DISTRICT OF METCHOSIN
AGENDA

ENVIRONMENTAL ADVISORY SELECT COMMITTEE MEETING

April 23, 2024 at 7:00 p.m.
Council Chambers
Metchosin Municipal Hall

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1. Agenda, Additions, Approval

2. Presentations

3. Public Participation

4. Adoption of Minutes
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5. Receipt of Minutes
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b) DRAFT Finance Committee Meeting, April 8, 2024 (not adopted) 7
c) Parks and Trails Advisory Committee Meeting, March 19, 2024 11
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6. Business Arising from the Minutes
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b) Capital Regional District Biosolids, Draft Letter to Minister Heyman from Regional Mayors, 2021 27
c) Climate Action Plan – Community Engagement
d) 2013 Shoreline Protection Plan 29
e) Mapping of Potential Sensitive Areas in Metchosin:
Conservation Data Centre, Data Submission

7. Reports
a) Chair's Verbal Report
b) Council Liaison Verbal Report
c) Capital Regional District: Climate Projections for the Capital Region 2024 87
d) Climate Action Plan – Draft Progress Report 159

8. Correspondence
a) Cougar Predation, Correspondence received from: 163
- Shannon Hamilton
- Nicole Shukin

9. Other Business
a) District of Metchosin Public Works Policy W-100:
Elimination of Pesticides and Herbicides for Cosmetic Purposes on Municipal Grounds 167
b) District of Metchosin Non-GMO Resolution 169
c) Wells and Alternatives Workshop, April 27, 2024 2:00-4:00 p.m.

10. Adjournment and Next Meeting

District of Metchosin

Minutes
Environmental Advisory Select Committee Meeting
March 26, 2024 at 7:00 p.m.
Council Chambers
Metchosin Municipal Hall

Present: Bill Cave, Garry Fletcher (Chair), Councillor Steve Gray (Council Liaison), Anna Hall, Merrilee Hoen, Andy MacKinnon (Recorder), Ric Perron, Erin Van de Water

The meeting was called to order.

1. Agenda, Additions and Approval

Moved and Seconded by Councillor Gray and Ric that the Committee approve the agenda with these changes: add 9d) Biosolids, 9e) Bullfrogs, and 9f) Climate Action Plan.

Carried

2. Public Participation

Joe Percival, resident, was a Metchosin resident for a long while, just recently returned. Concerns about environmental issues in Metchosin. Concerned about spreading biosolids on land. Also concerned about widespread use of glyphosate.

Brent Donaldson, resident, thirty sheep have been killed by cougars so far this year. And we are not yet to summer, when most killings occur. So, the farmers need to act quickly. There are too many sheep to keep them all inside each night. (John Buchanan alone has 700 sheep.) AASC is taking the lead on generating ideas on how best to approach the issue of human/wildlife conflict over the long term, and MEASC (Anna) will participate.

4. Adoption of Minutes

a) Environmental Advisory Select Committee, February 27, 2024

Two edits (from Andy):

- 6a. "… the Environment Committee agreed **with** the MEASC recommendation …".
- 6c. "agreed **with** the MEASC recommendat**ion**~~ed~~ that Council endorse the treaty. It will go to ~~e~~**C**ouncil next."

Moved and Seconded by Andy and Bill that the Committee approve the minutes of the Environmental Advisory Select Committee meeting held on February 27, 2024 as amended.

Carried

5. Receipt of Minutes

a) Environment and Natural Areas Committee, February 12, 2024

b) DRAFT Environment and Natural Areas Committee (not adopted), March 11, 2024

c) Special Community Planning Committee Joint Meeting with the Parks and Trails Advisory Committee Meeting, February 20, 2024

5c. “Suggestion that committee chairs meet annually to discuss common issues and that the minutes between committees continue to be received in agenda packages”. Including the MEASC Chair; excellent.

5c. “Suggestion that roadside trail opportunities should be taken into consideration in conjunction with ongoing road resurfacing”. Again, excellent. MEASC recommends that “roadside trail opportunities” also include “roadside cycle lane opportunities”.

Moved and Seconded by Merrilee and Anna the Committee receive these Committee Minutes for information.

Carried

6. Business Arising from the Minutes

a) Mapping of Potential Sensitive Areas in Metchosin

Conservation Data Centre (CDC) is the appropriate place for these data to go – where they’ll be available (as Element Occurrence Records) for anybody contemplating development in sensitive areas. (This was the idea behind the maps in the first place.) However, not only does the CDC not accept non-digital information, they don’t generally accept anybody’s data submissions, digital or not. Instead they mine other databases. What we have to do is access our digital spreadsheet (including at least species, lats & longs, observation date, observer), and then submit this to the Wildlife Species Inventory office. WSI have forms that we can use. A couple of additional notes:

- CDC doesn’t have EORs for marine species
- We could potentially send the Excel spreadsheet to the CDC and ask their taxonomic experts which species were of interest (i.e., we might not have to deal with them all)
- There might be value in bulk-uploading them to INaturalist, if we already have them in a spreadsheet.

Action Item: The CDC’s ‘Data Submission Guidance’ document will be added to the next agenda.

Garry will locate a digital version of our spreadsheet, and Garry and Andy will determine next steps with the Wildlife Species Inventory office and the CDC.

b) Fossil Fuel Non-Proliferation Treaty

Approved at Council; thanks Steve.

c) Provincial Biodiversity Letter

Approved at Council; thanks Steve.

d) BC Hydro Re-Greening Program Grant Application

Approved at Council; thanks Steve.

e) Lombardy Poplar Trees, Lombard Drive – Heritage Site
• Arborist Report

Received; thanks.

7. Reports

a) Chair's Verbal Report

None.

b) Council Liaison Verbal Report

Herbicide Policy. Municipality will minimize herbicide use on municipal property.
Steve Gray brought very interesting maps from the water and wells workshop held March 23, 2024.
Council wants to put a priority on protecting riparian zones.
Metchosin will be required to complete a Housing Needs Assessment by December 2024, and to incorporate this into a revised OCP by next June. This may also present an opportunity to make other changes to the OCP.

8. Correspondence:

None.

9. Other Business

a) Lantzville Mulls Future Old-Growth Zones

Received.

b) Invasive Species – Parrot's Feather (*Myriophyllum aquaticum*)
• Best Management Practices for Parrot's Feather, Metro Vancouver

In Weir's Beach Pond. Jenny Eastman has suggested that there's a new herbicide that may be useful.

Shouldn't be a threat in this location.

c) Elements of a Shoreline Protection Plan

MEASC produced one in 2013. Bill will pass it along to Steve.

STAFF: Please put this on our next Agenda.

d) Biosolids

Moved and Seconded by Ric and Erin that MEASC recommends to Council that they let the CRD know that these biosolids are not welcome on Metchosin's agricultural fields and forests.

Carried

e) Bullfrogs

For information.

f) Climate Action Plan

Merrilee reviewed where we are on this issue. The Climate Action Plan was adopted by Council last year. It's currently being evaluated by Metchosin's Planner.

We should be monitoring. Two well-received citizens' groups are doing good work: ReImagine Westshore and Regenerate BC. ReImagine Westshore made a presentation to Environment and Natural Areas Committee. Merrilee asks: what role should MEASC play (if any) in citizen support of the Climate Action Plan? Steve suggests that MEASC or APRM could work with one or both of these groups to host a lecture series.

Merrilee will speak with representatives of ReImagine Westshore and Regenerate BC to determine how we can best support them.

10. Adjournment and next meeting

Moved and Seconded by Bill and Erin that the Committee adjourn the meeting at 9:10 p.m.

Carried

The next MEASC meeting will be held on Tuesday, April 23, 2024 at 7:00 p.m.

District of Metchosin

Minutes
Environment and Natural Areas Committee Meeting
March 11, 2024 at 7:00 p.m.

Council Chambers
Metchosin Municipal Hall

PLEASE NOTE: The meeting has been recorded.

Present: Councillor Gray in the Chair, Mayor Little, Councillors Shukin, Donaldson and Epp. Also present was Bob Payette, Chief Administrative Officer, and Jennifer Miller, Legislative Services Assistant (recorder).

The meeting was called to order at 7:00 p.m.

The Chair provided a Territorial Acknowledgement.

1. Agenda, Additions and Approval

Moved and Seconded by Councillor Shukin and Mayor Little to approve the agenda with the addition of the following supplemental information:

- UBCM 2022 Resolution: NR38 New Legislation to Protect and Restore Biological Islands Trust Diversity and Ecosystem Health

Carried

2. Public Participation: None.

3. Presentations

a) Cindy Moyer, President, and Gwen Snyder, Treasurer, ReImagine West Shore Community "Making Shift Happen: Reconnecting and Reimagining Us".

Cindy Moyer provided an overview of her PowerPoint presentation including the following:

- Overview of the ReImagine West Shore non-profit society
- Importance of social and behavioural change in response to climate change
- ReImagine's Community Work Plan
- Request to the District of Metchosin for support of the ReImagine West Shore program
- Ways to support the program: amplify, in-kind, and funding
- Leadership Team review
- Vision, Mission, and Values
- Organizational structure
- Memberships and annual membership cost

4. Adoption of Minutes

Moved and Seconded by Councillors Epp and Shukin that the Committee adopt the minutes of the Environment and Natural Areas Committee meeting held February 12, 2024.

Carried

5. Receipt of Minutes

Moved and Seconded by Councillors Shukin and Donaldson that the Committee receive the minutes of the Environmental Advisory Select Committee meeting held February 27, 2024.

Carried

6. Business Arising

Environmental Advisory Select Committee Recommendations, February 27, 2024 meeting

Councillor Gray provided an overview of the Metchosin Advisory Select Committee (MEASC) recommendations including the following:

- Establishment of Local Natural Areas Protection Fund and Provincial Biodiversity Law
  - Draft Letter
  - UBCM Resolution EB32 Supporting Biodiversity in Local Communities
  - UBCM 2022 Resolution NR38 New Legislation to Protect and Restore Biological Islands Trust Diversity and Ecosystem Health

Moved and Seconded by Mayor Little and Councillor Shukin to recommend that Council send a letter to the province supporting the implementation of UBCM Resolutions 2023 EB32 and 2022 NR38: Establishment of Local Natural Areas Protection Fund and Provincial Biodiversity Law; **And that** a copy of the letter be provided to the Union of British Columbia Municipalities (UBCM).

Carried

7. Reports

a) Councillor's Update

Councillor Gray noted that there is little to report due to budget focus. More updates will follow next month.

8. Correspondence

The following correspondence was received:

- ReImagine West Shore Community 2024 Program

9. Adjournment

Moved and Seconded by Councillors Donaldson and Epp that the meeting be adjourned at 7:18 p.m.

Carried

Certified Correct:

_____ _____

Chair **Corporate Officer**

District of Metchosin

Minutes
Finance Committee Meeting
April 8, 2024 at 7:00 p.m.

Metchosin Municipal Hall
Council Chambers

PLEASE NOTE: The meeting has been recorded.

Present: Councillor Donaldson in the Chair, Mayor Little, Councillors Epp, Gray and Shukin. Also present was Bob Payette, Chief Administrative Officer, Stephanie Dunlop, Fire Chief and Jennifer Miller, Legislative Services Assistant.

The meeting was called to order at 7:00 p.m.

The Chair provided a Territorial Acknowledgement.

1. Agenda, Additions and Approval

Moved and Seconded by Councillor Shukin and Mayor Little that the Committee approve the agenda as amended with the following changes:

- New Business - Cougar Predation on Sheep in Metchosin, Correspondence from the Agricultural Advisory Select Committee
- Amend adoption of minutes (Agenda Item 4a) to specify Finance Committee Meeting, November 20, 2023 only (and remove reference to the Environment Committee).

Carried

2. Presentations

a) Maureen Sawa, CEO and Shahiri Khair, Board Vice-Chair, Greater Victoria Public Library Board

Maureen Sawa and Shahiri Khair, provided a PowerPoint presentation and overview of the Greater Victoria Public Library (GVPL) 2024 Budget including:

- GVPL Service area
- Services to the community
- Services to Metchosin (Juan de Fuca Branch)
- "Fine Free" Farewell to overdue fines
- Building a bridge to a better future
- 2024 Budget overview
- District of Metchosin 2024 Contribution

Council discussed:

- Library use trends
- Library spaces and uses
- Physical and digital materials management, demand, costs, and licensing
- Collection policy and criteria for selection of materials
- Municipalities served by the GVPL

b) Judith Cullington, President, Juan de Fuca Performing Arts Center Society, Accessibility & Inclusion Study

Judith Cullington provided a PowerPoint presentation and overview of the Juan de Fuca Performing Arts Centre Society's Accessibility & Inclusion Study including:

- Partnership with West Shore Arts Council
- Preliminary Feasibility Study
- Accessibility and Inclusion Study
- Key Findings
- Recommendations
- "Aha" moments
- Intermunicipal Committee
- Next Steps

Council discussed:

- Funding model
- Accessibility and inclusion

3. Adoption of Minutes

Moved and Seconded by Councillor Epp and Mayor Little that the Committee adopt the minutes of the Finance Committee Meeting held November 20, 2023.

Carried

Moved and Seconded by Councillors Shukin and Gray that the Committee adopt the minutes of the Special Finance Committee – Budget Meetings held January 25, February 8, February 22, March 7, and March 21, 2024.

Carried

4. Receipt of Minutes

Moved and Seconded by Councillor Epp and Mayor Little that the Committee receive the minutes of the Agricultural Advisory Select Committee meeting held March 21, 2024.

Carried

5. Reports

a) Councillor's Update

Councillor Donaldson provided an overview of her Councillor's Update including:

- Budget deliberations are now complete
- Agricultural Plan presentation to Council will take place in May
- Wildlife and Human conflict, community concerns
- Community garden site preparation underway
- Water presentations
- West Shore Parks and Recreation Society (WSPRS) - Tennis Club of Canada update
- Tennis courts resurfacing
- WSPRS updates to Tree policy
- Accessibility access tour of Metchosin museum and school sites
- Capital West Accessibility Advisory Committee survey

6. Other Business

a) New Business - Cougar Predation on Sheep in Metchosin, Correspondence from the Agricultural Advisory Select Committee (AASC)

Councillor Donaldson provided an overview of the correspondence received from the AASC regarding Cougar Predation.

Committee discussion:

- Advice from the Agricultural and Environmental Advisory Select Committees
- District responsibilities
- Potential solutions and resources
- Conservation Officer Service response times
- Provincial regulations and policy
- Suggestion for a joint meeting with Council and the AASC
- Potential to receive staff report/background in advance

Moved and Seconded by Councillors Shukin and Epp to direct staff to expeditiously schedule a joint meeting of the Finance Committee and the Agricultural Advisory Select Committee (AASC);
And That staff invite Conservation Officers from the BC Conservation Officer Service (COS) and retired conservation officer Peter Pauwels to the joint meeting of the Finance Committee and AASC.

Carried

7. Adjournment

Moved and Seconded by Councillors Shukin and Epp that the Committee adjourn the meeting at 8:02 p.m.

Carried

Certified Correct

_____ _____

Chair **Corporate Officer**

District of Metchosin

Minutes
Parks and Trails Advisory Select Committee Meeting
Tuesday, March 19, 2024 at 7:00 P.M.
Council Chamber, Municipal Hall

Present: Ron Aubrey (meeting chair), Kathy Atherton, Ryan Carter, Caroline Donahue, Karen Hoffman, Jim Nan**,** David Shanks (recorder), Councillor Jay Shukin.

Regrets: Gord Stodola

The meeting was called to order at 7:00 p.m.

1. Agenda, Additions and Approval:

- Kathy requested update on Weir Beach Stairs, under **Other Business 10 e)**

Moved by Karen that the committee approve agenda with amendment.

Carried

2. Welcome to New Members and Introductions

3. Presentations: N/A

4. Public Participation

- Darren Brown: Graceland Rd
  - Seeking 2 things from Petition:
    - Public Consultation
    - Alignment with Strategic Plans
  - Requested to record PTASC meetings using microphones
    - **Ask that all material presented to committee published with the meeting minutes**
  - Supported the P&T Master Plan; noted need to address the Buffer Lands
    - Asked not to rush ahead with Duke Rd Trail, conduct community consultation, consider various options (e.g. traffic calming, bollards)

- Diana Smith: William Head Rd
  - Expressed Appreciation for PTASC
  - Referenced her 20-July-2023 Public Communication; challenge with Village visitors parking along side of road in places they shouldn't be parking. (e.g. yellow line (like Witty's), or tow-away signs)
  - More recent Public Communication re: Madill Trail; the trail is very soggy. Her main concern is there is no feedback received regarding this & above Public Communication.

- Jill Armstrong: Lisandra Rd
  - Concerns about Albert Head Trails/Duke Rd bringing additional people into Tower Point, when CRD indicates that Tower Point is at its Breaking Point
    - Supports trail extension to Chapel Heights
    - Does not support Duke Trail from Chapel Heights to Metchosin Rd.

- Jim McPherson: Eagle Tree Place
  - Expressed he does not support Duke Rd Trail

- Albert Head community is relatively well represented, but other communities not represented but have also asked for trails
- Duke Rd proponents don't adequately consider connectivity to Colwood/Royal Bay
- Expressed concerns about costs to develop full trail discussed at past meetings
- Lack of detail about Duke Rd trail in official documents, but not in PTASC Minutes
- Any trail development should wait until P&T Master Plan Updated

- Avril Yoachim: Winfall Rd
  - Question about parking in Duke Rd area, will there be parking for users from outside Metchosin?

- Ellen Frisch: Parry Cross Rd
  - 14 years ago fought to put trails in for children walking on Metchosin Rd
  - Raised concern that regular vehicles parking on the trail, have cause trail to no longer be elevated relative to ditch/roadside
  - MOTI requires clear side of roads & ditches, **requests more defined delineation/separation of trails/ditches from roads**
    - **Please consider this for future trail development**
    - Referred to Crash Statistics (Vancouver Island crash statistics handout provided)
  - Noted she has been involved in much past work on Public & Indigenous Engagement, encourages this as plans move forward
  - Asked to focus on Safety Initiatives & Clear understandable plans

- Barb Sawatsky
  - Asked Jay what is the role of Council Liaison?
    - Raised concerns that Council Liaison is acting in biased manner
    - Not clear why residents have to come to both Council & PTASC meetings to understand/provide input on Trails
- Yaroslav (Parry Rd area)
  - Same concern as Diana & Ellen on trail along William Head
    - Had incident walking with baby in stroller where the trail was blocked by cars. Needed to walk on road, ended up with car behind & in front & very dangerous situation. Had another dangerous encounter trying to cross at the Crosswalk (this was occurrence during busy meeting at Metchosin Community Hall)
    - Chair requested written statement to provide to PTASC/Metchosin emails to ensure details captured
    - Asked about Parking restrictions & suggested to work with Community Hall Board to have their guests park courteously.

- Kyara Kahakauwila: Parry Cross Rd
  - William Head parking on roadside trail issue had been longstanding, always occurs when there are big events at MCH. Suggested Metchosin needs to come up with process/path forward with MCH Society
  - Duke Rd; used to live in area. If trail is needed, focus on the P&T Master Plan to move forward.
    - Noted this also needs to consider the Buffer Lands
    - Roadside trails are maintained by Public Works (added costs) vs connector trails maintained by volunteers. This needs to be considered for P&T Master Plan as well as budgeting

- Yvonne Duclos: Duke Rd
  - Expressed concern that a trail & improving safety is dividing people
  - Read email sent (18-March-2024)

- Expressed that Duke Rd trail initiative isn't new but is now being actioned as it should have been long ago. Feels it is lucky worse outcome has not happened already
- Noted that she has spoken to neighbours that avoid walking on road due fear for safety.
- Not opposed to having outsiders visit Metchosin

- Erin Ronsse: Cactus Pl
  - Welcomed new & experienced PTASC members
  - Expressed support for all Metchosin trails
  - Noted that Collector Roads (per OCD) with high crash statistics should warrant efforts on trails to improve safety
  - Suggested volunteers need to be sought to benefit community
  - Asked for Metchosin to reclaim its public spaces

- Jeanette McMillan: Duke Rd
  - Spoke to Sept 2023 "expression of interest", noted that it was not intended as Petition
  - Noted current ask is only for survey.
  - Noted opponents seem not to be regular users, while proponents are those walking daily
  - Noted that Tower Point needs to have vegetation restorative initiatives enacted

- Roxan Shanks: Dutnall Rd
  - Thanked everyone for speaking & listening.
  - Encouraged those interested/concerned to come see area both Duke Rd East & West, especially between 7-9am & 3-5pm
  - Noted safety concerns & regular wildlife killed by vehicles
  - Spoke to concerns about increased visitors due to new Royal Bay residents coming, and that trail development needs to consider this & provide options for visitors walk rather than drive

5. Adoption of Minutes

a) Parks & Trails Advisory Select Committee, January 16, 2024

Moved by Ron that committee approve the minutes of the Parks and Trails Advisory Select Committee meeting held on January 16, 2024.

Carried

6. Receipt of Minutes:

a) Special Community Planning Committee, November 7, 2023

Moved by Ryan that committee receive the above noted minutes.

Carried

b) Community Planning Committee, November 27, 2023, January 15, 2024

Moved by Ryan that committee receive the above noted minutes.

Carried

c) Environmental Advisory Select Committee, January 23, February 27, 2024

Moved by Ryan that committee receive the above noted minutes.

Carried

7. Business Arising from the Minutes

a) Memorial Bench Sponsor Request

Ron noted the requested bench is near to existing one, but that it seems to make sense for another in place under tree. Kathy asked about adding another name (Sonya Young; Ian's wife) on the bench. Suggested in memory of "Ian & Sonya Young".

Action: Kathy to have Bev Bacon to contact Ryan & Mr. Harding about addition to the memorial plaque.

Moved and Seconded by Jay and Kathy to accept cricket club bench request.

Carried

b) Intermunicipal Connectivity

For Jay to connect with counterparts in Langford & Colwood to interact & learn from each other's approaches. Langford only has councilors on P&T duties. Colwood has only just recently started a P&T committee. Langford important to consider Buffer Lands. Colwood good to consider alignment opportunities. Ryan just suggested to simply have a meeting to present what Metchosin PTASC is doing. Ron asked if Council or PTASC should be contacting counterparts in neighbouring Municipalities. Ron expressed that work near boundaries is shared both ways. Caroline asked if PTASC knows what is planned for P&T for Royal Bay. Ron noted also good to share with Langford & Colwood the challenges that Metchosin is facing. Kathy wants to see Metchosin work less in isolation from Langford, Colwood (& Sooke; noted by Caroline)

Jay noted that Council had no issues with PTASC contacting neighbouring P&T colleagues.

Action: Jay & Ryan to reach out to counterparts in Langford & Colwood P&T roles

c) Next Steps Identified at the Joint Community Planning and PTASC Meeting

Jay provided update that discussion on clarity of roles. Noted about method to communicate if trail/tree needs maintenance;

Recommended Action: Jay suggested requests by email go directly to CAO, Ryan, Ron, & Jay

Road resurfacing, Jay noted that plan for next year to step back (do less) & revisit road resurfacing plans. Noted ditching along sides of road, possible to do without excavating (soil from roadside must be considered toxic & big cost to dispose). Committee unclear what aspects of ditching need to be considered toxic.

8. Reports

a) Parks and Trails Coordinator Report Verbal Report

Ryan reported the following:

- Jim responded to request to fill potholes in Blinkhorn Park.
- Big tree fell on Libra trail, cleared by Public Works next day
- Ryan noted that district staff are regularly providing feedback on requests, & is appreciated
- With Donation Guidelines completed, need to re-open request for Duke Rd bench (stalled waiting for guideline). To be located at bus stop, BC Transit has been contacted

b) Council Liaison Verbal Report

Councillor Shukin reported the following:

- Metchosin budget: Council is continuing discussions. The projected tax increase was over 15% as of January 2024. This has dropped to 7.1%, per the last budget presented in March. Big thanks to our new CAO for working with Council and staff to manage expenditures.
- Council released its priorities the March 11 meeting. Of note for PTASC:
    - Explore, support and be involved in opportunities to enhance agricultural, recreational, cultural, and community building activities. Including
        - Launch the process of updating the District's Parks and Trails Master Plan, engaging PTASC and community stakeholders.
        - Continue pursuing viable opportunities to create or re-establish trails (roadside or forested): Weir Beach, Duke Road, Hans Helgesen/Rocky Point, other trails.
    - Obtain information for an informed decision on the future of the Buffer Land.
    - Other priorities:
        - Developing a management plan for the school;
        - Conduct a feasibility assessment for a new Fire Hall;
        - Update bylaws supporting environmental protection, a peaceful / livable community, housing challenges, and those with revenue implications;
        - Strengthen bylaw enforcement in the above areas;
        - Continue the work to protect our environment; support initiatives on biodiversity, water / watershed protection, shoreline, and greenspace area protection;
        - Enhance communication with residents.

c) Chair Verbal Report:

Ron reported the following:

- All Committee members need to have access to copy of P&T Master Plan
- He was asked to be at March 11th Council meeting. At that meeting he heard that people were complaining to Council & asked them to speak/raise concerns to PTASC.

9. Correspondence: N/A

10. Other Business

a) Election of Chair and Vice-Chair

Jay assumed chair at 8:39 to elect Chair & Vice-chair

- Jim nominated Ron as Committee Chair. No other nominations, Ron accepted.
- Karen nominated Kathy as Vice-chair. Kathy nominated Jim as Vice-chair, Jim declined. Kathy sought to nominate Gord (absent)

Moved by Kathy to defer Vice-chair election until next meeting.

Carried

- Jay suggested there is change for process for taking Meeting Minutes. Ron suggested 1 year term as it takes time to get familiar with discussion points and format.

- **Staff Action:** to provide template for meeting minutes, or Word document copy of Meeting Agenda to simplify recording meeting minutes. (Shelly Donaldson noted Ag Committee has requested same)
- **Staff Action:** Request to determine process for including public participant materials provided to committee

Ron resumed chair of meeting at 8:48 pm

b) Referral: Request for Memorial Bench on Municipal Grounds
- **Minutes and Resolution from the March 11, 2024 Community Planning Committee**
- **Email Request**

This request was discussed above **7 a)**

c) Referral: Duke Road East Roadside Trail Feasibility Study
- **Minutes and Resolution from the March 11, 2024 Community Planning Committee**

• Jay spoke to Council/Planning Committee discussions; Feasibility study discussed towards requesting budget for $10k for survey of all 3 phases & $10k for proposed construction of phase 1 (materials cost only - as labour and equipment will be provided by volunteers.)
- Council took public input at meetings as need for further Public Consultation
- Need understanding where Duke Rd E fits into P&T Master Plan
- Council request to PTASC, what are the best next steps in light of recent public input?
  - Ron noted any trails that have been built always depends on identifying where property pins are located. Many properties won't have known pin locations, so survey required.
- Jay asked how Duke Rd trail came to front relative to P&T Master Plan priorities? Update provided from Jim:
  - Trails Master Plan is 15 years old and almost every issue has been addressed.
  - Very proud of our accomplishments over the last 15 years, well on our way to completing the 2009 Master Plan.
  - The Plan advises us to work our way through the options and we are now at Duke Road East and Park Drive
  - Other accomplishments have been: Blaney – Duke Trail, Branson Trail, and Pearson College to Galloping Goose Trail.
  - As volunteers we have logged 226 hours (union employee wages and benefits would be minimum $50/hr = $11,000)
  - Priorities per 2009 Plan
    - 1. Kangaroo Road – has been developed as far as possible
    - 2. Rocky Point Road – very difficult, probably not possible
    - 3. Happy Valley Road – 3a has been completed, 3b and 3c are complex and the Galloping Goose runs parallel, not high priority
    - 4. Metchosin Road – village core has a trail now
    - 5. William Head Road – probably not possible
    - 6. Lindholm Road – excessive ditching has removed the possibility of a trail
    - 7. Glen Forest / Pears Road – a portion of this has been completed on Pears Road, the rest is very difficult and costly
    - 8. Park Drive – under discussion

- 9. Duke Road – under discussion
- 10. Arden Road – difficult, low priority
- 11. Liberty – difficult, not high priority
- 12. Neild Road – difficult but perhaps portions linking to the Buffer Lands

- Jim noted given most is complete, he feels that Duke Rd & Park Drive make sense to move forward.
- Karen noted many trails have been reviewed & some deemed not feasible
- Ron noted concern about growth in Royal Bay & need to communicate & align with municipalities & incorporate into Master Plan.
- Ron suggested to communicate thru Metchosin Muse about public meetings to discuss Master Plan updates. David suggested to engage Ellen Frisch to seek advise on Public Engagement

- **Duke Road East Roadside Trail Feasibility Study**
  - Jay noted Council is seeking to be frugal
  - Need to make sure neighbours concerns are addressed (e.g. in ROW, avoid cutting trees, respect privacy).
    - Jay noted there has been initial resistance to the development of roadside trails in the past.
  - Next steps rely on Budget P&T allocations from Council and an Open House
    - There should be notification from Metchosin to residents to inform about the survey being underway. Karen noted this should also include message "to assure residents that Open House will be held for public input".
    - Ryan suggested that clarification needed on reason for $10k for materials is to allow construction to go ahead (& not wait on next budget) IF the Feasibility & consultation is favourable.

d) Referral: Parks and Trails Master Plan

- **Minutes and Resolution from the March 11, 2024 Community Planning Committee**

Topic was covered under item **9 c)** above**.**

d) Weir Beach stairs, Update requested

- CAO is aiming for work to go ahead starting in April 2024, budget is $15k with build back better approach. Recognized as commitment made & to be kept by Council & PTASC.

f) Further discussion on P&T Master Plan

- Jay had questions shared just before meeting.

Action: Ron requested Jay to reframe (with aim to divide into chunks) and resend for next PTASC meeting

g) PTASC Contacts & Makeup

- Ron noted that the Committee Contacts are incomplete & need to be filled in.
- Ron also noted that Committee makeup does not follow the original plan with ½ of members rotating on terms on each year.

11. Adjournment and Next Meeting Date

Moved by Jay to adjourn the meeting at 9:21 pm

Carried

The next meeting will be held on April 24, 2024.

District of Metchosin

Minutes
Agricultural Advisory Select Committee Meeting
Wednesday, March 25, 2024 at 7:00 p.m.
Council Chamber
Metchosin Municipal Hall

Present: Councillor Shelly Donaldson, Robin Tunnicliffe (Chair), Brent Donaldson, Peter Chettleburgh, Alex Fletcher, Matt Ashton, Sasha Kubicek, Candace Lecompte (recorder)

Regrets: Andrew Penn

The meeting was called to order at 7:00 p.m.

1. Agenda, Additions and Approval

Additions:

- Alex – Update about agricultural land use who is meeting next month (new business)
- Robin – Regional goose working group and CRD response update
- Mountain lion issues – public participation

Moved and Seconded by Brent and Peter that the agenda be approved as amended.

Carried

2. Welcome to New Members and Introductions

3. Presentations

No presentations.

4. Public Participation

John Buchanan – reported that three farms with large flocks have been devastated by cougar kills, total 30 reported at this meeting. Conservation Officers are not always available to arrive in time to set traps or hunt with dogs to dispatch. Farmers are challenged by these predators and may seize farming which has an impact on the local economy and workforce.

5. Adoption of Minutes

Moved and Seconded by Candace and Sasha that the Committee approve the minutes of the September 3/23 AASC.

Carried

6. Receipt of Minutes

Moved and Seconded by Brent and Peter that the Committee receive the minutes of the Finance Committee held on July 17, September 11, October 23, November 20, and December 4.

Carried

7. Business Arising from the Minutes

None.

8. Reports

None.

9. Correspondence

a) Glenn Harris, Senior Manager, Environmental Protection, Capital Regional District: Establishing a Regional Canada Goose Working Group

Robin stated that at a recent PAAC meeting the Guardians of our Salish Estuaries (GooSE), a volunteer group that controls geese explained their mandate to manage predatory geese. GooSE shakes the eggs or spray them with an oil then place back in the nest which interferes with hatching and therefore reduces reproduction. GooSE did not apply for permits this past year therefore there is an increase in the goose population.

The Capital Regional District (CRD) has an annual budget of $250,000 specific to Goose Control however there seems to be a gap in applying these funds into actions that would control geese reproduction. Geese habitats thrive in the CRD due to the dry, warm climate however geese have become a liability to farmers as well as hindering salmon habitat and grazing recreational properties.
Robin suggested writing a letter to Council expressing farmers concerns of geese ruining vegetable crops, wheat, barley and other forage crops. A second letter can be sent to CRD to take action on controlling the geese population in the region before further destruction occurs.

C. Donaldson stated CRD has requested that an AASC member attend the Canada Goose Working Group that meets quarterly to collaborate with others to manage the geese population. Sasha expressed interest in attending these meetings. Shelly will forward the ToR to Sasha. representative sent a letter asking for a member of AASC attend the goose predication meetings,

Moved and Seconded by Alex and Peter that Robin draft a letter to send to Council to forward to the CRD.

10. Other Business

a) Debrief from the February 16, 2024 Open House

Uplands Consulting reviewed the draft Ag Plan with Metchosin farmers followed by a comprehensive series of questions during the breakout sessions. Each group had a representative from the consulting team guiding and documenting the discussions. Uplands affirmed there is a great deal of potential for agriculture based on our close proximity to urban towns. Much gratitude from AASC and Uplands Consulting for Bilston Farm sponsoring the venue for the Open House. The subcommittee met the next day to review the practical information from the farmers.

b) Map – Funding, Sponsors, Content – who/what/where/why

In 2023 AASC invested in a Farm Map applying funds from the district for the setup of the artwork and private funds from local farmers to print numerous copies for display at businesses, farms stands, farmers market and the District office.

- C. Donaldson suggested seeking sponsorship to help offset the reproduction costs. Metchosin Farmers Institute (MFI), Tractor Time, Willow Wind might be approached to sponsor the farm map.
- Alex reported that MFI may have grant funds available to help offset promoting Metchosin Grown map and other initiatives. Peter and Alex can explore interest from MFI.
- Alex would like to include other organizations from bordering communities to help promote agriculture regionally with Metchosin Grown farming being a destination.
- Adding a printed date helps keep tract of information, listings, changes for referencing.
- Farms coordinating the times of sale supports increased customer base.
- Adding Farm Stands in the future is a consideration.
- Collecting maps from other areas helps the Metchosin Grown map evolve.

c) Metchosin Farmers Institute Report

See above.

d) Review Advisory Select Committee Bylaw No. 493

Staff circulated the bylaw to AASC members which provided background on parameters for becoming a member of an advisory committee, i.e. – members need to live within the district.

e) Review Agricultural Advisory Committee Terms of Reference

C. Donaldson read the Terms of Reference aloud so that the committee and residents in the gallery understood the expectations of the role of AASC members by the Council they report to. Alex identified that upon completion of the Ag Plan, the ToR and Bylaw #493 will need to be updated.

f) Environment and Natural Areas Committee Recommendation, February 12, 2024

- **Addressing Human Wildlife Conflict**

Brent reported that MEASC had a presentation about human/wildlife conflict. C. Gray suggested a subcommittee of MEASC/AASC be established to seek solutions which was passed by the Council. Brent further explained that in 2023 61 sheep and goats were killed by cougars, previous kills were from bears, already 30+ kills for 2024.
Brent, Matt and Sasha are interested in the subcommittee if deemed useful.
Further discussion points:

- Wild animals are well protected by law.
- Farmers believe livestock needs protection as well.
- Farmers protect their animals using guardian dogs, donkeys, electric fencing and on a smaller scale, housing.
- Conservation Officers response time is broad and sometimes none.
- CO responsibilities, trapping, dogs, dispatch, records.
- BC regulations – what is the law, dispatching, responsibilities, etc.

- Cougar control – a realistic, workable solution is needed – harm reduction mechanism.
- Tracking collars for predators
- Best practices of other farming communities, proactive goals.

Spring is upon us and sheep will be turned out on spring grass and potentially in a vulnerable state as they graze the large pastures of Metchosin.

Moved and Seconded Alex and Sasha that Brent write a letter to Council regarding cougar management, include documented livestock deaths, solutions as discussed above.

g) Night Market

C. Donaldson indicated there is an interest for a Night Market in Royal Bay.

- Town of Colwood is supportive.
- Convenient to bring a market closer to residential neighborhoods.
- Weeknight – similar to Sooke and Esquimalt markets.
- Promotes local food growers – viable economy.

Robin suggested the MPA become members of the BC Association of Farmers Markets.

- $500 membership fee
- Government assistance coupons – nutrition coupons.
- Tourism maps, group insurance, etc.

Moved and Seconded by Alex and Robin to draft a letter proposing that Council review lease with Metchosin Producers Association as multiple documented requests from local producers to join MPA for market season have been denied.

h) 2024 Goals

- Wildlife, livestock and human conflict – solutions
- Metchosin Producers Association and AASC – meet to collaborate agriculture representation supporting viable outcomes.
- Community Garden (future farmers) – digging brambles is the biggest hold up as "call before you dig" is required, wet weather and school training activities preempted access to excavate roots and move gravel, fence quotes and grant funding being sought.

i) Final Review of Draft Agricultural Plan

- Draft Plan
- Background Report
- Engagement Summary

Alex stated that there have been multiple rounds of engagement with the Agricultural Plan. Reviewed edits in document. Action item to set up mechanisms for people wanting to receive or donate farmland for farming.

11. Adjournment and Next Meeting Date

Moved and Seconded by Sasha and Candace that the Committee adjourn the meeting at 9:36 p.m.

Carried

The next meeting May 15, 2024

April 5, 2024

Dear Mayor and Council;

During public participation at our Agriculture Advisory Select Committee meeting in March, we had a presentation from Parry Bay Sheep Farm to bring our attention to the urgent and serious issue of recent sheep kills in Metchosin.

As a result of this presentation, the AASC is asking council to demand more timely action from the BC Conservation Officer Service (COS), and to demand support from the Ministry of the Environment and the Ministry of Agriculture. We also would like your help in securing funding for research so that we can fully understand the scope of this problem, and implement an effective action plan.

One recent incident was a sheep kill by a cougar that occured on Saturday February 17 around 7 am on the Sea Bluff Trail. The farmer called COS immediately, and several more times for positive identification and the officer didn't arrive until evening. The farmer had to leave the three slain sheep in place on the very busy public trail. Another kill happened close to the Galloping Goose Trail and the officer wasn't available until two days later. This is an unacceptable public risk and is a loss of dignity to the animals.

There are approximately 1000 sheep in Metchosin, with the majority of these animals owned by the two larger sheep producers: Parry Bay Sheep Farm and Stillmeadow Farm. Parry Bay Sheep Farm has cut its flock by 30% already due to predation issues and on-going lack of access to pasture.

The first documented predation of sheep by cougars was in 1995 at Parry Bay Sheep Farm. Last year was the heaviest predation pressure by cougars that we have ever experienced: 61 kills of sheep, lambs and goats. This year we are expecting even greater losses with at least 30 sheep kills by cougars to date, and its early in the season. The committee also acknowledged that in the past bears have been the major threat.

Sheep have been a cornerstone of agriculture in Metchosin for the past 50 years, and they have been marketed successfully without significant predation problems. With the intense development pressure from our surrounding communities, and perhaps other factors, cougars are threatening our local economy and our food security. At a time when we have completed the community's first Agriculture Plan and are preparing to increase the amount of farming happening in our community, we need to stand behind rural livelihoods. Its hard to imagine a Metchosin without sheep and the pasture they rely on, but this is the direction in which we could be heading.

In closing, we need immediate action from you. We need you to contact the COS and demand that Metchosin be prioritized for COS support. We need you to contact both the Ministry of Environment and the Ministry of Agriculture and explain to them the severity of this unprecedented predatory pressure from cougars. We need your help in

seeking funding to research the scope of our situation and to help us develop and implement best practices*.

Sincerely,

The Agriculture Advisory Select Committee

Councillor Shelly Donaldson - Council Liaison
Matt Ashton
Peter Chettleburgh
Brent Donaldson
Alex Fletcher
Sasha Kubicek
Candace Lecompte
Andrew Penn
Robin Tunnicliffe, Chair

See attached letter from Lorraine Buchanan outlining how sheep farmers in Metchosin are following the best practices that they can. Also an anecdote from Violaine Mitchell, Stillmeadow Farm

From Lorraine Buchanan, Parry Bay Sheep Farm

The Conservation Officers continue to put the onus on the farmers to protect their sheep. They repeat advice like fence appropriately, put your animals in barns at night, use guardian animals. I d like to discuss these points, as they are neither practical or useful. Regarding fencing, we use a combination of page wire and a top electric wire and 4 strand electric fencing on various fields. As we lease the properties that we farm, we cannot afford to pay for refencing places that may not be available to us in the future if they sell. The lambs killed on March 23 and 24 were in a field fenced with a 4-strand high tensile electric fence and a heavy duty fence charger. We had also recently cleared brush off that fenceline so we know that the fence was carrying a substantial charge. That is another problem with electric fences – you can only clear brush off the lines if you have access to properties on both sides of the fence. In many cases, we can t just go into the neighbour s property and cut a 6 foot swath to keep blackberries and broom from growing through our side. If a 7 foot chain link fence such as the one now enclosing the Pantev s property (the old Helgeson Farm, on William Head at the bottom of Lombard, and up Swanwick Rd) can t keep a cougar out, I doubt there is much hope for any fence to achieve this. (They saw a cougar within their fence, on one of their security cameras.) With regard to putting our animals in a barn at night, most of the properties we lease don t have barns anymore or never did have them. Sheep are grazing animals and need to be out on the grass, grazing, day and night. We want to be able to continue to farm in a grass-fed, naturally raised manner, rather than using a confinement feeding model. Besides, the cougars that attacked Tom and Vio s sheep did so in the daytime, as is the case with Bev Propp s sheep and many of ours. They

certainly don t just hunt at night. As far as using guardian animals, they aren t safe from predators either – one of our donkeys was killed by a bear that was attacking some sheep near the Sea Bluff Trail a few years ago. Guardian llamas were present in the field when Bev Propp s sheep were killed in February – they were no deterrent to the cougar. Guardian dogs often protect by barking incessantly – not many neighbours will put up with that – and you need a couple for each field. There are many cases we know of where these dogs have roamed beyond the fence to attack perceived predators outside their fields. How would this work if fields were on opposite sides of a busy road (for example our fields along William Head, Lindholm and Rocky Point roads)? And many of our fields are adjacent to popular dog walking places, like down Taylor Road and the Galloping Goose trail. Picture what would happen if our guard dogs saw somebody s pooch and owner as predators. Unfortunately, when the CO s and Wild Wise publish information like this as advice as to what farmers should do in order to protect their livestock, the public doesn t question it and blames the farmer for not doing it. Bottom line is, we need to be able to dispatch the cougars which are habituated and repeatedly killing livestock. This doesn t mean killing all cougars, just the problem ones. Cougars are not endangered in this area (Vancouver Island has by far the largest number of cougars in North America) but sheep farmers sure are.

Anecdote from Violaine Mitchell, Stillmeadow Farm

I hesitate to criticize the Conservation Officers' Service because there are a few who are doing a very thorough and conscientious job and we sincerely appreciate this.

Dear Minister Heyman,

This letter is to request from the undersigned for a meeting to discuss the land application of biosolids in BC and associated impacts on the environment, food security and public health.

Concerned community members and elected officials in the Comox have now joined many residents, mayors and CRD Directors on southern Vancouver Island, the Mt. Work Coalition, Nicola Valley First Nation Bands and residents, and major regional/provincial and environmental organizations in opposing the land application of biosolids, just as you might recall doing in 2011 during your term at Executive Director of the Sierra Club of BC when you signed a letter of support for a ban on land application of biosolids that was ultimately passed by the CRD in 2011. Unfortunately, we're sorry to share that the situation has not improved since that time, and emerging academic research now adds perfluoroalkyl-and-polyfluoroalkyl substances (PFAs) and microplastics to the growing list of pharmaceuticals, PAHs, and other Chemicals of Emerging Concern (CECs) contained in Class A & B biosolids, and subsequently disbursed throughout BC's forests, farms and fields.

Furthermore, the current OMRR regulations governing land application of biosolids have not kept up with the current state of evidence, and only regulate and require monitoring of a small list of potential contaminants, thereby woefully underestimating the environmental and public health risks. As a result, the Province's existing policies wrongly suggest that the land application of biosolids is both safe and the best possible option to dispose of processed sewage waste, ultimately deterring municipalities from considering safer and more environmentally sustainable options such as pyrolysis/gasification.

Additionally, it has become apparent that while this practice is ongoing and/or expanding in many regions of BC, it is being done with little or no consultation with either regional residents and farmers that may be directly affected, or First Nation communities on whose unceded land biosolids are currently being applied, some of which are still used for wildcrafting by these same Bands.

Would you and your staff have time to meet with us over the next few weeks to discuss what steps might be taken to 1) update the current risk assessment of biosolids, which would include research on Chemicals of Emerging Concern (CECs) such as PFAs and microplastics via an independent scientific review of the state of the evidence; 2) use the resulting info to update the Provincial policies on land application of biosolids in BC in order to ensure we're doing all we can to improve food security, environmental sustainability and public health?

Thanks and best regards,

Metchosin Shoreline Report 2013



Prepared by the
Metchosin Environmental Advisory Select Committee
May 2013

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Executive Summary

The unique values attributed to the Coastal Areas of Metchosin have been outlined at length in the Official Community Plan and other documents produced for the District. They have also been recognized both historically and by outside researchers.

The objective of the Metchosin Shoreline Report is to provide Mayor and Council with a background document and decision-making tools for issues related to Metchosin's shoreline environment: the jurisdictional boundaries are delineated; examples of ecologically sensitive areas are highlighted; and the biological and geographical values of eight zones of the 45 km of shoreline are profiled.

The values of biodiversity, education, natural capital, aesthetics, philosophy, and ecotourism are all affected by our coastal areas. Therefore, the risks from human activity on the sustainability of these areas are emphasized.

With the increasing likelihood of changing climatic events impacting on our shoreline, and in order to mitigate these risks, a number of recommendations are proposed for the Municipality to implement:

1. Create a development permit zone in the area between the end of provincial jurisdiction at the high water mark and the end of the high tide storm-driven wash on the landowner's property.
2. Prevent the human-caused hardening of the shoreline by sea walls, roadways or bulkheading, and shoreline modifications.
3. Establish Development Permit Areas on the full length of the coast of Metchosin.
4. Design a "Coastal Covenant," which landowners could voluntarily sign, in order to guarantee the protection of the integrity of their section of shoreline.
5. Establish and protect vegetation buffer zones along streams and along the total shoreline, with special attention to salt marshes and eelgrass beds.
6. Protect eelgrass and macroalgae beds by reducing damage from log booms, docks and other structures.
7. Divert the runoff from farms, which might contain fertilizers, pesticides and herbicides, away from shoreline, salt marsh, and eelgrass habitats.
8. Develop emergency response plans for the District in the event of a land or ocean-based toxic spill which could potentially threaten the shoreline.

Introduction

Metchosin is highly regarded within the Capital Regional District (CRD) for its variety of natural ecosystems balanced by its rural lifestyle. It is this unique character of Metchosin that has been valued historically and continues to be valued by its residents and visitors. The diversity of natural terrestrial ecosystems that have been preserved by the community are well represented in the numerous parks and open areas. However, while the community has the power to exert authority over terrestrial environments, the 45 km of shoreline marine environments bordering Metchosin are governed by a variety of agencies and jurisdictions, leaving the risk of key issues being overlooked.
(See Appendix 1, Metchosin's Coastal Jurisdictions)

The Metchosin shoreline has been recognized by others as having a variety of unique features and ecosystems. In the past, most of the shoreline was considered for designation as a National Marine Park by the federal government. Two extensive reports were prepared in the mid 1970's, one for Parks Canada and the other for Indian Affairs. The area off Bentinck Island and Race Rocks is now a federally recognized Rockfish Conservation Area and a designated Marine Protected Area.
http://www.pac.dfo-mpo.gc.ca/fm-gp/maps-cartes/rca-acs/rca-acs/south-sud/BentinckRaceRocksChart3461-eng.htm
A provincial ecological reserve was established at Race Rocks in 1980.
http://www.env.gov.bc.ca/bcparks/eco_reserve/racerocks_er.html
(See Appendix 2, Recognition by Others of the Value of Metchosin's Shoreline)

The District and residents of Metchosin are keenly aware of the benefits of living adjacent to the marine shoreline. Marine values are documented in both the Official Community Plan and the Blue Green Spaces Strategy. *(See Appendix 3, Previous Shoreline Documents Presented to Metchosin Council).* In light of the variety of potential impacts to marine shorelines, such as the predicted rise in sea level and an increase in extreme weather events associated with climate change, the District must be concerned with the preservation and protection of the environmental, social, and economic values of these shores.
(See Appendix 4, Global Risks to Shorelines)

Purpose

The purpose of this document is to:

- Identify the ecological, educational, aesthetic, and economic values of Metchosin's 45 km of marine shorelines.
- Summarize the physical and ecological risks to our shoreline environments.
- Propose actions enabling the District to prepare for, and act on, shoreline risks.
- Describe the jurisdictional boundaries of Metchosin's shorelines.
- Provide reference material for further information



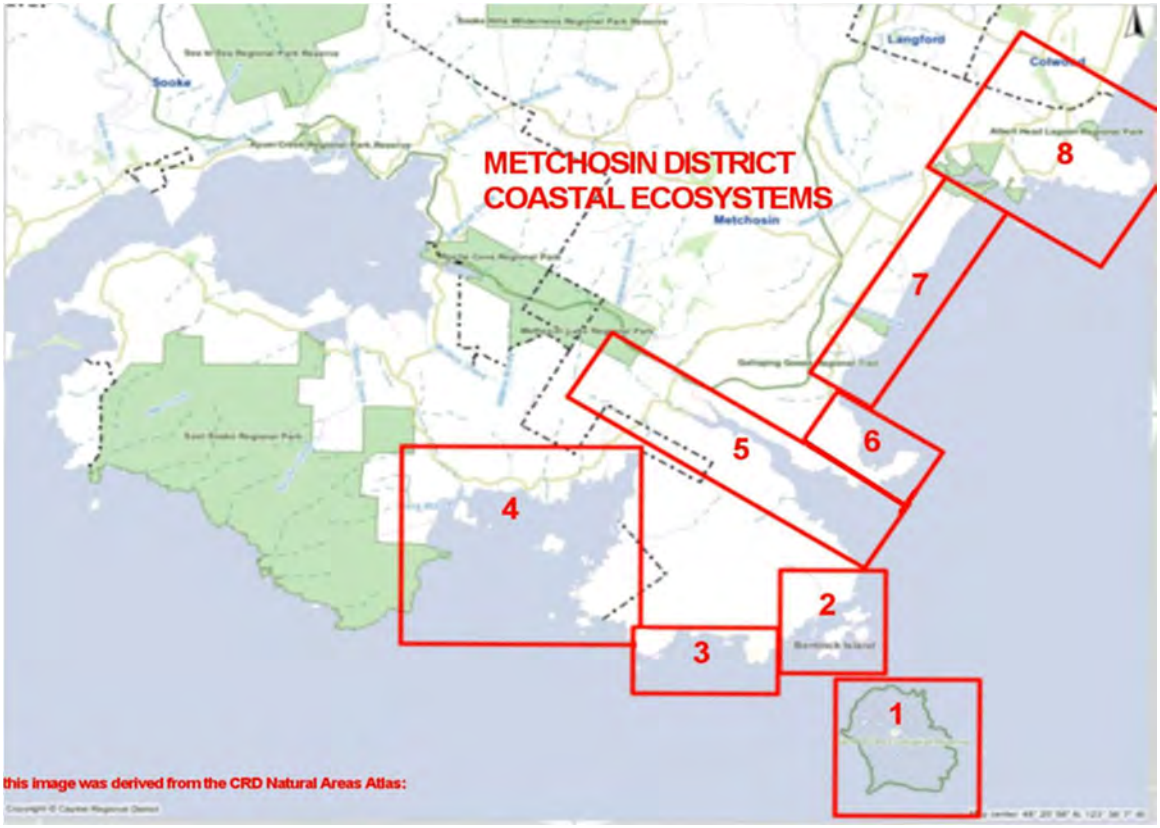
Physical Structure and Ecological Resources of the Metchosin Shoreline

In order to document various coastal features, this analysis takes the shoreline of Metchosin and divides it into eight smaller sections representing areas of similar physical and ecological make up. This approach is used in the website on Coastal Metchosin. (http://powweb.racerocks.ca/metchosinmarine/mapindex.htm

The coastal aerial images were provided by the Integrated Land Management Bureau, GEOBC Spatial Analysis Branch.

Aerial Maps were made available courtesy of the CRD Natural Areas Atlas http://www.crd.bc.ca/regionalplanning/maps/index.htm

The following map depicts the shoreline of Metchosin divided into eight sections representing areas of similar physical and ecological characteristics:



The following images provide examples of the coastlines of these zones. When the ecology and geography of each area is studied, and the different life forms are recognized, one can start to appreciate the variety in landforms and incredible biodiversity of the areas.

See Appendix 5 Coastal Areas and Sensitive Ecosystems for maps and details of these eight zones.

Zone 1. Race Rocks. Nine islands.



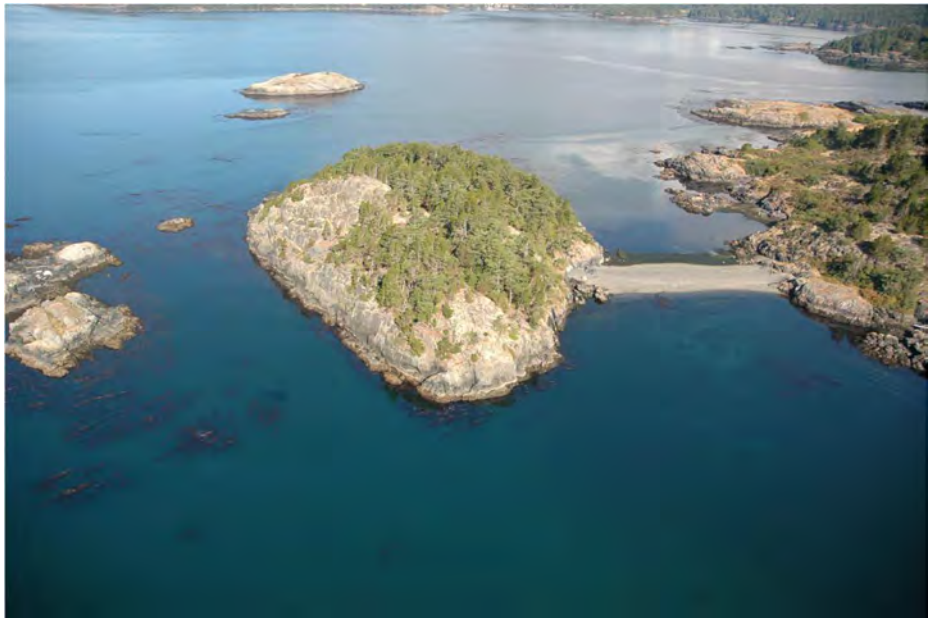
Zone 2. Bentinck Island and Rocky Point. DND property, a variety of ecosystems.



Zone 3. Church Island and Whirl Bay. Island and rocky coast.



Zone 4. Beecher Bay. First Nations reserve, shoreline, DND land, private land and park.



Zone 5. Pedder Bay. The shores of the Bay with Pearson College and Pedder Bay Marina; estuary and riparian areas.



Zone 6. William Head. A rocky shore headland.



Zone 7. Parry Bay Cliffs, Taylor Beach to Weir's Beach. Cliffs and beaches.



Zone 8. Witty's Lagoon to Albert Head. Beaches and lagoons.



Shoreline Values

Biodiversity (ecological values and sensitivities)

The term "biodiversity" encompasses the processes and variety of life on earth. It includes the complete range of organisms, their genetic differences, communities and ecosystems in which they occur, and the ecological and evolutionary processes that allow them to change, adapt and persist. Biodiversity manifests itself on the genetic, species, ecosystem, and landscape levels as well as in the interactions within and among levels. It supports:

- *Resource values (e.g. agricultural crops, fisheries as a food source, and medicinal uses of plants)*
- *Ecosystem services (e.g. maintaining air and water quality)*
- *Recreational and aesthetic values*
- *Intrinsic, spiritual, and ethical values*

With global resource challenges, such as the collapse of Atlantic cod fish stocks, monoculture crop failures, and locally the devastation of the forest industry due to pine beetle infestations, the necessity of maintaining a high natural biodiversity for environmental resilience has become very apparent.

Marine environments are extremely rich in their biodiversity and the ecosystem services they provide.

Natural Capital

Natural capital refers to the indispensable resources and benefits, essential for human survival and economic activity, provided by the ecosystem. (http://www.businessdictionary.com/definition/natural-capital.html)

Natural capital refers to any of the many goods (e.g. food and fuel) and services (e.g. water purification and carbon cycling) provided by the natural cycles. Natural ecosystems and biodiversity provide services that we take for granted, but which have immeasurable value. Eelgrass beds, kelp beds, and estuaries, in particular, supply critical habitat for juvenile fish and migratory birds, and provide a high degree of carbon sequestration.

Educational Value

Environmental education creates awareness and understanding of the relationship between humans and their many environments – natural, man-made, cultural, and technological. Environmental education is concerned with knowledge, values, and attitudes, and has as its aim responsible environmental behaviour. (NEEAC, 1996 North American Association for Environmental Education. http://www.naaee.net/what-is-ee)



Educational opportunities present themselves in many forms, from the structured ecology field studies in high school and colleges to less formal classroom field trips and casual family outings at Witty's lagoon. All of these represent opportunities to learn about biodiversity and ecological values while engaging in outdoor physical activity. The education of our youth represents an important step in creating greater awareness of the limits of natural resources and in developing future generations of responsible citizens, natural resource managers, and scientists, i.e. custodians of our planetary resources.

Aesthetic and Philosophical Values

Shoreline aesthetics are undeniably ingrained into the psyche of the human spirit, so much so that there is an extremely high demand for shoreline property, even at high property costs and potential environmental risks (such as tsunamis). Shorelines feature prominently in artistic endeavours (e.g. poetry, verse, song, photography,

painting and other visual arts). People enjoy the experience of walking near the sea, breathing sea air, bird watching, sunbathing, and seeing the expansive vistas. The artistic, spiritual and philosophical value of such experience is unquantifiable and priceless.

Eco-tourism

Eco-tourism is tourism designed to contribute to the appreciation and protection of the environment, or at least minimize damage to it. Regions and communities which have substantial natural resources offering aesthetics, biodiversity, natural capital, and educational value have much potential for developing an eco-tourism market. As the public has become more environmentally aware, so has eco-tourism grown.

Risks to Local Shorelines

- Natural shoreline erosion/change
- Shoreline alteration/disruption (dumping, filling, hard surfaces, groynes, seawalls, piers etc.)
- Shoreline erosion from climate change, storm surges, and associated extreme weather events
- Downstream impacts from developments, including increased sedimentation, more fresh water output, and erosion from stream channeling
- Contaminants in storm sewers and seepage from septic fields (sewage, toxic cleansers, fuel, oil, detergents, cosmetic pesticides/herbicides, anti-freeze, prescription drugs, etc.)
- Agriculture runoff (pesticides, herbicides, fertilizers, manure)
- Contamination from marine traffic in Georgia Strait and the Strait of Juan de Fuca. With the increase in marine traffic, there is an increase in the likelihood of collisions, bilge dumping, spills, and marine garbage
- Flotsam on shorelines (increased potential from tsunamis)
- Disturbance by recreational boaters, including kayakers and personal watercraft, of seabird feeding and nesting areas, and marine mammal haulout and nursery colonies
- Eco-tourism/recreational impacts – tread gently, observe from a distance, minimize disturbance
- Invasive species: Minimal so far but potential for alteration of ecosystems by the green crab, certain algae, and certain tunicates

Sustainable Shoreline Guidelines

- Preserve coastal processes.
- Restrict and control shoreline modifications, which can have wide-reaching effects. (See Coastal Shore Stewardship: A Guide for Planners, Builders and Developers on Canada's Pacific Coast http://stewardshipcentrebc.ca/PDF_docs/StewardshipSeries/Coastal.pdf)
- Maintain, and when possible, enhance habitat diversity. See the description of the variety of shoreline habitats in Metchosin (Appendix 5).
- Ensure the variety of habitats is protected. Important ecological services are derived from these habitats for various plant and animal species, for foraging and spawning habitats for marine fish and invertebrates, and for breeding and feeding areas for birds.
- At a local scale, reduce pollutant input to the marine environment (e.g. boating guide, information sessions at Pedder Bay). On a broader scale, observe and report any inbound pollutants (e.g. shoreline watch).
- PLAN to avoid cumulative impacts to the coastal environment. The shore is an important part of defining Metchosin's character.

Recommendations

- Create a municipal development permit zone in the "No man's land" between the end of provincial jurisdiction at the high water mark and the end of the high tide storm-driven wash zone. This is a zone of the landowners property that may be inundated or eroded in extreme conditions. It is not possible to put an exact setback distance on this zone as the slope and substrate of the coastline determines the potential impact. As examples, a rock cliff obviously has more stability than a clay cliff; a naturally vegetated sand beach has more resistance to storm damage than one that has been hardened by compaction from human activity (building roadways or cement pathways).

- Consider a bylaw to prevent the human-caused "hardening of the natural area:" prohibit sea walls, dumping, rip-rapping, bulkheading or groyne construction, or excavator work which could lead to eventual destabilization of the shoreline. This zone could be defined as the slope of natural repose of the shoreline, or the area to which the coastline may erode when impacted by extreme ocean storm events.

- Consider establishing Development Permit Areas on the full length of the coast of Metchosin, with a 100 metre minimum distance from the natural boundary area. An increase in this distance should be implemented where alterations to near-ocean topography could result in potential impacts on sedimentation and nutrient load in the coastal area (for example installation of sewer fields and watercourse alterations due to building of roads, creation of dams etc).

- Consider designing a "*Coastal Covenant*", which landowners could voluntarily sign, in order to guarantee the protection of the integrity of their section of shoreline. The description of Metchosin's coastline, outlining the ecologically sensitive areas discussed in the report, is presented as Appendix 5. The land-sea interface along the entire coast of Metchosin exhibits a wide diversity of landforms and marine communities within a relatively confined geographical area. The eight zones shown in the map above are perhaps the most pristine, varied and ecologically sensitive sites of the entire Victoria region. It is in these areas where the coastal habitats, marine communities, and oceanographic phenomena achieve their greatest expression.

- Establish and protect vegetation buffer zones along streams and the shoreline adjacent to salt marshes and eelgrass and macroalgae beds.

- Protect eelgrass and macroalgae beds by reducing damage from log booms, docks and other structures.

- Divert the runoff from farms, which may contain fertilizers, pesticides and herbicides, away from shoreline, salt marsh, and eelgrass and macroalge habitats.

- Evaluate the role of the Municipality in the event of a land- or ocean-based toxic spill which could potentially threaten the shoreline.

References

Coastal Shore Stewardship: A Guide for Planners, Builders and Developers on Canada's Pacific Coast
http://stewardshipcentrebc.ca/PDF_docs/StewardshipSeries/Coastal.pdf

The above reference is excellent and should be required reading for all municipal employees and owners of shoreline property.

If people have limited reading time the following 4 links give valuable information

Fact Sheet: Marine Guide to Preventing Shoreline Erosion. Fisheries and Oceans Canada
http://www.dfo-mpo.gc.ca/Library/281618.pdf

Living by Water Project. Working towards healthier human and wildlife habitat along the Shorelines of Canada. Nature Canada
http://livingbywater.ca/main2.html

Ecosystems of Southern Vancouver Island.
http://metchosinmarine.ca/
There are many other links to information on the topic on this page.

Coastal Sediment Process. Capital Regional District
http://www.crd.bc.ca/watersheds/protection/geology-processes/coastalsediment.htm

And more:

Chapman, Colin R. Blue Carbon — British Columbia. The Case for the Conservation and Enhancement of Estuarine Processes and Sediments in B.C.
http://www.sierraclub.bc.ca/publications/scbc-reports/Blue%20carbon%20bc%20report%20final_web.pdf

Estuaries in British Columbia.
http://www.env.gov.bc.ca/wld/documents/Estuaries06_20.pdf

Green Shores Technical and Advisory Committees: http://www.greenshores.ca
http://www.stewardshipcentre.bc.ca

IOC/UNESCO, IMO, FAO, UNDP (2011). *Summary for Decision-Makers : A Blueprint for Ocean and Coastal Sustainability.* Paris: IOC/UNESCO

NEEAC, 1996 North American Association for Environmental Education (NAAEE) a network of environmental educators throughout North America & in over 55 countries around the world. http://naaee.org/

Nelleman, C., E. Corcoran, C.M. Duarte, L. Valdes, C. DeYoung, L. Forseca, G. Grimsditch (editors) (2009) Blue Carbon: The Role of Healthy Oceans in Binding Carbon: A Rapid Response Assessment. UNEP, FAO, IOC/UNESCO. http://books.google.ca/books?hl=en&lr=&id=onCVCHQl4RoC&oi=fnd&pg=PA17&dq=Nellemann,+C.+et.+al.+(2009)+Blue+Carbon&ots=ZQuieTBfoW&sig=-Yk_uu9GkEhIhcAWke9S5DIpu9Q#v=onepage&q=Nellemann%2C%20C.%20et.%20al.%20(2009)%20Blue%20Carbon&f=false

Additional Web Links

Environment Canada	*http://www.ec.gc.ca*
Canadian Environmental Assessment Agency	*http://www.ceaa-acee.gc.ca*
Cumulative Effects Assessment Practitioners Guide	*http://www.ceaa-acee.gc.ca/default.asp?lang=En&n=43952694-1*
Environmental Assessment: Making a Difference	*http://publications.gc.ca/collections/Collection/En21-201-2000E.pdf*
The Citizens Guide: Canadian Environmental Assessment Process	http://publications.gc.ca/site/eng/46875/publication.html
Fisheries and Oceans Canada (DFO) Pacific Region	*http://www.pac.dfo-mpo.gc.ca/pages/default_e.htm*
Transport Canada - Office of Boating Safety	*http://www.tc.gc.ca/eng/marinesafety/debs-obs-menu-1362.htm*
Ecosystem Management Branch	http://www.pac.dfo-mpo.gc.ca/sep-pmvs/contact-contactez/oheb-dohmv-eng.htm
Marine Guide to Preventing Shoreline Erosion	http://www-heb.pac.dfo-mpo.gc.ca/publications/pdf/erosion_e.pdf
Marine Guide to Small Boat Moorage	*http://www-heb.pac.dfo-mpo.gc.ca/publications/pdf/moorage_e.pdf*
Navigable Waters Protection Division	*http://www.th.gov.bc.ca/key_enviro_topics/navigable.html*
Salish Sea: A Handbook for Educators	http://www.artistresponseteam.com/handbooks/
Government of Canada Legislative Summaries (SARA)	*http://www.parl.gc.ca/common/Bills_ls.asp?lang=E&ls=c5&source=library_prb&Parl=37&Ses=1*
Natural Resources Canada	*http://www.nrcan.gc.ca/*
Geological Survey of Canada	http://www.nrcan.gc.ca/earth-sciences/about/organization/organization-structure/geological-survey-of-canada/9590
Ministry of Environment: Develop with Care 2012: Environmental Guidelines for Urban and Rural Land Development in British Columbia	*http://www.env.gov.bc.ca/wld/documents/bmp/devwithcare2012/index.html*

Government-Provincial

BC Environmental Assessment Office	*http://www.eao.gov.bc.ca*
Guide to the British Columbia Environmental Assessment Process March 2011)-	http://www.eao.gov.bc.ca/pdf/EAO_User_Guide%20Final-Mar2011.pdf
BC Fisheries Act-	http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_96149_01
BC Treaty Commission	*http://www.bctreaty.net/*
BC Waste Management Act Finfish Aquaculture Water Control Regulation	http://www.env.gov.bc.ca/epd/industrial/regs/finfish/
Ministry of Agriculture, Food and Fisheries	*http://www.gov.bc.ca/agf/*
Fisheries and Aquaculture	*http://www.agf.gov.bc.ca/fisheries*
Ministry of Energy and Mines	*http://www.gov.bc.ca/ener/*
Ministry of Environment, Environmental Protection Div.	http://www.env.gov.bc.ca/epd/

Best Management Practices to Protect Water Quality
http://www.env.gov.bc.ca/wat/wq/nps/BMP_Compendium/BMP_Introduction/bmphome.htm
Environmental Impact Study Guideline:
A Companion Document to the Municipal Sewage Regulation
http://www.env.gov.bc.ca/epd/epdpa/mpp/pdfs/EIS_Guideline_Dec2000.pdf
Environmental Management/Industrial Waste:
Species and Ecosystems at Risk: A Guidebook for British Columbia http://wlapwww.gov.bc.ca/wld/serisk.htm
Stormwater Planning: A Guidebook for British Columbia http://www.env.gov.bc.ca/epd/mun-waste/waste-liquid/stormwater/
Baynes Sound Shellfish Aquaculture Action Plan
http://archive.ilmb.gov.bc.ca/slrp/marine/south_island/baynes/docs/Baynes_Plan_Dec19_2002.pdf
British Columbia Biophysical Shores Zone Mapping System ftp://ftp.luco.gov.bc.ca/pub/coastal/rpts/BCBiophysicalShore-ZoneMapping.pdf
British Columbia Marine Ecological Classification System
http://www.ilmb.gov.bc.ca/risc/pubs/coastal/marine/version%202/bcmec_version_2.pdf
Coastal Planning http://archive.ilmb.gov.bc.ca/cis/coastal/planning/index.html
Coastal Data http://archive.ilmb.gov.bc.ca/cis/coastal/others/crimsindex.htm
Coastal Resource Information Management System (CRIMS) http://geobc.gov.bc.ca/coastal/index.htm
Endangered Species and Ecosystems http://www.env.gov.bc.ca/atrisk/red-blue.htm
Resources Information Standards Committee http://www.ilmb.gov.bc.ca/risc/about.htm
Sensitive Ecosystem Inventory of Southeast Vancouver Island & the Gulf Islands
http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=2124



Surfgrass (*Phyllospadix scouleri*) and hydrocoral (*Allopora sp.*) community which is visible at the lowest tides in high current areas.

Appendices

Appendix 1: Jurisdiction: Who owns the Shoreline Features of Metchosin?

Appendix 2: Recognition by Others of the Value of Metchosin's Shoreline

Appendix 3: Previous Shoreline Documents Presented to Metchosin Council

Appendix 4: Global Risks to Shorelines

Appendix 5: Coastal Areas and Sensitive Ecosystems of Metchosin

Appendix 1: Jurisdiction: Who Owns the Shoreline Features of Metchosin?

Marine shorelines are governed by a number of jurisdictions. *http://salishsea.ca/resources/Riparianrights/Greenshores%20JurisdictionIssueSheet_finalVer4.pdf*

The provincial government

owns the ocean floor and the foreshore (the area between the low water level and the natural boundary) along Metchosin's Coastline as well as the beds of inland seas such as the Strait of Georgia, Juan de Fuca Strait, and Johnstone Strait. The Integrated Land Management Bureau (under the Ministry of Forests and Range) administers these aquatic lands and issues permits, licences or leases for a wide range of uses – private and public moorage, wharves, marinas, aquaculture, and log storage to name a few. The Province also establishes regional coastal zone plans where these are needed.

The federal government

has jurisdiction over offshore waters – from the low water mark out to 12 nautical miles along the outer coast. The federal Department of Fisheries and Oceans is responsible for managing and protecting fish populations and fish habitat under the Fisheries Act, including shoreline "riparian" habitats, as well as for maintaining maritime safety through the Coast Guard.

Local governments (municipalities and regional districts)

hold the authority to plan and regulate land use within their respective boundaries, which may extend over foreshore and nearshore areas. They do this through official community plans, zoning, development permits, subdivision authority, building permits, and a variety of regulatory bylaws that affect land development.

First Nations

have authorities similar to provincial and local governments over upland and aquatic lands within Indian Reserves. Outside Reserves, traditional rights to marine resources are the subject of ongoing Treaty negotiations for many of the First Nations along BC's coast. The provincial and federal governments have a duty to consult with First Nations on any shoreline tenure applications to ensure that they do not significantly affect aboriginal or treaty rights.

Waterfront property owners

hold "riparian rights" in association with their upland property. Based on "common law" these rights include:

- unimpeded access from their property to deep water for navigation. Waterfront improvements cannot interfere with the right of access for neighbouring properties.
- protection of property from erosion or flooding by installing protective structures on the property holders land. Extending structures below the current natural boundary requires approval of the Province. The Land Act specifically defines the boundary between upland and foreshore as: "natural boundary means the visible high water mark of any lake, river, stream or other body of water where the presence and action of the water are so common and usual, and so long continued in all ordinary years, as to mark on the soil of the bed of the body of water a character distinct from that of its banks, in vegetation, as well as in the nature of the soil itself." In marine systems the natural boundary is generally determined as the lower elevation of terrestrial vegetation or the upper boundary of distinctive aquatic vegetation.

Public

is permitted the use of foreshore and other aquatic lands held by the Crown. When the Province issues tenures, a leaseholder may restrict public access to the leased area; a permit or license of occupation does not allow the holder to restrict access.

See the diagram on page 35 of *Coastal Shore Stewardship: A Guide for Planners, Builders and Developers on Canada's Pacific Coast*
http://stewardshipcentrebc.ca/PDF_docs/StewardshipSeries/Coastal.pdf

Appendix 2: National Recognition by Others of the Value of Metchosin's Shoreline

National Park Proposals:

Background: In 1972, a task force comprised of representatives from the Governments of Canada and British Columbia identified ten areas in the Straits of Georgia and Juan de Fuca warranting National Marine Park consideration. Federal-Provincial discussions earlier that year resulted in the selection of the "Royal Roads" site as having the highest priority for establishment as a National Marine Park. A joint Federal-Provincial study team was subsequently formed to undertake the necessary studies in order to develop a proposal in this regard.

Preliminary investigations by the study team revealed that there was little or no information on the biota occurring in the coastal waters of the proposed Royal Roads National Marine Park area making it impossible for the study team to assess its national significance or importance, and to develop a complementary management plan. Consequently, there was an urgent need for a systematic and comprehensive survey of the macroinvertebrate fauna and seaweeds which occur in the area's coastal waters in order to fill this information gap and permit the orderly completion of the proposal. The results of this study are recorded in:

A study of the benthic macroinvertebrates, fauna and seaweeds at selected sites in the proposed Juan de Fuca National Marine Park. (From: http://www.racerocks.com/racerock/rreo/rreoref2/jdfmarpk/juanmarpark.htm)

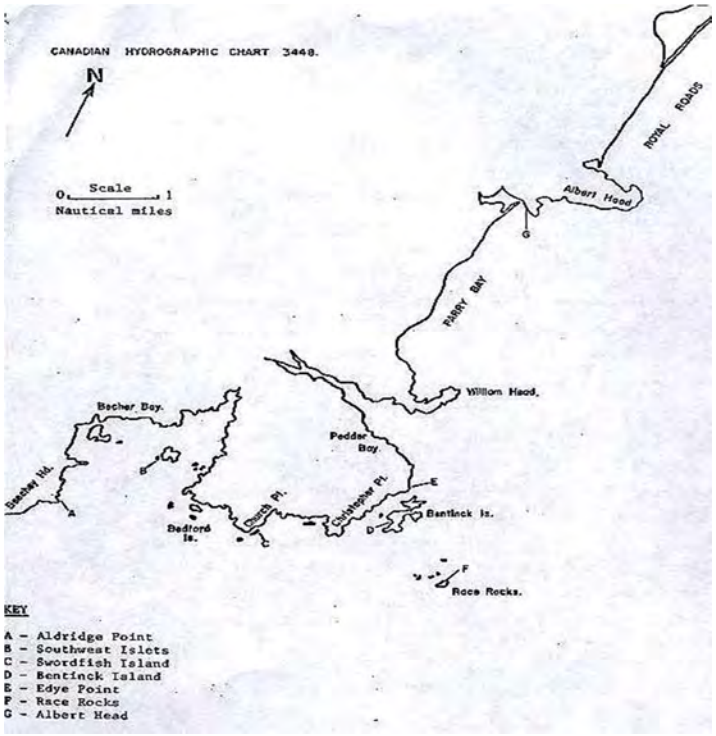
Purpose: in brief, this study included: (1) a professional discussion of the environmental factors which influence the vertical and horizontal distribution of marine organisms in the study area, e.g., type of substrate, salinity, degree of exposure to wave action; (2) a qualitative survey of the benthic macroinvertebrate fauna and seaweeds of six preselected sites within the proposed National Marine Park area.

A second federal proposal came later: Race Rocks National Marine Park: A Preliminary Proposal. Indian and Northern Affairs, Parks Canada (From: http://www.racerocks.com/racerock/rreo/rrrefer/rrnatpark.htm)

The result of these two studies was to recommend National Park Status for the coastline of Metchosin.

In reading these reports, a person who is not familiar with the marine biology of southern Vancouver Island will overlook the significance of the data presented here in support of the proposed marine park. Westwards from Race Rocks, one finds the marine flora and fauna of the partially exposed southwest coast of Vancouver Island, gradually merging with the species of the exposed (to heavy wave action) west coast of the Island. Thus, the flora and fauna of the William Head - Race Rocks - Beechey Head shoreline is not typical of conditions closer to Victoria and in Georgia Strait, but is still within a short distance of Victoria. The high current velocities around Race Rocks and towards Beechey Head tend to concentrate organisms to higher population densities than occur elsewhere. Thus some species, usually rare, may be found in this area in surprising numbers. The proposed park therefore encompasses an area which supports an unusual flora and fauna, of surprising beauty even to the non-biologist.

From Goddard, James M. 1975. The Intertidal and subtidal macroflora and macrofauna in the proposed Juan de Fuca National Marine Park. Dobrocky Seatech Ltd. (http://www.racerocks.com/racerock/rreo/rreoref2/jdfmarpk/juanmarpark.htm)



Below are some excerpts:

Proposed Park Boundaries
The proposed Park consisted of approximately twenty square miles of surface water and offshore lands defined on the west by Sooke Peninsula in a straight line from Beechey Head to Rosedale Rock and on the east by a line extending from Rosedale Rock to Fisgard Light. The proposed Park fronted on the regional land districts of Sooke, Metchosin and Esquimalt and encompassed some thirty-six miles of rugged shoreline, much of which remained in a relatively undisturbed state. The proposed shoreland component included portions of Rocky Point, Albert Head Peninsula and Aldridge Point and totaled some 2.5 square miles.

Marine Setting
The proposed Park is located in the transition zone between the Vancouver Island Inland Sea and the Pacific West Coast Marine Region. These two regions are part of a much larger oceanic system, namely the Pacific Coastal Domain, a temperate faunistic province extending from the middle of Baja California into the Bering Sea.

Tides and currents of varying velocities and direction control the exchange of waters as well as the chemical and physical properties of the water column in the Park and in Juan de Fuca Strait in general. The oceanographic phenomenon associated with this transition zone are responsible for the development of an outstanding marine environment with varied and abundant intertidal and subtidal community assemblages

A variety of erosional and depositional phenomenon characterize the coastal zone. The coastal geomorphology is controlled by the structural geology and the various facets of erosion and deposition common to the land-sea interface. The relatively undisturbed rugged volcanic coastline with secluded beaches, headlands, marshes, steep sandcliffs and offshore islands, offers a striking contrast to the more industrialized coastline surrounding Victoria to the east.

“A rich coastal and natural marine history combined with a congenial climate makes the Race Rocks area an excellent setting for Canada's first National Marine Park.”

The politicians who endorsed the study and supported the park were indeed visionaries but unfortunately only Race Rocks is protected.

Appendix 3: Previous shoreline documents presented to Metchosin Council

There is a history of concern about the values associated with the coastal part of Metchosin and the recognition of these values. The following examples illustrate this.

1. Sustainability Report

A large section of the **Sustainability Report** to Council of 2011 is devoted to marine systems:

Recommendations from Sustainability 2011 Report:

Metchosin's existing shoreline slopes development permit area, large lots and low density zoning have helped to reduce development impacts along coastlines, and have protected marine coastal habitat and its ability to store and sequester carbon.

Metchosin will help achieve sustainability and resiliency in its coastal areas by implementing the following:

- Lobby senior governments to recognize that municipalities are often the first to notice problems along their marine coasts and municipalities need the authority to protect these ecosystems;
- Consider zoning all marine shorelines in Metchosin as a development permit area in order to protect their natural values;
- Establish a program to document and monitor coastal resources, including eelgrass and kelp beds, and forage fish habitat, with the goal of ensuring no net loss of those resources;
- Identify and map areas important to forage fish and consider a method of restricting beach fires and other damaging activities in these areas at times of the year which are sensitive for forage fish.
- Emergency Preparedness Program – know who to contact, how, when where, why and in what circumstances
- Produce a pamphlet and help to educate both the public, and land owners with property bordering on the shoreline, of the sensitivity of coastal ecosystems, in order to reduce harmful impacts on coastal ecosystems.
- Post essential messages from and distribute Transport Canada's boaters guide at key locations to educate public.

2. The Blue Green Spaces Document

The Blue Green Spaces Document of 2008 emphasized the need for recognition of the Coastal Area. From Part 5 of this document:

> Marine areas.
> a. Nearshore marine areas. These areas occur along the coastlines of Metchosin. They are productive nursery areas and habitat for marine life, and include eelgrass beds, kelp beds, and subtidal rocky areas.
> b. Marine shorelines. These are areas of natural shoreline on land. They are an important part of the scenic character of the community, contain recreational trails or beach access points, and provide a buffer between buildings and natural dynamic processes such as shoreline erosion. Examples include: rocky marine shorelines and beaches (especially between Albert Head and Church Island), tidal lagoons, estuaries and offshore islands.

3. The Official Community Plan

The Official Community Plan (1995) makes reference to the Marine Area of Metchosin.

2.6 Marine Shorelands:

Definition: Within Metchosin, there are Rocky Shores, Drift Sector Beaches, Pocket Beaches, Low- Energy Shores and Lagoon Ecosystems…. In addition, the two types of beaches are further categorized into three distinct classes of beach based on the accretion and erosion characteristics. The combinations of shore categories and distinct beach classes produce a diverse range of marine shorelands. Most of the geotechnical and environmental concerns about shores relate to the processes of drift and accretion along the shore and the process of slope regression above the shores.

(a) General Marine Shoreland Policies:

2.6.1 The District of Metchosin may give consideration to the following:

(1) discuss with senior levels of government for coordinating future land use policies as they pertain to the management of Metchosin's marine shorelands.

(2) monitor shore processes with particular concern for slope regression rates, lateral drift rate and stability of Class I accretion beaches.

(3) determine, in conjunction with the Ministry of Environment, Lands and Parks, ways and means of undertaking:

(a) where desirable and feasible, a program of beach stabilization using natural nonstructural techniques, such as the planting of dune grasses where appropriate;

(b) beach enhancement programs wherever it is possible to upgrade a Class II beach to a Class I beach (see Definitions of beaches); and

(c) the removal or reduction of development intrusions not consistent with the maintenance of the shoreline.

2.6.2. The set-back requirements specified in this Section may be increased as local conditions warrant.

2.6.3 The improvement of public access should be ensured in the course of land development where such access is not detrimental to Sensitive Environments.

2.6.4 Any desired works to be placed on foreshore lands from the mean high water mark seaward requires application to the appropriate provincial and/or federal government agency responsible.

2.6.5 Public recreational use of marine shorelands should be consistent with the suitability of each shore type for the proposed use.

(b) Rocky Shores:

Definition: Rocky shores are stable shores comprised of exposed bedrock with an absence of unconsolidated material at extreme low tide. Relative to other types of shores, they are low in biological productivity but rich in biotic diversity and aesthetic quality and are characterized by lichens, snails, barnacles, mussels, seaweeds, anemones and sea stars.

2.6.6 No building or structure shall be located and no fill shall be placed or removed from any site within 15 horizontal metres (50 feet) of mean high water on Rocky Shore slopes except where engineering and resource management studies indicate that a lesser setback is acceptable.

2.6.7 Although the biological capability of Rocky Shore slopes to support life is relatively low, the natural biota may provide habitat for rare species of animal life and that value should be considered with each development proposed.

(c) Drift-Sector Beaches:

Definition: A Drift-Sector is an integrated and independently operating erosion beach system which may extend for many miles in length and be separated from adjacent drift-sectors by either natural or artificial boundaries. Metchosin contains one large drift-sector extending from Weir Beach to Witty's Lagoon. A drift-sector generally contains the following three classes of beaches:

Class III Beaches are erosional beaches located at the base of coastal bluffs or cliffs from which sand and gravel is provided for accretion of Class I beaches further along the drift-sector. Class III beaches are totally submerged at high tide with no dry backshore berm.

Class II Beaches are marginal erosion beaches located at the base of coastal bluffs or cliffs from which sand and gravel is eroded providing a secondary source of beach material for accretion on Class I beaches further along the drift-sector. Class II beaches are largely submerged at high tide with only a limited amount of walkable dry backshore under such conditions.

Class I Beaches are the accretion terminals of a drift-sector where material eroded from Class II and III beaches is deposited. Class I beaches remain dry and walkable at high tide and have a large backshore berm permitting ease of public access and use. They constitute the most important recreational beaches. Biotically, beach shores are of intermediate productivity and diversity relative to the other shore types.

2.6.8 The use and management of the Drift-Sector Beaches should be based on the maintenance of the present natural system of erosion, transport and build-up of beach material along the length of the Drift-Sector designated on Map 5 (*see OCP)*.

2.6.9 Because the existence and maintenance of the Class I beaches are dependent on the supply of material eroded from Class II and III beaches, no bulkheading or placement of any shore protection structures will be permitted within a drift-sector except where engineering and resource management studies indicate otherwise.

2.6.10 To ensure that material eroded from Class II and III beaches is transported the full length of the shoreline to Class I beaches, docking or other facilities which impede the natural processes will not be permitted within drift-sectors.

2.6.11 Due to active slope recession with considerable sloughing and slide evidence, no building or structure will be permitted within a minimum of 60 horizontal metres (200 feet) from mean high water adjacent to Class II and Class III drift-sector beaches except where geotechnical engineering and resource management studies indicate a lesser setback is acceptable.

2.6.12 On the slopes adjacent to Drift Sector Beaches, no material of any kind shall be removed within a minimum of 60 horizontal metres (200 feet) landward of mean high water.

2.6.13 The location of the mean high water mark and the establishing of setbacks from Class II and Class III slopes should be reviewed at 5 year intervals, or as required, to determine if slope regression has placed residences at risk.

(d) Pocket Beaches:

Definition: A Pocket Beach is a sand and gravel beach along which no lateral drift of beach material takes place because it is contained between two headlands. The Pocket Beach is formed by the onshore and offshore movement of material. Pocket beaches are generally between 30.5 metres (100 feet) and 91.5 metres (300 feet) in length.

With Pocket Beaches, as with Drift-Sector Beaches, there are three classes. However, unlike the classes of Drift-Sector Beaches which are contained adjacent to one another within the Drift- Sector, each class of Pocket Beach exists independently.

Class III Beaches are erosional beaches located at the base of coastal bluffs or cliffs with no dry backshore berm. Such beaches are totally submerged at high tide.

Class II Beaches are marginal erosion beaches located at the base of coastal bluffs or cliffs that supply the upper foreshore with a fairly heavy drift berm without creating a stable dry backshore zone above high tide.

Class I Beaches are rollback pocket beaches characterized by a backshore wetted only under extreme tide and wave conditions permitting ease of public

access and use. They constitute the most important recreational class of beach.

2.6.14 No building or structure shall be located and no fill shall be placed or removed from any site within 15 horizontal metres (50 feet) of mean high water adjacent to Class I and Class II pocket beaches except where engineering and resource management studies indicate that a lesser setback is acceptable.

2.6.15 Because Class III pocket beaches are located at the base of cliffs which are subject to erosion, no building or structure, no placing or removal of fill or other material will be permitted within 15 horizontal metres (50 feet) landward of mean high water adjacent to Class III pocket beaches.

2.6.16 No bulkheading or placement of any shore protection structures will be permitted on Class I, Class II or Class III pocket beaches except where engineering and resource management studies indicate otherwise.

(e) Low-Energy Shore Zone

Definition: Low-Energy Shores are estuarine shores which form part or all of a cove or inlet. They may be characterized by marshy shores, shallow and muddy foreshores, and generally having low banks. As with Pocket Beaches, there are three classes of Low-Energy Shores each existing independently. However, in Metchosin, there is only one Low-Energy Shore - entirely a Class III (erosional) located at the head of Pedder Inlet.

Similar to a Lagoon Ecosystem, the estuarine shore also provides a unique biological environment. Fresh-water creeks and streams flowing into the cove or inlet offer rather unusual habitat. There is currently insufficient information available relating to the protection and preservation of the Low-Energy Shore zones. Therefore, further research is recommended.

2.6.17 No building or structure shall be located and no fill shall be placed or removed from any site within 15 horizontal metres (50 feet) of mean high water adjacent to the Low-Energy Shore, except where engineering and resource management studies indicated that a lesser setback is acceptable.

2.6.18 No bulkheading or placement of any shore protection structures will be permitted on a Low- Energy Shore except where engineering and resource management studies indicate otherwise.

(f) Lagoon Ecosystems:

Definition: The central component of a Lagoon Ecosystem is a body of salt water which has been cut off from the ocean by a barrier or spit of land and which allows the formation of a sheltered biological environment. This unique environment frequently includes a salt-water marsh and estuarine area into which flows fresh water from upland creeks and streams. This combination of fresh and salt water has very high biological productivity and diversity. It offers significant aesthetic and habitat attributes.

2.6.19 Only such uses as limited agriculture and low intensity recreational uses, which do not require structural intrusion, will be permitted in Lagoon Ecosystems.

The Official Community Plan. Development Permit Areas. 2.16

The Municipal Act provides that a community plan may designate development areas to be protected from hazardous conditions. The Municipal Act further provides that in such areas land shall not be altered in any way or subdivided, and structures cannot be built or added to until a Development Permit has been issued. (see: http://www.retooling.ca/_Library/docs/WCEL_climate_change_FINAL.pdf *Preparing For Climate Change: An Implementation Guide for Local Governments in British Columbia* Page 35 Development Permit Areas)

There are well-established practices and many examples in BC with respect to using Development Permit Areas (DPAs) to manage land use in areas with defined hazards, such as slope stability issues. DPAs can also be used to restrict development and protect and/or restore natural features and areas, and to help protect key natural ecosystems in the face of climate change.

DPAs can offer local governments a more flexible approach to regulating development than zoning because guidelines can specify results and allow site-specific solutions.

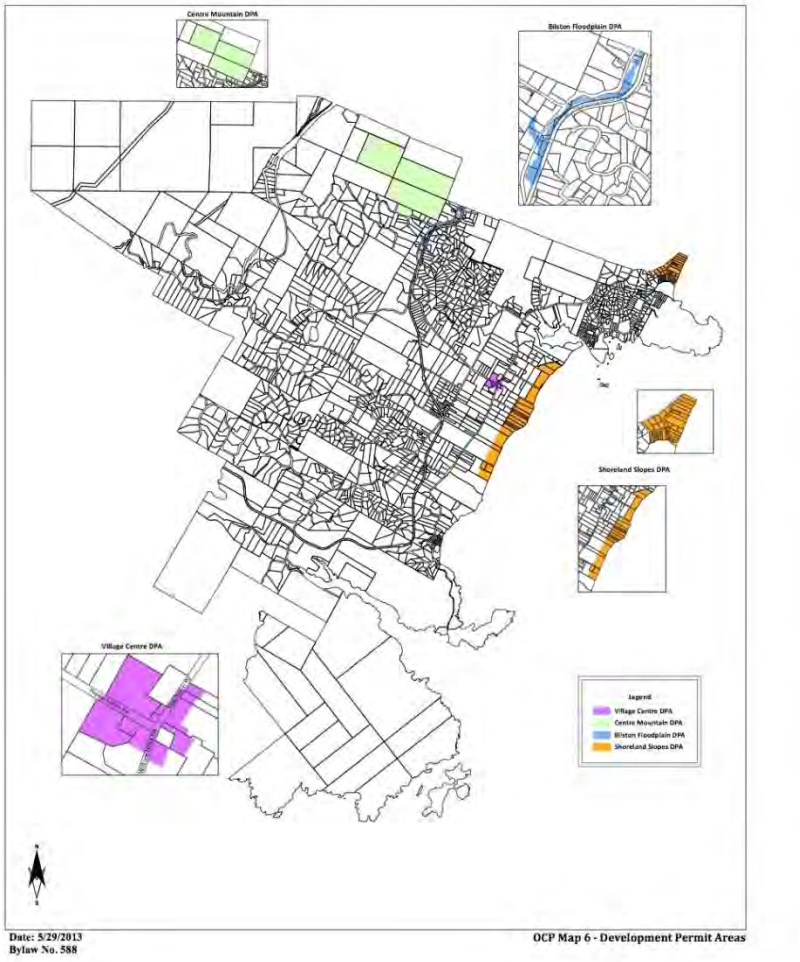
Metchosin's OCP has good provisions for establishing DPA's in sensitive areas. Unfortunately the District has not extended the DPAs to all of the sensitive areas of the coast and has not been entirely successful in enforcing development restrictions on existing DPA's.

From: District of Metchosin Official Community Plan Section on Shoreline Slopes Development Permit Areas:

"Designation: (Bylaw 418, 2004)

The 1993 Hazard Land Management Plan has identified areas of the Metchosin shoreland slopes as having erosion, land sloughing and drainage problems.

Map 6 (See website http://metchosinmarine.ca/gf/?tag=development-permit-areas)



The Shoreland Slopes areas are shown on Map 6 Shoreline Slopes DPA, and are hereby designated as areas for the protection of development from hazardous conditions pursuant to Section 919.1(1)(b) of the Local Government Act.

The Plan has identified three Shoreland Slope classification zones, based on the degree of slope instability and surface erosion potential. Slopes classified as zone 2 and 3 are slopes with the greatest potential for sloughing, slumping and debris flows and have been included in the Development Permit Area.

2.16.2 Special Conditions:

The major concern is that lands, particularly in the **Park Drive – Farhill Road area,** have experienced a dramatic rise in ground water levels due to adjacent developments during the last two decades. Other areas of the Shoreland slopes have experienced significant slope erosion in the past. There is a community desire to mitigate any further development related impacts on the marine shorelands.



2.16.3 Policies Development Permits issued shall be in accordance with the following:

(1) The construction or alteration of buildings on existing lots shall be permitted subject to the Building Permit process when Council is satisfied that the Development Permit Guidelines (Section 2.14.4) have been met, and, when required, Council is satisfied with the Engineer's Report (Section 2.14.5).

(2)Where a Development Permit is applied for in conjunction with an application for subdivision approval, rezoning, or both, the Development Permit shall be conditional on the successful completion of those other permits and shall lapse if the subdivision or rezoning is not approved.

2.16.6 Municipal Response

The District should

(1) evaluate the feasibility of purchasing environmentally sensitive shorelands for use as park, forest reserve, or greenbelt;
(2) initiate programs to monitor both surface and ground water to establish patterns of change;
(3) work with proximate agencies to establish erosion and land sloughing control measures."



Parry Bay (Taylor Beach) section of DPA lands

Information and maps on DPA's in Metchosin are found at
http://metchosinmarine.ca/gf/?tag=development-permit-areas



Taylor Beach looking towards William Head

Appendix 4: Global risks to shorelines

Perhaps one of the most compelling arguments for the value of marine environments came in 2011 from IOC/UNESCO, IMO, FAO, UNDP. A Blueprint for Ocean and Coastal Sustainability. Paris: IOC/UNESCO. (http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/interagency_blue_paper_ocean_rioPlus20.pdf)

"…*Maintaining the quality of life that the ocean has provided to humankind while sustaining the integrity of ocean ecosystems, requires changes in how we view, manage, govern and use ocean resources and coastal areas. Ocean and coastal areas provide many benefits to sustainable development, including both human (social and economic) and environmental (ecosystem services). This includes benefits to economic sectors such as fisheries, energy, tourism, and transport/shipping, as well as 'non-market' benefits such as climate regulation, carbon sequestration, habitat and biodiversity, among many others. The scale and intensification of the stresses on the ocean mean that deferring action will increase costs in the future leading to even greater losses of benefits. Many traditional economic and consumer values that formerly served society well, when coupled with current rates of population increase and economic growth, are not sustainable.*

Sustainable development is defined as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' Sustainable development is the approach recognized by the international community to deal with environmental, social and economic issues the world has faced in the past 20 years....Problems, for example, include the fact that very little of the world's ocean is monitored or protected; coastal habitats continue to be lost or degraded; the majority of global fish stocks are under pressure; invasive species are expanding; hypoxic zones are increasing; the ocean is acidifying; sea level is rising."

The IOC/UNESCO document puts forth three major objectives for ocean and coastal sustainability. The first objective identifies "…Actions to reduce stressors and maintain or restore the structure and function of marine ecosystems for equitable and sustainable use of marine resources and ecosystems…"

Two of the main actions are to:

- Develop and Execute a Global Program aimed at Greater Protection and Restoration of Vital Ocean and Coastal Habitats, and develop a Global Blue Carbon Market as a means of Creating Direct Economic Gain through Habitat Protection

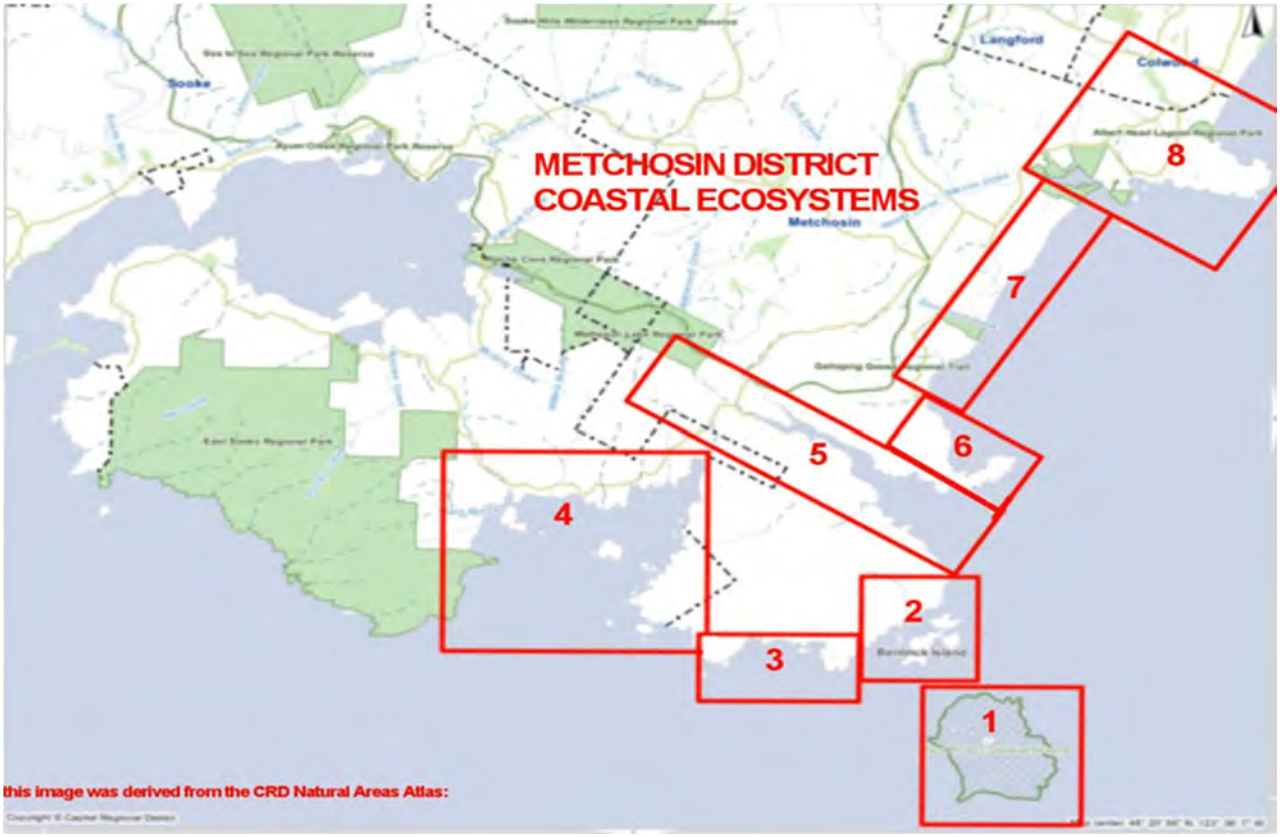
- Strengthen the Legal Framework to Effectively Address Aquatic Invasive Species

These same principles can be considered and applied to local shorelines.

Appendix 5: Ecologically Sensitive Areas and the Ecology of the Eight Zones of Metchosin Shoreline

The land-sea interface along the coast of Metchosin exhibits a wide diversity of landforms and marine communities within a relatively confined geographical area. It is in these areas, where the coastal habitats, marine communities and oceanographic phenomenon achieve their greatest expression.

For descriptive purposes, the map below (also on page 7) divides the coastal part of Metchosin into eight zones.



Each of the zones is described in more detail in the following pages, and some of the notable features are outlined. This is based on the Metchosin District Coastal maps of the Coastal South Vancouver Island website done by Garry Fletcher (2003) http://powweb.racerocks.ca/metchosinmarine/ecoareas.htm

We have started our descriptions at Zone 8 since Zones 5 – 8 will be more familiar to most readers.

Zone 8: Albert Head Beach to Witty's Beach.



On the Zone 8 map above: Areas 1 and 2: Albert Head Lagoon and Beach

Ecosystems represented	Importance (these overlap)
Lagoon ecosystem (intermittent salt water intrusions)	Migratory and resident seabird habitant. Nursery and rearing area for marine invertebrates, fish, and waterfowl
Sand spit and dune ecosystems	Sensitive dune vegetation
Sand-gravel beaches	Waterfowl and shorebird feeding and breeding area
Tide flats	Shellfish habitat – high concentration of univalves
Sand, mud, silt subtidal habitats	High nutrient and detritus production

Comments

This area is closest to the former gravel pit which is slated for high density development, and will be severely impacted by increased human traffic.

The south end of Albert Head on the inland side is a bird sanctuary where species such as killdeer and sandpipers nest. Native vegetation struggles hard with the human traffic. Gumweed grows on the upper part of the berm and Sand Burr, a native species, has a woody root deeply anchored in the sand. The American Sea Rocket grows closest to the ocean and, along with beach grass with its long underground root stems, helps to stabilize the beach.

Eco notes

The most stable shorelines which are resistant to erosion are those that have an unconsolidated berm of sand, pebbles, rocks and logs, and a vegetated backshore area, with sea grasses and other plants adapted with long and intertwined roots which anchor the sand. Natural areas have evolved through thousands of years and are able to absorb the impact of storms, as well as provide essential habitat for invertebrates and fish.

On the Zone 8 map above: Areas 3 - 9: Albert Head, Tower Point, and Duke Road waterfront

Coastal Islands with harbour seal haulouts

Ecosystems represented	Importance
Islets	Migratory seabird resting areas; nesting areas for resident birds
Geologically significant “pillow lava” islands	Harbor seal haulouts
Rocky intertidal and subtidal habitats	Rocky shore tide pools; kelp forests

Comments:
The islands provide good habitats for marine mammals and birds including protection from predators and food in the form of algae, fish, and invertebrates.

On the Zone 8 map above: Areas 10, 11: Witty's lagoon, estuary and beach spit

Coastal lagoon, migratory and resident seabird habitat.

Ecosystems represented	Importance (these overlap)
Salt water marsh	Specialized vegetation communities; example of natural succession
Fresh water estuary	Nursery area; waterfowl and shorebird feeding and roosting area; important for overwintering birds; nutrient supply for marine ecosystem
Tidal flats	Nursery area; shorebird feeding area
Sandspit and beach	Marine life adapted to sandy beaches; plant life adapted to bind sand.
Arbutus-Garry oak stands	Both are endangered tree species
Aspen parkland	One of the plants found on a complex coastal beach area

Comments

Witty's beach is an accretional beach with materials supplied from long shore drift from the cliffs to the south. Behind the beach is a large tidal lagoon, and estuary fed by Bilston Creek.

Salt pans form in the upper reaches of the lagoon where only the highest tides reach. In the fall, concentric layers of salt tolerant plant species form intriguing patterns in these pans. Two of these salt tolerant species are *Salicornia* sp.and *Distichlis spicata*. The dune grass, *Leymus mollis*, has underground creeping rootstocks that bind the sand together and can absorb heavy wave impact. Unfortunately, the introduced species scotch broom, *Cytisus scoparius*, has colonized the area, suppressing the natural beach vegetation and possibly leading to instability in high storm surges.

The edge of the lagoon gets flooded at high tide. The nutrients accumulated in the marsh are important to nourish the marine ecosystem. Runoff from golf courses, septic systems, and agriculture carry nutrients which cause algal growth and eutrophication when the lagoon is poorly flushed.

Seabirds frequent the lagoon throughout the year but are more abundant in migration periods.

Eco notes

Lagoons and salt marshes are a type of estuary - bodies of water that form at the mouths of rivers, where tidal water and fresh water meet and mix. They are among the earth's most productive environments providing an extremely rich and important habitat for a great variety of life. They support more plant and animal growth per unit of area than even the best agricultural lands. (Pacific Coast by Bayard H. McConnaughey and Evelyn McConnaughey, 1994). The interaction of salt water and fresh water result in fluctuating conditions and make this habitat an unstable and demanding one. Plants and animals that live in estuaries must be able to cope with these fluctuations. Plant growth consists of small to microscopic algae that live in the water, and most of the animals are either very small or are concealed in burrows within the mud or the sand.

The rich variety of seashore and underwater life along the coast of Metchosin is partly due to the many different habitats that are represented. Each habitat has a characteristic assemblage of organisms. Some of the biological interactions that go on in a particular situation are obvious, as when a sea star attacks a mussel, or when a limpet grazes on seaweed. More often, however, the interactions are subtle and many are still not understood.

Each environment has its own challenges for the organisms, both plant and animal, living there. For example, rocky shores often have surf or large waves so the plants and animals need to have good methods of attachment; sandy beaches shift and leave little space between grains of sand to live so the animals there need to make burrows or tubes with some substance, and the plants are mostly microscopic; pebbly beaches move so the organisms need to be able to withstand crushing; high speed current channels require organisms with special means of attachment and the animals need special ways to obtain food.

Each animal species has needs – food, oxygen, excretion, reproduction, protection. Each habitat is different and the organism inhabiting it has adaptations that allow it to live in that habitat. Some organisms are generalists and can live in several habitats; other organisms can only live under very specific conditions.

If any environment is changed, either naturally or by people, many organisms living there will not be able to meet their needs and will perish.

Zone 7: Parry Bay cliffs, Taylor Beach to Weir's Beach



On the Zone 7 map above: Area 1: Parry Bay cliffs north of Taylor Beach and south of Witty's Beach with boulder foreshore

Ecosystems represented	Importance (these overlap)
Subtidal boulders	Provide a stable substrate for a variety of attached green, brown and red algal species such as *Fucus*, *Ulva* and *Iridea*.
Intertidal rocky area	Habitat for many species of snails, chitons and tubeworms (which when submerged are a valuable food resource for fish)

Comments:
At the toe of the cliff, there is natural erosion caused by wave action. As sea levels rise, the risk of further cliff erosion increases.

In addition to natural erosion, the effects of grazing, water diversion, tree removal, and development on the top of the cliffs is evident in the increased slumping of soil and vegetation. As an example, the destabilization of the bluff at the north end of Taylor Beach, just south of the Witty's beach area resulted in a massive slide in the fall of 2007. Clay deposits covered the intertidal zone for 20 to 50 metres. Erosional deposits like this smother intertidal life.

On the Zone 7 map above: Areas 2,3,4: North end of Taylor Beach-Gooch Creek to cliffs; Gooch Creek and Lagoon; Taylor road to Gooch Creek

Ecosystems represented	Importance (these overlap)
Fresh water lagoon	Habitat for blue-listed coastal cutthroat trout and red-legged frogs
Fresh water estuary	High nutrient and detritus production; nutrient supply for marine ecosystem
Sand / gravel / rock beaches	River otter habitat; overwintering shorebirds, and shallow water feeders, (western and eared grebes, buffleheads and scoters, with pacific loons appearing occasionally). Several species of gulls feed in large numbers in the fall
Subtidal sand / gravel / rock	subtidal species adapted to the various habitats; green, brown and red algae; offshore concentration of eelgrass beds; Commercial crab fishing offshore

Comments:

Gooch Creek and associated ecosystems provides habitat for two provincially blue-listed species: coastal cutthroat trout (*Oncorhynchus clarki clarki*) and red-legged frog (*Rana aurora*) as well as three-spine stickleback (*Gasterosteus aculeatus*). The cumulative effects of land conversion, land use, livestock usage, invasive species encroachment, and road practices have altered the aquatic health of this system.

Eco note

The algae which ends up on the beach in the autumn is homogenized by wave action into small pieces. In this state, nutrients are more easily released in the decomposition process. They are then recycled offshore. An important part of energy conversion is the large numbers of amphipods or beach hoppers which use the cover of the algae to feed on decomposing material.

On the Zone 7 map above: Areas 4, 5 and 6: Devonian Park cobble beach and lagoon (south of Taylor Road), rocky shore of lower Taylor Beach to Weir's Beach

Ecosystems represented	Importance (these overlap)
Fresh water pond	Red-winged blackbird habitat; swan nesting habitat; sea-run cutthroat trout
Gravel / rock beaches	River otter habitat; waterfowl and shorebird feeding
Rocky intertidal and subtidal habitats	Subtidal species adapted to the various habitats; green, brown and red algae; offshore concentration of eelgrass beds; Commercial crab fishing offshore; sports fishing offshore
Pocket cobble beaches	Forage fish spawning areas
Rocky cliffs	Intertidal and subtidal organisms adapted to steep rocky habitats; plants adapted to rocky exposed habitats; Garry oak meadows with camas

Comments

The southern part of Taylor beach is made of coarse and fine cobbles. The profile of the beach changes from winter to summer as the wind patterns change. Behind the berm on the south end of Taylor beach lies Sherwood Pond. Devonian Park protects the riparian zone along the creek feeding Sherwood Pond. This is an important habitat for preservation of sea-run cutthroat trout. Sherwood Creek is held back from the ocean by a high ridge of coarse gravel. Throughout the early winter and late spring, the water seeps through the berm of gravel. After heavy rains the creek will often break out and erode the beach and the next big storm will fill the gravel berm back in again. From Taylor Beach to Weir's Beach there is a series of cliffs and pocket beaches.

Eco Notes

The gradient of living conditions for shore organisms is partly determined by the topography and substratum which affect the water-retaining capacity of the shore. As the tide recedes, the intertidal areas start to dry out. The rate of drying depends, firstly, upon the slope of the shore, with steeply sloping rock faces draining more rapidly than undulating platforms or shallow slopes. Cracks and crevices provide micro-environments in which the rate of drainage and the drying effects of sun and wind are greatly reduced, and permit colonization to higher levels on the shore than occurs on the open rock faces in the same location.

The vertical distribution of subtidal organisms is largely dependent upon illumination. Most of the green and brown algae are restricted to situations within 15 feet of the lowest tide level, whereas certain red algae may be found down to 50 feet in depth. Animals which graze upon the green and brown algae will thus be found only near the surface. The deeper-living species of invertebrates are primarily filter-feeders, predators or scavengers, rather than grazers.

On the Zone 7 map above: Area 7: Weir's beach and ponds

Ecosystems represented	Importance (these overlap)
Fresh water ponds	Nesting and feeding habitat for various duck species and swans; river otter habitat
Sand beach	Great variety of waterfowl and shorebirds feeding; several species of gulls feed in large numbers in the fall; high nutrient and detritus production from decomposing seaweed; seaweed collecting by local farmers and gardeners of the fall die-off of the sea lettuce, *Ulva lactuca*
Subtidal sand / gravel	offshore concentration of eelgrass beds; Commercial crab fishing offshore; sportsfishing offshore

Comments

Weir's Beach was originally a Class I beach with undisturbed porous berm and backshore lagoon. It has been heavily impacted by human modification.

Eco Note

Eelgrass (*Zostera marina*) is a seed-producing marine plant. It grows in flat shallow underwater muddy or sandy habitats.

- Eelgrass is not a seaweed; it is a blooming underwater grass which spreads by rhizomes or roots.
- Eelgrass meadows build up in the spring and summer, then decay in the fall and winter.
- Eelgrass blades can grow up to 3 feet long.

(http://www.ecy.wa.gov/programs/sea/pugetsound/species/eelgrass.html

- Eelgrass is protected by law, under the Federal Fisheries Act, due to its high fisheries value (primary production, substrate for food organisms, spawning substrate and cover).

Why are eelgrass beds important?

- Eelgrass beds assist with coastal protection by providing a physical baffle (leaves) and reducing erosion (roots & rhizomes).
- The beds support a high biodiversity of species. It has been estimated that over 80% of all commercial fish and shellfish species depend on eelgrass habitat for at least part of their lifecycle. Damage to eelgrass affects whole populations of fish (including salmon), waterfowl, shellfish, and other animals.
- Eelgrass contributes to marine food webs, and is carried by tides and currents throughout the ocean.
- Seagrasses, such as eelgrass, play a critical role in global climate and ocean cycles. Recent reports by the United Nations Environmental Protection Department demonstrate the value and urgency of seagrass conservation: "We are becoming aware of the role that seagrass plays in the climatic and oceanic carbon cycles and in coastal protection. The true economic value is difficult to measure, but work suggests it is immense. Seagrass beds have been overlooked by conservationists and coastal development planners throughout their range. Biosphere restoration must include seagrass conservation and restoration."

Zone 6: William Head



On the Zone 6 map above: Areas 1 to 4: Rocky headland

Ecosystems represented	Importance (these overlap)
Rocky shore habitats	Arbutus - Garry oak stands
Pocket beaches	Protected areas for migrating birds
Protected bays	Rocky tide pools; kelp forests (seasonal)
Shallow subtidal habitat	Important shellfish regeneration area
Deepwater habitats	Rich subtidal marine life; marine mammals (harbour seals and killer whales)

Comments

The shoreline surrounding William Head is a rich and productive area due to the upwelling wave action from the Strait of Juan de Fuca and current patterns around the Head. Due to this productivity, biological diversity of marine life is high in and amongst its shores. As recently as 1997 there were studies on the feasibility of making William Head a Marine Protected Area.

Since its establishment, the William Head Institution has provided *de facto* protection of marine life around William Head from fishermen and divers. Recent survey dives around William Head have revealed this area to be very productive with high biological diversity. For example, Northern Abalone *(Haliotis kamtschatkana),* a commercially extinct species in British Columbia, are possibly much larger and more abundant around William Head than anywhere else on the West coast. In addition, there is an abundance of marine mammals and plants, crustaceans, echinoderms, sponges, kelp beds, seaweeds, and fish. There are several valuable references illustrating the underwater diversity of this area:

http://www.racerocks.com/racerock/INVERTS/dgibbs.htm. This gives the species list from Dive 431 of Donna Gibbs (Vancouver Aquarium), William Head, June 12, 1997

http://www.racerocks.com/racerock/rreo/rrrefer/wmhead.htm (paper by Julie Barr, 1996 Interests of Stakeholders and Options for Establishing a Marine Protected Area at William Head - A Discussion Paper)

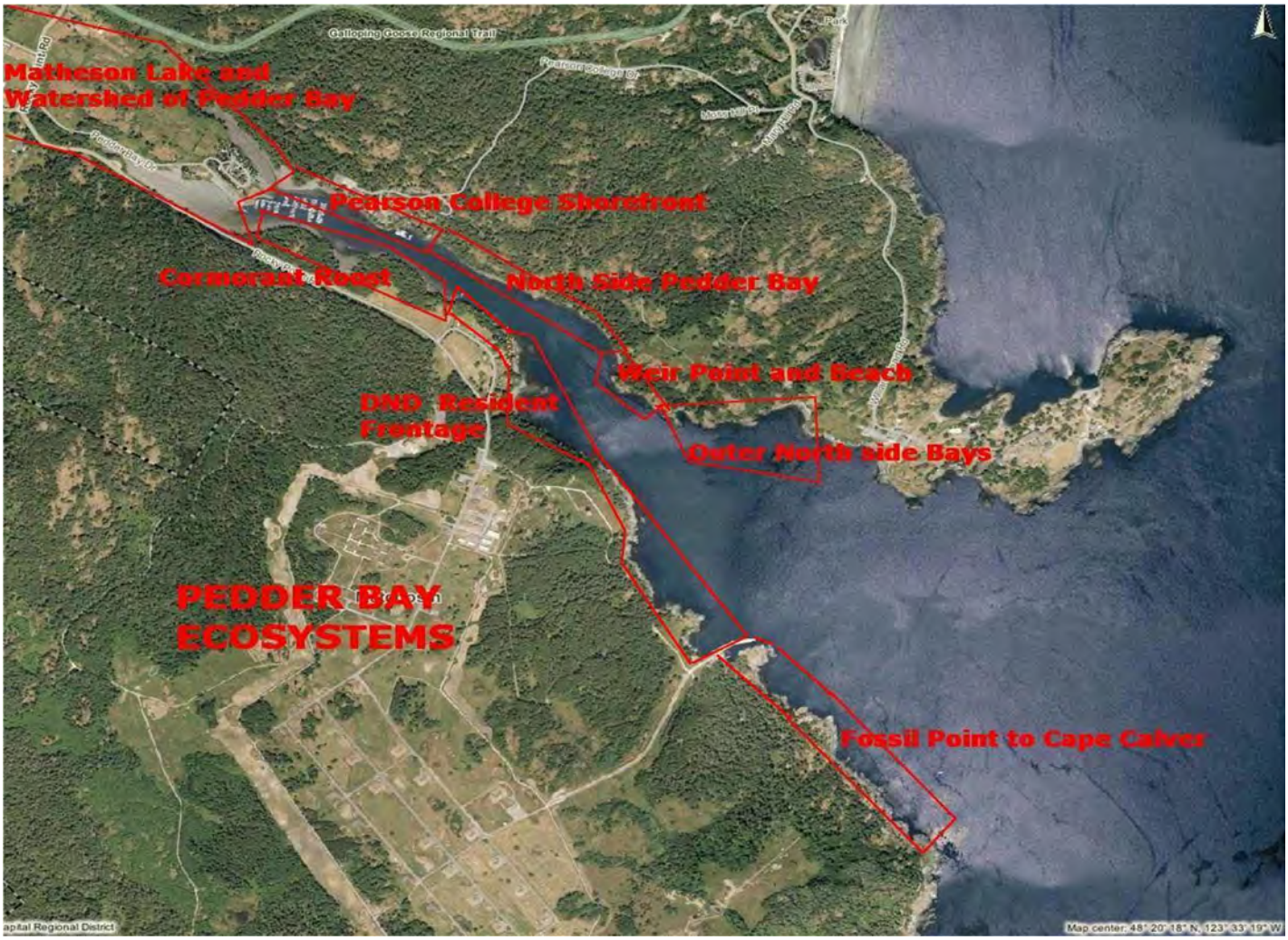
http://www.racerocks.com/racerock/rreo/rreoref2/jdfmarpk/juanmarpark.htm (Goddard, James M. 1975)

Econotes

Bull kelp (*Nereocystis luetkeana*) grows in large “forests” off the coast of William Head and other areas in this region. It is attached to the seafloor by a holdfast and can grow up to 60 cm/day, hence the fastest growing seaweed in the world. They have a high rate of photosynthesis and fix significant carbon.

Kelp beds provide ecosystem services including shelter and habitat for many species of fish and invertebrates including urchins, sea stars, snails, and crabs. They are an important food source for sea urchins and a feeding ground for seals, sealions, and birds.

Zone 5: Pedder Bay



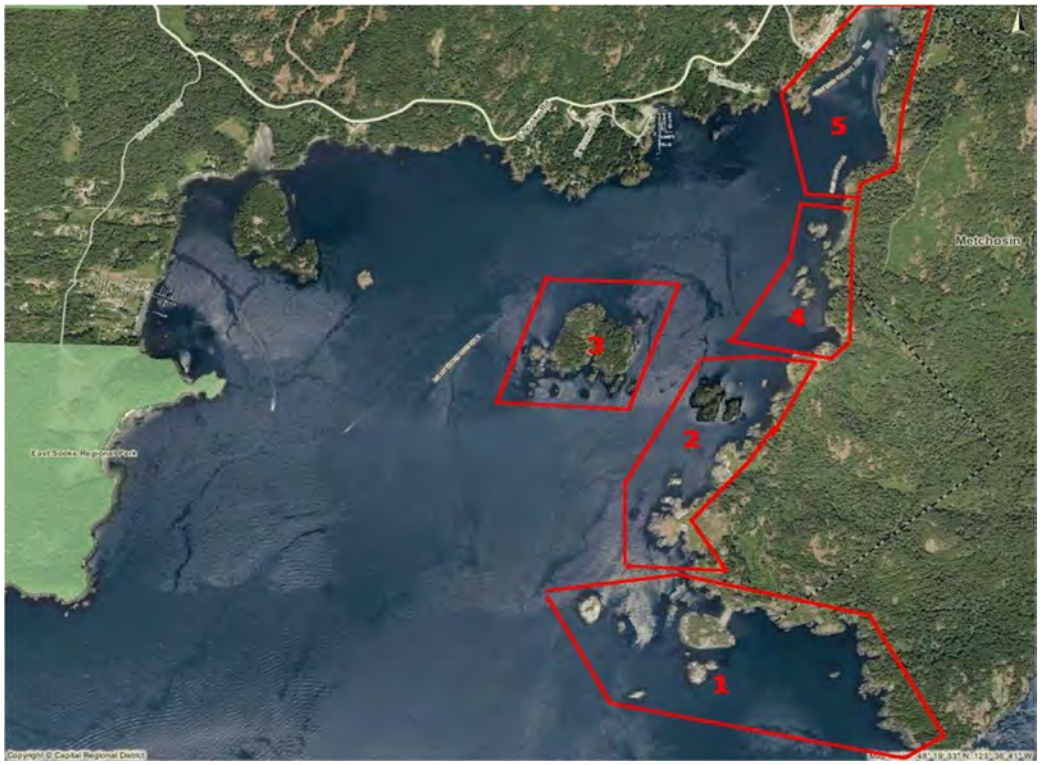
Ecosystems represented	Importance (these overlap)
Estuary mudflat at upper end	a valuable source of food for waterfowl throughout the year; habitat for burrowing organisms adapted to mud such as cockles and marine worms
Fresh water estuary	overwintering shorebirds such as Western Grebes, Scoters, and Buffleheads; Cormorant wintering roosting colony
Protected rocky intertidal shoreline	larva of organisms living here contribute to the rich planktonic mix in the waters of the bay

Comments:

The geography of Pedder Bay and the exposure of its shores to the marine environment results in a number of contrasting ecosystems on the upland part of the shores. It also contributes significant materials to the marine environment and through four or five months of the year contributes a large volume of freshwater, acting more like an estuary than a regular bay.

Zone 4: Beecher Bay and islands

Island ecosystems with significant invertebrate and kelp beds



Zone 4:
Area1: Swordfish Island to Bedford Island
Area 2: North West corner of Beecher Bay
Area 3: Islands in Beecher Bay
Area 4: East side of Beecher Bay
Area 5: North east inner corner of Beecher Bay

Ecosystems represented	Importance (these overlap)
Protected bays	Garry oak – arbutus habitat; Western hemlock forest
Sand beaches	Valuable habitat for forage fish
Spectacular headland and steep sea cliffs	Interesting geologic formations; salmon fishery; marine mammals (harbour seals, sea lions, killer whales and other cetaceans)
Parkland shoreline	Rocky tide pools; First Nations cultural remains
Rocky and sand subtidal habitats	Eelgrass beds; unique subtidal benthos including dense populations of the soft coral, *Gersemia rubiformis,* and the anemone, *Metridium farcimen,* in seacave

Comments:

Although much of this part of the Coast borders on First Nations Land, some of the islands are crown land and some of the shoreline is DND and privately owned land. Parts of the area have been used for years as log booming grounds and dock areas where some impacts are evident.

James M. Goddard (1975) gives a detailed description of the animal populations of Aldridge Point in Beecher Bay.
(http://www.racerocks.com/racerock/rreo/rreoref2/jdfmarpk/juanmarpark.htm)

Zone 3: Whirl Bay Area

Island and shoreline ecosystems swept with strong currents and bearing significant underwater invertebrate colonies



Several important areas are in Zone 3:

Christopher Point
Shelter Island
Whirl Bay
Swordfish Island
Church Island

Ecosystems represented	Importance (these overlap)
Steep nearshore topography	Vertical intertidal zonation
Surge channels	Rich subtidal flora and fauna
Strong ocean currents	Salmon fishery
Cold water upwelling	Rich subtidal flora and fauna; salmon fishery
Underwater caves and cliffs	Specialized flora and fauna
Protected bays and shallows	Waterfowl and seabirds; eelgrass, and kelp forests (seasonal)
Offshore islands, islets, shoals and reefs	Kelp forests; seabirds; harbor seals

Comments

Swordfish Island

A rare hydroid species, *Tubularia* sp., occurs near Swordfish Island. This species has been found in only two locations: here and in Norway. In the waters at Swordfish Island it grows in association with colonial ascidians and is as large as 15 cm in height. Pearson College students, observing this species over the last twenty years report that is has very limited distribution, with no more than one or two polyps appearing at any one time.

This area also contains populations of the soft pink coral, *Gersemia rubifromis,* at unusually shallow depths.

Church Island

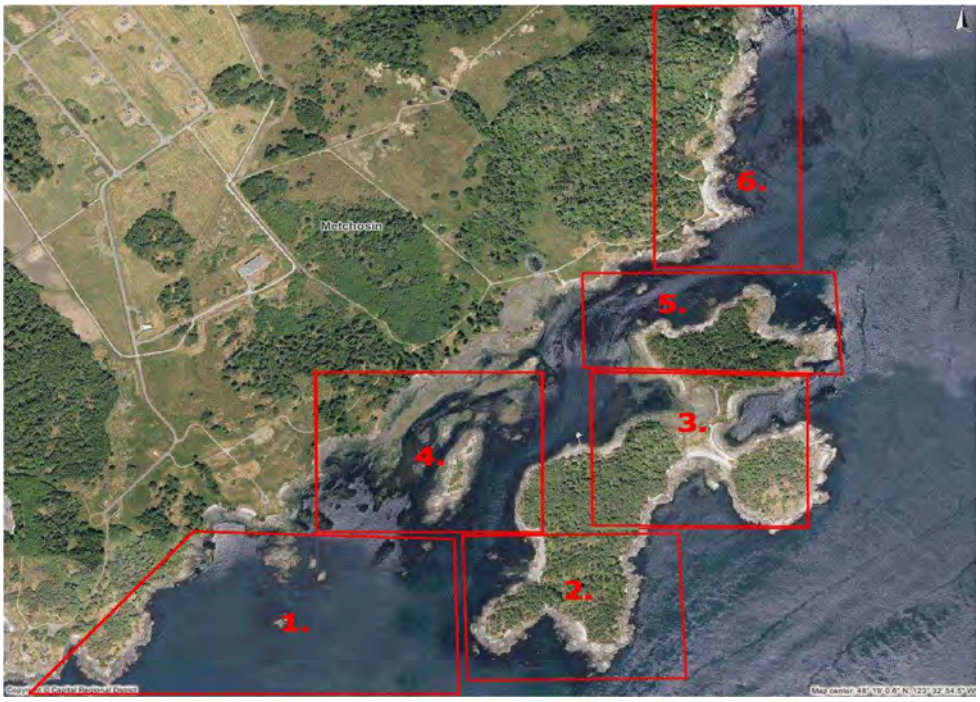
A large patch of the rare blue-listed seaside plant, *Romanzoffia tracyi,* (Tracy's mist maiden) sits on the north facing ridge at the top.

Eco Notes

This area is an example of the semi-exposed outer coast ecosystems. It has a relatively unsettled climate due to the influence of the outer coast climatic patterns and frequent southwesterly gales. The shoreline is exposed and experiences pronounced and continuous wave swells and tide surge due to the extended fetch across Juan de Fuca Strait.

The vegetation on the islands is considerably influenced by salt spray, resulting in flag-form and stunted vegetation, including mature trees of Gary Oak and Douglas-fir which grow uphill close to the ground for several metres.

Zone 2 Rocky Point and Bentinck Island



Important Areas of Zone 2 shown on the above map

Area 1: South entrance to Eemdyk Pass
Area 2: South Bentinck Island
Area3: Central bays and east wing of Bentinck Island
Area 4: Central Island in Eemdyk Passage
Area 5: North Bentinck Island
Area 6: Rocky Point shoreline between Cape Calver and Edye Point

Ecosystems represented	Importance (these overlap)
Steep nearshore topography	Good zonation of intertidal habitats; marine mammals (killer whales, porpoises and other whales)
Shoals and reefs	Rich subtidal flora and fauna; kelp forests (and over 30 species of macroalgae), marine mammals (harbor seal, sea lions)
Shingle beaches	Waterfowl and seabirds; otters, mink
Strong ocean currents; high current channels	Specialized invertebrates
Rocky shore tide pools	Variety of invertebrates; birds

Rocky salt-sprayed headlands	Populations of mist maiden, *Romanzoffia tracyi*, and highly coloured crustose lichens
Shallow high current velocity (Areas 2 & 4)	Specialized subtidal ecosystems
Protected Bays	Winter feeding grounds for seabirds; harbor seals

Comments

Sports fishery is closed due to Rockfish Conservation
Area 5 has historic burial cairns

Eco Notes

This marine area is an example of a “transition coast” with a variable climate pattern, frequent fogs and unsettled weather. The shoreline is exposed and experiences pronounced wave action and tide surge.

Offshore areas are subject to strong current and tide action; tide range approximates 1.86m (6.1 feet) but may reach 3.02m (9.9 feet); tide occurrence is similar to inner coast; 7˚C to 9˚C surface water temperature; water subject to constant mixing; whirlpools common in passages; variable water clarity (seasonal); mean salinity approximates 31 parts /1000 yearly; steep forested shoreline topography; rugged intertidal zone; offshore islands and islets occur throughout the area.

Currents are of relatively minor importance in influencing the local distribution of intertidal organisms. It matters little whether the currents are strong or weak so long as food and nutrients are supplied, and reproductive stages are dispersed to colonize or replenish distant as well as nearby areas. In subtidal situations, however, the magnitude of the current does have a marked influence upon the biotic communities. Certain species assemblages are found only where high-velocity currents occur, whereas other forms are characteristic of quiet, sheltered waters. Many of these areas show the species characteristic of moderate to high-velocity areas.

Zone 1 Race Rocks Ecological Reserve

This Ecological Reserve serves as a fish and invertebrate nursery which helps to provide species diversity to the nearby Metchosin Coastline.



Ecosystems represented	Importance (these overlap)
Strong ocean currents	Huge biodiversity of the community of organisms that live on, in or near the seabed; surf grass, *Phyllospadix scouleri* habitat
Shoals and reefs	Kelp forests (seasonal); seabird feeding
Rocky islands	Marine mammal feeding and resting area, (harbour seals, sea lions, elephant seals); birthing colonies for elephant seals and harbour seals; nesting areas for four species of seabirds
Current upwelling around the islands	Provides nutrients for high species diversity
Abundant subtidal flora and fauna community assemblages	High biodiversity values with several rare species, and a source of food for many fish, birds and mammals including killer whales and other cetaceans, seals, sealions, elephant seals

Comments

All areas subtidal to 40 metres is a rockfish conservation area (see below)
Area 4 and 5 - Elephant seal and harbour seal pupping
Area 5 - Black oystercatcher, Pigeon guillemot and Glaucous-winged gull nesting area
Area 5 - *Romanzoffia tracyi*, a rare plant (on the Blue list) often referred to as mist maiden. (http://www.racerocks.com/racerock/eco/taxalab/genevievea.htm)
Area 5 – an important wintering habitat for many species of marine seabirds and an important stopover for migrant birds.
Area 5 - historic lighthouse built in 1860 and also First Nations Burial Cairns

The Race Rocks website (http://www.racerocks.ca/wp/home/) has a large collection of historical and current information as well as documentation of its role as an Ecological Reserve, with photo and video galleries. A log is kept of significant events in the area.

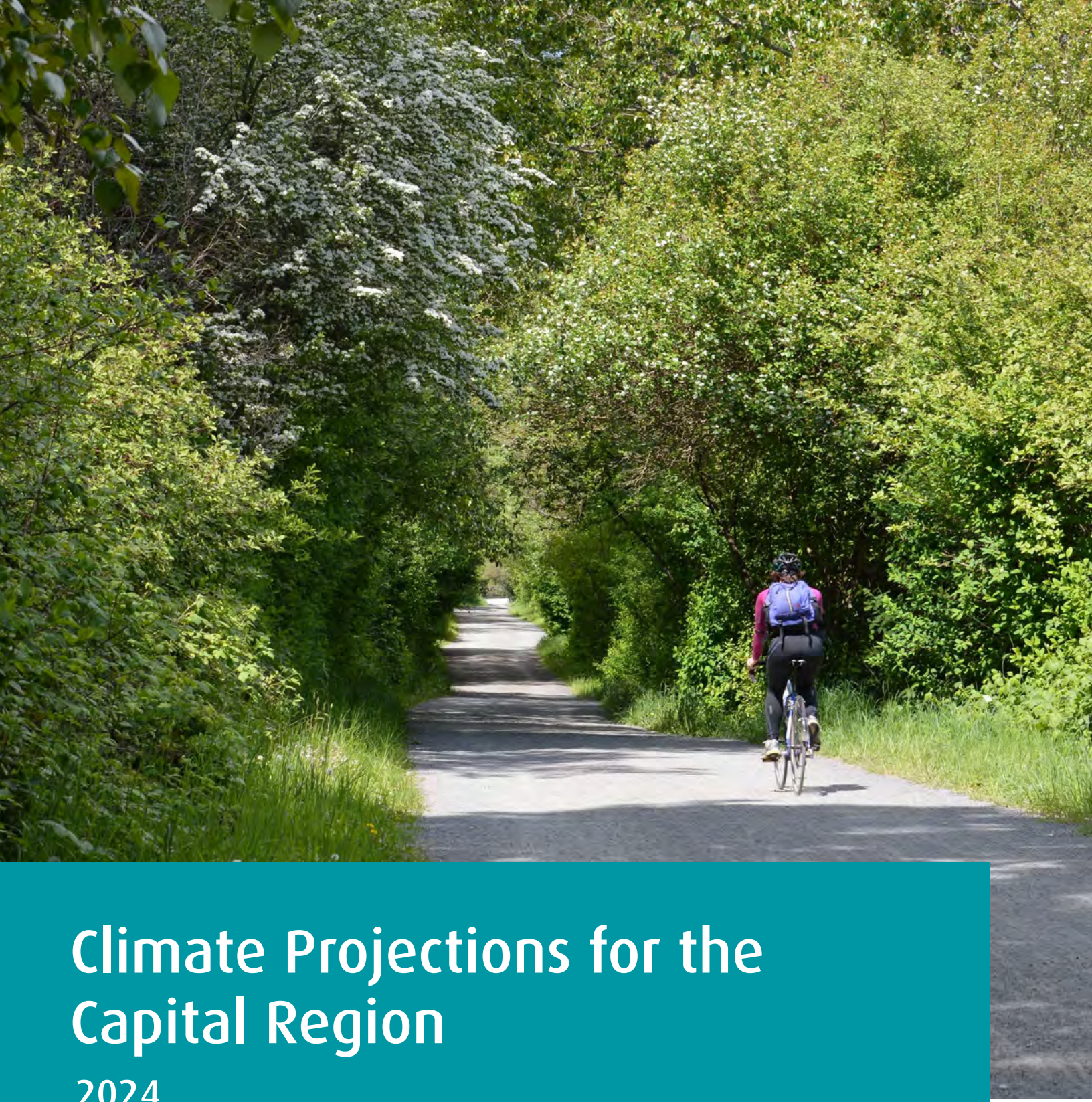
For information on the Ecosystems see:
http://www.racerocks.com/racerock/eco/ecosystem.htm
This includes a list of animal and plant species recorded at Race Rocks as either residents or transients. The list is currently at 332 species, 87 of those being vertebrates. This is an incredible number of species in a very small area.

The ocean environment in the area of Race Passage has also been recognized as an important habitat for the regeneration of Rockfish stock leading to the creation of a DFO rockfish conservation area where all fishing is prohibited.
http://www.pac.dfo-mpo.gc.ca/fm-gp/maps-cartes/rca-acs/rca-acs/south-sud/BentinckRaceRocksChart3461-eng.htm

Eco Notes

At Race Rocks, the other marine flowering plant, the Surf Grass, *Phyllospadix scouleri*, is found. This is largely because of the different environmental factors: eelgrass prefers shallow sandy-bottomed inlets with some current as it cannot withstand the pounding surf of the rocky coast.

The islands now have the world's most northerly breeding colony of the northern elephant seal, *Mirounga angustirostris*.



Climate Projections for the Capital Region

2024

Updated April 2024

PACIFIC CLIMATE IMPACTS CONSORTIUM

CRD
Making a difference...together

EXECUTIVE SUMMARY

The Earth's climate system is warming, and signs of climate change are becoming evident across the planet. The capital region, located on Southern Vancouver Island and Gulf Islands of British Columbia (BC), is no exception. The Capital Regional District (CRD) has partnered with the Pacific Climate Impacts Consortium (PCIC) to produce high-resolution regional projections for temperature, precipitation, and related indices of extremes. These projections use the most up-to-date global modeling data (i.e., the Sixth Coupled Model Intercomparison Project, CMIP6) to illustrate how the region's climate may change by the middle of this century. Information provided by this report and the accompanying data is intended to support decision makers and community partners in the region with an improved understanding of projected local climate change and related impacts.

At a high level, the results of this study show that in the coming decades, the capital region can expect:

- Hotter summer temperatures, with more extreme heat days and heatwaves;
- Warmer nights and a longer growing season;
- Warmer winter temperatures and less frequent frost;
- Less rain and more dry days in the summer months;
- More precipitation falling in fall, winter and spring;
- Less snowfall in the colder months;
- Extreme rainfall events becoming wetter.

More specifically, warming temperatures will shift seasonal patterns, prompting a longer growing season and greater cooling demand across the region. Extreme temperatures will continue to get hotter, with heat waves becoming longer and more frequent. By the 2050s, the capital region can expect the number of summer days exceeding 25°C to triple, going from an average of 10 days per year to 32 days per year. Nighttime temperatures in the summer will also increase. Nights where the temperature stays above 16°C (the lower threshold for heat alerts for Southern Vancouver Island) are projected to occur around 8 times per year. The temperature for the 1-in-20-year hottest is projected to increase from 32°C to 36°C.

By the end of this century, annual precipitation is projected to increase modestly (4% increase by the 2050s and 11% by the 2080s). However, these changes will not occur evenly across seasons. In the colder months, rainfall increases notably because of warmer temperatures that convert more snow into rain. (By the 2050s, total rainfall in the winter increases by 25%, while total snowfall drops by nearly 60%.) Much of the rainfall in the colder months will occur during extreme events, with the very wet days becoming wetter by mid-century. In contrast to the fall, winter and spring, the summer months will become increasingly dry. Total rainfall in the summer is projected to decrease by roughly 15% by the 2050s with the duration of dry spells becoming longer.

Many of the projected climate changes described in this report will be felt uniformly across the region. However, the magnitude of some variables will be accentuated by the existing West-to-East climatic gradient in the capital region. For example, the Western region is typically wetter and cooler compared to the Eastern Region, where conditions are typically warmer and drier. In addition, temperatures may be warmer or cooler in specific areas due to other factors including tree canopy cover (or a lack thereof), paved surfaces, and buildings density.

The projected warming for the capital region will have implications for regional ecosystems, watersheds, agriculture and horticulture, housing, energy demand, infrastructure, and community health and safety. Chapter 7 provides a high-level overview of some of the impacts that might be expected from the projected changes in this assessment. This chapter was informed by input from local government staff during a workshop in October 2023 and is not a comprehensive assessment of regional impacts. It is intended to support further discussion and analysis for how climate change may impact the capital region.

The CRD and PCIC also collected input from local government staff to understand how these climatic changes may impact the region as whole. Across the capital region, communities are already witnessing and experiencing varied impacts of climate change. These impacts will persist and, in many cases, intensify over the coming decades based on the future global greenhouse gas emissions trajectory. These impacts will not be experienced equally across the region. People facing the greatest burdens are often the ones who are most affected by climate change, particularly for impacts that are compounding.

Information within this report and the accompanying data provides the region's decision makers, community planners, and community partners with an improved understanding of projected local climate change and related impacts.

CONTRIBUTING AUTHORS

Charles Curry and Stephen Sobie from Pacific Climate Impacts Consortium (PCIC) conducted climate model downscaling, data analysis and interpretation and generated all data products, including maps, figures, and tables, for the report. Charles Curry and Izzy Farmer (PCIC) served as lead authors of this report, with advice and guidance from CRD staff.

ACKNOWLEDGMENTS

We would like to acknowledge the effort and input received from CRD staff, municipal staff, and the CRD Climate Action Inter-Municipal Working Group in the development of this report. Working together ensures that we share knowledge and build on each other's success to create a more resilient region.

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1. INTRODUCTION

Over the last 150 years, the global average temperature has increased by over 1°C and this warming has been clearly linked to the emission of greenhouse gases (GHGs), aerosols, and other aspects of human development. This warming is expected to continue unless we make significant cuts to GHG emissions globally. Understanding, monitoring, and preparing for the regional and local manifestations of climate change is important for supporting safe and resilient communities in the decades to come.

The Capital Regional District (CRD) has undertaken this study to better understand how the climate of our region is expected to change over the coming decades. British Columbia's capital region spans an area of 2,340 km^2 and an elevation range of 1 to 1,100 m above sea level (Figure 1). Since 1950, air temperature observations for Vancouver Island have been increasing by 0.26 ± 0.07 °C per decade.[2] Both global and regional warming are expected to influence other climate variables, such as rainfall.

To explore the changes that may be in store for our region, the CRD has partnered with the Pacific Climate Impacts Consortium (PCIC) to produce high-resolution climate projections for the capital region. These projections are based on the latest generation of comprehensive global climate models (CMIP6). Like other populated areas worldwide, the region requires up-to-date, science-based, high-resolution information to enable effective planning and policy decisions in a changing climate. This information will be used with other resources to help prepare the capital region for the impacts of climate change.

A selected number of climate indicators are provided in this report to demonstrate how our climate is expected to change over time. In the first section, Chapter 2 provides a brief description of the study methodology and includes support for interpreting the figures and tables. Chapters 3 through 6 provide an analysis of selected climate indicators for the region, including information about summer temperatures, winter temperatures, precipitation, and climate extremes. Each section includes a description of each indicator and a summary of how it is projected to change over time.

In the second section, Chapter 7 identifies potential impacts from climate change expected across the capital region. These impacts are categorized by different sectors, including health and wellbeing, water supply and demand, rainwater management and sewerage, ecosystems and species, buildings and energy systems, transportation, food and agriculture, and recreation and tourism.

It should be noted that the information provided in this report is limited to changes in temperature and precipitation only. Other climate-related phenomena, like surface hydrology, wind, humidity, sea level rise and storm surge require different modelling techniques and are not included in the scope of this report. Therefore, the report should be used alongside other resources to help prepare our region for the impacts of climate change. For example, in 2021, working with and on behalf of municipal partners, the CRD undertook a coastal flood inundation mapping project, which includes an analysis of current and future storm surge due to sea level rise. Since that time, some municipalities in the region have been undertaking efforts to build upon this work.

This report and the supplementary data that accompany it are intended to support climate-focused decision making throughout the region and help community partners better understand how their work may be affected by our changing climate. The information provided here should be used with careful consideration for the local context. For guidance on how climate information can be used to support adaptation planning, see the appendices appearing at the end of this report.

---

[1] IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001.

[2] Results of an analysis conducted by PCIC for the annual "State of the Pacific Ocean" report; see Curry, C.L. and Lao, I., "Land temperature and hydrological conditions in 2022," pp 17-21. In: Boldt, J.L., Joyce, E., Tucker, S., and Gauthier, S. (Eds.), State of the physical, biological and selected fishery resources of Pacific Canadian marine ecosystems in 2022. Can. Tech. Rep. Fish. Aquat. Sci. 3542: viii + 312 p. (2023). The nearby Lower Fraser Valley displays a larger trend of magnitude 0.42 ± 0.07 °C per decade, which may be more similar to what the capital region has experienced.

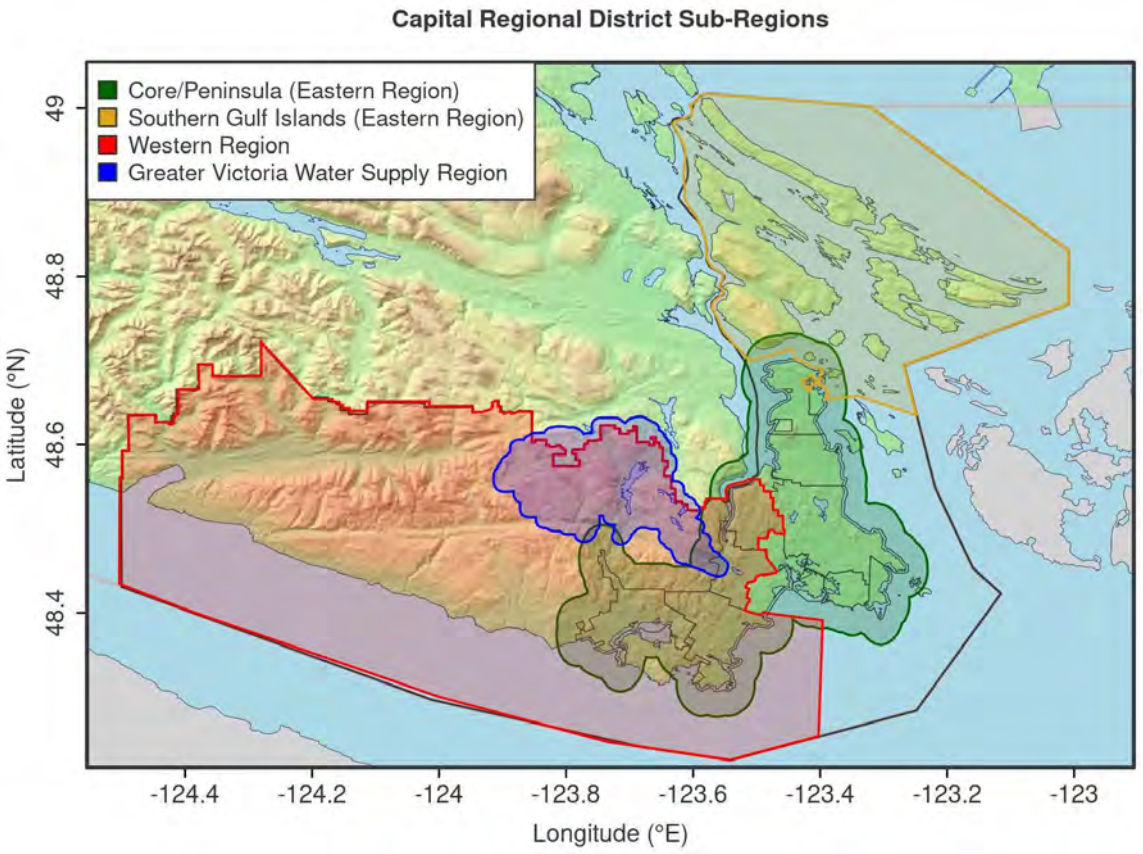


Figure 1. *Domain of interest, the Capital Regional District, with background relief map and four sub-regions of interest. In several of the tables in the report, results for the Core/Peninsula and Southern Gulf Islands are combined into a single Eastern Region.*

2. METHODS AND PRESENTATION

2.1 Climate Model Projections

The climate projections are based on an ensemble of 9 global climate models (GCMs) drawn from a larger collection of models developed during the Sixth Coupled Model Intercomparison Project (CMIP6), coordinated by the World Climate Research Programme. The climate projections presented here are based on a high greenhouse gas emissions scenario, known as the Shared Socioeconomic Pathway 5-8.5 (SSP585), which describes a trajectory of future emissions spurred by continued and expanded use of fossil-fuels worldwide. Two other scenarios are also presented in the data package accompanying this report: a medium-intensity emissions pathway, SSP245, and a low-intensity pathway, SSP126, which covers the possibility of a low-carbon technology transformation of worldwide energy systems.[3] Planning based on climate projections under SSP585 could be considered a "no regrets" strategy for adaptation. By the 2090s under SSP585, global mean surface air temperature reaches a level 4.3°C higher than the 1850-1900 average. The evolution of air temperature and precipitation under the three SSPs, for BC specifically, is shown in Figure 2.

Each GCM represents the climate system using a global, horizontal grid with a limiting resolution between 100 km and 250 km, depending on the model. These coarse-grained data are first bias-corrected against available observations (spanning 1950-2012) and then statistically downscaled to 10 km resolution.[4]

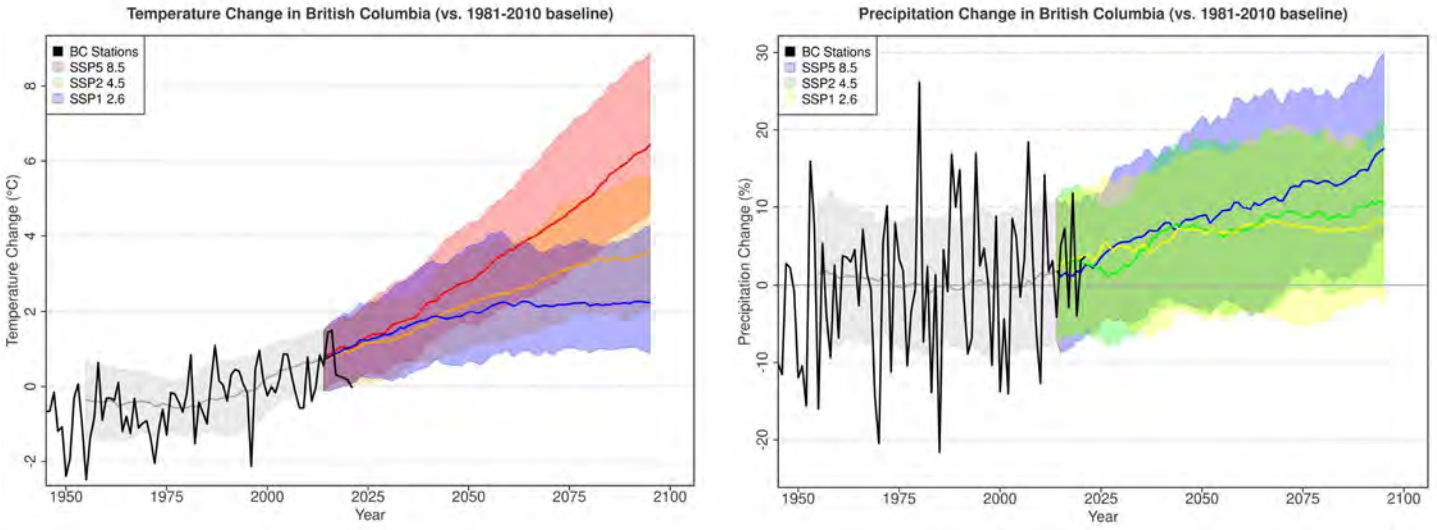


Figure 2. *Changes in annual mean air temperature (left) and total precipitation (right) relative to their values in 1981-2010, averaged over all of BC. The black curves show historical values obtained from the station data in BC from 1948-2021, while the coloured curves show median GCM projections under the three development pathways (SSPs) from 2015-2100. The shaded areas show the 10th-90th percentile range in model-simulated results over the historical and future periods, for each SSP.*

[3] An accessible description of the SSPs may be found at https://climatedata.ca/resource/understanding-shared-socio-economic-pathways-ssps/.

[4] Details on the downscaling methods used at PCIC may be found on the Data Portal section of our website, pacificclimate.org.

In a second downscaling step, the model data are further downscaled to a resolution of 800 m using fine-scale climatological maps. It should be recognized, however, that while the latter account for fine-scale topography, important features of, and influences on, local daily climate are not represented in the dataset.[5]

Downscaled climate model results are presented for three 30-year periods: the historical reference period, 1981-2010 (referred to as the "Past" or "1990s" for short), the near future, 2021-2050 (the "2030s"), mid-century, 2041-2070 (the "2050s") and the end-of-century, 2071-2100 (the "2080s"). These 30-year periods are chosen both to smooth out year-to-year climate variability, and to provide a long enough period to characterize the behaviour of fairly rare events. The seasonal definitions used are "meteorological" seasons: i.e., winter (December 1 to February 28), spring (March 1 to May 31), summer (June 1 to August 31) and fall (September 1 to November 30). A range of indices are computed from daily temperature and precipitation to describe various aspects of the climate. For projections, median estimates from the climate model ensemble are typically emphasized, with the 10th to 90th percentile ranges over the ensemble also provided where appropriate.

It is important to recognize that not all projected changes emerging from the climate model ensemble are necessarily substantial. For a given variable, location, and emissions pathway, each model produces a projected future climate, resulting in a range of possible outcomes. Since no single model is "right," the median value of the ensemble can be used as a practical best-guess projection, with the 10th to 90th percentile spread indicating the uncertainty amongst the models. *If the spread includes zero change, meaning that not all models agree on the sign of the change, then relatively low confidence should be placed in the median value.* In the relatively rare cases when less than half of the models agree on the sign of change, users are alerted to the reduced confidence via a printed message on the maps.



[5] Examples of these being realistic day-to-day variability and co-variability between nearby locations, and fine-scale land cover type, for example. It should also be recognized that since the models are bias-corrected to daily observations spanning a specific time period, here 1981-2010, more recent observations will not be reflected in results displayed for the "Past."

2.2 Interpreting Figures and Tables

The data deliverables for the project comprise: (i) maps of climate variables over the region in Past and Future periods, for each of the three scenarios; and (ii) tables (Excel spreadsheets) of area-averaged results for the same. Results for absolute or relative difference are also provided, where appropriate. References to the tables are occasionally made in the report. Most of the figures presented below are maps, showing the capital region and the surrounding area. Colour contours indicate values of the indicated variable, with a nominal limiting resolution of 800 m. *Due to the limitations of the downscaling methodology mentioned above, along with the inherent uncertainty in future outcomes, the exact position of contours on the maps should not be taken literally.* On each map, the area average shown at bottom left is computed over the capital region only (area inside the black curve).

This report presents results for a number of key indicators, derived from the model-simulated daily temperature and precipitation, representing a "highlight reel" of the much more extensive set of climate indices delivered for this project. In consultation with CRD staff, they were selected either because they have implications for a range of climate-related impacts, because they feature particularly large changes from recent historical conditions, or both. In the next few chapters, a plain language definition is provided for each indicator, followed by a summary of its projected change for the 2030s, 2050s, and 2080s, under the high (SSP585) emissions scenario. Detailed definitions of all indicators are provided in the Appendix.

There are two types of maps: single period and future change. Single period maps, e.g., "Past: 1990s" or "Projection: 2050s," show actual values of a variable, e.g., temperature in °C. Future change maps, e.g., "Projected Change: 2050s - 1990s," show differences between historical and future-simulated periods, and may be in the units of the variable or in relative terms, e.g., percent change in precipitation. In the interest of concision, all future change maps shown in this summary report are for the 2050s under the high emissions (SSP585) pathway. For most indicators, the magnitude of these changes should be roughly comparable to that projected for the 2080s under the moderate emissions scenario (i.e., SSP245).

Other figures in the report use area-averages for the capital region while expressing the range of projected values over models and years for a certain variable. An example of this

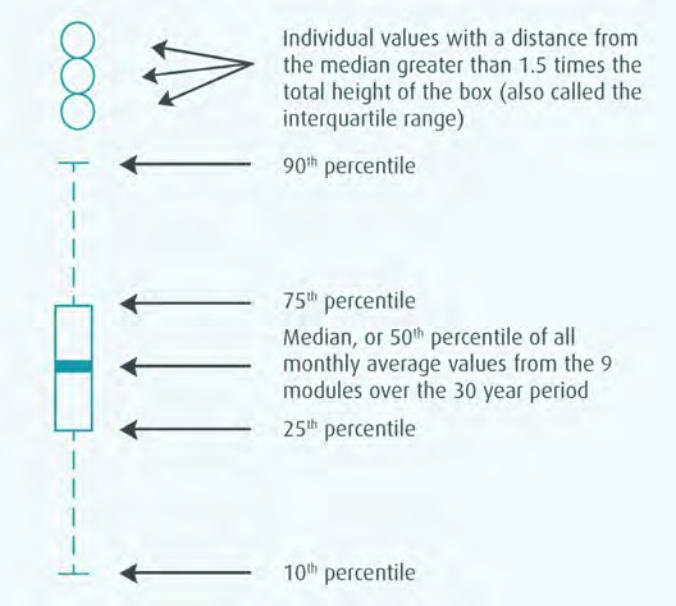


Figure 3. *Explanatory schematic of a box-and-whisker plot.*

type of presentation, the "box-and-whisker" plot, is shown in Figures 6 and 9, and an aid to their interpretation is given below. Note that, in these figures, the range shown by the whiskers reflects both year-to-year and model-to-model variability. Finally, note that when cited in the text, values from the spreadsheets are often rounded to indicate the likely precision of the quantity being discussed, given the known model uncertainties. For example, a temperature of 29.8°C would be cited as 30°C, while 2717 degree-days become 2715 degree-days. The tables contain median values with ranges given in parentheses (10th – 90th percentile of different model projections). Usually medians are cited in the text; but ranges encompass the range of possible behaviour, and should not be ignored, especially when the climate variable in question might enter into critical decision-making.

Values in tables are averaged over the capital region (within the regional boundary shown on the maps), unless labeled as *Eastern Region* (Greater Victoria and Southern Gulf Islands), *Western Region,* or *Greater Victoria Water Supply Area.*

3. GENERAL CLIMATE PROJECTIONS

3.1 Warmer Temperatures

We begin by examining future temperature change over the region. *Daytime High and Nighttime Low Temperatures* are averaged over each season and annually in the tables and maps below.

In concert with global and regional warming, both daytime and nighttime temperatures are projected to increase in the capital region in future, as detailed in the tables (all changes shown are positive). The accompanying maps show the spatial pattern of Past and future-projected temperatures throughout the region.

Projections

In the Past, winter daytime high temperatures in the region averaged around 6°C, while winter nighttime low temperatures averaged around 1°C. The median future-projected TX increases to around 8°C by the 2050s and to 9.5°C by the 2080s. The median future-projected TN reaches around 3°C by the 2050s and 4.5°C by the 2080s. Since the likelihood of snowfall rapidly decreases as temperatures rise above 0°C, we can anticipate that this local warming will affect the frequency of snowfall in the region, as detailed further below.



Table 1: Regional Average Daytime High Temperature (TX)

	Past (°C)	2050s Change (°C)	2080s Change (°C)
Winter	6	2.1 (*1.6 to 3.5*)	3.5 (*2.8 to 6.5*)
Spring	12	2.1 (*1.4 to 4.0*)	3.5 (*2.6 to 6.3*)
Summer	20	2.9 (*2.3 to 5.1*)	4.7 (*4.1 to 8.7*)
Fall	13	2.7 (*2.2 to 4.6*)	4.0 (*3.6 to 7.2*)
Annual	13	2.5 (*2.0 to 4.4*)	3.9 (*3.4 to 7.0*)

Table 2: Regional Average Nighttime Low Temperature (TN)

	Past (°C)	2050s Change (°C)	2080s Change (°C)
Winter	1	2.0 (*1.8 to 3.8*)	3.6 (*3.2 to 6.8*)
Spring	4	2.2 (*1.5 to 3.5*)	3.2 (*2.8 to 5.6*)
Summer	10	2.8 (*2.3 to 4.3*)	4.6 (*3.9 to 7.4*)
Fall	5	2.9 (*2.1 to 4.7*)	4.2 (*3.6 to 7.3*)
Annual	5	2.3 (*2.0 to 4.2*)	3.9 (*3.5 to 6.6*)

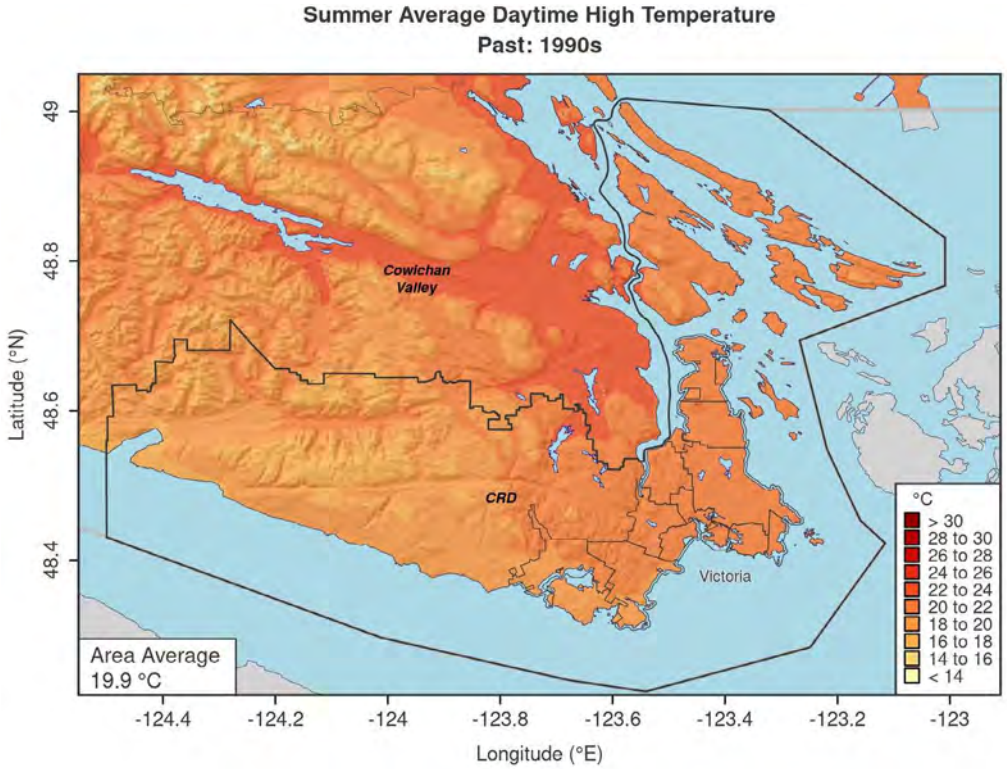


Figure 4a: *Summer average daytime high temperature in the Past.*

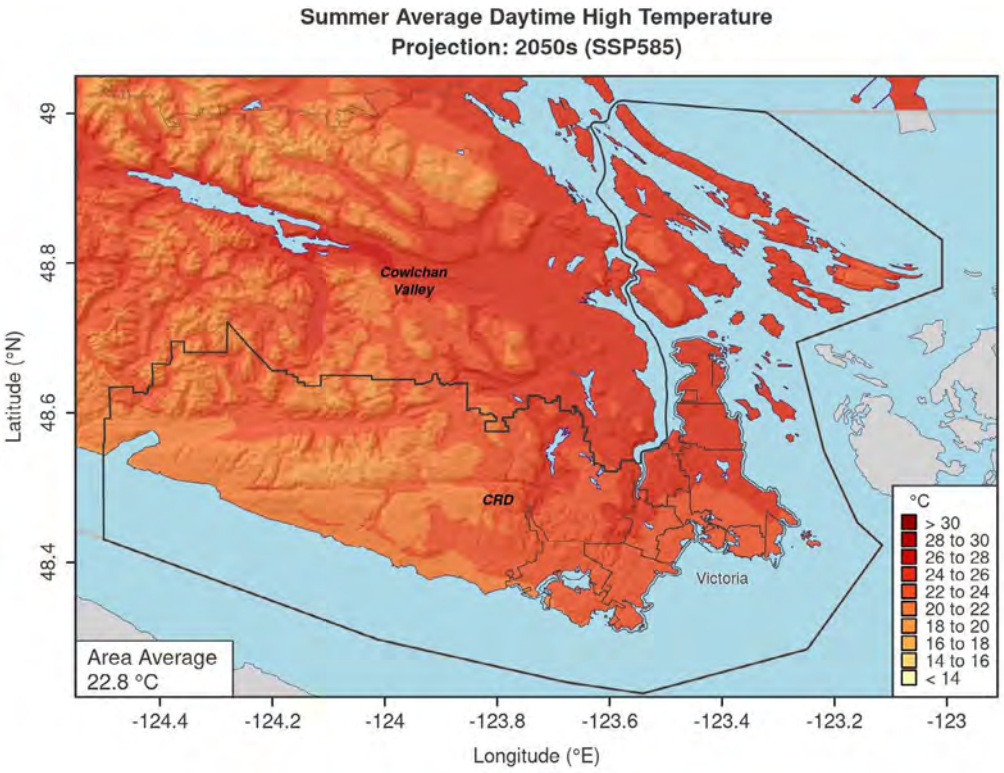


Figure 4b: *Projected summer average daytime high temperature in the 2050s.*

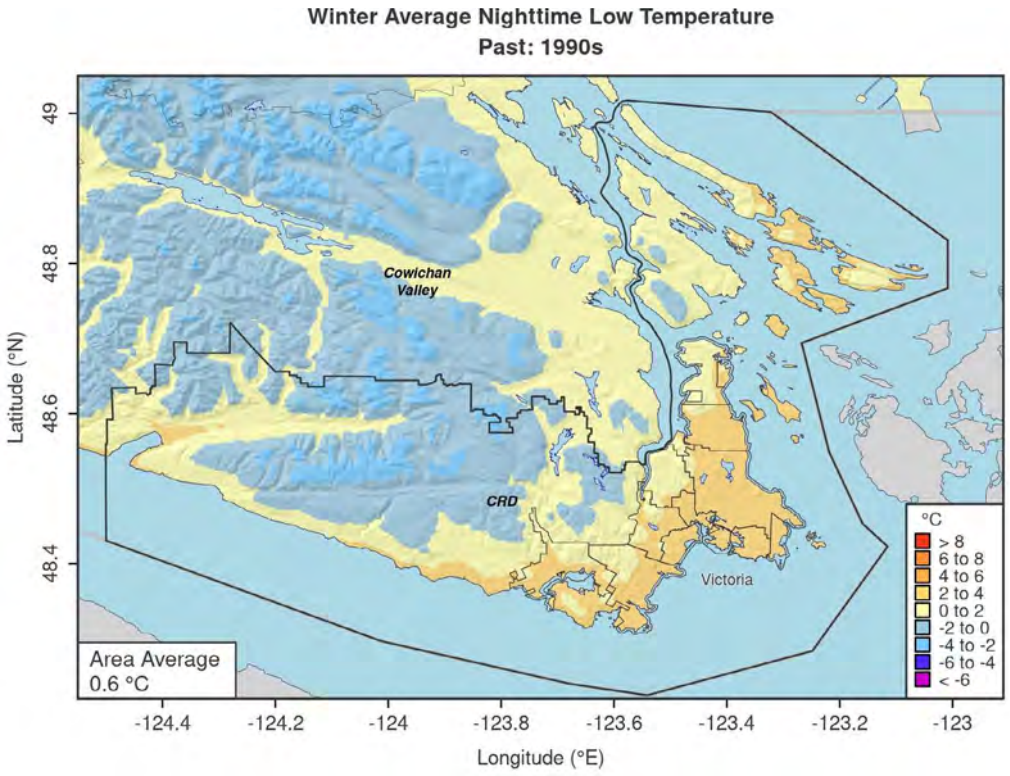


Figure 5a: *Winter average daytime high temperature in the Past.*

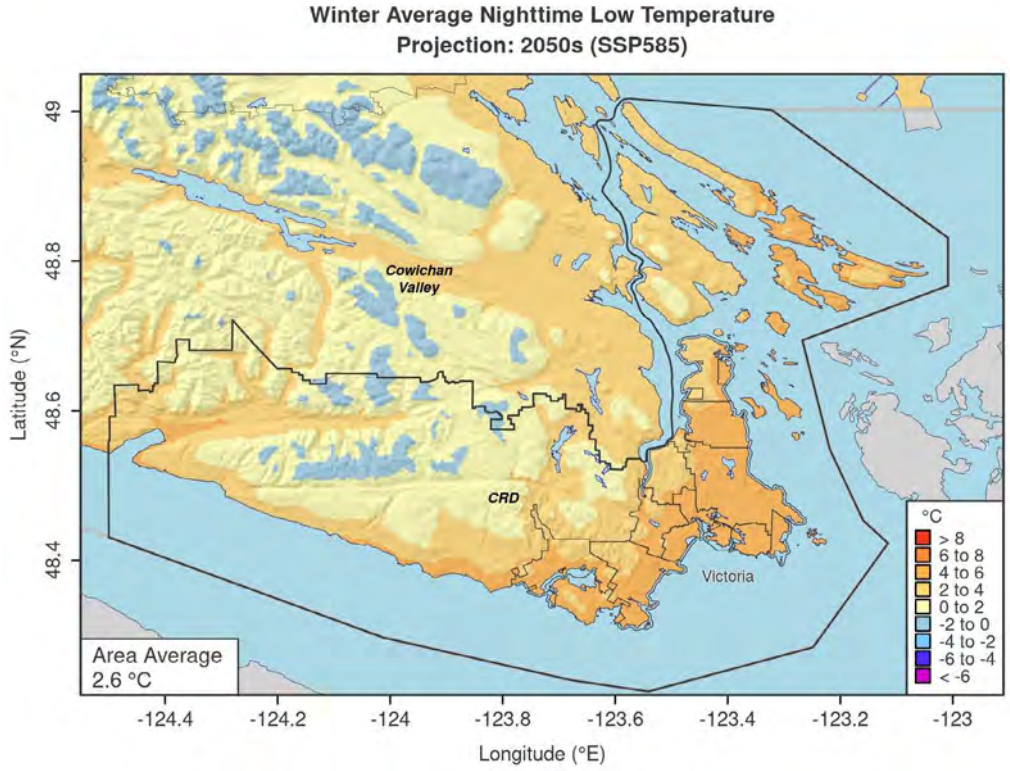


Figure 5b: *Projected winter average daytime high temperature in the 2050s.*

3.2 Seasonal Temperature Change and Variability

Future-projected temperatures are compared with Past temperatures on a monthly basis in the figure below. The box-and-whisker plots reflect both year-to-year and model-to-model variability in all 30 Januaries, Februaries, etc., over the Past and Future periods.

Some features worth noting are:

- Freezing temperatures in the cold months become increasingly rare in the Future.
- Spring—loosely defined as the beginning of the growing season, when daily mean temperature T_m consistently exceeds 5°C; see Temperature Indicators—begins earlier in the Future, while Fall—defined similarly as the end of the growing season—ends later, resulting in an effectively shorter winter season.
- The frequency of high extremes in summer increases notably, with July and August average daytime high temperatures exceeding 23°C in about three-quarters of models and years by the 2050s.



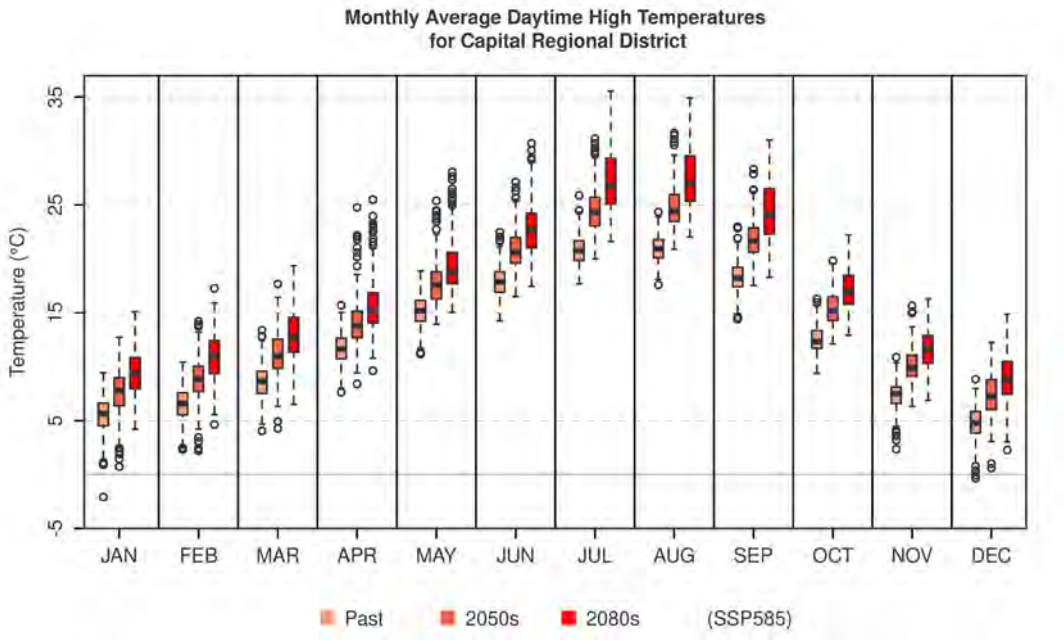


Figure 6a. *Annual cycle of monthly mean daytime high temperature in the Past, 2050s and 2080s periods under the SSP585 scenario.*

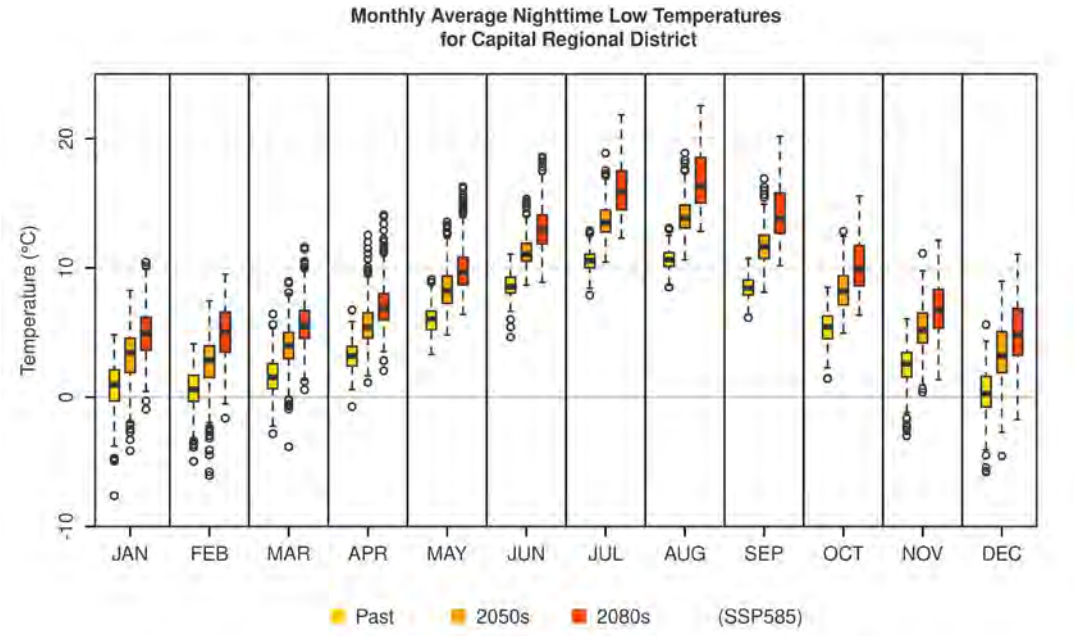


Figure 6b. *Annual cycle of monthly mean nighttime low temperature in the Past, 2050s and 2080s periods under the SSP585 scenario.*

3.3 Wetter Winters, Drier Summers

Precipitation is the sum of rainfall and snowfall (expressed as water equivalent). Precipitation in the capital region has a strong seasonality, characterized by wet winters and dry summers. In the future projections, this behaviour is reinforced, so that winter becomes wetter (as do spring and fall) while summer becomes drier.

Projections

In tandem with the higher summer temperatures mentioned above—which increase potential evaporation—reduced summer rainfall heightens the possibility of drought conditions. Rainfall increases are highest in winter, displaying a 25% increase in the 2050s region-wide, considerably higher in the west (+145 mm in the Western Region) than in the east (+25 mm in the Gulf Islands). Since the median increase in total winter precipitation by then is only +1%, we conclude that this is primarily due to the conversion of snow to rain under warmer winter conditions. While snowfall comprised about 15% of total precipitation in the Past, it amounts to only 5% in the 2050s. By the 2080s, the capital region should receive as little snowfall annually as it did in spring alone in the Past.



Table 3: Average Precipitation (Rain and Snow) over the Region

	Past (mm)	2050s (mm)	2080s (mm)	2050s Change (%)	2080s Change (%)
Winter					
Rain	643	804	864	25 (*11 to 39*)	34 (*19 to 54*)
Snow	197	83	36	−58 (*-85 to -45*)	−82 (*-97 to -75*)
Spring					
Rain	409	460	477	12 (*7 to 21*)	17 (*3 to 26*)
Snow	37	10	2	−73 (*-95 to -44*)	−95 (*-100 to -78*)
Summer					
Rain	159	135	129	−15 (*-32 to -2*)	−19 (*-46 to -4*)
Fall					
Rain	620	710	770	15 (*9 to 22*)	24 (*13 to 34*)
Snow	38	8	4	−79 (*-95 to -62*)	−89 (*-99 to -83*)
Annual					
Rain	1827	2102	2279	15 (*9 to 25*)	25 (*12 to 28*)
Snow	274	109	40	−60 (*-88 to -50*)	−85 (*-97 to -78*)
Precipitation[6]	2101	2179	2325	4 (*0 to 12*)	11 (*-1 to 13*)

[6] Note that in future, the summed medians of rain and snow may not equal the median precipitation, since the distribution of the two quantities may vary across the model ensemble.

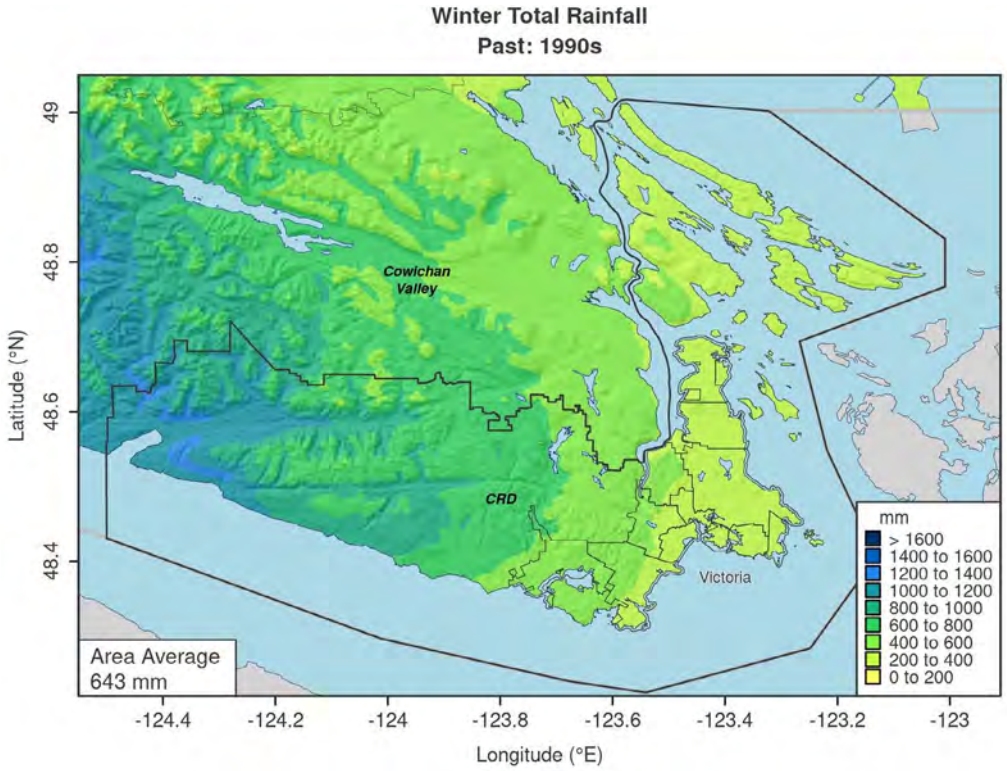


Figure 7a. *Winter rainfall in the Past.*

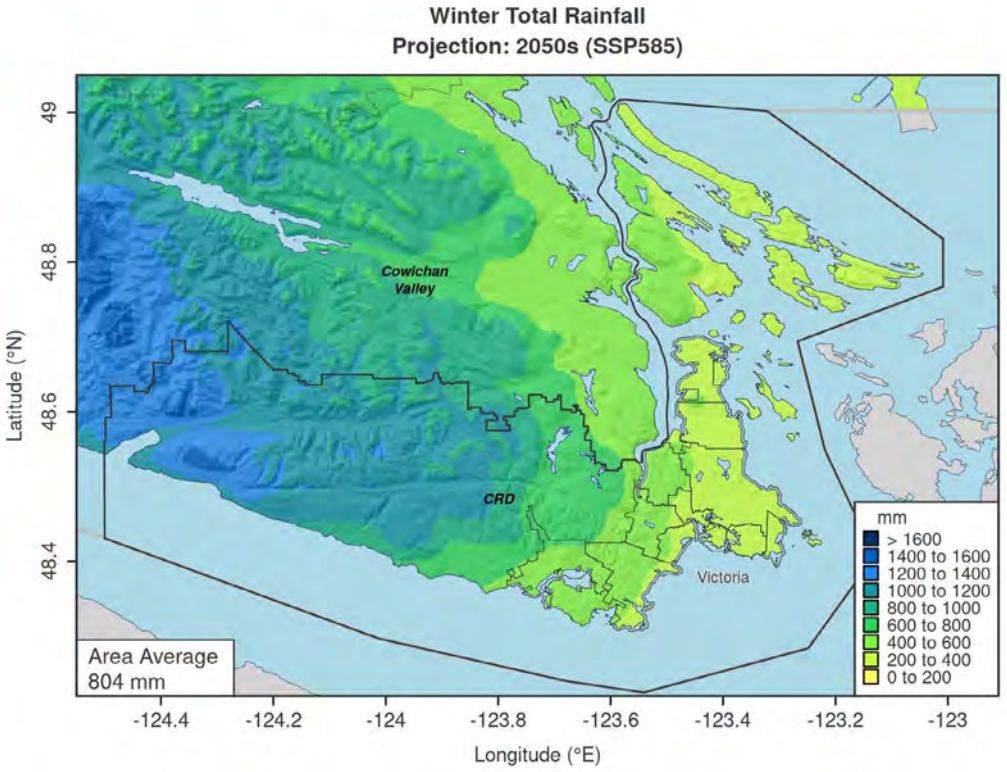


Figure 7b. *Projected winter rainfall in the 2050s.*

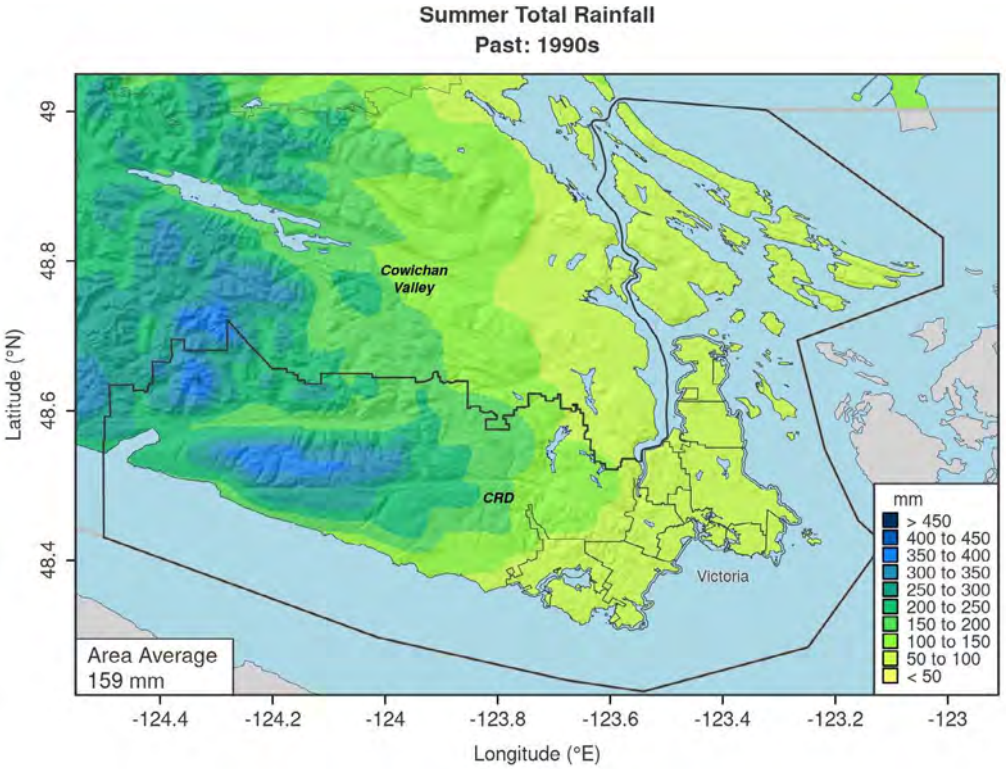


Figure 8a. *Summer rainfall in the Past.*

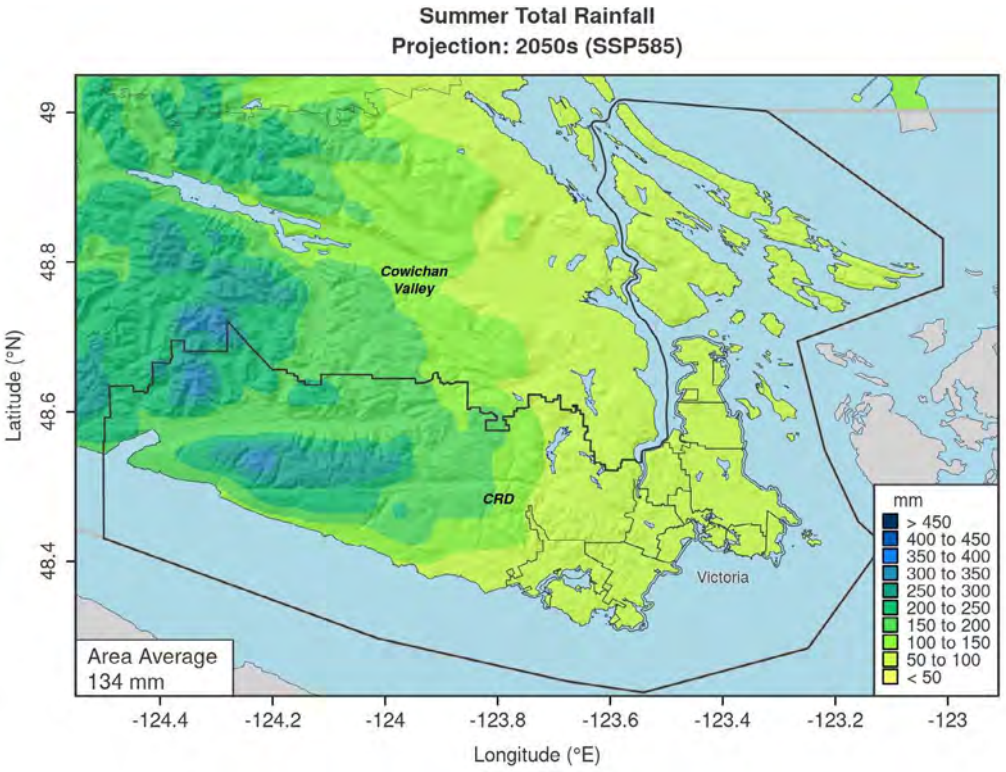


Figure 8b. *Summer rainfall in the 2050s.*

3.4 Seasonal Precipitation Change and Variability

While precipitation in the capital region exhibits a notable seasonality, with far larger amounts in the colder months, this occurs against the background of high year-to-year variability. As a result, a climate change signal is more difficult to distinguish in precipitation than in temperature. One exception is the projected strong decline in snowfall, summarized in Table 3 and Figure 17. Combined with an increase in annual total precipitation of +4%, the resulting median projection of annual total rainfall for the entire region in the 2050s is +15%.

The figure below shows model estimates of monthly total rainfall in the Past and both Future periods. While median values increase in the colder months throughout the century, what is more striking are the changes in variability (occurring across both individual models and years, as shown for temperature above). For example, we note the occurrence of higher extreme monthly rainfall amounts in future periods, especially during the autumn months; some November rainfall totals could exceed 750 mm in future, compared to around 600 mm in the Past.[7]

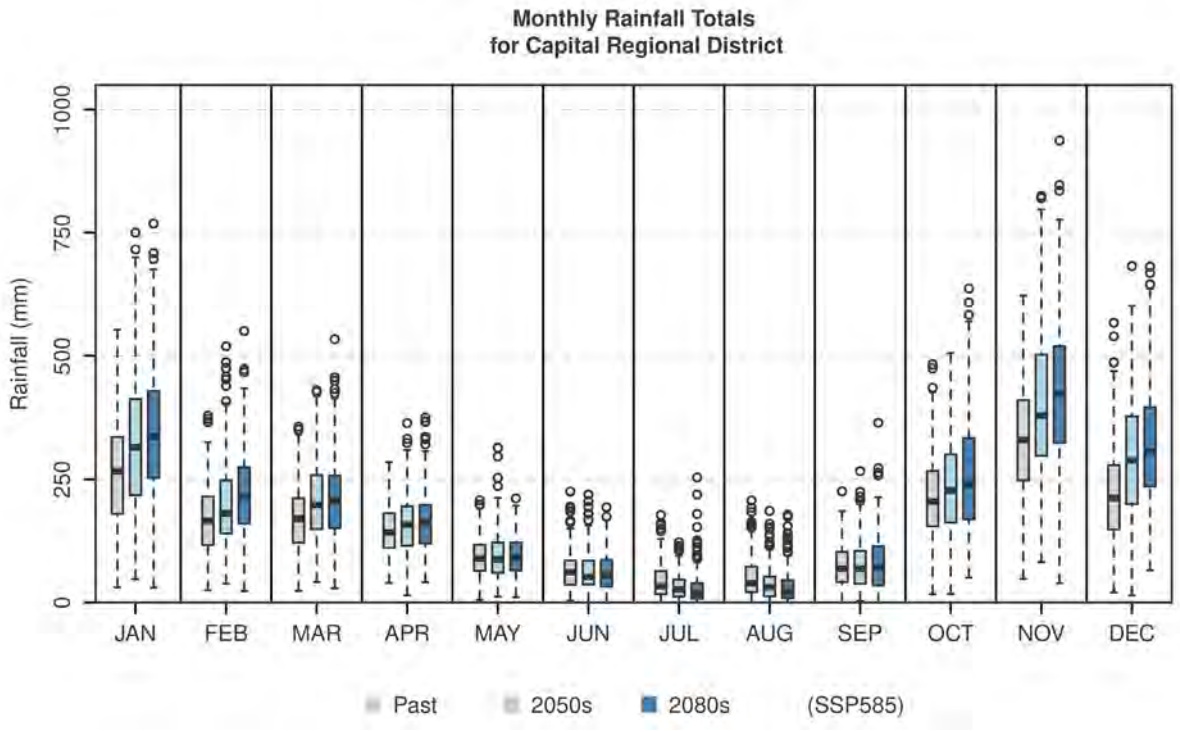


Figure 9. *Annual cycle of total monthly rainfall in the Past, 2050s and 2080s periods.*

[7] 90th percentile values are cited. These totals are averaged across the region, with Past November values spanning a large range from the wetter Western Region (~650 mm) to the drier Gulf Islands Region (~300 mm). For reference, the highest recorded November precipitation at Victoria International Airport is 316 mm (in 2021).

4. WINTER TEMPERATURE INDICATORS

4.1 Warmest Winter Day, Coldest Winter Night

The *Warmest Winter Day* is the highest daily maximum temperature recorded during the winter months, in an average year. When considered along with the *Coldest Winter Night* (i.e., lowest daily minimum temperature), these indicators describe the projected "new normal" for winters in our region.

Projections

By the 2050s, we can expect to see the warmest winter daytime temperature to rise from its Past value of 11°C to about 13°C, with a further increase to about 15°C by the 2080s.

In the Past, the coldest winter night had a temperature of about −8°C. Models project winter lows to increase by roughly 3.5°C by the 2050s, to −4.5°C, and by 6.5°C by the 2080s, to −1.5°C. The maps below illustrate that in the future, temperatures below freezing will usually occur only at the highest elevations in the region.

Warming winter temperatures will lead to an increased fraction of precipitation falling as rain instead of snow. Snow accumulation events, which typically occur a few times each winter in the region, will still occur, but less frequently.



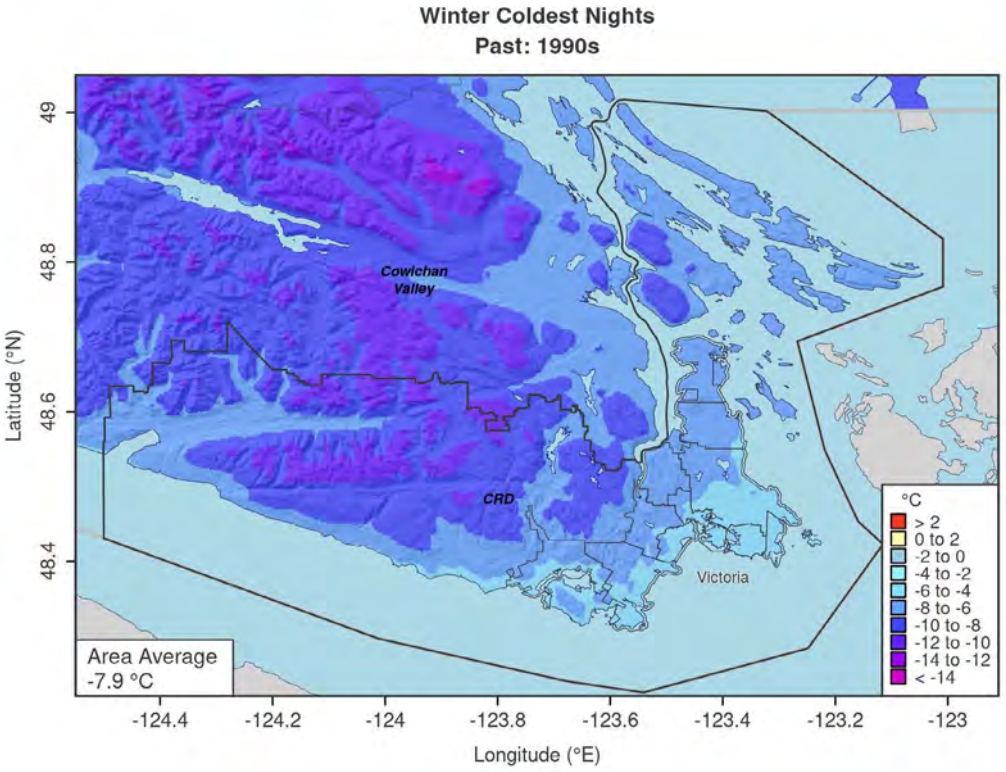


Figure 10a. *Coldest winter night in the Past.*

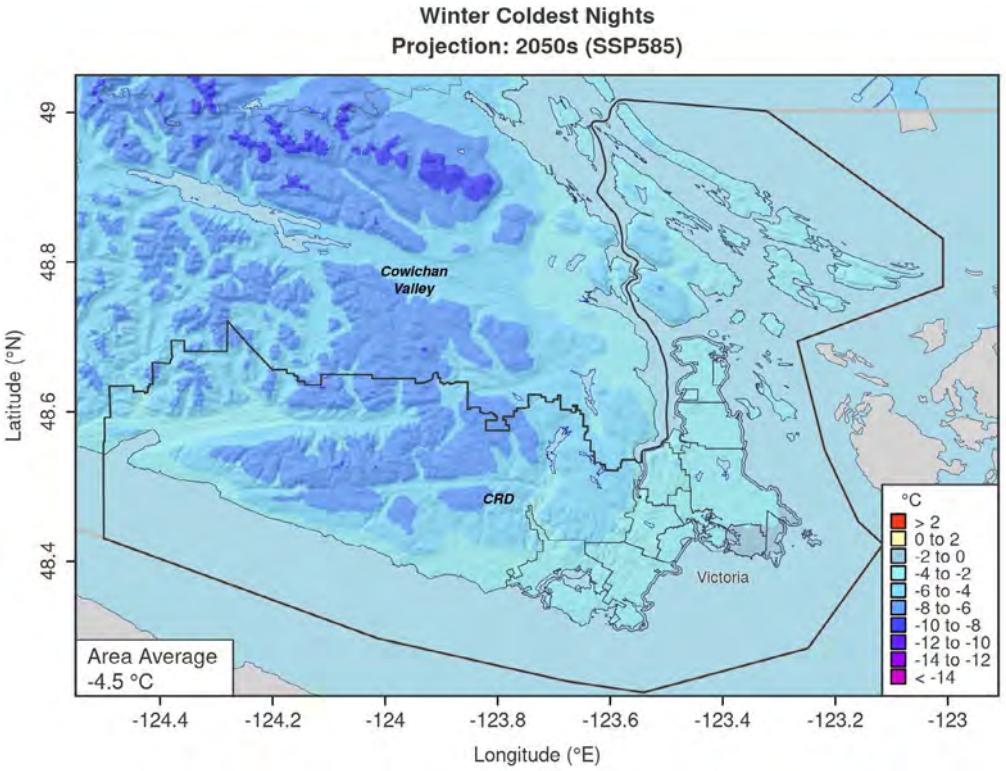


Figure 10b. *Projected coldest winter night in the 2050s.*

4.2 1-in-20 Year Coldest Nighttime Low Temperature

This indicator describes extreme cold temperatures so low that they are expected to occur only once every 20 years in the historical climate. Equivalently, in the recent past the *1-in-20 Year Coldest Night* had a 5% chance of occurring in any given year. [8]

Projections

In the Past, the 1-in-20 year coldest night had a temperature of −15°C. In the Future, the 1-in-20 year coldest night across the region will increase by about 5°C by the 2050s and by about 8.5°C by the 2080s.

[8] Note that the occurrence of such an event in one year doesn't preclude its occurrence in the following years, which is why the annual exceedance probability (i.e. 5% chance, in this case) is a helpful equivalent measure.

4.3 Frost Days and Ice Days

Frost Days is an annual count of days when the daily minimum temperature is less than 0°C which may result in frost at ground level. This indicator is useful to help predict how changes in the number of days with minimal temperatures below freezing could affect native and agricultural plant species.

Ice Days occur when daytime high temperatures do not exceed 0°C. While some of the same effects are expected as for frost days, these freezing temperatures may also affect transportation via the increased chance of icy road conditions.

Projections

In the Past, the capital region experienced an average of 60 frost days and 6 ice days per year. In the 2050s, we should expect far fewer such days: around half as many frost days by the 2050s and only around one-fifth as many by the 2080s. Ice days may be very rare by the mid- to late-century.

Table 4: Warmer Winter Extreme Temperatures

	Past (°C)	2050s (°C)	2080s (°C)	2050s Change (°C)	2080s Change (°C)
Warmest Winter Day	11	13	15	2.4 (*1.7 to 4.2*)	4.2 (*3.2 to 6.9*)
Coldest Winter Night	-8	-4.5	-1.3	3.4 (*2.9 to 5.5*)	6.6 (*5.4 to 10.4*)
1-in-20 Year Coldest Nighttime Low	-15	-10	-6.5	5.0 (*3.2 to 7.2*)	8.5 (*7.5 to 13*)

Table 5: Annual Frost and Ice Days

	Past (days)	2050s (days)	2080s (days)	2050s Change (days)	2080s Change (days)
Frost Days (TN <0 °C)					
Region	60	27	12	−33 (*−51 to −27*)	−48 (*−58 to −45*)
Eastern Region*	30	11	3	−19 (*−28 to −16*)	−27 (*−30 to −23*)
Water Supply Area	80	38	17	−42 (*−67 to −36*)	−63 (*−76 to −59*)
Ice Days (TX <0 °C)					
Region	6	2	0	-4 (*-6 to -3*)	-6 (*-7 to -5*)

**The Eastern Region encompasses both the Southern Gulf Islands and Core/Peninsula subregions (Figure 1).*

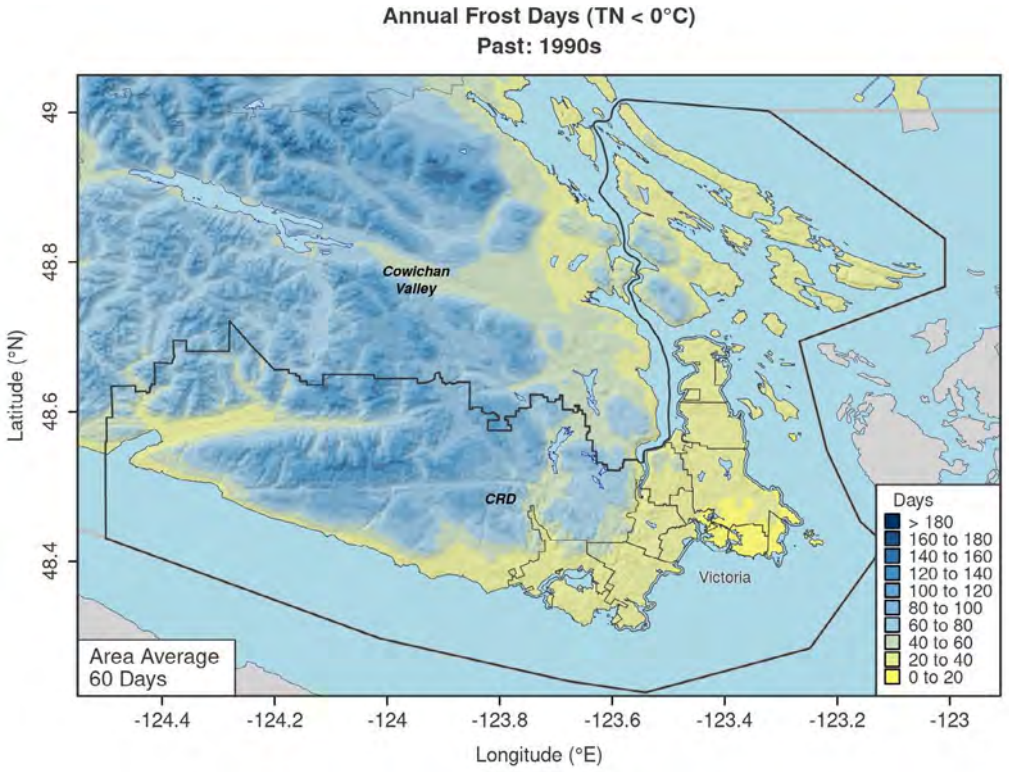


Figure 11a. *Number of annual frost days in the Past.*

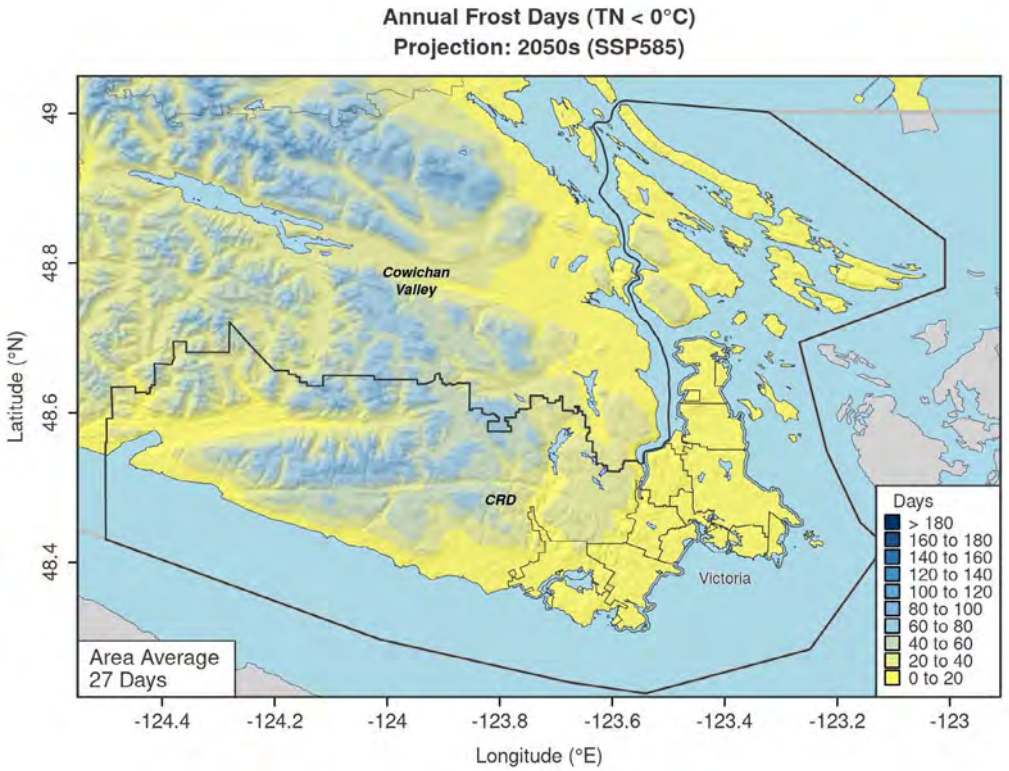


Figure 11b. *Projected frost days in the 2050s.*

4.4 Heating Degree Days

Heating Degree Days (HDD) are calculated by summing the number of degrees that the daily mean temperature falls below 18°C for every day in a year.[9] This measure is commonly used to estimate the heating demand for buildings in the cooler months.

Projections

In the Past, the capital region had a median of roughly 3405 HDD.[10] The median future-projected HDD decreases to 2644 (a 22% decrease) by the 2050s and to 2215 (a 35% decrease) by the 2080s. Due to its cumulative nature, a reduction in HDD is amongst the clearest indicators of warming, both in recent historical observations and in model projections. In addition, it should be noted that HDD varies considerably from west (higher values) to east (lower values) over the region.

Note that while mean winter temperatures will warm throughout the coming decades, the region's continued exposure to easterly polar outflows from Northwestern Canada through the Cascade Range suggests that the potential for multi-day cold snaps will persist in the future, though they should be less frequent. For this reason, building heating systems will still need to be responsive to occasional sub-zero winter temperatures.



Table 6: Heating Degree Days

	Past (°C-days)	2050s (°C-days)	2080s (°C-days)	2050s Change (%)	2080s Change (%)
Region	3405	2644	2125	-22 *(-40 to -19)*	-35 *(-56 to -32)*
Southern Gulf Islands	2836	2114	1755	−25 *(-45 to -22)*	−38 *(−63 to −35)*
Core / Peninsula	2904	2164	1773	−25 *(−44 to −22)*	−39 *(−62 to −35)*
Western Region	3387	2613	2158	-23 *(-41 to -20)*	-36 *(-57 to -33)*

[9] For example, if the daily mean temperature on January 1 is 10°C, followed by one day of 4°C, two days of −1°C and three days of 0°C, then HDD for that week are calculated as: (18−10) + (18−4) + 2 × (18−(−1)) + 3 × (18−0) = 114 degree-days. Note that days with a temperature equal to or greater than 18°C are not counted.

[10] Someone consulting the tables for the National Building Code of Canada (NBCC, 2015) will see different values of HDD listed for Victoria locations than the Past values cited in Table 6. One reason for this is the larger area covered by our Core/Peninsula subregion. Another is the different methodology and period of observations used to calculate HDD in the NBCC. As our estimate depends to some extent on coarse-grained climate models, while the NBCC employs interpolated station data, the NBCC value would normally be considered more reliable in this subregion (which contains several meteorological stations). For those interested in future HDD estimates, the relative differences from Past values can be used for HDD projections, regardless of which baseline value is used.

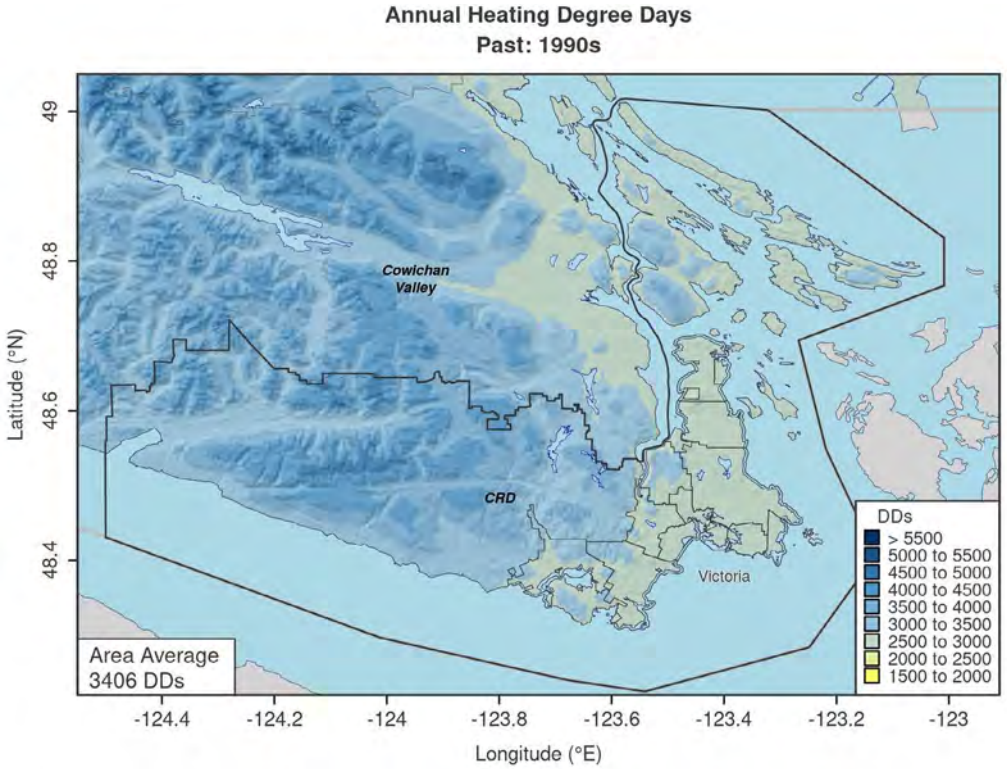


Figure 12a. *Heating Degree Days in the Past.*

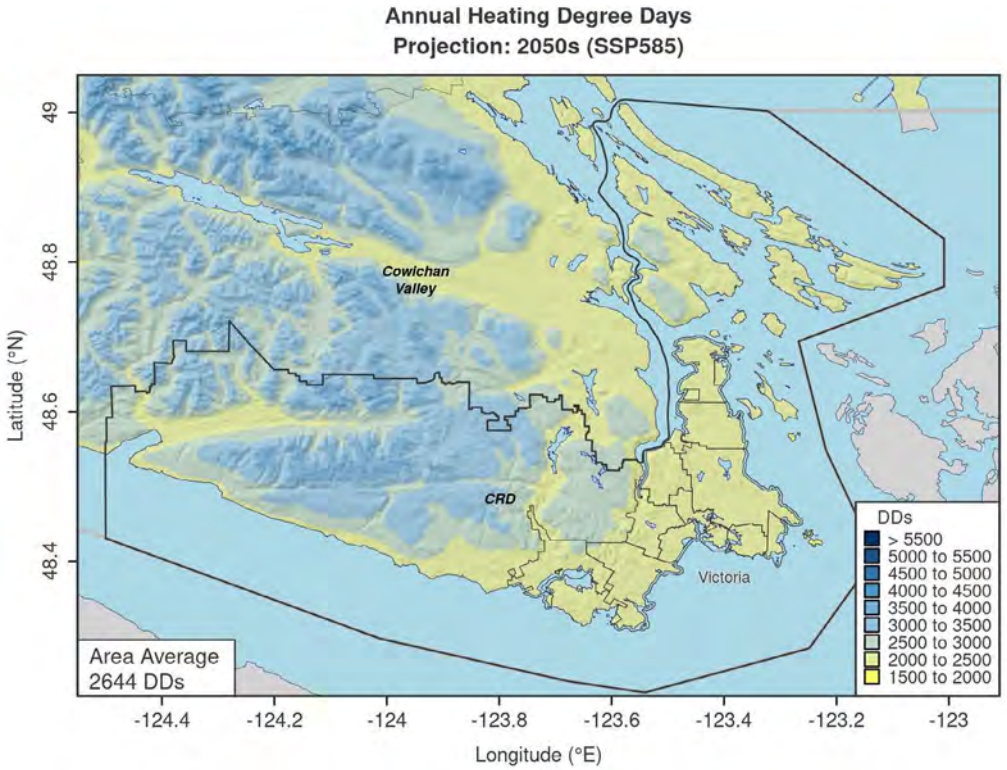


Figure 12b. *Projected (decreased) HDD in the 2050s*



5. SUMMER TEMPERATURE INDICATORS

5.1 Growing Season Length

Growing Season Length (GSL) is an annual measure indicating the period when temperatures are warm enough for most vegetation to grow. The GSL is the number of days between the first span of at least 6 consecutive days with daily average temperatures above 5°C, and the first span, after July 1, of six days with temperatures below 5°C. This measure helps to highlight how urban forests, agricultural and landscaped areas, grasses, weeds (and their pollens) may be affected by climate change.

Projections

In the Past, the growing season lasted roughly 270 days in the region. The median future-projected growing season increases by 47 days to 318 days by the 2050s and by 68 days to 339 days by the 2080s.

Other things being equal, a longer GSL implies potentially more productive vegetation in the future. However, since GSL uses only a lower temperature threshold (and not an upper threshold to account for heat stress) and ignores changes in precipitation (reduced rainfall in the warm season—Section 3.3, Table 3), it should be considered an upper limit for estimates of future productivity.

A related measure to GSL is the length of the frost-free season, which uses a lower threshold of 0°C for minimum daily temperature. As mentioned above, frost days will become increasingly rare in the future, resulting in frost-free conditions nearly year-round in the region by the 2080s.

Table 7: Growing Season Length

	Past (days)	2050s (days)	2080s (days)	2050s Change (days)	2080s Change (days)
Region	271	318	339	47 (*39 to 71*)	68 (*60 to 86*)
Eastern Region	315	348	358	33 (*25 to 42*)	44 (*37 to 49*)
Western Region	283	324	344	41 (*35 to 64*)	61 (*53 to 76*)
Water Supply Area	245	301	329	56 (*45 to 90*)	84 (*75 to 112*)

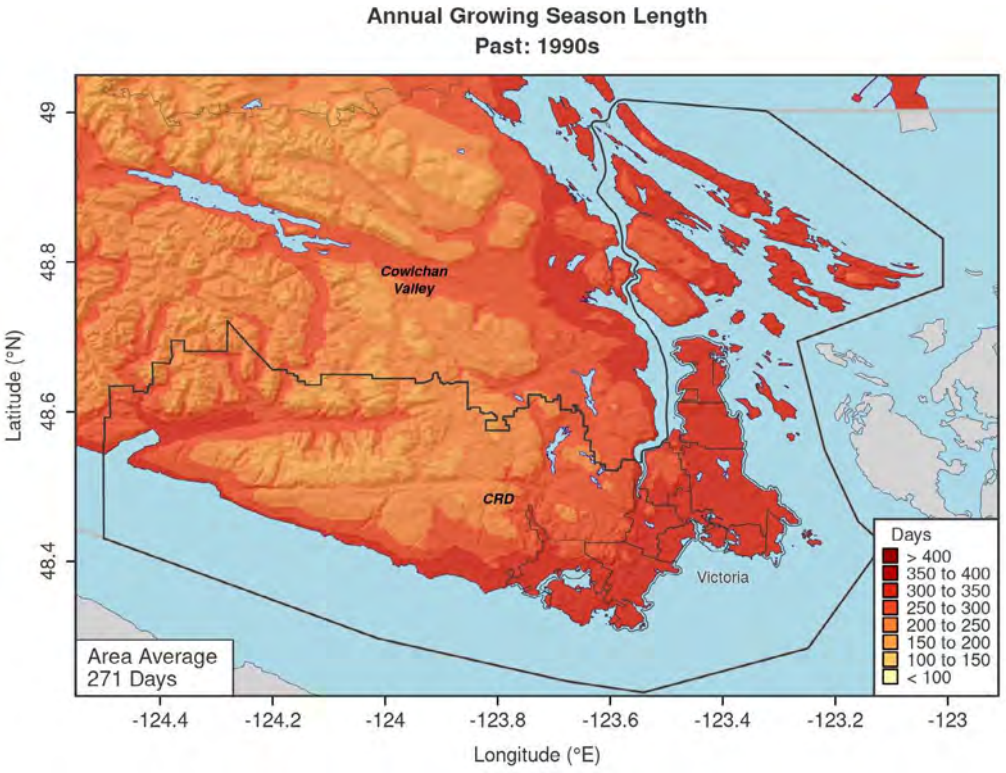


Figure 13a. *Growing season length in the past*

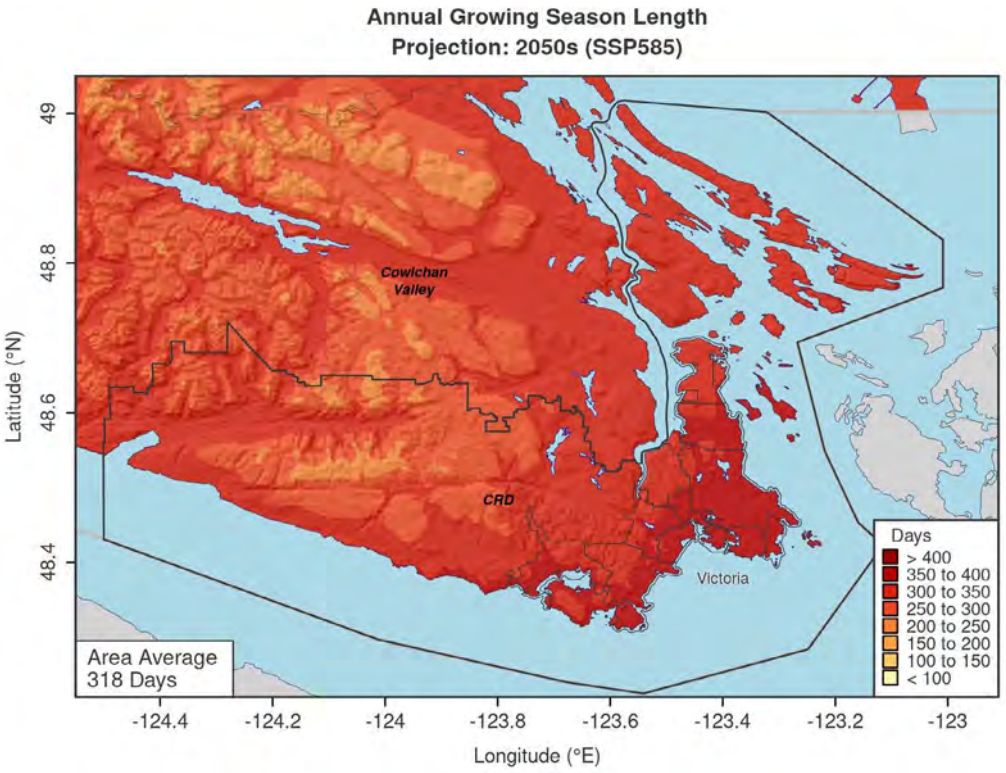


Figure 13b. *Projected (increased) growing season length by the 2050s*

5.2 Cooling Degree Days

The opposite of HDD, *Cooling Degree Days* are calculated by summing the number of degrees that the daily mean temperature exceeds 18°C for every day in a year.[11] This measure is commonly used to estimate the demand for mechanical cooling (i.e., air conditioning) in buildings in the warmer months.



Projections

In the Past, the capital region typically had around 17 cooling degree days, with the vast majority of such days occurring in summer. The median future-projected cooling degree days increase to about 119 (a 7-fold increase) by the 2050s and to nearly 240 (a 14-fold increase) by the 2080s. While most such days will continue to occur in summer, they will increasingly occur during late spring and early fall.

Like the projected decrease in HDD, an increase in cooling degree days is among the clearest indicators of warming, both in recent historical observations and model projections. Moreover, the magnitude of increase varies strongly from west (lower values) to east (higher values) across the capital region. To the extent that this index correlates with demand for cooling, new buildings may need to be designed differently to maintain thermal comfort.

Table 8: Cooling Degree Days

	Past (°C-days)	2050s (°C-days)	2080s (°C-days)	2050s Change (°C-days)	2080s Change (°C-days)
Region	17	119	237	102 (*62 to 235*)	220 (*176 to 592*)
Southern Gulf Islands	38	227	392	189 (*119 to 385*)	354 (*297 to 820*)
Core / Peninsula	25	169	317	144 (*87 to 310*)	292 (*234 to 716*)
Western Region	10	83	185	73 (*41 to 185*)	175 (*135 to 525*)

[11] For example, if the daily mean temperature on July 1 is 20°C, followed by three days of 21°C, one day of 25°C and two days of 16°C, then the cooling degree days for that week are calculated as: (20–18) + 3 × (21–18) + (25–18) = 18 degree-days.

Note that days with temperature equal to or less than 18°C are not counted.

5.3 Warm Summer Days and Nights, Annual Hottest Day and Heatwaves

These indicators highlight the most extreme warm temperatures occurring in the region. The results in the table below are for the Core/Peninsula subregion (see Figure 1) which has the highest population and therefore the highest exposure to many heat-related impacts (values for the Southern Gulf Islands are very similar). Three single-day extreme heat measures are included in the table: the peak temperature of the hottest day of the year (not necessarily occurring during a heatwave), the number of days with TX > 25°C (*Summer Days*), and the number of nights with TN > 16°C (*Temperate Nights*). Episodes of multi-day extreme heat, which were rare in the Past, are captured by several heatwave (HW) indicators defined in the Appendix. These are partly based on threshold temperatures for emergency health alerts used specifically in BC.[12] As with the variables discussed above, each of the indices describes a typical year within the indicated 30-year period.

Projections

In the Past, there were typically around 12 days per year with a high temperature exceeding 25°C, and rarely did nighttime temperatures rise above 16°C. The median future-projected number of Summer Days increases to roughly 40 per year by the 2050s and 62 per year by the 2080s, while Temperate Nights begin to occur by the 2030s, with a frequency of 15 per year in the 2050s and 52 per year in the 2080s.

When it comes to heatwaves, in the Past, there was usually one HW per year, lasting up to 3 days and having a peak daily temperature of around 30°C. The median future-projected number of HWs increases to roughly 3 per year by the 2050s and 5 per year by the 2080s. HWs are also projected to increase in length in the future (approaching 9 consecutive days or more by the 2080s) and will feature both warmer daytime and nighttime temperatures. It is clear that residents of the area will need to adapt to more frequent, longer, and intense HWs in future.

Table 9: Measures of extreme heat (Core/Peninsula subregion)

Core/Peninsula subregion: Heatwave (HW) Indices, Hot Summer Days and Warm Nights*					
Index	**Description**	**Past**	**2030s**	**2050s**	**2080s**
HWD	HW days (days)	1	4 (*3 to 11*)	10 (*6 to 27*)	23 (*17 to 74*)
HWXL	HW Maximum length (days)[13]	3	4 (*3 to 5*)	4.5 (*4 to 10*)	8.5 (*6 to 43*)
HWN	Annual number HWs	1	2 (*1 to 4*)	3 (*2 to 5*)	5 (*4 to 7*)
TXHX	Avg. TX in most extreme annual HW (°C)	30	31 (*30 to 32*)	31 (*31 to 33*)	32 (*32 to 34*)
TNHX	Avg. TN in most extreme annual HW (°C)	15	16 (*15 to 16*)	17 (*16 to 18*)	19 (*18 to 21*)
TXX	TX on hottest day of year (°C)	29	31 (*30 to 32*)	32 (*32 to 35*)	35 (*33 to 38*)
SU	Number of days reaching TX >25 °C	12	28 (*22 to 41*)	40 (*30 to 70*)	62 (*57 to 111*)
TR16C	Number of nights reaching TN >16°C	0	4 (*3 to 13*)	15 (*9 to 47*)	52 (*36 to 108*)

**Upper values in each table cell are the ensemble median, with values in parentheses giving the 10th to 90th percentile range over the model ensemble.*

[12] See the report, BC Provincial Heat Alert and Response System (BC HARS): 2023, May 2023. Available at: http://www.bccdc.ca/health-professionals/professional-resources/heat-event-response-planning. The lower threshold temperatures used in our HW definition, which is intended for use throughout BC, are TX = 28°C and TN = 13°C. In addition, a HW must: 1) last at least 2 full days; and 2) have TX and TN exceeding their 95th percentile values in the Past.

[13] It may seem strange that HWD < HWXL in the Past, but this is an artifact of small number statistics. Some years in the Past contained no HWs, leading to a mean annual value of 0.4 for HWD (rounded to 1 in the table, since some years had a HW). Nevertheless, one or more years had HW lengths of 2 or 3 days, leading to the mean HWXL = 2.5 days (rounded to 3) over the 30-year period. As the number of HWs increases in future years of the simulations, the expected behaviour HWD > HWXL emerges.

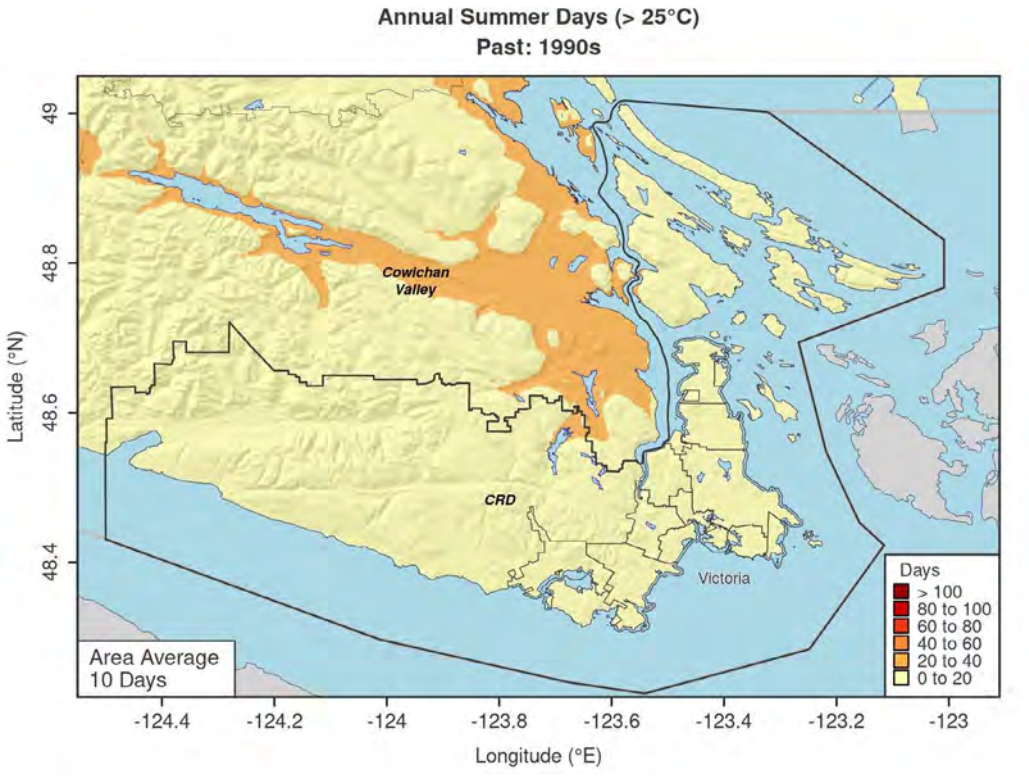


Figure 14a. *Annual count of summer days in the Past*

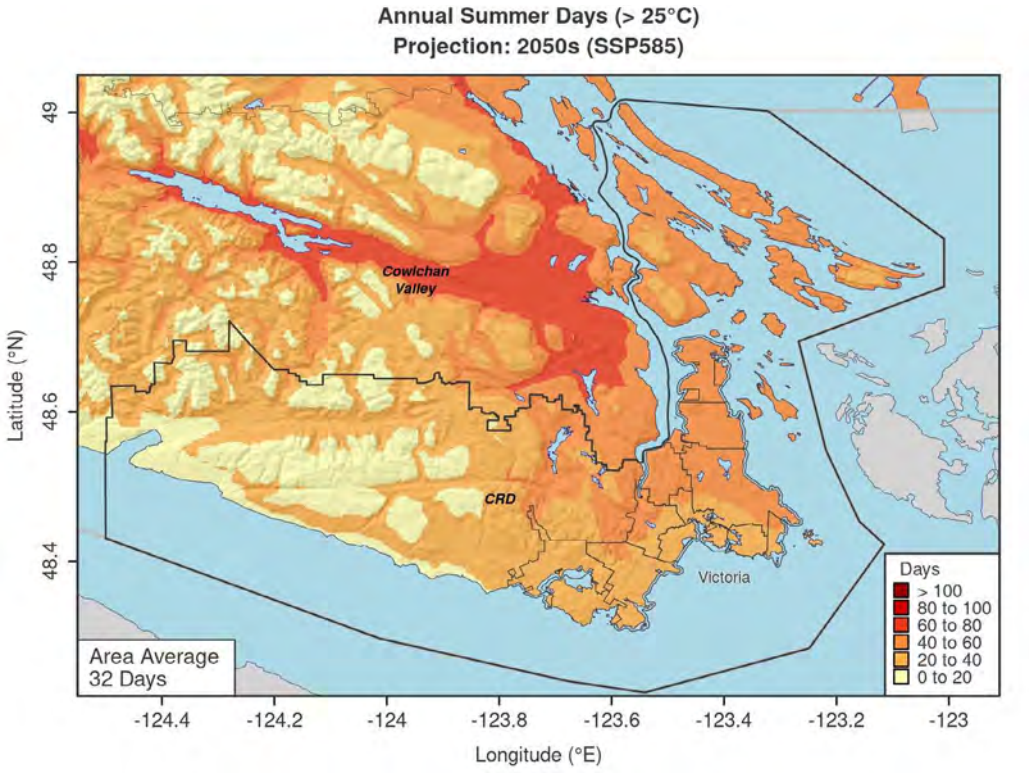


Figure 14b. *Projected number of annual summer days by the 2050s*

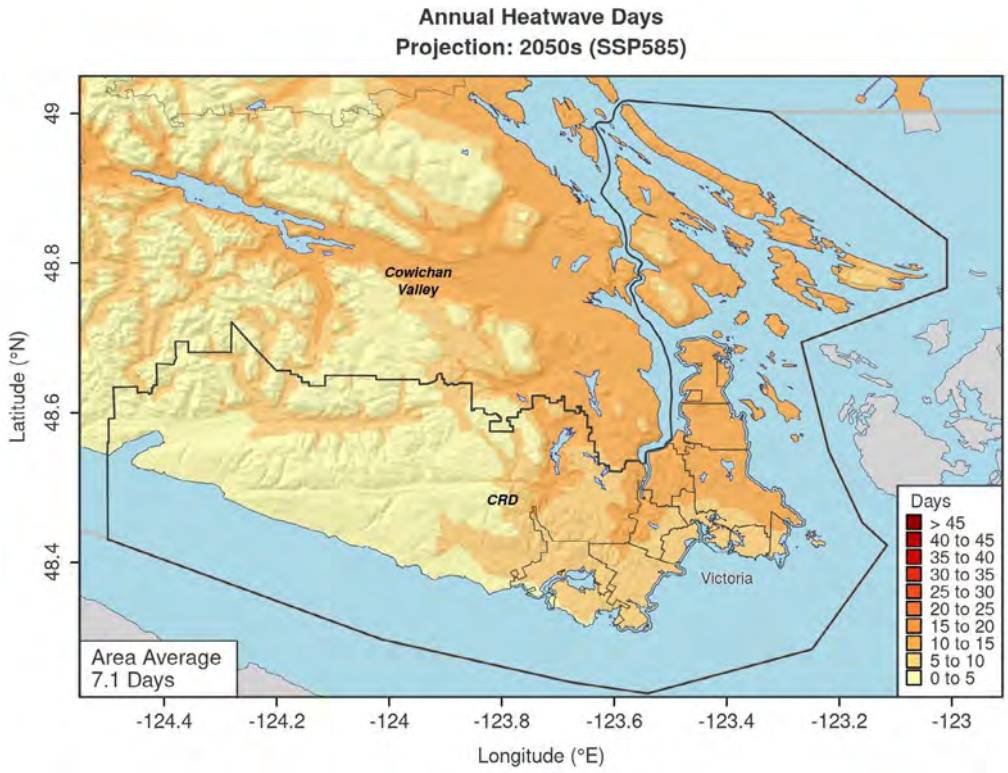


Figure 15a. *Projected annual count of heatwave days in the 2050s.*

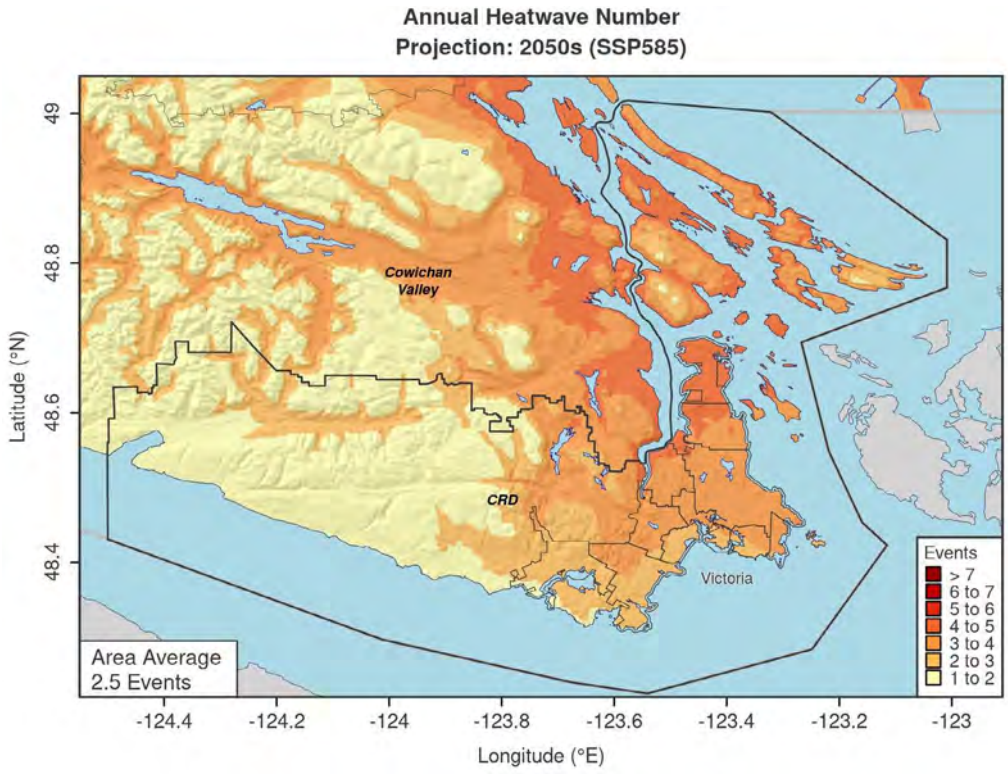


Figure 15b. Projected number of annual heatwaves in the 2050s.

Note that: (i) for both measures, counts in the Past are very low (about 1 per year) and uniform throughout the capital region; and (ii) average values for Core/ Peninsula (Table 9) are larger than capital region averages shown on the maps.

5.4 The 1-in-20-Year Annual Hottest Day

This indicator describes extreme daily high temperatures so warm, they are expected to occur only once every 20 years in the historical climate. In other words, the *1-in-20 Year Hottest Day* presently has a 5% chance of occurring in any given year.

Projections

The figure below shows the projected changes in this type of event in two ways: first, in terms of how frequently an event of the same TX value occurs in the future; and second, in terms of how much TX increases for an event occurring with the same frequency (or annual probability) in the future.

For example, in the Past, a daily maximum temperature of 32°C or higher occurred once every 20 years or so in the capital region, or with a 5% annual exceedance probability (AEP). In the projections for the 2050s, this temperature is exceeded around 8 times in a 20-year period, or with a 40% AEP. Alternatively, one can say based on the same projections that in the 2050s, the magnitude of a 1-in-20 year (5% AEP) event increases to around 35.5°C (see the 'Return Levels' tab in the SSP585 Summary Table).

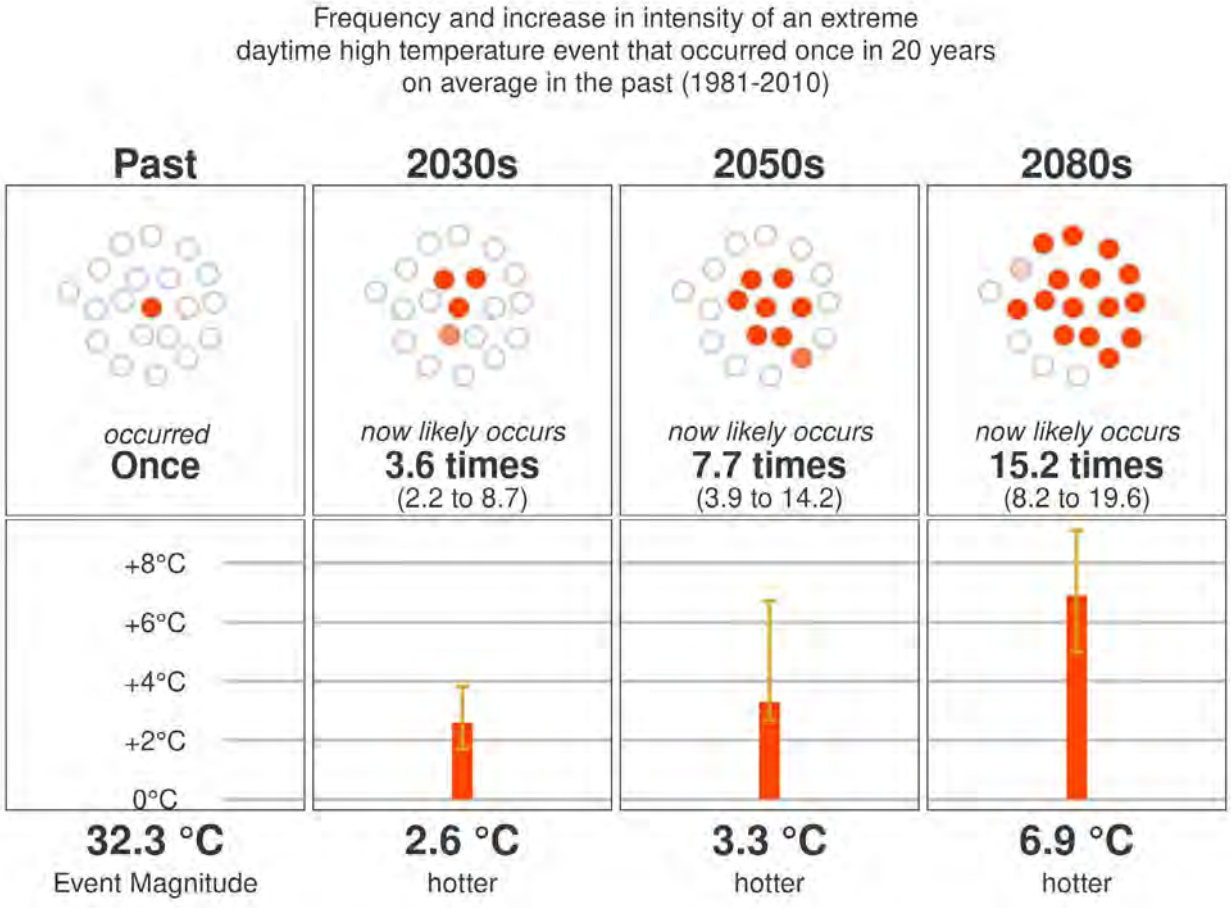


Figure 16. *Upper panels: Frequency of a 1-in-20 year daily maximum temperature (TX) event in the Past and projected frequency of the same magnitude event (i.e. TX = 32°C) in the three future periods. Lower panels: Increase in magnitude of a 1-in-20 year TX event from the Past to Future periods. Figure design is taken from similar infographics in the IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 3-32, doi:10.1017/9781009157896.001.*



6. PRECIPITATION INDICATORS

6.1 Dry Spells

The *Consecutive Dry Days* indicator tracks the annual longest string of days with less than 1 mm of precipitation.

Projections

In the Past, the median dry spell length in the capital region was 24 days. The median future-projected dry spell length increases by 8% to 26 days (range 24 - 34 days) by the 2050s and by 21% to 29 days (range 26 - 47 days) by the 2080s.

The increase in dry spell length is consistent with the higher summer temperatures and reduced summer rainfall highlighted in the previous chapters. The map of consecutive dry days (not shown) is quite uniform throughout the region, as are its changes in the future periods.

6.2 Snowfall

Snowfall is inferred from the downscaled total daily precipitation and temperature, using a widely validated empirical relationship.[14]

Projections

In the Past, the median annual snowfall in the capital region was around 275 mm (snow water equivalent, or SWE). The median future-projected snowfall decreases by 60% to around 110 mm (range 32 to 134 mm) by the 2050s and by 85% to just 40 mm (range 7 to 60 mm) by the 2080s. Due to the robust projection of an increase in cold season temperature (Chapters 3 and 4), the expectation of a smaller fraction of precipitation falling as snow in future decades is reasonable, even if its magnitude is somewhat uncertain.

Of more concern is the limited model ability to simulate the unique meteorological conditions that lead to the rare, but sometimes heavy, snowfalls in southwest BC. The CMIP6 models used in this study are probably not able to capture this behaviour very well, meaning that the change in frequency of winter storms resulting in heavy snowfall is largely unknown.

[14] Dai, A. (2008). "Temperature and pressure dependence of the rain-snow phase transition over land and ocean," Geophysical Research Letters, 35(12). Snowfall projections should be taken with special caution, for two reasons. First, the amount of total precipitation that falls as snow is a sensitive function of local temperature, so whatever temperature biases remain after the downscaling procedure result in uncertainty in snowfall. Over time, however, as local temperatures exceed 0°C more often in winter, this uncertainty decreases.

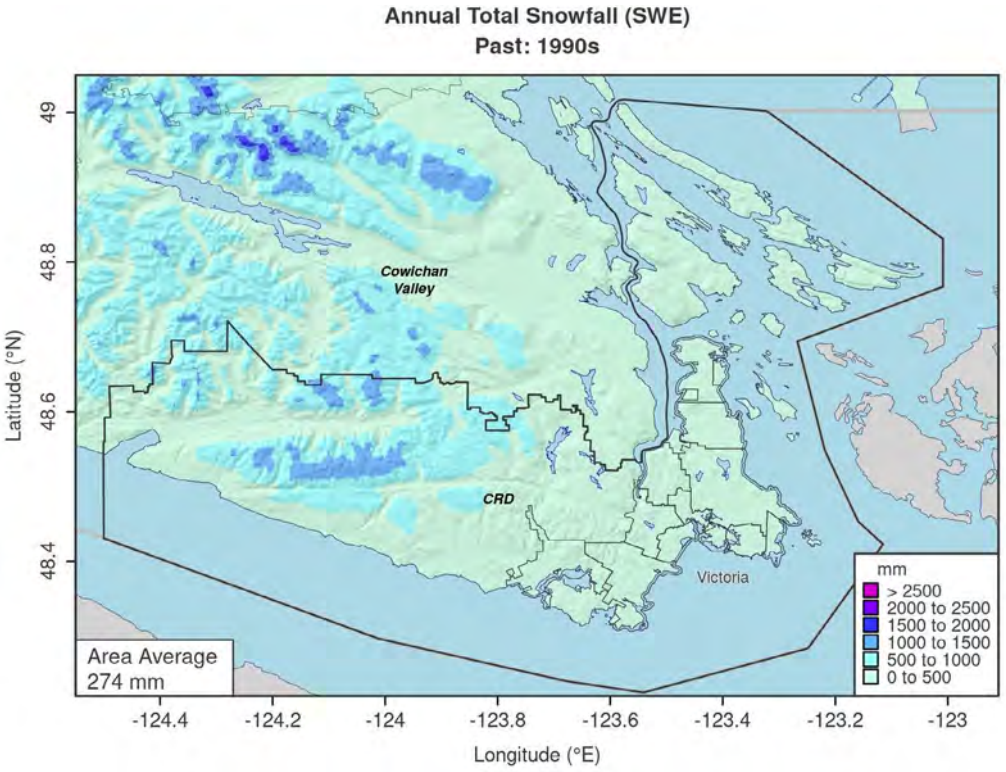


Figure 17a. *Annual total snowfall in the Past.*

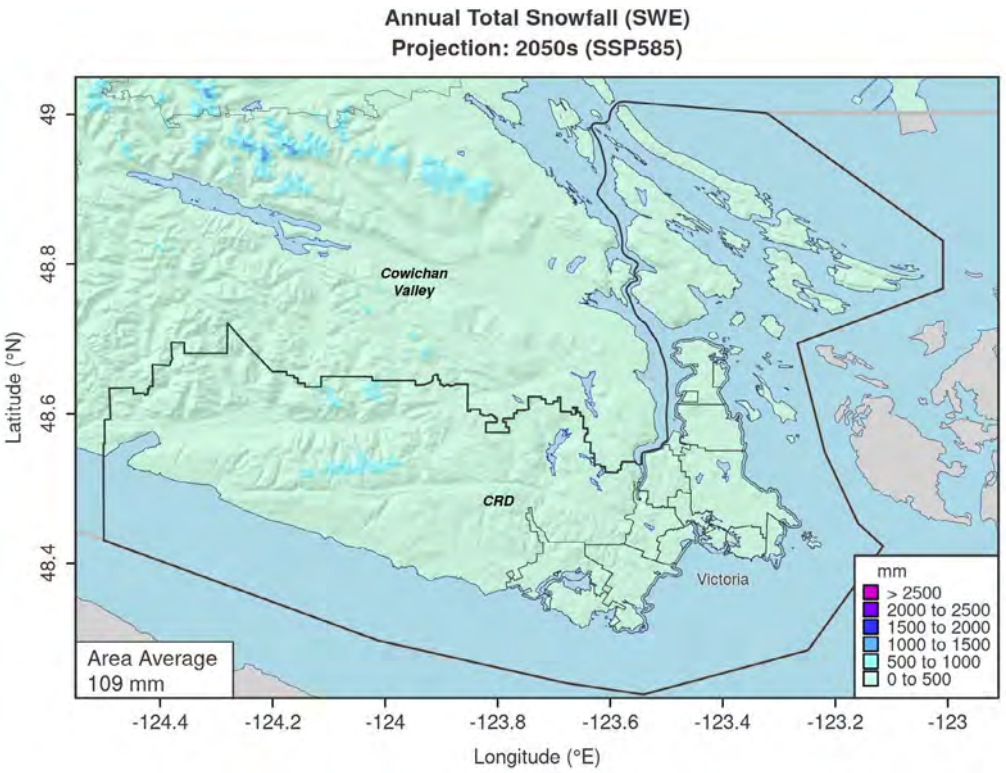


Figure 17b. *Projected snowfall in the 2050s.*

6.3 Annual Maximum One-Day and 5-Day Precipitation and 95th-percentile Wettest Days

These indicators describe the largest precipitation events of the year. The *Annual Maximum One-Day Precipitation* (RX1DAY) is self-explanatory, while the *Annual Maximum 5-Day Precipitation* (RX5DAY) tracks the accumulated amount over consecutive 5-day periods during the year. If we compute the 95th percentile of daily precipitation over all wet days in the Past (i.e. those with a daily amount of at least 1 mm), and then sum the amounts over that threshold that fell on especially wet days, then we obtain the 95th-percentile Wettest Days (R95P) index.

Note that R95P is potentially composed of several large precipitation events in a typical year, and does not (usually) describe single storms.

All amounts in the table below reflect the systematic difference in precipitation amount from west (high) to east (low) across the capital region. Across the region, percent increases for the 2050s differ somewhat for each index: from 10-16% for RX1DAY, to around 10% for RX5DAY to around 30% for R95P. Changes for the 2080s are correspondingly higher, as shown in the table.

Table 10: Annual Extreme Precipitation Indices

	Past (mm)	2050s(mm)	2080s(mm)	2050s Change (%)	2080s Change (%)
One-day maximum precipitation (RX1DAY)					
Region	63	72	77	14 (*4 to 24*)	22 (*17 to 29*)
Western Region*	67	74	80	10 (*4 to 24*)	19 (*17 to 30*)
Eastern Region	37	43	45	16 (*5 to 26*)	22 (*17 to 33*)
5-Day maximum precipitation (RX5DAY)					
Region	163	179	187	10 (*6 to 21*)	15 (*12 to 33*)
Western Region	172	188	197	9 (*6 to 20*)	15 (*13 to 24*)
Eastern Region	88	97	101	10 (*5 to 23*)	15 (*12 to 23*)
95th Percentile Wettest Days (R95P)					
Region	402	527	590	31 (*16 to 46*)	47 (*30 to 77*)
Western Region	423	553	622	31 (*16 to 46*)	47 (*30 to 79*)
Eastern Region	193	245	276	26 (*10 to 41*)	43 (*23 to 64*)

*Values for Water Supply Area and the entire region are slightly lower than those for the Western Region, and well within the spread of model results, so are not shown. Consult the data deliverable spreadsheets for values in all subregions.

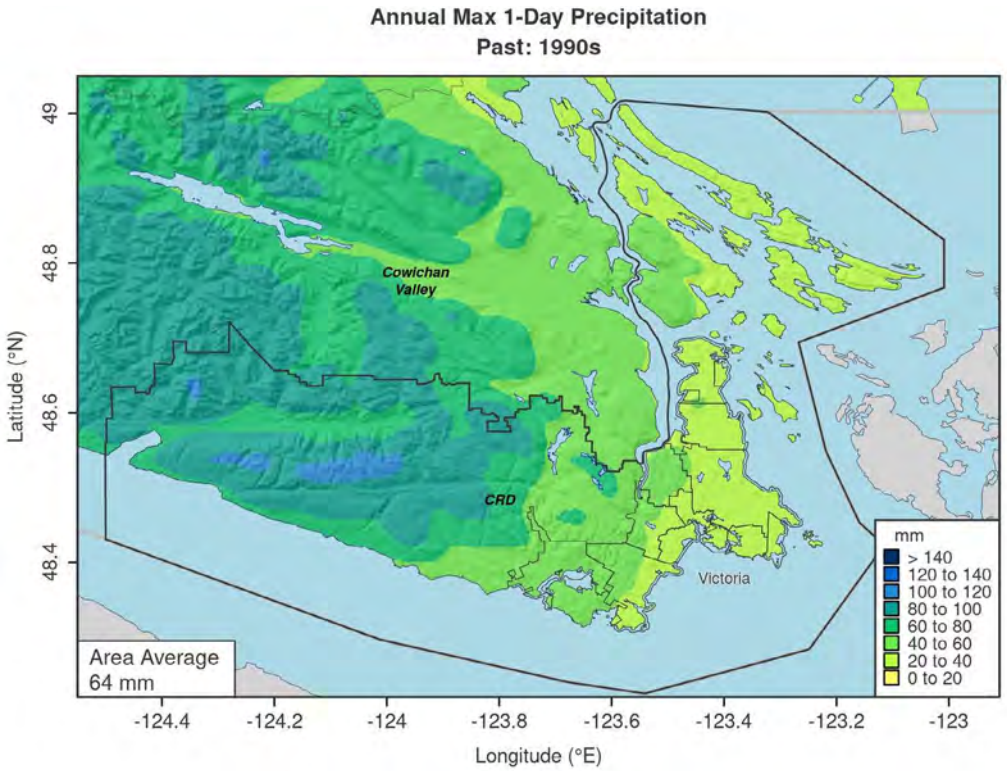


Figure 18a. *Annual maximum 1-day precipitation in the Past.*

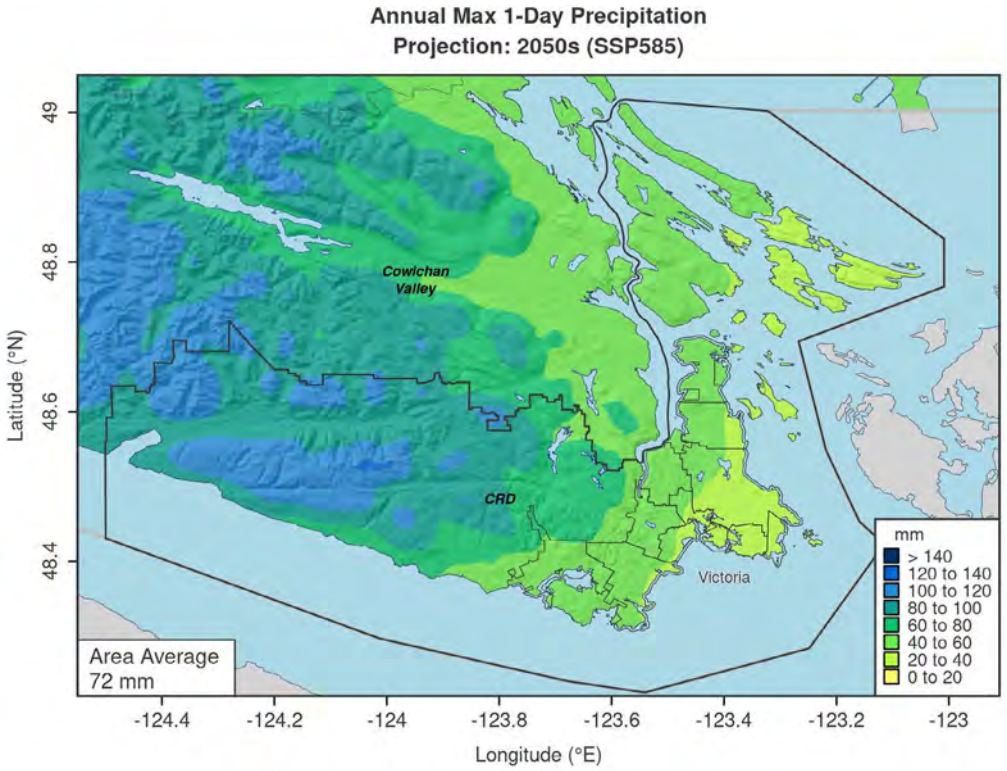


Figure 18b. *Projected Annual maximum 1-day precipitation in the 2050s.*

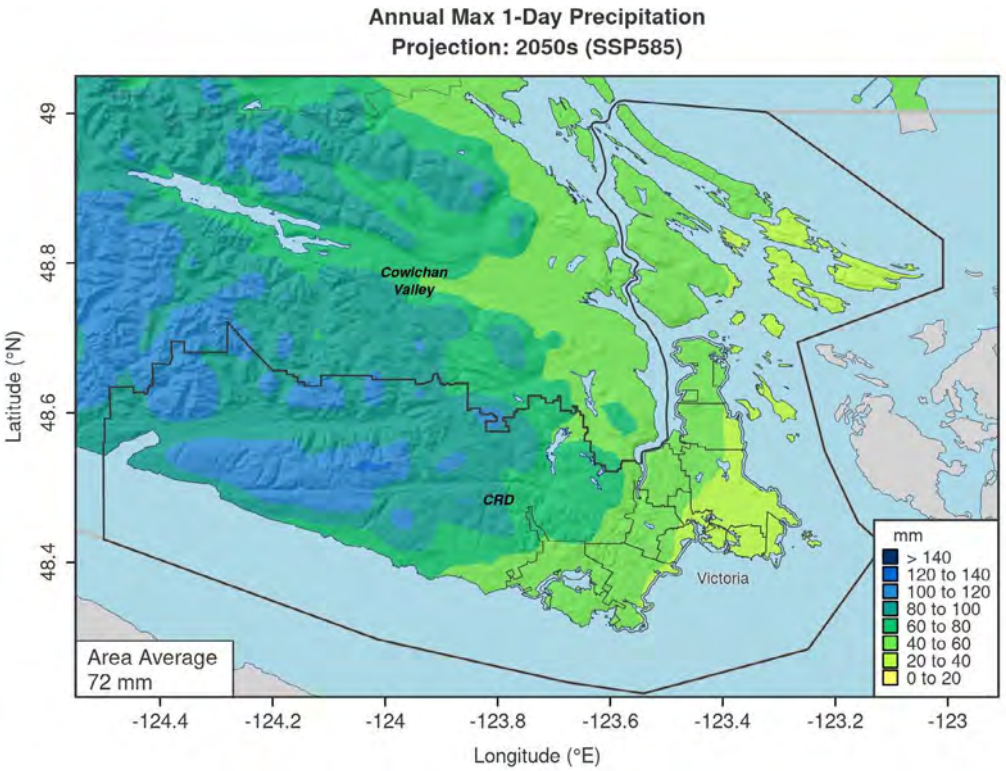


Figure 19a. *1-in-20 year, maximum 5-day rainfall in the Past.*

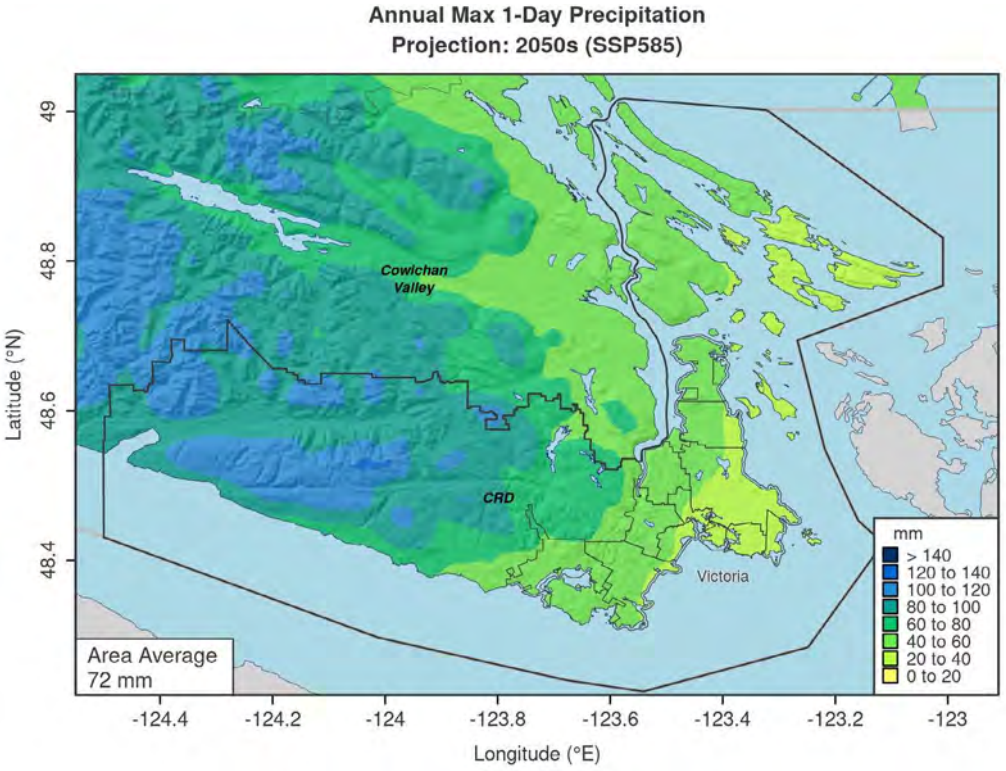


Figure 19b. *1-in-20 year, maximum 5-day rainfall in the 2050s.*

6.4 The 1-in-20 Year Wettest Day and 1-in-20 Year Wettest 5-Day Period

These indicators describe rainfall events so extreme, they are expected to occur only once every 20 years in the Past climate. In other words, the *1-in-20 Year Wettest Day* and *Wettest 5 Days* have a 5% chance of occurring in any given year in the Past.

Projections

In the Past, the median 1-in-20 Year, single-day rainfall in the capital region was around 100 mm, while the median 1-in-20 year, 5-day rainfall was about 230 mm. The median Future-projected 1-in-20 year, single-day rainfall increases by 15% to around 115 mm by the 2050s and by 25% to about 125 mm by the 2080s. The median future-projected 1-in-20 year, 5-day rainfall increases by 15% to around 270 mm by the 2050s and by 20% to about 280 mm by the 2080s. As shown in the maps above, the absolute rainfall amounts for both indices are considerably larger in the west of the region compared to the east.

By comparing these results with those shown in Table 3 of Chapter 3, it is evident that the relative changes in extreme rainfall indices are larger than those for seasonal or annual mean rainfall. Table 12, which gathers relevant results from other tables above, reinforces this point. This behaviour occurs due to the different mechanisms that control how extreme (e.g., daily) and average (e.g., monthly to annual) precipitation respond to warming.

As in the case of rare temperature events, one may express these changes in extreme rainfall in a more visually compelling way, as in the diagram on the following page.

Table 11: 20-Year Return Level Rainfall

	Past (mm)	2050s (mm)	2080s (mm)	2050s Change (%)	2080s Change (%)
1-in-20 Year Maximum One-Day Rainfall					
Region	101	116	124	15 (*9 to 30*)	24 (*22 to 42*)
Western Region[1]	105	122	129	16 (*9 to 28*)	23 (*21 to 39*)
Eastern Region	62	72	79	16 (*10 to 23*)	27 (*23 to 42*)
1-in-20 Year Maximum 5-Day Rainfall					
Region	232	268	281	14 (*3 to 31*)	21 (*11 to 27*)
Western Region	243	274	297	13 (*2 to 32*)	22 (*11 to 27*)
Eastern Region	132	155	159	17 (*0 to 32*)	20 (*10 to 27*)

Table 12: Change in various precipitation indices: Means versus extremes

	Region		Western Region		Eastern Region	
	2050s Change (%)	2080s Change (%)	2050s Change (%)	2080s Change (%)	2050s Change (%)	2080s Change (%)
Annual Mean	4	11	2	8	5	11
RX1DAY	14	22	10	19	15	22
RX5DAY	10	15	9	15	11	15
R95P	31	47	31	47	26	43
1-in-20 RX1DAY	15	24	16	23	16	27
1-in-20 RX5DAY	14	21	13	22	17	20

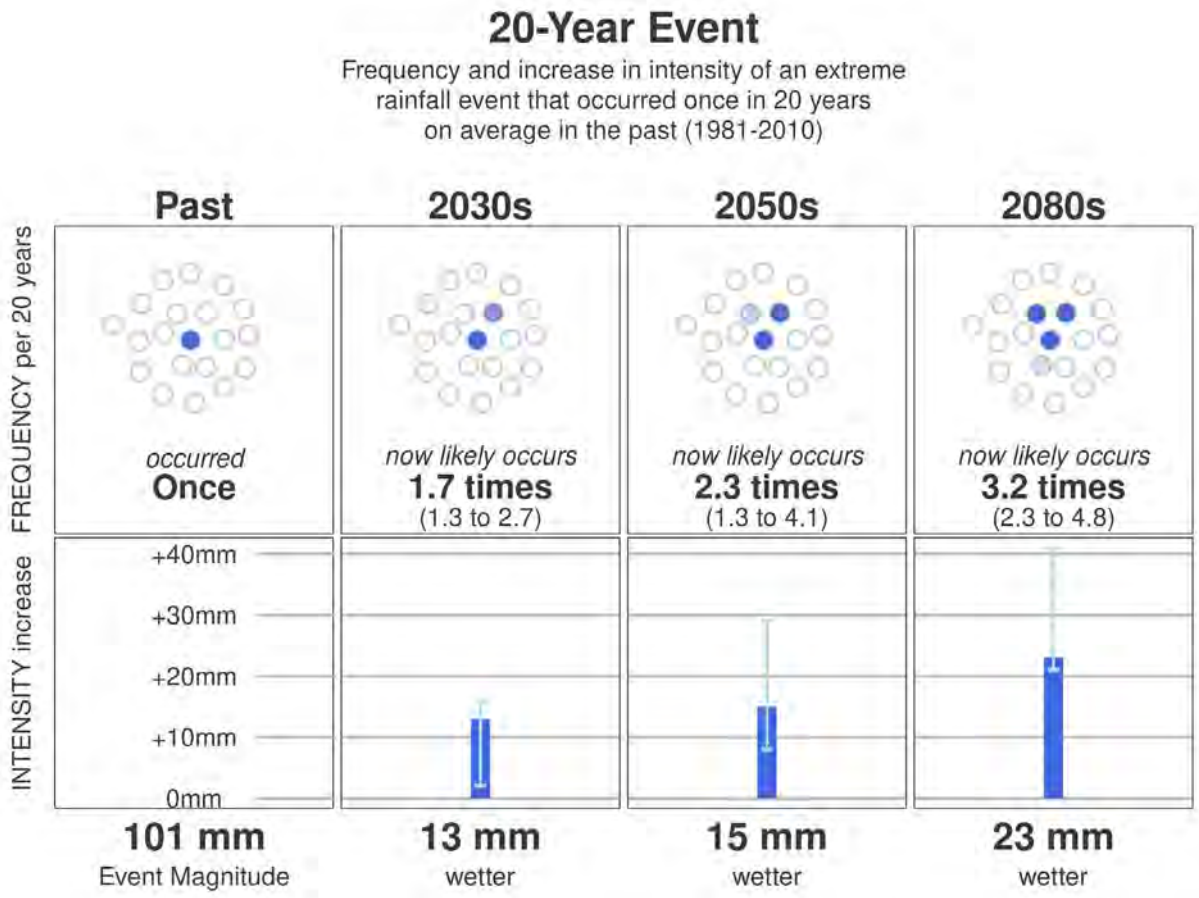


Figure 20. *Upper panels: Frequency of a 1-in-20 year daily maximum rainfall event in the Past and projected frequency of the same magnitude event (i.e. 101 mm) in the three future periods. Lower panels: Increase in magnitude of a 1-in-20 year single-day rainfall event from the Past to Future periods. Figure design is taken from similar infographics in the IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 3-32, doi:10.1017/9781009157896.001.*

7. REGIONAL IMPACTS

Communities across the capital region are already witnessing and experiencing impacts from climate change. These impacts are likely to persist and, in many cases, intensify over the coming decades based on projected global GHG emissions trajectories. Collective efforts to reduce emissions and thereby slow the rate of global warming will be necessary to lessen the severity of these impacts. Equally important will be action on climate adaptation and preparing for the environment as it will be in the future, not as it was in the past.

Investing in climate adaptation has the potential to support thriving communities and economies for generations to come. Adaptation actions can safeguard communities and their critical infrastructure from extreme weather events, protect and sustain natural ecosystems, increase the resiliency of food systems, and improve the efficiency of energy and water use. Importantly, there is no "one-size-fits-all-solution"; adaptation can take many forms depending on the unique context of the community.

By the 2050s, the capital region can expect a climate that has diverged from that of the past, with warmer year-round temperatures, shifting precipitation patterns, and more noticeable climate extremes. Due to climate variability, these changes may not occur evenly from one year to the next. Although winters will generally become warmer and wetter, it's important to be prepared for some winters in the future to be colder and drier, especially in the near term. Similarly, while summers will become increasingly hot and dry, there will be summers that are cooler and wetter than the average summer in the future. Adaptation strategies must consider the inherent complexity and variability of projected changes to the regional climate.

This section provides a brief overview of the multiple, intersecting climate impacts expected across various sectors in the capital region. **It is not a comprehensive assessment of the impacts that can be expected from the projected changes outlined in this report.** Rather, this chapter reflects a discussion of regional climate impacts that took place among local government staff, emergency planners and environmental scientists in October 2023. It is intended to spark deeper discussion that explores how to prepare for the interrelated climate impacts facing the region.

While the development of this report did not actively involve First Nations in the capital region, it's crucial to recognize that Indigenous Peoples and their traditional territories bear a disproportionate impact from climate change compared to other groups in Canada.[15] Indigenous knowledge systems play a pivotal role in comprehending ecological resilience, monitoring local and regional impacts, and effectively responding to climate change challenges. Future initiatives aimed at exploring and mitigating the impacts of climate change should prioritize meaningful engagement with First Nations throughout the region.

> The case for investing in climate adaptation is clear: for every $1 spent on adaptation measures today, $13 to $15 is estimated to be returned in future years through direct and indirect benefits.[16]



Figure 21. *Infographic summarizing key projections for the 2050s time period.*

[15] BC Centre for Disease Control. Climate Change and Health. http://www.bccdc.ca/health-info/prevention-public-health/climate-change-health

[16] Swayer, D., Ness, R., Lee, C., and Miller, S. (2022). Damage control: Reducing the costs of climate impacts in Canada. Climate Risk Institute.

Climate Equity

The impacts discussed in this chapter will not be experienced the same way by all residents of the region. People facing the greatest economic and social challenges are often the ones most affected by climate change, particularly for impacts that are compounding (see below). During and after climate-related events, some people and communities experience disproportionate impacts because of existing vulnerabilities that often overlap, including:[15]

- People who experience poverty, colonization, racism, inadequate housing, and a lack of access to health care,
- People who are most likely to be exposed to climate impacts because of where and how they live and work,
- People living with disabilities, chronic diseases, and mental illnesses, and
- Babies in the womb, pregnant people, infants, children, and older adults.

Climate equity can be woven into broader efforts to address the socioeconomic, sociocultural, and physical impacts of climate change. This will require collaboration across various sectors to understand where climate change intersects with other crises (e.g., housing, mental health), and to address these issues holistically.

> Climate equity[17] is the goal of recognizing and addressing the unequal burdens made worse by climate change, while ensuring that all people share the benefits of climate action efforts. Achieving climate equity means that all people in our region have access to a safe, healthy, and fair environment.

Impacts

The impacts examined in this chapter occur within a dynamic and increasingly complex global system. As a result, the impacts from projected climate change may be more severe due to the collective impact of multiple drivers. Examples of compounding interactions include, but are not limited to:



- In the warmer months, high temperatures combined with less rainfall can make drought conditions more likely. [18]
- Extended periods of drought can change soil conditions and reduce infiltration of heavy rainfall, exacerbating localized flooding.[19]
- Warmer water temperatures and increased stormwater runoff can promote conditions for algal blooms year-round.[19]
- Wildfire smoke during extreme heat events can aggravate pre-existing health conditions and cause exposure to poor air quality for residents seeking relief from the heat outdoors.[19]
- Ongoing emergency response associated with consecutive extreme events can overwhelm staff capacity and deplete emergency management resources.

[17] United States Environmental Protection Agency. Climate Equity. https://www.epa.gov/climateimpacts/climate-equity

[18] Intergovernmental Panel on Climate Change [IPCC]. 2023. Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 35-115, doi: 10.59327/IPCC/AR6-9789291691647

[19] Yumaguloca et al. 2022. Lived experience of extreme heat in BC: Final report to the Climate Action Secretariat. Government of BC.

Health and Well-Being

The capital region has a growing and aging population. By 2038, the population is expected to grow by 20% and the number of people aged 65+ is expected to increase by over 50%.[20] Historically, the region has had excellent air quality and comfortable temperatures, with nights cooling off in the summer. In recent years, wildfire smoke and periods of extreme heat during the warmer months have forced residents to seek refuge indoors. Higher temperatures are typically experienced in the eastern parts of the region and in urban areas further from the coast. Developed areas are typically hotter due to the urban heat island effect, which describes how closely packed buildings and widespread paved surfaces in urban areas absorb and re-emit heat more effectively than natural ecosystems and areas shaded by trees and vegetation.[21]

Impacts

In recent years, extreme weather events made worse by climate change have negatively impacted human health and well-being in the capital region. Climate change has the potential to undermine health determinants such as air quality, water supply, food security, cultural practices, and access to a safe environment. Climate change can also place additional strain on healthcare and social systems that are necessary for good health and well-being.

By the 2050s, the capital region can anticipate more multi-day extreme heat events that become longer and more intense by mid-century. The region can also expect hotter summer temperatures, with more days exceeding 25°C and more "temperate nights" where the temperature stays above 16°C.[22] These projected changes will increase the risk of heat-related illnesses and mortality and worsen pre-existing health conditions, particularly among equity-denied populations who do not have access to a cool indoor environment. Notably, these risks are heightened for the region's growing population of older adults.

Warming temperatures and shifting precipitation patterns may worsen air quality in the region. Across the Pacific Northwest, hotter and drier conditions can increase the likelihood of wildfire ignition. This may cause more frequent episodes of wildfire smoke in the capital region, which can irritate the lungs, cause inflammation, and alter immune function, particularly for people with pre-existing conditions.[24] The projected changes in temperature, precipitation and heat wave occurrence may also exacerbate other air pollutants that influence human health such as pollen, mould, and ground-level ozone.

Living through an extreme weather event, or grappling with uncertainty about the future, can impact mental health and wellbeing, often manifesting as stress, anxiety, fear, and exhaustion. During and after an extreme event, people who face property loss or displacement may endure significant and lasting trauma.

In June 2021, an unprecedented[23] "heat dome" event in the Pacific Northwest caused extended periods of record-breaking high temperatures that had severe implications for health and well-being. Over 600 heat-related deaths were recorded across BC, particularly among people with pre-existing medical conditions (including schizophrenia), older adults, people living alone, and people living in socially deprived areas[21]. In response to this event, numerous projects have been launched across the capital region to better understand extreme heat vulnerability and to build resilience towards extreme heat in the future. For more information, see Appendix D: Further Resources.

[20] BC Statistics. 2019. Capital Regional District 2019-2038 Population, Dwelling Units and Employment Projection Report.

[21] British Columbia Coroners Service. 2022. Extreme heat and human mortality: A review of heat-related deaths in BC in Summer 2021.

[22] The number of temperate nights is an important public health measure that reflects the lower temperature threshold for emergency health alerts used in the capital region. For more, see: Government of British Columbia. 2023. BC Provincial Heat Alert and Response System (BC HARS).

[23] The unprecedented nature of the June 2021 heat dome makes it difficult to estimate its return period (or annual probability of occurrence). Based on analysis of historical data, it was estimated as a 1-in-300-year (or 0.3% annually) at Seattle-Tacoma Airport to a 1-in-1000-year event (or 0.1% annually) in New Westminster (Philip et al., 2022; doi: 10.5194/esd-13-1689-2022). While the capital region can expect more frequent extreme temperatures in the future, estimates for how often an event of this magnitude will occur are difficult because historical records are far shorter than the estimated return periods for this event.

[24] Berry, P., and Schnitter, R. 2022. Health of Canadians in a changing climate. Government of Canada.

Water Supply and Demand

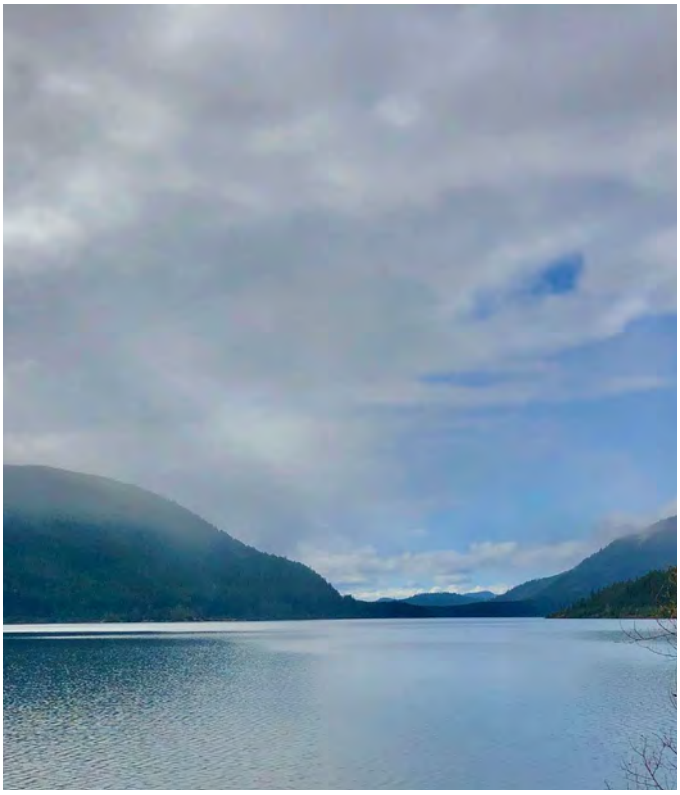
The CRD supplies drinking water to over 390,000 customers from large reservoirs in the Sooke, Leech and Goldstream watersheds that make up the protected Greater Victoria Water Supply Area (GVWSA). The CRD also provides water to small service areas in the Southern Gulf Islands and the western portion of the region through surface water and groundwater systems. Similar privately owned systems provide water in other areas. In some rural and less developed areas, residents rely on groundwater wells on their properties. Residential water use accounts for the largest portion of water use in the region (60%). Water supplies across Southern Vancouver Island are almost entirely replenished from rainwater in the late fall, winter, and early spring (the wet season). Snow melt runoff contributes to groundwater recharge and is needed to sustain summer flows.

Impacts

By the 2050s, less summer rainfall and longer dry spells will increase the risk of drought during the summer and into the early fall. At the same time, hotter temperatures and more extreme heat events will intensify water demand as residents consume more water to keep cool and stay hydrated. Hotter and drier conditions will also increase evaporation and evapotranspiration, raising outdoor watering demand. Water conservation initiatives will remain a priority in the region, given the growing population and the potential for the seasonal decline in water supplies to become more pronounced in the future. Greater densification and anticipated increases in peak demand may also trigger the need for more storage, supplements to existing water supplies, larger capacity infrastructure, and balancing reservoirs in water distribution systems.

> Hotter and drier summer conditions will be particularly challenging for those who rely on groundwater wells or small reservoirs that may not recharge sufficiently. In some instances, these systems may reach dangerously low levels or may even deplete completely. In coastal areas, overdrawing groundwater can lead to saltwater intrusion – an impact that is compounded by rising sea levels.

Hotter and drier conditions also increase the threat of wildfire in the GVWSA and other forested areas that supply water to residents of the region. Although fire is a natural and essential process in forest ecosystems, severe wildfire occurring in water supply areas can affect water quality and supply by increasing erosion during the following rainy season.[25] As the threat of wildfire increases in rural areas, water needs for wildfire protection will gain increasing importance in water conservation planning.



During the wet season, heavier rainfall may increase erosion of saturated slopes, leading to more fine sediment and organic material in streams entering water supply reservoirs. Increased turbidity from fine sediment can interfere with water disinfection and treatment, while excess organic material can promote algal blooms that produce cyanotoxins, cause taste and odour issues, and compromise disinfection and filterability. Where unprotected water supply catchment areas have been developed, more intense rainfall and runoff can lead to greater undesirable substances (pollutants) entering wells and surface reservoirs. Heavy rainfall and increased water inflows also pose a risk to dam safety. To support safe and resilient water supply through a changing climate, the potential for more intense rainfall events (see next section) will need to be considered in the planning and management of water supply systems.

[25] Brown et al. 2019. Long-term climate, vegetation and fire regime change in a managed municipal water supply area, SAGE Journals, 29(9), 1411-12.

Rainwater Management and Sewerage

A myriad of rainwater management and sewerage infrastructure aims to protect quality of life, property, and aquatic ecosystems across the capital region. Local governments in British Columbia are responsible for managing drainage; as a result, much of the region's drainage infrastructure (hard and soft) is integrated into local land use and infrastructure planning and processes. Historically, stormwater infrastructure was designed to move water away from the built environment, channeling high volumes of rainwater into creeks and streams. Recently, local governments are shifting towards the use of green infrastructure, which mimics natural drainage systems that play a crucial role in rainwater management. Natural drainage systems (i.e., creeks and wetlands) slow runoff through water retention, helping to reduce flood magnitude and filter out substances that impact water quality. The use of green infrastructure is particularly important in areas with increasing urbanization and development, where greater impermeable surfaces (i.e., roads, parking lots and buildings) contribute to additional runoff.

Impacts

In the past, flooding from extreme events has occasionally overwhelmed stormwater and sanitary systems in the region. With extreme precipitation events becoming wetter in the future, the region can expect aging and undersized infrastructure to continue to be overwhelmed, amplifying stressors on the receiving environment. During high intensity rain events, creeks may overflow and soils may become saturated, intensifying runoff, and increasing the chance of flooding in low-lying areas. This combination can increase erosion, decrease slope stability, and flood wetlands and lakes, impacting public infrastructure, drinking water quality, and surrounding aquatic ecosystems. Heavy rainfall events can also cause inflow and infiltration of rainwater into the sanitary system in crossover areas, increasing the likelihood of highly diluted sewage entering waterways.

When heavy rainfall occurs after prolonged periods of dry weather, the "first flush" of surface runoff typically contains high levels of contaminants that have accumulated on hard surfaces. This runoff makes its way into surface waters that are home to aquatic ecosystems. When paired with warmer water temperatures, increased stormwater runoff of nutrients can make conditions more favorable for algal blooms year-round – a growing issue in that region – that impacts water quality, ecosystems, recreation, and human health.



Malahat washout during November 2021 extreme rain event (Credit: Emcon Services Inc.)

Certain areas in the region are at increased risk of flooding during heavy rainfall events due to flat terrain and proximity to the ocean, particularly when these events occur simultaneously with high tides and onshore winds. The CRD Coastal Flood Inundation Mapping Project (2021) may be used in conjunction with the projected changes outlined in this report, to understand how these factors, along with sea level rise, will influence future flood risk for lower-lying areas near the coast.

The projected increase in heavy rainfall may lead to a higher volume of runoff than the current capacity of infrastructure is able to handle. Green infrastructure, low impact development and multijurisdictional watershed management approaches will remain important strategies for reducing the flooding, runoff and pollution associated with extreme precipitation events. Designers of stormwater infrastructure (i.e., culverts, storm drains, etc.) will also need to plan for higher single- and multi-day rainfall amounts. For more information about how future precipitation is estimated using climate model projections, including the adjustment of Intensity-Duration-Frequency (IDF) curves in a future climate, see Appendix D: Further Resources.

Ecosystems and Species

The capital region is home to various ecosystems, including Douglas-fir forests, Garry oak meadows, riparian zones, wetlands, estuaries, shorelines, and more. The diversity in the region brings with it a wide range of flora and fauna, including many species at risk that need protection. Natural assets providing connectivity and ecosystem services are essential for supporting climate resilience. Forests in the GVWSA contribute to the high quality of water in supply reservoirs, and green spaces in urban and suburban areas provide natural cooling capacity, stormwater retention, and help reduce air and water pollution.

Impacts

Warming year-round temperatures and seasonal changes in precipitation will have important impacts on the ecosystems, native species and associated ecological relationships and processes existing in the capital region. Because ecological systems are highly complex, it will be difficult to make specific predictions for how they will be impacted by a changing climate. In general, the speed and scale of climate change may threaten the capability of many species to adapt, altering the ecological landscape. Shifting seasonal patterns, characterized by an earlier onset of spring or a later start to fall, may threaten processes that rely on temperature cues, including predator/prey, parasite/host, and pollinator dynamics. This may cause population declines for certain species, and/or outbreaks of species that are considered pests. Specialist species may be particularly vulnerable, which may threaten regional biodiversity and create new opportunities for invasive species to thrive.

Climate change not only impacts ecosystems and species directly; it also interacts with environmental changes from human development.[26] Impacts from climate change may be amplified for ecosystems where land-use changes have caused fragmentation and, as a result, weakened resiliency. For example, the Bowker Creek watershed – covering 1,028 hectares of the capital region – historically supported coho and chum salmon and cutthroat trout. Today, Bowker Creek is highly urbanized, with roughly 50% now composed of impervious surfaces that cause low summer base flows and reduced water quality for aquatic ecosystems. Long range, multijurisdictional efforts are in place to protect its natural characteristics and reduce impacts from a changing climate.[27]



In the summer, hotter and drier conditions will continue to stress trees and other terrestrial and riparian (streamside) vegetation, particularly for species that are sensitive to drought such as the Western red cedar. Drought conditions can slow decomposition in below-ground communities consisting of bacteria, fungi, and other soil organisms, thereby reducing available nutrients. When plants undergo stress, they become more susceptible to competition with other plants and to damage from insects and diseases.

Warmer year-round temperatures will also raise water temperatures in aquatic ecosystems, which may be problematic for species that require cool water to thrive. In extreme cases, warm water can cause low oxygen levels and mortality, particularly when these conditions are compounded by low water levels and occur during critical life stages such as spawning, rearing, or hatching. Heavy rainfall can also disrupt critical ecological processes. For example, during an atmospheric river event in November 2021, increased channel erosion and sediment deposition resulting from high stream flows severely impacted salmon spawning beds.[28]

[26] IPCC. 2022. Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group, II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. [H.-O. Pörtner et al. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi: 10.1017/9781009325844.59327/IPCC/AR6-9789291691647

[27] Bowker Creek Initative. 2012. Bowker creek blueprint: A 100-year action plan to restore Bowker Creek Watershed.

[28] CBC. 2021, 21 November. For B.C.'s salmon, floods represent another challenge to survival.

Buildings and Energy Systems

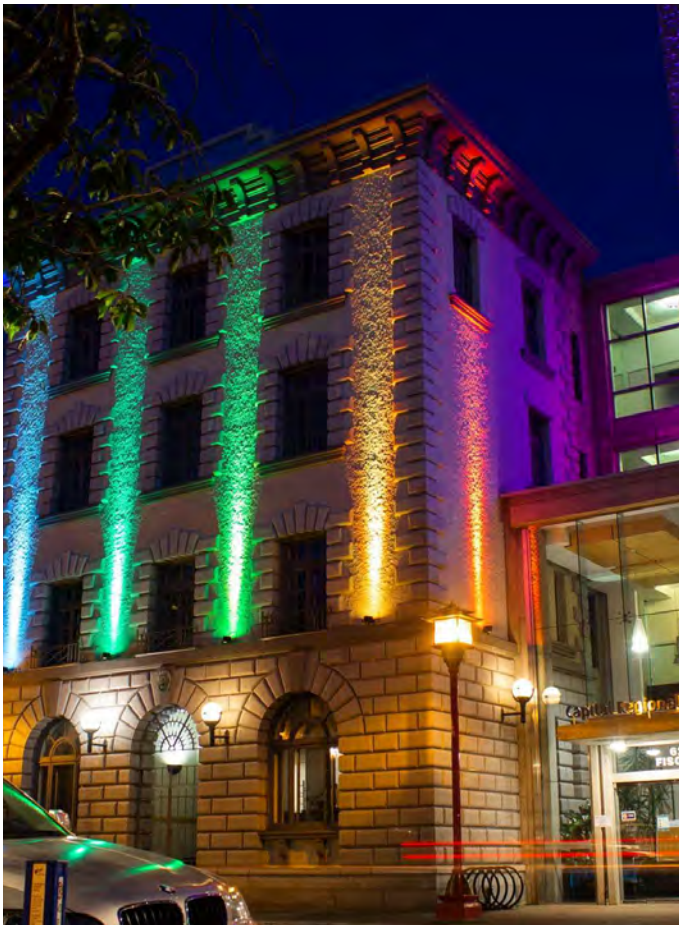
Energy use in buildings accounts for roughly one third of GHG emissions in the region. In the past climate, most buildings and homes in the capital region did not require active cooling capacity. During the 2021 heat dome, 98% of heat-related deaths in BC occurred in private residences, highlighting an urgency to implement cooling measures in homes across the region.[21] Retrofit programs and new building policies not only support the transition to renewable energy and energy efficient technologies but are leading to building envelope considerations and a greater adoption of low emission heat pumps that support thermal comfort. In both urban and rural communities across the region, many homes and other buildings are in coastal and riverine areas where flooding may be a concern.

Impacts

As the climate warms and precipitation patterns change, the case for investing in well-designed, resilient buildings improves. Heavier rainfall events may increase the risk of flooding in the fall and winter, which can cause property damage, personal injury, and economic losses, particularly where development is located on flood plains. More episodes of multi-day extreme heat can also stress foundations and building materials, and potentially affect the functioning of heating, ventilation, and air conditioning (HVAC) systems.

Across the region, warmer year-round temperatures and more days going above 25°C in the summer will shift seasonal and long-term energy demands. Whereas heating demand is expected to decrease in the colder months, hotter temperatures and more multi-day extreme heat events during the warmer months will generate cooling demand where it did not exist previously. In the past, buildings and homes have relied on the region's cool summer nights to support thermal comfort during the warmer months. In the future, an increasing number of "temperate nights" (i.e., nights when the temperature stays above 16°C) will heighten the risk of buildings overheating.

Adaptive design strategies, such as passive cooling, outdoor shading, rainwater capture and reuse, green roofs, resilient landscaping, and rain gardens, can help address challenges from heat, drought, and overland flooding. In addition, concentrating development in already developed areas, balanced with access to urban greenspace, can protect opportunities for the surrounding natural ecosystems to buffer changes to our climate.



The projected increase in cooling degree days by mid-century will require that most buildings have some form of active cooling to maintain thermal comfort and prevent overheating. Certain units, such as older, multi-unit residences, often lack air conditioning and are not designed to handle hot temperatures, leaving occupants at greater risk of heat-related illnesses and mortality. The use of energy efficient technologies like heat pumps will play an important role in aligning with efforts to reduce GHG emissions while avoiding additional costs to residents. Authorities with jurisdiction over building codes should consider how to proactively integrate future climate considerations into the design of new and existing buildings.

Transportation

The region's transportation network includes many local and arterial corridors, three major highway corridors (Highways 1, 14 and 17), two provincial and two international ferry corridors, a regional transit network, international and harbour airports, cruise ship and ferry terminals, and many active and multi-use trails. Regional transportation priorities include full realization of a multi-modal transportation network to help shift away from private vehicles to public transport, walking and cycling. As a coastal community, the capital region is vulnerable to significant transportation disruptions that complicate responses to emergencies and extreme events, and can interrupt the local supply chain.

Impacts

The projected increase in heavy rainfall may intensify flooding across the region, potentially causing more frequent road closures, vehicle collisions and construction delays. Some communities, such as Sooke, have already seen recurrent road closures due to flooding and may be particularly vulnerable to heavy rainfall.[29] Extreme precipitation events may also impede the reliability of major transportation corridors. In November 2021, extreme rainfall and runoff from a landfalling atmospheric river caused extensive damage to the Malahat Highway (Highway 1), prompting its temporary closure. This disruption reverberated through the local supply chain, resulting in shortages of fuel and other essential goods and services across the region. Like flooding from heavy rainfall events, wildfires also pose risk to the closure of regional highways and roads. In the future, hotter temperatures and less rainfall occurring in the warmer months will increase fire danger. Wildfire damage along hillslopes near roadways may also heighten the risk of landslides during the subsequent rainy season.

> The effects of extreme weather on transportation may be particularly challenging for some equity-denied groups. Residents may find themselves unprepared to leave their homes, hindering their ability to access essential supplies and services.



By the 2050s, a shorter winter season characterized by less snowfall and fewer freezing days may lower the costs associated with snow removal and the repair of cracked roads from freeze-thaw cycles. However, equipment to manage severe winter conditions will need to be maintained as changes to the frequency of heavy snowfall events remains largely unknown because they are driven by "Arctic outflow" events from Northern BC.

Warming temperatures may enhance the appeal of active transportation (walking, cycling and transit use) during the colder months. Conversely, high temperatures, multi-day extreme heat events, and poor air quality from wildfires in nearby regions may deter residents from choosing active transportation methods in the summer and early fall. Active transportation routes may also be interrupted by heavy rainfall, which can cause localized flooding and erosion along trails and pathways.

To safeguard transportation across the region, projected changes to temperature and precipitation should be considered in the design and retrofit of transportation infrastructure. These changes should also be considered against the backdrop of other existing weather hazards that will continue to affect the region (e.g., windstorms). Efforts to reduce GHG emissions across the region will rely on a resilient active transportation network. Strategies to support active transportation may involve installing adequate cooling infrastructure (i.e., trees, benches, shade structures, misting stations and water fountains) and supporting nature's capacity to buffer climate impacts through stewardship and community engagement.

[29] Chek News. 2021. Heavy flooding and road closures forces Sooke into temporary isolation.

Food and Agriculture

Food and agriculture are fundamental elements of the long-term sustainability, resilience and health and wellbeing of the capital region. In recent years, changes in climate, energy costs, water availability and agricultural production have drawn attention to the ongoing resilience of the region's food system. Ensuring a stable local food system requires management of changing wildlife populations, flooding and drainage concerns, water availability, as well as the amount of agricultural land in food crop production. The average age of farmers in the capital region remains higher than the Canadian average and represents a warning sign for the future of food production in the region.[30]

Impacts

Increasing year-round temperatures will lead to fewer frost days, an earlier start to spring, and extended summer-like weather into the fall. These changes will result in a longer and warmer growing season that could enhance agricultural productivity in the region. However, climate change is also expected to introduce greater uncertainty for growers, as temperatures become hotter in the warmer months and precipitation patterns change. The projected increase in growing season length by 2050 (estimated to be roughly 17%) should be considered an upper limit for estimates of future productivity. This measure uses only a lower temperature threshold and does not account for reduced summer precipitation, which increases the risk of drought. In addition, shifting seasonal conditions from warming temperatures may cause pollinating species to emerge at misaligned times, limiting potential crop yields.

During the growing season, reduced water availability and extended dry periods leading to drought could have significant impacts on agriculture in the region. Less total rainfall in the summer will reduce water levels in ponds, wetlands and streams used for irrigation, while hotter temperatures will promote further evaporation and evapotranspiration. These conditions can increase heat stress and sun scald, competition for water resources, and may create opportunities for invasive species, pests, and plant diseases to flourish. Increased demand for irrigation strains water supply systems with competing demands, and negatively impacts ecosystems in water bodies, wetlands, and streams. Addressing these challenges will require innovative strategies that improve the efficiency of agricultural irrigation and transition to crops requiring less water. Growers may need to consider alternative soil-management approaches, as changes to soil moisture and composition may accompany the projected changes to the region.



In the fall, heavy rainfall events may impact crop harvest by increasing the risk of flooding and creating more opportunities for diseases and pests. Extreme precipitation can also lead to more runoff onto and off agricultural land, leading to erosion, soil nutrient leaching, and crop loss and damage. For low-lying agricultural areas near the coast, these impacts may be compounded by high tides, storm damage, and saltwater intrusion from rising sea levels.

[30] Capital Regional District. 2018. Regional Growth Strategy.

Recreation and Tourism

With its mild climate, beautiful coastlines, and abundant ecosystems, the capital region continues to be a sought-after destination for visitors from across the globe and tourism remains a key local industry. Tourism is an estimated $1.9 billion dollar industry in Greater Victoria with more than three million visitors to the region annually.[31] The region boasts plenty of outdoor recreation, with more than 26,000 hectares of national, provincial, regional, and municipal parks and ecological reserves and four regional trails on southern Vancouver Island and the Gulf Islands.[32] In 2021, regional trails received over 3.7 million visits and regional parks received over 5 million visits from local residents and tourists. These areas contribute to the cultural, social, and economic vitality of the region.

Impacts

By the 2050s, warmer year-round temperatures could lead to a longer season for summer recreation, providing more opportunities for outdoor activities and potentially boosting economic productivity. However, the rise in the number of hot summer days and multi-day extreme heat events may encourage more people to seek relief near lakes and coastlines, which can place additional stress on freshwater, marine and shoreline ecosystems. Careful protection and monitoring of recreational sites will be important to ensuring ecological health in areas where visitor use may increase.

The projected changes in temperature and precipitation may also influence the access and safety of recreation and tourism across the region. Less summer rainfall and longer dry spells may result in longer and more frequent campfire bans. Increasing fire danger may also result in the closure of parks and campgrounds due to wildfire risk. During the wet season, heavier rainfall may impact trail access and safety, and increase the costs associated with the maintenance of recreational infrastructure. At all times of the year, the potential increase in algal blooms may pose challenges to recreational water users, fishing, and tourism. Ensuring climate-resilient design of new and existing infrastructure and supporting ecosystem health and integrity through a changing climate can benefit both the economy and the physical, mental, and spiritual health of people across the region.



[31] Greater Victoria Chamber of Commerce. Destination Greater Victoria. https://www.tourismvictoria.com/

[32] Capital Regional District. 2023. Regional Parks and Trails Strategic Plan.

Summary and Recommendations

This report uses the most up-to-date climate model projections to examine how climate change may unfold across the capital region in the coming decades. The region can expect an increase in daytime and nighttime temperatures throughout the year. In the summer months, this implies hotter daily highs, warmer nights, and more numerous and longer multi-day heatwaves. By the 2050s, winters will become milder overall with a steep reduction in frost days and snowfall.

The capital region can expect a modest increase in annual precipitation by the 2050s that will be distributed unevenly across the seasons. Whereas rainfall is projected to increase notably in the colder months, summers will become drier. Warmer cold season temperatures will result in less snowfall and increased rainfall, especially in winter. In the warmer months, longer dry spells are expected due to the combination of less rainfall and warmer temperatures. The magnitude and character of these changes will vary locally across the region.

Early action on climate adaptation will enable the region to best prepare for the changes ahead and increase climate resilience. The information provided in this chapter is intended to guide further discussion among decision makers and community partners across the region. Importantly, adaptation can take many forms depending on the unique context of each community. The regional impacts outlined in this report should be considered a starting point for further analysis of climate impacts and adaptation planning that engages relevant stakeholders and is tailored to the local context.

The CRD will continue to use these projections to incorporate climate change adaptation into planning cycles and ongoing activities. Adaptation planning is complex and requires consideration of multiple factors and compounding drivers. As such, continued data collection and monitoring will be important to establish baselines, monitor changes and ensure that adaptation actions are appropriate to the local context. Some examples of how the future climate projections provided in this assessment can be used to support climate adaptation include:

- Raising awareness about how climate change will impact the region
- Informing strategic and long-range planning
- Informing strategic planning for emergency responses to extreme events
- Conducting vulnerability and risk assessments to inform policy, planning, research, and monitoring
- Designing infrastructure that considers the future climate

This report highlights regional projections for the 2050s under a high emissions scenario, but alternative scenarios were also considered for this project. The complete data package includes information for low, moderate, and high emissions scenarios for the 2030s, 2050s and 2080s. It also includes separate assessments for four smaller sub-regions within the capital region. The report Appendices point to further online resources and general guidance for understanding and using climate projections.



Appendix A

BACKGROUNDER ON FUTURE CLIMATE DATA

The Earth's climate is changing due to the burning of fossil fuels, which emit greenhouse gases (GHGs) and aerosols into the atmosphere. Over the past century, these emissions have raised atmospheric GHG concentrations well above preindustrial levels, which has led to widespread warming over Earth's surface.

The global average temperature has increased by over 1°C to date, and Canada is warming even faster (Figure A1). This warming has resulted in widespread impacts in Canada and across the globe, and it is directly proportional to the total amount of GHGs emitted since the beginning of the industrial era. While a 1°C temperature change at your location may not feel like much, changes of only 1 or 2°C on a global scale are very substantial because they are averaged over the globe and a long period of time.

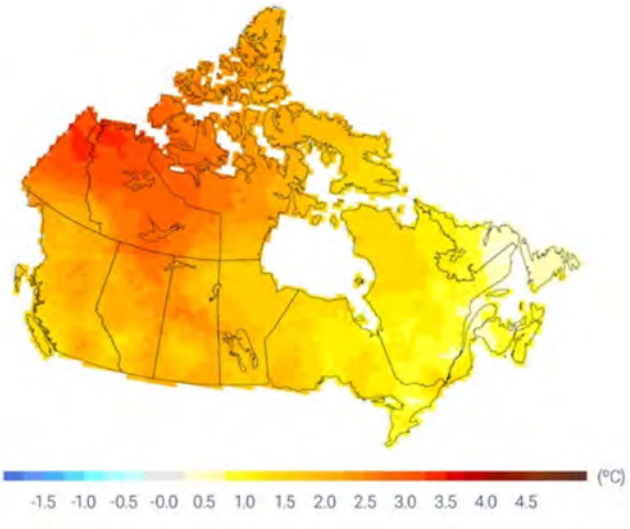


Figure A1. *Warming in Canada between 1948-2018.*

Understanding Weather, Climate, Natural Variability and Climate Change

To understand climate change, it is important to distinguish between weather and climate, and the natural and human influences that affect the climate on different time scales:

- Weather is what we experience when we step outside. It consists of short-term (minutes to days) variations in the atmosphere.
- Climate is the general state of weather, including its extremes, over periods ranging from months to many years. Climate can be thought of as the statistics of weather. Descriptions of normal climate conditions at a particular location are often derived from nearby weather observations and collected over long time periods – typically 30 years or more.
- Natural climate variability causes fluctuations in climate conditions that can span a few months to a few decades or longer. Natural climate variability is not influenced by human activity, but its influence can either mask or enhance human-induced climate change for the periods over which it occurs. Natural climate variability can also affect seasonal weather (e.g., El Niño/La Niña cycles).
- Climate change refers to changes in the state of the climate that persist over an extended period. Both natural processes and human influence can result in changes in climate. Climate science indicates that human influence is the unequivocal cause of the global warming that has been observed since the beginning of the 20th century.



Figure A2. *Timescales for weather, climate, natural climate variability, and climate change.*

What is Future Climate Data?

In the context of a changing climate, historical climate observations are no longer suitable for assessing future climate-related risks. As a result, engineers, planners, and decision-makers are increasingly using future climate data to estimate the growing risks associated with climate change. Practitioners and decision-makers want to know how much climate change (and risk associated with that change) they can expect to encounter over the coming decades.

The extent of further warming depends on how global emissions change in the future. Unfortunately, it is impossible to predict the exact societal conditions of the future that will directly influence global emissions. Therefore, a range of potential futures, or scenarios, can be used to plan for the changes associated with rising global temperatures. These scenarios are based on assumptions about population growth, climate policy, land use changes, energy intensity, economic activity, and more, that lead to different levels of global GHG emissions. The scenarios used in this assessment are known as Shared Socio-economic Pathways, or SSPs for short – but more on that later.

To understand the future climate, scientists develop global climate models (GCMs) to simulate Earth's future climate in detail under each of the various scenarios. GCMs are extensively tested against historical observations and compared to one another. Through the Coupled Model Intercomparison Project (CMIP), we can construct an ensemble of different GCMs that describes a range of plausible climate futures. In Figure A2 below, each red line represents an individual GCM projection, developed by research groups from around the world. The solid black line in this case represents the ensemble median, with the lower and upper dotted lines showing the 10th to 90th percentile range of the model ensemble.

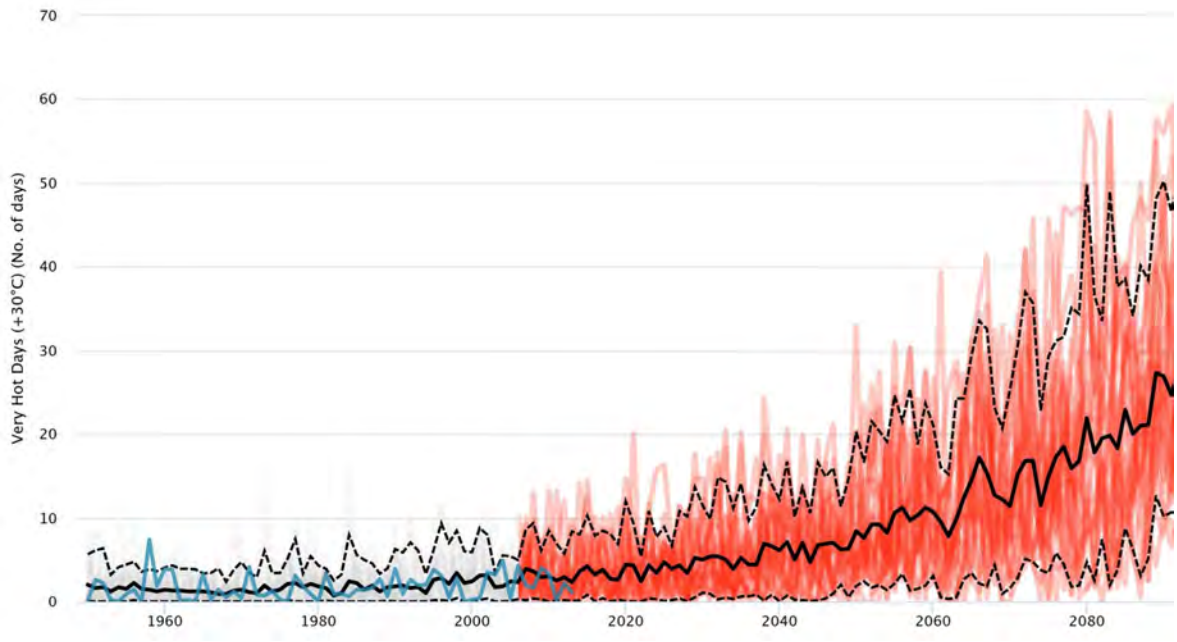


Figure A3. *Example of a GCM ensemble.[1] Each red line represents a single GCM projection for the number of annual days with a maximum temperature exceeding 30°C in British Columbia. The solid black line is the median and the dotted lines are the 10th (lower range) and 90th (upper range) percentile values across all GCMs in the ensemble.*

[1] Retrieved from ClimateAtlas.ca, using modeled data from PCIC.

Understanding Shared Socio-Economic Pathways

As noted above, to project the future climate, GCMs need input about the amount of future industrial emissions. Shared socio-economic pathways (or SSPs, Figure A3a) are such inputs, providing emissions scenarios based on assumptions of various societal decisions, including:

1. How population, education, energy use, technology – and more – may change over the next century, and;
2. The level of ambition for mitigating climate change globally.

The SSPs used in CMIP6 simulations are a set of five main socioeconomic pathways (SSP1 through SSP5) that illustrate different ways in which global societies may develop. They are the successors to the previous emissions scenarios used in CMIP5 called Representative Concentration Pathways, or RCPs. Figures A4a and A4b illustrate projections for GHG emissions and temperature under various SSPs. Here, it is important to note that global temperature projections for the near future are similar across different SSPs. The projections begin to diverge more meaningfully around 2050 (Figure A4b).

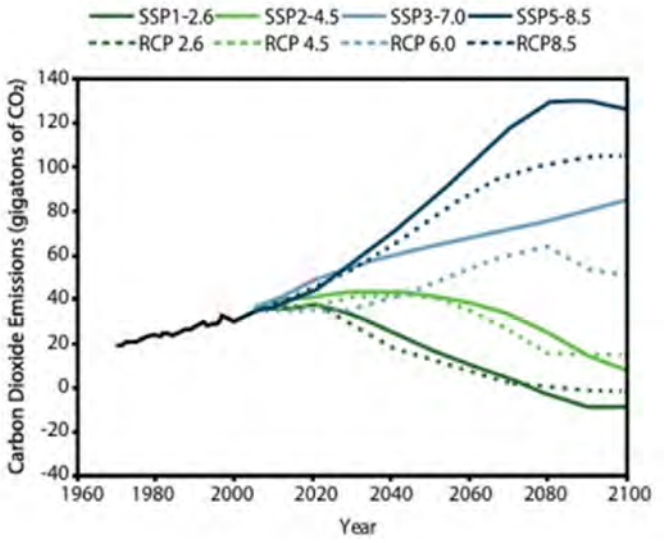


Figure A4a. *SSP scenarios used by CMIP6 models for global CO2 emissions by the end of this century. The scenarios used for CMIP5 (RCPs) are also shown.*

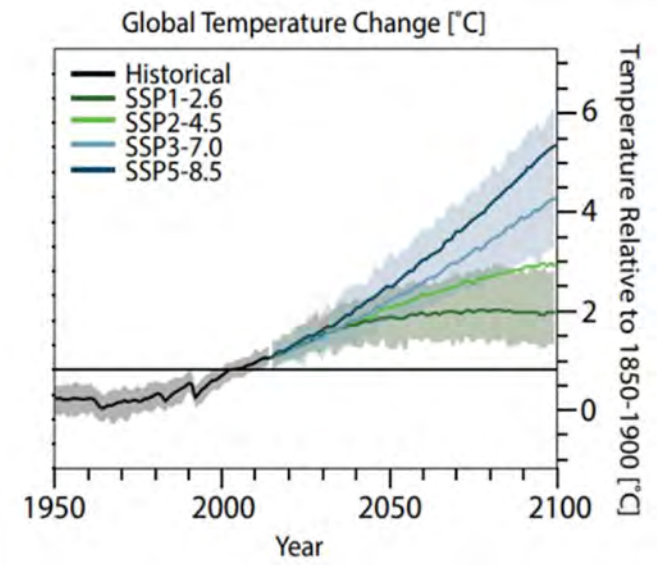


Figure A4b. *Historical and future temperature change from 1950-2100, relative to 1850-1900. After 2014, models are driven by the SSP scenarios indicated, with ranges shown for SSP1-2.6 and SSP3-7.0. The horizontal line shows temperature change that has occurred up to 1995-2014 (about +0.85°C).*

Future Climate Uncertainty

While we know the future climate will be different from the climate of the past, we cannot precisely predict what the future climate will look like. There are three main sources of uncertainty inherent in future climate data: natural climate variability, model uncertainty, and scenario uncertainty. In the following sections, we provide support for making decisions in the presence of scenario uncertainty.

- **Natural climate variability** (as discussed above) refers to climatic fluctuations that occur without any human influence (i.e., independent of GHG emissions). Natural climate variability is largely unpredictable and can mask or enhance human-induced climate change.
- **Model uncertainty** arises because models can only represent the climate and earth system to a certain degree. Although they are highly sophisticated tools, GCMs can differ from reality. Furthermore, not all models represent the system processes in the same way, nor do all include the same processes. To help address model uncertainty, it is best practice to use an ensemble (i.e., a set of multiple GCMs), to display a range of possible futures. PCIC uses an ensemble of 9 GCMs that are best suited to analyses focused on British Columbia.
- **Scenario uncertainty** arises because different emissions scenarios lead to different levels of climate response, and it is not possible to know what global emissions will be in the future. The emissions pathway of the future depends on a wide range of policy decisions and socioeconomic factors that are impossible to predict. To help address scenario uncertainty, it is best to evaluate future projections under more than one emissions pathway.



Uncertainty should not stand in the way of action. Decision makers should use climate projections as a guide to the future but should not discount the possibility of changes occurring outside the projected range when managing risk. In the following sections, we provide support for making decisions in the presence of scenario uncertainty.

Appendix B

WHAT DATA SHOULD I USE?

The decision tree shown in Figure B1 can help determine which data and information from this assessment might be most useful for a given application. Before using climate projections, it is important to do appropriate background reading, identify relevant stakeholders and determine the appropriate level of stakeholder engagement. Stakeholder engagement is important for ensuring that the projected changes are both meaningful and well-suited to your context.

Users accessing the complete data package should reference the Data Descriptor Document. Contact climateaction@crd.bc.ca for more information.

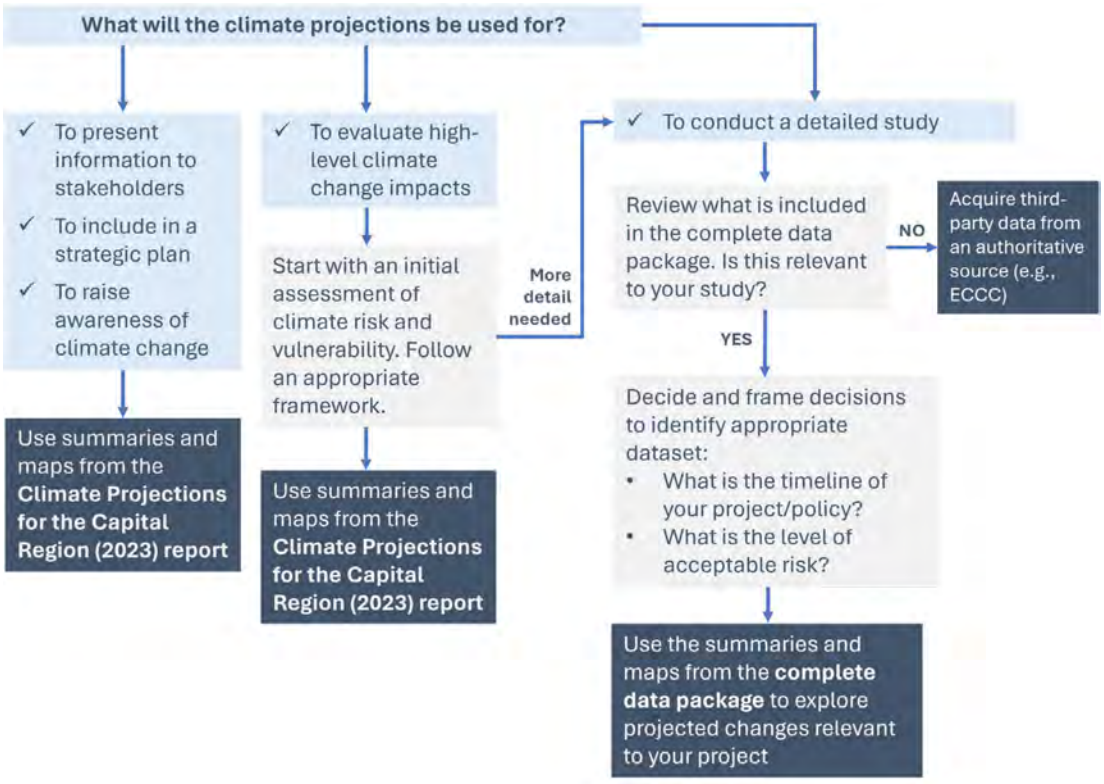


***Figure B1**. Decision tree for using climate projections data. This decision tree has been adapted from the Victoria (Australia) Climate Projections 2019 Technical Report (Clarke et al., 2019).*

What is Provided in the Complete Data Package?

The Climate Projections for the Capital Region 2023 report highlights projected changes for a host of indices derived from temperature and precipitation under the highest emissions scenario (SSP5-8.5), mostly for the 2050s. The complete data package contains summary tables (Excel XLSX) and maps (PNG) for the following additional time periods, scenarios and sub-regional breakdowns:

The capital region and four smaller sub-regions.

(see Figure B2 below)

- "Core/Peninsula" (Green)
- "Western Region" (Red)
- "Southern Gulf Islands" (Yellow) and
- "Greater Victoria Water Supply Region" (Blue)

Four time periods.

- 1981-2010 or "1990s" (baseline period)
- 2021-2050 or "2030s"
- 2041-2070 or "2050s", and
- 2071-2100 or "2080s",

Three emissions scenarios.

- Low: SSP1-2.6
- Moderate: SSP2-4.5, and
- High: SSP5-8.5.

77 indices derived from temperature and precipitation. *(see Appendix F for a complete list)*

Gridded data (NetCDF) is also available for all 77 climate indices projected to the 2050s under a high emissions scenario (SSP5-8.5). Contact climateaction@crd.bc.ca to access the complete data package and/or the gridded data.

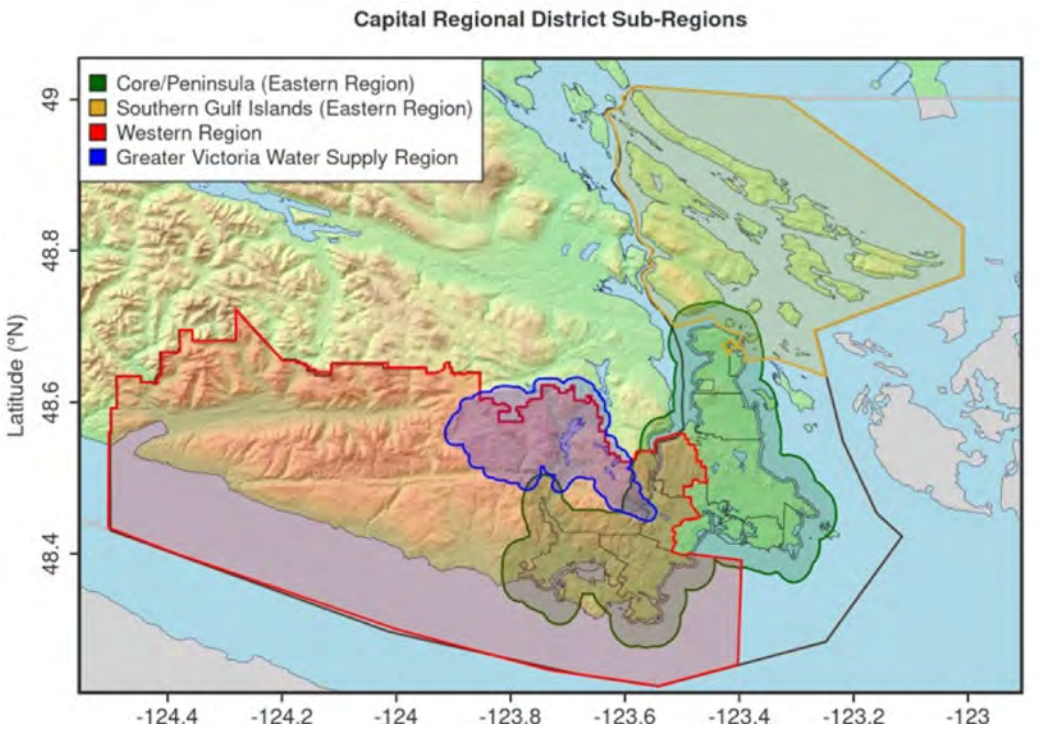


***Figure B2**. The capital region and four sub-regions. Separate Excel files are available for each sub-region and for the region as a whole.*

Appendix C

GUIDANCE FOR USING CLIMATE PROJECTIONS

Key Messages

- ✓ Projections of future climate are complex, and you will likely need advice and guidance from experts in the field. Allow adequate time for consultation.
- ✓ The climate has always been naturally variable. This variability now occurs on top of greenhouse-gas/aerosol forced trends. Over shorter time scales, climate variability can mask long-term trends.
- ✓ Since we do not know what future global emissions will be, climate projections are produced for a number of possible scenarios. In the CMIP6 ensemble, near-term projections are similar and diverge more clearly by the middle of this century (e.g., the 2050s).
- ✓ This assessment provides downscaled climate projections for variables derived from temperature and precipitation only. Variables related to other climate-related hazards, such as sea level rise or windstorms, are not provided. For supplemental resources, see Appendix D: Further Resources
- ✓ While climate models are run under different emissions scenarios, there is no such thing as a 'most likely' scenario. Selecting an emissions scenario is highly context-dependent and will depend on considerations such as risk tolerance and the life cycle of your project or policy.
- ✓ Consider multiple climate variables or indices to get a more complete picture for different manifestations of change. Review annual and seasonal projections to get a sense of how projections vary depending on the time of year.
- ✓ In many cases, using only the median climate projections will not be appropriate. Ensure the ranges of projected change (10th and 90th percentiles) are adequately accounted for in your assessment. Do not entirely discount changes above or below the projected range when managing risk – especially for high-impact, low-likelihood events.

Understanding Climate Risk

As shown in Figure C1, climate risk depends on the complex interaction between hazards affected by climate change and natural climate variability, exposure to these hazards, and the vulnerability of the exposed elements. For example, a hazard (e.g., extreme heat) may impact a community more due to its exposure (e.g., occurring in a densely populated area) and/or vulnerability (e.g., demographic factors influencing heat sensitivity).

While future climate data can support the assessment of hazards affected by future climate change, there are different approaches to understanding climate risk. Decision-making about climate risk often involves a combination of top-down and bottom-up approaches.

Top-down approaches start with an analysis of potential climate change that can be used to guide actions and decisions.

Bottom-up approaches start with the project, policy or activity of interest and analyze the factors and conditions that impact the exposure, vulnerability and resilience of systems. These approaches look for pathways to reduce exposure and vulnerability while increasing the capacity to cope (irrespective of the future climate hazard).

Hence, **future climate data can be used to inform a top-down approach** to assessing climate risk.

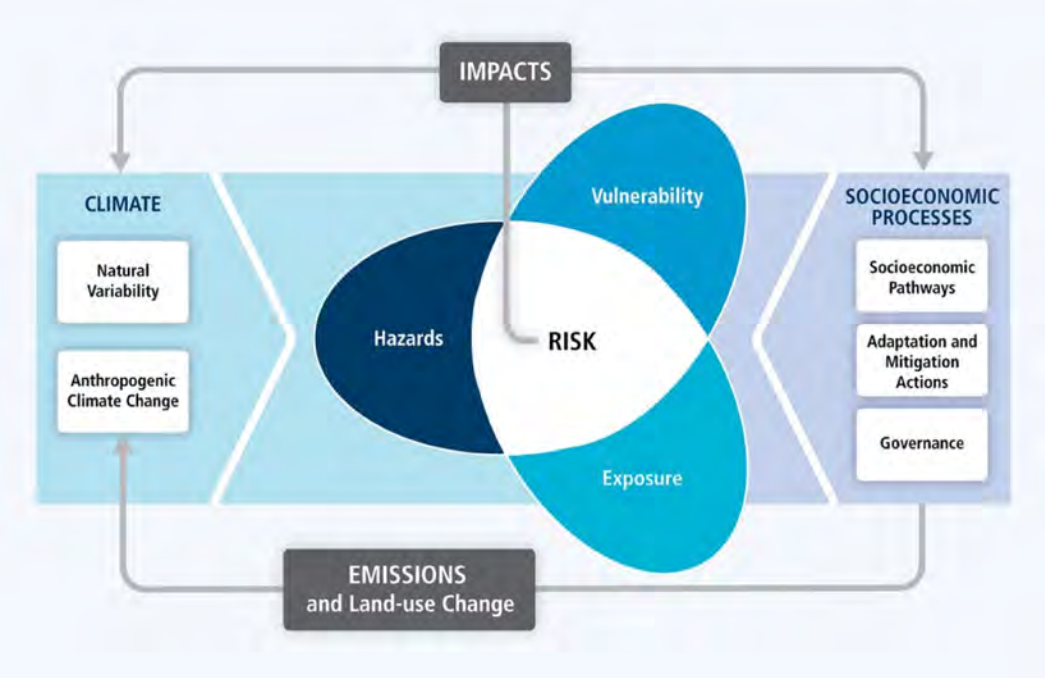


Figure C1. *Climate risk envisioned as the overlap of hazard, exposure, and vulnerability.*[2]

[2]IPCC, 2014: Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.

Which Emissions Scenario(s) Should I Use?

Climate projections are generated by different climate models and using a range of emissions scenarios. Differences in the projections due to the use of different climate models reflect the fact that we still have an incomplete understanding of how the climate system functions, and differences due to the choice of emissions scenarios reflect the fact that we have only imperfect knowledge of how society, its land use practices, and its emissions may change in the future. Given these diverse sources of uncertainty, it is best to examine a range of possible futures as represented by different climate models and emissions scenarios.

To reduce climate model uncertainty, PCIC has selected a range of climate models that are best suited to regions in BC. Ultimately, deciding on which emissions scenario(s) to assess will depend on the context of your project or policy, including your risk tolerance and time horizon, as discussed next.

Time Horizon

Users of climate projections should consider the time horizon, or life cycle, relevant to their project or policy before selecting a future scenario. This could be the expected lifetime of a given piece of infrastructure, or a policy that needs to be responsive to changing external conditions. As highlighted above in Understanding Shared Socioeconomic Pathways, in the near term – up to a few decades into the future – climate projections do not differ meaningfully across SSP scenarios. This is true at both the global regional scales. Hence, if there is a recurring opportunity to review a given decision every two to three decades, then the choice of emissions scenario may be less relevant. An example of a recurring decision might be the choice of paving material to use when repaving a roadway.

On the other hand, if an infrastructure element is expected to last 50 to 75 years, the choice of scenario becomes more critical because projected changes from different scenarios will differ substantially by the end-of-life of the structure. An example of a long-term infrastructure design decision might be determining the capacity of an upgraded storm sewer. Hence, planners and designers may be able to minimize the role of scenario uncertainty in adaptation planning by first determining the decision-making time-frame.

Level of Acceptable Risk

Climate scientists can help practitioners and decision makers understand how climate-related hazards that affect the assets they are responsible for (i.e., systems, infrastructure, or policy) may change in the future. This requires dialog among practitioners, decision makers and climate scientists to understand and describe the potential impacts of projected climate change under different emissions scenarios. Because climate scientists are not experts on how risk to assets will materialize, it remains the responsibility of practitioners and decision makers to manage future climate-related risks to their assets.

When assessing future scenarios, decision makers should consider four questions:

1. "What components of my project are vulnerable to climate change?"
2. "How likely is it that society will follow a future emissions pathway that will intensity the hazards to which my assets will be exposed?"
3. "What level of risk am I comfortable assuming?"
4. "What is the trade-off between risk and cost?"

Regardless of the rationale used, understanding the level of risk that is appropriate to your work is complex. It will undoubtedly require engagement with diverse partners and stakeholder groups to understand the range of potential impacts.

Scenario Choice

Ideally, public assets should be managed in a way that limits their vulnerability to plausible future hazards. Climate science has not yet ruled out the plausibility of any of the main socio-economic pathway scenarios that were considered in the most recent IPCC assessment. The choice of scenario will depend critically on the climate hazards that would affect the asset of interest. This is because some hazards will likely decline, such as extreme snow loads on buildings that could cause building collapse, while others, related to heat stress, intense rainfall, and flash flooding, will increase. If an asset is affected by both decreasing and increasing hazards, then the approach that would most completely limit vulnerability to future hazards would involve using a no change (historical climate) scenario for declining hazards, and a rapid change, high emissions scenario (e.g., SSP5-8.5) for increasing hazards.

Tips for Using Climate Data

✓ View multiple variables (indices) within each category

To get a more complete understanding of projected changes, users should consider multiple climate variables. For example, if you want to know how precipitation will change in your region, review both a frequency-based variable (e.g., Number of Wet Days > 20 mm) and a volume-based variable (e.g., Total Precipitation). The Hazard Reference Tables (Appendix E) can help users identify which climate variables may be best suited to a particular context or application.

✓ Review both annual and seasonal data

Annual mean changes can mask important seasonal behaviour. For example, a small annual mean precipitation projection might contain a substantial reduction in the summer along with a projected increase in the fall, winter, or spring. Therefore, users should assess both annual and seasonal projections for certain climate variables.

✓ Select a relevant time period

The complete data package offers projections for the "2030s" (2021-2050), "2050s" (2041-2070) and "2080s" (2071-2100). As highlighted above, users should select the period that is most appropriate to the entire life cycle of their project or policy.

✓ Determine an appropriate emissions scenario(s)

There is no right or wrong emissions scenario to use in decision-making: all scenarios represent possible futures and decision-making is highly context dependent. Selecting a scenario requires consideration of risk tolerance, sensitivity to climate impacts and extreme events, the time horizon of the project, and more. It can be useful to remember that planning for a high emissions scenario can help ensure that adaptation measures are resilient for a longer period of time if, in fact, a lower emissions scenario were to play out.

✓ Examine both means and extremes

The median, 10th percentile, and 90th percentile values have been provided in all summary tables for this assessment. Depending on the application, one, two or all three of these values may be important. For instance, if one were designing a building for general use (e.g., retail space, detached home) with an anticipate lifetime of 50 years or so, then the change in the median of Cooling Degree Days (CDDcool18C) under SSP5-8.5 might be appropriate to consider. Alternatively, if the building were classified as critical, long-lived infrastructure (e.g., a hospital, or power plant) then it might be more appropriate to design to the 90th percentile value for that climate index, to capture the upper range of possibility.

Appendix D

FURTHER RESOURCES

There are a growing number of guidance materials, learning resources, and data tools available to support the use of climate projections for regional assessments. Below is a non-exhaustive list of open access resources suited to a broad range of users. For additional guidance, contact PCIC (climate@uvic.ca) or the CRD Climate Action Program (climateaction@crd.bc.ca).

Additional Climate Projections Tools and Resources

ClimateData.ca

User-friendly tool for exploring climate projections and related data

Developed and maintained by the Canadian Centre for Climate Services, a team of information and outreach specialists at Environment and Climate Change Canada (ECCC), ClimateData.ca is an online, user-friendly data portal providing future climate projections for regions across Canada. Users can explore gridded data at small scales or aggregated by watershed, census subdivision, or health region. ClimateData.ca provides plain language descriptions for all climate variables and has various options for visualizing and analyzing climate data. Temperature and precipitation-based variables (the same as those provided by PCIC) as well as humidex, relative sea level change and climate change-scaled IDF data are available.

ClimateData.ca also includes a comprehensive learning zone (climatedata.ca/learn) that is regularly updated to support climate data users in a variety of applications, including some sector-specific information, as well as a Climate Services Support Desk for general or technical inquiries. The site is continuously evolving with more content and features in development.

PCIC Climate Explorer

Useful for intermediate or advanced users analyzing a specific location

PCIC Climate Explorer (PCEX) is an online map-based tool for viewing gridded historical climate data and future projections at any location of interest across Canada. Users can select an arbitrary region on the map, compare climate variables for that region, and download the results in Excel formats. Additional variables for extreme precipitation and streamflow are also available.

ClimateAtlas.ca

Useful for creating communications materials and learning more about climate adaptation

ClimateAtlas.ca is an interactive tool combining climate projections (again using PCIC's data), mapping, and storytelling to inspire local, regional, and national action and solutions. Users can explore videos, articles, educator resources, and various topic including Indigenous knowledges, agriculture, and health.

Spatial Analogues Tool* (ClimateData.ca)

Useful for visualizing the future climate at a target location

With this tool, starting with a target city of interest**, users can search for other cities whose historical climate closely matches the future-projected climate of the target city. Users can search for spatial analogues under a low or high emissions scenario and considering up to four different climate indices. For example, one combination of indices suggests that by the 2050s, Quebec City may have a climate similar to present-day Boston. By examining how Boston has adapted to its current climate, planners in Quebec City might gain insights on how to prepare and adapt to climate change.

*This tool is a beta app, meaning it is a new tool being carefully monitored and is still under development.

**Target cities for British Columbia are presently limited to: Victoria, Vancouver, Abbotsford, Kelowna, and Prince George.

Infrastructure Design Resources

PCIC Design Value Explorer (DVE)

Engineering design professionals can access future-projected climatic design values

The DVE is an online, open-access technical tool for assessing 19 climate design values based on observed data and projections of how they may change in the future. It provides engineers, architects, planners, and other professionals with quantitative, fine-scale historical and future-projected climate information for designing buildings and infrastructure.

PCIC Future-Shifted Weather Files

Energy Modelers can access future-projected weather files

Weather data adjusted for climate change has been produced for three time periods (2020s, 2050s, and 2080s) using the high emissions pathway RCP8.5 (CMIP5). Data are available for several hundred weather stations across Canada. Future-shifted weather files can help building designers simulate building performance under a changing climate, supporting resilient design. Further work is underway to update the weather files for CMIP6-SSPs and to create weather files that capture both mean change and extreme events.

CSA PLUS 4013-19: Development, interpretation, and use of rainfall intensity-duration-frequency (IDF) information: Guideline for Canadian water resource practitioners*

Guidance for Canadian water resource practitioners to better incorporate climate change into IDF information

Technical guidance from the Canadian Standards Association (CSA)—informed by scientists at ECCC and other subject matter experts—for the development, interpretation, and use of rainfall intensity-duration-frequency (IDF) information. Chapters 5 and 6 include guidance for how to incorporate climate change into the formulation and application of IDF information.

*Access fee required

Short-Duration Rainfall IDF Data (ClimateData.ca)

Users can explore historical and climate change-scaled IDF information for weather stations across Canada

ClimateData.ca offers easy access to historical short-duration rainfall IDF data (from 1 to 24 hours) and projected rainfall amounts under low, moderate, and high emissions scenarios at locations across Canada (12 locations within the capital region). This IDF information is consistent with the above-mentioned CSA guidance. Users can download a zip file containing all the historical and future estimated values.

In addition, the Learning Zone on ClimateData.ca has a topic dedicated to using IDF rainfall data to account for a changing climate. For more information on this product and about designing future-ready buildings, visit ClimateData.ca/learn/

Appendix E

HAZARD REFERENCE TABLES

The Hazard Reference Tables help users identify which climate variables included in the complete data package may be best suited to a particular context or application. Users should use the short name (left column) to navigate to the appropriate variable in the complete data package.

Seasonal Patterns and Climate Change

- ✓ Increasing temperatures year-round
- ✓ Fewer frost days and a longer growing season
- ✓ Shifting heating and cooling demands

Key sectors: Agriculture, Biodiversity, Parks, Infrastructure



Temperature	
TX	Daytime high temperature, averaged over all days in a year or season
TM	Mean daily temperature, averaged over all days in a year or season
TN	Daytime low temperature, averaged over all days in a year or season
Seasonal	
FD Frost Days	Number of days in a year when the minimum temperature is below 0°C
ID Ice Days	Number of days in a year when the maximum temperature is below 0°C
GSL Growing Season Length	Number of days between: (i) the first span of 6 or more days in the year with a daily minimum temperature > 5°C and (ii) the first span after July 1st of 6 or more days with a daily minimum temperature < 5°C.
WSDI Warm Spells	A "warm spell" is defined as 6 or more consecutive days when the daily maximum temperature exceeds the 90th percentile value of the historical baseline. This index measures the number of days in a typical year that a warm spell occurs. (A warm spell can occur at any time of year).
CSDI Cold Spells	A "cold spell" is defined as 6 or more consecutive days when the daily minimum temperature is less than the 10th percentile value of the historical baseline. This index measures the number of days in a typical year that a cold spell occurs. (A cold spell can occur at any time of year).
Design	
HDDheat18C Heating Degree Days	Number of degree days below 18°C in a year. A rough estimate for the energy demand needed to heat a building in a typical year.
CDDcold18C Cooling Degree Days	Number of degree days above 18°C in a year. A rough estimate for the energy demand needed to cool a building in a typical year.

Increasing Temperatures and Extreme Heat

- ✓ Hotter daytime temperatures
- ✓ Warmer nighttime temperatures
- ✓ Heat waves becoming hotter and more frequent

Key sectors: Emergency Management, Health, Biodiversity, Watershed



Daytime Temperatures	
TX	Daytime high temperature, averaged over all days in a year or season
TXx	Hottest daytime high temperature in a year or season
SU Summer Days	Number of days in a typical year when the daytime high is above 25°C
SU30 Hot Summer Days	Number of days in a typical year when the daytime high is above 30°C
Nighttime Temperatures	
TN	Daily minimum temperature in a typical year or season
TNx	Warmest nighttime low temperature in a typical year or season
TR16C Temperate Nights	Number of days in a year when the nighttime low stays above 16°C
TR Tropical Nights	Number of days in a year when the nighttime low stays above 20°C
Heat Extremes	
HWD Heat Wave Days	Number of days in a typical year classified as a "heat wave"
HWN Heatwave Number	Number of distinct heat wave events in a typical year
HWXL Heatwave Length	Length (in days) of the longest heat wave in a typical year
TXH Heatwave Intensity (Day)	Daytime high temperature averaged across all heat waves in a typical year
TNH Heatwave Intensity (Night)	Nighttime low temperature averaged across all heat waves in a typical year
TXHX	Daytime high temperature during the most extreme heat wave in a year
TNHX	Nighttime low temperature during the most extreme heat wave in a year
Return Periods (various)	The data package provides return levels and return period changes for the 5-, 10-, 20-, and 30-year Hottest Day.

Extreme Precipitation and Flooding

In this data package, there are no direct indices for flooding.
Rainfall extremes may trigger flooding under certain circumstances.



- ✓ More precipitation occurring over short time periods
- ✓ More days with heavy rainfall

Key sectors: Public Works/Engineering, Infrastructure, Biodiversity, Health, Agriculture, Watershed

Precipitation	
PR Total Precipitation	Total precipitation in a typical year or season
Rain Total Rainfall	Total rainfall in a typical year or season
Snow Summer Days	Total snowfall in a typical year or season
Rainfall Extremes	
RX1DAY	Maximum amount of precipitation (in mm) occurring in a single day in a typical year
RX5DAY	Maximum amount of precipitation (in mm) occurring over a 5-day period in a typical year
R10MM	Number of days in a typical year that receive more than 10mm of total precipitation
R20MM	Number of days in a typical year that receive more than 20mm of total precipitation
R95P / R95DAYS	Amount of precipitation over the year that exceeds the 95th percentile of historical (baseline) daily precipitation / Number of days in a typical year that exceed this amount.
R99P / R99DAYS	Amount of precipitation over the year that exceeds the 99th percentile of historical (baseline) daily precipitation / Number of days in a typical year that exceed this amount.
Return Periods (Various)	The data package provides 5-, 10-, 20-, 30-, and 50-year return periods for annual wettest 1-, 2-, and 5-day rainfall events. It also provides changes to rainfall return periods for an event of given magnitude.

Drought

In this data package, there are no direct drought variables. Hotter temperatures, less rainfall and reduced snowpack may lead to drought conditions in the warmer months.

Key sectors: Agriculture, Biodiversity, Health, Watershed



Precipitation	
PR – Summer Total Precipitation in Summer	Total precipitation in a typical summer (may also be important to consider PR for spring and fall)
SNOW Total Snowfall	Total snowfall (fall-winter-spring)
CDD Consecutive Dry Days	Number of days comprising the longest "dry spell" in a typical year. Dry spells are defined as consecutive days with less than 1mm of total precipitation.
Temperature	
TX	Daytime high temperature in a typical year or season
TXx	Hottest daytime high temperature in a typical year or season
SU Summer Days	Number of days in a typical year when the daytime high is above 25°C

Wildfire and Air Quality

In this data package, there are no direct wildfire variables. Hotter temperatures and less rainfall in the warmer months may lead to more favourable conditions for wildfire.

Key Sectors: Health, Biodiversity, Infrastructure, Agriculture



Variables listed under Drought (see above) can also be considered as informative for Wildfire. Additional variables such as humidity, wind speed, and wind direction must also be considered in order to establish favourable conditions for Wildfire. The Canadian Forest Service has analyzed such historical data to develop Fire Weather Normals, which provide insight into how "fire weather" varies spatially and throughout the year. See https://cwfis.cfs.nrcan.gc.ca/ha/fwnormals for more.

Future-projected temperature and precipitation conditions that may be favourable to increased incidence of Wildfire may be obtained from other regional climate projections reports in BC, including:

- Climate Projections for BC Northeast Region
- Climate Projections for the Okanagan Region
- Climate Projections for the Cowichan Valley Regional District
- Climate Projections for Metro Vancouver

Appendix F

COMPLETE LIST OF CLIMATE INDICES

Name	Variable	Definition	Units
		Standard	
PR	Precipitation	Annual/seasonal precipitation totals	mm
RAIN	Rainfall	Annual/seasonal rainfall portion of precipitation using temperature-based rain-snow partitioning	mm
SNOW	Snowfall	Annual/seasonal snowfall (snow water equivalent) portion of precipitation	mm (H2Oeq)
TM	Daily Average Temperature	Annual/seasonal daily average temperature	°C
TX	Daily Maximum Temperature	Annual/seasonal average daily maximum temperature	°C
TN	Daily Minimum Temperature (usually overnight)	Annual/seasonal average daily minimum temperature	°C
Name	**Variable**	**Definition**	**Units**
		CLIMDEX: Temperature Based	
TXX	Maximum TX	Annual/seasonal maximum of TX	°C
TNN	Minimum TN	Annual/seasonal minimum of TN	°C
TXN	Minimum TX	Annual/seasonal minimum of TX	°C
TNX	Maximum TN	Annual/seasonal maximum of TN	°C
TX90P	Hot Days	Annual percentage of days with TX > 90th historical percentile	%
TX10P	Cool Days	Annual percentage of days with TX < 10th historical percentile	%
TN90P	Warm Nights	Annual percentage of days with TN > 90th historical percentile	%
TN10P	Cold Nights	Annual percentage of days with TN < 10th historical percentile	%
DTR	Diurnal Temperature Range	Annual/seasonal diurnal temperature range, TX – TN	°C
SU	Summer Days	Annual number of days with TX > 25 °C	days
SU30	Hot Summer Days	Annual number of days with TX > 30 °C	days
TR	Tropical Nights	Annual number of days with TN > 20 °C	days
TR16C	Temperate Nights	Annual number of days with TN > 16 °C	days
ID	Ice Days	Annual number of days with TX < 0 °C	days
FD	Frost Days	Annual number of days with TN < 0 °C	days
CSDI	Cold Spells	Annual count of days with at least 6 consecutive days when TN < 10th historical percentile	days
WSDI	Warm Spells	Annual count of days with at least 6 consecutive days when TX > 90th historical percentile	days
GSL	Growing Season Length	Growing season length (number of days between first span of at least 6 days with TM >5°C and first span after July 1st of 6 days with TM <5°C)	days

Name	Variable	Definition	Units
		CLIMDEX: Precipitation-Based	
CDD	Consecutive Dry Days	Annual maximum length of consecutive dry days (PR < 1 mm)	days
CWD	Consecutive Wet Days	Annual maximum length of consecutive wet days (PR ≥ 1 mm)	days
SDII	Simple Daily Precipitation Intensity Index	Annual average PR on days with PR ≥ 1 mm	mm
R1MM	Precipitation ≥ 1 mm	Annual count of days with PR ≥ 1 mm	days
R10MM	Precipitation ≥ 10 mm	Annual count of days with PR ≥ 10 mm	days
R20MM	Precipitation ≥ 20 mm	Annual count of days with PR ≥ 20 mm	days
RX1DAY	Maximum 1-Day PR	Annual/seasonal maximum 1-day PR	mm
RX2DAY	Maximum 2-Day PR	Annual/seasonal maximum 2-day PR	mm
RX5DAY	Maximum 5-Day PR	Annual/seasonal maximum 5-day PR	mm
RN1DAY	Maximum 1-Day RAIN	Annual/seasonal maximum 1-day rainfall	mm
RN2DAY	Maximum 2-Day RAIN	Annual/seasonal maximum 2-day rainfall	mm
RN5DAY	Maximum 5-Day RAIN	Annual/seasonal maximum 5-day rainfall	mm
R95P	Very Wet Day PR	Annual total PR when PR > 95th percentile of daily PR in historical period	mm
R95DAYS	Very Wet Days	Annual number of days when PR > 95th percentile of daily PR in historical period	days
R99P	Extreme Wet Day PR	Annual total PR when PR > 99th percentile of daily PR in historical period	mm
R99DAYS	Extreme Wet Days	Annual number of days when PR > 99th percentile of daily PR in historical period	days
Name	Variable	Definition	Units
		Degree Days	
CDDcold18C	Cooling Degree Days	Annual, cumulative TM difference above 18 °C	°C-days
GDDgrow5C	Growing Degree Days	Annual, cumulative TM difference above 5 °C	°C-days
HDDheat18C	Heating Degree Days	Annual, cumulative TM difference below 18 °C	°C-days
FDDfreeze0C	Freezing Degree Days	Annual, cumulative TM difference below 0 °C	°C-days
Name	Variable	Definition	Units
		Heatwave Indices	
HWD	Heatwave (HW) days	Annual count of HW days, where a HW is defined as both TX and TN exceeding: 1) their 95th percentiles (historical), AND; 2) BC HARS thresholds[3] for at least 2 consecutive days.	days
HWN	HW number	Annual number of distinct HWs	#
HWXL	HW duration	Annual maximum HW length	days
TNH	HW intensity (night)	Average TN over all HWs in a year	°C
TXH	HW intensity (day)	Average TX over all HWs in a year	°C
TNHX	Maximum TNH	Average TN during most extreme HW in a year	°C
TXHX	Minimum TNH	Average TX during most extreme HW in a year	°C
HWDD	HW degree days	Annual, cumulative TM difference above HW threshold	°C-days

[3] The lower threshold temperatures used in our HW definition, which is intended for use throughout BC, are TX = 28°C and TN = 13°C. These are the lowest temperatures found in any region of the map in Figure 3, page 14 of the 2023 report, BC Provincial Heat Alert and Response System (BC HARS): 2023, May 2023. Available at: http://www.bccdc.ca/health-professionals/professional-resources/heat-event-response-planning.

Name	Variable	Definition	Units
		Return Levels	
TX_RP5	5-Year return level of TX	5-Year return level of TX	°C
TX_RP10	10-Year return level of TX	10-Year return level of TX	°C
TX_RP20	20-Year return level of TX	20-Year return level of TX	°C
TX_RP25	25-Year return level of TX	25-Year return level of TX	°C
TX_RP30	30-Year return level of TX	30-Year return level of TX	°C
TN_RP5	5-Year return level of TN	5-Year return level of TN	°C
TN_RP10	10-Year return level of TN	10-Year return level of TN	°C
TN_RP20	20-Year return level of TN	20-Year return level of TN	°C
TN_RP25	25-Year return level of TN	25-Year return level of TN	°C
TN_RP30	30-Year return level of TN	30-Year return level of TN	°C
RN1_RP5	5-Year return level of RN1DAY	5-Year return level of RN1DAY	mm
RN1_RP10	10-Year return level of RN1DAY	10-Year return level of RN1DAY	mm
RN1_RP20	20-Year return level of RN1DAY	20-Year return level of RN1DAY	mm
RN1_RP30	30-Year return level of RN1DAY	30-Year return level of RN1DAY	mm
RN1_RP50	50-Year return level of RN1DAY	50-Year return level of RN1DAY	mm
RN2_RP5	5-Year return level of RN2DAY	5-Year return level of RN2DAY	mm
RN2_RP10	10-Year return level of RN2DAY	10-Year return level of RN2DAY	mm
RN2_RP20	20-Year return level of RN2DAY	20-Year return level of RN2DAY	mm
RN2_RP30	30-Year return level of RN2DAY	30-Year return level of RN2DAY	mm
RN2_RP50	50-Year return level of RN2DAY	50-Year return level of RN2DAY	mm
RN5_RP5	5-Year return level of RN5DAY	5-Year return level of RN5DAY	mm
RN5_RP10	10-Year return level of RN5DAY	10-Year return level of RN5DAY	mm
RN5_RP20	20-Year return level of RN5DAY	20-Year return level of RN5DAY	mm
RN5_RP30	30-Year return level of RN5DAY	30-Year return level of RN5DAY	mm
RN5_RP50	50-Year return level of RN5DAY	50-Year return level of RN5DAY	mm

Priority Action Items	**Climate Action Plan 2023**	**STATUS as of April 2024**
All	CRD GHG Inventory by Sector data (all the available reports from 2020 to 2028)	See CRD 2022 Greenhouse Gas (GHG) Emissions Report
1.0	**Land Use, Agriculture and Waste**	
1.1 a)	Investigate and report to Council on development of land-use conservation and enhancement targets.	1) Staff investigating RAPR education and regulation targets 2) Tax exempt properties identified as Council priorities.
1.1 b)	Engage with partners to solicit external funding for new habitat protection and restoration projects	District supporting Sc'ianew Nation on Mary Hill Tribal Park initiative with partners including HAT and Pearson College.
1.1 c)	Leverage land acquisition funding to buy and convert additional District lands into designated protected areas.	
1.2 a)	Develop Agricultural Plan - climate resilience, enhanced biodiversity and low carbon agriculture	1) Draft Agricultural Plan completed 2) Engaging din dialogue re: human/wildlife conflict
	Additional opportunities:	
1.0	*Lobby senior and regional governments for improved land protection and ecological preservation.*	1) 2023 UBCM Resolutions - anchorages, biodiversity and old growth 2) March 2024 Letter to Ebby re local area protection fund and biodiversity law 3) March 2024 Endorsed Fossil Fuel Non-Proliferation Treaty
1.0	*Investigate opportunities to encourage wetland and riparian restoration.*	Supported BWHPA grant application for staffing
1.0	*Support partner efforts to enhance agricultural land preservation.*	Draft Agricultural Plan completed
1.0	*Continue support for invasive species management.*	Endorse work of MISC. Support Moralea's Meadow group in grant application. Collaborate with CRD on invasives removal. Bullfrog and rabbit management continues.
1.0	*Investigate the development of a municipal compost yard.*	
1.0	*Investigate the development of a waste gasification facility for the District.*	Participating in CRD Board decision-making on regional facility
1.0	*Investigate the development of recycling services.*	Supporting MCA metal bin, ReImagine Westshore promotional efforts
1.0	*Push for recognition of carbon sequestration in CRD emissions inventory assessments.*	Requested in 2023 through CRD Climate Action Inter-Municipal Task Force
2.0	**Risk Reduction from the Impacts of Climate Change**	
2.1 a)	Complete extreme heat assessment and mapping	Completed
2.1 b)	Develop a shoreline protection plan to address sea level rise.	MEASC to review previous plan 2) Promoted Greenshores training 3) working with Sc'ianew and WCMRC to identify spill response GRS's 4) Responses to TMX EAO consultation requests 5) Correspondence with Province on tanker traffic regulation in hostile env. conditions
2.1 c)	Investigate and apply for funding to conduct a localized climate hazard and vulnerability assessment.	Climate Hazard study underway
2.2 a)	Integrate climate change into District asset management planning and policy development.	Asset management plan included in 2024 budget
2.3 a)	Investigate and report to Council on opportunities to enhance groundwater protection and conservation (e.g., via increase rainwater harvesting, efficient irrigation, xeriscaping).	1) Staff are reviewing regulatory avenues re: well proofing 2) Three communitiy water workshops completed by April 2024 3) 2024 AVICC Resolution on aquifer monitoring 4) Ongoing approval process for Buffer Land detention pond 5) Council petitioned the Province to add observation wells to Aquifer 606
2.0	Additional opportunities:	
2.0	*Investigate opportunities to use natural asset management tools and approaches to manage climate impacts.*	Asset management plan included in 2024 budget
2.0	*Investigate building, plumbing code changes to permit outdoor greywater reuse.*	Building bylaw amendments pending
2.0	*Adoption of ZCSC Level 4 for all new builds*	Building bylaw amendments pending

Priority Action Items	**Climate Action Plan 2023**	**STATUS as of April 2024**
3.0	**Buildings**	
3.1a)	Continue to share information and promote participation in the CRD's regional home retrofit and fuel switching program.	District website
3.2 a)	Encourage residents to undertake home energy audits	Ditto
3.2 b)	Encourage residents to undertake *Firesmart* Home Ignition Zone assessments.	Fire Dept Firesmart Program underway
3.2 c)	Develop a 'sustainability checklist' to for retrofits and re-developments	
3.2 d)	Investigate cost/benefit of solar panels onproposed new firehall.	To be Included in feasibility study
3.0	Additional opportunities:	
3.0	*Advocate at CRD for enhanced recognition of carbon sequestration in greenhouse gas inventory.*	Requested in 2023 through CRD Climate Action Inter-Municipal Task Force
3.0	*Consider accelerated STEP code adoption at District level.*	Building bylaw amendments pending
3.0	*Promote voluntary adoption of Steps 4 and 5 of the BC Energy step code for private development.*	
3.0	*Investigate local implementation of property assessed clean energy (PACE) program.*	
4.0	**Transportation**	
4.1 a)	Investigate and report to Council on options to develop an active transportation plan for the District.	Grant application results pending
4.2 a)	Establish partnerships to repair and maintain existing public EV charging stations.	Grant application was successful
4.0	Additional opportunities:	
4.0	*Continue to lobby BC transit to further improve transit scheduling and bike-to-transit connectivity and advocate for BC Transit to accelerate implementation of on-demand transit service for Metchosin.*	Representation at Victoria Regional Transit Commission. Supported no fee and lower fee transit for youth.
4.0	*Identify and apply for external funds to purchase and install additional public EV charging stations.*	Grant application was successful
4.0	*Explore opportunities to support local businesses to install electric charging infrastructure.*	
4.0	*Require 220v EV charge connections - new builds + retrofits.*	Building bylaw amendments pending
5.0	**Community Engagement**	
5.1	Encourage a community-led climate change and sustainability lecture series.	Working with ReImagine Westshore and liaising with ReGeneration community group.
5.0	Additional opportunities:	
5.0	*Engage with partners to identify and solicit external funding for new habitat protection and restoration projects*	District supporting Sc'ianew Nation on Mary Hill Tribal Park initiative with partners including HAT and Pearson College.

Who will promote the plan and coordinate data gathering?		
Participation will required by District staff, MEASC, community groups but there should be a group designated with primary responsibility for this task. **Proposal**: that a community group be formed (either a new group or a coalition of existing groups) to undertake supporting activities for Metchosin's Climate Action Plan. Their mandate would be to:	Promote the principle that much of what Metchosin's climate change role is to preserve the natural environment and take full advantage of the ecosystem services that it provides. Our "priceless" natural environment needs to have its value assessed so it is recognized as a prime player in climate change mitigation and community resilience.	
	Build community support for the Climate Action Plan	
	Assist in gathering base line data in preparation for the 2028 review.	
	Engage with other community groups and individuals to plan climate-related initiatives. Examples include:	
	Repair cafes	MACCA
	Recycling days for items not picked up in Blue Bins such as soft plastic	
	Promote battery recycling	District, CRD Hartland
	Facilitation of ride sharing	
	Provide assistance for seniors to apply for rebate programs	SIRC
	Organize educational events and materials	Metchosin Day, Earth Day
	Update the District website regularly on climate plan progress	MEASC

From: Nicole Shukin [redacted]
Sent: Wednesday, April 10, 2024 9:46 AM
To: [redacted] Steve Gray <sgray@metchosin.ca>; [redacted]
Cc: Marie-Térèse Little <mtlittle@metchosin.ca>; Shelly Donaldson <sdonaldson@metchosin.ca>; Sharie Epp <sepp@metchosin.ca>; Jay Shukin <jshukin@metchosin.ca>; Bob Payette <bpayette@metchosin.ca>; Nitya Harris [redacted]
Subject: wildlife biodiversity & livestock predation

Dear Garry, Steve and MEASC committee members:

I'm writing in relation to a discussion around livestock predation that took place at Monday's Finance meeting (April 8, 2024). This recurring issue in Metchosin has also been discussed at MEASC and Agricultural Committee meetings this year.

It's hard to square the continued use of lethal tools – the euphemistic "dispatching" of wild predators who become habituated to preying on livestock - with the strong resolution advanced by Metchosin that calls on the province to protect and restore biological diversity in local communities.

The Role of MEASC

I believe that MEASC has a unique responsibility to engage with this issue, given that **last year Council acted on MEASC's recommendation that Metchosin advance a resolution on biodiversity at the UBCM.** How can Metchosin call for greater protection of biodiversity from the province, on the one hand, and call for a quicker response from provincial Conservation Officers to "dispatch" wildlife predators, on the other? The biodiversity resolution needs to be backed up with a sustained *resolve* to find practical approaches that better protect both wildlife and livestock in Metchosin.

At this critical moment of global and local biodiversity loss, it would be dismaying if MEASC was not fully engaged in this issue going forward. It is when real complexities and challenges arise around local protection of wildlife that MEASC's expertise and experience is most needed.

Protection of both wildlife and livestock is an ethical and practical conundrum that I believe requires close collaboration between MEASC, AASC, Council, Staff and others.

The Role of local government

At Monday's meeting it was suggested that the District's responsibility in relation to livestock predation by cougars and bears may be "next to none" since wildlife management is the regulatory purview of the province.

WildSafe BC disagrees, stating: "While the management of wildlife is a provincial responsibility, the regulation and management of refuse and other wildlife attractants that bring wildlife into communities is the responsibility of local government" (see excerpt from WildSafe BC's 2022 *Wildlife Attractant Toolkit*, below).

I believe that Nitya Harris (Coexisting With Carnivores) has talked with MEASC about codifying best management practices for livestock owners in a new or existing bylaw in order to support non-lethal deterrents to predation. Several communities in BC have already enacted bylaws that are specific to preventing bears, cougars and wolves from accessing and becoming conditioned to or dependent on livestock or human food sources. WildSafe BC's *Wildlife Attractant Toolkit* provides a sample bylaw based on the District of Squamish Wildlife Attractant Bylaw No. 2781, 2020. Tofino adopted a similar bylaw in 2022.

Conclusion

In closing, I am writing to respectfully request that MEASC devote its expertise and effort to the task of finding a sustainable alternative to "the needless and preventable human-caused loss of local wildlife," as it's put in the excerpt from WildSafe BC's *Wildlife Attractant Toolkit*, below.

Sincerely,

Nicole Shukin

Excerpt from *Wildlife Attractant Toolkit*

Why wildlife attractant bylaws are necessary

While the management of wildlife is a provincial responsibility, the regulation and management of refuse and other wildlife attractants that bring wildlife into communities is the responsibility of local government. This can be accomplished by (1) educating residents and visitors; and (2) by adopting bylaws that assist with minimizing, to the greatest extent possible, the availability of anthropogenic (human) foods and other substances.

Local government, whether a municipality or regional district, is responsible for providing a comprehensive range of services that enhance many aspects of life for its citizens and play a key role in ensuring the overall health, safety and well-being of their community. Creating a wildlife attractant bylaw is inherently within the scope of this local government responsibility as it improves public health and safety.

It is worth noting that local government elected officials/councils can direct enforcement staff to prioritize specific bylaws and can also provide direction on the enforcement process, such as when to provide more warnings than tickets and vice versa. Currently, wildlife is being killed in direct relation to being fed, whether intentionally or unintentionally. Local governments must place a higher priority on the creation and enforcement of these wildlife attractant bylaws to reduce the potential for human injury, injury to pets/livestock, agricultural losses, or property damage; and to reduce, and potentially eliminate, the needless and preventable human-caused loss of local wildlife.

From: Shannon Hamilton [redacted]
Sent: Tuesday, April 9, 2024 7:40 PM
To: Steve Gray <sgray@metchosin.ca>; Shelly Donaldson <sdonaldson@metchosin.ca>; Sharie Epp <sepp@metchosin.ca>; Jay Shukin <jshukin@metchosin.ca>; Marie-Térèse Little <mtlittle@metchosin.ca>
Subject: Livestock Predation

Good afternoon Metchosin Council Members,

I hope this email finds you all well. My name is Shannon and I am a new Metchosin resident as of December 1, 2023. One of the reasons I chose to reside in Metchosin is because of the unlimited access to hiking trails and wilderness. I am a wildlife enthusiast and advocate.

Last night I had the pleasure of tuning into the livestream of the council meeting. I have deep concerns with the issue that was raised of cougar livestock predation. I have been actively studying and observing cougar behaviour for the last 8 months using trail cameras which capture intimate videos of these animals in their natural element. While I am no expert, I can confidently say that these animals are extremely misunderstood. I place myself in areas of high cougar activity on a regular basis and have only had one encounter. This particular encounter involved a cougar observing me from a far distance and when I made eye contact with the animal, it ran off. I can confidently say that cougars do their absolute best to avoid interactions and encounters with humans.

While I can certainly understand the concern of cougar predation on livestock amongst our local farmers, I have concerns with some points that were made during the meeting. With I'll do respect, one member had stated that cougar livestock predation was happening too close to a public trail. Well, cougars are constantly on or closer to our public trails more than we realize. I understand that these predators can be scary to some but I believe that is due to lack of education and understanding. I firmly believe that cougars are not a threat to human safety. In conclusion, I worry about the misinformation and fear mongering that is voiced from individuals who do not understand cougar behaviour.

Cougars are an important part of our eco systems. With the high development rates happening in our area, cougar habitats are getting more and more encroached on. Cougars are also opportunistic hunters and unfortunately, livestock is an easy prey of opportunity, often resulting in habituation. I have read the letters from local farmers stating that the suggestions offered to them from Conservation Officers and Wildwise are not practical or feasible. However, when I read these letters it appears that the only solution is killing the animal. Killing the "problem cougars" is not a solution, as I believe that this will continue to happen if we don't implement effective practices to avoid habituation. We cannot keep killing cougars every year due to lack of responsible animal husbandry. Responsible animal husbandry is incredibly important to mitigate this type of habituation. We reside on their territory and we are encroaching on their habitats. It is disappointing and heart breaking to hear that we are resorting to lethal consequences to a wild animal that is simply trying to survive. In my opinion, there are still options to exhaust and I believe farmers AND the District of Metchosin play a role in this. For example, I have recently been in touch with a Wildlife Biologist in Montana as I know the state of Montana faces similar

issues with livestock predation from wolves, grizzly bears and mountain lions. The state of Montana has a "Livestock Loss Board" which is responsible for loss reduction and mitigation programs. Here is a brief description of their program's purpose:

- To provide financial reimbursements to producers for losses caused by wolves, grizzly bears or mountain lions based on program criteria.
- To proactively apply prevention tools and incentives to decrease the risk of wolf, grizzly bear or mountain lion caused losses.

This type of program would be highly valuable to not only our local farmers but our wildlife as well and this is just one idea to explore. I'd like to reiterate that responsible animal husbandry is a must. We MUST do our part.

I understand there will be a meeting in the future between council members and the Agricultural Society and perhaps Conservation Officers as well. However, I highly suggest you also invite someone who has extensively researched and has an understanding of cougar behaviour. I can recommend someone who is a wealth of knowledge on this topic if you wish.

Thank you for taking the time to read my email. This is a passionate subject for me as I care deeply about not only our local wildlife but also the health and wellbeing of our eco systems.

Kind regards,

Shannon

DISTRICT OF METCHOSIN

SUBJECT:	**PUBLIC WORKS POLICY** **Elimination of Pesticides and Herbicides for Cosmetic Purposes on Municipal Grounds**	**SECTION:**	**W-100**
		POLICY:	**W-100.50**
		COUNCIL:	**Feb. 19/01**
		AMENDS:	**W-100.45**

Elimination of Cosmetic Pesticide and Herbicide Use

1. It is the objective of this policy to eliminate the cosmetic use of pesticides and herbicides on the municipal grounds.

   It is to encourage the gradual reduction and elimination of all cosmetic pesticide and herbicide use within the district, focusing on specific areas including schools, daycare facilities, parks, playing fields, playgrounds and any facilities designed to serve the elderly in order to protect those at greatest risk.

   Whereas "cosmetic" is defined as the correction of physical defects, especially that to improve appearance.

   Whereas, under the BC Pesticide Control Act, a "pesticide" is any substance, or mixture of substances, other than a device, intended for killing, controlling or managing insects, rodents, fungi, weeds and other forms of plant or animal life that are considered to be pests.

   Whereas those at "greatest risk" in this instance refers to children and the elderly but may be expanded to include the embryo and young of all species whose reproductive and nervous systems are developing and most easily damaged.

2. It is also the objective of this policy to initiate a public education program using various media in which community awareness surrounding the issues of pesticide and herbicide use for both cosmetic and pest control purposes will be raised.

   Whereas the "issues" addressed include, but are not limited to: identification and explanation of those pesticides and herbicides which are persistent, bio-accumulate, cause hormone disruption, or acute toxicity and means to reduce exposure to; outline sources of exposure for children and discuss why they are at greater risk and solutions to reduce this risk; green alternatives for lawn care and the benefits of; occupational exposure and preventative measures; effects on local wildlife including direct exposure and exposure of that applied to food; information regarding integrated pest management (IPM) for landscape pests as well as home and garden pests; and implications of pesticide and herbicide use on a global level.

3. We are encouraged by the implementation of and support the use of methods employed to reduce pesticide and herbicide use in agriculture including organic farming and integrated pest management (IPM).

c) Parks Committee, November 19, 2012

Agricultural Advisory Select Committee Recommendation - October 4, 2012

Moved and Seconded by Councillors Mitchell and Milne that Council resolve the following:

Whereas genetic modification of agricultural crops has to date focused on large-scale commercial crops such as field corn, soybeans, canola and cotton. None of these crops has been grown in Metchosin. Recently, however, genetic modification of sweet corn and fruit, particularly apples, pears, cherries and peaches, and the marketing of these crops beginning in 2013 means that GM plants may be directly or indirectly introduced to Metchosin and;
Whereas organic production is important to the agricultural economy of Metchosin. The sale of organic produce to individuals as well as to restaurants, farm markets and food retailers underpins individual farm economics and contributes significantly to Metchosin branding. Market demand for organic – and locally grown -- produce simply keeps on expanding and;
Whereas the diversity of produce and the broad range of varieties grown provide and preserve genetic material of which seed is sold around the world. The preservation of this genetic pool is freely acknwledged by the largest seed companies which also contribute to seed banks and;
Whereas Metchosin's isolation from other agricultural areas in southern Vancouver Island along with the prevailing wind direction together provide Metchosin farmers with practical approaches to avoiding contamination by genetically modified organisms (GMO) and;
Whereas these conditions suggest that there is an opportunity for Metchosin farmers, with continuing organic production, to maintain long term sustainability, to foster a living seed bank, and to be a refuge from genetic contamination and;
Therefore be it resolved that the District of Metchosin recommends that no GMO plants (vegetables, fruit, herbs, etc.) be grown in the District.

Carried