Tuam Water Service Commission and distributed to all residents in the service area. A more formal conservation awareness program may be implemented by linking information presented by mail and at the AGM with a community homepage on the CRD website that includes:
   a. water use statistics, and comparison with other areas and benchmarks/targets
   b. best practice guides (e.g. fixture and appliance standards, rainwater harvesting, leak prevention)
   c. links to CRD regional water conservation resources
   d. links to other organizations that provide water conservation resources tailored to the Gulf Islands (e.g. Mayne Island Integrated Water Systems Society, Salt Spring Island Water Council).

   The cost of a modest community awareness program including the AGM, newsletters and website content, is currently budgeted.

5. **Water Conservation Plan Renewal** (2016, and every five years thereafter) – A review of this plan will be conducted approximately every five years to update forecasts and targets, consider new information, and adjust program activities as required to meet targets.

   The cost to review and update this conservation plan is anticipated to be roughly \$1,000 every five years, which would require a new annual contribution of \$200 to the capital reserve fund.

Program Implementation Responsibility, Cost and Schedule

This Water Conservation Plan will be implemented by CRD staff, under the authority of the Cedars of Tuam Water Service Commission. The Commission has administrative authority delegated by the CRD Board under CRD Bylaw No. 3693, "Salt Spring Island Water, Sewer and Liquid Waste Disposal Commissions Bylaw No. 1, 2010" for provision of the water service.

The following implementation schedule is proposed:

Item No.	Implementation Year	New Budget Requirement	Note
1	2009 (completed)	$ 500	Estimated annual cost of asset maintenance and renewal
2	2011 (completed)	$ 0	Included in current budget
3	2012	$ 0	Included in current budget
4	2012	$ 0	Included in current budget
5	2016	$ 200	Annual contribution to reserve for plan renewal

Linkages to Other Plans and Policies

Water Conservation Plans for CRD electoral area water services will adhere to a similar format. Targets, program measures and knowledge will be shared between these service areas. Where the CRD provides sewer services, the benefits of water conservation for these services will be taken into account. Water Conservation Plans will be linked to Strategic Plans for the services. Where practicable, planning and program implementation will also be linked with the Greater Victoria water conservation and climate action services delivered by the CRD. Knowledge will be shared, and policies and programs will be coordinated, with other stakeholders such as improvement districts, other regional districts, the Islands Trust and the Mayne Island Integrated Water Systems Society and the Salt Spring Island Water Council.

References

1. Hendren, Gary and Richard H. Edwards. Cedars of Tuam Feasibility Study, Salt Spring Island, BC – Preliminary Report for Comment. Capital Regional District. May 2000.

2. Walker, Deborah and Colwyn Sunderland. Water Use and Conservation Update 2008. Capital Regional District. 2008.

3. Bain, Ronald et.al. A Manual for Owners and Residents of the Cedars of Tuam Water System. Salt Spring Island. January 2010.

4. www.plan2adapt.ca website. "Summary of Climate Variables – Climate Change for CRD Region in 2050s Period". Pacific Climate Impacts Consortium. Accessed 24 June 2011.

Making a difference...together

REPORT TO SKANA WATER SERVICE COMMITTEE
MEETING OF TUESDAY, FEBRUARY 01, 2022

SUBJECT **Investing in Canada Infrastructure Program – Green Infrastructure – Environment Quality Grant Application for the Skana Water System Storage Tank Replacement**

ISSUE SUMMARY

A Capital Regional District (CRD) Board resolution is required to endorse the *Investing in Canada Infrastructure Program* (ICIP) – *Green Infrastructure – Environmental Quality,* grant application for the Skana Water System Storage Tank Replacement project.

BACKGROUND

The Skana water system has two horizontal steel water storage tanks. The tanks were installed in the 1970's, mounted on concrete cradles, on a gravel pad adjacent to the primary water source.

Operations staff noted increased rust coloured sediment when flushing the water storage tanks prompting a condition assessment in 2015. A structural consultant was retained to conduct an assessment consisting of visual inspections, ultrasonic thickness testing from the exterior, and estimate of remaining service life. Exterior and interior corrosion was observed, and the storage tanks were beyond their estimated service life of 40 years based on industry standards. Additionally, the foundations required retrofits or replacements if the tanks were to remain in service.

Project Overview
The proposed scope of work is to complete the replacement of the two steel tanks with a bolted steel tank and seismically appropriate foundation with proper water level control.

The new grant program will fund portions of the consulting and construction costs for design, supply and construction of the bolted steel tank and associated piping, and removal of the old steel tanks and concrete cradles.

The Skana water service will be responsible for ineligible costs such as CRD staff time associated with managing the project and operations staff facilitating design and construction. Additionally, the *Green Infrastructure – Environmental Quality* grant funds to a maximum of 73.33% of eligible costs.

Project Costing

- Total eligible costs are estimated at about $729,950 including engineering and contingency amounts.
- Reimbursable costs are estimated at $535,272 (73.33% of $729,950).
- Ineligible costs are estimated at $19,170 (for staff time associated with managing the project).
- Total costs to be borne by the Skana Water Service property owners are estimated at $194,678 (26.67% of $729,950) plus ineligible costs of $19,170 which totals $213,848.

Project Funding
As noted, the grant program could provide up to $535,272 and the Skana Water Service property owners would be responsible for $213,848. An alternative approval process or referendum would be required for voter assent to borrow required funds.

ALTERNATIVES

Alternative 1
The Skana Water Service Committee recommends the Electoral Areas Committee recommend to the Capital Regional District Board:

That staff be directed to submit an application for an *Investing in Canada Infrastructure Program - British Columbia – Green Infrastructure - Environmental Quality* grant for the project's grant-eligible costs for the Skana Water System Storage Tank Replacement.

Alternative 2
That the Skana Water Service Committee directs staff not to proceed with a grant application to the *Investing in Canada Infrastructure Program* (ICIP) - *Green Infrastructure – Environmental Quality* program.

IMPLICATIONS

If the recommendation is approved, staff will complete and submit the grant for the February 23, 2022 submission deadline. Should the grant be approved, there could be up to a $535,272 benefit to the community. Should the grant not be approved, the project can still commence at an estimated cost of $749,120 to be approved via an alternative approval process or referendum. Replacement of the water storage tanks are required and will improve system resilience.

CONCLUSION

An opportunity for grant funding to replace the deteriorating water storage tanks is available through the *Investing in Canada Infrastructure Program.* A resolution from the Capital Regional District Board is required to endorse the application. The deadline for submitting the grant application is February 23, 2022.

RECOMMENDATION

The Skana Water Service Committee recommends the Electoral Areas Committee recommend to the Capital Regional District Board:

That staff be directed to submit an application for an Investing in Canada Infrastructure Program - British Columbia – Green Infrastructure - Environmental Quality grant for the project's grant-eligible costs for the Skana Water System Storage Tank Replacement.

Submitted by:	Dale Puskas, P.Eng., Manager Capital Projects
Concurrence:	Ian Jesney, P.Eng., Senior Manager, Infrastructure Engineering
Concurrence	Matt McCrank, P.Eng., Senior Manager,
Concurrence:	Ted Robbins, B. Sc., C. Tech., General Manager, Integrated Water Services
Concurrence:	Robert Lapham, M.C.I.P., R.P.P., Chief Administrative Officer

Making a difference...together

REPORT TO ELECTORAL AREAS COMMITTEE
MEETING OF WEDNESDAY, FEBRUARY 09, 2022

SUBJECT **Request for Governance Study by the Magic Lake Property Owners' Society, North Pender Island**

ISSUE SUMMARY

To consider a request by the Magic Lake Property Owners' Society to the Province for a formal governance study that considers the incorporation of Magic Lake Estates as an island municipality.

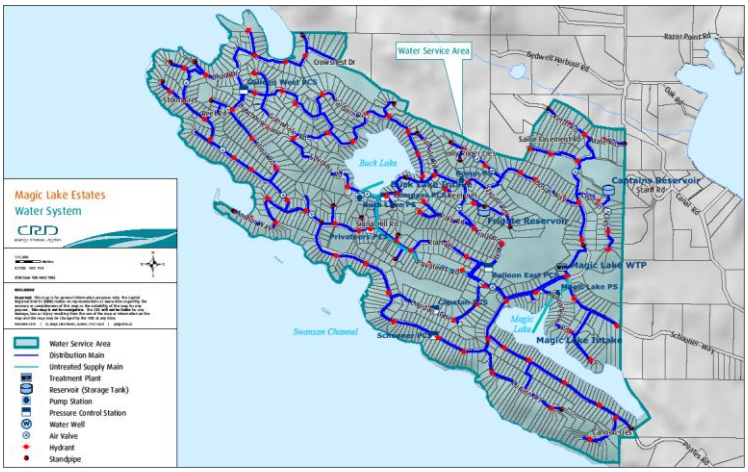
BACKGROUND

The Magic Lake Property Owners' Society (MLPOS) has identified issues of taxation, service delivery, and local governance and seeks the support of the CRD Board in requesting the BC Ministry of Municipal Affairs issue a Restructure Planning Grant to fund a Local Governance Study. The study's purpose would be to investigate the feasibility of incorporating Magic Lake Estates as an Island Municipality, as defined by the Local Government Act, Section 6. At the October 2, 2021 meeting of the MLPOS, the following resolution was passed:

> "… that the membership of the Magic Lake Property Owners' Society (MLPOS), agrees with the MLPOS Board of Directors that the Society, along with other interested parties, will formerly request, through the Capital Regional District, as well as other avenues if necessary, that the Minister of Municipal Affairs "Restructure Planning Grants" as outlined in the government's publications and on its website, fund a formal governance study for our community. And that, the MLPOS will facilitate the formation of a committee to guide the undertaking of the study, along with communications with various agencies."

Governance of the Southern Gulf Islands Electoral Area

Magic Lake Estates (MLE) is a residential neighbourhood on North Pender Island within the Southern Gulf Islands Electoral Area (SGIEA) of the CRD. For the EA, the Capital Regional District (CRD) is the local government along with the Islands Trust, a special purpose agency responsible for land use and conservation within the Islands Trust Area.



Magic Lake Estates is comprised of around 1200 small lots (+/- .5 acre), predominantly occupied by single family dwellings, with a population of approximately 2000 people. (The MLPOS uses a population estimate of 1930 in its proposal).

Developed in the 1960s, the subdivision that created MLE is well known for inspiring the creation of the Islands Trust and the establishment of the Island Trust Act. MLE is still highest density residential development in the Islands Trust Area.

Within the Magic Lake neighborhood there is not a commercial centre, but there is a fire hall, a baseball field, parks, and a marina. Originally serviced by a private water utility, MLE now receives water and wastewater service by CRD through the CRD Magic Lake Estates local area water and sewerage system.

Other services provided by the CRD in Magic Lake Estates (and on all of North and South Pender Islands) include parks and recreation, library services, economic development, emergency preparedness, building inspection, SGI Harbours, and by-law enforcement (animal and noise control). The CRD administers Community Works Fund (Gas Tax) grants on behalf of the Union of BC Municipalities and the Federal Government and issues CRD grants-in-aid for community groups.

SGI political representation on the twenty-four member CRD Board is through the election of one Director for the Southern Gulf Islands Electoral Area (SGIEA). Many CRD services are guided by volunteer commissions such as the Magic Lake Water and Sewer Committee, the Pender Island Parks and Recreation Commission, and EA wide services such as the SGI Harbours Commission and the Economic Sustainability Commission. These Commissions are comprised of local residents to advise the CRD Board on delivery of the service.

Under the Islands Trust Act and the Local Government Act, the Island Trust Council has 26 trustees from 13 Trust Areas (extends as far south as Saturna Island in the SGI to as far north as Denman/Hornby Islands in the Comox Valley Regional District). A Local Trust Committee, consisting of the two locally elected Trustees and Chaired by one member of the Islands Trust Executive Committee of Trust Council, makes land-use and planning decisions for each island.

The North Pender Local Trust Committee is responsible for community planning and land use (Official Community Plans and zoning) on North Pender Island. There is also a Local Trust Committee for South Pender Island (connected to North Pender by a canal/bridge), and as such representation on the governing body of the Islands Trust Council is provided through the election of four Trustees for North/South Pender Island.

In MLE, like in all unincorporated areas of the Province, the Ministry of Transportation and Infrastructure has authority over the roads.

MLE and North Pender are also served by many services provided by volunteer community groups and the private sector. Examples include waste management, social services, medical societies, and community hall societies.

ALTERNATIVES

Alternative 1:

The Electoral Areas Committee recommends to the Capital Regional District Board:

1. That the Board advance the request of the Magic Lake Property Owners' Society to the Ministry of Municipal Affairs to evaluate the local context of the Magic Lake Estates

neighborhood on North Pender Island and request the Ministry consider funding a Governance and Services Study to examine governance concerns within the community and provide options and alternatives to address those concerns.

Alternative 2:

1. That the CRD Board not advance the request from the Magic Lake Property Owners' Society for a restructure planning grant to the Ministry of Municipal Affairs.

IMPLICATIONS

Restructure Grants

The Provincial government has some funding for municipalities and regional districts that wish to examine their governance structure with an independent and credible examination of the impacts of governance restructuring. Restructure planning grants may be available to support the following initiatives:

- *Assess existing services and community issues*
- *Study governance options, such as the implications of municipal incorporation or restructure*
- *Undertake the public consultation process associated with incorporation or restructure*

Principles of the Restructure Process:

Restructure processes can be lengthy and complex, and cause division and have other impacts both inside and outside the community. The Province has established the following principles of restructure:

- *The process is initiated and supported by the elected local government representatives*
- *Understanding the problem precedes developing a solution*
- *All sectors of the community, including First Nations and other local governments, need to be involved in the discussion*
- *Changes emerging from the process should be supported by the elected local government representatives*
- *For municipal restructure, the electorate should be well-informed on the implications of change before making a decision*

Based on the restructure principles, the nature of the proposed restructure and on community circumstances, the restructure process generally follows six phases:

1. *Preliminary exploration - responding to signals from the community, local governments make their first contact with the Ministry. The Ministry evaluates the local context and provides general information on the restructuring process.*
2. *Process design - if the Minister sanctions the study process, the Ministry assists the local government with developing terms of reference and restructure planning grants to assist with hiring a consultant with expertise in local governance, services and finance to undertake a study.*

3. *Process initiation - the local government creates an oversight body and hires a consultant. The study is then conducted with the goal of obtaining information on the impact of restructuring on fiscal, political representation, and service delivery issues.*
4. *Community engagement - the study findings are shared with the community and, based on the results and public input, a recommendation is made on proceeding to restructure decision.*
5. *Decision and implementation - local (elector and/or local government) and Provincial decisions are made on whether to restructure, and the necessary documents developed to give the restructure legal effect (bylaw, Cabinet Order, Letters Patent) and implemented.*
6. *The local government(s) adapt to the new structure, which may involve transition or hiring of new staff, reconfiguring service delivery, and revision of local bylaws and community plans. The Ministry may provide some financial assistance with this transition.*

Staff have engaged in preliminary discussions with Ministry staff and received feedback that MLE does not have many of the characteristics that the Ministry would look for in a community seeking incorporation, however, the Ministry advised that the restructure process does not begin with an incorporation study, rather the Province first needs to understand the broader context of the area in question. This is done via a Governance and Services Study. This type of study is designed to educate the community on the nature of its current situation (e.g., who provides services and governance) and to encourage a local conversation about motives for change. This is an opportunity for the community to begin an important and complex discussion about local governance without immediate pressure to decide on a potential outcome. The study would also explore what the community issues are and the possible pathways for solving issues. A study does not necessary lead to municipal incorporation, as it may identify alternative ways to address community concerns. One of the important elements of restructure work is to educate residents about their current system, its variations and provide local context for alternative local government forms. This process, from drawing up the study terms of reference to completing it, typically takes around 12-18 months.

If the Governance and Services Study indicates however that incorporation may address some of the local issues, and the Electoral Area Director, Regional District Board, and community are in support, the next step would be undertaking a more detailed and focused restructure study. This may take the form of a boundary study (if it is necessary to focus in more closely on a specific area) or an incorporation study. An incorporation study would examine the taxation, revenue, infrastructure and service implications for the CRD and Magic Lake residents. In addition to local government support, there must be a broad base of resident support that is demonstrated through surveys, open houses and community forums before the Province commits funding to undertake such a restructure study, which is likely to take 1 to 2 years to complete. The study would provide residents with a clear understanding of the implications in order to have an informed understanding. An incorporation study would then culminate in an assent vote.

Alignment with Board Priorities

Advancing the request of the MLEOS supports the CRD Board priority of Accountability and the Corporate Plan Priority 15a: Develop a comprehensive strategy & operational review to reflect the unique needs of electoral areas.

The MLPOS has provided its analysis of the costs and benefits to the residents of incorporating as an Island Municipality. The assumptions and data used for these conclusions need to be evaluated by an independent and credible third party. A clear understanding of the problem needs to be advanced in the context of a detailed review of the current governance system and its challenges. This is the purpose of a restructure study. All sectors of the community, including First Nations and other local governments, need to be involved in the discussion.

CONCLUSION

The MLPOS has asked the CRD Board to advance its request to the Provincial Government for funding a governance restructure study for the community. The Provincial process provides that only local governments are eligible to apply to governance grants, and that Board support is necessary for Provincial staff to reach out and begin preliminary discussions to understand the rationale for the request and undertake an assessment of viability to receive funding for a study.

RECOMMENDATIONS

The Electoral Areas Committee recommend to the Capital Regional District Board:

1. That the Board advance the request of the Magic Lake Property Owners' Society to the Ministry of Municipal Affairs to evaluate the local context of the Magic Lake Estates neighborhood on North Pender Island and request the Ministry consider funding a Governance and Services Study to examine governance concerns within the community and provide options and alternatives to address those concerns.

Submitted by:	Justine Starke, MCIP, RPP, Manager, SGI Service Delivery, Corporate Services
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT(S)

Appendix A: Letter from Magic Lake Property Owners Association

P.O. Box 65,
Pender Island, BC
V0N 2M0

Mr. David Howe
Southern Gulf Islands Electoral Area Director
Capital Regional District
625 Fisgard Street
Victoria, British Columbia
Canada V8W 1R7

Mr Paul Brent
Southern Gulf Islands Electoral Area Alternate Director
Capital Regional District
625 Fisgard Street
Victoria, British Columbia
Canada V8W 1R7

Dear David Howe and Paul Brent:

Re: Magic Lake Property Owners' Society Governance Motion

This it to advise that, at the duly constituted meeting of the Magic Lake Property Owners' Society (MLPOS) Annual General Meeting on October 2, 2021, the membership of the MLPOS passed the following motion:

> Moved: Bob Coulson, Seconded: Jean Deschenes
>
> … that the membership of the Magic Lake Property Owners' Society (MLPOS), agrees with the MLPOS Board of Directors that the Society, along with other interested parties, will formerly request, through the Capital Regional District, as well as other avenues if necessary, that the Minister of Municipal Affairs authorize "Restructure Planning Grants" as outlined in the government's publications and on its website, fund a formal governance study for our community.
>
> And that, the MLPOS will facilitate the formation of a committee to guide the undertaking of the study, along with communications with various agencies.

The MLPOS has identified what it believes to be benefits to the residents of Magic Lake Estates in the areas of taxation, service delivery, and local governance.

We are requesting your assistance with having the Capital Regional District advocate on our behalf for a Restructure Planning Grant to fund a Local Governance Study of the feasibility of incorporating Magic Lake Estates as an Island Municipality as defined by the Province of British Columbia's Local Government Act, Section 6.

Thank you for your kind assistance so far and for the continuing support you can provide as we go forward with our endeavour.

We are in the process of forming a steering committee to guide this project along. If you haven't received an invitation to take part, you will shortly.

Sincerely



Robert (Bob) Coulson
President
Magic Lake Property Owners' Society
PO Box 65
Pender Island, BC, Canada, V0N 2M0

Making a difference...together

REPORT TO ELECTORAL AREAS COMMITTEE
MEETING OF WEDNESDAY, FEBRUARY 09, 2022

SUBJECT Regulation of Vacation Rentals on the Southern Gulf Islands and Salt Spring Island

ISSUE SUMMARY

To provide information on measures to restrict or control tourism accommodation, including the power to regulate business through the issuance of business licenses for Salt Spring Island and Southern Gulf Islands by requesting the Province pass enabling regulation through an Order in Council.

BACKGROUND

On July 14, 2021, the Electoral Areas Committee passed the following resolution:

> That the Electoral Areas Committee request staff to provide a report outlining the possibility of the Capital Regional District pursuing measures to restrict or control tourism accommodation, including the power to regulate business through the issuance of business licenses for Salt Spring Island and Southern Gulf Islands by requesting the Province pass enabling regulation through an Order in Council.

The Capital Regional District has received a similar request by way of resolutions from the Islands Trust Salt Spring Island Local Trust Committee, North Pender Island Local Trust Committee, South Pender Island Local Trust Committee, and the Galiano Island Local Trust Committee. While Local Trust Committees are the land use authorities for the islands, the LTCs lack the full range of tools for enforcement and administration of vacation rentals that can be utilized by municipalities. Please see the letter from Islands Trust, dated November 9, 2021 and attached as Appendix A.

In addition, in 2019, the Union of B.C. Municipalities (UBCM) and the Province convened a Joint Advisory Group on Short-Term Rentals. In 2021, the advisory group released a report with 13 priorities for action for the Province to consider in order to establish a regulatory framework for the short-term accommodations industry (see Appendix B). Key among the requests for action include greater regulatory tools for local government:

- *Amend the Local Government Act to allow regional districts to implement business licensing, by approval of the regional district board, as a tool to regulate short-term rentals.*

- *Increase the allowable fines that local governments can levy against short-term rental hosts operating out of compliance.*

- *Explore whether provincial bylaw notice adjudicators have sufficient information and awareness of short-term rental issues to understand these offences, preventing undue cancellation of violation notices.*

As discussed in the UBCM report, short-term vacation rentals can be problematic for communities by reducing the available long-term rental housing stock for residents. It can also encourage

buyers to acquire secondary homes in popular tourist destinations, such as the Gulf Islands, by offering a revenue stream to non-resident owners while still allowing them flexibility to access the property for personal use. The introduction of the Provincial Speculation and Vacancy Tax was designed in part to address some of these issues, however, the SSI and the SGI are exempt from the tax.

ALTERNATIVES

Alternative 1:

The Electoral Areas Committee recommends to the Capital Regional District Board:

> That the Regulation of Vacation Rentals on the Southern Gulf Islands and Salt Spring Island report be received for information.

Alternative 2:

> That the Capital Regional District Board request the Province of British Columbia bring forward an Order in Council to grant the Capital Regional District the authority to regulate business in the Salt Spring Island and Southern Gulf Islands Electoral Areas.

IMPLICATIONS

The regulatory tools available to local governments to regulate vacation rentals in residential zones include zoning bylaws, temporary use permits, and business licensing, all of which can be enforced by ticketing, fines or a court-issued injunction.

Regulation by Land Use Bylaw

On Salt Spring Island and in the Southern Gulf Islands, land use regulation is under the authority of the Islands Trust. Under the *Islands Trust Act*, Local Trust Committees (LTCs) have land use authority to adopt Official Community Plans and zoning regulations to regulate short-term vacation rentals. LTCs can permit or prohibit vacation rentals outright in accordance with zoning requirements within land use bylaws.

A contravention of a land use bylaw can be enforced by issuing a municipal ticket or a bylaw adjudication notice, or in more serious cases, obtaining a statutory injunction order from BC Supreme Court to prevent the continued use of the property in contravention of the bylaw. In cases where the rental is occurring in a secondary suite or guest cottage that is not authorized by zoning, the injunctive order can include the power to dismantle and remove the unauthorized suite at the owner's expense. Many local governments in BC use some or all of these enforcement tools under their land use bylaw to effectively regulate unauthorized vacation rentals.

While land use bylaws can be effective in regulating vacation rentals and are relatively simple to enforce, there are some limitations due to the fact that land use bylaw provisions are typically general and permissive in nature, rather than site-specific. Once a vacation rental use is permitted in a zone, the LTCs no longer have control over how the specific use is carried out at an individual property level. Some LTCs get around this by continuing to prohibit short-term vacation rental uses, but allowing them under temporary use permits and controlling the use on a conditional, case by case basis. Where there is a desire to further regulate how the use is carried out, to

monitor the extent of the use, or to collect data to inform adaptive management of vacation rental use, business licenses may be a more effective regulatory tool.

Regulation by Business Licensing

Under the *Local Government Act*, Regional Districts do not have business licensing authority. Regional Districts are different from municipalities in this respect, as municipalities have authority to regulate business by imposing a system of licenses, permits or approvals under section 15 of the *Community Charter*.

Regional Districts can request business licensing authority from the Province. If granted, it is enabled by an order-in-council or regulatory change. The UBCM request would enable this authority outright through a change to the *Local Government Act* and remove this as a barrier for Regional Districts that want to use business licensing to manage issues such as short-term rentals. However, currently, if the CRD would like business licensing powers, it must first be granted the authority by the Province.

Once granted the authority to regulate business by the Province, the CRD would have to adopt a business licensing bylaw which would then be used to define which categories of business it would regulate and set the conditions and requirements of the licensing regime. Normal provision of a business licensing bylaw would include the following:

- a requirement to obtain an annual permit for a fee (usually $100-$150);
- appointment of a License Inspector or Director;
- assignment of powers to the Inspector to set conditions on the issuance or cancellation of licenses and the appeal process for those decisions;
- power to conduct inspections;
- general conditions on the license such as the form, requirement to display, requirements to update information, renewal and transfer;
- specific conditions based on business type, such as home-based, commercial, personal services or inter-municipal.

If CRD were to regulate vacation rentals through business licensing, all vacation rental owners would need to purchase an annual business license issued by the CRD. Owners would need to comply with any of the terms and conditions placed on the license, which may include a requirement for an inspection of the property. Typically a business license would not be issued for any vacation rentals that are not compliant with the applicable zoning bylaws, so only those rental properties that are authorized by zoning would be licensed.

One of the benefits of licensing is that it can provide consumer protection by establishing minimum standards for businesses that are licensed. It also provides the local government a way to track and compile metrics on the number of businesses operating in the region.

Enforcement of License Contraventions

Business licensing would provide another avenue for enforcement against unauthorized vacation rental properties. Fines could be issued to a business that is operating without a license, or is operating in contravention of the terms and conditions of a license. Where a business is not complying with the requirements of a business license, the license can also be revoked by the License Inspector, however, under the *Community Charter* revocation of the license is a decision

that is subject to a right of appeal to the Regional Board. In addition, prior to revoking a license, the License Inspector must observe the rules of procedural fairness and provide the business owner an opportunity to be heard and make submissions before a decision is rendered, similar to what is required when a local government files a Section 57 Notice of Building Contravention on title of a landowner's property. The administrative law requirements that are triggered by revocation of a business license can make enforcement of a license contravention a more challenging and expensive process than enforcing compliance with a land use bylaw.

Financial Implications of Establishing a Business Licensing Function

A business license function would require new funding from the SGI and SSI electoral area for the administration and overhead of the regulatory service, as well as funding to enable Bylaw Enforcement Officers to enforce the provisions of the business licensing bylaw. A software system, such as Tempest, would be necessary to track and issue licenses, automate the renewal process and generate invoices. Business owners would need access to payment options to pay the annual license fee. Systems currently utilized by CRD Bylaw Enforcement staff could be customized to administer business licenses, however, it would require an estimated 2.0 additional FTEs for administration, operation and enforcement of the new regulatory service, depending upon the scope of the regulation. Some of the costs of the new service could be offset by the revenue generated from collection of the license fees, however, the offset would depend on the number of businesses subject to the licensing requirement. For example, if all business in the SGI and SSI electoral area required annual business licenses, the revenue offset would be greater than if the regulation was limited to vacation rentals. If Islands Trust zoning continued to prohibit vacation rentals, uptake of a business license program would be limited further.

CONCLUSION

Short-term vacation rentals can be regulated by land use bylaws or through business licensing. CRD does not currently have the authority under the *Local Government Act* to regulate business, however, the authority can be granted by the Province by an order-in-council, and enabled by the Board though the adoption of a business licensing bylaw. Establishing a business license function would require new funding be raised from the SGI and SSI electoral areas for increased staffing associated with administration and enforcement of the business license function. It is anticipated that some of the increased costs could be offset by the revenue generated from annual license fees. Staff recommend further analysis on financial impacts would be required prior to implementation.

RECOMMENDATIONS

The Electoral Areas Committee recommends to the Capital Regional District Board:

> That the Regulation of Vacation Rentals on the Southern Gulf Islands and Salt Spring Island report be received for information.

Submitted by:	Justine Starke, MCIP, RPP, Manager, SGI Service Delivery, Corporate Services
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT(S)

Appendix A: Letter from Islands Trust, dated November 9, 2021

Appendix B: Priorities for Action on Short-Term Vacation Rentals (Report of the Joint UBCM-Province Advisory Group on Short-Term Rentals).

Appendix A

200-1627 Fort Street Victoria BC VHR1H8
Telephone **250.405.5151** Fax 250.405.5155
Toll Free via Enquiry BC in Vancouver 604-660-2421 Elsewhere in BC **1.800.663.7867**
Email information@islandstrust.bc.ca
Web www.islandstrust.bc.ca

November 9, 2021 File Number: 12-14-6500-20

Justine Starke
Manager, Southern Gulf Islands Service Delivery
Capital Regional District
Via email

Dear Justine:

Re: Local Trust Committee Business Licensing Resolutions

I am writing to you concerning a number of resolutions recently adopted by local trust committees encouraging the Capital Regional District to explore business licensing. Trustees and residents in the Trust Area have been grappling with the impacts of short term vacation rentals for years, and most LTCs have policies and regulations in place to attempt to mitigate those impacts. However, it has become apparent to many trustees and residents that zoning and other land use regulations are insufficient to manage the impacts of vacation rentals. Consequently, a number of LTCs have adopted resolutions (please see attached) requesting that the CRD consider the implementation of business license regulations within the Salt Spring and Southern Gulf Islands electoral areas for tourist accommodation, specifically for enforcement and administration of vacation rentals.

Sincerely

Robert Koiima,
Regional Planning Manager
Islands Trust

Attachment: Table of Resolutions

z:\12 long range planning\14 multi-island\6500 ltc work program\20 projects (p)\2021 business licensing\crd business licensing letter.docx

Local Trust Committee	Date	Resolution
Galiano Island Local Trust Committee	July 5, 2021	**GL-2021-065** **It was Moved and Seconded,** that the Galiano Island Local Trust Committee requests that the Capital Regional District explore the implementation of business licensing for tourist accommodation and specifically for short term vacation rentals. **CARRIED**
Mayne Island Local Trust Committee	June 21, 2021	**MA-2021-042** **It was Moved and Seconded,** that the Mayne Island Local Trust Committee request that the Capital Regional District explore the implementation of business licensing for tourist accommodation and specifically for short term vacation rentals. **CARRIED**
North Pender Island Local Trust Committee	June 24, 2021	**NP-2021-078** **It was Moved and Seconded,** WHEREAS the North Pender Island Local Trust Committee is implementing additional policies and zoning to regulate and manage short term vacation rentals on North Pender island, the Local Trust Committee lacks the full range of tools for enforcement and administration of vacation rentals; THEREFORE the North Pender Island Local Trust Committee requests that the Capital Regional District explore the implementation of business licensing for tourist accommodation and specifically for short term vacation rentals. **CARRIED**
Salt Spring Island Local Trust Committee	May 25, 2021	**2021-108** **It was MOVED and SECONDED,** Whereas the Salt Spring Island Local Trust Committee wishes to see appropriate regulation and management of short term vacation rentals on Salt Spring Island but lacks the full range of tools for enforcement and administration of vacation rentals; Therefore the Salt Spring Island Local Trust Committee requests that the Capital Regional District explore the implementation of business licensing for tourist accommodation and specifically for short term vacation rentals. **CARRIED**
South Pender Island Local Trust Committee	May 7, 2021	**SP-2021-044** **It was Moved and Seconded,** that whereas the South Pender Island Local Trust Committee is implementing additional policies and zoning regulations to regulate and manage short term vacation rentals on South Pender Island, the Local Trust Committee lacks the full range of tools for enforcement and administration of vacation rentals; therefore, the South Pender Local Trust Committee requests that the Capital Regional District explore the implementation of business licensing for tourist accommodation and specifically for short term vacation rentals. **CARRIED**

PRIORITIES FOR ACTION ON SHORT-TERM RENTALS

Report of the Joint UBCM-Province Advisory Group on Short-Term Rentals

FINAL REPORT

June 30, 2021

Supported by

Housing Policy Branch
Office of Housing and Construction Standards
Ministry of Attorney General and Minister responsible for Housing

Executive Summary

The Province's Rental Housing Task Force recommended in December 2018 that the Province work with local governments to develop, implement, and enforce short-term rental rules to better protect long-term rental stock (Recommendation #11). In the May 2019 response to the Task Force recommendations, the Province agreed to address this recommendation in 2020 through further consultation with stakeholders and local governments. In fall 2019 the Province and UBCM established a Joint Advisory Group on Short-Term Rentals. The purpose of this group was established as follows:

> The Advisory Group will facilitate discussions with local governments about the impacts of STRs and tools for addressing them. Information generated by the Advisory Group will help **inform the Province's consideration of potential policy approaches to STRs**, including possible measures to support local governments interested in taking further actions to address STR impacts.

Housing affordability and availability are topics of utmost concern for all levels of government in British Columbia. The Advisory Group is particularly concerned about impacts of short-term rentals on long-term rental housing. While these impacts are hard to measure with available data set, the diversion of housing units from long-term supply is a significant problem affecting housing in many communities. The Advisory Group's work is informed by the need to take sensible precautionary steps to avoid negative outcomes for British Columbians.

The Advisory Group considered input from experts in various aspects of provincial legislation, research on short-term rental activity and broader rental housing data, and a series of stakeholder organizations. Through the Advisory Group's discovery and discussion process, a series of principles and outcomes were articulated that guided the identification of possible measures for the Province to consider. These principles were: recognition of regional differences, subsidiarity, fairness, future-proofing, and evidence-based policy balanced by precaution. The outcomes address various stakeholder viewpoints and seek to recognize both the opportunities and drawbacks presented by short-term rental platforms.

The priorities and requests to the Province in this report are intended to spark further discussion and exploration of potential policy approaches in the areas of platform accountability or regulation, data sharing, taxation, local government regulatory tools, capacity, and broader efforts to improve data sources and analysis on rental housing.

This Report represents the work done by the Advisory Group to understand the impacts of short-term rentals and suggest priorities and ideas to inform the Province's future work in this area. This report does not indicate formal endorsement by UBCM or the Province of these proposals.

Contents

Executive Summary....2
Background....4
Participating Organizations....6
Process....6
Principles....7
Outcomes....8
Priorities....9
Provincial Platform Regulation and Accountability....9
Data Sharing....10
Taxation....11
Regulatory Tools for Local Governments....12
Capacity Supports for Local Governments....14
Improve Availability of Data on Short-Term Rentals and the Rental Market....14

Background

Short-term rentals are the rental of a home, or room within a home, for a temporary stay (usually fewer than 30 consecutive nights). While vacation rentals and in-home bed-and-breakfasts have been a part of tourism accommodation for decades, the short-term rental industry saw significant growth with the advent of online platforms such as Airbnb and HomeAway (now VRBO).

The broad access and ease of transactions provided by these platforms led to a shift in the frequency of use and types of accommodation being listed for short-term use, with units not previously considered "tourism-oriented" being made available to travellers. The online accommodation bookings industry continues to evolve and grow despite the COVID-19 pandemic reducing worldwide travel, and hosts are now able to offer broader "experiences" and adjacent services via these platforms.

This shifting landscape in the accommodations industry has affected communities differently throughout the province. Impacts causing concern include:

- **Housing Availability:** The use of housing units for travellers has reduced long-term rental housing capacity at a time when housing availability and costs are already under pressure. While many short-term rental hosts use part of their primary residences for hosting, other types of spaces such as basement suites or accessory dwelling units also appear frequently on the platforms. Existing data on vacancy in the primary rental market (purpose-built apartments) shows no consistent correlation with short-term rental listings or bookings activity, but the true impact of short-term rentals is in the secondary market (other housing forms), which is more fluid and difficult to measure. The lack of consistent definition of what constitutes a "permanent dwelling" and limited capacity of local governments to monitor listings makes it nearly impossible to determine the actual scale of diversion from rental housing stock in a statistical sense, but observations by local governments indicate there is a significant unmeasured threat to long-term housing. As 70% of B.C.'s renter households rely on secondary rental market housing, and in some communities up to 100% of rental housing is in the secondary market, there is a strong case for responding to the potential impacts of short-term rentals even in lieu of appropriate data sources.
- **Housing Affordability:** The potential for earning revenue from short-term rental use of properties (whole or in part) often supports higher property prices than local incomes can support. This impacts housing cost in the rental market due to price competition and may be driving up the purchase price of homes in the resale market, as buyers are willing to pay a premium for units (especially condos) with potential for short-term rental use. Data to isolate and attribute this impact is not readily available, but anecdotal evidence appears in numerous B.C. communities.
- **Land Use:** In some cases, previously residential-use properties have been converted to commercial use despite local land use policies. Where short-term rentals represent a full-time business model, these properties are no longer serving their intended purpose as dwellings for local residents. In other communities (especially remote areas), the ease of promoting vacation rentals of properties has attracted tourism for which local governments are not equipped to regulate or support with infrastructure.

- **Public Impacts:** Increasing transient use of properties without oversight by hosts has contributed to noise, parking, garbage, safety, and disruption complaints. In some cases, short-term rental activity has been linked to public health risks via out-of-region visitors contributing to COVID-19 outbreaks.
- **Local Government Capacity:** Between the staff and Council time required to consult, evaluate options, and adopt short-term rental policies, and the licensing and enforcement staff time required to monitor listings and properties, regulating short-term rentals represents a significant (and new) imposition on local government capacity.

Short-term rentals also offer some benefits to communities and travellers:

- **Interim Worker Housing**: Employees arriving in a community for new employment, or for a temporary assignment, may use short-term rental housing while arranging for a permanent residence or to avoid occupying a rental unit only for a short period, freeing that unit up for a long-term residential tenant.
- **Tourism:** Short-term rentals provide some benefits to communities that are seeking to expand their tourism economies as a diversification strategy:
    - Short-term rentals expand tourist accommodation capacity, particularly in places with emerging tourism sectors where traditional lodging businesses have not yet established sufficient capacity.
    - Family travel: short-term rental units may be larger and provide more facilities that support families with children or specific accommodation needs, compared to hotels/motels. This opens up tourism in a community to different demographic segments.
    - Sports/group travel: teams or groups wishing to travel together may find an entire home with several bedrooms a more affordable way to travel for tournaments or events compared to the cost of booking multiple hotel rooms. Kamloops and Burnaby are two examples of communities with significant special event facilities where attendance may exceed local hotel capacity.
- **Economic Activity:** Hosts earn additional income on their short-term rentals (which may or may not be reported on tax returns) and visitors contribute in other ways to local economies through hospitality and experiences in the host community.

The challenge for the Province and local governments is to find a balance in regulating short-term rental activity to enhance the benefits and opportunities presented by the industry while reducing the detrimental effects on housing and neighbourhood livability.

An increasing number of local governments in B.C. have developed policies, or are in the process of doing so, to respond to the new opportunities, challenges, and impacts that short-term rentals bring to their communities. The Union of BC Municipalities (UBCM) identified short-term rentals as an ongoing issue of concern for local governments in 2016. Workshops and resolution discussions on the topic were featured at UBCM conventions in 2016, 2017, and 2018. A UBCM Special Committee on Housing included a series of

recommendations to address short-term rental regulation and taxation in the January 2018 report "*A Home for Everyone: A Housing Strategy for British Columbians"*.

Participating Organizations

The Advisory Group formed in January 2020 with representatives of nine local governments and participants from UBCM and the Ministry of Municipal Affairs and Housing (as it was then), and now also includes the Ministry of Attorney General and Minister responsible for Housing. Communities represented on the group were (in alphabetical order):

- City of Burnaby
- Islands Trust
- City of Kelowna
- City of Nelson
- Regional District of Thompson-Nicola
- Village of Tofino
- City of Vancouver
- City of Victoria
- Resort Municipality of Whistler

Process

The Advisory Group held in-person meetings in February and early March 2020, including presentations and discussions to inform the group's members about community objectives, housing impacts as measured by available data, and legislative context. The group heard presentations from:

- Housing Policy Branch (Ministry of Municipal Affairs and Housing)
- Residential Tenancy Branch (Ministry of Municipal Affairs and Housing)
- Property Tax and Assessment Branch (Ministry of Municipal Affairs and Housing)
- Tax Policy (Ministry of Finance)

The onset of the COVID-19 pandemic put the Advisory Group's process on hold during the spring and summer of 2020. Group members shared, via email, updates on the impacts of the pandemic on their communities and observations about how the short-term rental activity in their community changed (or not) while travel was affected by public health orders. Following the fall 2020 election, housing policy moved under the mandate of the Ministry of Attorney General and Minister responsible for Housing. The Advisory Group reconvened in April 2021.

Virtual meetings comprised the second stage of the Advisory Group's deliberations. In addition to local government representatives sharing the expertise and experiences from their own communities, the Advisory Group received presentations and written submissions from:

- Housing Policy Branch (Ministry of Attorney General and Minister responsible for Housing)

- Tourism Vancouver
- BC Hotel Association
- BC Real Estate Association
- Harvard Business School (on the evolution of short-term rentals and online accommodation platforms)

The Advisory Group participated in a virtual collaboration session on May 12 which captured and delved into numerous themes that had emerged from the presentation and discussions held throughout this process. A draft of this report was provided to government relations personnel from Airbnb and Expedia (owner of the VRBO platform) for comment and feedback to the panel prior to this report being finalized.

Principles

The Advisory Group identified five principles that inform the outcomes and priorities presented in this report.

- **Recognition of Regional Differences:** Economic and housing conditions vary among regions and communities. Any proposed outcomes or actions need to recognize and allow for these differences, including the need to balance needs within a community (e.g. tourism, economic development, housing).
- **Subsidiarity:** Law-making and implementation are often best achieved at a level of government that is most effective and closest to the issues affected. The federal, provincial, and local governments have different but overlapping roles in housing policy and land use planning. Subsidiarity as a guiding principle encourages complementary legislation while accommodating local circumstances.
- **Fairness:** As much as possible and where feasible, all businesses operating in an industry within a given market should be subject to the same restrictions and requirements under the law. Similarly, residents in a community should be subject to the same expectations and have access to the same types of protections or benefits.
- **Future-Proof:** The travel industry was evolving prior to the COVID-19 pandemic, which caused an abrupt and dramatic change to how and why people seek and use accommodation. The online accommodation booking industry is dynamic and any legislation or programs implemented in 2021 or 2022 need to consider the rapid changes and market reach of this platform-based industry. Relying only on local governments to adopt bylaws and pursue enforcement of this industry has already produced a fragmented regulatory landscape.
- **Evidence Based Policy balanced by Precaution:** Outcomes and priorities should be informed by multiple types of evidence, including quantitative data, qualitative research, observations, and experiences of governments in B.C., Canada, and elsewhere. Where the available data or evidence falls short of the reliability necessary for conclusive analysis, governments should exercise caution but also act to prevent likely harms.

Outcomes

Drawing from the perspectives and experience of local government representatives from a diverse range of communities, the Advisory Group identified a series of important outcomes of potential legislation or programs for various stakeholders. These outcomes will be achieved by complementary and collaborative work across orders of government.

- B.C. households seeking rental housing are not excluded from finding and affording housing that meets their needs as a result of suitable units being repurposed or developed specifically for short-term rentals instead of long-term tenancies.
- Local governments are able to set and enforce land use policies that designate residential property primarily for the purpose of providing long-term residences, while allowing ancillary uses that are aligned with community objectives.
- Local governments have sufficient and timely access to short-term rentals data, and capacity to enforce the land use policies and regulatory schemes set in their jurisdiction.
- All operators within the industry are subject to a clear and consistent regulatory structure, with the same level of accountability to B.C. communities.
- Businesses operating accommodation services via online platforms are held accountable for the same safety, labour practices, neighbourhood impacts, and taxes as accommodation providers operating in more traditional business models (e.g. hotels, motels, B&Bs, campgrounds, etc).
- Hosts, travellers, and neighbours are kept safe and have enjoyable experiences (or fewer negative experiences) resulting from short-term rental accommodations.
- Local governments and the Province have improved capability, through data sources and analysis, to understand the interaction between short-term rentals and the housing market.
- The Province continues to monitor and report on trends and impacts from the short-term rental industry to inform and support local governments.

Priorities

The following needs and ideas emerged during the Group's process as the most likely actions to lead to the desired Outcomes, while being informed by and respectful of the Principles described above. The Advisory Group acknowledges these ideas and priorities will likely require further analysis and collaboration to determine feasibility. Numerous other jurisdictions have introduced more stringent legislation and requirements for the short-term rental industry. Actions to address the impact of short-term rentals in British Columbia may carry some risk, but this needs to be balanced against the significant pressures facing rental housing in many communities.

Provincial Platform Regulation and Accountability

Priority: Where local governments have enacted regulatory tools, such as requiring business licenses for the operation of a short-term rental, these policies are only as strong as the capacity of the local government to enforce them. Platforms have a direct business relationship with their hosts which provides a greater opportunity to detect and deter non-compliant activity.

The Province has greater capacity to use legislative authority to regulate all online accommodation platforms offering services within the province. This framework could echo the provincial regulation of other travel or real-estate related industries such as travel agencies, home inspectors, and ride-hailing (e.g. Lyft, Uber, etc.). The parameters of a provincial framework need to be explored further, but the Advisory Group considers there to be many potential inclusions that would significantly address negative impacts of the short-term rental industry:

- Commercial operators (hosts with numerous short-term rental properties possibly listed across platforms and across communities) could be required to register as businesses through the B.C. Corporate Registries.
- While some platforms provide a field where hosts can display their business license or permit information, this could become a mandatory inclusion for all listings in B.C. where local governments have permit or license requirements. There needs to be validation of this information so that hosts are not providing false data simply to get their listing online. The Province could hold platforms accountable through provincial regulation to validate this information with local governments.
- Hosts could be asked to commit to a statutory declaration to the Province, via their platform, that their listing is compliant with provincial and local government requirements.
- Hosts could be held accountable to the province for standards regarding safety/hygiene, insurance, and consumer protection.

Rationale: Regulation of an industry at the provincial level, to the extent where common objectives exist, provides for greater clarity for the industry and efficiency for enforcement. A provincial regulatory framework is more future-proofed than relying on individual local governments to

keep abreast of advances in the technology and business models of online accommodation platforms and then update bylaws or policies in a patchwork form across the province.

Provincial regulation of other industries, such as ride-sharing, travel agencies, payday loans, and home inspections among others, provide standards that are intended to protect all British Columbians from safety and financial hazards that could be common if business activities are left unregulated. This applies to the customers in an industry as well as labour practices.

Requests:

1. Introduce a **provincial regulatory framework**, similar to those in place for ride-sharing and other regulated industries, for platform accountability and information validation for online accommodation platforms and short-term rental hosts.

Data Sharing

Priority: Local governments need data on short-term rentals that allows them to understand STR activity in their community, develop bylaws or policies to support community objectives, and enforce those bylaws or policies. The Province needs data on short-term rentals to understand trends across the province, monitor impacts on the housing market, and enforce tax policy.

Types of data that are needed include property information (address, ownership, unit type, legal tenure), host details (including multiple-property hosts), bookings (frequency of use and income), licensing information (if any), and information on complaints relating to public safety or neighbourhood impacts such as noise or standards of property maintenance.

In addressing this priority, governments need to consider appropriate protection for the personal privacy of short-term rental hosts, as data collected for a business purpose may not be redacted under FOIPPA as personal information. As short-term rental activity indicates potential vacancy of properties, it presents a security and safety threat to hosts if their property information or demographic details are released through a Freedom of Information Request.

Rationale: Current practices require governments to contract with third-party data providers or assign staff to manually scan online accommodation platforms, which are costly and inefficient approaches that may not always yield accurate and complete data. Requiring all participants in the online accommodation industry to adhere to common standards of data-sharing provides fairness in the industry and reduces the burden of tracking property listings across multiple platforms.

Requests:

2. Require all online accommodation platforms to **make data available through a provincial interface** from which local governments can pull information on property listings, hosts, bookings, and complaints in their community.

3. Require online accommodation platforms to **validate business license or permit information** with local governments to avoid false information in listings.

Taxation

Priorities: Undertaking a business activity, regardless of locale, should be subject to consistent taxation according to the law. Taxation provides revenue to governments to financially support (in part) the infrastructure and programs that create tourism opportunities and offset the potential negative impacts of the business activity, such as the pressures placed on local housing markets by short-term rentals. The collection and remittance of taxes does not prevent negative impacts on housing affordability and availability but is part of a coherent and aligned regulatory framework.

Tax Collection and Remittance

The Province regulates that the process by which Provincial Sales Tax (PST) and Municipal and Regional District Tax (MRDT) are collected and remitted as applicable on sales of short-term accommodation provided in B.C., including all accommodation listed on an online accommodation platform. Short-term rental hosts are required to register for the PST and MRDT (if applicable) unless they only list their accommodation on a platform that is registered to collect PST and MRDT.

The Province has negotiated with Airbnb to collect and remit taxes on behalf of hosts, but there are numerous other platforms not participating in these agreements, and current legislation does not allow the Province to require platforms to collect PST and MRDT (only to register voluntarily). All platforms operating in this industry should be subject to the same requirements for short-term rental bookings in the province.

Using Tax Revenues to Address Short-term Rental Impacts

Areas that have the MRDT in place can opt to direct tax revenues from online accommodation providers to housing purposes in their community, but not to the compliance and enforcement of short-term rental policies. Non-MRDT communities have more limited means to raise revenues to offset compliance and enforcement costs. Options to direct PST revenues from short-term rentals to the originating communities would support compliance and enforcement efforts.

The Advisory Group heard from industry stakeholders that the differing rates and coverage of MRDT is challenging for tourism operators and short-term rental hosts; making the MRDT consistent throughout the province could simplify administration and reduce confusion. Revisions to the MRDT could also yield tax revenue from short-term rentals that could support local communities to offset neighbourhood impacts by enabling more personnel to be allocated towards enforcement.

Addressing Commercial Use of Residential Property in Taxation

UBCM has previously endorsed a members' resolution calling for the Province to amend legislation so that properties used for short-term rental accommodation may be eligible for split classification between Class 1 and Class 6 under the Assessment Act. This would be consistent with the split classification of strata accommodation properties and "bed and breakfast" residential properties. The Advisory Group acknowledges the challenges involved in applying classification to short-term rental listings, and in keeping with the principle of fairness, supports a wider use of split classification so that commercial accommodation activities are taxed fairly. Higher property tax rates for commercial properties raise revenue directly for local governments to apply to the regulation and enforcement of the industry.

Rationale: Applying a consistent expectation across the industry to collect tax at the point of booking provides for tax fairness among all accommodation hosts (short-term rentals, traditional B&Bs, hotels, etc). This promotes accurate and complete collection of tax revenues which may be applied towards compliance and enforcement efforts.

Requests:

4. Introduce legislation to **make tax collection at the point of booking a requirement** for online accommodation platforms.

5**. Share PST revenues from short-term rentals with the local governments** affected by the taxed business activity.

6. Investigate further changes to the MRDT to **increase consistency across the province** and expand the uses of tax revenue to offset impacts to housing and neighbourhoods.

7. Explore options to **expand split classification of properties** so that commercial use of property for short-term rental accommodation is reflected in property tax assessments.

Regulatory Tools for Local Governments

Priority: Local governments have a variety of objectives that inform their policies on short-term rentals and need a flexible yet comprehensive suite of regulatory tools to help achieve those objectives. One of the most effective tools for addressing the impact of short-term rentals on housing availability and affordability is to prohibit listings that aren't within a host's principal residence. Additional conditions are used by local governments in response to specific community concerns, including having on-site or on-call property oversight, limiting the number of nights per year, and requiring off-street parking. The resource "Regulating Short-Term Rentals" published by Generation Squeeze provides an excellent reference for local governments seeking to identify options for their jurisdictions.

Some of the regulatory tools in use to implement this requirement include business licensing, temporary use permits, zoning bylaw definitions, and ticketing/fines. Yet not all local governments have access to the same tools, or some of these tools could be improved:

- Regional districts are currently required by the *Local Government Act* to request authority from the Province to issue business licenses. Enabling this authority by default would remove a barrier for regional districts wishing to adopt business licensing bylaws by choice, as a tool to manage short-term rentals and other industries as identified by the regional district. (The Province may also consider configuring the *Local Government Act* so that regional districts could adopt a licensing framework for specific industries instead of having to license all businesses).
- Increasing the allowable fines that can be levied through the Municipal Ticket Information system or Bylaw Enforcement System will enable local governments to apply deterrents to illegal short-term rental activity. Strata corporations are able to levy fines of up to $1,000 *per day* for contraventions of strata bylaw prohibiting short-term rentals. This is a high fine in the context of a strata corporation, though it may be insufficient in other environments; some jurisdictions outside Canada are levying fines of $1,000 for a first offence, $5,000 for a second offence, and $10,000 for a third offence.
- The Bylaw Enforcement Notice Adjudication process (Ministry of Attorney General) provides an avenue for citizens to dispute tickets; some communities have noted that after pursuing investigation and levying a bylaw notice to a short-term rental host who is not complying with local laws, the Provincial adjudicator may cancel the violation notice.

Rationale: Enabling local governments to use regulatory tools that fit their community's objectives acknowledges regional differences between communities and supports the principle of subsidiarity (placing regulations at the point closest to the resident/business that allows for efficient implementation).

Requests:

8. Amend the *Local Government Act* to **allow regional districts to implement business licensing**, by approval of the regional district board, as a tool to regulate short-term rentals.

9. **Increase the allowable fines** that local governments can levy against short-term rental hosts operating out of compliance.

10. Explore whether provincial bylaw notice adjudicators have sufficient information and awareness of short-term rental issues to understand these offences, **preventing undue cancellation of violation notices**.

Capacity Supports for Local Governments

Priority: Local governments vary widely in their objectives for regulating short-term rentals and the extent or impact of short-term rental activity in their communities. They also vary in size, and organizational capacity to develop, consult on, implement and enforce policies relating to short-term rentals. Building on past collaboration and outreach, the Province and UBCM can continue to jointly support all local governments in learning about, implementing and enforcing short-term rental policies by providing opportunities for knowledge sharing and community-to-community peer support.

A useful model for this is the BC Ideas Exchange, which focuses on local economic development practices and knowledge-sharing activities such as web-based toolkits, webinars and conference workshops. The "Regulating Short Term Rentals" Toolkit written by Third Space Planning with support from the Federation of Canadian Municipalities and others is an example of the type of content that can be shared with local governments.

Local governments have indicated the value of having knowledgeable people available to consult directly in addition to the plethora of written and online resources. Direct outreach to local governments helps bridge the capacity gap; this model is demonstrated by the Regional Economic Development Managers that support local governments through the Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

Rationale: Capacity for policy development and implementation is a major constraint facing local governments. Simply having the legislative authority to pass bylaws and implement licensing does not mean a local government (especially a small one) has the staff time or expertise to carry out research and consultation prior to policy implementation, to respond to public pressure from short-term rental hosts opposed to policies that limit their business opportunities, or to enforce policies that are passed by Council. The Province and UBCM can act jointly to support capacity development.

Requests:

11. Allocate Provincial resources to collaborate with UBCM on an **outreach program to support local governments** in identifying and implementing policy options that address housing priorities and needs, including short-term rental regulation and enforcement.

Improve Availability of Data on Short-Term Rentals and the Rental Market

Priority: Local governments and the Province need better data on both the availability and cost of housing in the rental market. Rental market data from CMHC pertains predominantly to the primary (purpose-built rental) market, and is only available at an annual frequency, which poses serious challenges and limitations to understanding the impacts of short-term rentals on the rental market. Data on the secondary rental market (i.e. basement suites, rental houses, etc.) is largely non-existent, thus measuring the impacts of short-term rentals more broadly remains an impossible task. Even where data exists, a further challenge comes in

distinguishing rental units that could potentially form permanent housing from properties that are unlikely to be used as permanent housing, even if removed from short-term rental use (e.g. temporary listings, remote vacation properties or residences located in designated tourist accommodation zones).

The Advisory Group is aware of the challenge of establishing data sources on the secondary rental market and raises this as a priority for the Province to work on with CMHC and using municipal data where available.

In addition to improving data on the secondary rental market, the Advisory Group noted that data on short-term rentals are not incorporated into the Housing Needs Reports required for all communities. If data-sharing becomes a requirement for online accommodations providers, this information can be included in Housing Needs Reports to help Councils recognize trends or challenges and adapt policies according to local needs.

Rationale: Through the Advisory Group process it became evident that gaps in data on the rental market made it difficult to measure and compare the impacts of short-term rentals on rental housing availability and cost in communities. Existing rental housing data from Canada Mortgage and Housing Corporation (CMHC) varies in coverage among communities, with data coverage of up to 55% in some larger metropolitan areas, but as little as 10% coverage in smaller communities. By contrast, it is known from Census data that roughly 70% of all renter households in British Columbia occupy rented dwellings in the secondary rental market, yet there are very few reliable data sources available to understand this very large segment of the rental market.

These data gaps confound meaningful discussions of what policies are really needed to address housing affordability across the spectrum of housing. The gaps also increase the risk that local government policies targeting short-term rentals will fail to respond to emerging trends in housing (or developing industries) or provide the necessary housing to meet future demands.

Requests:

12. Allocate Provincial resources and collaborate with the federal government (Statistics Canada and CMHC) and local governments **to improve the collection and analysis of data on secondary rental housing**, particularly as relates to short-term rental impacts.

13. **Expand the Housing Needs Reports data requirements** to include showing data on short-term rental listings and usage, utilizing platform data collected through a provincial regulatory framework.

Making a difference...together

REPORT TO ENVIRONMENTAL SERVICES COMMITTEE
MEETING OF WEDNESDAY, JANUARY 19, 2022

SUBJECT **2020 Regional Greenhouse Gas Inventory**

ISSUE SUMMARY

To provide the results of the 2020 Capital Regional District (CRD) and regional local government community greenhouse gas (GHG) emissions inventory.

BACKGROUND

The CRD's 2018 Regional Growth Strategy (RGS) targets a reduction in community GHG emissions of 33% (from 2007 levels) by 2020, and 61% by 2038. In February 2019, the CRD Board declared a climate emergency and committed to regional carbon neutrality. At its March 13, 2019 meeting, the CRD Board directed staff to complete a regional GHG inventory and, in July 2020, staff delivered a 2018 regional GHG Global Protocol for Cities (GPC) BASIC + GHG emission inventory.

Utilizing the internationally recognized GPC framework, the CRD retained Stantec Consulting Ltd. to update the CRD regional GPC BASIC + GHG emission inventory for the 2020 calendar year (Appendix A).

The 2020 CRD inventory indicates the capital region emits approximately 1.8 million tonnes of C02e annually. This represents a 9.8% reduction from 2007 levels and a 5% reduction from 2018. This precipitous drop is largely the result of a reduction in transportation-related emissions associated with the early 2020 COVID-19 pandemic response. Emissions associated with buildings increased 8.1% in 2020 relative to 2018. The Municipalities and Electoral Areas inventories (Appendix B) show increases in natural gas emissions in residential buildings relative to 2007 for most municipalities, as measured by Fortis BC. That result is partially indicative of the 2020 trend, as well as the proliferation of gas appliances in the capital region over the past 10 years. An increase in emissions from buildings electricity use can also be observed, which is largely due to a change in the electricity emission factor used. Trends for propane, wood and fuel GHG emissions were estimated using linear regression methods, with the exception of the City of Victoria and District of Saanich where fuel oil consumption was estimated based on the number of known tanks, average heated floor areas and fuel volume intensity.

Together building and transportation-related emissions continue to be the largest sources of emissions (approximately 79% in 2020), and waste-related emissions were observed to be approximately 34% below 2007 levels. Per capita emissions (Appendix C) were observed to be approximately 24% below 2007, which speaks to the efforts by the CRD and regional local governments to reduce energy consumption and GHG emissions despite significant regional growth. However, as established in the new 2021 Climate Action Strategy, the region will not meet the 2038 target unless greater effort is taken.

This inventory represents the best available information and includes several notable updates, including the best available emission factor for electricity for each inventory year, Insurance

Corporation of BC vehicle counts, and the separation of sequestration and land use change values. Due to limitations in how to quantify GHG emissions from sequestration and land use change, these values have been excluded from the calculation of total emissions. Values for these items are disclosed for information only in the CRD and regional local government community GHG emissions inventory reports. Understanding the sequestration potential of the region's natural assets will become increasingly important as emissions drop toward the RGS goal of a 61% reduction by 2038. Staff continue to pursue better data for estimating the sequestration rates of the region's natural assets and land use changes occurring in the region. See Figure 1 for the emission trend since 2007 and the approximate trajectory of emissions reductions to 2038 established in the 2021 Climate Action Strategy.

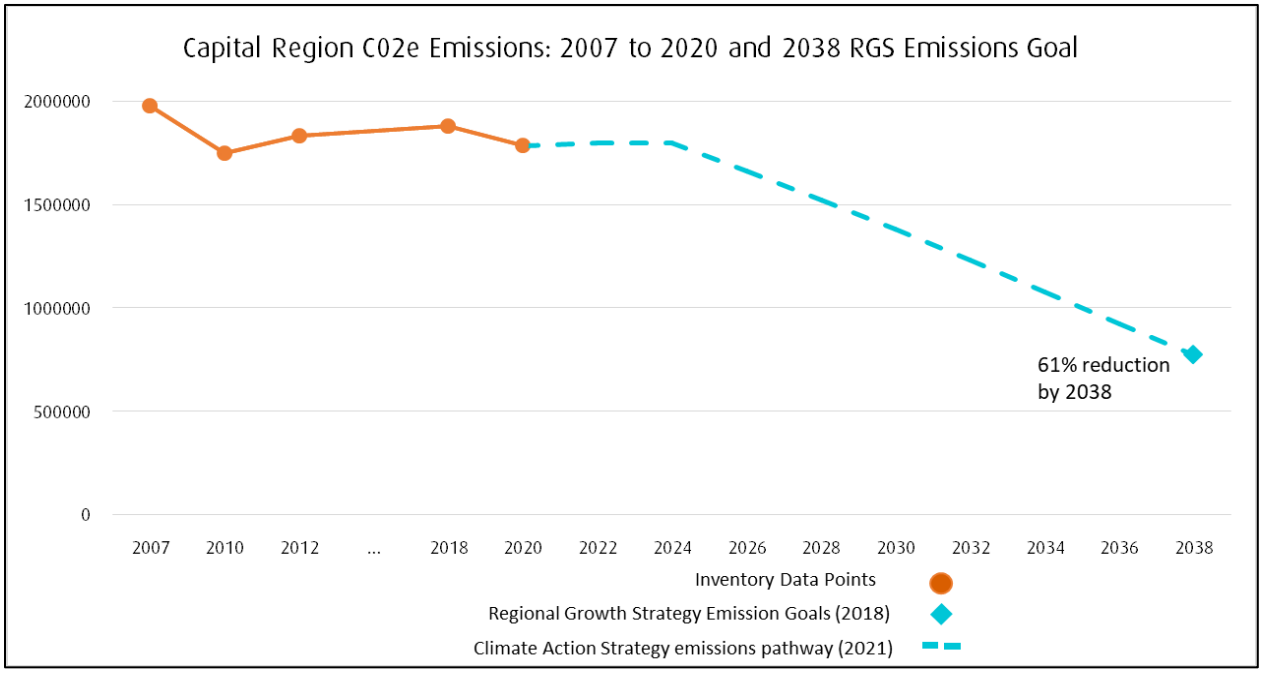


Figure 1: Capital Region Greenhouse Gas Global Protocol for Cities Basic + Emissions and 2038 Regional Growth Strategy Goal

CONCLUSION

The CRD completed a greenhouse gas emission inventory and report for the 2020 calendar year. Results indicate an approximate 9.8% decrease in regional emissions from 2007 to 2020, and a 5% reduction from 2018, largely associated with the early 2020 COVID-19 pandemic response. The analyses also indicated that on-road transportation and the built environment are the main sources of regional emissions, together accounting for approximately 79% of all emissions in 2020.

RECOMMENDATION

The Environmental Services Committee recommends to the Capital Regional District Board:
That the 2020 Regional Greenhouse Gas Inventory report be received for information.

Submitted by:	Glenn Harris, Ph.D., R.P.Bio., Senior Manager, Environmental Protection
Concurrence:	Larisa Hutcheson, P. Eng., General Manager, Parks & Environmental Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENTS

Appendix A: Capital Regional District 2020 GPC BASIC and Community Greenhouse Gas Emissions Inventory Report – Stantec Consulting Ltd. – October 2021
Appendix B: Capital Region District – Municipalities and Electoral Areas – 2007 Base Year and 2020 Reporting Year Energy & Greenhouse Gas Emissions Inventory – Stantec Consulting Ltd. – October 2021
Appendix C: Capital Region $C0_{2e}$ Emissions Per Capita

APPENDIX A

Capital Regional District 2020 GPC BASIC+ Community Greenhouse Gas (GHG) Emissions Inventory Report



Prepared for:
Capital Regional District
625 Fisgard Street, PO Box 1000
Victoria, BC V8W 2S6

Prepared by:
Stantec Consulting Ltd.
200-325 25 Street SE
Calgary, AB T2A 7H8

October 29, 2021

Limitation of Liability

This document entitled Capital Regional District 2020 GPC BASIC+ Community Greenhouse Gas (GHG) Emissions Inventory Report was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Capital Regional District (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Table of Contents

EXECUTIVE SUMMARY ..... **IV**

ABBREVIATIONS ..... **VI**

GLOSSARY ..... **VIII**

1.0 INTRODUCTION **1**
1.1 CLIMATE CHANGE AND GREENHOUSE GAS EMISSIONS 1
1.2 COMMUNITIES AND GREENHOUSE GAS EMISSIONS 1
1.3 VARIANCE FROM COMMUNITY ENERGY AND EMISSIONS INVENTORIES (CEEI) 2
1.4 PURPOSE OF THIS REPORT 3

2.0 GLOBAL PROTOCOL FOR COMMUNITY (GPC) SCALE EMISSION INVENTORIES PROTOCOL **5**
2.1 OVERVIEW 5
2.2 GPC PROTOCOL STRUCTURE 5
2.3 GHG EMISSION CATEGORIES 7
2.3.1 Stationary Energy 7
2.3.2 Transportation 8
2.3.3 Waste 9
2.3.4 Industrial Processes and Product Use (IPPU) 9
2.3.5 Agriculture, Forestry, and Other Land Use (AFOLU) 10
2.3.6 Other Scope 3 Emissions 10
2.4 ACCOUNTING AND REPORTING PRINCIPLES 10
2.5 BASE AND REPORTING YEAR RECALCULATIONS 11
2.6 DATA QUALITY 12

3.0 GHG ASSESSMENT BOUNDARIES **13**
3.1 SPATIAL BOUNDARIES 13
3.2 TEMPORAL BOUNDARIES 14
3.2.1 2007 Base Year 14
3.2.2 GHG Reduction Target 15
3.2.3 2020 GHG Boundary 15
3.3 GHG REPORTING 18

4.0 GHG METHODOLOGIES BY SOURCE CATEGORY **23**
4.1 STATIONARY ENERGY 23
4.1.1 Overview 23
4.1.2 Scope 2: Market Based Method 23
4.1.3 Activity Data 24
4.1.4 Assumptions and Disclosures 24
4.1.5 Calculation Methodology 25
4.2 TRANSPORTATION 26

4.2.1 Overview 26
4.2.2 Activity Data 26
4.2.3 Assumptions and Disclosures 27
4.2.4 Calculation Methodology 28
4.3 WASTE 38
4.3.1 Activity Data 38
4.3.2 Assumptions and Disclosures 38
4.3.3 Calculation Methodology 39
4.4 INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU) 40
4.4.1 Overview 40
4.4.2 Activity Data 41
4.4.3 Assumptions and Disclosures 41
4.4.4 Calculation Methodology 41
4.5 AGRICULTURE, FORESTRY, AND OTHER LAND USE (AFOLU) 41
4.5.1 Overview 41
4.5.2 Activity Data 42
4.5.3 Assumptions and Disclosures 42
4.5.4 Calculation Methodology 43

5.0 2020 GHG REPORTING YEAR RESULTS 47
5.1 OVERVIEW 47
5.2 SUMMARY 48
5.3 TOTAL GHG EMISSIONS 52
5.4 SECTORAL GHG EMISSIONS ANALYSIS 54
5.4.1 Stationary Energy 54
5.4.2 Transportation 57
5.4.3 Waste 59
5.4.4 Industrial Processes and Product Use (IPPU) 60
5.4.5 Agriculture, Forestry, and Other Land Use 61

6.0 QUALITY ASSURANCE AND QUALITY CONTROL 63

7.0 RECOMMENDATIONS 64
7.1 INVENTORY ASSUMPTIONS, ASSESSMENT, AND RECOMMENDATIONS 64

8.0 REFERENCES 69

LIST OF TABLES

Table 1. Summary of GHG Inventory Scope Differences 2
Table 2 GPC Protocol Recalculation Thresholds 11
Table 3 GPC Protocol Data Quality Assessment Notation Keys 12
Table 4 Inventory Information 14
Table 5 Original And Updated BASIC+ Base Year 15
Table 6 Summary of Emissions Scope and GPC Protocol Reporting Sector 17
Table 7 GPC Protocol Summary Table 19
Table 8 Stationary Energy GHG Emission Factors 26
Table 9 CRD On-Road In-Boundary/Transboundary Split 28

Table 10 Estimated VKT And Fuel Efficiencies by Vehicle Class For Reporting Year 29
Table 11 Total Registered Vehicles & Estimated Fuel Use For Reporting Year 30
Table 12 Vehicle GHG Emission Factors 31
Table 13 Aircraft Type, Estimated Percentage of Total Reported Movements, And Estimated Fuel Use 33
Table 14 Aviation GHG Emission Factors 33
Table 15 Aircraft Type, Estimated Percentage of Total Reported Movements, And Estimated Fuel Use 34
Table 16 Marine Aviation GHG Emission Factors 34
Table 17 BC Ferries GHG Emission Factors 35
Table 18 Coho and the Victoria Clipper Ferries Estimated GHG Emissions 35
Table 19 Year 2000 Other Watercraft Population Breakdown And Estimated Fuel Use 36
Table 20 Reporting Year Other Watercraft Population Breakdown and Estimated Fuel Use 36
Table 21 Watercraft GHG Emission Factors 37
Table 22 Composting Emission Factor 40
Table 23 Spatial Data Sources Representing Land Cover For The CRD Study Area 43
Table 24 IPCC Land Use Classification Cross-References 43
Table 25 Land-Use Change Emission Factors 44
Table 26 GHG Emissions Reporting Breakdown by GPC Reporting Method 47
Table 27 Breakdown of the CRD's 2020 GHG Emissions in GPC Reporting Format 49
Table 28 Breakdown of the CRD's 2020 BASIC+ GHG Emissions in the GPC Protocol Reporting Format 50
Table 29 Total Energy and GHG Emissions Per Person by Sector 52
Table 30 Change in GHG Emissions from Base Year 53
Table 31 2020 Energy and GHG Emissions by Stationary Energy Sector 55
Table 32 Stationary Energy—Energy and GHG Emissions Trends 57
Table 33 2020 On-Road Transportation Energy And GHG Emissions by Fuel Type 57
Table 34 2020 Aviation, Waterborne, and Off-Road Transportation Energy and Emissions by Fuel Type 58
Table 35 Summary of Waste Sub-Sector GHG Emissions 59
Table 36 Product Use GHG Emissions for the 2007 and 2020 Reporting Years 61
Table 37 Summary of Land-Use Change in 2020 61
Table 38 Total AFOLU GHG Emissions for 2020 62
Table 39 Summary of GHG Inventory Assumptions, Estimated Impacts, and Recommended Improvements 64

LIST OF FIGURES

Figure 1 Sources and Boundaries of a Community's GHG Emissions (GPC 2014) 7
Figure 2 GHG Boundary 13
Figure 3 2020 GHG Emissions Summary by GPC Reporting Level 48
Figure 4 CRD BASIC+ GHG Emissions by Emissions Scope 53
Figure 5 Stationary Energy GHG Emissions Contribution to the GHG Inventory 56
Figure 6 Total Stationary Energy Use By Sub-Sector 56
Figure 7 Breakdown of On-Road GHG Emissions by Vehicle Type 58
Figure 8 Summary of Transportation GHG Emissions by Sub-Sector 59
Figure 9 2020 GHG Emissions from Waste (tCO_2e) 60

Executive Summary

There is increasing evidence that global climate change resulting from emissions of carbon dioxide (CO_2) and other greenhouse gases (GHGs) is having a significant impact on the ecology of the planet. Delayed actions to respond to the effects of climate change are expected to have serious negative impacts on global economic growth and development.

Beyond the costs associated with delayed climate action, there are cost savings to be realized through efforts to improve energy efficiency, conserve energy, and reduce GHG emissions intensity. To make informed decisions on reducing energy use and GHG emissions at the community scale, community managers must have a good understanding of these sources, the activities that drive them, and their relative contribution to the total. This requires the completion of an energy and GHG emissions inventory. To allow for credible and meaningful reporting locally and internationally, the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (the GPC Protocol) was developed. The GPC Protocol has been adopted by the Global Covenant of Mayors—an agreement led by community networks to undertake a transparent and supportive approach to measure GHG emissions community-wide. The Global Covenant of Mayors and the Federation of Canadian Municipalities promotes the use of the GPC Protocol as a standardized way for municipalities to collect and report their actions on climate change.

This project set out to compile a detailed GHG inventory for the Capital Regional District (CRD) for the 2020 reporting year using the GPC Protocol. The CRD has historically relied on the Provincial 2007, 2010 and 2012 Community Energy and Emissions Inventories (CEEI) to baseline and track community GHG emissions. However, there have been some limitations to the CEEI which has resulted in the CRD preparing a GPC BASIC+ inventory. Following the requirements of the GPC Protocol, the GHG inventories considered emissions from all reporting Sectors, including Stationary Energy, Transportation, Waste, Industrial Process and Product Use (IPPU), and Agriculture, Forestry and Other Land Use (AFOLU). The purpose of this document is to describe the quantification methodologies used to calculate GHG emissions for the 2020 reporting year, and to present the CRD's 2020 community GHG emissions.

In 2020, the CRD's BASIC+ GHG emissions totaled 1,785,814 tonnes of carbon dioxide equivalent (tCO_2e). On an absolute basis, this is a 10% decline from the 2007 base year GHG emissions and a decline of 24% on a per capita basis. The 2020 energy and GHG emissions year was not typical in terms of energy and GHG emissions largely due to COVID-19 restrictions and associated closures. Transportation emissions were decreased and building emissions increased, which aligns with expectations associated with residents spending more time at home. However, building emissions were partially derived via estimates. Trends for propane, wood and fuel GHG emissions were estimated using linear regression methods, with the exception of the City of Victoria and District of Saanich, which were estimated based on the number of known tanks, average heated floor areas and fuel volume intensity. Due to limitations in how to quantify GHG emissions resulting from land use change (e.g., residential development), these GHG emissions have been excluded from the CRD's GHG emissions inventory, but have been disclosed, until a more robust measurement methodology can be developed. The GHG

emissions inventory does, however, include GHG emissions sequestered as a result of biological ecosystems (e.g., forests).

A summary of the 2020 GHG emissions is presented in Table E-1.

Table E-1 BASIC+ 2007 Base Year And 2020 Reporting Year GHG Emissions

Sector	Sub-Sector	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)
Stationary Energy	Residential Buildings	425,806	406,896
	Commercial & Institutional Buildings	262,171	303,112
	Manufacturing Industries & Construction	-	0
	Energy Industries	418	9,563
	Agriculture, Forestry & Fishing activities	62,060	56,418
	Fugitive Emissions	1,003	1,408
Transportation	In-Boundary On-road Transportation	869,591	692,329
	Trans-Boundary On-road Transportation	13,333	6,019
	Waterborne Navigation	48,246	22,341
	Aviation	26,120	12,564
	Off-road Transportation	56,291	51,623
Waste	Solid Waste	111,234	66,237
	Biological Treatment of Waste	72	5,307
	Wastewater Treatment & Discharge	18,998	15,035
IPPU	IPPU	77,348	130,139
AFOLU	Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**	-396,487	-399,707
	Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**	151,516	89,610
	Livestock	2,665	3,545
	Non-CO_2 Land Emission Sources	743	715
Change in GHG Emissions from Base Year		**1,976,100**	**1,783,251**
Total Per Capita GHG Emissions (tCO_2e / Capita)		**5.6**	**4.2**
Change GHG Emissions per Capita from Base Year			**-25.6%**
Change in GHG Emissions from Base Year			**-9.8%**

Data in the table above is depicted in Figure E-1.

Figure E-1 CRD's 2020 BASIC+ GHG Emissions Profile

Abbreviations

ACERT	Airport Carbon Emissions Reporting Tool
ACI	Annual Crop Inventory
AFOLU	Agriculture, Forestry, and Other Land Use
BC	British Columbia
C40	C40 Cities Climate Leadership Group
CH_4	Methane
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
CEEI	Community Energy and Emissions Inventories
CRD	Capital Regional District
VIA	Victoria International Airport
eMWh	megawatt hours equivalents
FCM	Federation of Canadian Municipalities
GDP	gross domestic product
GHG	greenhouse gas
GJ	Gigajoules
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
GVHA	Greater Victoria Harbour Authority
GWP	global warming potentials
HFC	Hydrofluorocarbons
ICAO	International Civil Aviation Organization
ICBC	Insurance Corporation of BC

ICLEI	International Council for Local Environmental Initiatives
IE	included elsewhere
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Process and Product Use
ISO	International Organization for Standardization
kg	Kilograms
kW	Kilowatt
kWh	kilowatt hours
L	Litres
MWh	megawatt hours
N_2O	nitrous oxides
NE	not estimated
NIR	National Inventory Report
NPRI	National Pollutant Release Inventory
NO	not occurring
PCP	Partnership for Climate Protection
PFC	Perfluorocarbons
SC	Other Scope 3
SF_6	sulfur hexafluoride
VIA	Victoria International Airport
WIP	waste-in-place
WRI	World Resources Institute

Glossary

Air pollution	The presence of toxic chemicals or materials in the air, at levels that pose a human health risk.
Base Year	This is the reference or starting year to which targets and GHG emissions projections are based.
BASIC	An inventory reporting level that includes all Scope 1 sources except from energy generation, imported waste, IPPU, and AFOLU, as well as all Scope 2 sources (GPC, 2014).
BASIC+	An inventory reporting level that covers all GPC BASIC sources, plus Scope 1 AFOLU and IPPU, and Scope 3 in the Stationary Energy and Transportation Sectors (GPC, 2014).
Biogenic emissions	Emissions produced by living organisms or biological processes, but not fossilized or from fossil sources (GPC, 2014).
Carbon dioxide equivalent (CO_2e)	The amount of carbon dioxide (CO_2) emissions that would cause the same integrated radiative forcing, over a given time horizon, as an emitted amount of a greenhouse gas (GHG) or a mixture of GHGs. The CO_2e emission is obtained by multiplying the emission of a GHG by its Global Warming Potential (GWP) for the given time horizon. For a mix of GHGs, it is obtained by summing the CO_2e emissions of each gas (IPCC 2014).
Climate change	Climate change refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC, 2014).
Emission	The release of GHGs into the atmosphere (GPC, 2014).
Emission factor(s)	A factor that converts activity data into GHG emissions data (GPC, 2014).
Flaring	The burning of natural gas that cannot be used.
Fossil fuels	A hydrocarbon deposit derived from the accumulated remains of ancient plants and animals which is used as an energy source.
Fugitive emission	Emissions that are released during extraction, transformation, and transportation of primary fossil fuels. These GHG emissions are not combusted for energy.
Geographic boundary	A geographic boundary that identifies the spatial dimensions of the inventory's assessment boundary. This geographic boundary defines the physical perimeter separating in-boundary emissions from out-of-boundary and transboundary emissions (GPC, 2014).
Gigajoule (GJ)	A gigajoule (GJ), one billion joules, is a measure of energy. One GJ is about the same energy as: • Natural gas for 3-4 days of household use • The electricity used by a typical house in 10 days

Global warming	A gradual increase in the Earth's temperature which is attributed to the greenhouse effect caused by the release of greenhouse gas (GHG) emissions into the atmosphere.
Global warming potential (GWP)	An index measuring the radiative forcing following an emission of a unit mass of a given substance, accumulated over a chosen time horizon, relative to that of the reference substance, carbon dioxide (CO_2). The GWP thus represents the combined effect of the differing times these substances remain in the atmosphere and their effectiveness in causing radiative forcing. The Kyoto Protocol is based on global warming potentials over a 100-year period (IPCC 2014).
Greenhouse gas (GHG)	GHGs are the seven gases covered by the UNFCCC: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); sulphur hexafluoride (SF_6); and nitrogen trifluoride (NF_3) (GPC, 2014).
GHG intensity	The annual rate to which GHG emissions are released in the atmosphere, relative to a specific intensity.
Gross domestic product (GDP)	An economic measure of all goods and services produced in an economy.
In-boundary	Occurring within the established geographic boundary (GPC, 2014).
Reporting year	The year for which emissions are reported (GPC, 2014).
Scope 1	Emissions that physically occur within a community.
Scope 2	Emissions that occur from the use of electricity, steam, and/or heating/cooling supplied by grids which may or may not cross Community boundaries.
Scope 3	Emissions that occur outside a community but are driven by activities taking place within a community's boundaries.
Tonne of CO_2e	A tonne of greenhouse gases (GHGs) is the amount created when we consume: • 385 litres of gasoline (about 10 fill-ups) • Enough electricity for three homes for a year (38,000 kWh)
Transboundary GHG emissions	Emissions from sources that cross the geographic boundary (GPC, 2014).

1.0 INTRODUCTION

1.1 CLIMATE CHANGE AND GREENHOUSE GAS EMISSIONS

There is increasing evidence that global climate change resulting from emissions of carbon dioxide and other greenhouse gases (GHGs) is having an impact on the global climate system. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), states the following consensus of scientific opinion about climate change and its causes and effects (IPCC, 2014):

- Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.
- Anthropogenic GHG emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in human-caused GHG concentrations.
- Continued emission of GHG will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive, and irreversible impacts for people and ecosystems.
- There is high agreement and much evidence that with current climate change mitigation policies and practices, global GHG emissions will increase over the next few decades.

1.2 COMMUNITIES AND GREENHOUSE GAS EMISSIONS

Communities are centers of communication, commerce, and culture. They are, however, also a significant and growing source of energy consumption and GHG emissions. On a global scale, communities are major players in GHG emissions. They are responsible for more than 70% of global energy-related carbon dioxide emissions and thus represent the single greatest opportunity for tackling climate change.

For a community to act on mitigating climate change and monitor its progress, it is crucial to have good quality GHG emissions data to build a GHG inventory. Such an inventory enables cities to understand the breakdown of their emissions and plan for effective climate action. The Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC Protocol) seeks to support exactly that, by giving cities the standards and tools that are needed to measure the emissions, build more effective emissions reduction strategies, set measurable and more ambitious emission reduction goals, and to track their progress more accurately and comprehensively.

Until recently there has been no internationally recognized way to measure community-level emissions. Inventory methods that community managers have used to date around the globe vary significantly. This inconsistency has made comparisons between cities and over the years difficult. The GPC Protocol offers an internationally accepted, credible emissions accounting and reporting practice that will help communities to develop comparable GHG inventories.

1.3 VARIANCE FROM COMMUNITY ENERGY AND EMISSIONS INVENTORIES (CEEI)

The CRD has historically relied on the Provincial 2007, 2010 and 2012 Community Energy and Emissions Inventories (CEEI) to baseline and track community GHG emissions. However, there have been some limitations to the CEEI in that it is an in-boundary inventory, the most recent version published is for 2012, and the CEEI Protocol does not fully meet the requirements of the GPC Protocol BASIC or BASIC+ reporting requirements which is the required reporting standard for local governments that have committed to the Global Covenant of Mayors—an agreement led by community networks to undertake a transparent and supportive approach to measure GHG emissions community-wide. A high-level summary of the differences between the CEEI and GPC Protocol inventories are presented in Table 1.

Table 1. Summary of GHG Inventory Scope Differences

Reporting Sector	CEEI	GPC BASIC	GPC BASIC+
Residential Buildings	✓	✓	✓
Commercial And Institutional Buildings And Facilities	✓	✓	✓
Manufacturing Industries And Construction	✓	✓	✓
Energy Industries		✓	✓
Energy Generation Supplied To The Grid		✓	✓
Agriculture, Forestry And Fishing Activities		✓	✓
Non-Specified Sources		✓	✓
Fugitive Emissions From Mining, Processing, Storage, And Transportation Of Coal		✓	✓
Fugitive Emissions From Oil And Natural Gas Systems		✓	✓
On-Road Transportation	✓	✓	✓
Railways		✓	✓
Waterborne Navigation		✓	✓
Aviation		✓	✓
Off-Road Transportation		✓	✓
Solid Waste	✓	✓	✓
Biological Waste	✓	✓	✓
Incinerated And Burned Waste		✓	✓
Wastewater		✓	✓
Emissions From Industrial Processes			✓

Reporting Sector	CEEI	GPC BASIC	GPC BASIC+
Emissions From Product Use			✓
Emissions From Livestock	✓		✓
Emissions From Land			✓
Emissions From Aggregate Sources And Non-CO_2 Emission Sources On Land	✓		✓

1.4 PURPOSE OF THIS REPORT

The purpose of this document is to describe the quantification methodologies used by the CRD to calculate its BASIC+ GHG emissions for the 2020 reporting year.

2.0 GLOBAL PROTOCOL FOR COMMUNITY (GPC) SCALE EMISSION INVENTORIES PROTOCOL

2.1 OVERVIEW

The GPC Protocol is the result of a collaborative effort between the GHG Protocol at the World Resources Institute (WRI), C40 Cities Climate Leadership Group (C40), and ICLEI—Local Governments for Sustainability (ICLEI). The GPC Protocol is recognized as one of the first set of standardized global rules for cities to measure and publicly report community-wide GHG emissions. It sets out requirements and provides guidance for calculating and reporting community-wide GHG emissions, consistent with the 2006 IPCC guidelines on how to estimate GHG emissions (IPCC, 2006). Specifically, the GPC Protocol seeks to:

- Help cities develop a comprehensive and robust GHG inventory to support climate action planning.
- Help cities establish a base year GHG emissions inventory, set GHG reduction targets, and track performance.
- Ensure consistent and transparent measurement and reporting of GHG emissions between cities, following internationally recognized GHG accounting and reporting principles.
- Enable community-wide GHG inventories to be aggregated at subnational and national levels.
- Demonstrate the important role that cities play in tackling climate change and facilitate insight through benchmarking—and aggregation—of comparable GHG data.

2.2 GPC PROTOCOL STRUCTURE

The GPC Protocol sets several assessment boundaries which identify the restrictions for gases, emission sources, geographic area, and time span covered by a GHG inventory:

- The GHG inventory is required to include all seven Kyoto Protocol GHGs occurring within the geographic boundary of a community. These include:
  - Carbon dioxide (CO_2)
  - Methane (CH_4)
  - Nitrous oxide (N_2O)
  - Hydrofluorocarbons (HFCs)
  - Perfluorocarbons (PFCs)
  - Sulfur hexafluoride (SF_6)
  - Nitrogen trifluoride (NF_3)
- The GHG emissions from community-wide activities must be organized and reporting under the following five Sectors, based on the selected reporting level:
  - Stationary Energy
  - Transportation
  - Waste
  - Industrial Processes and Product Use (IPPU)

- Agriculture, Forestry, and Other Land Use (AFOLU)

The GPC Protocol also requires that a community define an inventory boundary, identifying the geographic area, time span, gases, and emission sources.

Under the GPC Protocol, a community has the option of reporting GHG emissions under three different levels:

- **GPC BASIC—**This level covers emissions Scopes 1 and 2, from stationary energy and transportation, as well as emissions Scopes 1 and 3 from waste. The BASIC level aligns with the Community Energy and Emissions Inventories (CEEI) that have been released in the past for local governments by the Province of BC.
- **GPC BASIC+—**This level covers the same scopes as BASIC and includes more in-depth and data dependent methodologies. Specifically, it expands the reporting scope to include emissions from Industrial Process and Product Use (IPPU), Agriculture, Forestry, and Other Land-Use (AFOLU), and transboundary transportation. The sources covered in BASIC+ also align with sources required for national reporting in IPCC guidelines.
- **GPC BASIC+ Scope 3 (SC)—** This inventory extends beyond the BASIC+ GHG inventory to include Other Scope 3 (SC) emissions such as GHG emissions from goods and services production and transportation.

Activities taking place within a community can generate GHG emissions that occur inside a Community boundary as well as outside a Community boundary. To distinguish between these, the GPC Protocol groups emissions into three categories based on where they occur: Scope 1, Scope 2, or Scope 3 emissions. The GPC Protocol distinguishes between emissions that physically occur within a Community (Scope 1), from those that occur outside a Community but are driven by activities taking place within a Community's boundaries (Scope 3), from those that occur from the use of electricity, steam, and/or heating/cooling supplied by grids which may or may not cross community boundaries (Scope 2). Scope 1 emissions may also be termed "territorial" emissions, because they are produced solely within the territory defined by the geographic boundary (see Figure 1).

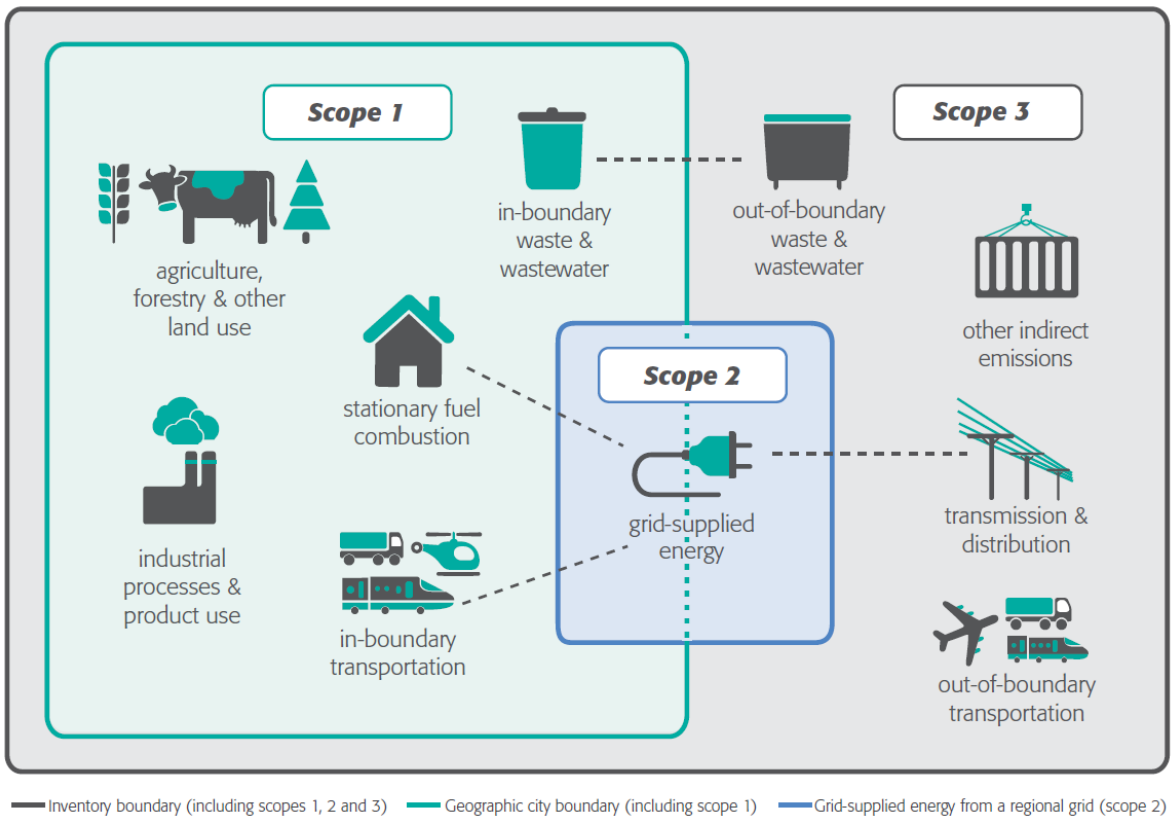


Figure 1 Sources and Boundaries of a Community's GHG Emissions (GPC 2014)

2.3 GHG EMISSION CATEGORIES

As noted previously, the GPC Protocol requires that different emission sources to be categorized into six main reporting Sectors. These high-level categories are described in more detail in Section 2.3.1 to Section 2.3.6. More information on how GHG emissions are captured within the GPC Protocol is available on the Greenhouse Gas Protocol website.

2.3.1 Stationary Energy

Stationery energy sources are typically one of the largest contributors to a community's GHG emissions. In general, these emissions come from fuel combustion and fugitive emissions. They include the emissions from energy to heat and cool residential, commercial, and industrial buildings, as well as the activities that occur within these residences and facilities, such as off-road transportation emissions from construction equipment. Emissions associated with distribution losses from grid-supplied

electricity/steam/heating/cooling are also included, as are some fugitive emissions from sources such as coal piles, and natural gas distribution systems.

The Stationary Energy Sector includes the following Sub-Sectors:

- Residential buildings
- Commercial and institutional buildings and facilities
- Manufacturing industries and construction
- Energy industries
- Energy generation supplied to the grid*
- Agriculture, forestry, and fishing activities
- Non-specific sources
- Fugitive emissions from mining, processing, storage, and transportation of coal
- Fugitive emissions from oil and natural gas systems

*Emissions related with electricity generation activities occurring within a community's boundaries are to be reported; however, the GHG emissions from these sources are not included in the total GHG inventory to prevent double counting (GPC 2014).

Under the GPC Protocol, cities are to report off-road GHG emissions under the Off-road Transportation Sub-Sector if and only if the GHG emissions are occurring at transportation facilities (e.g., airports, harbors, bus terminals, train stations, etc.). Other off-road transportation GHG emissions that occur on industrial premises, construction sites, agriculture farms, forests, aquaculture farms, and military premises, etc., are to be reported under the most relevant Stationary Energy Sub-Sector (GPC, 2014). For example, GHG emissions from commercial building off-road construction equipment would be included in the Commercial And Institutional Buildings And Facilities Sub-Sector, whereas GHG emissions from residential lawn mowers would be reported under the Residential Buildings Sub-Sector.

2.3.2 Transportation

The GHGs released to the atmosphere to be reported in the Transportation Sector are those from combustion of fuels in journeys by on-road, railway, waterborne navigation, aviation, and off-road. GHG emissions are produced directly by the combustion of fuel, and indirectly using grid-supplied electricity. Unlike the Stationary Energy Sector, transit is mobile and can pose challenges in both accurately calculating GHG emissions and allocating them to a specific Sub-Sector. This is particularly true when it comes to transboundary transportation, which includes GHG emissions from trips that either start or finish within a community's boundaries (e.g., departing flight emissions from an airport outside a Community boundaries) (GPC, 2014). Transboundary GHG emissions are only required for GPC BASIC+ GHG reporting.

The Transportation Sector includes the following Sub-Sectors:

- On-road
- Railways

- Waterborne
- Aviation
- Off-road

As noted previously, cities are to report off-road GHG emissions under the Off-road Transportation Sub-Sector if and only if the GHG emissions are occurring at transportation facilities (e.g., airports, harbors, bus terminals, train stations, etc.). For example, off-road railway maintenance support equipment GHG emissions are reported under the Off-Road Transportation Sub-Sector.

2.3.3 Waste

Cities produce GHG emissions that arise from activities related to the disposal and management of solid waste. Waste does not directly consume energy, but releases GHG emissions because of decomposition, burning, incineration, and other management methods.

The Waste Sector includes the following Sub-Sectors:

- Solid waste disposal
- Incineration and open burning
- Biological treatment of waste
- Wastewater treatment and discharge

Under the GPC Protocol, the Waste Sector includes all GHG emissions that result from the treatment or decomposition of waste regardless of the source of the waste (e.g., another community's waste in a Community's landfill). However, the GHG emissions that are associated with waste from outside a Community's boundary that is treated or decomposes within a Community boundary are deemed to be "reporting only" emissions and do not contribute to the GHG inventory (GPC 2014).

Any GHG emissions that result from the combustion of waste or waste related gases to generate energy, such as a methane capture and energy generation system at a landfill, are reported under Stationary Energy Generation Supplied To The Grid Sub-Sector (GPC, 2014). Any waste related GHG emissions that are combusted but not related to energy generation are reported in the appropriate Waste Sub-Sector. Lastly, any waste GHG emissions that are released to the atmosphere are also captured in the appropriate Waste Sub-Sector.

2.3.4 Industrial Processes and Product Use (IPPU)

Emissions from this Sector are only required for BASIC+ GHG reporting under the GPC Protocol. This Sector encompasses GHG emissions produced from industrial processes that chemically or physically transform materials and using products by industry and end-consumers (e.g., refrigerants, foams, aerosol cans) (GPC, 2014).

The IPPU Sector includes the following Sub-Sectors:

- Industrial processes
- Product use

Any GHG emissions associated with energy use for industrial processes are not reported in the IPPU Sector; rather, they are reported under the appropriate Stationary Energy Sub-Sector.

2.3.5 Agriculture, Forestry, and Other Land Use (AFOLU)

Emissions from the AFOLU Sector are only required for BASIC+ GHG reporting. AFOLU GHG emissions are those that are captured or released because of land-management activities. These activities can range from the preservation of forested lands to the development of crop land. Specifically, this Sector includes GHG emissions from land-use change, manure management, livestock, and the direct and indirect release of nitrous oxides (N_2O) from soil management, rice cultivation, biomass burning, urea application, fertilizer, and manure application (GPC, 2014).

The AFOLU Sector is organized into the following Sub-Sectors:

- Livestock
- Land
- Aggregate sources and non-CO_2 emission sources on land

2.3.6 Other Scope 3 Emissions

Cities, by their size and connectivity, inevitably give rise to GHG emissions beyond their boundaries. The GPC Protocol already includes the following Scope 3 emissions in other Sectors:

- On-road, waterborne, and aviation transboundary transportation
- Transmission and distribution losses associated with grid-supplied energy
- Solid waste disposal
- Biological treatment of solid waste
- Wastewater treatment and discharge

Cities may voluntarily report on other Scope 3 emissions as they are estimated. In the case of the CRD, no other Scope 3 GHG emissions, other than those listed above, have been estimated.

2.4 ACCOUNTING AND REPORTING PRINCIPLES

All GHG inventories following the GPC Protocol are required to meet GHG accounting principles. Specifically, these inventories should be relevant, consistent from year to year, accurate and transparent about methodologies, assumptions, and data sources. The transparency of inventories is fundamental to the success of replication and assessment of the inventory by interested parties.

The GHG inventories must also properly account for key energy and GHG emission sinks, sources, and reservoirs (SSR) that are occurring within municipal boundaries. The SSRs are a convenient way to identify and categorize all the GHG emissions to determine if they should be included or excluded from a GHG inventory. A "Source" is something that releases GHG emissions to the atmosphere, such as a diesel generator. A "Sink" is a process or item that removes GHG from the atmosphere, such as photosynthesis and tree growth. Finally, a "Reservoir" is a process or item with the capability to store or accumulate a GHG removed from the atmosphere by a GHG sink, such as a wetland or a peat bog. By assessing and reporting on the applicable SSRs, users of the GHG inventory can have confidence that the inventory is complete and representative of the types and quantities of the GHGs being released within community limits.

2.5 BASE AND REPORTING YEAR RECALCULATIONS

As communities grow and expand, significant changes to the GHG emissions profile can alter materially thus making it difficult to meaningfully assess GHG emission trends and changes over time. The GPC Protocol has requirements on how to treat changes in a community's GHG profile—this is presented in Table 2.

Table 2 GPC Protocol Recalculation Thresholds

Threshold	Example Change	Recalculation Needed	No Recalculation Needed
Changes in the assessment boundary	A local government is annexed in or removed from the administrative boundary	✓	
	Change in protocol reporting method (e.g., from BASIC to BASIC+, addition of GHGs reported, etc.)	✓	
	Shut down of a power plant		✓
	Building a new cement factory		✓
Changes in calculation methodology or improvements in data accuracy	Change in calculation methodology for landfilled municipal solid waste (MSW) that results in a material change in GHG emissions to that sector (i.e., +/-10%).	✓	
	Adoption of more accurate local emission factors, instead of a national average emission factors that results in a material change in GHG emissions (i.e., +/-10%).	✓	
	Change in electricity emission factor due to energy efficiency improvement and growth of renewable energy utilization.		✓
Discovery of significant errors	Discovery of mistake in unit conversion in formula used.	✓	

2.6 DATA QUALITY

Data collection and the assessment of its quality is an integral component of compiling any GHG inventory. Like the IPCC, the GPC Protocol requires users to establish first whether a source exists, and then assess the data availability and quality. To support GHG reporting, the following notation keys are used.

- If the GHG sink, source or reservoir does not exist, a “NO” is used to indicate it is “not occurring”.
- If the GHG sink, source or reservoir does occur, and data is available, then the emissions are estimated. However, if the data is also included in another emissions source category or cannot be disaggregated, the notation key “IE” would be used to indicate “included elsewhere” to avoid double counting.
- When GHG emissions are occurring in the CRD, but data is not available, then the notation key “NE” would be used to indicate “not estimated”.

For GHG data that does exist, in accordance with the GPC Protocol, an assessment of quality is also made on emission factors and GHG estimation methodologies deployed. The GPC Protocol data quality assessment notation keys are summarized in Table 3.

Table 3 GPC Protocol Data Quality Assessment Notation Keys

Data Quality	Activity Data	Emission Factor
High (H)	Detailed activity data	Site-specific emission factors
Medium (M)	Modeled activity data using robust assumptions	More general emission factors
Low (L)	Highly modeled or uncertain activity data	Default emission factors

3.0 GHG ASSESSMENT BOUNDARIES

This section sets out the reporting boundaries of the CRD's GHG inventory.

3.1 SPATIAL BOUNDARIES

This GHG inventory is defined geographically by the CRD's jurisdictional boundaries. As shown in Figure 2, the CRD consists of 13 municipalities and 3 electoral areas. For the purposes of this report, only the CRD GHG emissions are presented. A breakdown of GHG emissions by each CRD municipality and electoral area has been presented in a separate report.

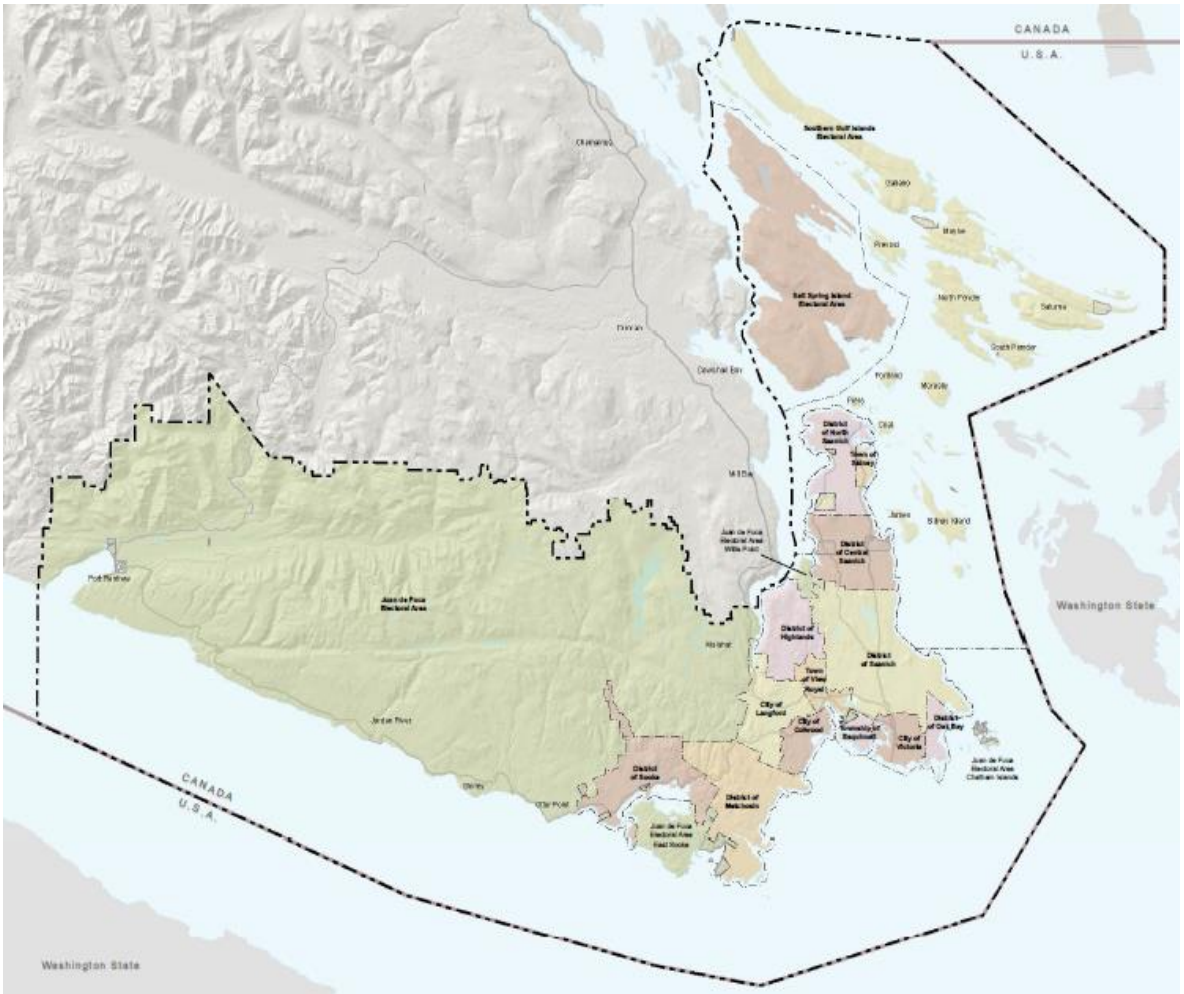


Figure 2 GHG Boundary

Table 4 Inventory Information

Inventory Boundary	Community / District Information
Name of Community / District	Capital Regional District
Municipality / Electoral Area	• District of Central Saanich • City of Colwood • Township of Esquimalt • District of Highlands • Juan de Fuca Electoral Area • City of Langford • District of Metchosin • District of North Saanich • District of Oak Bay • District of Saanich • Salt Spring Island Electoral Area • Town of Sidney • District of Sooke • City of Victoria • Town of View Royal • Southern Gulf Islands Electoral Area
Country	Canada
Inventory Year	2020
Geographic Boundary	See Figure 2
Land Area (km^2)	2,310.18
Resident population	419,697
GDP (US$)	Unknown at time of reporting
Composition of Economy	Government
Climate	Temperate, warm summer

3.2 TEMPORAL BOUNDARIES

3.2.1 2007 Base Year

Federal and provincial initiatives and legislation have been implemented to support local governments in acting to advance energy efficiency, promote energy conservation, and reduce GHG emissions. The CRD and its local governments have already been working to address sustainability and climate change through several initiatives over the past decade. The CRD's Regional Growth Strategy set a regional GHG reduction target) of 61% by 2038 (below 2007 levels).

To maintain consistency with the current reporting year, and as required by the GPC Protocol, the CRD has updated its 2007 GHG base year GHG emissions profile to be consistent with the GPC Protocol BASIC+ reporting level. Between the current reporting year and the 2007 base year, there were no boundary changes (e.g., annexes) and thus no additional modifications were made. All methods and assumptions, adjusted for the 2007 reporting year, are the same.

Due to limitations in how to quantify GHG emissions resulting from land use change (e.g., residential development), these GHG emissions have been excluded from the CRD's 2007 and 2020 GHG emissions inventories, but have been disclosed, until a more robust measurement methodology can be developed. The GHG emissions inventory does, however, include GHG emissions sequestered as a result of biological ecosystems (e.g., forests).

Table 5 summaries the original 2007 and the updated 2007 base year GHG emissions reported as tonnes of carbon dioxide equivalent (tCO_2e).

Table 5 Original And Updated BASIC+ Base Year

Aspect	Quantification Protocol	2007 GHG Base Year (tCO_2e)
Original Base Year	CEEI Protocol	1,563,000
Updated Base Year	GPC Protocol BASIC+	1,976,100

3.2.2 GHG Reduction Target

Recognizing the role that the CRD plays in achieving a significant and immediate reduction in global GHG emissions, the CRD has set a regional GHG reduction target of 61% (from 2007 levels) by 2038. With the CRD's 2007 base year GHG emissions being 1,976,100 tCO_2e, a 39% reduction would require a reduction of approximately 770,679 tCO_2e. On a per capita basis, this amounts to reducing emissions from approximately 4.3 tCO_2e per person in 2020 to 2.4 tCO_2e per person by 2038.

In February 2019, the CRD declared a climate emergency and committed to regional carbon neutrality.

3.2.3 2020 GHG Boundary

This inventory covers all GHG emissions for the 2020 reporting year. Where 2020 data was not available, the most recent year's data have been used, and the timescale noted accordingly. These are as follows:

- **Global Warming Potentials (GWP)**. The BC government is currently applying GWPs from the fourth IPCC report despite the fact that there are updated GWPs in available in the fifth IPCC report. On this basis, the CRD is applying GWPs from the fourth IPCC report.
- **Stationary Energy: Emission Factors.** The BC Government updated 2010-2020 electricity emission factors to include emissions from imported electricity resulting in a 5-10% increase in GHG emissions intensities. Since there was no update to the 2007, the BC Government has suggested utilizing the 2010 emission factor for 2007.

- **Stationary Energy: Electricity Data.** In 2019, the Province of BC received updated electricity data for 2007-2018 as a systematic error was uncovered across all years of BC Hydro data. The 2007 inventory was updated with the corrected information.
- **Stationary Energy: Residential, Commercial and Institutional Buildings**. Propane, and wood GHG emissions were estimated using linear regression methods. The data used in the estimates included historical propane and wood energy data published in the 2007, 2010 and 2012 CEEIs, and heating degree days (HDD) published by Environment and Climate Change Canada. This approach was also applied to the estimate of heating oil for all local governments, except the City of Victoria and District of Saanich. For the District of Saanich and the City of Victoria, heating oil GHG emissions were estimated based on the number of known tanks, average heated floor areas and fuel volume intensity.
- **Stationary Energy: Fugitives**. Fortis BC provided total fugitive emissions for the 2020 reporting year at the CRD level. Since no historical numbers were provided, the 2020 value was applied to the 2007 base year as well.
- **Transportation: On-Road**. The on-road transportation emissions are based on the total estimated fuel sales in the CRD, and the number of registered vehicles. Insurance Corporation of BC (ICBC) compiles data on an April 1 to March 31 basis, and thus the current on-road GHG emission estimate is based on the number of registrations from April 1, 2020 – March 31, 2021.
- **Transportation: Aviation.** 2020 aviation GHG emissions were estimated using 2015 aircraft flight profiles (the last available data), and the total number of aircraft movements reported in 2020.
- **Transportation: Waterborne Recreational Watercraft.** GHG emissions from recreational watercraft and US/Canada ferries were estimated based on a publicly available year 2000 study for the Victoria, Vancouver, and Washington harbors.
- **Transportation: Ferries.** BC Ferries did not disclose its total reported fuel use for 2020 but did publish that fuel consumption volumes fell by approximately 40% as compared to the 2019 reporting year. As such, the 2019 fuel volumes and the 40% factor were applied to estimate 2020 fuel volumes.
- **Transportation: Cruise Ships.** The Greater Victoria Harbour Authority (GVHA) reported on cruise ship emissions for the 2010 and 2018 reporting years but did not provide an estimate for 2007. As a result, the 2010 GHG emissions estimate and number of cruise ship visits to Ogden Point was used to create a proxy to estimate 2007 cruise ship emissions. The GVHA reported 163 visits in 2007. As a result of COVID-19 restrictions, there were no cruise ships in 2020.
- **Waste: Solid Waste.** To quantify GHG emissions from the Hartland Landfill, the CRD utilized the waste-in-place (WIP) method which is accepted under the GPC Protocol. The WIP assigns landfill emissions based on total waste deposited during that year. It counts GHGs emitted that year, regardless of when the waste was disposed. Except for the City of Victoria, who claims 31% of the CRD's landfill GHG emission, the remaining landfill GHG emissions were allocated to each local government on a per capita basis. Using this allocation method, the CRD members may over, or underestimate associated solid waste GHG emissions as the current year landfill GHG emissions are based upon cumulative waste over time, and each member may have contributed more waste in past years than the current year (and vice versa).
- **AFOLU: Aggregate Sources And Non-CO_2 Emission Sources On Land.** These emissions are based on the 2021 NIR as prepared by ECCC and the total area of farmland BC in 2016 as reported

by Statistics Canada. These GHG emissions were assigned to each local government on a per hectare (ha) of cropland basis.

- **AFOLU: Land-Use.** The land cover change analysis requires a consistent land-use category attribution and spatial data. For parts of the CRD, spatial data was available for the 2007, 2011 and 2019 reporting years. Differences between these data sets in terms of resolution and their timing of collection increase the uncertainty as to the accuracy of the land-use classifications. For example, the 2007 and 2011 land use data was collected at different times of the year and may not accurately reflect tree cover. Furthermore, no land use spatial data was collected the Juan de Fuca, Salt Spring Island and Gulf Islands and thus Annual Crop Inventory (ACI) settlement data collected by Agriculture Canada was used to inform the analysis. The challenge in utilizing this data is that it is provided in a 30m resolution. Furthermore, since annual data is not available, the change between land cover data years (2007-2011, 2011-2019) for all areas was averaged and may not represent actual changes in each year. Since no data was available for 2020, the 2019 estimates were applied.
  Due to limitations in how to quantify GHG emissions resulting from land use change (e.g., residential development), these GHG emissions have been excluded from the CRD's GHG emissions inventory, but have been disclosed, until a more robust measurement methodology can be developed.

3.3 GHG EMISSION SOURCES AND SCOPES

The following table summarizes the CRD's GHG emissions by source and GHG emission scope.

Table 6 Summary of Emissions Scope and GPC Protocol Reporting Sector

GHG Emissions Scope	GPC Protocol Reporting Sector
Scope 1	The GHG emissions occurring from sources located within the CRD's limits: • Stationary fuel combustion: – Residential buildings – Agriculture, forestry, and fishing activities – Commercial and institutional buildings, and facilities – Energy industries – Fugitive emissions from oil and natural gas systems • Transportation: – On-road: In Boundary – Waterborne Navigation – Off-road • Waste: – Solid waste disposal – Biological treatment of solid waste – Wastewater treatment and discharge • Industrial processes and product use (IPPU): – Product use • Agriculture, Forestry, and Other Land Use (AFOLU): – Land-use: emissions sequestered – Livestock

GHG Emissions Scope	GPC Protocol Reporting Sector
	– Aggregate sources and non-CO_2 emission sources on land
Scope 2	The GHG emissions occurring from using grid-supplied electricity, heating and/or cooling within the CRD's boundary: • Stationary fuel combustion: – Residential buildings – Commercial and institutional buildings and facilities • Transportation: – On-road
Scope 3	Other GHG emissions occurring outside of the CRD's limits as a result of the CRD's activities: • Stationary Energy: – Transmission, Distribution, and Line Losses • Transportation: – Aviation – On-Road: Transboundary – Waterborne Navigation

3.4 GHG REPORTING

Where relevant, the GPC Protocol recommends using methodologies that align with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The GHG inventory is required to include all seven Kyoto Protocol GHGs occurring within the geographic boundary of a community. These include:

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur hexafluoride (SF_6)
- Nitrogen trifluoride (NF_3)

Each GHG listed above has a different global warming potential (GWP) due to its ability to absorb and re-emit infrared radiation. This chemical property is recognized by the GWP set out by the IPCC Fourth Assessment Report. A larger GWP value means the substance has a greater affinity to absorb and re-emit infrared radiation. The GWP of these GHGs are CO_2 = 1.0, CH_4 = 25, N_2O = 298 (IPCC, 2006).

Total GHG emissions are normally reported as CO_2e, whereby emissions of each of the GHGs are multiplied by their GWP and are reported as tonnes of CO_2e.

The GHG inventory results following the GPC Protocol reporting table format is presented in Section 5.0. The GPC Protocol reporting format is presented in Table 7 below which also indicates the reporting level (BASIC / BASIC+) for each source.

Table 7 GPC Protocol Summary Table

GPC Protocol Reference Number	Reporting Level	Emissions Scope	GHG Emissions Source
I	**Stationary Energy Sources**		
I.1	**Residential Buildings**		
I.1.1	BASIC	1	Emissions from in-boundary fuel combustion
I.1.2	BASIC	2	Emissions from consumption of grid-supplied energy
I.1.3	BASIC+	3	Transmission and distribution losses from grid-supplied energy
I.2	**Commercial and Institutional Buildings/Facilities**		
I.2.1	BASIC	1	Emissions from in-boundary fuel combustion
I.2.2	BASIC	2	Emissions from consumption of grid-supplied energy
I.2.3	BASIC+	3	Transmission and distribution losses from grid-supplied energy
I.3	**Manufacturing Industry and Construction**		
I.3.1	BASIC	1	Emissions from in-boundary fuel combustion
I.3.2	BASIC	2	Emissions from consumption of grid-supplied energy
I.3.3	BASIC+	3	Transmission and distribution losses from grid-supplied energy
I.4	**Energy Industries**		
I.4.1	BASIC	1	Emissions from in-boundary production of energy used in auxiliary operations
I.4.3	BASIC+	3	Transmission and distribution losses from grid-supplied energy
I.5	**Agriculture, Forestry, and Fishing Activities**		
I.5.1	BASIC	1	Emissions from in-boundary fuel combustion
I.5.2	BASIC	2	Emissions from consumption of grid-supplied energy
I.5.3	BASIC+	3	Transmission and distribution losses from grid-supplied energy
I.7	**Fugitive Emissions from Mining, Processing, Storage, And Transportation of Coal**		
I.7.1	BASIC	1	In-boundary fugitive emissions
I.8	**Fugitive Emissions from Oil and Natural Gas Systems**		
I.8.1	BASIC	1	In-boundary fugitive emissions
II	**Transportation**		
II.1	**On-road Transportation**		
II.1.1	BASIC	1	Emissions from in-boundary transport
II.1.2	BASIC	2	Emissions from consumption of grid-supplied energy
II.1.3	BASIC+	3	Emissions from transboundary journeys

Table 7 GPC Protocol Summary Table

GPC Protocol Reference Number	Reporting Level	Emissions Scope	GHG Emissions Source
II.2	**Railways**		
II.2.1	BASIC	1	Emissions from in-boundary transport
II.2.2	BASIC	2	Emissions from consumption of grid-supplied energy
II.2.3	BASIC+	3	Emissions from transboundary journeys
II.3	**Waterborne Navigation**		
II.3.1	BASIC	1	Emissions from in-boundary transport
II.3.2	BASIC	2	Emissions from consumption of grid-supplied energy
II.3.3	BASIC	3	Emissions from transboundary journeys
II.4	**Aviation**		
II.4.1	BASIC	1	Emissions from in-boundary transport
II.4.2	BASIC	2	Emissions from consumption of grid-supplied energy
II.4.3	BASIC+	3	Emissions from transboundary journeys
II.5	**Off-road**		
II.5.1	BASIC	1	Emissions from in-boundary transport
II.5.2	BASIC	2	Emissions from consumption of grid-supplied energy
III	**Waste**		
III.1	**Solid Waste Disposal**		
III.1.1	BASIC	1	Emissions from waste generated and treated within the Community
III.1.2	BASIC	3	Emissions from waste generated within but treated outside of the Community
III.2	**Biological Treatment of Waste**		
III.2.1	BASIC	1	Emissions from waste generated and treated within the Community
III.2.2	BASIC	3	Emissions from waste generated within but treated outside of the Community
III.3	**Incineration and Open Burning**		
III.3.1	BASIC	1	Emissions from waste generated and treated within the Community
III.3.2	BASIC	3	Emissions from waste generated within but treated outside of the Community
III.4	**Wastewater Treatment and Discharge**		
III.4.1	BASIC	1	Emissions from wastewater generated and treated within the Community

Table 7 GPC Protocol Summary Table

GPC Protocol Reference Number	Reporting Level	Emissions Scope	GHG Emissions Source
III.4.2	BASIC	3	Emissions from wastewater generated within but treated outside of the Community
IV	**Industrial Processes and Product Use (IPPU)**		
IV.1	BASIC+	1	In-boundary emissions from industrial processes
IV.2	BASIC+	1	In-boundary emissions from product use
V	**Agriculture, Forestry, and Other Land Use (AFOLU)**		
V.1	BASIC+	1	In-boundary emissions from livestock
V.1	BASIC+	1	In-boundary emissions from land
V.1	BASIC+	1	In-boundary emissions from other agriculture
VI	**Other Scope 3 Emissions**		
VI.1	BASIC / BASIC+	3	Other indirect emissions

4.0 GHG METHODOLOGIES BY SOURCE CATEGORY

The following sections describe the reporting source category, assumptions, activity data applied, and quantification methodology. The results of the analysis are presented in Section 5.0.

4.1 STATIONARY ENERGY

4.1.1 Overview

Stationery energy sources are one of the largest contributors to the CRD's GHG emissions. For the District, the Stationary Energy Sector encompasses the following GHG emissions scopes and Sub-Sectors:

- Scope 1 Emissions:
  - Residential buildings
  - Agriculture, forestry, and fishing activities
  - Commercial and institutional buildings, and facilities
  - Energy industries
  - Fugitive emissions from oil and natural gas systems
- Scope 2 Emissions:
  - Emissions from the consumption of grid-supplied electricity, steam, heating, and cooling.
- Scope 3 Emissions:
  - Transmission and distribution losses of electricity, steam, heating, and cooling.

There are GHG emissions from construction of buildings and infrastructure as the CRD region grows and changes. However, these GHG emissions have not been quantified due to a lack of available data. Environment and Climate Change Canada does estimate BC GHG emissions for manufacturing industries, mining and construction, but these GHG emission sources are not disaggregated and cannot reasonably be applied to the CRD (there is no mining and limited manufacturing activities). As a result, the notation "Not Estimated (NE)" is reported.

4.1.2 Scope 2: Market Based Method

As per the GPC Protocol, cities can report on Scope 2 GHG emissions using either the market-based, or the location-based method. A market-based method utilizes utility-specific grid emission intensity factor, whereas a location-based method uses a regional or Provincial average grid emission intensity factor. At present, the fuel mix and GHG emissions data relative to the CRD's energy consumption is not available. As such, the CRD is defaulting to the BC Provincial electricity grid consumption intensity factor of 0.04010 tCO_2e/MWh reported by the BC Government.[1]

[1] https://www2.gov.bc.ca/gov/content/environment/climate-change/industry/reporting/quantify/electricity

4.1.3 Activity Data

BC Hydro and Fortis BC provided the Province of BC electricity and natural gas consumption data in MWh and GJ, respectively. Based on the utility provider descriptions of the data, each is categorized as follows:

- Residential Buildings based on the BC Hydro and Fortis BC descriptor: “Residential”
- Commercial and Institutional Buildings/Facilities based on BC Hydro and Fortis BC descriptors: “Commercial”, and “CSMI”

The Province developed 2007, 2010 and 2012 residential fuel oil, propane and wood GHG energy use estimates from the number and type of dwellings and the average dwelling consumption by authority and region from the BC Hydro Conservation Potential Review. This data was used to estimate the reporting year GHG emissions for all CRD members except for the District of Saanich and the City of Victoria who provided fuel oil estimates for residential and commercial buildings.

Fortis BC provided the fugitive emission estimate.

The CRD provided landfill gas energy generation data from the Hartland landfill.

Applicable, off-road GHG emissions included in the Stationary Energy Sector are based on the 2021 NIR as prepared by Environment and Climate Change Canada. These emissions are pro-rated to the CRD on a per capita basis.

4.1.4 Assumptions and Disclosures

The following assumptions were made in the calculation of the 2020 GHG emissions:

- The Province of BC received updated electricity data for 2007-2018 as a systematic error was uncovered across all years of BC Hydro data. The 2007 base year inventory was updated with the corrected information.
- The BC Government updated 2010-2020 electricity emission factors to include emissions from imported electricity resulting in a 5-10% increase in GHG emissions intensities. Since there was no update to the 2007 value, the BC Government has suggested utilizing the 2010 emission factor for 2007.
- BC Hydro estimates that the combined energy losses- transmission and distribution- to be approximately 6.28%. This value was used to calculate the Scope 3 emissions for each Stationary Energy Sub-Sector. It is assumed that this is accurate.
- Fortis BC provided total fugitive emissions for the 2020 reporting year at the CRD level. Since no historical numbers were provided, the 2020 value was applied to the 2007 base year as well.
- Propane and wood GHG emissions were estimated using linear regression methods. The data used in the estimate included historical propane and wood energy data published in the 2007, 2010 and 2012 CEEIs, and heating degree days (HDD) published by Environment and Climate Change Canada.

- Fuel oil consumption values for the District of Saanich and the City of Victoria were derived by each local government and provided to the CRD. For the remaining local governments, fuel oil values were estimated using linear regression methods. The data used in the estimate included historical fuel oil data published in the 2007, 2010 and 2012 CEEIs, and heating degree days (HDD) published by Environment and Climate Change Canada.

4.1.5 Calculation Methodology

The Province of BC developed residential fuel oil, propane and wood GHG energy use estimates for the 2007, 2010 and 2012 reporting years, using the number and type of dwellings and the average dwelling consumption by authority and region contained in the BC Hydro Conservation Potential Review. Actual electricity and natural gas consumption values were subtracted from the total energy use, with the remainder assumed to be heating oil, propane, or wood. To estimate the 2020 propane, fuel oil and wood energy use, historical 2007, 2010 and 2012 values and the number of heating degree days (HDD) were linearly regressed to estimate future propane and wood energy use using reporting year HDD values. these values were prorated to each local government based on the 2012 consumption estimates. This resulted in the development of the following equations:

- Propane (L) = 163,133 + 87.38 * HDD
- Wood (GJ) = 557,864 + 191.39 * HDD
- Fuel Oil (GJ) = 1,728,690 + 127.49 * HDD

To calculate GHG emissions from electricity, natural gas, heating oil, propane, and wood, the total net annual energy values (where applicable, less transmission, distribution, and line losses of 6.28%) were multiplied by applicable emissions factors. These values were then multiplied by the pollutant's GWP to give total CO_2e emissions in tonnes.

These quantification methods are captured as follows:

Energy $_{\text{Stationary Energy – Electricity}}$ $= Electricity * (1 – Line\ Loss\ (\%))$

Energy $_{\text{Stationary Energy – Transmission, Distribution, and line Losses}}$ $= Electricity * Line\ Loss\ (\%)$

Emissions $_{\text{Stationary Energy – Electricity}}$ $= Fuel\ (MWh) * EF_{tCO2e}$

Emissions $_{\text{Stationary Energy – Natural Gas}}$ $= (Fuel\ (GJ) * EF_{CO2}) + (Fuel\ (GJ) * EF_{CH4} * GWP_{CH4}) + (Fuel\ (GJ) * EF_{N2O} * GWP_{N2O})$

Emissions $_{\text{Stationary Energy – Propane}}$ $= (Fuel\ (GJ) * EF_{CO2}) + (Fuel\ (GJ) * EF_{CH4} * GWP_{CH4}) + (Fuel\ (GJ) * EF_{N2O} * GWP_{N2O})$

Emissions $_{\text{Stationary Energy – Wood}}$ $= (Fuel\ (GJ) * EF_{CO2}) + (Fuel\ (GJ) * EF_{CH4} * GWP_{CH4}) + (Fuel\ (GJ) * EF_{N2O} * GWP_{N2O})$

Emissions $_{\text{Stationary Energy – Heating Oil}}$ $= (Fuel\ (GJ) * EF_{CO2}) + (Fuel\ (GJ) * EF_{CH4} * GWP_{CH4}) + (Fuel\ (GJ) * EF_{N2O} * GWP_{N2O})$

The emission factors used in the 2020 reporting year are from the 2021 NIR. These are summarized in Table 8.

Table 8 Stationary Energy GHG Emission Factors

Emission Factor	Units	CO_2	CH_4	N_2O	tCO_2e
Electricity (BC Hydro)	tCO_2e / MWh				0.0401000
Natural Gas	tonne CO_2e / m^3	0.0019260	0.0000000	0.0000000	0.0019374
Propane	tonne CO_2e / L	0.0015150	0.0000000	0.0000001	0.0015478
Heating Oil	tonne CO_2e / GJ	0.0681200	0.0000007	0.0000008	0.0683759
Wood	tonne CO2e / kg	-	0.0000150	0.0000002	0.0004227

4.2 TRANSPORTATION

4.2.1 Overview

Transportation covers all GHG emissions from combustion of fuels in journeys by on-road, railways, waterborne navigation, aviation, and off-road. GHG emissions are produced directly by the combustion of fuel, and indirectly using grid-supplied electricity. For the CRD, the Transportation Sector encompasses the following GHG emissions scopes and Sub-Sectors:

- Scope 1 Emissions:
  - On-road: In Boundary
  - Waterborne
  - Aviation
  - Off-road
- Scope 2 Emissions:
  - Emissions from the consumption of grid-supplied electricity.
- Scope 3 Emissions:
  - On-road: Transboundary
  - Waterborne
  - Aviation
  - Off-road

4.2.2 Activity Data

The Province of BC provided 2007, 2010 and 2020 ICBC vehicle registration data.

BC Transit provided total diesel and gasoline fuel use. This data was used to estimate GHG emissions from busses serving the CRD.

The 2017 CRD Origin Destination Travel Survey was used to estimate on-road in-boundary and transboundary split for registered vehicles and busses. The CRD Origin Destination Travel Survey is based on travel patterns observed in the Capital Regional District (CRD) level.

Aviation GHG emissions from the Victoria International Airport were estimated using 2015 aircraft flight profiles, and the total number of aircraft movements reported in 2020. These data sets were provided by the Victoria International Airport.

Victoria harbour aviation GHG emissions were estimated using Victoria harbor aircraft movement statistics, estimated taxi times, and estimated fuel use for the DHC-6 Twin Otter type of plane. This data was taken from Statistics Canada.

Marine watercraft GHG emissions were estimated using published BC Ferries fuel statistics. GHG emissions from the Coho Ferry, the Victoria Clipper Ferry, personal and commercial watercraft, were estimated based on a Study entitled “Marine Vessel Air Emissions in BC and Washington State Outside of the GVRD and FVRD for the Year 2000”. The Transport Canada Vessel Registration System provided the total number of registered waterborne vehicles for the reporting year.

Other off-road transportation emissions are based on the 2021 NIR as prepared by Environment and Climate Change Canada.

4.2.3 Assumptions and Disclosures

The following assumptions were made in the calculation of the Transportation Sector GHG emissions:

- The on-road transportation emissions are based on the total estimated fuel sales in the CRD, and the number of registered vehicles. Insurance Corporation of BC (ICBC) compiles data on an April 1 to March 31 basis, and thus the current on-road GHG emission estimate is based on the number of registrations from April 1, 2020 – March 31, 2021.
- Vehicle fuel consumption rates and Vehicle Kilometer Travelled (VKT) were taken from the activity data summary for British Columbia on-road transportation from the 2021 National Inventory Report (1990-2019) as prepared by Environment and Climate Change Canada. Based on the clear diesel and clear gasoline consumption values reported by the Province of BC for the Victoria region, the VKT and fuel efficiency values are reasonable and result in a similar estimate of fuel consumption for the Region.
- Gasoline and diesel GHG emissions from BC Transit busses are pro-rated to the CRD based on the proportion of population in each municipality within the CRD. A more accurate estimation method would be to prorate fuel use based on total bus service kilometers in the CRD. However, this data is not available, and thus the method applied provides the best estimate at the time of reporting.
- It is assumed that the 2015 aircraft flight profiles at the Victoria International Airport are representative of the 2020 reporting year.
- Statistics Canada stopped collecting Victoria Harbor aircraft movement data in 2016. To estimate 2020 marine aviation GHG emissions, the 2016 Victoria data was applied and adjusted using the

change in aircraft traffic between the 2016 and 2020 reporting years at the Victoria International Airport. It is assumed that the activity at both airports would be corelated, but not causational.

- The aviation GHG emissions are prorated based on the total Victoria population relative to the CRD population.
- As there is currently no publicly available energy or GHG related information on the operation of the Coho and the Victoria Clipper Ferries, it was assumed that the GHG emissions for these ferries calculated in the Study entitled "Marine Vessel Air Emissions in BC and Washington State Outside of the Greater Victoria Regional District (GVRD) and FVRD for the Year 2000".
- There were no cruise ships in 2020.
- BC Ferries did not disclose its total reported fuel use for 2020 but did publish that fuel consumption volumes fell by approximately 40% as compared to the 2019 reporting year. As such, the 2019 fuel volumes and the 40% factor were applied to estimate 2020 fuel volumes.
- The Transport Canada Vessel Registration System provided the total number of registered waterborne vehicles for the reporting year; however, it does not provide any detail on the type, size, use, and owner of the watercraft. It was therefore assumed that the watercraft would have been similar to those in the referenced study.
- No railway GHG emissions are occurring in the CRD.
- The off-road transportation emissions are based on the 2021 NIR as prepared by Environment and Climate Change Canada. This is deemed to be the best available data.

4.2.4 Calculation Methodology

4.2.4.1 On-Road

The GPC Protocol identifies several methods for determining on-road emissions. The vehicle kilometers travelled (VKT) methodology and fuel sales methods were utilized to estimate the GHG emissions from on-road transportation (Scope 1) and transboundary transportation (Scope 3). The VKT uses the number and type of vehicles registered in a geopolitical boundary, the estimated fuel consumption rate of individual vehicles, and an estimate of the annual vehicle kilometres traveled (VKT) by various vehicle classes. ICBC provided the number of registered vehicles in the CRD by style and by fuel type for 2020. To estimate the split between on-road in-boundary and transboundary traffic, data from the 2017 CRD Origin Destination Survey was applied. The results of the survey as it applies to the CRD is presented in Table 9.

Table 9 CRD On-Road In-Boundary/Transboundary Split

Aspect	By Vehicle
Estimated proportion of on-road in-boundary travel	99.1%
Estimated proportion of on-road transboundary travel	0.9%

To quantify the 2020 reporting year on-road and transboundary GHG emissions, the following steps were taken:

1. Sort the ICBC vehicle registration data by postal code.

2. Review each vehicle model and fuel type and assign it to one of 4 classes (for each fuel type): LDV, LDT, HDV, ORVE
3. Assign estimated NRCan vehicle fuel consumption rates and estimated VKT to each vehicle class (Table 10).
4. Estimate total fuel use by vehicle classification.
5. Summate and allocate estimated fuel use, by vehicle class using the applicable in-boundary and transboundary split.
6. Pro-rate the gasoline and diesel fuel use from busses.
7. Summate and allocate estimated bus fuel use using the applicable in-boundary and transboundary split.
8. Compare fuel estimated fuel volumes to the regional fuel sales volumes reported by the CRD. Adjust the VKTs as needed to make sure that the fuel estimate is at least above the fuel sales volumes reported in the region.

Table 10 Estimated VKT And Fuel Efficiencies by Vehicle Class For Reporting Year

Vehicle Classification	Estimated VKT / Year	Estimated Fuel Efficiency (L/100 km)
Diesel-HDV	25,730	45.6
Diesel-LDT	12,916	11.8
Diesel-LDV	14,746	9.2
Diesel-ORVE	Not Estimated	45.6
Electric-HDV	9,651	30.0
Electric-LDT	10,290	20.0
Electric-LDV	11,328	20.0
Electric-ORVE	Not Estimated	30.0
Gasoline-HDV	9,180	54.1
Gasoline-Hybrid-HDV	8,214	37.9
Gasoline-Hybrid-LDT	8,901	10.0
Gasoline-Hybrid-LDV	9,799	7.0
Gasoline-Hybrid-ORVE	Not Estimated	37.9
Gasoline-LDT	8,901	12.2
Gasoline-LDV	9,799	9.0
Gasoline-ORVE	Not Estimated	54.1
Hydrogen-Hybrid-LDV	10,883	Not Estimated
Hydrogen-LDV	11,717	Not Estimated
Hydrogen-LDT	12,840	Not Estimated
Motorcycle - Electric	1,973	17.0
Motorcycle - Non catalyst	1,973	9.9
Natural Gas-HDV	25,730	22.9
Natural Gas-LDT	12,916	8.3

Vehicle Classification	Estimated VKT / Year	Estimated Fuel Efficiency (L/100 km)
Natural Gas-LDV	14,746	5.4
Natural Gas-ORVE	Not Estimated	22.9
Propane-HDV	25,730	22.9
Propane-Hybrid-LDV	16,384	13.1
Propane-LDT	12,916	12.6
Propane-LDV	14,746	8.2
Propane-ORVE	Not Estimated	22.9

Table 11 Total Registered Vehicles & Estimated Fuel Use For Reporting Year

Vehicle Classification	Total Estimated Registered Vehicles	Total Estimated Fuel Use	Units
Diesel-HDV	2,335	35,372,719	Liters (L)
Diesel-LDT	9,380	14,320,821	Liters (L)
Diesel-LDV	1,541	2,083,052	Liters (L)
Diesel-ORVE	2,309	-	Liters (L)
Electric-HDV	17	49,218	kWh
Electric-LDT	4,039	8,312,213	kWh
Electric-LDV	3,951	8,951,252	kWh
Electric-ORVE	44	-	kWh
Gasoline-HDV	3,451	17,329,273	Liters (L)
Gasoline-Hybrid-HDV	1	3,111	Liters (L)
Gasoline-Hybrid-LDT	609	542,059	Liters (L)
Gasoline-Hybrid-LDV	3,848	2,639,344	Liters (L)
Gasoline-Hybrid-ORVE	2	-	Liters (L)
Gasoline-LDT	140,562	152,118,048	Liters (L)
Gasoline-LDV	96,400	85,200,133	Liters (L)
Gasoline-ORVE	2,673	-	Liters (L)
Hydrogen-Hybrid-LDV	-	-	Liters (L)
Hydrogen-LDV	3	-	Liters (L)
Hydrogen-LDT	3	-	Liters (L)
Motorcycle - Electric	2	671	kWh
Motorcycle - Non catalyst	5,491	1,074,790	Liters (L)
Natural Gas-HDV	16	738,879	Kilogram (kg)
Natural Gas-LDT	41	43,953	Kilogram (kg)

Vehicle Classification	Total Estimated Registered Vehicles	Total Estimated Fuel Use	Units
Natural Gas-LDV	3	2,389	Kilogram (kg)
Natural Gas-ORVE	7	-	Kilogram (kg)
Propane-HDV	54	318,585	Liters (L)
Propane-Hybrid-LDV	2	4,284	Liters (L)
Propane-LDT	179	291,303	Liters (L)
Propane-LDV	12	14,510	Liters (L)
Propane-ORVE	75	-	Liters (L)
Total	**277,050**	**N/A**	**N/A**

Once the fuels were allocated amongst the vehicle classes and sectors, the GHG emissions were calculated accordingly. The GHG quantification method is captured, for all fuel types, is as follows:

$$\textbf{\textit{Emissions}}_{\textbf{\textit{On-road}}} = \textit{In-Boundary Split \% * ((Vol. Fuel * } EF_{CO2}\textit{) + (Vol. Fuel * } EF_{CH4} \textit{ * } GWP_{CH4}\textit{) + (Vol. Fuel * } EF_{N2O} \textit{ * } GWP_{N2O}\textit{))}$$

$$\textbf{\textit{Emissions}}_{\textbf{\textit{Transboundary}}} = \textit{Transboundary Split \% * ((Vol. Fuel * } EF_{CO2}\textit{) + (Vol. Fuel * } EF_{CH4} \textit{ * } GWP_{CH4}\textit{) + (Vol. Fuel * } EF_{N2O} \textit{ * } GWP_{N2O}\textit{))}$$

The emission factors used in the reporting year GHG inventory are from the 2021 NIR. These are summarized in Table 12.

Table 12 Vehicle GHG Emission Factors

Vehicle Class	Units	CO_2	CH_4	N_2O	tCO_2e
Gasoline-LDV	tonne CO_2e / L	0.00220000	0.00000023	0.00000047	0.00234581
Gasoline-LDT	tonne CO_2e / L	0.00220000	0.00000024	0.00000058	0.00237884
Gasoline-HDV	tonne CO_2e / L	0.00220000	0.00000068	0.00000020	0.00227660
Gasoline-ORVE	tonne CO_2e / L	0.00220000	0.00000270	0.00000050	0.00241650
Gasoline-Hybrid-LDV	tonne CO_2e / L	0.00220000	0.00000023	0.00000047	0.00234581
Gasoline-Hybrid-LDT	tonne CO_2e / L	0.00220000	0.00000024	0.00000058	0.00237884
Gasoline-Hybrid-HDV	tonne CO_2e / L	0.00220000	0.00000068	0.00000020	0.00227660
Gasoline-Hybrid-ORVE	tonne CO_2e / L	0.00220000	0.00000270	0.00000050	0.00241650
Electric-LDV	tonne CO_2e / kWh	-	-	-	0.00004010
Electric-LDT	tonne CO_2e / kWh	-	-	-	0.00004010
Electric-HDV	tonne CO_2e / L	-	-	-	0.00004010
Electric-ORVE	tonne CO_2e / L	-	-	-	0.00004010
Diesel-LDV	tonne CO_2e / L	0.00258200	0.00000005	0.00000022	0.00264884

Vehicle Class	Units	CO_2	CH_4	N_2O	tCO_2e
Diesel-LDT	tonne CO_2e / L	0.00258200	0.00000007	0.00000022	0.00264926
Diesel-HDV	tonne CO_2e / L	0.00258200	0.00000011	0.00000015	0.00262975
Diesel-ORVE	tonne CO_2e / L	0.00258200	0.00000015	0.00000100	0.00288375
Hydrogen-Hybrid-LDV	tonne CO_2e / L	-	-	-	-
Hydrogen-LDV	tonne CO_2e / L	-	-	-	-
Hydrogen-LDT	tonne CO_2e / L	-	-	-	-
Natural Gas-LDV	tonne CO_2e / kg	0.00273800	0.00001300	0.00000009	0.00308863
Natural Gas-LDT	tonne CO_2e / kg	0.00273800	0.00001300	0.00000009	0.00308863
Natural Gas-HDV	tonne CO_2e / kg	0.00273800	0.00001300	0.00000009	0.00308863
Natural Gas-ORVE	tonne CO_2e / kg	0.00273800	0.00001300	0.00000009	0.00308863
Propane-LDV	tonne CO_2e / L	0.00151500	0.00000064	0.00000003	0.00153934
Propane-LDT	tonne CO_2e / L	0.00151500	0.00000064	0.00000003	0.00153934
Propane-HDV	tonne CO_2e / L	0.00151500	0.00000064	0.00000003	0.00153934
Propane-ORVE	tonne CO_2e / L	0.00151500	0.00000064	0.00000003	0.00153934
Propane-Hybrid-LDV	tonne CO_2e / L	0.00151500	0.00000064	0.00000003	0.00153934
Motorcycle - Non catalyst	tonne CO_2e / L	0.00231600	0.00000230	0.00000005	0.00238780
Motorcycle - Electric	tonne CO_2e / L	-	-	-	0.00004010

4.2.4.2 Aviation: Victoria International Airport

The Victoria International Airport (VIA) estimated its 2015 airplane GHG emissions following the ACI ACERT standard. This includes GHG emissions from aircraft and GHG emissions from auxiliary power units (APU). APUs provides electricity to the aircraft prior to the engine start up. Within the ACERT model, it is assumed all aircraft have APUs and the duration of the APU operation (of five minutes per aircraft) was generically applied to every landing take-off (LTO) cycles. It should also be noted that the EIA has quantified aircraft GHG emissions from planes up to 3,000 ft. to avoid double counting with other airports and cities. This is consistent with the ACERT standard.

The CRD's 2020 aviation emissions estimate is based on the 2015 aircraft flight profiles, which included the estimated landing and takeoff (LTO) and auxiliary power unit (APU) fuel use, and an estimated percentage allocation of total flights to the following aviation class groupings (Table 13). The total reported flight movements for the reporting year (79,099) provided by the VIA and the aircraft flight profile data was used to estimate aviation GHG emissions for the reporting year at the VIA.

Table 13 Aircraft Type, Estimated Percentage of Total Reported Movements, And Estimated Fuel Use

Aviation Class	Aircraft Type	Estimated Percentage of Annual Movements	Estimated LTO Fuel Use by Aircraft Type (kg)	Estimated APU Fuel Use by Aircraft Type (kg/min)
Jet	Large: 2-aisle, long-haul	0.01%	1,853	4.00
	Medium: 2-aisle, medium-haul	0.01%	1,321	4.00
	Small: 1-aisle, small/medium haul	7.95%	565	1.78
	Regional: 1-aisle, short-haul	0.01%	315	1.78
	Business: 2-eng business jets	0.01%	41	1.78
Turboprop	Turboprop (all engines)	22.29%	46	1.78
Piston	Piston (all engines)	66.30%	41	0.00
Helicopter	Helicopter small (1 engine/turbine)	1.72%	13	0.00
	Helicopter large (2 engine/turbine)	1.72%	8	0.00

Calculating fuel use for each aviation class applied the following equation:

$$\textbf{Fuel Use}_{\text{Per Aviation Class}} = \textit{Number of Aircraft Movements} * (\textit{LTO Fuel Use} + (\textit{APU Fuel Use} * 15\ \textit{minutes}))$$

The GHG quantification method, that was applied to each aviation class, is as follows:

$$\textbf{Emissions}_{\text{Per Aviation Class}} = (\textit{Vol. Fuel} * \textit{Aviation Class } EF_{CO2}) + (\textit{Vol. Fuel} * \textit{Aviation Class } EF_{CH4} * GWP_{CH4}) + (\textit{Vol. Fuel} * \textit{Aviation Class } EF_{N2O} * GWP_{N2O}))$$

The ACERT GHG calculator used by the VIA utilized emission factors from the 2021 NIR. Actual airplane emission factors are from the International Civil Aviation Organization (ICAO) GHG database. These are summarized in Table 14.

These GHG emissions were reported in the Scope 3 category as directed by the GPC Protocol.

Table 14 Aviation GHG Emission Factors

Airplane Type	Units	CO_2	CH_4	N_2O	tCO_2e
Jet	tCO_2e/kg fuel	0.0031380	0.0000001	0.0000003	0.0032254
Turbo Propeller	tCO_2e/kg fuel	0.0031380	0.0000001	0.0000003	0.0032254
Piston	tCO_2e/kg fuel	0.0032530	0.0000031	0.0000003	0.0034154
Helicopter	tCO_2e/kg fuel	0.0031380	0.0000001	0.0000003	0.0032254

4.2.4.3 Aviation: Victoria Harbour

Victoria harbor aviation emissions were estimated using 2016 NAV Canada airplane movement statistics, estimated taxi times, and estimated fuel use for the DHC-6 Twin Otter type of plane (Table 15).

Table 15 Aircraft Type, Estimated Percentage of Total Reported Movements, And Estimated Fuel Use

Aviation Class	Aircraft Type	Estimated Percentage of Annual Movements	Estimated LTO Fuel Use by Aircraft Type (kg)	Estimated APU Fuel Use by Aircraft Type (kg/min)
Turboprop	DHC-6 Twin Otter	100%	56	0.00

Statistics Canada stopped collecting Victoria Harbor aircraft movement data in 2016. To estimate 2020 Victoria harbor aviation GHG emissions, the 2016 data was applied and adjusted using the change in aircraft traffic between the 2016 and 2020 reporting years at the Victoria International Airport. This resulted in an estimated 19,573 movements.

Calculating aviation fuel use in the Victoria harbor for applied the following equation:

$$\textbf{Fuel Use}_{\text{Per Aviation Class}} = \textit{Number of Aircraft Movements} * (\textit{LTO Fuel Use} + (\textit{APU Fuel Use} * 15\ \textit{minutes}))$$

The GHG quantification method is as follows:

$$\textbf{Emissions}_{\text{Per Aviation Class}} = \textit{CRD Population} * ((\textit{Vol. Fuel} * \textit{Aviation Class } EF_{CO2}) + (\textit{Vol. Fuel} * \textit{Aviation Class } EF_{CH4} * GWP_{CH4}) + (\textit{Vol. Fuel} * \textit{Aviation Class } EF_{N2O} * GWP_{N2O}))$$

The airplane emission factors are from the International Civil Aviation Organization (ICAO) GHG database. These are summarized in Table 16.

Table 16 Marine Aviation GHG Emission Factors

Airplane Type	Units	CO_2	CH_4	N_2O	tCO_2e
Turbo Propeller	tCO_2e/kg fuel	0.0031380	0.0000001	0.0000003	0.0032254

These GHG emissions were reported in the Scope 3 category as directed by the GPC Protocol.

4.2.4.4 Waterborne Transportation

4.2.4.4.1 BC Ferries

Marine waterborne transportation emissions encompass GHG emissions from the use of the BC Ferries. GHG emissions from BC Ferries are estimated using an estimated fuel use 64,650,000 liters of diesel and

8,100,000 liters of CNG for the 2020 reporting year, and a provincially derived GHG emissions factor (Table 17).

Table 17 BC Ferries GHG Emission Factors

Aspect	Units	CO_2	CH_4	N_2O	tCO_2e
Ferry (Diesel)	tonne CO_2e / L	0.0025820	0.0000002	0.0000011	0.0029136
Ferry (CNG)	tonne CO2e / L	0.0011782	0.0000046	0.0000004	0.0014137

As BC Ferries operate outside of the CRD's boundary, the GHG emissions were allocated to Scope 3 based on the proportion of the CRD population relative to the total Vancouver Island and Mainland / Southwest populations.

4.2.4.4.2 Other Watercraft

The GHG emissions from the Coho Ferry, the Victoria Clipper Ferry, and personal and commercial watercraft were estimated based on a publicly available year 2000 study for the Victoria, Vancouver, and Washington harbors and the Transport Canada Vessel Registration System. As there is currently no publicly available energy or GHG related information on the operation of the Coho and the Victoria Clipper Ferries, it was assumed that the GHG emissions for these ferries were 25% of the value calculated in the Study entitled "Marine Vessel Air Emissions in BC and Washington State Outside of the GVRD and FVRD for the Year 2000" for 2020 to account for the change in transportation patterns associated with COVID-19. The GHG emissions for these ferries are summarized in Table 18.

Table 18 Coho and the Victoria Clipper Ferries Estimated GHG Emissions

Aspect	Units	CO_2	CH_4	N_2O	tCO_2e
Coho Ferries	tonnes	290.00	0.03	0.10	320.43
Victoria Clipper	tonnes	473.75	0.03	0.20	533.98

Cruise ship GHG emissions were estimated by the Greater Victoria Harbour Authority.[2] The Greater Victoria Harbour Authority (GVHA) reported on cruise ship emissions for the 2010 and 2020 reporting years but did not derive an estimate for 2007. As a result, the 2010 GHG emissions estimate and number of cruise ship visits to Ogden Point was used to create a proxy to estimate 2007 cruise ship emissions. The GVHA reported 163 visits in 2007. There were no cruise ships in 2020.

The GHG quantification method to estimate 2007 GHG emissions from the Odgen Point cruise ship terminal was as follows:

$$\textbf{\textit{Emissions}}_{\textbf{\textit{Waterborne}}} = (\textit{GVHA Reported Emissions}_{2010} / \textit{Cruise Ship Visits}_{2010}) * \textit{Cruise Ship Visits}_{2007}$$

[2] https://gvha.ca/wp-content/uploads/2019/10/EmissionsInventory-2019.pdf

The Transport Canada Vessel Registration System provided the total number of registered waterborne vehicles which was 2,215 vessels all registered boats in Victoria; however, the registration system does not provide any detail on the type, size, use, and owner of the watercraft. It was therefore assumed that the watercraft would have been similar to those in the referenced study. To estimate the personal / watercraft GHG emissions, the breakdown of vessels and total fuel use by category were used to estimate what the current population and fuel use might be in the reporting year. To do this, the following steps were taken.

1. Calculate the percentage of the population and per unit fuel use of the year 2000 population (Table 19).
1. Take the total number of registered vessels, and the percentage breakdown of the year 2000 population, and apply the per unit fuel use factor to determine the total gasoline and diesel fuel use (Table 20).
2. Using 2021 NIR emission factors estimate the GHG emissions from other watercraft.

Table 19 Year 2000 Other Watercraft Population Breakdown And Estimated Fuel Use

Type of Watercraft from Year 2000 Study	Year 2000 Study Vancouver Island Population	Percentage of Population	Fuel Use (m^3/Year)	Fuel Use Per Unit (m^3/Year)
Inboard: 4 stroke - gasoline	1,689	0.19%	175	0.10
Inboard: Diesel	199	0.02%	62	0.31
Outboard: 2 stroke - gasoline	23,494	2.66%	1,632	0.07
Outboard: 4 stroke - gasoline	622	0.07%	7	0.01
Stemdrive: 2 stroke - gasoline	68	0.01%	8	0.12
Stemdrive: 4 stroke - gasoline	6,576	0.74%	535	0.08
Stemdrive: Diesel	784	0.09%	216	0.28
Personal Watercraft: 2 stroke - gasoline	848,492	96.00%	342	0.00
Sailboat Auxiliary Inboard: 4 stroke - gasoline	428	0.05%	1	0.00
Sailboat Auxiliary Inboard: Diesel	1,088	0.12%	6	0.01
Sailboat Auxiliary Outboard: 2 stroke - gasoline	396	0.04%	1	0.00
Sailboat Auxiliary Outboard: Diesel	1	0.00%	0	0.01

Table 20 Reporting Year Other Watercraft Population Breakdown and Estimated Fuel Use

Type of Watercraft	Estimated Breakdown of Currently Registered Vessels	Estimated Fuel Use (L/year)
Inboard: 4 stroke - gasoline	4	438.6

Type of Watercraft	Estimated Breakdown of Currently Registered Vessels	Estimated Fuel Use (L/year)
Inboard: Diesel	0	155.4
Outboard: 2 stroke - gasoline	59	4,090.0
Outboard: 4 stroke - gasoline	2	17.5
Stemdrive: 2 stroke - gasoline	0	20.0
Stemdrive: 4 stroke - gasoline	16	1,340.8
Stemdrive: Diesel	2	541.3
Personal Watercraft: 2 stroke - gasoline	2,126	857.1
Sailboat Auxiliary Inboard: 4 stroke - gasoline	1	1.3
Sailboat Auxiliary Inboard: Diesel	3	15.0
Sailboat Auxiliary Outboard: 2 stroke - gasoline	1	1.3
Sailboat Auxiliary Outboard: Diesel	0	0.0

To calculate the GHG emissions, for the other watercraft, provincially derived GHG emissions factors were used (Table 21).

Table 21 Watercraft GHG Emission Factors

Aspect	Units	CO_2	CH_4	N_2O	tCO_2e
Marine Gasoline	tonne CO_2e / L	0.0022000	0.0000013	0.0000001	0.0022522
Marine Diesel	tonne CO_2e / L	0.0025820	0.0000002	0.0000011	0.0029136

The GHG quantification method, that was applied to the BC Ferries and other watercraft was as follows:

$$\textbf{\textit{Emissions}}_{\textit{Waterborne}} = (\textit{CRD Population / Vancouver Island; Mainland; Southwest Population}) * ((\textit{Vol. Fuel} * EF_{CO2}) + (\textit{Vol. Fuel} * EF_{CH4} * GWP_{CH4}) + (\textit{Vol. Fuel} * EF_{N2O} * GWP_{N2O}))$$

4.2.4.5 Off-Road

Currently, there is limited data available to estimate off-road GHG emissions. As such, a GHG emissions per capita estimate for each off-road category was developed using Provincial emissions data from the 2021 NIR, and BC's population from Statistics Canada. To develop each off-road factor, the total BC GHG emissions for each reporting category was divided by the BC population for the NIR reporting year (2021). Each derived per-capita value was applied to the current reporting year CRD population (2020) to estimate off-road GHG emissions.

The NIR currently reports the following off-road emissions:

- Total BC off-road agriculture and forestry GHG emissions
- Total BC off-road commercial and institutional GHG emissions
- Total BC off-road residential GHG emissions
- Total BC other off-road GHG emissions

Total BC off-road manufacturing, mining, and construction GHG emissions were not included on the basis that manufacturing and mining GHG emission could not be split out.

Other than other off-road GHG emissions, which is reported in the Off-Road Transportation Sub-Sector, the remaining off-road GHG emissions are reported in the Stationary Energy Sector as required by the GPC Protocol.

The GHG quantification method is presented below:

$$Emissions_{Off\text{-}Road} = (NIR\ Off\text{-}Road\ GHG\ Emissions_{BC} / BC\ Population_{BC}) * Current\ Reporting\ Year\ Population_{CRD}$$

4.3 WASTE

Cities produce GHG emissions because of the disposal and management of solid waste, incineration and open burning of waste, the biological treatment of waste, and through wastewater treatment and discharge. Waste does not directly consume energy, but releases GHG emissions because of decomposition, burning, incineration, and other management methods.

For the CRD, the Waste Sector encompasses the following GHG emissions scopes and Sub-Sectors:

- Scope 3: Emissions:
  - Solid waste disposal
  - Biological treatment of waste
  - Wastewater treatment and discharge

4.3.1 Activity Data

The CRD provided landfill gas volumes, energy and GHG related data for the Hartland landfill (fugitives and flaring), total CRD wastewater volumes, average biological oxygen demand (BOD) and Total Kjeldal Nitrogen (TKN) annual average values (mg/L) from the wastewater for all relevant outfalls. The wastewater volumes are based on total budgeted sewer costs.

Some GHG emissions from incineration and open burning are likely to be occurring in the CRD but cannot readily be estimated. This the notation key for “Not Estimated” has been used to indicate this.

4.3.2 Assumptions and Disclosures

The following assumptions were made in the calculation of the 2020 GHG emissions:

- To quantify GHG emissions from the Hartland Landfill, the CRD utilized the waste-in-place method which is accepted under the GPC Protocol. The Waste-in-place (WIP) assigns landfill emissions

based on total waste deposited during that year. It counts GHGs emitted that year, regardless of when the waste was disposed. GHG emissions from the Hartland Landfill for the reporting year are allocated based upon the percentage of Community waste, relative to total waste received at to the Hartland Landfill. It is assumed that the GHG emissions data provided is reasonably accurate and the method deployed correct.

- It is assumed that the landfill gas has a constant higher heating value (HHV) of 0.01865 (GJ/m^3).
- Composting GHG emissions are estimated based on the total tonnage estimated by the CRD. It is assumed that all compost is treated aerobically.
- Wastewater is not currently treated. As such, IPCC wastewater methane (CH_4) producing capacity and CH_4 correction default factors were used. These factors used are for untreated wastewater being deposited into deep or moving waters. It is likely that ocean sequesters more CH_4 than is estimated.
- It is likely that GHG emissions from incineration and open burning are occurring on an infrequent and controlled (property by property) basis, but without available data the GHG emissions cannot be reasonably quantified.

4.3.3 Calculation Methodology

4.3.3.1 Solid Waste

The Hartland Landfill has a landfill gas (LFG) collection and destruction system at the Hartland Landfill to which the LFG is either combusted in a flare, or in an engine to generate electricity which is exported to the grid. The GHG emissions associated with energy generation are reported as a reporting only GHG emission under Stationary Energy: Energy Industries Reporting Only and are not included in the total GHG emissions estimate. The GHG emissions associated with flaring of the landfill gas are reported under Stationary Energy: Energy Industries Scope 1.

The GHG quantification method for Stationary Energy: Energy Industries is as follows:

$$\textbf{\textit{Emissions}}_{\textbf{\textit{Stationary Energy: Energy Industries}}} = (LFG\ Consumed_{m3} * HHV_{LFG} * EF_{RNG\ CH4} * GWP_{CH4}) + (LFG\ Consumed_{m3} * HHV_{LFG} * EF_{RNG\ N2O} * GWP_{N2O})$$

The fugitive landfill GHG emissions estimates were generated by the CRD using the waste-in-place (WIP) method which is accepted under the GPC Protocol. The WIP assigns landfill emissions based on emissions during that year. It counts GHGs emitted that year, regardless of when the waste was disposed.

4.3.3.2 Biological Treatment of Solid Waste

The CRD provided 2020 composting data which is assumed to be treated aerobically at the Hartland Landfill. The composting emission factor used in the estimation of GHG emissions was derived from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 5, Chapter 4: Biological Treatment of Solid Waste) (Table 22).

Table 22 Composting Emission Factor

Emission Factor	Units	CO_2	CH_4	N_2O	tCO_2e
Composting	tCO_2e / kg waste	-	0.0000010	-	0.0000250

To quantify GHG emissions from the biological treatment of solid waste, the following GHG quantification methods was deployed:

$$Emissions_{Anaerobic\ Waste} = Compost\ Waste_{Total} * EF_{CH4} * GWP_{CH4}$$

4.3.3.3 Wastewater Treatment And Discharge

Wastewater is currently treated on Vancouver Island prior to being sent to ocean-based outfalls. The CRD provided the 2020 wastewater volumes (m^3), the average biological oxygen demand (BOD) and the average Total Kjeldal Nitrogen (TKN) in wastewater. IPCC default wastewater methane (CH_4) producing capacity (0.6 kg CH_4/kg BOD) and methane correction factor (MCF) (0.1 – unit less) were used to estimate CH_4 from the wastewater. To estimate N_2O from the wastewater, the Total Kjeldal Nitrogen (TKN) annual average in conjunction with the total wastewater volumes to calculate the total TKN in the wastewater. The IPCC default conversion value of 0.01 kg N_2O-N/kg sewage-N was used to estimate N_2O from the wastewater. These factors used are for treated wastewater being deposited into deep or moving waters. It is likely that ocean sequesters more CH_4 than what has been estimated.

To quantify GHG emissions from the wastewater treatment, the following GHG quantification method is deployed:

$$Emissions_{Wastewater\ CH4} = ((Wastewater_{m3} * (BOD_{ml/L} / 1000) * (0.06_{kg\ CH4/kg\ BOD} * 0.01)) / 1000) * GWP_{CH4}$$

$$Emissions_{Wastewater\ N2O} = ((Wastewater_{m3} * (TKN_{ml/L} / 1000) * 0.01_{kg\ N2O\text{-}N/kg\ sewage\text{-}N}) / 1000) * GWP_{N2O}$$

4.4 INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)

4.4.1 Overview

Emissions from the IPPU Sector are only required for BASIC+ GHG reporting under the GPC Protocol. This Sector encompasses GHG emissions produced from industrial processes that chemically or physically transform materials and using products by industry and end-consumers (e.g., refrigerants, foams, and aerosol cans) (GPC, 2014).

For the CRD, the IPPU encompasses the following GHG emissions scopes and Sub-Sectors:

- Scope 1 Emissions:

- Product use

No GHG emissions from Industrial Processes are known to be occurring and thus the notation key for "Not Occurring" has been used to indicate this.

4.4.2 Activity Data

As there is limited data available on Product Use GHG emissions, the GHG Emissions estimate was derived on a per capita basis using the 2021 NIR GHG data for the Province of BC and BC population data for the reporting year.

4.4.3 Assumptions and Disclosures

The following assumptions were made in the calculation of the 2020 GHG emissions:

- The product use emissions are based on the 2021 NIR product use GHG emissions as prepared by Environment and Climate Change Canada.
- The NIR uses the Tier 1 methodology to estimate these emissions and thus uncertainty around their accuracy remains quite high.

4.4.4 Calculation Methodology

4.4.4.1 Product Use Emissions

For the 2020 reporting year, only the emissions estimated were production and consumption of halocarbons, SF_6 and NF_3 were estimated for the Province. To estimate product use GHG emissions for the CRD, a per capita estimate was developed using the Provincial emissions data from the 2021 NIR, and BC's NIR reporting year population from Statistics Canada. This value was applied to the 2020 reporting year CRD population to estimate the total product use emissions.

The GHG quantification method is presented below:

$$\textbf{\textit{Emissions}}_{\textbf{\textit{Product Use}}} = (\textit{NIR Product Use GHG Emissions}_{BC} / \textit{NIR Population}_{BC}) * \textit{Current Reporting Year Population}$$

4.5 AGRICULTURE, FORESTRY, AND OTHER LAND USE (AFOLU)

4.5.1 Overview

The AFOLU Sector includes emissions from livestock, land-use, and all other agricultural activities occurring within a community's boundaries. For the CRD, the AFOLU encompasses the following GHG emissions scopes and Sub-Sectors:

- Scope 1 Emissions:
  - Land
  - Livestock
  - Aggregate Sources And Non-CO_2 Emissions Sources On Land

4.5.2 Activity Data

The CRD provided remotely sensed imagery to estimate land-cover change. This data included:

- Habitat Acquisition Trust (HAT) Land Cover Mapping (2007 and 2011)
- Annual Crop Inventory (ACI), Agriculture Canada
- Satellite Imagery interpretation (2011 and 2019), CRD
- Vegetation Resources Inventory (VRI), British Columbia Government.
- Earth Observation for Sustainable Development of Forests (EOSD) Land Cover Classification, Service Natural Resources Canada

Livestock and aggregate sources and non-CO_2 emissions sources on land were estimated using GHG emissions data from the 2021 NIR, and land-use data from the 2016 Statistics Canada Census of Agriculture, to create a GHG emissions per hectare value.

4.5.3 Assumptions and Disclosures

The following assumptions were made in the calculation of the 2020 GHG emissions:

- It is conservatively assumed that all cropland is used for livestock and agricultural purposes.
- Infrequent and small source open burning may be occurring, but there is no data to estimate this emissions source.
- The land cover change analysis requires a consistent land-use category attribution and spatial data. For parts of the CRD, spatial data was available for the 2007, 2011 and 2019 reporting years. Differences between these data sets in terms of resolution and their timing of collection increase the uncertainty as to the accuracy of the land-use classifications. For example, the 2007 and 2011 land use data was collected at different times of the year and may not accurately reflect tree cover. Furthermore, no land use spatial data was collected for the Juan de Fuca, Salt Spring Island or Gulf Islands and thus Annual Crop Inventory (ACI) settlement data collected by Agriculture Canada was used to inform the analysis. The challenge in utilizing this data is that it is provided in a 30m resolution. Furthermore, since annual data is not available, the change between land cover data years (2007-2011, 2011-2019) for all areas was averaged and may not represent actual changes in each year. Lastly, due to limitations in how to quantify GHG emissions resulting from land use change (e.g., residential development), these GHG emissions have been excluded from the CRD's GHG emissions inventory, but have been disclosed, until a more robust measurement methodology can be developed. Since no data was available for 2020, the 2019 estimates were applied.

4.5.4 Calculation Methodology

4.5.4.1 Land Use

Remotely sensed imagery was used to estimate land-cover changes during the 2007-2020 reporting periods. Using the remotely sensed imagery an annual average land-use change between land classes (e.g. cropland forestland, etc.) was determined and applied to BC-based emission factors to estimate GHG emissions resulting from changes between land-uses for the reporting year.

The following table identifies the data sources used for the reporting years for each of the study area's geographies.

Table 23 Spatial Data Sources Representing Land Cover For The CRD Study Area

		CRD Study Area Geography		
		CRD Core	**Gulf Islands**	**Juan de Fuca Region**
Reporting Year	**2007**	2005 HAT Land Cover Mapping	2001 EOSD Land Cover Classification	2011 HAT Land Cover Mapping[2]
	2011	2011 HAT Land Cover Mapping	2001 EOSD Land Cover Classification + 2011 ACI 'Settlement'	2011 HAT Land Cover Mapping[2] + 2011 ACI 'Settlement'
	2020	2019 HAT Land Cover Mapping + 'Settlement' satellite image interpretation[1]	2001 EOSD Land Cover Classification + 2019 ACI 'Settlement'	2011 HAT Land Cover Mapping[2] + 2019 ACI 'Settlement'

Notes:

[1] Settlements land cover category is a combination of i) municipality provided building footprint as acquired mostly from digitizing roofline from satellite and orthoimagery, ii) new roads (ParcelMap BC parcel with parcel start dates > 2011 and parcel class = 'road') and iii) and theoretical building footprints (average building footprint areas as buffered centroids of new ParcelMap BC parcel with start dates > 2011 with a residential parcel class)

[2] The 2011 land cover classification was interpreted mostly from 2005 imagery in the Juan de Fuca region making it more suitable for the 2007 reporting year.

The spatial data sources representing land cover in this analysis include more categories than the 6 IPCC land-use categories. To align with the IPCC land classification definitions (as required by the GPC Protocol), the following data categories were re-assigned to the most appropriate IPCC land class.

Table 24 IPCC Land Use Classification Cross-References

IPCC Land Cover	EOSD Land Cover	HAT Land Cover	Annual Crop Inventory
Cropland	Annual Cropland, Perennial Cropland And Pasture	Agricultural Fields	-

IPCC Land Cover	EOSD Land Cover	HAT Land Cover	Annual Crop Inventory
Forest	Broadleaf Dense, Broadleaf Open, Coniferous Dense, Coniferous Open, Coniferous Sparse	Tree	-
Grassland	Grassland, Herb, Shrub Low	Grass, Herb	-
Settlement	Developed	Pavement/Building	Developed
Wetland	Wetland - Herb, Wetland - Shrub, Wetland - Treed	Riparian Tree, Riparian Herb, Pond	-
Other	Water, Exposed Land	Shadow, Ocean, Lake, River, Sand/Gravel Shoreline, Bedrock Shoreline, Exposed Soil, Exposed Bedrock	-

The analysis resulted an estimate of an annual average change in hectares' value for each land class. Once the land use change values were determined for the reporting year, BC-based and IPCC emission factors were applied to estimate reported and disclosed (not-reported) GHG emissions from land use (Table 25).

Table 25 Land-Use Change Emission Factors

Sector	Emission Factor	Units
Forestland	224.1	tCO_2e / ha
Grasslands	205.7	tCO_2e / ha
Wetlands	471.5	tCO_2e / ha
Cropland	239.8	tCO_2e / ha
Settlements	0	tCO_2e / ha
Other	0	tCO_2e / ha
Forestland	1.8	tCO_2e / ha / year
Grasslands	2.6	tCO_2e / ha / year
Wetlands	3.3	tCO_2e / ha / year
Croplands	0.4	tCO_2e / ha / year
Settlements	0	tCO_2e / ha / year
Other	0	tCO_2e / ha / year

The GHG quantification methods for land use change is presented below:

$$Emissions_{Lands\ Not\ Converted} = Land\ Type_{ha} * EF_{Sequester}$$

$$Emissions_{Lands\ Converted} = Land\ Type_{ha} * (EF_{Release} / (Current\ Land\ Reporting_{Year} - Last\ Land\ Reporting_{Year} + 1))$$

4.5.4.2 Emissions from Aggregate Sources and Non-CO_2 Emission Sources on Land

Emissions from Aggregate Sources and Non-CO_2 Emission Sources on Land includes direct N_2O emissions from agricultural soil management and indirect N_2O emissions from applied nitrogen. To estimate these GHG emissions, the total area of farmland for BC was used in conjunction with 2021 NIR data to develop a tCO_2e / ha value estimate for:

- Livestock
- Aggregate Sources And Non-CO_2 Emissions Sources On Land

To calculate GHG emissions from urea application, the calculated total crop land in hectares for the reporting year was applied against an IPCC GHG emissions factor of 0.20 tCO_2e / ha. This emission factor is also applied in the 2021 NIR.

The GHG quantification method is presented below:

$$Emissions_{Direct\ \&\ Indirect\ N2O} = ((BC_{Direct\ N2O\ Emissions} + BC_{Indirect\ N2O\ Emissions} + BC_{Indirect\ N2O\ Manure\ Management\ Emissions}) / BC_{Land\ In\ Crops\ ha})) * CRD\ Cropland_{ha}$$

$$Emissions_{Urea\ Application} = CRD\ Cropland_{ha} * 0.66\ tCO_2e / ha$$

5.0 2020 GHG REPORTING YEAR RESULTS

5.1 OVERVIEW

This section presents the 2020 reporting year GHG emissions for the CRD. The following table classifies each of the GPC Protocol GHG emission categories by scope and reporting level. Note that these are cumulative.

Table 26 GHG Emissions Reporting Breakdown by GPC Reporting Method

GHG Emissions Scope	BASIC Reporting Level	BASIC+ Reporting Level
Scope 1	• Emissions from in boundary fuel combustion • In boundary fugitive emissions • Emissions from in boundary transport	Everything in the box at left, plus in-boundary emissions from: • Industrial process and product use • Livestock • Land use • Emissions from Aggregate Sources and Non-CO_2 Emission Sources on Land
Scope 2	• Emissions from consumption of grid-supplied energy	• Emissions from consumption of grid-supplied energy
Scope 3	• Emissions from solid waste, and composting generated within but treated outside of the GHG boundaries	Everything in the box at left, plus: • Transmission, distribution, and line losses from grid-supplied energy • Emissions from transboundary journeys
Outside of Reporting Scopes & GPC Protocol	• Upstream fuel emission extraction, processing, and transport • Food and drink imports • Construction materials (imports) • Other supply chain emissions • Vehicle fuel exports	

5.2 SUMMARY

Total BASIC, and BASIC+ emissions for the CRD for the 2020 reporting year are presented in the Figure 3 below.

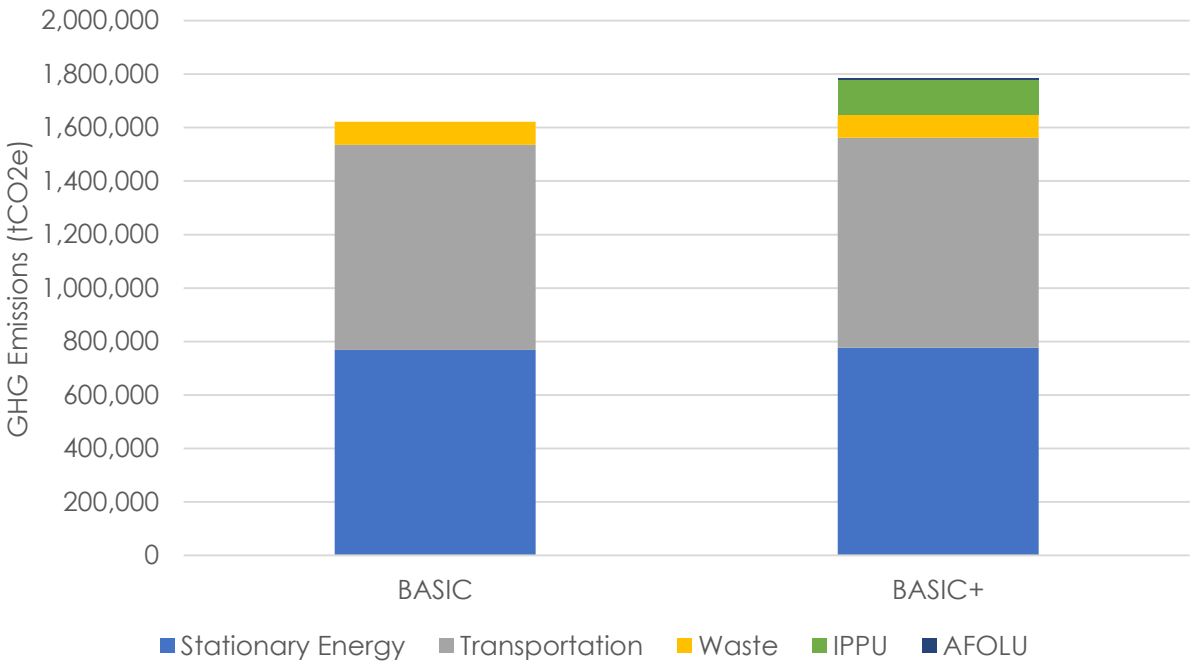


Figure 3 2020 GHG Emissions Summary by GPC Reporting Level

Emission by reporting level are presented in the Table 27 below which shows a difference in emissions under the GPC Protocol's BASIC, and BASIC+ reporting levels. This is due to the inclusion of additional sources in BASIC+ which are very significant for almost any growing community. These additional emissions include transboundary emissions, industrial and product use emissions, and emissions from land-use change. Under the GPC Protocol, emissions included within each higher reporting level are cumulative from lower levels.

Table 27 Breakdown of the CRD's 2020 GHG Emissions in GPC Reporting Format

GHG Emissions Source (by Sector)		Total GHGs (metric tonnes CO_2e)					
		Scope 1	Scope 2	Scope 3	BASIC	BASIC+	BASIC+ S3
Stationary Energy	Energy use (all emissions except I.4.4)	643,162	125,805	8,430	768,967	777,397	777,397
	Energy generation supplied to the grid (I.4.4)	8,209					
Transportation	(all II emissions)	765,604	694	18,577	766,298	784,875	784,875
Waste	Waste generated in the Community (III.X.1 and III.X.2)	86,580		0	86,580	86,580	86,580
	Waste generated outside community (III.X.3)	NO					
IPPU	(all IV emissions)	130,139				130,139	130,139
AFOLU	(all V emissions)	4,261				4,261	4,261
Other Scope 3 (S3)	(all VI emissions)	86,580		0	86,580	86,580	86,580
TOTAL		**1,629,745**	**126,499**	**27,007**	**1,621,845**	**1,783,251**	**1,783,251**

NOTES:
Notation Keys: IE = Included Elsewhere; NE = Not Estimated; NO = Not Occurring.
Cells in green are required for BASIC reporting
Cells in green and blue are required for BASIC+ reporting
Cells in purple are for disclosure purposes only but are not included in the summary totals as required by the GPC Protocol.
Cells in orange are not required for BASIC or BASIC+ reporting

Table 28 presents the breakdown of the CRD's BASIC+ GHG emissions by Sector and Sub-Sector.

Table 28 Breakdown of the CRD's 2020 BASIC+ GHG Emissions in the GPC Protocol Reporting Format

GPC ref No.	GHG Emissions Source (by Sector and Sub-Sector)	Total GHGs (metric tonnes CO_2e)			
		Scope 1	Scope 2	Scope 3	Total
I	**Stationary Energy**				
I.1	Residential buildings	323,268	78,377	5,252	406,896
I.2	Commercial and institutional buildings and facilities	252,506	47,428	3,178	303,112
I.3	Manufacturing industries and construction	NE	NE	NE	NE
I.4.1/2/3	Energy industries	9,563	NO	NO	9,563
I.4.4	Energy generation supplied to the grid	8,209			
I.5	Agriculture, forestry, and fishing activities	56,418	IE	IE	56,418
I.6	Non-specified sources	IE	IE	IE	IE
I.7	Fugitive emissions from mining, processing, storage, and transportation of coal	1,408			1,408
I.8	Fugitive emissions from oil and natural gas systems	NO			0
Sub-Total	(community induced framework only)	**643,162**	**125,805**	**8,430**	**777,397**
II	**Transportation**				
II.1	On-road transportation	691,640	694	6,013	698,348
II.2	Railways	NO	NO	NO	NO
II.3	Waterborne navigation	22,341	IE	IE	22,341
II.4	Aviation	NO	IE	12,564	12,564
II.5	Off-road transportation	51,623	IE	IE	51,623
Sub-total	(community induced framework only)	**765,604**	**694**	**18,577**	**784,875**
III	**Waste**				
III.1.1/2	Solid waste generated in the Community	66,237		NO	66,237
III.2.1/2	Biological waste generated in the Community	5,307		NO	5,307
III.3.1/2	Incinerated and burned waste generated in the Community	NE		NE	NE
III.4.1/2	Wastewater generated in the Community	15,035		IE	15,035
III.1.3	Solid waste generated outside the Community	NO			
III.2.3	Biological waste generated outside the Community	NO			
III.3.3	Incinerated and burned waste generated outside community	NE			

Table 28 Breakdown of the CRD's 2020 BASIC+ GHG Emissions in the GPC Protocol Reporting Format

GPC ref No.	GHG Emissions Source (by Sector and Sub-Sector)	Total GHGs (metric tonnes CO_2e)			
		Scope 1	Scope 2	Scope 3	Total
III.4.3	Wastewater generated outside the Community	NO			
Sub-total	(community induced framework only)	**86,580**		**0**	**86,580**
IV	**Industrial Processes and Product Uses**				
IV.1	Emissions from industrial processes occurring in the Community boundary	NE			NE
IV.2	Emissions from product use occurring within the Community boundary	130,139			130,139
Sub-Total	(community induced framework only)	**130,139**			**130,139**
V	**Agriculture, Forestry, and Other Land Use**				
V.1	Emissions from livestock	3,545			3,545
V.2	Emissions from land	NE			NE
V.3	Emissions from aggregate sources and non-CO_2 emission sources on land	715			715
Sub-Total	(community induced framework only)	**4,261**			**4,261**
VI	**Other Scope 3**				
VI.1	Other Scope 3			NE	NE
Total	(community induced framework only)	**1,629,745**	**126,499**	**27,007**	**1,783,251**

NOTES:
Cells in green are required for BASIC reporting
Cells in green and blue are required for BASIC+ reporting
Cells in purple are for disclosure purposes only but are not included in the summary totals as required by the GPC Protocol.
Cells in orange are not required for BASIC or BASIC+ reporting

5.3 TOTAL GHG EMISSIONS

Under the BASIC+ method, the CRD's GHG emissions totaled 1,783,251 tCO_2e. On a per capita basis, this works out to 4.2 tCO_2e per person.

Table 29 Total Energy and GHG Emissions Per Person by Sector

Sector	Sub-Sector	Energy (GJ)	GHG Emissions (tCO_2e)	GJ Per Capita	tCO_2e Per Capita
Stationary Energy	Residential Buildings	13,592,223	406,896	32	1.0
	Commercial & Institutional Buildings	9,361,348	303,112	22	0.7
	Manufacturing Industries & Construction	-	-	-	-
	Energy Industries	-	9,563	-	0.0
	Agriculture, Forestry & Fishing Activities	804,183	56,418	2	0.1
	Fugitive Emissions	-	1,408	-	0.0
Transportation	In-Boundary On-road Transportation	11,001,396	692,329	26	1.6
	Trans-Boundary On-road Transportation	95,649	6,019	0	0.0
	Waterborne Navigation	304,172	22,341	1	0.1
	Aviation	168,854	12,564	0	0.0
	Off-road Transportation	735,833	51,623	2	0.1
Waste	Solid Waste		66,237		0.2
	Biological Treatment of Waste		5,307		0.0
	Wastewater Treatment & Discharge		15,035		0.0
IPPU	Product Use		130,139		0.3
AFOLU	Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**		(399,707)		(1.0)
	Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**		89,610		0.2
	Livestock		3,545		0.0
	Non-CO2 Land Emission Sources		715		0.0
Total		**36,063,658**	**1,783,251**	**85.9**	**4.2**

Total GHG emissions for 2020 are 1,783,251 tCO_2e and have decreased 10% from the 2007 base year. Scope 1 and 2 Emissions are 91% and 7% of the total GHG inventory. Scope 1 emissions are the GHG

emissions that result from the combustion of fuel in sources within the CRD's boundaries, primarily from Stationary Energy and Transportation. Scope 1 GHG emissions also include IPPU and some AFOLU GHG emissions. Scope 2 emissions result from the use of electricity supplied to the CRD which includes emissions associated with the generation of electricity and other forms of energy (e.g., heat and steam). Scope 2 emissions are low compared to other geographies, due to the predominance of hydroelectric generation technologies in the BC. Scope 3 emissions are emissions from electricity line losses, transboundary traffic, and emissions associated with the CRD that are occurring outside of the CRD's boundaries. For 2020, Scope 3 GHG emissions make up 2% of the GHG inventory. This breakdown by emission scope is depicted in Figure 4.

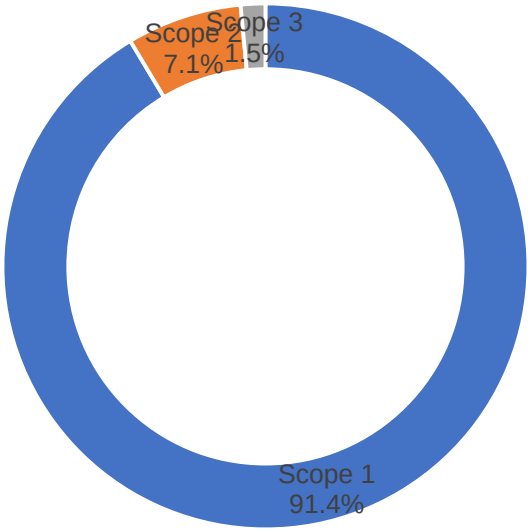


Figure 4 CRD BASIC+ GHG Emissions by Emissions Scope

A breakdown of GHG emissions by reporting scope for the 2007 base and reporting year are presented in Table 30 below.

Table 30 Change in GHG Emissions from Base Year

Emissions Scope	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change
Scope 1	1,812,737	1,629,745	-10.1%
Scope 2	116,129	126,499	8.9%
Scope 3	47,234	27,007	-42.8%
Total	**1,976,100**	**1,783,251**	**-9.8%**

5.4 SECTORAL GHG EMISSIONS ANALYSIS

5.4.1 Stationary Energy

Stationary energy sources are one of the largest contributors to the CRD's GHG emissions. In 2020, it contributed 44% of the community's GHG emissions. In general, stationary energy emissions include the energy to heat and cool residential, commercial, and industrial buildings, as well as the activities that occur within these residences and facilities. Fugitive methane emissions from natural gas pipelines and other distribution facilities, and related off-road GHG emissions, are also reported in this Sector. The table below shows the breakdown of energy use in the stationary energy reporting category.

Table 31 summarizes the energy and GHG emissions for the 2020 reporting year.

Table 31 2020 Energy and GHG Emissions by Stationary Energy Sector

Sector	Electricity (tCO_2e)	Natural Gas (tCO_2e)	Heating Oil (tCO_2e)	Propane (tCO_2e)	Wood (tCO_2e)	Other Sources (tCO_2e)	**Total GHG Emissions (tCO_2e)**	**Total Energy (GJ)**
Residential Buildings	83,628	128,018	136,540	21,219	22,556	14,934	**406,896**	**13,592,223**
Commercial & Institutional Buildings	50,606	209,576	9,778			33,152	**303,112**	**9,361,348**
Energy Industries						9,563	**9,563**	
Agriculture, Forestry & Fishing activities						56,418	**56,418**	**804,183**
Fugitive Emissions						1,408	**1,408**	
Total GHG Emissions (tCO_2e)	**134,235**	**337,594**	**146,318**	**21,219**	**22,556**	**115,475**	**777,397**	
Total Energy (GJ)	**12,050,882**	**6,769,810**	**2,139,902**	**346,989**	**960,568**	**1,489,604**		**23,757,755**

It can be seen in Figure 5 that heating oil and natural gas use contributed to 62% of the CRD's total Stationary Energy GHG emissions.

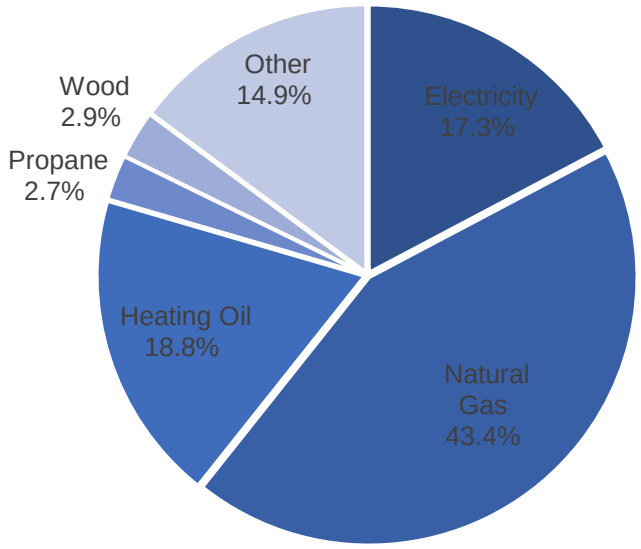


Figure 5 Stationary Energy GHG Emissions Contribution to the GHG Inventory

Figure 6 shows that more than 90% of the stationary GHG emissions arise from the operation of buildings.

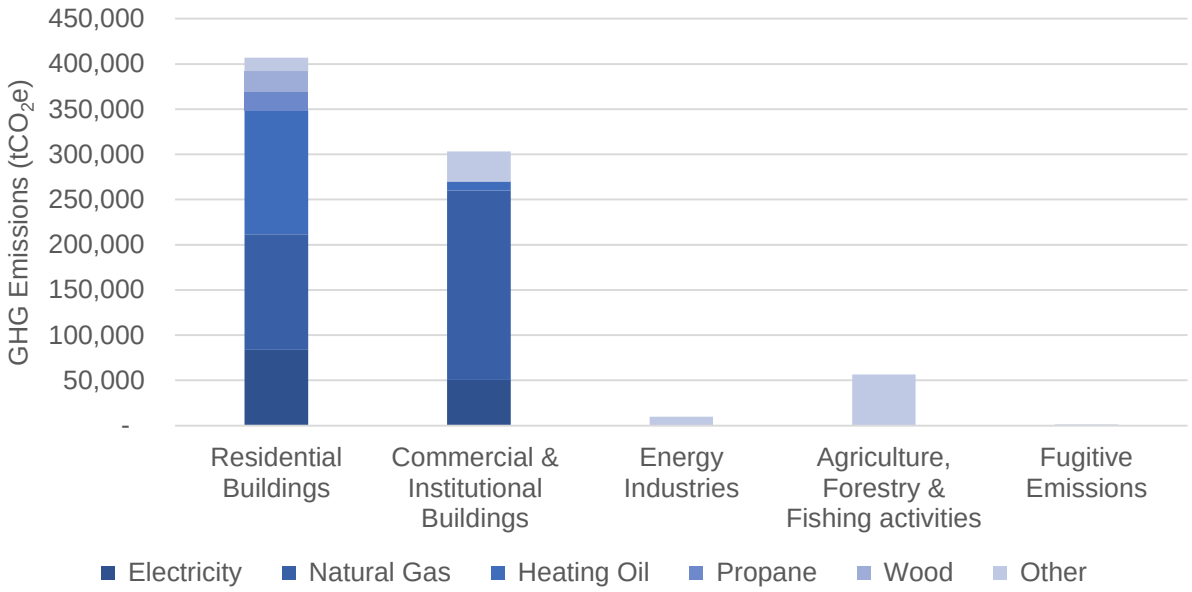


Figure 6 Total Stationary Energy Use By Sub-Sector

Stationary energy GHG emissions have increased by nearly 4% since the base year (Table 32). This is mainly the result of the changing electricity emission factor which increased by 12% in 2020 (as compared to 2007).

Table 32 Stationary Energy—Energy and GHG Emissions Trends

Sector	Change in GJ: 2007 & 2020	Change in tCO_2e: 2007 & 2020
Residential Buildings	-4.2%	-4.4%
Commercial & Institutional Buildings	5.1%	15.6%
Energy Industries	N/A	2,186.5%
Agriculture, Forestry & Fishing activities	-3.4%	-9.1%
Fugitives	N/A	40.4%
Total	**-0.7%**	**3.5%**

5.4.2 Transportation

Transportation covers all emissions from combustion of fuels in journeys by road, rail, water, and air, including inter-community and international travel. For the 2020 reporting year, transportation GHG emissions accounted for 44% of the CRD GHG inventory with the bulk of transportation GHG emissions resulting from the on-road transportation sub-sector (89%). The transportation GHG emissions are produced directly by the combustion of fuel or indirectly because of the use of grid-supplied electricity. Unlike stationary emission sectors, transit is mobile and can pose challenges in both accurately calculating emissions and allocating them to the cities linked to the transit activity. The following sections summarize energy and GHG emissions by on-road transportation, which is then followed by off-road transportation (marine, aviation, and other).

Table 33 summarizes the on-road energy and GHG emissions for the 2020 reporting year.

Table 33 2020 On-Road Transportation Energy And GHG Emissions by Fuel Type

Fuel Type	Number of Registered Vehicles	Total Fuel Use	Fuel Use Units	Energy (GJ)	GHG Emissions (tCO_2e)
Electricity	8,053	17,313,354	kWh	62,328	694
Gasoline	253,037	258,906,758	Liters (L)	8,973,708	566,035
Diesel	15,565	51,776,592	Liters (L)	2,002,719	128,426
Propane	322	628,682	Liters (L)	16,050	911
Hydrogen	6	-	Liters (L)	-	-
Natural Gas	67	785,220	Kilograms (kg)	42,240	2,282
Total	**277,050**	**N/A**	**N/A**	**11,097,044**	**698,348**

Overall, GHG emissions from on-road transportation have decreased by 21% compared to the 2007 base year. The majority of these GHG emissions (82%) are from passenger vehicles, light trucks, and SUVs (Figure 7).

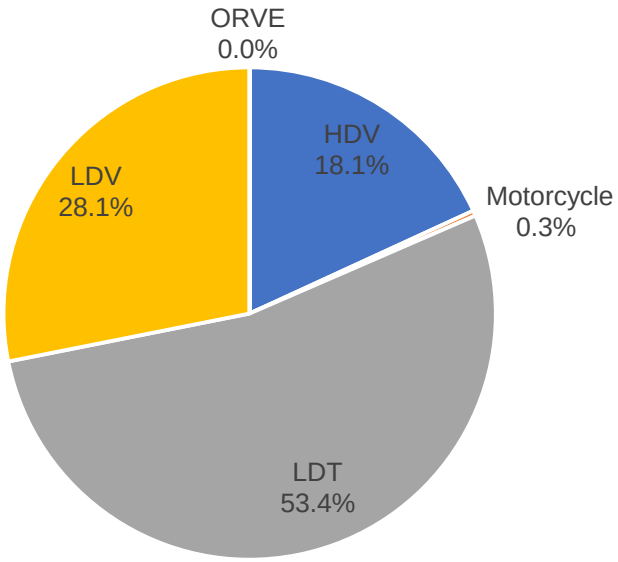


Figure 7 Breakdown of On-Road GHG Emissions by Vehicle Type

Table 34 summarizes the aviation, waterborne, and off-road transportation energy and emissions by fuel type. These GHG emissions contribute to 11% of the total transportation GHG emissions and 5% to the total inventory (Figure 8).

Table 34 2020 Aviation, Waterborne, and Off-Road Transportation Energy and Emissions by Fuel Type

Fuel Type	Total	Units	Energy (GJ)	GHG Emissions (tCO_2e)
Marine Gasoline	7,478	Liters (L)	259	17
Marine Diesel	7,010,603	Liters (L)	271,170	20,426
Marine Natural Gas	842,791	Liters (L)	32,742	1,898
Aviation Jet Fuel	4,866,104	Liters (L)	168,854	12,564
Other Off-Road Transportation Diesel	19,023,601	Liters (L)	735,833	51,623
Total	**N/A**	**N/A**	**1,208,859**	**86,527**

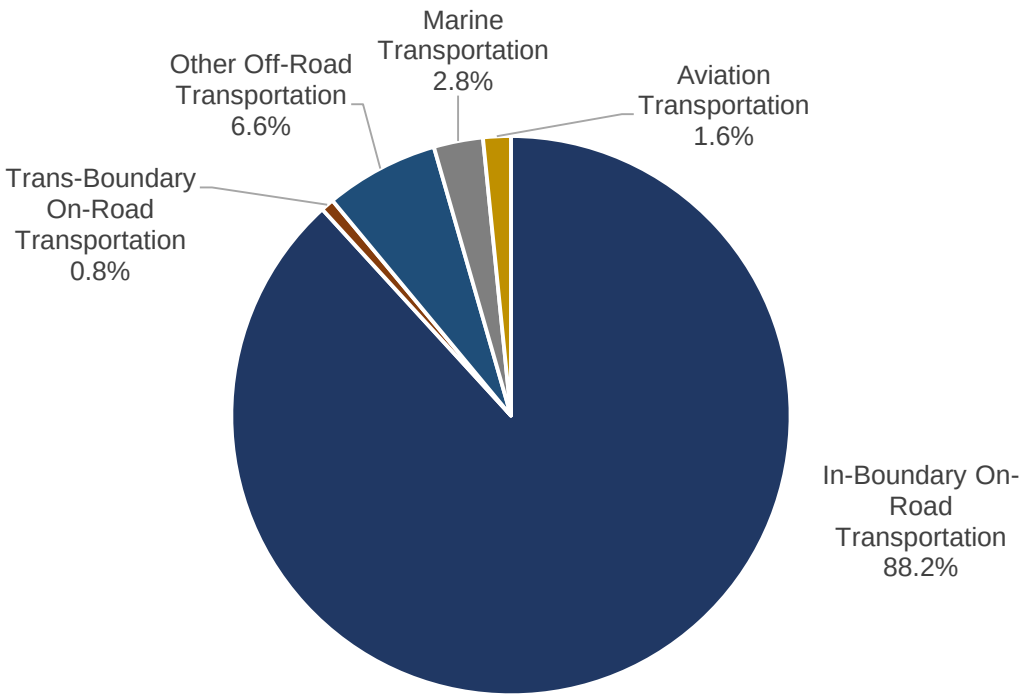


Figure 8 Summary of Transportation GHG Emissions by Sub-Sector

5.4.3 Waste

Communities produce solid waste, compost, and wastewater. Waste does not directly consume energy, but when deposited into landfills, or left exposed to the atmosphere, it decomposes and releases methane (CH_4) gas which is a potent GHG. The GHG emissions from the solid waste, composting, and wastewater facilities for the reporting year is summarized in the following table. For the 2020 reporting year, waste emissions contributed 5% to the GHG inventory. A breakdown of the Waste Sub-Sector GHG emissions is presented in Table 35.

Table 35 Summary of Waste Sub-Sector GHG Emissions

Sector	2020 GHG Emissions (tCO_2e)	GHG Emissions Per Capita (tCO_2e / Capita)	Change from Base Year (2007)
Wastewater Treatment And Discharge	15,035	0.04	-20.9%
Biological Treatment of Solid Waste	5,307	0.01	7236%
Solid Waste	66,237	0.16	-40.5%
Total	**86,580**	**0.21**	**-33.6%**

For the 2020 reporting year, in scope GHG emissions from waste have decreased by 34% compared to the 2007 base year. Fluctuations in waste will occur over the reporting periods as waste is driven by both the population, as well as economic prosperity in the region. The Solid Waste Sub-Sector contributes more than 77% of total waste GHG emissions (Figure 9). To reduce the amount of waste landfilled, and thus GHG emissions, the CRD and its members are making a significant effort to reduce waste going to landfills through organics diversion and recycling.

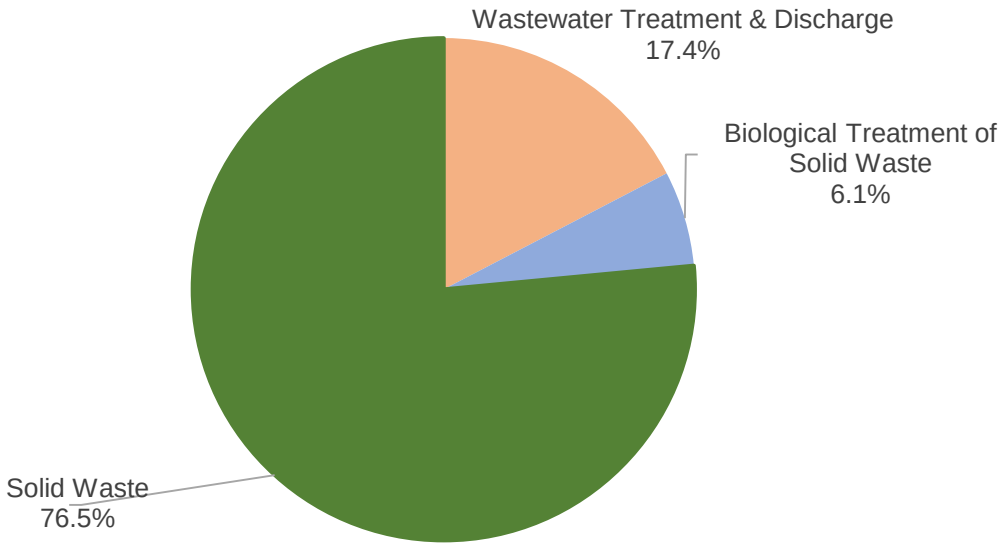


Figure 9 2020 GHG Emissions from Waste (tCO_2e)

5.4.4 Industrial Processes and Product Use (IPPU)

Reporting on IPPU GHG emissions are required for BASIC+ reporting only. Industrial GHG emissions are produced from a wide variety of non-energy related industrial activities which are typically releases from industrial processes that chemically or physically transform materials. During these processes, many different GHGs can be produced. It is not clear if there are industrial GHG emissions occurring within the CRD's boundaries and thus a "Not Estimated" notation is used in the GPC tables.

Also included in the IPPU Sector is Product Use GHG emissions. Certain products used by industry and end-consumers, such as refrigerants, foams or aerosol cans, also contain GHGs which can be released during use and disposal and thus, as with best-practice, must be accounted for. For the reporting year, only the emissions estimated were production and consumption of halocarbons, SF_6 and NF_3 were estimated for the CRD on the basis that other GHG emissions sources identified in the NIR are not likely to be occurring in the CRD. The sources of these GHG emissions are typically fridges, heat pumps, and air conditioners. To estimate Product Use GHG emissions for the CRD, a per capita estimate was developed using the Provincial emissions data from the 2021 NIR, and BC's NIR reporting year

population from Statistics Canada. This value was applied to the 2020 reporting year population to estimate the total Product Use emissions for the CRD.

Between the 2007 and 2020 reporting years, IPPU GHG emissions have increased 68%. The reason for the increase is attributed to Environment and Climate Change Canada having better data available to make the estimate, than the actual GHG emissions increasing such an amount.

Table 36 Product Use GHG Emissions for the 2007 and 2020 Reporting Years

Sub-Sector	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change
Product Use Emissions	77,348	130,139	68.3%

5.4.5 Agriculture, Forestry, and Other Land Use

The AFOLU Sector includes GHG emissions from livestock, land use, and all other agricultural activities occurring within the CRD's boundaries.

The following information is provided for disclosure purposes only. Using remotely sensed imagery, land cover data was used to estimate land use changes between the reporting years. In 2020, the CRD's greenspace is estimated to have sequestered and stored 339,707 tCO_2e (Table 37), released 89,610 tCO_2e for a net effect of 244,972 tCO_2e. Upon review, the result was deemed to contradict expectations relative known trends of development in the region. Therefore it was excluded from the total inventory calculations.

Table 37 Summary of Land-Use Change in 2020

Land Type	Total Hectares (Ha)	GHG Emissions Sequestered (tCO_2e)	GHG Emissions Released (tCO_2e)
Forest Land	170,611.2	(311,402.2)	-
Cropland	6,044.8	(2,592.9)	-
Grassland	16,052.4	(43,783.8)	-
Wetlands	11,972.8	(41,928.1)	-
Settlements	12,938.0	-	46,066.8
Other Land	13,373.4	-	43,542.9
Total	**230,992.6**	**(399,707.0)**	**89,609.7**

5.4.5.1 Livestock and Other Agriculture

In addition to land use change, GHG emissions from the AFOLU Sector are produced through a variety of non-land use pathways, including livestock (enteric fermentation and manure management), and aggregate sources and non-CO_2 emission sources on land (e.g., fertilizer application). Under this Sector, the CRD is reporting on GHG emissions from the following sources, and Sub-Sectors:

- Scope 1 GHG Emissions:
  - Livestock:
    - Methane (CH_4) Emissions from Enteric Fermentation
    - Methane (CH_4) Emissions from Manure Management
    - Direct Nitrous Oxide (N_2O) GHG Emissions
  - Aggregate Sources and Non-CO_2 Emissions Sources on Land
    - Direct Nitrous Oxide (N_2O) Emissions from Agricultural Soil Management
    - Indirect Nitrous Oxide (N_2O) Emissions from Applied Nitrogen

Table 38 summarizes these other land-use GHG emissions for the 2020 reporting year. Compared to the 2007 base year, these GHG emissions have increased 25%.

Table 38 Total AFOLU GHG Emissions for 2020

AFOLU Sub-Sector	GHG Emissions (tCO_2e)
Livestock	3,545
Aggregate Sources And Non-CO_2 Emissions Sources On Land	715
Total	**4,261**

6.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality Assurance and Quality Control (QA/QC) procedures are applied to add confidence that all measurements and calculations have been made correctly and to reduce uncertainty in data. Examples include:

- Checking the validity of all data before it is processed, including emission factors
- Performing recalculations to reduce the possibility of mathematical errors
- Recording and explaining any adjustments made to the raw data
- Documenting quantification methods, assumptions, emission factors and data quality

With respect to the GHG inventory, the data was subject to various quality assurance and quality control checks throughout the collection, analysis, and reporting phases. Specifically, the following procedures were followed:

- Upon receipt of data from the CRD, the data was checked for completeness (e.g., all months of data are present), relevancy (e.g., the correct calendar year is presented), and reasonableness (e.g., comparing similar transportation data sets). Incorrect or incomplete datasets were queried directly with the data provider.
- Where estimates were used (e.g., fuel oil consumption), all possible data sources were considered for their accuracy and relevance to the community before a final method and data source was selected.
- All manual data transfers were double-checked for data transfer accuracy.
- The inventory was compared to other third party inventories (e.g. CEEI) to assess for reasonableness of the estimates.
- The inventory underwent internal CRD reviews to confirm assumptions, data and reasonableness of the estimates.

7.0 RECOMMENDATIONS

To remain accurate and reflective of the current community conditions, the CRD should revise and improve its GHG emissions inventory either annually or in line with capital planning cycles (i.e., every 3-4 years), to which there are the following aspects should be focused on:

- Improving activity data collection and management, including Sector and Sub-Sector allocations.
- Performing recalculations, where applicable, and tracking GHG emissions over time.
- Reviewing methodologies and data to assess for opportunities to improve the estimates.
- Assessing changes to boundaries, methodologies, assumptions or data that may be material and require a base year restatement.

The next section provides a summary of specific GHG inventory improvement recommendations.

7.1 INVENTORY ASSUMPTIONS, ASSESSMENT, AND RECOMMENDATIONS

In the preparation of the 2020 GHG emissions inventory, there are several assumptions were made in the analysis that will have some influence on accuracy of the CRD's estimate of GHG emissions. Most emission sources have been calculated with a high level of confidence, due to the presence of utility records, and direct energy and emissions data being provided by stakeholders. Data sources and assumptions with medium to high uncertainty are presented in Table 39 which summarizes the main assumptions, possible impacts on the data, and recommended improvement. It is recommended that the CRD prioritize improvements for that are likely to have a material (>5%) influence on the GHG inventory estimate.

Table 39 Summary of GHG Inventory Assumptions, Estimated Impacts, and Recommended Improvements

Sector	Assumption	Possible Impact on The GHG Inventory	Recommended Improvements
Stationary Energy	The energy utility providers provide energy in lump sum amounts for: residential, commercial, and industrial. As such, other sectors, like agricultural buildings, could not be split out. A related accuracy issue is the assignment of mixed use buildings without separate metering.	No impact on the GHG inventory. The change would only happen between emission sub-sectors.	Work with the utility provider to get a more detailed breakdown of energy use by sub-sector.

Table 39 Summary of GHG Inventory Assumptions, Estimated Impacts, and Recommended Improvements

Sector	Assumption	Possible Impact on The GHG Inventory	Recommended Improvements
Stationary Energy	Propane, fuel oil and wood GHG emissions were estimated based on 2007, 2010, and 2012 CEEI GHG emissions. for the District of Saanich and the City of Victoria, heating oil emissions were estimated based on the number of known tanks and the estimated square footage based on BC Assessment data, and the estimated average annual energy usage.	Immaterial impact on the GHG inventory (<5%)	Consider completing a residential energy labelling program. With such a program, an energy and fuel profile for buildings could be developed so that a reasonable estimate of other fuel use be determined. Work with the Province on developing a methodology to estimate wood fuel use.
Stationary Energy	FortisBC provided a total estimate of fugitive emissions for the CRD region for 2020; however, this did not include upstream fugitive emissions as suggested as best practice by the GPC Protocol.	Immaterial impact on the GHG inventory (<5%)	Work with FortisBC to refine this estimate.
Transportation	Taxable fuel volumes only represent about 67% of taxable fuel sales (a value that fluctuates yearly). Without more detailed information, a fuel allocation amount could not be allocated to the CRD. As such, the CRD had to rely on vehicle registration data from ICBC and estimated vehicle kilometers travelled (VKT). The CRD's 2016 Origin and Destination Study estimates total VKT data was considered but was deemed to likely result in significant underestimate of GHG emissions as the study estimates that light duty vehicles in the CRD travel less than 5,000 km per year. This is less than 1/3 of the national average. On this	Possibly material (>10%) impact to the GHG inventory. Using the estimated VKT data, it is likely that the CRD is over-estimating the GHG emissions from transportation. This is the most conservative approach available to the CRD at this point.	If the CRD can get complete fuel sales data for the Region, a more robust estimate of fuel use and GHG emissions, using vehicle registration data, can be determined. If the CRD can incorporate estimated travel data, in VKT through its next Origin Destination Survey, this data could be used to replace the 2009 study and be more specific to CRD and its members.

Table 39 Summary of GHG Inventory Assumptions, Estimated Impacts, and Recommended Improvements

Sector	Assumption	Possible Impact on The GHG Inventory	Recommended Improvements
	basis, the VKTs from a 2009 National vehicle travel study for Canada were applied.		
Transportation	The Victoria International Airport does not report on GHG emissions from tenants or aircraft. Keeping in line with the GPC Protocol, only the aircraft GHG emissions were estimated using NAV Canada airplane movement statistics, estimated taxi times, and estimated fuel use. The fuel use only accounts for departing and arriving planes up to 3,000ft to avoid double counting with other cities.	Immaterial impact on the GHG inventory (<5%)	The Victoria International Airport will not be collecting or reporting on GHG emissions from tenants or aircraft. This is the best available data at this point.
Transportation	The GHG emissions from recreational watercraft and US/Can ferries were estimated based on a publicly available year 2000 study for the Victoria, Vancouver, and Washington harbors.	Immaterial impact on the GHG inventory (<5%)	Work with the Victoria Harbor Master as they begin to deploy a database tracking the types and number of boats entering the Victoria harbor.
Transportation	The GHG emissions from marine aviation are estimated based on Victoria Harbor NAV Canada air traffic movements for 2016. Statistics Canada stopped collecting Victoria Harbor aircraft movement data in 2016. To estimate 2020 marine aviation GHG emissions, the 2016 data was applied and adjusted using the change in aircraft traffic between the 2016 and 2020 reporting years at the Victoria International Airport. It is assumed that the activity at both airports would be corelated, but not causational.	Immaterial impact on the GHG inventory (<5%)	No recommended improvement currently.

Table 39 Summary of GHG Inventory Assumptions, Estimated Impacts, and Recommended Improvements

Sector	Assumption	Possible Impact on The GHG Inventory	Recommended Improvements
Waste	There is tracking to the origin of solid waste but is based on reported origin which may or may not be accurate. For example, some haulers will identify that they are hauling waste from Victoria when in fact the waste is originating from Saanich.	There is no impact to the GHG Inventory for the CRD but will have impacts to the CRD member inventories.	Work with waste haulers to devise a better system to track waste origination.
IPPU	Product use emissions were estimated on a per capita basis using the 2021 NIR estimates. The product use emissions were estimated by the NIR using an IPCC Tier 1 approach and thus will have high uncertainty.	Immaterial impact on the GHG inventory (<5%)	No recommendations currently.
AFOLU	GHG estimates for land use change are based on a period of years (2011-2019) and thus were averaged for each period. As there was no current data, land use change for the reporting year was estimated using the average value between the data years.	Immaterial impact on the GHG inventory (<5%)	Work with the planning department to track land-use change annually so that a more refined estimate can be made.
AFOLU	The land-use sequestration and storage GHG emission factors are taken from the literature, for BC ecozones, and may not reflect the productivity, or lack thereof, of land uses in the CRD. The land-change emission factors for changes between land types were derived by the Province. These are average values by ecozone and are based on a 20-year horizon. Since land-use change in the CRD is typically related to development, it was assumed that the loss of emissions is immediate which may overestimate GHG emission	Possibly a material impact on the GHG inventory (>10%)	Work with the Province and the post-secondary institutions to derive refined sequestration emission factors.

Table 39 Summary of GHG Inventory Assumptions, Estimated Impacts, and Recommended Improvements

Sector	Assumption	Possible Impact on The GHG Inventory	Recommended Improvements
	losses. In both emission factor applications, the use of non-site emission factors may result in an over or underestimate of GHG emissions.		

8.0 REFERENCES

ACI (Airports Council International). 2020. Airport Carbon and Emissions Reporting Tool (ACERT). Available at: http://www.aci.aero/About-ACI/Priorities/Environment/ACERT

Environment and Climate Change Canada. 2021. National Inventory Report 1990 to 2019: Greenhouse Gas Sources and Sinks in Canada. Part 1-3. April 2020. Available at: https://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php

GPC (Global Protocol for Community-Scale Greenhouse Gas Emission Inventories). 2014. Global Protocol for Community-Scale Greenhouse Gas Emission Inventories: An Accounting and Reporting Standard for Cities"; World Resources Institute, C40 Cities Climate Leadership Group, and ICLEI – Local Governments for Sustainability.

ICAO. International Civil Aviation Organization. 2020. Emissions Factors Database. Available at: https://www.icao.int/about-icao/Pages/default.aspx

IPCC (Intergovernmental Panel on Climate Change). 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Available at: https://www.ipcc-nggip.iges.or.jp/public/2006gl/

IPCC (Intergovernmental Panel on Climate Change). 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

WRI (World Resource Institute/ World Business Council for Sustainable Development). 2004. The Greenhouse Gas Protocol. A Corporate Accounting and Reporting Standard. Revised Edition. Available at: http://www.ghgprotocol.org

CAPITAL REGIONAL DISTRICT 2020 GPC BASIC+ COMMUNITY GREENHOUSE GAS (GHG) EMISSIONS INVENTORY REPORT

October 29, 2021

Stantec

APPENDIX B

Capital Region District – Municipalities and Electoral Areas
2007 Base Year and 2020 Reporting Year Energy & GHG Emissions Inventory

Prepared for:

Capital Regional District
625 Fisgard Street, PO Box 1000
Victoria, BC V8W 2S6

Prepared by:

Stantec Consulting Ltd.
200-325 25 Street SE
Calgary, AB T2A 7H8

Date: October 29, 2021

Limitation of Liability

This document entitled Capital Region District – Municipalities and Electoral Areas2007 Base Year and 2020 Reporting Year Energy & GHG Emissions Inventory Report was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Capital Regional District (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

TABLE OF CONTENTS

Summary 5

1 Introduction 7

1.1 GHG Emissions & Climate Change 7
1.2 GPC Protocol 8
1.3 Variance from Community Energy and Emissions Inventories (CEEI) 8
1.4 Purpose of Document 9

2 Inventory Scope 10

2.1 GPC BASIC+ Inventory Scope 10
2.2 GHG Emissions Boundary 11
2.3 Assumptions & Disclosures 11

3 Capital Regional District Energy & GHG Emissions 14

3.1 Base Year (2007) Energy & GHG Emissions 14
3.2 CRD GHG Reduction Target 17
3.3 Reporting Year (2020) Energy & GHG Emissions 17
3.4 Energy & GHG Emissions Trends 21

4 District of Central Saanich 25

4.1 2020 Profile 25
4.2 Energy & GHG Emissions 25

5 City of Colwood 28

5.1 2020 Profile 28
5.2 Energy & GHG Emissions 28

6 Township of Esquimalt 31

6.1 2020 Profile 31
6.2 Energy & GHG Emissions 31

7 District of HIghlands 34

7.1 2020 Profile 34
7.2 Energy & GHG Emissions 34

8 Juan de Fuca Electoral Area 37

8.1 2020 Profile 37
8.2 Energy & GHG Emissions 37

9 City of Langford 40

9.1 2020 Profile 40
9.2 Energy & GHG Emissions 40

10 District of Metchosin 43

10.1 2020 Profile 43
10.2 Energy & GHG Emissions 43
11 District of North Saanich 46
11.1 2020 Profile 46
11.2 Energy & GHG Emissions 46
12 District of Oak Bay 49
12.1 2020 Profile 49
12.2 Energy & GHG Emissions 49
13 The District of Saanich 52
13.1 2020 Profile 52
13.2 Energy & GHG Emissions 52
14 Salt Spring Electoral Area 55
14.1 2020 Profile 55
14.2 Energy & GHG Emissions 55
15 Town of Sidney 58
15.1 2020 Profile 58
15.2 Energy & GHG Emissions 58
16 District of Sooke 61
16.1 2020 Profile 61
16.2 Energy & GHG Emissions 61
17 City of Victoria 64
17.1 2020 Profile 64
17.2 Energy & GHG Emissions 64
18 Town of View Royal 67
18.1 2020 Profile 67
18.2 Energy & GHG Emissions 67
19 Southern Gulf Islands Electoral Area 70
19.1 2020 Profile 70
19.2 Energy & GHG Emissions 70

SUMMARY

Climate change has emerged as the next unprecedented social, economic, and environmental challenge facing society today. It poses a serious threat to quality of life, jobs, and physical and natural assets. Scientists believe that the human-production of greenhouse gas (GHG) emissions since pre-industrial times have already surpassed the Earth's "carrying capacity" of natural systems and pose significant future risks to human well-being.

Recognizing the role that Capital Regional District (CRD) plays in achieving a significant and immediate reduction in global GHG emissions, the CRD set a regional GHG reduction target of 61% (from 2007 levels) by 2038. In February 2019, the CRD declared a climate emergency and committed to regional carbon neutrality. Local governments across the region have also set similar ambitious GHG reduction targets and commitments.

To meet these climate commitments, the CRD seeks a better understanding of the energy and GHG emissions at the regional level, as well as at the local government level which includes 13 municipalities and 3 electoral areas. The following document presents a summary of energy and GHG emissions at both the CRD and local government level for the 2007 and 2020 reporting years. This document compliments a 2020 inventory report which describes the methodologies and data sources applied to derive the estimate of GHG emissions for the CRD and local governments. A summary of the 2007 and 2020 energy and GHG emissions by local government is presented in **Table 1** and **Table 2**.

Table 1. Summary of GHG Emissions By CRD Local Government

Local Government	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
District of Central Saanich	97,077	96,437	-0.7%
City of Colwood	82,439	76,591	-7.1%
Township of Esquimalt	96,314	80,712	-16.2%
District of Highlands	11,358	14,614	28.7%
Juan de Fuca Electoral Area	62,493	69,270	10.8%
City of Langford	134,791	165,160	22.5%
District of Metchosin	27,015	20,624	-23.7%
District of North Saanich	63,747	54,424	-14.6%
District of Oak Bay	90,483	76,427	-15.5%
District of Saanich	582,422	486,037	-16.5%
Salt Spring Island Electoral Area	48,689	42,920	-11.8%
Town of Sidney	62,744	53,276	-15.1%
District of Sooke	51,194	55,790	9.0%
City of Victoria	484,582	408,761	-15.6%
Town of View Royal	49,949	54,477	9.1%
Southern Gulf Islands Electoral Area	30,803	27,730	-10.0%

Table 2. Summary of Energy Use By CRD Local Government

Local Government	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)
District of Central Saanich	1,867,417	1,903,819	1.9%
City of Colwood	1,533,734	1,487,893	-3.0%
Township of Esquimalt	1,784,465	1,565,499	-12.3%
District of Highlands	217,328	291,021	33.9%
Juan de Fuca Electoral Area	1,282,178	1,399,797	9.2%
City of Langford	2,594,734	3,335,434	28.5%
District of Metchosin	513,449	436,613	-15.0%
District of North Saanich	1,323,026	1,234,114	-6.7%
District of Oak Bay	1,664,925	1,484,989	-10.8%
District of Saanich	11,054,201	9,457,076	-14.4%
Salt Spring Island Electoral Area	1,058,268	1,002,959	-5.2%
Town of Sidney	1,234,379	1,096,986	-11.1%
District of Sooke	961,620	1,114,759	15.9%
City of Victoria	9,852,916	8,467,486	-14.0%
Town of View Royal	962,988	1,080,921	12.2%
Southern Gulf Islands Electoral Area	754,738	704,290	-6.7%

1 INTRODUCTION

1.1 GHG Emissions & Climate Change

There is overwhelming evidence that global climate change resulting from emissions of carbon dioxide and other greenhouse gases (GHGs) is having a significant impact on the ecology of the planet. In addition, climate change is expected to have serious negative impacts on global economic growth and development. In 2005, the UK government commissioned an independent economic review called the Stern Review, which states that the *"costs of stabilizing the climate are significant but manageable; delay would be dangerous and much more costly"*.

Beyond the costs associated with delayed action, there are cost savings to be realized through efforts to conserve energy and to use it more efficiently, and economic opportunities available to communities that develop local energy supply and infrastructure. Actions to encourage energy efficiency and conservation and to promote implementation of renewable energy will assist local governments in developing energy resilient communities, in addition to mitigating climate change. Local governments are at the forefront of global action on climate change, setting both ambitious commitments and targets while going about the difficult task of reducing emissions. Per the latest report from the C40 Cities Climate Leadership Group, ICLEI Local Governments for Sustainability, UN Habitat, and others, most GHG reduction commitments are set for 2020 or 2050 and range from a 10% to 100% reduction (**Figure 1**).

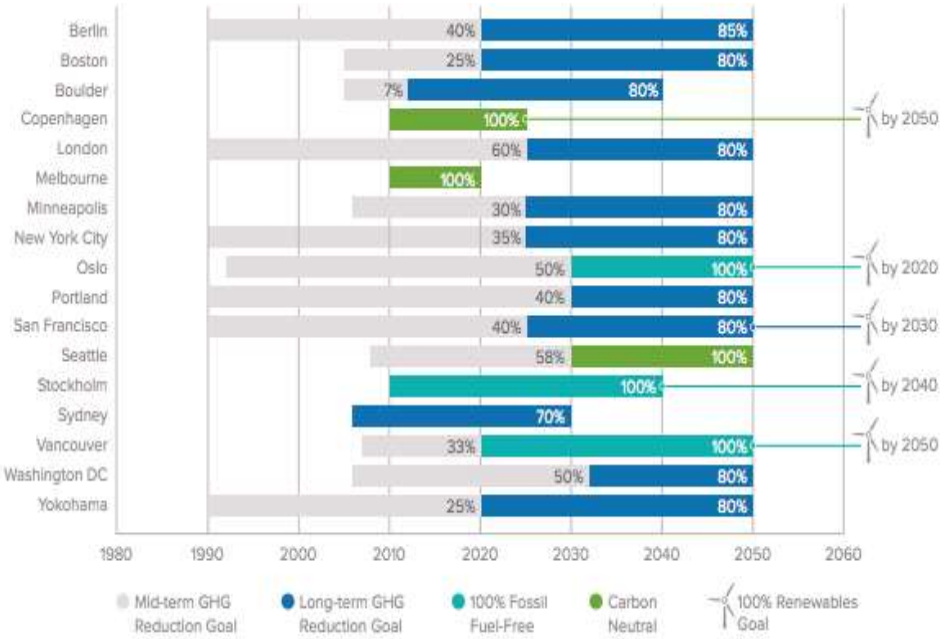


Figure 1. Summary of Long-Term Global GHG Emission Reduction Targets[1]

[1] http://www.c40.org/

1.2 GPC Protocol

To make informed decisions on reducing energy use and GHG emissions at the regional and local government scale, community managers must have a good understanding of these sources, the activities that drive them, and their relative contribution to the total. This requires the completion of an energy and GHG emissions inventory. To allow for credible and meaningful reporting locally and internationally, the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (the GPC Protocol) was developed as a partnership between ICLEI-Local Governments for Sustainability, The World Resources Institute (WRI) and C40 Cities Climate Leadership Group (C40), with additional collaboration by the World Bank, United Nations Environment Program (UNEP) and UN-Habitat. The GPC Protocol has now become recognized as the standardized way for local governments to collect and report their actions on climate change. Over 9,000 cities have committed to using the GPC Protocol.

The Protocol has two established levels of reporting: BASIC and BASIC+ which are defined as the following:

- The BASIC level covers scope 1 and scope 2 emissions from stationary energy and in-boundary transportation, as well as scope 1 and scope 3 emissions from waste.
- The BASIC+ level covers the same scopes as BASIC and includes more in-depth and data dependent methodologies. Specifically, it expands the reporting scope to include emissions from industrial process and product use (IPPU), agriculture, forestry and other land-use (AFOLU), and transboundary transportation.

1.3 Variance from Community Energy and Emissions Inventories (CEEI)

The CRD has historically relied on the Provincial 2007, 2010 and 2012 Community Energy and Emissions Inventories (CEEI) to baseline and track community GHG emissions. However, there have been some limitations to the CEEI in that it is an in-boundary inventory, the most recent version published is for 2012, and the CEEI Protocol does not fully meet the requirements of the GPC Protocol BASIC or BASIC+ reporting requirements which is the required reporting standard for local governments that have committed to the Global Covenant of Mayors—an agreement led by city networks to undertake a transparent and supportive approach to measure GHG emissions community-wide. A high-level summary of the differences between the CEEI and GPC Protocol inventories are presented in **Table 3**.

Table 3. Summary of GHG Inventory Scope Differences

Reporting Sector	CEEI	GPC BASIC	GPC BASIC+
Residential Buildings	✓	✓	✓
Commercial And Institutional Buildings And Facilities	✓	✓	✓
Manufacturing Industries And Construction	✓	✓	✓
Energy Industries		✓	✓
Energy Generation Supplied To The Grid		✓	✓
Agriculture, Forestry And Fishing Activities		✓	✓
Non-Specified Sources		✓	✓

Reporting Sector	CEEI	GPC BASIC	GPC BASIC+
Fugitive Emissions From Mining, Processing, Storage, And Transportation Of Coal		✓	✓
Fugitive Emissions From Oil And Natural Gas Systems		✓	✓
On-Road Transportation	✓	✓	✓
Railways		✓	✓
Waterborne Navigation		✓	✓
Aviation		✓	✓
Off-Road Transportation		✓	✓
Solid Waste	✓	✓	✓
Biological Waste	✓	✓	✓
Incinerated And Burned Waste		✓	✓
Wastewater		✓	✓
Emissions From Industrial Processes			✓
Emissions From Product Use			✓
Emissions From Livestock	✓		✓
Emissions From Land			✓
Emissions From Aggregate Sources And Non-CO_2 Emission Sources On Land	✓		✓

1.4 Purpose of Document

The purpose of this document is to provide the 2007 and 2020 GPC BASIC+ energy and GHG emissions inventories at the regional and local government level. This document compliments a 2020 inventory report which describes the methodologies and data sources applied to derive the estimate of GHG emissions for the CRD region and local governments.

2 INVENTORY SCOPE

2.1 GPC BASIC+ Inventory Scope

In accordance with the GPC Protocol, the 2007 and 2020 BASIC+ GHG inventories presented herein accounts for GHG emissions from the following Reporting Sectors:

- **Stationary Energy** – These are GHG emissions from fuel combustion, fugitive emissions, and some off-road transportation sources (e.g. construction equipment, residential mowers, etc.). They include the emissions from energy to heat and cool residential, commercial, institutional, and light/heavy industrial buildings, as well as the activities that occur within these residences and facilities.
- **Transportation** – These are GHG emissions from the combustion of fuels as a result of vehicular on-road, off-road, including marine, aviation, and other off-road, and trans-boundary journeys.
- **Waste** – These are GHG emissions from the disposal and management of solid waste, the biological treatment of waste, and wastewater treatment and discharge. Waste does not directly consume energy, but releases GHG emissions because of decomposition, burning, and other management methods.
- **Industrial Process and Product Use (IPPU)** – These are GHG emissions from products such as refrigerants, foams or aerosol cans can release potent GHG emissions, known as product use GHG emissions. There are no known industrial process emissions in the CRD.
- **Agriculture, Forestry and Other Land-Use (AFOLU)** – These are GHG emissions that are captured or released as a result of land-management activities. These activities can range from the preservation of forested lands to the development of crop land. This Sector includes GHG emissions from land-use change, manure management, livestock, and the direct and indirect release of nitrous oxides (N_2O) from soil management, urea application, fertilizer and manure application.

  Due to limitations in how to quantify GHG emissions resulting from land use change (e.g., residential development), these GHG emissions have been excluded from the GHG emissions inventories presented herein but have been disclosed.

2.2 GHG Emissions Boundary

The GHG inventories are defined geographically by the CRD, which includes 13 municipalities and 3 electoral areas, as shown in Figure 2.

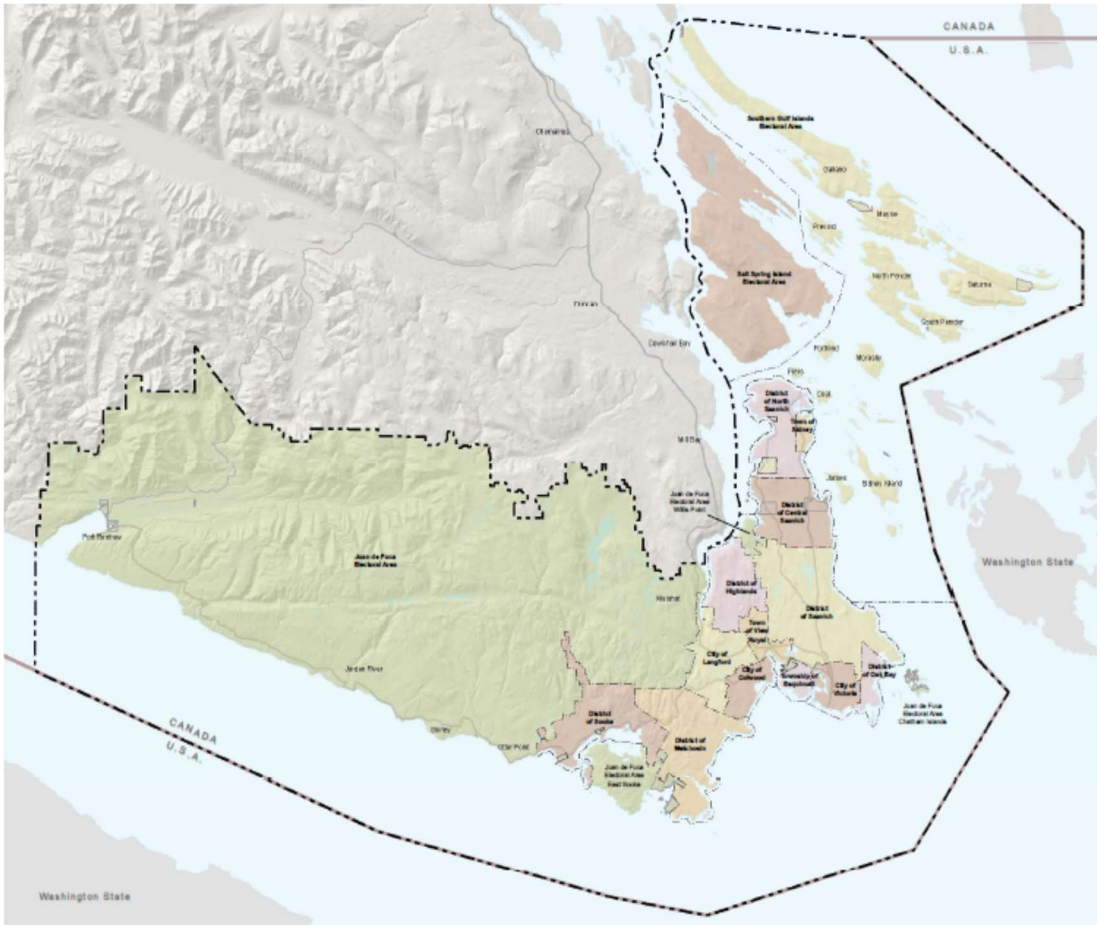


Figure 2 CRD GHG Boundary

2.3 Assumptions & Disclosures

The following inventories covers all GHG emissions for the 2007 and 2020 reporting years. Where data was not available, the most recent year's data have been used, and the timescale noted accordingly. These disclosures are as follows:

- **Global Warming Potentials (GWP)**. The BC government is currently applying GWPs from the fourth IPCC report despite the fact that there are updated GWPs in available in the fifth IPCC report. On this basis, the CRD is applying GWPs from the fourth IPCC report.
- **Stationary Energy: Emission Factors.** The BC Government updated 2010-2020 electricity emission factors to include emissions from imported electricity resulting in a 5-10% increase in GHG emissions intensities. Since there was no update to the 2007, the BC Government has suggested utilizing the 2010 emission factor for 2007.

- **Stationary Energy: Electricity Data.** In 2019, the Province of BC received updated electricity data for 2007-2018 as a systematic error was uncovered across all years of BC Hydro data. The 2007 inventory was updated with the corrected information.
- **Stationary Energy: Residential, Commercial and Institutional Buildings**. Propane, and wood GHG emissions were estimated using linear regression methods. The data used in the estimates included historical propane and wood energy data published in the 2007, 2010 and 2012 CEEIs, and heating degree days (HDD) published by Environment and Climate Change Canada. This approach was also applied to the estimate of heating oil for all local governments, except the City of Victoria and District of Saanich. For the District of Saanich and the City of Victoria, heating oil GHG emissions were estimated based on the number of known tanks, average heated floor areas and fuel volume intensity.
- **Stationary Energy: Fugitives**. Fortis BC provided total fugitive emissions for the 2020 reporting year at the CRD level. Since no historical numbers were provided, the 2020 value was applied to the 2007 base year as well.
- **Transportation: On-Road**. The on-road transportation emissions are based on the total estimated fuel sales in the CRD, and the number of registered vehicles. Insurance Corporation of BC (ICBC) compiles data on an April 1 to March 31 basis, and thus the current on-road GHG emission estimate is based on the number of registrations from April 1, 2020 – March 31, 2021.
- **Transportation: Aviation.** 2020 aviation GHG emissions were estimated using 2015 aircraft flight profiles (the last available data), and the total number of aircraft movements reported in 2020.
- **Transportation: Waterborne Recreational Watercraft.** GHG emissions from recreational watercraft and US/Canada ferries were estimated based on a publicly available year 2000 study for the Victoria, Vancouver, and Washington harbors.
- **Transportation: Ferries.** BC Ferries did not disclose its total reported fuel use for 2020 but did publish that fuel consumption volumes fell by approximately 40% as compared to the 2019 reporting year. As such, the 2019 fuel volumes and the 40% factor were applied to estimate 2020 fuel volumes.
- **Transportation: Cruise Ships.** The Greater Victoria Harbour Authority (GVHA) reported on cruise ship emissions for the 2010 and 2018 reporting years but did not provide an estimate for 2007. As a result, the 2010 GHG emissions estimate and number of cruise ship visits to Ogden Point was used to create a proxy to estimate 2007 cruise ship emissions. The GVHA reported 163 visits in 2007. As a result of COVID-19 restrictions, there were no cruise ships in 2020.
- **Waste: Solid Waste.** To quantify GHG emissions from the Hartland Landfill, the CRD utilized the waste-in-place (WIP) method which is accepted under the GPC Protocol. The WIP assigns landfill emissions based on total waste deposited during that year. It counts GHGs emitted that year, regardless of when the waste was disposed. Except for the City of Victoria, who claims 31% of the CRD's landfill GHG emission, the remaining landfill GHG emissions were allocated to each local government on a per capita basis. Using this allocation method, the CRD members may over, or underestimate associated solid waste GHG emissions as the current year landfill GHG emissions are based upon cumulative waste over time, and each member may have contributed more waste in past years than the current year (and vice versa).
- **AFOLU: Aggregate Sources And Non-CO_2 Emission Sources On Land.** These emissions are based on the 2021 NIR as prepared by ECCC and the total area of

farmland BC in 2016 as reported by Statistics Canada. These GHG emissions were assigned to each local government on a per hectare (ha) of cropland basis.

- **AFOLU: Land-Use.** The land cover change analysis requires a consistent land-use category attribution and spatial data. For parts of the CRD, spatial data was available for the 2007, 2011 and 2019 reporting years. Differences between these data sets in terms of resolution and their timing of collection increase the uncertainty as to the accuracy of the land-use classifications. For example, the 2007 and 2011 land use data was collected at different times of the year and may not accurately reflect tree cover. Furthermore, no land use spatial data was collected the Juan de Fuca, Salt Spring Island and Gulf Islands and thus Annual Crop Inventory (ACI) settlement data collected by Agriculture Canada was used to inform the analysis. The challenge in utilizing this data is that it is provided in a 30m resolution. Furthermore, since annual data is not available, the change between land cover data years (2007-2011, 2011-2019) for all areas was averaged and may not represent actual changes in each year. Since no data was available for 2020, the 2019 estimates were applied.

Details surrounding all GHG emissions sources quantification methods, assumptions, and assessment of uncertainties are contained in a complimentary GHG emissions methodology document and are not presented herein.

3 CAPITAL REGIONAL DISTRICT ENERGY & GHG EMISSIONS

3.1 Base Year (2007) Energy & GHG Emissions

In 2007, the CRD's GHG BASIC+ emissions totaled 1,976,100 tCO_2e. Buildings are the CRD's second largest GHG emissions source at 35%, with 40% of those GHG emissions coming from natural gas for heating and cooling, 21% from heating oil for heating, 17% from electricity use, 7% from wood and propane use for heating and the remainder from other-related off-road activities like residential lawn mowing. On-road transportation GHG emission sources contributed 45% to the GHG inventory, almost all of which came from passenger vehicles, light trucks, and SUVs (83%). Off-road transportation, which includes marine, aviation, and other off-road emission sources contributed 7% to the overall GHG inventory. Solid waste, organic waste treatment methods, and wastewater treatment and discharge accounted for 7% of the total community GHG emissions. IPPU emissions accounted for 4% of total GHG emissions while AFOLU GHG emissions resulted for less than 1% of community GHG emissions.

A summary of the GHG emissions by sector and energy use by source is presented in the following table and figures.

Table 4. Base Year (2007) CRD Regional GHG Energy & GHG Emissions by Source

Source	Type	Consumption	Units	Energy (GJ)	GHG Emissions (tCO_2e)
Stationary Energy					
Residential Buildings	Electricity	2,102,967	MWh	7,570,620	75,076
	Natural Gas	2,639,980	GJ	2,639,980	131,649
	Fuel Oil	83,335	L	2,147,821	146,859
	Propane	10,747	L	424,600	25,882
	Wood	1,144,369	GJ	1,144,369	26,872
	Diesel	6,750,851	L	261,123	19,468
Commercial & Industrial Buildings	Electricity	1,367,919	MWh	4,924,469	48,835
	Natural Gas	3,352,456	GJ	3,352,456	167,179
	Fuel Oil	6,272	L	161,638	11,052
	Diesel	12,173,666	L	470,877	35,106
Energy Industries	LFG Combustion				6,956
Agriculture, Forestry And Fishing Activities	Diesel	21,520,635	L	832,418	62,060
Natural Gas Fugitive Emissions					1,003
Total				**23,930,370**	**751,459**
On-Road Transportation					
Electric Vehicles	Electricity	51,201	MWh	0	0

Source	Type	Consumption	Units	Energy (GJ)	GHG Emissions (tCO_2e)
Hydrogen Vehicles	Hydrogen	0	L	0	0
Passenger Vehicles	Gasoline + Diesel	163,062,222	L	5,673,042	384,119
Light Trucks, Vans, SUVs	Gasoline + Diesel	142,617,615	L	5,003,722	343,341
Heavy Duty Vehicles	Gasoline + Diesel	59,156,416	L	2,230,995	150,544
Propane Vehicles	Propane	1,322,222	L	33,756	2,035
Natural Gas Vehicles	Natural Gas	0	kg	0	0
Motorcycles	Gasoline	1,208,124	L	41,874	2,885
Total On-Road Transportation				**12,983,390**	**882,924**
Off-Road Transportation					
Marine, Aviation and Other Off-Road Vehicles	Marine Gasoline + Marine Diesel + Jet Fuel	46,196,808	L	1,746,608	130,656
Total Off-Road Transportation				**1,746,608**	**130,656**
Waste					
Wastewater					18,998
Composting					72
Solid Waste					111,234
Total Waste					**130,304**
Agriculture Forestry & Other Land Use (AFOLU)					
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-396,487
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					151,516
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					3,408
Total AFOLU					**3,408**
Industrial Process & Product Use (IPPU)					
Process Use Emissions					77,348
Total IPPU					**77,348**
TOTAL				**38,660,368**	**1,976,100**
TOTAL Per Capita				**110.0**	**5.6**

Energy consumption and GHG emissions by source are shown in **Figure 3**, **Figure 4** and **Figure 5**. On-road and transboundary transportation (82%) account for most of the energy consumption in the region.

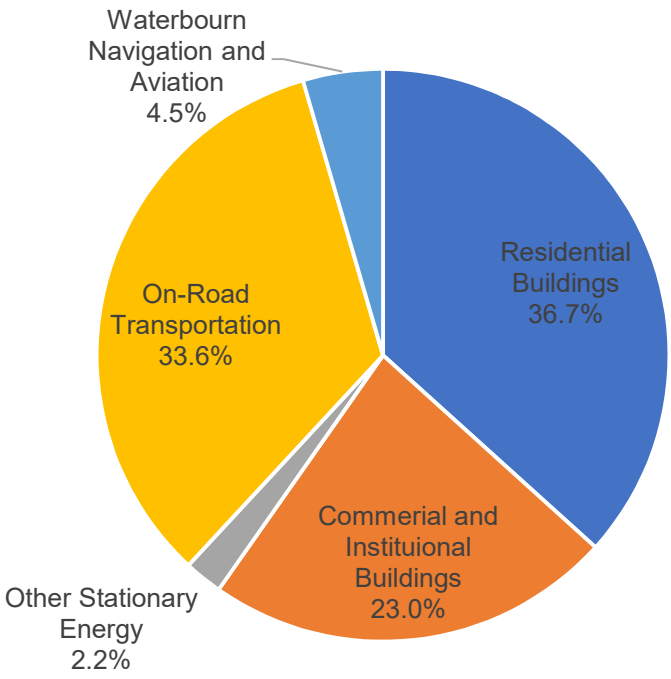


Figure 3. 2007 Regional Energy Consumption By Sector

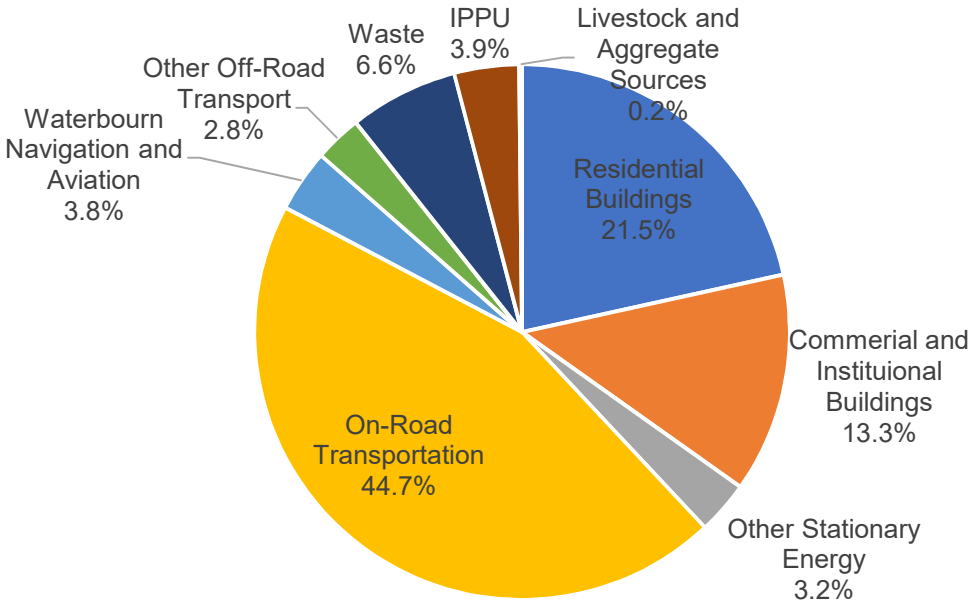


Figure 4. 2007 Regional GHG Emissions By Sector

GHG emissions by fuel type is presented in **Figure 5**.

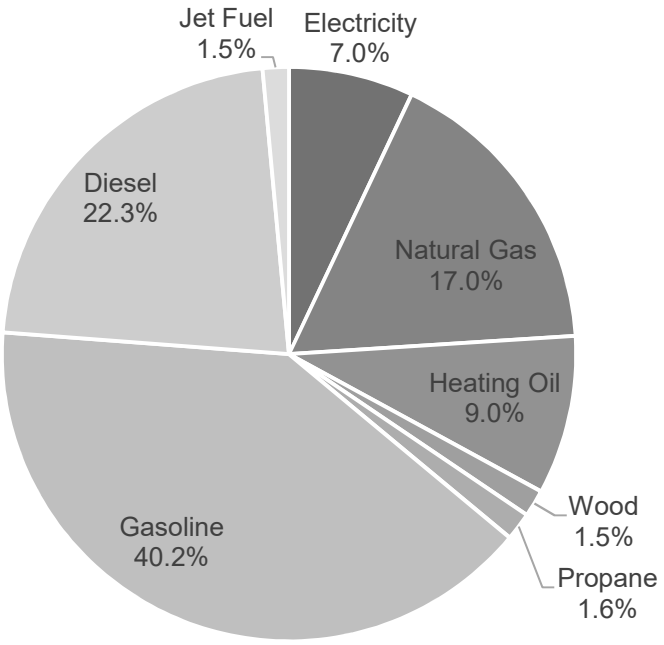


Figure 5. 2007 Regional GHG Emissions By Fuel Type

3.2 CRD GHG Reduction Target

Recognizing the role that the CRD plays in achieving a significant and immediate reduction in global GHG emissions, the CRD has set a regional GHG reduction target of 61% (from 2007 levels) by 2038. With the CRD's 2007 base year GHG emissions being 1,976,100 tCO_2e, a 39% reduction would require a reduction of approximately 770,679 tCO_2e. On a per capita basis, this amounts to reducing emissions from approximately 4.3 tCO_2e per person in 2020 to 2.4 tCO_2e per person by 2038.

In February 2019, the CRD declared a climate emergency and committed to regional carbon neutrality.

3.3 Reporting Year (2020) Energy & GHG Emissions

In 2020, the CRD's BASIC+ GHG emissions totaled 1,785,814 tCO_2. On an absolute basis, this is a 10% decline from the 2007 base year GHG emissions and a decline of 24% on a per capita basis. The 2020 energy and GHG emissions year was not typical in terms of energy and GHG emissions largely due to COVID-19 restrictions and associated closures.

Similar to the 2007 base year, buildings are the second largest GHG emissions source at 40%, with 44% of those GHG emissions coming from natural gas for heating and cooling, 19% from heating oil for heating, 17% from electricity use, 6% from wood and propane use for heating and the remainder from other-related off-road activities like residential lawn mowing. On-road transportation GHG emission sources contributed 44%, almost all of which came from passenger vehicles, light trucks, and SUVs (82%). Off-road transportation, which includes marine, aviation, and other off-road emission sources contributed 5% to the overall GHG inventory. Solid waste, organic waste treatment methods, and wastewater treatment and discharge accounted for 5% of the total community GHG emissions. IPPU emissions

accounted for 7% of total GHG emissions while AFOLU GHG emissions contributed to less than 1% of community GHG emissions.

A summary of the 2020 GHG emissions by sector and energy use by source is presented in the following table and figures.

Table 5. Reporting Year (2020) CRD Regional GHG Energy & GHG Emissions by Sector

Source	Type	Consumption	Units	Energy (GJ)	GHG Emissions (tCO_2e)
Stationary Energy					
Residential Buildings	Electricity	2,085,498	MWh	7,507,733	83,628
	Natural Gas	2,567,162	GJ	2,567,162	128,018
	Fuel Oil	77,480	L	1,996,899	136,540
	Propane	8,782	L	346,989	21,219
	Wood	960,568	GJ	960,568	22,556
	Diesel	5,503,439	L	212,873	14,934
Commercial & Industrial Buildings	Electricity	1,261,996	MWh	4,543,149	50,606
	Natural Gas	4,202,648	GJ	4,202,648	209,576
	Fuel Oil	5,549	L	143,003	9,778
	Diesel	12,216,854	L	472,548	33,152
Energy Industries	LFG Combustion				9,563
Agriculture, Forestry And Fishing Activities	Diesel	20,790,676	L	804,183	56,418
Natural Gas Fugitive Emissions					1,408
Total				**23,757,755**	**777,397**
On-Road Transportation					
Electric Vehicles	Electricity	124,712	MWh	62,328	694
Hydrogen Vehicles	Hydrogen	0	L	0	0
Passenger Vehicles	Gasoline + Diesel	89,922,529	L	3,125,089	195,999
Light Trucks, Vans, SUVs	Gasoline + Diesel	166,980,928	L	5,845,129	371,982
Heavy Duty Vehicles	Gasoline + Diesel	52,705,103	L	1,968,957	124,065
Propane Vehicles	Propane	628,682	L	16,050	911
Natural Gas Vehicles	Natural Gas	785,220	kg	42,240	2,282
Motorcycles	Gasoline	1,074,790	L	37,252	2,415
Total On-Road Transportation				**11,097,044**	**698,348**
Off-Road Transportation					
Marine, Aviation and Other Off-Road Vehicles	Marine Gasoline + Marine Diesel + Jet Fuel	31,750,577	L	1,208,859	86,527
Total Off-Road Transportation				**1,208,859**	**86,527**

Source	Type	Consumption	Units	Energy (GJ)	GHG Emissions (tCO_2e)
Waste					
Wastewater					15,035
Composting					5,307
Solid Waste					66,237
Total Waste					**86,580**
Agriculture Forestry & Other Land Use (AFOLU)					
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-399,707
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					89,610
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					4,261
Total AFOLU					**4,261**
Industrial Process & Product Use (IPPU)					
Process Use Emissions					130,139
Total IPPU					**130,139**
TOTAL				**36,063,658**	**1,783,251**
TOTAL Per Capita				**85.9**	**4.2**

Energy consumption and GHG emissions by source are shown in **Figure 6**, **Figure 7** and **Figure 8**.

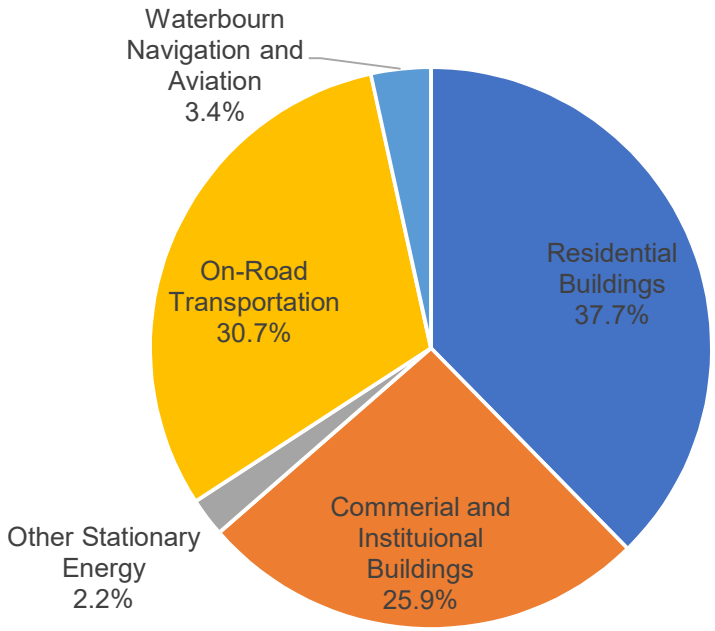


Figure 6. 2020 Regional Energy Consumption By Sector

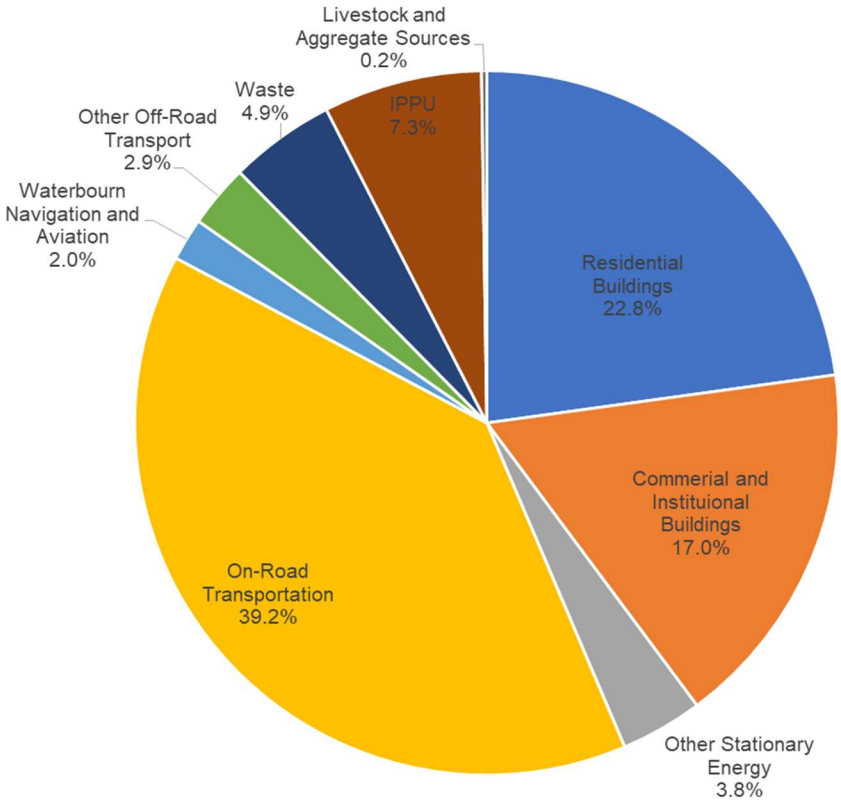


Figure 7. 2020 Regioanal GHG Emissions By Sector

GHG emissions by fuel type is presented in **Figure 8**.

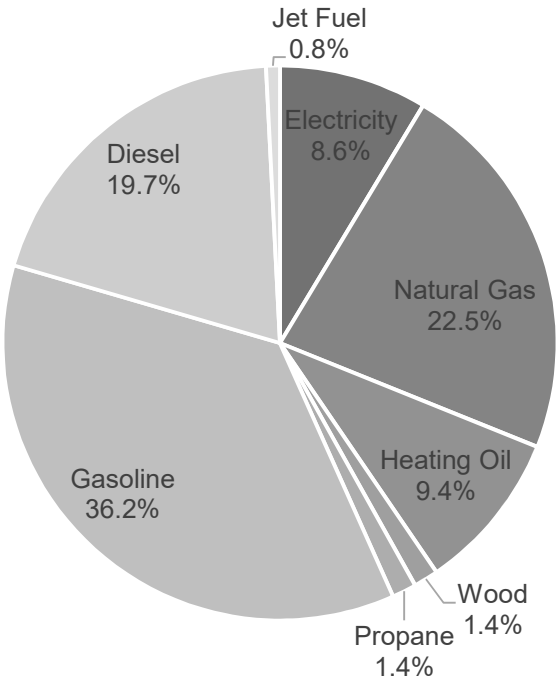


Figure 8. 2020 Regional GHG Emissions By Fuel Type

3.4 Energy & GHG Emissions Trends

Table 6 presents the changes between the 2007 and 2020 reporting years, showing that GHG emissions decreased in most reporting sectors. There were decreases in energy consumption in the stationary energy and transportation sectors as a result of COVID-19 restrictions. While there was a corresponding decrease in transportation GHG emissions, there was a slight increase in GHG emissions in the stationary energy sector simply due to the electricity grid emissions factor increasing by approximately 13% from 2007.

There was an increase in composting emissions which is the direct result of waste diversion programs which result in some direct GHG emissions, but overall have a net reduction impact as the process avoids releasing more fugitive methane emissions from the landfill. Total waste emissions declined 34% from the base year as a result.

IPPU GHG emissions increased as these GHG emissions are driven by population and increased by 68%. AFOLU GHG emissions, which accounted for livestock, aggregate sources and non-CO_2 emission sources on land, increased 25%.

Table 6. Change in CRD GHG Energy & GHG Emissions

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	7,570,620	7,507,733	-0.8%	75,076	83,628	11.4%
	Natural Gas	2,639,980	2,567,162	-2.8%	131,649	128,018	-2.8%
	Fuel Oil	2,147,821	1,996,899	-7.0%	146,859	136,540	-7.0%
	Propane	424,600	346,989	-18.3%	25,882	21,219	-18.0%
	Wood	1,144,369	960,568	-16.1%	26,872	22,556	-16.1%
	Diesel	261,123	212,873	-18.5%	19,468	14,934	-23.3%
Commercial & Industrial Buildings	Electricity	4,924,469	4,543,149	-7.7%	48,835	50,606	3.6%
	Natural Gas	3,352,456	4,202,648	25.4%	167,179	209,576	25.4%
	Fuel Oil	161,638	143,003	-11.5%	11,052	9,778	-11.5%
	Diesel	470,877	472,548	0.4%	35,106	33,152	-5.6%
Energy Industries	LFG Combustion			-	418	9,563	2186.5%
Agriculture, Forestry And Fishing Activities	Diesel	832,418	804,183	-3.4%	62,060	56,418	-9.1%
Natural Gas Fugitive Emissions				-	1,003	1,408	40.4%
Total		**23,930,370**	**23,757,755**	**-0.7%**	**751,459**	**777,397**	**3.5%**
On-Road Transportation							
Electric Vehicles	Electricity	-	62,328	-	-	694	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	5,673,042	3,125,089	-44.9%	384,119	195,999	-49.0%
Light Trucks, Vans, SUVs	Gasoline + Diesel	5,003,722	5,845,129	16.8%	343,341	371,982	8.3%
Heavy Duty Vehicles	Gasoline + Diesel	2,230,995	1,968,957	-11.7%	150,544	124,065	-17.6%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Propane Vehicles	Propane	33,756	16,050	-52.5%	2,035	911	-55.3%
Natural Gas Vehicles	Natural Gas	-	42,240	-	-	2,282	-
Motorcycles	Gasoline	41,874	37,252	-11.0%	2,885	2,415	-16.3%
Total On-Road Transportation		**12,983,390**	**11,097,044**	**-14.5%**	**882,924**	**698,348**	**-20.9%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	1,746,608	1,242,888	-28.8%	130,656	89,090	-31.8%
Total Off-Road Transportation		**1,746,608**	**1,208,859**	**-31.8%**	**130,656**	**86,527**	**-33.8%**
Waste							
Wastewater					18,998	15,035	-20.9%
Composting					72	5,307	7235.5%
Solid Waste					111,234	66,237	-40.5%
Total Waste					**130,304**	**86,580**	**-33.6%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-396,487	-399,707	0.8%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					151,516	89,610	-40.9%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					3,408	4,261	25.0%
Total AFOLU					**3,408**	**4,261**	**25.0%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					77,348	130,139	68.3%
Total IPPU					**77,348**	**130,139**	**68.3%**
TOTAL		**38,660,368**	**36,097,687**	**-6.6%**	**1,976,100**	**1,785,814**	**-9.6%**

Table 7 presents the changes between the 2007 and 2020 years for each CRD local government.

Table 7. Change in Member GHG Energy & GHG Emissions

Member	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
District of Central Saanich	1,867,417	1,903,819	1.9%	97,077	96,437	-0.7%
City of Colwood	1,533,734	1,487,893	-3.0%	82,439	76,591	-7.1%
Township of Esquimalt	1,784,465	1,565,499	-12.3%	96,314	80,712	-16.2%
District of Highlands	217,328	291,021	33.9%	11,358	14,614	28.7%
Juan de Fuca Electoral Area	1,282,178	1,399,797	9.2%	62,493	69,270	10.8%
City of Langford	2,594,734	3,335,434	28.5%	134,791	165,160	22.5%
District of Metchosin	513,449	436,613	-15.0%	27,015	20,624	-23.7%
District of North Saanich	1,323,026	1,234,114	-6.7%	63,747	54,424	-14.6%
District of Oak Bay	1,664,925	1,484,989	-10.8%	90,483	76,427	-15.5%
District of Saanich	11,054,201	9,457,076	-14.4%	582,422	486,037	-16.5%
Salt Spring Island Electoral Area	1,058,268	1,002,959	-5.2%	48,689	42,920	-11.8%
Town of Sidney	1,234,379	1,096,986	-11.1%	62,744	53,276	-15.1%
District of Sooke	961,620	1,114,759	15.9%	51,194	55,790	9.0%
City of Victoria	9,852,916	8,467,486	-14.0%	484,582	408,761	-15.6%
Town of View Royal	962,988	1,080,921	12.2%	49,949	54,477	9.1%
Southern Gulf Islands Electoral Area	754,738	704,290	-6.7%	30,803	27,730	-10.0%

4 DISTRICT OF CENTRAL SAANICH

4.1 2020 Profile

Profile	
Population	18,353
Dwellings	7,672
Registered Vehicles	17,330
Energy (Thousands of GJ)	1,904
GHG Emissions (tCO_2e)	96,437

4.2 Energy & GHG Emissions

Table 8 presents a summary comparison of the District of Central Saanich's 2007 and 2020 energy and GHG emissions.

Table 8. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	400,574	372,185	-7.1%	3,972	4,146	4.4%
	Natural Gas	101,999	137,929	35.2%	5,086	6,878	35.2%
	Fuel Oil	18,644	25,623	37.4%	1,275	1,752	37.4%
	Propane	3,220	2,625	-18.5%	196	161	-18.2%
	Wood	7,150	5,957	-16.7%	168	140	-16.7%
	Diesel	11,997	9,309	-22.4%	894	653	-27.0%
Commercial & Industrial Buildings	Electricity	231,056	224,451	-2.9%	2,291	2,500	9.1%
	Natural Gas	152,986	147,828	-3.4%	7,629	7,372	-3.4%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	21,633	20,664	-4.5%	1,613	1,450	-10.1%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	57,230	51,363	-10.3%	4,267	3,603	-15.5%
Natural Gas Fugitive Emissions				-	57	77	36.0%
Total		**1,006,488**	**997,933**	**-0.8%**	**27,449**	**28,731**	**4.7%**
On-Road Transportation							
Electric Vehicles	Electricity	-	3,573	-	-	40	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	278,538	158,354	-43.1%	18,862	9,933	-47.3%
Light Trucks, Vans, SUVs	Gasoline + Diesel	324,185	381,136	17.6%	22,243	24,262	9.1%
Heavy Duty Vehicles	Gasoline + Diesel	179,749	307,951	71.3%	12,153	19,279	58.6%
Propane Vehicles	Propane	2,375	664	-72.0%	143	38	-73.7%
Natural Gas Vehicles	Natural Gas	-	43	-	-	2	-
Motorcycles	Gasoline	2,245	1,798	-19.9%	155	117	-24.7%
Total On-Road Transportation		**787,093**	**853,520**	**8.4%**	**53,556**	**53,670**	**0.2%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	73,836	52,366	-29.1%	5,520	3,746	-32.1%
Total Off-Road Transportation		**73,836**	**52,366**	**-29.1%**	**5,520**	**3,746**	**-32.1%**
Waste							
Wastewater					668	592	-11.4%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	0	-
Solid Waste					5,110	2,579	-49.5%
Total Waste					**5,778**	**3,170**	**-45.1%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-5,014	-4,845	-3.4%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					5,925	154	-97.4%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					1,221	1,408	15.3%
Total AFOLU					**1,221**	**1,408**	**15.3%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					3,554	5,711	60.7%
Total IPPU					**3,554**	**5,711**	**60.7%**
TOTAL		**1,867,417**	**1,903,819**	**1.9%**	**97,077**	**96,437**	**-0.7%**

5 CITY OF COLWOOD

5.1 2020 Profile

Profile	
Population	19,373
Dwellings	7,345
Registered Vehicles	12,247
Energy (Thousands of GJ)	1,488
GHG Emissions (tCO_2e)	76,591

5.2 Energy & GHG Emissions

Table 9 presents a summary comparison of the City of Colwood's 2007 and 2020 energy and GHG emissions.

Table 9. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	304,680	320,194	5.1%	3,021	3,567	18.0%
	Natural Gas	100,740	159,872	58.7%	5,024	7,972	58.7%
	Fuel Oil	65,936	90,620	37.4%	4,508	6,196	37.4%
	Propane	11,388	9,284	-18.5%	694	568	-18.2%
	Wood	25,284	21,063	-16.7%	594	495	-16.7%
	Diesel	11,473	9,826	-14.4%	855	689	-19.4%
Commercial & Industrial Buildings	Electricity	159,630	134,739	-15.6%	1,583	1,501	-5.2%
	Natural Gas	94,097	90,451	-3.9%	4,692	4,511	-3.9%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	20,689	21,813	5.4%	1,542	1,530	-0.8%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	54,732	54,218	-0.9%	4,081	3,804	-6.8%
Natural Gas Fugitive Emissions				-	61	98	61.1%
Total		**848,651**	**912,079**	**7.5%**	**26,656**	**30,930**	**16.0%**
On-Road Transportation							
Electric Vehicles	Electricity	-	2,215	-	-	25	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	233,329	125,517	-46.2%	15,797	7,871	-50.2%
Light Trucks, Vans, SUVs	Gasoline + Diesel	265,308	274,955	3.6%	18,205	17,500	-3.9%
Heavy Duty Vehicles	Gasoline + Diesel	112,247	80,606	-28.2%	7,581	5,095	-32.8%
Propane Vehicles	Propane	1,441	566	-60.7%	87	32	-63.0%
Natural Gas Vehicles	Natural Gas	-	34,784	-	-	1,879	-
Motorcycles	Gasoline	2,145	1,893	-11.8%	148	123	-17.0%
Total On-Road Transportation		**614,470**	**520,536**	**-15.3%**	**41,818**	**32,525**	**-22.2%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	70,613	55,277	-21.7%	5,279	3,955	-25.1%
Total Off-Road Transportation		**70,613**	**55,277**	**-21.7%**	**5,279**	**3,955**	**-25.1%**
Waste							
Wastewater					397	516	30.0%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	0	-
Solid Waste					4,887	2,722	-44.3%
Total Waste					**5,285**	**3,238**	**-38.7%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-2,536	-3,208	26.5%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					2,482	2,755	11.0%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					2	0	-83.9%
Total AFOLU					**2**	**0**	**-83.9%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					3,399	5,942	74.9%
Total IPPU					**3,399**	**5,942**	**74.9%**
TOTAL		**1,533,734**	**1,487,893**	**-3.0%**	**82,439**	**76,591**	**-7.1%**

6 TOWNSHIP OF ESQUIMALT

6.1 2020 Profile

Profile	
Population	19,015
Dwellings	9,268
Registered Vehicles	11,322
Energy (Thousands of GJ)	1,565
GHG Emissions (tCO_2e)	80,712

6.2 Energy & GHG Emissions

Table 10 presents a summary comparison of the Township of Esquimalt's 2007 and 2020 energy and GHG emissions.

Table 10. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	282,544	258,816	-8.4%	2,802	2,883	2.9%
	Natural Gas	133,315	87,824	-34.1%	6,648	4,380	-34.1%
	Fuel Oil	116,338	159,889	37.4%	7,955	10,933	37.4%
	Propane	20,190	16,460	-18.5%	1,231	1,007	-18.2%
	Wood	44,358	36,952	-16.7%	1,042	868	-16.7%
	Diesel	12,894	9,645	-25.2%	961	677	-29.6%
Commercial & Industrial Buildings	Electricity	167,991	172,756	2.8%	1,666	1,924	15.5%
	Natural Gas	323,843	321,319	-0.8%	16,149	16,023	-0.8%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	23,251	21,409	-7.9%	1,733	1,502	-13.4%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	-	-	-	-	-	-
Natural Gas Fugitive Emissions				-	44	52	17.5%
Total		**1,124,723**	**1,085,069**	**-3.5%**	**40,231**	**40,248**	**0.0%**
On-Road Transportation							
Electric Vehicles	Electricity	-	1,968	-	-	22	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	263,197	139,858	-46.9%	17,819	8,771	-50.8%
Light Trucks, Vans, SUVs	Gasoline + Diesel	215,762	225,218	4.4%	14,805	14,325	-3.2%
Heavy Duty Vehicles	Gasoline + Diesel	97,205	55,964	-42.4%	6,551	3,507	-46.5%
Propane Vehicles	Propane	1,908	467	-75.5%	115	27	-76.9%
Natural Gas Vehicles	Natural Gas	-	548	-	-	30	-
Motorcycles	Gasoline	2,312	2,151	-7.0%	159	139	-12.5%
Total On-Road Transportation		**580,384**	**426,175**	**-26.6%**	**39,450**	**26,820**	**-32.0%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	79,358	54,255	-31.6%	5,933	3,882	-34.6%
Total Off-Road Transportation		**79,358**	**54,255**	**-31.6%**	**5,933**	**3,882**	**-34.6%**
Waste							
Wastewater					1,388	1,037	-25.3%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	95	-
Solid Waste					5,493	2,672	-51.4%
Total Waste					**6,880**	**3,804**	**-44.7%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-828	-1,152	39.2%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					1,155	1,284	11.2%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					0	0	-
Total AFOLU					**0**	**0**	**-**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					3,819	5,959	56.0%
Total IPPU					**3,819**	**5,959**	**56.0%**
TOTAL		**1,784,465**	**1,565,499**	**-12.3%**	**96,314**	**80,712**	**-16.2%**

7 DISTRICT OF HIGHLANDS

7.1 2020 Profile

Profile	
Population	2,451
Dwellings	920
Registered Vehicles	2,657
Energy (Thousands of GJ)	291
GHG Emissions (tCO_2e)	14,614

7.2 Energy & GHG Emissions

Table 11 presents a summary comparison of the District of Highland's 2007 and 2020 energy and GHG emissions.

Table 11. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	63,637	73,144	14.9%	631	815	29.1%
	Natural Gas	69	5,126	7281.1%	3	256	7281.1%
	Fuel Oil	9,468	13,012	37.4%	647	890	37.4%
	Propane	1,633	1,331	-18.5%	100	81	-18.2%
	Wood	3,637	3,030	-16.7%	85	71	-16.7%
	Diesel	1,459	1,243	-14.8%	109	87	-19.8%
Commercial & Industrial Buildings	Electricity	6,447	15,511	140.6%	64	173	170.3%
	Natural Gas	20,440	24,233	18.6%	1,019	1,208	18.6%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	2,630	2,760	4.9%	196	194	-1.3%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	6,958	6,859	-1.4%	519	481	-7.2%
Natural Gas Fugitive Emissions				-	0	3	1527.9%
Total		**116,378**	**146,249**	**25.7%**	**3,374**	**4,259**	**26.2%**
On-Road Transportation							
Electric Vehicles	Electricity	-	523	-	-	6	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	25,510	19,587	-23.2%	1,728	1,229	-28.9%
Light Trucks, Vans, SUVs	Gasoline + Diesel	43,712	63,436	45.1%	2,999	4,044	34.9%
Heavy Duty Vehicles	Gasoline + Diesel	21,645	53,613	147.7%	1,461	3,411	133.5%
Propane Vehicles	Propane	779	192	-75.3%	47	11	-76.8%
Natural Gas Vehicles	Natural Gas	-	-	-	-	-	-
Motorcycles	Gasoline	327	427	30.5%	23	28	22.8%
Total On-Road Transportation		**91,972**	**137,778**	**49.8%**	**6,258**	**8,729**	**39.5%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	8,978	6,993	-22.1%	671	500	-25.5%
Total Off-Road Transportation		**8,978**	**6,993**	**-22.1%**	**671**	**500**	**-25.5%**
Waste							
Wastewater					0	0	-

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	0	-
Solid Waste					621	344	-44.6%
Total Waste					**621**	**344**	**-44.6%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-7,090	-7,504	5.8%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					1,957	3,157	61.4%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					2	4	102.2%
Total AFOLU					**2**	**4**	**102.2%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					432	777	79.9%
Total IPPU					**432**	**777**	**79.9%**
TOTAL		**217,328**	**291,021**	**33.9%**	**11,358**	**14,614**	**28.7%**

8 JUAN DE FUCA ELECTORAL AREA

8.1 2020 Profile

Profile	
Population	5,098
Dwellings	2,234
Registered Vehicles	4,212
Energy (Thousands of GJ)	1,400
GHG Emissions (tCO_2e)	69,270

8.2 Energy & GHG Emissions

Table 12 presents a summary comparison of Juan de Fuca Electoral Area's 2007 and 2020 energy and GHG emissions.

Table 12. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	275,784	296,557	7.5%	2,735	3,303	20.8%
	Natural Gas	-	-	-	-	-	-
	Fuel Oil	442,152	606,090	37.1%	30,233	41,442	37.1%
	Propane	82,743	67,453	-18.5%	5,044	4,125	-18.2%
	Wood	184,018	153,297	-16.7%	4,321	3,600	-16.7%
	Diesel	3,223	2,586	-19.8%	240	181	-24.5%
Commercial & Industrial Buildings	Electricity	47,620	62,548	31.3%	472	697	47.5%
	Natural Gas	-	-	-	-	-	-

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	5,812	5,740	-1.2%	433	403	-7.1%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	15,377	14,269	-7.2%	1,146	1,001	-12.7%
Natural Gas Fugitive Emissions				-	-	-	-
Total		**1,056,729**	**1,208,540**	**14.4%**	**44,624**	**54,752**	**22.7%**
On-Road Transportation							
Electric Vehicles	Electricity	-	823	-	-	9	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	7,521	36,872	390.2%	513	2,315	351.2%
Light Trucks, Vans, SUVs	Gasoline + Diesel	119,903	104,053	-13.2%	8,225	6,631	-19.4%
Heavy Duty Vehicles	Gasoline + Diesel	76,109	33,664	-55.8%	5,174	2,129	-58.9%
Propane Vehicles	Propane	1,830	815	-55.5%	110	46	-58.1%
Natural Gas Vehicles	Natural Gas	-	-	-	-	-	-
Motorcycles	Gasoline	247	482	94.8%	17	31	83.3%
Total On-Road Transportation		**205,611**	**176,709**	**-14.1%**	**14,040**	**11,161**	**-20.5%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	19,838	14,547	-26.7%	1,483	1,041	-29.8%
Total Off-Road Transportation		**19,838**	**14,547**	**-26.7%**	**1,483**	**1,041**	**-29.8%**
Waste							
Wastewater					0	0	77.5%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	0	-
Solid Waste					1,373	716	-47.8%
Total Waste					**1,373**	**717**	**-47.8%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-259,223	-255,625	-1.4%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					31,481	706	-97.8%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					18	6	-68.5%
Total AFOLU					**18**	**6**	**-68.5%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					955	1,594	67.0%
Total IPPU					**955**	**1,594**	**67.0%**
TOTAL		**1,282,178**	**1,399,797**	**9.2%**	**62,493**	**69,270**	**10.8%**

9 CITY OF LANGFORD

9.1 2020 Profile

Profile	
Population	44,069
Dwellings	16,654
Registered Vehicles	26,768
Energy (Thousands of GJ)	3,335
GHG Emissions (tCO_2e)	165,160

9.2 Energy & GHG Emissions

Table 13 presents a summary comparison of the City of Langford's 2007 and 2020 energy and GHG emissions.

Table 13. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	514,977	724,587	40.7%	5,107	8,071	58.0%
	Natural Gas	122,432	248,420	102.9%	6,105	12,388	102.9%
	Fuel Oil	103,002	141,561	37.4%	7,043	9,679	37.4%
	Propane	17,793	14,505	-18.5%	1,085	887	-18.2%
	Wood	39,489	32,896	-16.7%	927	772	-16.7%
	Diesel	18,289	22,352	22.2%	1,364	1,568	15.0%
Commercial & Industrial Buildings	Electricity	343,772	429,804	25.0%	3,409	4,788	40.4%
	Natural Gas	186,387	344,294	84.7%	9,295	17,169	84.7%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	32,980	49,618	50.5%	2,459	3,481	41.6%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	87,246	123,333	41.4%	6,505	8,652	33.0%
Natural Gas Fugitive Emissions				-	81	167	106.9%
Total		**1,466,368**	**2,131,371**	**45.4%**	**43,378**	**67,623**	**55.9%**
On-Road Transportation							
Electric Vehicles	Electricity	-	4,542	-	-	51	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	364,717	284,365	-22.0%	24,694	17,833	-27.8%
Light Trucks, Vans, SUVs	Gasoline + Diesel	432,627	591,061	36.6%	29,684	37,619	26.7%
Heavy Duty Vehicles	Gasoline + Diesel	211,623	187,913	-11.2%	14,314	11,886	-17.0%
Propane Vehicles	Propane	3,348	1,547	-53.8%	202	88	-56.5%
Natural Gas Vehicles	Natural Gas	-	5,250	-	-	284	-
Motorcycles	Gasoline	3,488	3,643	4.4%	240	236	-1.7%
Total On-Road Transportation		**1,015,805**	**1,078,322**	**6.2%**	**69,134**	**67,997**	**-1.6%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	112,562	125,741	11.7%	8,415	8,996	6.9%
Total Off-Road Transportation		**112,562**	**125,741**	**11.7%**	**8,415**	**8,996**	**6.9%**
Waste							
Wastewater					621	1,093	76.0%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	0	-
Solid Waste					7,791	6,192	-20.5%
Total Waste					**8,412**	**7,285**	**-13.4%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-6,609	-7,108	7.6%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					6,886	8,316	20.8%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					35	52	47.7%
Total AFOLU					**35**	**52**	**47.7%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					5,417	13,207	143.8%
Total IPPU					**5,417**	**13,207**	**143.8%**
TOTAL		**2,594,734**	**3,335,434**	**28.5%**	**134,791**	**165,160**	**22.5%**

10 DISTRICT OF METCHOSIN

10.1 2020 Profile

Profile	
Population	5,049
Dwellings	2,018
Registered Vehicles	3,794
Energy (Thousands of GJ)	437
GHG Emissions (tCO_2e)	20,624

10.2 Energy & GHG Emissions

Table 14 presents a summary comparison of the District of Metchosin's 2007 and 2020 energy and GHG emissions.

Table 14. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	136,893	138,768	1.4%	1,358	1,546	13.9%
	Natural Gas	8,173	10,441	27.8%	408	521	27.8%
	Fuel Oil	9,003	12,373	37.4%	616	846	37.4%
	Propane	1,553	1,266	-18.5%	95	77	-18.2%
	Wood	3,457	2,880	-16.7%	81	68	-16.7%
	Diesel	3,601	2,561	-28.9%	268	180	-33.1%
Commercial & Industrial Buildings	Electricity	38,037	39,630	4.2%	377	441	17.0%
	Natural Gas	33,858	27,808	-17.9%	1,688	1,387	-17.9%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	6,494	5,685	-12.5%	484	399	-17.6%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	17,180	14,130	-17.8%	1,281	991	-22.6%
Natural Gas Fugitive Emissions				-	4	4	9.7%
Total		**258,249**	**255,542**	**-1.0%**	**6,660**	**6,460**	**-3.0%**
On-Road Transportation							
Electric Vehicles	Electricity	-	970	-	-	11	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	80,035	32,755	-59.1%	5,421	2,057	-62.1%
Light Trucks, Vans, SUVs	Gasoline + Diesel	110,966	92,513	-16.6%	7,613	5,897	-22.5%
Heavy Duty Vehicles	Gasoline + Diesel	40,316	39,888	-1.1%	2,721	2,521	-7.3%
Propane Vehicles	Propane	1,051	125	-88.1%	63	7	-88.8%
Natural Gas Vehicles	Natural Gas	-	-	-	-	-	-
Motorcycles	Gasoline	668	414	-38.1%	46	27	-41.7%
Total On-Road Transportation		**233,036**	**166,665**	**-28.5%**	**15,865**	**10,520**	**-33.7%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	22,165	14,406	-35.0%	1,657	1,031	-37.8%
Total Off-Road Transportation		**22,165**	**14,406**	**-35.0%**	**1,657**	**1,031**	**-37.8%**
Waste							
Wastewater					0	0	-

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	0	-
Solid Waste					1,534	709	-53.8%
Total Waste					**1,534**	**709**	**-53.8%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-12,139	-12,971	6.9%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					4,011	4,030	0.5%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					232	294	26.3%
Total AFOLU					**232**	**294**	**26.3%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					1,067	1,611	51.0%
Total IPPU					**1,067**	**1,611**	**51.0%**
TOTAL		**513,449**	**436,613**	**-15.0%**	**27,015**	**20,624**	**-23.7%**

11 DISTRICT OF NORTH SAANICH

11.1 2020 Profile

Profile	
Population	11,965
Dwellings	5,096
Registered Vehicles	10,318
Energy (Thousands of GJ)	1,234
GHG Emissions (tCO_2e)	54,424

11.2 Energy & GHG Emissions

Table 15 presents a summary comparison of the District of North Saanich's 2007 and 2020 energy and GHG emissions.

Table 15. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	375,413	355,429	-5.3%	3,723	3,959	6.3%
	Natural Gas	41,591	79,120	90.2%	2,074	3,946	90.2%
	Fuel Oil	5,953	8,182	37.4%	407	559	37.4%
	Propane	1,027	837	-18.5%	63	51	-18.2%
	Wood	2,286	1,905	-16.7%	54	45	-16.7%
	Diesel	8,138	6,069	-25.4%	607	426	-29.8%
Commercial & Industrial Buildings	Electricity	156,437	182,752	16.8%	1,551	2,036	31.2%
	Natural Gas	99,927	101,626	1.7%	4,983	5,068	1.7%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	14,674	13,472	-8.2%	1,094	945	-13.6%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	38,821	33,486	-13.7%	2,894	2,349	-18.8%
Natural Gas Fugitive Emissions				-	21	38	80.1%
Total		**744,266**	**782,876**	**5.2%**	**17,471**	**19,421**	**11.2%**
On-Road Transportation							
Electric Vehicles	Electricity	-	3,078	-	-	34	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	208,096	105,673	-49.2%	14,094	6,633	-52.9%
Light Trucks, Vans, SUVs	Gasoline + Diesel	227,960	231,300	1.5%	15,641	14,730	-5.8%
Heavy Duty Vehicles	Gasoline + Diesel	89,923	74,597	-17.0%	6,043	4,691	-22.4%
Propane Vehicles	Propane	1,012	680	-32.8%	61	39	-36.8%
Natural Gas Vehicles	Natural Gas	-	231	-	-	12	-
Motorcycles	Gasoline	1,684	1,540	-8.6%	116	100	-13.9%
Total On-Road Transportation		**528,675**	**417,098**	**-21.1%**	**35,956**	**26,238**	**-27.0%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	50,085	34,140	-31.8%	3,744	2,442	-34.8%
Total Off-Road Transportation		**50,085**	**34,140**	**-31.8%**	**3,744**	**2,442**	**-34.8%**
Waste							
Wastewater					196	235	19.8%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	0	-
Solid Waste					3,467	1,681	-51.5%
Total Waste					**3,663**	**1,916**	**-47.7%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-5,055	-5,135	1.6%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					4,758	5,160	8.5%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					502	665	32.4%
Total AFOLU					**502**	**665**	**32.4%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					2,410	3,741	55.2%
Total IPPU					**2,410**	**3,741**	**55.2%**
TOTAL		**1,323,026**	**1,234,114**	**-6.7%**	**63,747**	**54,424**	**-14.6%**

12 DISTRICT OF OAK BAY

12.1 2020 Profile

Profile	
Population	18,918
Dwellings	8,132
Registered Vehicles	11,966
Energy (Thousands of GJ)	1,485
GHG Emissions (tCO_2e)	76,427

12.2 Energy & GHG Emissions

Table 16 presents a summary comparison of the District of Oak Bay's 2007 and 2020 energy and GHG emissions.

Table 16. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	370,574	323,663	-12.7%	3,675	3,605	-1.9%
	Natural Gas	276,642	299,206	8.2%	13,795	14,921	8.2%
	Fuel Oil	66,466	91,348	37.4%	4,545	6,246	37.4%
	Propane	11,487	9,364	-18.5%	700	573	-18.2%
	Wood	25,469	21,217	-16.7%	598	498	-16.7%
	Diesel	13,651	9,595	-29.7%	1,018	673	-33.9%
Commercial & Industrial Buildings	Electricity	106,747	95,438	-10.6%	1,059	1,063	0.4%
	Natural Gas	83,140	122,251	47.0%	4,146	6,096	47.0%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	24,616	21,300	-13.5%	1,835	1,494	-18.6%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	-	-	-	-	-	-
Natural Gas Fugitive Emissions				-	83	110	32.6%
Total		**978,790**	**993,382**	**1.5%**	**31,454**	**35,280**	**12.2%**
On-Road Transportation							
Electric Vehicles	Electricity	-	4,154	-	-	46	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	322,115	148,012	-54.1%	21,812	9,282	-57.4%
Light Trucks, Vans, SUVs	Gasoline + Diesel	199,128	235,082	18.1%	13,665	14,953	9.4%
Heavy Duty Vehicles	Gasoline + Diesel	78,248	48,579	-37.9%	5,271	3,048	-42.2%
Propane Vehicles	Propane	857	239	-72.1%	52	14	-73.8%
Natural Gas Vehicles	Natural Gas	-	58	-	-	3	-
Motorcycles	Gasoline	1,771	1,506	-15.0%	122	98	-20.0%
Total On-Road Transportation		**602,119**	**437,628**	**-27.3%**	**40,922**	**27,444**	**-32.9%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	84,016	53,978	-35.8%	6,281	3,862	-38.5%
Total Off-Road Transportation		**84,016**	**53,978**	**-35.8%**	**6,281**	**3,862**	**-38.5%**
Waste							
Wastewater					1,968	1,229	-37.5%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	95	-
Solid Waste					5,815	2,658	-54.3%
Total Waste					**7,783**	**3,982**	**-48.8%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-1,461	-1,846	26.3%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					1,731	1,898	9.6%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					0	0	68.7%
Total AFOLU					**0**	**0**	**68.7%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					4,044	5,860	44.9%
Total IPPU					**4,044**	**5,860**	**44.9%**
TOTAL		**1,664,925**	**1,484,989**	**-10.8%**	**90,483**	**76,427**	**-15.5%**

13 THE DISTRICT OF SAANICH

13.1 2020 Profile

Profile	
Population	125,107
Dwellings	50,365
Registered Vehicles	81,162
Energy (Thousands of GJ)	9,457
GHG Emissions (tCO_2e)	486,037

13.2 Energy & GHG Emissions

Table 17 presents a summary comparison of the District of Saanich's 2007 and 2020 energy and GHG emissions.

Table 17. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	2,358,702	2,161,003	-8.4%	23,391	24,071	2.9%
	Natural Gas	743,960	847,026	13.9%	37,099	42,239	13.9%
	Fuel Oil	518,953	318,823	-38.6%	35,484	21,800	-38.6%
	Propane	97,519	79,499	-18.5%	5,944	4,862	-18.2%
	Wood	216,161	180,074	-16.7%	5,076	4,229	-16.7%
	Diesel	82,502	63,455	-23.1%	6,151	4,452	-27.6%
Commercial & Industrial Buildings	Electricity	1,176,089	1,004,564	-14.6%	11,663	11,190	-4.1%
	Natural Gas	759,454	817,053	7.6%	37,872	40,744	7.6%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	38,936	20,302	-47.9%	2,662	1,388	-47.9%
	Diesel	148,774	140,861	-5.3%	11,092	9,882	-10.9%
Energy Industries	LFG Combustion			-	418	9,563	2186.5%
Agriculture, Forestry And Fishing Activities	Diesel	393,575	350,128	-11.0%	29,343	24,563	-16.3%
Natural Gas Fugitive Emissions				-	314	438	39.4%
Total		**6,534,625**	**5,982,788**	**-8.4%**	**206,509**	**199,421**	**-3.4%**
On-Road Transportation							
Electric Vehicles	Electricity	-	19,566	-	-	218	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	1,877,530	959,118	-48.9%	127,117	60,145	-52.7%
Light Trucks, Vans, SUVs	Gasoline + Diesel	1,549,388	1,681,901	8.6%	106,319	107,018	0.7%
Heavy Duty Vehicles	Gasoline + Diesel	564,907	442,895	-21.6%	38,090	27,964	-26.6%
Propane Vehicles	Propane	8,605	3,749	-56.4%	519	213	-59.0%
Natural Gas Vehicles	Natural Gas	-	807	-	-	44	-
Motorcycles	Gasoline	11,374	9,288	-18.3%	784	602	-23.2%
Total On-Road Transportation		**4,011,803**	**3,117,323**	**-22.3%**	**272,828**	**196,203**	**-28.1%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	507,773	356,966	-29.7%	37,961	25,538	-32.7%
Total Off-Road Transportation		**507,773**	**356,966**	**-29.7%**	**37,961**	**25,538**	**-32.7%**
Waste							
Wastewater					4,989	3,995	-19.9%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	3,923	-
Solid Waste					35,144	17,578	-50.0%
Total Waste					**40,134**	**25,496**	**-36.5%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-15,421	-16,969	10.0%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					22,453	13,619	-39.3%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					551	649	17.9%
Total AFOLU					**551**	**649**	**17.9%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					24,438	38,730	58.5%
Total IPPU					**24,438**	**38,730**	**58.5%**
TOTAL		**11,054,201**	**9,457,076**	**-14.4%**	**582,422**	**486,037**	**-16.5%**

14 SALT SPRING ELECTORAL AREA

14.1 2020 Profile

Profile	
Population	11,697
Dwellings	5,158
Registered Vehicles	8,996
Energy (Thousands of GJ)	1,003
GHG Emissions (tCO_2e)	42,920

14.2 Energy & GHG Emissions

Table 18 presents a summary comparison of Salt Spring Island Electoral Area's 2007 and 2020 energy and GHG emissions.

Table 18. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	360,697	362,362	0.5%	3,577	4,036	12.8%
	Natural Gas	-	-	-	-	-	-
	Fuel Oil	9,967	14,122	41.7%	682	966	41.7%
	Propane	9,006	7,569	-16.0%	549	463	-15.7%
	Wood	75,133	64,526	-14.1%	1,764	1,515	-14.1%
	Diesel	7,344	5,933	-19.2%	548	416	-24.0%
Commercial & Industrial Buildings	Electricity	91,954	105,860	15.1%	912	1,179	29.3%
	Natural Gas	-	-	-	-	-	-

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	13,243	13,170	-0.5%	987	924	-6.4%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	35,033	32,736	-6.6%	2,612	2,297	-12.1%
Natural Gas Fugitive Emissions				-	-	-	-
Total		**602,377**	**606,278**	**0.6%**	**11,630**	**11,796**	**1.4%**
On-Road Transportation							
Electric Vehicles	Electricity	-	3,002	-	-	33	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	166,502	74,130	-55.5%	11,276	4,651	-58.8%
Light Trucks, Vans, SUVs	Gasoline + Diesel	191,257	217,638	13.8%	13,124	13,852	5.5%
Heavy Duty Vehicles	Gasoline + Diesel	50,339	66,371	31.8%	3,348	4,157	24.2%
Propane Vehicles	Propane	857	950	10.9%	52	54	4.4%
Natural Gas Vehicles	Natural Gas	-	-	-	-	-	-
Motorcycles	Gasoline	1,737	1,214	-30.1%	120	79	-34.2%
Total On-Road Transportation		**410,693**	**363,306**	**-11.5%**	**27,920**	**22,827**	**-18.2%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	45,198	33,375	-26.2%	3,379	2,388	-29.3%
Total Off-Road Transportation		**45,198**	**33,375**	**-26.2%**	**3,379**	**2,388**	**-29.3%**
Waste							
Wastewater					49	10	-79.6%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	0	-
Solid Waste					3,128	1,643	-47.5%
Total Waste					**3,177**	**1,653**	**-48.0%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-33,060	-33,443	1.2%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					32,083	12,143	-62.2%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					407	604	48.4%
Total AFOLU					**407**	**604**	**48.4%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					2,175	3,652	67.9%
Total IPPU					**2,175**	**3,652**	**67.9%**
TOTAL		**1,058,268**	**1,002,959**	**-5.2%**	**48,689**	**42,920**	**-11.8%**

15 TOWN OF SIDNEY

15.1 2020 Profile

Profile	
Population	12,312
Dwellings	6,182
Registered Vehicles	8,066
Energy (Thousands of GJ)	1,097
GHG Emissions (tCO_2e)	53,276

15.2 Energy & GHG Emissions

Table 19 presents a summary comparison of the Town Sidney's 2007 and 2020 energy and GHG emissions.

Table 19. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	242,453	222,028	-8.4%	2,404	2,473	2.9%
	Natural Gas	70,155	91,578	30.5%	3,498	4,567	30.5%
	Fuel Oil	58,189	79,973	37.4%	3,979	5,468	37.4%
	Propane	10,069	8,209	-18.5%	614	502	-18.2%
	Wood	22,263	18,547	-16.7%	523	436	-16.7%
	Diesel	8,473	6,245	-26.3%	632	438	-30.6%
Commercial & Industrial Buildings	Electricity	187,401	168,687	-10.0%	1,858	1,879	1.1%
	Natural Gas	80,240	85,014	5.9%	4,001	4,239	5.9%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	15,280	13,862	-9.3%	1,139	973	-14.6%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	40,422	34,457	-14.8%	3,014	2,417	-19.8%
Natural Gas Fugitive Emissions				-	47	67	40.7%
Total		**734,947**	**728,600**	**-0.9%**	**21,710**	**23,459**	**8.1%**
On-Road Transportation							
Electric Vehicles	Electricity	-	1,393	-	-	16	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	199,863	94,379	-52.8%	13,532	5,919	-56.3%
Light Trucks, Vans, SUVs	Gasoline + Diesel	162,604	167,907	3.3%	11,158	10,685	-4.2%
Heavy Duty Vehicles	Gasoline + Diesel	82,565	68,182	-17.4%	5,565	4,293	-22.9%
Propane Vehicles	Propane	973	384	-60.5%	59	22	-62.8%
Natural Gas Vehicles	Natural Gas	-	-	-	-	-	-
Motorcycles	Gasoline	1,276	1,011	-20.8%	88	66	-25.5%
Total On-Road Transportation		**447,282**	**333,256**	**-25.5%**	**30,401**	**20,999**	**-30.9%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	52,151	35,130	-32.6%	3,899	2,513	-35.5%
Total Off-Road Transportation		**52,151**	**35,130**	**-32.6%**	**3,899**	**2,513**	**-35.5%**
Waste							
Wastewater					612	563	-8.1%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	170	-
Solid Waste					3,610	1,730	-52.1%
Total Waste					**4,222**	**2,463**	**-41.7%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-543	-514	-5.3%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					823	1,251	52.1%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					2	24	1373.0%
Total AFOLU					**2**	**24**	**1373.0%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					2,510	3,818	52.1%
Total IPPU					**2,510**	**3,818**	**52.1%**
TOTAL		**1,234,379**	**1,096,986**	**-11.1%**	**62,744**	**53,276**	**-15.1%**

16 DISTRICT OF SOOKE

16.1 2020 Profile

Profile	
Population	15,083
Dwellings	5,936
Registered Vehicles	10,132
Energy (Thousands of GJ)	1,115
GHG Emissions (tCO_2e)	55,790

16.2 Energy & GHG Emissions

Table 20 presents a summary comparison of the District of Sooke's 2007 and 2020 energy and GHG emissions.

Table 20. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	257,364	316,621	23.0%	2,552	3,527	38.2%
	Natural Gas	13,108	58,248	344.4%	654	2,905	344.4%
	Fuel Oil	56,455	77,589	37.4%	3,860	5,305	37.4%
	Propane	9,744	7,943	-18.5%	594	486	-18.2%
	Wood	21,667	18,049	-16.7%	509	424	-16.7%
	Diesel	7,633	7,650	0.2%	569	537	-5.7%
Commercial & Industrial Buildings	Electricity	68,790	82,223	19.5%	682	916	34.3%
	Natural Gas	16,506	33,412	102.4%	823	1,666	102.4%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	13,765	16,982	23.4%	1,026	1,191	16.1%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	36,415	42,212	15.9%	2,715	2,961	9.1%
Natural Gas Fugitive Emissions				-	13	44	243.7%
Total		**501,448**	**660,930**	**31.8%**	**13,997**	**19,962**	**42.6%**
On-Road Transportation							
Electric Vehicles	Electricity	-	1,944	-	-	22	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	141,887	103,480	-27.1%	9,610	6,493	-32.4%
Light Trucks, Vans, SUVs	Gasoline + Diesel	187,290	231,487	23.6%	12,850	14,742	14.7%
Heavy Duty Vehicles	Gasoline + Diesel	80,537	71,487	-11.2%	5,442	4,497	-17.4%
Propane Vehicles	Propane	1,986	839	-57.8%	120	48	-60.2%
Natural Gas Vehicles	Natural Gas	-	58	-	-	3	-
Motorcycles	Gasoline	1,490	1,499	0.6%	103	97	-5.3%
Total On-Road Transportation		**413,191**	**410,793**	**-0.6%**	**28,125**	**25,901**	**-7.9%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	46,981	43,036	-8.4%	3,512	3,079	-12.3%
Total Off-Road Transportation		**46,981**	**43,036**	**-8.4%**	**3,512**	**3,079**	**-12.3%**
Waste							
Wastewater					0	0	-

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	0	-
Solid Waste					3,252	2,119	-34.8%
Total Waste					**3,252**	**2,119**	**-34.8%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-9,952	-11,192	12.5%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					6,213	5,442	-12.4%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					47	149	212.9%
Total AFOLU					**47**	**149**	**212.9%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					2,261	4,580	102.6%
Total IPPU					**2,261**	**4,580**	**102.6%**
TOTAL		**961,620**	**1,114,759**	**15.9%**	**51,194**	**55,790**	**9.0%**

17 CITY OF VICTORIA

17.1 2020 Profile

Profile	
Population	94,415
Dwellings	49,635
Registered Vehicles	53,483
Energy (Thousands of GJ)	8,467
GHG Emissions (tCO_2e)	408,761

17.2 Energy & GHG Emissions

Table 21 presents a summary comparison of the City of Victoria's 2007 and 2020 energy and GHG emissions.

Table 21. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	1,235,156	1,186,142	-4.0%	12,249	13,212	7.9%
	Natural Gas	952,641	453,369	-52.4%	47,506	22,608	-52.4%
	Fuel Oil	617,245	287,746	-53.4%	42,205	19,675	-53.4%
	Propane	118,617	96,698	-18.5%	7,230	5,913	-18.2%
	Wood	259,255	215,974	-16.7%	6,088	5,072	-16.7%
	Diesel	60,085	47,888	-20.3%	4,480	3,360	-25.0%
Commercial & Industrial Buildings	Electricity	1,983,621	1,648,080	-16.9%	19,671	18,358	-6.7%
	Natural Gas	1,377,709	1,937,984	40.7%	68,703	96,643	40.7%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	122,702	122,702	0.0%	8,390	8,390	0.0%
	Diesel	108,350	106,304	-1.9%	8,078	7,458	-7.7%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	-	-	-	-	-	-
Natural Gas Fugitive Emissions				-	240	260	8.3%
Total		**6,835,381**	**6,102,886**	**-10.7%**	**224,839**	**200,949**	**-10.6%**
On-Road Transportation							
Electric Vehicles	Electricity	-	11,335	-	-	126	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	1,250,314	692,954	-44.6%	84,656	43,457	-48.7%
Light Trucks, Vans, SUVs	Gasoline + Diesel	774,818	1,017,832	31.4%	53,168	64,746	21.8%
Heavy Duty Vehicles	Gasoline + Diesel	468,309	348,840	-25.5%	31,632	22,032	-30.3%
Propane Vehicles	Propane	5,840	3,944	-32.5%	352	224	-36.5%
Natural Gas Vehicles	Natural Gas	-	404	-	-	22	-
Motorcycles	Gasoline	8,968	8,555	-4.6%	618	555	-10.2%
Total On-Road Transportation		**2,508,250**	**2,083,864**	**-16.9%**	**170,425**	**131,161**	**-23.0%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	509,285	280,736	-38.2%	38,153	20,127	-40.5%
Total Off-Road Transportation		**509,285**	**280,736**	**-44.9%**	**38,153**	**20,127**	**-47.3%**
Waste							
Wastewater					7,699	5,400	-29.9%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					72	854	1080.1%
Solid Waste					25,595	20,533	-19.8%
Total Waste					**33,367**	**26,787**	**-19.7%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-1,798	-1,932	7.4%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					3,725	3,744	0.5%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					0	0	-
Total AFOLU					**0**	**0**	**-**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					17,798	29,736	67.1%
Total IPPU					**17,798**	**29,736**	**67.1%**
TOTAL		**9,852,916**	**8,467,486**	**-14.0%**	**484,582**	**408,761**	**-15.8%**

18 TOWN OF VIEW ROYAL

18.1 2020 Profile

Profile	
Population	11,829
Dwellings	4,796
Registered Vehicles	10,297
Energy (Thousands of GJ)	1,081
GHG Emissions (tCO_2e)	54,477

18.2 Energy & GHG Emissions

Table 22 presents a summary comparison of the Town of View Royal's 2007 and 2020 energy and GHG emissions.

Table 22. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	185,833	195,051	5.0%	1,843	2,173	17.9%
	Natural Gas	75,155	89,003	18.4%	3,748	4,438	18.4%
	Fuel Oil	22,724	31,231	37.4%	1,554	2,135	37.4%
	Propane	3,926	3,201	-18.5%	239	196	-18.2%
	Wood	8,710	7,256	-16.7%	205	170	-16.7%
	Diesel	6,704	6,000	-10.5%	500	421	-15.8%
Commercial & Industrial Buildings	Electricity	113,772	130,614	14.8%	1,128	1,455	29.0%
	Natural Gas	123,868	149,375	20.6%	6,177	7,449	20.6%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
	Fuel Oil	-	-	-	-	-	-
	Diesel	12,088	13,319	10.2%	901	934	3.7%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	31,979	33,105	3.5%	2,384	2,322	-2.6%
Natural Gas Fugitive Emissions				-	38	50	31.8%
Total		**584,760**	**658,154**	**12.6%**	**18,717**	**21,744**	**16.2%**
On-Road Transportation							
Electric Vehicles	Electricity	-	2,319	-	-	26	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	138,335	116,597	-15.7%	9,366	7,313	-21.9%
Light Trucks, Vans, SUVs	Gasoline + Diesel	135,581	221,254	63.2%	9,303	14,081	51.3%
Heavy Duty Vehicles	Gasoline + Diesel	60,935	47,063	-22.8%	4,111	2,950	-28.2%
Propane Vehicles	Propane	895	446	-50.2%	54	25	-53.1%
Natural Gas Vehicles	Natural Gas	-	-	-	-	-	-
Motorcycles	Gasoline	1,223	1,336	9.3%	84	87	2.8%
Total On-Road Transportation		**336,970**	**389,016**	**15.4%**	**22,919**	**24,481**	**6.8%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	41,258	33,752	-18.2%	3,084	2,415	-21.7%
Total Off-Road Transportation		**41,258**	**33,752**	**-18.2%**	**3,084**	**2,415**	**-21.7%**
Waste							
Wastewater					386	361	-6.7%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Composting					0	170	-
Solid Waste					2,856	1,662	-41.8%
Total Waste					**3,242**	**2,193**	**-32.4%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-2,585	-2,738	5.9%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					1,738	1,807	4.0%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					1	6	355.1%
Total AFOLU					**1**	**6**	**355.1%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					1,986	3,638	83.2%
Total IPPU					**1,986**	**3,638**	**83.2%**
TOTAL		**962,988**	**1,080,921**	**12.2%**	**49,949**	**54,477**	**9.1%**

19 SOUTHERN GULF ISLANDS ELECTORAL AREA

19.1 2020 Profile

The Southern Gulf Islands Electoral Area consists of: Galiano, Mayne, North Pender, Saturna and South Pender.

Profile	
Population	4,963
Dwellings	2,432
Registered Vehicles	4,300
Energy (Thousands of GJ)	704
GHG Emissions (tCO_2e)	27,730

19.2 Energy & GHG Emissions

Table 23 presents a summary comparison of the Southern Gulf Islands Electoral Area 2007 and 2020 energy and GHG emissions.

Table 23. Estimated Energy and GHG Emissions By Reporting Source

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Stationary Energy							
Residential Buildings	Electricity	205,339	201,183	-2.0%	2,036	2,241	10.1%
	Natural Gas	-	-	-	-	-	-
	Fuel Oil	27,326	38,718	41.7%	1,868	2,647	41.7%
	Propane	24,684	20,746	-16.0%	1,505	1,269	-15.7%
	Wood	206,032	176,945	-14.1%	4,838	4,155	-14.1%
	Diesel	3,658	2,517	-31.2%	273	177	-35.2%

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Commercial & Industrial Buildings	Electricity	45,106	45,491	0.9%	447	507	13.3%
	Natural Gas	-	-	-	-	-	-
	Fuel Oil	-	-	-	-	-	-
	Diesel	6,596	5,588	-15.3%	492	392	-20.3%
Energy Industries	LFG Combustion			-	-	-	-
Agriculture, Forestry And Fishing Activities	Diesel	17,449	13,889	-20.4%	1,301	974	-25.1%
Natural Gas Fugitive Emissions				-	-	-	-
Total		**536,190**	**505,076**	**-5.8%**	**12,760**	**12,362**	**-3.1%**
On-Road Transportation							
Electric Vehicles	Electricity	-	922	-	-	10	-
Hydrogen Vehicles	Hydrogen	-	-	-	-	-	-
Passenger Vehicles	Gasoline + Diesel	115,551	33,438	-71.1%	7,821	2,098	-73.2%
Light Trucks, Vans, SUVs	Gasoline + Diesel	63,232	108,354	71.4%	4,339	6,898	59.0%
Heavy Duty Vehicles	Gasoline + Diesel	16,337	41,345	153.1%	1,084	2,605	140.3%
Propane Vehicles	Propane	-	441	-	-	25	-
Natural Gas Vehicles	Natural Gas	-	58	-	-	3	-
Motorcycles	Gasoline	916	495	-45.9%	63	32	-49.1%
Total On-Road Transportation		**196,036**	**185,054**	**-5.6%**	**13,307**	**11,672**	**-12.3%**
Off-Road Transportation							
Marine, Aviation and Other Off-Road Vehicles	Gasoline + Diesel + Jet Fuel	22,512	14,160	-37.1%	1,683	1,013	-39.8%
Total Off-Road Transportation		**22,512**	**14,160**	**-37.1%**	**1,683**	**1,013**	**-39.8%**
Waste							

Source	Type	2007 Energy (GJ)	2020 Energy (GJ)	Change (%)	2007 GHG Emissions (tCO_2e)	2020 GHG Emissions (tCO_2e)	Change (%)
Wastewater					24	5	-78.7%
Composting					0	0	-
Solid Waste					1,558	697	-55.2%
Total Waste					**1,582**	**702**	**-55.6%**
Agriculture Forestry & Other Land Use (AFOLU)							
Land-Use: Emissions Sequestered **(Disclosure Only - Not Included In Total)**					-33,172	-33,526	1.1%
Land-Use: Emissions Released **(Disclosure Only - Not Included In Total)**					24,093	24,143	0.2%
Livestock, Aggregate Sources and Non-CO_2 Emission Sources on Land					387	400	3.5%
Total AFOLU					**387**	**400**	**3.5%**
Industrial Process & Product Use (IPPU)							
Process Use Emissions					1,083	1,581	45.9%
Total IPPU					**1,083**	**1,581**	**45.9%**
TOTAL		**754,738**	**704,290**	**-6.7%**	**30,803**	**27,730**	**-10.0%**

Capital Region CO_{2e} Emissions Per Capita

January 2022

Capital Region CO_{2e} (tonnes) Emissions Per Capita		
	2007	2020
Capital Region	5.6	4.2
Central Saanich	6.0	5.3
Colwood	5.3	3.9
Esquimalt	5.5	4.2
Highlands	5.8	6.0
Juan De Fuca Electoral Area	14.4	13.6
Langford	5.5	3.7
Metchosin	5.6	4.1
North Saanich	5.8	4.5
Oak Bay	4.9	4.0
Saanich	5.2	3.9
Salt Spring Island Electoral Area	4.9	3.7
Sidney	5.5	4.3
Sooke	5.0	3.7
Victoria	6.0	4.3
View Royal	5.5	4.6
Southern Gulf Islands Electoral Area	6.3	5.6

Making a difference...together

EEP 22-01

REPORT TO ENVIRONMENTAL SERVICES COMMITTEE
MEETING OF WEDNESDAY, JANUARY 19, 2022

SUBJECT **Zero-Emissions Fleet Initiative – Final Study Report**

ISSUE SUMMARY

To present the Final Study Report to the Capital Regional District (CRD) Board as the final commitment of the Zero-Emissions Fleet Initiative (ZEFI).

BACKGROUND

In September 2017, the Federation of Canadian Municipalities' Green Municipal Fund approved a $350,000 pilot project grant to fund the CRD's Zero-Emissions Fleet Initiative. The project was a multi-year, federally-funded partnership between the CRD, the University of Victoria's Institute for Integrated Energy Systems, and the BC Ministry of Energy, Mines and Petroleum Resources.

The project had three primary areas of focus:

- a zero-emission vehicle (ZEV) pilot in the CRD's corporate fleet
- research and analysis; and
- public outreach

The ZEV pilot included two electric vehicles, two plug-in hybrid electric vehicles, two hydrogen fuel cell electric vehicles and several e-bikes. Vehicle driving distances were recorded and driver feedback was gathered to better understand how ZEVs could be effectively integrated into the CRD fleet. The fuel cell electric vehicles were some of the first users of the newly-built hydrogen refuelling station in Saanich, a provincial government-supported project. Operation of the ZEVs resulted in a reduction of 41.8 tonnes of greenhouse gas emissions during their operation.

The research and analysis conducted as part of this project produced several reports that are appended to the Final Study Report (Appendix A):

- A *Fleet Telematics and EV Suitability Study* to enable the CRD to identify improvements to fleet use.
- An *E-bike Fleet Deployment Analysis* to understand the environmental, economic, and logistical performance of the operation of E-bikes in corporate fleets.
- A *Fleet Vehicle Energy Consumption Software Prediction Thesis Project* that proposes a data-driven model for prediction of the energy consumption of fleet vehicles in various missions.
- A report on *Earthquake Resiliency Implications of CRD EV Adoption* to examine possible post-earthquake use scenarios for Electric Vehicles.

Results of the project were shared with the public through two outreach sessions:

- A *ZEV Symposium*, an in-person event that enabled practitioners in government, non-profits, and industry to connect, share best practices and identify potential collaborations

- An *E-bikes in Fleets presentation*, as part of a West Coast Electric Fleets online webinar focused on E-bike adoption in the Pacific Northwest.

With completion of the final steps of the initiative, staff finalized a project report summarizing the activities, results and conclusions of the project.

ENVIRONMENTAL & CLIMATE IMPLICATIONS

The project was integral in developing new information and experience for the CRD around ZEVs. With strong future goals for EV adoption and greenhouse gas emission reduction, the project was a key step on the CRD's path to its climate goals.

From 2017 to 2021, the grant funding provided a zero-emission vehicle jump-start for the capital region. It provided the opportunity for the CRD to purchase and test its first ZEVs and install charging infrastructure, leading to continued corporate EV purchases and charging infrastructure installations. The program supported the development of the first hydrogen fuelling station for vehicles on Vancouver Island. The project also supported and funded localized academic research regarding ZEVs.

The project was essential in CRD policy development, informing the development of the CRD's corporate Green Fleet Strategy and recently-updated Climate Action Strategy.

CONCLUSION

The CRD has completed the Zero-Emissions Fleet Initiative that kick-started the organization's adoption and promotion of zero-emission transportation, both corporately and in the community. The project was funded through federal grant money aligned to promote a pathway to net zero by 2050. The information has been used for several initiatives under the CRD's Climate Action Strategy. The results motivate the continuing effort to transition the corporate fleet to Electric Vehicles through the corporate Green Fleet Policy and fleet procurement procedures. This rate of adoption is expected to accelerate as EV prices continue to decrease and more all-wheel drive and medium- and heavy-duty vehicle options become available. The summary report needs to be received by the Board as a final commitment to the grant funding.

RECOMMENDATION

The Environmental Services Committee recommends to the Capital Regional District Board:
That the Zero-Emissions Fleet Initiative Final Study Report be received for information.

Submitted by:	Glenn Harris, Ph.D., R.P.Bio., Senior Manager, Environmental Protection
Concurrence:	Larisa Hutcheson, P. Eng., General Manager, Parks & Environmental Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT

Appendix A: Zero-Emissions Fleet Initiative – Final Study Report

APPENDIX A



ZERO-EMISSIONS FLEET INITIATIVE

Final Study Report

Making a difference...together

Capital Regional District | January 2022

© 2022, Capital Regional District. All Rights Reserved.

The preparation of this pilot project was carried out with assistance from the Green Municipal Fund, a fund financed by the Government of Canada and administered by the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

Introduction

The Capital Regional District's (CRD) Zero-Emissions Fleet Initiative (the Initiative) launched in February 2018 and completed in October 2021. The 'technology neutral' initiative focused on testing and comparing the use of zero-emissions vehicles, including battery electric vehicles (BEV), hydrogen fuel cell electric vehicles (FCEV), plug-in hybrid gas/electric vehicles (PHEV), and electric bicycles (e-bikes).

Project Objectives

The aim of the initiative was to embark on a process to eventually reduce greenhouse gas (GHG) emissions from the CRD fleet to almost zero. The Initiative supports the gradual replacement of internal combustion engine (ICE) vehicles with zero-emission models using hydrogen or electricity for fuel, as well as sizing vehicles for the appropriate use, reducing kms travelled, improving driver efficiency and, in some cases, using a modal shift with e-bikes replacing vehicles. The CRD has the potential to replace up to 100 existing ICE vehicles in the coming years as part of its ongoing fleet replacement process.

This project aimed to meet multiple objectives:

- Reduce GHG emissions in the CRD fleet by:
    - Conducting a field trial of FCEVs as part of the CRD fleet, with a view to broad adoption of this technology within the fleet
    - Testing and analyzing the use of additional zero-emission alternatives, including BEV and e-bikes where operationally appropriate
    - Conducting an in-depth "smart fleet" study to learn from and optimize these applications in terms of operating costs and GHG reduction
    - Investigating opportunities to use electric vehicles as an emergency power source
- Reduce GHG emissions from other vehicles on southern Vancouver Island by:
    - Sharing the results of the CRD pilot with local governments, businesses and interested individuals within the region and across British Columbia
    - Supporting fuel cell electric vehicle infrastructure deployment in coordination with the provincial government, the private sector and the host municipality
    - Supporting the uptake of FCEVs by other fleets and individuals on southern Vancouver Island
- Support economic development opportunities associated with hydrogen fuelling infrastructure

Project Partners

The CRD was the lead partner for this initiative, supported by the Institute for Integrated Energy Solutions at the University of Victoria (IESVic) and the Province of British Columbia (through the Ministry of Energy and Mines).

Capital Regional District

The CRD is the regional government for 13 municipalities and three electoral areas on southern Vancouver Island and the nearby Gulf Islands, serving more than 377,000 citizens. As a local government and shared services provider, the CRD develops partnerships to facilitate and deliver projects and services that benefit municipalities, electoral areas, First Nations and the region as a whole. The CRD has more than 200 service, infrastructure and financing agreements with municipalities and electoral areas to deliver services in the following categories:

- regional, where all municipalities and electoral areas are served;
- sub-regional, where two or more jurisdictions are served; and
- local, in the electoral areas where the CRD is the local government.

The CRD has clearly acknowledged and committed to taking action to address climate change within our operations, as well as at the regional level, to reduce emissions and to prepare for the uncertainty a changing climate brings. This was highlighted in the CRD Board's declaration of a climate emergency in early 2019 and commitment to taking a leadership role to pursue regional carbon neutrality.

In response to the climate emergency, the CRD developed an updated five-year Climate Action Strategy in 2021, replacing two former strategies and integrating with existing local, provincial and federal climate action initiatives.

Developing and supporting low-carbon mobility within the capital region is a key pillar of the CRD's Climate Action Strategy. The CRD is technology neutral and is committed to exploring and using zero-emissions technology that can meet operational and duty-cycle needs in a cost-effective manner.

The Institute for Integrated Energy Systems at the University of Victoria

The mission of the IESVic is "To chart feasible paths to sustainable energy." IESVic conducts sustainable energy research, using a collaborative approach between mechanical engineers, economists and environmental scientists. It has become a 'go-to' source of expertise for industry leaders.

Study of fuel cell technologies is part of IESVic's current research. Researchers are working to address most steps in a hydrogen energy system, including generation, storage, distribution, economics, and fuel cell electricity generation. Because the transportation sector poses particularly strong challenges to eliminating carbon emissions, fuel cell stack and system development is a key initiative at IESVic. The institute receives support from a number of government and industrial partners for its research into stack modelling and design for vehicle scale polymer electrolyte membrane (PEM) systems. More recently, research on regenerative hydrogen systems driven by renewable energy sources have been investigated with a focus on the dynamic response and efficiency. As well, IESVic researchers are pursuing the development of novel methods for storing hydrogen with a focus on new liquefaction processes.

IESVic is working on a Transportation Futures project focusing on electrification of transportation. This includes a wide range of vehicle classes, from e-bikes through to personal vehicles, busses, fleet (e.g., delivery) vehicles and heavy-duty transport. The emphasis on the project is optimizing the introduction of these vehicles, understanding battery degradation effects, and quantifying overall CO_2 reductions resulting from plugging into the interconnected BC/AB to California grid with and without control over charging behaviour. An aspect of the work also involves comparing battery-electric drivetrains to fuel cell options, in terms of performance, cost and overall round-trip energy efficiency.

IESVic undertook various aspects of research in this project, both during the developmental stages and analyzing the project implementation.

British Columbia Ministry of Energy and Mines

The Province of British Columbia has set legislated targets for reducing GHG emissions that contribute to global climate change. Under the *Greenhouse Gas Reduction Targets Act*, the Province must achieve a 33% reduction in GHG emissions below 2007 levels by 2020, and an 80% reduction by 2050. Personal and commercial vehicle transportation account for 13% and 24% of BC's GHG emissions, respectively, making a transition to clean energy vehicles an important part of the Province's climate strategy.

Through the BC Ministry of Energy and Mines and the Clean Energy Vehicle Program, the Province supports the adoption of clean energy vehicles, including FCEVs. Currently, the purchase or lease of a hydrogen fuel cell vehicle can qualify for an incentive of up to $6,000, while purchasers of BEV can qualify for up to $5,000 off of the purchase price. The Province also supports the Fleet Champions Program, which assists fleets in British Columbia in their efforts toward deploying clean energy vehicles by offering technical and financial support for an electric vehicle business case, as well as providing incentives for the installation of charging infrastructure.

The Province provided funding toward the installation of a hydrogen fuelling station for southern Vancouver Island. In addition, BC Ministry of Energy and Mines staff provided technical support to this project.

Part 1: Zero-Emission Vehicle Pilot Project

A key objective of the Initiative project was to test multiple types of zero-emissions vehicles, including hydrogen fuel cell vehicles, BEV, plug-in hybrid electric/gas vehicles, and e-bikes. This pilot project investigated matching zero-emission vehicles with operational requirements and the challenges and benefits they would provide.

Program Design

The complete pilot project was designed as three separate vehicle tests:

Fuel Cell Electric Vehicles

The FCEV pilot was designed as the follows:

- Lease six FCEVs (ultimately reduced to two FCEVs due to supply issues from vehicle manufacturer).
- Provide training for staff on the use and fuelling of these vehicles.
- Work with CRD staff and IESVic to monitor the benefits and challenges of using FCEVs in the CRD fleet.
- Work with the Province and Canadian Hydrogen and Fuel Cell Association to provide publicly available hydrogen fuelling facilities in the CRD region.

E-bikes

The initial testing of e-bikes will be done by source control inspectors who inspect businesses within a 5-km or less radius of CRD headquarters. The City of Victoria is continuously upgrading its system of cycling lanes, making cycling an even more desirable choice. The e-bikes were equipped with data loggers, and the benefits and challenges of this trial were monitored by IESVic, which provided an analysis of the program and recommendations for expanding this trial.

The pilot project included the following actions:

- Purchase two e-bikes and associated gear (helmets, lights, high-vis vests, locks, etc.);
- Coordinate safety training for inspectors using the bikes;
- Map the inspection territories to be visited by e-bike;
- Create standard operating procedures (and ensuring adherence to) to guide e-bike use and care (safety, parking, anti-theft, recharging, etc.);
- Define minimums for use (e.g., minimum twice per week, dependent on safety/weather factors);
- Track the mileage and electric energy use and estimate GHG savings; and
- Provide final reporting out of number of trips, distances travelled, cost benefits, successes/challenges, observations and recommendations.

Battery Electric Vehicles

The BEV pilot project included the following:

- Purchasing two 'tester' BEVs
- Adding at least two more BEVs to the fleet, replacing ICE vehicles
- Adding telematics to 40 fleet vehicles
- Studying the opportunities for using EVs as an emergency or off-grid power source

The CRD purchased two BEVs that are additional to normal fleet requirements and made them available to staff to test their applicability. These BEVs did not replace existing vehicles, but were used in a series of different locations for a test period of two-six weeks so that staff could test them and provide feedback on the results. At the end of the two-year testing period, the "tester" BEVs were incorporated fully into the fleet as replacements for ICE vehicles.

Two additional PHEVs were added to the pilot instead of additional electric vehicles. The earlier fleet analysis indicated that all-wheel drive (AWD) and long driving distances were a requirement for some vehicle operation scenarios, and available EVs at the time could not meet these requirements.

Implementation

The procurement and testing of ZEVs stretched across a five-year period, and some changes in scope occurred. Details are described, as follows.

Timeline

The ZEV pilot project began with the installation of an electric vehicle charger in September 2016, and ended with the return of the FCEVs in April 2021. A brief outline of the timeline is presented below:

2016	September	First Level 2 electric vehicle charger installed at CRD HQ
2017	January	Two Kia Soul electric vehicles purchased
	March	Twin Level 2 electric vehicle charger installed at Integrated Water Services building
2018	February	E-bikes were purchased and the four-month trial was completed
	November	First Mitsubishi Outlander AWD PHEV purchased
2019	February	Second Mitsubishi Outlander AWD PHEV purchased
2020	September	Two FCEVs leased
2021	January	Hydrogen fuelling station completed; FCEV pilot beings
	April	FCEV pilot ends and vehicles returned

Changes in Scope

Over the three-year project timeline, some changes from the initial project plan occurred, as described below. While implementation details varied, the goals of the project remained the same.

Replacement of Two Electric Vehicles with Plug-in Hybrid Electric Vehicles

The project plan called for the CRD to procure four EVs. Results of the telematics analysis found that PHEVs were better suited for the CRD's uses (offering AWD), and would be used in electric mode for over 97% of trips taken, while providing greater range for the 3% of trips that were beyond the plug-in electric vehicle range. Consequently, the CRD shifted procurement of two of the EVs to PHEVs. This change was confirmed with the Green Municipal Fund advisor. The change in environmental benefits is expected to be negligible.

Procurement of Additional E-bikes

The project plan anticipated piloting two e-bikes. However, bicycles come in various sizes and to accommodate all of the staff participating in the pilot, three bicycles (sized small, medium and large) were required. This change has no impact on the environmental benefits. Additional costs were covered by the CRD.

Delay in Procurement of Hydrogen Fuel Cell Electric Vehicles

The project plan anticipated piloting six FCEVs in the CRD fleet beginning in 2017, subject to the availability of hydrogen fuelling in the capital region. Synergistically, but separate to the Initiative, a hydrogen fuelling station is opening in the capital region, as part of the Province of BC's Hydrogen Fuelling Infrastructure Program. The opening of the hydrogen fuelling station was delayed until 2021. Consequently, the CRD delayed procuring and piloting the FCEVs until January 2021. Due to the limits of the vehicle leases, the vehicles were returned in April 2021, resulting in a four-month trial period rather than the initial goal of three years.

Results

The pilot program looked for insight and feedback in the following categories. Summary of results are described in each.

Vehicle Performance

ZEVs were generally found to be acceptable for the use cases expected of them. Full BEVs with AWD were not available, so PHEV with AWD were substituted, resulting in higher emissions. The driving range of the Kia Soul EVs (approx. 150 km) was seen as sufficient for most intended trips, but too short for some, leading staff to select ICE or PHEV vehicles for these trips instead.

It should be noted that range and AWD availability is improving with time. The average electric vehicle driving range on a single charge is now double that of the Kia Souls from 2017, thanks to technological improvements.

Driver Response

After the FCEV pilot, a qualitative survey was sent to staff who had operated the vehicle asking about what they enjoyed, disliked, their refuelling experience, and overall opinion of the vehicles.

Driver feedback was generally positive, with some mixed feedback, particularly regarding refuelling. Operators appreciated the smooth driving experience and knowing that the vehicle was greener to drive. Users mentioned the vehicle was a little different to drive compared to what they were used to, for example, the acceleration was "quiet".

There were concerns and hesitancy about refuelling. Some had no issues, but some mentioned learning the new procedure was slow and one user called it frustrating. The single available location for refuelling was seen as inconvenient by several users and it was not necessarily in a location that they were normally driving in.

One user was concerned about the safety of driving with compressed hydrogen on board.

Benefits and Challenges

Fuelling of the FCEVs provided the benefit of the CRD not having to own and operate fuelling infrastructure, as this was handled by the private company.

However, the lack of widespread fuelling locations was seen as an inconvenience by FCEV operators and likely results in more distance being driven by the vehicles to reach the fuelling station.

The new fuelling method is more complicated than an electric vehicle charger, and required additional training for staff.

Public Response

The testing of FCEVs received some negative reaction from the public. On January 21, 2019, the Residents for Responsible Renewables lobby group sent a letter to the CRD Board Chair and Members, cc-ing municipal staff across the region. The group presented economic and environmental concerns related to the development of hydrogen fuelling infrastructure in the capital region, and the CRD's pilot of FCEVs within the CRD fleet.

Hydrogen Fuelling Infrastructure

The external partners experienced some challenges in establishing a hydrogen fuelling station in the region, resulting in a significant time delay to open the station. Other than the initial station, no other growth in hydrogen fuelling for passenger vehicles has been seen in the capital region so far.

Part 2: Research and Analysis

The second objective of the Initiative was supporting vehicle trials with research into ways to substantially reduce energy use in the fleet through use of telematics and modelling; additional zero-emission transportation through BEVs and e-bikes replacing traditional vehicles; and exploring the potential for innovative ways to use electric vehicles as a power source in an emergency situation. These are described in detail below.

Fleet Telematics and Electric Vehicle Suitability Study

Partnering with Fleet Carma, a fleet management consultant, and student researchers at IESVic, the goal of this portion of the project was to conduct a smart fleet analysis and tools for fleet optimization.

Initial Program Design

The smart fleet analysis was designed to focus on the existing fleet and its usage. Analysis would be aided by the addition of telematics on about 30 ICE vehicles, to gather detailed information on vehicle usage. IESVic would analyze this data to answer the question of the adequacy of each alternative fuel technology or any combination of them that will lead to the lowest GHG emissions per year. The analysis would then look at the question of the optimal scheduling of functions/operations associated to each unit in the fleet over a time span, having the fundamental targets of minimizing the operational cost and associated GHG emissions. Both evaluations would be bounded by the operational and corporate constraints.

Operational constraints include vehicle status/performance, weather conditions, fuelling/charging locations, etc. Corporate structural constraints are those imposed by the corporate body of the CRD, which is characterized by a fleet distributed throughout a wide region in sub-fleets, each one of them serving the specific needs and under the particular conditions of each CRD service. Corporate constraints may include topology and/or geography, spectrum of ranges served, services provided, number and classes of vehicles assigned, etc. Comparing the scenarios with and without the corporate constraints, would be essential for future policy decision making regarding GHG emissions.

The outcomes of this research were planned to include:

- A mathematical tool for planning replacement of fleet units, considering alternative fuel drive train technologies.
- A mathematical tool for optimal scheduling of a mixed fleet of vehicles.
- Data-based recommendations for fleet renewal decisions and policy developments to promote reduction of corporate GHG emissions in the public sector in BC.

This information was planned to enable CRD to identify improvements to fleet use with existing vehicles, as well as vehicles that could practically be replaced by BEV or FCEV options.

Implementation

Between February 2018 and February 2019, 43 telematics devices were installed within 62 fleet vehicles. Information was gathered on vehicle usage, with a focus on reducing GHG emissions, enhancing utilization and reducing operating costs. Before installing the devices, CRD undertook a privacy impact assessment, and rolled out an extensive internal communications campaign in conjunction with the device installment.

Results of the telematics study were presented in an Electric Vehicle Suitability Assessment (Appendix A) based on the telematics data, which recommended replacing 13 ICE vehicles with plug-in hybrid electric vehicles. An IESVic post-graduate student is currently conducting a more comprehensive analysis of the data, and trying to verify fuel consumption predictions through a micro-trip approach and assumed stoichiometric fuel rates from mass airflow sensors against data-logger fuel consumption predictions.

Summary of Results

From the Electric Vehicle Suitability Assessment, it was found that if 13 of the baseline vehicles were replaced with the plug-in hybrid vehicles, the fleet would see the following total savings over the service lives of the baseline vehicles:

- the fleet could save $147,446 in total savings over the service life. This represents 13% of the fleet budget.
- the fleet could realize an emission reduction of 49.2 tonnes per year over the service life, representing a 43% reduction in CO_2 emissions.
- the fleet could reduce gasoline and diesel consumption by a total of 16,067 L annually over the service life, representing a 43% reduction in fuel.

The study found that few vehicles are being used heavily, and a few were under-utilized. The threshold for an under-utilized vehicle is less than 25 kms per day, and less than one hour of engine on-time. Vehicles that meet this criteria could be replaced by a mileage reimbursement vehicle or a pool vehicle.

Evaluation of anonymized, averaged driver behaviour indicated possible opportunities within the fleet to review safe driving practices. Smooth braking and smooth acceleration can help reduce maintenance costs over the life of the vehicle. For an electric vehicle, smooth braking allows for more energy to be captured via the regenerative braking process.

Looking at the comparative data in the reports, two key areas were identified to consider in order to begin plug-in vehicle adoption:

1. Implementing PHEVs will ensure the vehicles are range capable and able to support the level of utilization observed in the fleet. To facilitate the implementation of an electric fleet, charging stations must be available and drivers must be encouraged to plug in the vehicles to maintain a high electric vehicle fraction. This will allow the fleet to realize the maximum level of savings.

2. There is a large opportunity to transition light duty trucks and/or SUVs to PHEV SUVs. At the time of the study, there were not many SUV EVs available. However, additional significant fuel and emission savings can be realized if the conventional light duty trucks and SUVs can be replaced with suitable PHEVs or newly available BEV.

E-bike Fleet Deployment Analysis

The CRD E-bike pilot was a joint project between IESVic and the CRD. The proposed research goals for the e-bike project were:

1. To make recommendations regarding the optimal use of e-bikes in urban commercial fleets
2. To compare the environmental, economic, and logistical performance of the operation of e-bikes in urban fleets to other vehicle modes
3. To make recommendations regarding the regulatory constraints placed on e-bike use with respect to motor power limits

Methodology

The research goals were answered through the deployment of three e-bikes outfitted with multiple sensors to capture a variety of data. The purpose of this work is to provide quantifiable, evidence-based results to inform the CRD as to the efficacy of the use of e-bikes in their corporate fleet. Additionally, this project was meant to inform other fleet operators as to the operational costs and benefits of e-bikes in commercial fleets. The project abstract is presented below and the complete project report is available in Appendix B.

Abstract of Final Report

The deployment of three e-bikes into the CRD fleet resulted in over 600 km of recorded trip data. This data was used to inform several academic research projects, as well as to determine typical operational capabilities of e-bikes for the CRD fleet. The collected data showed a reduction of emissions by 99% when compared to a typical car found in the CRD fleet. Even compared to battery electric cars, the e-bikes represent a 95% reduction in emissions. Compared to both of these modes, the e-bikes also represent an over 80% reduction in capital and operating costs.

Overall, the deployment of the e-bikes saved approximately 250 kg of CO_2, if they are considered to have replaced ICE car trips. The operating capabilities of e-bikes show them as having half the pace of cars in urban environments. Where a car can cover 5 km in 8.5 minutes, an e-bike typically covered the same distance in 20 minutes.

Fleet Vehicle Energy Consumption Software Prediction Project

In partnership with IESVic, CRD fleet logger data was used as a basis for development and verification of a data-driven, software-based tool for improved-accuracy predictions of fleet fuel and energy consumption. The resulting deliverable was a Master's thesis by student Autumn Umanetz. The thesis abstract is presented below and the complete thesis document is available in Appendix C.

Abstract of Final Thesis Project

This study proposes a data-driven model for prediction of the energy consumption of fleet vehicles in various missions, by characterization as the linear combination of a small set of exemplar travel segments. The model was

constructed with reference to a heterogeneous study group of 29 light municipal fleet vehicles, each performing a single mission, and each equipped with a commercial global positioning system logger. The logger data was cleaned and segmented into three-minute periods, each with 10 derived kinetic features and a power feature. These segments were used to define three essential model components, as follows:

The segments were clustered into six exemplar travel types (called "eigentrips" for brevity). Each vehicle was defined by a vector of its average power in each eigentrip. Each mission was defined by a vector of annual seconds spent in each eigentrip. Ten percent of the eigentrip-labelled segments were selected into a training corpus (representing historical observations), with the remainder held back for testing (representing future operations to be predicted). A Light Gradient Boost Machine classifier was trained to predict the eigentrip labels with sole reference to the kinetic features, i.e., excluding the power observation. The classifier was applied to the held-back test data, and the vehicle's characteristic power values applied, resulting in an energy consumption prediction for each test segment. The predictions were then summed for each whole-study mission profile, and compared to the logger-derived estimate of actual energy consumption, exhibiting a mean absolute error of 9.4%. To show the technique's predictive value, this was compared to prediction with published L/100 km figures, which had an error of 22%. To show the level of avoidable error, it was compared with a Light Gradient Boost Machine direct regression model (distinct from the Light Gradient Boost Machine classifier), which reduced prediction error to 3.7%.

Earthquake Resiliency Implications of CRD Electric Vehicle Adoption

This sub-project of the Initiative was aimed at assessing the ramifications and potential roles of electric vehicles in a post-disaster scenario. A Cascadia earthquake has been chosen as the disaster framework to analyze as many of its disaster effects (e.g., damaged roads, landslides, disruption of power) are also experienced during other disaster concerns for Victoria, such as landslides and wildfires. The project summary is presented below and the complete report is available in Appendix D.

Background

The goal of the project was to provide a research paper for use cases tailored specifically to the CRD based on two key research question covered below:

1. What is the risk inherent in the adoption of an increasing share of electric vehicles in a local government fleet?
    a. To answer this question, research is being conducted into the resiliency of the liquid fuel vs. electrical supply infrastructure in a post-earthquake context. Initial research in this area has been conducted into what information is available for the Cascadia subduction zone of North America (extending from northern Vancouver Island to northern California), but the paper itself will focus Lower Mainland and the entirety of Vancouver Island, with more detail given to Vancouver Island.

    b. Research will also be conducted into the post-earthquake resiliency of electric vehicle charging infrastructure (electric vehicle charging stations for multiple vehicles, individual workplace charging ports, connectors).

2. What are the possible post-earthquake use scenarios for electric vehicles?
    a. How could electric vehicles act as individual nodes in an ad-hoc communication network in the case that the main 5G communication network has failed?

    b. Could electric vehicles provide power to emergency response shelters for people displaced in the earthquake?

Executive Summary

The following is the executive summary from the final research report, which can be found in its entirety in the appendices.

The adoption of electric vehicles has many benefits, such as reduced emissions, better performance, and economic savings on maintenance and fuelling. The Greater Victoria area has one of the largest concentrations of electric vehicles in BC, and this concentration is only expected to grow with time. Greater Victoria is also located in a portion of BC with a high seismic hazard and would be profoundly affected by a Cascadia subduction zone earthquake. Until recently, maintaining vehicle use after an earthquake has depended on the resilience of the fuel infrastructure, but the increasing use of electric vehicles will transfer some of that dependence to the resilience of the electrical system.

Analyzing past earthquakes in Chile, Japan and New Zealand provides some insight into how to increase earthquake resilience. The 2010 Chile earthquake showed the importance of available excess generation capacity, private forms of communication, and utilizing small generators for recovery in isolated areas. The 2011 Japan earthquake illustrated the value of not locating too much generation capacity in tsunami zones, utilizing rolling blackouts for recovery, and the exceptional performance of microgrids. The 2011 New Zealand earthquake taught the danger of buried cables in liquefaction zones and how impactful spending money on resilience upgrades can be.

BC Hydro can improve the resilience of the electrical grid by adding generation capacity, relocating grid elements from tsunami and liquefaction zones, planning to have resources for repairs available, and establishing aid agreements with surrounding areas. Vancouver Island can improve its fuel resilience by retrofitting ports, increasing fuel storage, and planning for how fuel will be prioritized after an earthquake.

The CRD can improve its organizational earthquake resilience by establishing a local microgrid and utilizing the battery capacity of its electric vehicle fleet to provide mobile storage following an earthquake. The CRD can also plan for what its expected vehicle and generator fuel needs would be after an earthquake and establish sufficient storage.

Electric vehicles can be used after an earthquake to establish a communication network by acting as individual nodes in the network. Over 24 hours, an electric vehicle would use 0.533 kWh to provide this function, and a Nissan Leaf Plus could act in this capacity for about 116 days before battery depletion. In a 24-hour period, a Nissan Leaf Plus was found to able to donate 400 kWh of energy to a local shelter, assuming the vehicle had access to a fast charger and a microgrid with a 100 kW solar array. Given the Leaf's 363-km single-charge range, the same microgrid was able to provide power for eight Leafs to deliver supplies and people for a 24-hour period, assuming that each vehicle charged once per 24 hours.

Part 3: Project Outreach

A key focus of the Initiative project was community benefit through outreach and knowledge sharing. Final results and reports will be available on the CRD's public-facing website. Additionally, the project included the following direct outreach activities.

Zero-Emission Vehicle Symposium

The CRD hosted the Zero-Emission Vehicle Transportation Showcase on October 28, 2021 at the University of Victoria. This event enabled practitioners in government, non-profits and industry to connect, share best practices and identify potential collaborations.

Event Overview

The Showcase included:

- three themed sessions focused on local government best practices, academic research trends, and long-term community vision; and
- an evening networking event with local practitioner presentations.

Participation and Feedback

The event brought together 22 in-person participants, including 12 presenters and 11 online participants.

The CRD received positive feedback overall on the content, with guests noting that the event was a balance of detail and big-picture presentations, underscoring the value of knowledge sharing. Participants enjoyed the hybrid format, though the in-person attendees were particularly pleased to be able to discuss the topic in person, often for the first time since the COVID-19 pandemic began.

This event could be a useful model for regional knowledge sharing as more municipalities and organizations move forward on their paths to decarbonized transportation. It also highlighted the importance of regional coordination and the role the CRD can play in helping to connect key players and support the delivery of important initiatives.

Key Themes

Several key themes emerged from participant questions and comments, as well as from the various presentations:

Table 1: Key Themes of ZEV Symposium

Theme	Description
Beyond the commute 	Many governments and organizations have made key steps toward supporting or requiring zero-emission passenger vehicles for commuting and other household travel. Showcase discussions highlighted interest in looking beyond the commute to broader ZEV opportunities, such as recreation, tourism, and emergency planning, and emphasized other co-benefits like health metrics and economic development.
Beyond the car 	Efforts to shift passenger vehicle kms to zero-emission are important. However, organizations are investigating how to reduce the total number of vehicle kms by shifting and electrifying other modes. Participants identified e-bikes, electric buses, and mode connectivity as increasingly important parts of the transportation system.
Knowledge sharing is vital 	Municipalities across the region have different approaches and are at various stages of ZEV transportation implementation. It can be difficult to balance local interests in electric vehicle infrastructure and requirements. Integrating best practices and learnings from other organizations is highly valuable when tailored to the local municipal context. The CRD's efforts to connect and support municipalities play a key role in this exchange.
Measuring what matters 	Data from zero-emission vehicle and infrastructure adoption is critical for tracking climate, transportation, and implementation metrics. Strong data can inform future designs, capture benefits, and mitigate negative impacts. Further, data availability can also foster research collaborations, as data availability can be a limiting factor in analysis.
A transition for everyone 	Ensuring equitable access to zero-emission transportation is top of mind. Organizations are aiming to bring everyone along in the transition, but the 'how' continues to be explored and iterated. Pilot projects and dedicated funding for target groups are being explored to evaluate potential solutions.

E-Bike Fleet Webinar

On February 26, 2019, CRD staff shared results of the e-bike pilot as part of an 'E-Bikes in Fleets' webinar presented by West Coast Electric Fleets, an initiative of the Pacific Coast Collaborative, a joint initiative of California, Oregon, Washington, and BC to accelerate a vibrant, low-carbon economy on the West Coast. The presentation covered the following topics:

- Introduction to the CRD and the Initiative project as a whole
- E-Bike pilot project description
- Safe staff operating procedures
- Cost and procurement
- Storage and Security
- Results and GHG reductions
- Lessons learned and next steps

The complete presentation can be found Appendix E.

Final Project Results

The Initiative project aimed to take essential first steps toward reducing GHG emissions from the CRD fleet to almost zero. The project piloted zero-emission models using hydrogen or electricity for fuel, including FCEVs, EVs, PHEVs and e-bikes.

This project aimed to directly reduce GHG emissions in the CRD fleet, support the reduction of GHG emissions from other vehicles on southern Vancouver Island, and support economic development opportunities associated with hydrogen fuelling infrastructure.

A summary of the project results is as follows.

Benefits and Drawbacks of ZEV Technologies

The Initiative examined a number of ZEV technologies and use cases. A brief summary of the benefits and drawbacks of these technologies identified by the project are outlined in the table below.

Table 2: Benefits and Drawbacks of ZEV Technologies

New Technology	Benefits	Drawbacks
Smart fleet analysis	Rigorous evidence-based comparative data on zero-emissions vehicles; new applied research findings for optimizing Smart Fleets. Microtrip modelling of vehicle duty cycles appears to be quite promising in terms of applying method to other fleets with varied duty cycles, as an alternative to trying to build bottom-up drivetrain models.	Data loggers do not capture data from heavy-duty fleet vehicles (however, a suitable electric vehicle or FCEV replacement does not exist at this time).
FCEVs	Reduced GHGs; support for emerging industry	Difficulty in providing fuelling for new technology type; difficulty procuring vehicles; lack of models suitable for CRD needs capital cost of vehicles (without factoring in subsidies).
BEV	Reduced GHGs; reduced operational costs	Vehicle range; range anxiety; limited electric vehicle charging infrastructure; length of charge time; lack of models suitable for CRD needs (e.g., pickups, heavy duty, AWD SUV with range).

Continued on next page

New Technology	Benefits	Drawbacks
Plug-in Hybrid Electric Vehicles	Longer ranges; more model types available (e.g., AWD); can refuel at gas stations; reduced GHGs compared to ICE vehicles	Can operate without being charged using fuel only and limiting their GHG reduction and operating cost savings; dual drive-train requires more maintenance than either EVs or ICEs
E-bikes	Reduced GHGs; reduced operational costs; employee health and fitness. E-bike modelling has been useful in showing implications of regulatory limitations and rider behaviour on GHG emissions impacts.	Mode of transport not suitable for all staff, or for all weather/climates; lack of cargo capacity; slower mode of transport, when compared to conventional vehicle.
Electric vehicles for emergency power	Potential to enhance emergency preparedness and resiliency.	Many external factors in post-disaster recovery are beyond the CRD's direct control (e.g., delivery of fuel or electricity).

Quantitative Results

From its initiation, the Initiative project defined several quantitative project parameters to track the effect of the program. These are outlined in the table below with commentary, as follows.

Table 3: Quantitative results summary of complete project

Project Parameter	Units	Baseline Performance (before project)	Final Performance (in 2020)
Greenhouse gas emissions (target portion of fleet)	t CO_2e	158.4	116.6 (reduction of 41.8)
Vehicles in fleet	number	304	296 (in 2020)
Vehicle km travelled (total fleet)	km	1,443,828	1,791,500
Electric vehicles in fleet	number	1	9 permanently (11 during lease period of FCEV; 9 on order for 2022
E-bikes in fleet	number	0	9
Hydrogen fuelling stations in region	number	0	1

t CO_2e = tonnes of carbon dioxide equivalent emissions

Greenhouse Gas Emissions

The vehicles purchased and tested as part of the Initiative project directly avoided 16.8 t of GHG emissions and indirectly avoided an additional 25 t thanks to additional electric vehicles purchased by the CRD after the success of the Initiative pilot. In total, 41.8 t of GHG emissions were avoided (see Table 4). For the FCEVs, this considers only the tank-to-wheel emissions and it assumes that hydrogen can be produced in a zero-emission method (e.g., hydro-power).

Table 4: Estimated GHG reductions from ZEV operations

ZEV	GHG reduction (t CO_2e)	Notes
2 FCEVs	0.4	44 total trips totaling 1,969 km of driving distance over four months; tank-to-wheel
2 BEV	11	Purchased as part of Initiative pilot project; 41,000 km driven
2 PHEV	3.9	Purchased as part of Initiative pilot project; 25,000 km driven
E-bikes	1.5	Extrapolated data from four-month trial: eight months per year for three years
Additional EVs	25	The CRD has purchased five additional electric vehicles since the Initiative pilot project; 94,000 km driven
TOTAL	41.8	

While the avoided GHG emissions were significant, the initial program goals were higher than what was achieved. Several project setbacks reduced the final number. Due to lack of manufacturer availability, the FCEV pilot was reduced from six vehicles to only two. Additionally, due to the delay by external parties in opening the hydrogen fuelling site on Vancouver Island, the FCEV pilot was reduced in scope from three years to four months. Furthermore, lacking available AWD electric vehicle models, two of the four vehicles in the electric vehicle pilot were swapped for PHEVs, which have improved fuel efficiency, but significantly more GHG emissions than an electric vehicle.

Advantageously for the future, most of these setbacks were solved by the end of the project. Because the electric vehicle pilot project was seen as successful, the CRD has purchased an additional five electric vehicles for its corporate fleet, resulting in further GHG reductions as a result of the Initiative. The CRD has nine electric vehicles on order for 2022 and further plans to purchase an additional 12.

Vehicles in Fleet

Over the course of the pilot project, the CRD corporate fleet reduced from 304 vehicles in 2017 to 296 vehicles in 2020. While not directly related to the Initiative, the project has significantly increased awareness of fleet usage and vehicle alternatives and undoubtedly informed fleet purchasing decision-making that has resulted in an approximate 3% reduction in fleet size.

Vehicle kms Travelled

The aim of the Initiative project was to analyze fleet usage and hopefully identify possibilities to reduce vehicle use. Unfortunately, vehicle use based on distance travelled has increased over the course of the project. Accurate data gathering was put in place in 2020; however, due to the COVID-19 pandemic, it is likely that fleet behaviour changed in 2020 compared to the baseline year. For example, drivers were less likely to share vehicles and more likely to drive to sites individually, which would have resulted in increased kms driven.

Beneficially, the Initiative project was a contributing factor in the CRD developing accurate distance data monitoring that will support future efforts in fleet analysis.

Electric Vehicles in Fleet

One of the triumphs of the Initiative was the success in breaking electric vehicles into the CRD fleet. Over the course of the project, the CRD went from zero electric vehicles in operation to nine electric vehicles in 2021, with nine more already on order for 2022. This exceeded the expectations of the project. By overcoming the initial challenges of installing charging infrastructure, and giving staff experience with electric vehicles to ensure that they would fit existing work requirements, the Initiative program opened the door for widespread electric vehicle adoption at the CRD.

E-bikes in Fleet

E-bike adoption was another success for the project and the CRD. Due to popularity, additional e-bikes were purchased after the pilot program, bringing the total number of e-bikes to nine. They continue to be used regularly by CRD staff, as shown in the figure below.

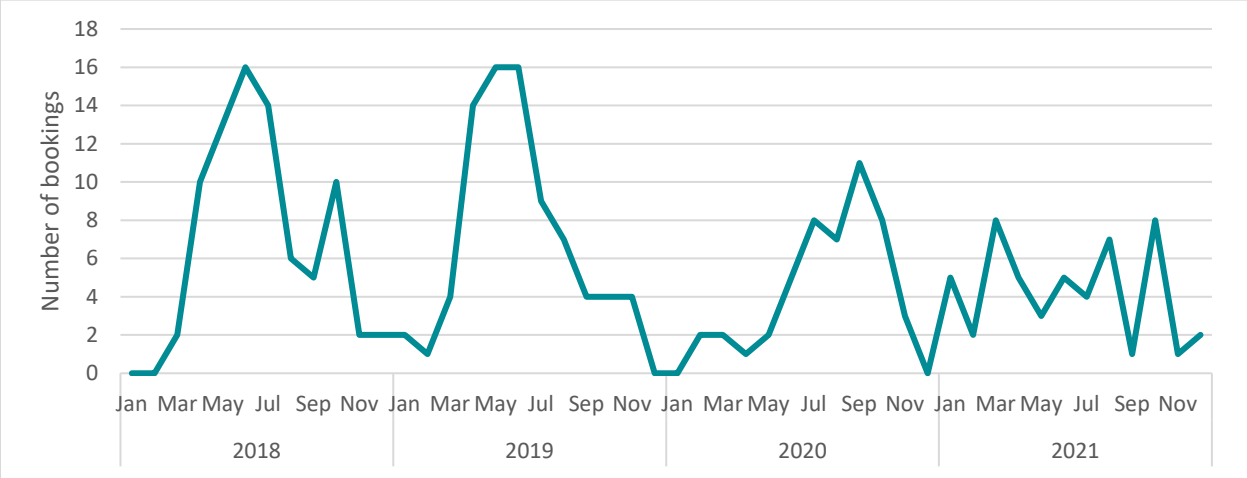


Figure 1: CRD E-bike usage by month

Hydrogen Fuelling Stations in Region

While there were some delays in timeline, the support of the Initiative program helped bring about the development of a hydrogen fuelling station in the Greater Victoria area. The hydrogen infrastructure safety study (Appendix F) completed in support of this project provided valuable information about the feasibility of the fuelling station and

addressed common concerns. This project provides new opportunity for future use and development of hydrogen fuel cell technologies in the region.

Socio-Economic Impacts

In addition to the environmental benefits of reducing GHG emissions, the Initiative project also had a variety of social and economic benefits.

Social

Some of the social benefits of the program included the following:

- Improved air quality in CRD service areas, including neighbourhoods and parks.
- Reduced noise pollution in CRD service areas, including neighbourhoods and parks.
- Increased visibility of ZEVs throughout the capital region to draw public attention, instill curiosity, and generate impromptu opportunities for engaging with the public.
- Significant organizational experience with ZEVs will provide significant knowledge to be shared as part of outreach programs.
- Hydrogen fuelling infrastructure made available to Vancouver Island residents.
- Notable opportunity for civic pride about being early adopters and significant adopters of ZEV technology.
- Significant increase in electric vehicles, and resulting increased opportunity for electric vehicles to be used as a power source in emergency events.

Economic

Economic benefits of the program included the following:

- Reduction in fleet operational costs in fuel purchases and maintenance.
- Multiple hydrogen fuelling stations in the region would result in business growth and local employment opportunities, and accelerate the development of a clean hydrogen industry in BC and Canada.
- Widespread availability of hydrogen fuelling infrastructure would support new supporting business, such as hydrogen vehicle and infrastructure maintenance. Businesses that benefit from the availability of hydrogen would be attracted.

Conclusion

From 2017 to 2021, the Initiative provided a zero-emission vehicle jump-start for the capital region. It supported and funded academic research regarding ZEVs. It gave the opportunity for the CRD to purchase and test its first ZEVs and install the required infrastructure. The opportunity to understand ZEV applicability led to a further five electric vehicle purchases for the CRD corporate fleet and a growing rate of adoption (nine more purchases on order for 2022, with potential for 12 more), as well as efforts to expand the corporate charging infrastructure. The program supported the development of the first hydrogen fuelling station for vehicles on Vancouver Island, opening up business and

economic opportunities that may use this infrastructure. Overall, the program contributed to increasing rate of ZEV adoption both at the CRD and regionally.

The Initiative project was essential in CRD policy development around transportation emissions. It supported and informed the development of the CRD's corporate Green Fleet Strategy, ensuring ZEVs are considered in all fleet purchases. Furthermore, the findings and experience gained from the Initiative were key in the development of the CRD's Climate Action Strategy, with goals for reducing emissions from vehicle use in the capital region and the CRD corporate fleet, as well.

The project encountered some challenges; however, the hydrogen fuelling station was delayed and FCEVs were not available from the manufacturer in the quantity expected. The project overall timeline increased, while the FCEV pilot duration was significantly shortened. Finding AWD electric vehicles was challenging, requiring PHEVs to be selected as alternatives, which are lower-emission but not zero-emission vehicles. Encountering and overcoming these challenges was valuable organizational learning and provided a basis for future ZEV decisions.

In summary, the Initiative was integral in developing new information and experience for the CRD around ZEVs. With strong future goals for electric vehicle adoption and GHG emission reduction, the Initiative project was a key stepping-stone on the CRD's path to its climate goals.

List of Abbreviations

AWD	All-wheel drive
BEV	Battery electric vehicle
CO_2	Carbon dioxide
FCEV	(hydrogen) fuel cell electric vehicle
GHG	Greenhouse gas
HQ	Headquarters
ICE	Internal combustion engine
IESVic	Institute for Integrated Energy Systems at the University of Victoria
PHEV	Plug-in hybrid gas/electric vehicles
SUV	Sport utility vehicle
t CO_2e	Tonnes of carbon dioxide equivalent

List of Appendices

Appendix A: Electric Vehicle Suitability Assessment Report
Appendix B: CRD-UVic E-Bike Fleet Deployment Report
Appendix C: Predicting Fleet-Vehicle Energy Consumption With Trip Segmentation Thesis Paper
Appendix D: Earthquake Resiliency Implications of CRD EV Adoption Report
Appendix E: Incorporating Electric Bikes into a Regional Government Fleet CRD Webinar Presentation
Appendix F: CRD Feasibility Study-Zero Emissions Fleet Initiative-Infrastructure Safety Study

ELECTRIC VEHICLE SUITABILITY ASSESSMENT

Capital Regional District

DECEMBER 2018

Making a difference...together

fleetcarma

STRATEGICALLY ADOPT PLUG-IN ELECTRIC VEHICLES SO THAT THEY WORK BEST FOR YOU.

Table of Contents

Introduction	4
Fleet Benchmark	6
FleetCarma Recommended EV Deployment	8
Best Fit Duty Cycles for EVs	10
Summary Results	11
More Thoughts on Fleet Efficiency	14
Vehicle Charging Infrastructure	17
Where to Begin	18
Study Details	19
Electric Fleet Management Goals	20
Next Steps	22
Appendix	24



INTRODUCTION

FleetCarma's efficiency assessments inform organizational decision-making by using data from your current vehicles to evaluate the potential pathways to a cleaner and more cost-effective vehicle fleet.

The primary purpose of this fleet assessment report is to demonstrate the potential strategies that can be employed to achieve efficiency savings through the use of plug-in electric vehicles and enhanced management of existing vehicle assets. Efficiency savings include the financial benefits gained through Total Cost of Ownership (TCO) reductions as well as the corresponding reductions in fuel usage and greenhouse gas (GHG) emissions.

This process started with collecting second-by-second vehicle diagnostics data from your existing vehicles to formulate your fleet baseline, and in turn, drive FleetCarma's EV analysis. This approach ensures you are comparing vehicle options in your own real-world drive cycles.

The powertrain analysis developed by FleetCarma provides an independent third party methodology for your organization to evaluate your options. This predictive analytics system also simplifies the complexity of adopting plug-in vehicles that offer a range of performance and suitability capabilities across any fleet's portfolio of applications. The algorithms used deliver a reliable determination of the amount of



fuel and electricity that would be used by your plug-in vehicles and the anticipated savings potential of the more efficient vehicles you are considering. The data provided in this summary report serves as a review of the results from the study and a guide for making decisions regarding the electrification of your vehicle fleet. We start this report with highlights from the fleet baseline data that serve as a benchmark on how your vehicle fleet is currently performing. We follow with a summary of results from the powertrain model outputs and translate those into actionable recommendations. Our primary objective is to evaluate the extent to which plug-in electric vehicles would be suitable for your organization. This includes an examination of when and how they may charge, the anticipated reductions in operating costs and emissions, and the electric driving range capabilities as they relate to each of your duty cycles. In the final section of the report, we examine other types of efficiency opportunities to take advantage of, even in areas where plug-in electric vehicles may not work for you. For example, you will find specific saving opportunities as they relate to idle reduction, eco-driving, and fleet right-sizing. We welcome any and all questions and appreciate being partners with you in this process.

This process begins with data collected from your current vehicles to drive FleetCarma's EV powertrain algorithms in your real-world drive cycles.

FLEET BENCHMARK

Data logging your current duty cycles with FleetCarma devices provides two benefits. (1) The granularity of the data collected enables us to drive EV powertrain models with statistical confidence and (2) the data from your current vehicles provides a comparative benchmark to evaluate a series of potential EV adoption scenarios. Below are some baseline metrics collected from your vehicles.

All Fleet

39
duty cycles
(were monitored)

11 light duty trucks, 17 SUVs, 5 passenger vans, 3 full-sized vans and 3 sedans monitored.

45
kilometres
(average daily utilization)

This translates to an average calendar year utilization of 7,115 kilometres per vehicle.

13
L/100 km
(average fleet fuel economy)

Baseline vehicle fuel economy ranged from 4-27 L/100 km.

1.5
hours / day
(average engine-on hours)

Engine-on hours can help you evaluate the potential maintenance benefits of vehicles that run on electricity.

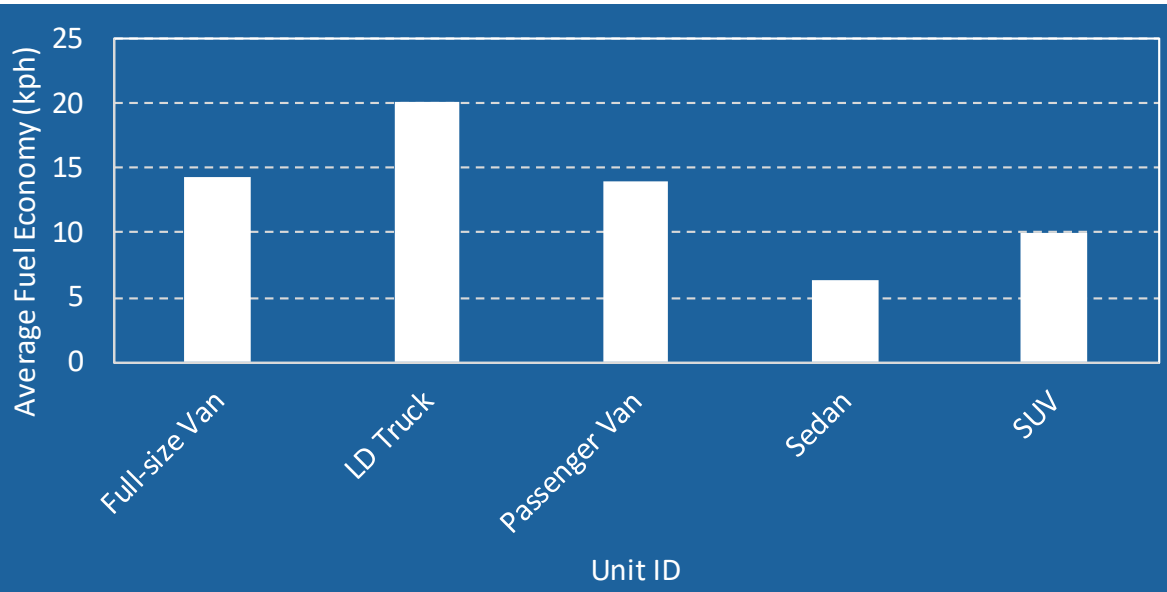
29
kph
(average duty cycle speed)

Average speeds are a high level indicator of the type of driving that your drivers do (highway or city).

27
%
(average time idling)

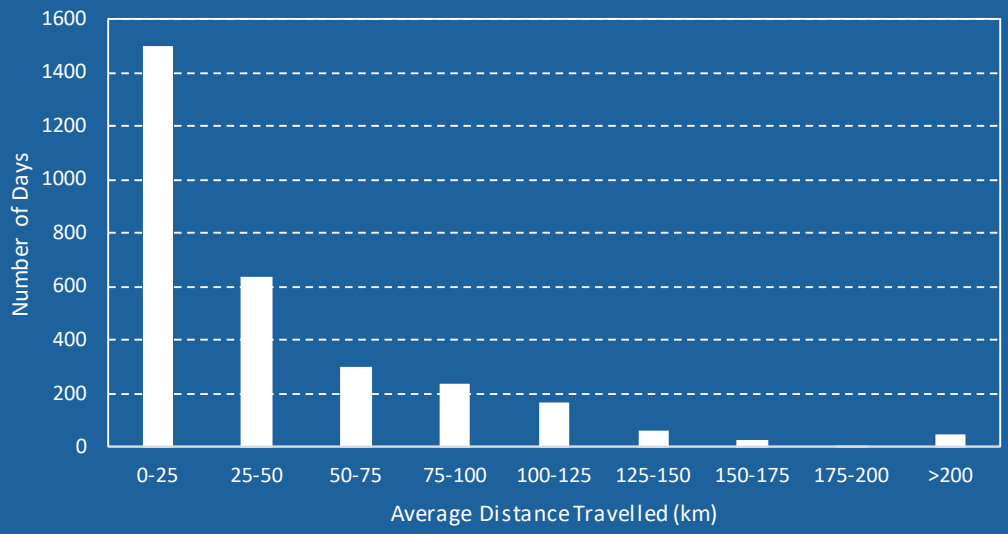
The amount of idling will impact fuel spend, tailpipe emissions, and even maintenance requirements.

Fuel Economy by Vehicle Type



Your Daily Utilization Histogram

Distance Travelled per Day Driven



Your average fuel economy is shown in the graph above with the current mix of vehicle types in your fleet. We provide the full fuel economy picture for every vehicle and every trip in the FleetCarma web portal as well. Clearly, since the fuel economy of your baseline vehicles varies from one duty cycle to the next, the potential fuel cost savings from plug-in vehicles should be highest on a per kilometer basis with the duty cycles that have the lowest fuel economy. However, daily utilization will have a substantial impact on the overall electric vehicle miles travelled (eVMT). In your daily utilization histogram above, we can see that of the days on which your vehicles were driven, 72% drove less than 50 kilometres, and 90% drove less than 100 kilometres. When considering EVs in ideal operating conditions, these thresholds are useful to evaluate the suitability of a hybrid or fully electric vehicle for your fleet.

FLEETCARMA RECOMMENDED EV DEPLOYMENT

This section shows your FleetCarma recommended EV deployment. Given this deployment, our simulation models show that in order to maximize ROI, the purchase price of your EVs should be no larger than the target.

The table below shows the recommended EV deployment purchase price, based upon the MSRP. By purchasing all recommended vehicles at this price and spreading savings across the fleet, you can expect to achieve the returns indicated on page 12. This analysis assumes that all of the recommended vehicles are purchased and deployed as indicated below. Please see page 9 to match the duty cycle with the recommended electric vehicle.

EV Model	Number of Vehicles	Bid Price	Duty Cycles
Mitsubishi Outlander PHEV	13	$43,000	See Page 9

BEST FIT DUTY CYCLES FOR EVs

In the table below, all of the baseline vehicles are listed in order of highest to lowest TCO Savings over the service life.

Department	Make & Model	Recommended EV	TCO Savings
Integrated Water Services	2017 Ford F-150	Mitsubishi Outlander PHEV	$35,339.06
Integrated Water Services	2017 Ford F-150	Mitsubishi Outlander PHEV	$32,645.42
Integrated Water Services	2017 Ford F-150	Mitsubishi Outlander PHEV	$18,335.52
Parks & Environmental Services	2018 Toyota RAV4	Mitsubishi Outlander PHEV	$16,164.51
Executive Services	2017 Ford F-150	Mitsubishi Outlander PHEV	$11,685.18
Planning & Protective Services	2017 Chevrolet Equinox	Mitsubishi Outlander PHEV	$8,857.45
Executive Services	2017 Ford F-150	Mitsubishi Outlander PHEV	$5,343.46
Integrated Water Services	2011 Ford Ranger	Mitsubishi Outlander PHEV	$4,723.49
Integrated Water Services	2017 Toyota RAV4 Hybrid	Mitsubishi Outlander PHEV	$3,835.21
Executive Services	2017 Ford F-150	Mitsubishi Outlander PHEV	$3,214.73
Integrated Water Services	2007 Ford Ranger	Mitsubishi Outlander PHEV	$3,131.00
Parks & Environmental Services	2010 Ford Ranger	Mitsubishi Outlander PHEV	$2,480.89
Integrated Water Services	2009 GMC Canyon	Mitsubishi Outlander PHEV	$1,690.23

The vehicles above were chosen based upon information provided by the Captial Regional District (CRD). By downsizing duty cycles that do not need the passenger or cargo capacity provided by a LD truck, van or SUV, there is an additional opportunity to reduce CO_2 emissions, and fuel expenditure.

BEST FIT DUTY CYCLES FOR EVs



13 Mitsubishi Outlander PHEV

$43,000 Bid Price

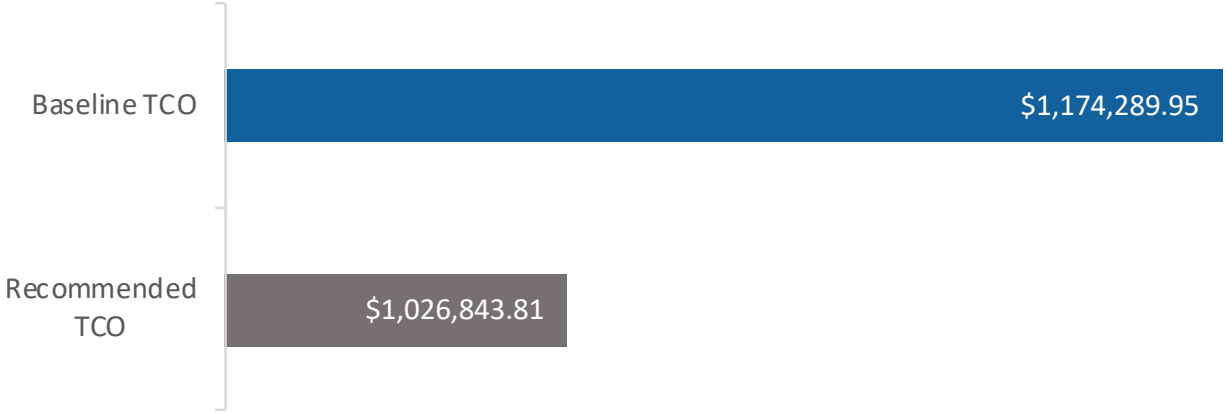


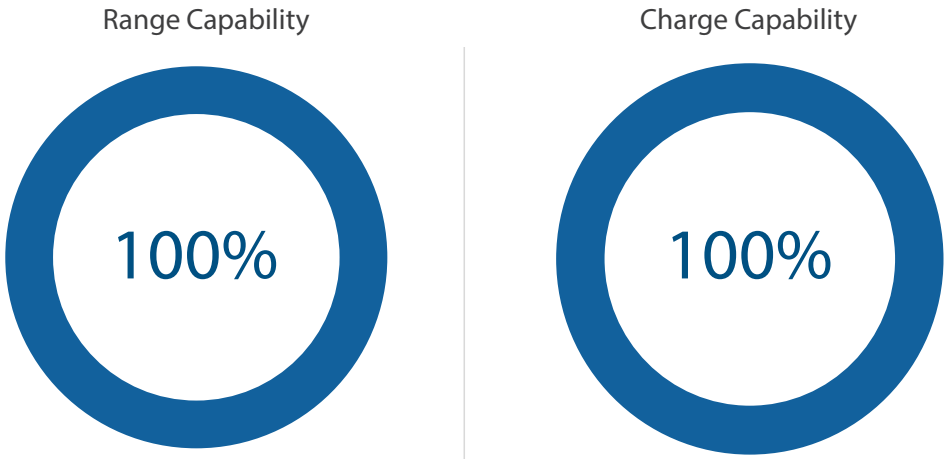
SUMMARY RESULTS

Providing quantified, independent third party, financial, and environmental results of plug-in electric vehicles in your duty cycles is what we do best.

Imagine logging all the speeds and all the energy demands from your vehicles for every second of every trip that your fleet drivers make. Now, imagine being able to use all that data to determine how alternative, more efficient technology would perform for any given trip, day, week, or year. These are the results that we are able to capture here. Using these data and our powertrain modelling tools we accurately compare the total cost of ownership of your baseline vehicles to the vehicles you are considering. Total costs include the vehicle acquisition costs and operating costs. In all cases presented, we assess EV suitability with one chance to charge per day, at the time that the vehicle finishes its final trip. For plug-in hybrids, the powertrain models determine the electric distance travelled and the corresponding overall fuel economy to drive the TCO calculations. In addition to the total cost perspective, these results help provide the framework to discuss further EV benefits such as GHG reductions, green marketing opportunities, and grid services that could enhance the total EV value equation.

When comparing your baseline vehicles to the optimal EV deployment scenario, it is clear that there is the potential for significant cost savings across the fleet.





Using the results of the recommended deployment shown on page 9, we can determine the potential savings that can be achieved from the most optimal EV deployment. We anticipate this potential to be about $147,446.16 in Total Cost of Ownership savings over the individual vehicle service lives. To do this analysis, we chose electric vehicles which we thought would be the most suitable to carry out each individual duty cycle in this fleet study and save your fleet the most on cost. We also take into account the capabilities of any potential EV deployments by running powertrain models of each EV on the data that we obtained from your baseline vehicles to determine whether the EV would be able to do the job of the baseline. We never recommend an EV which is not range capable. In your fleet, we found that the best-fit vehicles were 100% charge capable. This is the percentage of overnight times on average the vehicles will be able to fully charge.

If 13 of the baseline vehicles are replaced with the FleetCarma Recommended plug-in vehicles, the fleet will see the following total savings over the service lives of the baseline vehicles.

Total Fleet Savings (13%)

$147,446

If 13 vehicles are replaced with the best fit vehicle, the fleet could save $147,446 in total savings over the service life. This represents 13% of the fleet budget.

Annual Emission Reductions (43%)

↓49 tons

If 13 vehicles are replaced with the best fit vehicle, the fleet could realize an emission reduction of 49.2 tons per year over the service life, representing a 43% reduction in CO_2 emissions.

Annual Fuel Reduction (43%)

↓16,067 L

If 13 vehicles are replaced with the best fit vehicle, the fleet could reduce gasoline and diesel consumption by a total of 16,067 L annually over the service life, representing a 43% reduction in fuel.

MORE THOUGHTS ON FLEET EFFICIENCY

We understand that not every duty cycle in the fleet will be suitable for a plug-in electric vehicle right away. In the meantime, we present in this section of the report other opportunities for your fleet to capture further efficiency savings which relate to idling, eco-driving, and fleet right-sizing.



IDLING

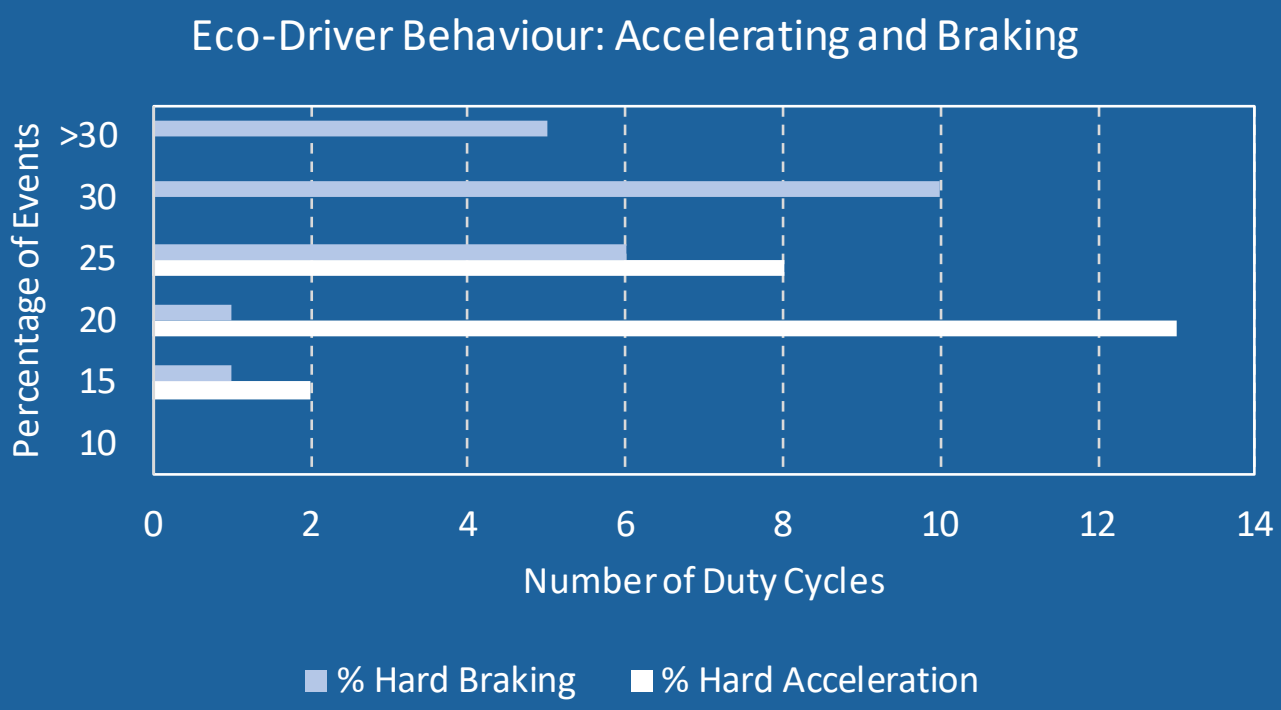
Based on the data collected from your vehicles, 27% of engine-on time is spent idling. Using a telematics system to manage idle-reduction programs could save 187 L of gasoline per month, resulting in a savings of $7 per vehicle.

27%	187 L	$7
engine-on time spent idling	total monthly fuel used for idling	average potential savings each month per vehicle

DRIVER SAFETY

The graph below shows a histogram of the acceleration and braking scores for each driver. In this case, the lower the score the better they are performing. For your fleet, 95% of drivers are below the hard braking threshold of 20% and 100% of drivers are below the hard acceleration threshold of 20%.

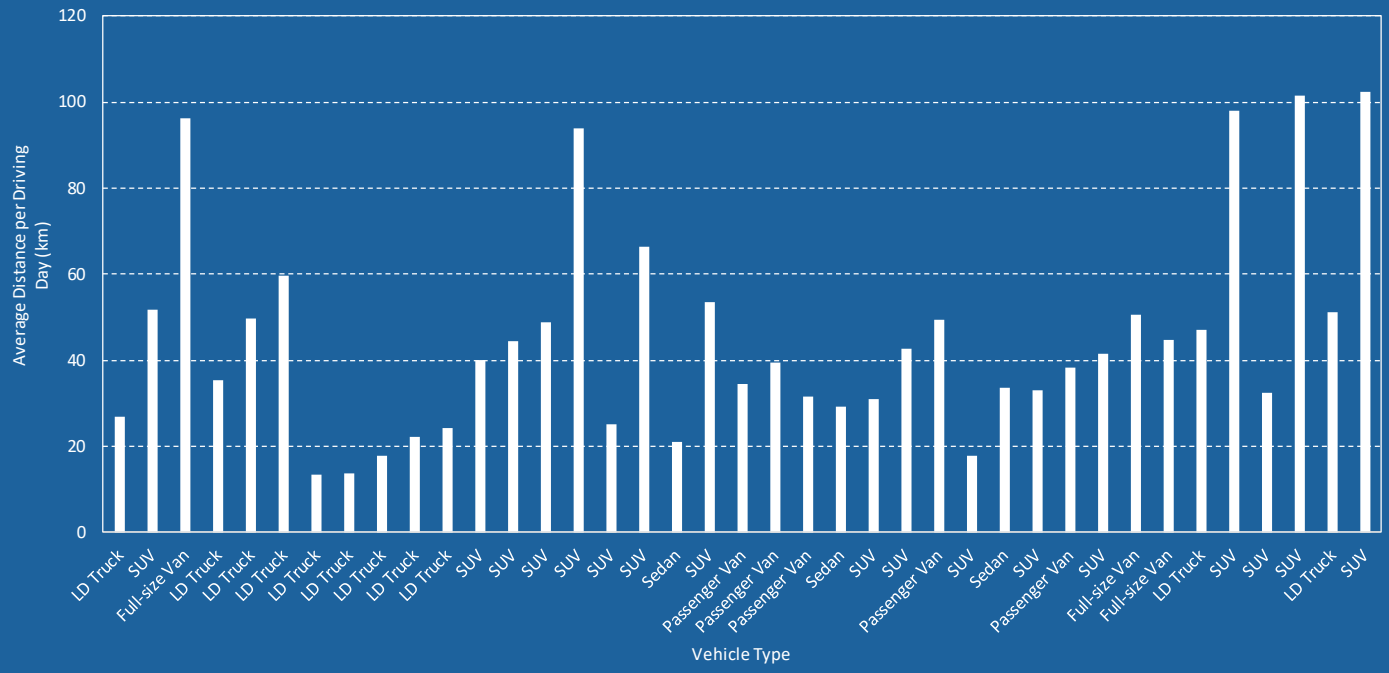


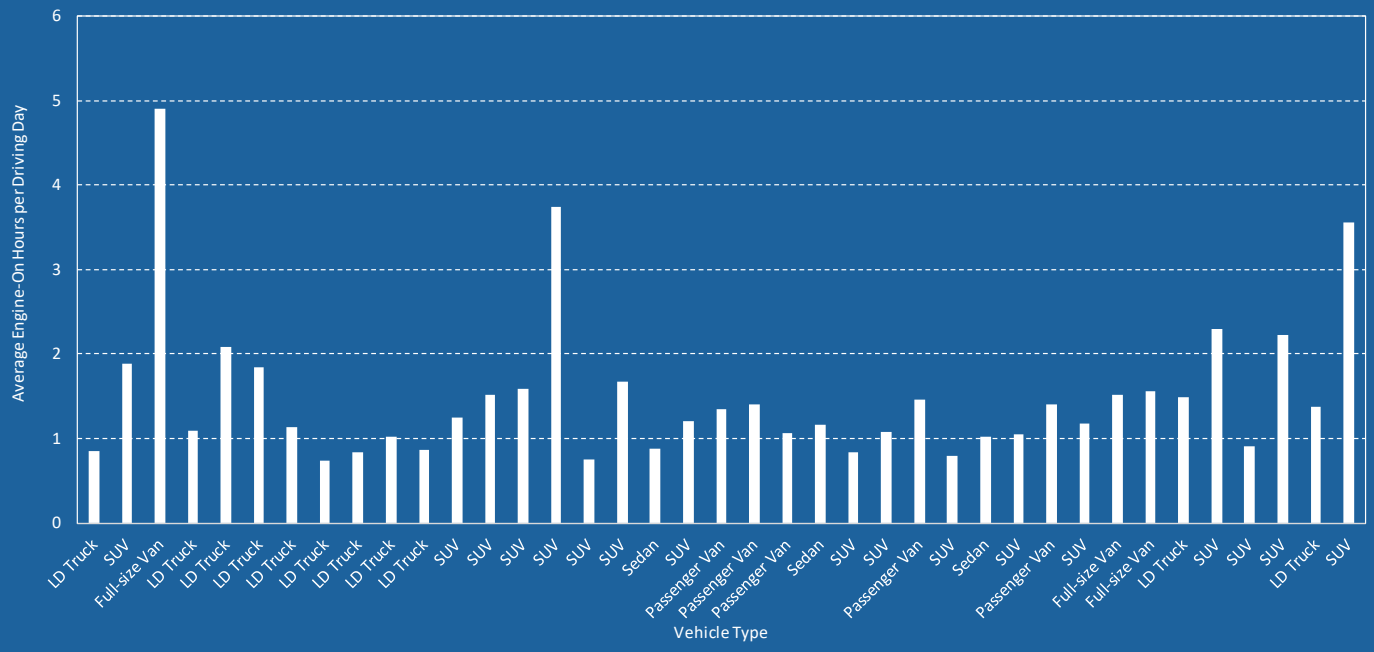


These Eco-Driver Behaviour scores may indicate opportunities within your fleet to review safe driving practices. Smooth braking and smooth acceleration can help reduce maintenance costs over the life of the vehicle. For an electric vehicle, smooth braking allows for more energy to be captured via the regenerative braking process.

UTILIZATION

Based on your daily utilization, we found that few of your vehicles are being used heavily, and a few were under utilized. The threshold for an under utilized vehicle is less than 25 kilometres per day, and less than 1 hour of engine on-time. Vehicles that meet this criteria could be replaced by a mileage reimbursement vehicle or a pool vehicle.





VEHICLE CHARGING INFRASTRUCTURE

To find out what to expect in terms of the charging needs of your new EVs, we looked at the amount of time your current vehicles spend parked overnight - their "dwell time".

Based on the recommended EV deployment on page 8, we estimated the amount of time each vehicle would need to charge at a Level 1 station versus a Level 2 station to determine the potential charging needs of your EV fleet. These requirements from the EV can then be combined with the nightly dwell times[2] for each of your current vehicles to determine the number and types of charging stations your fleet may require with this deployment. There are multiple strategies that can be employed when purchasing charging infrastructure to make sure you meet the needs of your fleet drivers, budget, and organization. We offer four of these potential strategies below so that your organization can determine what will work best in your particular case. The options we consider here include Level 1 (wall outlet), Level 2 (charging station) Single Port, and Level 2 Dual Port. Dual port stations are generally more expensive, but do not require someone to move the plug from one vehicle to another when the first vehicle has completed charging.

Current Dwell Time[1]	Number of Vehicles
Short	4
Medium	1
Long	8

Infrastructure Scenario	Total Cost[3]	Charging Power Level	Number of Stations	
1 - Dedicated	$15,000	1	8	
		2	5	
2 - Plug Sharing	$15,000	1	8	
		2	5	
3 - Power Sharing	$15,000	1	8	
		2	5 Single Port	0 Dual Port
4 - Complete	$39,000	1	0	
		2	13	

1 Short, medium, and long dwell times for the suggested PHEVs are < 4 hrs, 4-8 hrs, and > 8 hrs, respectively. Short, medium, and long dwell times for the suggested BEVs are < 12 hrs, 12-16 hrs, and > 16 hrs, respectively.

2 Please see the Appendix for more information on the nightly dwell times for each vehicle and strategies to optimize charging.

3 We assumed Level 1 stations cost $0 and Level 2 stations cost $3,000 for single port and $4,500 for dual port.



WHERE TO BEGIN

As you start purchasing plug-in vehicles for your fleet, you want to begin with the vehicles that will have the lowest total cost of ownership when compared to the vehicles you are currently operating with.

Looking at the comparative data in the reports, we can identify two key areas to begin to consider plug-in vehicle adoption.

1. Implementing PHEVs will ensure the vehicles are range capable and able to support the level of utilization observed in this fleet. To facilitate the implementation of an electric fleet, charging stations must be available and drivers must be encouraged to plug in the vehicles to maintain a high EV fraction. This will allow you to realize the maximum level of savings.
2. There is a large opportunity to transition light duty trucks and/or SUVs to PHEV SUVs. At this time, there are not many SUV EVs available. However, additional significant fuel and emission savings can be realized if the conventional light duty trucks and SUVs can be replaced replaced with suitable PHEVs.



STUDY DETAILS

The results and recommendations in this report have been analyzed using the following information while accounting for vehicle resale value, range capability, and charge capability:

Service Life and Energy Costs		Emissions Factors	
Service life per vehicle	7 years	Tailpipe (Gas)	2,325g $C0_2$/L
Current cost of fuel	$1.45/L (Gasoline)	Upstream (Gas)	740g $C0_2$/L
Current cost of electricity	$0.12/kWh	Upstream (Electricity)	259g $C0_2$/kWh

ELECTRIC FLEET MANAGEMENT GOALS

Once you have begun to deploy electric vehicles in your fleet, the following goals will help you to realize the savings potentials described in this report. FleetCarma Telematics Technology can be used to track performance on the KPIs listed below.

Along with opportunities for savings on costs, fuel, and emissions, electric vehicles also offer new opportunities to better manage the vehicles you own. Active management of fleet vehicles to ensure that EVs get used first can drive up your EV ROI and ensure that your fleet is never paying for high-cost, high-emissions fuel when it is not necessary.

Adding EVs to your fleet also opens up opportunities to show sustainability leadership as an organization through implementing new and more efficient technologies. Electric vehicles are just one part of a holistic sustainability plan which aims to reduce the overall greenhouse gas emissions of the organization as well as promoting and educating others about sustainability best-practices.

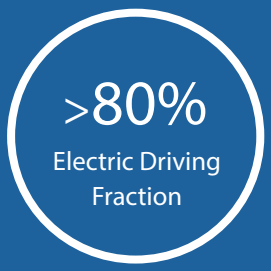
Employing systems to manage charging and day-to-day usage can help fleet drivers feel comfortable driving the new electric vehicles that have been added to the fleet, avoiding hesitation and range anxiety. With the remaining gasoline vehicles that you have in the fleet, there are also opportunities to improve fuel efficiency and driver safety mentioned earlier in this report. This section allows us to attach goals to these metrics like Hard Acceleration and Braking.

QUALITATIVE GOALS

1. Demonstrate EV leadership through outreach and technology demonstration.

2. Practice environmental stewardship through reductions in carbon intensity (CO_{2eq}) per mile

QUANTITATIVE GOALS



The electric driving fraction refers to the percentage of trips driven using electricity rather than gasoline. This applies to Plug-in Hybrid Electric Vehicles. A higher electric driving fraction results in a lower TCO.



Plug-in compliance refers to the percentage of nights that drivers plug in their vehicles after the last trip of the day so that it can have time to charge overnight. It ensures that Starting SOC is as high as possible.



SOC stands for State of Charge and refers to the degree to which the high-voltage battery of a plug-in vehicle has been charged or depleted. Starting SOC refers to the SOC at the beginning of the first trip of the day. A more fully charged battery allows for a higher electric driving fraction, and limits range anxiety.



Hard Acceleration Events is another metric used by FleetCarma clients to measure driving efficiency and driver safety. This is calculated as a percentage of total acceleration events.



Braking style does impact plug-in vehicle efficiency since smooth braking helps the vehicle regenerate energy while driving and also improves driver safety. This is calculated as a percentage of total braking events.



NEXT STEPS

The core objective of an EV suitability assessment is to help you determine your best strategy for EV adoption, to formulate customized EV utilization goals, and to have the information your need to move forward with confidence.

Understanding your fleet utilization to the level presented here should give you all that you need to make informed decisions about your fleet composition. If fleet efficiency is a priority for your organization then we have got your back. As vehicle technology evolves, the complexity of managing these vehicles changes. This is why at FleetCarma we have worked hard to provide our customers with a vehicle monitoring and fleet management system flexible enough to work on all vehicle types. As you continue to strive to deploy a diverse set of vehicles, we would be happy to help you along the way. For more information see some of the features we offer through our telematics system on the next page or contact us again any time.



EV Utilization Metrics

Track all the your EV KPIs with FleetCarma EV monitoring system. No need to pay for sub-metering - with this system you can track all your driving and charging data in one common system.



Charge Management

Want to improve the TCO of your electric vehicles? Consider using them as energy assets for your local grid. With real-time EV monitoring, we can automate your managed charging strategy.



Vehicle Location Tracking

FleetCarma's vehicle monitoring technology can help you keep track of real-time vehicle location with live mapping tools. Also track historic locations of trips and charge events for your vehicles.



Odometer Readings & DTCs

Can you benefit from a more automated preventive maintenance program? With FleetCarma's system you can instantly know your vehicles' odometers and when diagnostic trouble codes are present.



Full Fleet Support

Monitor plug-in vehicles, conventional vehicles, and heavy-duty vehicles with one common system. FleetCarma's system is the most flexible fleet monitoring technology on the market today.



EV ROI Scorecard

FleetCarma's customer support team will work with you along the way to a positive EV experience. We'll provide periodic EV ROI Scorecards for you and your team to ensure goals are met.

APPENDIX 1

This appendix was included to show the individual dwell times of the vehicles.

Department	Make & Model	Recommended EV	Dwell Time
Integrated Water Services	2017 Ford F-150	Mitsubishi Outlander PHEV	Short
Integrated Water Services	2017 Ford F-150	Mitsubishi Outlander PHEV	Short
Integrated Water Services	2017 Ford F-150	Mitsubishi Outlander PHEV	Long
Parks & Environmental Services	2018 Toyota RAV4	Mitsubishi Outlander PHEV	Long
Executive Services	2017 Ford F-150	Mitsubishi Outlander PHEV	Long
Planning & Protective Services	2017 Chevrolet Equinox	Mitsubishi Outlander PHEV	Long
Executive Services	2017 Ford F-150	Mitsubishi Outlander PHEV	Long
Integrated Water Services	2011 Ford Ranger	Mitsubishi Outlander PHEV	Short
Integrated Water Services	2017 Toyota RAV4 Hybrid	Mitsubishi Outlander PHEV	Short
Executive Services	2017 Ford F-150	Mitsubishi Outlander PHEV	Long
Integrated Water Services	2007 Ford Ranger	Mitsubishi Outlander PHEV	Medium
Parks & Environmental Services	2010 Ford Ranger	Mitsubishi Outlander PHEV	Long
Integrated Water Services	2009 GMC Canyon	Mitsubishi Outlander PHEV	Long



2-60 Northland Road,
Waterloo Ontario, N2V2B8
1-800-975-2434

www.fleetcarma.com

CRD-UVic E-bike fleet deployment

Daniel Clancy, B.Eng

February 4, 2019

Abstract

The deployment of three E-bikes into the CRD fleet resulted in over 600km of recorded trip data. This data was used to inform several academic research projects as well as determine typical operational capabilities of E-bikes for the CRD fleet. The collected data showed a reduction of emissions by 99% when compared to a typical car found in the CRD fleet. Even compared to battery electric cars, the E-bikes represent a 95% reduction in emissions. Compared to both of these modes, the E-bikes also represent an over 80% reduction in capital and operating costs.

Overall, the deployment of the E-bikes saved approximately 250kg of CO2 if they replaced internal combustion engine car trips. The operating capabilities of E-bikes shows them as having half the pace of cars in urban environments. Where a car can cover 5km in 8.5 minutes, an E-bike typically covered the same distance in only 20 minutes.

Contents

1 Introduction **1**

2 Project Details **1**

3 Energy Results **2**

4 Environmental and Economic Assessment **6**

5 Conclusion **8**

List of Figures

1 Per-trip energy use, average per-trip power, and trip distance for all recorded CRD project trips. 3
2 The percentage of total time of occurrence of energy, power, and distance for each trip that had a recorded power value 4
3 Energy and power related to distance and grade. Mean and standard deviation are shown in each subfigure. 5
4 Estimated upper and lower average typical human power contributions for full range of Bosch Assist levels. Corresponding average grade for each speed and power. 10
5 Human power contributions for various assist levels with impacts of grade removed. Filtered to only include power corresponding to grades less than 2%. 11
6 Human power contributions with speed and grade data points at maximum assist factor A = 2.75 12

1 Introduction

The CRD E-bike pilot is a joint project between IESVic and the Capital Regional District (CRD) that is funded by a grant from the Federation of Canadian Municipalities (FCM). The E-bike project forms one part of a larger FCM funded transportation program, the Zero Emissions Fleet Initiative (ZEFI) that focuses on reducing the transportation based emissions of the CRD through fleet equipment upgrades, and academic research to support this goal.

The proposed research goals for the E-bike project are:

1. To make recommendations regarding the optimal use of E-bikes in urban commercial fleets
2. To compare the environmental, economic, and logistical performance of the operation of E-bikes in urban fleets to other vehicle modes;
3. to make recommendations regarding the regulatory constraints placed on E-bike use with respect to motor power limits

The research goals are answered through the deployment of three E-bikes outfitted with multiple sensors to capture a variety of data. The purpose of this work is to provide quantifiable, evidence-based results to inform the CRD as to the efficacy of the use of E-bikes in their corporate fleet. Additionally, this project is meant to inform other fleet operators as to the operational costs and benefits of E-bikes in commercial fleets. The final purpose of the project that is of less relevance of the CRD is to provide insight into regulatory constraints and future E-bike design guidelines to manufacturers.

The remainder of this report details the methodology and results that were used to answer the first two research goals, with some of the results that are of less relevance to the CRD detailed in the appendix.

Section 2 provides further details regarding the deployment of equipment and data collection.

Section 3 shows the relevant parts of the raw data before further analysis.

Section 4 presents the results of the analysis and subsequent discussion

2 Project Details

The data collection side of the project was achieved through the deployment of three E-bikes outfitted with sensors that logged performance metrics during each trip: a speed sensor, a GPS sensor, and a power meter. The sensor package installed on each E-bike consisted of a Garmin Edge 520 cycle computer, a Garmin ANT+ protocol speed sensor mounted on the front wheel hub, and an PowerTap ANT+ protocol hub based power meter built into the rear wheel.

Each of these sensors was connected to a Norco VLT R1 E-bike, synced to the Garmin Edge 520, with the data collected from the Garmin Edge on a weekly

Table 1: Data collection equipment for CRD E-bike Trial.

Sensor	Accuracy	Metric	OEM
Edge 520 Cycle Computer	Not listed	GPS	Garmin
Bike Speed Sensor	Not listed	m/s	Garmin
G3 Power Meter	± 1.5 %	Watts	PowerTap

basis. The CRD staff involved in the project could reserve an E-bike through the CRD's internal online vehicle booking system. Each time staff rode the E-bike they would simply press a button to initiate data logging, and press the same button to end the ride and save the data. Seventeen users were recruited into the project, with each rider's trip data anonymized to meet CRD privacy concerns.

By the end of data collection, the CRD project resulted in a large number of trips representing over 4 months of data. There was a significant amount of non-compliance when it came to data recording with the E-bike odometers showing a total of nearly 1200km and the actively recorded data only totalling just over 600km. While the data logging was optional for CRD staff, this did likely impact the fidelity of the results as a large number of trips were missed. A summary of the recorded data used in the final analysis is presented in table 2.

Table 2: Summary statistics of E-bike use in urban commercial fleet. Values show mean of results along with one standard deviation

Metric	Value
Total kilometres travelled	607 km
Number of trips	92
Average speed	20.3 ± 5.9 kph
Average trip length	6.6 ± 5.8 km
Average trip time	25.9 ± 25.2 min

3 Energy Results

The recorded energy use while riding the E-bikes comes from the PowerTap G3 power-meter. The power data, along with the other ride characteristics (speed, location, grade) are used to understand how and when energy was expended during the trip. The energy use also allows for determination of the GHG emissions that occur from using the E-bike, as well as the electricity costs.

Table 3 shows the total energy use and power as recorded by the power meter over the course of the experimental campaign. In addition to the summary table, the recorded power data can be categorized into total energy use in response to

distance travelled, grade, and speed to provide further insight as to how E-bikes are used in an urban setting.

Table 3: Total energy use and power as recorded by the rear-hub power meter.

Metric	Value
Average per-trip power	234 ± 73 W
Average per-trip energy use	40.3 ± 48.0 Wh
Average per-kilometre energy use	7.8 ± 2.5 Wh/km

Figure 1 shows on the top the per-trip values for total energy use, in the middle the average instantaneous power, and on the bottom the distance per-trip. This is done to provide further insight into how the trips vary. Some of the trips don't have a recorded power value due to issues with the sensors pairing improperly during use by CRD staff. This was remedied early on but the speed and distance values are still useful to include in the overall results.

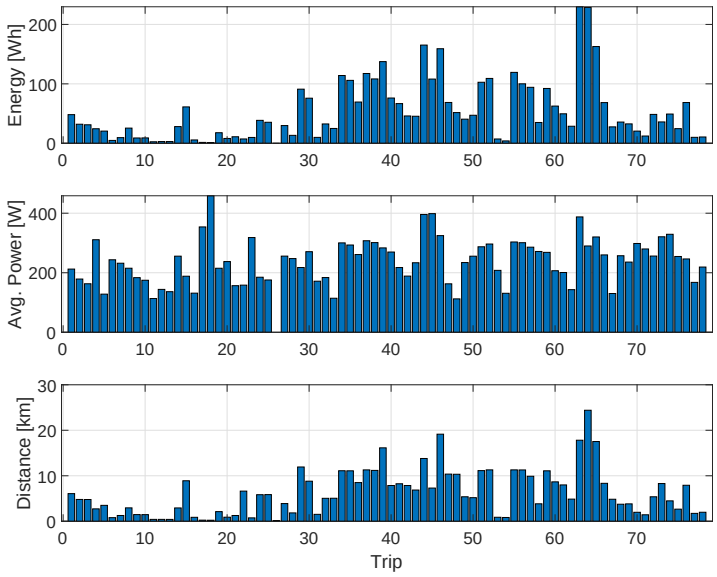


Figure 1: Per-trip energy use, average per-trip power, and trip distance for all recorded CRD project trips.

Figure 2 shows on top the time spent moving on a given grade during all trips, and on the bottom the time spent moving at a given speed during all trips. This figure is shown so that weight can be given to further findings and claims relating to energy use at these different speed, grade, and distance states. The more time spent in one of these states, the more reliable the findings can be

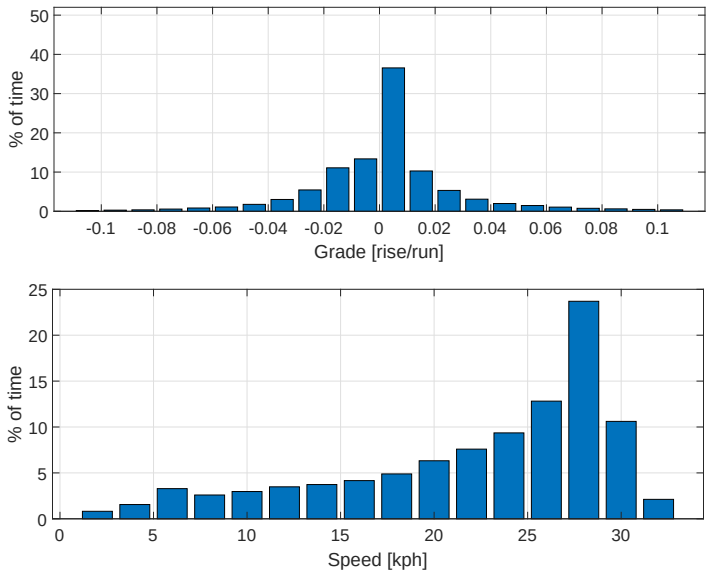


Figure 2: The percentage of total time of occurrence of energy, power, and distance for each trip that had a recorded power value

labelled. The grade portion of the figure can also be thought of as a topological characterization of the riding environment in downtown Victoria for comparisons to any other urban environments with the caveat that it is dependent upon the routes chosen by the CRD participants.

In the bottom half of figure 2 it can be seen that a clear majority of the time (50%) is spent at near the speed limit of the E-bike, meaning that participants are able to reach and maintain optimal speeds during the majority of trips.

Figure 3 shows three different figures. The top shows the energy use per distance travelled as determined by calculating the cumulative energy for each trip, divided by the cumulative distance covered. The middle shows the average instantaneous power within each distance segment. Both the top and middle sub-figure indicate that the participants did not appear to significantly reduce energy expenditure the longer they rode. This would imply that for longer trips, riders did not tire noticeably in total system output, either through maintaining personal exertion or by increasing the assist factor. The energy use remains relatively constant regardless of the distance, which shows that at least for the distances covered, the riders didn't show any major signs of fatigue. The bottom sub-figure shows some consistency in that at positive grades the rider had to output on average more power.

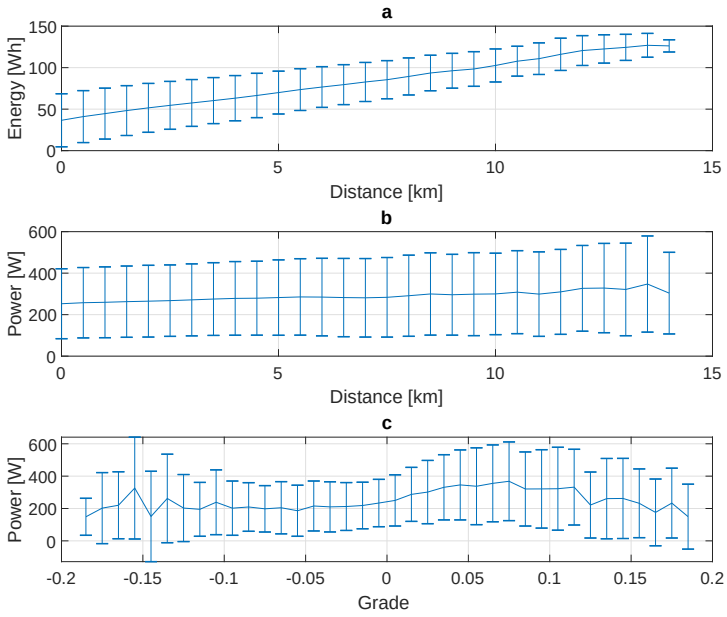


Figure 3: Energy and power related to distance and grade. Mean and standard deviation are shown in each subfigure.

4 Environmental and Economic Assessment

This section covers the quantification of the impacts of the CRD E-bike pilot project as relevant to the CRD or any other commercial fleet operator. Using the energy data detailed in the previous section, the use-phase emissions are reported, along with the operational and capital expenditures. The results are then compared to some standard fleet vehicle values to give further context as to the benefit of E-bikes in commercial fleets.

The emission accounting is straight forward. The electric energy use per kilometre as required to charge the battery at a wall outlet includes the efficiency losses due to the E-bike charger, the battery, the motor, and the losses through the mechanical drive train which are detailed in table 4.

Table 4: E-bike system efficiency estimates that links the recorded power at Powertap power meter to electricity at a wall outlet.

Charger efficiency	0.95
Charging efficiency	0.85
Motor efficiency	0.90
Drive train efficiency η_{DT}	0.96
Total electrical system efficiency η_{Elec}	0.70

The CRD E-bike emission intensity is the product of the efficiencies, times the recorded power, times the BC Hydro electrical emission intensity. The per-kilometre emission intensity is listed in table 5 along with comparative estimates for a typical sedan used in the CRD fleet. The sedan data was obtained from CRD fleet data involved in another ZEFI project. The average pace includes time stopped in traffic so at to best represent typical urban driving conditions.

Table 5: Use-phase emission intensity along with typical urban pace for E-bikes, fossil fuel and electric cars, and walking [1, 2].

Mode	Emission Intensity [kg CO2e/km]	Typical Pace [min/km]
E-bike	0.00009	4
Standard sedan	0.21580	1.7
Electric Car	0.00210	1.7
Walking	0	20

These results show a very favourable comparison for E-bikes. The E-bike offers a relative reduction in emissions of 99% compared to standard fossil fuel power cars, and a relative reduction of 95% compared to electric cars when comparing 'tail-pipe' emissions only. This near complete reduction in use-phase emissions only comes at the cost of being just over two times slower, which can shift a 5 minute trip to nearly 12 minutes.

Walking reduces emissions over E-bikes but E-bikes already represent a bare-fraction of emissions relative to fossil fuel and electric cars such that the trade-offs between emissions and pace aren't as worth-while. Since the E-bike project with the CRD logged approximately 1160 km (the riders only actively logged 623 km), an estimate of the total use-phase emissions from the E-bikes is accounted for and presented in table 6 along with an estimate of the same distance covered by a standard car.

Table 6: CRD Project tail-pipe emissions for E-bikes and comparison to other transportation modes for the same distance.

Mode	Total Emissions [kg CO2e]
E-bike	0.104
Standard Sedan	250
Electric Car	2.44

The other metric of importance is the financial costs for each of these modes. While electric cars reduce emissions versus the traditional fossil fuel car by nearly 99%, they cost significantly more than E-bikes. The financial costs of the E-bikes were detailed by the CRD and are summarized in table 7. E-bike values is sourced from the CRD project and includes safety equipment for users, added security features, and added storage such as panniers and baskets on the E-bike. Also includes regularly scheduled maintenance and an estimate of annual parts replacement costs (tires, drivetrain, etc). It does not include training costs for users or parking requirements for the E-bikes (such as secured storage, charging infrastructure, etc) as these can vary quite widely from one organization to the next and are not included in the car ownership costs.

The vehicle values assume annual travel of 10,000 km which is a low value for a commercial fleet but is meant to make it more comparable to the E-bike with respect to short urban trips. It includes maintenance, license and registration feeds, insurance costs, and upfront vehicle cost. Vehicle capital costs are sourced from respective brand websites, and the operating costs are sourced from the CAA online car costs calculator.

Table 7: E-bike, fossil fuel and electric car capital and operational costs per vehicle representing ownership over 5 years. [3, 4, 5].

mode	Capital costs [$ CAD]	Operational Costs [$ CAD]
E-bike	4,400	1,730
Chevrolet Malibu	22,295	14,000
Kia Soul EV	35,895	8,300

The type of trips the E-bikes are typically used for definitely do not cover the entire range of trip types presented by traditional cars. Cars provide a much

wider range of possible trip lengths and cargo capacities. For a smart fleet planner, E-bikes open up a new category in the fleet that is optimal for short urban single occupancy trips. Larger vehicles will still be needed but when appropriate, E-bikes offer a virtual elimination of use-phase emissions as accounted for by the fleet manager, as well as an 83% and 86% cost reduction over 5 years when compared to a typical CRD fleet car and electric car respectively.

5 Conclusion

The deployment of the E-bikes resulted in a substantial amount of data to be collected detailing the costs and capabilities of these vehicles as used in an urban commercial fleet. From this data, it was shown that E-bikes emissions and operating costs are dramatically lower than both internal combustion engine and battery electric cars. E-bikes also have a highly competitive pace in urban environments with travel time only double that of cars on average.

The research also showed that the power output of the rider and E-bike didn't decrease over time even on trips longer than 10 kilometres. The energy in relation to distance in the top sub-figure of figure 2 is linear which means that average energy expenditure remained constant across most trips regardless of distance. This would imply that according to the data collected so far, fatigue is not a major issue for E-bike trips.

The data also incorporated a significant amount of travel along varying road grade. The power and speed measurements on inclines did not show any significant impacts that would indicate riders having to exert themselves or slow down dramatically.

The data collected shows E-bikes as a cost effective, environmentally friendly, and effective urban transportation solution that would fit well in most any fleet that has the appropriate trip types: 10km or less, urban environments with stop and go traffic, and limited cargo requirements.

Appendix

This section of the appendix covers a small portion of the additional analysis that was performed on the collected data. This section is included as an overview of what some of the other research was aiming to achieve.

Human Energy Contributions The typical human energy contributions that occur while riding an E-bike are important because they allow for later analysis to model larger motors while still replicating expected human behaviour. This section estimates the human power contributions that occurred during the CRD project by using a differential equation that is detailed in the author's thesis, along with equation 1 which shows the relationship between human power ($\dot{E}_h$) and motor power ($\dot{E}_m$) as a function of assist level (A).

$$\dot{E}_m = A\dot{E}_h \tag{1}$$

This analysis follows a similar format to that of section 4 but without any human or electrical energy conversion efficiencies. The results of this analysis will show the range of human power contributions as a function of speed of the E-bike as delivered directly to the shaft of the pedals from the motor and the human. Figure 4 was created by discretizing all of the power data from the CRD project into speed bins. Within each speed bin, the power was averaged (not including zero values), and the grade data was also averaged within each bin. The assist varies from a factor of 0.5 up to 2.75, matching the capabilities of the Norco E-bike used in the CRD project.

Figure 4 shows the definitive impacts of the max assisted speed (approximately 30-32 kph) after which the electric motor stops assisting the rider. As the limited speed is approached, the human power contributions diminish rapidly due to the increased power requirements. It also shows that riders don't typically exceed the maximum assisted speed unless they are on a decline (or negative grade) and in doing so have dramatically decreased power requirements.

The discretization process was repeated but now with the filter that only uses data that has a recorded grade less than 0.02 (2%) and greater than -0.02, in an attempt to remove the impact of grade on human power. The results of this process are shown in figure 5 and are used to compare with the results of an external study. Langford et al recorded an average human power contribution of 62 watts at approximately 20 kph while on level ground while using a maximum level of assist on an E-bike. Langford et al's results are very similar to the results of figure 5 which show a power of approximately 60 W at maximum assist and relatively level ground.

Finally, human power as a function of speed and grade is modelled using MATLAB's surface fit function. This fit will act as a look-up table to determine an averaged human power contribution at any particular speed and grade, such that later research can dynamically subtract this amount to determine motor contributions as loads are increased. Figure 6 shows human power as a function of grade and speed.

The surface fit plot in figure 6 has negative power values removed as displayed

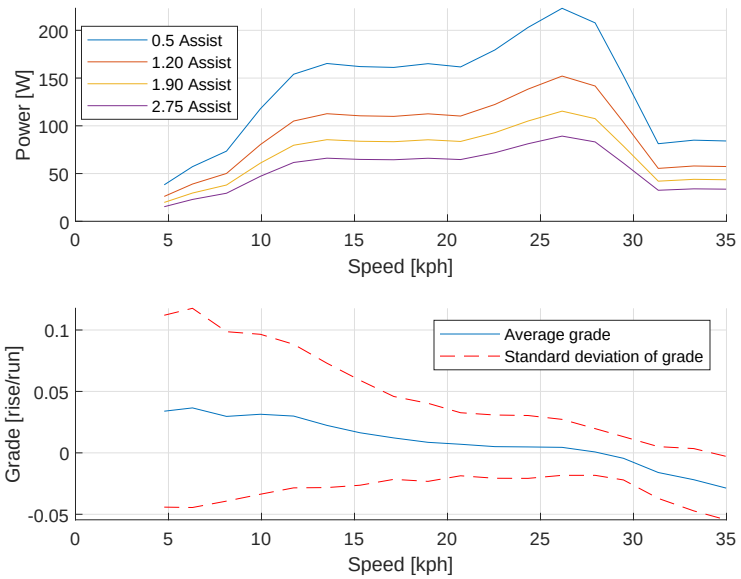


Figure 4: Estimated upper and lower average typical human power contributions for full range of Bosch Assist levels. Corresponding average grade for each speed and power.

by the white space in the figure. A clear trend can be seen that for positive grade values, speed doesn't typically exceed about 30 kph (at which point the electric assist cuts off due to B.C. regulations on pedal assisted E-bikes). In addition, almost all human power input, assuming maximum levels of assist, is less than 150 watts except in a few cases of large grade and high speed when it gets up to approximately 250 to 300 watts.

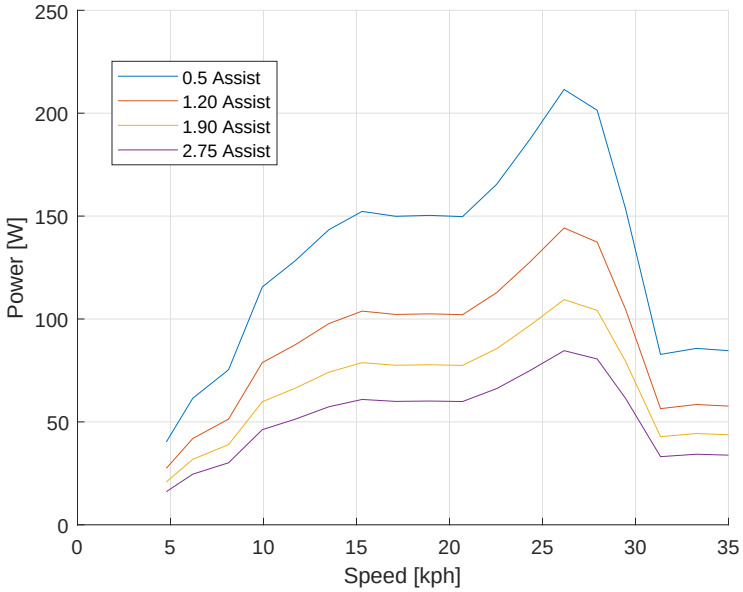


Figure 5: Human power contributions for various assist levels with impacts of grade removed. Filtered to only include power corresponding to grades less than 2%.

References

[1] "2016 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions," tech. rep., British Columbia Ministry of Environment, 2016.

[2] T. Litman, "Transportation Cost and Benefit Analysis II- Travel Time Costs," tech. rep., Victoria Transport Policy Institute.

[3] K. Canada, "Kia Build & Price — Kia Canada." http://www.kia.ca/build-and-price-kia?sourceid=new-nav-cta.

[4] "2018 Chevrolet Malibu — Mid-Size Car — Chevrolet Canada." https://www.chevrolet.ca/malibu-mid-size-sedan.html.

[5] "CAA Driving Costs Calculator." https://www.caa.ca/carcosts/.

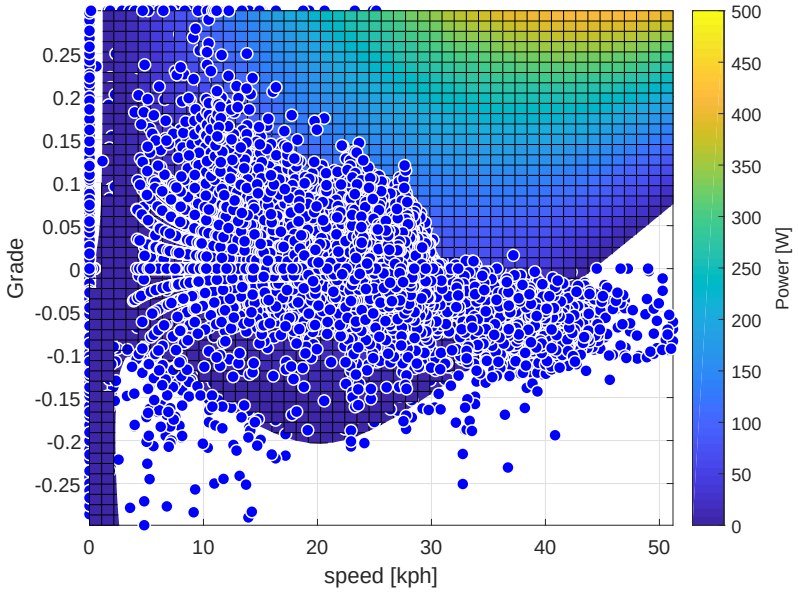


Figure 6: Human power contributions with speed and grade data points at maximum assist factor A = 2.75

Predicting fleet-vehicle energy consumption with trip segmentation

by

Autumn Umanetz

B.A.Sc, University of Waterloo, 1995

A Thesis Submitted in Partial Fulfillment

of the Requirements for the Degree of

Master of Applied Science

in the Department of Mechanical Engineering

©Autumn Umanetz, 2021

University of Victoria

All rights reserved. This thesis may not be reproduced in whole or in part, by photocopy or other means, without the permission of the author.

Predicting fleet-vehicle energy consumption with trip segmentation

by

Autumn Umanetz

B.A.Sc, University of Waterloo, 1995

Supervisory Committee

Dr. Curran Crawford, Co-Supervisor

Department of Mechanical Engineering

Dr. Nedjib Djilali, Co-Supervisor

Department of Mechanical Engineering

Abstract

This study proposes a data-driven model for prediction of the energy consumption of fleet vehicles in various missions, by characterization as the linear combination of a small set of exemplar travel segments.

The model was constructed with reference to a heterogenous study group of 29 light municipal fleet vehicles, each performing a single mission, and each equipped with a commercial OBD2/GPS logger. The logger data was cleaned and segmented into 3-minute periods, each with 10 derived kinetic features and a power feature. These segments were used to define three essential model components as follows:

- The segments were clustered into six exemplar travel types (called "eigentrips" for brevity)
- Each vehicle was defined by a vector of its average power in each eigentrip
- Each mission was defined by a vector of annual seconds spent in each eigentrip

10% of the eigentrip-labelled segments were selected into a training corpus (representing historical observations), with the remainder held back for testing (representing future operations to be predicted). A Light Gradient Boost Machine (LGBM) classifier was trained to predict the eigentrip labels with sole reference to the kinetic features, i.e., excluding the power observation. The classifier was applied to the held-back test data, and the vehicle's characteristic power values applied, resulting in an energy consumption prediction for each test segment.

The predictions were then summed for each whole-study mission profile, and compared to the logger-derived estimate of actual energy consumption, exhibiting a mean absolute error of 9.4%. To show the technique's predictive value, this was compared to prediction with published L/100km figures, which had an error of 22%. To show the level of avoidable error, it was compared with an LGBM direct regression model (distinct from the LGBM classifier) which reduced prediction error to 3.7%.

Contents

Front Matter i

Title Page i
Supervisory Committee ii
Abstract iii
Contents iv
List of Figures v
List of Tables vi
Glossary vii
Acknowledgements viii

1 Introduction 1

1.1 Overview 1
1.2 Project Context 4
1.3 Research Structure 8

2 Background 12

2.1 Travel Data 12
2.2 Machine Learning 16
2.3 Data Collection 23

3 Data Cleaning and Preparation 27

3.1 Raw Data 27
3.2 Speed Data Cleaning 30
3.3 Power Data Cleaning 32
3.4 Regularization 35

4 Methodology 37

4.1 Feature Preparation 37
4.2 Clustering 41
4.3 Classification Algorithm . . . 42
4.4 Classification Method 48
4.5 Energy Prediction 49
4.6 Parameter Refinement 50
4.7 Comparison Predictions . . . 55

5 Results 57

5.1 Presentation of Error 58
5.2 Discussion 60
5.3 Application 65
5.4 Shapley Additive Explanation 68

6 Conclusions 71

7 Recommendations and Future Work 73

7.1 Assumptions 73
7.2 Cleaning Decisions 76
7.3 Data Structure 78
7.4 Modeling 81
7.5 Data and Features 83
7.6 Applications 86

8 Bibliography 88

A Logger features 100

B Embodied energy and Fuel Intensity 101

List of Figures

1 Decision support data-flow and work-flow . . . 10
2 UDDS and HWFET drive cycles . . . 13
3 Sample counts by vehicle, studied and non-studied . . . 28
4 Data collection timespans for individual vehicles . . . 29
5 Trip SOC vs Voltage . . . 34
6 SOC and V vs time . . . 34
7 Linear interpolation problems . . . 36
8 Timeseries trace of speed and accelerations, overlaid with eigentrip labels . . . 38
9 Feature value distributions, including end-of-range values . . . 40
10 Feature value distributions after removing common end-of-range values . . . 40
11 Clustering example vehicle . . . 43
12 Example of a single-node decision tree, or "stump" . . . 45
13 MAPE surface vs K and PS (broad) . . . 50
14 MAPE surface vs K and PS (narrow) . . . 51
15 Prediction and classification error vs K and PS . . . 52
16 Final clustering (K=6 PS=7), PCA kinetic features, and power . . . 53
17 Power by vehicle category and eigentrip . . . 54
18 Segment prediction error distribution . . . 61
19 Example power vs prediction . . . 62
20 Feature value distribution by eigentrip . . . 64
21 SHAP explanation summaries . . . 69

List of Tables

1 Vehicle LCA . . . 6
2 Kinetic features for study . . . 15
3 Derived ICE features . . . 16
4 OBD2 Log Problem Example . . . 24
5 Data Collection Statistics . . . 28
6 Speed data cleaning impact . . . 31
7 EV cleaning impact . . . 35
8 PCA components for visualization . . . 44
9 LGBM hyperparameters selected for optimization . . . 51
10 Error by timescales . . . 60
11 Trip error by vehicle categories . . . 60
12 Mission error by vehicle categories . . . 66
13 SHAP single prediction . . . 68
14 CRD FleetCarma logger features . . . 100
15 Vehicle LCA calculations 2018 . . . 102
16 Vehicle LCA calculations 2030 . . . 102

Glossary

BAU business-as-usual

BEV battery electric vehicle

CAN controller area network

CRD Victoria Capital Regional District

CSV comma-separated-value

ECU engine control unit

EM expectation maximization

EV electric vehicle

FCEV hydrogen fuel-cell electric vehicle

GHG greenhouse gas

GMM Gaussian mixture model

GPS global positioning system

GWP global warming potential

HEV hybrid electric vehicle

HV high-voltage

HWFET highway fuel economy test

ICEV internal combustion engine vehicle

ICE internal combustion engine

IQR inter-quartile range

K number of clusters in K-means clustering

L_e equivalent to litres of gasoline

LCA life-cycle analysis

LGBM light gradient boosting machine

LVQ learning vector quantization

MAF mass-airflow

MAPE mean absolute percentage error

MMAPE modified mean absolute percentage error

mission typical whole-study travel pattern observations for a specific vehicle

ML machine learning

MOE Canadian Ministry of Environment & Climate Change Strategy

MSE mean-square error

OBD2 on-board diagnostic system v2

PCA principle component analysis

PID parameter identifier

PAE percent absolute error

PHEV plug-in hybrid electric vehicle

PS power-scaling factor

Q95 95th percentile

Q98 98th percentile

RPM revolutions per minute

SAE Society of Automotive Engineers

SHAP Shapley additive explanations

SOC state of charge

SSE sum of squared errors

UDDS urban dynamometer driving schedule

US EPA United States Environmental Protection Agency

ZEFI Zero Emissions Fleet Initiative

Acknowledgements

In writing this thesis, I have benefited from many kinds of assistance from a remarkable assortment of people at the Victoria Capital Region District (the CRD), the University of Victoria's Institute for Integrated Energy Systems (IESVic), and the Sustainable Systems Design Lab (SSDL).

My work could not have been conducted without the CRD's commitment to sustainability and green transportation. The CRD's generous funding and donation of logger data has been the cornerstone of this research, and I am very grateful for the opportunity to participate in the Zero-Emission Fleet Initiative (ZEFI) and the Smart Fleet project. In particular I'd like to single out Liz Ferris, Maryanna Kenney, and Dave Goddard for their enthusiastic advice on practically bringing sustainability to fleet operations.

My supervisors, Dr. Curran Crawford and Dr. Ned Djilali have been excellent advisors, and enthusiastic providers of advice, instruction, and encouragement. I have deeply appreciated the opportunity to work closely with them.

I've also benefited greatly from my association with Dr. Stephen Neville, who taught me the skills to perform robust large-scale analysis, and Dr. Ted Darcie, who has helped me many times to find appropriate middle ground between perfect and possible.

My colleagues in the Sustainable Systems Design Lab have created a welcoming community out of a diverse range of backgrounds and interests, and I've felt privileged to be part of it. In particular, I'd like to thank Markus and Rad for making it into a community, and my labmates Julian, Orhan, Charlotte, Marvin, and Graham for creating a great place to work.

The deepest thanks of all go to my thesis-widow and partner in everything, Sarah, whose turn it is now.

1 Introduction

1.1 Overview 1
1.1.1 Problem statement 1
1.1.2 Goals and motivations . . . 1
1.1.3 Document outline 3
1.2 Project Context 4
1.2.1 CRD ZEFI project 4
1.2.2 Operational and embodied emissions 4
1.2.3 Simple distance-based fuel consumption 6
1.3 Research Structure 8
1.3.1 Research hypothesis 8
1.3.2 Model validity and predictive power 9
1.3.3 Preliminary validation . . . 9
1.3.4 Research contributions . . . 9

1.1 Overview

1.1.1 Problem statement

In the effort to reduce operational fleet greenhouse gas (GHG) emissions, one important tool is the selective replacement of individual vehicles with low-emission alternatives. Given limited capital, it is important to ensure that the correct vehicles are targeted for replacement in the course of rightsizing, ongoing fleet turnover, or policy-driven phased replacement of individual high-emission vehicles.

No clear path is seen to directly modelling the GHG emissions of existing and replacement vehicles. However, a change in operational CO2 emissions can be inferred with reasonable accuracy from the change in the quantity and type of fuel consumed. It should be possible to predict the change in GHG footprint by modelling the change in operational energy consumption caused by vehicle replacement, and applying an appropriate fuel-specific emission intensity factor.

1.1.2 Goals and motivations

Fleet vehicles are typically assigned to perform an ongoing specific set of duties, commonly referred to as a "mission." In order to more easily predict GHG emission changes resulting from mission-vehicle replacement, this thesis proposes a data-driven model for

estimating the change in input energy consumption associated with assigning new vehicles to existing, well-known roles.

In other words, the model will be suitable for estimating the GHG emissions reduction associated with performing a known mission profile with a different vehicle. As discussed below in §1.2.2, this approach is specific to operational emissions, a decision which is limiting, but appropriate for use with many current policy initiatives, such as the municipal GHG action plan [1] that inspired this work.

Since one important application is in a decision support tool for non-technical fleet managers, it should be accessible to the end-user without installing custom software. Even a cloud-hosted service may violate privacy requirements – the movements of individual vehicles are considered protected private information by many organizations.

The traditional method of predicting vehicle operational energy consumption – applying distance-based L/100km fuel economy ratings such as those provided by Natural Resources Canada [2] or the US EPA [3] – is held to be too inaccurate for travel which does not precisely match the conditions under which the ratings were measured [4, 5].

Conversely, a fully accurate fuel consumption model that infers nonlinear relationships from a much larger list of operational properties would have impractical data collection requirements, and would require the distribution and management of specialized software. The source data may provide information regarding the movements of fleet users, and there would be significant privacy and security concerns if a model were to be cloud-deployed [6]. These criteria would make such a model impractical for use as a fleet procurement decision support tool. Such a model would potentially be so computationally expensive that the model itself would have a significant GHG footprint.

In short, in order to promote emissions reduction, it is desirable to develop a new method for predicting operational vehicle energy consumption in fleets, which is:

- simple enough to perform in a spreadsheet
- does not require massive cloud computing overhead
- requires a minimum amount of data collection

- is more accurate than distance-based economy ratings

This thesis explores the development of a data-driven model that will meet all of these criteria, in the context of vehicles with logger data, and mission profiles which have been previously logged.

1.1.3 Document outline

This document begins with an extensive Introduction, which (a) lays out the above overview of the problem, motivation and goals, (b) describes the research context in terms of municipal partnership that provided the data and informed the motivations, and (c) explains the structure of the research problem.

The remainder of the document roughly follows the chronology of the research effort, as follows:

§2. The Background section provides a literature review, and a summary of background material fundamental to understanding the topic and approach.

§3. Data Cleaning and Preparation was a key and challenging element of the work undertaken, and was sufficiently involved to merit its own section.

§4. The actual machine learning techniques used to build the predictive model are described in Methodology.

§5. The model's predictive error is evaluated, its value is demonstrated by comparison with L_e/100km, and avoidable error quantified by comparison to an ML regression model in Results.

§6. Finally, the findings are wrapped up and summarized in the form of a short section of Conclusions.

§7. Lays out a number of potential topics for further refinement, exploration and other Recommendations and Future Work.

1.2 Project Context

1.2.1 CRD ZEFI project

As a part of the Victoria Capital Regional District (CRD)'s Zero Emissions Fleet Initiative (ZEFI) project, a number of vehicles in the CRD fleet were equipped with FleetCarma on-board diagnostic system v2 (OBD2) telematic logging devices at various periods for approximately a year starting in early 2018 [7].

A motivating goal in this project was to determine actions needed to meet the organization's GHG reduction targets, given that 47% of the CRD's baseline 2007 GHG emissions resulted from fleet fuel consumption [1]. An early finding was that, at least on the restricted basis of range requirements, nearly all of the studied vehicle missions could be executed by current battery electric vehicles (BEVs) [8].

Further detail on the nature of the data collection and the logged data is presented in §2.3.1.

1.2.2 Operational and embodied emissions

The intent of this research is to address a core accessibility problem for modelling fleet operational emissions, as needed to address reduction goals similar to those of the CRD's ZEFI program.

For internal combustion engine vehicles (ICEVs), this reduces to tailpipe emissions, calculated by estimating the fuel directly consumed by the vehicle – traditionally called "tank-to-wheel" energy. For gasoline, the GHG emissions of this energy are estimated at an intensity of 88.1 $g\ CO2_e/MJ$ [9]. For electric vehicles (EVs), this is a reflection of the emissions associated with the grid electricity consumed by the drive motor, at the utility's published carbon intensity. For BC Hydro, this is 10.67 t $CO2_e/GWh$ [10] (2.96 $g\ CO2_e/MJ$).

The BC GHG Reduction Act [11] references the 2007 baseline GHG inventory report [12] as a baseline. Emissions in the inventory report are attributed to the jurisdiction

where emission is *generated*, rather than the jurisdiction where the *benefit* of the emission accrues. E.g. if H2 gas or lithium-ion batteries are used in BC, the associated manufacturing emissions are attributed to the foreign H2 steam reformation plant or battery factory, rather than to the BC point of beneficial use. This may be seen as constituting a perverse incentive, insulating end-users from any financial costs associated the embodied emissions of manufactured goods, and driving manufacturing to under-regulated jurisdictions.

In the late 2010s there were claims in the US popular press such as [13, 14] that BEVs have a higher lifetime GHG impact than equivalent ICEVs. Anecdotally, the claims are sometimes echoed by concerned Canadian citizens. The core argument appears to be that BEV proponents ignore or under-represent emissions associated with manufacturing the battery pack, and the high carbon intensity of some sources of grid electricity. Although this probably constitutes an example of the "balance-as-bias" fallacy [15], a short discussion is warranted regarding the full cradle-to-grave lifecycle analysis for different light vehicle technologies and their fuel sources.

A 2018 comprehensive comparison by Elgowainy et al [16] summarized full cradle-to-grave GHG emissions (including fuel cycle and manufacturing cycle), for several different types of light vehicles. The study included ICEVs, hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), hydrogen fuel-cell electric vehicles (FCEVs) and BEVs, as well as other vehicle types excluded from this discussion. Retaining that study's figures for manufacturing and fuel efficiency, but applying current and forecasted 2030 intensities for the appropriate fuel pathways for BC as follows, it is clear that alternative fuel vehicles have a significant and improving advantage, shown in table 1. Some discussion of the assumptions and calculations for this comparison appears in appendix B.

Ultimately, the scope of this research is constrained to local tailpipe emissions as required for the planning requirements of organizations like the CRD. It explicitly excludes a full carbon lifecycle analysis, including all carbon emissions embodied in the vehicle's manufacture and eventual recycling, as well as all carbon emitted or embodied

Table 1: Current and 2030 vehicle combined operational and embodied LCA GHG footprint, at BC fuel carbon intensities

Vehicle	2018 Fuel Intensity (g CO2e/MJ)	Emissions (g CO2e/km)	2030 Fuel Intensity (g CO2e/MJ)	Emissions (g CO2e/km)
ICEV	88.1	295	70.5	187
HEV	88.1	221	70.5	130
PHEV35	64.9	129	51.1	83.1
FCEV	5.	48.2	1.18	34.5
BEV90	2.5	29.6	1.11	23.1

by associated infrastructure for manufacture, repair, fuelling, and eventual recycling.

1.2.3 Simple distance-based fuel consumption

In Canada, light passenger vehicles are labelled with EnerGuide fuel consumption ratings, reflecting their expected performance in typical conditions [17]. This program is similar to the US EPA's fuel economy database, fueleconomy.gov [18]. The EPA's fuel economy ratings have been found to be quite inaccurate, with recent studies finding that they predict consumption ranging from 15.5% too low [4] to 17% too high [5] relative to real-world consumption.

EnerGuide numbers result from manufacturer tests of vehicles against defined drive cycles [19], in order to provide an apples-to-apples comparison between vehicles. Prior to 2015, the test platform was a 2-cycle city/highway test (essentially a modified UDDS/HWFET [20]). In 2015, three additional cycles were added, resulting in a 5-cycle test (adding tests to reflect the impacts of cold-weather conditions, aggressive driving, and air conditioning [21]), with incremental updates in 2016 and 2017 [22]. For accessibility, this rating is expressed in units of litres of fuel consumed per 100km driven: L/100km. Non-internal combustion engine (ICE) vehicles are rated in litres-equivalent (L_e), at a standard conversion rate of 8.9 kWh per litre of gasoline [23]. Notwithstanding the 2015 change from two to five cycles, three separate fuel consumption numbers are published to reflect city, highway, and combined performance.

This method of predicting consumption is an important baseline, since the fundamental

metric for evaluating an individual vehicle replacement will be "avoided emissions", which quantifies the change in operational emissions associated with replacing a current (incumbent) vehicle, with a lower-emission alternative (replacement) vehicle.

The traditional method of computing avoided emissions is to apply the difference in fuel consumption ratings and fuel carbon intensities between the incumbent (1) vs replacement (2) vehicles, thus:

$$\Delta Emissions = CO_2e^{(2)} - CO_2e^{(1)} \tag{1}$$

$$\text{where} \begin{cases} CO_2e \approx D \times [\eta \times e \times I]^{(vehicle)} \\ D = \text{Distance } (km) \\ \eta_{c/h} = \text{Vehicle's static tested city/hwy fuel economy } (L_e/100km) \\ e = \text{Fuel energy density } (kWh/L) \\ I = \text{CO2 intensity of vehicle's fuel } (kg/kWh) \end{cases} \tag{2}$$

In other words, each vehicle has a pair of characteristic CO2 emission values per km of operation, directly related to its standardized rates of fuel consumption.

This approach is an oversimplification, assuming constant values for η, and neglecting the facts that drivetrains are optimized for specific drive cycles, and that efficiency is impacted significantly by the nature of the driving undertaken. For example: electric-drivetrain vehicles have technologies such as regenerative braking and automatic shutoff, allowing them to perform efficiently in conditions where conventional internal combustion engine (ICE) vehicles are wasteful, such as stop-and-go traffic, or conditions requiring extensive idling. Conversely, a conventional diesel ICE drivetrain is designed specifically to optimize efficiency at constant highway speed, while a series-hybrid in the same conditions would suffer from avoidable energy conversion losses.

1.3 Research Structure

1.3.1 Research hypothesis

This study proposes and tests the hypothesis that energy consumption for arbitrary periods of vehicle travel can be accurately predicted by decomposing the proposed travel period into a linear combination of characteristic trip segments, each with a known constant characteristic power consumption for each vehicle type. The prediction will be the sum of vehicle-specific energy consumption totals for that combination of segments. The prediction should hold for travel periods ranging in duration from a single trip to a multi-month mission profile.

To simplify further discussion, the following terms are defined:

"*Mission profile*" refers to the operations typically undertaken by a specific vehicle. Municipal examples include "bylaw supervisor", "meter reader", and pool vehicle".
"*Kinetic travel data*" refers to a specific portion of a vehicle's speed history, or summary statistics derived from it.
"*Eigentrips*" are a basis set of vehicle-agnostic travel segments with the following characteristics:

- Each eigentrip is defined by characteristic kinetic travel data
- Every vehicle has characteristic energy consumption for each eigentrip
- All historical and predicted travel data can be decomposed into a linear combination of eigentrips

The primary technical problems addressed in this thesis are:

- Selecting an appropriate basis set of eigentrips using kinetic travel data.
- Evaluating the predictive power of a linear combination of eigentrips, relative to the observed energy consumption of vehicles on specific missions.

1.3.2 Model validity and predictive power

The new method's validity will be evaluated by comparing its prediction error to the real-world energy consumption, as inferred from the full raw dataset. This prediction error will be contrasted with the prediction error of the traditional distance-based fuel economy statistic described above in §1.2.3.

It is worth noting that the "observed energy consumption" baseline is an estimate of unknown accuracy derived from the available proxy values (MAF and SOC) as discussed in §3.3. This assumption is addressed in §7.5.2.

1.3.3 Preliminary validation

The author conducted a preliminary experiment [24] as a coursework project, studying 300 hours of kinetic travel data and fuel flow rates inferred from MAF (mass-airflow) values, for ten similar vehicles.

In that study, the data was partitioned into 10-minute segments by clock time (segment boundaries were placed at even 10-minute intervals starting at the top of each hour). A fingerprint of representative statistics was then calculated for each segment. K-means clustering [25, §10.4.3] was performed on the resultant dataset to find three clusters. Based on the clustering results, held back test data was classified with a softmax [25, §6.6.2] logistic classifier [26], and engine load was predicted. The average engine load prediction error using this method was approximately 2%.

Although not proven to generalize, the result was sufficient to suggest that the method warranted further study.

1.3.4 Research contributions

This research explores and validates a new method for predicting the energy consumption of different vehicle types when used to execute a well-known mission profile.

The method requires logger data attainable with nearly any commodity OBD2 logger – although some care must be taken to assure the quality of fuel / energy consumption

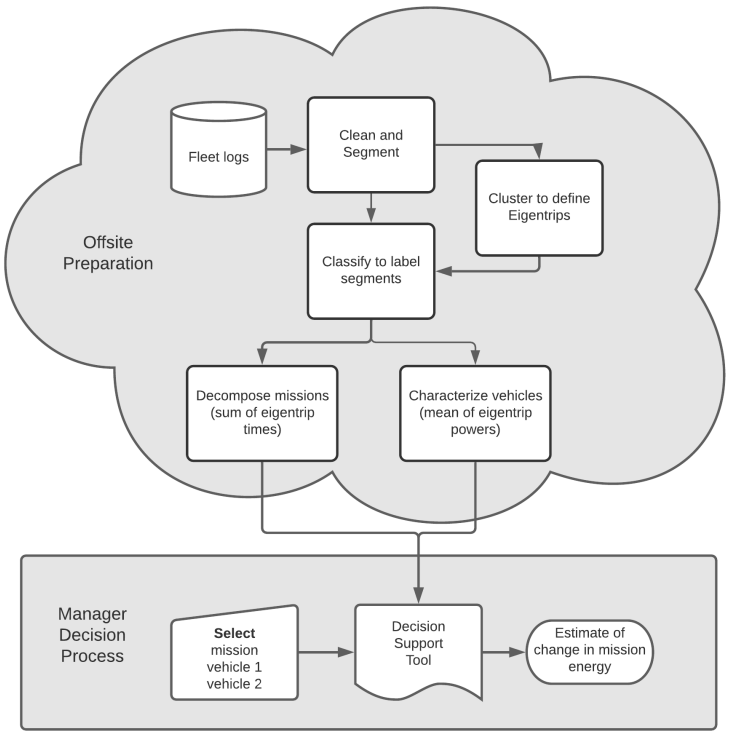


Figure 1: Decision support data-flow and work-flow

data. The data will be used to calculate characteristic parameters describing the study vehicles and mission profiles. The characteristic parameters can then be used to predict energy consumption according to a simple linear calculation that can be implemented in a spreadsheet-based decision support tool. A potential data-flow is shown in figure 1, illustrating the path that the data takes from initial capture, through the generation of the decision-support spreadsheet. This figure also illustrates the fleet manager's workflow, where a known mission is selected from those listed in the tool, along with a pair of vehicles (presumably the incumbent and a potential replacement), resulting in a predicted change in energy footprint.

This will allow fleet managers to accurately predict the energy requirements (and hence GHG emission footprint) of any logger-equipped vehicle, applied to any mission profile which has been previously performed by any other logger-equipped vehicle. In other words, the characterization of the fleet's various *missions* can be collected by any ICEV or BEV. The collection of logger data to compute characteristic energy consumption for the same or other vehicles of the same type can be collected on entirely different

routes/missions, and even by entirely different organizations. Sharing real-world vehicle performance data between organizations would improve estimation of energy consumption based on different procurement scenarios, including new vehicle models of which a given organization has no direct experience – in much the same manner as $L_e/100km$ figures are currently used.

Other research contributions include:

- Shapley additive explanations (SHAP) showing the relative importance of various input features to the prediction of input power.
- a technique for reconstructing serial OBD2 values that have been tabularized
- evaluation of error inherent in traditional L/100km technique
- comparison to direct regression, to gauge efficacy & accuracy of both proposed method and L/100km method

2 Background

2.1 Travel Data 12
2.1.1 Drive cycles 12
2.1.2 Microtrips 14
2.2 Machine Learning 16
2.2.1 Feature selection 16
2.2.2 Time-series analysis 18
2.2.3 Binning and segmentation . 19
2.2.4 Regression analysis 19
2.2.5 Clustering 20
2.2.6 Classification 22
2.2.7 Gradient boost and LGBM 23
2.3 Data Collection 23
2.3.1 OBD2 logger implementation 23
2.3.2 Fuel vs airflow 25

This section addresses background material fundamental to the topic. Quantitative analysis of travel patterns is typically performed on data comprising *drive cycles* and *microtrips*, so a brief background on these concepts is presented.

The proposed method involves *feature selection, clustering, and classification* of multi-dimensional timeseries data, so various tools for these tasks are discussed.

Finally, this section contains a short background of the technology used for *data collection*, and limitations around the collection of *fuel flow rates*.

2.1 Travel Data

2.1.1 Drive cycles

A drive cycle (or driving cycle) is the speed-time data that describe a portion of a vehicle's travel history [27], either measured, generated, or synthesized. A large number of standardized drive cycles have been published by various government agencies and private organizations, to facilitate optimization and testing to standardized benchmarks [28].

Two of the most heavily-referenced examples are the urban dynamometer driving schedule (UDDS) and highway fuel economy test (HWFET) cycles [29], defined by the United States Environmental Protection Agency (US EPA), and shown in figure 2. Elevation

and grade are not a fundamental part of the generally accepted drive cycle definition and no mention is made of these in UDDS, HWFET, nor the other drive cycles referenced in the EPA's federal test procedure [1]. However, vehicle performance is strongly impacted by road grade, so an elevation profile is often used in parallel for simulations [30]. As discussed in §7.5.3, the road grade information used in this study was not of particularly high quality, and the topic merits additional work.

In machine learning, "classification" is the process of labelling an observation with a discrete nominal label (e.g., a category name) which best corresponds, on the basis of a set of "training" observations with known labels [25]. Drive cycle classification has been the subject of a substantial body of work. A frequent topic is the optimization of HEV battery energy management, such as the work of Wu et al on fuzzy energy management [31], with the goal of determining whether a vehicle was being operated in urban, suburban, or highway conditions. This paper used fixed-length partitions of 3 minutes, to match the typical urban stop-go-stop cycle length.

Other papers had goals such as BEV range estimation by Yu et al [32], or optimization for battery size (Redelbach et al) [33] and battery lifespan (Smith et al) [34].

However, most treatments of the subject do not restrict themselves to easily-logged kinetic parameters, but include classification features such as engine power, road gradient, and road-type. Indeed, in many papers, the data was collected by shadowing each subject vehicle with a chase-car, a method that is prohibitive for any kind of fleet data collection at scale.

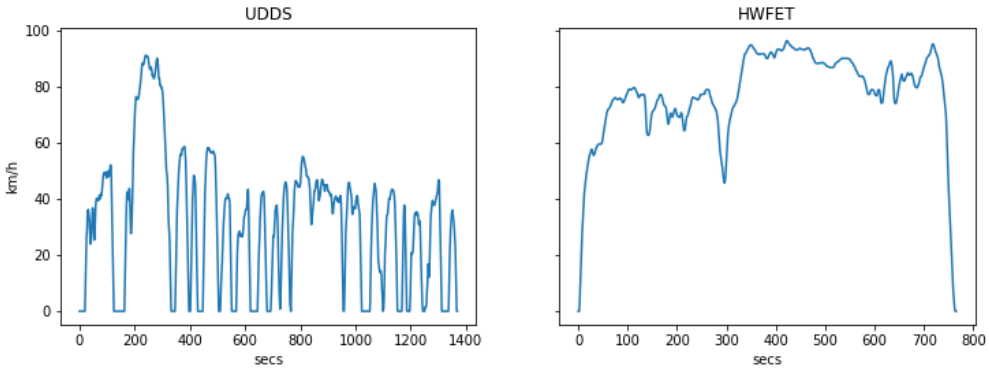


Figure 2: UDDS and HWFET drive cycles

2.1.2 Microtrips

Microtrips are "the sections of travel between consecutive stops", first used for travel analysis by General Motors Research in 1976 [35], where it was used to demonstrate that fuel rate varied linearly with average trip speed (true of the automotive technology of the time). They are used frequently as an aid to the development of new drive cycles, as per Kamble et al [36], where synthetic geography-specific drive cycles were created from a number of real microtrips.

The microtrip concept has seen very little use in the problem of drive cycle classification, with only a couple of examples seen in the literature. One example is described by Shankar and Marco in [37], which applies neural network classification to determine the road-type (e.g., highway, arterial, or local), as well as a congestion index, for use in predicting an input power appropriate to the driving conditions. However, the method was addressed specifically to battery vehicles, and presumes that the only factors influencing energy consumption are derived from road congestion and type. The method does not consider the possibility that different travel types in the same context might have different energy requirements, for example because the mission requires regular stops or extensive idling.

Shankar and Marco's paper does point out an inherent limitation of microtrips: that they are defined from stop to stop. This means that a single microtrip is likely to encompass more than one type of travel, and/or to unnecessarily segment a single type of travel that includes stops.

Another relevant example [38] by He et al extracted microtrips from the definitions of several predefined drive cycles, calculated the first seven of the aggregated velocity-derived features shown in table 2, and applied principle component analysis (PCA) to retain four principal components. These principal components were calculated on segments of actual travel data, in order to classify the segments in an learning vector quantization (LVQ) neural net, with very good classification results. The first seven features gave excellent classification results and may be expected to provide an excellent

Table 2: Studied kinetic features, as derived from logger data

Description	Units
Mean speed	(km/h)
Max speed	(km/h)
Mean acceleration	$(m/2^2)$
Max acceleration	(m/s^2)
Mean deceleration	$(-m/s^2)$
Max deceleration	$(-m/s^2)$
Idle time fraction	$(\%)$
Mean climb	(m/s)
Mean descent	(m/s)
Acceleration reversals	$(\#/s)$
Power	(kW)

starting point for fuel consumption prediction. However, features were excluded from that work, which will contribute to fuel consumption in a heterogeneous fleet; road grade and a count of acceleration reversals were added, and other non-studied examples include payload, accessory load, and others discussed in §7.5.

He's technique is not directly applicable to fleet fuel prediction, for a number of reasons:

- The technique was only demonstrated on artificial drive-cycles, and may not perform well on the complexity of real local driving conditions
- The exemplar microtrips are not shown to be predictive of fuel consumption between vehicle types
- PCA uses the largest eigenvectors to project data onto the lower-dimensional space that best represents the data's variation [25]. By design, PCA is an unsupervised technique with no relationship to regression; it captures the variance of the individual input features by weighting them accordingly, but without explicit regard to their relationship to the target variable. Hence, the weight of a feature in the principal components is not indicative of whether it has predictive power.

In general, the body of work on microtrips is informative with regards to feature selection and supports the notion of predictive analysis by decomposition. However, the fundamental definition of a micro-trip as a "stop-go-stop" cycle means that it is likely to mix some types of travel that should be separated, and to artificially partion others

Table 3: Derived ICE features with relative impact on fuel consumption [39]

Relative impact	Factor description
5	stop
4	acceleration with strong power demand
2	speed oscillation
2	acceleration with moderate power demand
2	extreme acceleration
-2	speed 50+/-70
-2	moderate engine speeds at gears 2 and 3
1	late gear changing from gear 2 and 3
-1	deceleration
-1	speed 70+/-90
-1	low engine speed at gear 4
-1	low engine speed at gear 5
0	speed 15+/-30
0	speed 90+/-110
0	engine speed $>$ 3500
0	speed $>$ 110

that would more effectively be considered as a unit.

2.2 Machine Learning

2.2.1 Feature selection

In machine learning, a “feature” is a measured property of the system under study, and usually implies a dimension in the system’s state-space, either direct or a projection. It is not always obvious which features are salient for a given problem, so careful consideration of the problem is required with respect to the available data, plus experimentation, pre-processing, and investigation. There are a number of important problems that can arise from an improper choice of features for use in a machine-learning model.

When aspects of a feature’s behaviour can be probabilistically predicted from knowledge of another feature (such as when the features are correlated, or otherwise functionally related), the two features are said to share "mutual information" [25, §A.7.3]. For most cost or distance functions, error related to given information is redundantly counted for every additional feature axis on which the information is represented. In many machine

learning algorithms, this has potential to create a problem wherein the learning system over-values the importance of the duplicated information.

The curse of dimensionality [40] refers to the counter-intuitive fact that adding additional features will degrade accuracy for many forms of machine learning. This property devolves out of two geometric properties of high dimensional spaces.

First, the state-space volume expands exponentially with the addition of dimensions, quickly leading to a sample density too low for generalizable classification. A second property, called the "concentration of norms," refers to the surface area of a hypersphere expanding faster than its volume with the addition of dimensions – meaning that in a set of data normally distributed in multiple dimensions, most points will lie in the tail of at least one dimension. In this situation, it is easy to inadvertently construct an arbitrary classifier which works extremely well on the existing data, but which does not generalize – a situation referred to as over-fitting [41]. Together, these issues mean that intuition is not informative as to the behaviour of high-dimensional models, and the feature set should be minimized as much as practical.

The question of which loggable features are most clearly related to fuel consumption and/or emissions was addressed comprehensively for conventional ICE vehicles in [39]. In this study, 62 logged and derived features were investigated, and reduced to the most important compound features using PCA and factor analysis (which is similar to PCA in that it attempts to find a lower-dimensional representation, but dissimilar in that it accounts for correlations among the features [25]). These techniques are problematic in that PCA selects for high variance but not prediction, and factor analysis corrects for correlation, but not for any other forms of mutual information. Nevertheless, the resultant set of factors seems to be an excellent starting point for selecting features that will describe the fuel consumption rate of ICE vehicles. The relative impact on fuel consumption (in units of 1/10ths of a standard deviation) of several of the compound factors found in Ericsson's study are shown in table 3.

2.2.2 Time-series analysis

Time-series data consists of sequential measurements of the same feature over time, with the characteristic property that the data are generated by a process, and are not statistically independent of earlier samples in the process [42]. A drive-cycle is an excellent example, describing a trip in terms of measurements of the vehicle's speed over time.

Time-series data is commonly analyzed by the direct application of time-domain analysis techniques – finding patterns and behaviours with respect to temporal ordering. In the context of trip-segment similarity, it seems intuitively obvious that order does *not* much matter, relative to many other aspects of the driving patterns. For example: the segments of the urban drive cycle, driven in reverse order, could be expected to have energy consumption very similar to that of the forward-ordered version (stipulating a similar net elevation profile), but it is hard to imagine a meaningful time-domain measure that would expose the similarity. This intuition suggests that time-domain analysis techniques will miss important commonalities between trips.

Transforming into the frequency domain can address this problem and give insight into the relative importance of various cyclical behaviours. Applied to segments of kinetic driving data, it might give insight into the rate of start-stop or speed-slow cycles, where they exist. However, since acyclic behaviours might be critical differentiators, and would be lost in the transformation out of the time domain, we certainly cannot rely on frequency analysis alone.

Apart from the inter-sample interval necessary to calculate acceleration, the key features used in this research draw no useful information from their time sequencing. Thus, for the insights to be derived from the data, time series techniques do not provide a great deal of analytical power, and are left as a topic for future investigation (§7.3).

2.2.3 Binning and segmentation

Data binning is the process of grouping data points with similar values together, such that they can be referenced by a common value. This is useful to reduce the volume of data for faster processing, or to improve its comprehensibility, as with histograms. Segmentation is conceptually similar; it consists of partitioning time series data into time intervals, allowing each segment to be characterized as a group [43].

A key technique used in this research combines both techniques: partitioning the data into fixed-length segments, which are thereafter treated as non-time series bins. A selection of representative summary statistics (a fingerprint) for each segment are calculated, after which the time information can be discarded or ignored. Similar segments can then be binned, allowing the application of simple and intuitive non-time series analytical techniques.

This has the advantage that the similarity measure between segments can be as simple as Euclidean distance, or as complex as necessary to capture prior understanding of "similarity" for the system in question.

The primary disadvantages of using bin fingerprints are difficulties in (a) determining appropriate statistics such that if two trips are subjectively similar, then their statistics will have objectively similar values, and (b) finding segment boundaries, such that segments do not encompass multiple types.

2.2.4 Regression analysis

Regression analysis is a branch of mathematical statistics concerned with quantifying the relationships between some number of variables using statistical data [44]. In the most general sense, this involves finding the appropriate parameters for a mathematical model, which will allow it to calculate predicted values for the dependent variable(s) based on the input values for the independent variables.

The most commonly used example is *linear* regression, which consists of finding the coefficients $\boldsymbol{b}$ for the independent variables $\boldsymbol{x}$ that will best predict target variable y,

typically by minimizing the mean-square error (MSE) for all training values $\hat{y}$.

$$y = b_0 + b_1 x_1 + ... + b_n x_n + \epsilon \tag{3}$$

$$MSE = \frac{1}{n} \sum (y - \hat{y})^2 \tag{4}$$

If the relationship between the independent and dependent variables is more complex, nonlinear techniques are used – either by fitting coefficients to a more complex formula that better describes the relationship, or by using some other model entirely, such as a decision tree or artificial neural net [41]. These nonlinear techniques result in a better fit to the observed data, but at the cost of a more complex formula and the risk of overfitting.

Traditional regression techniques are not a good fit for the primary stated goals of this research, as it would not be possible to develop a spreadsheet-deployable model that could clean and process the millions of rows of logger data. Setting aside the unique requirements of a deployable decision support tool, tree or neural net regression would be the simplest path to predicting vehicle energy consumption, and will be used in §5 to provide a basis for comparison of the accuracy of the proposed spreadsheet-capable model.

2.2.5 Clustering

Clustering is the general name for unsupervised techniques that have the goal of grouping similar data samples according to an appropriate definition of similarity.

For the problem at hand, it is impractical to manually define a basis set of eigentrips that will (a) adequately represent all travel in the dataset, and (b) be sufficiently discriminatory with regards to fuel consumption between the studied vehicle types. In this study, the entire corpus of segmented travel data will be clustered, and the characteristics of each group will be considered to represent one eigentrip. This section will address appropriate methods for clustering.

The simplest and arguably most intuitive clustering technique is K-means clustering, most easily understood with an interactive visualization, such as the one linked at [45]. The technique consists of selecting a number *(k)* of randomly distributed cluster centroids, assigning every data point to the cluster defined by the nearest centroid, and then iteratively redefining each cluster centroid as the mean of its constituent points. The technique's simplicity is balanced by two significant limitations. First, it must be provided with a predefined cluster count [25], which is a key tuning parameter. Second, it presumes clusters in normal, spherical distributions; its cost function is most appropriate for points which have a Gaussian distribution of equal variance in every dimension.

The technique can be generalized to data in non-spherical distributions by maximizing the probabilistic membership in each cluster – this is called expectation maximization (EM) clustering – or more specifically, Gaussian mixture models (GMMs) if the clusters are normally distributed.

Any clustering technique relies on an appropriate definition of distance between points in the feature space. A common and intuitive choice is the L2 norm – Euclidean distance – applied to appropriately normalized features. This works well, because non-discriminatory features are likely to balance themselves by virtue of being equally distributed between the clusters. However, the measure is sensitive to outliers, and cannot account for desired similarities that can only be described by nonlinear combinations of features.

K-means also requires a number of clusters (k) as an input. Typically, this number is found by inspection (the "elbow" method [46]) or by minimizing a loss function such as silhouette score [47]) against different values for k.

In addition to the advantage of simplicity, K-means has a well-known implementation in the Scikit-learn library. Although it presumes spherical, normalized clusters [48], this requirement is also an advantage, since it allows features to be given relative weights by the simple expedient of linear scaling.

There is an obvious argument against the use of K-means: that the best clusters (for

a domain-specific definition of similarity) may not be normal and spherical. However, the travel data at hand is continuous, and does not *have* distinct clusters. For the immediate goal – selecting "similar" data to train the eigentrip classifier, we can allow the clustering algorithm to define the shape of its clusters. Reviewing the impact of alternate clustering techniques on classifier accuracy will be an excellent topic for future refinement of the model.

2.2.6 Classification

Classification is similar to regression analysis, but with a goal of predicting a discrete value, rather than a scalar, commonly used for determining which of a fixed number of categories is the best fit for a particular datum [41].

Classification is a key element of the proposed method: each trip segment will be classified and labelled with its most similar eigentrip. If the thesis is correct, the characteristic power of that eigentrip will be similar to the actual power of the trip segment.

Classification algorithm selection is more art than science, with the "No Free Lunch" theorem demonstrating that there is no model that is best across domains [41]. In general, the researcher must evaluate the characteristics of their data and the requirements of their model, and attempt to find an algorithm that suits both.

In this case, since several of the features have unknown multi-modal distributions, Bayesian algorithms will not be a good fit. Neural nets require computationally intensive training, have non-explainable results, and do not extrapolate outside their training volume. The remaining family of classifiers which seem appropriate are ensemble decision trees. The light gradient boosting machine (LGBM) algorithm is selected for initial review as demonstrating a good balance between training speed and prediction accuracy.

2.2.7 Gradient boost and LGBM

Model selection is arguably the most difficult aspect of practical, applied ML. The proposed model has aspects that make it particularly challenging:

- features are multi-modal and do not follow a common distribution
- features may have unknown mutual information
- target feature has no obvious structure
- explanation of feature impact on prediction may be important for future work
- millions of data points

The unknown distribution renders Bayesian methods impractical. The possible shared information duplicated between features and potential requirement for explainability comprise good arguments against artificial neural nets. Finally, due to the need for iterative evaluation over the relatively large dataset discussed below in §4.6, slow-training methods would not be practical. Given these exclusions, an ensemble decision tree method warranted consideration.

Although at risk of running afoul of Maslow's Hammer [49], the common-sense admonition that practitioners are prone to over-application of familiar tools, the popular LightGBM model meets all of the above criteria, described in more detail in §4.3.

2.3 Data Collection

2.3.1 OBD2 logger implementation

In order to understand a significant primary data collection issue, the reader will require some background on the technology used for data collection.

The dataset used in this study was collected by FleetCarma Inc., a commercial company based in Waterloo, Ontario. FleetCarma uses telematics loggers connected to the vehicles' OBD2 interface. OBD2 is a protocol defined by Society of Automotive Engineers (SAE) standard J1962 for vehicle data access, and specifies a female 16-pin electrical connector for access, commonly known as the OBD2 port. It accesses the

vehicle's controller area network (CAN) bus, a serial hardware layer commonly used to transport vehicle sensor data between various engine control unit (ECU)s. Information in this subsection is summarized primarily from an instructional website [50] and the original Texas Instruments application document [51].

Devices on a CAN bus communicate exclusively by broadcast. Some devices may report their status at a regular interval, while others only report in response to a request broadcast, and others may communicate by both methods. In essence, the CAN bus data stream consists of a sequence of (key, value) pairs.

Fleet Carma's logger has a list of parameter identifier (PID) values that are to be collected from the OBD2 system. Whenever any of those PIDs appear on the CAN bus, the logger records and timestamps it. To ensure a data log meeting the specified resolution requirements (1 second while moving), the logger periodically sends update requests for over the CAN bus for appropriate PIDs, requesting that a new value be returned.

The problem derives from the logger's conversion of the sequential stream of PID-value pairs, into an analyst-friendly timeseries table format, with one row per timestamp and one column per PID. In this conversion, a row is generated shortly after an updated value is received over the CAN bus. Unfortunately, any PIDs which have *not* reported updated values appear to have been assigned *their last known value* for a given row. Table 4 presents an exaggerated illustration of the problem, showing how a reasonable acceleration to $5\,m/s$ over 10s could generate an apparent acceleration of $50\,m/s^2$:

Table 4: OBD2 Log Problem Example

Seconds	ΔT	**CAN message**	**MAF** (g/s)	**Speed** (m/s)	**Acceleration** $(m/s^{2)}$
30.0	-	speed=0	4.3	0	-
30.1	0.1	MAF=11.3	11.3	0	0
39.9	9.8	MAF=10.9	10.9	0	0
40.0	0.1	speed=5	10.9	5	50

2.3.2 Fuel vs airflow

Unfortunately, a parameter for fuel-flow rate is not part of the OBD2 specification [52]. Most vehicle manufacturers supply a proprietary PID for this value, but our FleetCarma loggers were not configured to retrieve it from the individual vehicles. A valuable proxy for fuel flow is the standard PID mass-airflow (MAF), which estimates the mass of air entering the engine from measurements of airstream temperature and velocity at the intake. The well-known stoichiometric mass ratio of 14.7 for gasoline combustion is inferred from the oxidation reaction [53]:

$$25\,O_2 + 2\,C_8H_{18} \rightarrow 16\,CO_2 + 18\,H_2O + E \tag{5}$$

Since tailpipe emissions are an important design consideration, modern vehicles attempt to minimize emissions by ensuring good operation of the catalytic converter. One outcome of this intent is that the vehicle continually modifies its fuel flow (a process referred to as *trimming*) relative to MAF, in order to maintain clean combustion as indicated by the oxygen content of the exhaust stream. There *do* exist standard PIDs for both the commanded and measured ratios of fuel to air [52], but these values were unavailable to this study, having not been logged in the CRD's Smart Fleet project.

In any case, a properly operating vehicle should generally have a fuel flow within 10% of the stoichiometric ratio relative to the MAF [54]. It is noteworthy that there are certain events (notably engine-braking) that will be expected to cause significant transient departures from the stoichiometric ratio. The author's personal experience, having reviewed trim data logs from five personal vehicles, is that short and long-term fuel trim levels generally remain consistent within 3% for normal driving, outside of a few minutes for engine warm-up.

The conclusion from this background material is that calculating fuel flow by applying the stoichiometric ratio of 14.7 to the measured MAF can be reasonably expected to have a *per-vehicle precision* of ±3%, and an *absolute accuracy* within ±10%.

Ultimately, the MAF estimate must stand alone as a ground truth for this work, as no means of validating the MAF estimate was found. The CRD does track fleet fuel consumption under BC's Climate Action Revenue Incentive Program (CARIP) program, but not in a manner that could be isolated to specific vehicles, or even to the subset of vehicles under observation. A project was underway to implement a card system that will ultimate track the fuel consumption of individual vehicles, but no data was available for the study period.

3 Data Cleaning and Preparation

3.1 Raw Data 27
3.1.1 Collection 27
3.1.2 Parsing and selection 27
3.1.3 Feature selection 29
3.2 Speed Data Cleaning 30
3.2.1 Speed data problems 30
3.2.2 Recurrent speeds 30
3.2.3 Stop-start errors 31
3.2.4 Other errors 32
3.3 Power Data Cleaning 32
3.3.1 ICE power 32
3.3.2 BEV power 32
3.4 Regularization 35

This section describes the process required to make the timeseries logger data ready for segmentation and fingerprinting. This was a key and challenging element of the research, requiring approximately 4000 lines of python code.

3.1 Raw Data

3.1.1 Collection

As discussed above, the CRD's ZEFI project [7] included telematic loggers installed in fleet vehicles for approximately a year starting in early 2018. Summary statistics of the data collection effort are shown in table 5, with the distribution of samples between vehicle-missions shown in figure 3.

The loggers were capable of logging and transmitting global positioning system (GPS) locations and a collection of engine data parameters that differed from vehicle to vehicle, but which always included speedometer (wheel) speed. FleetCarma was asked to collect fuel flow rates, but as this is not part of the OBD2 standard, FleetCarma instead collected various proxies for fuel flow, primarily MAF and AbsLoad.

3.1.2 Parsing and selection

The raw logger data was received in one text file per trip, where trips comprised periods of time where the logger was supplied with accessory power from the host vehicle. The

Table 5: Data Collection Statistics

Feature	Value
Total vehicles	55
Total samples	18356982
Study vehicles	29
Study samples	10617365
First datum	2018-01-29
Last datum	2019-02-20

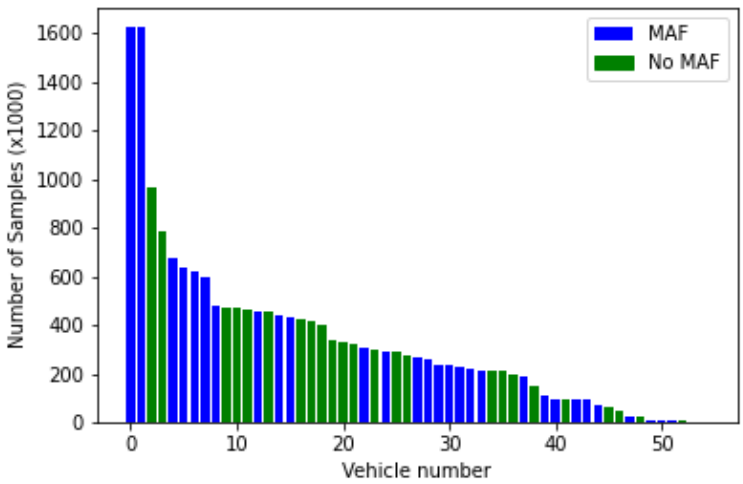


Figure 3: Sample counts by vehicle, studied and non-studied

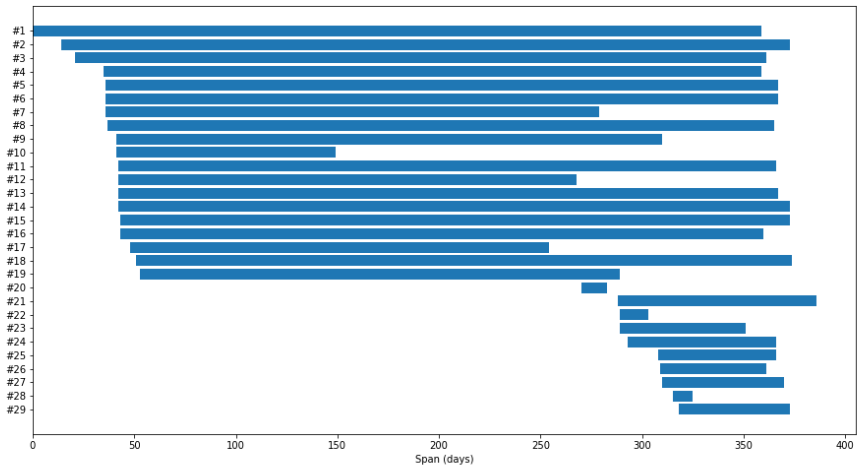


Figure 4: Data collection timespans for individual vehicles

files were in comma-separated-value (CSV) format, indexed by time or time-offset (one row per timestamp, one column per sensor), but did not use consistent file-formats, units, column selections, nor column naming conventions, so ingestion of the data into a standard format was a challenging and time-consuming task.

Only about half of the ICE study vehicles were configured to log MAF. The OBD2 PID AbsLoad was provided for the remainder, but this is not a proxy for fuel consumption without reference to engine revolutions per minute (RPM), which was not collected. ICE vehicles without MAF were therefore eliminated from the study group. This was a significant and disappointing setback, and a stern reminder to attempt a limited model proof of concept early in the data collection process. However, the remaining data is sufficient in breadth and depth to demonstrate the core thesis, albeit not so clearly shown to generalize across many different vehicle and mission types.

The various vehicles were monitored for different time periods, with the length of their study period shown in figure 4.

3.1.3 Feature selection

The complete list of attribute names collected by the various loggers is listed in appendix A, table 14. Several of these features are duplicated with alternate names – e.g., Speed

and Signal #131 are synonymous. For this work, only various aspects of vehicle speed (including vertical speed, from GPS altitude) and derived variables were selected as features, with a target feature of vehicle energy consumption – derived from MAF on ICE vehicles, and primarily state of charge (SOC) for BEVs.

3.2 Speed Data Cleaning

3.2.1 Speed data problems

Various statistics related to vehicle acceleration were of primary interest to this study. Accelerations were trivially computed from the measured timeseries speed logs for each trip, but examination showed a large fraction of impossibly high accelerations.

It seems well-accepted that consumer-grade tires on dry pavement offer a peak static friction coefficient of around 0.7 [55], so all acceleration values in excess of $0.7 \times 9.8 = 6.9\frac{m}{s^2}$ are suspect. About 132k (or 1.25%) of the 10.6M speed samples implied accelerations above this threshold. Examination of the log data showed 56.2% of log speed values were unchanged from the previous value, suggesting "sticky" sensor readings at the OBD2 logger, as described in section §2.3.1.

Since statistics derived from vehicle acceleration comprise the primary features to be investigated for fingerprinting travel segments, it was of critical importance to remediate the speed data collection/integration errors and restore a true reflection of the vehicles' speed and acceleration profiles prior to attempting analysis. This section explains how the speed data was cleaned.

3.2.2 Recurrent speeds

Since the speed of a moving vehicle is inherently variable, nonzero speed values should only recur very infrequently. It seems obvious that a large fraction of the recurring values are invalid data integration artifacts. In the absence of any information about *which* recurrent speed values happened to be valid, the author elected to eliminate all of

Table 6: Impact of data cleaning methods on rate of "impossible acceleration" errors

Rows removed	Samples	Errors	Error Rate (%)	Error reduction (%)
Nil	10,617,365	132,291	1.25	NaN
Moving recurrent	7,874,102	12,727	0.162	90.4
Impossible starts	7,861,375	69	0.000878	99.5

them. This substantially improved the quality of the data – that is to say, the deletions removed most of the invalid acceleration values. The number of valid data points also deleted is believed to be very small, and in aggregate likely to do little harm for the purpose of this study. The obvious exception is made for periods of zero speed, where it was to be expected that the vehicle's zero speed was indeed constant for some period of time.

Accordingly, all recurrent speed samples were deleted, except for zero-speed samples. This deletion reduced the number of samples by almost 1/3, but reduced the number of impossible acceleration events from 132k to 12k – a reduction of 91.4%.

A summary of the reduction in error rates from data cleaning is shown in table 6

3.2.3 Stop-start errors

Of these remaining impossible acceleration events, nearly all occur during vehicle starts – samples where the previous speed was zero.

This comprises an error rate of 5.01% during starts from zero speed. Examination of the offending high-acceleration samples reveals an extraordinarily high number of short (sub-second) intervals after the final zero-speed sample. This strongly implies that these accelerations are another artifact of the "sticky" value problem discussed in section 2.3.1.

In the interest of simplicity, these roughly 12,000 impossible-start samples were dropped. Since the way a vehicle is started may have useful predictive power (e.g., jackrabbit

starts), future work should be applied to recovering the information in start samples, as discussed in section 7.2.1.

3.2.4 Other errors

With the above cleaning methods applied, the corpus contained only 69 remaining samples with impossibly high acceleration values. Inspection showed these to generally correspond to high rates of change over short sample periods, but with no obvious cause. These samples could very well be true values, perhaps due to wheels spinning under high power or wheel-lockup due to hard braking. These samples have been left intact.

3.3 Power Data Cleaning

Again, the core problem of this thesis is to predict each vehicle's characteristic input power for each eigentrip. The model's ground truth will be the input power consumed during each trip segment, so a new power feature was calculated from the available features.

3.3.1 ICE power

For ICE vehicles, the energy input is fuel consumed. Fuel consumption was approximated from logged MAF at the stoichiometric fuel:air ratio, an assumption discussed in §2.3.2 and §7.1. The energy value was then calculated using the LHV of 46.4 $\frac{MJ}{kg}$ [56].

The MAF PID suffered from the same "stickiness" problem as the other PIDs discussed above, and had an effective sample period of about 2 s. This was addressed by the same means as for speed: removing all recurrent values, except zero-value periods.

3.3.2 BEV power

For the BEVs, input power is from the high-voltage (HV) main drive battery.

Although FleetCarma attempted to provide 1-second resolution power data, the data suffered from the same stickiness problem as elsewhere; the real sampling rate was much lower than expected. SOC was sampled at a median period of 87 s, HV battery current at 29 s, and HV battery voltage at 30 s. This low sampling frequency complicated the power calculation; multiplying spot-sampled voltage and current with the elapsed time would miss transient events, and be unlikely to provide an accurate reflection of total consumption. Reported SOC is not perfectly suitable, being unlikely to have been sampled near a given segment boundary.

A rejected course of investigation was to interpolate SOC along the better-sampled HV voltage reading, on the assumption that battery voltage would drop linearly with expended energy. Plots of SOC vs voltage for multiple trips (figure 5) suggested that there is a good relationship between these features. However, inspection of a number of actual time-domain plots of battery voltage and SOC similar to figure 6 suggest that the correlation only exists reliably at a scale too broad to be of practical use.

As shown in figure 6, the HV system's voltage readings are highly variable while the vehicle is in motion; this reading shows system voltage rather than open-circuit battery voltage. Furthermore, the system's logging resolution is far too low to estimate energy consumption (E) from voltage (V) and amperage (I) in the typical manner, as:

$$\Delta E = \int V(t) \times I(t)\, dt \tag{6}$$

Fortunately the vehicle's on-board computer has high-resolution access to the electrical sensors, and can make use of a combination of several methods for establishing the remaining useful charge in the battery [57]. SOC is therefore a reasonably trustworthy absolute measurement relative to the vehicle's known battery pack capacity, and a reasonable estimate of energy consumption over time can be obtained from it.

Ultimately, no better method was found than applying vehicle-reported SOC to manufacturer-published battery capacity of 27 kWh for the Kia Souls [58, 59], and 12 kWh for the Outlander PHEV [60]. This required linear interpolation of SOC to the

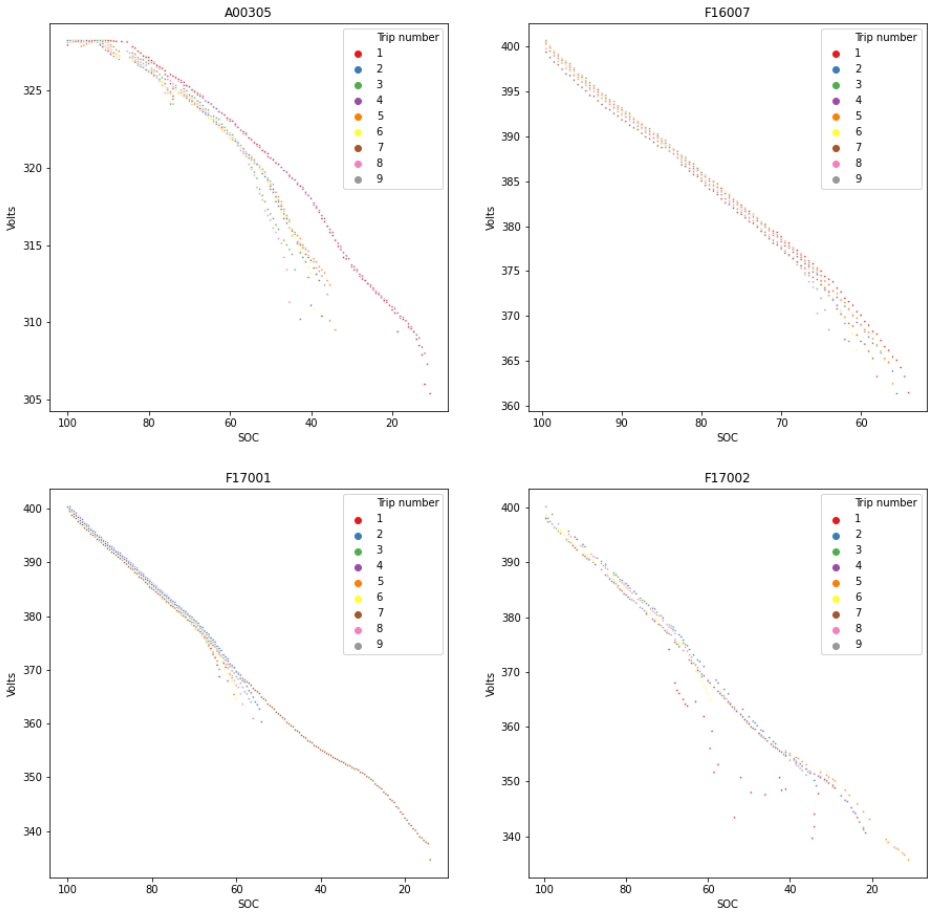


Figure 5: EV example trips showing the broad relationship of SOC vs the main battery's voltage

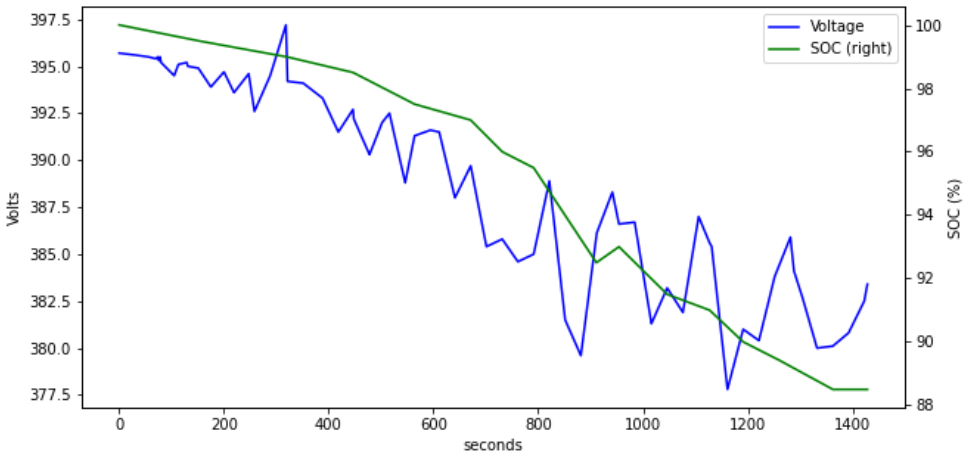


Figure 6: One EV example trip showing the rapid changes of voltage readings over time

Table 7: Number of samples and trips removed by EV data cleaning procedures

	EV Samples	Removed	EV Trips
Nil	817,820	0	2,308
Zero power	817,641	179	2,181
Charging	796,022	21,619	1,762
Zero-time	796,022	0	1,762

segment boundaries as described below in §3.4, a significant assumption that merits the future work discussed in §7.2.3. Given these assumptions, energy used in a period is then simply:

$$\Delta E = \Delta SOC \times Capacity \tag{7}$$

Inspection of the power thus calculated showed a large number of null SOC and V-I measurements. Nearly all of these were addressed by deleting a small number of unusable data-logs, presumed to represent data collection artifacts generated by loggers not well-configured for their host BEVs, described in table 7.

3.4 Regularization

In order to reduce the amount of data uploaded over the cellular devices, the supplier configured their loggers to use a sample period of about 1 second while moving, and 30 seconds while stopped. After collection was complete, the "sticky" problem discussed in §2.3.1 was discovered, and with it the realization that various sensor values were recorded at different frequencies, and at fractional-second offsets from each other. The above process of removing recurrent values adequately eliminated the spurious readings, but introduced two distinct problems:

1. The longer-than-expected sampling period introduces complexity in handling segment boundaries – the final sample in each segment must be extrapolated across the boundary in order to be included in the second segment.

2. the sample following a 'stopped' sample may have a non-zero speed; barring the

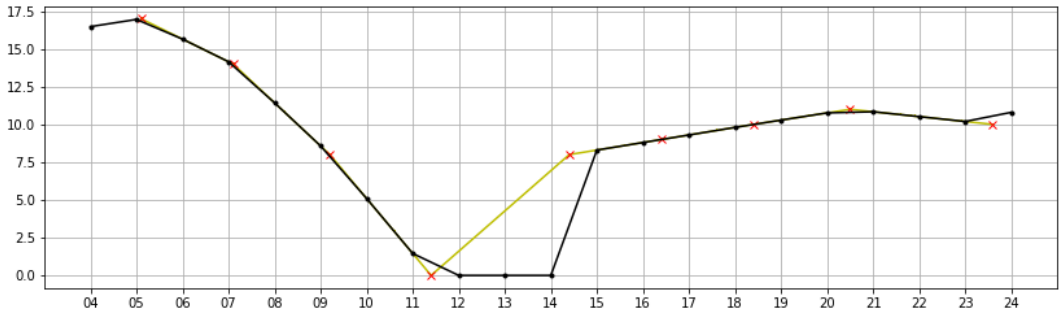


Figure 7: Problems caused by linear sample interpolation with and without regularization

introduction of synthetic 0-speed samples to terminate each stop, point-wise interpolation would result in apparent movement during the stop period. This is illustrated in figure 7, with sample points in red, direct interpolation in yellow, and the regularized interpolation shown in black.

To address these problems, the entire dataset was regularized to uniform 1s intervals, zeroed to clock time. I.e., regularized timestamps are at even multiples of 1 second from the top of the hour, rather than from the beginning of the trip, which would likely have been offset by a fractional second. Zero-speed periods were forward-filled to 1s intervals, and all in-motion data was linearly interpolated onto the regularized 1s interval.

4 Methodology

4.1 Feature Preparation 37
4.1.1 Segmentation 37
4.1.2 Feature values 38
4.1.3 Assumptions 39
4.1.4 Data review 39
4.2 Clustering 41
4.2.1 Intent 41
4.2.2 Key insight 42
4.2.3 Cluster visualization 42
4.3 Classification Algorithm 42
4.3.1 Algorithm selection 42
4.3.2 Decision Trees 44
4.3.3 Boosting and AdaBoost . . 45
4.3.4 Gradient Boosting Machines 46
4.3.5 LightGBM 47
4.4 Classification Method 48
4.4.1 Wrong-class error 48
4.5 Energy Prediction 49
4.6 Parameter Refinement 50
4.6.1 First pass iteration 50
4.6.2 Second pass iteration 51
4.6.3 Hyperparameter tuning . . 51
4.6.4 Interpretation and parameter selection 52
4.7 Comparison Predictions 55
4.7.1 Published fuel economy . . 55
4.7.2 LGBM regression 55

This section describes the process chosen to build a spreadsheet-compatible energy prediction model from the cleaned timeseries logger data. In broad terms, the steps were as follows:

- Divide travel data into segments
- Compute kinetic fingerprint features and average power
- Select reasonable starting clustering parameters
- Cluster into groups representing eigentrips
- Characterize missions by classifying travel data
- Iteratively refine clustering parameters and model hyperparameters

4.1 Feature Preparation

4.1.1 Segmentation

As in Wu's drive cycle classifier [31], the data was consolidated into 3-minute segments to match the resolution of a typical urban stop-go-stop cycle. The resampling is relative

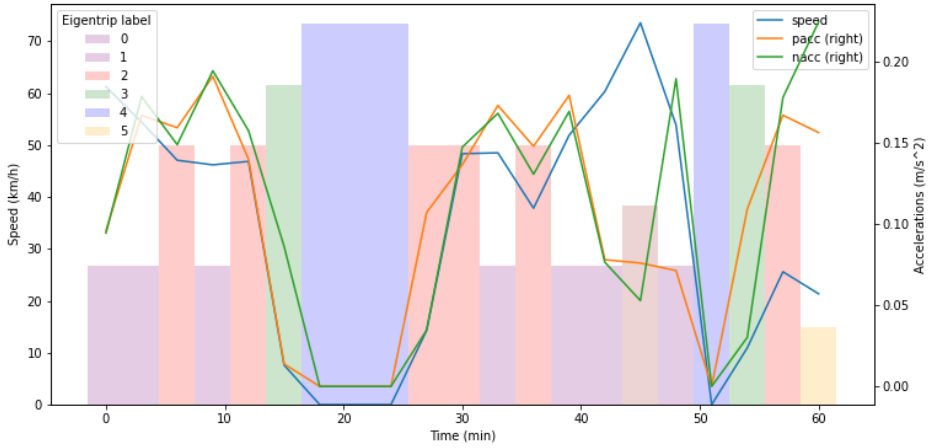


Figure 8: Timeseries trace of speed and accelerations, overlaid with eigentrip labels

to the top of the hour (IE, segments begin and end at even multiples of 3 minutes past the hour). This has the advantages of consistency and simplicity with the tools at hand, but it also results in the first and last segment of each trip having shorter durations. E.g., if a trip began at 15:02:15, its first segment will end at 15:02:59 for a duration of only 45 seconds.

The fixed segment duration, the choice of 3-minute segments, and the clock-time interval boundaries are all assumptions meriting further investigation as discussed in §7.3.4 and §7.3.5.

An example period of travel is shown in in figure 8, with a timeseries plot of the average speed, acceleration, and deceleration values in each 3-minute segment. The plot segments are superimposed on blocks representing their eigentrip labels, to give a sense of the decomposition process.

4.1.2 Feature values

For each 3-minute segment, Wu's vehicle-independent trip features [31] were computed, including averages and maximums for speed, acceleration, and deceleration, as well as the fraction of time spent idling (see table 2).

One oversight in Wu's choice of features is road grade – a significant factor in short-term power requirements. Fully 42% of the data collected in this study lacked GPS altitude,

and of the non-null data, 61% were repeat values. Where possible however, positive and negative vertical speed features were calculated. To give some insight into regenerative braking, an additional feature was computed from the count of acceleration reversals – the number of times the vehicle changed from acceleration to deceleration, or vice versa.

Each travel segment was additionally labelled with its mean input power in kW. The derivation of power from the available log data is described in detail above in §3.3. In brief, ICEV power is derived from MAF at the stoichiometric ratio, and BEV power from the time-interpolated SOC.

4.1.3 Assumptions

Refining and simplifying assumptions were applied to the feature calculations as follows:

- Null samples indicate that either the logger or CANbus is inactive, which should typically only happen when the vehicle is at rest and/or the engine is stopped. Null values were therefore presumed to indicate zero speed and/or energy consumption.
- For maximum values, the 98th percentile (Q98) value was selected to minimize the effect of outliers and incorrectly captured values.
- In spite of using a quantile for maximums, the mean was used to represent average, since the other measures of central tendency minimize the informational effect of skewness, which is valuable here.
- Information doubly-represented in other statistics (eg, zero-speed samples, also captured in the idle-fraction statistic) was not excluded.

4.1.4 Data review

Histograms of the feature values plus power consumption rate are visualized stripped of outliers (beyond 2.5 IQR) in figure 9, and further stripped of the minimal value and maximal value in 10.

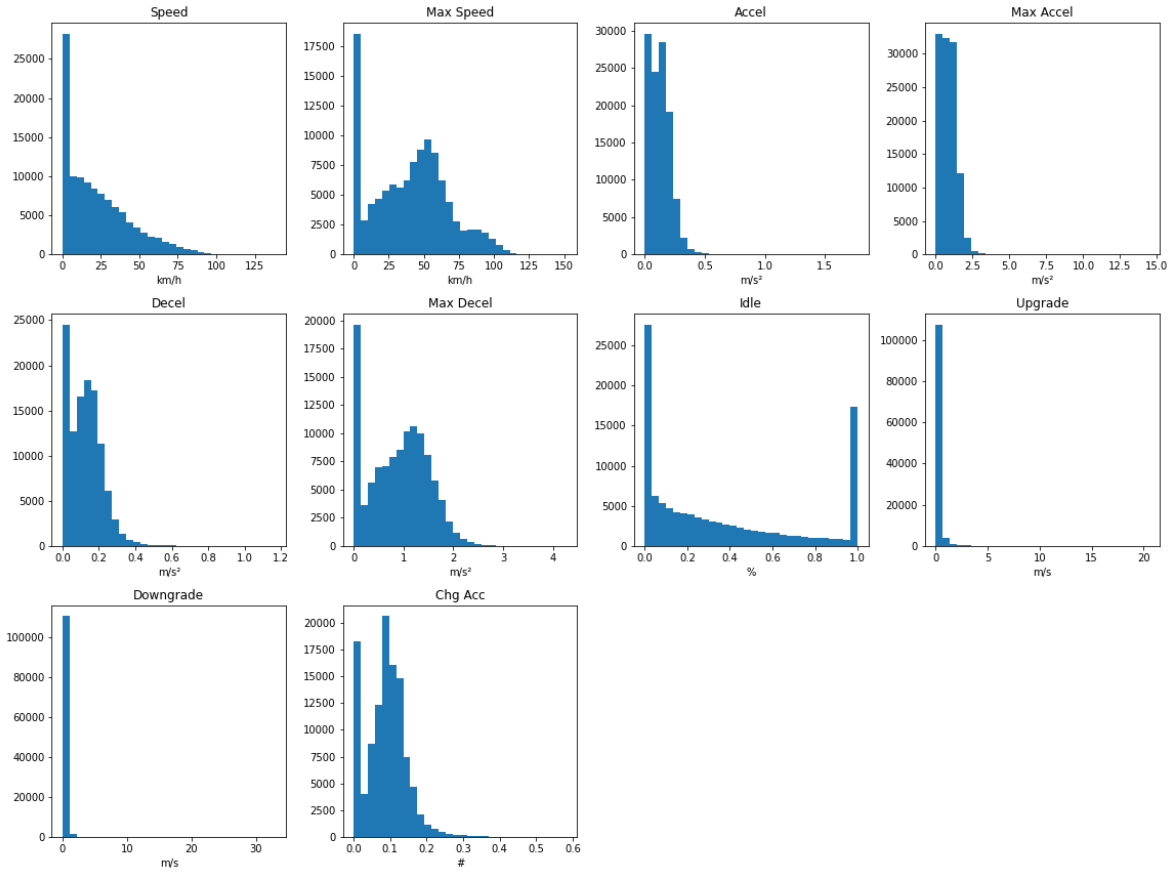


Figure 9: Feature value distributions, including end-of-range values

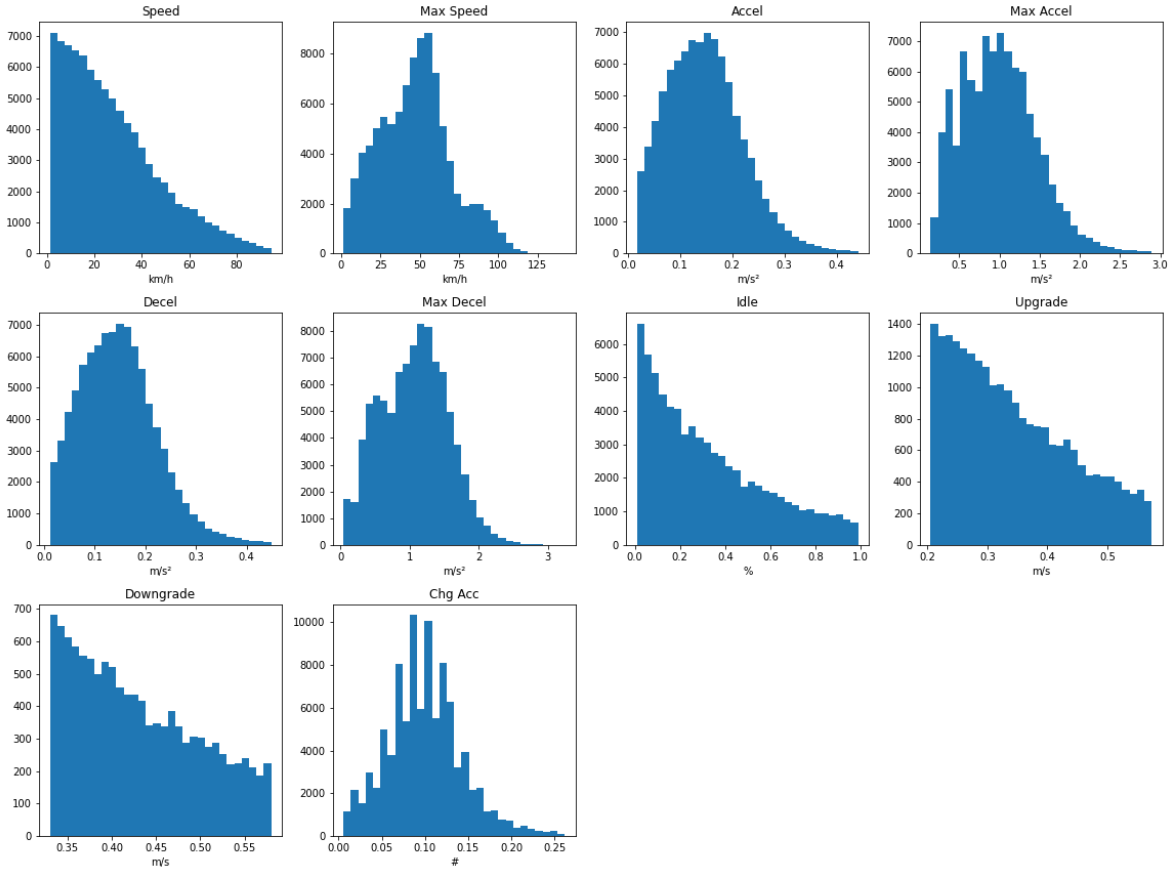


Figure 10: Feature value distributions after removing common end-of-range values

4.2 Clustering

Having established a clean corpus of fingerprinted travel segments, the next step was to perform a preliminary clustering of the segments into similar groups.

The individual features did not exhibit significant modalities other than those obviously caused by segments where the vehicle was idle; there is no reason to expect that the data is inherently clustered. Since the clusters will be selected arbitrarily to improve the model's performance, a simple clusterer using Euclidean distance suffices for initial validation. K-means clustering was chosen due to its simplicity and the fact that the Scikit-learn implementation does not scale its inputs, permitting feature weighting by scaling. Since K-means greedily minimizes within-cluster sum-of-squares [48],

$$\sum_{i=0}^{n} \min_{\mu_j \in C}(||x_i - \mu_j||^2) \tag{8}$$

it tends to result in clusters which are roughly spherical, rather than elongated or convex. This is a limiting factor deserving additional work (§7.4.1), but it does not prevent the technique from establishing reasonable cluster centroids, nor from providing labelled groups which will train a functional classifier.

4.2.1 Intent

The centroids of these groups define the characteristic travel-type exemplars that we are calling "eigentrips". The eigentrips are used to estimate a vehicle's input power according to the vehicle's type, and the kinetic characteristics of the travel it is undertaking. The goal is therefore to find a set of eigentrips, each of which represent a travel regime with both (a) consistent kinetic characteristics, and (b) similar input power within each vehicle type.

4.2.2 Key insight

It was desired that the eigentrips represent regimes of travel with similar power *within each vehicle-type*, but not necessarily *across* vehicle-types, so power was added as a feature for the purpose of clustering, and weighted to emphasize its importance relative to the individual kinetic features.

The inter-vehicle difference in power for a given travel-type would be a confounding factor, so the power feature is standardized to Mahalanobis distance (shifted to have a zero mean, and scaled to number of standard deviations) *separately for each vehicle.*

4.2.3 Cluster visualization

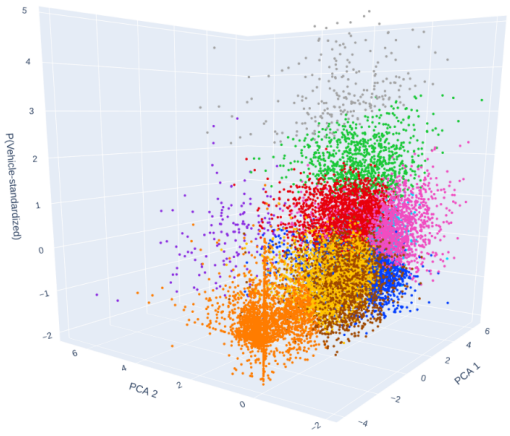
A preliminary K-means clustering operation was performed with K=10 clusters, and the power feature weighting increased by applying a power-scaling factor (PS) of 2.0. The kinetic features were reduced to 2 dimensions with PCA as shown in table 8. The PCA-reduced kinetic features were visualized on a 3D scatter plot, with the Z axis showing power, and the cluster labels differentiated by colour. Clustering for the complete training datasest is visualized in figure 11(a), with power standardized within each vehicle. The similar subfigure (b) shows the subset of data for a single vehicle, with non-standardized power.

4.3 Classification Algorithm

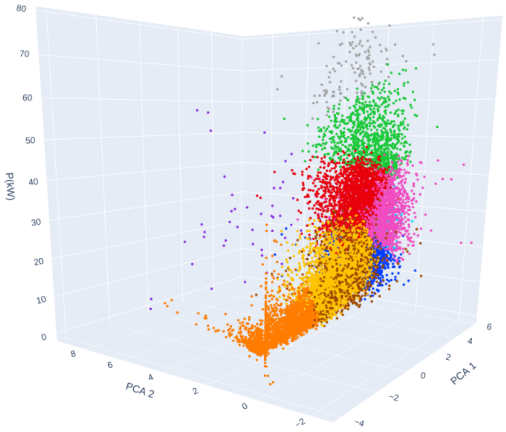
4.3.1 Algorithm selection

The core of the proposed model is the classification of travel segments by their kinetic features, and labelling them with the most-similar eigentrip. This label permits predicting a likely vehicle-specific characteristic power for the segment. In other words, the clustering process above has *defined* the eigentrips, and now they can be *applied.*

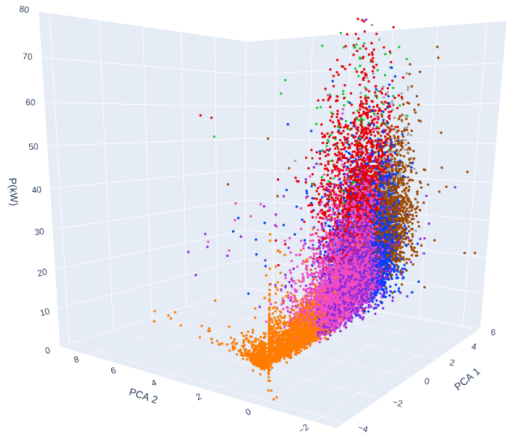
The feature histograms (figure 10) showed the bulk of feature data in well-ordered distributions, but many with a large additional peak at zero (as well as unity, in the case



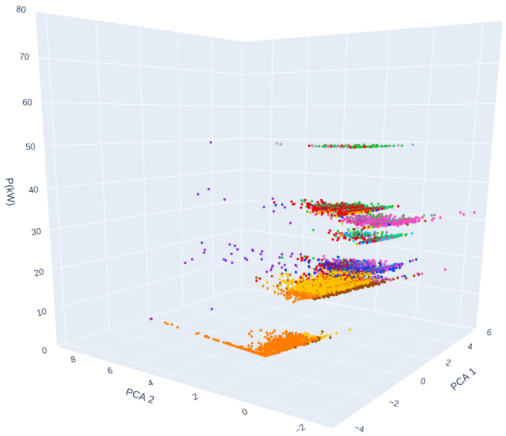
(a) Standardized power (all training data)



(b) Actual power



(c) Actual power, predicted labels



(d) Predicted characteristic power

Figure 11: Visualization of preliminary clustering (K=10, PS=2) and classification, as applied to one example vehicle

Table 8: PCA components for 2D visualization of kinetic features(K=10, PS=2)

	PCA 1	PCA 2
Speed	0.302	0.0828
Max speed	0.355	0.0551
Acceleration	0.372	-0.100
Max acceleration	0.342	-0.110
Deceleration	0.365	-0.0745
Max deceleration	0.368	-0.0778
Idle	-0.39	0.0139
Climb	0.0884	0.684
Descent	0.0878	0.692
Acceleration reversals	0.303	-0.0976

of the idle fraction feature). This modality means that parametric classifiers assuming a single distribution will be ill-suited. Since selecting cluster parameters required an iterative search of K (number of clusters) and PS (power-scaling) combinations, a fast classifier was desired.

The LightGBM classifier [61] meets these requirements. LightGBM is a gradient boosting framework, with several interesting optimizations. The remainder of §4.3 is a short introduction to some core concepts underlying the LightGBM model: decision trees, boosting, gradient boosting, and a short description of LightGBM's optimizations.

4.3.2 Decision Trees

The simplest possible decision tree is a single inequality criterion that branches a dataset into two leaves. Figure 12 illustrates an example, letting records where feature #2 <= 4.85 go into the *left* leaf, the remainder into the right.

Selecting the best choice for the split criterion requires a method of quantifying the "purity" of potential splits – the degree to which information is added by by creating the split. Shannon entropy, mis-classification error rate, and Gini impurity are common metrics for classification, and sum of squared error for regression [62, §9.2]. In the simplest illustration, every unique datum is examined as a split point, selecting the one which results in the lowest total impurity in its leaves.

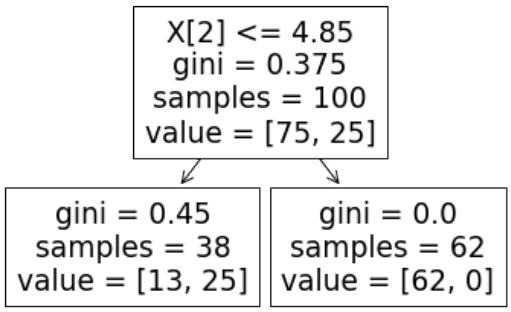


Figure 12: Example of a single-node decision tree, or "stump"

4.3.3 Boosting and AdaBoost

Gradient Boosting is the name for a group of methods for building an ensemble of "weak" learning machines (often small decision trees), each building on the weaknesses of its predecessors.

It is best illustrated with AdaBoost, the first adaptive boosting machine, and arguably the simplest and best-known [62]. The following pseudocode, derived from [63], uses the simplest possible real classifier (a decision tree stump) applied to an input dataset X with labels y.

1. Start by defining the first weak learner F_1 (a decision tree stump, as discussed in §4.3.2), trained from the initial input dataset $X_1 = X, y_1 = y$

2. Use the F_1 to generate predictions $\hat{y}_1$ against labels y_1.

3. Compute loss L_1. For classification, this might be the fractional error rate

$$L_1 = \frac{1}{N} \sum |\hat{y} \neq y| \tag{9}$$

4. Compute *performance value* α_1, a number that is larger if the classifier performs well.

$$\alpha_1 = 0.5log(\frac{1 - L_1}{L_1}) \tag{10}$$

5. Halt iteration if stop conditions met (e.g. a predetermined number of iterations).

6. Create a new input dataset X_2, y_2, with a larger proportion of records incorrectly classified by L_1. Selection is pseudo-random, using a weight vector

$$w_2 = e^{-\alpha_1 s_1} \tag{11}$$

$$\text{where } s_1 = \begin{cases} 1, \hat{y_1} = y_1 \\ -1, \hat{y_1} \neq y_1 \end{cases} \tag{12}$$

7. Train a new tree F_2 from the new dataset X_2, y_2, and iterate from step 2.

The final classification decision takes the form of a weighted vote between the weak learners, weighted by each learner's performance metric α_i.

4.3.4 Gradient Boosting Machines

Gradient Boosting Machines are a generalization of the AdaBoost concept, allowing different loss functions, and applying a kind of gradient descent in order to reduce error in a smaller number of iterations. A gradient boost model is superficially similar to AdaBoost, in that it consists of an ensemble of weighted weak learners:

$$F(X) = F_0(X) + F_1(X) + ... + F_m(X) \tag{13}$$

$$where \begin{cases} F_i = & \gamma_i r_i \\ r_i = & -g(L)|_{i-1} \text{ (negative gradient of loss function)} \\ \gamma_i = & \underset{\gamma}{argmin} L(F_{i-1} - \gamma r_i) \end{cases} \tag{14}$$

Where γ_i are weights and r_i are the pseudo-residuals of the preceding weak learners. In essence, each element F_m is the output of a decision tree trained to predict the pseudo-residual r_m. In the special case where the loss function is sum of squared errors (SSE), this is the (true) residual of the prior elements. The output is then scaled by a weighting factor γ_m, selected to minimize the overall loss.

In other words, gradient boosting is conceptually different from AdaBoost in that each

element F_i is a weak learner tuned to directly address a pseudo-residual – an incremental step in the direction of steepest improvement in the loss function. In other words, the gradient of loss L with respect to the prediction F: $\frac{\delta L}{\delta F}$ [62, §10.10].

Unsurprisingly, nearly every teaching example (e.g. [64]) of gradient boosting tends to use the same, extremely convenient loss function; the one which produces the simplest gradient:

$$L_i = \frac{1}{2}(y - \hat{y}_i)^2 \tag{15}$$

$$\text{so...} \; r_i = -\frac{\delta L_i(X)}{\delta F_i(X)} = \hat{y}_i - y \tag{16}$$

Additional weak learners are added until a stop condition is met, typically either (a) a specified number of estimators have been added, or (b) the loss has been reduced to an acceptable threshold.

4.3.5 LightGBM

The Light Gradient Boosting Machine (LGBM) is a framework for applying gradient-boosted decision trees (a specialization of GBM where the weak learners are always small decision trees), with a number of optimizations to improve training speed and improve accuracy [65]. In particular, it provides the following [66]:

- gradient-based one-side sampling (GOSS) histogram split finding: an alternative method of tree construction which finds high-performance splits very quickly by keeping high-gradient rows, as well as samples from rows with small gradients
- exclusive feature bundling (EFB), allowing sparse, mutually exclusive features (IE, those with few overlapping nonzero values) to be grouped into a single feature for split evaluation
- best-first tree training; for a given maximum number of leaves, this method often improves overall accuracy by splitting the leaf which most reduces loss
- bagging, helpful to reduce variance [62], and implicitly to reduce the likelihood of over-fitting

4.4 Classification Method

An LGBM classifier was constructed by training with the kinetic features using 10% of the labelled data for each vehicle, with the remaining 90% held back for testing. This method is at odds with the apparent industry standard method of 80% training / 20% hold-back, but given a reasonable quantity of data, a small, well-distributed training set in conjunction with extensive testing serves to ensure that the model is generalizable and not over-fitted.

Figure 11 shows the results of classification on the sample vehicle. Subfigure (c) shows the eigentrip label (colour) of each segment predicted by the classifier solely with reference to the kinetic parameters, and subfigure (d) shows the as-clustered original labels, but with the predicted power.

4.4.1 Wrong-class error

In general, a multi-class classifier returns the set of probabilities that a given element (in this case, a travel segment) belongs to each possible class (in this case, the various eigentrips). Typically, the class with the highest probability (the *maximum likelihood* class) is selected. Applying this technique, the trained classifier had a label selection accuracy of 77.9%. The misclassification rate is not as concerning as it might seem: since the dataset is not in distinct clusters, segments of indeterminate class can be expected to have an actual power somewhere between the characteristic powers of its most probable classes.

It seems possible that the correct power may often fall between the highest and second-highest probability classifications. A refinement for future work (discussed in §7.4.2) is for cases where membership is unclear, to attempt selecting the two most probable classes, and pro-rating the segment's eigentrip membership by probability.

4.5 Energy Prediction

For the purpose of energy prediction, each travel segment is represented as a time-weighted vector, where each element represents a time-weighted (and potentially probability-weighted) count of eigentrips. E.g., if the segment is 180s long, and is best represented by eigentrip e_2, the segment is now represented by $\boldsymbol{S} = [0, 180, 0, 0, ...]$, where the elements of $\boldsymbol{S}$ represent the number of seconds spent in each of the eigentrip types. Any period of travel ($\boldsymbol{T}$) can now be represented as the sum of its segment vectors:

$$\boldsymbol{T} = \sum \boldsymbol{S_i} \tag{17}$$

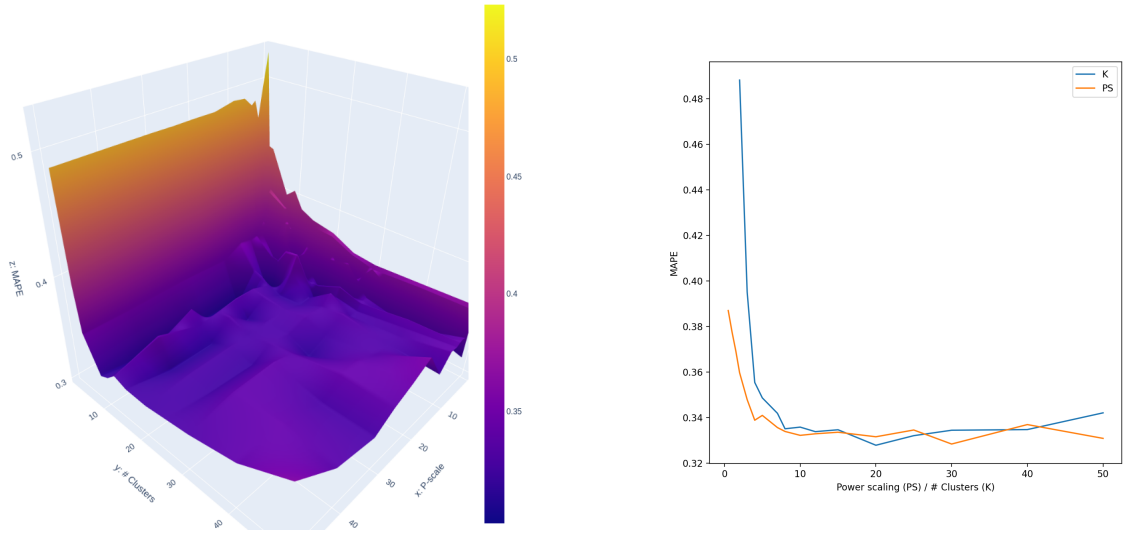
Given a vehicle's list of characteristic power values for each eigentrip $\boldsymbol{C_v} = [P_{v,e1}, P_{v,e2}, ...]$, the predicted energy consumption for that travel is:

$$E = \boldsymbol{T} \cdot \boldsymbol{C_v} \tag{18}$$

Accuracy is assessed relative to the logger estimate of observed power for any given period of travel, in terms of modified mean absolute percentage error (MMAPE):

$$MMAPE = \frac{100\%}{n} \sum_{t=1}^{n} \left| \frac{y_t - \hat{y}_t}{1 + y_t} \right| \tag{19}$$

This initial model configuration (K=10, PS=2) exhibited a per-segment MMAPE of 37.4%, somewhat better than the baseline prediction error of 50.9%, calculated below in §5.



(a) MMAPE surface

(b) Median MMAPE cross-sections

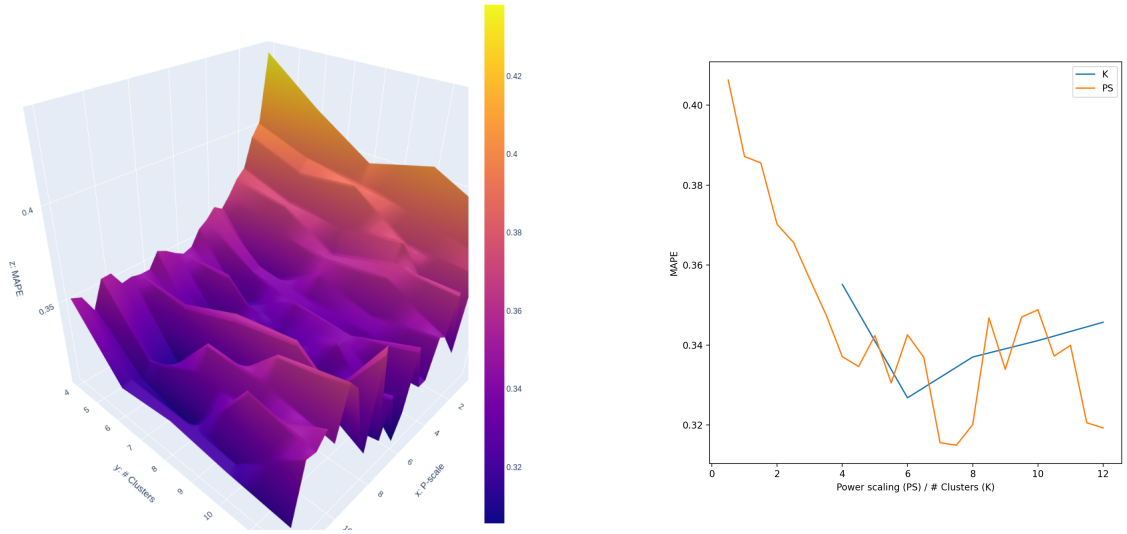
Figure 13: Two visualizations of prediction error (MMAPE) versus a broad selection of number of clusters (K) and power-scaling factor (PS)

4.6 Parameter Refinement

4.6.1 First pass iteration

Having elected to cluster by K-means with a weighted power feature and demonstrated a process, the next step was to select (a) an appropriate number of clusters (K), and (b) appropriate weighting with power-scale (PS).

A number of values for K and PS were evaluated by clustering at each combination, and generating a prediction of average segment power to each configuration as described in §4.4 and §4.5. The MMAPE was calculated for each configuration, shown in figure 13(a). For clarity, the median of MMAPE values at various levels of PS is plotted for each value of K and vice-versa in (b). The figures show substantial random-appearing variation in error as PS is increased, presumably the result of classification error as the importance of the kinetic features in the clusters is reduced by over-weighting the power feature.



(a) MMAPE (b) Median MMAPE

Figure 14: Local visualizations of prediction error (MMAPE) versus a narrowed selection of number of clusters (K) and power-scaling factor (PS)

Table 9: LGBM hyperparameters selected for optimization

Hyperparameter	Value
bagging fraction	0.800
feature fraction	0.900
learning rate	0.0100
max bin	60.0
max depth	27.0
min data in leaf	39.0
min sum hessian in leaf	59.0
num leaves	80.0
subsample	0.0100

4.6.2 Second pass iteration

Noise notwithstanding, the figures show a significant drop in MMAPE in the vicinity of K=8 and PS=5, so a smaller-scale, higher-resolution iteration was performed in those regions (figure 14).

4.6.3 Hyperparameter tuning

As with most ML algorithms, LGBM uses data-nonspecific settings called hyperparameters, which must be adjusted for best performance with the specific application.

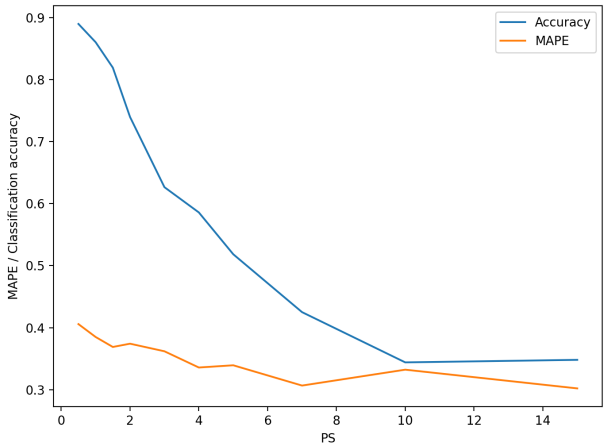


Figure 15: Prediction error and Classification Accuracy for various values of power-scaling factor (PS) with 10 clusters (K=10)

It is common to select these by iteratively testing the cross-validated performance of various values, and selecting the set which reliably perform best. A popular method is implemented in Fernando Nogueira's optimization toolkit [67], which employs an evolving Bayesian process to home in on a likely minimum value for the loss function in a shorter number of steps than required by an exhaustive grid search. The technique is not central to this research; a simple grid search would return similar results at the cost of time. However, the implementation details are interesting and well illustrated in the author's github page [68], with an application to LGBM published to Kaggle by Somang Han [69]. The application of this technique resulted in the hyperparameters shown in table 9.

4.6.4 Interpretation and parameter selection

A deterministic optimization could be employed to find an absolute minimum MMAPE, but since the results would vary with every new random draw of training data, the improvement would not be persistent. Instead, parameters were selected from the region of the plot which appeared to best balance low MMAPE with low randomness. 10 clusters was chosen as a starting point due to the visible trough on the 3D surface plot.

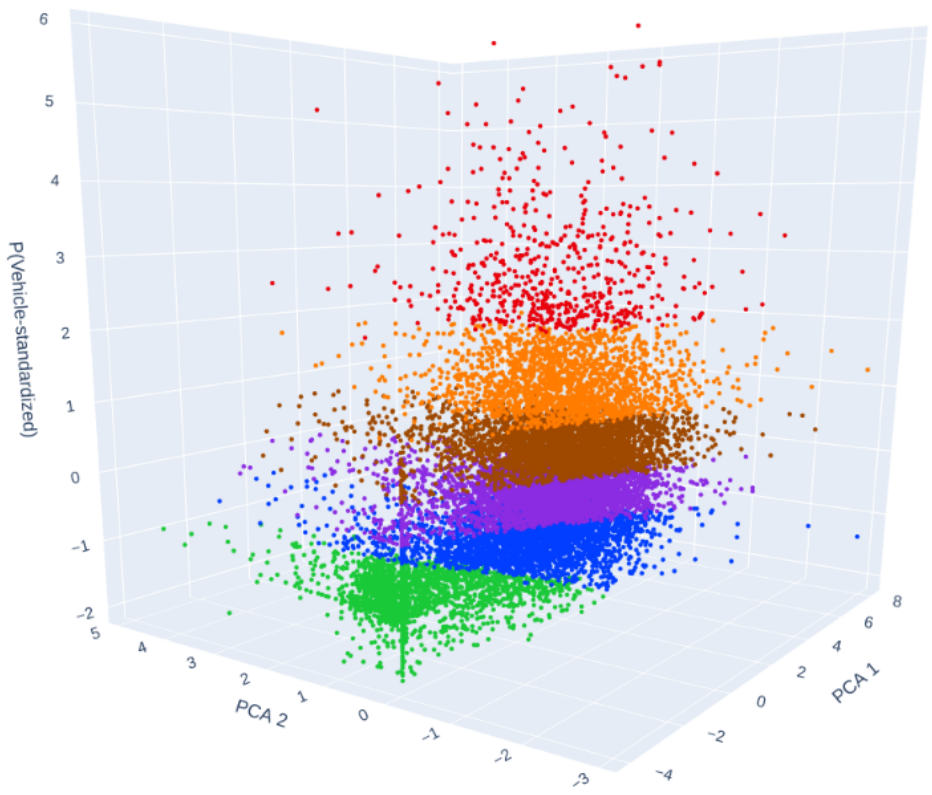


Figure 16: Final clustering (K=6 PS=7), PCA kinetic features, and power

Classification accuracy and MMAPE were plotted at various values of PS that number of clusters, with results shown in figure 15. As desired, the increase in PS initially improves MMAPE, as clusters are defined with less internal scatter with respect to power. Classification accuracy drops rapidly with increasing PS, as clusters are defined which cannot be recalled without reference to the power feature, quickly overriding the improved prediction accuracy.

The final clustering with K=6 and PS=7 is visualized in figure 16. The noteworthy visual difference relative to the original clustering is that at the same visual Z-axis scale, the clusters appear "pancaked" – this reflects the desired stratification according to power levels. It is important to remember that this is a visual artifact; in the 11-dimensional hyperspace where the clustering operation was performed, the cluster boundaries still approximate hyperspheres, much as a cluster of soap bubbles approximate spheres.

This final clustering also permits the calculation of characteristic power values for each vehicle. Figure 17 shows the spread of actual power observations sorted by their cluster (eigentrip) labels, and divided into the various vehicle categories.

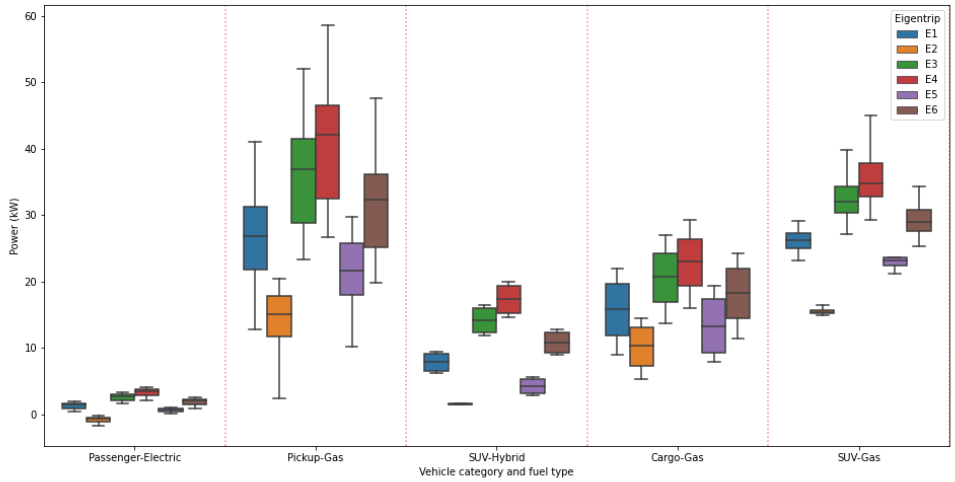


Figure 17: Power distribution of each vehicle category, as divided between the eigentrip labels

The average per-segment MMAPE of the eigentrips model was 32.3%.

4.7 Comparison Predictions

4.7.1 Published fuel economy

Business-as-usual (BAU) energy consumption prediction was established by applying published city/highway $L_e/100km$ figures to the logged travel distances for each segment. The consumption test protocol [17] drive cycles had a mean speed of 34 km/h for city driving and 78 km/h for highway, so a dividing speed of 56 km/h was established midway between those means. Travel segments with an average speed at or below that dividing speed were predicted at the city figure, and those above predicted at the highway figure.

Fuel economy figures were selected for each vehicle with reference to NRCan's fuel consumption rating search tool [70]. In each case, the base model was selected unless the CRD's vehicle database indicated a specific sub-model or trim level.

The average per-segment MMAPE of this method was 50.9%.

4.7.2 LGBM regression

Finally, to establish the level of avoidable error with the information available to the model, a LightGBM regression model [66] was trained on the 10 kinetic features, as well as three additional features capturing specific information about each vehicle: its fiel type (ICE, HEV, BEV), vehicle category (passenger, pickup, SUV, etc), and an identifier for each specific vehicle.

The decision to include all three of these additional features was not obvious; the vehicle ID is over-specific, and in a wider application would instead use a detailed model and trim-level specification. Furthermore, much of the predictive information in the vehicle's fuel and category is shared with the vehicle ID, and as discussed in §2.2 mutual information and unnecessary features are to be avoided.

The core conflict is that on one side, some vehicle categories spanned a wide range of power levels (e.g., a modern F-150 base-model vs an older F-150 4x4 super-duty), best

addressed by permitting the model to modify power based on the observations of specific vehicles. On the other hand, some specific vehicles were only observed for a short period of time, and would not generalize well without reference to the information of other similar vehicles. On the balance, it was decided to include all three, since boosted tree models split on a single feature at a time, and therefore do not tend to overemphasize based on mutual information.

Once the feature-set was selected, the regression model's hyperparameters were tuned as described in §4.6.3, and power predictions made for each segment. The average per-segment MMAPE of this method matched that of the eigentrips model, at 32.3%.

5 Results

5.1 Presentation of Error 58
5.1.1 Error measures 58
5.1.2 Chosen error measure . . . 60
5.2 Discussion 60
5.2.1 Error interpretation 60
5.2.2 BEV prediction 62
5.2.3 PHEV prediction 63
5.2.4 HEV prediction 63
5.2.5 Physical interpretation . . . 63
5.3 Application 65
5.3.1 Replacement by predicted distance 66
5.3.2 Replacement by published fuel economy 67
5.3.3 Replacement by logged energy 67
5.3.4 Replacement by best savings 67
5.4 Shapley Additive Explanation . . . 68
5.4.1 SHAP overview 68
5.4.2 SHAP summary visualization 69
5.4.3 SHAP implications 70

This section presents the predictive error of the proposed "eigentrips" model relative to the logger-data estimate of actual power. The eigentrips model is compared with two alternative means of prediction: first, business-as-usual prediction based on standard L/100km fuel economy figures, and second, an LGBM regression model trained to directly predict segment fuel consumption. The eigentrips model is piecewise-constant, so the regression model is presented to give a sense of the eigentrip model's avoidable quantization error.

Much of the discussion in this section is with regards to the MMAPE for individual 3-minute segments, since that is the most intuitive initial indicator of the model's accuracy. For the end user's purpose, trip-level or mission-level (ie, for the duration of the vehicle's participation in the study) aggregate error is likely to be of more interest, and that is addressed at greater length in the discussion section, §5.3.

5.1 Presentation of Error

5.1.1 Error measures

The most appropriate intuitive measure for prediction error was not immediately obvious, for the following reasons:

- Absolute (non-relative) error over-represents error in high-power vehicles.
- Relative (to actual-error) over-represents error when actual power is very low.
- Relative (to vehicle) requires a fixed per-vehicle denominator, resulting in unexpected error values for segments unrelated to the selected denominator.

Several measures of prediction error were considered, described below with their shortcomings. For the formulae below, a=actual, p=predicted, q=vehicle max power, μ=vehicle mean power.

1. **MSE (mean squared error)**

$$\epsilon = (a - p)^2 \tag{20}$$

   Problem: Although $Min(\Sigma MSE)$ is the model's actual objective function, it does not give a good intuitive grasp of the magnitude of the prediction error when actually applied to a real-world prediction problem. A lay user would expect that a model described as having 25% error will generate predictions incorrect by approximately 25%, not by 50%.

2. η **(absolute/non-relative error)**

$$\eta = |a - p| \tag{21}$$

   Problem: Error will be exaggerated in high-power vehicles, and they will dominate summary results.

3. ϵ_μ **(relative to vehicle-mean)**

$$\epsilon_\mu = \left| \frac{a - p}{\mu_v} \right| \tag{22}$$

Problem: The mean can be different in similar vehicles, depending on operation. Some mission profiles are dominated by idle!

4. ϵ_q **(relative to vehicle-max)**

$$\epsilon_q = \left| \frac{a - p}{q_v} \right| \tag{23}$$

Problem: Unintuitive at low power. EG: consider a 100kW vehicle, on a segment where actual power is 1kW and prediction was 2kW. This measure would return an error of $\epsilon_q = (2 - 1)/100 = 1\%$, even though the prediction was double the observed value.

5. **TMAPE (true mean absolute-value percent error)**

$$TMAPE = \left| \frac{a - p}{a} \right| \tag{24}$$

Problem: Segments with zero or near-zero actual power will have excessively high error. This is of particular concern with EVs and HEVs, which frequently "idle" at fractional kW power. Almost 1% of EV samples were observed at under 1kW, causing unreasonably high segment prediction errors.

6. **MMAPE (mean absolute-value percent error, modified)**

$$MMAPE = \left| \frac{a - p}{1 + |a|} \right| \tag{25}$$

This metric retains much of the intuitive power of TMAPE, while avoiding excessive error at for very small values of actual power.

Problem: The added 1 in the denominator is arbitrary. In the previous example,

Table 10: Error for various timescales, contrasting eigentrips model vs business-as-usual vs LightGBM regression

	L/100km (%)	Eigentrips (%)	Regression (%)
Segment	50.9	32.0	32.4
Trip	38.5	23.7	20.3
Mission	21.8	9.59	2.90
Study	19.3	7.45	0.120

Table 11: Per-trip error for various vehicle fuels/categories, contrasting eigentrips model vs business-as-usual vs LightGBM regression

Fuel	Category	L/100km (%)	Eigentrips (%)	Regression (%)
Electric	Passenger	47.8	64.8	127.
Gas	Cargo	43.9	56.0	34.1
	Pickup	51.6	35.1	21.0
	SUV	17.0	21.9	10.4
PHEV	SUV	34.6	38.9	33.5

MMAPE $= (2-1)/(1+1) = 50\%$, which bears no contextual intuitive relationship to the error.

5.1.2 Chosen error measure

In the remainder of this chapter, modified MMAPE is used to compare and contrast relative error. The arbitrary 1 added to the denominator is a common means of addressing the near-zero error problem, while retaining a sensible range of relative error across the range of actual values.

5.2 Discussion

5.2.1 Error interpretation

Table 10 shows MMAPE at various levels of aggregation, split out for business-as-usual L/100km prediction, for the proposed eigentrips model, and for direct regression with the LightGBM comparison model. In general, the prediction performance is as

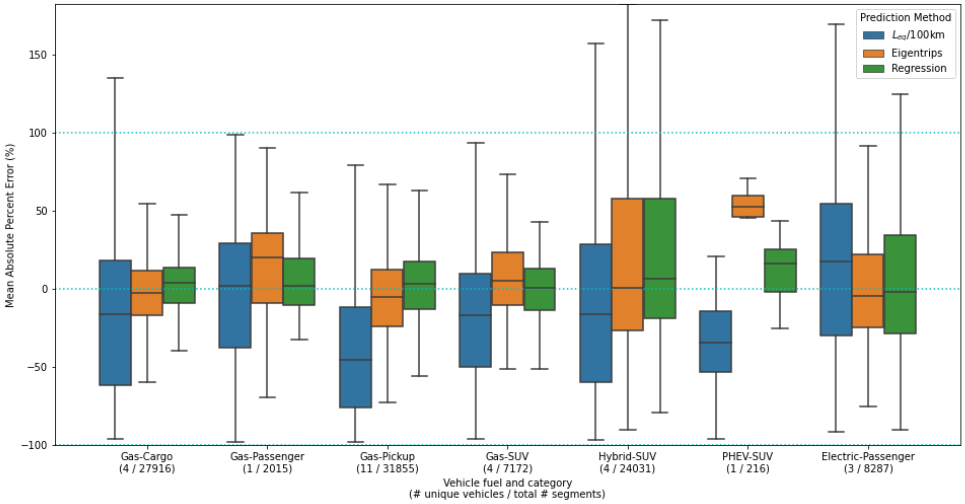


Figure 18: Prediction error distribution of segment-level predictions, contrasting eigentrips model vs business-as-usual vs LightGBM regression

expected: the eigentrips model outperforms traditional L/100km prediction, and is in turn outperformed by direct regression.

The segment level error for both the Eigentrips and Direct regression models is very high, and remarkably similar. Since the eigentrips model is expected to have significantly more error due to quantization inherent in the technique, the behaviour is anomalous, and suggests that the predictions are missing information relative to the ground truth. This may reflect an erratic ground truth (due to error in the MAF approximation of true fuel flow), or changes in power requirement disguised by missing features such as missing or inaccurate road grade, or other features discussed in §7.5.5.

Table 11 shows the per-trip aggregate error, broken down by "fuel" (actually drivetrain type) and vehicle category. It is noteworthy that the LightGBM regression model and eigentrips model did not perform particularly well for the various hybrid and battery-electric vehicles, although they did still tend to outperform traditional fuel economy.

Figure 18 shows the per-segment MMAPE for each fuel and vehicle type. The boxes show the quartile range of error values (25% and 75%, with a horizontal line to indicate median), with whiskers to show the extent of the 10th and 90th percentile. The plot does an excellent job of showing that in general, the LightGBM regression model and the eigentrips model have lower bias and lower variance than the L/100km technique.

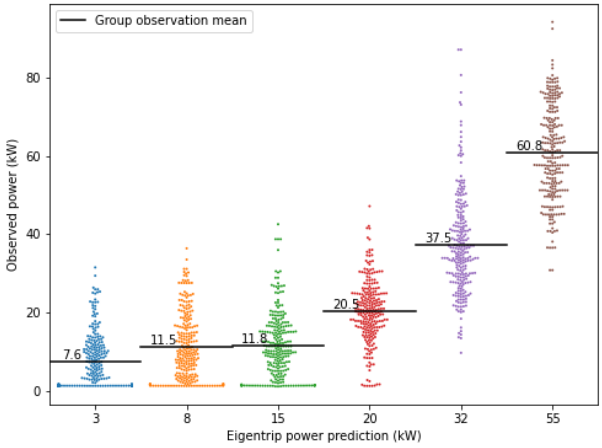


Figure 19: Example power versus prediction within eigentrips

However, this plot also shows unexpectedly wide variance for HEVs and BEVs, and high bias *and* variance for the PHEV, all discussed in detail below. It is also noteworthy that the $L_e/100km$ prediction shows an error of -100% in many cases, since it has no means to appropriately predict idle power.

Figure 19 uses a single example vehicle to illustrate the variance in actual powers within each labelled eigentrip, presented in the form of a swarm plot against the power prediction, taken as the vehicle's characteristic power. The horizontal bar on each swarm shows the mean *actual* power, which is seen to be quite close to the quantized *predicted* power – which is the vehicle's characteristic power for that eigentrip.

5.2.2 BEV prediction

For the BEVs, this excessive variability is attributed largely to the 90-second low-resolution power sampling discussed in §3.3. Although the BEVs' onboard SOC computation is presumed to be reliable, it is impossible to know how much power consumption is measured in one segment when it is better attributed to the next. This lack of accuracy is a key outcome of this research: high-resolution data-driven energy prediction requires high-resolution input data.

It is noteworthy that since the reported error is relative to actual consumption, the apparent error of the BEVs is amplified relative to the ICEVs; the 25-75 IQR in figure

18 shows that the eigentrip model has about double the relative error for BEVs as for ICE pickup trucks – but since the BEV's power is so much lower, this in fact represents a prediction of 35.7 ± 7.0 kW for the pickup truck, and 3.0 ± 0.88 kW for the BEV; the BEV's absolute error range is in fact much smaller.

5.2.3 PHEV prediction

The single PHEV suffered from the same low-resolution sampling problem as the BEVs, and additionally had a very short data-collection period, with only 216 travel segments recorded, totalling about 10 hours of travel.

Furthermore, the PHEV had no mechanism for capturing the likelihood that a given segment is in ICE-mode. Future work with PHEVs should attempt to create additional kinetic features to capture that information, such as total distance travelled this trip, or total distance today.

5.2.4 HEV prediction

The study included 4 Toyota RAV4 mild HEVs, which were predicted with a reasonable MMAPE, but a wide spread in the segment level predictions. The loggers in the HEVs were not configured to capture HV battery status, so it can be presumed that the short-term error included a significant amount of energy consumption being shifted between adjacent segments, EG, by regenerative braking.

Improving HEV energy prediction would be an interesting extension to this work, and would require additional feature engineering to capture HEV-specific behaviour, such as regenerative braking and any periods of sub-optimal engine operation.

5.2.5 Physical interpretation

Figure 20 shows a box plot for each kinetic feature, showing the distribution of values broken down by eigentrip label. Examination of these plots may help with understand-

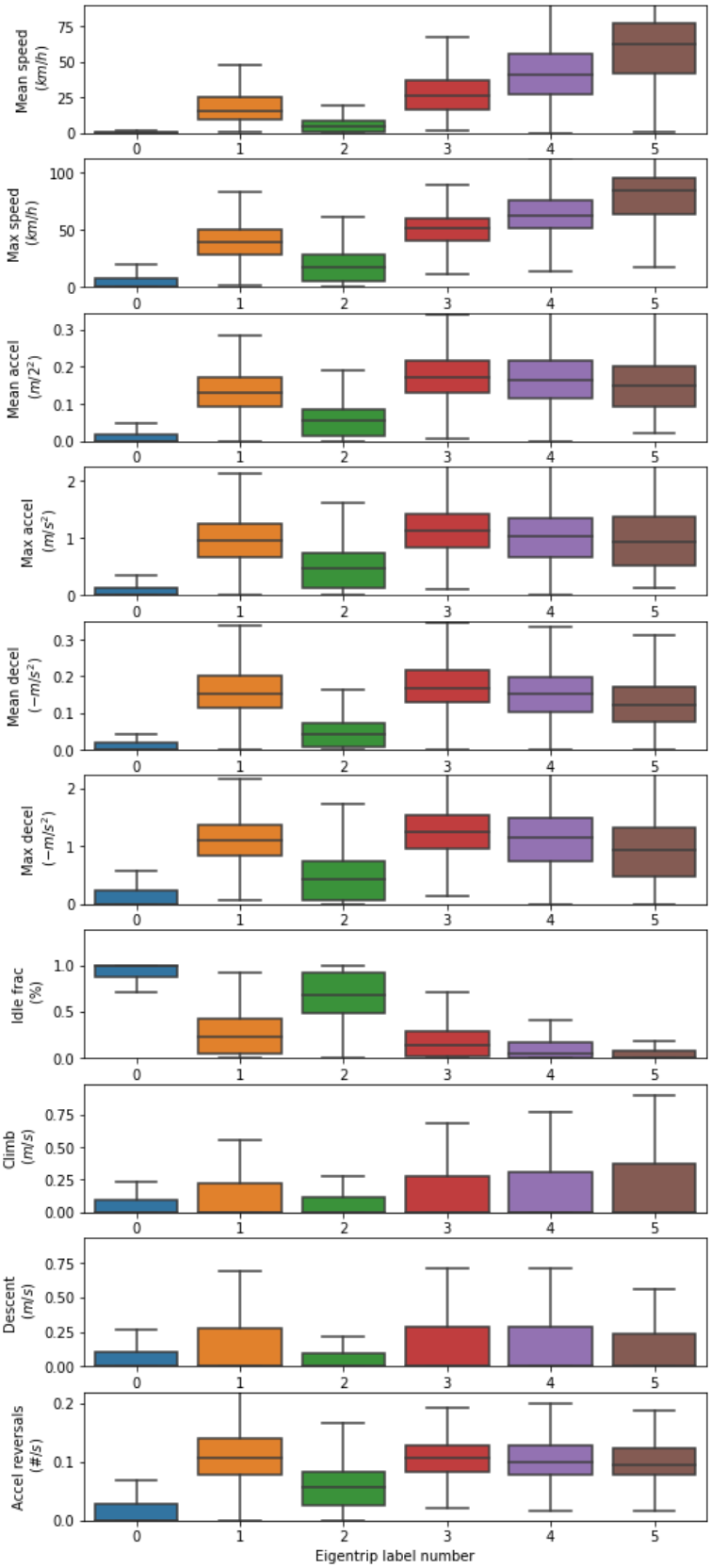


Figure 20: Per-eigentrip distribution of feature values across all missions

ing of the physical nature of travel likely to be labelled as most similar to a particular eigentrip.

5.3 Application

To illustrate the application of the eigentrip model, imagine that a fleet manager has been allocated budget for three new vehicles, with the explicit goal of minimizing annual carbon-based fuel consumption. The manager is faced with the decision of which vehicles to replace. Without logger information (and, for this purpose, in the absence of mission constraints) the decision will be informed by whatever information is at hand.

This section explores the information that the manager might have, the vehicle replacement decisions they might make with various information, and the likely impact of those decisions in light of the logger data. The impact is given in terms of saved energy in MJ, and the volume of consumed gasoline for ICEVs. Additionally, to highlight the impact of high-efficiency BEVs consuming low-intensity BC grid electricity, the related GHG emissions are also listed, given global warming potentials (GWPs) of 88.1 $g\ CO2_e/MJ$ for gasoline [9] and 2.96 $gCO2_e/MJ$ for BC Hydro's grid electricity [10].

Fuel consumption in this section is given relative to a power baseline derived from the logger MAF and SOC data, as described in §3.3. As discussed in §7.5.2, the validity of this baseline estimate is one of the study's core assumptions – there is no validated fuelling data from which to calculate error bars.

The prediction estimates are given as maximum likelihood values – given the vehicle's single characteristic power value for each eigentrip, and a count of the most-probable eigentrips for the mission, the prediction estimate becomes a simple dot product. As discussed in §7.3.6, it would be valuable to have a generalized measure of uncertainty for each mission-vehicle prediction, but this would require characterizing each mission and vehicle as a probability distribution rather than a singular value, defeating the model's core goal of simplicity. To give *some* sense of the prediction reliability and impact on decision-making, the replacement vehicle's whole-study MMAPE is applied

Table 12: Whole-mission error averaged for various vehicle fuels/categories, contrasting eigentrips model vs business-as-usual vs LightGBM regression

FuelType	L/100km (%)	Eigentrips (%)	Regression (%)
Electric-Passenger	20.7	15.3	19.2
Gas-Cargo	20.1	13.8	9.43
Gas-Pickup	40.2	9.55	11.2
Gas-SUV	9.44	7.15	0.685
PHEV-SUV	40.2	0.0965	2.85

to the resulting prediction. The replacement vehicle in all cases happens to be the Kia Soul BEV, so an expected error of 10.7% is selected from the Electric-Passenger row of table 12 and calculated for each prediction.

5.3.1 Replacement by predicted distance

If the fleet manager has accurate mileage records and can predict the mission distances, then they might choose to predict per-mission energy consumption by multiplying predicted mission distance by the published fuel economy of the vehicle currently assigned. The top three energy consumers by this prediction would be two pickup trucks and a van, predicted to annually drive 58,700 km, and to consume 246 GJ of fuel.

The actual logged consumption of these three vehicles extrapolated to a full year was in fact 350 GJ (equating to 10300 L of gasoline, and GHG emissions of 30900 $kg\ CO2_e$) – an error of 24%, illustrating that this method is not particularly accurate. Applying the eigentrips model, we find that replacing these three vehicles with a BEV similar to one of the tested passenger vehicles (not actually an appropriate replacement for a cargo vehicle) would result in a predicted consumption of 26.9 GJ, and cause GHG emissions equating to about 79.7 $kg\ CO2_e$. This replacement, if it were possible, would save 321 GJ of energy and avoid 30800 $kg\ CO2_e$ of GHG emissions. The expected prediction error of 10.7% for this vehicle category equates to an error estimate of ± 2.88 GJ and ± 8.5 $kg\ CO2_e$.

5.3.2 Replacement by published fuel economy

Lacking mileage or fuelling records, the fleet manager might select the three vehicles in the fleet with the worst fuel economy ratings – two pickup trucks and an SUV, in this example. In the absence of distance or fuelling records, there will be no predicted consumption better than the manager's educated guess, perhaps by pro-rating the fuel budget for the entire studied fleet (1167 GJ) by fuel economy numbers, resulting in a predicted consumption of 203 GJ.

The extrapolated logger data suggests that these vehicles would have a total annual consumption of 200 GJ (5900 L gasoline, emitting 17600 $kg\ CO2_e$ of GHGs). Their BEV replacements would result in a new predicted consumption of 14.9 GJ (44.2 $kg\ CO2_e$) – a savings of 185 GJ, and avoiding 17600 $kg\ CO2_e$ of GHG emissions. The expected error of 10.7% equates to an error estimate of ± 1.60 GJ and ± 4.73 $kg\ CO2_e$.

5.3.3 Replacement by logged energy

In the absence of actual pump-to-tank records, the loggers themselves have the best record of the energy consumed by each vehicle. Extrapolating each vehicle's actual logged consumption to a year, the top three consumers will total 388 GJ (11500 litres gasoline, emitting 34200 $kg\ CO2_e$). Their BEV replacements would consume 25.7 GJ (76.3 $kg\ CO2_e$), saving 362 GJ and avoiding 34100 $kg\ CO2_e$ of GHG emissions. The BEV's expected error of 10.7% equates to an error estimate of ± 2.75 GJ and ± 8.16 $kg\ CO2_e$.

5.3.4 Replacement by best savings

The theoretical best solution is to consider all missions, and select the replacements offering the highest predicted savings over the incumbent vehicles. In this case, the result happens to be the same as the case above: replacing the highest energy consumers with the most efficient available alternative. However, this would not be the case if the highest energy consumers were already relatively efficient.

Table 13: Illustration of SHAP for a single prediction

	Feature Values	SHAP Values
Speed	52.8	18.8
Max speed	64.7	1.01
Acceleration	0.125	-0.382
Max acceleration	1.03	0.0332
Deceleration	0.104	0.797
Max deceleration	1.06	0.195
Idle	0	-0.769
Climb	0.324	0.0151
Descent	0.273	-3.32
Acceleration reversals	0.15	1.85
vid	Vehicle 10	23.1
Type	Pickup	4.8
Fuel	Gas	2.16

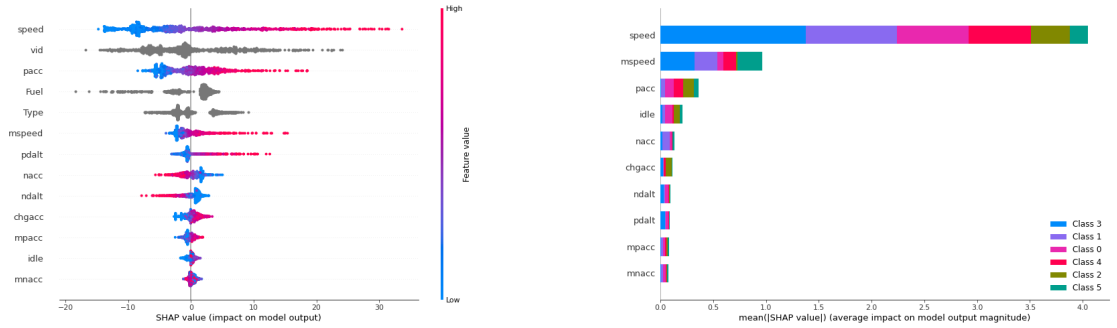
5.4 Shapley Additive Explanation

5.4.1 SHAP overview

Shapley additive explanation (SHAP) [71] is a method for understanding the contribution of each individual feature to a specific final prediction. The explanation is *additive*, because the individual contributions sum to the actual prediction.

To illustrate, consider the lightGBM regression comparison model described above in §5.2, applied to predict the power of a single segment vector. An example is shown in the "Feature Values" column of table 13. The SHAP explainer constructs a general null prediction (an estimate in the absence of any feature information, typically the training mean), and then computes the individual additive contributions of each feature to increase or decrease the specific prediction under consideration from the general null prediction. In this case, the sum of the 28.4 kW null prediction and the individual SHAP values (again, shown in table 13) is equal to the regression model's final prediction of 89.0 kW.

The method of computing the individual feature contributions is somewhat involved. Mazzantzi has written an excellent simplified explanation in [72]. Further summarized, the method involves creating a directed graph of models for every possible combination



(a) Regression SHAP, showing feature relationship to prediction impact

(b) Multiclass SHAP, showing absolute feature impact on individual class membership probabilities

Figure 21: SHAP explanation summaries, showing each feature's contributions to the model's prediction, across the entire dataset

of available features, arranged such that the edges in the graph imply the addition of an individual feature relative to the source node. The contribution of a feature is a weighted average of the change in predicted values along all the edges where that feature is added.

5.4.2 SHAP summary visualization

A second application of SHAP is to explain the relative importances of the features, across all samples in a dataset [73]. It is easy to imagine, for example, that the climb rate feature would have a much larger impact on the visible power requirement of a heavily loaded ICE cargo vehicle, as opposed to a mild hybrid using its traction battery to invisibly average its engine power output between climbs and descents.

Figure 21(a) addresses this requirement by showing the distribution of absolute contributions of each feature to the predictions. For numeric values, red implies a high value, and the right side of the chart indicates a positive impact on the power prediction. EG, higher mean speed (red) tends to increase the power prediction (i.e., rightward), and a low mean speed (blue) tends to decrease the power prediction (i.e., leftward). The categorical features have no scalar values (grey), and this SHAP visualization has no intuitive way to show *which* categories shift the prediction in a particular direction; the only information presented is the range of impact magnitudes caused by various values

in the feature.

The eigentrip technique centrally uses a multiclass classifier, not a regression model; the classifier's output for each prediction is in fact a vector of class probabilities, rather than a single predicted value. Plot (a) could at best be used to show the absolute impact of each feature on the probability of predicting one of six eigentrips. Instead, figure 21(b) illustrates the *mean absolute* impact of each feature on each class probability – in other words the absolute change on the prediction probability if the feature is known, vs not known. For example, the figure shows that knowing the Speed value tends to change the probability of class 3 by an absolute magnitude of about 1.4; it has a large impact, although the plot gives no information about whether the impact tends to be positive, negative, or even mixed.

5.4.3 SHAP implications

On the summary figure(21a), the features for acceleration reversals (chgacc), maximum positive acceleration (mpacc), idle fraction (idle), and maximum deceleration (mnacc) are seen to have relatively small contributions to the prediction.

To illustrate that this is valid, the regression and eigentrip models were re-applied with reference to only the *other* features. The impact of deleting these less-important features from the direct regression model was indeed quite modest, increasing the average segment MMAPE by only 0.21% – from 32.7% to 32.9%.

The impact on the Eigentrips model was somewhat more significant, increasing from 32.1% to 39.4% – perhaps highlighting the impact of an increased number of marginal samples no longer being nudged into the correct classification by the additional features.

6 Conclusions

The eigentrip approach developed in this research has reasonably good accuracy, and produces whole-year mission predictions averaging a MAPE of 9.4%. The concept can be expected in the field to give significantly better predictive results than the baseline (L/100km) method's MAPE of 22%, although there is clearly room for improvement, as shown by the direct-regression model's average MAPE of 3.7%.

The reduced error of either machine-learning model is balanced against added complexity; adding a new vehicle to the model would require computing the new vehicle's per-eigentrip characteristic power values. Similarly, adding a new mission profile (or updating a modified one) would require logging some weeks worth of representative travel data, sanitizing it, and deconstructing it into a combination of eigentrips.

The criterion of spreadsheet-compatibility no longer seems as important as it originally was, due to the advent of low-barrier options for deploying ML models in the cloud, such as managed notebook hosting services. Such a model would have better predictive accuracy, and could be designed to facilitate the direct upload of new data – either representing new vehicles, or in order to better represent the evolution of the fleet's mission profiles. That said, a spreadsheet-deployed model would still be helpful to address potential concerns around the public exposure of individual travel information. This issue was deeply significant for the CRD, whose requirements informed this research.

The research performed here has been severely limited on several fronts, hampered by data collection problems and limited by inadequate temporal resolution. One of the initial goals, choosing the best of several alternative high-efficiency replacements, has been rendered impossible by the elimination of alternatives in the source data – the initial study was intended to include several HFCEVs, PHEVs, and other types of BEV beyond the Kia Soul EV. None of the desired alternatives were ultimately included in the logged data, and the single PHEV logged only about 10 hours of travel time before the data collection phase was terminated.

An important outcome of this research is reinforcement of the idea that any data-driven

model for predicting per-trip or per-mission vehicle energy consumption will be limited in accuracy by the quality of the data that informs it. A good model would require higher-resolution input data, and an exploratory data campaign facilitating iterations of the experiment with various sampling frequencies and methods would be yet another excellent subject for further study.

Ultimately, a data-driven model will be an effective recommendation tool for selecting replacement vehicles to minimize energy consumption and carbon footprint. Careful design of a data collection strategy will be the foundation of any trustworthy model.

7 Recommendations and Future Work

7.1 Assumptions . . . 73
7.1.1 Stationarity and ergodicity 73
7.1.2 Baseline energy consumption . . . 74
7.1.3 Standardized GHG intensity 75
7.1.4 Fixed MAF ratio . . . 75
7.1.5 Clustered eigentrip definitions . . . 76
7.2 Cleaning Decisions . . . 76
7.2.1 Smoothing starts . . . 77
7.2.2 Regularization . . . 78
7.2.3 BEV power interpolation . 78
7.3 Data Structure . . . 78
7.3.1 Time-domain features . . . 78
7.3.2 Feature evaluation . . . 79
7.3.3 Microtrip boundaries . . . 79
7.3.4 Clock time segment boundaries . . . 79
7.3.5 Iterative segment refinement 80
7.3.6 Characterize as distributions 80
7.4 Modeling . . . 81
7.4.1 Improved clustering . . . 81
7.4.2 Probabilistic class membership . . . 82
7.4.3 Prediction error and missing features . . . 82
7.4.4 Characteristic power by vehicle model . . . 83
7.5 Data and Features . . . 83
7.5.1 Data requirements . . . 83
7.5.2 High-quality energy input data . . . 83
7.5.3 Road grade . . . 84
7.5.4 Features to support other vehicle types . . . 85
7.5.5 Other features . . . 85
7.6 Applications . . . 86
7.6.1 Real-time allocation . . . 86
7.6.2 Information sharing . . . 86
7.6.3 Connected Vehicles . . . 87

This section discusses a number of limitations, assumptions, and other potential improvements to the studied process and model.

7.1 Assumptions

Several simplifying assumptions were made that could benefit from more rigorous treatment, either to quantify the resultant error, or to find a more precise method.

7.1.1 Stationarity and ergodicity

This entire study is predicated on two key assumptions: that the power and kinetic features are stationary (i.e., that the statistics do not change over time) and that they

are ergodic (the statistics do not change erratically and inconsistently with respect to uncontrolled parameters).

All of this is to say that the work assumes that the kinetic features are dictated by the mission, and not unduly influenced by changing factors such as the physical characteristics of the vehicle, the habits of the driver, and changing traffic patterns. Future work should validate and quantify these assumptions by observing the same mission operated with different vehicles, and confirming that e.g., a difference in power or handling characteristics doesn't result in a confounding change in the observable kinetic features.

Most power-impacting differences in driver habits would likely be captured and accounted for in the speed and acceleration features. However, an exploration of driver-mission and driver-vehicle stability might be warranted since (a) drivers might affect non-engine power consumption, such as climate control, changing the power characterization of a vehicle, and (b) a difference in driving technique might be so extreme as to alter the kinetic profile of a measured mission, depending on who is driving it.

The same assumptions apply to the per-vehicle characteristic power values. Future work should compare data collected from similar or identical vehicles, while driven by different drivers, in different missions, in different geography, and in different organizations.

7.1.2 Baseline energy consumption

This thesis evaluates the validity of the new method for predicting energy consumption, as compared to the traditional model-specific fuel economy statistic measured in $L_e/100km$. The validity of the two predictions is compared by measuring error relative to the best available estimate of "actual" energy consumption, as derived from MAF and SOC.

It is a significant assumption that the inferred estimate of input energy from logger values is valid and correct. As discussed in §7.5.2, it would be a significant improvement to this research to collect actual per-vehicle fuelling records for ICEVs and electrical

metering for grid-powered BEVs in order to establish the accuracy of the logged energy consumption estimates.

7.1.3 Standardized GHG intensity

A primary intended use of this work – the prediction of GHG emissions – presumes that it is possible to easily convert a known quantity of input energy into a specific GHG footprint in kg CO2e, by applying standard GHG intensities such as those published by the BC Canadian Ministry of Environment & Climate Change Strategy (MOE) or BC Hydro [74, 10].

Events such as Volkswagen's "Dieselgate" [75] have made it clear that this is a weak assumption for ICE vehicles, and that there may be a need for model-specific intensity factors. Further investigation will be necessary to quantify the associated error.

Other factors may impact the emissions calculation for grid-powered BEVs, depending on how grid emissions intensity is to calculated. BC Hydro reports an overall carbon intensity of 11 $gCO2_e/kWh$, with specific renewable and fossil sources rated at 4g and 593g respectively, and conducts a significant bidirectional trade with Alberta, which is attributed an intensity of 820g [76]. A 2017 paper found that carbon intensity in New Zealand should be considered as varying between 32g and 188g depending strictly on time-of-day [77]. It is easy to imagine a dynamic fleet model with reallocates vehicles according to changing requirements for calculating emissions, or even from the the time-dependent change in the carbon intensity attributed to their power sources.

7.1.4 Fixed MAF ratio

Fuel consumption rates were inferred from the OBD2 log values for MAF. This is only accurate if the fuel:air mixture is known. The stoichiometric ratio of 14.7 is commonly accepted [54], and as described above in §2.3.2, the author's undocumented personal experience supports it. No peer-reviewed literature nor authoritative texts were found supporting or refuting this assumption.

Since fuel flow is not a standard OBD2 PID, it would be an excellent contribution to the literature to publish a model or a dataset helping to more accurately infer actual fuel flow from MAF and other standard OBD2 parameters.

7.1.5 Clustered eigentrip definitions

An early assumption was that the eigentrip definitions should be inferred from the data, rather than synthesized from expert knowledge of how different driving patterns are likely to influence fuel consumption. The basis set was therefore constructed using unsupervised clustering.

It would be possible to instead construct a set of exemplar trips that are representative of trip-types which a domain expert intuitively believes are likely to be predictive of energy consumption variability between vehicle types. Examples might include situations such as

- point-to-point highway travel, off-peak hours
- highway travel, rush-hour
- point-to-point city travel
- patrolling and parking enforcement
- idling to supply vehicle-mounted equipment

If the eigentrips were modelled on intuitively understandable travel-type exemplars, users would be better able to infer the nature of new or blended missions, and be better able to apply sanity checking to unexpected model results.

It would be interesting to repeat the experiment with such a set of intuitive eigentrips, and contrast the level of error with that found from the inferred ones.

7.2 Cleaning Decisions

The extensive data cleaning and preparation process required a number of judgement calls and simplifications. The most important of those are listed here.

7.2.1 Smoothing starts

As discussed above in §3.2.3, a large number of in-motion samples immediately following an at-rest sample were dropped due to impossibly high accelerations, presumably due to sampling errors.

Simple rejection of these potentially informative samples was to be avoided. An aborted attempt was made to impute reasonable speed profiles to these samples using the following process:

1. Compute a "typical low-speed acceleration" for each vehicle, consisting of the median of in-motion positive acceleration values at speeds below an arbitrary threshold of 15 km/h.

2. For vehicle starts with impossibly high logged accelerations, the zero-speed sample is time-shifted to an earlier time that would reflect that vehicle's typical acceleration – but never such that it would precede the prior speed sample.

3. If the time-shifting would cause the zero-speed sample to precede a legitimate logged non-speed sample, then "required acceleration" is computed from that legitimate sample. If that required acceleration is found to have a reasonable magnitude, then the earlier sample time is retained and deemed to be the new start time.

Unfortunately, many of the error periods were found to bracket other sensor readings, particularly MAF readings. Inserting an imputed speed value would call into question the validity of the the subsequent MAF observation, causing irreconcilable discrepancies between inferred acceleration and inferred fuel flow. The method has potential, but requires detailed review of the original datastream to be sure that it was not introducing more error than it is removing.

7.2.2 Regularization

As discussed in §3.4, the entire corpus was regularized to 1s intervals to simplify segmentation. This implies linear interpolation and extrapolation – both of which unavoidably introduce error relative to the actually-measured real samples.

Given the potential to process variable-length segments as discussed in §7.3.5, it would instead be possible to divide segments precisely at sample times, minimizing the amount of interpolation required.

7.2.3 BEV power interpolation

Since sampling of the BEV's power was done at a relatively low resolution, a simple time-interpolation on SOC was performed to help estimate power consumption within each trip segment.

Hopefully future work will have direct access to higher resolution BEV power data.

With only the data at hand, a number of techniques might do better at predicting SOC at the segment boundaries, perhaps using a timeseries regression model inferring from additional other features such as distance travelled and acceleration profile.

7.3 Data Structure

7.3.1 Time-domain features

As discussed in §2.2.2, there are good reasons for this model to be structured as a non-timeseries problem. However, there are likely to be some time-domain or frequency-domain features with predictive power. Examples for possible exploration include the effects of stop-and-go traffic and time-of-day. Possibilities to extract predictive features from these characteristics include spectral power density [42] as a fingerprint feature, and the use of time-domain techniques like Kalman filters, [78] might help to generate predictions of otherwise unknowable state features such as the vehicle's kinetic energy

or a mild hybrid's drive battery SOC. Another possibility is the employment of dynamic time warping, [79] or wavelet convolutions [80] in order to find recurrences of observed patterns that might characterize driving segments as being similar.

7.3.2 Feature evaluation

The initial short set of features in §4.1 is based on the work of others [38]. It would be a valuable contribution to compile an exhaustive list of features directly available from OBD2 or computed from them, and apply a rigorous evaluation for relative predictive power. A simple example is the selection of the 98th percentile to illustrate the feature "maximum acceleration". It is possible that some other quantile (or even the unfiltered maximum observed value) would be more predictive.

One method for this would be to derive an expanded feature set (such as those listed in §2.1.2), and apply SHAP [73] analysis to determine which features are most predictive of energy consumption.

7.3.3 Microtrip boundaries

An early assumption was the rejection of stop-go-stop microtrips as the fundamental trip segment, due to concern about excessive mixing of trip types. The requirement for fixed-length segments added significant complexity to the data preparation phase.

It is possible that the presumptive concern is unfounded. It would be interesting to perform the entire experiment again with microtrips to see the impact on prediction accuracy.

7.3.4 Clock time segment boundaries

For simplicity, the segments were regularized to clock time, beginning at even multiples of three minutes from 00:00:00 each day. This assumption results in final and initial segment in each trip being shorter by an average of 50%. Since each segment is given equal weight in the model, this difference over-weights the importance of measurements

in those segments. However, since the first and last segments might legitimately have more predictive power than mid-trip segments, it is possible that over-weighting them is doing more good than harm.

It would be reasonable to validate this assumption by using only segments of precisely 3 minutes' length, discarding a contiguous period of "leftover" modulus samples between a random segment-pair.

7.3.5 Iterative segment refinement

Another simplifying assumption was the use of segments of specified (3-minute) constant duration. This naturally has the following effects at the arbitrary boundaries:

- combines disparate travel types into single segments
- arbitrarily splits similar travel types, creating unneeded additional segments

A refinement to this approach would be to use the boundaries defined by the initial classifier in order to re-partition the travel data. Given an initial set of characteristic travel types, it would instead be possible to segment the trip at "type boundaries", where travel transitions from one type to another. This would result in segments of variable length, but of more consistent travel types. It is to be expected that this would result in more accurate energy consumption prediction within each travel type.

7.3.6 Characterize as distributions

The eigentrips model characterizes each vehicle as a vector of characteristic power values for each eigentrip, and each mission as a vector containing the sum of time spent in each eigentrip. The prediction of energy for applying a vehicle to a new mission is the dot product of the two vectors. This value does not give any reflection of the prediction's level of uncertainty, and it would be preferable to have some sense of the variance of the prediction.

Many regression models (including LightGBM) support so-called "quantile regression", allowing the model to output a prediction interval – eg, the 90th percentile model will

return a prediction indicating a value higher than 90% of actual expected values. This allows the user to intuitively understand the broadness of the prediction, as well as its central value.

This intuitive simplicity does not transfer to the eigentrips model. Extracting the 90th percentile energy prediction from a combination of vehicles and missions is *not* the dot product of the 90th percentile characteristic powers with the vector of singular mission times. It would instead require the computing the product of the nonparametric random variable representing the distribution of characteristic powers, with the eigentrip class probabilities, and determining the desired interval limits of the resulting product distribution.

Given that a primary goal of the eigentrips model is simplicity, this is *not* a recommended topic for future research. If a prediction interval is required, direct quantile regression would be a simpler and more reliable path.

7.4 Modeling

7.4.1 Improved clustering

The clustering step was performed by means of the well-known K-means algorithm, which returned a set of cluster centroids that were effective and useful, and which provided an excellent basis to prove the concept. The number of clusters was selected by inspection (the "elbow method"), and it would be informative to investigate more refined methods.

Other clustering mechanisms which do not presume spherical, normally distributed data would be likely to provide more representative centroids, and/or would lead more directly to an optimal number of clusters. For example, density clustering is a well-regarded process when the appropriate number of clusters is not known, however it was deemed unsuitable since the dataset is continuous without sparse regions between clusters.

Finally, the simple method used to select centroids predictive of energy consumption (adding weight to the energy consumption feature) does not necessarily select the optimal centroids for the following criteria:

1. minimize error from the selected fuel consumption model, but
2. are maximally discriminatory on fuel consumption for at least some vehicle features
3. provide adequate representation for all vehicle-eigentrip pairs

Finding centroids that meet all of these criteria may require developing a clustering strategy from first principles. A good first step would be to implement a GMM clusterer from first principles, in such a way as to allow feature-weighting.

7.4.2 Probabilistic class membership

Multiclass classifiers initially provide a probability of membership in *every* class, and only provide a singular prediction by application of maximum likelihood. A preliminary experiment with pro-rating segment time to *all* eigentrips by class probability was found to increase segment MAPE by nearly 50%.

However, for segments which fall close to the boundary between two (or more) segments, it seems reasonable that the segment's power contribution is likely to fall somewhere between the characteristic powers of the nearest segments. It might therefore be reasonable to assign the segment a blended contribution to energy consumption, weighted by the fractional probability of its nearest eigentrips. Since there is no requirement that a travel segment be characterized by whole numbers of eigentrips, it would be entirely acceptable to use multiple fractional membership, if it were found to reduce error.

7.4.3 Prediction error and missing features

Evaluating the actual operation associated with clusters that have the highest predictive error will be an excellent starting point for determining whether additional features are

needed to improve accuracy.

7.4.4 Characteristic power by vehicle model

Predictions are executed by multiplying the number of eigentrips by the characteristic eigentrip power as calculated for each individual vehicle. It would be valuable to have an understanding of the model's accuracy when energy consumption is predicted by vehicle *model or category*, rather than by specific vehicle. Figure 17 shows the spread of characteristic power values within each vehicle category in the study. It appears that each category's power is relatively consistent, in spite of each category containing several models with different performance characteristics.

7.5 Data and Features

7.5.1 Data requirements

This model has been demonstrated to generalize quite well, even when trained on only 10% of the available data. An interesting exploration would be to evaluate how much log data is required to accurately characterize each mission profile.

Additionally, when a new vehicle type is added to the fleet, it would be valuable to know how much logging (and of what sorts of travel) should be conducted before its power consumption characteristics are sufficiently well known for use with this model.

7.5.2 High-quality energy input data

As described in sections 2.3.2 and 3.3, the fuel and electrical consumption data logged for this project was not of ideal quality. It would be an excellent extension to this work to evaluate its accuracy against target energy data of known accuracy. To that end, future work would be well-served by a logger-data corpus that includes:

- time-integrated fuel-flow (IE, total fuel since last sample) OR
- fuel-flow sampled at 1s resolution or better, OR

- all PIDs necessary to accurately calculate fuel flow, such as MAF and commanded air-fuel equivalence ratio

Additionally, in fleets where vehicle fuelling is controlled and monitored through a per-vehicle card system, it would be instructive to cross-check logger consumed-fuel totals against actual pumped-fuel totals.

For EVs, charging totals could be compared to consumption totals to evaluate accuracy and charge-discharge efficiency.

7.5.3 Road grade

Road grade has an obvious impact on power requirements, and can be expected to illustrate a significant difference in energy consumption between conventional vs hybrid or electric vehicles. A reliable road-grade feature would be an excellent addition to this study.

Positive and negative vertical speed features were calculated from the available GPS data. Unfortunately, the altitude feature was completely missing from a significant fraction of travel data. The feature was informative, improving predictive error from 45% to 35% in spite of large gaps in coverage, and the inherently low precision of the GPS altitude signal.

Since the horizontal accuracy of GPS is better than vertical, consideration was given to the idea of extracting elevation data from an open elevation dataset, such as NRCan's High Resolution Digital Elevation Model [81], based on the vehicle's reported coordinates. A preliminary investigation of this technique showed improvement, but still yielded an unfortunately high fraction of impossible grades, perhaps due to a failure of the terrain dataset to account for the significant amount of grade smoothing involved in road building in the Victoria area. This method showed some potential, but was felt to be a large source of complexity for an unknown amount of predictive power; it may merit future study, but is neglected in this work.

The best realistic source for road grade would be a barometric altimeter. For example,

The Freematics open-hardware logger provides for the direct integration of external sensors [82]. It would also be an interesting side project to determine whether the OBD2 PID 0x133 (barometric pressure) [83] has sufficient precision to be used for a road grade calculation.

7.5.4 Features to support other vehicle types

Prediction was less precise than anticipated for the high-tech, high-efficiency vehicles. In particular:

- Prediction was poor for the mild HEVs. Investigation will be required to determine what additional features are required to capture hybrid performance, such as HV battery state, or additional kinetic features related to stop-and-go behaviour that could be impacted by regenerative braking.
- The BEV had a very wide range of error. Higher-resolution power data will be required, but they might also benefit from additional features indicating stop-and-go performance.
- If multi-fuel vehicles become common, a kinetic feature will be needed that can differentiate the circumstances under which they will switch from one energy source to the other. EG, total travel distance this day, or since last charge would probably work well for PHEVs.

7.5.5 Other features

There are other known/predictable factors that might be suspected to have a significant impact on fuel consumption, although most of them would present substantial data-collection challenges. Examples include:

- payload, particularly in heavy vehicles. It could be estimated given road grade and high-resolution torque and acceleration.
- different drivers, subject to privacy concerns
- accessory load

- environmental load
- vehicle maintenance status
- road type, perhaps inferred from GIS data
- traffic density by location and time-of-day, perhaps from a data source such as Google Maps
- rigorous collection of vehicle sub-model and trim level

7.6 Applications

The originally envisioned application was evaluating re-allocation of existing vehicles, and evaluating procurement decisions for additional copies of existing known fleet vehicles. This subsection addresses additional potential applications.

7.6.1 Real-time allocation

It would be reasonable for a booking system to respond to a request for a pool-vehicle by preferentially assigning the vehicle which is most energy-efficient (or most GHG-efficient) for the specific task at hand. The proposed system is simple enough to be implemented in a browser-based booking application, allowing the back-end to be simplified to a simple database lookup for availability, potentially requiring no additional custom back-end software development.

7.6.2 Information sharing

If multiple municipalities (or other organizations) established a shared set of eigentrip definitions, it would allow them to share information about their vehicles and their missions.

Vehicle information sharing would allow organization A to evaluate the local performance of a vehicle model owned by organization B.

On the other hand, sharing mission information sharing might highlight opportunities to improve operational efficiency. For example, organization A's parking enforcement

mission might have a much more efficient eigentrip profile, as its new optical license plate reading equipment allows it to spend a much higher portion of its time cruising rather than idling. The improved energy performance might be sufficiently impressive to encourage organization B to acquire the same equipment, solely to save the associated vehicle emissions.

7.6.3 Connected Vehicles

The advent of fully-connected vehicles (e.g., Tesla and other new EV manufacturers) has potential to provide a ready source of detailed, high-resolution vehicle performance data. It would be quite simple for a manufacturer to publish real-world samples of operations logs, allowing potential buyers to evaluate mission-vehicle energy and GHG performance without any need to purchase an evaluation copy.

It would also be reasonable to establish a universal set of eigentrips, allowing manufacturers to publish statistically verifiable real-world performance statistics for their vehicles.

Having new vehicles providing logger information by default would provide other opportunities when connected to a power-vs-mission analysis. For example, departure from manufacturer-published vehicle performance statistics could trigger owner alerts, as a potential indication of required maintenance.

8 Bibliography

[1] CRD, "CRD Corporate Climate Action Strategy," 2016, p. 51. [Online]. Available: https://www.crd.bc.ca/docs/default-source/crd-document-library/annual-reports/climate/corporateclimateactionstrategy.pdf?sfvrsn=e2372bca_4.

[2] NRCan. (Oct. 2013). "Fuel consumption ratings by model year," [Online]. Available: https://www.nrcan.gc.ca/energy/efficiency/11938 (visited on 12/21/2018).

[3] US EPA. "Find and Compare Cars," [Online]. Available: http://www.fueleconomy.gov/feg/findacar.shtml (visited on 10/21/2019).

[4] H. Huo, Z. Yao, K. He, and X. Yu, "Fuel consumption rates of passenger cars in China: Labels versus real-world," *Energy Policy*, vol. 39, no. 11, pp. 7130–7135, Nov. 2011, ISSN: 03014215. DOI: 10.1016/j.enpol.2011.08.031. [Online]. Available: https://linkinghub.elsevier.com/retrieve/pii/S0301421511006288 (visited on 12/21/2018).

[5] Mark Huffman. (Jun. 2015). "How accurate is your car's fuel economy rating?" [Online]. Available: https://www.consumeraffairs.com/news/how-accurate-is-your-cars-fuel-economy-rating-062615.html (visited on 12/21/2018).

[6] "Zero Emission Fleet Initiative Fleet Logging Project - Summary Report Capital Regional District . . Autumn Umanetz University of Victoria," p. 46,

[7] IESVic, "Zero Emissions Fleet Pilot App Feasibility Study," 2017. [Online]. Available: https://www.crd.bc.ca/docs/default-source/climate-action-pdf/zefi-feasibilitystudy.pdf?sfvrsn=5a11e0ca_2.

[8] A. Umanetz, "ZEFI Fleet Logging Project - Summary Report," 2019.

[9] M. a. L. C. I. Ministry of Energy. "BC-LCFS Requirements - Province of British Columbia," [Online]. Available: https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/renewable-low-carbon-fuels/fuel-supplier-compliance-50005 (visited on 02/21/2021).

[10] BC Hydro, "Greenhouse Gas Intensities," p. 1, 2016. [Online]. Available: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/environment-sustainability/environmental-reports/ghg-intensities-2004-2014.pdf.

[11] BC Government. "Greenhouse Gas Reduction Targets Act," [Online]. Available: http://www.bclaws.ca/civix/document/id/consol22/consol22/00_07042_01 (visited on 08/16/2019).

[12] BC Ministry of Environment, "B.C. Provincial Greenhouse Gas Inventory Report 2007," 2007. [Online]. Available: https://www2.gov.bc.ca/assets/gov/environment/climate-change/data/provincial-inventory/2007/pir-2007-full-report.pdf (visited on 12/30/2020).

[13] J. Lesser. "Are electric cars worse for the environment?" The Agenda, [Online]. Available: https://politi.co/2wHrT9T (visited on 02/19/2021).

[14] (Nov. 10, 2017). "Motor Mouth: A few more inconvenient truths about EV CO2 emissions," Driving, [Online]. Available: https://driving.ca/auto-news/news/motor-mouth-a-few-more-inconvenient-truths-about-ev-co2-emissions (visited on 02/20/2021).

[15] M. T. Boykoff and J. M. Boykoff, "Balance as bias: Global warming and the US prestige press," *Global Environmental Change*, vol. 14, no. 2, pp. 125–136, Jul. 2004, ISSN: 09593780. DOI: 10.1016/j.gloenvcha.2003.10.001. [Online]. Available:

https://linkinghub.elsevier.com/retrieve/pii/S0959378003000669 (visited on 02/20/2021).

[16] A. Elgowainy, J. Han, J. Ward, F. Joseck, D. Gohlke, A. Lindauer, T. Ramsden, M. Biddy, M. Alexander, S. Barnhart, I. Sutherland, L. Verduzco, and T. J. Wallington, "Current and Future United States Light-Duty Vehicle Pathways: Cradle-to-Grave Lifecycle Greenhouse Gas Emissions and Economic Assessment," *Environmental Science & Technology*, vol. 52, no. 4, pp. 2392–2399, Feb. 20, 2018, ISSN: 0013-936X, 1520-5851. DOI: 10.1021/acs.est.7b06006. [Online]. Available: https://pubs.acs.org/doi/10.1021/acs.est.7b06006 (visited on 02/20/2021).

[17] NRCan. (Apr. 30, 2018). "2020 Fuel Consumption Guide," [Online]. Available: https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation/fuel-consumption-guide/21002 (visited on 12/30/2020).

[18] "FuelEconomy.gov - The official U.S. government source for fuel economy information.," [Online]. Available: http://www.fueleconomy.gov (visited on 12/30/2020).

[19] FPInnovations, "Testing and Verification Protocol for Engine and Vehicle After-market Devices," 2013. [Online]. Available: https://etvcanada.ca/wp-content/uploads/2013/08/Report-Protcol-EAMDs-Testing-and-Verification.pdf.

[20] Transport Canada. (Mar. 10, 2013). "2-cycle testing," [Online]. Available: https://web.archive.org/web/20130310085554/http://www.tc.gc.ca/eng/programs/environment-fcp-2cycle-517.htm (visited on 02/13/2021).

[21] ——, (Oct. 18, 2012). "5-cycle testing," [Online]. Available: https://web.archive.org/web/20121018023539/http://www.tc.gc.ca/eng/programs/environment-fcp-5cycle-530.htm (visited on 02/13/2021).

[22] NRCan. (Apr. 30, 2018). "Fuel consumption testing," [Online]. Available: https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation/2020-fuel-consumption-guide/understanding-fuel-consumption-r/fuel-consumption-testing/21008 (visited on 12/29/2020).

[23] ——, (Sep. 11, 2018). "EnerGuide label for battery-electric vehicles," [Online]. Available: https://www.nrcan.gc.ca/energy/efficiency/energy-efficiency-transportation-and-alternative-fuels/choosing-right-vehicle/tips-buying-fuel-efficient-vehicle/energuide-vehicles/energuide-label-battery-electric-vehicles/21379 (visited on 12/29/2020).

[24] A. Umanetz, "Classification of fleet micro-trips using kinetic parameters."

[25] R. O. Duda, P. E. Hart, and D. G. Stork, *Pattern Classification*, 2nd ed. New York: Wiley, 2001, ISBN: 978-0-471-05669-0.

[26] (Jul. 9, 2019). "Logistic Regression For Machine Learning and Classification," Kambria, [Online]. Available: https://kambria.io/blog/logistic-regression-for-machine-learning/ (visited on 01/01/2021).

[27] X. Zhang and C. Mi, *Vehicle Power Management: Modeling, Control and Optimization*, ser. Power Systems. London ; New York: Springer Verlag, 2011, ISBN: 978-0-85729-735-8.

[28] P G Boulter, T J Barlow, S Latham, and I S McCrae, "A reference book of driving cycles for use in the measurement of road vehicle emissions," Department for Transport, Cleaner Fuels & Vehicles 4.

[29] EPA. "Dynamometer Drive Schedules | Vehicle and Fuel Emissions Testing | US EPA," [Online]. Available: https://www.epa.gov/vehicle-and-fuel-emissions-testing/dynamometer-drive-schedules (visited on 12/07/2018).

[30] NREL. "APPENDICES–ADVISOR Documentation," [Online]. Available: http://adv-vehicle-sim.sourceforge.net/advisor_appendices.html (visited on 12/07/2018).

[31] J. Wu, C. .-H. Zhang, and N. .-X. Cui, "Fuzzy energy management strategy for a hybrid electric vehicle based on driving cycle recognition," *International Journal of Automotive Technology*, vol. 13, no. 7, pp. 1159–1167, Dec. 2012, ISSN: 1229-9138, 1976-3832. DOI: 10.1007/s12239-012-0119-z. [Online]. Available: http://link.springer.com/10.1007/s12239-012-0119-z (visited on 12/08/2018).

[32] H. Yu, F. Tseng, and R. McGee, "Driving pattern identification for EV range estimation," in *2012 IEEE International Electric Vehicle Conference*, Greenville, SC, USA: IEEE, Mar. 2012, pp. 1–7, ISBN: 978-1-4673-1561-6. DOI: 10.1109/IEVC.2012.6183207. [Online]. Available: http://ieeexplore.ieee.org/document/6183207/ (visited on 12/08/2018).

[33] M. Redelbach, E. D. Özdemir, and H. E. Friedrich, "Optimizing battery sizes of plug-in hybrid and extended range electric vehicles for different user types," *Energy Policy*, vol. 73, pp. 158–168, Oct. 2014, ISSN: 03014215. DOI: 10.1016/j.enpol.2014.05.052. [Online]. Available: https://linkinghub.elsevier.com/retrieve/pii/S030142151400367X (visited on 12/08/2018).

[34] R. Smith, S. Shahidinejad, D. Blair, and E. Bibeau, "Characterization of urban commuter driving profiles to optimize battery size in light-duty plug-in electric vehicles," *Transportation Research Part D: Transport and Environment*, vol. 16, no. 3, pp. 218–224, May 2011, ISSN: 13619209. DOI: 10.1016/j.trd.2010.09.001. [Online]. Available: https://linkinghub.elsevier.com/retrieve/pii/S1361920910001318 (visited on 12/08/2018).

[35] L. Evans, R. Herman, and T. N. Lam, "Gasoline Consumption in Urban Traffic," Feb. 1976. DOI: 10.4271/760048. [Online]. Available: http://papers.sae.org/760048/ (visited on 12/07/2018).

[36] S. H. Kamble, T. V. Mathew, and G. Sharma, "Development of real-world driving cycle: Case study of Pune, India," *Transportation Research Part D: Transport and Environment*, vol. 14, no. 2, pp. 132–140, Mar. 2009, ISSN: 13619209. DOI: 10.1016/j.trd.2008.11.008. [Online]. Available: http://linkinghub.elsevier.com/retrieve/pii/S136192090800148X (visited on 12/07/2018).

[37] R. Shankar and J. Marco, "Method for estimating the energy consumption of electric vehicles and plug-in hybrid electric vehicles under real-world driving conditions," *IET Intelligent Transport Systems*, vol. 7, no. 1, pp. 138–150, Mar. 2013, ISSN: 1751-956X, 1751-9578. DOI: 10.1049/iet-its.2012.0114. [Online]. Available: https://digital-library.theiet.org/content/journals/10.1049/iet-its.2012.0114 (visited on 12/07/2018).

[38] H. He, C. Sun, and X. Zhang, "A Method for Identification of Driving Patterns in Hybrid Electric Vehicles Based on a LVQ Neural Network," *Energies*, vol. 5, no. 9, pp. 3363–3380, Sep. 5, 2012, ISSN: 1996-1073. DOI: 10.3390/en5093363. [Online]. Available: http://www.mdpi.com/1996-1073/5/9/3363 (visited on 12/07/2018).

[39] E. Ericsson, "Independent driving pattern factors and their influence on fuel-use and exhaust emission factors," p. 21, 2001.

[40] M. Verleysen and D. François, "The Curse of Dimensionality in Data Mining and Time Series Prediction," in *Computational Intelligence and Bioinspired Systems*, vol. 3512, Berlin, Heidelberg: Springer Berlin Heidelberg, 2005, pp. 758–770, ISBN: 978-3-540-26208-4. DOI: 10.1007/11494669_93. [Online]. Available: http://link.springer.com/10.1007/11494669_93 (visited on 12/11/2018).

[41] E. Alpaydin, *Introduction to Machine Learning*, 2nd ed, ser. Adaptive Computation and Machine Learning. Cambridge, Mass: MIT Press, 2010, 537 pp., ISBN: 978-0-262-01243-0.

[42] Falk, Michael, *A First Course on Time Series Analysis*. University of Würzburg, 2012.

[43] S. L. Sclove, "Time-series segmentation: A model and a method," *Information Sciences*, Institute of Electrical and Electronics Engineers Workshop "Applied Time Series Analysis", vol. 29, no. 1, pp. 7–25, Feb. 1, 1983, ISSN: 0020-0255. DOI: 10.1016/0020-0255(83)90007-5. [Online]. Available: http://www.sciencedirect.com/science/article/pii/0020025583900075 (visited on 01/03/2021).

[44] Encyclopedia of Mathematics. "Regression analysis," [Online]. Available: http://encyclopediaofmath.org/index.php?title=%20Regression_analysis&oldid=17714 (visited on 01/03/2021).

[45] Karanveer Mohan. "Visualizing K-Means Clustering Webpage," [Online]. Available: http://stanford.edu/class/ee103/visualizations/kmeans/kmeans.html (visited on 12/18/2018).

[46] "Elbow Method — Yellowbrick v1.2 documentation," [Online]. Available: https://www.scikit-yb.org/en/latest/api/cluster/elbow.html (visited on 01/01/2021).

[47] T. Alade. (Dec. 23, 2019). "Tutorial: How to determine the optimal number of clusters for k-means clustering," Medium, [Online]. Available: https://blog.cambridgespark.com/how-to-determine-the-optimal-number-of-clusters-for-k-means-clustering-14f27070048f (visited on 01/01/2021).

[48] "KMeans — scikit-learn 0.24.0 documentation," [Online]. Available: https://scikit-learn.org/stable/modules/clustering.html (visited on 01/01/2021).

[49] A. H. Maslow, *The Psychology of Science: A Reconnaissance*. Harper & Row, 1966, 200 pp., ISBN: 978-0-8092-6130-7. Google Books: qitgAAAAMAAJ.

[50] "OBD2 Explained - A Simple Intro (2019)," [Online]. Available: https://www.csselectronics.com/screen/page/simple-intro-obd2-explained/language/en#OBD2-Intro-Dummies-Basics (visited on 01/13/2020).

[51] Texas Instruments. (2002). "Introduction to the Controller Area Network."

[52] *SAE On-Board Diagnostics for Light and Medium Duty Vehicles Standards Manual*. SAE International, 2010, ISBN: 978-0-7680-2173-8.

[53] "The Chemistry of Combustion," [Online]. Available: https://www.chem.fsu.edu/chemlab/chm1020c/Lecture%207/01.php (visited on 01/17/2020).

[54] N. Goodnight and K. VanGelder, *Automotive Engine Performance*. Jones & Bartlett Learning, Feb. 2019, ISBN: 978-1-284-10206-2. Google Books: sBmIDwAAQBAJ.

[55] E. R. Jones and R. L. Childers, *Contemporary College Physics*. Addison-Wesley Publishing Company, Jan. 1990, ISBN: 978-0-201-11951-0.

[56] "Fuels - Higher and Lower Calorific Values," [Online]. Available: https://www.engineeringtoolbox.com/fuels-higher-calorific-values-d_169.html (visited on 01/17/2020).

[57] W.-Y. Chang. (Jul. 23, 2013). "The State of Charge Estimating Methods for Battery: A Review," ISRN Applied Mathematics, [Online]. Available: https://www.hindawi.com/journals/isrn/2013/953792/ (visited on 01/04/2021).

[58] "2017 Kia Soul EV Specifications," [Online]. Available: https://www.kiamedia.com/us/en/models/soul-ev/2017/specifications (visited on 01/18/2020).

[59] "2016 Kia Soul EV Specifications," [Online]. Available: https://www.kiamedia.com/us/en/models/soul-ev/2016/specifications (visited on 02/02/2020).

[60] Mitsubishi Motor Corp. (2018). "2018-Mitsubishi-Outlander-PHEV-Brochure," [Online]. Available: https://mcarsstatic.cachefly.net/pdf/section/request-a-brochure/2018-Mitsubishi-Outlander-PHEV-Brochure.pdf (visited on 02/02/2020).

[61] "Welcome to LightGBM's documentation! — LightGBM 3.1.1.99 documentation," [Online]. Available: https://lightgbm.readthedocs.io/en/latest/ (visited on 01/18/2021).

[62] Hastie, Trevor, Tibshirani, Robert, and J. Friedman, *The Elements of Statistical Learning*. Springer, 2017.

[63] "Jamesajeeth/Data-Science," GitHub, [Online]. Available: https://github.com/jamesajeeth/Data-Science (visited on 02/19/2021).

[64] "Gradient Boosting in Python from Scratch | by Carl Dawson | Towards Data Science," [Online]. Available: https://towardsdatascience.com/gradient-boosting-in-python-from-scratch-4a3d9077367 (visited on 02/19/2021).

[65] "Parameters Tuning — LightGBM 3.1.1.99 documentation," [Online]. Available: https://lightgbm.readthedocs.io/en/latest/Parameters-Tuning.html (visited on 02/08/2021).

[66] G. Ke, Q. Meng, T. Finley, T. Wang, W. Chen, W. Ma, Q. Ye, and T.-Y. Liu, "LightGBM: A Highly Efficient Gradient Boosting Decision Tree," p. 9,

[67] "Scikit-optimize: Sequential model-based optimization in Python — scikit-optimize 0.8.1 documentation," [Online]. Available: https://scikit-optimize.github.io/stable/ (visited on 02/01/2021).

[68] fernando, *Fmfn/BayesianOptimization*, Feb. 21, 2021. [Online]. Available: https://github.com/fmfn/BayesianOptimization (visited on 02/21/2021).

[69] "Tuning Hyperparameters Under 10 Minutes (LGBM)," [Online]. Available: https://kaggle.com/somang1418/tuning-hyperparameters-under-10-minutes-lgbm (visited on 02/01/2021).

[70] NRCan. "Fuel consumption ratings search tool," [Online]. Available: https://fcr-ccc.nrcan-rncan.gc.ca/en (visited on 02/14/2021).

[71] S. Lundberg and S.-I. Lee. (Nov. 24, 2017). "A Unified Approach to Interpreting Model Predictions." arXiv: 1705.07874 [cs, stat], [Online]. Available: http://arxiv.org/abs/1705.07874 (visited on 02/21/2021).

[72] S. Mazzanti. (Apr. 26, 2020). "SHAP explained the way I wish someone explained it to me," Medium, [Online]. Available: https://towardsdatascience.com/shap-explained-the-way-i-wish-someone-explained-it-to-me-ab81cc69ef30 (visited on 02/21/2021).

[73] S. Lundberg, *Slundberg/shap*, Jan. 24, 2021. [Online]. Available: https://github.com/slundberg/shap (visited on 01/24/2021).

[74] BC Ministry of Environment, "2016 B.C. BEST PRACTICES METHODOLOGY FOR QUANTIFYING GREENHOUSE GAS EMISSIONS," 2016. DOI: 10.1007/s12273-013-0159-y.

[75] C. Atiyeh. (Dec. 4, 2019). "Everything You Need to Know about the VW Diesel-Emissions Scandal," Car and Driver, [Online]. Available: https://www.caranddriver.com/news/a15339250/everything-you-need-to-know-about-the-vw-diesel-emissions-scandal (visited on 01/02/2021).

[76] Bullfrog Power, *Canadian Emission Factors for Grid Electricity*, 2015.

[77] I. Khan, M. W. Jack, and J. Stephenson, "Use of time-varying carbon intensity estimation to evaluate GHG emission reduction opportunities in electricity sector," in *2017 IEEE Conference on Technologies for Sustainability (SusTech)*, Phoenix, AZ: IEEE, Nov. 2017, pp. 1–2, ISBN: 978-1-5386-0452-6. DOI: 10.1109/SusTech.2017.8333479. [Online]. Available: https://ieeexplore.ieee.org/document/8333479/ (visited on 02/15/2021).

[78] P. S. Maybeck, *Stochastic Models, Estimation and Control*, ser. Mathematics in Science and Engineering v. 141. New York: Academic Press, 1979, 3 pp., ISBN: 978-0-12-480701-3.

[79] Mueller, M., *Information Retrieval for Music and Motion*. Springer, 2007, ISBN: 978-3-540-74047-6. [Online]. Available: http://www.springer.com/978-3-540-74047-6.

[80] D. Li, T. F. Bissyandé, J. Klein, and Y. L. Traon, "Time Series Classification with Discrete Wavelet Transformed Data: Insights from an Empirical Study," presented at the The 28th International Conference on Software Engineering and Knowledge Engineering, Jul. 1, 2016, pp. 273–278. DOI: 10.18293/SEKE2016-067. [Online]. Available: http://ksiresearchorg.ipage.com/seke/seke16paper/seke16paper_67.pdf (visited on 12/07/2018).

[81] NRCan. "High Resolution Digital Elevation Model (HRDEM) - CanElevation Series - Open Government Portal," [Online]. Available: https://open.canada.ca/data/en/dataset/957782bf-847c-4644-a757-e383c0057995 (visited on 01/01/2021).

[82] Freematics.com. "Freematics ONE+ Model B spec sheet," [Online]. Available: https://freematics.com/pages/products/freematics-one-plus-model-b/ (visited on 01/01/2021).

[83] ——, "Freematics Packed Data Format," [Online]. Available: https://freematics.com/pages/hub/freematics-data-logging-format/ (visited on 01/01/2021).

[84] Ministry of Energy, Mines and Petroleum Resources, *Carbon Intensity Records under the Renewable and Low Carbon Fuel Requirements Regulation.*

[85] BC Hydro, "Greenhouse Gas Intensities 2007, 2011-2015," p. 1,

[86] J. I. Levene, M. K. Mann, R. M. Margolis, and A. Milbrandt, "An analysis of hydrogen production from renewable electricity sources," *Solar Energy*, vol. 81, no. 6, pp. 773–780, Jun. 2007, ISSN: 0038092X. DOI: 10.1016/j.solener.2006.10.005. [Online]. Available: https://linkinghub.elsevier.com/retrieve/pii/S0038092X06002635 (visited on 02/21/2021).

[87] A. Umanetz, "Well-to-Wheel GHG Intensity for Vehicular Hydrogen Fuel in British Columbia," University of Victoria, (Unpublished), 2018.

[88] B. James, "Current Forecourt Hydrogen Production from Natural Gas (1,500 kg per day) version 3.101," NREL, 2012.

[89] O. Schmidt, A. Gambhir, I. Staffell, A. Hawkes, J. Nelson, and S. Few, "Future cost and performance of water electrolysis: An expert elicitation study," *International Journal of Hydrogen Energy*, vol. 42, no. 52, pp. 30 470–30 492, Dec. 2017, ISSN: 03603199. DOI: 10.1016/j.ijhydene.2017.10.045. [Online]. Available: https://linkinghub.elsevier.com/retrieve/pii/S0360319917339435 (visited on 02/21/2021).

A Logger features

Table 14: CRD FleetCarma logger features

Feature	Unit	Comment
Absolute Load	[%]	
Air Conditioning Power	[W]	
Altitude	[m]	GPS
C2 Input Voltage	[V]	
Charge Latitude	[deg]	
Charge Longitude	[deg]	
Engine RPM	[RPM]	
GpsAlt	(m)	
GpsLat	(deg)	
GpsLon	(deg)	
HDOP		
HV Battery Current	[A]	
HV Battery SOC	[%]	
HV Battery Voltage	[V]	
Heater Power	[W]	
Is Charging	[bool]	
Is Driving	[bool]	
Latitude	[deg]	GPS
LoggerName		
Longitude	[deg]	GPS
MAF	[g/sec]	
NumberOfSatellites	GPS	
OAT	[degC]	
Pck		
Signal #131		Speed
Start Time	(UTC)	
Time	(UTC)	
Timestamp	(ms)	
Vehicle Speed	[km/h]	
Vin		

B Embodied energy and Fuel Intensity

This is a discussion of assumptions and sources needed to convert life-cycle analysis (LCA) figures by Elgowainy et al [16] to apply study-contemporaneous and forecasted fuel intensities for BC. Detailed column calculations are shown for 2018 in table 15 and for 2030 in table 16.

B.0.1 Vehicle assumptions

Elgowainy's (reasonable) PHEV efficiency figure was not supported; to properly apportion emissions to gasoline and BC grid electricity, Elgowainy's figure was decomposed and found to imply an operational regime of 27.1% in BEV mode for 2018, and at 28.0% BEV mode in 2030.

In order to give a fair apples-to-apples comparison, the BEV90 was given the full lifetime travel distance of 286,000 km, differing from Elgowainy's treatment, which amortized the vehicle' manufacturing emissions over a much shorter lifetime travel distance.

B.0.2 Legend for LCA tables

Legend for tables 15 and 16:

- MPGGE: miles per gallon, gasoline equivalent, taken directly from Elgowainy
- Le/100km: MPGGE directly converted to metric Gasoline-equivalent litres per 100km
- Fuel Intensity: assumptions and sources are discussed in the remainder of this section
- Tailpipe: total lifetime tailpipe emissions, at Elgowainy's assumption of a 15-year vehicle life of 286,000 km (178,000 miles)
- Vehicle: total vehicle manufacturing and decommissioning emissions
- Lifetime: sum of Tailpipe and Vehicle fields
- Amortized: Lifetime emissions, divided by lifetime travel distance.

Table 15: Calculations to apply BC intensities to 2018 vehicle LCA

		ICEV	HEV	PHEV35	FCEV	BEV90
Efficiency	(MPGGE)	26.2	36.5	53.7	54.1	100
	(Le/100km)	8.98	6.44	4.38	4.35	2.34
	(MJ/km)	3.04	2.18	1.48	1.47	0.793
Fuel Intensity	(gCO2e/MJ)	88.1	88.1	64.9	5.	2.5
Emission	(gCO2e/km)	268	192	96.3	7.37	1.98
Tailpipe	(tCO2e)	76.8	55.1	27.6	2.11	0.568
Vehicle	(tCO2e)	7.78	8.2	9.4	11.7	7.9
Lifetime	(tCO2e)	84.6	63.3	37	13.8	8.47
Amortized	(gCo2e/km)	295	221	129	48.2	29.6
Battery-mode	(fraction)	0	0	0.271	0	1

Table 16: Calculations to apply BC intensities to 2030 vehicle LCA

		ICEV	HEV	PHEV35	FCEV	BEV90
Efficiency	(MPGge)	34.5	53.5	72	72	120
	(Le/100km)	6.82	4.4	3.27	3.27	1.97
	(MJ/km)	2.31	1.49	1.11	1.11	0.667
Fuel Intensity	(gCO2e/MJ)	70.5	70.5	51.1	1.18	1.11
Emission	(gCO2e/km)	163	105	56.5	1.31	0.74
Tailpipe	(tCO2e)	46.6	30.1	16.2	0.375	0.212
Vehicle	(tCO2e)	6.9	7.1	7.6	9.5	6.4
Lifetime	(tCO2e)	53.5	37.2	23.8	9.88	6.61
Amortized	(gCo2e/km)	187	130	83.1	34.5	23.1
Battery-mode	(fraction)	0	0	0.28	0	1

- Battery-mode: Fraction of time that PHEV is assumed to be operating from grid power

B.0.3 Intensity assumptions - 2018

Gasoline: The MOE published a 2018 intensity of 88.1 g CO2e/MJ [84].

BC grid power: BC Hydro's published intensity of 2.50 g CO2e/MJ for grid power is the average of internal generation, and that purchased from independent power producers [85].

Hydrogen fuel: For the small volumes required by the current low adoption rates for FCEVs, it is reasonable to assume a carbon intensity for H2 gas of 5.0 g CO2e/MJ. This figure is based on the energy requirements for small-scale electrolysis [86] at BC Hydro's grid power intensity, and short-range transportation in high-pressure tube trailers [87].

At higher volumes, it would in the short term likely be necessary to import hydrogen

produced by steam-methane reformation, at a probable intensity of 85.3 g CO2e/MJ [88].

B.0.4 Intensity assumptions - 2030

The following forecasts were were used for 2030 fuel carbon intensities.

Gasoline: 70.51 g CO2e/MJ as required under the BC Renewable & Low Carbon Fuel Requirements Regulation [9].

BC Hydro grid electricity: 1.11 g CO2e/MJ. In the absence of any public goal or regulatory target, it seems reasonable to expect to use the intensity of BC Hydro's directly owned facilities; on the assumption that there will be pressure on external independent power producers to find low-carbon power sources, or require them to purchase offsets [85]. This will vary depending on the level of import/export trade, any changes in the associated carbon accounting practices, and the amortized emission associated with the Site C hydroelectric project.

Hydrogen fuel: Schmidt et al [89] suggest that H2 electrolysis efficiency will not improve significantly. However, the same work states that a solid-oxide electrolyser can take much of its input energy in the form of heat, and can deliver electrical efficiencies in excess of 100%. The assumed 2030 intensity of 1.18 g CO2e/MJ for H2 gas [87] is a best-case assumption, predicated on the existence of an SOEC plant with a source of zero-impact industrial heat, and fully powered by electricity at BC Hydro's internal grid power intensity.

University of Victoria

CRD Report

Earthquake Resiliency Implications of CRD EV Adoption

Mike Churchill – MASc Candidate

Table of Contents

List of Figures ii
Executive Summary iii
Introduction 1
Motivation 1
EV Adoption in the Capital Regional District (CRD) 1
Vehicle Disaster Relief Functions and Propulsion System Resiliency 1
Focus of the Report 2
Cascadia Earthquake Background 3
Past Earthquake Impacts on the Power System 4
Chile 2010 Earthquake 4
Japan 2011 Earthquake 6
New Zealand 2011 Earthquake 8
Discussion 10
Lessons Learned from Past Earthquakes 10
Vancouver Island Electrical Grid 11
Increasing the Resilience of the Electrical Grid 13
Suggestions for BC Hydro 13
Suggestions for the CRD 14
Vancouver Island Fuel Infrastructure 15
Increasing the Resilience of the Fuel Infrastructure 16
Suggestions for the CRD 16
EV Use Cases after an Earthquake 17
EV Communication Network 17
EV Donating Power with V2B 18
EV Providing Transport for Goods and People 20
Conclusions 20
References 22

List of Figures

Figure 1 - British Columbia Seismic Hazard Map [11] 2
Figure 2 - Cascadia Subduction Zone and Earthquake Sources [15] 3
Figure 3 - Network of Dependencies between Critical Infrastructures [16] 4
Figure 4 - Chilean Energy Generation Mix Before and After Earthquake [19] 5
Figure 5 – The Sendai Microgrid at Tohuku Fukushi University [27] 8
Figure 6 - Christchurch, New Zealand 2011 Earthquake Electrical Grid Damage [29] 9
Figure 7 - BC Hydro Vancouver Island Hydroelectric Systems [35] 11
Figure 8 - Tsunami Hazard [42] and PGA for Vancouver Island [43] 13
Figure 9 - 2022 Nissan Leaf Plus [54] 18
Figure 10 - Monthly Energy Production of a 100 kW Fixed Tilt Solar Array in Victoria, BC 19

Executive Summary

The adoption of electric vehicles (EVs) has many benefits, such as reduced emissions, better performance, and economic savings on maintenance and fueling. The Capital Regional District (CRD) of Victoria has one of the largest concentrations of EVs in British Columbia (BC), and this concentration is only expected to grow with time. The CRD is also located in a portion of BC with a high seismic hazard and would be profoundly affected by a Cascadia Subduction Zone (CSZ) earthquake. Until recently, maintaining vehicle use after an earthquake has depended on the resilience of the fuel infrastructure, but the increasing use of EVs will transfer some of that dependence to the resilience of the electrical system.

Analyzing past earthquakes in Chile, Japan, and New Zealand provides some insight into how to increase earthquake resilience. The 2010 Chile earthquake showed the importance of available excess generation capacity, private forms of communications, and utilizing small generators for recovery in isolated areas. The 2011 Japan earthquake illustrated the value of not locating too much generation capacity in tsunami zones, utilizing rolling blackouts for recovery, and the exceptional performance of microgrids. The 2011 New Zealand earthquake taught the danger of buried cables in liquefaction zones and how impactful spending money on resilience upgrades can be.

BC Hydro can improve the resilience of the electrical grid by adding generation capacity, relocating grid elements from tsunami and liquefaction zones, planning to have resources for repairs available, and establishing aid agreements with surrounding areas. VI can improve its fuel resilience by retrofitting ports, increasing fuel storage, and planning for how fuel will be prioritized after an earthquake.

The CRD can improve their organizational earthquake resilience by establishing a local microgrid and utilizing the battery capacity of their EV fleet to provide mobile storage following an earthquake. The CRD can also plan for what their expected vehicle and generator fuel needs would be after an earthquake and establish sufficient storage.

EVs can be used after an earthquake to establish a communication network by acting as nodes in a mobile network, and a 180 s simulation showed that a Nissan Leaf Plus would only use 0.018% of its battery capacity to provide this function for that time. In a 24 hour period, a Nissan Leaf Plus was found to able to donate 400 kWh of energy to a local shelter, assuming the vehicle had access to a fast charger and a microgrid with a 100 kW solar array. Given the Leaf's 363 km single charge range, the same microgrid was able to provide power for 8 Leafs to deliver supplies and people for a 24 hour period.

Introduction

Motivation

The adoption of electric vehicles (EVs) offers a host of benefits compared to internal combustion engine (ICE) vehicles, such as reduced greenhouse gas (GHG) emissions, better performance, and economic savings over the vehicle lifetime [1]. EVs also offer the emergent ability to transfer power from EV batteries to the grid or a building which allows better integration of renewable energy, controlled charging, and the ability to use EVs as mobile energy storage [1] [2].

EVs have seen rapid growth during the last decade, and, even during the pandemic, worldwide EV registrations increased by 41% in 2020 [3]. The resilience of EV sales to the pandemic can be attributed to many countries strengthening emissions standards and ZEV sales mandates, along with the expanding number of available EVs and falling battery costs [3]. By 2040, EVs could represent 12 – 28% of the global fleet, depending on factors such as battery cost reduction and the amount of government subsidies [4].

EV Adoption in the Capital Regional District (CRD)

The British Columbia Hydro and Power Authority (BC Hydro) is the main electricity distributor in the province of BC and generates 43,000 GWh of electricity annually to supply more than 1.9 million residential, commercial, and industrial customers [5]. Close to 95% of BC's electricity comes from renewable sources (hydro, wind, biomass), and about 90% of the province's installed generating capacity is renewable energy [6]. This means that operating and charging an EV in BC has very little associated GHG emissions, and EV fleet adoption has huge potential to reduce GHG emissions for organizations such as the CRD.

Compared to other provinces, BC has been ahead of the curve for EV adoption, and 2020 saw BC with the highest uptake of zero emissions vehicles (ZEVs) in North America, with ZEV sales averaging 9.4% of new vehicle sales for the year [7]. The greatest adoption of EVs in BC continues to be in major urban centers where public charging is more readily available. In particular, the largest concentrations of EVs in BC can be found in the Metro Vancouver area and the Capital Regional District (CRD) on Vancouver Island [8]. With the passing of the Zero Emissions Vehicles Act, mandating 100% of light-duty vehicle sales to be ZEVs by 2040, adoption of ZEVs is almost certain to continue increasing in these regions.

Vehicle Disaster Relief Functions and Propulsion System Resiliency

Vehicles play crucial roles during the early stages of disaster recovery. In the hours or days following a disaster, vehicles are needed for search and rescue efforts and provide assistance by transporting people in medical need, along with critical supplies, such as food, water, and medicine. In medium to long term recovery, vehicles resume their pre-disaster functions as permanent physical and social structures begin to be restored [9].

Until recently, maintaining vehicle propulsion after a disaster relied on the resilience of the fuel infrastructure, and vehicles would only be able to provide disaster relief for as long as fuel supplies lasted.

Natural disasters can impact the fuel infrastructure in a multitude of ways. Loss of power can lead to refineries being unable to operate and pumping stations not able to move oil and gas through pipelines. Pipelines themselves can be damaged by high winds, flooding, and earthquake induced stresses. Additionally, natural disasters can impact fuel supply by blocking or destroying transportation networks such as roadways, bridges, and ports [10].

While the fuel infrastructure will remain critical for the foreseeable future, increased adoption of EVs will mean that maintaining vehicle propulsion after a disaster will start to depend more heavily on the resilience of the electrical system.

Focus of the Report

As shown in figure 1, the CRD coincides with the portion of BC that has a high level of seismic hazard and would be most affected by a great Cascadia Subduction Zone (CSZ) earthquake. As this type of earthquake is considered a worst-case natural disaster for the region, it will be the focus of this report. To study the impacts of this scale of earthquake on the power system, past earthquakes in Chile, Japan, and New Zealand will be examined. Lessons from these earthquakes will be compiled and applied to how the CRD can increase earthquake resiliency and maintain the use of EVs in the disaster aftermath. These suggestions will be compared with how fuel resiliency might be improved in the region.

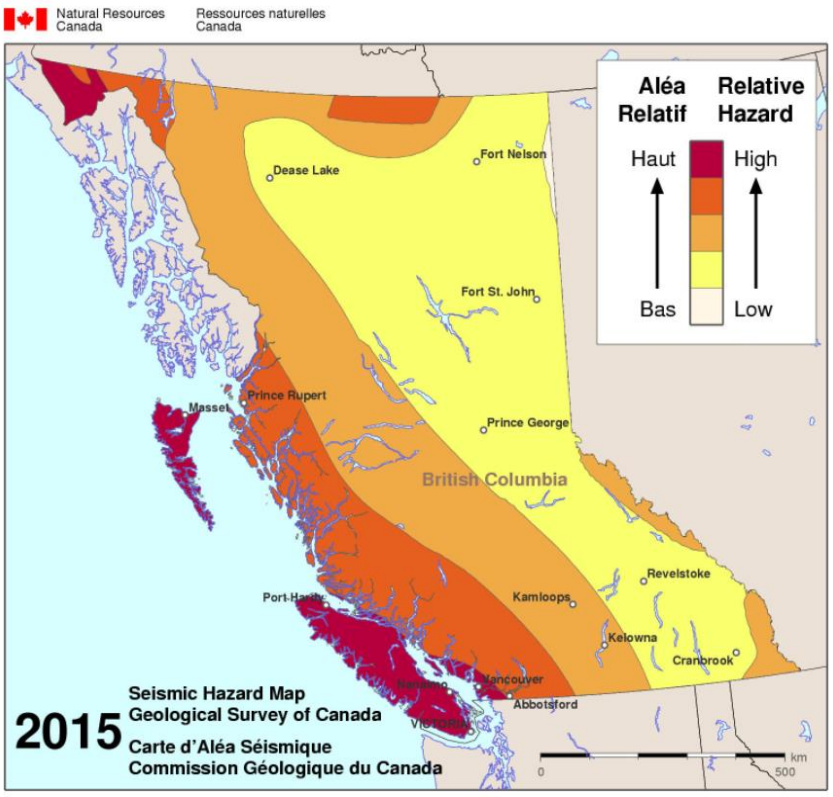


Figure 1 - British Columbia Seismic Hazard Map [11]

Cascadia Earthquake Background

The CSZ is a region extending from northern California to central Vancouver Island (VI), where the Juan De Fuca, Explorer, and Gorda plates are driven beneath the North American plate in a subduction process [12]. Shown in figure 2, VI is located where the eastward moving Juan De Fuca plate is sliding beneath the western portion of the North American plate. The subduction zone is locked and slowly accumulating strain. When the strain is released, a massive "megathrust" earthquake is produced. This type of great subduction zone earthquake is the largest in the world and the only type capable of earthquake magnitudes in excess of 8.5 M [13]. Geologic evidence from buried soils, tsunami deposits, and liquefaction features have provided the understanding that many great earthquakes have occurred in this region over the last several thousand years, with the most recent being a 9.5 M earthquake in 1700 AD [14]. Estimates of the probability of another earthquake of this magnitude occurring over the next 50 years range from 7-15% for an earthquake that affects the entire Pacific Northwest to about 37% for an earthquake that affects southern Oregon and northern California [12] [13].

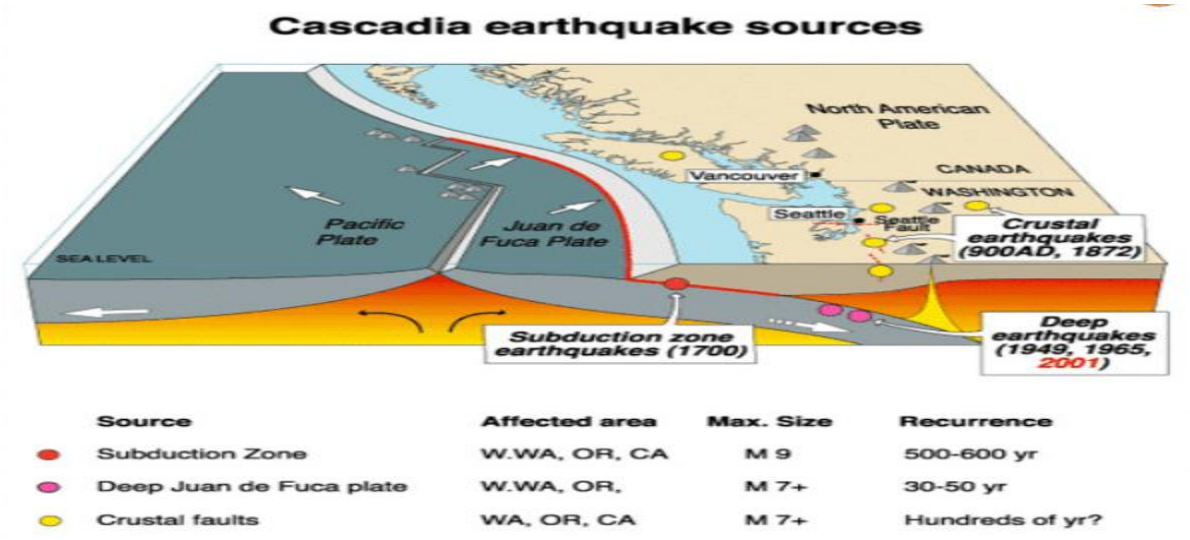


Figure 2 - Cascadia Subduction Zone and Earthquake Sources [15]

Earthquakes mainly cause damage through ground shaking and secondary effects, such as liquefaction, landslides, and tsunamis. Liquefaction is a phenomenon where an earthquake increases pore-water pressure in sediment and reduces grain-to-grain contact forces. The sediment then loses strength and behaves as a fluid [14]. Large earthquakes can also cause damage through aftershocks which can bring down already weakened structures. Following the 2010 earthquake in Chile, 19 aftershocks larger than 6.0 M were experienced in the first month [12].

The economic impacts of a Cascadia earthquake would be staggering, with losses estimated at upwards of $70 billion USD for Washington, Oregon, and California [12]. Much of the infrastructure in the region was constructed before it was understood that this area could experience subduction zone earthquakes. Roads and bridges are likely to see damage from shaking and landslides. Coastal ports could see damage from tsunami, severe currents, and liquefaction. Underwater landslides and debris could lead to the closure of shipping channels. Water systems could take from weeks to months to restore functionality

and could take several years for complete restoration. Power outages could only be a matter of days in inland areas but could range from weeks to months in coastal regions. Communication networks may see damage or be overwhelmed in the immediate aftermath [12]. Many critical infrastructure systems are also interdependent. Damaged transport routes may impair crews from repairing downed power lines, and extended blackouts can lead to the failure of communication systems, water treatment plants, and hospitals [16]. Figure 3 shows an example of the possible connections between critical infrastructures.

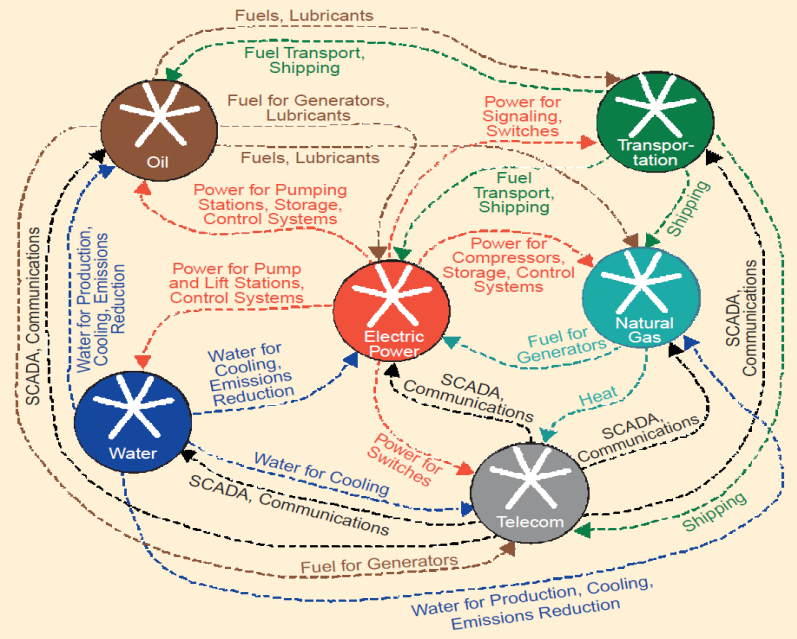


Figure 3 - Network of Dependencies between Critical Infrastructures [16]

Past Earthquake Impacts on the Power System

Chile 2010 Earthquake

On Saturday, February 27th, 2010, an 8.8 M earthquake struck the central region of Chile, affecting over 8 million people [17]. 521 people were killed, and the economic impact was valued at $30 billion US dollars [18]. The epicenter of the quake was located where the Nazca plate subducts beneath the South American plate. It resulted in a rupture 500 km long by 100 km wide and produced a tsunami that damaged 500 km of coastline. Highways, railroads, ports, and airports all saw damage due to ground shaking and liquefaction [17]. The earthquake caused a blackout that affected 4.5 million people and took days in some areas, and weeks in others, to recover the full supply [18].

The Chilean Central Interconnected System (SIC) provides power to over 93% of the population. Following the earthquake, a blackout took place for a load of 4522 MW. 693 MW of the existing generation plants were affected and removed from service for repairs, while 950 MW of plants that were still being built were put on hold to conduct assessment [19]. In previous years, Chile had seen growing investment in power plants, so the missing plants did risk the general supply of energy [18].

Generation equipment is generally built to high standards which contributed to its good performance during the quake. Figure 4 illustrates the impact the earthquake had on the various sources of energy generation.

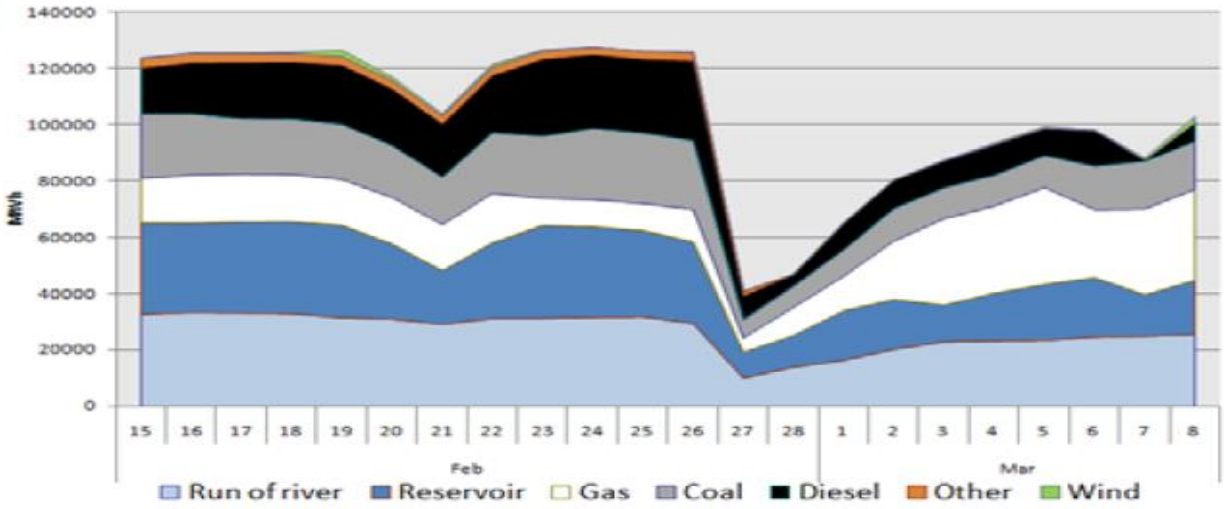


Figure 4 - Chilean Energy Generation Mix Before and After Earthquake [19]

Chile's transmission network has limited route dispersion and redundancy since it follows the long and narrow layout of the country [17]. The electrical grid in Chile is designed using the N-1 security criteria which allows system operation to continue normally in front of any line circuit or generation outage, without cascading failure. After the earthquake, the central part of the country was separated from the south and a two-island scheme was used for operation [19]. The transmission network was able to provide power within 24 hours and the islands were connected within two days. The fast recovery of the transmission service was attributed to quality infrastructure construction and the fast and competent response of the repair staff.

While restoring supply at the generation and transmission levels was quick, restoring the supply to the end consumer was a longer process. Several parts of the distribution network were severely damaged, and there were coastal regions where the distribution network was completely destroyed by falling houses or washed away by the tsunami [19]. The 220 kV system had been designed to appropriate seismic standards and performed well. In coastal regions, the lower voltage subtransmission system suffered sporadic damage from high levels of shaking. After two weeks, distribution system service was brought back online [17].

Commercial power outages and loss of reserve power in distributed network facilities lead to telecommunication being overwhelmed [17]. Problems with the communication network lead to difficulty assessing the damage and safety of the distribution network and reporting points of failure between low level voltages lines and buildings [17] [19]. Private communication systems remained functional as they used repeaters that fed through still operational low voltages lines, batteries, and photovoltaic (PV) panels. While these networks collapsed when the batteries had lost their capacity, they still offered enough use to facilitate the initial energy restoration activities [18].

The distribution companies did not have the resources available for the huge number of repairs and relied heavily on imported human and technical resources from other parts of the country and subsidiaries in neighbouring countries [18]. Since distribution equipment generally failed due to collapsing walls, landslides, and tsunamis, and not due to design, it didn't seem necessary for Chile to increase future design specifications. Rather, investigators in the incident have encouraged Chile to use a decentralized, local focus on distribution dispatch, during system recovery, to improve operation reaction speed and adapt to local realities [18]. Mobile generators in the 100 to 250 kW range were found to be most effective in supporting recovery in isolated areas and tsunami affected towns. Units in the 1 to 10 kW range were helpful in supplying electricity to critical loads such as hospitals, firehalls, gas stations, and communication antennas. Unfortunately, fuel supplies were extremely limited due to the behaviour of the population, damaged roads, and fallen bridges. Emergency trucks were still able to be refueled by using the army's strategic fuel reserves [18].

Japan 2011 Earthquake

On March 11th, 2011, a large earthquake occurred off the coast of Tohoku, Japan. The earthquake was 9.0 M, caused intense shaking for 120 – 190 s, and triggered a tsunami that reached heights of 9.3 m along the coastline of the Fukushima prefecture [20]. The earthquake resulted 15,984 confirmed deaths, with more than 2,000 people unaccounted for, and caused an estimated $15 billion (US) worth of damage [21]. Most of the earthquake damage was in the Tohuku region, served by the Tohuko Electric Power Company (ToPo), and the northern part of the Kanto region, served by the Tokyo Electric Power Company (TEPCO). The earthquake interrupted electricity for 8.7 million customers [20]. After two days, 1.5 million were still without power, and after three days, 300,000 remained without electricity [21].

14,000 MW of generation plants were impacted, mainly by the tsunami and some shaking damage [22]. Significant damage was caused to thermal power stations. Three thermal stations (generation capacity of 3.4 GW) were flooded by the tsunami and required one to two years to fully recover [20]. Renewable energy generation capacity generally performed well. No major damaged was reported on wind farms, and PV capacity outside of the affected region was undamaged but was unavailable due to grid-tied inverters that disconnected during the outage. There was some landslide damage to penstocks and headraces at small hydroelectric power facilities [22].

In February 2011, nuclear power supplied roughly 31% of Japan's electricity. It was considered to be the country's baseload energy and represented 40% of TEPCO's output [23]. The greatest damage inflicted by the earthquake took place at the Fukushima Daiichi Nuclear Power Station. The plant had a total generation capacity of 4.7 GW and consisted of six reactors, three of which were in operation when the earthquake struck [20]. The earthquake caused the loss of the plant's external power supply, and, while the emergency generators started successfully, they were located underground and were flooded by the tsunami [24]. The loss of power lead to core melt in reactors 1, 2, and 3, releasing a massive amount of

radioactive material. Within a few days, hydrogen had leaked from the reactor pressure vessels into the building and caused the explosion of reactors 1, 3, and 4 [24].

High voltage transmission lines saw damage from shaking and floating debris and high voltage substations were damaged by shaking [22]. For more than two decades before the disaster, Japanese power utilities had been installing high voltage substations that met seismic qualification guidelines. Quite a number of components at these substations still failed which was likely caused by older, non-qualified equipment encountering higher than assumed ground motions [22].

The tsunami caused some damage to medium voltage substations (66 kV) and extreme damage to the low voltage distribution system [22]. It was noted that an important substation in Hachinohe City stayed intact due to being elevated above tsunami height [20]. Some inland substations suffered short circuits and ground faults from seismic damage. Substations also saw damage to circuit breakers and disconnectors, as well as oil leaking from transformer bushings [20].

Following the earthquake, TEPCO's electrical capacity decreased from 52 million kW to 31 million kW [23]. To combat the power shortage, each electric power company took measures to restore their older fossil fuel-based generation facilities. This lead to thermal power accounting for 90% of ToPo and TEPCO's generating capacity [25]. The disaster also caused the operation of many nuclear power plants to be postponed, dropping nuclear plant operation to 15% by the end of 2011 [25]. To continue meeting customer demand after the earthquake, TEPCO implemented rolling blackouts, allowing groups of two to three million customers to receive power for a three-hour window every 24 hours. TEPCO and ToPo both targeted reductions in customer power use by 15% and achieved this by having large factories shift operation to off-peak hours and installing onsite generation, the commercial sector reducing the use of lighting and air conditioning, and households reducing consumption through any means possible [20].

Japan uses mainly above ground low voltage lines and relatively few buried high voltage or distribution power lines. This design style helped to minimize liquefaction damage to buried power lines [22]. Mobile transformers were an effective measure to quickly restore power to small substations that were damaged [22]. A study by the American Society of Civil Engineers (ASCE) noted that distributed generation resources could reduce the risk associated with extensive power outages after a disaster [21]. The earthquake also showcased the role electric vehicles could play in disasters when 65 Nissan Leafs were made available to local authorities in Sendai to deliver goods and medical supplies while the fuel infrastructure continued to be unavailable [26].

Analysis of the earthquake brought attention to the exceptional performance of microgrids in the aftermath. The Sendai microgrid at the Tohoku Fukushi University in Sendai, shown in figure 5, was developed by NTT Facilities and consists of several distributed energy resources (DERs). Under normal conditions, the microgrid is connected to the ToPo grid and can be disconnected in times of power outage. While the gas engines initially stopped function due to abnormal voltage detection, the PV and battery storage systems remained able to supply critical loads during the outage. The following day, the gas engines were able to be restarted and provided power to important loads until full service was returned [20].



A: Photovoltaic Panels 50 kWp
B: Gas Engine Gen-Set
350 kW X2
C: Molten Carbonate Fuel Cells
250 kW
D: Dynamic Voltage Restorer 1
600 kVA
E: Dynamic Voltage Restorer 2
200 kVA
F: Building 1
Integrated Power Supply
G: Building 2
Back-to-Back
Voltage-Source Converters
(For Test Equipment)

Figure 5 – The Sendai Microgrid at Tohuku Fukushi University [27]

New Zealand 2011 Earthquake

On September 4th, 2010, a 7.1 M earthquake occurred near the Canterbury region of New Zealand. Due to its distance from urban areas, the earthquake only injured approximately 100 people and caused no fatalities. This earthquake initiated an aftershock sequence which lead to a 6.3 M earthquake beneath Christchurch, New Zealand on February 22nd, 2011 [28]. This earthquake was substantially more damaging due to extreme ground shaking, with recorded accelerations of up to 2.2 g, and resulted in 185 fatalities and 7,171 people injured [28]. Although, it was relatively small in magnitude, the position of the epicentre, depth, acceleration experienced, and ground conditions combined to create an extremely devastating event [29]. The repair cost of the earthquake sequence was estimated at around $28 billion US dollars [28].

The earthquake caused significant changes to the environment through liquefaction, lateral spreading near waterways, land level changes, and landslides. Liquefaction caused large amounts of damage to the built environment of Christchurch, with much of the damage experienced by unreinforced masonry buildings [28]. The initial effects on the power grid were primarily due to liquefaction, even though strong ground shaking was observed. Although landslides and rockfalls occurred, they were primarily in regions without dense power infrastructure deployment [30]. It took 10 days to get 90% of the power back on [29]. As electric power is generated south of Christchurch, and was not in the area affected by the Canterbury earthquake sequence, the earthquakes had no impact on power generation [30].

The electric power system in Christchurch is served by Transpower and Orion which operate the country-wide transmission system and local distribution system, respectively [31]. The impacts of both Canterbury earthquakes on the transmission grid were negligible. The Christchurch earthquake caused power to the Christchurch City feeders and substations to be unavailable for 4.5 hours to facilitate safety checks and minor repairs. Following the safety checks, the supply at the grid exit points was restored to full capacity and n-1 security, excluding the Bromley substation which had supply restored to an n security level [31]. The minimal damage to the transmission grid can be credited to the

implementation of lessons learned after the 1987 Edgecrumbe earthquake which demonstrated the need to seismically restrain heavier equipment on substations [31]. Transpower's equipment for 220 kV lines were also well installed to IEEE 693 (high zone) standards and were well anchored [30]. Figure 6 illustrates damage from the Christchurch earthquake at various levels of the electrical grid.

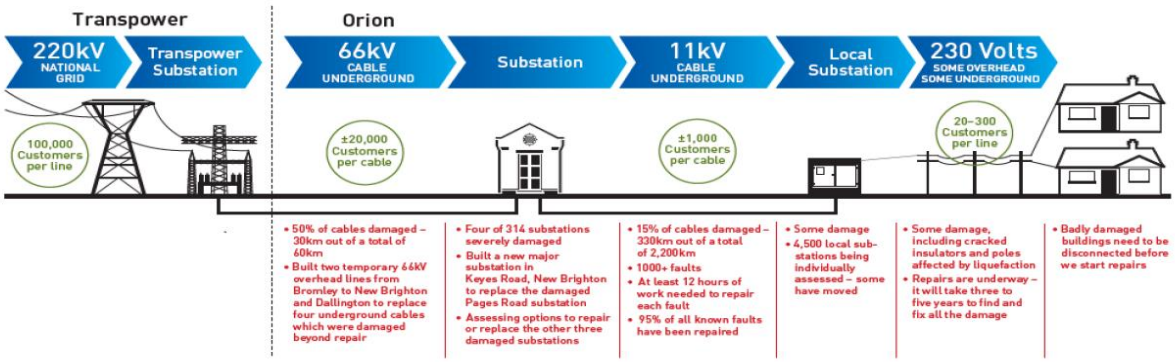


Figure 6 - Christchurch, New Zealand 2011 Earthquake Electrical Grid Damage [29]

While most of Transpower's power lines are overhead, Orion's lines are mostly buried underground. The difference in performance between the transmission and distribution networks can be attributed to buried infrastructure being more vulnerable to the effects of liquefaction [30]. 4 of 314 substations were severely damaged: one due to liquefaction, one from shaking, one from a boulder, and one from its infill wall failing [29]. The lack of damage to the above ground distribution network was credited to work Orion had performed in the previous decade, such as the reinforcement of unreinforced masonry substation buildings [30]. Orion was able to restore power to 50% of households on the day of the event, 75% after two days, 90% within ten days, and 98% after two weeks [31].

Earthquake liquefaction lead to damage of 50% of the 66 kV and 10% of the 11 kV buried cables which lead to widespread power outage [32]. In the 66 kV lines, the cables that were damaged beyond repair were oil-filled. Oil-filled cables in the run from Bromley GXP to the New Brighton and Dallington substations were deemed unrepairable and replaced by temporary 66 kV overhead lines [29]. A total of more than 1,000 faults were identified in the 11 kV cables and occurred in either aluminum or copper core cables [31]. 66 and 11 kV cable failures generally occurred in places that experienced substantial permanent ground displacement (5 cm to 50 cm) [30]. A large amount of the damage occurred in the PILCA (paper-insulated, lead-covered, armoured) 11 kV cables due to existing joints pulling apart.

The successful performance of the New Zealand electrical infrastructure came from a combination of risk planning for likely earthquake events, seismic strengthening of the substations, improvement to key bridge approaches, and improvements in design standards [29]. After the mid-1990s, Orion contributed over $6 million to seismic protection work and a further $35 million to build resilience into their network. It is likely that Orion's $70 million earthquake repair costs would have more than doubled without this work [31]. Following the earthquake, a long-term recommendation was made for Orion and other power utilities to re-assess the seismic weakness of buried power cables. Use of these cables

could be mitigated by using overhead transmission and distribution lines through liquefaction zones [30].

Discussion

Lessons Learned from Past Earthquakes

- Available excess generation capacity enables quick recovery
- Electrical grid design with n-1 criteria prevents cascading failure
- The ability to island different portions of the electrical grid increases resilience
- Have available resources to perform grid repairs and plan for aid agreements with surrounding areas
- Where possible, move distribution equipment away from seismically vulnerable buildings, landslide areas, and coastal regions in tsunami zones
- Reinforce unreinforced masonry buildings that contain, or could collapse on, grid components
- If transformers cannot be moved out of tsunami inundation areas, they can be elevated to above flooding height
- Mobile generators and transformers are effective for restoring power
- Telecommunication systems are crucial after an earthquake but can be overwhelmed or unavailable due to lack of power, better to use private forms of communication
- Fuel supply is often scarce following an earthquake
- All three countries had improved grid seismic resilience before the event and were able to restore power to the vast majority of consumers within a week or two
- Utilizing above ground components can prevent liquefaction damage, if buried components must be used, locate them out of liquefaction zones where possible
- There is risk involved in locating generation capacity in tsunami zones or locating too much generation capacity in a single location that could sustain damage – opt instead for a distributed layout
- Rolling blackouts paired with customers reducing demand can be an effective recovery tool if available generation capacity will not meet demand
- Microgrids can remain functional during grid outages and allow power to still be supplied to critical loads
- Electric vehicles can provide mobile energy storage in the aftermath of an earthquake
- Seismic strengthening of existing substations is effective at improving resilience
- Building resilience is less costly than repairing or replacing damaged components after an earthquake

Vancouver Island Electrical Grid

Vancouver Island (VI) is located in the northeastern Pacific Ocean and is part of the Canadian province of British Columbia (BC). The island trends northwest-southeast and is located about 50 km off the southwest coast of mainland BC. VI is separated from the Lower Mainland by the Salish Sea, extends 460 km from northwest to southeast, and is up to 80 km in width [33]. In 2016, VI was home to a population of close to 800,000, with about half of that number living in the metropolitan area of Greater Victoria [34]. Located where the Juan De Fuca plate is subducting beneath the western portion of the North American plate, VI's tectonic environment predisposes the region to earthquakes of the shallow crustal, deeper sub-crustal, and great inter-plate (subduction zone) variety [33].

On VI, BC Hydro runs four hydroelectric systems, with six generating stations and a total capacity of 471 MW. These facilities are supported by transmission infrastructure and additional facilities on the mainland and represent 4% of BC Hydro's total capacity [35]. Figure 7 shows the different hydroelectric systems on VI.



Figure 7 - BC Hydro Vancouver Island Hydroelectric Systems [35]

BC Hydro's generating facilities are only able to meet about 20% of VI's total demand, with about 80% the electricity coming from the mainland through underwater cables [36]. The bulk of VI's power is provided by BC Hydro from the Peace River hydroelectric system through the Kelly Lake substation and from the Columbia River system through the Nicola substation [37]. VI is also home to several independent power producers (IPPs). These include biogas facilities, a wind farm in Cape Scott, run of river hydro projects, a natural gas generation station, and the T'Souke First Nation solar energy project [37].

VI's power grid is connected to the mainland by AC and DC submarine and overhead cables. Two parallel HVAC 525 kV circuits connect the south of Powell River to VI in two submarine and three overhead sections, with a reactor station on Texada Island. There is one 138 kV and one 230 kV AC line that

connect Delta to North Cowichan in two submarine and three overhead sections. There are also two HVDC links from Delta to North Cowichan that are considered obsolete and unreliable [38].

Conversations between UVIC and BC Hydro have provided some insight into what damage a Cascadia earthquake event could cause to the VI electrical grid.

BC Hydro expects that damage from a CSZ event could be severe for both the power and natural gas infrastructure (BC Hydro uses a 275 MW natural gas plant in Campbell River which may not renew its electricity production contract in 2022 [39]). Damage to the northern or southern lines connecting with the mainland would lead to outages on the island, and the extent of damage would determine the outage length. The length of the outage could extend anywhere from days to months, depending on the severity of the earthquake. BC Hydro's modelling of CSZ events generally lead to estimates of weeks to months without power and partial restoration following that. After the event, the timeline could extend to years to get back to full functionality. All of the generation plants on the island can run disconnected from the mainland but would not be able to serve the full load. A partial load would be created by temporarily cutting service to industrial customers and by utilizing rolling blackouts (blackout could range from 1 hour on/off to 12 hours or more). It is also likely that load will be reduced due to damage in the distribution system that would lower demand. It was noted that seismic design is not used on system elements past the substations since those portions are commodity designed.

The Peace River and Columbia River hydroelectric systems are located far enough away from the CSZ that they would sustain no damage from the earthquake. It is also likely that the 500 kV transmission system connecting those dams to the Lower Mainland would remain unscathed. BC Hydro is in the process of upgrading dams and water passage systems on VI to align with the necessary seismic standards. If there were to be a major earthquake (over 1 in 1000-year event) before the upgrades are completed, the dams would be at risk of failure. The John Hart dam provides 50% of power generation on the island and has received seismic upgrading. Two upstream upgrades for the John Hart are to be completed by the 2030s, along with a power tunnel replacing the aging penstocks. As it stands, power generation from BC Hydro's VI facilities would not be dependable following a CSZ event.

While the CRD is the most population dense region of VI, it has relatively little nearby generation capacity. The Jordan River Dam is close to Victoria but has the highest seismic hazard of any of VI's dams and is likely to fail in a CSZ event. BC Hydro has also acknowledged that seismically upgrading the dam is not feasible [40]. The Hartland Landfill Project is located within the CRD and generates energy from methane from decomposing waste but would only be capable of producing a fraction of the energy required by the area. Of the nearby AC line connections to Delta, the 138 kV line has the highest risk of failure, and, as of 2021, is not BC Hydro's ten-year plan for replacement. The 230 kV line (installed in 2010/2011) is engineered for a 1 in 2475 earthquake event and would likely weather a CSZ event quite well. There is concern for how much of a power bottleneck would form if the 138 kV line went down and only the 230 kV line was available to bring power to the area. The oil-filled northern crossing lines (found to be bulging and leaking oil in a June 2021 heatwave which resulted in it being temporarily removed from service [41]) from Powell River are only engineered for a 1 in 475 event and are at risk from earthquake damage to their pumping stations. If these lines went down, it is possible that power

would have to be directed from the Victoria area to the central and northern reaches of VI. That said, the central and northern regions of VI are closer to the upgraded dam systems and may be able to rely on power from there. There are also elements of the CRD area electrical grid that are located in regions of intermediate tsunami run-up potential of 1-5 m and strong to very strong peak ground accelerations of 0.1 to 0.3 g, shown in figure 8, which could result in substantial damage.

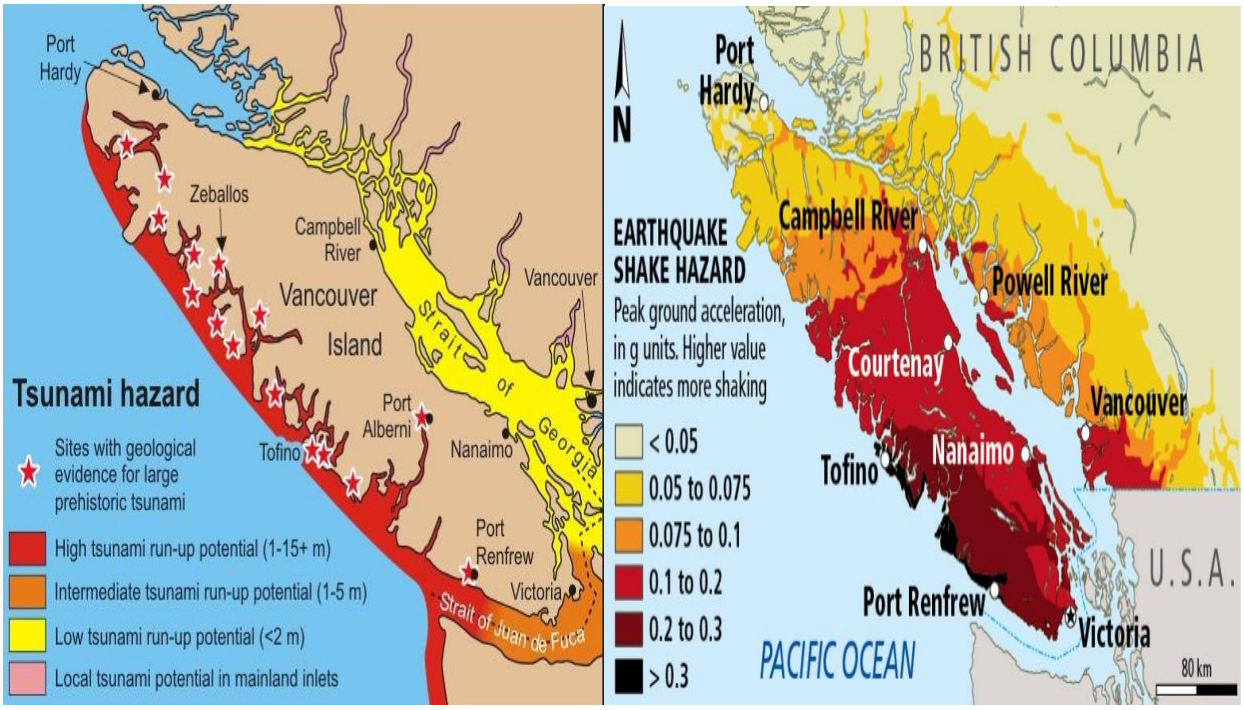


Figure 8 - Tsunami Hazard [42] and PGA for Vancouver Island [43]

Increasing the Resilience of the Electrical Grid

This section will cover actions that can be taken by BC Hydro and the CRD to increase grid resilience and maintain the use of EVs following an earthquake. As it stands, a CSZ event could cause a power outage lasting multiple months on VI. The past earthquakes in Chile, Japan, and New Zealand all had power returned to greater than 90% of customers within two weeks. The actions suggested to BC Hydro are made with the intent of hopefully reducing the outage time from months to weeks. The suggested actions for the CRD are intended to keep their organization able to power their vehicle fleet during an outage and provide power for critical loads.

Suggestions for BC Hydro

More generation capacity should be added to VI which would allow faster recovery in the aftermath of an earthquake. This new generation capacity should be added in a distributed layout, ideally close to the

end user, and located outside of tsunami zones. As mentioned above, the CRD contains close to half the population of VI but has little nearby power generation. Adding new generation capacity to the region will mean that it is constructed to modern seismic standards and will able to help meet the increasing electrical load expected from the growing uptake of EVs. If BC Hydro does not want to add more generation to the region, the Province could look at ways to encourage IPPs to create power generation projects in the area.

BC Hydro should ensure that the grid on VI is designed with n-1 criteria and has the ability to island different portions. Where possible, vulnerable system elements should be moved away from seismically unfit buildings (unreinforced masonry buildings, common in Victoria, are a particular concern) and landslide areas. As much of VI has areas of tsunami run up potential ranging from 1 to 15+ meters, grid elements in these areas should be relocated, if possible, or raised to above flooding height. Liquefactions maps can be used to determine where buried system elements cross liquefaction zones and whether they can be relocated above ground. BC Hydro could also focus on seismically reinforcing substations and unreinforced masonry buildings that could damage electrical equipment.

BC Hydro can increase earthquake resiliency by planning for the event. They can plan to have resources available to perform grid repairs and establish agreements with surrounding areas to provide aid following an earthquake. VI should have an available supply of mobile generators and transformers on hand to aid recovery in more remote areas. BC Hydro could also plan for how rolling blackouts can be utilized as power is slowly brought back online and how customers can be compelled to reduce power use if available generation cannot meet demand.

Suggestions for the CRD

Since public communication networks can be brought down due to power outages or from being overwhelmed following an earthquake, the CRD could consider establishing private forms of communication to be able to coordinate their organization in the aftermath of a disaster. Further in this report, an example is provided of a private communication network that could be established with the use of EVs.

The CRD could establish a microgrid to assure that power can still be supplied to charge EVs and power critical loads after an earthquake. The purpose of a microgrid is to generate energy close to the end user. This is different from a more centralized grid, such as operated by BC Hydro, where power is transported long distances from where it is generated to arrive at the end user. Microgrids can be connected to the central grid or operate independently which allows them to continue to provide for customers during a power outage. Microgrids are generally constructed with battery storage and some arrangement of distributed energy resources (solar, wind, combined heat and power, natural gas, fuel cells etc). Currently, BCIT operates a campus microgrid that utilizes wind, solar, and thermal co-gen, along with battery storage, smart grid control systems, and EV charging stations, among other features [44]. In the “EV Use Cases” portion of this report, we’ll look at a Victoria based microgrid that uses a solar array to provide energy for EVs in a post-earthquake scenario.

In net metering programs, a customer who generates electricity is billed for the difference between their electricity use and the electricity that they have provided to the grid. BC Hydro's current policy is to temporarily disconnect net metering customers after a disaster, since they are considered a danger until BC Hydro can conduct site visits. This means that a microgrid that has been established as a net metering customer would not be able to be used after a disaster. To work around this, microgrids can be established "behind the meter", meaning that the power that is generated can be used on site but does not pass through a meter to the larger grid. An organization like the CRD could build a behind-the-meter microgrid that would help to reduce their need for power from BC Hydro under normal circumstances and would allow for EV charging during a disaster. Ideally, a microgrid would allow the CRD to continue charging EVs for an outage lasting a couple of weeks. In the case of an outage lasting multiple months, a microgrid would need substantial attached generation capacity (diesel generators, natural gas turbines etc) to remain a viable source of energy for that entire time period.

Finally, the CRD could utilize the EVs in their fleet as a form of mobile energy storage. Through Vehicle-to-Building (V2B) technology, the CRD can use the battery capacity of their EVs to provide power for important loads. This will be looked at further in the subsequent "EV Use Cases" section.

Vancouver Island Fuel Infrastructure

The information in this section comes from a 2016 University of British Columbia thesis by Allanah Brown that illustrated the fuel transportation system in coastal British Columbia [45].

BC receives crude and refined oil from Alberta, eastern Canada, and Washington State. Fuel arrives in the Lower Mainland by the Trans-Mountain Pipeline (TMPL), marine tankers, rail, and truck. These modes of transport bring fuel to several large storage and distribution facilities in the region. Almost all fuel imports arrive refined, but some crude oil is refined locally at Chevron's Burnaby refinery. A third of BC's transportation fuel is produced at Chevron Burnaby which receives the majority of its crude oil by pipeline, with supplemental deliveries by rail and truck. More than 50% of Vancouver's fuel demand comes via the TMPL and almost 30% of the TMPL's daily oil arrivals are transported from the Westridge Terminal to California, the Gulf Coast, and China. Supplementary fuel supply for the region is imported from Washington State refineries. Marine fuel transport arrives in the Port Metro Vancouver or one of the four petroleum terminals within it. Transportation from distribution centers to end-users is done through trucks, pipelines, storage tanks, and barges. The airport receives its fuel via a 41 km jet fuel pipeline that connects the airport to Chevron Burnaby and the Westridge Marine Terminal.

The majority of fuel that arrives on VI is delivered via the TMPL to the Lower Mainland and then by marine transport to VI. Fuel is transported from the Lower Mainland by barge or marine vessel across the Strait of Georgia to various ports along the East coast of VI. Some ports receive fuel every other week, while others see deliveries as frequently as 2 to 3 times per week. VI has tank farms near Nanaimo, Cobble Hill, and Chemainus which receive fuel through pipelines from nearby marine terminals. After arriving at a port, fuel can be pumped directly into storage where trucks collect and deliver fuel to depots and end-users. Fuel can also be transported in the "roll-on roll-off" fashion, where trucks drop their load on to a departing marine vessel and the load is picked up by another truck after

the vessel docks. Additionally, some of the fuel transport on VI is done via rail. The region also receives supplementary fuel from Washington State.

Increasing the Resilience of the Fuel Infrastructure

It bears mention that, as VI gets much of its fuel from the Lower Mainland, VI is directly dependent on how resilient the Lower Mainland fuel infrastructure is.

The Lower Mainland should ensure that the sections of the TMPL that run through potential earthquake damaged areas are built to current seismic standards or are retrofit. TMPL pumping stations should have back up power available to deal with the likely power outage that will follow an earthquake. A study should be conducted to look at locations that receive fuel in the Lower Mainland and how seismically vulnerable they are. Ports in liquefaction areas can improve resiliency through retrofitting or by hardening liquefaction prone soils. The region could also develop an alternate location for a fuel delivery hub that is outside of liquefaction zones [46]. As it is a crucial facility for the region, it should be ensured that the Chevron Burnaby location is seismically robust. Planning should be done with respect to how fuel will be prioritized following an earthquake. There may be temporary measures after an earthquake to stop fuel deliveries to other parts of the world and possibly Vancouver Airport, assuming flights are grounded.

Since VI depends so heavily on ports to receive fuel, it should be a top priority for the region to study how the current port structures are likely to weather an earthquake event. Other than retrofitting existing ports, VI could add additional port locations or capacity, emergency berth structures, alternate landings with roll-on-roll-off capabilities, floating tank farms, and ships equipped with cranes to transfer cargo to land [45]. As VI receives fuel using a “just in time model” that allows 3 days-worth of fuel at any given time, resiliency can be increased by adding additional fuel storage to the region. Planning should be done for how much fuel is expected to be required after an earthquake for vehicle operation and generators. VI should also coordinate planning with the Lower Mainland for how fuel will be prioritized after an earthquake and how much of a decrease in supply from the Lower Mainland could be expected. It may be that regions of the US are less affected by the earthquake and are able to supplement fuel deliveries from the Lower Mainland.

Suggestions for the CRD

The CRD can determine how much liquid fuel the organization would need per day in the aftermath of an earthquake. This would include an assessment of how many gas or diesel vehicles are expected to be operating in that scenario and how much liquid fuel various backup generators would require. Since it is highly likely that ports and road transport networks will be damaged after an earthquake, the Victoria area may be cut off from fuel shipments for some time. As VI only has about a three day supply of fuel at any given time, the CRD could establish a private storage of fuel for the organization.

It is worth noting that hydrogen vehicle fuel would have the same resilience issues as gas and diesel with respect to how it would be transported to VI after an earthquake. The CRD would be need to stockpile enough hydrogen fuel locally to continue the use of hydrogen vehicles after a disaster. An idea to

increase hydrogen resilience would be to add local production of it to VI. There is potential to reform hydrogen through thermal, electrolytic, solar-driven, and biological processes [47]. Production of hydrogen via electrolysis using BC's clean energy would also have very low carbon intensity [48].

The CRD can also consider what the resilience implications are of their fleet composition. Adoption of EVs will allow the organization to reduce GHG emissions, lower costs for fuel and maintenance, and potentially donate energy in a disaster. That said, if there is a prolonged power outage, and there is no local energy generation, the EV fleet would become effectively useless after their batteries had been drained. There is also the question of charging availability. If fast charging is unavailable, it could take up to 8 hours to charge an EV at a conventional charger which would be 8 hours that the vehicle would be unable to provide disaster relief for. ICE vehicles would still contribute to the organization's GHG emissions but would have beneficial features in a disaster, such as further travel distance on a full tank and very short times to refuel. ICE vehicles are also dependent on fuel that could be unable to make it to VI following an earthquake. Hydrogen vehicles don't create GHG emissions (assuming hydrogen fuel has been refined from clean energy) and offer quick refueling times but rely on hydrogen that may be unavailable after an earthquake. An idea for optimal fleet resilience would be for the CRD to maintain a fleet of several different vehicle types, along with trying to mitigate vehicle risk by methods such as using microgrids and creating storage of conventional fuel and hydrogen.

EV Use Cases after an Earthquake

EV Communication Network

As mentioned previously, public forms of communication are frequently overwhelmed in the aftermath of an earthquake. Communication networks are important for disaster recovery as they allow the delivery of crucial information to help the preservation of life. Mobile ad hoc networks (MANETs) offer the ability to connect a group of wireless mobile nodes without the use of existing network infrastructure or centralized administration. These wireless nodes can form a temporary network dynamically which makes them well suited for disaster recovery and search and rescue efforts [49].

A vehicular ad-hoc network (VANET) is a variety of MANET where vehicles act as mobile nodes. In the past, VANETs have often been constructed with gasoline powered vehicles. A benefit of using an EV in a VANET is that an EV can operate as a communication node for a long period of time whether it is moving or stationary, due to the large capacity battery of an EV [50]. It has also been proposed that unmanned aerial vehicles (UAVs) could be used in conjunction with EVs to help guide rescue efforts, due to their ability to monitor terrain from an elevated perspective [51].

Researchers at the University of Malaga studied the energy consumption of a VANET composed of 40 vehicles and covering an area of 120,000 m^2. In a 180 s scenario, each vehicle consumed roughly 4,000 J of energy [52]. This would only represent 0.0018% of a Nissan Leaf Plus's 62 kWh battery capacity.

EV Donating Power with V2B

Another application of EVs is the use of them as mobile energy storage. With its onboard battery, an EV can charge at a station, drive to another location, and donate its power via V2B (vehicle-to-building) technology. Until recently, EVs had only been capable of one-way charging. Bidirectional charging allows vehicles to discharge battery power into a building or the electrical grid. Currently, the Nissan Leaf and the Mitsubishi Outlander are the only vehicles capable of this on the Canadian market [53]. For the purpose of this example, we'll assume that the CRD is using the Nissan Leaf Plus, shown in figure 9, with a 62 kWh battery capacity.



Figure 9 - 2022 Nissan Leaf Plus [54]

The example for this use case takes place after an earthquake in July. There is a complete power outage, and the CRD is providing a Nissan Leaf Plus to donate its power to a shelter for people displaced in the earthquake. The Nissan Leaf Plus will have access to a 50 kW fast charger that can charge the battery to full in about 60 minutes [55]. The fast charger is located on a community microgrid that is still able to provide power during the outage. The shelter that the EV will donate power to is located 10 km away from the charging station, and the Nissan Leaf Plus uses roughly 2 kWh/10 km [56]. We will assume that the Nissan Leaf Plus will discharge a power of 50 kW to the shelter for about one hour, an energy donation of 50 kWh. For reference, the average Canadian household uses about 19 kWh per day [57]. In this example, the total energy use for the EV to provide this function is 54 kWh (50 kWh for energy donation, 4 kWh for travel). We will also assume that the time required to drive the round trip distance of 20 km in a post-earthquake damaged transport network, along with the time to hook the EV up at either the shelter or the charging station, will take a total of one hour. The process would look as follows:

1. EV starts at fully charged state
2. EV drives 10 km to shelter and hooks up V2B discharging (about 30 mins)
3. EV donates 50 kW of power for one hour
4. EV drives 10 km to fast charging station and hooks up to charger (about 30 mins)
5. EV is charged fully at fast charging station in one hour

All told, the process would take around 3 hours, and each 3 hour cycle would donate another 50 kWh to the shelter while using 54 kWh of energy at the fast charging station. It is worth noting that discharging this deeply, fast charging, and charging the battery to 100% capacity would increase battery degradation, but it is assumed that post-disaster circumstances have necessitated using the EV in this fashion. If the vehicle provides disaster relief for a full 24 hours (assuming employees working in shifts), the EV could repeat this cycle 8 separate times, donating 400 kWh to the shelter and using 432 kWh at the fast charging station.

The microgrid that the vehicle returns to is assumed to have a 100 kW (standard size for a commercial rooftop) solar array available. Using the System Advisor Model (SAM) software provided by the National Renewable Energy Lab (NREL), a simulation was performed for a 100 kW roof-mounted solar array in Victoria, BC with a fixed tilt angle. Figure 10 shows what the monthly energy production would look like for the proposed array.

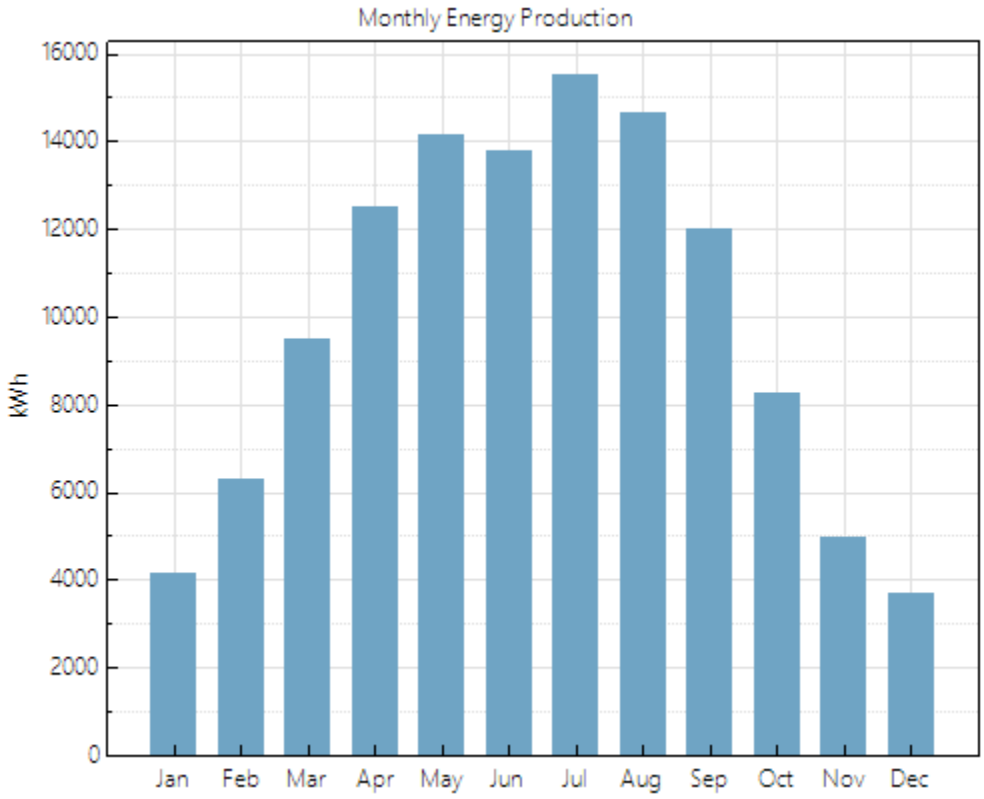


Figure 10 - Monthly Energy Production of a 100 kW Fixed Tilt Solar Array in Victoria, BC

Looking at the energy generation for the month of July, the array would produce about 15,500 kWh. Averaging this number over the 31 days of the month leads to an average daily energy production of 500 kWh. This means that the 24 hour EV use case of 432 kWh, described above, would use almost the total daily energy production of the array. It bears mention that this is also for an earthquake occurring in a month with the most available solar energy. The solar array would only produce about 122 kWh of energy in an average December day which would only accommodate 2 of the energy donation cycles described previously. If multiple EVs were wanted to provide this same functionality, the microgrid would have to have substantial battery storage, along with alternative forms of attached energy generation, such as diesel generators or natural gas turbines. A green solution to this problem could be to use renewable natural gas synthesized from the Hartland Landfill.

EV Providing Transport for Goods and People

A final application of EVs in a post-earthquake setting is the transport of important goods, such as food and medical supplies, along with people. In this context, people could be skilled employees to perform a certain task or those in medical need. It may be the case that certain CRD duties, such as ones relating to water and waste, continue to be crucial in the aftermath of a disaster.

For this case, we will once again consider the 62 kWh Nissan Leaf Plus. Nissan lists the Leaf Plus's maximum single charge range as 363 km [55]. While it's hard to predict what sort of driving distances would occur when providing earthquake relief, it is likely that an EV that is providing 24 hour disaster relief would only need to charge once or twice a day with that amount of vehicle range.

Assuming that the vehicle is close to completely discharged after use, it would take about 60 kWh to charge the vehicle completely. If a vehicle providing disaster relief is only charged once a day, the 500 kWh solar energy production, described in the previous July earthquake scenario, would be able to provide for 8 separate vehicles acting in this fashion. In comparison with the previous EV use case, you would be looking at a single vehicle that performs 8 power donation cycles over a 24 hour period vs 8 separate vehicles that are transporting supplies or people over the same period of time.

Conclusions

EVs offer many benefits when compared to ICE vehicles, such as reduced GHG emissions, better performance, and economic savings. EVs sales have continued to grow, even during the pandemic, and could represent 12-28% of the global fleet by 2040. The CRD has one of the largest concentrations of EVs in the province, and this will only continue to grow as the Zero Emissions Vehicles Act takes effect in 2040. The CRD also coincides with the region of BC that would be hugely impact by a CSZ earthquake event. To maintain the use of EVs in an earthquake, it is integral that the power system infrastructure is resilient.

To understand how to improve earthquake resilience, this report examined past earthquakes in Chile, Japan, and New Zealand. The 2010 Chile showed the importance of having available excess generation capacity, designing the grid with n-1 security criteria, establishing private forms of communication, and utilizing smaller sized generators for recovery in isolated areas. The 2011 Japan earthquake illustrated the risks of locating generation capacity in a tsunami zone and taught lessons on the importance of elevating transformers in flood zones, utilizing rolling blackouts for recovery, and the resilience of microgrids after an earthquake. The 2011 New Zealand earthquake taught lessons on the potential damage that can be caused to electrical equipment running through liquefaction zones, along with how impactful spending money on resilience upgrades can be. All three earthquakes had power returned to most customers within two weeks, and this success can be at least somewhat attributed to the robust seismic standards that had been put into place in all three countries.

The electrical grid on VI was examined and ideas for increasing resilience were applied to the region. The grid on VI depends heavily on imported power from the mainland of BC. BC Hydro's earthquake modelling suggest that the region could experience power outages in the range of months after a CSZ event. BC Hydro could increase resilience by adding more generation to the area, specifically near to the CRD, where there is little nearby generation capacity. BC Hydro could also relocated grid elements from tsunami zones, reinforce substations and masonry buildings, move buried system elements from liquefaction zones, and plan for the event by having resources available and arranging for aid agreements with surrounding areas. The CRD could increase organizational resilience by establishing private forms of communication, building a local microgrid to be able to charge EVs in a disaster, and utilizing their EV fleet battery capacity to provide mobile storage and provide power to important loads.

The fuel infrastructure on VI was also examined, including its connections to the Lower Mainland. VI depends heavily on fuel that arrives in the Lower Mainland from the TMPL and is then brought to VI by marine transport. Improvement to the Lower Mainland fuel resilience, such as hardening liquefaction prone soils in ports, providing backup power for pumping stations, and deciding fuel prioritization will all help to ensure there is a supply of Lower Mainland fuel available for VI. VI can also improve its resilience by adding additional ports or emergency berth structures, increasing fuel storage, and planning for how fuel will be prioritized and where it can be sourced from. As an organization, the CRD can plan for what their expected fuel needs will be after an earthquake for vehicles and generators and establish how much storage that would require.

Post earthquakes use cases were examined for EVs. EVs have the potential to act as nodes in a mobile communication networks. In a 180 s simulation, the power need for this application was found to only represent 0.018% of a Nissan Leaf Plus's 62 kWh battery. In a scenario with an EV donating power to a shelter and charging at a 50 kW fast charger, it was found that an EV could donate about 400 kWh to a shelter in a given 24 hour period. It was assumed that the EV was recharging at a microgrid with a 100 kW solar array which was able to provide power for a single vehicle acting in this fashion. Finally, the case of an EV delivering supplies and personnel was observed, and it was found that, given the Leaf's single charge range of 363 km, 8 vehicles could charge once a day at the 100 kW solar microgrid and provide this function for 24 hours.

References

[1] L. Noel, G. Zarazua de Rubens, J. Kester, and B. K. Sovacool, "Beyond emissions and economics: Rethinking the co-benefits of electric vehicles (EVs) and vehicle-to-grid (V2G)," *Transp. Policy*, vol. 71, pp. 130–137, Nov. 2018, doi: 10.1016/j.tranpol.2018.08.004.

[2] C. Zhang, J. B. Greenblatt, P. MacDougall, S. Saxena, and A. Jayam Prabhakar, "Quantifying the benefits of electric vehicles on the future electricity grid in the midwestern United States," *Appl. Energy*, vol. 270, p. 115174, Jul. 2020, doi: 10.1016/j.apenergy.2020.115174.

[3] "Global EV Outlook 2021 – Analysis," *IEA*. https://www.iea.org/reports/global-ev-outlook-2021 (accessed Aug. 03, 2021).

[4] N. O. Kapustin and D. A. Grushevenko, "Long-term electric vehicles outlook and their potential impact on electric grid," *Energy Policy*, vol. 137, p. 111103, Feb. 2020, doi: 10.1016/j.enpol.2019.111103.

[5] BC Hydro, "Generation System." https://www.bchydro.com/energy-in-bc/operations/generation.html (accessed Aug. 16, 2021).

[6] C. E. R. Government of Canada, "NEB – Canada's Renewable Power Landscape 2016 – Energy Market Analysis," Feb. 11, 2021. https://www.cer-rec.gc.ca/en/data-analysis/energy-commodities/electricity/report/2016-canadian-renewable-power/province/canadas-renewable-power-landscape-2016-energy-market-analysis-british-columbia.html (accessed Aug. 19, 2021).

[7] "B.C. electric vehicle sales charge ahead in pandemic 2020," *Victoria News*, Apr. 06, 2021. https://www.vicnews.com/news/b-c-electric-vehicle-sales-charge-ahead-in-pandemic-2020/ (accessed Aug. 03, 2021).

[8] "Werner's Blog: The state of electric vehicle adoption in British Columbia | UBC Sauder School of Business." https://www.sauder.ubc.ca/news/insights/werners-blog-state-electric-vehicle-adoption-british-columbia (accessed Aug. 03, 2021).

[9] "Phases of Disaster Recovery: Emergency Response for the Long Term - World," *ReliefWeb*. https://reliefweb.int/report/world/phases-disaster-recovery-emergency-response-long-term (accessed Aug. 03, 2021).

[10] Intek Inc., "QER Analysis - United States Fuel Resiliency Volume II," *United States Fuel Resiliency*, Sep. 2014. https://www.energy.gov/sites/prod/files/2015/04/f22/QER%20Analysis%20-%20United%20States%20Fuel%20Resiliency%20Volume%20II.pdf (accessed Aug. 03, 2021).

[11] N. R. C. Government of Canada, "Simplified seismic hazard map for Canada, the provinces and territories." https://seismescanada.rncan.gc.ca/hazard-alea/simphaz-en.php (accessed Sep. 16, 2021).

[12] "A Magnitude 9.0 Earthquake Scenario," Cascadia Region Earthquake Workgroup, 2013. Accessed: Nov. 23, 2020. [Online]. Available:

http://cmscontent.nrs.gov.bc.ca/geoscience/PublicationCatalogue/InformationCircular/BCGS_IC2013-03.pdf

[13] "Cascadia: Oregon's Greatest Natural Threat," The Oregon Resilience Plan, Feb. 2013.

[14] J. J. Clague, "The Earthquake Threat in Southwestern British Columbia: A Geologic Perspective," p. 28.

[15] "Cascadia Subduction Zone," *Pacific Northwest Seismic Network*. https://pnsn.org/outreach/earthquakesources/csz (accessed Aug. 04, 2021).

[16] S. M. Rinaldi, J. P. Peerenboom, and T. K. Kelly, "Identifying, understanding, and analyzing critical infrastructure interdependencies," *IEEE Control Syst. Mag.*, vol. 21, no. 6, pp. 11–25, Dec. 2001, doi: 10.1109/37.969131.

[17] "The Mw 8.8 Chile Earthquake of February 27, 2010," Earthquake Engineering Research Institute, Jun. 2010. Accessed: Mar. 22, 2021. [Online]. Available: https://www.eeri.org/site/images/eeri_newsletter/2010_pdf/Chile10_insert.pdf

[18] H. Rudnick, S. Mocarquer, E. Andrade, E. Vuchetich, and P. Miquel, "Disaster Management," *IEEE Power Energy Mag.*, vol. 9, no. 2, pp. 37–45, Mar. 2011, doi: 10.1109/MPE.2010.939948.

[19] J. C. Araneda, H. Rudnick, S. Mocarquer, and P. Miquel, "Lessons from the 2010 Chilean earthquake and its impact on electricity supply," in *2010 International Conference on Power System Technology*, Zhejiang, Zhejiang, China, Oct. 2010, pp. 1–7. doi: 10.1109/POWERCON.2010.5666023.

[20] H. Aki, "Demand-Side Resiliency and Electricity Continuity: Experiences and Lessons Learned in Japan," *Proc. IEEE*, vol. 105, no. 7, pp. 1443–1455, Jul. 2017, doi: 10.1109/JPROC.2016.2633780.

[21] M. Kobayashi, "Experience of infrastructure damage caused by the Great East Japan Earthquake and countermeasures against future disasters," *IEEE Commun. Mag.*, vol. 52, no. 3, pp. 23–29, Mar. 2014, doi: 10.1109/MCOM.2014.6766080.

[22] N. Null, "Tohoku, Japan, Earthquake and Tsunami of 2011 - Electric Power Systems," pp. 225–335, May 2017, doi: 10.1061/9780784479834.ch04.

[23] N. Elamin and M. Fukushige, "Effects of the 2011 Great East Japan Earthquake on Electricity Load Demand: Structural Changes During Recovery Periods," *Rev. Urban Reg. Dev. Stud.*, vol. 31, no. 1–2, pp. 118–136, 2019, doi: 10.1111/rurd.12097.

[24] E. Hollnagel and Y. Fujita, "THE FUKUSHIMA DISASTER – SYSTEMIC FAILURES AS THE LACK OF RESILIENCE," *Nucl. Eng. Technol.*, vol. 45, no. 1, pp. 13–20, Feb. 2013, doi: 10.5516/NET.03.2011.078.

[25] A. Otsuka, "Natural disasters and electricity consumption behavior: a case study of the 2011 Great East Japan Earthquake," *Asia-Pac. J. Reg. Sci.*, vol. 3, no. 3, pp. 887–910, Oct. 2019, doi: 10.1007/s41685-019-00129-4.

[26] “EV for resilience: The electric road to recovery,” *Official U.S. Newsroom*, Mar. 16, 2015. https://usa.nissannews.com/en-US/releases/ev-for-resilience-the-electric-road-to-recovery (accessed Aug. 10, 2021).

[27] C. Marnay, H. Aki, K. Hirose, A. Kwasinski, S. Ogura, and T. Shinji, “Japan’s Pivot to Resilience: How Two Microgrids Fared After the 2011 Earthquake,” *IEEE Power Energy Mag.*, vol. 13, no. 3, pp. 44–57, May 2015, doi: 10.1109/MPE.2015.2397333.

[28] S. H. Potter, J. S. Becker, D. M. Johnston, and K. P. Rossiter, “An overview of the impacts of the 2010-2011 Canterbury earthquakes,” *Int. J. Disaster Risk Reduct.*, vol. 14, pp. 6–14, Dec. 2015, doi: 10.1016/j.ijdrr.2015.01.014.

[29] A. Massie and N. R. Watson, “Impact of the Christchurch Earthquakes on the Electrical Power System Infrastructure,” *Bull. N. Z. Soc. Earthq. Eng.*, vol. 44, no. 4, pp. 425–430, 2011.

[30] A. Kwasinski, J. Eidinger, A. Tang, and C. Tudo-Bornarel, “Performance of Electric Power Systems in the 2010–2011 Christchurch, New Zealand, Earthquake Sequence,” *Earthq. Spectra*, vol. 30, no. 1, pp. 205–230, Feb. 2014, doi: 10.1193/022813EQS056M.

[31] S. Giovinazzi *et al.*, “LIFELINES PERFORMANCE AND MANAGEMENT FOLLOWING THE 22 FEBRUARY 2011 CHRISTCHURCH EARTHQUAKE, NEW ZEALAND: HIGHLIGHTS OF RESILIENCE,” p. 16.

[32] Technical Council on Lifeline Earthquake Engineering, *Christchurch, New Zealand, Earthquakes of 2010 and 2011, Lifeline Performance*. Reston, VA: American Society of Civil Engineers, 2016. doi: 10.1061/9780784414217.

[33] M. R. Seemann, “A Disaster Risk Management Approach to Seismic Risk on Vancouver Island, British Columbia,” University of Victoria, 2012. [Online]. Available: https://dspace.library.uvic.ca/bitstream/handle/1828/4402/Seemann_Mark_PhD_2012.pdf?sequence=1&isAllowed=y

[34] S. C. Government of Canada, “Census Profile, 2016 Census - Vancouver Island and Coast [Economic region], British Columbia and British Columbia [Province],” Feb. 08, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=ER&Code1=5910&Geo2=PR&Code2=59&SearchText=Vancouver%20Island%20and%20Coast&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=5910&TABID=1&type=0 (accessed Aug. 16, 2021).

[35] BC Hydro, “Vancouver Island.” https://www.bchydro.com/energy-in-bc/operations/our-facilities/vancouver-island.html (accessed Aug. 16, 2021).

[36] BC Hydro, “Vancouver Island - Sunshine Coast Community Relations.” Accessed: Aug. 16, 2021. [Online]. Available: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/community/vancouver-island-sunshine-coast-annual-report-2018.pdf

[37] Vancouver Island Economic Alliance, “Energy and Infrastructure on Vancouver Island.” https://viea.ca/regional-statistic/energy-and-infrastructure/ (accessed Aug. 16, 2021).

[38] “Power lines connecting Vancouver Island with Canadian Mainland,” *Wikipedia*. Oct. 31, 2019. Accessed: Aug. 16, 2021. [Online]. Available: https://en.wikipedia.org/w/index.php?title=Power_lines_connecting_Vancouver_Island_with_Canadian_Mainland&oldid=923841186

[39] Sean Feagan, “BC Hydro planning future without Vancouver Island’s largest gas fired power plant,” *Parksville Qualicum Beach News*, Aug. 25, 2021. https://www.pqbnews.com/news/bc-hydro-planning-future-without-vancouver-islands-largest-gas-fired-power-plant/ (accessed Sep. 21, 2021).

[40] BC Hydro, “Seismic hazard at Jordan River.” https://www.bchydro.com/energy-in-bc/operations/dam-safety/seismic-hazards/jordan-river-options.html (accessed Sep. 17, 2021).

[41] Bridgette Watson · CBC News ·, “BC Hydro investigating damage to submarine cables that carry power to Vancouver Island | CBC News,” *CBC*, Jul. 13, 2021. https://www.cbc.ca/news/canada/british-columbia/hydro-heat-damage-1.6100521 (accessed Aug. 16, 2021).

[42] “Tsunami Preparedness,” *https://www.victoria.ca*. https://www.victoria.ca/EN/main/residents/public-safety/emergency-preparedness-victoriaready/tsunami-preparedness.html (accessed Sep. 22, 2021).

[43] K. DeRosa, “Insurance study warns Canadians unprepared for carnage of next big earthquake,” *Times Colonist*. https://www.timescolonist.com/news/local/insurance-study-warns-canadians-unprepared-for-carnage-of-next-big-earthquake-1.676230 (accessed Sep. 22, 2021).

[44] “Tour the Smart Microgrid – BCIT.” https://www.bcit.ca/applied-research/smart-microgrid/tour-the-smart-microgrid/ (accessed Sep. 22, 2021).

[45] A. Brown, “The fuel transportation system in British Columbia : attributes and vulnerabilities,” University of British Columbia, 2016. doi: 10.14288/1.0314120.

[46] OSSPAC, “CEI Hub Mitigation Strategies: Increasing Fuel Resilience to Survive Cascadia.” Oregon Seismic Saftey Policy Advisory Commission, Dec. 31, 2019.

[47] Office of Energy Efficiency and Renewable Energy, “Hydrogen Fuel Basics,” *Energy.gov*. https://www.energy.gov/eere/fuelcells/hydrogen-fuel-basics (accessed Sep. 18, 2021).

[48] cleanBC, “B.C. Hydrogen Strategy.” cleanBC, Jul. 2021. Accessed: Sep. 18, 2021. [Online]. Available: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/electricity/bc-hydro-review/bc_hydrogen_strategy_final.pdf

[49] L. Onwuka, A. Folaponmile, and M. Ahmed, “MANET: A RELIABLE NETWORK IN DISASTER AREAS,” *J. Res. Natl. Dev. Transcampus*, vol. 9, pp. 1596–8308, Jan. 2012.

[50] K. Mase and J. Gao, “Electric vehicle-based ad-hoc networking for large-scale disasters design principles and prototype development,” in *2013 IEEE Eleventh International Symposium on Autonomous Decentralized Systems (ISADS)*, Mar. 2013, pp. 1–6. doi: 10.1109/ISADS.2013.6513414.

[51] A. Raza, S. H. R. Bukhari, F. Aadil, and Z. Iqbal, “An UAV-assisted VANET architecture for intelligent transportation system in smart cities,” *Int. J. Distrib. Sens. Netw.*, vol. 17, no. 7, p. 15501477211031750, Jul. 2021, doi: 10.1177/15501477211031750.

[52] J. Toutouh and E. Alba, “An efficient routing protocol for green communications in vehicular ad-hoc networks,” in *Proceedings of the 13th annual conference companion on Genetic and evolutionary computation - GECCO ’11*, Dublin, Ireland, 2011, p. 719. doi: 10.1145/2001858.2002076.

[53] E. C. · C. News ·, “How electric vehicles could transform the power grid | CBC News,” *CBC*, Jul. 14, 2021. https://www.cbc.ca/news/science/ev-to-grid-1.6100454 (accessed Sep. 19, 2021).

[54] “2022 Nissan LEAF Prices Slashed to Keep Up With Bolt EV,” *The Car Guide*. https://www.guideautoweb.com/en/articles/61327/ (accessed Sep. 19, 2021).

[55] “2022 Nissan LEAF Range, Battery, & Charging | Nissan Canada,” *Nissan*. https://www.nissan.ca/vehicles/electric-cars/leaf/features/range-charging-battery.html (accessed Sep. 19, 2021).

[56] Jil McIntosh, “How It Works: Making sense of EV specifications,” *How It Works / Electric Vehicles*, May 19, 2021. https://driving.ca/column/how-it-works/how-it-works-making-sense-of-ev-specifications (accessed Sep. 19, 2021).

[57] A. Parekh, P. Wang, and T. Strack, “Survey Results of User-Dependent Electricity Loads in Canadian Homes,” p. 12.

Incorporating Electric Bikes into a Regional Government Fleet

Lessons Learned from the CRD

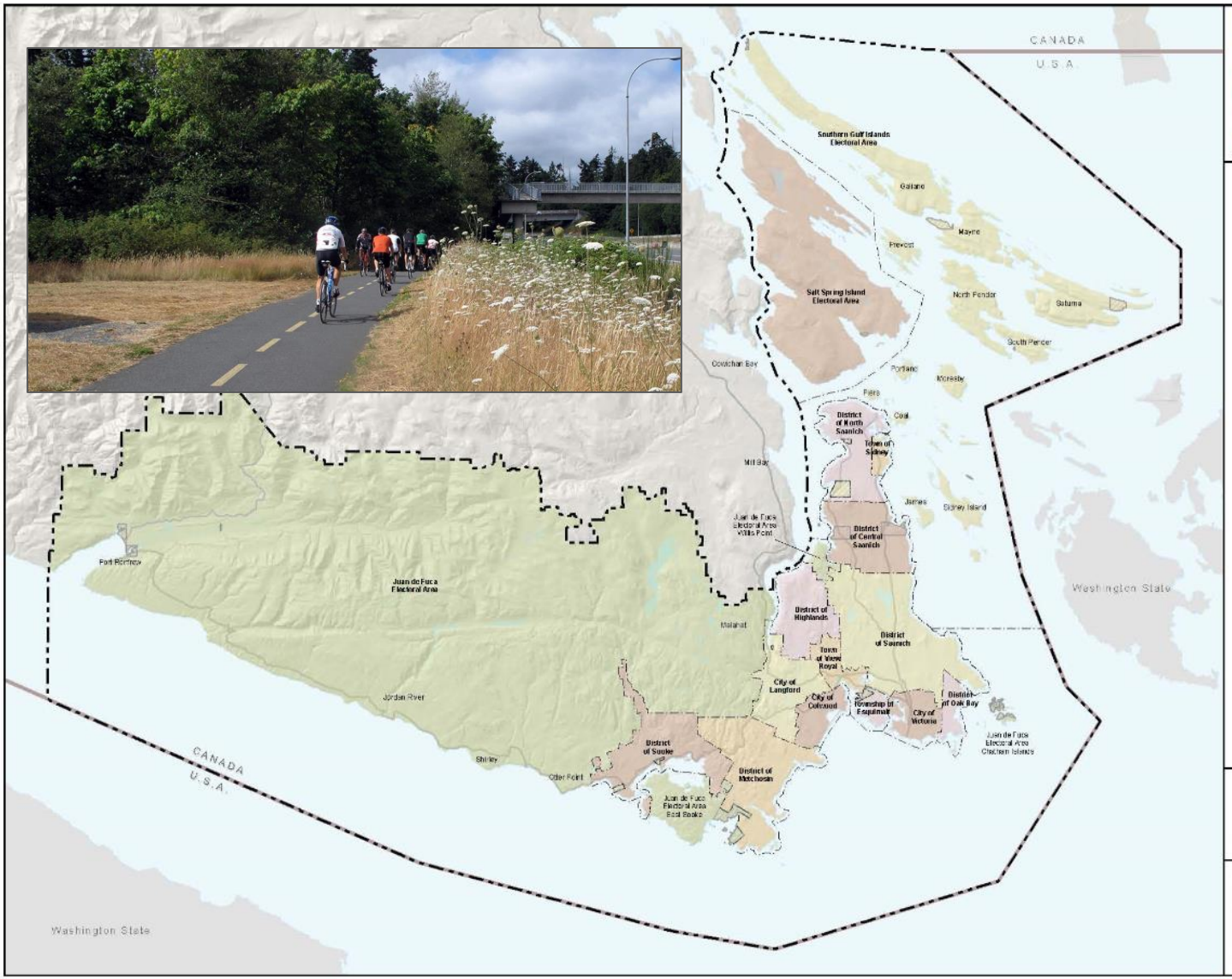
Attachment 5



Liz Ferris, Corporate Climate Action Coordinator

Making a difference...together

The Capital Region



Capital Regional District

Administrative Boundaries

Capital Region Municipalities

City of Victoria	District of Oak Bay
District of Saanich	Town of Sidney
Township of Esquimalt	Town of View Royal
District of Central Saanich	City of Colwood
District of North Saanich	District of Highlands
City of Langford	District of Metchosin
District of Sooke	

Unincorporated Areas

- Juan de Fuca Electoral Area
- Salt Spring Island Electoral Area
- Southern Gulf Islands Electoral Area
- First Nation Reserves



Please visit us on-line for more information:
http://www.crd.bc.ca | gis@crd.bc.ca

1:350,000

Kilometres

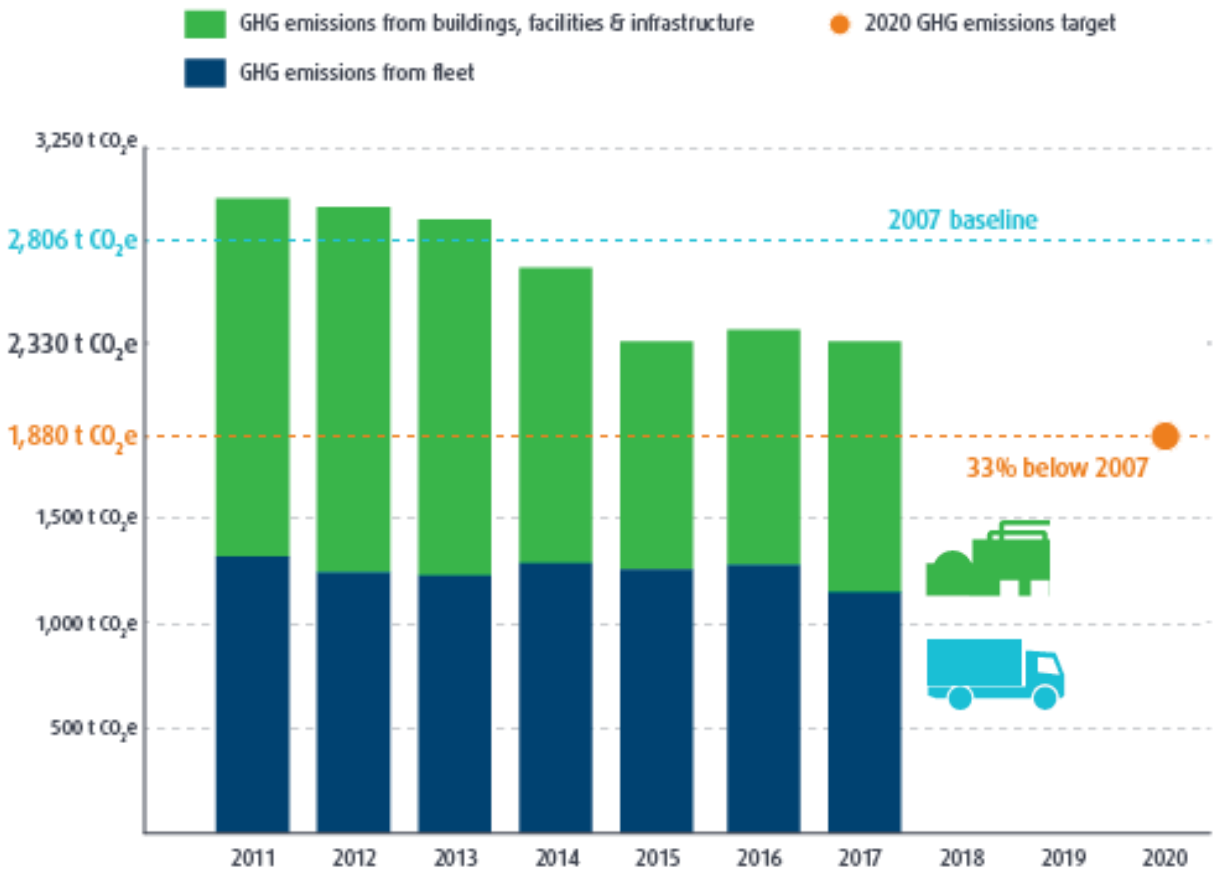
0 2.5 5 10 15

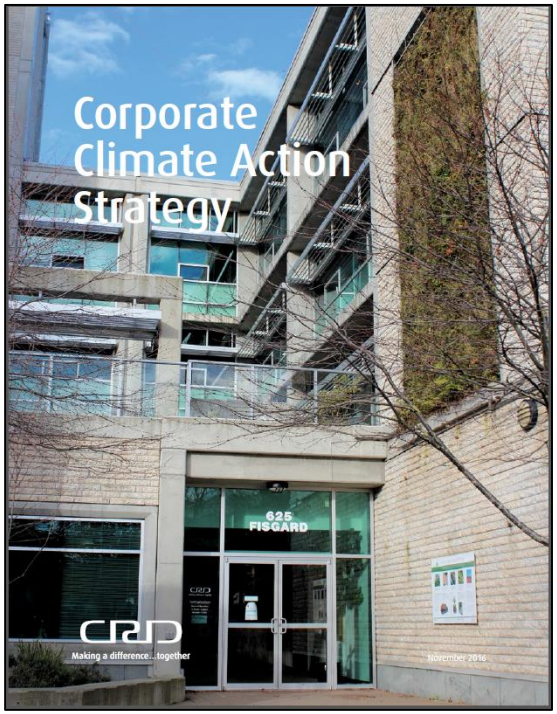
Projection: Universal Transverse Mercator Zone 10, North, North American Datum

DISCLAIMER:
Important: The map is for general information purposes only. The Capital Regional District (CRD) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of this map for any purpose.
This map is not for navigation. The CRD will not be liable for any damages, loss or injury resulting from the use of this map or information on it. The map and the map may be changed by the CRD at any time.

September 2009 | CRD_Administrative_Boundaries_11x17_Color.mxd

Climate Action at CRD

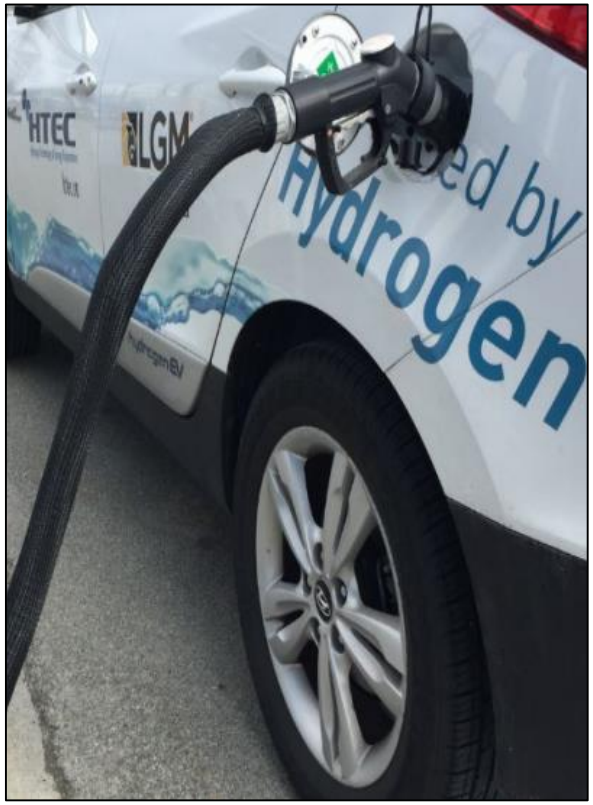




- ✓ Signatory of the BC Climate Action Charter
- ✓ Signatory of the West Coast Electric Fleet Initiative
- ✓ Carbon neutral in operations since 2012

Zero Emissions Fleet Initiative

The CRD ZEFI is technology neutral *and* committed to investigating any cost effective technology that can reduce GHG emissions and meet operational needs.







Pilot Summary

Timeline

February 2018 - September 2020: trial within corporate fleet
February 2018 - February 2019: 1 year intensive focus with IESVic

Participants

17 staff from 4 Departments
3 E-bikes



Purpose

Transport to:

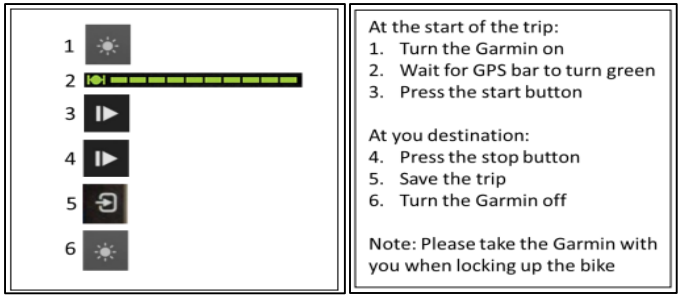
- ✓ Site inspections
- ✓ Meetings

E-bike Pilot Research Goals

1. Recommend the optimal use of e-bikes in urban commercial fleets.

2. Compare the environmental, economic, and logistical performance of the operation of e-bikes in urban fleets to other vehicle modes.

3. Recommend regulatory constraints placed on E-bike use with respect to motor power limits.



E-bike data collection instructions

Standard Operating Procedures

- ✓ PPE & safety training
  - ✓ Safe routes & cycling infrastructure
  - ✓ Communication/ navigation device
  - ✓ Weather restrictions
- ✓ Booking procedure
- ✓ Pre/post trip checklists
- ✓ Research requirements
- ✓ Bike security







STANDARD OPERATING PROCEDURES
TABLE OF CONTENTS

1.0 INTRODUCTION
- 1.1 PURPOSE
- 1.2 SCOPE
- 1.3 LIMITATIONS

2.0 PARTICIPANT ELIGIBILITY
- 2.1 ORIENTATION

3.0 SAFETY
- 3.1 HEALTH AND FITNESS
- 3.2 RIDER SKILLS
- 3.3 TRAFFIC AND ROAD RULES
- 3.4 NAVIGATION
- 3.5 WEATHER
- 3.6 DEAD BATTERY AND OTHER MECHANICAL ISSUES

4.0 PERSONAL PROTECTION EQUIPMENT
- 4.1 CERTIFIED HELMETS
- 4.2 HIGH VISIBILITY VESTS
- 4.3 STURDY FOOTWEAR
- 4.4 GLOVES
- 4.5 E-BIKE ACCESSORIES

5.0 BOOKING AN E-BIKE
- 5.1 E-BIKE LOCATION
- 5.2 PRE AND POST TRIP PROCEDURES
- 5.3 PRE-TRIP RESEARCH REQUIREMENTS
- 5.4 POST-TRIP RESEARCH REQUIREMENTS

6.0 THEFT

APPENDIX A: ICBC SAFETY TIPS FOR CYCLISTS
APPENDIX B: E-BIKE FAQ

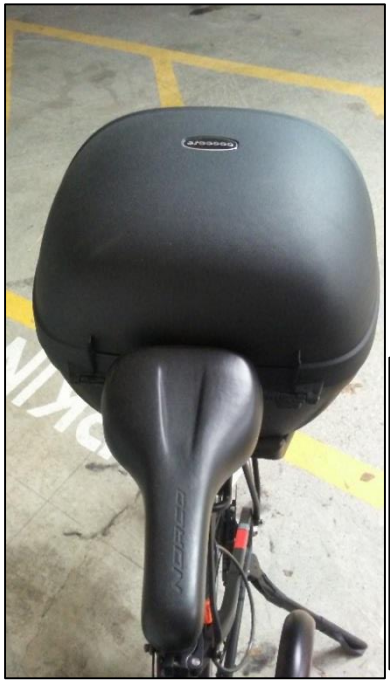
Procurement



Norco VLT S1 – Bosch Performance CX motor

Photo credit: Norco Bicycles, https://www.norco.com/bikes/2018/pavement/e-urban/vlt-aluminum/vlt-s1/

Outfitting the Bikes



zero emissions fleet initiative

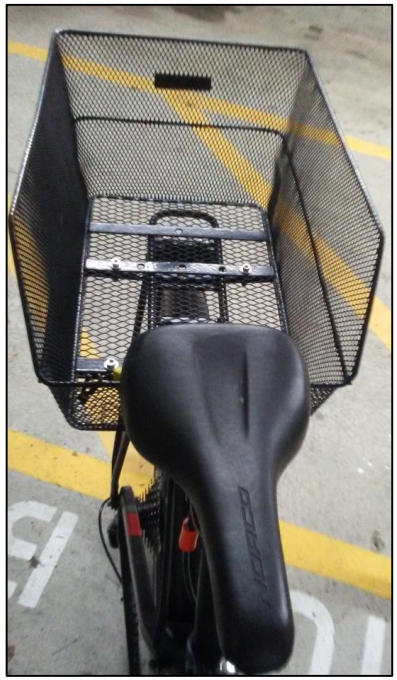
Branding



First Aid Kit



Water bottle holder





Lockable trunk vs. Basket with rain cover



Capital Cost

Category	Item	Cost (taxes excluded)
E-bikes	3 E-bikes	~$11,200
PPE	21 helmets, 6 visi vests, 3 first aid kits, bells	~$1,100
Security	Wheel pinheads, cables, locks	~$700
Storage on the Bike	3 bicycle baskets & covers, 3 water bottle holders, 1 bungie net, 1 locked truck	~$300
Storage of Bikes	Electrical installation, labour, lockers, painting	~$5,500
Branding	40 bike stickers, 6 bike stickers	~$100
	Capital Cost of E-bike Pilot	~$18,900

Operating Cost

Category	Item	Cost (taxes excluded)
Maintenance	6 bi-annual tune-ups ($85 ea)	~$500
	Ongoing maintenance (drivetrain replacement, & other parts; $300 -$1,300 per bicycle over its lifecycle)	Variable
	Tire pump, chain lube, tube replacement	~$100
Training	Safety training (17 staff)	~$1000
	Operating Cost of E-Bike Pilot	~$1,600

Storage & Security





Secure storage includes:

- ✓ Racks
- ✓ Electrical outlets
- ✓ Storage lockers

Bike security includes:

- ✓ Abus Bordo 6000 folding lock
- ✓ Cable for quick release bike seat
- ✓ Pinheads through rear & front axle



Summary Statistics

Summary Statistics of CRD E-bike Use April 2018 – August 2018 (mean value +/- one standard deviation)	
Total km travelled	607 km
Total trips taken	92
Average speed	20.3 +/- 5.9 km/h
Average trip length	6.6 +/- 5.8 km
Average trip time	25.9 +/- 25.2 min

Source: Clancy, Dan. (2019). CRD-UVic E-bike Fleet Deployment.

GHG Emissions Reductions

Emission Intensity for Four Transportation Modes April 2018 – August 2018 (mean value +/- one standard deviation)	
Mode	Emissions (kg CO_2e/km)
E-bike	0.00009
Standard sedan	0.216
Electric car	0.002
Walking	0

Source: Clancy, Dan. (2019). CRD-UVic E-bike Fleet Deployment.

- ✓ 99% reduction in GHGs compared to typical CRD fleet vehicle
- ✓ 95% reduction in GHGs compared to battery electric cars
- ✓ ~250kg of CO_2 was saved by the deployment of the e-bikes

Cost Savings

Capital & Operational Costs per Vehicle over 5 years		
Mode	Capital costs ($)	Operational Costs ($)
E-bike	4,400	1,700
Chevrolet Malibu	22,300	1,400
Electric car	35,900	8,300

Source: Clancy, Dan. (2019). CRD-UVic E-bike Fleet Deployment.

- ✓ E-bike use results in an 80% reduction in capital and operating costs.



Utilization

Comparison between E-bikes & Pool Vehicles April 1, 2018 - August 31, 2018	
Vehicle	**Total % use**
Large e-bike	15%
Medium e-bike	19%
Small e-bike	8%
Prius	28%
Smart	13%
Kia Soul (Electric)	35%
Chevy Malibu (Hybrid)	25%

- ✓ E-bikes may save up to 2 hours daily in downtown area.

Staff Taking Climate Action

"Arriving to businesses on an e-bike sparks discussions around ***CRD climate action*** *initiatives, work efficiencies, and health benefits of cycling."*

-e-bike pilot participant



2019 - 2022 Board Priorities

Community Wellbeing – Transportation & Housing

The CRD Board will advocate, collaborate and form partnerships to address the affordable housing and transportation needs of the region's diverse and growing population.

Climate Action & Environmental Stewardship

The CRD Board will encourage and implement bold action on climate change by enhancing its natural and built assets to achieve environmental resilience, food security and continued wellbeing of our current and future residents.

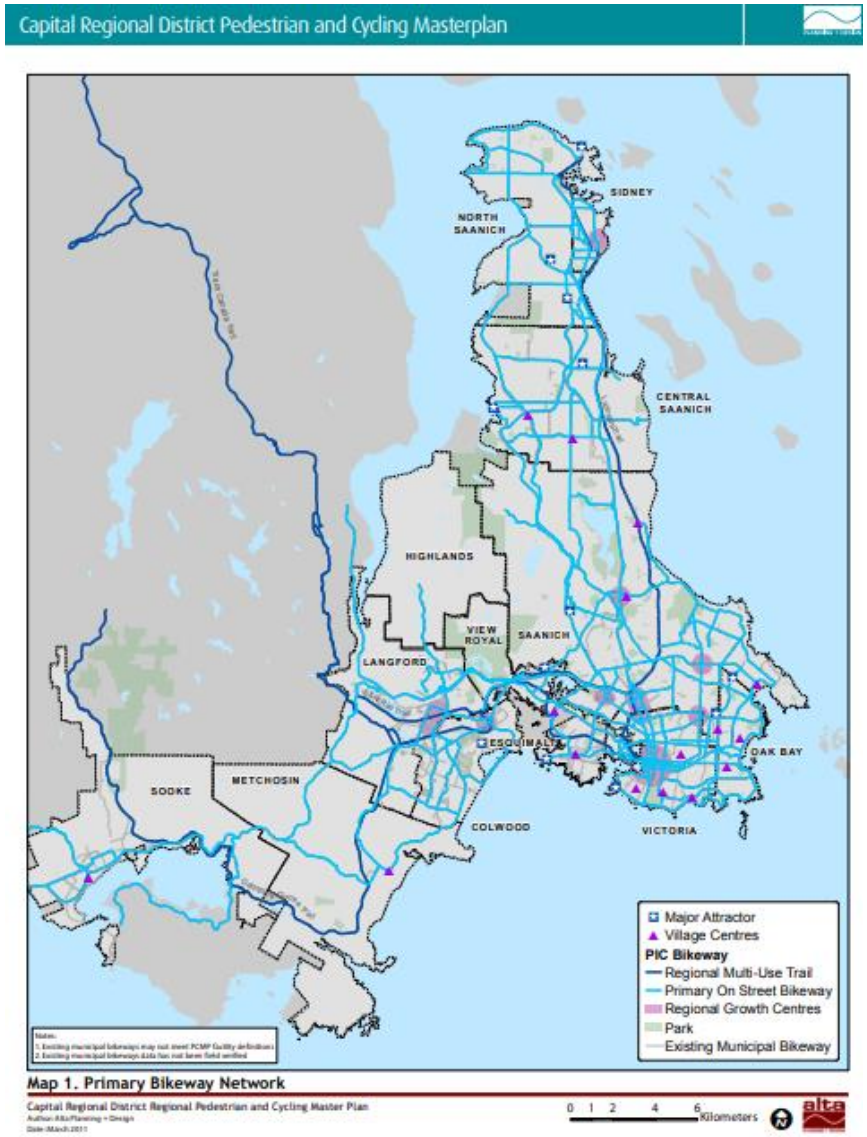
Lessons Learned

- Fit testing
- Data collection compliance (for IESVic)
- Completion of pre/post trip inspection forms
- Training time required
- Style of bike
- Battery life for extended trips
- Storage constraints on bike
- Secure storage of bikes
- Staff uptake



Next Steps

- ✓ Continue pilot until September 2020, unless new direction is given
- ✓ Maintain waitlist of interested staff
- ✓ Integrate e-bikes into fleet upon pilot's completion
- ✓ Provide lunch n learn for CRD Board members
- ✓ Continue to support and promote regional cycling infrastructure



Thank-you!

Questions?



Contact:

Liz Ferris, Corporate Climate Action Coordinator
lferris@crd.bc.ca
250-360-3643

Feasibility Study

Zero Emissions Fleet Initiative- Infrastructure Safety Study

Capital Regional District | 6-Nov-2017



Feasibility Study

Zero Emissions Fleet Initiative- Infrastructure Safety Study

Developed by:

The Capital Regional District, Zero Emissions Fleet Initiative Team

Supported by:

Ministry of Energy and Mines, Province of British Columbia
Institute for Integrated Energy Solutions at the University of Victoria

Prepared by:

HTEC Hyrogen Technology & Energy Corp
North Vancouver, BC

Feasibility Study

Zero Emissions Fleet Initiative- Infrastructure Safety Study

Table of Contents

1. Introduction 4
2. Hydrogen - a safe fuel 4
   a. Properties and why it is safe 4
   b. Hydrogen as a regulated fuel 5
3. Permitting 5
   a. Applicable Codes and Regulations 6
   b. Temporary Installations 6
   c. Regulatory Approval and Safety 7
   d. Site layout, setbacks and hazardous zone considerations. 7
4. Infrastructure – OEM requirements and station components 11
   a. OEM Requirements 11
   b. Station components 12
      i. Hydrogen storage tank(s) 12
      ii. Compressor 12
      iii. Chiller 12
      iv. Dispenser 13
   c. Hydrogen fuelling station maintenance considerations 13

Appendix A 15

Appendix B 17

1. Introduction

This document summarizes the overall requirements for the safe and successful construction of a permanent hydrogen fuelling station to fill Fuel Cell Electric Vehicles (FCEVs) within the Capital Regional District (CRD). These requirements relate to the vehicle Original Equipment Manufacturers' (OEM) key expectations for station performance, overall technical specifications, station components, common safety concerns, and applicable codes and regulations for safe operation. Permitting and the importance of early public engagement, as well as the practicality of mobile refuelling will also be discussed.

2. Hydrogen - a safe fuel

Hydrogen is a carbon-free, non-toxic fuel that can be domestically produced from local resources. Most hydrogen is made from natural gas, but increasingly it is made from water, biogas and biomass. For more than 75 years, hydrogen has been safely handled, distributed and dispensed.

a. Properties and why it is safe

Hydrogen is the lightest molecule in the universe and diffuses rapidly in its gaseous state, elevating at approximately 20 meters per second. This property is known as high buoyancy. High buoyancy makes it unlikely to accidentally form a flammable mixture with hydrogen. Codes and standards take into account the buoyancy and diffusivity of hydrogen when designing structures to store, transport, and use hydrogen safely. Generally, a hydrogen release dissipates very quickly.

Hydrogen is odorless, colorless and tasteless: Hydrogen sensors are used to detect leaks and have been used to meet safety standards for decades.

Hydrogen falls under special electrical classification as it is deemed flammable, and as such, explosive atmospheres exist when this gas is present above the lower explosive limits (LEL). The LEL of hydrogen gas is 4.0% by volume. Section 18 of the Canadian Electrical Code, CSA22.1, requires the use of specific classified electrical equipment in locations defined as Hazardous.

A typical fueling station will have from 76 000 to 284 000 liters of gasoline on site at a time, while the current hydrogen station configurations will have 50kg to 1 000 kg on site. Typical gasoline tankers will carry 34 000 liters of gasoline, while hydrogen delivery vehicles will carry 100 to 300 kg of the gas.

A hydrogen fueling station has several safety features that include emergency stop button to de-energize the system if problems occur, fire and flame detection equipment in both open and enclosed spaces, hydrogen detection equipment, pressure relieving devices throughout, safety signage, and equipment interlock to ensure only trained personnel have access.

b. Hydrogen as a regulated fuel

Hydrogen is a recognized fuel for transportation and has been classified as such. In addition to transportation, hydrogen is commonly used in large quantities in the petroleum refinery process, in several industrial applications, and as fuel for space exploration. These uses resulted in reliable standards used to safely produce, store, and transport hydrogen. For example the National Fire Protection Association standard - NFPA 55 – Compressed Gases and Cryogenic Fluids Code, which is still in use, was established as early as 1975 and covered the installation and safe handling of hydrogen equipment. With the continued development of hydrogen as a fuel for transportation, a dedicated standard, NFPA 2 - Hydrogen Technologies Code was first issued in 2011, to better issues associated with dispensing and laboratory applications.

The Canadian Hydrogen Installation Code, Standard CAN/BNQ 1784-000, sets the installation requirements for hydrogen generating equipment, hydrogen-powered equipment, hydrogen dispensing equipment, hydrogen storage containers, hydrogen piping systems and their related accessories. The code applies to all gaseous and liquid hydrogen applications with some exceptions that don't relate to fuelling stations. This code is approved by the Standards Council of Canada, however NFPA-2 is the most widely adopted standard and also the standard that the British Columbia Safety Authority (BCSA, now known as Technical Safety BC) is most familiar with. It can be argued that a precedent has been set in BC to follow NFPA-2 for the time being.

The application of appropriate codes and standards make hydrogen fuel just as safe as—or safer than—gasoline or other commonly used fuels, such as compressed natural gas (CNG). Hydrogen systems are engineered systems that follow prescriptive hydrogen standards. They have proven to be very safe in numerous stations and vehicles, and they are approved by a wide variety of groups for operation in public settings in British Columbia, California, Germany, UK, Korea, and Japan. Many other countries are also beginning to install hydrogen station networks.

A series of typical questions and answers as they related to community concerns around hydrogen can be found in Appendix A. These questions can be reasonably anticipated at a public meeting.

3. Permitting

Permitting requirements will differ from station to station depending on the site characteristics, station type, and the local jurisdiction's unique processes. In BC, local governments have the ultimate authority to approve or deny any project. A design approved in one community does not guarantee approval of the same design in another community. However HTEC has successfully applied for permits in Vancouver, North Vancouver, Surrey, Burnaby, Whistler, and Woodside California, which should lend itself to valuable guidance for the permitting process within the CRD.

A major piece of the station permitting process is dedicated to ensuring stations are built to current codes and standards. The following text provides references to BC codes and guidance, which can be amended by local jurisdictions in certain circumstances. In BC, cities typically grant building permits as they relate to site usage, parking, setbacks, building code and electrical code compliance. Technical Safety BC is responsible for pressurized systems to ensure they comply with code and are operated safely. Both the Jurisdiction having authority (JHA) and Technical Safety BC will grant the operating permits.

a. Applicable Codes and Regulations

The following is a list of the most applicable codes to hydrogen fuelling infrastructure in BC.

- NFPA-2 National Fire Protection Association Hydrogen Technologies Code (2016). The purpose of this code shall be to provide fundamental safeguards for the generation, installation, storage piping, use, and handling of hydrogen in compressed gas (GH2) form or cryogenic liquid (LH2) form.
- CAN/BNQ 1784-000/2007 – Canadian Hydrogen Installation Code. The purpose of this code is to establish the installation requirements for hydrogen generating equipment, hydrogen utilization equipment, hydrogen dispensing equipment, hydrogen storage containers, hydrogen piping systems and their related accessories.
- ASME – B31.12 – Hydrogen Piping and Pipelines. This code is applicable to piping in gaseous and liquid hydrogen service and to pipelines in gaseous hydrogen service.
- CSA - C22.1-12 Canadian Electrical Code (2012) the object of this Code is to establish safety standards for the installation and maintenance of electrical equipment. In its preparation, consideration has been given to the prevention of fire and shock hazards, as well as proper maintenance and operation.
- CSA - B51-14 Boiler, Pressure Vessel, and Pressure Piping Code (2014) It is intended mainly to fulfill two objectives: first, to promote safe design, construction, installation, operation, inspection, testing, and repair practices, and second, to facilitate adoption of uniform requirements by Canadian jurisdictions.

b. Temporary Installations

The subject of temporary installations, moving stored hydrogen, and mobile refuellers as an option to permanent installations reveals that the overall permitting and safety requirements are similar at best, and in the case of mobile refuellers much more complex (see Appendix B for a discussion of mobile refuelling in California).

Moving stored hydrogen in Canada requires special Transport Canada permits, while moving a temporary fuelling station simply requires the station to be completely purged of any hydrogen, essentially making it an inert assembly of equipment.

Installing a temporary fuelling station has few precedents and by all indications would need to meet all of the codes and regulations set out for a permanent station. A temporary installation might fall under the category of a short term event, and each municipality may have less stringent requirements for foundations and structures, however it is unlikely the requirements

around siting, setbacks, and related safety equipment will be any different from a permanent station.

c. Regulatory Approval and Safety

Fuelling stations must meet the requirements of the local authorities having jurisdiction which include:

- Approval of the Municipality and Fire Department in which the Hydrogen refuelling station will be installed.
- Registration of pressure vessels pressure piping and fittings Boiler and Pressure Vessel Safety Program of the BCSA. The pressure retaining components for which the Boiler and Pressure Vessel Program has jurisdiction and for which design registration is required are defined in Part 1, section5.1
- Approval in principle from the BCSA, Engineering and Standards, for the proposed installation design.
- Satisfactory site inspection of the installed pressure vessels by a BCSA Boiler Safety officer as well as the complete fuelling station by a BCSA Gas Safety officer.

d. Site layout, setbacks and hazardous zone considerations.

Choosing the correct site is critical for hydrogen fuelling stations because installation of pressurised gas systems in British Columbia requires the review and approval by the BCSA. For public fuelling facilities a definitive set of Canadian codes and standards is not available when it comes to setback requirements. As such a Professional Engineering firm like HTEC must work with the BCSA and apply a combination of best practice and applicable codes from similar installations. From this, a design basis would be generated that ensures a safe design that would be accepted by the BCSA and fit on the selected site.

What makes this process complex is the need to balance regular building code requirements, hazardous zone needs, hydrogen specific setbacks, and general aesthetics. The biggest driver of setback requirements is the amount of stored hydrogen on site, and how far the storage is from exposures, which is defined as, among other things, existing building HVAC, property lines, public roads, sidewalks, parking, adjacent buildings, and overhead power lines.

A hydrogen fuelling facility integrated into an existing gas station needs to consider several codes including gasoline, cryogenic fluids, and hydrogen installation codes. Setbacks, or clearances to exposures, are prescribed by the codes in the case where there is a real risk to people or property (exposures) due to the amount of energy contained in the system. These are distinctly different from the hazardous zones required for electrical equipment. Hazardous zones for electrical equipment add further complexity to the siting requirements and have a direct bearing on the overall footprint of the hydrogen fuelling infrastructure and therefor the site itself. Hazardous zones are defined in Table 3.2 below.

The National Fire Protection Association's NFPA -2 and the National Standard of Canada's BNQ-1784-000 Canadian Hydrogen Installation Code set out a number of requirements regarding the installation of hydrogen systems. The NFPA-2 code is set to provide fundamental safeguards for the generation, installation, storage, piping, use, of hydrogen in compressed gas form. NFPA-2 provides a more comprehensive set of guidelines and as such HTEC recommends following NFPA-2 for hydrogen installations.

Table 3.1 is an excerpt from NFPA-2 and outlines the required clearance distances from bulk storage to exposures based on typical maximum pipe size. The hydrogen system will need to be examined for specific pressures and line size to determine exact setback requirements. The bulk storage system is defined as the storage vessel and associated pipework to the automatic shut-off valve, which the system can close in the event of a shut-down (emergency or otherwise). Bulk storage is any amount of compressed hydrogen storage above 141.6 Nm^3 (5,000 scf).

Table 3.1 : Excerpt from NFPA 2 – Minimum Distance from Outdoor GH2 Systems to Exposures (NFPA -2 Table 7.3.2.3.1.1(a))

Pressure	**>15 to ≤ 250 psig**	**>250 to ≤3000 psig**	**>3000 to ≤7500 psig**	**>7500 to ≤15000 psig**
Group 1 Exposures	m	m	m	m
• Lot line • Air intakes (HVAC, compressors, other) • Operable openings in buildings and structures • Ignition sources such as open flames and welding	12	14	9	10
Group 2 Exposures	m	m	m	m
• Exposed persons other than those servicing the system • Parked cars	6	7	4	5
Group 3 Exposures	m	m	m	m
• Buildings of non-combustible non-fire-rated construction • Buildings of combustible construction • Flammable gas storage systems above or below ground *Cont'd…*	5	6	4	4

• Hazardous materials storage systems above or below ground • Heavy timber, coal, or other slow-burning combustible solids • Ordinary combustibles, including fast-burning solids such as ordinary lumber, excelsior, paper, or combustible waste and vegetation other that found in maintained landscaped areas • Inoperable openings in buildings and structures • Encroachment by overhead utilities (horizontal distance from the vertical plane below nearest overhead electrical wire of building service) • Piping containing other hazardous materials • Flammable gas metering and regulating stations such as natural gas or propane				

In addition to setbacks based on stored energy, hazardous zone classification is required to meet section 18 of the Canadian Electrical Code. Section 18 of the Canadian Electrical Code, CSA22.1, requires the use of specific classified electrical equipment in locations defined as Hazardous. Hydrogen falls under this classification as it is deemed flammable, and as such, Class I atmospheres exist when this gas is present above the lower explosive limits (LEL). The LEL of hydrogen gas is 4.0% by volume.

Class I locations are further divided in to three zones depending on the frequency and duration of the explosive atmosphere. These zones are defined as follows:

Table 3.2 Hazardous Zone Definition

Zone	Definition
Zone 0	Explosive gas atmosphere present continuously or are present for long periods of time
Zone 1	Explosive gas atmosphere are likely to occur in normal operation, or, the location is adjacent to a Class I, Zone 0 from which explosive gas atmosphere could be communicated
Zone 2	Explosive gas atmospheres are not likely to occur in normal operation and, if they do occur, they will exist for a short time only; or, the location is adjacent to a Class I, Zone 1 location, from which explosive gas atmospheres could be communicated, unless such communication is prevented by means of positive ventilation (with safety system)

Depending on the rating of the classified zone, different requirements exist for the installation of electrical equipment. The specifics of these installation requirements are beyond the scope of this report, but can be ascertained from Section 18 of CSA22.1. Rigorous engineering calculations are required to ensure each hydrogen installation meets the electrical code in order to be considered safe. HTEC has gone through this exercise on numerous projects and is well equipped to provide guidance on hazardous zone classifications and related design and installation requirements. Pre-application outreach, public engagement, stakeholder buy in.

HTEC successfully designed and built a H2 station in Woodside, California and has successfully garnered building permits and BCSA approval for the first public hydrogen fuelling station to be built in BC, sited in the city of Vancouver. HTEC has installed, or participated in installing private stations in BC, which went through the same approval process as the public station, with the AHJ being the BCSA.

Key elements of success were finding the right site. For the public station in California HTEC analysed over 50 different site locations around San Francisco and engaged with specific station owners at good potential sites.

A good site is one that is situated close to early adopter neighbourhoods and close to major routes. The site has to have enough space to put an H2 station and separated H2 dispenser without complicated underground piping and without significantly affecting current traffic flows in area. Typically, it would require between 85-135 m^2 depending on the H2 production and onsite storage. The site has to have enough space for the manoeuvrability of a class 8 truck and trailer, which is similar to current gasoline delivery trucks. Since the compressors can generate noise a station should not be located in a very quiet neighbourhood. Compressor noises from a station located next to a relatively busy street would hardly be noticeable. The site should ideally already have high voltage supply onsite (600VAC).

In order to facilitate a successful approval early engagement and education of the property owner, particularly around the technology, the opportunities and the risks is important. The property owner will be called on throughout the application and construction process, so it is critical that they are fully educated to avoid costly changes or retraction of their commitment to the project.

Engagement with the fire department to provide first responder training, and local neighbours, educating them on the technology, the applicable codes, and how a proposed station will meet those codes will impart confidence and stave off any uninformed resistance during any public hearings.

Early engagement with the local municipality to understand concerns and local public hearings on site with vehicles, responding to public queries face to face meetings are all effective tools to facilitate a smooth permitting process.

HTEC are the only experts in BC in designing and building high pressure hydrogen systems, especially filling stations. HTEC is well positioned to would work with the local municipality, fire department, and the BCSA to get the approval of the building permit, and HTEC can work with the contractors to facilitate trade specific permits and ensure problem free construction and commissioning.

4. Infrastructure – OEM requirements and station components

In order to ensure complete compatibility between hydrogen vehicles and fuelling stations a set of protocols and equipment standards have been developed. These protocols and standards ensure problem free fuelling at any station build in North America. Stations that conform to these standards and protocols can reliably sell hydrogen fuel to for any hydrogen vehicle built by North American OEMs.

a. OEM Requirements

Published standard protocols and standards that relate to hydrogen fueling have been adopted by OEMs and most jurisdictions in order to ensure safety. The OEMs require rigorous validation testing of new hydrogen stations against the standards before they will allow their vehicles to be filled by customers. These protocols and standards are discussed here.

The Society of Automotive Engineers (SAE) International J2601:2014 – Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles sets out the filling rate and target pressure of the vehicle based on a number of input conditions such as vehicle temperature, ambient temperature, pressure and tank size. The protocol specifies a maximum hydrogen temperature of the hydrogen gas leaving the station. This standard also establishes under what conditions a fill must fall back to a more conservative fill case, and ultimately when a fill must be aborted. The outcome of the standard is to limit the maximum temperature of the hydrogen in the vehicle at the end of the fill. The act of filling a vehicle causes the hydrogen to warm up, and the Type 4 tanks used on FCEV have a maximum working temperature of 85C. This standard was developed to ensure that this temperature would never be exceeded under all conditions.

SAEs J2799:2014 - Communication Protocol establishes how the vehicle communicates critical information to the station, and is an integral part of J2601. There is provision within J2601 to fill a vehicle without this communication, but it is at a substantially reduced rate as a conservative alternative.

SAE J2600:2012 - Nozzle Geometry or ISO 14687 establishes the physical hydrogen interface between the vehicle and station to ensure a proper fit of the nozzle and the vehicle receptacle.

Hydrogen dispensed at the station shall meet the requirements in the SAE J2719: 2011, “Hydrogen Fuel Quality for Fuel Cell Vehicles”. This standard establishes the purity requirements for fuel cell grade hydrogen for use in FCEVs. The OEM’s will require a Quality

Control Plan to be implemented as part of the ongoing verification of compliance to J2719. Stations must undergo and pass the hydrogen purity test to become considered to be operational, and must undergo testing every 6 months. Station must also be tested if hydrogen lines are potentially exposed to contamination due to maintenance or other activity.

Under NFPA 2, hydrogen stations are required to conduct an initial leak check with the vehicle and 1-2 mid-fill checks depending on the starting pressure of the vehicle. While NFPA 2 is not legislated in BC, it is generally accepted as the best practice.

Under NFPA 2, hydrogen stations are required include a pressure reliving valve which conforms to ASME B31.3 and CGA S-1.3 located as close to the vehicle as possible. This is typically positioned inside the dispenser housing. While NFPA 2 is not legislated in BC, it is generally accepted as the best practice.

Hydrogen Vent Systems - CGA 5.5 and API 521 outline requirements for the design and installation of hydrogen vent systems. These are the requirements under both NFPA 2 and BNQ CHIC.

b. Station components

Hydrogen stations will have different designs depending on how the hydrogen is produced, delivered, and where the station is located. Hydrogen stations may be integrated into an existing fueling station, such as a gasoline or compressed natural gas station, or constructed as a stand-alone project. Every hydrogen station includes, at minimum:

i. Hydrogen storage tank(s)

At a fuelling station, hydrogen is stored on site in a storage tank. Different tanks exist to accommodate cryogenic liquid hydrogen, and low- and high-pressure compressed gaseous hydrogen. Storage tanks are constructed from hydrogen-safe materials and contain several pressure relief and safe-venting mechanisms. While all stations will have medium and high-pressure storage tanks, the hydrogen supply method will dictate the bulk storage tank design (cryogenic, low or medium pressure gaseous). Most stations in North America utilise gaseous delivery due to the proximity of liquid hydrogen facilities.

ii. Compressor

Hydrogen flows from the storage tank to the compressor, which reduces the volume and increases the pressure, preparing the hydrogen for fuelling. Compressors also contain real-time monitoring controls and pressure relief systems.

iii. Chiller

After leaving the compressor, hydrogen typically enters a closed-loop cooling system to chill the molecules prior to dispensing. The chiller enables high-pressure, fast fills. The SAE J2601 standard requires the hydrogen to be delivered (when possible, for maximum transfer rate) at -

37C. This results in a fairly large cooling load to be handled by the station. Alternatively, the station may choose to cool a warmer temperature (with a slower filling rate). The old J2601 standard allowed for very slow fills at ambient conditions, but this now requires special approval from the OEM's as it is not currently part of the current version of J2601.

iv. Dispenser

Modern hydrogen dispensers are very similar to typical gasoline, diesel or CNG dispensers. Dispensing equipment can sometimes be placed under the canopy at an existing fueling station, but some station agreements do not allow alternative fuels to be co-located under the branded canopy. Some stations have hydrogen dispensers on the same island as other dispensers; other stations have hydrogen dispensers on their own island under the fueling canopy, just outside of canopy or on a separate section of property. This typically comes down to the site owner's preference.

- The station shall meet the requirements of SAE J2601:2014 "Fuelling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles.
- Applicant should describe how they will demonstrate to the OEMs that they meet all performance and safety requirements.
- Station communications available for H70 fuelling according to SAE J2799

c. Hydrogen fuelling station maintenance considerations

General principles of routine preventative maintenance shall be applied, each component will require specific maintenance considerations and those need to be included in a comprehensive maintenance program. Information should be obtained from the equipment supplier to establish recommended practice for each item of the plant. The station developer should establish the overall maintenance program to be implemented once the station is operational.

Specific considerations for hydrogen fuelling station will include:

- Weekly on-site visual inspections
- Daily remote inspections via system monitoring and onsite security cameras
- Routine leak detection (monthly), such as bubble tests, at connections along the hydrogen supply infrastructure
- Routine calibration of hydrogen sensing equipment (every 3 months)
- Routine calibration of heat sensing equipment (every 3 months)
- Routine calibration of process sensors (annually) (pressure, flow, temperature, etc.)
- Periodic pressure tests of the pressurized systems
- Typical station control systems will run daily diagnostic pressure integrity test.
- Hydrogen compressor maintenance (annually).
- Coolant system inspection of level, temperature, and circulation loop integrity (monthly).
- Periodic third-party hydrogen quality sampling to ensure SAE standard compliance.
- Maintenance of hazardous zone compliance in terms of site cleanliness and proper storage of combustible materials

- Periodic manual safety system tests, including triggering hydrogen and flame sensors and e-stop push buttons (every 6 months)
- Safety relief device inspection and recertification (every 3 years)

Prior to station start-up a comprehensive maintenance program and supporting documentation should be in place.

Appendix A

Typical Safety Questions and Answers:

How safe is venting hydrogen? Venting hydrogen is safe. Vented hydrogen does not directly pose a threat to humans as it is neither toxic nor carcinogenic. However, it can lead to a fire, explosion or excessive noise so it is vented through vent stacks high above people and equipment. Once in the atmosphere, the vented hydrogen disperses and rises very rapidly thus further reducing any potential issues.

Is hydrogen safe to breathe in? Hydrogen should not be inhaled due to its fuel properties. In the event of inhalation or contact, hydrogen is neither toxic nor carcinogenic.

Does hydrogen have an odour like Natural Gas? Hydrogen does not have an odour. It is noted that pure natural gas does not have an odour. A sulphur smelling additive causes the odour of natural gas smelt by the public.

Is hydrogen flammable and could there be an explosion? Hydrogen is flammable and can lead to an explosion in a similar way as gasoline and diesel. All fuels need to be used and handled properly to ensure safety. Hydrogen stations have numerous safety systems including fire sensors, hydrogen sensors, non-sparking electrical systems, and specifically designed vent systems to ensure safety.

Is hydrogen more or less flammable than typical fuels? The flammability of hydrogen is very similar to gasoline and natural gas however ignition and burning characteristics are slightly different. Both gasoline and diesel will ignite if a flame or spark is applied to a mixture of less than 1.5% in air, hydrogen needs to be in a mixture of at least 4% in air to ignite. Due to the lightness of hydrogen compared to air, hydrogen will disperse rapidly in an open area which means hydrogen will not pool like the fumes of other fuel sources. . Although hydrogen has a lower energy density, it can be ignited with a smaller amount of energy, therefore the potential dangers of hydrogen are similar to incumbent fuels. All need to be treated as flammable.

Can my kids still play outside during venting/deliveries? Yes, no problems at all, the process and systems are designed to be safe with multiple fail-safe features.

What are the risks for neighbors (especially those that live nearby) and customers visiting the site? The addition of hydrogen fuel to an existing fueling station does not increase the risk to neighbors or drivers, or general public. The quantity of hydrogen fuel at the site is far less than what is contained in gasoline, diesel or propane tanks at a typical station. Hydrogen is delivered in fully contained systems such that any venting is directed away safely. Customers

will not be exposed to hydrogen fuel in the way they are to gasoline or diesel while using filling nozzles.

What are we doing to ensure the safety of the community and customers/site staff?
Emergency response programs will be created that integrate with existing site procedures as well as coordinating with first responders and fire fighters to make sure they are aware that hydrogen is on site and how to handle it in the event of emergency. Special site signage is also added to help improve safety.

Appendix B

As more FCEVs take the road and the hydrogen station network expands, mobile refuelers will be able to provide additional capacity in the case of station repair, or other unforeseen needs. With a hydrogen compressor, storage and dispenser on-board, mobile refuelers have capability to travel to designated locations and fill vehicles.

Mobile refuelers require specific approvals. Tanks on the mobile refueler will need to meet U.S. Department of Transportation (DOT) standards for moving flammable gases, either as pre-approved DOT tanks or special permit tanks. (The primary relevant regulation is 49 CFR 173.301.)67,68

The Compressed Gas Association TB25 “Design Considerations for Tube Trailers,” which has been incorporated by reference into 49 CFR 173.01, offers a solid starting point for planning to comply with DOT regulations. It should be used for performing analysis or performance testing. For composite tanks commonly used to store hydrogen, DOT standards require a full range of testing to verify integrity. Prior to testing, it is recommended that manufacturers of mobile refuelers contact the Pipeline and Hazardous Materials Safety Administration (PHMSA) at DOT to ensure tests and methods meet all requirements.

The California Fire Code and International Fire Code do not contain guidance on mobile fueling, but, depending on the site, there is information on mobile refueling in NFPA 2. Manufacturers of mobile refuelers should review NFPA 2 to ensure project compliance.

Making a difference...together

REPORT TO FIRST NATIONS RELATIONS COMMITTEE
MEETING OF WEDNESDAY, JANUARY 26, 2022

SUBJECT **First Nations Relations Operational Update**

ISSUE SUMMARY

To provide, for information, an update on some of the initiatives underway in support of the Board priority of advancing strong relationships with First Nations.

BACKGROUND

The CRD's Statement of Reconciliation acknowledges the fundamental right of self-determination to Indigenous peoples, and commits to working with First Nations through the governance systems they choose. Initiatives underway to support this goal include:

- Staff are developing a First Nations Relations Communications Framework to provide a guide for CRD employees on the essentials of respectful, concise, constructive and professional intergovernmental communication with First Nations. Through this framework staff can be more effective and strategic on how and when to engage the Nations, so as to support respectful, positive relationships.

- Staff are developing a Working with Indigenous Elders Guidance Document, to support staff to build respectful relationships with Indigenous Elders.

- CRD staff are exploring requests from First Nations to develop Memorandum of Understandings and to provide capacity funding to enable First Nations to more effectively engage with CRD operations. It is anticipated that governance and funding requests arising from these discussions will be brought forward to the Board.

The CRD's Statement of Reconciliation recognizes the gap in wealth between First Nations and settler governments, and commits to working towards a prosperous economic future for all. To this end, initiatives include:

- Assisting operations staff in collaborating with First Nations in response to requests regarding land use planning, wastewater and water servicing, and solid waste management.

- One of the recommendations in the CRD First Nation Economic Development Partnership Model Feasibility Study Report (May 2020) was to increase opportunities for First Nations employment across CRD, through mentorship and job shadowing opportunities, Indigenous internships, and an Indigenous employment strategy. A consultant will be engaged to produce a report with recommendations for best practices around Indigenous employment in a settler government context, based on lessons learned elsewhere from Indigenous internship programs and Indigenous employment more broadly, to lay the groundwork for what would need to be put in place internally prior to any new program. Staff, with the support of the consultant, will also connect with the local Nations regarding

their employment goals and how to support a culturally safe working environment within the CRD. It is anticipated that the launch of an Indigenous internship program will require additional funding. Staff will bring forward recommendations and a budget request to the Board on receipt of the consultant's recommendations on program design and the delivery model.

One of the Calls to Action from the Truth and Reconciliation Commission was to provide education "on the history of Aboriginal peoples, including the history and legacy of residential schools, the United Nations Declaration on the Rights of Indigenous Peoples, Treaties and Aboriginal rights, Indigenous law, and Aboriginal–Crown relations. This will require skills-based training in intercultural competency, conflict resolution, human rights, and anti-racism." The following education initiatives are underway:

- The CRD Board will be offered a 3-hour Introduction to Cultural Perspectives Training on February 23rd, delivered by Indigenous Perspectives Society. The training will focus on understanding history, dispelling myths and stereotypes, and building local relationships.

- All CRD leadership, managers and staff, including auxiliary staff, will be offered an essential 2-hour Cultural Competency Seminar. To reach all staff, twenty seminars will be delivered between March to June 2022, incorporating 90 minutes offered by Indigenous Perspectives Society and 30 minutes with First Nations Relations staff.

- CRD Executive Leadership Team, plus those managers and staff who work directly with members from the local First Nations, will also be offered a 3-hour Building Local Relationships Workshop. For these staff, eight workshops will be offered between March to June 2022, delivered by Indigenous Perspectives Society.

- First Nations Relations and Corporate Communications continue to proactively identify opportunities for education, such as was done with informative posts for all staff related to the National Day for Truth and Reconciliation.

ALTERNATIVES

Alternative 1
The First Nations Relations Committee recommends to the Capital Regional District Board:
That the First Nations Relations Operation Update report be received for information.

Alternative 2
The First Nations Relations Committee recommends to the Capital Regional District Board:
That the report be sent back to staff for additional information.

IMPLICATIONS

Intergovernmental Implications
By uplifting self-determination, promoting opportunities for economic prosperity and raising awareness amongst CRD staff and Board, these initiatives contribute towards efforts to build trusting, reciprocal government-to-government relationships with First Nations.

Social Implications

The CRD's Statement of Reconciliation recognizes the gap in wealth between First Nations and settler governments. By exploring ways to support First Nations economic opportunities, such as through wastewater and water servicing, the CRD is taking steps to support the economic goals of First Nations.

Alignment with Board & Corporate Priorities
This aligns with the Board priority of taking measurable steps toward developing respectful government-to-government relationships and partnerships with First Nations to foster shared prosperity for all.

Alignment with Existing Plans & Strategies
This work aligns with the CRD's Task Force on First Nations Relations and the CRD's Statement of Reconciliation, and complements the CRD's ability to engage with First Nations on all relevant plans and strategies.

CONCLUSION

Some of the initiatives underway in support of the Board priority of advancing strong relationships with First Nations include: offering cultural competency training to all CRD employees and Board Directors; exploring best practices for supporting Indigenous employment; producing a respectful communications framework for staff; participating in intergovernmental discussions regarding CRD service delivery and collaboration to support the development of government-to-government relationships.

RECOMMENDATION

The First Nations Relations Committee recommends to the Capital Regional District Board:
That the First Nations Relations Operational Update report be received for information.

Submitted by:	Caitlyn Vernon, MES, Manager, First Nations Relations
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

Making a difference...together

REPORT TO GOVERNANCE COMMITTEE
MEETING OF WEDNESDAY, OCTOBER 06, 2021

SUBJECT **Capital Regional District Board Policy on Regional Grants-in-Aid**

ISSUE SUMMARY

To provide an overview and history of the Regional Grants-In-Aid Board Policy.

BACKGROUND

As directed at the February 3, 2021, Governance Committee meeting, this report provides an overview of the legislation, policy and history of regional grants-in-aid (GIA).

The Capital Regional District (CRD) receives funding requests from various organizations for initiatives, programs, and/or capital purchases.

- Under the *Local Government Act* Section 263 (1) (c) the CRD has authority to provide regional GIA to organizations in the form of grants, benefit, or advantage, and under Section 380 (g) costs may be apportioned either by way of all electoral areas and municipalities or only those electoral areas or municipalities benefitting from the service.
- Under the Supplementary Letters Patent (SLP), dated March 24, 1977, and amended 17 April 1985, the CRD also has authority to deliver GIA to organizations within the Electoral Areas (EA).
- Under Section 273, as a limitation on section 263 (1) (c) a board must not provide assistance to an industrial, commercial or business undertaking.

A Board policy approved on February 23, 1994, is currently still in place. The policy states that "the Board establish a no grants policy regarding regional grant-in-aid, other than those regional grants-in-aid from a single jurisdiction". Appendix A includes an excerpt of the February 1994 minutes, providing context to the Board decision at the time. This policy allows for requisition of regional GIA only when it is to be collected from a single jurisdiction.

Appendix B provides a summary of the regional GIA requests received by the CRD over the years. The two cases where an exception to the policy was made since 1994 are as follows:

1. November 14, 2012: Island Corridor Foundation (ICF) Funding Request, for $1.2 million. The CRD raised the funds in 2013, 2014, and 2015 through tax requisition, and the funding has not yet been distributed.
2. May 26, 2016: Support to the Fort McMurray Region in the Wake of Northern Alberta Wildfires, for $2,500.

The current Regional Grants-In-Aid Board Policy aligns current legislation and has not been revised since 1994.

ALTERNATIVES

Alternative 1
The Governance Committee recommends to the Capital Regional District Board:
That the Capital Regional District Board Policy on Regional Grants-in-Aid report be received for information.

Alternative 2
The Governance Committee recommends to the Capital Regional District Board:
That staff be directed to amend the Regional Grants-in-Aid Board Policy.

IMPLICATIONS

Service Delivery Implications

Alternative 1
While the Board has the service authority to provide GIA to regionally significant projects and has made exceptions, the CRD has an established no regional GIA policy and practice since 1994. The current policy allows for regional GIA requests to be funded by a single municipality or EA. The Board has the authority by way of policy to keep and maintain the existing practice without changes.

Alternative 2a
As many municipalities provide GIA funding programs at the municipal level, regional GIA requests only benefiting the single jurisdiction are more likely to be considered by the municipality. The Board policy could be amended to exclude all grants-in-aid by removing “regional grants-in-aid collected from a single jurisdiction”, aligning the Board Policy “no grants-in-aid” to include those from a single jurisdiction.

Alternative 2b
The Board has the service authority to provide GIA regionally or within electoral areas and municipalities benefitting from the service. The policy could be rescinded or amended to allow for grants, in which case requests for regional and specified area grants-in-aid would be considered and approved on a case-by-case basis.

Financial Implications

The CRD has authority to provide regional GIA to external organizations. The LGA (s. 374(9)) sets the annual requisition limit of $0.10 per $1,000 on the net taxable value of land and improvements in the regional district. Based on 2021 assessment value, the maximum requisition is $13 million. Requisition is cost apportioned on the basis of the converted value of land and improvements per LGA (s. 380 (2)) across all regional participants or only those EA’s and municipalities benefitting from the service.

CONCLUSION

The CRD has service authority under the LGA to provide funding to regional GIA projects. Historically, the CRD has maintained a no regional GIA policy, except in exceptional circumstances or in a single jurisdiction.

RECOMMENDATION

The Governance Committee recommends to the Capital Regional District Board:
That the Capital Regional District Board Policy on Regional Grants-in-Aid report be received for information.

Submitted by:	Rianna Lachance, BCom, CPA, CA, Senior Manager, Financial Services
Concurrence:	Nelson Chan, MBA, FCPA, FCMA, Chief Financial Officer
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT(S)

Appendix A: CRD Board Minutes from February 23, 1994
Appendix B: History of Past Regional GIA Requests

Delegation re: Proposed Cecelia Septage Disposal Rates

Mr. James Stewart, owner\operator of a septage service business, indicated that the increase in septage rates under Bylaw No. 2195 was the third increase in nine months and in that time the fees have risen 54%. Mr. Stewart asked for an explanation of the reasons for an increase at this time and whether any future increase was contemplated. Mr. Stewart also commented that it would be helpful if haulers were notified prior to increases being set in motion.

Director Butler explained that the increase in rates for septage disposal came about as part of the Environment Committee's budget deliberations in January and that Committee recommended to the Board that the fee be raised. Mr. Williams noted that as soon as Committee made this decision, haulers were notified and that the reason for the increase is that Committee believes the septage function should operate on a complete user pay system . If this policy continues then there will be further increases. Director Butler added that this service is currently subsidized and that the user fee would be $5.60 per 100 imperial gallons if the service were to operate on a complete user pay basis.

2142 Tabled item from January 26, 1994 Meeting: Board Policy on Regional Grants-in-Aid

MOVED by Director Clark, SECONDED by Director Camden,
that this item be lifted from the table.

CARRIED

Mr. Jordan spoke to the staff report on this subject which reviewed the statutory authority for regional grants and provided background information on the grant policies of the Intermunicipal Committee and the various municipalities in the region. It was indicated that regional grants-in-aid are entirely separate from Electoral Area grants-in-aid and that the disbursement of regional grants-in-aid has been very limited, i.e. two to date.

MOVED by Director Imrie, SECONDED by Director Ranns,
that the Board establish a no grants policy regarding regional grants-in-aid.

There was considerable debate on the motion. Directors in support of the motion felt that the CRD should hold the line on such grants and that it was not appropriate for the CRD Board to be involved in a grant program. It was noted that the increasing trend towards downloading of various programs by senior levels of government could result in more requests for grant money at the local government level. There was concern that there could be duplication in requests for grants at the municipal and regional level.

Directors opposed to the policy indicated that some grants are for very worthy causes that should be supported where appropriate. It was noted that for many years the four core municipalities have supported numerous organizations and events which benefit the entire region. A suggestion was made that a coordinated strategy for funding grants on a regional basis be explored whereby the tax burden could be shared by all of the benefitting areas. It was stated that the Municipal Act provides the authority to levy for regional grants and that the proposed policy would mean that the CRD would not be in a position to consider worthy requests. In response to the concern over a possible increase in grant requests, it was pointed out that the Board would have the right to reduce the level of grants and would be in a position to approve or disapprove any grant request thereby exercising control over the situation. It was recommended that the CRD look at how something similar to the Intermunicipal Committee could be put in place in the region.

There was discussion regarding the difference between regional grants-in-aid and electoral area grants-in-aid. Mr. Jordan explained that regional grants-in-aid are levied on the whole of the CRD and cost shared on the basis of converted assessments. However, there is provision for costs of regional grants-in-aid to be levied in a single benefitting municipality or electoral area.

With the permission of the Mover and Seconder, the motion was amended to add the following:

"other than those regional grants-in-aid collected from a single jurisdiction."

Following further debate, the motion as amended was then put, CARRIED

2143 Regional Grant-in-Aid Request for "Artspring" (Salt Spring Island)

MOVED by Director Luth, SECONDED by Director Clark, that the matter be tabled.

CARRIED

2144 Contract with District of Langford for Provision of a Message Relay Service for CRD 9-1-1 Emergency Response Telephone System

MOVED by Director Camden, SECONDED by Director Bergbusch, that the Board approve the contract with the District of Langford, and authorize the signing officers of the Board to execute the contract.

CARRIED

2145 Payment of Sooke Incorporation/Restructure Study

MOVED by Director Clark, SECONDED by Director Rosko, that the Minister of Municipal Affairs be advised that the Capital Regional District does not wish to be the banker for the present incorporation study for Sooke.

CARRIED

2146 Young Offenders Act

MOVED by Director Butler, SECONDED by Alternate Director Blackwell, that the correspondence be received.

CARRIED

2147 Sooke Parks and Recreation Commission - Park Land Acquisition and Exchange

MOVED by Director Clark, SECONDED by Director West, that the Board approve:

1. a bylaw to authorize the Capital Regional District to exchange a portion of land dedicated as Park (as shown on Plan 40027 attached to the report) for other land described in the Bylaw suitable for park purposes within the Sooke Electoral Area, and;

2. the Contract of Purchase and Sale between the Capital Regional District and Braemar Developments Ltd. on the terms and conditions detailed herein.

CARRIED

2148 Proposed Boundary Extension - City of Colwood

MOVED by Director Bergbusch, SECONDED by Director Coell, that the correspondence be received.

CARRIED

6. BYLAWS AND RESOLUTIONS

Bylaw No. 2195, "Septage Regulation Bylaw No. 1, 1980, Amendment Bylaw No. 14, 1994"

MOVED by Director Prentice, SECONDED by Director Coell, that Bylaw No. 2195 be reconsidered and finally adopted.

CARRIED

Bylaw No. 2191, "Sooke Advisory Planning Commission Bylaw No. 1, 1994"

MOVED by Director Clark, SECONDED by Director West, that Bylaw No. 2191 be introduced and read a first time.

CARRIED

Appendix B History of Past Regional Grant-in-Aid Requests (since 1994)

1. May 26, 2016: Support to the Fort McMurray Region in the Wake of Northern Alberta Wildfires, approved for $2,500.

2. September 9, 2015: Urban Wildlife Stewardship Society Funding Request, request for $35,000, regional GIA request declined.

3. November 14, 2012: Island Corridor Foundation Funding Request, approved for $1.2 million.

4. August 8, 2012: Salish Express Commuter Rail Implementation Funding Plan Request, request for $70,000, regional GIA request declined.

5. April 11, 2007: Island Corridor Foundation Grant-in-Aid Request, request for $4,899.02, regional GIA request declined.

6. February 23, 1994: Board Policy on Regional GIA
    a. Moved that "the Board establish a no grants policy regarding regional GIA" and amended to include "other than those regional GIA collected from a single jurisdiction."
        i. The Board adopted a regional GIA policy in February 1994 (Appendix A).

7. January 26, 1994: Regional GIA Request from the Community Social Planning Council of Victoria, request for $22,100, regional GIA request declined.

Making a difference...together

REPORT TO PERFORMING ARTS FACILITIES SELECT COMMITTEE
MEETING OF WEDNESDAY, JANUARY 19, 2022

SUBJECT **2022 Performing Arts Facilities Select Committee Terms of Reference**

ISSUE SUMMARY

This report is to provide the 2022 Performing Arts Facilities Select Committee updated Terms of Reference for the Committee's review.

BACKGROUND

At its meeting of March 10, 2021, the Board supported a motion "to begin the process of establishing a regional service for the purposes of planning, developing and funding of performing arts facilities that have regional impact."

On April 14, 2021, the Board approved the 2021 Terms of Reference (TOR) for the Performing Arts Facilities Select Committee (the "Committee").

On October 13, 2021, the Board passed an amended motion that sent the issue back to the Committee for further study of options for a full regional service that does not include Alternative Approval Process or for a sub-regional service.

On December 8, 2021, the Committee reconvened to consider a new set of staff reports on full regional and sub-regional options. The Committee passed a motion asking staff to provide more information on the costs, timeline, and staffing required to conduct a region-wide referendum.

The Committee's mandate remains to define the scope of a service that will plan, develop and fund regional performing arts facilities. Without a need for ongoing external participation and, in having a defined purpose, the most appropriate committee structure is a Select Committee, which will be dissolved once its purpose is completed.

For 2022, item 2.0, c in the TOR has been removed as the work of the Committee has continued through 2021 and may continue to send recommendations and/or reports to the CRD Board in 2022. Draft terms of reference, showing the change, are attached to this report at Appendix A. The proposed revision to the TOR will require ratification by the Board.

CONCLUSION

The Performing Arts Facilities Select Committee reviewed its Terms of Reference to ensure they were still relevant to its work and applicable to any timelines contained therein.

RECOMMENDATION

The Performing Arts Facilities Select Committee recommends to the Capital Regional District Board:
That the 2022 Performing Arts Facilities Select Committee Terms of Reference attached at Appendix A be approved.

Submitted by:	Chris Gilpin, MPA, Manager, Arts & Culture
Concurrence:	Nelson Chan, MBA, FCPA, FCMA, Chief Financial Officer
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT(S)

Appendix A: 2022 Performing Arts Facilities Select Committee Terms of Reference

Terms of Reference

PERFORMING ARTS FACILITIES SELECT COMMITTEE

PREAMBLE

Acting on the Board motion to establish a regional performing arts facilities service for the planning, development and funding of regional performing arts facilities, the Performing Arts Facilities Select Committee is established by the CRD Board to advise and make recommendations to the Board on the scope and function of a CRD Performing Arts Facilities Service.

The Performing Arts Facilities Service is intended to provide regional oversight on the planning, development and funding of regionally significant arts facilities. Participants would be all municipalities and electoral areas.

The Select Committee's official name is to be:

Performing Arts Facilities Select Committee

1.0 PURPOSE

The mandate of the Committee is to:

- Provide recommendations to the CRD Board on the scope of a service that will plan, develop and fund regional performing arts facilities in order to provide staff direction in the creation of an establishing bylaw.

2.0 ESTABLISHMENT AND AUTHORITY

a) The Board Chair will appoint the Committee Chair and Committee members.
b) The Committee will make recommendations to the Board for consideration.
~~c) A report is expected by the end of 2021.~~

3.0 COMPOSITION

a) The Chair, Vice-Chair and Committee members are appointed annually by the Board Chair.
b) Committee members will be comprised of a number of CRD Directors providing regional representation as deemed appropriate by the Board. Directors appointed to the Select Committee may have their Alternates attend in their place.

4.0 PROCEDURES

a) The Committee shall meet at the call of the Committee Chair.
b) The Committee Chair shall determine the agenda or meetings in consultation with staff and any Committee member may request that a matter be placed on the agenda.

5.0 RESOURCES AND SUPPORT

a) The CFO/General Manager, Finance and Technology, will provide strategic support and act as a liaison.
b) Minutes and agendas are prepared and distributed by the Corporate Services Division.
c) The Arts & and Culture Support Service will provide additional administrative support as required.

Approved by CRD Board on _____, 2022

Making a difference...together

REPORT TO REGIONAL PARKS COMMITTEE
MEETING OF WEDNESDAY, JANUARY 26, 2022

SUBJECT **2022 Regional Parks Committee Terms of Reference**

ISSUE SUMMARY

This report is to provide the 2022 Regional Parks Committee Terms of Reference for the Committee's review.

BACKGROUND

Under the *Local Government Act* and the Capital Regional District (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 December 8, 2021, the Regional Board approved the 2022 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.

For 2022, the mandate for Regional Trails was added to the defined purpose of the Transportation Committee and removed from the Regional Parks Committee TOR. A redlined copy of the 2022 Regional Parks Committee TOR is attached as Appendix B.

The TOR are being provided for review by 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.

RECOMMENDATION

That the Regional Parks Committee receive the 2022 Terms of Reference, attached as Appendix A.

Submitted by:	Kristen Morley, JD, General Manager and Corporate Officer, Corporate Services
Concurrence:	Larisa Hutcheson, P.Eng., General Manager, Parks & Environmental Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENTS

Appendix A: 2022 Regional Parks Committee Terms of Reference
Appendix B: 2022 Regional Parks Committee Terms of Reference (Redlined)

APPENDIX A

Terms of Reference

REGIONAL PARKS COMMITTEE

PREAMBLE

The Capital Regional District (CRD) Regional Parks Committee is a standing committee established by the CRD Board and will oversee and make recommendations to the Board regarding regional parks.

The Committee's official name is to be:

Regional Parks Committee

1.0 PURPOSE

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

i. Regional parks, including land acquisition, management, operations and programs
ii. Regional Parks Strategic Plan, Land Acquisition Strategy

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, except August and December, 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 & 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 December 8, 2021



REGIONAL PARKS COMMITTEE

PREAMBLE

The Capital Regional District (CRD) Regional Parks Committee is a standing committee established by the CRD Board and will oversee and make recommendations to the Board regarding regional parks.

The Committee's official name is to be:

Regional Parks Committee

1.0 PURPOSE

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

i. Regional parks ~~and trails~~, including land acquisition, management, operations and programs
ii. Regional Parks Strategic Plan, Land Acquisition Strategy

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, except August and December, 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 & 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 _____

Making a difference...together

REPORT TO CAPITAL REGIONAL DISTRICT BOARD
MEETING OF WEDNESDAY, FEBRUARY 09, 2022

SUBJECT **Bylaw No. 4478: Cedars of Tuam Loan Authorization Bylaw No. 2, 2022**

ISSUE SUMMARY

A Capital Regional District (CRD) Board resolution is required to approve Loan Authorization Bylaw No. 4478 for the purposes of financing the non-grant portion of the project costs for Cedars of Tuam Water System Upgrade.

BACKGROUND

The Cedars of Tuam Water System service provides potable water to 16 residences. The water system obtains its drinking water from a well located 200m southwest of Roland Road. The existing well and water treatment plant are at the end of their useful life and have seen declining production over the past number of years. During the summer 2021 drought, water had to be trucked in to meet the demand of the residents. Funds are required to complete the new well and water treatment plant upgrade project. This will provide a safe and secure supply of potable water to the community.

To fund this project, the Cedars of Tuam Water Service will be submitting an application to the Investing in Canada Infrastructure Program – Environmental Quality Stream (ICIP-EQ). The ICIP-EQ program requires a loan authorization bylaw prior to submitting an application if local governments use debt borrowing to fund the non-grant portion of the project. A certified copy of the loan authorization bylaw at third reading is required with the application package. The deadline for the grant program is February 23, 2022.

The total borrowing up to $600,000 over a 30-year term to fund the non-grant portion of the project is recommended by Cedars of Tuam Water Service Commission (the "Commission") to the Electoral Areas Committee and CRD Board for approval.

Borrowing from the Municipal Finance Authority of British Columbia (MFABC) under this bylaw will only occur if the grant application is successful.

The following bylaw is proposed:

Service Area	Action	Purpose	Bylaw
2.622	Loan Authorization Bylaw	To create a loan authorization bylaw to permit long-term borrowing related to the capital plan for this service.	4478 "Cedars of Tuam Loan Authorization Bylaw No. 2, 2022"

ALTERNATIVES

Alternative 1

1. That Bylaw No. 4478, "Cedars of Tuam Loan Authorization Bylaw No. 2, 2022", be introduced and read a first, second and third time; and
2. That the referral of Bylaw No. 4478 to the Inspector of Municipalities for approval be withheld until staff report back on the result of the grant application.

Alternative 2

That this report be referred back to staff for additional information.

IMPLICATIONS

Legislative Implications

Long-term borrowing (i.e. loans with term of more than 5 years) cannot be undertaken without the loan authorization bylaw being approved by the Inspector of Municipalities. In addition, in accordance with the Local Government Act, elector approval is required in order to approve the loan authorization bylaw by consent on behalf of the service's participating areas, by Alternative Approval Process (AAP) or by petition. The method of elector approval process will be presented at a future CRD Board meeting for approval.

The recommendation is to give third reading to the loan authorization bylaw to support the grant application. The request for approval by the Inspector of Municipalities will be withheld pending a successful grant application.

Financial Implications

The total estimated project cost is $1,743,500 to be funded by potential ICIP-EQ grant ($1,143,500) for eligible portion and the debt ($600,000) for in-eligible portion. The estimated debt servicing costs for borrowing $600,000 and the Water System Upgrade project are included in the final 2022-2026 financial plan. Based on MFABC's indicative interest rate, the estimated annual debt servicing cost of $600,000 over an amortization term of 30 years is $32,160 or $2,010 per taxable folio (based on 16 taxable folios in the service). This would be an additional parcel tax requisition for taxpayers in the service area. This project will not likely proceed without ICIP-EQ grant award. Other grant opportunities could be sought in the future.

The timing of the actual debt issuance and commencement of payments will be based on grant approval and the subsequent timing of expenditures. The parcel tax amount will be dependent on prevailing interest rates at the time.

To ensure optimization of interest and timing of long term debt, issuance of a temporary borrowing bill is proposed if the grant is approved, electoral assent is received and the Ministerial Approval is obtained. The timing of the debt issuance will be based on the timing of expenditures and will be dependent on the prevailing interest rates at that time. Before long term debt issuance can be exercised, a security issuing bylaw will be brought forward for approval. The term of any debt issuance under such loan authorization will be 30 years.

CONCLUSION

The Salt Spring Island Cedars of Tuam Water System requires upgrade to provide a safe and secure supply of potable water to the community. To fund the project costs estimated at $1,743,500, CRD will be submitting a grant application through ICIP-EQ for $1,143,500. The non-grant funded portion of $600,000 will require long-term borrowing. The ICIP-EQ grant program requires a loan authorization bylaw to receive its three readings prior to application submission. The elector approval process for the loan authorization bylaw will be determined by staff if the ICIP-EQ grant application is successful.

RECOMMENDATION

1. That Bylaw No. 4478, "Cedars of Tuam Loan Authorization Bylaw No. 2, 2022", be introduced and read a first, second and third time; and
2. That the referral of Bylaw No. 4478 to the Inspector of Municipalities for approval be withheld until staff report back on the result of the grant application.

Submitted by:	Rianna Lachance, BCom, CPA, CA, Senior Manager, Financial Services
Concurrence:	Nelson Chan, MBA, FCPA, FCMA, Chief Financial Officer
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT(S)

Appendix A: Bylaw No. 4478, "Cedars of Tuam Loan Authorization Bylaw No. 2, 2022"

CAPITAL REGIONAL DISTRICT

BYLAW NO. 4478

****

A BYLAW TO AUTHORIZE THE BORROWING OF SIX HUNDRED THOUSAND DOLLARS ($600,000) FOR THE CEDARS OF TUAM WATER SYSTEM UPGRADE

****

WHEREAS:

A. Under Bylaw No. 3021, "Salt Spring Island Cedars of Tuam Water System Establishment Bylaw No. 1, 2002", the Capital Regional District established a local service for the operation of a service for the supply, conveyance, treatment and storage and distribution of water;

B. The Cedars of Tuam water system requires capital renewal and upgrades, which will involve the planning, study, project administration, project communications, and staff time required for design and construction of facilities, design and construction of facilities for supply, conveyance, treatment and storage and distribution of water, as well as other related works, facilities and equipment purchases;

C. The estimated cost of the works, facilities and equipment, including expenses incidental thereto to be funded from debt servicing, is the sum of Six Hundred Thousand Dollars ($600,000) which is the amount of debt intended to be authorized by this bylaw;

D. Pursuant to Section 407 of the *Local Government Act*, participating area approval is required and shall be obtained by alternative approval process under Section 345 of the *Local Government Act*;

E. The approval of the Inspector of Municipalities is required under Section 403 of the *Local Government Act*;

F. The financing is to be undertaken by the Municipal Finance Authority of British Columbia.

NOW THEREFORE the Board of the Capital Regional District in open meeting assembled enacts as follows:

1. The Board is hereby empowered and authorized to undertake and carry out or cause to be carried out the capital renewal and upgrade of the Cedars of Tuam water system, which will involve the planning, study, project administration, project communications, staff time required for design and construction of facilities for the supply, conveyance, treatment and storage and distribution of water, as well as other related works, facilities and equipment purchases:

   (a) to borrow upon the credit of the Capital Regional District a sum not exceeding Six Hundred Thousand Dollars ($600,000);

(b) to acquire all such real property, easements, rights-of-way, leases, licenses, rights or authorities as may be requisite or desirable for or in connection with the planning, study, design and construction of the water system for the collection, conveyance, treatment and all related ancillary works, studies and equipment deemed necessary by the Board.

2. The maximum term for which debentures may be issued to secure the debt intended to be created by this bylaw is 30 years.

3. This Bylaw may be cited as the "Cedars of Tuam Loan Authorization Bylaw No. 2, 2022".

READ A FIRST TIME THIS ___ day of _____ 202_

READ A SECOND TIME THIS ___ day of _____ 202_

READ A THIRD TIME THIS ___ day of _____ 202_

APPROVED BY THE
INSPECTOR OF MUNICIPALITIES THIS — day of _____ 202_

RECEIVED PARTICIPATING AREA
APPROVAL UNDER SECTION 342(2) OF
THE *LOCAL GOVERNMENT ACT* THIS ___ day of _____ 202_

ADOPTED THIS ___ day of _____ 202_

_____ _____
CHAIR CORPORATE OFFICER

FILED WITH THE INSPECTOR OF MUNICIPALITIES THIS ____ day of _____ 202_

Making a difference...together

REPORT TO ELECTORAL AREAS COMMITTEE
MEETING OF WEDNESDAY, FEBRUARY 9, 2022

SUBJECT **Bylaw No. 4480 - Building Permit Information Reports – Fee Increase**

ISSUE SUMMARY

Increasing fees for a Building Permit Information Report to $100 from $30.

BACKGROUND

On October 13, 2021, the Electoral Areas Committee directed staff to review and report on the current fees charged for Building Permit Information Reports.

The Building Inspection Division has seen steady increases in most types of information requests over the past several years. Information requests come to the Division as Freedom of Information and Protection of Privacy (FOI) requests, for which we may only charge for staff time beyond 3 hours, and property file requests by owners must be provided at little to no cost. These requests are most frequently requested by real estate agents or parties interested in purchasing a property. Building Permit Information Reports have been more stable, are restricted to permit statuses, and cost $30 under Bylaw No. 3741, "Building Regulation Bylaw No. 5, 2010".

In order to ensure costs for the staff time needed to prepare these reports is recovered, Bylaw No. 4480, "Building Regulation Bylaw No. 5, 2010, Amendment Bylaw No. 3, 2022", now increases the cost of these reports to $100.

The fee recommended includes actual staff cost per hour and an estimate of associated time spent per report by the Administrative Clerk and, when necessary, the Administrative Coordinator or Division Manager. In establishing a recommended fee, consideration was made to ensure that the fee not be so high as to discourage these requests and to inadvertently encourage the submitting of FOI requests instead, at a higher cost to the Division and a slower rate of fulfillment to the applicant.

ALTERNATIVES

Alternative 1
The Electoral Areas Committee recommends to the Capital Regional District Board:
1) That Bylaw No. 4480, "Building Regulation Bylaw No. 5, 2010, Amendment Bylaw No. 3, 2022", be introduced and read a first, second, and third time; and
2) That Bylaw No. 4480 be adopted.

Alternative 2
That the Bylaw No. 4480 - Building Permit Information Reports – Fee Increase report be referred back to staff for further information based on Electoral Areas Committee direction.

IMPLICATIONS

Service Delivery Implications
Requests for all types of information reports will continue to increase as we have seen over recent years. The increase will continue to demand more staff time, with associated costs, and less time will be available for staff to perform other needed Division duties. An increase in Building Permit Information Report fees will lead to more realistic cost recovery.

Financial Implications
Staff time associated with the preparation of each of these reports includes 2 hours of administrative work and 0.2 hours of supervisory review resulting in a total cost of approximately $100. This is expected to increase the cost recovery, or revenue, by approximately $20,000 per year (from $10,000 to $30,000).

Recent changes to the *Freedom of Information and Protection of Privacy Act* relating to permissible fees for other records are being examined by the Capital Regional District's Corporate Services Department.

CONCLUSION

Information requests to the Building Inspection Division have increased steadily over the past few years resulting in an increased demand on staff time and less availability for other necessary duties. Building Permit Information Reports' associated fee does not reflect the actual cost. A $100 fee per request rather than $30 will better cover direct staff costs. Bylaw No. 3741 should be revised to reflect the proposed fee.

RECOMMENDATION

The Electoral Areas Committee recommends to the Capital Regional District Board:
1) That Bylaw No. 4480, "Building Regulation Bylaw No. 5, 2010, Amendment Bylaw No. 3, 2022" be introduced and read a first, second, and third time; and
2) That Bylaw No. 4480 be adopted.

Submitted by:	Mike Taylor, RBO, Manager and Chief Building Inspector, Building Inspection
Concurrence:	Kevin Lorette, P. Eng., MBA, General Manager, Planning & Protective Services
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT

Appendix A – Bylaw No. 4480, "Building Regulation Bylaw No. 5, 2010, Amendment Bylaw No. 3, 2022"

CAPITAL REGIONAL DISTRICT
BYLAW NO. 4480

****

A BYLAW TO AMEND BUILDING REGULATION BYLAW NO. 5, 2010 (BYLAW NO. 3741)

****

WHEREAS:

A. Under Bylaw No. 3741, “Building Regulation Bylaw No. 5, 2010”, the Regional Board established a service to regulate construction of buildings and structures;

B. The Board wishes to amend Bylaw No. 3741 to increase fees for permit information reports;

NOW THEREFORE, the Capital Regional District Board in open meeting assembled hereby enacts as follows:

1. Bylaw No. 3741, “Building Regulation Bylaw No. 5, 2010” is hereby amended replacing section 2.4.10 in its entirety:

   2.4.10 The fee for a letter report on the status of an existing building or structure shall be $100 (one hundred dollars).

2. This Bylaw may be cited for all purposes as “Building Regulation Bylaw No. 5, 2010, Amendment Bylaw No. 3, 2022".

READ A FIRST TIME THIS	day of	20__
READ A SECOND TIME THIS	day of	20__
READ A THIRD TIME THIS	day of	20__
ADOPTED THIS	day of	20__

CHAIR

CORPORATE OFFICER

Making a difference...together

REPORT TO GOVERNANCE COMMITTEE
MEETING OF WEDNESDAY, FEBRUARY 02, 2022

SUBJECT **Cost Recovery Options and Cost Allocations for Freedom of Information (FOI) Requests**

ISSUE SUMMARY

The CRD Board directed staff to provide a follow-up report on cost recovery options and cost allocations for Freedom of Information (FOI) requests.

BACKGROUND

At the February 3, 2021 meeting, the Governance Committee received report 21-111, *"Freedom of Information and Protection of Privacy Act (FIPPA) 2020 Overview"* for information and recommendation to the CRD Board. Discussion ensued on various aspects of the report, including:

- volume of building inspection requests;
- commercial FOI requests;
- future online access for property information;
- digitization of records;
- policy of general disclosure;
- cost allocations;
- current fees for FOI requests.

At its February 10, 2021 meeting, the Capital Regional District (CRD) Board approved the following Motion from the Governance and Finance Committee:

> *That the Freedom of Information and Protection of Privacy Act (FIPPA) 2020 Overview report be received for information.*
>
> *That staff be directed to provide a follow-up report on cost recovery options and cost allocations for Freedom of Information requests in 9 months.*

On November 25, 2021 changes were enacted to FIPPA and its regulation to enable public bodies to impose an application fee of up to $10 on certain FOI requests to help manage the scope of broad-reaching requests.

ALTERNATIVES

Alternative 1
The Governance Committee recommends to the Capital Regional District Board:

1. That staff be directed to amend Bylaw No. 3945, "*Freedom of Information and Protection of Privacy*" to include a $10 application fee for general FOI requests in accordance with the *Freedom of Information and Protection of Privacy Ac*t and the *Freedom of Information and Protection of Privacy Regulation*;
2. That staff be directed to further investigate and establish appropriate categories of building

and property records which are available to the public without a FOI request in accordance with section 71 of the *Freedom of Information and Protection of Privacy Act* and the *Copyright Act*, including setting prescribed fees for providing copies of available records; and,

3. That staff report back with proposed amendments to Bylaw No. 3741, *"Building Regulation Bylaw No. 5, 2010"* to include a list of routinely available records and their associated fees.

Alternative 2
That this report be referred back to staff for additional information.

IMPLICATIONS

Relevant Legislation and Changes to the Freedom of Information and Protection of Privacy Act

As a guiding principle of the *Freedom of Information and Protection of Privacy Act* (referred to herein as the "Act", or the "FOIPP Act"), fees are viewed as a barrier to information access. Section 75 of the Act deals with fee matters. It sets out which services can or cannot be charged for FOI requests, establishes a 3-hour "free" threshold for time spent by a public body locating and retrieving records for a request and excepts fees for a request for an applicant's own information. Section 13 of the *Freedom of Information and Protection of Privacy Regulation* (referred to herein as the "Regulation" or the "FOIPP Regulation") sets out the prescribed maximum fees which can be charged. Further, the Act provides the head of a public body the discretion to waive fees for financial hardship, or when records are deemed of public interest, or for any other reason deemed fair. Complaints arising from fee matters are dealt with by the Office of the Privacy Commissioner (OIPC).

On November 25, 2021 amendments were made to the Act and Regulation to include for the first time the ability to impose a $10 application fee for general FOI requests. The amended Regulation has not been published at the time of writing this report; however, the Ministry of Citizens' Services has published that the application fee is not applicable to "personal FOI requests" which, "continue to be without a cost."[1]

The rationale of charging application fees for general FOI requests is to try and limit broad-reaching requests to a more narrowed focus which is more relevant and manageable for a public body to respond to. The application fee is non-refundable and is not subject to fee waiver requests or complaints to the OIPC under the Act, though a public body may at its discretion determine not to charge application fees to any persons or entities where it has reasonably determined the fees are a barrier to access. For example, the Province has determined not to charge fees for Indigenous Governing Entities.

Section 71 of the Act requires public bodies to establish categories of records which can be routinely released outside of the FOI request process and allows the public body to charge a fee for providing a copy of a record disclosed under this section. The fees are not legislated and can be set by the public body but must be reasonable and without substantive mark up. Any established categories of records for routine release containing personal information must only

[1] https://www2.gov.bc.ca/assets/gov/british-columbians-our-governments/services-policies-for-government/information-management-technology/information-privacy/resources/2021-amendments/foippa_amendments_application_fee.pdf

be disclosed as authorized under the Act or severed from the record prior to disclosure.

Section 32.1 of the federal *Copyright Act* allows the release of a copy of copyright protected materials under the FOIPP Act, for research or private use. Due to the copyright implications, these records cannot be made publicly accessible (i.e. published online for open access).

Current Disclosure Practices for Building and Property Records and Fees for Personal Information

Currently, access to building and property records held by the Building Inspection division is done through the FOI request process when requests are made for records that contain personal information for any individuals other than the requestor (i.e. previous owners), or for copyright protected records, such as building plans, surveys and technical reports. Building Inspection staff routinely release certain records, including copies of permits, that only contain the requestor's own personal information, or contain no personal information (i.e. commercial building permits).

Financial and Administrative Implications and Cost-Recovery Options for FOI Request Processing by the Privacy and Information Division

In 2021, the Privacy and Information division received 239 FOI requests of which 154 were for building and property information (roughly 64% of FOI requests.) A total of 12 fee estimates were issued for requests that required more than 3 hours of staff time, resulting in $626.40 in revenue.

Administering fees for FOI requests is somewhat administratively burdensome. The Privacy and Information division is not set up to administer point-of-sales types of transactions, or invoicing. Staff manually generate fee estimate letters which must be sent to requestors within 20 business days after receiving a request. Once a requestor responds they agree to pay the fees, an invoice request is submitted to Financial Services for processing and issuing. Financial Services' staff send the requestor an email (or letter) with the invoice and payment options. Payment options include cheque, credit-card (by telephone) or online payment through a bank. For online payment, the requestor must set up a specific CRD account assigned for FOI payment, even for one-time transactions.

Under the Act, FOI processing is put on hold until fee matters are resolved; the statutory deadline for responding to a request is adjusted accordingly based on the number of business days delayed.

Introducing a $10 application fee will increase the processing time for FOI requests, as there is no real-time transaction system in place to support direct payment and confirmation of payment. Further, FOI requests are not currently tracked based on whether a request is for personal information about the requestor (fee exempt), or general (subject to the application fee). A reasonable estimate, based on the FOI requests received for 2021, is that roughly 30% of requests could be charged the $10 fee, yielding approximately $700.00 in additional revenues. While this is not material in terms of offsetting costs of providing FOI processing services, staff would like to proceed with implementing the application fee to reduce the number of broad-reaching requests we receive. Unlike the fee estimate process, which happens after a request is initiated, the application fees can be communicated on the FOI request form and through communications on the CRD public website, so applicants for general FOI requests should expect to pay fees before any work is done on processing their request.

Cost Recovery for Building Inspection Records

The best option for reducing costs associated with processing FOI requests for building and property information, is to determine which records can be routinely released by the Building Inspection division under section 71 of the Act, and establish appropriate fees and privacy practices that meet the CRD's legal obligations under the FOIPP Act and Regulations and the *Copyright Act*. Staff anticipate that building permits, inspection notes and other information from building and property records may be routinely releasable under section 71 of the Act, with no redactions or minimal redactions of basic personal information.This would reduce the volume of pages of building and property records processed by staff and will likely reduce the overall number of FOI requests. Any revenues would be collected by Building Services and provide some cost-recovery for staff time spent providing records.

Not all building and property records will qualify to be released under section 71, and many reports such as those compiled in the course of an investigation, financial information, or correspondence with homeowners will still need to be processed as FOI requests by Information and Privacy staff. Prior to reporting back with proposed bylaw changes, staff will need to further investigate and establish appropriate categories of building and property records which are available to the public without a FOI request in accordance with section 71 of the *FOIPP Act* and the *Copyright Act*, including setting prescribed fees for providing copies and applying redactions in accordance with legal advice.

Alignment with Existing Bylaws

Bylaw No. 3945, *"Freedom of Information and Protection of Privacy Bylaw No. 1, 2014"* sets out the maximum fees allowed for FOI requests in Schedule A; these fees are derived from section 13 of the FOIPP Regulation. This bylaw will require amending before the new $10 application fee could be implemented.

Bylaw No. 3741, "*Building Regulation Bylaw No. 5, 2010*" ("Building Regulation") will need to be amended with a new fee schedule before any new fees for documents can be implemented.

CONCLUSION

The CRD Board requested a follow-up report on cost recovery options and cost allocations for Freedom of Information (FOI) requests. Recent changes to the Act and Regulations have enabled public bodies to impose an application fee of up to $10 for an FOI request. While the revenue generated from the imposition of the fee will be nominal, staff expect it will be a useful tool to manage the scope of broad-reaching requests. For building inspection and property records, staff will undertake an analysis to create categories of routinely releasable records that may be provided to applicants outside the FOI process for a prescribed fee. Further work and due diligence are needed before it is advisable that the CRD update its Building Regulation bylaw to introduce new fees for processing requests for building and property records outside of the FOI process, to ensure CRD can continue to meet its obligations under the Act to protect any personal information in those records.

RECOMMENDATION

The Governance Committee recommends to the Capital Regional District Board:

1. That staff be directed to amend Bylaw No. 3945, "*Freedom of Information and Protection of Privacy*" to include a $10 application fee for general FOI requests in accordance with the *Freedom of Information and Protection of Privacy Ac*t and the *Freedom of Information and Protection of Privacy Regulation*;
2. That staff be directed to further investigate and establish appropriate categories of building and property records which are available to the public without a FOI request in accordance with section 71 of the *Freedom of Information and Protection of Privacy Act* and the *Copyright Act*, including setting prescribed fees for providing copies of available records; and,
3. That staff report back with proposed amendments to Bylaw No. 3741, *"Building Regulation Bylaw No. 5, 2010"* to include a list of routinely available records and their associated fees.

Submitted by:	Sharon Byrch, Manager, Information Services
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Kevin Lorette, P. Eng., MBA, General Manager, Planning & Protective Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT(S)

Appendix A: Bylaw 3945, "Freedom of Informtion and Protection of Privacy Bylaw No. 1, 2014"

CAPITAL REGIONAL DISTRICT
BYLAW NO. 3945

****

A BYLAW FOR THE ADMINISTRATION OF THE FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY ACT

****

WHEREAS, under section 77 of the *Freedom of Information and Protection of Privacy Act*, a local government:

(a) must designate a person or group of persons as the head of the local public body for the purposes of the *Freedom of Information and Protection of Privacy Act*; and

(b) may set any fees the local public body requires to be paid under section 75 of the *Freedom of Information and Protection of Privacy Act;*

WHEREAS, under section 66 of the *Freedom of Information and Protection of Privacy Act,* the Head of a public body may delegate to any person any duty, power or function of the Head under the Act, except the power to delegate;

NOW, THEREFORE, the Board of the Capital Regional District in open meeting assembled enacts as follows:

1.0 Definitions and Interpretation

1.1 The definitions contained in Schedule A of the Act shall apply to this bylaw except where the context requires otherwise.

1.2 In this bylaw:

"Act" means the *Freedom of Information and Protection of Privacy Act*, R.S.B.C. 1996, c.165.

"Commercial Applicant" means a person who makes a request for access to a record to obtain information for use in connection with a trade, business, profession or other venture for profit.

"Corporate Officer" means the person assigned the responsibility of corporate administration under section 198 of the *Local Government Act* and for the purposes of this bylaw does not by default include the Deputy Corporate Officer in the absence of the Corporate Officer;

"Head" means the person or group of persons designated as the Head of the Regional District under section 2 of this Bylaw.

"Regional District" means the Capital Regional District.

"Request" means a request under section 5 of the Act.

2.0 Administration

2.1 The Corporate Officer is designated as the Head for the purposes of the Act;

2.2 In the absence of the Corporate Officer, the Manager, Information Services is designated as the Head for the purposes of the Act;

2.3 In the absence of both of the Heads specified in 2.1 and 2.2, the Deputy Corporate Officer is designated as the Head for the purposes of the Act;

2.4 The Head shall perform the duties of the head specified in the Act.

3.0 Fees

A person who makes an application to request access to a record must pay the fees set out in Schedule A to the Regional District. Fees may be charged for the purpose of:

(a) locating, retrieving and producing the record;
(b) preparing the record for disclosure;
(c) shipping and handling the record;
(d) providing a copy of the record.

4.0 Bylaw 2257, "Capital Regional District Freedom of Information Bylaw No. 1, 1994" is hereby repealed.

5.0 This Bylaw may be cited as "Freedom of Information and Protection of Privacy Bylaw No. 1, 2014".

READ A FIRST TIME THIS	12th	day of	March	2014
READ A SECOND TIME THIS	12th	day of	March	2014
READ A THIRD TIME THIS	12th	day of	March	2014
ADOPTED THIS	12th	day of	March	2014

CHAIR

CORPORATE OFFICER

CAPITAL REGIONAL DISTRICT BYLAW NO. 3945
Schedule A

SCHEDULE OF MAXIMUM FEES

1. For applicants other than commercial applicants:

	Description of Service	Management Fees
(a)	for locating and retrieving a record	$7.50 per 1/4 hour after the first three hours
(b)	for producing a record manually	$7.50 per 1/4 hour
(c)	for producing a record from a machine readable record from a server or computer	$7.50 per 1/4 hour for developing a computer program to produce the record
(d)	for preparing a record for disclosure and handling a record	$7.50 per 1/4 hour
(e)	for shipping copies	actual cost of shipping method chosen by applicant
(f)	for copying records	
	(i) photocopies and computer printouts	$.25 per page (8.5" x 11" & 8.5" x 14") $.30 per page (11" x 17")
	(ii) floppy disks	$2 per disk
	(iii) CDs and DVDs, recordable or rewritable	$4 per disk
	(iv) computer tapes	$40 per tape, up to 2400 feet
	(v) microfiche	$3 per fiche
	(vi) 16 mm microfilm duplication	$25 per roll
	(vii) 35 mm microfilm duplication	$40 per roll
	(viii) mircrofiche or microfilm to paper duplication	$.50 per page (8.5"x11")
	(ix) photographs (colour or black and white)	$5 to produce a negative $12 each for 16" x 20" $9 each for 11" x 14" $4 each for 8" x 10" $3 each for 5" x 7"
	(x) photographic print of textual, graphic or cartographic record (B/W)	$12.50 each (8" x10")
	(xi) dot matrix, ink jet, laser print or photocopy, B/W	$.25 per page (8.5"x11", 8.5"x14" or 11"x17")
	(xii) dot matrix, ink jet, laser print or photocopy, colour	$1.65 per page (8.5"x11", 8.5"x14" or 11"x17")
	(xiii) scanned electronic copy of a paper record	$.10 per page
	(xiv) photomechanical reproduction of 105 mm cartographic record/plan	$3 each
	(xv) slide duplication	$0.95 each
	(xvi) plans	$1 per square metre
	(xvii) audio cassette tape duplication (90 minutes or fewer)	$5 per cassette plus $7 per ¼ hour of recording

	(xvii) video cassette recorder (VHS) tape duplication	$5 per cassette plus $7 per ¼ hour of recording

2. For commercial applicants:

	For each service listed in Item 1	The actual cost to the public body of providing that service

Making a difference...together

REPORT TO GOVERNANCE COMMITTEE
MEETING OF WEDNESDAY, FEBRUARY 02, 2022

SUBJECT **Bylaw No. 4479 - Delegations Amendment to Board Procedures Bylaw**

ISSUE SUMMARY

To update the procedure for delegations and use of electronic presentations at CRD Board and Committee meetings by adopting a bylaw to amend the Board Procedures Bylaw.

BACKGROUND

On June 2, 2021, the Governance Committee carried the following motions:

> *"That the Governance Committee be requested to review Section 13 of the Procedures Bylaw related to Delegations, with the goal of providing fair access to delegations and a reasonable use of the Board's time."*
>
> *"Invite staff to bring back any other recommendations on amendments to the Procedure Bylaw"*

On December 8, 2021, the Board approved the following Governance Committee recommendations:

> *"1. a) That the maximum speaking time for each delegation be reduced to 3 minutes; and*
> *b) That staff review the impact of this procedural change and report back to the committee by the first quarter of 2024."*

Attached as Appendix A is Bylaw No. 4479, "Capital Regional District Board Procedures Bylaw, 2012, Amendment Bylaw No. 12, 2022", which amends Bylaw No. 3828, "Capital Regional District Board Procedures Bylaw, 2012". In accordance with s. 225 of the *Local Government Act* and Bylaw No. 3828, notice of the proposed amendment was mailed to each Director.

ALTERNATIVES

Alternative 1
The Governance Committee recommends to the Capital Regional District Board:

1. That Bylaw No. 4479, "Capital Regional District Board Procedures Bylaw, 2012, Amendment Bylaw No. 12, 2022" be introduced and read a first, second and third time.
2. That Bylaw No. 4479 be adopted.

Alternative 2
That this report be referred back to staff for additional information.

IMPLICATIONS

A consolidated redlined copy of Bylaw No. 3828 is attached as Appendix B.

The only change to delegation procedure under Section 13 is reducing the maximum speaking time from 4 minutes to 3 minutes. A minor housekeeping amendment was made to remove the option of having the Corporate Officer provide hard copies of written submissions to Board or Committee Members. All correspondence from delegations should be provided electronically and is distributed via the Board Correspondence Portal. There are no changes to the procedure for applying to address a CRD Board or Committee as a delegation.

The sub-section on video presentation was updated to "electronic presentation" to be consistent with the definition and submission deadline in the Corporate Procedure for Board and Committee Delegation Procedure - Electronic Presentations (attached as Appendix C).

A revision to section 15(6) relating to items on the consent agenda is included. Bylaw No. 4479 deletes the requirement to group items by voting rule for the consent agenda and clarifies that a unanimous vote is required. This section currently requires that only items subject to the same voting rule could be voted on in one motion. It is not necessary to group items by voting rule, as consent agenda items can only be passed by a unanimous vote.

If adopted, the CRD website page on Delegations titled "Addressing the Board" and the instructions e-mailed to delegations prior to the meeting will be updated.

CONCLUSION

A bylaw amendment was drafted to update delegations speaking time to a maximum of three minutes and further clarify the use of electronic presentations. Minor changes to clarify electronic presentations and grouping items on the consent agenda are also proposed. If adopted, the information on delegations will be updated on the CRD website and in the instructions sent to delegations prior to meetings. Staff will review the impact of this procedural change and report back to the Governance Committee by the first quarter of 2024.

RECOMMENDATION

The Governance Committee recommends to the Capital Regional District Board:

1. That Bylaw No. 4479, "Capital Regional District Board Procedures Bylaw, 2012, Amendment Bylaw No. 12, 2022" be introduced and read a first, second and third time.
2. That Bylaw No. 4479 be adopted.

Submitted by:	Marlene Lagoa, MPA, Manager, Legislative Services & Deputy Corporate Officer
Concurrence:	Steven Carey, B.Sc., J.D., Senior Manager, Legal Services & Risk Management
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENTS

Appendix A: Bylaw 4479
Appendix B: Bylaw 3828 Consolidated (redlined)
Appendix C: Delegation Procedures – Electronic Presentations

CAPITAL REGIONAL DISTRICT
BYLAW NO. 4479

****

A BYLAW TO AMEND THE PROCEDURES BYLAW (BYLAW NO. 3828)

****

WHEREAS:

A. Under Bylaw No. 3828, "Capital Regional District Procedures Bylaw, 2012", the Regional Board established a bylaw to regulate the proceedings of the Capital Regional District Board; and

B. The Board wishes to amend Bylaw No. 3828 to limit delegations to a maximum of three minutes and clarify the use of electronic presentations by delegations;

NOW THEREFORE, the Capital Regional District Board in open meeting assembled hereby enacts as follows:

1. Bylaw No. 3828, "Capital Regional District Procedures Bylaw, 2012", is hereby amended as follows:

   (a) By inserting the following in alphabetical list order under section 1 [Definitions]:

   "Electronic Presentation" means a digital video, PowerPoint presentation, or any other type of visual media used in conjunction with a delegation presentation.

   (b) By replacing section 13(1) in its entirety with:

   The Board may allow a delegation to address the meeting in person on the subject of an agenda item, provided written application on a prescribed form has been received by the Corporate Officer no later than 4:30 pm two (2) calendar days prior to the meeting. Each address shall be limited to three (3) minutes unless a longer period is agreed to by 2/3 vote of those Members present. The order of speakers will be based on the order in which the request was received.

   (a) As an alternative to addressing a meeting as a delegation, a person may submit their comments in writing to the Corporate Officer for circulation to Members in advance of the next meeting.

   (c) By replacing section 13(3) in its entirety with:

   Any Electronic Presentations used as part of a delegation's address to the Board will count toward the time limit permitted for the delegation. Electronic Presentations must be received by the Corporate Officer no later than 12:00 pm one (1) calendar day prior to the meeting.

   (d) By replacing section 15(6) in its entirety with:

   Members may adopt in one motion all recommendations appearing on the Consent Agenda by a unanimous vote.

2. This bylaw may be cited for all purposes as “Capital Regional District Procedures Bylaw, 2012, Amendment Bylaw No. 12, 2022".

READ A FIRST TIME THIS	th	day of	2022
READ A SECOND TIME THIS	th	day of	2022
READ A THIRD TIME THIS	th	day of	2022
ADOPTED THIS	th	day of	2022

CHAIR

CORPORATE OFFICER

Making a difference...together

BYLAW NO. 3828

CAPITAL REGIONAL DISTRICT BOARD PROCEDURES BYLAW, 2012

(as amended by Bylaw No. 3951, 3999, 4024, 4044, 4129, 4206, & 4262, 4312, 4313, 4353, 4368, 4479)

A bylaw to regulate the proceedings of the Capital Regional District Board

For further details, please contact the Capital Regional District,
Legislative Services Department, 625 Fisgard St., PO Box 1000, Victoria BC V8W 2S6
T 250·360·3128, F 250·360·3130, www.crd.bc.ca

CAPITAL REGIONAL DISTRICT
BYLAW NO. 3828
REGIONAL DISTRICT PROCEDURES BYLAW

Contents

BYLAW NO. 3828 1

CAPITAL REGIONAL DISTRICT BOARD 1

PROCEDURES BYLAW, 2012 1

PART 1 – INTRODUCTION 4

DEFINITIONS 4
APPLICATION OF RULES OF PROCEDURE 5
SUSPENSION OF RULES OF PROCEDURE 5

PART 2 – BOARD MEETINGS 6

INAUGURAL MEETING 6
ELECTION OF CHAIR AND VICE CHAIR 6
MEETINGS AND ADJOURNMENT 7
QUORUM 7
NOTICE OF REGULAR MEETINGS 8
NOTICE OF SPECIAL MEETINGS 8
NOTICE OF COMMITTEE MEETINGS 8
NOTICE OF COMMISSION MEETINGS 9
AGENDA 9

PART 3 – BOARD PROCEEDINGS 9

DELEGATIONS 9
PRESENTATIONS 11
ORDER OF PROCEEDINGS AND BUSINESS 11
MINUTES 12
CORRESPONDENCE 13
ATTENDANCE OF PUBLIC AT MEETINGS 13
CLOSED MEETINGS 13
USE OF VIDEO RECORDING DEVICES 14
CHAIR AND PRESIDING OFFICERS 14
RULES OF ORDER 14
MOTIONS 15
RECONSIDERATION OF AN ADOPTED BYLAW, RESOLUTION OR PROCEEDING 16
DEBATE AND CONDUCT 16
VOTING 17

PART 4 – COMMITTEES AND COMMISSIONS 17

BOARD STANDING COMMITTEES 17
ADVISORY COMMITTEES 18
SELECT COMMITTEES 18
COMMISSIONS 18
ELECTRONIC PARTICIPATION AT COMMISSION MEETINGS 18
ELECTRONIC PARTICIPATION IN CASE OF EMERGENCY OR SPECIAL CIRCUMSTANCE 19
ATTENDANCE AT COMMITTEE MEETINGS 20
COMMITTEE REPORTS 20
QUORUM 20

VOTING AT MEETINGS 20
OPERATION 20
PART 5 – COMMITTEE OF THE WHOLE 21
PROCEDURES FOR COW MEETINGS 21
PART 6 – BYLAWS 21
PART 7 – RESOLUTIONS 22
PART 8 – GENERAL 22

CAPITAL REGIONAL DISTRICT

BYLAW NO. 3828

****

A BYLAW TO REGULATE THE PROCEEDINGS OF THE CAPITAL REGIONAL DISTRICT BOARD

****

The Board of the Capital Regional District enacts as follows:

PART 1 – INTRODUCTION

Definitions

1. In this Bylaw:

"Board" means the governing and executive body of the CRD;

"Chair" means the Chair or Vice Chair of the CRD elected pursuant to section 215 of the *Local Government Act* or other person presiding at a meeting of the Board or committee, as the context requires;

(Bylaw No. 4262)

"Committee" means a standing, advisory, select, or other committee of the Board, but does not include Committee of the Whole or a local service committee or a service committee;

"Commission" means a commission established by the Board under section 263(1)(g) of the *Local Government Act* and a local service committee and a service committee established by the Board.

(Bylaw No. 4262)

"Corporate Officer" means the officer of the CRD assigned the corporate administration responsibilities of section 236 of the *Local Government Act*, and includes that officer's designate;

(Bylaw No. 4262)

"COW" means the Committee of the Whole Board;

"CRD" means the Capital Regional District;

"CRD Offices" means the CRD located at 625 Fisgard Street, Victoria, BC;

"CRD Website" means the information resource found at an internet address provided by the CRD;

"Delegation" means an individual or an organization addressing the Board, a committee or commission about a specific item on the agenda of a meeting;

"Electronic Presentation" means a digital video, PowerPoint presentation, or any other type of visual media used in conjunction with a delegation presentation.

(Bylaw No. 4479)

"First Nation Member" means a First Nations' elected representative who is permitted to participate on an Advisory Committee, Select Committee, or Standing Committee by the relevant Terms of Reference and includes their alternate if acting in the place of a First Nation Member;
(Bylaw No. 4368)

"Member" means a Member of the Board, whether a municipal director or an electoral area director, and includes their alternates if acting in the place of a Member;

"Presenter" means a person(s) or organization(s) invited by the CRD to make a presentation to the Board. It also includes a request to speak by a First Nations Elder or Chief and a federal, provincial or local government elected official.
(Bylaw No. 4024)

"Public Notice Posting Place" means the notice board, whether electronic or not, located in the front foyer of the CRD offices and the CRD Website; and, in the case of a Commission, means a consistent local public location designated by the Commission;

"Vice Chair" means the Member elected as Vice pursuant to section 215 of the *Local Government Act*.
(Bylaw No. 4262)

Application of Rules of Procedure

2. (1) The provisions of this Bylaw govern the proceedings of the Board, COW, all standing and select committees of the Board and all commissions, as applicable.

(2) In cases not provided for under this Bylaw, The Newly Revised Robert's Rules of Order, 11th edition, 2011, apply to the proceedings of the Board, COW, committees and commissions to the extent that those rules are:

(a) applicable in the circumstances; and

(b) not inconsistent with provisions of this Bylaw, the *Local Government Act* or the *Community Charter*.

(3) No provision of this bylaw relating to the procedure of the Board shall be altered unless notice of the proposed amendment is given in accordance with section 225 of the *Local Government Act*.

Suspension of Rules of Procedure

3. Except for those provisions of this Bylaw that are statutorily mandated, the rules of procedure contained in this Bylaw may be suspended for a temporary time period specified by the Board with a 2/3 vote of those Members present.

PART 2 – BOARD MEETINGS

Inaugural Meeting

4. (1) The Board shall meet in an inaugural meeting during the month of November at such time as shall be advised by the Corporate Officer in writing.

(Bylaw No. 4129)

(2) The presiding officer of the inaugural meeting shall be the Chief Administrative Officer until such time as the Chair has been elected.

(3) The Chief Administrative Officer shall announce results of elections and confirm that new Members have completed the Oath of Office set out in the *Local Government Act*, following which the Chair shall be elected from among the Members of the Board.

Election of Chair and Vice Chair

5. (1) The Chief Administrative Officer shall call for nominations for Chair and conduct a vote by secret ballot in which the person receiving a majority vote of those Members present shall be elected Chair. Each Member shall have only one vote. If only one candidate is nominated for an office, that candidate shall be declared elected by acclamation. The call for nominations for the office of Vice Chair shall be called by the Chair.

(2) Nominations do not need to be seconded and a candidate must consent to the nomination.

(3) If a candidate is not present at the meeting, his or her written consent to the nomination must be provided to the Corporate Officer at the meeting.

(4) At the close of nominations, if more than one candidate has been nominated, each candidate will be given a maximum of four (4) minutes to address the Board in favour of his/her candidacy in the order of his/her nomination. If a candidate is not present at the meeting, he or she may have their nominator deliver a prepared speech on his or her behalf not to exceed three minutes in duration.

(5) At the conclusion of the candidates' speeches, the Corporate Officer and Deputy Corporate Officer or designate will circulate a ballot box in which the completed ballots will be placed. When all of the ballots have been collected the Corporate Officer will remove the ballot box to a separate room and the ballots will be counted in accordance with subsection (6).

(6) The counting of the ballots will be conducted by the Corporate Officer together with the Deputy Corporate Officer or designate. Either the CRD's legal counsel or a judicial justice appointed under the *Provincial Court Act* will be present to observe the counting of the ballots.

(7) Following the counting of the ballots, the Corporate Officer shall advise the Chief Administrative Officer of the candidate that has received a majority of the votes.

(8) The number of votes received by each candidate will not be disclosed to the Board unless

a resolution requiring disclosure is passed.

(9) In the event that there are more than two candidates for the election of Chair or Vice Chair and if no person receives a majority of the votes of those Members present, the candidate receiving the least number of votes shall be eliminated and subsequent ballots shall be taken until one candidate receives the majority of votes of those Members present; unless there is a tie between the two candidates with the least votes of those Members present, in which case, subsequent ballots shall be taken until one candidate receives the least number of votes of those Members present and is eliminated. If the tie for the least number of votes of those Members present continues after three elections have been held, the candidate who shall be eliminated will be decided by a lot between the candidates as outlined in section 5(3). The voting on subsequent ballots will then proceed without the eliminated candidate until one candidate receives the majority of votes of those Members present.

(10) In the event of a tie vote for the most votes of two (2) or more candidates, the candidates who are tied remain in the election. If a definitive election result cannot be declared after three (3) elections have been held, then the majority vote shall be deemed to be determined by a lot between the candidates as follows:

(a) the names of the candidates shall be written on separate pieces of paper and placed in a container;

(b) the Corporate Officer shall be asked to withdraw one paper; and

(c) the candidate whose name is on the withdrawn paper shall be declared elected.

(11) Once a candidate has been declared elected, the ballots shall be destroyed by way of a Board resolution.

(12) Following the election of the Chair, the CRD Board shall elect one of its Members to be Vice Chair. The procedure for determining the Member to be elected Vice Chair shall be as set out in sections 5(1) to (11) for electing the Chair of the Board.

(Bylaw No. 4044)

Meetings and Adjournment

6. Regular meetings shall be held at the CRD Board Room, 625 Fisgard Street, Victoria, BC on the second Wednesday of the month commencing at 1:00 pm unless otherwise determined by resolution of the Board.

(Bylaw No. 4262)

6.1 Regular and special meetings shall be adjourned no later than three (3) hours from the scheduled start time of the meeting unless the Board resolves to proceed beyond that time by an affirmative vote of the majority of the members present.

(Bylaw No. 3951)

Quorum

7. (1) The quorum for a meeting of the Board shall be a majority of all the Members.

(2) At the appointed time for commencement of the meeting, the Chair or, in his/her absence, the Vice Chair, shall ascertain that a quorum is present before proceeding to the business of the meeting. If neither the Chair nor the Vice Chair is present within fifteen (15) minutes after the time appointed for a meeting, the Corporate Officer shall call the Members to order, ascertain that a quorum is present and, if so, the Board shall appoint an Acting Chair who shall preside during the meeting or until the arrival of the Chair or Vice Chair. Such person appointed as Acting Chair shall have all the powers and be subject to the same rules as the Chair.

(3) If a quorum has not been made within sixteen (16) minutes after the appointed time, the Corporate Officer shall record the names of the Members then present and the Board shall stand adjourned until the next meeting date or until another meeting shall have been called in accordance with this bylaw or to such time as the Chair shall appoint.

Notice of Regular Meetings

8. At least seventy-two (72) hours before a regular meeting of the Board, the Corporate Officer must give public notice of the time, place and date of the meeting by way of a notice and agenda posted at the Public Notice Posting Place.

Notice of Special Meetings

9. (1) Except where notice of a special meeting is waived by a unanimous vote of all Members under section 220(3) of the *Local Government Act*, before a special meeting of the Board, the Corporate Officer shall:

(a) at least twenty-four (24) hours in advance, give notice of the general purpose, time, place and date of the meeting by way of a notice posted at the Public Notice Posting Place; and

(b) at least five (5) days before the date of the meeting, mail to each Member the notice of the general purpose, time, place and date of the meeting.

(Bylaw No. 4262)

(2) Despite section 9(1), in the case of an emergency, notice of a special meeting may be given in accordance with section 220(4) of the *Local Government Act.*

(Bylaw No. 4262)

Notice of Committee Meetings

10. (1) At least seventy-two (72) hours before a regular meeting of a committee or COW, excluding a commission, public notice must be given of the time, place and date of the meeting by way of a notice posted at the Public Notice Posting Place.

(2) At least twenty-four (24) hours before a special meeting of a committee or COW, excluding a commission, public notice must be given of the time, place and date of the meeting by way of a notice posted at the Public Notice Posting Place.

Notice of Commission Meetings

11. (1) At least seventy-two (72) hours before a regular meeting of a commission, public notice must be given of the time, place and date of the meeting by way of a notice posted in a consistent public location in the area served by the commission.

(2) At least twenty-four (24) hours before a special meeting of a commission, public notice must be given of the time, place and date of the meeting by way of a notice posted in a consistent public location in the area served by the commission.

Agenda

12. (1) The Corporate Officer, under the direction of the Chair, shall prepare an agenda and shall circulate a copy of the agenda to each Member at least four (4) days before the meeting. If necessary, a supplementary agenda for a meeting of the Board will be circulated at least 24 hours before the meeting. At any meeting other than a special meeting, the Chair may add items of an emergent or time sensitive nature to the agenda.
(Bylaw No. 4262)

(2) At a meeting, a Member may, at the time adoption of the agenda is being considered, propose to place an additional item of an emergent or time sensitive nature on the agenda. The item must be added to the agenda only if the resolution is adopted by at least two thirds of the votes cast.

PART 3 – BOARD PROCEEDINGS

Delegations

13. (1) The Board may allow a delegation to address the meeting in person on the subject of an agenda item, provided written application on a prescribed form has been received by the Corporate Officer no later than 4:30 pm two (2) calendar days prior to the meeting. Each address shall be limited to three (3) minutes unless a longer period is agreed to by 2/3 vote of those Members present. The order of speakers will be based on the order in which the request was received.

(a) As an alternative to addressing a meeting as a delegation, a person may submit their comments in writing to the Corporate Officer for circulation to Members in advance of the next meeting.

(Bylaw No. 4479)

~~The Board may, by resolution, allow a delegation to address the meeting in person on the subject of an agenda item, provided written application on a prescribed form has been received by the Corporate Officer no later than 4:30 pm two (2) calendar days prior to the meeting. Each address shall be limited to four (4) minutes unless a longer period is agreed to by 2/3 vote of those Members present. The order of speakers will be based on the order in which the request was received. The Corporate Officer may determine the number of copies of any written submissions to be provided by each delegation to~~

~~the Board. Each delegation shall provide the number of copies as determined by the Corporate Officer, for distribution at the time of the delegation's appearance.~~

~~(a) As an alternative to addressing a meeting as a delegation, a person may submit their comments in writing to the Corporate Officer for circulation to Members in advance of the next meeting.~~

~~*(Bylaw No. 3951)*~~

(2) Where written application has not been received as prescribed in section 13(1), an individual or delegation may address the meeting if approved by a unanimous vote of the Members present.

(3) Any Electronic Presentations used as part of a delegation's address to the Board will count toward the time limit permitted for the delegation. Electronic Presentations must be received by the Corporate Officer no later than 12:00 pm one (1) calendar day prior to the meeting.

(Bylaw No. 4479)

~~Any video presentations used as part of a delegation's address to the Board will count toward the time limit permitted for the delegation.~~

(4) If a delegation has registered to address a meeting but is no longer able to attend the meeting, a different delegation will not be permitted to address the meeting in substitution.

(5) The Board shall not permit a delegation to address a meeting of the Board regarding a bylaw in respect of which a public hearing has been held, where the public hearing is required under an enactment as a prerequisite to the adoption of the bylaw.

(6) The Board shall not permit a delegation to address a meeting of the Board regarding a matter to be dealt with as a grievance under a collective agreement, or that is within the exclusive mandate of the Greater Victoria Labour Relations Association Board.

(7) The subject matter upon which a delegation wishes to speak must:

(a) be within the jurisdiction of the Board; and

(b) be within the terms of reference of the Committee or Commission for which the delegation wishes to appear.

(8) The Chair may deny any delegation the right to address a meeting if, in the Chair's opinion, the spokesperson or any Member of the delegation:

(a) immoderately raises his or her voice, or uses profane, vulgar or offensive language, gestures or signs; or

(b) addresses issues not contained within the written application of the individual or delegation.

Presentations

14. (1) The CRD may, with the Chair's approval, invite a person, persons, or organization(s) to make a presentation to the Board. Time permitting, the Corporate Officer shall include the subject of the presentation and the designated speaker on the meeting agenda.

(2) With the Chair's approval, the Corporate Officer shall include a request to speak by a presenter on the meeting agenda.

(3) All presentations shall be limited to 10 minutes unless a longer period is approved by a majority vote of those Members present.

(Bylaw No. 4024)

Order of Proceedings and Business

15. (1) The order of business at all regular meetings shall be as follows:

1. Territorial Acknowledgement
2. Approval of Agenda
3. Adoption of Minutes of Previous Meeting
4. Report of the Chair
5. Presentations/Delegations
6. Consent Agenda
7. Administration Reports
8. Reports of Committees (not included in the Consent Agenda)
9. Correspondence
10. Bylaws and Resolutions
11. Motions for Which Notice Has Been Given
12. New Business
13. Motion to close the meeting in accordance with the applicable provisions of the *Community Charter*
14. Adjournment

(Bylaw No. 4262, 4312)

(2) The order of business at all special meetings shall be as follows:

1. Territorial Acknowledgement
2. Approval of Agenda
3. Presentations/Delegations
4. Special Meeting Matters
5. Motion to close meeting in accordance with the applicable provisions of the *Community Charter*
6. Adjournment

(Bylaw No. 4312)

(3) The order of business at all closed meetings whether regular or special shall be as follows:

1. Approval of Agenda
2. Approval of Minutes of Previous Closed Meeting
3. Closed Meeting Matters
4. Rise and Report
5. Adjournment

(4) A change to the prescribed order of business other than a special meeting may be ordered by the Chair or moved by a Member, with unanimous consent.

(5) The Consent Agenda portion of the agenda shall consist of staff or committee report items that contain clear take action, give approval, or receive for information recommendations.

(6) Members may adopt in one motion all recommendations appearing on the Consent Agenda by a unanimous vote.

(Bylaw No. 4479)

~~Members may vote on and adopt in one motion all recommendations appearing on the Consent Agenda that are subject to the same voting rule.~~

(7) At approval of the Consent Agenda, a Member may for the purpose of:

(a) debate or discussion;

(b) voting in opposition to a recommendation on the consent agenda or to propose an amendment to the motion; or

(c) declaring a conflict of interest with respect to an item on the consent agenda;

request that an item be removed from the consent agenda, without debate or vote of the Members.

(Bylaw No. 4262)

Minutes

16. (1) Minutes of all proceedings of the Board shall be kept by the Corporate Officer; such minutes to be concise and to detail proceedings of the Board. The minutes shall be legibly recorded, certified as correct by the Corporate Officer, and signed by the Chair, Vice Chair, or the person presiding at such meeting or at the next meeting at which they are adopted.

(2) Minutes of proceedings of standing and select committees, and commissions shall be legibly recorded and signed by the Chair, or Member presiding.

(3) Subject to section 16(4), and in accordance with sections 97(1)(b) and (c) of the *Community Charter*, minutes of the proceedings of the Board or of a body referred to in section 17(2) must be open for public inspection at the CRD Offices, Legislative Services, during their regular office hours and may be posted to the CRD website.

(4) Section 16(3) does not apply to minutes of a Board meeting or a meeting of a body referred to in section 17(2) for that part of the meeting from which persons were excluded under section 90 of the *Community Charter*.

Correspondence

16.1 (1) Following consultation with the Chair or other person who is to preside at the applicable meeting, the Corporate Officer may place correspondence from another government or government agency that requests an action from the Board, on the agenda of the next convenient Board meeting, or on an agenda of the meeting of a committee or commission whose mandate or terms of reference includes the requested action, together with any report from Regional District staff that the Chair or the Chief Administrative Officer consider advisable.

(2) Any other correspondence to the Board not accounted for in section 16.1(1), including but not limited to written comments received pursuant to section 13(a), may be placed on the meeting agenda at the request of the Chair or such other person who is to preside at the meeting where the correspondence is to be considered, or by way of Notice of Motion made in accordance with section 22(6). *(Bylaw No. 3951)*

Attendance of Public at Meetings

17. (1) Except where the provisions of section 90 of the *Community Charter* apply, all Board meetings must be open to the public. Before a meeting or part of a meeting is closed to the public, the Board must pass a resolution in the public meeting in accordance with section 92 of the *Community Charter.*

(2) The requirement in section 17(1) applies to meetings of bodies referred to in section 93 of the *Community Charter* including, without limitation:

(a) Advisory Commissions
(b) Advisory Committees
(c) a Commission established under s. 263(1)(g) of the *Local Government Act*
(d) Board of Variance
(e) Parcel Tax Review Panel
(f) Select Committees
(g) Standing Committees
(h) Committee of the Whole
(i) a body that under the *Local Government Act* or another *Act* may exercise the powers of the CRD or its Board

(Bylaw No. 4262)

(3) Despite section 17(1), the Chair may expel or exclude a person from a Board meeting or meeting of a body listed in section 17(2) of this Bylaw in accordance with section 133 of the *Community Charter*.

Closed Meetings

18 (1) No Member shall disclose to the public the proceedings of a closed meeting, unless a resolution has been passed at the closed meeting to allow disclosure.

(2) As soon as practicable, the Corporate Officer shall review and determine whether to seek a resolution of the Board for the release of closed minutes and related information that

would no longer undermine the reason for discussing it in a closed meeting.

(3) Minutes of a closed meeting shall be kept in the same manner as a regular meeting but shall not be filed with the minutes of regular meetings.

(4) The Board must not vote on the reading or adoption of a bylaw when its meeting is closed to the public.

Use of Video Recording Devices

19. (1) The Chair shall preserve order and decorum at a meeting and at his/her discretion may require that any video recording devices be placed in a designated location while being used and remain in that location during the course of the meeting. This applies to the Chairs of Board, Committee, Commission and COW meetings.

Chair and Presiding Officers

20. (1) The Chair, if present, shall preside at meetings of the Board. Any Member of the Board may preside at a COW.

(2) The Vice Chair shall preside in the absence of the Chair or when the Chair vacates the chair.

(3) In the event that neither the Chair nor the Vice Chair is able to take the chair, the presiding officer shall be such person, as the Board may choose.

(4) The Chair shall preserve order and decorum and shall rule on all points of order, stating his/her reasons and the authority for ruling when making a ruling. The ruling of the Chair shall be subject to an appeal to the Board without debate.

(5) (a) If an appeal be taken from the decision of the Chair, the question "Shall the Chair be sustained?" shall be put forthwith and decided without debate by a simple majority of the Members present (exclusive of the Chair) and in the event of the votes being equal, the question shall pass in the affirmative. The names of the Members of the Board voting for or against the question shall be recorded in the minutes.

(b) If the Chair refuses to put the question "Shall the Chair be sustained?", the Board shall forthwith appoint the Vice Chair or, in his/her absence, one of the Members, to preside temporarily in lieu of the Chair. The Vice Chair, or Member so appointed, shall proceed in accordance with paragraph 20(5)(a).

(6) The Chair shall vote at the same time as the other Members of the Board.

Rules of Order

21. (1) The Chair's ruling on a point of order shall be based on rules of order as stated in section 2 herein.

(2) All questions shall be decided by a vote on motion.

(3) The Chair shall have the discretion to call the question on completion of debate and the Chair shall then advise that the debate is closed. Following closure of debate no Member shall speak further to the question.

Motions

22. (1) Motions shall be phrased in a clear and concise manner so as to express an opinion or achieve a result.

(2) The Chair may divide a motion containing more than one subject if the Chair feels this would produce a fairer or clearer result and the same shall be voted on in the form in which it is divided.

(3) A motion to adjourn the meeting or to adjourn the debate shall always be in order.

(4) An amendment to a motion does not require notice. Only one amendment to an amendment shall be allowed at one time and the same shall be dealt with before the amendment is decided. Amendments must be strictly relevant to the main motion and not alter in a material way or be contrary to the principle embodied in the main motion.

(5) Any Member desiring to bring before the Board any new matter, other than a point of order or privilege, shall do so by way of motion; provided, however, that any new matter of major import, which may require further information than could or would normally be available to the Board at such meeting, may be referred to a Board Standing Committee agenda by the Chair, or may be ruled by the Chair as a notice of motion and shall be dealt with as provided by section 22(6).

(6) Any Member may give notice of a motion to the Board by providing the Corporate Officer with a written copy of much motion before or during a meeting, and the Corporate Officer shall, upon the Member being acknowledged by the Chair and the notice of motion being read to the meeting, include it in the minutes of that meeting as a notice of motion and shall add the motion the agenda of the next regular Board meeting, or to the agenda of a special Board meeting scheduled for that purpose.

(7) Notwithstanding section 12(2), a motion under section 22(6) shall only be decided at its meeting of introduction if all of the following are met:

(a) the motion's subject matter falls into one or more of the following classes:

(i) those items with an urgent deadline;

(ii) those items of minor organization impact (e.g. simple advocacy or letters of support); or

(iii) those items supporting the position of member local governments;

(b) the Members present vote with a two-thirds majority to consider it.

(Bylaw 4313)

Reconsideration of an Adopted Bylaw, Resolution or Proceeding

23. (1) The Chair may require a matter to be reconsidered in accordance with Section 217 of the *Local Government Act* and if it has not been acted on by an officer, servant or agent of the Board.

(Bylaw No. 4262)

(2) The Chair may state his/her reasons to the Board. The Corporate Officer shall record in the Minute Book the reasons, suggestions or amendments of the Chair.

(3) The Board shall, as soon as convenient, consider the reasons and either reaffirm or reject the bylaw, resolution or proceeding, and if rejected, it is deemed repealed and is of no force or effect.

(4) The rejected bylaw, resolution or proceeding shall not be reintroduced to the Board for six (6) months, except with the unanimous consent of the Board.

(5) The conditions which apply to the passage of the original bylaw, resolution or proceeding apply to its rejection.

Debate and Conduct

24 (1) Debate shall be strictly relevant to the question before the meeting and the Chair shall warn speakers who violate this rule.

(2) No Member shall speak until recognized by the Chair.

(3) Every Member desiring to speak shall address himself to the Chair. No Member shall interrupt a person speaking except to raise a point of order.

(4) A matter of privilege (a matter dealing with the rights or interests of the Board as a whole or of a Member personally) may be raised at any time and shall be dealt with forthwith before resumption of business.

(5) Members speaking at a Board meeting:

(a) must use respectful language;

(b) must not use offensive gestures or signs;

(c) must speak only in connection with the matter being debated; and

(d) must adhere to the rules of procedure established under this Bylaw and to the decisions of the Chair and the Board in connection with the rules and points of order.

(6) If a Member does not adhere to section 24(5) or the Chair considers the Member to be acting improperly, the Chair may order the Member to leave the Member's seat.

(7) A Member may speak to a question, or speak in reply, for no longer than fifteen (15) minutes unless the majority of the votes of the Board support a time extension.

(8) A Member may speak more than once in connection with the same question only if:

(a) every other Member has spoken, or has had the opportunity to speak; and

(b) if the Member has already spoken for fifteen (15) minutes, the Member who wishes to speak a second time may request to do so by making a motion that must be approved by at least two-thirds of the votes cast by the Board.

(9) (a) a Member may not speak for longer than a total time of fifteen (15) minutes unless the Member has done so in accordance with sections 24(7) and (8); and

(b) a Member speaking for a second time under section 24(8) shall speak for a maximum of five (5) minutes only.

(10) The conflict of interest guidelines *(disclosure of conflict and restrictions on participation)* shall be in accordance with section 100 of the *Community Charter*.

Voting

25. (1) Voting rules will be in accordance with the *Local Government Act*.

(2) On any question where the numbers of votes, including the vote of the person presiding, are equal, the question is defeated.

(3) Where a Member who is present when a vote is taken abstains from voting, that Member shall be deemed to have voted in the affirmative.

(4) Whenever a vote of the Board is taken, after the vote is taken the Chair must then state the names of those Members voting in the negative, and the Corporate Officer must enter those names in the minutes.

PART 4 – COMMITTEES AND COMMISSIONS

Board Standing Committees

26. (1) The Chair may establish a Board Standing Committee as a regular permanent committee whose mandate will be in relation to a CRD service or potential service.

(2) The Chair shall appoint only Board Members to a Board Standing Committee with the following exceptions:

(a) Unless the authorizing legislation or Letters Patent for the Board Standing Committee defines its membership; and

(b) Where a Board Standing Committee Terms of Reference allow a First Nation Member to participate.

(Bylaw No. 4368)

(3) The general duties of Board Standing Committees shall be as follows:

(a) To consider and report to the Board from time to time or whenever desired by the Board and as often as the interest of the CRD may require, on all matters referred to them by the Chair of the Board, or coming within their purview, and to recommend such action by the Board in relation thereto as they, the Committee, deem necessary or expedient.

(b) To carry out the instructions of the Board expressed by resolution in regard to any matter referred by the Board to any Committee for immediate action thereon, but in such cases the instruction of the Board shall be specific and the Committee shall report its action in detail at the next regular or other meeting of the Board thereafter as specified in the instructions of the Board Advisory Committees.

Advisory Committees

27. (1) The Board, or Board Standing Committees, may establish an Advisory Committee to provide advice and recommendations to the Board, or to a Board Standing Committee, on matters determined to be within approved terms of reference or within a specific resolution of the Board.

(2) Members of an Advisory Committee shall be appointed by the Board, a Board Standing Committee, or the appointments may be delegated by the Board to the Chair.

(3) Persons who are not Members may be appointed to an Advisory Committee but each Advisory Committee should include at least one (1) Member of the Board.

(4) The term of any person who is appointed to an Advisory Committee who is not a Member of the Board shall not exceed three (3) years.

Select Committees

28. (1) The Board may establish a Select Committee to consider or inquire into any matter dealing with a specific subject or issue referred to it by the Board and report its findings, opinions and recommendations to the Board, following its consideration and inquiry. Select Committees must have terms of reference approved by the Board.

(2) The Select Committee will cease to exist once it has reported its findings, opinions and recommendations to the Board.

(3) The Board may delegate to the Chair the establishment of a Select Committee and the appointment of its Members.

Commissions

29. (1) The Board may establish a Commission regarding a CRD service within the authorities delegated to it and as mandated by the Board by bylaw.

Electronic Participation at Commission Meetings

29.1 (1) A member of a Commission may participate in a regular or special meeting by means of electronic or other communication facilities that:

(a) enable the meeting's participants to hear, or watch and hear, each other;

(b) except for a meeting that is closed to the public, enable the public to hear, or watch and hear, the member participating by electronic or other communication facilities.

(2) The person presiding at the Commission meeting must not participate electronically.

(3) A person participating in a Commission meeting electronically is deemed to be present at the meeting as though they were physically present.

(4) The recording secretary shall record in the minutes the persons present including those participating electronically.

(5) Subject to section 29.1(9), no more than one person at one time may participate electronically.

(Bylaw No. 4206)

(6) The person wishing to participate in a Commission meeting electronically must advise the Corporate Officer at least 24 hours in advance of the meeting;

(7) Subject to section 29.1(9), if more than one person wishes to participate electronically at a Commission meeting, the Corporate Officer will by lot choose the person who is entitled to participate electronically. *(Bylaw Nos. 4206,4262)*

(8) Electronic participation will only be permitted where existing technical facilities at the location of the Commission meeting accommodate electronic participation.

(Bylaw No. 3951)

(9) Sections 29.1(5) and 29.1(7) do not apply to meetings of a Commission that operates a service that includes the entire Southern Gulf Islands Electoral Area as the service area.

(Bylaw No. 4206)

Electronic Participation in case of Emergency or Special Circumstance

29.2 (1) In an emergency, special circumstance, or public health event that prevents or restricts members from being able to physically meet in one location, members or persons appointed by the Board may participate in a meeting by means of electronic or other communication facilities that:

(a) enable the meeting's participants to hear, or watch and hear, each other; and,

(b) except for a meeting that is closed to the public, enable the public to hear, or watch and hear, the member(s) and person(s) participating by electronic or other communication facilities.

(2) Meetings called under subsection (1) will be at the call of the Board Chair.

(3) Special meetings called under subsection (1) will be in accordance with section 9 of this bylaw and will comply with the requirements set out in subsection 2(2)(d) of the *Regional District Electronic Meetings Regulations*, B.C. Reg. 118/2018.

(Bylaw No. 4353)

Attendance at Committee Meetings

30. Members of the Board who are not Members of a Committee may attend meetings of that Committee and may take part in any discussion or debate by permission of a majority of the Committee Members present but may not vote.

Committee Reports

31. A Standing or Select Committee of the Board may report to the Board at any regular meeting or shall report as required by the Board.

Quorum

32. The quorum in a Standing or Select Committee shall be the majority of the Persons appointed to the Committee, but shall not include First Nation Members.

(Bylaw No. 4368)

Voting at Meetings

33. (1) On a vote in a Committee each person shall have only one (1) vote.

(2) (a) The Chair shall be a Member of all Committees and entitled to vote on all matters.

(b) Despite section 33(2)(a) the Chair, when in attendance, may be counted as one Member for the purpose of constituting a quorum.

(c) First Nation Members are permitted to abstain from voting on an item, provided that they declare their abstention prior to the vote being called on the item.

(Bylaw No. 4368)

(d) When an abstention from voting on an item is declared by a First Nation Member, it shall be noted in the meeting minutes and the total number of votes on the item shall not include those First Nation Members who have abstained from voting.

(Bylaw No. 4368)

Operation

34. No Committee or Commission will operate outside of its expressed mandate or terms of reference without prior approval of the Board.

PART 5 – COMMITTEE OF THE WHOLE

Procedures for COW Meetings

35. (1) The Board may resolve to sit as a COW at any time.

(2) The Chair may appoint another Member to preside over the COW who shall maintain order therein and report the proceedings thereof to the Board.

(3) The rules of the Board shall be observed in COW as far as may be applicable. Motions shall be seconded and the names of Members shall not be recorded in case of a division. Divisions in COW shall be decided by a show of hands. A motion in COW to rise without reporting, or that the Chair of the Committee do leave the Chair, shall always be in order and shall take precedence over any other motion. A motion to rise without reporting, if affirmed shall be considered as disposing of the matter before the Committee in the negative.

(4) When all matters referred to the COW have been considered, a motion to rise and report shall be adopted. The Committee may report progress and ask leave to sit again if the matter before it has not been disposed of. On the Committee rising, the Chair shall report to the Board and an adoption of the report shall be moved.

(5) Discussion in COW shall be strictly relevant to the item or clause under consideration.

(6) First Nation Members may attend COW when invited in advance by the Board Chair.

(Bylaw No. 4368)

PART 6 – BYLAWS

36. (1) Bylaws shall be passed by the following stages:

(a) Introduction and first reading shall be decided by the motion "that Bylaw No. ____ be introduced and read a first time". The question shall be decided without amendment or debate.

(b) Second Reading - Debate on second reading shall be limited to the general principle of the bylaw.

(c) Third Reading - A bylaw may be amended at third reading and passed upon the motion "that Bylaw No. ____ (as amended or as presented) be read a third time".

(d) Despite sections 36(1)(a), (b) and (c) every proposed bylaw may be introduced and given first, second, and third readings at the same meeting by one motion for all three readings.

(e) Adoption - Not less than one clear day after third reading, the bylaw shall be adopted upon the motion "that Bylaw No. ____ be adopted", unless the Board adopts the bylaw in accordance with subsection (2) and section 228 of the *Local Government Act*.

(Bylaw No. 4262)

(2) A bylaw that does not require approval, consent or assent under the *Local Government Act* or any other Act before it is adopted may be adopted at the same meeting at which it passes third reading, so long as the motion for adoption receives at least two thirds of the votes cast.

(3) A copy of every bylaw shall be endorsed by the Corporate Officer with a record of the stages through which it has proceeded and shall be kept among the records of the Board. A copy of every adopted bylaw signed, sealed and where necessary bearing evidence of registration by the Inspector of Municipalities shall be kept with the records of the Board.

PART 7 – RESOLUTIONS

37. A resolution may be introduced at a Board meeting only if a written copy is given to each Member before consideration unless the Board waives this requirement.

PART 8 – GENERAL

38. The rules of the Board shall be observed in proceedings of the Capital Regional Hospital District Board, and Standing and Select Committees of the Board as far as may be applicable.

39. The provisions of sections 22 and 24 of this bylaw that apply to Members shall apply to First Nation Members. *(Bylaw No. 4368)*

40. The following bylaw is repealed: Bylaw No. 3708, "Capital Regional District Board Procedures Bylaw, 2010", and any amendments thereto.

41. This Bylaw may be cited as "Capital Regional District Board Procedures Bylaw, 2012".

READ A FIRST TIME THIS	19th	day of	September,	2018
READ A SECOND TIME THIS	19th	day of	September,	2018
READ A THIRD TIME THIS	19th	day of	September,	2018
ADOPTED THIS	10th	day of	October,	2018

[Original signed by]
CHAIR

[Original signed by]
CORPORATE OFFICER

Making a difference...together

CAPITAL REGIONAL DISTRICT

CORPORATE PROCEDURE

Section	*Board*	
Subsection	Policies, Procedures, Manuals	*(policy #)*
Title	BOARD AND COMMITTEE DELEGATION PROCEDURES – ELECTRONIC PRESENTATIONS	

PROCEDURE:
To outline the procedures for Board and Committee delegations wishing to use an electronic presentation as part of their delegation.

PURPOSE:
To apply stricter controls and requirements to the uploading of electronic presentations on CRD equipment to mitigate tampering of files and the introduction of viruses onto CRD equipment.

RESPONSIBILITIES:
Legislative Services is responsible for the control, coordination, implementation and modification of the policy after it has been approved by the ELT.

SCOPE:
The policy applies to all delegations who register to address the CRD Board and its standing committees and commissions.

DEFINITIONS:
"Delegation" means an individual or an organization addressing the Board, a committee or commission oabo ut a specific item on the agenda of a meeting.

"Electronic presentation" means a video, PowerPoint presentation, youTube clip or any other type of visual media used in conjunction with a delegation presentation.

PROCEDURE:

1. All delegations wishing to use an electronic presentation in conjunction with their delegation must provide a copy to Legislative Services 24 hours in advance of the meeting.

2. Legislative Services will forward a copy of the presentation to IT for review and scan of any viruses or inappropriate material.

3. IT will upload a copy of the presentation onto the laptop prior to the meeting.

4. IT will set up the laptop in the Boardroom ½ hour prior to the start of any Board or committee meeting and will remain in attendance to assist delegations with electronic presentations.

5. Delegations will not be permitted to upload any electronic presentations without the assistance of CRD staff.

6. Legislative Services will ensure a copy of the presentation has been retained for record keeping purposes prior to the item being deleted from the laptop.

Approval Date:	October 10, 2013	Approved By:	ELT
1. Amendment Date:		Approved By:	
2. Amendment Date:		Approved By:	
3. Amendment Date:		Approved By:	
Next Review Date:		Reviewed By:	
Supersedes:			

Related Policy,Procedure or Guideline: CRD Board Procedures Bylaw

Making a difference...together

REPORT TO GOVERNANCE COMMITTEE
MEETING OF WEDNESDAY, FEBRUARY 02, 2022

SUBJECT **Bylaw No. 4453, "Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2022"**

ISSUE SUMMARY

To present a bylaw to continue the Victoria Family Court and Youth Justice Committee as a delegated commission.

BACKGROUND

In 2019, the Board directed staff to work collaboratively with the Victoria Family Court and Youth Justice Committee (the "Committee") on a review of the Committee's mandate, governance, finances and communications. In November 2020, the CRD Board received the review. It directed staff provide it to all service participants, report on restructuring options, and consult further.

On January 21, 2021, service participants were provided with the report and informed of upcoming consultations. On January 27 and February 3, 2021, CRD engaged with the Committee on recommendations and potential governance and structure options. Based on feedback, on February 26, 2021, CRD staff provided a list of mandatory and recommended changes to the Committee's governance and structure. Staff requested the Committee indicate by motion interest in implementing change.

The Committee did this on April 21, 2021. It formed its own working groups to make further recommendations. On June 2, 2021, the Board directed staff draft a delegated commission bylaw and provide it to the Committee for feedback. Also in June, Committee Chair Cynthia Day wrote to the Provincial Attorney General asking whether there were objections to CRD undertaking a delegated bylaw for the Committee.

On August 23, 2021, CRD staff provided a draft bylaw and a reporting letter to the Committee (Appendix "A"), which on September 22, 2021, the Committee referred to its working groups. It also adopted its working group recommendations made over the summer months.

In October, the Committee received a response from Ministry of Attorney General Acting Assistant Deputy Minister Paul Craven (Appendix "B") confirming that the Ministry did not have any comment on the changes to the governance structure of the Committee, provided it complies with the provisions of the *PCA* and *YCJA*. He referred the Committee to guidance on regional district committees and delegation and stated the Ministry could not provide legal advice.

On November 17, 2021 the Committee adopted its working groups' recommendations on the draft bylaw and its review of requirements of CRD's policies, procedures, and applicable legislation and passed the following resolution:

> *THAT the Victoria Family Court and Youth Justice Committee adopt the recommendations of the Procedures, Policies, and Community Charter Working Group as outlined in the Working Group's October 28, 2021 Report to the VFC&YJ Committee, specific to:*

> *1. Formalizing Meetings: Complying with Community Charter, holding meetings that are open to the public and provisions for closed meetings, Steering committee purpose and function, adoption of CRD's procedure bylaw (with reasonable variations) including guidelines pertaining to minutes, agendas, and meeting and speaking times.*
>
> *2. Follow existing CRD policies. Members of the VFCYJ committee will follow the Capital Regional District Commission Handbook 2020 and CRD Bylaw 3828, CRD Procedures Bylaw (with reasonable variations) to ensure compliance with privacy, safety, information management, and expenses. Importantly, the VFCYJ committee will comply with all laws regarding the Freedom of Information and Protection of Privacy Act, the corporate policy and procedure regarding a respectful workplace, debate and conduct.*
>
> *AND THAT, the Chair of the VFCYJ Committee send a letter to the CRD Board and Staff providing the wording of the Committee's resolution and including a copy of the Work Group's Report, dated October 28, 2021*

It requested CRD provide a written version of an oral opinion that the draft bylaw was consistent with the *PCA* and *YCJA*, to address concerns some members had as a result of the A/ADM's letter. Staff provided written confirmation to the Committee that the proposed bylaw was consistent with the legislation. Attached at Appendix "C" is the Committee's January 10, 2022 letter confirming the motions cited above and including the notes of the working group.

On January 19, 2022, the Committee at its Annual General Meeting affirmed its September and November adoptions and recommendations, as well as decided to centralize its finances in the CRD after becoming a delegated commission.

Incorporation of Committee's Feedback

As a result of feedback, some edits have been made to Bylaw No. 4453 (Appendix "D"). These include refining the Committee's duties in section 20 to match the wording of the *PCA*; inserting "advocacy", to clarify it as a Committee function; stating that school districts may appoint individuals other than trustees (consistent with past practice); and clarifying that an annual meeting to elect officers must be held within the first two months of the year, rather than limiting it to a specific week or date.

Other recommendations are not actioned at this time. These include reduction of CRD appointees (which can be used to represent the Juan de Fuca, and to provide voting positions to community organizations, First Nations, and other groups), extended terms for officers (as historically a one year term has been used), creation of a "past Chair" position by bylaw (which is not considered necessary as the Committee may create any officer position by resolution), and other items that may best be dealt with by the Committee moving forward rather than having those items incorporated into a governance bylaw. Should issues arise or further changes become recommended, these can be reviewed at the one year anniversary of the proposed Bylaw No. 4453 and changes can be enacted through an amending bylaw.

ALTERNATIVES

Alternative 1
The Governance Committee recommends to the Capital Regional District Board:

1. That Bylaw No. 4453, "Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2022", be read a first, second, and third time;
2. That Bylaw No. 4453 be adopted.
3. That staff be directed to advise service participants of Bylaw No. 4453.

Alternative 2
That this report be referred back to staff for additional information.

IMPLICATIONS

Committee's Actions Post-Review

The Committee has taken steps to resolve identified issues. Its annual report has been shortened; its website operates and contains key documents and background information; its agendas include specific times for resource members to present; it is attempting to limit speaking times, keep speakers on topic, and run orderly meetings; and it has provided past minutes for 2020 to the CRD for the purposes of the *Community Charter* access to records provisions and continues to assemble prior minutes. Its priority for 2022 is to work on its strategic plan, refocusing on its mandate as the region's youth justice and family court advocacy committee.

It continues to struggle with administration and procedure. It will benefit with guidance in agendas, minutes, attendance, working with and documenting motions, and running online meetings. Support from CRD's Corporate Services and other staff will likely resolve these issues in time.

Staffing & Financial Implications

No additional costs are expected. It is expected that the Committee will continue to implement changes to meeting procedures and practices and will work with its officers and CRD staff over the next year. Legislative and Legal Services are expected to have additional regular staff in 2022 who may absorb any additional workload. Corporate Services and the Finance department will assist in implementing supports. Legal Services will draft a sponsorship agreement for the Committee's grants program, assist with any modifications to the Constitution and Terms of Reference if required; and on an ongoing basis, be the point of contact for invoices for the Committee and inquiries.

On becoming a delegated commission, the Committee has resolved to transfer its funds to CRD's Finance department, to be held for the service. Invoices and receipts will be forwarded to Legal Services for review and Finance for payment in accordance with purchasing policies.

Impact on Appointments and Recruitment

CRD's Corporate Services department will send a letter every two years to service participants reminding them of the need to appoint qualified individuals to the Committee and conduct recruitment for CRD positions. The CRD would also follow up on non-attendance.

Impact on the Committee's Constitution and Terms of Reference

While the Committee's Constitution and Terms of Reference are not necessary under the new governance structure, given it has operated with these generally since inception, these documents can be retained if made consistent with the commission bylaw.

Impact on Capital Region Action Team for Sexually Exploited Youth

The Capital Region Action Team for Sexually Exploited Youth (CRAT) is an unincorporated association run by a CRD-appointee to the Committee. Its funds are held by Oak Bay, and it runs programming in schools, presently on hold during the COVID-19 pandemic. It continues to receive about $1,500 per year from the service. Under the delegated commission bylaw, the decision for how much funding CRAT receives would be made by the Committee as part of its delegated authority to select "board approved committees" for youth and family micro-grants.

CONCLUSION

Staff have prepared a delegated commission bylaw, based on best practices and incorporating certain Committee feedback. This structure is compliant with the legislated status of the committee. Going forward, staff will provide ad hoc assistance to the Committee to help its meeting processes and educate members on policies and procedures.

RECOMMENDATION

The Governance Committee recommends to the Capital Regional District Board:

1. That Bylaw No. 4453, "Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2022", be read a first, second, and third time.
2. That Bylaw No. 4453 be adopted.
3. That staff be directed to advise service participants of Bylaw No. 4453.

Submitted by:	Steven Carey, B.Sc, J.D., Senior Manager, Legal Services & Risk Management
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENTS

Appendix A: Correspondence with VFC&YJC and its recommendations
Appendix B: October 2021 Letter to VFC&YJC from A/ADM Paul Craven
Appendix C: January 10, 2022 Letter from C. Day enclosing adopted motions and AGM-adopted resolution from Finance Working Group
Appendix D: Redlined Draft Bylaw No. 4453, showing modifications
Appendix E: Bylaw No. 4453, "Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2022"

Appendix "A"

Victoria Family Court and Youth Justice Committee

Correspondence from Committee

Tab	Page	Date	Item
1	2	August 27, 2021	CRD Reporting Letter and Draft Bylaw No. 4453
2	21	October 20, 2021	Letter from C. Day containing minutes and attaching Committee-adopted recommendations from Succession and Priorities-Grants working groups (adopted September 22, 2021)
3	48	November 17, 2021 (as amended)	Committee-adopted Joint-working group recommendations on Draft Bylaw No. 4453

Tab	Page	Date	Item
1	2	August 27, 2021	CRD Reporting Letter and Draft Bylaw No. 4453

Making a difference...together

Corporate Services
625 Fisgard Street, PO Box 1000
Victoria, BC, V8W 2S6

T: 250.360.3128

www.crd.bc.ca

August 23, 2021

VIA E-MAIL

Victoria Youth and Family Court Committee
c/o Cynthia Day, Chair
cday@colwood.ca / vfamcourt@gmail.com

Dear Committee Members:

Re: CRD Review of Youth and Family Court Committee Service: Recommendations as a result of consultation

Further to the Victoria Family Court and Youth Justice Committee resolution of April 21, 2021, the Capital Regional District's letter of February 26, 2021, and consultations dated January 27, 2021 and February 3, 2021, we enclose a copy of a draft commission bylaw for the Committee's review.

The draft bylaw establishes a delegated commission, which will permit the Committee the broadest administrative delegation to conduct its work with minimal CRD corporate involvement. The proposed short title of the bylaw is the "Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2021".

Bylaw Review

Whereas Clauses

These whereas clauses provide a background on the Committee and its establishing bylaw.

Clauses 1 and 2, Creation and Delegation

These clauses establish the commission is a continuation of the Victoria Family Court and Youth Justice Committee, and delegate all the powers of the regional board under the service establishing bylaw – that is, the funding, participation, and operation of the Committee and the ability to fund youth and family issues – to the commission, acting as a whole in open meeting assembled. These are consistent with the recommendation the delegation to the Committee be clearly spelled out in a bylaw.

Clauses 3 to 10, Composition and Eligibility

These clauses set out that the Committee, as now, has 23 voting members:

- up to seven individuals appointed by the CRD, who may be representatives of the Juan de Fuca Electoral Area, community members, municipal councilors, First Nations representatives, or community members such as service providers or individual concerned residents;
- up to 13 individuals representing municipal participants, with a primary council member and an alternate, who may be a community member;

- up to 3 school district representatives.

The Committee may resolve to have any number of non-voting resource members.

Clauses 11 to 15, Term and Officers

Terms of appointment are set at two years, the same as now. A maximum term limit of six years is set, with reappointment possible after a one year absence. Even in the face of a term limit, in unique circumstances, an appointing agency may reappoint its voting member for an additional term. This is consistent with other CRD appointment bylaws with term limits.

Each year, in February, the Committee may select from its voting members chair, vice-chair, and treasurer. It may create additional officer roles and staff them with voting or non-voting members. This removes the requirement for the CRD to appoint the chair and treasurer, or to ratify the appointments made by the Committee at its annual meeting.

Clauses 16 to 18, Disqualification and Vacancies

These clauses list when termination occurs. Relating to member vacancies, the ability to terminate a member for failing to appear at three consecutive meetings continues. If vacancies are not filled within a reasonable time, this can be reported to CRD or the appointing organization.

Clauses 19 to 24, Commission Objectives and Duties

These clauses set out objectives and duties of the Committee, and are consistent with the recommend that mandate and delegation be set out in a bylaw. The language is based on the *Provincial Court Act* and *Youth Criminal Justice Act* mandate of the Committee, as well as the Committee's own constitution and terms of reference.

Clause 19 details the objectives of the Committee, a series of guiding principles for its work and for new and future committee members to understand the work it is meant to do for the region.

Clause 20 is a reproduction of the *Provincial Court Act* mandate of family court committees, but includes the ability to solicit and consider applications for receipt of grant-funding, something the Committee has been doing for the past 20 years but now clearly has delegated authority to do. It is assumed the Committee, working as a whole, will develop and adjust grant criteria and intake schedules as part of its work, based on its existing materials.

Clause 21 confirms that the Committee may take policy positions, independent of the Capital Regional District, on matters affecting families and youth justice in the region, provided it does so in the name of the "Victoria Family Court and Youth Justice Committee". It may also undertake other activities permitted of such committees if authorized by law.

Clause 22 confirms the Committee may establish advisory groups, who must report back to the Committee on their work; can contract for services (subject to CRD bylaws and policies relating to competitive purchasing); and can perform necessary and incidental administrative tasks (e.g. approving an advertisement or announcement outside a meeting). This is consistent with the recommendation that the Committee's advisory groups report up to the Committee before making final decisions, and that the Committee follow existing policies and procedures rather than create its own.

Clause 23 covers liability to individual commission members should they ever be requested by the Court or another qualified party to act as a referral under the *Provincial Court Act* or *Youth Criminal Justice Act*. It establishes that the Committee will create a body of registered volunteers, by resolution, to undertake the referral or action on behalf of the Court or qualified party. This will ensure that the group of volunteers are insured; acting within their scope of authority for a *Local Government Act* indemnity; are properly constituted of persons who have skills and interest in the referral; and can meet to discharge those statutory duties.

Clause 24 requires any volunteers (which are Committee members acting outside their role as Committee members, as in delivering services or making individual decisions on projects or programs outside meetings to effect the work of the Committee) to be registered with the CRD's Risk and Insurance department. This will ensure insurance coverage applies. It also requires those volunteers working with vulnerable persons or persons under 18 years of age provide a recent criminal record check to CRD.

Clauses 25 to 28, Conduct of Meetings and Quorum

These clauses set quorum at seven members (the historical quorum), confirm the Committee is subject to the CRD Procedures Bylaw, must hold meetings publicly unless in-camera meetings are permitted by law, and may meet by electronic means where other requirements are met. These clauses are based on other similarly sized commissions, and are consistent with the requirement the Committee comply with the *Community Charter* when acting as a body of local government.

Clauses 29 and 30, Conflict of Interest

This section sets out the conflict of interest provisions, largely applicable to elected officials and resource members who may be applying for grant funding for third party organizations they are associated with. It requires them to declare the conflict and step aside, not influencing the vote on a matter.

However, unlike most conflict of interest provisions, this permits non-voting members representing an organization (such as a resource member) or School District representatives, to be invited to present on an application, but such individuals must leave for the debate and not vote on a grant.

Clause 31, Budget

This clause requires the Committee to establish an annual budget by October 1 of each year. Many CRD committees and commissions now establish budgets in late August or early September; however, due to the nature of the Committee's work, an October deadline appears appropriate. This amount is used to set the next fiscal year's requisition.

Clauses 32 and 33, Record Keeping

The Committee shall comply with record keeping requirements at law. For example, it is required to provide agendas in compliance with CRD's Procedures Bylaw prior to each meeting, and provide meeting minutes and records to CRD after each meeting for storage. This is consistent with the mandatory requirement to keep records in a manner required by the *Community Charter* and *Local Government Act*.

Clause 34, Citation

This clause sets out the short title of the bylaw.

Conclusion

While the bylaw is silent on non-mandatory obligations listed in our letter of February 26, 2021 date, these issues will be addressed by active decisions by the Chair and the Committee as a whole as it moves forward with its business.

The writer anticipates discussion of this bylaw at the Committee's meeting in September, and can be available to answer questions at that time. The next CRD Governance Committee is scheduled for October, however, should further time be needed to review, a CRD Governance Committee meeting is also scheduled for December.

Should you have questions, please contact the writer by e-mail, scarey@crd.bc.ca, or at the direct line, 250-360-3128.

Best regards,

Steven N. Carey, B.Sc, J.D.
Manager, Legal Services
Lawyer and Trademark Agent

Encl. Draft Bylaw 4453, "Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2021"
CRD Letter of February 26, 2021

CAPITAL REGIONAL DISTRICT
BYLAW NO. 4453

****

A BYLAW TO CONTINUE THE VICTORIA FAMILY COURT AND YOUTH JUSTICE COMMITTEE AS A DELEGATED COMMISSION

****

WHEREAS:

A. Under Bylaw No. 2560, *Family Court Committee Extended Service Establishment Bylaw No. 1,* 1997, the Capital Regional District ("CRD") continued a service to operate, participate in and fund a *Provincial Court Act* family court committee created for the capital region, as well as to provide funding to approved youth justice initiative involved third parties;

B. Since the 1960s, the Victoria Family Court Committee, also known as the Victoria Family Court and Youth Justice Committee, has operated as an advisory body, first as a committee of the City of Victoria then of the Capital Regional District, and continues to operate for the coordination and grant-making benefit for regional youth and family justice initiatives;

C. The Board wishes to set out clearly the community mandate of the Committee in a commission bylaw and ensure it has legal status and delegated authority to continue its work;

NOW THEREFORE, the Capital Regional District Board in open meeting assembled hereby enacts as follows:

CREATION OF COMMISSION

1. A commission is hereby established, to be known as the "Victoria Family Court and Youth Justice Committee" (hereinafter the "Committee"), and shall be a continuation of the Victoria Family Court and Youth Justice Committee presently operated in the capital region.

DELEGATED AUTHORITY

2. The Committee is hereby delegated all of the administrative powers of the Regional Board with respect to the service set out in Bylaw No. 2560, *Family Court Committee Extended Service Establishment Bylaw No. 1,* 1997 (the "Bylaw No. 2560"), that is, the funding, participation, and operation of the Committee and the granting of funding to youth and family issues; and the Board's ability under s.263(1)(c) of the *Local Government Act* to provide assistance to youth and family groups as contemplated by Bylaw No. 2560, other than assistance to business.

COMPOSITION AND ELIGIBILITY

3. The Committee shall have the following number of voting members, up to a total of 23, each having one vote:
    (a) Up to seven individuals as Capital Regional District appointed representatives under section 7;
    (b) Thirteen municipal council representatives, who may each have an alternate, under section 8; and
    (c) Three school district trustees representing School Districts 61, 62, and 63, under section 9.

4. Available openings for voting membership vacancies will be advertised by November of each year of a vacancy in a term in a form acceptable to the appointing organization.

5. A majority of members must have experience in education, health, probation, or welfare.

6. Members must represent the interests of their community or organization to the best of their ability.

Capital Region Representatives

7. The Regional Board may appoint up to seven individuals as voting members of the Committee. Such appointments may be, but are not limited to, representatives of the Juan de Fuca Electoral Area, community members, representatives of youth and family justice organizations, municipal councilors, regional district Board members, or First Nations' representatives.

Municipal Representatives

8. Each municipal participant may appoint a municipal council representative as a voting member, and may appoint as an alternate voting member a member of the public or a municipal councilor to act in the absence of the municipal council representative, for a total of 13 municipal council representatives.

School District Representatives

9. Each school district in areas served by the Committee may appoint a representative as a voting member, for a total of three school district representatives.

Resource Members

10. The Committee may resolve to have any number of non-voting resource members, including individuals, service providers, organization representatives, public authorities, First Nations, or other groups working in the capital region in family court and youth justice initiatives.

TERM OF OFFICE

11. A member's term of office is from the date of appointment in one year to December 31 in the second year of appointment.

12. No voting member may serve more than six consecutive years on the Committee. A former member may be reappointed after one year of absence. Despite the term limit in this section, in unique circumstances, an appointing agency may reappoint its voting member for an additional term.

OFFICERS

13. At the Committee's first meeting in February of each year (the "Annual Meeting"), by show of hands, or, if a secret ballot is requested by one-third of members present, by secret ballot, the Committee shall select from among its voting members a Chair, Vice-Chair, and Treasurer.

14. The Committee may create additional officer roles it considers advisable and staff them with voting or non-voting members from time-to-time.

15. In the event of a vacancy, the Committee may select a voting member to fill an officer role until the next Annual Meeting.

DRAFT

DEATH, RESIGNATION, DISQUALIFICATION AND TERMINATION

16. A member's appointment ends on the end of term; resignation; death or incapacity; revocation of appointment; ceasing to be an employee, volunteer, elected official or officer of an appointing agency; or on the cessation of a municipal council voting member ceasing to be a municipal councilor.

MEMBER VACANCIES

17. In the event of a member vacancy before the end of term, the appointing organization may appoint an individual to complete the term. If not filled within a reasonable time, the Committee shall reported such vacancy to the Capital Regional District's Corporate Officer.

18. If a member is absent for more than two consecutive meetings with notice, the Committee shall contact the member to determine interest in continuing on the Committee. If absent for three consecutive meetings, the member may be removed by resolution of the Committee and the Committee shall alert the appointing organization, requesting appointment.

COMMISSION OBJECTIVES AND DUTIES

19. The Committee has the following objectives:
    (a) to identify, inform, educate, and report on gaps in regional resources for youth justice and family court issues;
    (b) to act as a resource for the public and youth and family organizations; and
    (c) to encourage collaboration between and visibility of community services.

20. The Committee is hereby tasked with the following duties:
    (a) to meet at least four times per year to:
        i. consider and examine community resources for family and children's matters;
        ii. make recommendations to the court, the Attorney General, or others;
        iii. solicit and consider applications for receipt of grant-funding; and
        iv. connect family-and-justice-involved individuals, service providers, and government in a way that encourages collaboration and identifies service gaps;
    (b) if requested by the court, to act a resource or assist as directed; and
    (c) report annually to its member local governments and the Attorney General on its activities and recommendations.

21. The Committee may, within its mandate:
    (a) take positions on policy initiatives, legislation, and services affecting families and youth justice in the region, in the name of the "Victoria Family Court and Youth Justice Committee"; and
    (b) undertake other activities consistent with the activities of a family court and youth justice committee, as permitted by law.

22. Subject to Capital Regional District bylaws, policies, and procedures, the Committee, in open meeting assembled or through supervised volunteers, may:
    (a) establish advisory groups to examine specific issues, who will report on their work;
    (b) contract for support services, volunteer coordination, communications, feasibility studies, and other services and goods related to its mandate;
    (c) undertake necessary, incidental, or ancillary administrative tasks in order to effect its work.

23. If acting under referral or as otherwise directed under the *Provincial Court Act,* RSBC 1996, c 379, or *Youth Criminal Justice Act*, SC 2002, c 1, the Committee shall discharge its duties through one or more registered volunteers assembled for that purpose by resolution of the Committee, unless otherwise directed by the court.

24. All volunteers shall be supervised by the Committee or its appointed volunteer coordinator, if any; shall register with the CRD's Risk and Insurance Department; and must, if working with vulnerable persons or persons under 18 years of age, provide a recent criminal record check to CRD.

CONDUCT OF MEETINGS AND QUORUM

25. A quorum shall be seven (7) voting members.

26. The Committee must follow Bylaw No. 3828, "Capital Regional District Board Procedures Bylaw, 2012", when conducting a meeting (the "CRD Procedures Bylaw").

27. All meetings of the Committee must be held in a public facility and must be open to the public. Meetings may be in-camera, where authorized by law.

28. The Committee may meet by electronic means, where the requirements in the CRD Procedures Bylaw are met.

CONFLICT OF INTEREST

29. In discharging the Committee's grant function, any member who considers themselves in a pecuniary or non-pecuniary conflict of interest shall declare a conflict, which may include:
    (a) where their appointing agency is a direct recipient of a grant or assistance; or
    (b) where a member or their immediate family owes a fiduciary duty, as a director, senior manager, or employee of an organization receiving funding,

    and shall recuse themselves in accordance with the CRD Procedures Bylaw and the *Community Charter,* SBC 2003, c 26.

30. On a majority vote of the Committee, School District and non-voting members representing an organization with a direct pecuniary interest in a grant may be invited to present on their organization's application, but shall not be present for debate nor the vote on the matter.

BUDGET

31. Upon its establishment and by October 1 of each year, the Committee shall prepare an annual budget, which shall include estimates for administrative costs, operations, grants, and other expenditures, and shall submit such estimates to the CRD's Chief Financial Officer for Regional Board approval and inclusion in provisional and annual budgets.

RECORD KEEPING

32. The Committee shall comply with all public record keeping requirements under the *Community Charter*, *Local Government Act*, and other applicable legislation.

33. Records shall be stored at the CRD. Agendas shall be provided in advance of meetings in accordance with the CRD Procedures Bylaw and meeting minutes shall be provided after each meeting.

DRAFT

CITATION

34. This bylaw may be cited for all purposes as “Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2021".

READ A FIRST TIME THIS	th	day of	20__
READ A SECOND TIME THIS	th	day of	20__
READ A THIRD TIME THIS	th	day of	20__
ADOPTED THIS	th	day of	20__

CHAIR

CORPORATE OFFICER

DRAFT

Corporate Services
625 Fisgard Street, PO Box 1000
Victoria, BC, V8W 2S6
T: 250.360.3128
www.crd.bc.ca

February 26, 2021

VIA E-MAIL

Victoria Youth and Family Court Committee

Attn: Members of the Committee

Dear Sirs/Mesdames:

Re: CRD Review of Youth and Family Court Committee Service: Recommendations as a result of consultation

Further to our consultation at Victoria Youth and Family Court Committee (the "Committee") meetings January 27, 2021 and February 3, 2021, we write to request the Committee's membership, by resolution passed in open meeting properly assembled, confirm it is interested in continuing with the process as outlined in this letter.

On January 27, 2021, we canvassed the Committee's history, problems faced by it and other family court committees, how grants can be made, and options for resolving structure and governance issues. On February 3, 2021, we went through each recommendation in the CRD report. Discussion occurred on public meeting and record keeping requirements, the role of the Provincial Ombudsperson, and on delegated versus advisory commissions. At this meeting, CRD was prepared to present a delegated commission model, but was informed January 26, 2021 by the Committee's Chair that it was not ready for further consultation and would not be ready until after an orientation session in February had been held for new members.

Suggested Motion Language

We ask that you consider a motion, in open meeting assembled, showing a group intention to continue with this process. We suggest the following:

> *That the Victoria Youth and Family Court Committee recommend to the Capital Regional District Board:*
>
> 1. *Consider creation of a delegated commission, rather than an advisory committee or commission, to continue the work of the Victoria Youth and Family Court Committee;*
> 2. *Direct staff to continue to engage with the Committee to work to implement certain mandate, governance, and structure changes in accordance with the recommendations set out in the CRD's letter of February 26, 2021.*

Recommended Structure – Delegated Commission

A delegated commission will provide independence over administration and operation of the service, similar to how the Committee currently operates, but with a delegation of grant-making authority and a clear mandate set out in a bylaw. Similar commissions exist already at CRD: no

new model would need to be created. This has the least burden in time, monetary cost, and personal financial risk to appointees. A draft commission bylaw has been prepared to implement certain recommendations set out in this letter. Please note that though it would be a delegated commission, the Committee name would not change: "commission" is a legal status.

An advisory commission is not recommended. It would cause unnecessary delays relating to grant-making, would require additional Board referrals, and increase use of Board and staff time. Committee issues are specialized, funding applications are received throughout the year (particularly from youth) and the Committee is ideally staffed with persons able to advise on community need, something it has done in the capital region since the 1960s.

A society is not recommended. The administrative burden and need for additional insurance and other materials (risk, privacy, work safety, human rights policies) would quickly deplete resources. Volunteers who provide assistance to the Committee and certain local government appointments undertaking Committee work between meetings are likely be ineligible for the *Local Government Act* indemnity and would not be covered by CRD's insurance.

Recommendations

Recommendations are organized into "must" or "may" categories and additional considerations contained in the below table.

Mandatory Recommendations - Structure

The following are recommendations based on legislative requirements and best practices.

Recommendation	Must / May	Reasoning
Set out mandate and delegation in a bylaw	Must	A commission bylaw sets out delegation for grant-making and a clear mandate to guide the Committee in its business. A proposed mandate, compared to prior mandates and legislation is Schedule "A". The Committee should examine its mandate to ensure it is accurately reflecting both its historical purpose per the *PCA* and the broader work it does. Quorum is currently set to seven members, the same number as CRD appointments. This is appropriate based on attendance and is approximately 30% of membership.
Comply with *Community Charter (Formalize meetings)*	Must	As a body of a local government, meetings and any sessions where decisions are made must be in open. Does not apply to work by volunteers or sub-committees, provided they are not making final decisions for the Committee.
Public minutes and agendas unless in closed *(Formalize meetings)*	Must	*Community Charter* requires these to be published within a certain time, and to be publicly available or inspected on request. Publication could be met by online publication through CRD; prior minutes could be made available by CRD to meet requirements for public inspection. *YCJA* provides confidentiality provisions, if ever requested as a conference by the Court.

Maintain records consistent with the obligations of a public authority	Must	Required by *Community Charter* and *FIPPA.* Covered by CRD records and privacy policies, use of Corporate Officer and FOI Manager for FOI requests. Records should be stored at CRD. A CRD e-mail address should be provided. Meeting minutes should be publicly accessible and available.
Procedures bylaw compliance *(Formalize meetings)*	Must	To resolve the existing complaints faced by the Committee, it should ensure: • Agenda items can be raised with Chair in advance of meeting, or at a meeting itself by Notice of Motion; • Meetings have set times, with resolution required to continue them; • Speakers and delegations have set times, with resolution to extend; • Alternating speakers' lists are used to keep matters on topic, ensure small voices can be heard – members should not have wide-ranging discussions on topics outside the floor; • Compliance with Robert's Rules. While a Priorities sub-committee can assist in preparing an agenda, it should not bump items from prior meetings or items raised by Notice of Motion. It should not be deciding agenda items without the full committee. Decisions should be made in an open, properly constituted meeting.
Institute term limits	Must	Representatives should exit after a certain time to ensure fulsome representation by other members and others sought to fill their roles as part of a transition plan. Two year terms are proposed, with a maximum of three consecutive terms. After one year, a Committee member is eligible for re-appointment. Staggered terms are also recommended for community appointments (e.g. CRD appointments). For transition, existing committee members who are beyond their term limits should receive the balance of their term plus the option for one additional two years term. A further term of two years can be provided at appointing organization's option with consent of Committee. Past long-time volunteers can be non-voting resource members or participate as volunteers, a practice formerly used by the Committee.
Consolidate finances in CRD	Must	There is no need to have separate bank account. Approved grants, honoraria, and reimbursements of expenses can be issued directly from CRD. Can be included in CRD financial checks and audit.

Follow existing policies rather than create its own	Must	As a body of the CRD, the Committee should follow CRD policies, such as those relating to expenses; records management; standards of conduct; respectful workplace; and the like. If necessary, specific policies or exceptions can be developed in accordance with CRD's Policy Framework.
Re-arrange agenda items	Must	Agenda items should be re-arranged such that resource members speak at a dedicated time in the meeting (done).

Non-Mandatory Recommendations – Governance

The following are non-mandatory governance recommendations. Implementing a few would likely resolve many of the conflicts and issues faced by the Committee relating to its work.

Reduce or restructure meetings	May	Consider (non-exhaustively, and based on needs): - Setting a topic-based schedule for potential meetings, set in the January or February meeting of each year in advance - Aiming for the required four meetings per year to focus on family and youth resources in the region, with specific mandates for each meeting - Two grant intake and review meetings per year - Two resource member coordination meetings per year (Fall and Spring, for example), which may result in a greater focus on these organizations and greater attendance Reducing the number of meetings annually may improve attendance and free-up member time to work on specific projects or volunteer tasks.
Set specific mandates for sub-committees with dates for deliverables (reduce or restructure meetings)	May	Sub-committee creation and appointments should be at the call of the Board, not at the call of the Chair, to ensure consistent direction. Consider reducing the number of sub-committees, depending on the projects and workloads is advisable. When creating such groups, set a mandate, time limit, and staff with volunteers (who do not need to be Committee members) – did this historically. Using time or mandate-limited sub-committees, will allow work to get done to be reported up to the Committee as a whole example: e.g. Court Watch 2021, goal to attend court a certain number of times, visit a certain number or type of proceedings, report on a set future date. e.g. Working groups specific to certain issues, such as youth services on the West Shore, family services on the peninsula, with a set mandate and a time for reporting
Look at membership composition *(reduce numbers and appoint family-and-*	May	The Committee may wish to consider: • requesting CRD not utilize all seven of its community appointments, to reduce the numbers of voting members unless quorum or workload becomes an issue;

youth-involved individuals)		• requesting each municipal member appoint an elected official and a community member, such that they can act in each other's absence and collaborate on the municipalities needs; • methods and recruitment to ensure a majority of members must have experience in "education, health, probation, and welfare"; • look to actively recruit successors for long-time members, as well as new resource members; and • establishing a qualifications matrix, to determine what skill sets are missing on the Committee. CRD can also assist in coordinating appointments with service participants, such as developing standards advertisement language, setting reminders for intake periods, and the like.
Grant intake procedure and grant agreement form	May	May set grant-intakes per year and reserve some amount for applications that come up between meetings. May wish to establish non-exhaustive criteria for grants. Can still review grants through sub-committee, with recommendations and summary to Committee for approval. Have a conflicts recusal procedure to avoid allegations of bias or impropriety (as with other CRD granting bodies). Before any funding is provided, a grant-agreement must be entered into to protect funds (simple, mandatory).
Maintain a volunteer registry	May	This is strongly recommended if the Committee intends to continue to perform work outside properly constituted meetings, such as Court Watch, facility visits, or assistance to individual youth and families. The *Local Government Act* indemnity only applies to elected officials when working within their role, not when doing hands-on volunteer work (say court watching) not typically the duty of a local government official; for individual appointments and volunteers, it only applies when under the local government's direction: the Committee would need to specifically mandate tasks to its volunteers and sub-committees (if any) by resolution to ensure works are being properly supervised. It can do this by specific, mandated resolutions or by utilizing a volunteer coordinator, similar to how other delegated commissions operate. To qualify for insurance for their own injuries, volunteers must also register with CRD's Risk and Insurance Department. Individuals working with vulnerable youth should have a recent valid criminal record check on file with CRD. This will satisfy an insurer should a claim arise relating to misconduct involving youth.

Additional Recommendations Arising

From the questions asked by members and others since the July CRD report, the following items are recommendations arising.

Annual work plan	May	The Committee may wish to consider setting an annual work plan, similar to the City of Vancouver's committee. While the Committee does do forward planning, planning of the year may help it remain focused.
Continued online meetings	May	Local Government bodies, even post-COVID health orders, can host electronic meetings. CRD has facilities to do so via WebEX and Microsoft Teams; some use Zoom depending on the circumstances. This will facilitate attendance and engagement.
Maintain a region-wide focus	Must	On January 27, it was brought to the attention of the writer that the Committee had previously engaged in suicide watch of a vulnerable young person. This is outside the mandate of the committee and the insurance and indemnity of the individual members. Specific policies are available for this work but only where doing so when properly trained, registered, and with appropriate supports in place, none of which the Committee has. Committee members also attended a First Nations Court sentencing hearing in Duncan and participated in sentencing. As it is work outside the regional district, this may be outside the mandate of the committee. Any court appearances on behalf of the Committee should first be instigated by a direct request from the Court or a specific individual seeking assistance.

Conclusion

This review was conducted on the basis of the documents available and interviews with Committee members. Despite requests, the writer remains without access to past minutes and agendas. The Committee's 2021 annual report has not been finalized or distributed. If available, these documents may affect our opinion relating to certain governance recommendations.

Should you have questions, please contact the writer by e-mail, scarey@crd.bc.ca, or at the direct line, 250-360-3128.

Best regards,

Steven N. Carey, B.Sc, J.D.
Manager, Legal Services
Lawyer and Trademark Agent

cc. Cynthia Day, Chair, Victoria Youth and Family Court Committee; Robert Lapham, Chief Administrative Officer; Kristen Morley, General Manager, Corporate Services
Encl. Schedule "A" – Mandate Samples

Schedule "A"
Mandate and Objectives Summaries

Objectives

Suggested by CRD	Existing Committee Objective/Mandate
The Committee has the following objectives: (a) to identify, inform, assess, educate, and report on regional resources for youth justice and family court issues and related needs; (b) to act as a resource for the public and youth and family organizations; and (c) to encourage collaboration between and visibility of community services.	N/A The current Committee Constitution and Terms of Reference make no mention of mandate or purposes, though there are references to the *PCA* and *YCJA.*

Comments: The Committee should clearly identify objectives to guide it in its core work.

Additional Activities of the Committee

Suggested by CRD	Existing Committee Objective/Mandate
The Committee may, within its mandate: (a) take positions on policy initiatives, legislation, and services affecting families and youth justice in the region, in the name of the "Victoria Family Court and Youth Justice Committee"; and (b) undertake other activities consistent with the activities of a family court and youth justice committee, as permitted by law. Subject to bylaws, policies, and procedures, the Committee may: (a) establish advisory groups to examine specific issues, who will report on their work; (b) contract for support services, volunteer coordination, communications, feasibility studies, and other services and goods related to its mandate; (c) undertake necessary, incidental, or ancillary administrative tasks in order to effect its work.	The Family Court Committee can: a) Be a force in educating the public on issues related to Family Court; b) Sit in on court hearings to monitor the actions of all officials concerned with the welfare of youth and to assist judges upon request; c) Inform the Intermunicipal and the Capital Regional Electoral District Committees of the problems which are of concern to the community; d) Enter and monitor both open and closed custody facilities as concerned members of the public; e) Comment upon legislation concerning families and youth; f) Make recommendations to appropriate legislative bodies concerning any matters deemed to be covered by our several mandates; g) Be visible within the community and recognized as the appropriate body to whom complaints can be made, and to whom recommendations can be proposed for improvement. *[1985 Constitution Summary]*

Comments: Concerns were raised by the Committee's Chair about losing the ability to perform certain work as a body of CRD. The suggested mandate is broad enough to encompass historical tasks and undertake future obligations consistent with its objectives.

PCA Language Summary

Suggested	***Provincial Court Act***
The Committee is hereby tasked with the following duties: (a) to meet at least four times per year to: i. consider and examine community resources for family and children's matters; ii. make recommendations to the court, the Attorney General, or others; iii. solicit and consider applications for receipt of grant-funding;* and iv. connect family-and-justice-involved individuals, service providers, and government in a way that encourages collaboration and identifies service gaps; (b) if requested by the court, to act a resource or assist as directed; and (c) report annually to its member local governments and the Attorney General on activities and recommendations.	(6) The family court committee must do the following: (a) meet at least 4 times a year to consider and examine the resources of the community for family and children's matters, to assist the court when requested and generally, and to make the recommendations to the court, the Attorney General or others it considers advisable; (b) assist the officers and judges of the court, if requested, to provide a community resource or assistance in individual cases referred to the committee; (c) report annually to the municipalities involved and to the Attorney General respecting their activities during the past year.

Comments: A plain-language *PCA* reproduction, with grant-making and collaboration added.

YCJA Language Summary

Suggested by CRD	***Youth Criminal Justice Act***
Not considered necessary to reproduce due to length. Encompassed in the "act as a resource or as directed", "undertake other activities", and mandate.	(a) in the case of a young person alleged to have committed an offence, (i) giving advice on the appropriate extrajudicial measure to be used in respect of the young person, (ii) supporting any victim of the alleged offence by soliciting his or her concerns and facilitating the reconciliation of the victim and the young person, (iii) ensuring that community support is available to the young person by arranging for the use of services from within the community, and enlisting members of the community to provide short-term mentoring and supervision, and (iv) when the young person is also being dealt with by a child protection agency or a community group, helping to coordinate the interaction of the agency or group with the youth criminal justice system; (b) advising the federal and provincial governments on whether the provisions of this Act that grant rights to young persons, or provide for the protection of young persons, are being complied with;

	(c) advising the federal and provincial governments on policies and procedures related to the youth criminal justice system; (d) providing information to the public in respect of this Act and the youth criminal justice system; (e) acting as a conference; and (f) any other functions assigned by the person who establishes the committee.

Other Mandate Language

Richmond

- Mandate copies the *PCA*;
- RFCC functions as a link between the Court and City Council whereby:
    - Court personnel and clients may draw on the concern and support of the community;
    - Family and youth resources may be monitored; and
    - Community may become educated about the justice system and its effects on children, youth and families;

Vancouver

- Provides input to City Council and staff about issues of concern;
- Considers any matters which may referred to the Committee by Council or staff and take under consideration matters proposed by the Vancouver Board of Education;
- Reviews and advises Council and staff on the development, implementation and assessment of City policies and services related to children, youth and families;
- Advocates for the best interests of children, youth and families;
- Identifies opportunities and empowers children and youth to have a voice in civic decision making;
- Provides recommendations to staff and Council on issues affecting children, youth and families;
- May take positions on policy initiatives from other levels of government within the mandate of the Committee; and
- Acts as a family court committee under the BC *Provincial Court Act …* or a youth justice committee under the *Youth Criminal Justice Act*.
- Works co-operatively with other agencies whose activities affect constituent communities, including initiating and developing relevant projects;
- Acts as a resource for staff doing public involvement processes and civic events;
- Exchanges information with constituent communities and the general public about relevant programs and areas of interest; and
- Engages in outreach to disseminate information and encourage participation from constituent communities.

Tab	Page	Date	Item
2	21	October 20, 2021	Letter from C. Day containing minutes and attaching Committee-adopted recommendations from Succession and Priorities-Grants working groups (adopted September 22, 2021)

Victoria Family Court
& Youth Justice Committee

October 20, 2021

VIA EMAIL: scarey@crd.bc.ca

CRD Board and Staff
625 Fisgard Street
Victoria, BC V8W 1R7

Dear Members of the Board and Staff,

Re: Victoria Family Court and Youth Justice Review

The Victoria Family Court and Youth Justice Committee met on September 22, 2021. The agenda included reports from two working groups struck to review a) Succession Planning and b) Priorities Grants. The reports from these two working groups are attached for information. The following excerpt is from the September 22 Minutes of the Victoria Family Court and Youth Justice Committee:

Excerpt from the September 22, 2021 Minutes on the CRD Review:

a. **Succession Working Group** – Report attached

Recommendation: That the Victoria Family Court and Youth Justice Committee adopt the recommendations of the Succession Planning/Meetings Work Group as outlined in the Work Group's August 16, 2021 Report to the VFC&YJ Committee, specific to:

1. Term Limits
2. Committee member numbers and committee appointments (members & volunteers); and
3. Meetings

and that the Chair of the VFC&YJ Committee send a letter to the CRD Board and Staff providing the wording of the Committee's resolution and including a copy of the Work Group's Report, dated August 16, 2021.

To move the Recommendation
MOTION: J. Bateman/ M.T. Little
CARRIED

b. **Priorities Working Group** – Report Attached

Recommendation:
That the minutes with recommendations of August 27, 2021, from the Priorities-Grants Working Group be placed on the September 22, 2021 agenda for consideration of the main committee, and
That the Priorities-Grants Working Group's Recommendations within their report/minutes of August 27, 2021 be supported by the main Committee, and
That the Priorities-Grants Working Group minutes, recommendations and applicable attachments be forwarded to both the CRD Board and CRD Staff in respect of the CRD Review by way of a formal letter from the chair together with any carried motions from the September 22, 2021 meeting.

To move the Recommendation
MOTION: E. Paterson/ M. T. Little
CARRIED

c. CRD Bylaw – Correspondence was attached with the meeting mail out.

Recommendation: That the Draft CRD Delegated Commission Bylaw be forwarded to the working groups for review, and that the working groups provide comment to the next regular meeting.

To move the Recommendation
MOTION: M. McLean/ A. Flint
D. Thomas abstained
CARRIED

The Executive anticipate that changes to our structure/operation will be operationalized through motions at our Annual General Meeting in January, consistent with those changes made in 2010 when the last review was completed. This is to ensure that all members have the necessary resources and notice to participate and to facilitate the ongoing operation of the committee without undue interruption. (We anticipate moving our date of meeting from Wednesday to Thursday, which may or may not fit with existing members availability and this will be communicated out to our appointing agencies for new appointments.)

We also have communication from the Ministry of the Attorney General that confirms that we must continue to meet the requirements of the enabling Legislation, specifically the Family Court Act (and the Youth Criminal Justice Act), and that becoming a delegated commission of the CRD does not specifically interfere with that duty.

The committee has expressed, and I pass onto you, our sincere appreciation for CRD staff's expertise and support in pursuit of advocating appropriately for youth and families who may come be impacted by the Justice System.

Working groups continue to meet for a) Mandate, Procedures, b) Policies and Community Charter, and c) Finances/CRATsey. Working Group meetings in the next month will also review the draft Delegated Commission Bylaw. Our goal is to have carefully examined all aspects to bring forward motions to be endorsed at the Annual General Meeting in January.

Sincerely,

Cynthia Day
Chair, Victoria Family Court and Youth Justice Committee

Attachments
from Succession Planning:
Attch 1 vfc&yjc Succession-Meetings Report August 16, 2021
Attch 2 vfc&yjc Succession-Meetings Report August 16, 2021
Attch 3 vfc&yjc Succession-Meetings Report August 16, 2021
from Priorities/Granting :
Priorities Motions for Restructure and Review
Priorities-Grants Work Group Minutes 2021-08-27 w-4 attach[51648] – Copy

SUCCESSION PLANNING-MEETINGS WORK GROUP

REPORT TO VICTORIA FAMILY COURT & YOUTH JUSTICE COMMITTEE

AUGUST 16, 2021

WORK GROUP MEMBERS:

Esther Paterson, Chair, Councillor (Oak Bay)
Sandra Sarsfield, Co-Chair (CRD)
Marie-Térèse Little, Councillor (Metchosin)
Marcie McLean, Councillor (Highlands)
Jeff Bateman, Councillor (Sooke)
Angie Hentze, Trustee SD 61

SUBJECT: **Victoria Family Court and Youth Justice Work Group (VFC&YJC) review of policies and procedures relating to Member Term Limits, Succession Planning and Meetings**

With respect to Schedule H of the CRD Staff Report dated October 7, 2020, and the CRD Staff letter to VFC&YJ Committee dated February 26th, 2021 this review addresses specific issues defined as:

- Institute VFC&YJ Committee member term limits and eligibility for re-appointment
- Reduce numbers and appoint family-and-youth involved individuals with experience in education, health, probation or welfare
- Reduce Meetings

BACKGROUND:

At the October 7, 2020 CRD Governance and Finance Committee meeting, the Committee adopted a recommendation requesting that CRD Staff report back on the process to restructure the VFC&YJ Committee in accordance with the recommendations set out in Appendix H of the October 7, 2020 CRD staff report. That CRD Committee recommendation was received and adopted by the CRD Board on November 18, 2020.

A motion was approved at the May 19, 2021 VFC&YJ Committee meeting to appoint Work Groups to review the recommendations set out in CRD Schedule H and CRD letter dated February 26, 2021 (Attachments 1 and 3). Everyone was welcome to contribute to the Work Groups. The Work Groups were asked to bring forward reports and recommendations to VFC&YJ Committee for consideration at the September 2021 meeting. Recommendations of the VFC&YJC Succession Planning/Meeting Work Group are as follows:

Matters and Recommendations:

1. Institute Term Limits

1.1. Committee members will serve three terms of two years, for a total of six years. Following the expiry of a member's term, the Committee could request with a two-thirds majority and the appointing voting agency's approval to extend the term for a further two years to ensure continuity of the Committee's work.

1.2. Following a one year absence, a Committee member will be eligible for reappointment for a further term of up to six years.

1.3. Members will attend Committee Meetings, and will participate in the Steering Committee or a subcommittee.

1.4. Officers will be elected at the VFC&YJC AGM, for the positions of Chair, Vice-Chair, Treasurer, and add a new position of Past Chair.

1.5. Consider requirement for the Chair to serve a four year term.

1.6. The Past Chair will serve for a one year term; the role of the Past Chair will be to provide assistance with orientation training and with potential recruitment process.

1.7. Past long-time members may continue to participate as non-voting resource members and/or volunteers on sub-committees.

1.8. Member terms will be staggered to ensure continuity of knowledge and experience.

1.9. Terms will commence effective with VFC&YJ Committee/CRD adopted agreement for VFC&YJC to become a CRD Delegated Authority Committee.

2. Reduce numbers and appoint family and youth involved individuals

2.1. Voting membership will be minimum of 19 members and maximum 23 members; quorum will be 7 voting members.

2.2. Participating municipalities will appoint a principal member and alternate member to attend in absence of principal member. Municipalities have the discretion to appoint an elected official or representative as the principal and alternate member.

2.3. School Districts will appoint a principal member and an alternate member. School Districts have the discretion to appoint a School Trustee or a representative having expertise in education programs or who work directly with youth.

2.4. CRD may appoint a maximum of 4 members.

2.5. Institute a qualifications matrix to identify knowledge/expertise of existing Committee members, and to aid recruitment to fill gaps where expertise is required (education, health, welfare and probation). Non-voting resource members may include representatives of the Ministries of the Attorney General, Education, Children and Family Development, Public Safety and Solicitor General, Restorative Justice Health, Housing and Social Development, Police Forces and First Nations.

2.6. Institute a program of succession planning and recruitment; consider best methods and practices for communication.

2.7. Institute an orientation program for new members and new volunteers.

3. Meetings

3.1. Minimum six meetings per year of two to three hours in duration. No meetings will be held in March, July, August and December.

3.2. Consider a combination of in-person and on-line meetings.

3.3. Meetings will not be scheduled for Mondays or Wednesdays to avoid conflict with CRD and municipal Council meetings.

3.4. In each calendar year, a VFC&YJC meeting agenda will include the following: Annual General Meeting, Budget, and Work Plan.

4. CONCLUSION

The VFC&YJC Succession-Meetings Work Group acknowledges that some of the recommendations outlined in this Report will necessitate further work to develop specific criteria prior to implementation. Further, in establishing criteria for expertise, VFC&YJC interpret references to education, health, welfare and probation to have a broad scope of meaning that includes mental health, addictions, indigenous and restorative justice, family law and other issues that affect youth in our communities.

WORK GROUP RECOMMENDATION:

THAT the Victoria Family Court and Youth Justice Committee adopt the recommendations of the Succession Planning/Meetings Work Group as outlined in the Work Group's August 16, 2021 Report to the VFC&YJ Committee, specific to:

1. Term Limits
2. Committee member numbers and committee appointments (members & volunteers)
3. Meetings

AND THAT, the Chair of the VFC&YJ Committee send a letter to the CRD Board and Staff providing the wording of the Committee's resolution and including a copy of the Work Group's Report, dated August 16, 2021.

Should the Committee be supportive of the above recommendation, the following resolution would be in order:

THAT the recommendations of the Succession Planning/Meetings Work Group specific to:

- **Term Limits**
- **Committee member numbers and committee appointments (members & volunteers), and**
- **Meetings**

be adopted as outlined in the Work Group's August 16, 2021 Report to the VFC&YJ Committee;

AND THAT, the VFC&YJC Chair send a letter to the CRD Board and Staff providing the wording of the Committee's resolution and including a copy of the Work Group's Report, dated August 16, 2021.

ATTACHMENT 1
VFC&YJC SUCCESSION-MEETINGS WORK GROUP REPORT DATED AUGUST 16, 2021

CRD APPENDIX H
RECOMMENDATIONS FOR COMMITTEE REORGANIZATION

- **Clearly define a mandate in a bylaw.**
  - State the purpose and function of the committee.
  - Clarify its delegation to make grants or, alternatively, advise on grants with CRD's Board making the final determination.
- **Institute term limits.**
  - Term limits should be to a maximum of six years, absent exceptional circumstances.
  - After a reasonable absence, a member can again become eligible for appointment for another six years in total.
- **Re-arrange agenda items.**
  - Resource member items should occur at a set time in the meeting, rather than occurring at the end after other agenda items. This will free-up the resource members to leave meetings while the work of the Committee is conducted that is not related to them. The Committee has already instituted this change on its own.
- **Reduce numbers and appoint family-and-youth involved individuals.**
  - The Committee is not required to include elected officials from each participant.
  - It is required to have individuals "with experience in education, health, probation or welfare".
  - It may be better served by a smaller group of elected officials and a larger portion of justice-involved individuals who may perform the work of the Committee.
- **Formalize meetings.**
  - Meetings must comply with the *Community Charter*.
  - Provisions exist allowing meetings to be closed and should be utilized appropriately.
  - Meetings should follow the CRD's Procedures Bylaw. They should be time limited.
- **Restrict speaking times.**
  - Speakers should be restricted to five minutes on an issue absent a vote. Time limits and alternating speaker's lists should be enforced.
  - Members should not have wide-ranging discussions outside the topic on the floor.
- **Set a grant-application intake procedure.**
  - Setting and following a transparent grants procedure with defined intake periods and criteria will allow more organizations to be aware of funding and bring a greater range of applications. It will also avoid any potential for allegations – which the writer considers without merit – of bias, overreaching authority, or any other potential impropriety that could be raised under the current model.
  - Grant restrictions and conditions are already used by the Committee.
- **Follow existing policies rather than create its own.**
  - Adopting existing CRD policies, with reasonable variations approved by the Board, will ensure compliance with privacy, safety, information management, and expenses.
- **Reduce meetings.**
  - Four to six meetings per year of two to three hours in duration would be ideal, if the purpose is to connect service providers and educate elected officials on justice issues. This will ensure more fulsome attendance.
- **Maintain a volunteer registry.**

    - If the Committee is to continue work, such as specific research projects, it should utilize volunteers where appropriate.
    - CRD is equipped to insure volunteers and to provide a corporate umbrella for recruiting volunteers.
- **Maintain records consistent with the obligations of a public authority.**
    - Records should be stored at CRD. This would avoid lengthy annual reports and a potential loss of critical historical documents and information.
    - Meeting meetings should be publicly available and accessible.
- **Consolidate finances in the CRD.**
    - CRD regularly operates funds for committee and commission use and provides limited float chequing accounts for small expenses. There is no need for the Committee or CRAT to have a separate bank account.
    - Approved grants can be issued directly from CRD, as can honorariums and reimbursement of Committee expenses.

ATTACHMENT 2

VFC&YJC WORK GROUP SUCCESSION-MEETINGS REPORT AUGUST 16, 2021

Source: VFCYJC Information Manual Updated September, 2016

Page 7:

RESPONSIBILTIES OF MEMBERS

Since membership in this committee is non-remunerated and voluntary, there is very little that can be formally required of anyone. Each member is encouraged to be:

- aware of our Bylaws and prepared to give time and energy so as to make the work of the committee effective
- an active participant in the affairs of one or more subcommittees
- continually watchful as to the welfare of the children and youth involved in the justice, protection, divorce and custody systems
- involved in discussion, workshops, visitations to open and closed custody facilities, and in communication with other Family Court and Youth Justice Committees and –

Each member is required to take the oath of Confidentiality and to respect the terms of the *Young Offenders Act*.

Page 9:

ORGANIZATIONAL CHART

Provincial Court Act **Chapter 57 42-2**	*Young Offenders Act* **Section 69 Bill C-61**	**Commissioner of Corrections Sec. G-2 Par. 101 Manual of Operations Youth Correctional Program**
Examine community resources for family and children matters. Assist and make recommendations to the court	Attorney General appointment to make youth justice committees more effective service as Youth Justice Committee	Signed agreement to be the 'community committee' of the Victoria Youth Custody Division

Page 10:

SUB-COMMITTEES

Under the Committee's constitution, there are six sub-committees, each representing aspects of the three distinct pieces of legislation under which the Committee operates. The Chairperson of the main Committee appoints the chairperson of each sub-committee, who must also be a member of the main Committee. The chairperson of each sub-committee can determine the membership of that sub-committee and the members need not be members of the main Committee.

The Victoria Family Court and Youth Justice Committee sets the Agendas at a Steering Committee meeting one week prior to the main committee meeting, consisting of the executive, sub-committee chairs and any member who chooses to attend. The sole purpose of the meeting is to determine a time appropriate agenda and schedule guest speakers, as well as to discuss the Annual General Meeting Agenda and issues to be brought forward, including notice of motions. Changes to subcommittee structures are considered at the AGM and notice of a motion to amend is required.

Two subcommittees have been added to the Victoria Family Court and Youth Justice Committee: The Capital Region Action Team for Sexually Exploited Youth (CRATSEY) and

CASA for Children (Court Appointed Special Advocates) of Canada.

It was determined at the 2011 Annual General Meeting that we would discontinue the Custody subcommittee, but that continued liaison between the Youth Containment Centre and the Committee was most valuable. It is noteworthy that in 2012, female youth were no longer received at the Victoria Youth Containment Facility and instead are transported to the mainland. While we advocated for continued containment options for girls here on Vancouver Island (and supported the same for northern municipalities with similar concerns), we understand that these changes have been made with additional supports for female youth and their families. We have a good relationship with the staff including their attendance at our meetings and, continue to be offered tours of the facility whenever we feel it appropriate or necessary.

The Family Matters subcommittee has been inactive due to the difficulty in finding dedicated members to investigate the family and family court issues. Our long time chair continues to report to the main committee on issues of concern to families, but larger committee work has not been required and therefore the need to create reports for the main committee is relieved by the ability of our secretary to capture issues brought to the attention of the committee on an 'as needed' reporting basis.

The Court Watch Committee has regular observation at the Court House and offers tours for members as they are able to attend, to help the main committee understand the routines and shortfalls experienced by our service providers, families and youth.

Communications/Planning

Responsible for bringing community youth issues and resources to the attention of members, and for promoting Committee initiatives in the community. The Communications/Planning Committee is responsible for website, correspondence and print material development, with the assistance of the main committee.

Youth Matters

Concerned with matters involving youth at risk in the community or in the court system. Under the *Federal Young Offenders Act*, the mandate for community involvement falls to the youth justice committees.

Priorities

Responsible for assessing applications for support of appropriate youth initiatives in the community, and making recommendations to the full Committee for consideration.

Court Watch

Concerned with monitoring any matters pertaining to youth or family in the court system. Members will attend youth, family or aboriginal court, follow-up and report on concerns, assist judges and other officers of the court.

CRATSEY – Capital Region Action Team for Sexually Exploited Youth

Advocate for youth who are or may be at risk of sexual exploitation through education of both youth and adults and, advocacy to mitigate those risks. CRAT is inclusive and the members come from the three levels of government, the health region, school districts, police forces, youth-serving agencies, parents, former sexually exploited youth and individuals with a commitment to helping solve the problem of a growing number of underage (under 19) youth who were trading and selling sex for survival. You can learn more about CRAT at www.crat.ca

CASA- Court Appointed Special Advocates

CASA became a subcommittee of the Victoria Family Court and Youth Justice Committee in 2010, modeled after the U.S. CASA ceased operations as a separate entity as of June, 2016 and remaining funds (provided by VFCYJC to assist in startup) were returned to the committee. Advocacy for youth has continued under the Court Watch Committee. CASA had sought "To support and promote court-appointed volunteer advocacy for abused and neglected children so that they can thrive in safe, permanent homes."

There is no subcommittee for **Restorative Justice**, however, we do have resource members and CRD appointments from Restorative Justice Agencies who assist the sub and main committees. We have advocated for stable funding of Restorative Justice Alternative Measures as these measures serve the community, victims and offenders, and relieve pressure on the Court System. The Victoria Family Court and Youth Justice Committee has supported numerous Alternative Justice development programs over the years, including multi-jurisdictional training and training materials.

ATTACHMENT 3
VFC&YJC WORK GROUP SUCCESSION-MEETINGS REPORT AUGUST 16, 2021

Intentionally omitted from this package -- contains copy of CRD Letter of February 26, 2021 (Tab 1)

PRIORITIES-GRANTS WORK GROUP

MINUTES OF MEETING

Friday, August 27, 2021

Work Group Members:

Marcie McLean, Chair, Councillor (Highlands)
Adam Flint, Citizen Representative (View Royal
Marie-Térèse Little, Councillor (Metchosin)
Esther Paterson, Councillor (Oak Bay)

1. First Nations territorial acknowledgement by Chair
2. Meeting was called to order at 10:05 a.m.
3. Chair provided introduction of materials previously circulated for discussion.
4. Work Group members approved framework of discussion points as circulated.

Topics for discussion:

1. **CRD February 26, 2021 Correspondence** (Carey/VFC&YJ Committee) (attachment 1)
   - 1.1. Grant-intakes per year and reserve and threshold amounts
   - 1.2. Grants criteria
   - 1.3. Grant-agreement to be executed prior to funding (simple, mandatory)
2. **CRD recommendations Appendix** H (attachment 2) for transparent grants procedure with defined intake periods and criteria, and restrictions/conditions
3. **Marcie McLean:**
   - 3.1. **VFC&YJ Priorities-Grants Application Form** existing document (attachment 3)
   - 3.2. **Discussion Paper for Priorities-Grants Work Group** (attachment 4)

4. Priorities (Grants) Application Form - Title

4.1. Work Group agreed that a separate document should be created for "Extraordinary Committee Member Expenses" and to be used to reimburse Committee Members for registration and attendance at conferences, or events and training as VFC&YJ Committee representative. Process will be the same as for Grants; recommendation by the Priorities/Grants subcommittee, and approval by VFC&YJ Committee in advance of event.

4.2. Based on suggestion from Bill McElroy, Work Group considered whether to change the name of the application form from *Grant Submissions* to *Sponsorship Submissions,* as a less formal approach to the process. Marcie will contact Steve Carey (CRD) for guidance on legal or other issues related to terminology.

5. Priorities (Grants) Application Form – Content

5.1. The Work Group agreed to develop a checklist for applicants, to outline the process and ensure submissions are complete. Adam Flint, Chair Communications Subcommittee, is willing to draft a checklist for future consideration.

5.2. The Work Group agreed grants applications should also be in web based format.

The Work Group agreed Grants Application information requirements should include:

5.3. Required Information

5.3.1. Name of organization
5.3.2. Address of organization
5.3.3. Purpose of the organization
5.3.4. Name of person applying
5.3.5. Contact person's name, email address, and phone number
5.3.6. Alternate contact person's information same as above
5.3.7. Listing of Board of Directors names and positions
5.3.8. Is your organization a registered society in BC?
5.3.9. If yes, what is the name of your society and your number under the BC Society Act?
5.3.10. Does your organization have charitable status registered with Canada Revenue Agency (CRA) under their Charitable Directorate?
5.3.11. Is your organization a business?

5.4. Project name, location, start date, and completion date.

5.5. Experience and/or qualifications of staff who will be responsible for the Project; history of similar or related projects. Include information on volunteers who will participate in the project.

5.6. Financial Statement for the organization for previous year and budget for the current year

5.7. Total amount of grant being requested, and proposed use of grant funds. Include information on funding requests made to other commissions, societies, governments, agencies, or other groups for this project.

5.8. Indicate if the grant request is for one-time or recurring project.

5.9. List previous grant requests made to VFC&YJC, and indicate if approved.

5.10. Declaration that funds not used will be returned to Victoria Family Court and Youth Justice Committee via cheque, within sixty days of conclusion of the project.

6. Criteria for qualifying expenses excludes salaries, capital items, not businesses other than not-for-profits but will include project website development, guest speaker(s), advertising, venue rentals, etc.

7. Objectives

7.1. The statement of intended outcomes submitted with the application will be used to assess success of the project to accomplish goals.

7.2. Applicant statement must demonstrate in some detail the service(s) that your proposal would provide for youth and families of the CRD that ties in with the mandate for VFC&YJC.

7.3. Applicant statement must indicate how your proposal will help educate and bring awareness to youth and families living within the CRD about reducing risks and reducing potential involvement with the judicial court systems.

8. Reporting to Victoria Family Court & Youth Justice Committee at conclusion of project

8.1. The applicant must agree to provide a brief summary report on the outcomes of the project. The report will be submitted in written format, and, if warranted, there may be an expectation or request to present the summary report in-person at a meeting of the Victoria Family Court and Youth Justice Committee.

9. Other:

9.1. Applicant acknowledges it has reviewed Victoria Family Court & Youth Justice Committee mandate which will be attached to the grant application.

9.2. Victoria Family Court & Youth Justice Committee title, name or logo will not be used without prior written consent of the Committee.

9.3. Grants may not be used for the purpose of producing revenue for the applicant, or for purposes that are outside of the scope of the project.

10. **Uptake Dates for submissions**

    10.1. Completed applications must be submitted to the VFC&YJC Grants subcommittee Chair and the secretary and be received in the months of March or December in each calendar year.

    10.2. Applications process is approximately 60-90 days.

11. Business that requires clarification/follow-up by Marcie:

    11.1. Consult with Steven Carey re the language "sponsorship or grants"

    Note: Received from Steven Carey (per Marcie): Not really. They're kind of interchangeable. Sponsorship references are usually to when we're asked to support local events (concerts, etc.) and we're not involved any more than that. We have grant projects that have direct funding for operations, sponsorship for events, and the like. We also have grant projects that fund specific deliverables, like reports. Perhaps call it grants and include sponsorship as something that you can do as part of it?

    11.2. The Chair of the Grants subcommittee will consult with CRD re process for issuing/distributing cheques to applicants following VFC&YJ Committee decision.

    11.3. Work Group deferred discussion on threshold amounts of grants (not presently used).

    11.4. Chair of Victoria Family Court and Youth Justice Committee will notify the applicant in writing of the Committee's decision.

    11.5. Process for distributing cheques will be coordinated with CRD.

    11.6. The Work Group goal is that the future VFC&YJC grant application will be revised and improved, and the CRD will prepare a draft grant application for Priorities Sub-committee for review and input.

12. No future meeting date was set. The Work Group agreed that Meeting Minutes and Report could be completed via email exchange of documents.

13. Meeting adjourned at 12:00 pm.

Pages intentionally omitted
- copy of Feb. 26, 2021 CRD Letter
- Appendix H of November 2020 CRD staff report

Priorities Sub-Committee
Form for Good and Services Submissions
(Grant and Extraordinary Committee Expenses)

Please send your submission to marciemclean@shaw.ca and vfamcourt@gmail.com for distribution.

In the event that the project is not able to proceed, or is substantially changed, the committee expects that the monies provided for the project would be returned to the Victoria Family Court and Youth Justice Committee c/o City of Colwood, 3300 Wishart Road, V9C 1R1. A new application is required where the project is substantially changed.

Name of Organization:			
Contact Person:		**Date of Application:**	
Email:		**Phone Number:**	

Background of organization/person(s) or applicable history of related projects

Clear goals and objectives of the project with clear indications of relevance to the Family Court and Youth Justice Committee Mission. The VFCYJC Mission is*: To facilitate connections between municipal and First Nations governments, school districts, service providers, and the broader community in order to educate and advocate on the challenges and shortfalls facing youth and families who may come into contact with the justice system.* **Please explain how this initiative will further our Mission.**

Features of the project pertinent to this application

Budget (include clear accounting with potential line items and accompanying narrative)

	Item	Detail	Cost	Total Funder
Revenue				
Expenses				
TOTAL				

Other funding avenues/partners being explored:

Catchment area served – target population

Needs/problems to be addresses through project work:

Deliverables (goods and services to be provided)

Timeframes (e.g. intended start date of project, length of time from start of project to deliverables, one time project or on-going)

Evaluation framework - We expect applicants to spell out exactly how they will evaluate the success of their initiative in advance, and that the applicant will share the results in a written report, and in person via a presentation to the committee.

Date applicant anticipates the Evaluation will be complete. _____

NOTE: If the applicant does not provide their evaluation within the timeframe indicated, they may expect the committee will follow up with them.

August 20, 2021

From: Marcie McLean, chair VFC&YJC Priorities sub-committee

To: **Priorities (grants) Working Group**, then Recommendations & associated Report to main VFC&YJC on an agenda (Sept 22) to vote on and, then forward both Recommendations & Report to CRD Staff and CRD Board.

Re: Priorities Application Form (Form) updating for consideration prior to CRD Review discussion and possible inclusion of the notion of "sponsorships of resource agencies". (A suggestion from Bill)

This update opportunity is offered for consideration of the Working Group and then, Recommendations for main Committee to review, discuss and offer input into the Priorities application Form and the process of uptake timing in order to have a potential consolidated voice to go forward to the CRD in a timely manner.

A current uncompleted Priorities application Form is provided for your reference. (separately)

In preparation for these meetings I offer the following for your consideration. These proposed changes are intended to provide better clarity and accountability from applicants. However, they are only suggestions up for discussion at this time.

In respect to the title of the application Form at this time, I would suggest we have **a separate application form for Extraordinary Committee Member Expenses.**

1 (a) Do we want to **change the title** of the application form (Form)? If yes, any suggestions?

From the application form (Form):

1. Name of organization / person(s) applying: (I suggest we seek more detail here by adding in specific areas to be completed) such as:

Name of organization:

Address of organization:

Purpose of the organization:

Name of person applying:

Contact person's name, email address, and phone number:

Alternate contact person's information same as above:

Listing of Board of Directors names and positions:

Is your organization a registered society in BC?

If yes, what is the name of your society and your number under the BC Society Act?

Does your organization have charitable status registered with Canada Revenue Agency (CRA) under their Charitable Directorate?

Is your organization a business?

2. Project name: (Note: I include this as it does not appear consistently on our applications).

3. Background of organization/person(s) or applicable history of related projects: (Note: I include this as it does not appear consistently on some of our applications for some odd reason). Question: Do we need this information?

4. Evaluation framework:

I suggest that more details need to be added here in order for the applicant to know what type of information we are seeking and the expectation. Perhaps a different header might be appropriate, but certainly some additional information.

If this is an expectation for us then I think the process needs to be explained a bit and how the evaluation would occur.

For example: as a requirement, then, will the applicant provide their evaluation of their project to us and within a specific time period of the end date or the completion date? And, what do we need to know?

In addition, I think we would like to know if the project was successful and how the applicant made that determination.

5. Some additional items for your consideration are:

Should we add into the application a requirement for their previous year's audited **financial statements**? Or, just previous year's financial statements?

6. In respect to the Form (previous number 5), should we include the VFC&YJC **Mandate** with the application? The Form currently states: Clear goals and objectives of the project-clear indications of relevance to the Family Court & Youth Justice Committee mandate: (I sense improved wording would be helpful for all)

7. Should we have annual application uptake with a date deadline? Or,

Should we have 1 or 2 specific opportunities in our fiscal year to receive applications with a deadline as well? (Might need to work around the CRD's fiscal year as well which is Jan. 01-Dec. 31)

If yes, then **may we suggest** the months of Feb with a January 31 deadline to apply and, April with March 31 deadline to make application(s)? Or? (To not impact when we don't meet and do not work.)

8. Should we be indicating what types of projects, proposals or expenses are **not** eligible? Possibly on the Form or, a possible policy with the CRD?

9. Should we have a criteria listing? If yes, then what might we consider putting on that list?

10. Any additional information required that we might need to evaluate the proposal?

11. Consideration of use of best methods to evaluate applicant's proposals/projects? Ideas?

12. Despite the present accumulation of VFC&YJC funds due to the CRD Review and Covid 19; should we consider requesting potential additional annual funding from the CRD for future grants (or sponsorships) as the current funding is formally designated for VFC&YJC **"operational purposes"** by CRD Bylaw.

13. Other suggestions for the Form for improved information to/from the applicant such as: (but not limited to)

13.1 Incomplete applications will not be considered.

13.2 Any/all approved funds are intended for the purposes specified in the application only.

13.3 Any unused funds **must be returned** in the form of a cheque to VFC&YJC within 30 or 60? days of the completion date of the **project/event.**

13.4 If an application is approved do we expect anything from the applicant in return? Such as an acknowledgement of VFC&YJC or ?? Ideas?

13.5 For approved applications applicants may expect follow up from the chair of the sub-committee if we do not receive written follow up or a presentation from the applicant on their event/project within 30 days of its completion.

14 Other suggestions?

Draft prepared by:

Marcie McLean

Councillor Highlands

250-474-4725

Tab	Page	Date	Item
3	48	November 17, 2021 (as amended)	Committee-adopted Joint-working group recommendations on Draft Bylaw No. 4453

Working Group Collaborative Meeting

November 10, 2021 at 11:00 am via zoom

Present: Esther Paterson, Cynthia Day, Marie-Terese Little, Marcie McLean, Adam Flint.

A. Bylaw - Members were provided with the letter and draft bylaw from the CRD for review. We anticipate that some changes (based on the endorsed working group recommendations forwarded from the main committee) will be made.

Members stated that their goal is to help create a document that is concise, flexible, and amendable.

The Following were noted:

1. Our AGM is scheduled for the 3rd Wednesday in January (not February)
2. The committee needs a definition of 'business' to comply with requirement to not provide a benefit to business
3. School Districts representatives should not be identified as 'trustees' in the bylaw, School Districts should not be limited in their representation, wording should be consistent throughout the bylaw
4. The Chair (not the committee) would be expected to send attendance letters to appointing agencies to inform them if their representative is unable to attend 2 consecutive regular committee meetings (special meetings not counted) VFCYJC to draft template.
5. Page 3 of the draft bylaw
   20. The Committee is hereby tasked with the following duties:
       (a) to meet at least four times per year to:
           i. consider and examine community resources for family and children's matters;
           ii. make recommendations to the court, the Attorney General, or others;
           iii. solicit and consider applications for receipt of grant-funding; and
           iv. connect family-and-justice-involved individuals, service providers, and government in a way that encourages collaboration and identifies service gaps;
       (b) if requested by the court, to act a resource or assist as directed; and
       (c) report annually to its member local governments and the Attorney General on its activities ~~and recommendations.~~

   "and recommendations" is not part of enabling legislation
6. Add 'advocacy' to #19
   19. The Committee has the following **advocacy** objectives:
       (a) to identify, inform, educate, and report on gaps in regional resources for youth justice and family court issues;
       (b) to act as a resource for the public and youth and family organizations; and
       (c) to encourage collaboration between and visibility of community services.
7. There is no mechanism/method for coordination of member experience, ie: experience in probation, education, etc. as defined in the act.
8. Note: 22(b) – "related to its mandate" legislated mandate may change as legislation is amended from time to time.
   "(b) contract for support services, volunteer coordination, communications, feasibility studies, and other services and goods related to its mandate;"

B. Legal Opinion - The committee discussed efforts to fulfil the motion from the October meeting to get a legal opinion after receiving the October 2021 Letter from the Ministry of Attorney the General:

> "… I understand that staff from our branch have been in contact with you and, since we received your email in June, your committee decided to become a delegated commission under the Capital Regional District (CRD). I've been advised that **a by-law formalizing this arrangement will be considered by the CRD in the coming months. As the roles and responsibilities of your committee are outlined in both the Provincial Court Act (specifically, section 5, Family court committee) and the Youth Criminal Justice Act (specifically, section 18, Youth Justice Committees), any by-laws, changes to your committee's constitution, and/or mandate will need to be in keeping with these statutory provisions**. …"

After contacting 3 legal firms with little success due to potential conflicts (having advised the CRD, workloads, area of expertise etc.) Members suggest the following request of the CRD:

Potential Motion:

That the CRD Board provide legal opinion confirming that appointment of The Victoria Family Court Youth Justice Committee as a Delegated Authority Commission of the CRD complies with the statutory provisions and obligations of the Committee as set out by the Provincial Court Act and the Federal Youth Criminal Justice Act.

The committee seeks written assurance from the CRD that the changes proposed in the Delegated Authority Commission Bylaw have been investigated as to their legality and that any consequences of this decision would be the responsibility of the CRD.

The committee also discussed how we might protect legal professionals who may choose to participate as a member of the Delegated Commission due to the recent concerns that those legal professionals who make comment as members of the committee make those comments as committee members and not in their capacities as legal professionals.

Appendix "B"

Cynthia Day
Email: cday@colwood.ca

Dear Cynthia Day:

I have been asked to respond to your email of June 24, 2021, addressed to the Honourable David Eby, Attorney General and Minister responsible for Housing regarding the Victoria Family Court and Youth Justice Committee.

I understand that staff from our branch have been in contact with you and, since we received your email in June, your committee decided to become a delegated commission under the Capital Regional District (CRD). I've been advised that a by-law formalizing this arrangement will be considered by the CRD in the coming months. As the roles and responsibilities of your committee are outlined in both the *Provincial Court Act* (specifically, section 5, Family court committee) and the *Youth Criminal Justice Act* (specifically, section 18, Youth Justice Committees), any by-laws, changes to your committee's constitution, and/or mandate will need to be in keeping with these statutory provisions.

While I appreciate the Committee's efforts to consult with the Ministry of Attorney General on any changes it may make to its governance documents or structure, the role of the Attorney General does not extend to providing legal advice to members of the public. One potential resource for the committee as it transitions to a delegated commission of the CRD may be found on the Ministry of Municipal Affairs website. Specifically, the information on Committees and Commissions can be found at this website:

> https://www2.gov.bc.ca/gov/content/governments/local-governments/governance-powers/powers-services/regional-district-powers-services/committees-commissions

Additionally, information outlining the processes by which a Regional District delegates its authority can be found within the associated Guide to Regional District Board Delegation to Committees and Commissions, and is available at this website:

> https://www2.gov.bc.ca/assets/gov/british-columbians-our-governments/local-governments/governance-powers/guide_regional_district_delegation_to_committees.pdf

In closing, I would like to commend the work of this committee in assisting youth and families in the CRD. Thank you for taking the time to reach out to the ministry regarding this matter.

Sincerely,

Paul Craven

Paul Craven
A/Assistant Deputy Minister

Justice Services Branch

pc: The Honourable Mitzi Dean, MLA

CLIFF number: 618717

Appendix "C"

Victoria Family Court and Youth Justice Committee

Correspondence from Committee re: adopted motions

Tab	Page	Date	Item
1	2	January 10, 2022	Letter from C. Day enclosing November 17 adopted motions from Policy and Procedures working group
2	9	January 19, 2021	Committee-adopted resolution from Finance working group

Tab	Page	Date	Item
1	2	January 10, 2022	Letter from C. Day enclosing November 17 adopted motions from Policy and Procedures working group

Victoria Family Court & Youth Justice Committee

January 10, 2022

Via Email: scarey@crd.bc.ca ; kmorley@crd.bc.ca

To CRD Board, Governance Committee & Staff,

At the November 17, 2021 Victoria Family Court and Youth Justice Committee meeting the agenda included the attached Procedures, Policies, and Community Charter Working Group Report which was endorsed by motion at that meeting:

> **THAT the Victoria Family Court and Youth Justice Committee adopt the recommendations of the Procedures, Policies, and Community Charter Working Group as outlined in the Working Group's October 28, 2021 Report to the VFC&YJ Committee, specific to:**
>
> > **1 Formalizing Meetings: Complying with Community Charter, holding meetings that are open to the public and provisions for closed meetings, Steering committee purpose and function, adoption of CRD's procedure bylaw (with reasonable variations) including guidelines pertaining to minutes, agendas, and meeting and speaking times.**
> >
> > **2 Follow existing CRD policies. Members of the VFCYJ committee will follow the Capital Regional District Commission Handbook 2020 and CRD Bylaw 3828, CRD Procedures Bylaw (with reasonable variations) to ensure compliance with privacy, safety, information management, and expenses. Importantly, the VFCYJ committee will comply with all laws regarding the Freedom of Information and Protection of Privacy Act, the corporate policy and procedure regarding a respectful workplace, debate and conduct.**
>
> **AND THAT, the Chair of the VFCYJ Committee send a letter to the CRD Board and Staff providing the wording of the Committee's resolution and including a copy of the Work Group's Report, dated October 28, 2021.**

The Reports (3) from the Working Groups and the Letter from the Acting Deputy Minister, Paul Craven have been shared with our appointing agencies to ensure that all organizations have the information that they require for the AGM. I anticipate that the AGM Agenda and Annual Report will be shared later this week.

The committee is grateful for the inclusive process of this review and the support of the CRD in ensuring that the circumstances for youth and families who may come into contact with the justice system is systemically included in our regional governance.

Sincerely,

Cynthia Day
Chair, Victoria Family Court and Youth Justice Committee

Procedures, Policies, and Community Charter Working Group

Report to Victoria Family Court & Youth Justice Committee
October 28, 2021

Working Group Participants:
Marie-Térèse Little, Chair, Councillor (Metchosin)
Marnie Essery, Secretary VFCYJ committee
Esther Paterson, Councillor (Oak Bay)
Marcie McLean, Councillor (Highlands)
Adam Flint, Citizen representative (View Royal)

Subject: Victoria Family Court & Youth Justice Committee (VFCYJ) Working Group review of procedures, policies and Community Charter relating to formalising meetings and following existing CRD policies.

With respect to Schedule H of the CRD Staff Report dated October 7, 2020, and the CRD Staff letter to VFC&YJ Committee dated February 26th 2021, this review addresses specific issues defined as:

- Meetings to comply with the Community Charter including provisions made for Open and Closed meetings,
- Objective and guidelines for the Steering Committee of the VFCYJ committee,
- Meeting to follow CRD procedure bylaw (specifically guidelines for minutes, agendas, motions, meeting times, and speakers' times),
- Meetings to be conducted according to Roberts Rules of Order, and
- VFCYJ to follow existing CRD policies.

Background:

At the October 7, 2020 CRD Governance and Finance Committee meeting, the Committee adopted a recommendation requesting that CRD Staff report back on the process to restructure the VFCYJ Committee in accordance with the recommendations set out in Appendix H of the October 7, 2020 CRD staff report. That CRD Committee recommendation was received and adopted by the CRD Board on November 18, 2020.

A motion was approved at the May 19, 2021 VFCYJ Committee meeting to appoint Work Groups to review the recommendations set out in CRD Schedule H and CRD

letter dated February 26, 2021 (Attachments 1 and 3). All members of the VFCYJ committee were encouraged and welcome to contribute to the Work Groups. The Work Groups were asked to bring forward reports and recommendations to VFCYJ Committee for consideration at the September to November 2021 meetings.

Regarding procedures, policies, and community charter, two specific areas of concern were identified by the CRD: formalize meetings (including restricting speaking times) and follow existing polices (of the Community Charter and CRD).

Recommendations of the VFCYJ Procedures, Policies, and Community Charter Working Group including links to relevant documents are as follows:

1. Formalize Meetings

a) Meetings will comply with the Community Charter.
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/03026_00

b) Open Meetings and Provisions to allow meetings to be closed.
Meetings to be open to the public. Meeting and any sessions where decisions are made must be done in the open. This does not apply to work by volunteers and sub-committees provided they are not making final decisions for the committee.

Provisions exist and will be applied to allow meetings to be closed and will be utilized appropriately.

Meetings may be closed if:

i) personal information about an identifiable individual who holds or is being considered for a position as an officer, employee or agent of the committee or another position appointed by the committee;
ii) labour relations or other employee relations.
iii) litigation or potential litigation affecting the committee
iv) the receipt of advice that is subject to solicitor-client privilege, including communications necessary for that purpose; and,
v) information that is prohibited, or information that if it were presented in a document would be prohibited, from disclosure under section 21 of the Freedom of Information and Protection of Privacy Act.

Before holding a meeting or part of a meeting that is to be closed to the public, the committee must state, by resolution passed in a public meeting,

i) the fact that the meeting or part is to be closed, and
ii) the basis on which the meeting or part is to be closed.

c) Steering committee meetings – no decisions, just recommendations to the main Committee- open to all committee members to attend. The purpose of the steering committee is to make recommendations for the agenda and propose guest speakers' name.

d) Meeting should follow CRD's Procedure Bylaw with reasonable variations as agreed upon by the Committee.

https://www.crd.bc.ca/docs/default-source/crd-document-library/bylaws/procedureandfoi/3828---capital-regional-district-board-procedures-bylaw-2012b.pdf?sfvrsn=76c387c3_25

Specifically, the following guidelines must be followed:

i) Minutes and agendas: Community charter requires that agendas and minutes be published within a certain time and to be publicly available or inspected on request. Publications could be met by online publication through the CRD, including agendas, minutes, and annual reports. A link to the VFCYJ committee website will also be included on the proposed CRD site. Prior minutes could be made available by the CRD to meet requirements for public inspection. Minutes and agendas will be posted within 7 days of the meeting and within 7 days of adoption.

Minutes of a meeting that record the decisions made are required for each duly constituted meeting. Minutes will follow the approved CRD guidelines for minutes. Minutes are intended to be a record of decisions made by the commission and not a verbatim record of what was said at the meeting. Including some summary of discussion for context is good practice. (Appendix 12: Guidelines for the Preparation of Minutes of CRD Board, Committee and Commission Meetings; Appendix 12a: Sample Minutes)

Motions signify the intent for action by the commission and are recorded in the minutes. The minutes need to identify the name of the member that proposed the motion, the name of the member that seconded the motion, identification if the motion carried or was defeated. The minutes must also record the names of members voting against the motion. For example: 1) MOVED by Commissioner Smith, SECONDED by Commissioner Gordon, That the minutes of August 2, 2018 be adopted. CARRIED Opposed: Commissioner Wayne.

ii) Agenda items can be raised with the Chair in advance of the meeting or at the meeting itself by a Notice of Motion.

iii) Agenda items will be re-arranged so that resource members may speak at a dedicated time in the meeting before the business of the meeting

iv) Meetings will have set times (2 hours) and a resolution to extend beyond hours will be required to continue the meeting.

v) Guest Speakers will have a set time (30 minutes, 20 minutes for presentation and 10 minutes for questions). Time for guest speakers may be determined by the Chair to a maximum of one hour. A list of members wishing to speak to a motion will be kept. Members speaking to a motion on the floor will have a limit of 4 minutes to add their viewpoints to the discussion of an issue. A member is allowed to speak again only after all other members are given the opportunity to speak. Petitions and delegations will be given 5 minutes and a request can be made for an additional 4 minutes. It is the Chair's responsibility to maintain speaking list, order, and time limits.

vi) Meeting will be conducted according to the most current edition of Roberts Rules of Order.

vii) The Chair will keep meeting moving and encourage members to focus on the topics discussed to avoid wide-ranging and side conversations.

2. Follow existing CRD policies.

a) Members of the VFCYJ committee will follow the Capital Regional District Commission Handbook 2020.

https://www.crd.bc.ca/docs/default-source/legislative-pdf/2020commission-orientation-handbook.pdf?sfvrsn=2b428bca_2

b) This document provides information for Committee members about their roles and responsibilities, describes requirements and processes, and offers information to assist members in fulfilling their obligations to both the Committee, Regional District and to their local community as effectively and efficiently as possible.

c) The CRD policies will be followed with reasonable variations approved by the Committee and will ensure compliance with privacy, safety, information management, and expenses.

d) The VFCYJ will comply with all laws regarding the Freedom of Information and Protection of Privacy Act.

3. Conclusions.

The VFCYJ Procedures, Policies and Community Charter Working Group acknowledges that the recommendations to follow existing CRD policies and procedures and to abide by the Commission orientation handbook include the caveat that these polices and procedures will be adopted with reasonable variations as agreed upon by the Committee (for example, some of the information contained in these documents is specific to the CRD, and its location, times and structure and do not necessarily apply to the VFCYJ committee).

4. Working Group Recommendations:

THAT the Victoria Family Court and Youth Justice Committee adopt the recommendations of the Procedures, Policies, and Community Charter Working Group as outlined in the Work Group's October 28, 2021 Report to the VFC&YJ Committee, specific to:

1 Formalizing Meetings: Complying with Community Charter, holding meetings that are open to the public and provisions for closed meetings, Steering committee purpose and function, adoption of CRD's procedure bylaw (with reasonable variations) including guidelines pertaining to minutes, agendas, and meeting and speaking times.

2 Follow existing CRD policies. Members of the VFCYJ committee will follow the Capital Regional District Commission Handbook 2020 and CRD Bylaw 3828, CRD Procedures Bylaw (with reasonable variations) to ensure compliance with privacy, safety, information management, and expenses. Importantly, the VFCYJ committee will comply with all laws regarding the Freedom of Information and Protection of Privacy Act, the corporate policy and procedure regarding a respectful workplace, debate and conduct.

AND THAT, the Chair of the VFCYJ Committee send a letter to the CRD Board and Staff providing the wording of the Committee's resolution and including a copy of the Work Group's Report, dated October 28, 2021.

Tab	Page	Date	Item
2	9	January 19, 2021	Committee-adopted resolution from Finance working group

8. Finances THAT the finances of the Victoria Family Court and Youth Justice Committee be consolidated under the CRD as a delegated Commission, once a bylaw has been enacted, in a separate ledger account AND any required changes to our Terms of Reference, Policies and procedures be instituted as per the January 19, 2022 Financial Controls Report for the Victoria Family Court and Youth Justice Committee.

CAPITAL REGIONAL DISTRICT
BYLAW NO. 4453

****

A BYLAW TO CONTINUE THE VICTORIA FAMILY COURT AND YOUTH JUSTICE COMMITTEE AS A DELEGATED COMMISSION

****

WHEREAS:

A. Under Bylaw No. 2560, *Family Court Committee Extended Service Establishment Bylaw No. 1,* 1997, the Capital Regional District ("CRD") continued a service to operate, participate in and fund a *Provincial Court Act* family court committee created for the capital region, as well as to provide funding to approved youth justice initiative involved third parties;

B. Since the 1960s, the Victoria Family Court Committee, also known as the Victoria Family Court and Youth Justice Committee, has operated as an advisory body, first as a committee of the City of Victoria then of the Capital Regional District, and continues to operate for the coordination and grant-making benefit for regional youth and family justice initiatives;

C. The Board wishes to set out clearly the community mandate of the Committee in a commission bylaw and ensure it has legal status and delegated authority to continue its work;

NOW THEREFORE, the Capital Regional District Board in open meeting assembled hereby enacts as follows:

CREATION OF COMMISSION

1. A commission is hereby established, to be known as the "Victoria Family Court and Youth Justice Committee" (hereinafter the "Committee"), and shall be a continuation of the Victoria Family Court and Youth Justice Committee presently operated in the capital region.

DELEGATED AUTHORITY

2. The Committee is hereby delegated all of the administrative powers of the Regional Board with respect to the service set out in Bylaw No. 2560, *Family Court Committee Extended Service Establishment Bylaw No. 1,* 1997 (the "Bylaw No. 2560"), that is, the funding, participation, and operation of the Committee and the granting of funding to youth and family issues; and the Board's ability under s.263(1)(c) of the *Local Government Act* to provide assistance to youth and family groups as contemplated by Bylaw No. 2560, other than assistance to business.

COMPOSITION AND ELIGIBILITY

3. The Committee shall have the following number of voting members, up to a total of 23, each having one vote:
    (a) Up to seven individuals as Capital Regional District appointed representatives under section 7;
    (b) Thirteen municipal council representatives, who may each have an alternate, under section 8; and
    (c) Three school district representatives, representing School Districts 61, 62, and 63, under section 9.

4. Available openings for voting membership vacancies will be advertised by November of each year of a vacancy in a term in a form acceptable to the appointing organization.

Deleted: trustees

DRAFT

5. A majority of members must have experience in education, health, probation, or welfare.

6. Members must represent the interests of their community or organization to the best of their ability.

Capital Region Representatives

7. The Regional Board may appoint up to seven individuals as voting members of the Committee. Such appointments may be, but are not limited to, representatives of the Juan de Fuca Electoral Area, community members, representatives of youth and family justice organizations, municipal councilors, regional district Board members, or First Nations' representatives.

Municipal Representatives

8. Each municipal participant may appoint a municipal council representative as a voting member, and may appoint as an alternate voting member a member of the public or a municipal councilor to act in the absence of the municipal council representative, for a total of 13 municipal council representatives.

School District Representatives

9. Each school district in areas served by the Committee may appoint a representative as a voting member, for a total of three school district representatives.

Resource Members

10. The Committee may resolve to have any number of non-voting resource members, including individuals, service providers, organization representatives, public authorities, First Nations, or other groups working in the capital region in family court and youth justice initiatives.

TERM OF OFFICE

11. A member's term of office is from the date of appointment in one year to December 31 in the second year of appointment.

12. No voting member may serve more than six consecutive years on the Committee. A former member may be reappointed after one year of absence. Despite the term limit in this section, in unique circumstances, an appointing agency may reappoint its voting member for an additional term.

OFFICERS

13. By the end of February in each year, the Committee shall hold an annual meeting for the purpose of appointing officers (the "Annual Meeting"). The Committee shall select from among its voting members a Chair, Vice-Chair, and Treasurer, with voting by show of hands, or, if a secret ballot is requested by one-third of members present, by secret ballot.

14. The Committee may create additional officer roles it considers advisable and staff them with voting or non-voting members from time-to-time.

15. In the event of a vacancy, the Committee may select a voting member to fill an officer role until the next Annual Meeting.

Deleted: At the Committee's first meeting in February of each year (the "Annual Meeting"), by show of hands, or, if a secret ballot is requested by one-third of members present, by secret ballot, the

DEATH, RESIGNATION, DISQUALIFICATION AND TERMINATION

16. A member's appointment ends on the end of term; resignation; death or incapacity; revocation of appointment; ceasing to be an employee, volunteer, elected official or officer of an appointing agency; or on the cessation of a municipal council voting member ceasing to be a municipal councilor.

MEMBER VACANCIES

17. In the event of a member vacancy before the end of term, the appointing organization may appoint an individual to complete the term. If not filled within a reasonable time, the Committee shall reported such vacancy to the Capital Regional District's Corporate Officer.

18. If a member is absent for more than two consecutive meetings with notice, the Committee shall contact the member to determine interest in continuing on the Committee. If absent for three consecutive meetings, the member may be removed by resolution of the Committee and the Committee shall alert the appointing organization, requesting appointment.

COMMISSION OBJECTIVES AND DUTIES

19. The Committee has the following objectives:
    (a) to identify, inform, educate, advocate for, and report on gaps in regional resources for youth justice and family court issues;
    (b) to act as a resource for the public and youth and family organizations; and
    (c) to encourage collaboration between and visibility of community services.

20. The Committee is hereby tasked with the following duties:
    (a) to meet at least four times per year to:
        i. consider and examine community resources for family and children's matters;
        ii. make recommendations to the court, the Attorney General, or others;
        iii. solicit and consider applications for receipt of grant-funding; and
        iv. connect family-and-justice-involved individuals, service providers, and government in a way that encourages collaboration and identifies service gaps;
    (b) if requested by the court, to act a resource or assist as directed; and
    (c) report annually to its member local governments and the Attorney General on its activities.

21. The Committee may, within its mandate:
    (a) take positions and advocate on policy initiatives, legislation, and services affecting families and youth justice in the region, in the name of the "Victoria Family Court and Youth Justice Committee"; and
    (b) undertake other activities consistent with the activities of a family court and youth justice committee, as permitted by law.

22. Subject to Capital Regional District bylaws, policies, and procedures, the Committee, in open meeting assembled or through supervised volunteers, may:
    (a) establish advisory groups to examine specific issues, who will report on their work;
    (b) contract for support services, volunteer coordination, communications, feasibility studies, and other services and goods related to its objectives and duties;
    (c) undertake necessary, incidental, or ancillary administrative tasks in order to effect its work.

23. If acting under referral or as otherwise directed under the *Provincial Court Act,* RSBC 1996, c 379, or *Youth Criminal Justice Act*, SC 2002, c 1, the Committee shall discharge its duties through one or more registered volunteers assembled for that purpose by resolution of the Committee, unless otherwise directed by the court.

Deleted: and recommendations

Deleted: mandate

24. All volunteers shall be supervised by the Committee or its appointed volunteer coordinator, if any; shall register with the CRD's Risk and Insurance Department; and must, if working with vulnerable persons or persons under 18 years of age, provide a recent criminal record check to CRD.

CONDUCT OF MEETINGS AND QUORUM

25. A quorum shall be seven (7) voting members.

26. The Committee must follow Bylaw No. 3828, "Capital Regional District Board Procedures Bylaw, 2012", when conducting a meeting (the "CRD Procedures Bylaw").

27. All meetings of the Committee must be held in a public facility and must be open to the public. Meetings may be in-camera, where authorized by law.

28. The Committee may meet by electronic means, where the requirements in the CRD Procedures Bylaw are met.

CONFLICT OF INTEREST

29. In discharging the Committee's grant function, any member who considers themselves in a pecuniary or non-pecuniary conflict of interest shall declare a conflict, which may include:
    (a) where their appointing agency is a direct recipient of a grant or assistance; or
    (b) where a member or their immediate family owes a fiduciary duty, as a director, senior manager, or employee of an organization receiving funding,

    and shall recuse themselves in accordance with the CRD Procedures Bylaw and the *Community Charter,* SBC 2003, c 26.

30. On a majority vote of the Committee, School District and non-voting members representing an organization with a direct pecuniary interest in a grant may be invited to present on their organization's application, but shall not be present for debate nor the vote on the matter.

BUDGET

31. Upon its establishment and by October 1 of each year, the Committee shall prepare an annual budget, which shall include estimates for administrative costs, operations, grants, and other expenditures, and shall submit such estimates to the CRD's Chief Financial Officer for Regional Board approval and inclusion in provisional and annual budgets.

RECORD KEEPING

32. The Committee shall comply with all public record keeping requirements under the *Community Charter*, *Local Government Act*, and other applicable legislation.

33. Records shall be stored at the CRD. Agendas shall be provided in advance of meetings in accordance with the CRD Procedures Bylaw and meeting minutes shall be provided after each meeting.

CITATION

34. This bylaw may be cited for all purposes as "Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2022".

Deleted: 2021

READ A FIRST TIME THIS	th	day of	20__
READ A SECOND TIME THIS	th	day of	20__
READ A THIRD TIME THIS	th	day of	20__
ADOPTED THIS	th	day of	20__

CHAIR

CORPORATE OFFICER

CAPITAL REGIONAL DISTRICT
BYLAW NO. 4453

****

A BYLAW TO CONTINUE THE VICTORIA FAMILY COURT AND YOUTH JUSTICE COMMITTEE AS A DELEGATED COMMISSION

****

WHEREAS:

A. Under Bylaw No. 2560, *Family Court Committee Extended Service Establishment Bylaw No. 1,* 1997, the Capital Regional District ("CRD") continued a service to operate, participate in and fund a *Provincial Court Act* family court committee created for the capital region, as well as to provide funding to approved youth justice initiative involved third parties;

B. Since the 1960s, the Victoria Family Court Committee, also known as the Victoria Family Court and Youth Justice Committee, has operated as an advisory body, first as a committee of the City of Victoria then of the Capital Regional District, and continues to operate for the coordination and grant-making benefit for regional youth and family justice initiatives;

C. The Board wishes to set out clearly the community mandate of the Committee in a commission bylaw and ensure it has legal status and delegated authority to continue its work;

NOW THEREFORE, the Capital Regional District Board in open meeting assembled hereby enacts as follows:

CREATION OF COMMISSION

1. A commission is hereby established, to be known as the "Victoria Family Court and Youth Justice Committee" (hereinafter the "Committee"), and shall be a continuation of the Victoria Family Court and Youth Justice Committee presently operated in the capital region.

DELEGATED AUTHORITY

2. The Committee is hereby delegated all of the administrative powers of the Regional Board with respect to the service set out in Bylaw No. 2560, *Family Court Committee Extended Service Establishment Bylaw No. 1,* 1997 (the "Bylaw No. 2560"), that is, the funding, participation, and operation of the Committee and the granting of funding to youth and family issues; and the Board's ability under s.263(1)(c) of the *Local Government Act* to provide assistance to youth and family groups as contemplated by Bylaw No. 2560, other than assistance to business.

COMPOSITION AND ELIGIBILITY

3. The Committee shall have the following number of voting members, up to a total of 23, each having one vote:
    (a) Up to seven individuals as Capital Regional District appointed representatives under section 7;
    (b) Thirteen municipal council representatives, who may each have an alternate, under section 8; and
    (c) Three school district representatives, representing School Districts 61, 62, and 63, under section 9.

4. Available openings for voting membership vacancies will be advertised by November of each year of a vacancy in a term in a form acceptable to the appointing organization.

5. A majority of members must have experience in education, health, probation, or welfare.

6. Members must represent the interests of their community or organization to the best of their ability.

Capital Region Representatives

7. The Regional Board may appoint up to seven individuals as voting members of the Committee. Such appointments may be, but are not limited to, representatives of the Juan de Fuca Electoral Area, community members, representatives of youth and family justice organizations, municipal councilors, regional district Board members, or First Nations' representatives.

Municipal Representatives

8. Each municipal participant may appoint a municipal council representative as a voting member, and may appoint as an alternate voting member a member of the public or a municipal councilor to act in the absence of the municipal council representative, for a total of 13 municipal council representatives.

School District Representatives

9. Each school district in areas served by the Committee may appoint a representative as a voting member, for a total of three school district representatives.

Resource Members

10. The Committee may resolve to have any number of non-voting resource members, including individuals, service providers, organization representatives, public authorities, First Nations, or other groups working in the capital region in family court and youth justice initiatives.

TERM OF OFFICE

11. A member's term of office is from the date of appointment in one year to December 31 in the second year of appointment.

12. No voting member may serve more than six consecutive years on the Committee. A former member may be reappointed after one year of absence. Despite the term limit in this section, in unique circumstances, an appointing agency may reappoint its voting member for an additional term.

OFFICERS

13. By the end of February in each year, the Committee shall hold an annual meeting for the purpose of appointing officers (the "Annual Meeting"). The Committee shall select from among its voting members a Chair, Vice-Chair, and Treasurer, with voting by show of hands, or, if a secret ballot is requested by one-third of members present, by secret ballot.

14. The Committee may create additional officer roles it considers advisable and staff them with voting or non-voting members from time-to-time.

15. In the event of a vacancy, the Committee may select a voting member to fill an officer role until the next Annual Meeting.

DEATH, RESIGNATION, DISQUALIFICATION AND TERMINATION

16. A member's appointment ends on the end of term; resignation; death or incapacity; revocation of appointment; ceasing to be an employee, volunteer, elected official or officer of an appointing agency; or on the cessation of a municipal council voting member ceasing to be a municipal councilor.

MEMBER VACANCIES

17. In the event of a member vacancy before the end of term, the appointing organization may appoint an individual to complete the term. If not filled within a reasonable time, the Committee shall reported such vacancy to the Capital Regional District's Corporate Officer.

18. If a member is absent for more than two consecutive meetings with notice, the Committee shall contact the member to determine interest in continuing on the Committee. If absent for three consecutive meetings, the member may be removed by resolution of the Committee and the Committee shall alert the appointing organization, requesting appointment.

COMMISSION OBJECTIVES AND DUTIES

19. The Committee has the following objectives:
    (a) to identify, inform, educate, advocate for, and report on gaps in regional resources for youth justice and family court issues;
    (b) to act as a resource for the public and youth and family organizations; and
    (c) to encourage collaboration between and visibility of community services.

20. The Committee is hereby tasked with the following duties:
    (a) to meet at least four times per year to:
        i. consider and examine community resources for family and children's matters;
        ii. make recommendations to the court, the Attorney General, or others;
        iii. solicit and consider applications for receipt of grant-funding; and
        iv. connect family-and-justice-involved individuals, service providers, and government in a way that encourages collaboration and identifies service gaps;
    (b) if requested by the court, to act a resource or assist as directed; and
    (c) report annually to its member local governments and the Attorney General on its activities.

21. The Committee may, within its mandate:
    (a) take positions and advocate on policy initiatives, legislation, and services affecting families and youth justice in the region, in the name of the "Victoria Family Court and Youth Justice Committee"; and
    (b) undertake other activities consistent with the activities of a family court and youth justice committee, as permitted by law.

22. Subject to Capital Regional District bylaws, policies, and procedures, the Committee, in open meeting assembled or through supervised volunteers, may:
    (a) establish advisory groups to examine specific issues, who will report on their work;
    (b) contract for support services, volunteer coordination, communications, feasibility studies, and other services and goods related to its objectives and duties;
    (c) undertake necessary, incidental, or ancillary administrative tasks in order to effect its work.

23. If acting under referral or as otherwise directed under the *Provincial Court Act,* RSBC 1996, c 379, or *Youth Criminal Justice Act*, SC 2002, c 1, the Committee shall discharge its duties through one or more registered volunteers assembled for that purpose by resolution of the Committee, unless otherwise directed by the court.

24. All volunteers shall be supervised by the Committee or its appointed volunteer coordinator, if any; shall register with the CRD's Risk and Insurance Department; and must, if working with vulnerable persons or persons under 18 years of age, provide a recent criminal record check to CRD.

CONDUCT OF MEETINGS AND QUORUM

25. A quorum shall be seven (7) voting members.

26. The Committee must follow Bylaw No. 3828, "Capital Regional District Board Procedures Bylaw, 2012", when conducting a meeting (the "CRD Procedures Bylaw").

27. All meetings of the Committee must be held in a public facility and must be open to the public. Meetings may be in-camera, where authorized by law.

28. The Committee may meet by electronic means, where the requirements in the CRD Procedures Bylaw are met.

CONFLICT OF INTEREST

29. In discharging the Committee's grant function, any member who considers themselves in a pecuniary or non-pecuniary conflict of interest shall declare a conflict, which may include:
    (a) where their appointing agency is a direct recipient of a grant or assistance; or
    (b) where a member or their immediate family owes a fiduciary duty, as a director, senior manager, or employee of an organization receiving funding,

    and shall recuse themselves in accordance with the CRD Procedures Bylaw and the *Community Charter,* SBC 2003, c 26.

30. On a majority vote of the Committee, School District and non-voting members representing an organization with a direct pecuniary interest in a grant may be invited to present on their organization's application, but shall not be present for debate nor the vote on the matter.

BUDGET

31. Upon its establishment and by October 1 of each year, the Committee shall prepare an annual budget, which shall include estimates for administrative costs, operations, grants, and other expenditures, and shall submit such estimates to the CRD's Chief Financial Officer for Regional Board approval and inclusion in provisional and annual budgets.

RECORD KEEPING

32. The Committee shall comply with all public record keeping requirements under the *Community Charter*, *Local Government Act*, and other applicable legislation.

33. Records shall be stored at the CRD. Agendas shall be provided in advance of meetings in accordance with the CRD Procedures Bylaw and meeting minutes shall be provided after each meeting.

CITATION

34. This bylaw may be cited for all purposes as “Victoria Family Court and Youth Justice Committee Commission Bylaw No. 1, 2022".

READ A FIRST TIME THIS	th	day of	20__
READ A SECOND TIME THIS	th	day of	20__
READ A THIRD TIME THIS	th	day of	20__
ADOPTED THIS	th	day of	20__

CHAIR

CORPORATE OFFICER

Making a difference...together

REPORT TO THE JUAN DE FUCA LAND USE COMMITTEE
MEETING OF TUESDAY, JANUARY 18, 2022

SUBJECT **Zoning Amendment for Lot 28, Section 15, Otter District, Plan VIP87643 – 3312 Otter Point Road**

ISSUE SUMMARY

The owners have applied to amend the Rural Residential A Kennel (RR-AK) zone to permit an existing accessory athletic facility.

BACKGROUND

The 0.983 ha subject property is located at 3312 Otter Point Road and is zoned Rural Residential A Kennel (RR-AK) in the Juan de Fuca (JdF) Land Use Bylaw, 1992, Bylaw No. 2040 (Appendix A). The parcel is adjacent to Rural A zoned Crown Land to the west, a CRD owned right-of-way to the east, the Denfield Road right-of way and Sooke Business Park to the south, and Otter Point Road and Rural Residential A (RR-A) properties to the north. There are an existing dwelling, including secondary suite, and accessory building on the property (Appendix B).

The property is designated as Settlement Area 1 in the Otter Point Official Community Plan (OCP), Bylaw No. 3819, and falls outside any designated development permit areas. The parcel is within the Otter Point Fire Protection Local Service Area, and is serviced by well water and onsite septic.

The property was the subject of a zoning amendment application (RZ000227) in 2012/13 to rezone the parcel from RR-A to RR-AK to permit a kennel and dog obedience training operation. The kennel is no longer active; however, a fitness facility (Otter Point Athletics) is operating out of the accessory building. The original building permit for the accessory building expired in 2018 and a new permit application was submitted in 2021 to complete the outstanding items and receive a final inspection. In order to complete the permit, the athletic facility use must either be legalized through rezoning, or discontinued. The owners have applied to rezone the property and staff have prepared Bylaw No. 4454 (Appendix C) to amend the RR-AK zone by adding “athletic facility accessory to a principal residential use” to the list of permitted uses (Appendix C).

At its meeting of September 21, 2021, the Juan de Fuca Land Use Committee recommended referral of proposed Bylaw No. 4454 to the Otter Point Advisory Planning Commission (APC), CRD departments, first nations and other external agencies. Comments have been received from agencies and are included in Appendix D.

ALTERNATIVES

Alternative 1
The Land Use Committee recommends to the Capital Regional District (CRD) Board:

1. That the referral of proposed Bylaw No. 4454, “Juan de Fuca Land Use Bylaw, 1992, Amendment Bylaw No. 154, 2021”, to the Otter Point Advisory Planning Commission, appropriate CRD departments, BC Hydro, District of Sooke, FLNR - Archaeology Branch, FLNR - Ministry of Forests, Lands, Natural Resource Operations and Rural Development, FLNR – Water Protection, Island Health, Ministry of Environment & Climate Change Strategy – Environmental Protection and Sustainability, Ministry of Transportation & Infrastructure, Otter Point Fire Department, RCMP, Sc’ianew First Nation, and T’Sou-ke First Nation be approved and the comments received;
2. That proposed Bylaw No. 4454 be introduced and read a first time and read a second time; and

3. That in accordance with the provisions of section 469 of the *Local Government Act*, the Director for the Juan de Fuca Electoral Area, or Alternate Director, be delegated authority to hold a Public Hearing with respect to Bylaw No. 4454.

Alternative 2
That the CRD Board not proceed with proposed Bylaw No. 4454.

Alternative 3
That more information be provided.

IMPLICATIONS

Legislative
The Advisory Planning Commissions (APCs) were established to make recommendations to the Land Use Committee on land use planning matters referred to them relating to Part 14 of the *Local Government Act* (*LGA*). The Otter Point APC considered the application at its meeting on November 2, 2021.

Should the proposal proceed, a public hearing pursuant to Part 14, Division 3 of the *LGA* will be required subsequent to the amendment passing second reading by the CRD Board. Property owners within 500 m of the subject property will be sent notice of the proposed bylaw amendment and a public hearing will be advertised in the local paper and on the CRD website.

Regional Growth Strategy
Section 445 of the *LGA* requires that all bylaws adopted by a regional district board after the board has adopted a Regional Growth Strategy (RGS) be consistent with the RGS. In accordance with CRD policy, where a zoning bylaw amendment that applies to land within the Otter Point OCP area is consistent with the OCP, it does not proceed to the full CRD Board for a determination of consistency with the RGS. Staff are of the opinion that the proposed amendment is consistent with the policies of the Otter Point OCP.

Referral Comments
Referrals were sent to 17 agencies and CRD departments, and to the Otter Point APC. Comments received are summarized below and included in Appendix D.

BC Hydro stated that they had no objection and that their interests were unaffected by the proposal.

RCMP stated that they had no concerns.

Ministry of Transportation & Infrastructure stated that they had no objection to the rezoning as proposed.

District of Sooke stated that their interests are unaffected by the proposed bylaw amendment.

CRD Bylaw Enforcement commented that they did not foresee any significant impacts to its services by this application.

FLNR – Ecosystems Section stated that their interests were unaffected by the proposal.

FLNR – Archaeology Branch stated there are no known archaeological sites on the property and archaeological potential modelling for the area does not indicate a high potential for previously unidentified archaeological sites to be found on the subject property. Should any suspected archaeological deposits be encountered during land alterations on the property, all work must be halted and the Archaeology Branch contacted.

The Otter Point Fire Department stated that they had no concerns with the rezoning application.

The Otter Point APC met on November 2, 2021, to consider the application, with one member of

the public in attendance. Two letters were received in response to public notification. The first letter stated support for the application. The second letter advised of the owner's requirement to licence the existing well for commercial use, but expressed no objection the rezoning. The Otter Point APC moved the following motion:

> **MOVED** by Sid Jorna, **SECONDED** by Bud Gibbons that the Otter Point Advisory Planning Commission recommends to the Juan de Fuca Land Use Committee (LUC) that the zoning amendment proceed and that the well be registered.
>
> **CARRIED**

Land Use

The proposed bylaw includes an amendment to add "athletic facility accessory to a principal residential use" in order to legalize an existing fitness centre and allow the building permit process for the accessory building to be completed.

The subject property was rezoned in 2013 from RR-A to RR-AK in order to allow a dog obedience training operation under the *kennel* definition. The Settlement Area designation of the Otter Point Official Community Plan, Bylaw No. 3819, supports accommodating limited industrial and commercial development with a focus on the Sooke Business Park. The property is located in close proximity to local industrial, commercial and institutional uses, including light industrial and warehousing activities in Sooke Business Park, Otter Point Collision and the CRD Local Area Services Building.

As a permitted accessory use, the fitness facility would be limited in size to the maximum floor area of accessory buildings (250 m^2). Parking requirements are regulated under Part 3 of Bylaw No. 2040 which requires a minimum of 1 space per 3.18 m^2 of floor area used by patrons. Parking allocation will be assessed through by JdF Planning through the building permit process.

Water licensing requirements under the *Water Sustainability Act* will be addressed through the building permit process.

The proposed bylaw was sent to 17 agencies and CRD departments, and to the Otter Point APC. No comments received expressed any concern with the bylaw or proposal activity.

Based on the information provided by the applicant, referral comments received and the policies of the Otter Point OCP, staff recommend that proposed Bylaw No. 4454 be introduced, read a first and a second time, and that a public hearing be held.

CONCLUSION

The purpose of this zoning bylaw amendment application is to amend the Rural Residential A Kennel (RR-AK) zone to permit an athletic facility accessory to a principal residential use. Staff have prepared proposed Bylaw No. 4454 and recommend receipt of referral comments, first and second reading and advancement to public hearing.

RECOMMENDATION

Alternative 1
The Land Use Committee recommends to the Capital Regional District (CRD) Board:

1. That the referral of proposed Bylaw No. 4454, "Juan de Fuca Land Use Bylaw, 1992, Amendment Bylaw No. 154, 2021", to the Otter Point Advisory Planning Commission, appropriate CRD departments, BC Hydro, District of Sooke, FLNR - Archaeology Branch, FLNR - Ministry of Forests, Lands, Natural Resource Operations and Rural Development, FLNR – Water Protection, Island Health, Ministry of Environment & Climate Change Strategy – Environmental Protection and Sustainability, Ministry of Transportation & Infrastructure, Otter Point Fire Department, RCMP, Sc'ianew First Nation, and T'Sou-ke First Nation be approved and the comments received;
2. That proposed Bylaw No. 4454 be introduced and read a first time and read a second time; and
3. That in accordance with the provisions of section 469 of the *Local Government Act*, the Director for the Juan de Fuca Electoral Area, or Alternate Director, be delegated authority to hold a Public Hearing with respect to Bylaw No. 4454.

Submitted by:	Iain Lawrence, RPP,MCIP, Manager, Juan de Fuca Community Planning
Concurrence:	Kevin Lorette, P.Eng., MBA, General Manager, Planning & Protective Services
Concurrence:	Larisa Hutcheson, P.Eng., Acting Chief Administrative Officer

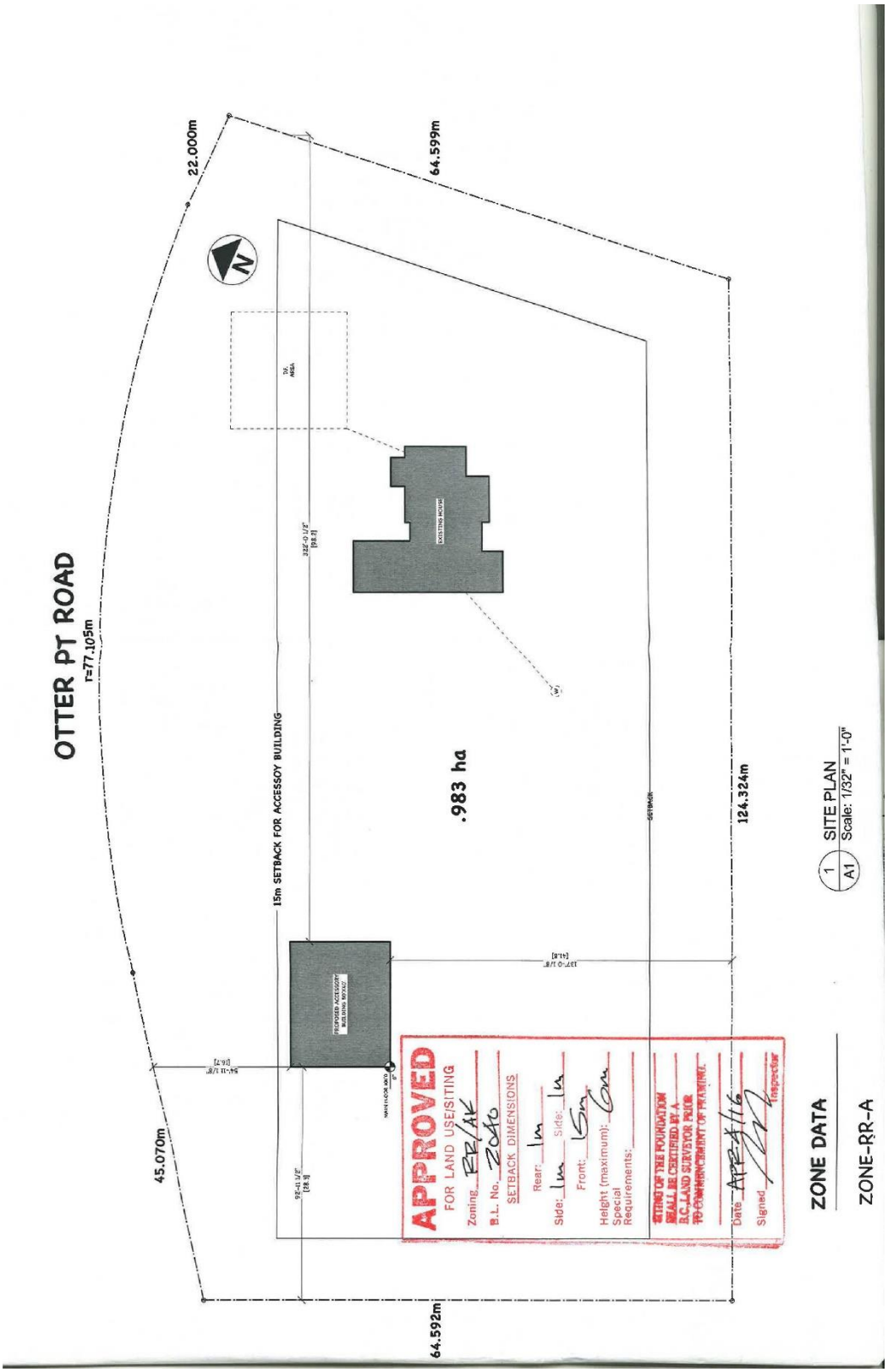
ATTACHMENTS

Appendix A: Subject Property
Appendix B: Site Plan
Appendix C: Proposed Bylaw No. 4454
Appendix D: Referral Comments

Appendix A: Subject Property



Appendix B: Site Plan



Appendix C: Bylaw No. 4454

CAPITAL REGIONAL DISTRICT
BYLAW NO. 4454

****

A BYLAW TO AMEND BYLAW NO. 2040, THE "JUAN DE FUCA LAND USE BYLAW, 1992"

****

The Capital Regional District Board, in open meeting assembled, enacts as follows:

1. Bylaw No. 2040 being the "Juan de Fuca Land Use Bylaw, 1992" is hereby amended as follows:

A. SCHEDULE A, PART 2, SECTION 4A.01 RURAL RESIDENTIAL A KENNEL ZONE – RR-AK

(a) By renumbering Section 4A.01 as Section 4AK.0 and renumbering the subsections accordingly; and

(b) By adding a new paragraph 4AK.01(h) as follows:

"(h) athletic facility accessory to a principal residential use";

2. This bylaw may be cited as "Juan de Fuca Land Use Bylaw, 1992, Amendment Bylaw No. 154, 2021".

READ A FIRST TIME THIS	day of	, 2022.
READ A SECOND TIME THIS	day of	, 2022.
READ A THIRD TIME THIS	day of	, 2022.
ADOPTED THIS	day of	, 2022.

CHAIR CORPORATE OFFICER

Appendix D: Referral Comments

Wendy Miller

From: Towstego, Lucas FLNR:EX <Lucas.Towstego@gov.bc.ca>
Sent: Wednesday, October 13, 2021 1:11 PM
To: Wendy Miller; Roden, Jacqueline FLNR:EX; South Island District Office, Forests FLNR:EX; Doyle, Jessica FLNR:EX; Bracher, Grant FLNR:EX
Subject: RE: Zoning Amendment Application RZ000274 - CRD Referral

CAUTION: This Email is from an EXTERNAL source. Ensure you trust this sender before clicking on any links or attachments.

Dear Wendy,

Thank you for your archaeological information request regarding 3312 Otter Point Road (PID 028147057 Legal: L 28 SEC 15 OTTER DISTRICT PL VIP87643). Please review the screenshot of the property below (outlined in yellow) and notify me immediately if it does not represent the property listed in your information request.

Results of Provincial Archaeological Inventory Search

According to Provincial records, there are no known archaeological sites recorded on the subject property.

However, an archaeological site is recorded within 60 m of the subject property, and there is high potential for unrecorded portions of the archaeological site to extend onto the subject property.

Archaeology Branch Advice

If land-altering activities (e.g., home renovations, property redevelopment, landscaping, service installation) are planned on the subject property, a Provincial heritage permit is not required prior to commencement of those activities.

However, a Provincial heritage permit will be required if archaeological materials are exposed and/or impacted during land-altering activities. Unpermitted damage or alteration of a protected archaeological site is a contravention of the *Heritage Conservation Act* and requires that land-altering activities be halted until the contravention has been investigated and permit requirements have been established. This can result in significant project delays.

Therefore, the Archaeology Branch strongly recommends engaging an eligible consulting archaeologist prior to any land-altering activities. The archaeologist will review the proposed activities, verify archaeological records, and possibly conduct a walk-over and/or an archaeological impact assessment (AIA) of the project area to determine whether the proposed activities are likely to damage or alter any previously unidentified archaeological sites.

Please notify all individuals involved in land-altering activities (e.g., owners, developers, equipment operators) that if archaeological material is encountered during development, they **must stop all activities immediately** and contact the Archaeology Branch for direction at 250-953-3334.

Rationale and Supplemental Information

- A protected archaeological site is located within 60 m the subject property, and there is high potential for previously unidentified portions of the site to extend to other parts of the property.
- Archaeological sites are protected under the *Heritage Conservation Act* and must not be damaged or altered without a Provincial heritage permit issued by the Archaeology Branch. This protection applies even when archaeological sites are previously unidentified or disturbed.

- If a permit is required, be advised that the permit application and issuance process takes approximately 8-12 weeks; the permit application process includes referral to First Nations and subsequent engagement.
- The Archaeology Branch must consider numerous factors (e.g., proposed activities and potential impacts to the archaeological site[s]) when determining whether to issue a permit and under what terms and conditions.
- The Archaeology Branch has the authority to require a person to obtain an archaeological impact assessment, at the person's expense, in certain circumstances, as set out in the *Heritage Conservation Act*.
- Occupying an existing dwelling or building without any land alteration does not require a Provincial heritage permit.

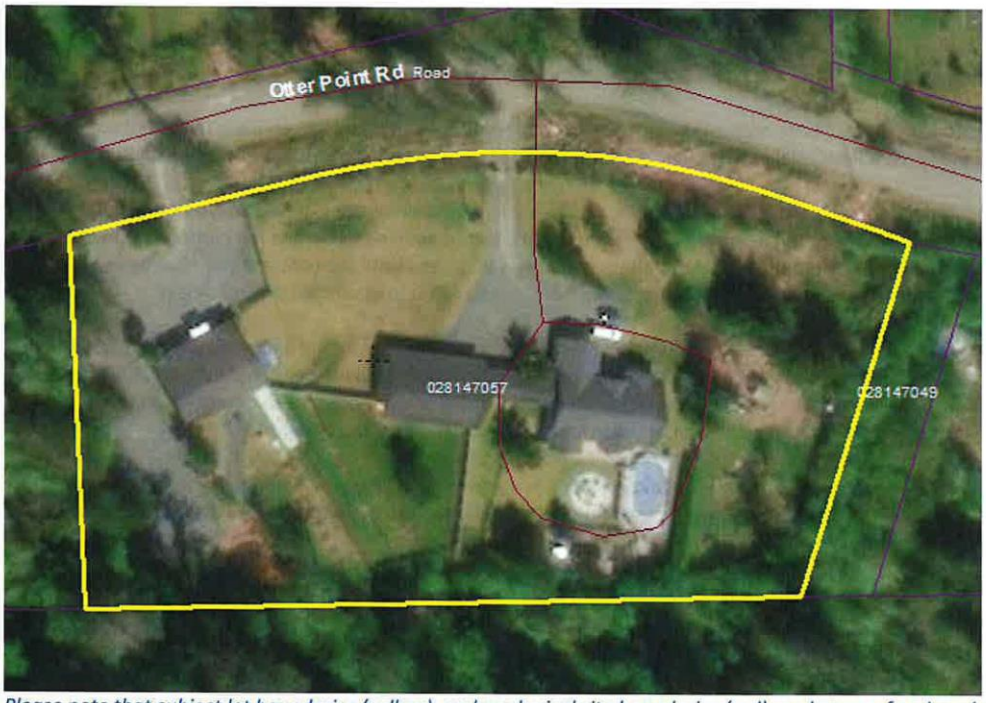
How to Find an Eligible Consulting Archaeologist

An eligible consulting archaeologist is one who can hold a Provincial heritage permit to conduct archaeological studies. To verify an archaeologist's eligibility, ask an archaeologist if he or she can hold a permit in your area, or contact the Archaeology Branch (250-953-3334) to verify an archaeologist's eligibility. Consulting archaeologists are listed on the BC Association of Professional Archaeologists website (www.bcapa.ca) and in local directories.

Questions?

For questions about the archaeological permitting and assessment process, please contact the Archaeology Branch at 250-953-3334 or archaeology@gov.bc.ca.

For more general information, visit the Archaeology Branch website at www.gov.bc.ca/archaeology.



Please note that subject lot boundaries (yellow), archaeological site boundaries (red), and areas of archaeological potential indicated on the enclosed screenshot are based on information obtained by the Archaeology Branch on the date of this communication and may be subject to error or change. Archaeological site boundaries may not be identical to actual site extent.

2

Wendy Miller

From: Mann, Elaine <Elaine.Mann@bchydro.com>
Sent: Tuesday, October 12, 2021 2:54 PM
To: Wendy Miller
Subject: RE: [External] Zoning Amendment Application RZ000274 - CRD Referral

Hi Wendy,

BC Hydro, Property Rights have no objection as our interests are unaffected by this proposal.

Regards,

Elaine Mann | Property Coordinator, Property Rights Services

BC Hydro
Vancouver Island

P 250-755-7169
E elaine.mann@bchydro.com

bchydro.com

Smart about power in all we do.

District of Sooke
2205 Otter Point Road, Sooke, British Columbia, Canada V9Z 1J2
Phone: 250-642-1634 Fax: 250-642-0541 Email: info@sooke.ca Website: www.sooke.ca

CRD Rezoning Application Referral to District of Sooke Planning Department

Friday, October 8, 2021 DOS File No.: CRD Referral

Juan de Fuca Community Planning
3-7450 Butler Road
Sooke, BC V9Z 1V1 Via Email: wmiller@crd.bc.ca

Dear Iain Lawrence, RPP, MCIP, Manager, Juan de Fuca Community Planning

Re: Referral Comments on rezoning application to amend Bylaw No. 2040 to amend the Rural Residential A Kennel (RR-AK) zone to permit an existing accessory athletic facility.

Upon review of the proposed bylaw amendment to Bylaw No. 2040, Planning staff have determined that the District of Sooke's interest are unaffected by the proposed bylaw amendment RZ000274.

Thank you for providing the opportunity to comment on the proposed rezoning application.

If you have any further questions, please do not hesitate to contact me at the email provided below.

Yours Truly,

Kasha Janota-Bzowska, Planner I
Planning and Development Department
2205 Otter Point Road
Sooke, BC, V9Z 1J2

Email: kjanotabzowska@sooke.ca
Web: www.sooke.ca

CC: Matthew Pawlow, RPP, MCIP, Director of Planning and Development Services

Wendy Miller

From: Page, Owen TRAN:EX <Owen.Page@gov.bc.ca>
Sent: Thursday, October 07, 2021 11:27 AM
To: Wendy Miller
Subject: RE: Zoning Amendment Application RZ000274 - CRD Referral

CAUTION: This Email is from an EXTERNAL source. Ensure you trust this sender before clicking on any links or attachments.

Good Morning Wendy,

Please consider this the official response from the Ministry of Transportation and Infrastructure regarding the proposed rezoning of 3312 Otter Point Road to permit an accessory athletic facility.

The Ministry has no objections to the rezoning as proposed.

Thank you for the opportunity to comment. Should you wish to discuss further, please feel free to contact me.

Regards,

Owen Page
Development Officer
Ministry of Transportation and Infrastructure
Vancouver Island District
Ph: 236-478-1552

BRITISH COLUMBIA Ministry of Transportation and Infrastructure

WEBSITE FOR DEVELOPMENT APPROVALS:
www.th.gov.bc.ca/Development_Approvals/home.htm | MINISTRY WEBSITE: http://tranbc.ca/

Wendy Miller

From: John McCrea <jmccrea@otterpointfire.bc.ca>
Sent: Friday, September 24, 2021 1:25 PM
To: Wendy Miller
Cc: Jonathan Reimer; chief@otterpointfire.bc.ca
Subject: Re: Zoning Amendment Application RZ000274 - CRD Referral

CAUTION: This Email is from an EXTERNAL source. Ensure you trust this sender before clicking on any links or attachments.

Good Morning Wendy

Thank you for the opportunity to comment on this rezoning application.

The Otter Point Fire Department has no concerns with the rezoning application for 3312 Otter Point Road.

Regards

John

John McCrea; Fire Chief
Otter Point Fire Department and Training Centre
3727 Otter Point Road
Sooke, BC. V9Z 0K1
P: 250 642-6211
C: 250 213-7745

RESPONSE SUMMARY – REZONING APPLICATION RZ000274

___ Interest Affected by Proposal for Reasons Outlined Below

__X__ Interest Unaffected by Proposal

Our interests are unaffected as this pertains solely to rezoning and no new construction is planned.

Dr. Grant Bracher P.Ag., R.P.Bio.

	Ecosystem Biologist
Signed	Title
September 24, 2021	Ecosystems, FLNRORD
Date	Agency

Wendy Miller

From: Sinden, Brett <brett.sinden@rcmp-grc.gc.ca>
Sent: Wednesday, September 22, 2021 11:59 AM
To: Wendy Miller
Subject: RE: Zoning Amendment Application RZ000274 - CRD Referral

CAUTION: This Email is from an EXTERNAL source. Ensure you trust this sender before clicking on any links or attachments.

No concerns.

S/Sgt Brett SINDEN
Detachment Commander
Sooke RCMP
250-642-5241 extension 2227

CONFIDENTIALITY NOTICE
This information is the property of the RCMP. It should not be shared or disseminated without the authority of the sender. This communication may contain privileged or confidential information. If you have received this message in error, or are not the named recipient(s), please immediately notify the sender and delete the message without copying or disclosing it. Third Party Rule applies.

Making a difference...together

Minutes of a Meeting of the Otter Point Advisory Planning Commission
Held Tuesday, November 2, 2021, at Juan de Fuca Local Area Services Building,
3-7450 Butler Road, Otter Point, BC

PRESENT: Sid Jorna (Vice Chair), Bud Gibbons, Stephen Smith (EP), Al Wickheim
Staff: Iain Lawrence, Manager, Juan de Fuca Community Planning (EP); Wendy Miller, Recorder (EP)
ABSENT: Anne Miller (Chair)
PUBLIC: 1 (EP)

EP – Electronic Participation

The meeting was called to order at 7:00 pm.

1. **Approval of the Agenda**

   MOVED by Bud Gibbons, **SECONDED** by Al Wickheim that the agenda be approved.
   CARRIED

2. **Approval of the Supplementary Agenda**

   MOVED by Bud Gibbons, **SECONDED** by Stephen Smith that the supplementary agenda be approved. **CARRIED**

3. **Adoption of the Minutes of August 11, 2021**

   MOVED by Stephen Smith, **SECONDED** by Bud Gibbons that the minutes of the meeting of August 11, 2021, be adopted. **CARRIED**

4. **Planner's Report**
   No report.

5. **Zoning Amendment Application**
   a) **RZ000274 – Lot 28, Section 15, Otter District, Plan VIP87643 (3312 Otter Point Road)**
   Iain Lawrence spoke to the staff report for the application to amend the Rural Residential A Kennel (RR-AK) zone to permit an existing accessory athletic facility.

   Iain Lawrence highlighted the subject property map and advised that:
   - the building permit for the accessory building used for the athletic facility has lapsed and the use to which the uncompleted building permit is being put does not comply with the RR-AK zone
   - the zoning amendment would legalize the athletic facility and allow the building permit to be completed
   - the athletic facility is serviced by an onsite well and septic
   - eleven letters of support submitted at application intake are included in the staff report considered by the Juan de Fuca Land Use Committee
   - there have been no bylaw enforcement complaints regarding the athletic facility

Iain Lawrence directed attention to the supplementary agenda which includes a further submission of support, as well as one submission regarding a water licence for use of groundwater for non-domestic purposes.

Iain Lawrence confirmed that the applicant was present.

The applicant responded to questions from the APC stating that:
- the athletic facility has one washroom with a toilet and a sink
- there have been no issues with the well, even during the last drought
- trucked water has not been required
- one septic field services the single family dwelling
- the secondary suite and athletic facility are serviced by a separate septic field
- increased sewerage is not anticipated
- the Province has been contacted regarding the well licence

MOVED by Sid Jorna, **SECONDED** by Bud Gibbons that the Otter Point Advisory Planning Commission recommends to the Juan de Fuca Land Use Committee (LUC) that the zoning amendment proceed and that the well be registered.

CARRIED

6. Adjournment

The meeting adjourned at 7:12 pm.

_____
Chair

PPSS-35010459-2632

Making a difference...together

REPORT TO PERFORMING ARTS FACILITIES SELECT COMMITTEE MEETING OF WEDNESDAY, JANUARY 19, 2022

SUBJECT **Costs and Timeline Associated with a Region-Wide Referendum on a Full Regional Performing Arts Facilities Service**

ISSUE SUMMARY

The only remaining option for electoral approval of a full regional performing arts facilities service is through region-wide referendum. This report estimates the costs, timeline, and additional required staff capacity required to deliver a region-wide referendum on this issue.

BACKGROUND

On September 8, 2021, the Board considered a set of four recommended motions from the Performing Arts Facilities Select Committee (PAFSC) that would establish a new full regional performing arts facilities service as set out in Bylaw No. 4445 through Alternative Approval Process (AAP). The motions related to the service itself carried, but the motion related to AAP did not carry, resulting in no clear path forward for bylaw approval.

On October 13, 2021, the Board voted to take no further action on Bylaw No. 4445 and refer the matter to PAFSC to explore full regional options without AAP as well as sub-regional options.

On December 8, 2021, PAFSC considered a report on advancing a full regional performing arts facilities services without AAP. Because the Board voted against using AAP and Langford Municipal Council indicated by letter that they would not consent to participate in a new performing arts facilities service, the only remaining option for electoral approval would be a region-wide referendum. PAFSC passed a motion that "staff report back to the Committee with detailed costing and timeline for running a region-wide referendum, including additional requirements for staff capacity".

This report responds to the December 8, 2021, PAFSC motion. Costs and additional staffing requirements are detailed in the *Financial Implications* section below. Assuming the Board approves the funding as part of the 2022 CRD budget, the timeline of a region-wide referendum would be coordinated to take advantage of the general local elections occurring on October 15, 2022 (see Table 1 for timeline details).

Table 1. Timeline for Region-Wide Referendum

Dates	Action	Rationale
March 2022	Add referendum expenses to 2022 CRD final budget	Necessary to fund referendum through feasibility reserve fund
April 13 2022	Board resolution to appoint CEO and DCEOs	s. 58 LGA
April – June 2022	Onboarding of auxiliary staff to support legislative services with referendum; Draft, negotiate and execute service contacts with all 13 municipalities	Staff will be required to negotiate individual service contracts with all municipalities for administration of referendum ballots and shared polling locations

Dates	Action	Rationale
June 8, 2022	Ensure bylaw has 1st–3rd reading; Board resolution to establish polls and referendum question; approval of bylaw synopsis	s. 344 of LGA
June 16, 2022	Bylaw sent to Inspector of Municipalities for approval (to be approved after July 27, 2022 for 80-day window)	s.174(2)(d) of LGA
July 15, 2022	Set up webpage for referendum process and details, including bylaw synopsis and FAQs on service	Inform public on the referendum purpose and process
July 15, 2022	Launch Public Awareness Plan (see *Communications Considerations* below)	Inform public on costs and benefits of the proposed new service
August, 2022	Notice of Advance Registration & Notice of Application to Volunteer as Scrutineer	S. 182(1) LGA
August 30 – September 9, 2022	10-day Period for receiving Applications for Scrutineers	S. 183(2)(b) LGA
September 15 – October 9, 2022	Notice of referendum; to be published in a newspaper at least once each week for 2 consecutive weeks	s. 176 LGA
October 5 & 12, 2022	Advance Voting Opportunities	s. 107(1) CRD Elections Bylaw
October 15, 2022	Referendum held on same day as general local elections	Leverage existing voting infrastructure where possible
November 16, 2022	CRD Board receives results of referendum and if successful, adopts bylaw	s. 158(1) LGA
December 17, 2022	Adopted Establishing Bylaw filed with Inspector of Municipalities following one month quashing period	s. 623(3) LGA

ALTERNATIVES

Alternative 1
That the Costs and Timeline Associated with a Region-Wide Referendum on a Full Regional Performing Arts Facilities Service report be received for information and policy options for sub-regional performing arts facilities services be considered.

Alternative 2
The Performing Arts Facilities Select Committee recommends to the Capital Regional District Board:

1. That staff be directed to implement the elector approval process by way of a region-wide referendum for Bylaw No. 4445, with the general voting day held on October 15, 2022 in conjunction with the general local elections.
2. That third reading of Bylaw No. 4445, “Regional Performing Arts Facilities Service Establishing Bylaw No. 1, 2021”, be rescinded.
3. That the amended Bylaw No. 4445, “Regional Performing Arts Facilities Service Establishing Bylaw No. 1, 2021”, be read a third time;
4. That Bylaw No. 4445 be forwarded to the Inspector of Municipalities for approval.
5. That the 2022 Budget for the Feasibility Reserve Fund be increased by $504,000 to cover the expenses of a region-wide referendum for Bylaw No. 4445.

IMPLICATIONS

Financial Implications

The estimated total cost of a region-wide referendum is $504,000 (Appendix A). This cost estimate is based on the CRD conducting the referendum in conjunction with the 2022 municipal election and having the referendum question on each of the individual municipal election ballots.

If the Board elects to proceed by way of a region-wide referendum, it would require the establishment of at least 25 in-person polling locations across all 13 municipalities and the 3 electoral areas. The locations would need be staffed by a minimum of 4 to 6 staff per location, for at least one advance polling day in addition to the general voting day. A referendum requires many of the same steps that are required for a general election (see Table 1 above). However, for a regional referendum the magnitude of the work is exponentially greater given the expansion of the potential number of voters (all eligible voters within the CRD) and the geographic distribution and number of polling locations.

There are efficiencies that would be realized by having a regional referendum in conjunction with the municipal general election on October 15, 2022, as CRD could contract with municipalities to assist by placing the referendum question on municipal ballots, and sharing polling locations and staff, similar to how municipalities administer School District elections on a cost-share basis.

The financial estimate provided in Appendix A is based on an informal canvasing of municipal staff of the potential costs they would seek to recover under contract from CRD if they were to assist with the administering the referendum question. There are a number of contingent factors that could increase or decrease the cost estimate. For example, a municipality may choose not to assist or may not be required to run an election if the seats are acclaimed, in which case CRD would assume the full cost of establishing a polling location in that area. Other factors that would affect costs are whether a separate ballot is required (or whether there is space on the municipal ballot), whether statutory advertising can be combined, or even whether electronic vote counting machines are being used (which can significantly increase the cost of each ballot printed).

Legislative Services staff currently have no capacity to administer a stand-alone referendum in 2022. Staff could administer a referendum in conjunction with the general election with additional contracted staff support; however, service plan adjustment would need to be made to defer other governance projects and processes requiring electoral approval. Arts and Culture staff would also be required to dedicate substantial capacity to support the referendum. The total estimated additional staffing expenses for a region-wide referendum held in conjunction with the general election are $54,000. This cost forms part of the $504,000 total estimate.

If the new full regional performing arts facilities service receives electoral approval in October 2022, then the financial requirements of the new service would be incorporated into the budget planning process for the 2023 CRD budget.

Legislative Considerations

Participating area approval may be obtained by way of region-wide assent vote, commonly called referendum, per sections 336, 342 (4), and 344 of the LGA. Other potential forms of approval that have been previously considered by the Board, but rejected, are municipal consent on behalf with alternative approval processes in the electoral areas, or a region-wide alternative approval process.

To initiate a region-wide assent vote, commonly known as referendum, the Board must select this method by a two-thirds majority vote.

The Board's choice on approval method is subject to review by the Inspector of Municipalities, who retains discretion to direct an alternative method.

Bylaw No. 4445 currently specifies that electoral approval would be sought through region-wide AAP. In order to advance this initiative by region-wide referendum, the third reading of Bylaw No. 4445 would need to be rescinded by the CRD Board. An amended Bylaw No. 4445 is required to specify that electoral approval is being sought through region-wide assent voting (Appendix B).

Communication Considerations

In addition to the legal requirements, a public awareness plan would be launched in conjunction with the public notice (see Appendix C for more details). The plan would ensure that voters have all the facts on the costs and benefits associated with a new fully regional performing arts facilities service under proposed Bylaw No. 4445. The plan would leverage the CRD's new engagementHQ digital tools, as well as social media channels and traditional media advertising. The goal of the public awareness plan is not to advocate in favour nor against the referendum issue, but instead to provide unbiased factual information about the proposed new service.

Service Delivery Implications

If the new full regional performing arts facilities service receives electoral approval in October 2022, then the service could launch its programs in 2023, as detailed in the updated service plan (Appendix D).

CONCLUSION

The Performing Arts Facilities Select Committee directed staff to provide more details on region-wide referendum as a potential method of gaining electoral approval for a new full regional performing arts facilities service. At this time, region-wide referendum is the only remaining option to advance a full regional service. The staff report details costs and additional required staff capacity, as well as a timeline for a potential region-wide referendum aligned to the 2022 general local elections in order to leverage existing voting infrastructure.

RECOMMENDATION

That the Costs and Timeline Associated with a Region-Wide Referendum on a Full Regional Performing Arts Facilities Service report be received for information and policy options for sub-regional performing arts facilities services be considered.

Submitted by:	Chris Gilpin, MPA, Manager, Arts and Culture Division
Concurrence:	Nelson Chan, MBA, FCPA, FCMA, Chief Financial Officer
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT(S)

Appendix A: Cost Estimate for Region-Wide Referendum as part of 2022 Municipal Elections
Appendix B: Amended Bylaw No. 4445
Appendix C: Communications Plan for Public Awareness on Referendum and Proposed Service
Appendix D: Updated Service Plan for Full Regional Performing Arts Facilities Service

Appendix A
Cost Estimate for Region-Wide Referendum as Part of 2022 Municipal Elections

On December 8, 2021, the Performing Arts Facilities Select Committee asked staff to provide detailed costs on running a region-wide referendum to obtain electoral approval for a full regional performing arts facilities service. The estimated total cost of a region-wide referendum is $504,000 as detailed in Table 1. This cost estimate is based on the CRD conducting the referendum in conjunction with the 2022 municipal election and having the referendum question on each of the individual municipal election ballots.

Table 1. Estimated cost of a region-wide referendum

Expense	Estimated Cost
CRD share of municipal polling cost (to be negotiated)	$350,000
Contribution to CRD election costs in the Electoral Areas	$40,000
Statutory required advertising/signage/equipment	$30,000
Advertising and media costs for outreach	$20,000
Contribution to contracted staff support for Legislative Services	$20,000
Staff time to provide community outreach on question for Arts & Culture	$34,000
Misc	$10,000
Total	$504,000

Appendix B: Amended Bylaw 4445

CAPITAL REGIONAL DISTRICT
BYLAW NO. 4445

****

A BYLAW TO ESTABLISH A REGIONAL PERFORMING ARTS FACILITIES OPERATION, FUNDING, AND GRANTING SERVICE

****

WHEREAS:

A. Under Bylaw No. 2587, Royal Theatre Local Service Area Establishment Bylaw No. 1, the Regional Board on behalf of the municipalities of Victoria, Oak Bay, and Saanich established a service to fund, operate, and maintain the Royal Theatre;

B. Under Bylaw No. 2685, McPherson Playhouse Local Service Area Establishment Bylaw No. 1, 1999, the Regional Board established a local service on behalf of the City of Victoria to fund, operate, and maintain the McPherson Playhouse;

C. By assent of the electors under section 336, 342, and 344 of the *Local Government Act*, the region's electors have approved the creation of a regional performing arts facilities funding service to encompass both the services set out in Bylaws No. 2587 and 2685, as well as the operation and funding of other performing arts facilities with regional impact;

D. The Board wishes to establish a service to operate and fund the planning, development, capital, and operation of performing arts facilities with regional impact;

NOW THEREFORE, the Capital Regional District Board in open meeting assembled hereby enacts as follows:

Definitions

1. The following definitions are used in this bylaw, both in plural and singular:
   (a) A "performing arts facility with regional impact" and "regional performing arts facility" means a public venue that:
      i. is located within the boundaries of the service area, that is, the Capital Regional District;
      ii. is designed for the primary purpose and function of performing arts presentations;
      iii. attracts audiences from beyond its local area (e.g. regional or multi-regional draw);
      iv. functions as a roadhouse-style presentation venue that is available for bookings form a wide range of commercial and community user groups on a year-round basis;
      v. is not embedded within an educational, religious, or for-profit organization; and
      vi. is owned or operated by a public authority, non-profit, registered charity, or local government, or a combination thereof.

   (b) "roadhouse-style presentation venue" means a venue available for rental or use by travelling and local productions, and not possessed or controlled by a single performing arts producing company or organized group of such companies.

Service

2. The Capital Regional District hereby establishes a service for the purpose of recreation, leisure, and community use in relation to operation and funding of performing arts facilities with regional impact, including the operation and funding of the planning, development, capital and operating costs of performing arts facilities with regional impact.

3. The scope of the service includes, without limiting the foregoing:
   (a) Annual capital and operating funding for the Royal Theatre and McPherson Playhouse to established minimum levels, being:
      i. $400,000 in capital and $350,000 in operating for the McPherson Playhouse; and
      ii. $480,000 in capital and $100,000 in operating for the Royal Theatre,
   where capital amounts may be used for but are not limited to the renovation, reconstruction, or rebuilding of the respective theatre facilities, machinery, equipment, reserve fund transfers or annual debt servicing, and where annual operating amounts may also include capital expenditures of the same nature if necessary or desirable;

   (b) Operation of grant programs benefitting performing arts facilities with regional impact, including:
      i. for regional facility planning projects;
      ii. for major and minor capital improvements to regional performing arts facilities, including payment of debt; and
      iii. for operations of such regional performing arts facilities;

   (c) Establishment of a capital reserve fund to benefit performing arts facilities with regional impact, including the construction of new facilities, renovation of existing facilities, and payment of debt for capital projects; and

   (d) Operation of a grants assistance program, to apply for grants on behalf of the CRD for regional performing arts facilities associated with or operated by the service and to assist regional performing arts facilities in applying for planning, capital, operating, and other grants.

Boundaries

4. The boundaries of the Service Area are the boundaries of the Capital Regional District, including all municipalities and electoral areas.

Participating Area

5. The participating areas for the service are the electoral areas and municipalities making up the Capital Regional District: the Electoral Areas of Salt Spring Island, Southern Gulf Islands, and the Juan de Fuca; and the Municipalities of Victoria, Oak Bay, Esquimalt, Saanich, Central Saanich, North Saanich, Sidney, View Royal, Highlands, Colwood, Langford, Sooke, and Metchosin.

Cost Recovery

6. As provided in Section 378 of the *Local Government Act*, the annual costs of providing the Service, net of grants and revenue, shall be recovered by one or more of the following:

   (a) property value taxes imposed in accordance with Division 3 [*Requisition and Tax Collection*], Part 11 of the *Local Government Act*;

   (b) fees and charges imposed under Section 397 of the *Local Government Act;*

   (c) revenues raised by other means authorized under the *Local Government Act* or another Act;

   (d) revenues received by agreement, enterprise, gift, grant or otherwise.

Cost Apportionment

7. The annual costs recovered by requisition in accordance with this bylaw shall be apportioned among the participants by dividing the costs into two equal parts, one part apportioned on the basis of population, where population is the total population estimate as determined annually by the Regional

District; and one part apportioned on the basis of assessments, where assessments are the annual converted value of land and improvements in the participating areas.

Maximum Requisition

8. In accordance with Section 339(1)(e) of the *Local Government Act*, the maximum amount that may be requisitioned annually for the cost of the Service is the greater of:
   (a) Three Million and Sixty Thousand dollars ($3,060,000); or
   (b) An amount equal to the amount that could be raised by a property value tax rate of $0.023 per One Thousand Dollars ($1,000) that, when applied to the net taxable value of land and improvements in the Service Area, will yield the maximum amount that may be requisitioned for the Service.

Transition of Services

9. Despite section 8, if the services established by Bylaw No. 2587, Royal Theatre Local Service Area Establishment Bylaw No. 1, and Bylaw No. 2685, McPherson Playhouse Local Service Area Establishment Bylaw No. 1, 1999 are still operating and are used to requisition funds, the requisition for this service shall be reduced in proportion by the amounts requisitioned under the respective services under Bylaw No. 2587 and 2685. For clarity, should services under Bylaw No. 2587 or 2685 continue to be operated and no requisition of funds occurs under the respective service, the maximum requisition for this service shall not be reduced.

Agreement

10. The Capital Regional District may enter into agreements with one or more organizations to operate regional performing arts facilities held or operated by the service.

Citation

11. This Bylaw may be cited as the “Performing Arts Facilities Service Establishing Bylaw No. 1, 2021”.

READ A FIRST TIME THIS	th	day of	20__
READ A SECOND TIME THIS	th	day of	20__
READ A THIRD TIME THIS	th	day of	20__
APPROVED BY THE INSPECTOR OF MUNICIPALITIES THIS	th	day of	20__
RECEIVED THE ASSENT OF THE ELECTORS UNDER SECTION 336 OF THE *LOCAL GOVERNMENT ACT* THIS	th	day of	20__
ADOPTED THIS	th	day of	20__

CHAIR

CORPORATE OFFICER

Appendix C:
Communications Plan for Public Awareness on Referendum and Proposed Service

Communications Plan

Performing Arts Facilities Service Region-wide Referendum

CRD | CRD Department

January 2022

Capital Regional District
625 Fisgard Street, PO Box 1000
Victoria, BC V8W 2S6

Communications Plan

Performing Arts Facilities Service Region-wide Referendum

CRD | **Arts & Culture Support Service**

Purpose

- Support awareness about a referendum on creation of a full regional Performing Arts Facilities Service –Bylaw No. 4445
- Provide factual information on the costs and benefits of the proposed new full regional Performing Arts Facilities Service so that electors can make an informed decision.

Background

Proposed Bylaw No. 4445 is an establishing bylaw, which would create a full regional service to **Plan, Develop, and Fund** performing arts facilities that have regional impact.

A Regional Performing Arts Facility (RPAF) is defined as a venue that:

- Is located within the boundaries of the Capital Regional District;
- Is designed for the primary purpose and function of performing arts presentation;
- Attracts audiences from beyond its local area (i.e. has a regional draw);
- Functions as a roadhouse-style presentation venue that is available for bookings from a wide range of commercial and community user groups on a year-round basis;
- Is not embedded as part of an educational, religious, or for-profit organization; and
- Is owned and operated by a non-profit or local government (or combination thereof).

Communications Plan

Performing Arts Facilities Service Region-wide Referendum

CRD | **Arts & Culture Support Service**

Function	Implementation	Financial / Service Implications
Plan	Planning Grants Program to support: feasibility plans, business plans, renovation or expansion plans, or construction plans. Maximum request amount = 50% of project expenses	Grants administered by CRD to non-profits or local governments. Annual program budget = $120,000/yr Unspent rolls into next year's budget.
Develop	1. Major Capital Access Program to support major capital projects (construction, expansion) and Minor Capital Grants Program (maintenance, accessibility). 2. Staff support for external grants to apply to provincial and federal funds.	$1,000,000/yr contribution toward growing reserve fund for major capital projects. Royal Theatre ($480,000) + McPherson Playhouse ($400,000) + Charlie White Theatre (TBD, ~$300,000) = $1,180,000 for existing minor capital expenses. Annual total budget = $2,180,000/yr
Fund	Operating Grants Program to existing RPAF at current or comparable level of existing contribution.	Royal Theatre ($100,000) + McPherson Playhouse ($350,000) + Charlie White Theatre (TBD,~$180,000) Annual program budget = $630,000/yr
Governance	CRD Board for first year. Reviewed and new committee or commission model could be proposed for some or all of service.	Depends on outcome of review.
CRD operations	1.2 FTE support in Arts and Culture division	Administers granting programs. $130,000/yr (with benefits).
		Total Requisition = $3,060,000
		Existing Requisition Included= $1,330,000
		Total New Fiscal Impact = $1,730,000

Communications Plan

Performing Arts Facilities Service Region-wide Referendum

CRD | Arts & Culture Support Service

Corporate Alignment

Board Priority 4e: Seek 100% participation in the CRD arts function and facilitate a discussion of the region's art facility needs.

Cautionary Points

The CRD is conducting the referendum and must remain neutral throughout the process.

Target Audiences

Qualified Capital Region electors

Key Messages

- The Capital Regional District is asking qualified electors to vote in the Performing Arts Facilities Service regional referendum in conjunction with the General Local Election scheduled for Saturday, October 15, 2022.
- Information on how an elector may register in advance and when advance voter registration period ends.
- Bylaw No. 4445 would establish a new full regional service that would provide financial assistance to plan, develop and fund performing arts facilities with regional impact.
- To pay for the new service, there would be increases to the CRD component of property taxes. All property owners in all CRD jurisdictions would contribute. The amount of tax increase per average household is determined by formula. A financial simulation including estimates of costs for the new service for each jurisdiction is available at engagementHQ.

- In December 2020, the CRD released Stage One: A Public Conversation about Performing Arts Facilities in the CRD. This report shows widespread support for the CRD to take on a greater role in supporting performing arts facilities with regional impact.
- This referendum will ask electors whether they are in support of a Regional Performing Arts Facilities Service and is binding to all jurisdictions in the Capital Regional District (i.e. Public Assent process).

Spokespeople

- Political: Colin Plant
- Organization Representative: Chris Gilpin

Strategies & Actions

Statutory requirements:

- Print advertising in newspaper(s) with circulation throughout the area:
    - Notice of Advance Registration and Notice of application to Volunteer as Scrutineers (once a week for two consecutive weeks)
    - Notice of assent voting (once a week for two consecutive weeks)
- Notice available for public inspection must include how an elector may register in advance and when advance voter registration period ends

Additional strategies:

- Media release

- CRD's custom online platform, engagementHQ, with:
    - Text of Bylaw No. 4445
    - Details of proposed service
    - Financial implications by jurisdiction / average cost per household
    - Options to proceed if the assent vote is not successful
    - Key documents and reports
    - Background including information as to why Board has determined assent voting is necessary and why they decided on the option they are putting forward
    - How/when/where to vote
    - Q&A
- Facebook and Twitter posts
- As needed: direct mailouts, radio ads, postering at public facilities (e.g. libraries recreation centres & community centres)

The initiatives that will be implemented to support the objectives in communicating with identified audiences. These may include paid media, social media, printed materials, direct mail outs, online content, events, etc.

If the details for an action are too many to include in this communications plan and will be outlined in a supporting plan (such as a media, social media, or event plan), please indicate that and provide only the high-level overview here.

Communications Plan

Performing Arts Facilities Service Region-wide Referendum

CRD | Arts & Culture Support Service

Implementation Plan & Timelines

Target Start / Completion Dates	Action	Department Responsible
March 2022	Add referendum expenses to 2022 CRD final budget	Finance
Prelaunch	Notices available on website: • Advance Registration • Application to Volunteer as Scrutineers	Legislative Services/ Corporate Communications
Mid-July, 2022	Launch of Public Awareness Campaign: • Launch of Engagement HQ site • Distribution of Media release • Regular social media posts	Arts & Culture / Corporate Communications
September 16, 2022	Public notice of referendum -notices must be available for public inspection in the local government offices	Legislative Services/ Corporate Communications
Between Sept 16-Oct 9	Publish official notice of assent voting in a newspaper with a circulation in the area once a week for two consecutive weeks (can be in different publications for each area) and/or mailer?	Legislative Services/ Corporate Communications
	Zoom Info Session	Arts & Culture/ Corporate Communications
	Posts on Facebook and Twitter CRD accounts	Arts & Culture/ Corporate Communications
October 15, 2022	Referendum held on same day as local municipal elections	Legislative Services

Informed by LECFA Parts 1 and 4, LGA, s.163(4)

Collateral Materials

The materials that will be produced or used to implement the strategies and actions.

Budget

$30,000 to cover required statutory required advertising.

Other Resources

Staff-time:

Corporate Communications

- Ad review, contracts, booking & invoicing: 14-21 hours
- Ad development and booking: 2-4.5 hours

Arts & Culture:

- Visual and copy development for social media posts: 5-7 hours
- Development and management of HQ site: 20+ hours
- Zoom info sessions: 20+ hours
- Media release: 5 hours

Appendix D:
Updated Service Plan for Full Regional Performing Arts Facilities Service

Service Plan for Establishment of a Performing Arts Facilities Service

Capital Regional District

Revised: January 10, 2022

Making a difference...together

Table of Contents

1 Overview 1
1.1 Division & Service Summary 1
1.2 Organization Chart 2
1.3 Key Trends, Issues & Risks – Service Specific 2
1.4 Link to Board Strategic Priorities 3
2 Services 4
2.1 Service Levels 4
2.2 Workforce Considerations 5
3 Divisional Initiatives & Budget Implications 5
4 Goals & Performance Indicators 7
Contact 7

Appendix D:
Updated Service Plan for Full Regional Performing Arts Facilities Service

1 Overview

1.1 Division & Service Summary

WHY

- On May 19, 2021, the Performing Arts Facilities Select Committee (PAFSC) provided direction that "Staff develop a service bylaw, service plan and a process to consult with municipalities, electoral areas, arts organizations, and other bodies."
- On December 8, 2021, PAFSC asked staff to provide detailed costs and timeline on running a region-wide referendum to obtain electoral approval for a full regional performing arts facilities service. This adjusted timeline has implications for the timing of service delivery.

WHAT

A regional service to Plan, Develop, and Fund performing arts facilities that have regional impact.

A Regional Performing Arts Facility (RPAF) is defined as a venue that:

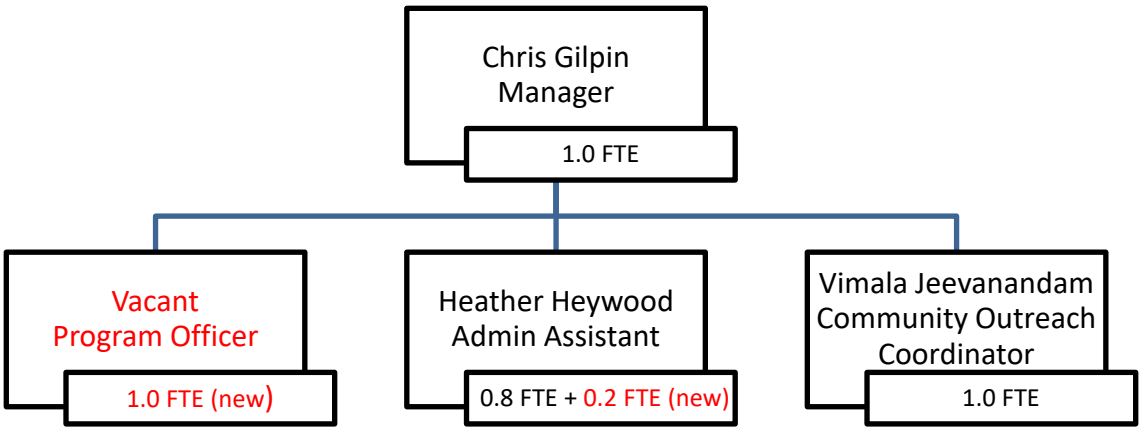
- Is located within the boundaries of the Capital Regional District;
- Is designed for the primary purpose and function of performing arts presentation;
- Attracts audiences from beyond its local area (i.e. has a regional draw);
- Functions as a roadhouse-style presentation venue that is available for bookings from a wide range of commercial and community user groups on a year-round basis;
- Is not embedded as part of an educational, religious, or for-profit organization; and
- Is owned and operated by a non-profit or local government (or combination thereof).

HOW

Function	Implementation	Financial / Service Implications
Plan	Planning Grants Program to support: feasibility plans, business plans, renovation or expansion plans, or construction plans. Maximum request amount = 50% of project expenses	Grants administered by CRD to non-profits or local governments. Annual program budget = $120,000/yr Unspent rolls into next year's budget.
Develop	1. Major Capital Access Program to support major capital projects (construction, expansion) and Minor Capital Grants Program (maintenance, accessibility). 2. Staff support for external grants to apply to provincial and federal funds.	$1,000,000/yr contribution toward growing reserve fund for major capital projects. Royal Theatre ($480,000) + McPherson Playhouse ($400,000) + Charlie White Theatre (TBD, ~$300,000) = $1,180,000 for existing minor capital expenses. Annual total budget = $2,180,000/yr
Fund	Operating Grants Program to existing RPAF at current or comparable level of existing contribution.	Royal Theatre ($100,000) + McPherson Playhouse ($350,000) + Charlie White Theatre (TBD,~$180,000) Annual program budget = $630,000/yr
Governance	CRD Board for first year. Reviewed and new committee or commission model could be proposed for some or all of service.	Depends on outcome of review.
CRD operations	1.2 FTE support in Arts and Culture division	Administers granting programs. $130,000/yr (with benefits).
		Total Requisition = $3,060,000
		Existing Requisition Included= $1,330,000
		Total New Fiscal Impact = $1,730,000

1.2 Organization Chart

Proposed staffing for both existing Arts and Culture Support Service and new Performing Arts Facilities Service (new required capacity in red).



Arts and Culture Division would require 1.2 net new FTE to deliver the Performing Arts Facilities Service:

- 0.2 FTE new capacity added to Administrative Assistant (currently at 0.8 FTE)
    - Rationale: higher volume of applications requires additional capacity for data input and processing, as well as secretariat support for committees and adjudications.
- 1.0 FTE new position – Program Officer
    - Rationale: four additional grant programs requires a dedicated program officer to support applicants, adjudication process, and evaluate outcomes, and to draft CRD applications for provincial and federal funding to major infrastructure programs in collaboration with local governments and/or non-profit clients.

The new Performing Arts Facilities Service will also receive staff support from existing roles in finance, information technology, corporate services, and other cross-departmental administrative areas.

1.3 Key Trends, Issues & Risks – Service Specific

A study commissioned by the Capital Regional District (CRD) Regional Arts Facilities Select Committee titled, *Stage One: A Public Conversation about Performing Arts Facilities in the CRD*, proposed a unified decision-making framework for planning, development and funding of regional performing arts facilities. The report highlighted the economic and social value of investing in the arts and confirmed community support for CRD funding and leadership with a priority on performing arts infrastructure.

Facilities and arts programming across the region are varied, with local, sub-regional services or inter- municipal agreements currently governing operational or capital funding. Municipalities and regions would need to be engaged to explore how existing and future states of arts facilities would be integrated into the new service. Specifically, Sidney and North Saanich would need to be consulted on how this service would affect their current inter-municipal arrangement to fund the Charlie White Theatre in the Mary Winspear Centre.

The COVID-19 virus and the corresponding Provincial Health Officer restrictions on events and gatherings has posed major challenges to the performing arts sector throughout 2020 and 2021. Many performing arts facilities have been completely closed or, if open, staged performances in limited ways. The COVID-19 pandemic has also spurred some performing arts organizations to innovate new methods of connecting to audiences online through upgraded livestreaming experiences and to retrofit or upgrade HVAC systems and other health-related infrastructure in their facilities.

Ticket sales at performing arts venues for shows in late 2021 and 2022 have been robust, showing strong renewed consumer demand for performing arts activities, although the level of this demand is clearly connected to trends in COVID-19 virus transmission at the local and provincial levels. According to recent studies, culture goers increasingly plan to return to indoor cultural events as soon as they have reopened with public health guidelines in place. Over 50% of culture goers said that vaccinated audiences are the main precaution necessary to make them feel comfortable in attending indoor cultural events.[1]

The Arts and Culture Support Service is guided by its 2020-2023 Strategic Plan, which is co-created with the arts community through consultations. The Performing Arts Facilities Service could have significant implications for the next round of strategic planning, but in the meantime is in alignment with and builds off of current Vision, Mission, Goals and Priorities.

1.4 Link to Board Strategic Priorities

The establishment of a regional performing arts facilities service is in fulfillment of Initiative 12a-1 of the *CRD 2019-2022 Corporate Plan*:

> "Facilitate a discussion of the region's art facility needs & explore partnerships to support 100% participation in the CRD arts function."

[1] Business in the Arts / Nanos. (June 2021). *Optimism for in-person activities continues to increase among culture-goers*, p. 8.

2 Services

2.1 Service Levels

	Service Level Adjustments in Role/Scope				
Service	**Base year**	**Year 1 (2023)**	**Year 2 (2024)**	**Year 3 (2025)**	**Year 4 (2026)**
Plan: Planning Grants Program		Design Planning Grants Program. Deliver pilot version.	Deliver Planning Grants Program.	Deliver Planning Grants Program.	Deliver Planning Grants Program.
Develop: Major Capital Access Program		Design Major Capital Access Program.	Deliver Major Capital Access Program.	Deliver Major Capital Access Program.	Deliver Major Capital Access Program.
Develop: Minor Capital Grants Program		Design Minor Capital Grants Program. Transition from current services funding Royal & McPherson.	Deliver Minor Capital Grants Program.	Deliver Minor Capital Grants Program.	Deliver Minor Capital Grants Program.
Fund: Operating Grants Program for Existing Facilities		Design Operating Grants Program. Transition from current services funding Royal & McPherson (2587 & 2685).	Deliver Operating Grants Program.	Deliver Operating Grants Program.	Deliver Operating Grants Program.
Committee Support	Provide support to Performing Arts Facilities Select Committee	Provide support to Performing Arts Facilities Select Committee for service development and CRD Board.	Provide support for governance review and potential to form new standing committee or commission.	Provide support to committee or commission responsible for oversight of service.	Provide support to committee or commission responsible for oversight of service.
Information Resource and Data Collection	Consultations, as necessary.	Privacy Impact Assessment conducted as part of grant program design.	Application form information and data collected by Arts and Culture Division.	Application form and final report information and data collected by Arts and Culture Division.	Application form and final report information and data collected by Arts and Culture Division.

2.2 Workforce Considerations

	Workforce (FTEs)				
Service	**Base year 2022**	**Year 1 (2023)**	**Year 2 (2024)**	**Year 3 (2025)**	**Year 4 (2026)**
Total	No change	1.2 FTE Total (1.0 FTE Program Officer 0.2 Admin Assistant)	1.2 FTE Total	1.2 FTE Total	1.2 FTE Total

3 Divisional Initiatives & Budget Implications

Title & Estimated Completion Date	Description	Priority	Budget Implications
2022			
Establish Service	Acting on Board direction to "begin the process of establishing a regional service for the purposes of planning, developing and funding of performing arts facilities that have regional impact." - Draft establishing bylaw and service plan. - Additional staff support for referendum from Legislative Services and Arts & Culture	12a-1	$504,000 (Feasibility Reserve Fund)
Approval Process	- Electoral approval process by region-wide referendum - Authorization by Inspector of Municipalities. - Bylaw comes into force.	n/a	TBD
Existing Bylaws Amended or Repealed	- Royal Theatre bylaws (2587, 2855) - McPherson Playhouse bylaws (2685, 3270)	n/a	Funding for Royal Theatre and McPherson Playhouse absorbed into new service, but still in effect for Budget 2022
Governance Review	- Governance Committee examines possible standing committee or commission models.	n/a	None
Programs Designed	-Draft program guidelines and application forms for Planning Grants, Major Capital Access Program, Minor Capital Grants Program, and Operating Grants.	n/a	None
CRD Board Oversees Establishment	- CRD Board establishes service parameters. ○ Reviews grant program design. ○ Reviews Budget 2023 allocations.	n/a	Service levels for Charlie White Theatre determined.
2023			
Planning Grants Program Launched	-1st intake for planning projects	n/a	$120,000 (core)

Title & Estimated Completion Date	Description	Priority	Budget Implications
Major Capital Access Program Launched	-1st intake for major capital projects	n/a	$1,000,000 contributed to Capital Access Reserve Fund (core)
Minor Capital Grants Program Launched	-1st intake for minor capital projects	n/a	Royal Theatre ($480,000) + McPherson Playhouse ($400,000) + Charlie White Theatre (TBD, $300,000 approx.) = $1,180,000 Total (core)
Operating Grants Program Launched	-1st intake for operating grants	n/a	Royal Theatre ($100,000) + McPherson Playhouse ($350,000) + Charlie White Theatre (TBD, $180,000 approx.) = $630,000 Total (core)
Staff Support	- Programs integrated into core budget - Program Officer (1.0 FTE) - Admin Assistant (0.2 FTE)	n/a	1.2 FTE $130,000 (core)
2024			
Programs Evaluated	- Full program review after 1st year of programs ○ Improvements recommended ○ Guidelines and application forms revised	n/a	None
Planning Grants Program Delivered	-2nd intake for planning projects	n/a	$120,000 (core)
Major Capital Access Program Launched	-2nd intake for major capital projects	n/a	$1,000,000 contributed to Capital Access Reserve Fund (core)
Minor Capital Grants Program Launched	-2nd intake for minor capital projects	n/a	Royal Theatre ($480,000) + McPherson Playhouse ($400,000) + Charlie White Theatre (TBD, $300,000 approx.) = $1,180,000 Total (core)
Operating Grants Program Launched	-2nd intake for operating grants	n/a	Royal Theatre ($100,000) + McPherson Playhouse ($350,000) + Charlie White Theatre (TBD, $180,000 approx.) = $630,000 Total (core)
Staff Support	- Program Officer (1.0 FTE) - Admin Assistant (0.2 FTE) - Supports committee and delivers programs	n/a	1.2 FTE $130,000 (core)

4 Goals & Performance Indicators

	Service Goals	Performance Indicators
2022	1. Design four new programs (guidelines and application form) 2.	1. Guidelines and application forms for new programs endorsed. Privacy Impact Assessment completed. 2. Funding levels established for Royal Theatre, McPherson Playhouse, and Charlie White Theatre in Minor Capital Grants and Operating Grants programs through Budget 2023 planning process.
2023	1. Merge existing Royal Theatre service and McPherson Playhouse service into new Performing Arts Facility Service. 2. Deliver four new programs • Planning Grants Program • Major Capital Access Program • Minor Capital Grants Program • Operating Grants Program	1. Consistent funding levels to Royal Theatre and McPherson Playhouse maintained with no disruption to funding support. 2. At least two applicants to Planning Grants Program.
2024	1. Deliver four programs.	1. Two or more applicants to Planning Grants Program. 2. Equal or greater number of applicants to other three programs.
2025	1. Deliver four programs.	1. Two or more applicants to Planning Grants Program. 2. Equal or greater number of applicants to other three programs.

Contact

Name: Chris Gilpin
Title: Manager, Arts and Culture Division
Contact information: 250.360.3205

Making a difference...together

REPORT TO REGIONAL PARKS COMMITTEE
MEETING OF WEDNESDAY, JANUARY 26, 2022

SUBJECT **Regional Parks – Strategic Plan Update**

ISSUE SUMMARY

To seek input and accept the proposed direction of the new Capital Regional District (CRD) Regional Parks Strategic Plan prior to seeking input from stakeholders, First Nations and the public.

BACKGROUND

The CRD Board initiated an update of the Regional Parks Strategic Plan at its meeting on December 8, 2021 and passed the following motion:

1. *That the Board extend the 2012-2021 Regional Parks Strategic Plan's term for eight months and that staff bring back an updated Strategic Plan for Board approval in July 2022.*
2. *And that a workshop of the Regional Parks Committee members be convened in January 2022 to provide input on the plan.*
3. *That staff report back at the January workshop with a list of proposed stakeholders for direct engagement.*
4. *That the committee request that staff, including the First Nations Relations division, engage all First Nations in the region in an early, meaningful and ongoing manner in the development of the plan.*

The development of the Regional Parks Strategic Plan 2012-2021 (Strategic Plan) was initiated in 2009 to replace the CRD Parks Master Plan that had been in effect since 2000. The development of the Strategic Plan was staff supported but primarily led by a volunteer Citizens Advisory Panel and included extensive engagement with stakeholders, the public, government, First Nations and other park agencies. The current Strategic Plan has been extended until July 2022 when an updated document will be brought forward.

The Strategic Plan continues to provide ongoing direction and remains useful as a “roadmap” for the Regional Parks Division, as many of the trends, challenges and priorities are still relevant today. A status review of strategic actions from the Strategic Plan is included as Appendix A. This review provides a benchmark from which to consider the direction of an updated Strategic Plan. There are 13 actions that have not started or are still being initiated and 13 actions that are developed.

The current planning context in the region has evolved since 2012 with the adoption of other CRD strategies and Board initiatives. Updating the Strategic Plan to reflect how these strategies relate to Regional Parks, as well as modernizing the format of the document, will improve its application to service delivery. This exercise will draw from corporate knowledge, First Nations and public engagement outcomes, and recent Board direction.

Components of the Strategic Plan update that would benefit from Committee and Board input are: the proposed vision, value and mission statements, key priorities, and potential targets. Staff have prepared a presentation outlining the Strategic Plan update context and framework (Appendix B).

Proposed key priority statements are included in more detail for the Board's consideration (Appendix C).

Engagement with First Nations, key stakeholders and the public will seek feedback on the proposed materials to be included in the Strategic Plan update. As requested, staff have prepared a list of stakeholder groups to be invited to participate in a series of focus groups (Appendix D).

ALTERNATIVES

Alternative 1

The Regional Parks Committee recommends to the Capital Regional District Board:
That the proposed vision, value and mission statements and proposed priorities be accepted for stakeholder, First Nations and public input.

Alternative 2

The Regional Parks Committee recommends to the Capital Regional District Board:
That the proposed vision, value and mission statements and proposed priorities, as amended, be accepted for stakeholder, First Nations and public input.

IMPLICATIONS

Alignment with Board & Corporate Priorities

Board priorities, approved plans, corporate priorities and established service mandates drive our work. Initiative 6a-1 in the 2019-2022 Corporate Plan directs staff to "Ensure appropriate funding for parks & trails infrastructure, improvements & maintenance by updating the Regional Parks Strategy with consideration to ecological, recreation & reconciliation principles, land acquisition capacity, & expanded partnerships with First Nations & parks user groups."

Alignment with Existing Plans & Strategies

An updated Strategic Plan will reflect outcomes that haven't already been considered in current CRD plans, reports and strategies, such as the Regional Growth Strategy, Climate Action Strategy, the Regional Transportation Plan, and the First Nations Task Force Report. These strategies have undergone extensive public engagement and have been endorsed by the CRD Board since the adoption of the 2012-21 Regional Parks Strategic Plan.

Intergovernmental Implications

The CRD's path toward reconciliation with Indigenous peoples commits to supporting First Nations' self-determination, shared prosperity and working together to take care of the land and water. First Nations in the region are invited to engage in the Regional Parks Strategic Plan update in an early, meaningful and ongoing manner to determine the key priorities and initiatives to work on together over the next five to ten years. Staff from CRD Regional Parks and First Nations Relations, with the support of a consultant, have sent letters to the Nations outlining the purpose of the Strategic Plan update and inviting participation to better understand the reconciliation objectives related to the Strategic Plan update and the priority initiatives of focus going forward. The updated Strategic Plan will support the CRD's commitment to reconciliation as a key priority and highlight opportunities for ongoing and meaningful engagement with First Nations on initiatives such as park management, ecosystem restoration, and shared prosperity.

Social Implications

Proposed values and key priorities to be included in the Strategic Plan include accessibility, equity and outdoor recreation opportunities that improve our health and well-being.

Stakeholder engagement will invite feedback on the Board's input for the vision, values, mission, issues and key priorities to be included in the Strategic Plan. A stakeholder engagement plan has been developed that establishes key interest groups and level of engagement. Staff have developed objective criteria for selecting key stakeholder groups to participate and provide feedback. Information sessions and an online survey will also be available for public input. Engagement is anticipated to occur between February and April 2022.

Environmental & Climate Implications

Resiliency and conservation are proposed as key priorities to be included in the Strategic Plan. Regional parks and trails are vital in helping to achieve the region's climate action, natural resource protection and active transportation goals.

Service Delivery Implications

Staff time has been allocated to update the Strategic Plan and conduct engagement. In this way, the Strategic Plan can be updated at minimal cost and with the least amount of delay between expiration of the existing plan and adoption of an updated plan.

Financial Implications

Costs associated with this Strategic Plan update will be covered by the Regional Parks 2022 core budget.

CONCLUSION

The 2012-2021 Regional Parks Strategic Plan expires in July 2022. The workshop of the Regional Parks Committee will provide input on the vision, values, mission, issues and priorities to be incorporated in the new Strategic Plan. Following the Board's approval, staff will seek stakeholder feedback and provide public engagement opportunities. First Nations in the region are invited to ongoing and meaningful engagement in the Strategic Plan. An updated plan will be presented to the CRD Board for consideration in July 2022.

RECOMMENDATION

The Regional Parks Committee recommends to the Capital Regional District Board:
That the proposed vision, value and mission statements and proposed priorities be accepted for stakeholder, First Nations and public input.

Submitted by:	Jeff Leahy, RPF, Senior Manager, Regional Parks
Concurrence:	Larisa Hutcheson, P.Eng., General Manager, Parks & Environmental Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENTS

Appendix A: Status Review
Appendix B: Presentation
Appendix C: Key Priority Statements
Appendix D: Stakeholder Engagement

APPENDIX A

2012-2021 REGIONAL PARKS STRATEGIC PLAN
STATUS OF STRATEGIC PRIORITIES

January 2022

X	I	D
Not started	Initiated	Developed

Strategic Priority	Strategic Action	Highlight			
1. Strengthen management of existing parks and trails	a. Upgrade, maintain, repair or replace major facilities.	X	I	D	Sustainable service delivery report cards; Asset management
	b. Cultivate partnerships, explore new approaches and adopt best management practices and technologies.	X	I	D	MBAC & Mtn Bike Guidelines; SIMBS & SBC agreements for trail stewardship; Dog management framework; CRISP involvement
	c. Explore opportunities for generating non-tax revenue.	X	I	D	Revenue strategy presented March 10, 2021
	d. Complete or update park and trail management plans for priority parks and trails.	X	I	D	Prioritization of park management plans presented; 19 parks have park management plans, 16 parks without, 9 parks needing review
	e. Complete ecological inventories and conservation plans for priority parks and address priority conservation issues.	X	I	D	Funding secured for Species at Risk inventories; 15 research permits issued/year supporting academic and community projects
	f. Collaborate on the development of a natural area connectivity plan.	X	I	D	Land evaluation project underway; Engagement completed
	g. Complete asset, maintenance and operation plans.	X	I	D	Initiated Management Plan implementation process; Prepare annual operating plans; Conduct criticality assessment of park assets

Strategic Priority	Strategic Action	Highlight			
	h. Develop an environmental education plan & provide leadership in review of interpretive facilities in the region.	X	I	D	Resources not currently in place
	i. Develop an outdoor recreation strategy.	X	I	D	Recreation specialist position created in 2020
2. Strategically plan for and open existing land banked parks and trails as resources are approved	a. Develop a park and trail opening strategy.	X	I	D	Approx. 1,600 ha park land acquired since 2010; 3 new parks (Sooke River, St. John Point, Mountain Rd) plus additions to existing parks
	b. Continue construction of the E&N Rail Trail.	X	I	D	Phase 3 complete; Phase 4 underway; Phase 5 subject to route & funding
	c. In partnership with other public agencies, local government and private landowners, initiate planning for the regional trails system on Salt Spring Island and the Southern Gulf Islands.	X	I	D	Gulf Islands Regional Trails Plan adopted 2018; Mayne Island Regional Trail Phase 1 construction
3. Strengthen community involvement, education and partnerships	a. Engage the community by providing volunteer & educational experiences for people, including youth and families, to discover, learn about, protect and restore parks and trails.	X	I	D	Cultural Programmer position established 2020; Volunteer Steward program continuing; 280 programs delivered annually; 90% programs target all ages

Strategic Priority	Strategic Action	Highlight			
	b. Foster and initiate partnerships and expand volunteer opportunities.	X	I	D	CRISP and Partners in Parks agreements to remove invasive species; SIMBS & SBC agreements for Mtn Bike trails
	c. Integrate First Nations interests into planning for, and management and stewardship of, regional parks and trails.	X	I	D	Traditional Use Agreements; Sooke Potholes campground operating agreement; MOU with WSANEC
	d. Undertake a visitor use survey.	X	I	D	Visitor use surveys conducted on rotating bases; completed in 2018, 2019, 2021 in 17 regional parks & 3 regional trails
	e. Undertake a survey of residents.	X	I	D	Resident surveys conducted on rotating basis; 2017 completed, 2022 proposed
4. Prepare for future land acquisitions	a. In partnership with other CRD departments, First Nations and the federal and provincial governments, prepare a sensitive ecosystem inventory for land west of the Sooke River.	X	I	D	Land Evaluation project initiated; Public engagement completed 2019.
	b. Prepare a land acquisition strategy and examine acquisition options to achieve the future regional parks and trails system.	X	I	D	Extension of land acquisition fund to 2029 approved

Strategic Priority	Strategic Action	Highlight			
	c. Prepare a boundary rationalization plan for recent acquisitions prior to park dedication and declare land that does not have regional park or trail value as surplus and sell these lands. Proceeds from the sale of the surplus lands would be used for further park or trail acquisitions.	X	I	D	Surplus lands identified at time of acquisition; 26 ha land not suitable for park disposed
5. Promote the health benefits of regional parks and trails	a. Partner with other levels of government and health agencies to promote the health benefits of regional parks and trails to the community.	X	I	D	MOU established with MOTI to co-manage Galloping Goose Regional Trail; participate annually in events (e.g., Bike to Work week)
	b. Undertake a study on the natural capital value of regional park land.	X	I	D	Not started
	c. Focus programs on engaging youth and families in park activities.			D	90% events target families and youth
	d. Provide more accessible opportunities for people of all ages and abilities to connect with nature.		I		Regional Trails Widening Study completed; Accessibility study not started
6. Engage in planning for regional sustainability	a. Bring forward, as part of the process to prepare the Regional Sustainability Strategy, the discussion of the concept that at least half of the region's land base should be managed for nature conservation.	X	I	D	Regional Growth Strategy adopted 2018

Strategic Priority	Strategic Action	Highlight			
	b. Partner with CRD Regional Planning to advance Regional Parks' interests into planning for regional sustainability.	X	I	D	Regional trails identified as key active transportation priority; Regional park interests to be identified in municipal OCP regional context statements

APPENDIX B

Regional Parks Strategic Plan Update 2022



Strategic Planning Workshop January 26, 2022
Regional Parks Committee

Session Outline

Regional Parks Strategic Planning Workshop

1. Current Context
2. Planning Context
3. Engagement
4. Setting Direction
5. Priority Statements
6. Facilitated Discussion

Status Review 2012-21

- Strengthen management of existing parks & trails
- Plan for and open land banked parks & trails
- Strengthen community involvement, education & partnerships
- Promote health benefits
- Engage in planning for regional sustainability





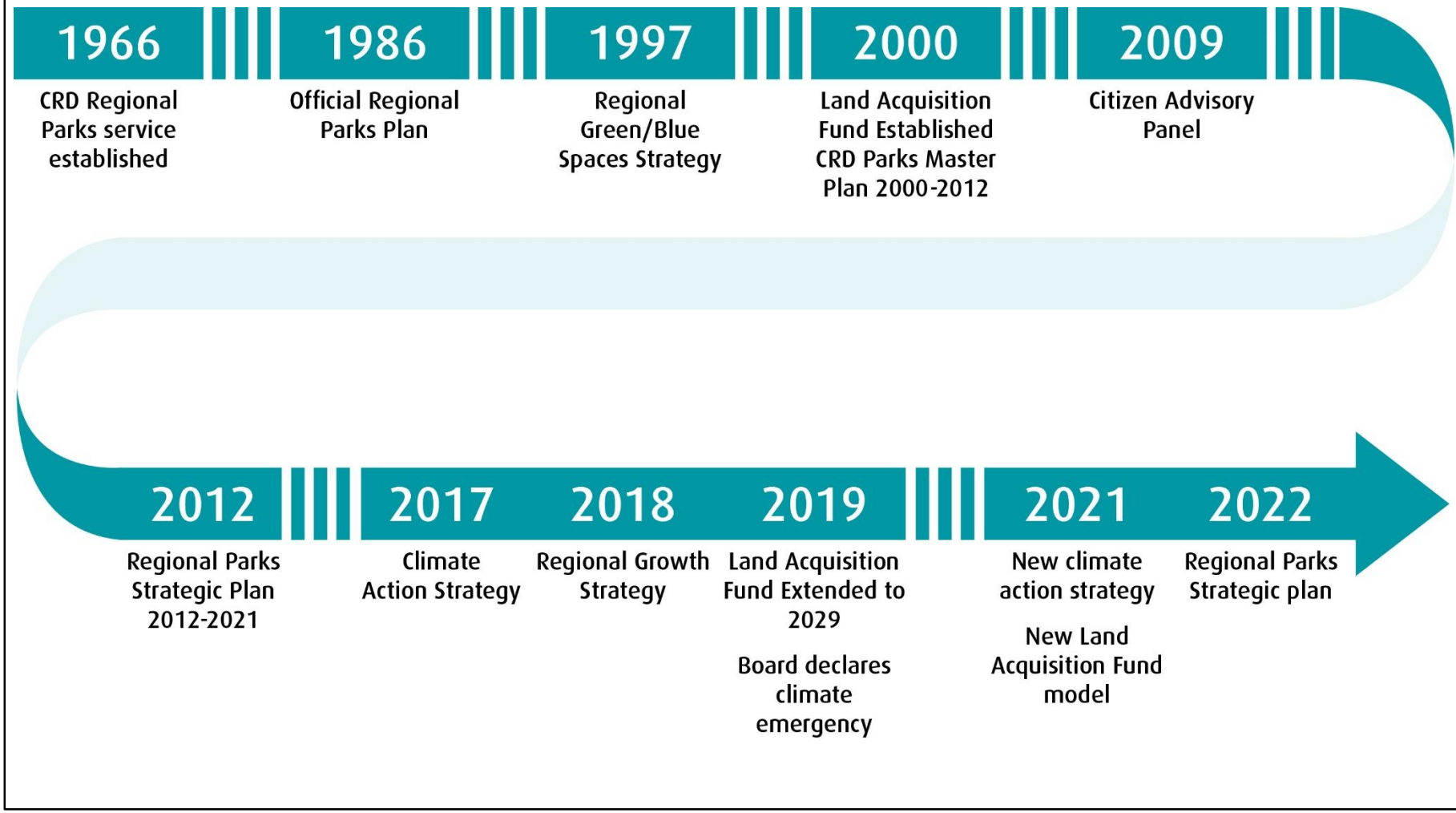


Current Context

Regional Parks Classification



Current Context



Planning Context

Strategic Plan – how we consistently make core directional choices to move the organization towards our hoped-for future

Vision – the preferred future state

Mission – what service is provided & why

Values/Principles – what is important, core beliefs

Context – setting, trends & issues

Priorities – goals, aspirations, desired outcomes

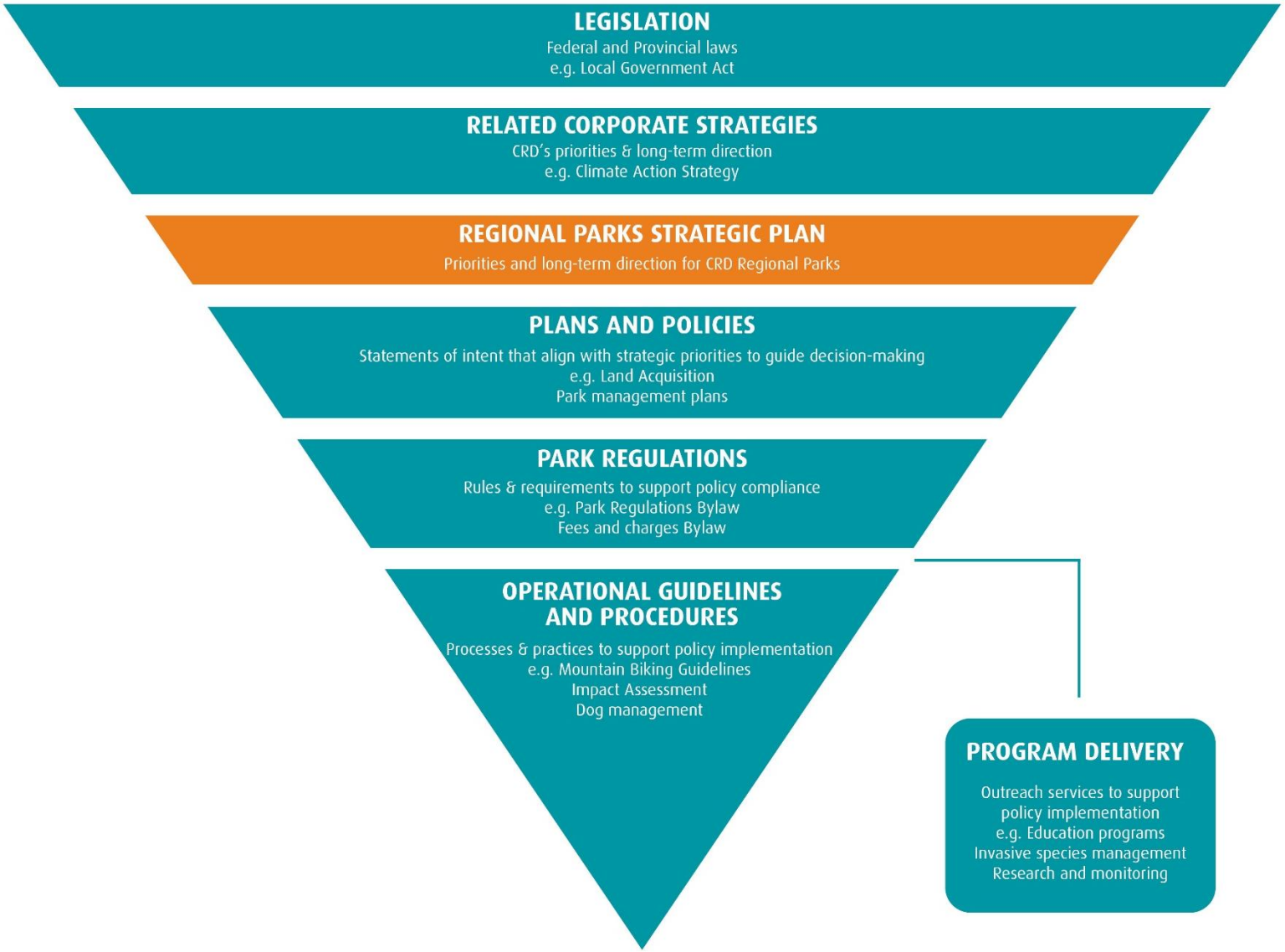
Initiatives – objectives or actions involved to achieve the results

Targets – measure success for monitoring and reporting

Planning Context



Planning Context



Engagement

Who	What level	When	How
Regional Parks Committee & Board	Decision-maker	January – July 2022	Workshop Meeting
First Nations	Collaborate	Ongoing	Invitation letter Meetings
Key Stakeholders	Involve	February – March	Focus groups
Public	Consult	March – April	Information sessions Survey polls Website Media

Vision 2032

A legacy of regional parks and trails for conservation and outdoor recreation.



Setting Direction

Mission



Secure a diverse and connected system of regional parks and trails that protect and restore the integrity of our region's biodiversity and cultural landscapes.



Provide access to regional parks and trails that facilitates healthy, safe and enjoyable outdoor recreation experiences for all.



Foster stewardship of ecological and cultural resources by informing, engaging and collaborating with the public, volunteers, partners, and First Nations.



Work with First Nations in taking care of the land and water.



Ensure regional parks and trails are resilient by delivering a sustainable service that is adaptable and takes action on climate change.

Setting Direction

Values and Principles



Equity – We work together to ensure regional parks and trails are inclusive and maintained as a common good



Accessibility – We provide access to nature for all ages and abilities



Conservation – We work together to protect, restore and celebrate the region's natural and cultural landscapes



Recreation – We offer outdoor recreation experiences that improve our health and well-being



Reconciliation – We are committed to work towards reconciliation with First Nations



Resiliency – We take action on climate change by being adaptive and using resources sustainably with a view to benefiting future generations

Key Trends and Issues

- Changes to the system
- Changes to Regional development
- Changes to recreational use
- Sustainable service delivery
- First Nations reconciliation
- Demographic changes
- Human disturbance
- Ecological integrity
- Listed species
- Climate change
- Monitoring and research
- Events
- Volunteerism
- Ecological integrity

Priority Statements

Conservation & Recreation

- Conserve biodiversity
- Enable outdoor recreation
- Work with partners
- Foster stewardship
- Balance conservation & recreation



Access & Equity

- Enhance health & well-being
- Promote complete and connected communities
- Ensure economic fairness
- Accessibility & equity lens



Priority Statements

Climate Action & Resiliency

- Align sustainable service delivery with climate action
- Advance regional active transportation
- Develop partnerships
- Acquire and manage natural areas



Reconciliation

- Incorporate First Nations reconciliation objectives
- Provide space for cultural use
- Strengthen engagement
- Support shared prosperity



Facilitated Discussion

- Does the Committee accept the proposed vision, value and mission statements?
- Does the Committee accept the proposed strategic priorities?
- What types of targets is the Committee interested in achieving? For which priorities?

UPDATED APPENDIX B: Presentation (Feb 9, 2022)

Regional Parks Strategic Plan Update 2022



Strategic Planning Workshop February 9, 2022
Capital Regional District Board

Session Outline

Regional Parks Strategic Planning Workshop

1. Current Context
2. Planning Context
3. Engagement
4. Setting Direction
5. Priority Statements
6. Facilitated Discussion

Status Review 2012-21

- Strengthen management of existing parks & trails
- Plan for and open land banked parks & trails
- Strengthen community involvement, education & partnerships
- Promote health benefits
- Engage in planning for regional sustainability





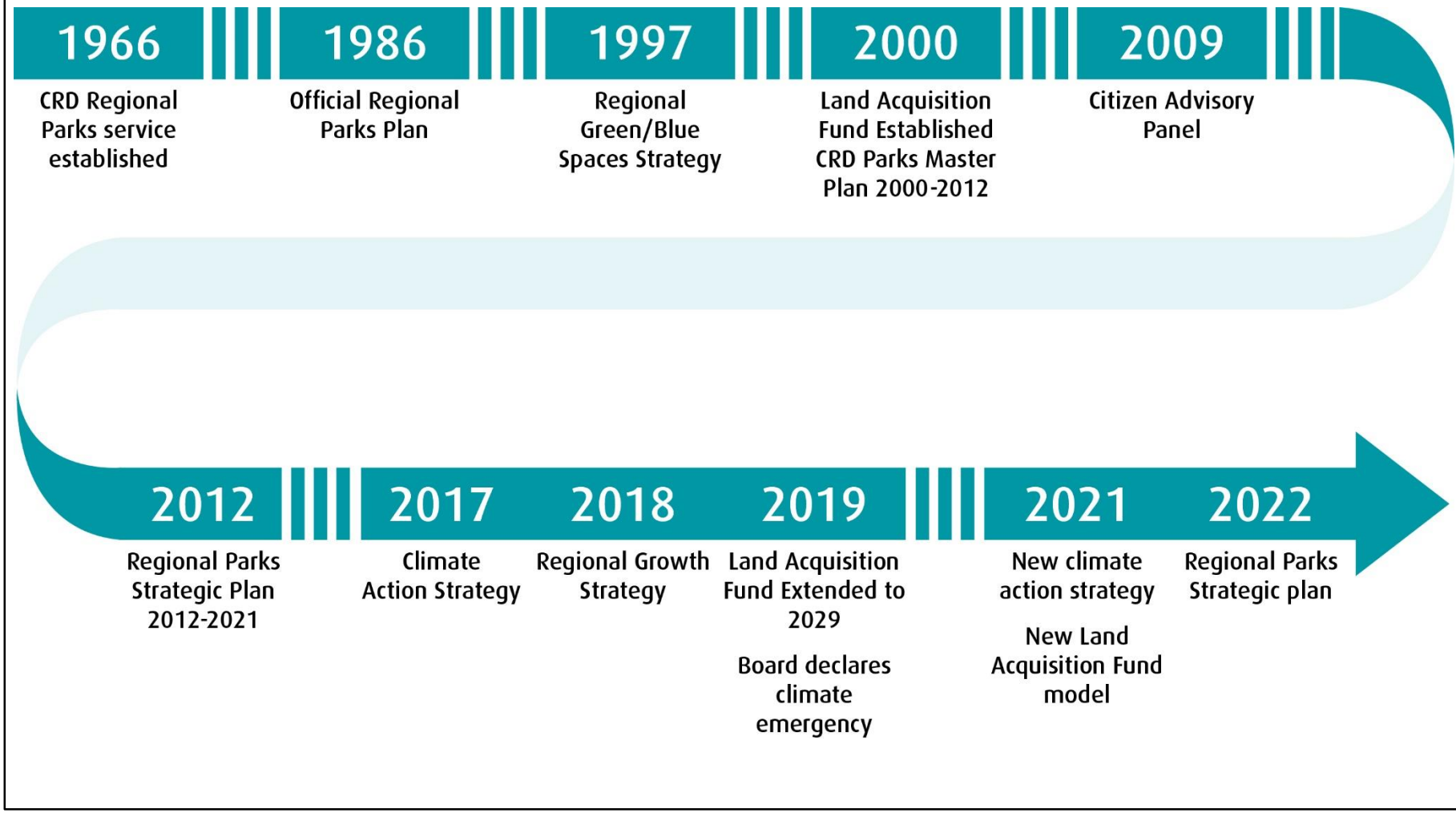


Current Context

Regional Parks Classification



Current Context



Planning Context

Strategic Plan – how we consistently make core directional choices to move the organization towards our hoped-for future

Vision – the preferred future state

Mission – what service is provided & why

Values/Principles – what is important, core beliefs

Context – setting, trends & issues

Priorities – goals, aspirations, desired outcomes

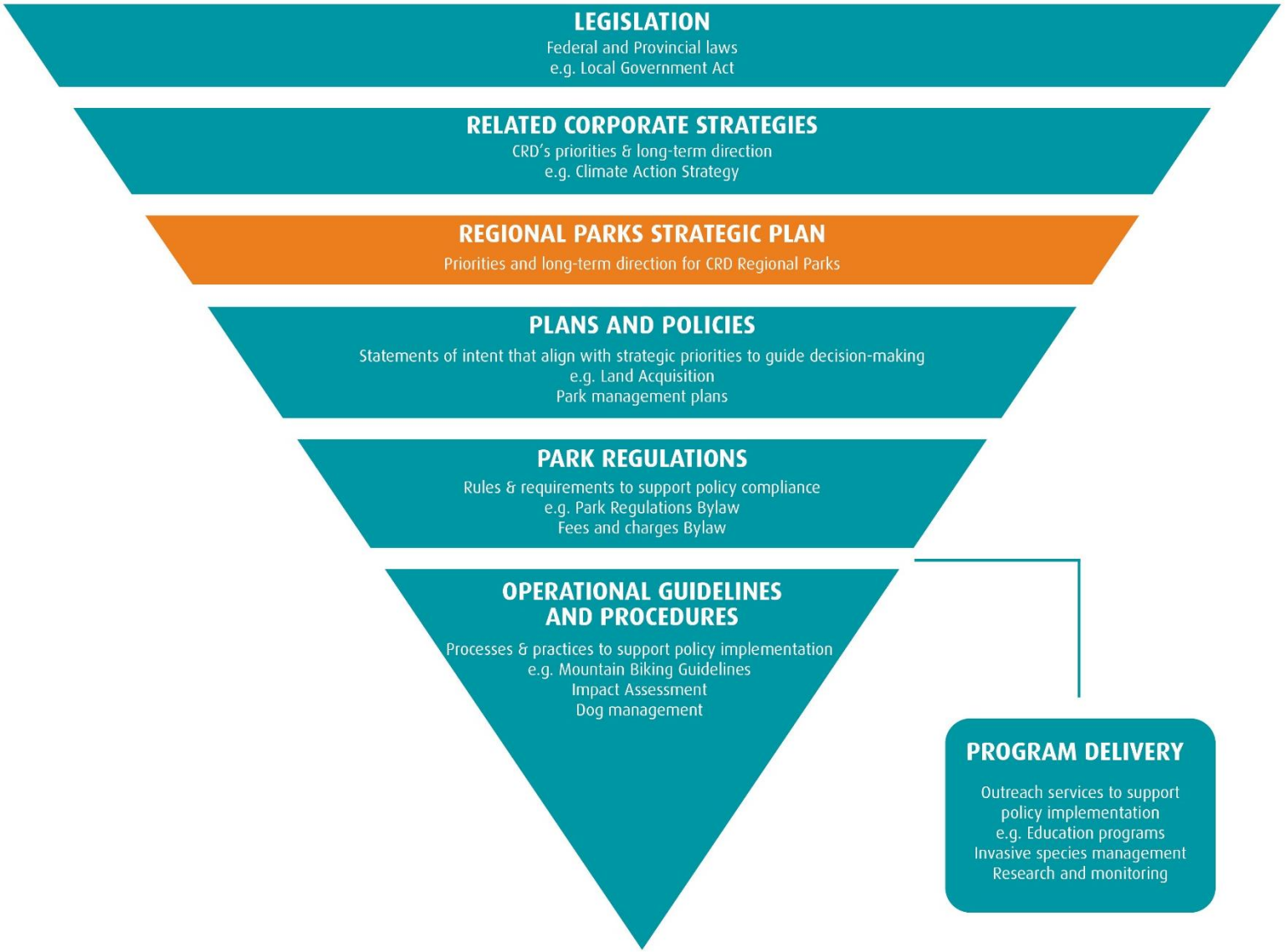
Initiatives – objectives or actions involved to achieve the results

Targets – measure success for monitoring and reporting

Planning Context



Planning Context



Engagement

Who	What level	When	How
Regional Parks Committee & Board	Decision-maker	January – July 2022	Workshop Meeting
First Nations	Collaborate	Ongoing	Invitation letter Meetings
Key Stakeholders	Involve	February – March	Focus groups
Public	Consult	March – April	Information sessions Survey polls Website Media

Vision 2032

A legacy of regional parks and trails for conservation and outdoor recreation.



Setting Direction

Mission



Ensure regional parks and trails are resilient by delivering a sustainable service that is adaptable and takes action on climate change.



Foster stewardship of ecological and cultural resources by informing, engaging and collaborating with the public, volunteers, partners, and First Nations.



Provide access to regional parks and trails that facilitates healthy, safe and enjoyable outdoor recreation experiences for all.



Secure a diverse and connected system of regional parks and trails that protect and restore the integrity of our region's biodiversity and cultural landscapes.



Work with First Nations in taking care of the land and water.

Values and Principles



Accessibility – We provide access to nature for all ages and abilities



Conservation – We work together to protect, restore and celebrate the region's natural and cultural landscapes



Equity – We work together to ensure regional parks and trails are inclusive and maintained as a common good



Reconciliation – We are committed to work towards reconciliation with First Nations



Recreation – We offer outdoor recreation experiences that improve our health and well-being



Resiliency – We take action on climate change by being adaptive and using resources sustainably with a view to benefiting future generations

Key Trends and Issues

- Changes to the system
- Changes to Regional development
- Changes to recreational use
- Sustainable service delivery
- First Nations reconciliation
- Demographic changes
- Human disturbance
- Ecological integrity
- Listed species
- Climate change
- Monitoring and research
- Events
- Volunteerism
- Ecological integrity

Priority Statements

Conservation & Recreation

- Conserve biodiversity
- Enable outdoor recreation
- Work with partners
- Foster stewardship
- Balance conservation & recreation



Access & Equity

- Enhance health & well-being
- Promote complete and connected communities
- Ensure economic fairness
- Accessibility & equity lens



Priority Statements

Climate Action & Resiliency

- Align sustainable service delivery with climate action
- Advance regional active transportation
- Develop partnerships
- Acquire and manage natural areas



Reconciliation

- Incorporate First Nations reconciliation objectives
- Provide space for cultural use
- Strengthen engagement
- Support shared prosperity



Facilitated Discussion

- Does the Committee accept the proposed vision, value and mission statements?
- Does the Committee accept the proposed strategic priorities?
- What types of targets is the Committee interested in achieving? For which priorities?

APPENDIX C

KEY PRIORITY STATEMENTS
REGIONAL PARKS STRATEGIC PLAN

January 2022

Conservation & Recreation

- Take action to conserve biodiversity through acquiring land, restoration and monitoring of ecosystems across the region (UN; LAS; RGS, 2.1; RPSP, p.9)
- Enable users to recreate and have outdoor recreation experiences that are enjoyable, safe and compatible (RPSP, p.9 & 12)
- Work with partners in taking care of the land and water and providing sustainable outdoor recreation (Board, #6d & #6b-1 & #6b-2; RPSP, p.10; LAS)
- Foster stewardship through program delivery, knowledge sharing and leading by example (RPSP, p.10)
- Strengthen the balance between conservation and recreation in service delivery (LAS; RPSP, p.9 & 10)

Access & Equity

- Enhance health and well-being by providing nature and outdoor recreation experiences for all ages and abilities (Board, #6e; RPSP, p.9)
- Promote complete and connected communities by ensuring recreation, parks and green space can be easily accessed by transit, walking or cycling (RGS, 3.1 & 4.1; RPSP, p.9)
- Ensure economic fairness by managing regional parks and trails as a common good (RGS 5.1; Revenue, p.4)
- Strengthen an accessibility and equity lens in service delivery

Climate Action & Resiliency

- Align sustainable service delivery and infrastructure improvements with climate action (RGS 7.1; CAS, 1.1 & 5.1; RPSP)
- Advance regional active transportation opportunities that contribute to greenhouse gas reduction (CAS, 3.7; RPSP; RGS, 4)
- Develop partnerships for the long-term consistent and connected management of green space and ecosystem services (RPSP; Board, #5a-5).
- Strategically acquire and manage natural areas to address climate mitigation, urban containment and access to green space for a growing population (RGS 7.1, CAS, 5.1; RPSP)

Reconciliation

- Incorporate First Nation worldviews, knowledge and reconciliation objectives in the management of natural assets and cultural heritage (Board, #3a-3 & #6d; RPSP; FNSR; RNTF, p.44-45)
- Provide space for cultural and ceremonial use, food and medicine harvesting, traditional management practices and reclaiming Indigenous place names (Board, #3a-3 & #6d; RPSP; FNSR; FNTF, p.44-45)
- Strengthen engagement with First Nations in service delivery initiatives (Board, #3a-3 & #6d; RPSP; FNSR; FNTF, p.44-45; LAS)

- Seek partnerships, share information and deliver fair and equitable services in working with First Nations on achieving their economic goals (Board, #3a-3 & #6d; RPSP; FNSR; FNTF, p.44-45)

Reference Abbreviations:

Board	Capital Regional District 2019-2021 Board Priorities
CAS	Climate Action Strategy 2021
FNSR	First Nations Statement of Reconciliation
FNTF	First Nations Task Force Final Report, 2018
LAS	Land Acquisition Strategy 2020-2021
RGS	Regional Growth Strategy (RGS), Bylaw No. 4017, 2018
RPSP	Regional Parks Strategic Plan (RPSP) 2012-2021
Revenue	Draft Revenue Generation Strategy, 2021
UN	United Nations Decade on Ecosystem Restoration 2021-2030

APPENDIX D

STAKEHOLDER ENGAGEMENT
REGIONAL PARKS STRATEGIC PLAN

January 2022

Scope

The Regional Parks Committee and Capital Regional District (CRD) Board will provide input to support development of a new Strategic Plan. This input will provide direction for a vision, value and mission statements, trends and issues, and key priorities. The Regional Parks Strategic Plan will also be developed based on current CRD Board priorities and high-level CRD strategies.

Following Committee and Board input, staff will seek to involve stakeholders and provide public consultation opportunities.

The goal of stakeholder engagement is to receive feedback from stakeholders on the proposed vision, values, mission, issues, and key priorities to be considered in the CRD Regional Parks Strategic Plan update.

Feedback received through the engagement process will be analyzed and considered in the updated Strategic Plan, which will be presented to the Board in July 2022.

Once approved, the updated Regional Parks Strategic Plan will set a long-term vision, define priorities and guide future decisions but will not prescribe outcomes of future financial planning and management planning processes.

This engagement process will not focus on specific regional parks and/or trails and/or topics. Other mechanisms are in place for such discussion, such as the park management plan process.

Engagement Methods

Key stakeholders will be invited to participate in one of four focus groups to provide feedback on the proposed vision, values, mission, issues and key priorities to be included in the Strategic Plan update.

A diversity of perspectives and experiences will be sought for participation in each focus group. Each focus group will include 18-20 participants representing different stakeholder interest groups. Overall, approximately 80 stakeholder groups from the region will be invited to participate.

Targeted emails/phone calls will be used to invite stakeholders to the focus groups. Through the invitation, staff will explain the purpose of the focus group and request confirmation of interest to participate. If no interest is expressed, other stakeholder groups representing a similar interest will be invited to participate to ensure representativeness in opinion across groups participating to the focus groups.

The focus groups will last approximately two hours and be offered in-person and/or virtually. In-person engagement will be developed only if in line with the CRD communicable disease plan and will include a safety plan to minimize risk of exposures.

The focus group sessions will be taped for later analysis and review by staff. The results of the focus group sessions will be used to inform further public engagement, to update the Strategic Plan, and will be provided to the Regional Parks Committee and Board for consideration.

Focus groups are an ideal participation methodology to involve stakeholders in providing feedback on a defined topic through facilitated discussion. Participants are encouraged to engage on topics as well as to respond to and reflect on narratives conveyed by other participants in the group.

Selection Criteria

Staff developed objective criteria to select key stakeholders for participation in the focus groups from a master stakeholder list compiled by Regional Parks. The master stakeholder list is updated by staff based on local knowledge, previous contacts, past participation in engagement activities, referrals, and general interest inquiries. The master stakeholder list currently identifies approximately 240 stakeholder groups in the CRD, British Columbia and Canada potentially interested in CRD Regional Parks management and projects. The criteria have been successfully used by Regional Parks to engage a diversity of stakeholder groups in previous engagement processes, including recently the Mountain Biking Advisory Committee and the Land Evaluation project.

The following selection criteria were applied to evaluate the suitability of stakeholder groups for direct engagement in the Strategic Plan update:

- Being located in the CRD (yes=1 or no= 0);
- Representing a broad outdoor recreation, conservation/nature and/or cultural/social interest (yes=2 or no= 0);
- Having knowledge and experience with CRD Regional Parks (yes=2 or no= 0);
- Having an interest and experience in working in multi-stakeholder groups (yes=1 or no= 0);
- Self-identifying as a First Nation (yes=1 or no= 0);

Based on the above criteria, a total of 80 stakeholder groups having a score between 5 and 7 were identified for direct engagement in the Strategic Plan update. Three broad categories of stakeholder groups to be invited to participate in the focus groups have been identified, as follows: cultural/social interests, conservation interests and outdoor recreation interests (table 3). A balance of stakeholders from each category will be invited to each focus group to promote a diversity of perspectives in the discussion.

A snowball technique will be also used to expand the list of possible interest groups. Snowball sampling is a recruitment technique in which invited stakeholders are asked to assist in identifying other potential subjects that may have been missed from initial screening. The same criteria used to select the initial stakeholders will be applied to potential subjects for consistency in selection.

Cultural/Social Interests	Stakeholder Group
Economic	• Greater Victoria Chamber of Commerce • Tourism Victoria • Urban Development Institute • Tourism Association Vancouver Island
Community	• Greater Victoria Placemaking Network • Creating Community Wellness Society • South Island Prosperity Project • Parks and Recreation Foundation Victoria • Metchosin Foundation • Victoria Foundation • Community Social Planning Council
Education	• Royal BC Museum • YMCA-YWCA of Vancouver Island • Shaw Centre for the Salish Sea
Accessibility & Equity	• Victoria Disability Resource Centre • Community Living Victoria • SPARC BC • Power To Be
Youth & Family	• Post-secondary Student Societies • Family Services of Greater Victoria

Conservation	Stakeholder Group
Nature Stewardship	• Victoria Natural History Society • Gorge Waterway Action Society (GWAS) • Swan Lake Christmas Hill Nature Sanctuary • Raincoast Conservation Foundation • Pacific Wild Alliance • Saltspring Island Conservancy • Galiano Conservancy Association
Land Stewardship	• Greater Victoria Greenbelt Society • Habitat Acquisition Trust (HAT) • The Land Conservancy (TLC) • Ancient Forest Alliance • Land Trust Alliance of British Columbia
Wildlife	• Juan de Fuca Salmon Restoration Society • SeaChange Conservation Society • Wilderness Committee • Peninsula Streams Society • Rocky Point Bird Observatory • World Fisheries Trust • Watershed Watch Salmon Society • Coexistence with Carnivore Alliance
Invasive Species	• Coastal Invasive Species Committee

Experts	• University of Victoria • Camosun College • Royal Roads University • Vancouver Island University • University of British Columbia

Outdoor Recreation	**Stakeholder Group**
Rock Climbing	• South Island Climbing Association (SICA) • Climbers' Access Society of British Columbia
Hiking & Running	• Southern Vancouver Island Nature Trails Society • Alpine Club of Canada • Vancouver Island Trail Association • Kludahk Outdoors Club • Juan de Fuca Community Trails Association • RunVictoria • Outdoor Club of Victoria • Victoria Club Tread
Geocaching & Orienteering	• Victoria Orienteering Club
Horse Riding	• Backcountry Horsemen of BC - South Vancouver Island • Capital Regional Equestrians • Elk Beaver Lake Equestrian Society
Dog Walkers and Associations	• Capital Region Association of Dog Walkers • Citizen Canine Dog Owners Association
Mountain Biking & Cycling	• Sooke Bike Club • South Island Mountain Biking Society (SIMBS) • Dirtys Girlz Bike Club • Greater Victoria Cycling Coalition • Wheelhouse Cycling Society
Water Sports	• Surfrider Foundation Vancouver Island • Victoria City Rowing Club • Rowing BC • Freshwater Fisheries Society of BC • Amalgamated Conservation Society • Diving Industry of Victoria Association • South Island Sea Kayaking Association • Victoria Canoe and Kayak Club (VCKC)
Youth & Community	• Victoria Youth Paddling Club • Greater Victoria Youth Rowing Society • KidSport • YMCA/YWCA Vancouver Island • Outdoor Recreation Council of BC

Making a difference...together

REPORT TO CAPITAL REGIONAL DISTRICT BOARD
MEETING OF WEDNESDAY, FEBRUARY 09, 2022

SUBJECT **Regional Parks – Strategic Plan Vision Statement**

ISSUE SUMMARY

To seek input and accept a proposed vision statement for the new Capital Regional District (CRD) Regional Parks Strategic Plan prior to seeking input from stakeholders, First Nations and the public.

BACKGROUND

The Regional Parks Committee met on January 26, 2022 to provide input and accept the proposed direction of the new CRD Regional Parks Strategic Plan. A proposed vision, mission, values and priority statements were presented and deliberated.

The proposed vision statement, "A legacy of regional parks and trails for conservation and outdoor recreation" was not accepted by the Regional Parks Committee at the January 26 meeting. Instead, the Committee moved the following motion arising:

> *That we refer the vision statement back to staff for further revision and have it presented as an option at the February Board meeting with this report.*

Discussion around the proposed vision statement by the Regional Parks Committee focused on having a more ambitious, forward-looking vision. Staff have prepared three proposed vision statements that incorporate the feedback from the Regional Parks Committee, as well as reflect language from vision statements in other CRD strategies, that relate to the future of the Regional Parks' service.

ALTERNATIVES

Alternative 1

That the following proposed vision statement be accepted for the new CRD Regional Parks Strategic Plan prior to seeking input from stakeholders, First Nations and the public:
We work cooperatively and respectfully to steward and expand an exceptional system of regional parks and trails that is rich in biodiversity and cultural heritage, resilient to change, connects people to nature and provides healthy outdoor experiences for all.

Alternative 2

That the following proposed vision statement be accepted for the new CRD Regional Parks Strategic Plan prior to seeking input from stakeholders, First Nations and the public:
We enjoy access to a resilient system of natural parks and trails that protect the region's biodiversity, respects culturally significant landscapes and offers compatible outdoor recreation experiences for current and future generations.

Alternative 3

That the following proposed vision statement be accepted for the new CRD Regional Parks Strategic Plan prior to seeking input from stakeholders, First Nations and the public:
We inspire people to discover, explore and experience nature through collaborative stewardship of our natural and cultural heritage.

Alternative 4

That this report be referred back to staff for additional information.

IMPLICATIONS

Environmental & Climate Implications

The proposed vision statement for the new Regional Parks Strategic Plan aligns with the Climate Action Strategy vision statement, which reads: "Through collective action, we eliminate emissions and foster healthy and resilient communities and natural areas now and in the future."

Intergovernmental Implications

The proposed vision statement for the new Regional Parks Strategic Plan supports the CRD's commitment to reconciliation with First Nations in the region.

Regional Growth Strategy Implications

The proposed vision statement for the new Regional Parks Strategic Plan aligns with the Regional Growth Strategy vision statement, which reads: "In 2038, Capital Regional District residents enjoy a healthy and rewarding quality of life. We have a vital economy, livable communities and steward our environment and natural resources with care. Our choices reflect our commitment to collective action on climate change."

Alignment with Board & Corporate Priorities

The proposed vision statement for the new Regional Parks Strategic Plan complements the CRD's corporate vision, as follows: "Our communities strive to achieve exemplary environmental stewardship, a dynamic vibrant economy and an inclusive, caring society. Regional cooperation, mutually beneficial decision making and advancing shared interests shape the essence of the CRD."

CONCLUSION

The Regional Parks Committee met on January 26, 2022 to provide input on the vision, values, mission, issues and priorities to be incorporated in the new Regional Parks Strategic Plan. The Committee referred the proposed vision statement back to staff for further revision and to be presented as an option, or options, for consideration by the CRD Board prior to seeking input from stakeholders, First Nations and the public. Staff have prepared proposed vision statements that incorporate the feedback from the Regional Parks Committee, as well as reflect language from

vision statements in other CRD strategies, that relate to the future of the Regional Parks' service.

RECOMMENDATION

That the following proposed vision statement be accepted for the new CRD Regional Parks Strategic Plan prior to seeking input from stakeholders, First Nations and the public:
We work cooperatively and respectfully to steward and expand an exceptional system of regional parks and trails that is rich in biodiversity and cultural heritage, resilient to change, connects people to nature and provides healthy outdoor experiences for all.

Submitted by:	Jeff Leahy, RPF, Senior Manager, Regional Parks
Concurrence:	Larisa Hutcheson, P. Eng., General Manager, Parks & Environmental Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

CAPITAL REGIONAL DISTRICT
BYLAW NO. 4085

****

A BYLAW TO AMEND THE SALT SPRING ISLAND LIQUID WASTE COLLECTION, CONVEYANCE, TREATMENT AND DISPOSAL SERVICE (BYLAW NO. 2118)

****

WHEREAS:

A. Under Bylaw No. 2118, "Salt Spring Island Liquid Waste Disposal Additional Local Service Establishment Bylaw No. 1, 1993", the Regional Board established a service to collect, treat, and dispose of septage and sewage sludge, and co-compost septage and sewage sludge with wood waste;

B. Salt Spring Island has fats, oils, greases; animal and agricultural liquid wastes; and organic materials from other on-island sources that would be beneficial sources of feedstock for existing and planned composting works associated with the service, and would assist with generating a usable community compost product;

C. The Salt Spring Island Farmland Trust are providing lands for the purposes of composting under Bylaw No. 2118, and the Salt Spring Island Abattoir Society desires to operate the composting portion of the service for animal, farm, and organic liquid waste and organic solids by way of a service agreement, which would divert certain liquid wastes from the existing facilities;

D. The Electoral Area Director has consented in writing to this change pursuant to sections 347(2) and 349 of the *Local Government Act*, RSBC 2015 c 1;

E. The Board wishes to amend Bylaw No. 2118 to ensure liquid wastes can be composted with organics and the service may be operated by service of contribution agreement;

NOW THEREFORE, the Capital Regional District Board in open meeting assembled hereby enacts as follows:

1. Bylaw No. 2118, "Salt Spring Island Liquid Waste Disposal Additional Local Service Establishment Bylaw No. 1, 1993" is hereby amended as follows:

    (a) By replacing "wood waste" wherever it appears in the bylaw with "organics";

    (b) By renumbering the existing section 7 as section 8 and inserting as section 7 the following:

        7. The Capital Regional District may enter into one or more service or contribution agreements with third parties, including non-profit societies, to deliver, provide, or operate the service.

2. This bylaw may be cited for all purposes as “Salt Spring Island Liquid Waste Disposal Additional Local Service Establishment Bylaw No. 1, 1993, Amendment Bylaw No. 3, 2021”.

READ A FIRST TIME THIS	10th	day of	November	2021
READ A SECOND TIME THIS	10th	day of	November	2021
READ A THIRD TIME THIS	10th	day of	November	2021
APPROVED BY THE ELECTORAL AREA DIRECTOR THIS	17th	day of	November	2021
APPROVED BY THE INSPECTOR OF MUNICIPALITIES THIS	21st	day of	January	2022
ADOPTED THIS	th	day of		2022

CHAIR

CORPORATE OFFICER

CAPITAL REGIONAL DISTRICT
BYLAW NO. 4468

****

A BYLAW TO AMEND THE ANNUAL REQUISITION OF THE REGIONAL CLIMATE ACTION AND ADAPTATION SERVICE (BYLAW NO. 3510)

****

WHEREAS:

A. The Board of the Capital Regional District wishes to amend Bylaw No. 3510, "Capital Regional District Climate Action and Adaptation Service Establishment Bylaw, 2008", to increase the maximum amount that may be requisitioned;

B. Pursuant to s. 349 of the *Local Government Act* (*LGA*), participating area approval is required and is to be obtained by Municipal Council and Electoral Area Director consent on behalf, per ss. 346 and 347 of the *LGA*.

NOW THEREFORE the Capital Regional District Board in open meeting assembled enacts as follows:

1. Bylaw No. 3510, "Capital Regional District Climate Action and Adaptation Service Establishment Bylaw, 2008", is amended by replacing Section 6 in its entirety as follows:

   "6. In accordance with Section 339(1)(e) of the *Local Government Act*, the maximum amount that may be requisitioned annually for the cost of the Service is the greater of:

      a) One-million, seven-hundred-thirty-seven thousand, six-hundred-thirty-five Dollars ($1,737,635); or

      b) A property value tax rate of $0.0130 per One Thousand Dollars ($1,000) that, when applied to the net taxable value of land and improvements in the Service Area, will yield the maximum amount that may be requisitioned for the Service."

2. This Bylaw may be cited as the "Capital Regional District Climate Action and Adaptation Service Establishment Bylaw, 2008, Amendment Bylaw No. 2, 2021".

READ A FIRST TIME THIS	27th	day of	October	2021
READ A SECOND TIME THIS	27th	day of	October	2021
READ A THIRD TIME THIS	27th	day of	October	2021
APPROVED BY TWO-THIRDS OF PARTICIPANTS THIS	23rd	day of	November	2021
APPROVED BY THE INSPECTOR OF MUNICIPALITIES THIS	21st	day of	January	2022
ADOPTED THIS		day of		2022

CHAIR

CORPORATE OFFICER