REGIONAL DISTRICT OF NANAIMO

REGIONAL DISTRICT OF NANAIMO
COMMITTEE OF THE WHOLE
AGENDA

Tuesday, November 20, 2018
3:00 P.M.
RDN Board Chambers

This meeting will be recorded

			Pages
1.	**CALL TO ORDER**		
2.	**APPROVAL OF THE AGENDA**		
3.	**ADOPTION OF MINUTES**		
	3.1	**Regular Committee of the Whole Meeting - October 2, 2018** That the minutes of the Regular Committee of the Whole meeting held October 2, 2018, be adopted.	4
4.	**DELEGATIONS**		
	4.1	**Kyle Clifford, President, Gabriola Recreation Society, re 2019 Budget Request**	9
5.	**CORRESPONDENCE**		
6.	**COMMITTEE MINUTES** That the following minutes be received for information:		
	6.1	**Drinking Water and Watershed Protection Technical Advisory Committee - October 25, 2018**	10
	6.2	**District 69 Recreation Commission - October 18, 2018**	13
	6.3	**Agricultural Advisory Committee - September 21, 2018**	16
7.	**COMMITTEE RECOMMENDATIONS**		
	7.1	**District 69 Recreation Commission**	

7.1.1 District 69 Youth Recreation Grants

1. That the following District 69 Youth Recreation Grant applications be approved:

- 893 Beaufort Cadet Squadron - equipment, ski lessons, transportation and lunch - $2,500
- Errington War Memorial Hall Association - equipment, rent - $1,590
- Family Resource Association - recreation passes, bus passes, snacks - $2,500

Total - $6,590

2. That the following District 69 Youth Recreation Grant application be approved subject to the outstanding 2015 Recreation Grant Summary Report being submitted by November 15, 2018:

- Oceanside Minor Lacrosse Association - field lacrosse equipment - $2,000

Total - $2,000

7.1.2 District 69 Community Recreation Grants

That the following District 69 Community Recreation Grant applications be approved:

- Arrowsmith Agricultural Association - Family Day - $1,351
- Bow Horne Bay Community Club - Lighthouse Fall Fair - $2,500
- Corcan Meadowood Residents Association - Halloween event 2019 - $2,355
- Oceanside Women's Hockey Travel Team - jerseys - $1,555
- Parksville Golden Oldies Sports Association - rental - $500
- Parksville Indoor Slow-Pitch League - equipment - $1,600
- Qualicum Beach Community Garden Society - raised beds - $1,691
- Ravensong Masters Swim Club - pool rental - $1,200

Total - $12,752

8. RECREATION AND PARKS

8.1 UBCM 2019 Age Friendly Communities Grant Application 19

That the Board endorse the grant application to the Union of BC Municipalities (UBCM) for the Age Friendly Communities Grant (Stream 1) for the purposes of funding an active aging asset mapping project within the Northern Recreation Services area.

8.2 Gabriola Recreation Society Increase Funding Request — 21

That the Regional District supplement annual grant funding received by Gabriola Recreation Society from the Canada Summer Jobs program for their Summer Student Coordinator position to a maximum combined total of eight thousand dollars ($8,000) for the 2019 and 2020 fiscal years.

9. REGIONAL AND COMMUNITY UTILITIES

9.1 EPCOR Hydrant Maintenance Contract Approval — 43

That the Board enter into a contract with EPCOR Water (West) Inc. to provide hydrant maintenance services in French Creek for the period January 1, 2018 to December 31, 2020 at a total cumulative cost of approximately $300,000.

9.2 Final Report – 10 Year Action Plan Review for Drinking Water and Watershed Protection — 83

That the Board receive the final report on the 10 Year Action Plan Review for the Drinking Water and Watershed Protection program for information.

9.3 Surface Water Quality Trend Analysis for RDN Community Watershed Monitoring Network Data (2011-2017) — 148

That the Board endorse presentations to the City of Nanaimo, the City of Parksville, the Town of Qualicum Beach and the District of Lantzville councils to provide the results of the report.

10. TRANSPORTATION AND EMERGENCY PLANNING SERVICES

10.1 Fire Services Automatic Response Agreement Renewal — 397

That the Automatic Response Agreement for a five-year term from March 1, 2018 to March 1, 2023 be approved.

11. BUSINESS ARISING FROM DELEGATIONS

12. NEW BUSINESS

12.1 Chair's Appointments to Board Standing and Select Committees, and External Organizations

12.2 Directors' Roundtable

13. IN CAMERA

That pursuant to Section 90 (1) (a) of the *Community Charter* the Committee proceed to an In Camera meeting for discussions related to Board appointments.

14. ADJOURNMENT

REGIONAL DISTRICT OF NANAIMO

MINUTES OF THE REGULAR COMMITTEE OF THE WHOLE MEETING

Tuesday, October 2, 2018
3:00 P.M.
RDN Board Chambers

In Attendance:	Director W. Veenhof	Chair
	Director I. Thorpe	Vice Chair
	Director A. McPherson	Electoral Area A
	Director H. Houle	Electoral Area B
	Director M. Young	Electoral Area C
	Director B. Rogers	Electoral Area E
	Director J. Fell	Electoral Area F
	Director J. Stanhope	Electoral Area G
	Director B. McKay	City of Nanaimo
	Alternate	
	Director S. Armstrong	City of Nanaimo
	Director B. Bestwick	City of Nanaimo
	Director D. Brennan	City of Nanaimo
	Director J. Hong	City of Nanaimo
	Director B. Yoachim	City of Nanaimo
	Director M. Lefebvre	City of Parksville
	Director K. Oates	City of Parksville
	Director B. Colclough	District of Lantzville
	Director T. Westbroek	Town of Qualicum Beach
Regrets:	Director G. Fuller	City of Nanaimo
	Director J. Kipp	City of Nanaimo
Also in Attendance:	P. Carlyle	Chief Administrative Officer
	R. Alexander	Gen. Mgr. Regional & Community Utilities
	G. Garbutt	Gen. Mgr. Strategic & Community Development
	T. Osborne	Gen. Mgr. Recreation & Parks
	D. Wells	Gen. Mgr. Corporate Services
	D. Pearce	Director of Transportation & Emergency Services
	C. Midgley	Mgr. Strategic Initiatives and Asset Management
	T. Mayea	Legislative Coordinator
	C. Golding	Recording Secretary

CALL TO ORDER

The Chair called the meeting to order and respectfully acknowledged the Coast Salish Nations on whose traditional territory the meeting took place.

APPROVAL OF THE AGENDA

It was moved and seconded that the agenda be approved as presented.

CARRIED UNANIMOUSLY

ADOPTION OF MINUTES

Regular Committee of the Whole Meeting - September 4, 2018

It was moved and seconded that the minutes of the Regular Committee of the Whole meeting held September 4, 2018, be adopted.

CARRIED UNANIMOUSLY

DELEGATIONS

Joan Miller, Film Commissioner, Vancouver Island North Film Commission (INFilm), re Update

Joan Miller, Film Commissioner with Vancouver Island North Film Commission provided an overview of filming activities and events that have taken place in 2018. The presentation included information about the financial benefits to the region, charitable donations, professional development, marketing, and screen tourism.

Joan Merrifield, President, and Gloria Filax, Vice-President, Gabriola Historical Museum Society, re Update

Joan Merrifield, President of the Gabriola Historical Museum Society provided an overview of events and activities the museum has organized in 2018. The presentation included information about budget projections, gift shop sales, and a marked increase in visitors. It was noted that they will be requesting an increase in funding from the Board early in the new year.

COMMITTEE MINUTES

It was moved and seconded that the following minutes be received for information:

District 69 Recreation Commission - September 20, 2018

CARRIED UNANIMOUSLY

COMMITTEE RECOMMENDATIONS

District 69 Recreation Commission

Accessible Fitness Centre in Oceanside

It was moved and seconded that the following motions be referred back to staff:

1. That Island Health be requested to assist Universal Access Qualicum Beach in securing a suitable location, developing an operational model and creating a business plan for the placement of specialized universal access fitness equipment in the District 69 area.
2. That if the Regional District of Nanaimo undertakes the development of a fitness and wellness facility for the District 69 area in the future, that the provision of accessible fitness equipment be considered in the design.

CARRIED UNANIMOUSLY

It was moved and seconded that Regional District of Nanaimo Recreation add a Universally Accessible Fitness and Wellness Facility to its list of Oceanside recreation facility needs as a high priority (in a five to 10 year timespan), collaborative community project.

CARRIED UNANIMOUSLY

CORPORATE SERVICES

Flag Policy

It was moved and seconded that the Board adopt the attached Flag Policy A1.34.

CARRIED UNANIMOUSLY

STRATEGIC AND COMMUNITY DEVELOPMENT

Regional District of Nanaimo 2017-2018 Green Building Series Summary and 2018-2019 Green Building Series Workshops and Activities.

It was moved and seconded to receive the Regional District of Nanaimo’s (RDN) 2017-2018 Green Building Series summary and 2018-2019 Green Building Series workshops and activities for information.

CARRIED UNANIMOUSLY

Proposed Amendments to the Floodplain Bylaw, Bylaw 500 and Board Policy B1.5 to Modernize Flood Mitigation Requirements

It was moved and seconded that the Board introduce and give first and second reading to “Regional District of Nanaimo Floodplain Management Amendment Bylaw No. 1469.02, 2018”.

CARRIED UNANIMOUSLY

It was moved and seconded that the Board introduce and give first and second reading to “Regional District of Nanaimo Land Use and Subdivision Amendment Bylaw No. 500.417, 2018”.

CARRIED UNANIMOUSLY

It was moved and seconded that the Board approve revisions to “Regional District of Nanaimo Board Policy No. B1.5 Development Variance Permit, Development Permit with Variance & Floodplain Exemption Application Evaluation”.

CARRIED UNANIMOUSLY

It was moved and seconded that the public hearing for “Regional District of Nanaimo Land Use and Subdivision Amendment Bylaw No. 500.417, 2018” be waived and notice of the Board’s intent to consider third reading be given in accordance with Section 467 of the *Local Government Act.*

CARRIED UNANIMOUSLY

It was moved and seconded that the District of Lantzville and Gabriola Island Local Trust Area be notified of “Regional District of Nanaimo Floodplain Management Amendment Bylaw No. 1469.02, 2018”.

CARRIED UNANIMOUSLY

2018 Operational Plan Update

It was moved and seconded that the Board endorse the Regional District of Nanaimo 2018 Operational Plan Update.

CARRIED UNANIMOUSLY

MOTIONS FOR WHICH NOTICE HAS BEEN GIVEN

Filming Permits

It was moved and seconded that staff be directed to report back to the Board on developing filming permits.

CARRIED UNANIMOUSLY

NEW BUSINESS

Protocol Meetings with Islands Trust

It was moved and seconded that staff be directed to work with Islands Trust staff to set two dates per year for protocol meetings between Islands Trust staff, Regional District of Nanaimo staff and elected officials.

CARRIED UNANIMOUSLY

Directors' Roundtable

Directors provided updates to the Board.

ADJOURNMENT

It was moved and seconded that this meeting be adjourned.

CARRIED UNANIMOUSLY

TIME: 4:05 PM

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CHAIR

Delegation: **Kyle Clifford, President, Gabriola Recreation Society, re 2019 Budget Request**

Summary: The Gabriola Recreation Society (GRS) provides recreation services to the resident population of Gabriola (est. 4,100 people). Originally these services were provided directly by the Regional District of Nanaimo with a staff person commuting regularly to the Island. However it was felt a more cost-effective method to provide such services was to set up a volunteer board, the GRS, with a core budget to hire a part time programmer with a small office on the Island.

Over the years the core budget has not increased but the demand for services has. The GRS has attempted to supplement staffing on the Island through the Canada Summer Jobs (CSJ) program. However this has covered only the wages of a high school level position.

By adding this $8,000 to our core budget, we remove it from the uncertainty and restrictions of CSJ grants, and create a meaningful job that would be open to the most capable person, student or not. The community is sorely in need of more good jobs.

We would be able to pay the wage at a rate comparable to the RDN, rather than continuing to pay the current low wage we have had for many years. The wage is no longer enticing for an experienced candidate.

Without this funding, GRS will have to cut back on other services. Our budget is very tight, and we are attempting to expand our new low income access program, grants-in-aid fund, and support of community events.

This funding would enable us to set our own deadline for hiring to this position to more effectively assist with early program planning and better overall set-up. It would also be a benefit to have more flexibility in this person's hours and work load, and not be tied to CSJ limitations.

Action Requested: The Gabriola Recreation Society (GRS) is requesting an $8,000 increase in our budget allocation from the RDN for 2019. The funds are to be specifically targeted towards wages for a summer coordinator position. The GRS is requesting support for this increase from the RDN Committee of the Whole.

The 5 minute briefing to the RDN Committee will include an overview of the GRS, the services it provides to the residents of Gabriola and how the GRS is an extension of the RDN's recreation program services.

REGIONAL DISTRICT OF NANAIMO

MINUTES OF THE DRINKING WATER AND WATERSHED PROTECTION TECHINCAL ADVISORY COMMITTEE MEETING

Thursday, October 25, 2018
12:30 P.M.
RDN Board Chambers

In Attendance:	S. De Pol	Chair
	K. Epps	Forest Industry Representative
	P. Jorgenson	Forest Industry Representative
	P. Lapcevic	BC Ministry of Forests, Lands & Natural Resource Operations
	K. Miller	Cowichan Valley Regional District
	H. Rueggeberg	General Public Representative (South)
	W. Shulba	Islands Trust Representative
	B. Silenieks	Municipal Representative (City of Parksville)
	B. Weir	Municipal Representative (Town of Qualicum Beach)
	G. Wendling	Hydrogeologist Representative
	H. Cao	City of Nanaimo
Regrets:	O. Brandes	Academic Community Representative (POLIS)
	L. Cake	Water Purveyors (Coastal Water Suppliers Assoc.)
	A. Fiddick	Environment Community Representative
	A. Gilchrist	Academic Community Representative (VIU)
	N. Leone	Department of Fisheries and Oceans
	L. Magee	Island Health
	P. Shaw	Mt Arrowsmith Biosphere Region
	F. Spears	Municipal Representative (District of Lantzville)
	K. Fagervik	Ministry of Transport & Infrastructure
	C. Cole	General Public Representative (North)
Also in Attendance:	M. Walters	Regional District of Nanaimo
	R. Alexander	Regional District of Nanaimo
	J. Pisani	Regional District of Nanaimo

CALL TO ORDER

The Chair called the meeting to order and respectfully acknowledged the Coast Salish Nations on whose traditional territory the meeting took place.

APPROVAL OF THE AGENDA

It was moved and seconded that the agenda be approved as presented.

CARRIED UNANIMOUSLY

ADOPTION OF MINUTES

Drinking Water and Watershed Protection Technical Advisory Committee Meeting - April 19, 2018

It was moved and seconded that the minutes of the Drinking Water and Watershed Protection Technical Advisory Committee meeting held April 19, 2018, be adopted.

CARRIED UNANIMOUSLY

INVITED PRESENTATIONS

Committee Roundtable Updates

Committee members shared updates from their area of representation or organization.

Monitoring Station Update

J. Pisani updated the committee on two new monitoring stations installed in priority areas this year. This included the Upper Nanoose Creek Climate Station in partnership with Island Timberlands and the French Creek hydrometric monitoring station in partnership with DFO and MFLNRORD.

Water Trax Demo – Groundwater Quality Data

L. Fegan provided an update and a demo on the WaterTrax platform that the DWWP program is newly set up with for internally managing groundwater quality data, particularly the data shared via the Well Water Testing Rebate program. The WaterTrax platform will allow for easier data query by location and analyte, as well as offers a map interface.

Rebate Program Update

C. Brugge updated the committee on the water stewardship rebate programs allocations and issuance so far this year.

Update on Team WaterSmart Activities

C. Brugge shared an update on the events, water saver contest, school field trips, irrigation check-ups and wellSMART workshops offered this year through Team WaterSmart.

Econics - 10 Year Action Plan Review

J. Pisani presented slides provided by Econics on their review of the DWWP Action Plan Implementation to date. Key findings in terms of accomplishments and challenges were highlighted as were high level recommendations for the upcoming Action Plan update. The final report from Econics will be presented to the Board before it is distributed to the committee.

REPORTS

Ecoscape – Surface Water Quality Trend Analysis

J. Pisani presented the findings from the Surface Water Quality Trend Analysis for RDN's Community Watershed Monitoring Network data from 2011-2017, reported on by Ecoscape Environmental Consultants Ltd. The analysis included data from 34 different surface water monitoring sites. The analysis performed comparison to BC water quality guidelines and objectives, trend analysis to detect changes in water quality over time, and statistical modelling to determine if watershed characteristics and land uses affect water temperature, dissolved oxygen, conductivity and turbidity. The committee discussed the report findings and the key recommendations and suggested follow-up efforts focusing on the agricultural sector.

NEW BUSINESS

2019 Projects

J. Pisani introduced the planned major projects for DWWP in 2019 for committee feedback and discussion. This included the DWWP Action Plan update, two Phase 3 water budget analysis projects, the RDN Water Service Areas Water Conservation Plan Update and more. Committee members acknowledged partnership opportunities particularly with member municipalities, neighbouring Regional Districts, Islands Trust and subject matter experts in hydrogeology and forestry.

ADJOURNMENT

It was moved and seconded that the meeting be adjourned.

CARRIED UNANIMOUSLY

TIME: 2:10 PM

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CHAIR

REGIONAL DISTRICT OF NANAIMO

MINUTES OF THE DISTRICT 69 RECREATION COMMISSION MEETING

Thursday, October 18, 2018
2:00 P.M.
Oceanside Place

In Attendance:	Commissioner J. Fell	Chair
	Commissioner L. Krofta	Electoral Area E
	Commissioner R. Nosworthy	Electoral Area F
	Commissioner T. Malyk	Electoral Area G
	Commissioner K. Burden	City of Parksville
	Commissioner E. Young	School District 69 Trustee
Regrets:	Commissioner B. Veenhof	Electoral Area H
	Commissioner N. Horner	Town of Qualicum Beach
Also in Attendance:	T. Osborne	Gen. Mgr. Recreation & Park Services
	D. Banman	Mgr. Recreation Services
	A. Harvey	Recording Secretary

CALL TO ORDER

The Chair called the meeting to order and respectfully acknowledged the Coast Salish Nations on whose traditional territory the meeting took place.

APPROVAL OF THE AGENDA

It was moved and seconded that the agenda be approved as presented.

CARRIED UNANIMOUSLY

ADOPTION OF MINUTES

District 69 Recreation Commission Meeting - September 20, 2018

It was moved and seconded that the minutes of the District 69 Recreation Commission meeting held September 20, 2018, be adopted.

CARRIED UNANIMOUSLY

CORRESPONDENCE

It was moved and seconded that the following Correspondence be received for information:

S. Hobson, Accessible Oceanside Association, re: Thank you to District 69 Recreation Commission

J. Miller, Jim's Gym, re: Universal Accessible Fitness Centre

CARRIED UNANIMOUSLY

COMMITTEE MINUTES AND RECOMMENDATIONS

District 69 Recreation Commission Grants Committee Meeting - October 10, 2018

It was moved and seconded that the minutes of the D69 Recreation Grants Committee Meeting held October 10, 2018, be adopted.

CARRIED UNANIMOUSLY

It was moved and seconded that the following District 69 Youth Recreation Grant applications be approved:

- 893 Beaufort Cadet Squadron - equipment, ski lessons, transportation and lunch - $2,500
- Errington War Memorial Hall Association - equipment, rent - $1,590
- Family Resource Association - recreation passes, bus passes, snacks - $2,500

CARRIED UNANIMOUSLY

It was moved and seconded that the following District 69 Youth Recreation Grant application be approved subject to the outstanding 2015 Recreation Grant Summary Report being submitted by November 15, 2018:

- Oceanside Minor Lacrosse Association - field lacrosse equipment - $2,000

CARRIED UNANIMOUSLY

It was moved and seconded that the following District 69 Community Recreation Grant applications be approved:

- Arrowsmith Agricultural Association - Family Day - $1,351
- Bow Horne Bay Community Club - Lighthouse Fall Fair - $2,500
- Corcan Meadowood Residents Association - Halloween event 2019 - $2,355
- Oceanside Women's Hockey Travel Team - jerseys - $1,555
- Parksville Golden Oldies Sports Association - rental - $500
- Parksville Indoor Slow-Pitch League - equipment - $1,600
- Qualicum Beach Community Garden Society - raised beds - $1,691
- Ravensong Masters Swim Club - pool rental - $1,200

CARRIED UNANIMOUSLY

REPORTS

District 69 Recreation Services Update June 2018 to September 2018

D. Banman spoke on some of the highlights of the report and answered questions from Commissioners.

It was moved and seconded that the District 69 Recreation Services Update for June 2018 to September 2018 be received for information.

CARRIED UNANIMOUSLY

COMMISSIONER ROUNDTABLE

Some Commissioners gave updates of their prospective areas to the Commission.

ADJOURNMENT

It was moved and seconded that the meeting be adjourned.

CARRIED UNANIMOUSLY

TIME: 2:57

CHAIR

REGIONAL DISTRICT OF NANAIMO

MINUTES OF THE AGRICULTURAL ADVISORY COMMITTEE MEETING

Friday, September 21, 2018
2:00 P.M.
RDN Board Chambers

In Attendance:	Director H. Houle	Chair
	Director J. Fell	Electoral Area F
	Director T. Westbroek	Town of Qualicum Beach
	M. Ryn	Regional Agricultural Organization
	K. Reid	Shellfish Aquaculture Organization
	K. Wilson	Representative District 68
	G. Laird	Representative District 68
	R. Thompson	Representative District 69
Regrets:	J. Thony	Regional Agricultural Organization
	C. Watson	Representative District 69
Also in Attendance:	B. Rogers	Electoral Area E
	J. Holm	Mgr. Current Planning
	B. Ritter	Recording Secretary

CALL TO ORDER

The Chair called the meeting to order and respectfully acknowledged the Coast Salish Nations on whose traditional territory the meeting took place.

APPROVAL OF THE AGENDA

It was moved and seconded that the agenda be approved as amended to move Item 8.1 - Request for Comment on Non-Farm Use in the Agricultural Land Reserve Application No. PL2018-075, 3452 Jingle Pot Road – Electoral Area C, and 8.2 Request for Comment on Subdivision in the Agricultural Land Reserve Application No. PL2018-1062298, Northwest Bay Road – Electoral Area E, before Item 4.

CARRIED UNANIMOUSLY

ADOPTION OF MINUTES

Agricultural Advisory Committee Meeting - April 6, 2018

That the minutes of the Agricultural Advisory Committee meeting held April 6, 2018, be adopted.

CARRIED UNANIMOUSLY

REPORTS

Request for Comment on Non-Farm Use in the Agricultural Land Reserve Application No. PL2018-075 – 3452 Jingle Pot Road, Electoral Area C

Diana Chalmers from Discover Montessori Society spoke in support of the application and answered questions from the Committee. The architect for the project, Brent Murdoch, also answered questions from the Committee.

It was moved and seconded that the application for Non-Farm Use in the Agricultural Land Reserve Application No. PL2018-075 - 3452 Jingle Pot Road, Electoral Area C, be forwarded to the Agricultural Land Commission with a recommendation to approve.

Opposed (3): M. Ryn, G. Laird, and R. Thompson

CARRIED

Request for Comment on Subdivision in the Agricultural Land Reserve Application No. PL2018-106 – 2298 Northwest Bay Road, Electoral Area E

It was moved and seconded that the application for Subdivision in the Agricultural Land Reserve Application No. PL2018-106 - 2298 Northwest Bay Road, Electoral Area E, be forwarded to the Agricultural Land Commission with a recommendation to approve.

Opposed (4): M. Ryn, K. Wilson, G. Laird, and R. Thompson

DEFEATED

Reports

Agricultural Land Commission Final Decisions Chart

Staff provided an update on the status of ALC decisions.

INVITED PRESENTATIONS

Ron Wallace from Agricultural Land Commission

Ron Wallace from Agriculture Land Commission (ALC) spoke on the value of Agricultural Advisory Committee comments for applications to the ALC for subdivision, exclusion and non-farm use. He also answered questions from the Committee.

NEW BUSINESS

Bylaw No. 2 Placement of Fill in the Agricultural Land Reserve - ALC Regulation Update

Staff provided an update on the Agricultural Land Commission regulation on placement of fill.

Cannabis Production in the Agricultural Land Reserve - ALC Regulation Update

Staff provided an update on the Agricultural Land Commission regulation on cannabis production in the Agricultural Land Reserve.

Revitalizing the Agricultural Land Reserve and the Agricultural Land Commission - Status Update

Staff provided an update on the ALC's interim report on revitalizing the Agricultural Land Reserve, following stakeholder consultation earlier this year.

Update on Public Information for Gathering for an Event

It was moved and seconded that staff provide an update on the public information program for Gathering for Events in the Agricultural Land Reserve at the next Agricultural Advisory Committee meeting.

CARRIED UNANIMOUSLY

ADJOURNMENT

It was moved and seconded that the meeting be adjourned.

CARRIED UNANIMOUSLY

TIME: 3:55 PM

CHAIR

REGIONAL DISTRICT OF NANAIMO

STAFF REPORT

TO: Committee of the Whole **MEETING:** November 20, 2018

FROM: Hannah King
Superintendent, Recreation Program Services

SUBJECT: UBCM 2019 Age Friendly Communities Grant Application

RECOMMENDATIONS

That the Board endorse the grant application to the Union of BC Municipalities (UBCM) for the Age Friendly Communities Grant (Stream 1) for the purposes of funding an active aging asset mapping project within the Northern Recreation Services area.

SUMMARY

RDN Board endorsement is required for the RDN's application for a UBCM's Age Friendly Communities Grant application. The grant provides $25,000 to communities for the completion of age-friendly assessments, action plans and planning projects that when implemented will enhance the quality of life for people as they age. One requirement of the grant application is an indication that the community has passed a Board resolution to actively support, promote and work towards becoming an age-friendly community.

BACKGROUND

The UBCM Age Friendly Communities Grant was announced in September 2018. An application has been submitted but the application now requires the Board's endorsement.

If successful the UBCM grant proceeds would be combined with funds ($9,500) budgeted within the Northern Recreation Services 2019 Preliminary Financial Plan for initiatives identified in the 2019 - 2029 Oceanside Recreation Services Master Plan. A needs assessment and GIS mapping project of identified recreation assets would be completed with community organizations serving the active aging population (50 years plus) to identify strengths, weaknesses, opportunities and challenges involved in the provision of recreation services for this age group. From this work strategic objectives will be identified. The project being proposed aligns with the service delivery and programming recommendations within the recently approved (May 2018) Oceanside Recreation Services Master Plan. The project will build on other key initiatives conducted over the past year in Oceanside by the RDN and in collaboration with community partners. These include a community recreation facilities fees review and a social inclusion and physical accessibility audit of recreation facilities. The collaborative approach being proposed as a part of the asset mapping project and the resulting data will align with no less than 5 of the 34 Oceanside Recreation Services Master Plan recommendations. Specifically, the project speaks to Recommendation #17 - that Recreation Services undertake a number of strategic planning initiatives within the next 2 to 5 years including the development of an older adults/age friendly strategy. Such a strategy will explore specific program and activity needs, demands, barriers to participation and ways to remove or lessen those barriers.

ALTERNATIVES

1. That the Board endorse the application to the Union of BC Municipalities (UBCM) for the Age Friendly Communities Grant (Stream 1) for the purposes of funding an active aging asset mapping project within the Northern Recreation Services area.

2. That the Board not endorse the application submitted by the Recreation and Parks Department to UBCM for the Age Friendly Communities Grant (Stream 1) for the purposes of funding an active aging asset mapping project within the Northern Recreation Services area.

3. That the Board provide alternative direction.

FINANCIAL IMPLICATIONS

If successful the Active Aging Assessment and Mapping Project would receive $25,000 in grant funding. Funding would be used to retain a consulting firm through a public request for proposal process to oversee the project. Costs associated with the project would include; document review, community consultation, process planning and implementation strategy, drafting of final report, and secondary costs such as room rental fees, food and travel. Preliminary estimates show the total cost of the project to be $34,500. Awarded funding would be combined with funds ($9,500) budgeted in the 2019 Preliminary Financial Plan for initiatives identified in the 2019 - 2029 Oceanside Recreation Services Master Plan. If funding for these initiatives is not approved in the 2019 financial plan by the RDN Board and the UBCM grant application is successful, then the project would be scaled back to equal the amount of the grant and/or alternative funding sources would be sought.

The grant writing firm ACCESS Grant Services Inc., currently on contract with the RDN, assisted in the writing of the grant application. The cost of the work related to the preparation of the grant application is estimated to be $2,500.

STRATEGIC PLAN IMPLICATIONS

The Board's endorsement of this grant application and the proposed project aligns with the RDN's current strategic priority to focus on service and organizational excellence. By making such a commitment the Board will be strengthening the statement within the Strategic Plan that the Region recognizes and plans for the impact of our aging population. The consultative nature of the asset mapping project will serve as an example of the commitment to develop and encourage meaningful relationships with community partners.

Focus On Service And Organizational Excellence - We Recognize And Plan For The Impact Of Our Aging Population

HKing

Hannah King
hking@rdn.bc.ca
November 8, 2018

Reviewed by:

- D. Banman, Manager, Recreation Services
- T. Osborne, General Manager, Recreation and Parks
- P. Carlyle, Chief Administrative Officer

REGIONAL DISTRICT OF NANAIMO

STAFF REPORT

TO: Committee of the Whole **MEETING:** November 20, 2018

FROM: Hannah King
Superintendent, Recreation Program Services

SUBJECT: Gabriola Recreation Society Increase Funding Request

RECOMMENDATION

1. That the Regional District supplement annual grant funding received by Gabriola Recreation Society from the Canada Summer Jobs program for their Summer Student Coordinator position to a maximum combined total of eight thousand dollars ($8,000) for the 2019 and 2020 fiscal years.

SUMMARY

The Gabriola Recreation Society (GRS) has requested an increase of $8,000 (Attachment 1) in the annual payment for recreation program services the Society (GRS) provides under contract with the RDN. Annually the Society applies for summer employment funding through the Canada Summer Jobs program (CSJ) for wage support for their summer student position(s). The CSJ program provides wage subsidies to employers to create employment for secondary and post-secondary students.

The Society has reported that in recent years the amount of CSJ funding has fluctuated and decreased. GRS also reports that the demand for summer programming on Gabriola Island continues regardless of the decreasing CSJ funding. In order to meet this demand with reduced CSJ grant funding GRS reallocates funds from within their operational budget. This places a strain on other services provided by the Society. With the uncertainty and reduction of CSJ funding the Society is no longer able to offer a competitive rate for their Summer Student Coordinator position.

BACKGROUND

The Society oversees the planning and implementation of direct community recreation programming for residents of Gabriola Island. The Regional District and the Gabriola Recreation Society have been working in partnership in the provision of recreation services since 2002. The current Recreation Services Agreement (Attachment 2) between the RDN and the Gabriola Recreation Society is set to expire December 31, 2020.

Due to the contractual relationship between Gabriola Recreation Society and the Regional District, the Society is considered a public sector employer per the criteria of the CSJ program. Within the terms of the CSJ program private and public sector employers are only eligible to receive funding for up to 50% of the provincial minimum hourly wage. As a result the Society will not be able to fully fund the Summer Student Coordinator position without the recommended supplementation of the grant funding and/or additional funding source(s).

ALTERNATIVES

1. That the Regional District supplement annual grant funding received by Gabriola Recreation Society from the Canada Summer Jobs program for the Summer Student Coordinator position to a maximum combined total of eight thousand dollars ($8,000) for both the 2019 and 2020 fiscal years.

2. That the eight thousand dollar ($8,000) increase in annual funding requested by Gabriola Recreation Society for the delivery of recreation services as outlined in the Recreation Services Agreement be approved beginning January 1, 2019 contingent on the Society making an annual application for CSJ grant funding.

3. That the eight thousand dollar ($8,000) increase in annual funding requested by the Gabriola Recreation Society be declined and addressed during contract renegotiation in 2020 for the 2021-2023 term.

4. That alternative direction be given.

FINANCIAL IMPLICATIONS

The requested increase would be used for the payment of wages for the Summer Student Coordinator position for the months of May through August at a rate of $20/hour. This wage rate is reasonable based on comparison to the wage paid by the RDN Northern Recreation Services for the Summer Leader 2 ($19.90) and Summer Program Assistant ($28.22) positions. It is understood that the GRS Summer Student Coordinator position involves a blend of these two positions.

The following figures are the annual contract payment amounts made to Gabriola Recreation Society by the RDN over the past five years (not including adjustments for inflation).

2014	2015	2016	2017	2018
$66,465	$72,000	$72,714	$72,714	$77,161

The existing recreation services contract annual payment to GRS is $77,161 for 2018-2020. If approved by the Board the maximum matching wage funding payment would increase the annual contract services payment to $85,161 in 2019 and the same amount in 2020. This payment increase would be paid by Gabriola Island residents directly through the same tax requisition used to fund the existing agreement. Alternative two would provide $8,000 directly to GRS with no condition of matching funds from CSJ.

The Board may elect to not amend the annual contract payment or provide any financial support at this time and defer the request for discussions during the renegotiation of the next agreement.

Although not approved by the Board at this time, the $8,000 funding request has been included in the 2019 Preliminary Budget for the Gabriola Recreation Services function. The application deadline for the CSJ grant program is typically the first Friday of February with notification from CSJ of grant funding as late as June. It is expected that the Society would like confirmation of RDN financial support prior to submitting their CSJ application.

STRATEGIC PLAN IMPLICATIONS

Focus On Relationships- We Look For Opportunities To Partner With Other Branches Of Government/Community Groups To Advance Our Region

The Service Agreement with Gabriola Recreation Society demonstrates the District's commitment to working with the community based nonprofit society in the provision of direct recreation services in an efficient and impactful way.

HKing

Hannah King
hking@rdn.bc.ca
November 14, 2018

Reviewed by:

- D. Banman, Manager, Recreation Services
- T. Osborne, General Manager, Recreation and Parks
- P. Carlyle, Chief Administrative Officer

Attachment

1. Budget Request Letter RDN October 2018
2. Recreation Services Agreement 2018-2020

Gabriola
RECREATION SOCIETY

Box 355, Gabriola, B.C. V0R 1X0
250-247-2014; gabrec@telus.net
www.gabriolarecreation.org.

RECEIVED
OCT 18 2018

October 12, 2018

Hannah King
Superintendent of Recreation Program Services
Regional District of Nanaimo
830 Island Highway
Parksville, B.C.
V9P 2X4

Dear Ms. King

As requested, I am providing a separate letter requesting a budget increase of $8,000 for the Gabriola Recreation Society (GRS) for the 2019 budget year.

To my knowledge the GRS has not requested a budget increase of this nature in the past. The request for $8,000 increase in funding from the RDN is for our senior summer student coordinator. We have found, in recent years, that the funding provided through the Canada Summer Jobs (CSJ) program is not sufficient to be able to recruit a senior summer coordinator without redirecting core funding from within our budget. This has the domino effect of reducing our ability to fund priority areas of low income access to recreation programs and support for various community events. The work load of the summer student coordinator is such that an additional entry level summer student assistant at the high school level and funded through CSJ along with this increase in core funding would be adequate and enable us to better provide the services we are attempting to deliver. Summers have become so busy at the GRS that we require both a senior (college/university) student position as well as an entry level high school position.

By adding the $8,000 to our core budget, we remove it from the uncertainty and restrictions of the CSJ grants, and create a meaningful job the would be recruited through competition to hire the most capable person available. Our community is sorely in need of more good jobs. At this pay rate we would be able to pay a rate similar to the RDN rather than continuing the same low rate we have paid for many years. Our wage rate is no longer enticing for the type of experienced candidate we require.

If I can be of further assistance in the explanation of this budget increase please contact me at (250) 325-2251 or at kyle.clifford@shaw.ca.

Kyle Clifford
President
Gabriola Recreation Society

cc Howard Houle
GRS members
Virginia Ebbles

THIS AGREEMENT made the 13 day of December 2017

BETWEEN:

REGIONAL DISTRICT OF NANAIMO
6300 Hammond Bay Road
Nanaimo, BC
V9T 6N2

OF THE FIRST PART

AND:

GABRIOLA RECREATION SOCIETY
PO Box 355
Gabriola, BC
V0R 1X0

(Herein called the "Society")

OF THE SECOND PART

A. WHEREAS the Regional District did, by Bylaw No. 1023 (“Bylaw 1023”) and subsequent amendments, establish a service known as the Gabriola Island Recreation Local Service Area, within a portion of the Electoral Area ‘B’, and did within that Local Service Area authorize the Regional District to undertake and carry out or cause to be carried out and provide for recreation services in and for the Service Area;

B. And WHEREAS the Society was incorporated on the February 14, 2002 and the objects of the Society are to provide recreation services;

C. AND WHEREAS Section 332(1) (3) of the *Local Government Act* provides that the Board may make agreements for the operation of services and the Board wishes to engage the Society to provide recreation and parks services as set out in this Agreement;

NOW THEREFORE THIS AGREEMENT WITNESSETH that in consideration of the premises, terms and conditions to be hereinafter contained (the receipt and sufficiency of which is hereby acknowledged), the parties hereto covenant and agree each with the other as follows:

INTERPRETATION

In this Agreement the following terms have the following meanings:

“Board” means the Board of the Regional District of Nanaimo.

“Lands” means Rollo McClay Community Park and Huxley Community Park.

“Recreation Services” means the services set out in *Schedule ‘A’* to this Agreement.

"Parks Services" means the services for both Rollo McClay Community Park and Huxley Community Park as set out in *Schedule 'B'* to this Agreement.

"Service Area" means the Gabriola Island Recreation Local Services Area established under the Regional District's Bylaw 1023.

"Year End" means the calendar year ending December 31st.

TERM

1. The term (the "Term") of this Agreement is for a three (3) year Term and will commence on January 1, 2018 and end on December 31, 2020, unless otherwise terminated under this Agreement as provided herein. The Agreement may be renewed for further terms at the sole option of the Board.

SERVICE AREA

2. The Society will, under the terms hereof and subject to any applicable bylaw of the Regional District and any Federal or Provincial enactment, provide the Recreation and Parks Services in and for the Service Area.

COST

3. It is acknowledged, understood and agreed that the cost of providing for establishing and equipping the Society for the purpose of carrying out the Recreation and Parks Services within and for the Service Area shall be borne by the owners of land within the Service Area.

RECREATION AND PARKS MANAGEMENT SERVICES

4. The Society shall provide the Recreation and Parks Services attached as *Schedules 'A'* and *'B',* respectively, in accordance with the Society's Constitution and Bylaws.

FUNDING AND PAYMENT

5.
    a) In consideration of the Society providing the services outlined in *Schedules 'A' and '*B', the Regional District will provide funds to support the Society as outlined herein.

    b) In addition to the annual funding provided under this Agreement, the Regional District agrees to pay the annual fees associated with the preparation of the Society's review engagement statement as described in Paragraph 9. The Society shall inform the Regional District, upon submission of the annual Recreation Services budget, of a quote for completing a review engagement statement.

    c) A brief narrative summary reviewing the goals, objectives and the results achieved for the year for the Recreation Services; which would also include challenges encountered, Recreation Services program cancellations, and any other significant issues addressed.

6. The funding described herein is subject to the Regional District being satisfied in each year of the Term that the Society has performed in accordance with *Schedules 'A' and 'B'* and has satisfied all other terms of this agreement.

7. The Society shall annually by September 15 provide the Regional District for the upcoming year of the Term:

   a) A detailed proposed budget showing the revenues and expenditures projected for Recreation Services;

   b) A statement of the goals and objectives for the following year with respect to the Recreation Services being provided, including program content related specifically to the Recreation Services;

   c) A brief written narrative highlighting any significant Recreation Services program changes, deletions, and/or additions in relation to specific line items in the budget;

   d) Any other significant issues that may pertain to the Recreation and Parks Services being provided.

8. On or before February 15 of each year of the Term, the Society shall provide the Regional District, an annual report regarding the Recreation and Parks Services. The annual report shall include at a minimum:

   a) A preliminary summary of Recreation Services operating results showing revenues and expenditures to December 31st of the preceding year;

   b) A summary of Recreation Services programs showing registration statistics and number of sessions held; and,

   c) A brief narrative summary reviewing the goals, objectives and the results achieved for the year for the Recreation and Parks Services; which would also include challenges encountered, Recreation Services program cancellations, and any other significant issues addressed.

9. On or before March 31 of the year following the end of the Society's Year End, the Society will have prepared by a Certified General Accountant or Chartered Accountant qualified to practice publicly in British Columbia, a review engagement statement of its accounts containing particulars of assets and liabilities, and a statement of revenue and expenditures for the year which shall include the public funds provided under PAYMENT in this Agreement. The statements shall be submitted to the Manager of Recreation Services.

10. The Regional District shall provide the following funding with the respect to this agreement:

    a) FOR THE CALENDAR YEAR 2018

    For the **Recreation Services**, two installments equal to the sum of $77,161.00

    i. On or before January 10th, $38,580.50
    ii. On or before July 1st, $ 38,580.50

    For **Parks Services** related to Rollo McClay Park as outlined in *Schedule 'B'*; two installments equal to the sum of $3,360:

    i. On or before January 10th, $1,680
    ii. On or before July 1st, $1,680

    b) FOR THE CALENDAR YEARS 2019-2020

    Funding for 2019 shall be $77,161 and $3,360 respectively for the Recreation Services and the Parks Services, each increased by the change in the Consumer Price Index for Vancouver Island (Victoria) as stated as November 30, 2018.

    Funding for 2020 for each service shall be the amount calculated under 18 (b)(i) above and adjusted for the change in the Consumer Price Index for Vancouver Island (Victoria) as stated at November 30, 2019.

    i. In each year, on or before January 10th – 50% of the funding for the year.
    ii. In each year, on or before July 1st – 50% of the funding for the year.

    The Society shall administer the funds in accordance with the budget approved by the Regional District.

SEPARATE FUNDS AND FINANCIAL STATEMENTS

11. The books of account of the Society shall be kept in such manner and provide such detail as may be required from time to time by the Regional District 's Director of Finance or their designate.

12. The public funds provided under PAYMENT in this Agreement shall be accounted for separately from any other funds of the Society and shall be separated in its books of account.

13. Shall keep all operating revenues and expenditures pursuant to this Agreement separate from other activities that may be undertaken by the Society from time to time.

14. The Regional District 's auditors may rely on the Society's review engagement report, but in any case may require and shall have access to the working papers of the Society's accountant for examination during the Year End audit of the Regional District.

15 The Society will prepare, in a form approved by the Regional District's Director of Finance, a budget related to the Recreation and Parks Services being provided, which reflects its anticipated income and expenses for its next fiscal year as referenced in Section 10.

16. The Recreation Services budget shall contain details as to the funds anticipated to be required by the Society for the annual operation of its Recreation Services, both of a capital and operating nature for the purpose of operating, equipment and other facilities and chattels utilized by the Society for the purpose of providing and carrying out the Recreation Services.

17. The budget shall be presented to the Regional District's Director of Finance on or before September 15 of each year of the Term to prepare the Regional District's budget for the following calendar year. The Regional District will review the budget and may either approve the budget or return the budget for amendment by the Society, which will return the budget as amended to the Regional District for its approval on or before the day specified by the Director of Finance for the purpose of completing the Regional District's budget for the following calendar year.

18. Any accumulated surplus or deficit from the prior year as recorded in the Society's records must be carried forward and be applied to the next year's budget in accordance with accounting rules established for Regional District s in the Province of British Columbia.

19. A deficit incurred in a prior year may or may not be funded by the Regional District and is subject to the Regional District's approval of the Society's budget which forms part of the Regional District's overall financial plan for the relevant year.

20. The Society will not expend or contract for or otherwise commit the Society to any expenditure in any calendar year except one that has first been approved in a budget by the Regional District as above provided and will not incur any liability in any year beyond the amount of the funds to be paid to the Society by the Regional District, as provided in the budget adopted for that year by the Board. General program costs are an acceptable line item within the submitted budget.

RIGHT OF AUDIT

21. At any time, the Regional District may give to the Society written notice that it desires its representatives to examine the books of account of the Society, and the Society shall produce for examination to such representative within ten days after receipt of such notice, its books of account, and the said representative shall have a right of access to all records, documents, books, accounts and vouchers of the Society and shall be entitled to require from the Directors and Officers of the Society such information and explanations as, in his/her opinion, may be necessary to enable the staff to report to the Board on the financial position of the Society.

OPERATION

22. The Society will provide and carry out the Recreation and Parks Services without negligence and in accordance with standards comparable to those of similar services provided within the Regional District of Nanaimo, and in accordance with any operational guidelines as may be established from time to time by the Regional District in consultation with the Society.

23. The Regional District may consult the Society with respect to operational guidelines but shall retain the sole right to determine whether a guideline shall apply to the Society.

CAPITAL ASSETS

24. The parties to this Agreement acknowledge and agree that all the items, furniture, supplies and equipment, currently owned by the Regional District and all other items, furniture, supplies and equipment purchased by the Society with public funds, listed in *Schedule 'C'* to this Agreement, will remain the property of the Regional District free and clear of any claim by the Society and the Society shall not mortgage, charge, pledge, hypothecate or otherwise post such property as security for any purposes whatsoever. *Schedule 'C'* shall be updated for additions and replacements annually after the Year End and a certified copy shall be forwarded to the Regional District's Director of Finance. Subsequent amendments to *Schedule 'C'* shall automatically replace previous schedules and shall become a part of this Agreement.

25. During the Term of this Agreement, the Society, subject to the terms of this Agreement, shall have be responsible for, at all times, equipment listed in *Schedule 'C'* and all other items, furniture, supplies and equipment subsequently purchased out of funds obtained from the Regional District, for the purpose of providing the Recreation and Parks Services within the Service Area.

MAINTENANCE

26. The Society will, to the satisfaction of the Regional District, maintain, all items, furniture, supplies and equipment, and any chattels paid for out of funds obtained through the Regional District and provided by the Regional District to the Society for the purpose of providing the Recreation and Parks Services in a good working condition so that equipment is available at all times for the purpose of providing the Recreation and Parks Services.

27. The Society agrees to return Regional District owned equipment to the Regional District upon request.

INSURANCE

28. The Society shall provide a copy of each insurance certificate each year upon renewal to the Director of Finance of the Regional District.

29. The Society may, at its cost, take out and maintain insurance for the personal effects of the volunteers, Directors and Officers of the Society.

30. The Society shall take out and maintain, during the Term of the Agreement, a policy of comprehensive general liability insurance, including without limitation non-owned automobile insurance and tenant fire and legal liability insurance and declaring the Regional District as an additional named insured, against claims for personal injury, bodily injury, death or property damage arising out of the Recreation and Parks Services provided by the Society in an amount of not less than three million ($3,000,000) dollars per single occurrence or such amount as the Regional District may require from time to time. The Policy shall include a cross liability clause and a waiver of subrogation in favour of the Regional District. The Society shall provide a copy of each year's renewed policy to the Regional District's Director of Finance.

31. In the event of any injury to person(s) on the premises and/or involved in the Recreation and Parks Services or, the Society shall forthwith notify the Regional District of such event. Failure to notify the Regional District within one week of knowledge of an injury or loss may result in the termination of this Agreement.

INDEMNITY

32. The Society shall indemnify and save harmless the Regional District from and against all actions, causes of action, claims, liabilities, damages, losses, costs, fees, fines, charges or expenses which the Regional District may incur, be threatened by or be required to pay by reason of or arising out of the provision of the Recreation and Parks Services by the Society, the Society's use of and occupation of the Portable or any facility where Recreation and Parks Services are provided, the breach by the Society of any term of this Agreement, or by the Society's contravention of any law, enactment or regulation of a federal, provincial or local government.

33. This indemnity shall survive the expiry or sooner termination of this Agreement.

COMPLIANCE WITH LAWS

34. The Society will comply with all enactments as defined in the Interpretation Act and all orders and requirements under an enactment including orders and requirements under and authorized by the *Workers Compensation Act*.

35. The Society shall file a copy of its annual Society Act filing with the Regional District's Director of Finance.

DIRECTORS

36. At all times, while this Agreement is in force, a representative of the Regional District nominated by the Regional District shall be entitled to attend all meetings of the Board of Directors of the Society.

REMEDIAL ACTION

37. If the Society fails to do anything required of the Society under this Agreement, the Regional District may fulfill or complete such thing at the cost of the Society and may, if necessary, by its agents, Officers, employees or contractors enter onto the Lands to fulfill and complete all or part of such thing as the Regional District determines in its sole discretion. If the Society leaves any property, goods or chattels on the Lands or in the Portable after the expiry of the Term, the Regional District may remove them and dispose of them in its sole discretion, and may retain any proceeds of its disposition to cover all costs incurred as a result of the default of the Society to fulfill such thing.

38. The Society releases the Regional District , its elected officials, appointed Officers, employees and agents from and waives any claim, right, remedy, action, cause of action, loss, damage, expense, fee or liability which the society may have against any or all of them in respect of an act of the Regional District under Section 48 except insofar as such claim, right, remedy, action, cause of

action, loss, damage, expense, fee or liability arises from the negligence of the Regional District , its elected officials and appointed Officers, employees, agents or contractors.

TERMINATION

39. The Regional District may terminate this Agreement upon giving ninety (90) days written notice to the Society should the Regional District or any successor to the Regional District provide alternate Recreation and Parks Services, within the Service Area.

40. The Regional District may terminate this agreement immediately without notice to the Society or other party should:

a) The Society, in the opinion of the Regional District , fail to perform any of the terms of its obligations or covenants of the Society hereunder and such failure shall continue beyond thirty (30) days from delivery by the Regional District to the Society of written notice specifying the failure and requiring remedy thereof;

I. Should the Society fail to file its annual report or provide an annual audited financial statement;

II. The Society makes an assignment in bankruptcy or is declared bankrupt;

III. The Society ceases, for any reason, to be current in its obligations under the *Society Act* and fails to maintain the Society in good standing.

41. The Society may terminate this Agreement upon giving not less than ninety (90) days written notice to the Regional District of its intention to so terminate in the event of breach by the Regional District of a material term of this Agreement.

DISPUTE RESOLUTION

42. The parties agree that both during and after the performance of their responsibilities under this Agreement, each of them shall:

a) .Make bona fide efforts to resolve any disputes arising between them by amicable negotiations; and

b) Provide frank, candid and timely disclosure of all relevant facts, information and documents to facilitate those negotiations.

If the dispute cannot be settled within sixty (60) days the parties will refer the matter to the arbitration of a single arbitrator mutually agreed to by the parties. If the parties cannot agree on an arbitrator, the dispute shall be referred to and finally resolved by arbitration pursuant to the *Commercial Arbitration Act* (B.C.). The cost of arbitration shall be borne equally by the parties.

NOTICE

43. It is hereby mutually agreed that any notice required to be given under this Agreement will be deemed to be sufficiently given:

    a) if delivered by hand or

    b) if mailed from any government postal outlet in the Province of British Columbia by prepaid registered mail addressed as follows:

    if to the REGIONAL DISTRICT :

    Manager of Recreation Services
    Regional District of Nanaimo
    6300 Hammond Bay Road
    Nanaimo, BC
    V9T 6N2

    if to the Society:

    President
    Gabriola Recreation Society
    PO Box 355
    Gabriola, BC
    V0R 1X0

44. Unless otherwise specified herein, any notice required to be given under this Agreement by any party will be deemed to have been given if mailed by prepaid registered mail, or sent by facsimile transmission, or delivered to the address of the other party set forth on the first page of this Agreement or at such other address as the other party may from time to time direct in writing, and any such notice will be deemed to have been received if mailed or faxed seventy-two (72) hours after the time of mailing or faxing and, if delivered, upon the date of delivery. If normal mail service or facsimile service is interrupted by strike, slow down, force majeure or other cause, then a notice sent by the impaired means of communication will not be deemed to be received until actually received, and the party sending the notice must utilize any other such services which have not been so interrupted or must deliver such notice in order to ensure prompt receipt thereof.

MISCELLANEOUS

45. Time is to be the essence of this Agreement.

46. The execution and delivery of this Agreement and the completion of the transactions contemplated by this Agreement, if any, have been duly and validly authorized by all necessary corporate action of the Society, and this Agreement constitutes a legal, valid and binding obligation of the Society enforceable against the Society in accordance with its terms and the persons signing this Agreement on the Society’s behalf are duly authorized to do so.

47. This Agreement will ensure to the benefit of and be binding upon the parties hereto and their respective heirs, administrators, executors, successors and permitted assignees.

48. The waiver by a party of any failure on the part of the other party to perform in accordance with any of the terms or conditions of this Agreement is not to be construed as a waiver of any future or continuing failure, whether similar or dissimilar.

49. Wherever the singular, masculine and neuter are used throughout this Agreement, the same is to be construed as meaning the plural or the feminine or the body corporate or politic as the context so requires.

50. No remedy under this Agreement is to be deemed exclusive but will, where possible, be cumulative with all other remedies at law or in equity.

51. This Agreement is to be construed in accordance with and governed by the laws applicable in the Province of British Columbia.

IN WITNESS WHEREOF the parties hereto have set their hands and seals as of the day and year first above written.

For the REGIONAL DISTRICT OF NANAIMO

____ (Seal)
Authorized Signatory

____
Authorized Signatory

For the GABRIOLA RECREATION SOCIETY

____ (Seal)
Authorized Signatory

____
Authorized Signatory

SCHEDULE 'A'

Recreation Services

The Gabriola Recreation Society (GRS), as part of this agreement will provide the following Recreation Services:

1. Offer a wide variety of structured and unstructured recreation programs and/or special events, and other related recreation services deemed appropriate by the Board throughout the year in a variety of community venues in the Service Area, whether coordinated by volunteer or paid staff.

2. Provide a Grant program for the purpose of providing funds to assist local recreation organizations in providing a variety of recreation services to residents of Gabriola Island in addition to the services provided by the Society.

3. Maintain an accurate service evaluation program to include numbers of residents being served and a qualitative and quantitative evaluation of recreation programs and services being offered.

SCHEDULE 'B'

Parks Services

Rollo McClay Community Park:

The Gabriola Recreation Society (GRS), as part of this agreement will provide the following Rollo McClay Community Park Services:

GRS Responsibilities:

1. GRS is responsible for all field scheduling. GRS will coordinate between all sports groups, recreation programmers and special events organizers in an attempt to meet the scheduling requirements of all users. GRS will consider the wear and tear on the field when scheduling and will provide for field recovery time between heavy use groups. GRS will close the field when it is too wet for use, after discussion with the Regional District and the mowing contractor, and will inform the user groups and post signage.

2. GRS will ensure that the Field House is clean and safe for the public. This will include regular janitorial work such as cleaning and stocking of the washrooms, cleaning of the coaches' room, cleaning and garbage pick-up around the building, and coordinating the emptying of garbage containers with the contractor. Any damage, vandalism or equipment failures will be reported to the Regional District immediately.

3. GRS will monitor the fence around the detention pond to ensure it is secure. Any damage, vandalism or major equipment failures will be reported to the Regional District immediately. GRS will work with the contractor when setting the irrigation timer to ensure that the field receives adequate water while giving consideration to the fact that the pond must remain at a level to serve the field throughout the season. The irrigation system and timer are the responsibility of the contractor and any proposed changes to the system need to be vetted through the Regional District and contractor. The contractor is responsible for cleaning the filter system. The drilled well is not to be used for irrigation at any time.

4. GRS will monitor the field maintenance and garbage collection contractors to ensure those services are delivered in a timely manner and that the services meet the standards set out by the Regional District in the contracts. Any issues related to these services that arise to be reported to the Regional District. Minor issues can be discussed directly with the contractor.

5. Coordination of Permits and Commercial events – GRS will provide information, permit applications and permit requirements to parties interested in holding special events. The GRS will liaise with and provide information to the Regional District and will forward the completed application and documentation.

Regional District of Nanaimo Responsibilities:

The Regional District of Nanaimo will, as part of this agreement, carry out and be responsible for the duties listed below.

1. General Maintenance to Field House/Well Water System – The Regional District will undertake repairs to the Field House and Well Water System. This includes repairs/replacements of fixtures, doors, eaves troughs and any major structural damage. The Regional District will regularly test the concession water through the Vancouver Island Health Authority (VIHA).

2. General Pump House/Irrigation System – The Regional District will repair any damage or equipment failure to the pump, pond lining, the fence surrounding the pond and the pump house building.

3. Contracting of Field Maintenance and Garbage Collection – The Regional District will tender, select and award contracts for Field Maintenance and Garbage Collection in accordance with Regional District Purchasing Policies. The Regional District will pay for these services. The Regional District will establish the scope of work and standards, and share these with GRS.

4. Capital Improvements – The Regional District is responsible for all capital improvements to the field, buildings and fixtures. The Regional District will work with the GRS to ensure timely asset replacement. The Regional District will create plans and the budget for asset replacement with input from the GRS. The Regional District will award any contracts in accordance with Regional District Policy.

6. Issuing of Permits – The Regional District will approve or deny any permit application forwarded from the GRS and will notify both the GRS and the applicant of the decision. The Regional District reserves the right to deny any permit applications which are in contravention to the Parks Bylaw 1399 or could damage the field.

7. Contracting of general park maintenance services – The Regional District will tender, select and award the contracts in accordance with Regional District Purchasing Policies. The Regional District will pay for these services. The Regional District will establish the scope of work and standards. The Regional District will provide GRS staff with copies of established schedules as per the contract as soon as available (spring annually).

SCHEDULE ‘B’ (Continued)

Huxley Community Park:

The Gabriola Recreation Society (GRS), as part of this agreement will provide the following Huxley Community Park Management Services:

GRS Responsibilities:

1. Scheduling of Huxley Community Park – GRS is responsible for park facility and event scheduling and ensuring this information is effectively disseminated to the community including accurate and up to date signage information on site if required.

2. GRS will monitor park maintenance contractors to ensure that service is delivered in a timely manner and that the service meets the standards set out by the Regional District in the contract. Any issues related to these works that arise to be reported to the Regional District. Minor issues can be discussed directly with the contractor. Garbage collection and a portable toilet are the only recurring service agreements at Huxley. This park is undergoing several phases of upgrade and redevelopment over the next several years. Service requirements will be subject to ongoing change. GRS should communicate any concerns to Park Operations for follow-up.

3. Coordination of Permits and Commercial events – GRS will provide information, permit applications and permit requirements to parties interested in booking park facilities for scheduled use and/or holding special events in close consultation with the RDN. The GRS will forward the completed application and documentation to the Regional District for approval.

4. GRS will coordinate with the Island Health (IH) for the issuance of any operation/health permits if required. All vendors must be Foodsafe certified.

Regional District of Nanaimo Responsibilities:

The Regional District of Nanaimo will, as part of this agreement, carry out and be responsible for the duties listed below.

1. Capital Improvements/Replacement – The Regional District is responsible for all capital improvements/ replacements to Park facilities. The Regional District will work with the GRS to ensure timely asset replacement. The Regional District will create plans and the budget for asset replacement with input from the GRS. The Regional District will award any contracts in accordance with Regional District Policy.

2. Issuing of Permits – The Regional District will approve or deny any permit application forwarded from the GRS and will notify both the GRS and the applicant of the decision. The Regional District reserves the right to deny any permit applications which are in contravention to the Parks Bylaw 1399 or could damage the park.

3. Contracting of general park maintenance services – The Regional District will tender, select and award the contracts in accordance with Regional District Purchasing Policies. The Regional District will pay for these services. The Regional District will provide GRS staff with copies of established schedules as per the contract as soon as available (spring annually).

SCHEDULE 'C'

GABRIOLA RECREATION SOCIETY – Equipment Inventory
2017

OFFICE

- Computer – Dell Studio 1; Laptop – Asus X751L; 1 Printer – HP Officejet 4630
- 4 filing cabinets – 3 large, 1 small; 1 - 2 drawer lockable cabinet; 1 2 drawer office desk
- 8, 30" x 6' folding tables;
- 1, 2' x 3' folding table
- 7 black chairs; 7 grey folding chairs; 2 swivel office chairs
- 1 large whiteboard
- 1 broom with dustpan
- 1 small aluminum step ladder
- 1 VTech phone
- 1 Panasonic portable stereo - with CD player/radio/2 tape decks; partially working

GYMNASTICS

- Incline Mats – 1 small, 1 large
- 1 step; 1 donut; 1 cartwheel mat
- Trapezoids – 1 small, 1 medium, 1 large
- 8 blue Team Skyline 4 panel mats
- 10 blue single panel mats – 5' long; 10 blue single panel mats – 4' long
- 2 multi-coloured parachutes

SOCCER

- 10 balls – assorted sizes; 1 hand pump
- 2 small metal frame goals – at GES soccer field
- 4 corner markers; 8 safety cones; 20 saucers

SAILING

- 2 420 sailboats – including sails, rigging. Boats currently stored at Gun & Conservation Club

SWIMMING

- 8 kickboards
- 8 youth lifejackets – need replacing

FITNESS

- 6 3 lb. grey Weider weights
- 2 4lb medicine balls
- 2 8lb medicine balls
- 5 yoga mats

BASKETBALL

- 4 basketballs – (all old)
- 1 ball pump
- 29 pinnies
- 1 large CCM gear bag

MISCELLANEOUS

- 5 totes
- 4 first aid kits
- 2 mesh ball bags
- 2 beach volleyballs
- 2 regular volleyballs
- 1 volleyball net
- 1 Foosball table – at Gathering Place
- 3 nylon mesh badminton nets
- 6 badminton racquets (old & heavy)
- 10 tennis racquets – 3 adults; 7 kids
- 2 tennis ball machines – 1 small (silent partner)/1 large; 2 metal tennis ball hoppers (1 broken)
- 2 large notice boards with plexiglass
- 2 large cork boards
- 2 small cork boards
- 1 Freeway audio enhancer unit
- 20 dragon boat paddles
- 4 Janome SAHG1208 sewing machines
- 1 roll used Marley flooring – 10’x 100’ (portable dance flooring)
- 10 adjustable training hurdles

REGIONAL
DISTRICT
OF NANAIMO

STAFF REPORT

TO: Committee of the Whole **MEETING:** November 20, 2018

FROM: Murray Walters
Manager, Water Services **FILE:** 2240-20-EPCOR

SUBJECT: EPCOR Hydrant Maintenance Contract Approval

RECOMMENDATION

That the Board enter into a contract with EPCOR Water (West) Inc. to provide hydrant maintenance services in French Creek for the period January 1, 2018 to December 31, 2020 at a total cumulative cost of approximately $300,000.

SUMMARY

EPCOR Water (West) Inc. (EPCOR) provides fire hydrant maintenance services within their water service area (French Creek) under a contract with the Regional District of Nanaimo (RDN). EPCOR has recently received provincial approval for their 2018-2020 Revenue Requirements and Water Rates, and has prepared a proposed “FIRE PROTECTION SERVICES AGREEMENT” (a.k.a. Hydrant Maintenance Contract). Under this contract, EPCOR is responsible for maintaining and testing the hydrants and standpipes in that area for the years 2018 to 2020. This contract term matches the term of EPCOR’s rate agreement with the Province.

BACKGROUND

The RDN budgets for and has paid EPCOR for these services for many years. The provincial Comptroller of Water Rights approvesd the cost and level of services provided by EPCOR, including RDN hydrant maintenance, in the third quarter of 2018. Preparation of this contract was delayed until EPCOR received approval of their proposed rates.

In 2017 there were a total of 167 hydrants and standpipes, and the total cost for these services was $107,093.93. The estimated number of units and the specified unit charges for the term of the contract (2018-2020) are shown below in Table 1, along with the 2017 figures for comparison. The unit costs have decreased about 10% in EPCOR’s new rate agreement with the Comptroller due to a reduction in their expected overall expenses in the next three year period. The exact final value of the contract is not known at this time as EPCOR is required to add 3 hydrants in each year of their agreement with the province, and they have not consistently met that requirement in the past.

The Hydrant Maintenance Contract and the work described in it remains consistent with the RDN’s standards for hydrant maintenance.

The contract has been reviewed by the RDN’s legal advisors.

Table 1 – Number of Hydrants and Unit Costs

	2017 (ref)	*2018*	*2019*	*2020*
Number of Hydrants (estimated)	163	166	170	173
$ per hydrant, net of rate riders	650.63	568.71	590.31	582.84
Number of Standpipes	4	4	4	4
$ per standpipe, net of rate riders	260.31	227.49	236.13	233.14
Total yearly cost (estimated)	$107,094	$95,316	$101,297	$101,764

ALTERNATIVES

1. Direct staff to execute the contract with EPCOR for hydrant maintenance for a three year period at a total cumulative cost of approximately $300,000.

2. Provide alternate direction to RDN staff regarding the contract.

FINANCIAL IMPLICATIONS

These expenditures are included in the fire protection budget for French Creek. No other financial implications are anticipated as a result of approving this contract.

STRATEGIC PLAN IMPLICATIONS

Focus On Service And Organizational Excellence - We View Our Emergency Services As Core Elements Of Community Safety

M Walters

Murray Walters, P.Eng.
mwalters@rdn.bc.ca
October 15, 2018

Reviewed by:
- S. De Pol, Director, Water and Waste Water Services
- R. Alexander, General Manager, Regional and Community Utilities
- P. Carlyle, Chief Administrative Officer

Attachments
1. EPCOR WATER (WEST) FIRE PROTECTION SERVICES AGREEMENT

REGIONAL DISTRICT OF NANAIMO

AND

EPCOR WATER (WEST) INC.
(Inc. No. A0049806)

FIRE PROTECTION SERVICES AGREEMENT

TABLE OF CONTENTS

<u>SCHEDULES</u>

Schedule “D” - Special Terms

THIS AGREEMENT (the “Agreement”) dated the ___ day of_____________, 2018.

BETWEEN

REGIONAL DISTRICT OF NANAIMO,
a Regional District incorporated under the laws of the Province of British Columbia
(the “District”)

-and-

EPCOR WATER (WEST) INC.
a corporation incorporated under the laws of the Province of British Columbia
(“EPCOR”)

WHEREAS:

A. In February 2006, EPCOR assumed ownership of the public water utility from Breakwater Enterprises Ltd.;

B. Since February 2006, in connection with its role as the operator of the public water utility, EPCOR has been providing to the District maintenance, repair and other services relating to the fire Hydrants that are a component of the public water utility;

C. The Parties now wish to reduce to writing their agreement with respect to the provision by EPCOR of maintenance, repair and other services relating to the fire Hydrants and fire protection services that are a component of the public water utility;

NOW THEREFORE THIS AGREEMENT WITNESSES that in consideration of the premises and the covenants herein contained, EPCOR and the District covenant and agree each with the other as follows:

1.0 DEFINITIONS, INTERPRETATION AND SCHEDULES

1.1 Definitions

For the purposes of this Agreement, each of the following expressions has the meaning ascribed to it in this section 1.1. Any capitalized word or expression that is not defined in this Agreement has the ordinary meaning given to it.

1.1.1 "Additional Services" means those services to be provided and performed by EPCOR employees or subcontractors hereunder in addition to the Standard Services, as more particularly described in Schedule "A" hereto;

1.1.2 "Agreement", "hereto", "herein", "hereby", "hereunder", "hereof" and similar expressions when used in this Agreement refer to the whole of this Agreement which includes the attached Schedules and not to any particular, article, part, section, Schedule or portion thereof;

1.1.3 "Confidential Information" means information considered proprietary by either Party and which is delivered or disclosed under or pursuant to this Agreement and identified as such, and includes all material, data and information (regardless of form and whether or not patentable or protectable by copyright) which is not available to the public. Notwithstanding the generality of the foregoing, the term "Confidential Information" shall not include any information that:

(a) is now in or subsequently enters the public domain through means other than by the direct or indirect disclosure by either Party hereto in violation of the terms of this Agreement;

(b) is already in the possession of the Party receiving that information free of any obligation of confidence to the other Party;

(c) is lawfully communicated to the Party receiving the information by a Third Party, free of any confidential obligation, subsequent to the time of communication thereof by, through or on behalf of the other Party;

(d) is developed independently by employees of the Party receiving that information not in contravention of this Agreement;

(e) the Party disclosing that information has given its prior written approval to disclose; or

(f) the District or EPCOR is required to disclose pursuant to an applicable statute, regulation or bylaw, or that either Party is required to disclose pursuant to any law or order of the Court.

1.1.4 "District Event of Default" means an event described in section 11.4;

1.1.5 "Effective Date" means January 1, 2018; **[Note to District: EPCOR intends for this Agreement to be effective starting next year to align with the new tariff and to be in place for the length of the new tariff.]**

1.1.6 "EPCOR Event of Default" means an event described in section 11.4;

1.1.7 "Fees" means those fees, reimbursements, charges and other amounts to be paid by the District to EPCOR as more particularly described in Schedule "B" hereto;

1.1.8 "Hydrant" means a Hydrant that is owned by EPCOR and connected to the public water utility in the District;

1.1.9 "Party" means either EPCOR or the District and "Parties" means both of them;

1.1.10 "Prime Rate" means the variable reference interest rate per month declared by the Royal Bank of Canada from time to time to be its prime rate for Canadian dollar loans made by the Royal Bank of Canada;

1.1.11 "Schedule" means a schedule attached to this Agreement and all amendments, supplements, replacements and additions thereto;

1.1.12 "Services" means the Standard Services and the Additional Services;

1.1.13 "Standard Services" means those services to be provided and performed by EPCOR employees or subcontractors hereunder, as more particularly described in Schedule "A" hereto;

1.1.14 “Term” means that period of time from the Effective Date to the date of termination of this Agreement as stated in Schedule “A” hereto; and

1.1.15 “Third Party” means any person or persons other than EPCOR and the District, and includes the federal, provincial and municipal governments and any department, agency, board or commission thereof and any firm or corporation.

1.2 Interpretation

1.2.1 Conflict with Schedules - Except as otherwise expressly provided for in the Schedules any conflict between the provisions in the body of this Agreement and the provisions in the Schedules shall be resolved in favour of the provisions in the Schedules.

1.2.2 Singular and Plural - Words importing the singular number include the plural and vice versa.

1.2.3 Gender - Words importing gender include the masculine, feminine and neuter genders.

1.2.4 Derivations - Where the context permits, derivations of terms defined herein shall have a meaning corresponding to the meaning of the defined term.

1.2.5 Person - The word “person” includes an individual, partnership, firm, body corporate or politic, government or department thereof.

1.2.6 Headings and Division - The division of this Agreement into parts and sections and the headings used herein are inserted for convenience of reference only and shall not define, enlarge or limit the terms nor affect the construction or interpretation of this Agreement.

1.2.7 Reference to Statutes, Regulations and Codes - Any reference to a statute, regulation, bylaw, ordinance, policy, procedure or code shall include and be deemed to be a reference to that statute, regulation, bylaw, ordinance, policy, procedure or code as amended and in force from time to time, and to any statute, regulation, bylaw, ordinance, policy, procedure or code that may be passed which has the effect of supplementing or superseding that statute, regulation, bylaw, ordinance, policy, procedure or code.

1.2.8 Continuous Effect - Except where specifically provided to the contrary herein, this Agreement shall be construed as always speaking and shall be interpreted and applied to circumstances as they arise.

1.2.9 Including - The words “include” and “including”, when following any general statement, term or matter, shall not be construed to limit that general statement, term or matter to the specific items or matters set forth immediately following those words or to similar items or matters following those words or to similar items or matters, whether or not non-limiting language (such as “without limitation” or “but not limited to” or words of similar import) is used with reference thereto but shall be deemed to refer to all other items or matters that could reasonably fall within the broadest possible scope of that general statement, term or matter.

1.2.10 Covenants Implied - All provisions of this Agreement requiring one Party or the other to do or to refrain from doing something shall be interpreted as the covenant of that Party with respect to that matter notwithstanding the absence of the words “covenants” or “agrees”.

1.3 Schedules

1.3.1 The following Schedules are attached hereto and form part of this Agreement:

(a) Services

(b) Fees and Terms of Payment

(c) Contacts

(d) Special Terms

2.0 GENERAL MATTERS

2.1 Effective Date

2.1.1 The provisions of this Agreement come into effect on the Effective Date and shall thereafter be binding upon the Parties until the termination of this Agreement pursuant to Article 11.

2.2 Services

2.2.1 EPCOR shall provide the Services in accordance with the terms and conditions contained herein.

2.3 Performance of Work

2.3.1 EPCOR shall diligently and punctually perform the Services in compliance with the terms of this Agreement. EPCOR shall perform the Services with the standard of professional skill, care, diligence and expertise customarily applied by qualified and experienced professionals performing similar services in the Province of British Columbia and adhere to all applicable professional standards and shall only use qualified personnel.

2.4 No Acquisition of Interests

2.4.1 Subject to any other Agreement between the Parties, notwithstanding the Fees paid by the District to EPCOR, the District shall not acquire any interest in the assets of EPCOR employed in the provision of the Services and, without restricting the generality of the foregoing, the District shall not, acquire any interest in any intellectual property owned or used by EPCOR in the provision of the Services, including any patents, copyrights, trademarks and industrial designs.

2.5 Changes in the Number of Hydrants

2.5.1 The Parties acknowledge that Hydrants may be added to EPCOR’s inventory or sold by EPCOR over the Term and that the Fees payable by the District will be adjusted as set forth in Schedule “B” to reflect such changes in the inventory.

3.0 LEGISLATION AND REPORTING

3.1 Compliance with Legislation by EPCOR

3.1.1 In performing the Services (including any portion thereof performed by any subcontractors), EPCOR shall comply with the provisions and requirements of all laws, rules and regulations by lawful authority applicable including, without limitation, all relevant legislation, codes, bylaws, regulations and ordinances. Where there are two or more laws, codes, bylaws, ordinances or regulations applicable to the Services, the more restrictive shall apply. In particular, EPCOR shall at all times observe and cause its personnel, agents and subcontractors to observe the provisions of all applicable environmental, health, safety and labour legislation. Evidence of compliance with any applicable legislation shall be furnished by EPCOR to the District at such times as the District may reasonably request. If EPCOR, its personnel, any agent or subcontractor or their respective personnel, fail to comply with any legislation or any regulations thereunder and the District is required to do anything or take any steps or pay any amounts to rectify that non-compliance, the provisions of section 5.3 shall apply.

3.2 Compliance with Legislation by the District

3.2.1 The District shall make its personnel and facilities suitable and available to enable EPCOR to efficiently provide the Services and the District shall comply with the provisions and requirements of all laws, rules and regulations by lawful authority applicable including, without limitation, all relevant legislation, codes, bylaws, regulations and ordinances. Where there are two or more laws, codes, bylaws, ordinances or regulations applicable to the District's obligations, the more restrictive shall apply. Evidence of compliance shall be furnished by the District to EPCOR at such times EPCOR may reasonably request. If the District, its personnel, any agent or subcontractor or their respective personnel, fail to comply and for the proper performance of the services EPCOR elects to do anything or take any steps or pay any amounts to rectify that non-compliance, the provisions of section 5.4 shall apply.

3.3 Permits and Licenses

3.3.1 EPCOR shall not be required to pay for any registrations, permits or licenses required by the District in connection with the fire Hydrants and fire protection services.

3.3.2 EPCOR shall be responsible for acquiring all registrations, permits and licenses required to operate and maintain the Hydrants. The costs associated with acquiring all required registrations, permits and licenses will be the responsibility of the District and will be included in the Additional Services Fee.

4.0 PERSONNEL AND SUBCONTRACTORS

4.1 Safety

4.1.1 While performing the Services, EPCOR shall be responsible for the safety of its personnel, agents and subcontractors, and for all property of EPCOR, its personnel, agents and subcontractors. The District shall be responsible for the safety of its personnel, agents and subcontractors, and all property of the District, its personnel agents and subcontractors.

4.2 Subcontractors

4.2.1 EPCOR may arrange to have some or all of the Services performed or provided by subcontractors provided that those subcontractors have sufficient skills, expertise and resources to perform the Service and provided that EPCOR shall remain at all times responsible for the due performance of its obligations hereunder notwithstanding any such subcontracting of the Services.

5.0 PAYMENTS FOR SERVICES

5.1 EPCOR Invoices

5.1.1 Upon the provision of the Services, the District shall pay Fees to EPCOR in accordance with the provisions of Schedule “B”. On a monthly basis, EPCOR shall submit to the District an invoice for the Additional Services rendered to or prior to the date thereof. On a yearly basis, EPCOR shall submit to the District an invoice for the Standard Services rendered during the 365 day period immediately prior to the date of the invoice.

5.2 No Payment for EPCOR Negligence

5.2.1 The District shall not be required to make any payment to EPCOR under this Agreement for any costs, expenses, losses or damages suffered or incurred by EPCOR to remedy errors or omissions resulting from the negligence of EPCOR in the provision of the Services.

5.3 Performance upon Default of EPCOR

5.3.1 Upon the failure of EPCOR to provide some or all of the Services, the District shall provide written notice to EPCOR setting out the nature of EPCOR’s default. EPCOR shall have thirty (30) days to remedy such default to the satisfaction of the District, acting reasonably. If EPCOR fails to remedy the default, an EPCOR Event of Default will be deemed to have occurred and the District may terminate this Agreement in accordance with section 11.3.

5.4 Performance upon Default of the District

5.4.1 Upon the failure of the District to fulfill its obligations under this Agreement, EPCOR shall provide written notice to the District setting out the nature of the District’s default. The District shall have thirty (30) days to remedy such default to the satisfaction of EPCOR, acting reasonably. If the District fails to remedy the default, a District Event of Default will be deemed to have occurred and EPCOR may terminate this Agreement in accordance with section 11.3.

5.5 Interest and Overdue Fees

5.5.1 Upon the failure of the District to pay any Fees within thirty (30) days of receipt of any invoice thereof, the District shall pay interest to EPCOR thereon at a rate per month equal to the Prime Rate plus two percent (2%).

5.6 Withholdings

5.6.1 Notwithstanding any other provision of this Agreement, the District shall be entitled to withhold and remit to the appropriate taxing authorities, or otherwise withhold, federal withholding taxes or any other amounts required by law to be withheld from payments made to EPCOR pursuant to this Agreement.

5.7 Deductions and Remittances

5.7.1 EPCOR is responsible for all deductions and remittances required by law in relation to its employees including those required for Canada Pension Plans, unemployment insurance, workers' compensation or income tax. The District shall have no liability or responsibility for the withholding, collection or payment of income taxes, unemployment insurance, statutory or other taxes or payments of any other nature on behalf of or in respect of or for the benefit of EPCOR or any of its employees or any other person.

5.8 Taxes

5.8.1 In addition to the Fees, the District shall pay to EPCOR all taxes applicable to and payable for the Services or in respect to any other amount payable to EPCOR pursuant to this Agreement (including, but not limited to, GST and PST) and the District shall indemnify and hold EPCOR, its directors, officers, agents and employees harmless against any order, fine, penalty, interest or tax that may be assessed or levied against EPCOR or those persons as a result of the failure or delay of the District to make that payment or to file any return or information required by any law, ordinance, regulation or other lawful authority.

5.9. Release

5.9.1 EPCOR hereby releases and forever discharges the District and each of its elected officials, officers, directors, and agents, and its and their heirs, executors, administrators, personal representatives, successors and assigns from and against all claims, demands, damages, actions, or causes of action by reason of or arising out of or which would or could not occur but for the negligence of EPCOR or EPCOR's breach of this agreement, or the exercise by the District of any of its rights under this Agreement.

6.0 INFORMATION

6.1 No Obligation to Disclose

6.1.1 Except as contemplated herein or in any other agreement or arrangement between the District and EPCOR, neither Party shall have any obligation to disclose to the other any particular data, information or material which is considered by the former to be exempt or confidential. Subject to the foregoing, the District agrees to give to EPCOR all data, information and material necessary to enable EPCOR to provide the Services to the District pursuant to this Agreement.

6.2 Non-Disclosure

6.2.1 Each Party shall make all reasonable efforts to maintain in confidence the Confidential Information of the other. Without limiting the generality of the foregoing each Party shall make all reasonable efforts to keep, file and store all Confidential Information, together with any notes or other material incorporating or relating to the Confidential Information, in a manner consistent with its confidential nature and to take all reasonable action, whether by instruction, agreement or otherwise, to ensure that its directors, officers, employees and sub-contractors do not disclose or use the Confidential Information of the other directly or indirectly, for any purpose other than the purposes of this Agreement.

6.3 Need to Know

6.3.1 Each of EPCOR and the District shall limit the provision of Confidential Information to those of its employees and sub-contractors in its business or organization, as applicable, who are required to have knowledge of the Confidential Information as a result of their participation in the provision or receipt of the Services. Each Party shall inform its employees and sub-contractors involved in the provision or receipt of the Services of the confidential nature of the information provided under this Agreement and shall require those employees and sub-contractors to comply with the terms herein to the same extent as a Party hereto.

6.4 No Rights

6.4.1 Nothing contained in this Agreement shall be construed as granting a right to a recipient, by license or otherwise, to disseminate any Confidential Information.

6.5 Term of Confidentiality Obligations

6.5.1 The obligations of confidentiality herein imposed upon a recipient of Confidential Information shall continue until the Party originally claiming the information to be confidential releases that claim by deed or action.

6.6 Injunctive Relief

6.6.1 The Parties acknowledge that improper disclosure or use of any Confidential Information may cause irreparable harm to EPCOR, or the District, as the case may be, which harm may not be adequately compensated by damages. As a result, in addition to all other remedies either Party may have and not in derogation thereof, either Party may seek and obtain from any court of competent jurisdiction injunctive relief in respect of any actual or threatened disclosure or use of any

Confidential Information contrary to the provisions of this Agreement.

6.7 Indemnity

6.7.1 Each of the Parties shall indemnify and save the other Party harmless from and against any and all liabilities, claims, suits or actions, losses, costs, damages and expenses which may be brought against or suffered by that other Party as a consequence of the unauthorized disclosure by the indemnifying Party of the Confidential Information of that other Party.

7.0 INDEMNITIES

7.1 Indemnity by EPCOR

7.1.1 Subject to sections 7.3 and 7.4, EPCOR shall be liable to the District, its elected and appointed officials, officers, agents and employees for and indemnify and hold harmless the District, its elected and appointed officials, officers, agents and employees from and against any and all liabilities, claims, suits or actions, losses, costs, damages and expenses (and without limiting the generality of the foregoing, any direct losses, costs, damages and expenses of the District or those persons, including costs as between a solicitor and his own client) which may be brought or made against the District or those persons, or which the District or those persons may pay, suffer or incur as a result of or in connection with:

(a) any breach, violation or non-performance of any obligation on the part of the EPCOR herein; or

(b) any damage to property (including loss of use thereof) or injury to any person or persons, including death resulting at any time therefrom, arising out of or in consequence of the negligent or willfully deficient provision of the Services;

except to the extent that such liabilities, claims, suits or actions, losses, costs, damages and expenses are caused by or arise out of actions of the District or councilors, officers, agents or employees of the District or Third Parties.

7.2 Indemnity by the District

7.2.1 Subject to section 7.4, the District shall, to the extent not covered by insurance, be liable to EPCOR, its directors, officers, agents and employees for and indemnify and hold harmless EPCOR, its directors, officers, agents and employees from and against any and all liabilities, claims, suits or actions, losses, costs, damages and expenses (and without limiting the generality of the foregoing, any direct losses, costs, damages and expenses of EPCOR or those persons, including costs as between a solicitor and his own client) which may be brought or made against EPCOR or those persons, or which EPCOR or those persons may pay, suffer or incur as a result of or in connection with:

(a) any breach, violation or non-performance of any obligation on the part of the District herein; or

(b) any damage to property (including loss of use thereof) or injury to any person or persons, including death resulting at any time therefrom, arising out of or in consequence of the negligent or deficient performance of the District's obligations under this Agreement or arising as a result of the actions of a Third Party;

except to the extent that such liabilities, claims, suits or actions, losses, costs, damages and expenses are caused by or arise out of actions of EPCOR or directors, officers, agents or employees of EPCOR.

7.3 Limitation of Liability

Notwithstanding any other provision of this Agreement, in no event, and under no circumstances shall the aggregate liability of EPCOR to the District or Third Parties in connection with this Agreement and the Services performed hereunder, exceed the Fees paid by the District to EPCOR for the performance of the Services.

7.4 Consequential Damages

Neither Party will be liable to the other for any damage, cost, expense, injury, loss or other liability of an indirect, special or consequential nature suffered by the other Party or claimed by any third party against the other Party, howsoever arising (including negligence). Without limiting the generality of the foregoing, damage, injury or loss of an indirect, special or consequential nature shall include loss of revenue, loss of profits, loss of production, loss of earnings, loss of contract, cost of capital and loss of use of any facilities or property or any other similar damage or loss whatsoever.

8.0 INSURANCE BY EPCOR

8.1 Coverage Details

EPCOR shall maintain in full force and effect with insurers licensed in the Province of British Columbia, the following insurance:

8.1.1 comprehensive general liability insurance in respect of the operations of EPCOR for bodily injury and property damage with policy limits of not less than five million dollars ($5,000,000.00) per occurrence; and

8.1.2 standard automobile insurance providing coverage of at least two million dollars ($2,000,000.00) inclusive for bodily injury and property damage (if EPCOR is required to use a vehicle in the performance of the Services).

8.2 Placement of Insurance by EPCOR

8.2.1 EPCOR shall obtain and maintain the insurance coverage required by section 8.1.

8.3 Premiums and Deductibles

8.3.1 EPCOR shall be responsible for the payment of all premium and deductible amounts relating to any insurance policies obtained and maintained by EPCOR.

8.4 Additional Provisions

8.4.1 The policy of insurance required under section 8.1.1 shall contain the following:

(a) a provision naming the District as an additional insured;

(b) a provision requiring the Insurer not to cancel or materially change the policy without thirty (30) days prior written notice to the District; and

(c) a provision stating that the policy is primary and not contributory.

9.0 AUDIT

9.1 Records and Access

9.1.1 Each of the Parties shall keep accurate and complete records of the Services provided and received and shall make those records available to the other Party during normal business hours upon five (5) working days' notice. Once in each calendar year and upon reasonable written notice, either Party may audit the records of the other Party with respect to the Services provided and received. If any audit or inspection of the records reveals that the amount of any Fees paid by the District to EPCOR was more or less than the amount then due and payable, the difference including applicable interest shall be immediately due and payable by EPCOR to the District or by the District to EPCOR as the case may be. The Parties shall retain all such records for a period of seven (7) years from the end of the Term.

9.2 Unpaid Amounts

All amounts due to a Party pursuant to section 9.1 which remain unpaid thirty (30) days after the date on which the payment or refund was required shall be considered overdue and the Party obligated to make that payment or refund shall also pay interest thereon at a rate per month equal to the Prime Rate plus two percent (2%).

9.3 Limitation of Claims

9.3.1. Neither Party may advance a new claim for a re-adjustment of Fees paid or payable for any calendar year after the 30th day of June in the following calendar year.

10.0 RESOLUTION OF DISPUTES

10.1 Negotiation

10.1.1 The Parties shall attempt to resolve by discussion and negotiation any dispute (a "Dispute") which may arise between them regarding any matters arising out of this Agreement, including any dispute as to the interpretation, application or operation of this Agreement or of any of the provisions hereof

10.2 Dispute Resolution

10.2.1 Except as otherwise specifically provided herein, every Dispute not resolved by discussion and negotiation shall be resolved by arbitration in accordance with the following provisions:

(a) the Party desiring to refer the Dispute for arbitration (the "Notifying Party") shall notify the other Party (the "Notified Party") in writing (the "Notice") of the nature of and the matters alleged by the Notifying Party to be in dispute;

(b) within thirty (30) days of the receipt of the Notice, the Notified Party, by written notice (the "Notice Back"), may notify the Notifying Party of all matters in the Notice which are in dispute;

(c) if the Notified Party does not send a Notice Back to the Notifying Party as contemplated in section 10.2.1(b), the Notified Party shall be deemed to have admitted or accepted responsibility or liability for all matters alleged by the Notifying Party to be in dispute in the Notice;

(d) the Notified Party shall be deemed to have admitted or accepted responsibility or liability for all matters alleged by the Notifying Party to be in dispute and which the Notified Party has not disputed in the Notice Back;

(e) the terms of reference for arbitration shall be only those matters in the Notice which remain in dispute and are described, as such, in the Notice Back;

(f) within seven (7) days of the establishment of the terms of reference pursuant to section 10.2.1(e), the Parties shall appoint a single arbitrator to decide the Dispute, failing which, within a further five (5) days, they shall each appoint an arbitrator, and within seven (7) days from the date that the last of them appointed an arbitrator, the two (2) arbitrators shall appoint a third arbitrator and the three (3) arbitrators shall comprise the arbitration committee (the "Committee");

(g) the arbitrator appointed by the two (2) arbitrators shall be the "chair" of the Committee, provided further, that if the two (2) arbitrators fail to appoint a third arbitrator, then both Parties or either of them may apply to a Justice of the Supreme Court of British Columbia to have the third arbitrator appointed;

(h) if either Party fails to appoint an arbitrator within the five (5) day period described in section 10.2.1(F), the arbitrator appointed by the other Party shall be deemed to be the Committee and the decisions of that arbitrator on the Dispute shall be binding upon the Parties;

(i) within thirty (30) days of the establishment of the Committee, or such further period as may be agreed upon by the Parties, the Committee shall hear and endeavour to resolve the Dispute in accordance with the terms of reference;

(j) the decision of the majority of the Committee shall be the decision of the Committee provided that if no majority decision is reached, the decision of the chair shall be deemed to be the decision of the majority of the Committee;

(k) the decision of the Committee on the Dispute will be final and binding upon the Parties;

(l) the cost of the arbitration shall be borne by the Party against which the decision is made, provided however, that if neither Party is entirely successful in that decision, at the discretion of the Committee, the cost of the arbitration may be apportioned between the Parties in any manner the Committee finds equitable in the circumstances;

(m) if within thirty (30) days of the date:

  (i) on which the Notified Party is deemed to have admitted or accepted responsibility or liability for any matters alleged by the Notifying Party to be in dispute; or

  (ii) of a decision of the Committee;

the Notified Party or the Party against whom a decision of the Committee is made, as the case may be, (the “Defaulting Party”) fails to remedy the matter or comply with the terms of the decision of the Committee, the

Notifying Party or the Party in whose favour a decision of the Committee is made, as the case may be, may apply ex parte, to a Justice of the Supreme Court of British Columbia for a judgment against the Defaulting Party; and

(n) except as hereby modified, the provisions of the *Commercial Arbitration Act* (British Columbia), as amended, shall apply to the arbitration procedure.

11.0 TERMINATION AND EVENTS OF DEFAULT

11.1 Termination

11.1.1 This Agreement shall terminate:

(a) upon the mutual agreement of the Parties; or

(b) upon termination by a Party in accordance with this Article 11; or

(c) on the expiration of the Term, which shall occur on December 31, 2020. **[Note to the District: EPCOR would like this Agreement to be in place for a 3 year term so that it's in place for the length of the next tariff. If this presents a problem for the District please let us know.]**

11.2 Termination by EPCOR on Sale of Public Water Utility Assets

11.2.1 In the event of the sale or disposition of all or substantially all of the public water utility assets by EPCOR, EPCOR may terminate this Agreement effective the date of such sale by providing the District with thirty (30) days prior written notice of the date of termination.

11.3 Termination for Default

11.3.1 Subject to the rights of EPCOR pursuant to section 11.5, the District may terminate this Agreement upon the occurrence of an EPCOR Event of Default.

11.3.2 Subject to the rights of the District pursuant to section 11.5, EPCOR may terminate this Agreement upon the occurrence of a District Event of Default.

11.4 Events of Default

11.4.1 The following events shall constitute an EPCOR Event of Default:

(a) if EPCOR defaults in the observance or performance of any obligation on its part under this Agreement and does not correct that default within thirty (30) days of receiving written notice thereof from the District;

(b) if an order is made or an effective resolution is passed for the winding up of EPCOR; or

(c) if EPCOR ceases to carry on its business, becomes insolvent or bankrupt, commits any act of bankruptcy, goes into liquidation either voluntarily or under an order of a Court of competent jurisdiction, makes a general assignment for the benefit of its creditors, files a proposal or a voluntary assignment under the *Bankruptcy and Insolvency Act* (Canada), admits its inability to pay its debts generally as they become due or otherwise acknowledges its insolvency, or if a petition is filed against EPCOR under the *Bankruptcy and Insolvency Act* (Canada).

11.4.2 The following event shall constitute a District Event of Default:

(a) if the District defaults in the observance or performance of any obligation on its part under this Agreement and does not correct that default within thirty (30) days of receiving written notice thereof from the EPCOR;

(b) if an order is made or an effective resolution is passed for the winding-up of the District; or

(c) if the District ceases to carry on its business, becomes insolvent or bankrupt, commits any act of bankruptcy, goes into liquidation either voluntarily or under an order of a Court of competent jurisdiction, makes a general assignment for the benefit of its creditors, files a proposal or a voluntary assignment under the *Bankruptcy and Insolvency Act* (Canada), admits its inability to pay its debts generally as they become due or otherwise acknowledges its insolvency, or a petition is filed against the District under the *Bankruptcy and Insolvency Act* (Canada).

11.5 Time to Remedy Defaults

11.5.1 For the purposes of section 11.4, time shall not be computed during any period of time where:

(a) in good faith, the Party alleged to be in default disputes the allegation of default and pursues the resolution of that dispute in the manner contemplated in Article 10; or

(b) the Party alleged to be in default diligently endeavours to remedy the default.

11.6 Payment upon Termination

11.6.1 Upon the termination of this Agreement, the District shall pay to EPCOR all Fees for completed Services. The District shall have no liability of any nature whatsoever to EPCOR for any losses or damages suffered or sustained, either directly or indirectly, by EPCOR including, without limitation, loss of profit, as a result of the termination of this Agreement. Upon termination of this Agreement, EPCOR shall have no liability of any nature whatsoever to the District for any losses or damage suffered or sustained, either directly or indirectly, by the District including, without limitation, loss of profit, as a result of the termination of this Agreement.

11.7 Effect of Termination

11.7.1 Upon termination or expiration of this Agreement, each of the Parties shall forthwith return to the other all Confidential Information in the form in which it was received, together with all copies thereof or, at the written direction of either Party, all Confidential Information in possession of the other shall be destroyed and the destroying Party shall provide the other with confirmation of that destruction. Notwithstanding the foregoing, a Party shall not be required to return or destroy any Confidential Information contained or embodied in any evaluations, models or analysis prepared for internal proprietary management evaluation purposes, or which may be subject to privileged legal communications, or if such destruction would violate any of such Party's formal documentation retention policies, or any Confidential Information which is on backed-up computer records, and provided that all such retained Confidential Information shall continue to be held by such Party subject to this Agreement.

11.8 Survival of Obligations

11.8.1 The provisions of this Agreement regarding outstanding payment obligations, indemnities, confidentiality obligations and proprietary rights shall survive any expiration or termination of this Agreement.

11.8.2 EPCOR hereby releases and forever discharges the District and each of its elected officials, officers, directors, and agents, and its and their heirs, executors, administrators, personal representatives, successors and assigns from and against all claims, demands, damages, actions, or causes of action by reason of or arising out of or which would or could not occur but for the negligence of EPCOR or EPCOR's breach of this agreement, or the exercise by the District of any of its rights under this Agreement.

12.0 GENERAL PROVISIONS

12.1 Force Majeure

12.1.1 If the District or EPCOR is delayed in the performance of or is unable to perform any part of their respective obligations hereunder due to labour disputes, strikes, walkouts, fire, unusual delay by common carriers, unavoidable catastrophes, explosion, flood, earthquake, tsunami, act of God or public enemy, war, government regulation, any law, act or order of any court, government body or regulator or circumstances of any kind beyond the control of EPCOR or the District, then EPCOR or the District, as the case may be, shall be excused from the performance of those obligations to the extent that the performance is prevented, hindered or delayed by those causes and EPCOR or the District, as the case may be, shall not be liable hereunder during the period and to the extent of the inability to perform. Upon the occurrence of any of the events referred to above, the Party unable to perform shall immediately notify the other Party of the inability and the extent of any delay or inability to perform its obligations and shall use its reasonable efforts to remedy the delay or failure to perform as soon as reasonably possible.

12.2 Notices

12.2.1 A notice in writing or other correspondence required or permitted to be given to EPCOR pursuant to this Agreement shall be sufficiently given:

(a) when transmitted by facsimile (addressed as if to be mailed in the manner hereafter provided) and transmitted to the facsimile number of EPCOR identified in Schedule “C”; or

(b) when personally delivered or mailed by registered mail, postage prepaid, addressed to EPCOR to the address identified in Schedule “C”.

12.2.2 A notice in writing or other correspondence required or permitted to be given to the District pursuant to this Agreement shall be sufficiently given:

(a) when transmitted by facsimile (addressed as if to be mailed in the manner hereafter provided) and transmitted to the facsimile number of the District identified in Schedule “C”, or 1-250-390-1542 .

(b) when personally delivered or mailed by registered mail, postage prepaid, addressed to the District to the address identified in Schedule “C”.

12.2.3 Any notice transmitted by facsimile or delivered or mailed shall be deemed to have been received by the addressee on the day of actual facsimile transmission or delivery (if a business day) or the first business day after actual facsimile transmission or delivery (if facsimile transmission or delivery is not on a business day) and, when mailed, on the fifth (5th) business day following the date of mailing except in the case of a postal strike or disruption of postal services in which case the deemed time of service shall be extended one (1) week past the resumption of normal postal services.

12.2.4 Any facsimile number or any address for giving notice to any Party may be changed from time to time by that Party by notice given as hereinbefore provided.

12.3 Waiver

12.3.1 The failure of a Party to insist in any one or more cases upon the strict performance of any of the covenants of this Agreement or to exercise any option herein contained shall not be construed as a waiver or relinquishment for the future of that covenant or option and no waiver by EPCOR or the District of any provision of this Agreement shall be deemed to have been made unless expressed in writing and signed by EPCOR or the District, as the case may be.

12.4 No Agency

12.4.1 Nothing in this Agreement, nor in any acts of EPCOR or the District pursuant to this Agreement, shall be construed, implied or deemed to create an agency, partnership, joint venture or employer and employee relationship between EPCOR and the District, and neither Party has the authority to bind the other to any obligation of any kind.

12.5 Entire Agreement

12.5.1. This Agreement constitutes the entire agreement between the Parties with respect to the Services and supersedes all prior negotiations, representations or agreements concerning the Services whether written or oral.

12.6 Amendment

12.6.1. This Agreement shall not be altered or amended except by a document in writing signed by the Parties.

12.7 Partial Invalidity

12.7.1 If any term, condition or provision of this Agreement or the application thereof to any person or circumstance shall to any extent be invalid or unenforceable, the remainder of this Agreement or the application of that term, condition or provision to persons or circumstances other than those as to which it is held invalid or unenforceable, shall not be affected thereby and each term, condition or provision shall be separately valid and enforceable to the fullest extent permitted by law.

12.8 Time of Essence

12.8.1 Time shall be of the essence of this Agreement.

12.9 Expiration of Time

12.9.1 In any case where the time limited by this Agreement expires on a Saturday, Sunday or legal holiday (as defined in the *Interpretation Act* (British Columbia) in the Province of British Columbia, the time limited shall be extended to and shall include the next succeeding day which is not a Saturday, Sunday or legal holiday (as defined in the *Interpretation Act* (British Columbia) in the Province of British Columbia.

12.10 Further Assurances

12.10.1 Each of the Parties to this Agreement shall at the request of the other Party hereto, execute and deliver any further documents and do all acts and things as that Party may reasonably require to carry out the full intent and meaning of this Agreement.

12.11 Governing Law

12.11.1 This Agreement shall be governed by the laws in force in the Province of British Columbia and the courts of the Province of British Columbia shall have exclusive jurisdiction with respect to any question of law arising from this Agreement.

12.12 Limitation of Authority

12.12.1 Notwithstanding any other provision contained in this Agreement, any right, power or authority to be exercised by the District or any of its departments, authorities, boards or tribunals pursuant to this Agreement shall be exercised in accordance with, and subject to, any applicable law including without limitation the *Community Charter* (British Columbia) and the *Local Government Act* (British Columbia) and the District shall only be bound to comply with and carry out the provisions contained herein insofar as it can legally do so and, accordingly, nothing herein contained shall operate as a waiver or abrogation by the District of its rights under any applicable law and for greater clarity, and without limiting the generality of the foregoing, nothing herein contained shall fetter the discretion of the District with respect to the rights and duties of the District pursuant to any applicable law,

12.13 Permitted Assignment

12.13.1 Neither Party may assign this Agreement without the prior written consent of the other, which consent cannot be unreasonably withheld, provided that either Party may assign this Agreement to an “affiliate”, as such term is defined in the *Business Corporations Act* (British Columbia) without the consent of the other Party and provided further that EPCOR may utilize subcontractors in accordance with section 4.2. In addition, EPCOR shall be permitted to assign this Agreement without the consent of the District in the event that EPCOR disposes of all or substantially all of its interests in the public water utility it is operating for the benefit of the District and its citizens.

12.13.2 A Party assigning all or any part of this Agreement pursuant to section 12.13.1 shall provide to the other Party:

(a) a true copy of the assignment agreement or instrument; and

(b) an agreement and undertaking from the assignee to be bound by the provisions of this Agreement and not to further assign its rights hereunder without complying with the provisions of this section.

12.13.3 A Party assigning all or any part of this Agreement shall remain responsible to the other Party for the covenants assigned unless the assignee has the financial and operational capacity to observe and perform the covenants assigned or the assigning Party indemnifies the other Party or guarantees to the other Party the observance and performance of the covenants assigned.

12.14 Special Terms

12.14.1 The special terms, if any, contained in Schedule “D” shall be binding on the Parties and any conflict between those special terms and any other provision in this Agreement, shall be resolved in favour of the special terms.

12.15 Enurement

12.15.1 This Agreement shall be binding upon and enure to the benefit of the District and EPCOR and, subject to section 12.13.3, upon their respective successors and assigns.

IN WITNESS WHEREOF the Parties hereto have executed this Agreement as of the day and year first above written.

REGIONAL DISTRICT OF NANAIMO

Per: ______________________________
Name:
Title:

EPCOR WATER (WEST) INC.

Per: ______________________________
Name:
Title:

Schedule “A”

SERVICES

Services (1.1.8)

Standard Services

EPCOR shall provide to the District the following Standard Services in accordance with the terms of this Agreement:

i) At least one (1) time per year EPCOR will perform a general inspection on each Hydrant (the “Annual Inspection”).

ii) At least one (1) time every two years EPCOR will perform a maintenance inspection on each Hydrant (the “Biannual Maintenance Inspection”).

iii) Upon discovery, or notification by the District, EPCOR shall repair and/or replace leaking or inoperative Hydrants by dig-up if necessary as soon as possible after the discovery or notification of such defect. Immediately on identifying a defective Hydrant, EPCOR shall attach a disk or bag to the Hydrant signifying that it is out of service and notify the District and all potentially impacted District fire departments that such Hydrant is out of service. Further notice will be given to the District and all potentially impacted District fire departments if repair or replacement cannot be reasonably completed within a two (2) week timeframe.

For clarity, when undertaking the Annual Inspection, the following tasks will be performed:

i) Check for any obstructions and brush out around each Hydrant within a one (1) metre radius if required. Those obstructions that are identified and cannot be removed will be reported to all potentially impacted District fire departments. Obstructions of the hose port will be checked for and removed, if possible.

ii) Inspect the condition of the paint on each Hydrant, including the paint on the Hydrant body, caps, gaskets and nozzle threads. As required, EPCOR will power wash and re-paint the Hydrants. If re-painting the Hydrants, EPCOR will use only those colours approved by the District.

iii) Check for ease of operation of each Hydrant. If it is determined that the Hydrant is difficult to operate, EPCOR will record this and report such difficulties to the District and all potentially impacted District fire departments.

iv) Check for leaks at ground level of each Hydrant. In addition, EPCOR shall listen for internal leakage within each Hydrant.

v) Flush or purge each Hydrant and branch line.

vi) Conduct a water hydrostatic test on each Hydrant.

vii) Check for drainage by suction at each hose port.

viii) Check that all ports are accessible and that the streamer port is facing the possible access route.

ix) Complete an inspection report.

x) Check, record and report any external structural damage to the Hydrants to the District. In addition, any deficiencies that require further repair shall be immediately reported to all potentially impacted District fire departments.

For clarity, when undertaking the Biannual Maintenance Inspection, the following tasks will be performed:

(i) Close of each Hydrant isolation valve in order to check the operation of the valve. Any repairs required shall be recorded and reported to the District. Upon completion of such test, the Hydrant isolation valve should be reopened.

(ii) Disassembly of each Hydrant to remove serviceable parts and to check for worn or broken parts and to check for leaks in the assembly or their component parts. Parts that shall be checked shall include, but not be limited to: (a) head or "O" ring assembly; (b) drain valve assembly; (c) main gate or main valve assembly; and (d) hose nozzle assembly.

(iii) All external and internal working parts of each Hydrant shall be lubricated. Lubrication of such parts shall occur during the reassembly of each Hydrant.

(iv) Each Hydrant shall be operated from fully opened to fully closed with caps in place. The pressure and number of turns required to open the Hydrant shall be recorded.

(v) Each Hydrant shall be flushed or purged.

(vi) Complete an inspection report for each Hydrant, a summary of each such report which will then be provided to the District.

Additional Services

In addition to the Standard Services, during the Term, prior to the end of each calendar year the District and EPCOR shall, acting reasonably, agree upon a list of services to be performed by EPCOR during the upcoming calendar year outside the scope of the Standard Services and the fees to be paid by the District for the performance of such Additional Services. In the event that the Parties cannot agree upon a list of Additional Services to be performed or the fees to be paid with respect to such Additional Services, EPCOR shall only perform those Additional Services that must be performed to ensure the continued operation of the Hydrants and the District agrees to pay EPCOR for the performance of such Additional Services.

These Additional Services may include, but shall not be limited to:

(i) Services, repairs or upgrades identified by the District, EPCOR or Fire Department personnel and not included in the "Standard Services" section in "Appendix A". This includes but not limited to:

  a. Hydrants off grade and need to be raised or lowered.

  b. New hydrants to improve spacing.

  c. Replace 5" port Hydrants with 4" port Hydrants.

  d. Replace 2 port Hydrants with 3 port 4" Hydrants.

  e. Install isolation valves (Seaward Way).

  f. Replacement of out of date hydrants.

  g. Color coding of hydrants.

(ii) Upgrades due to changes in applicable regulations, codes, bylaws, statutes and ordinances, standards policies, procedures, etc.

Furthermore, as part of the Additional Services, EPCOR shall repair all Hydrants that are damaged by Third Parties. Such damage may include, but shall not be limited to, damage due to vandalism or damage due to a motor vehicle collision with the Hydrant.

Notwithstanding the fact that the Parties reached an agreement on the Additional Services to be provided during a calendar year, if the Parties agree, acting reasonably, that other services should take higher priority over the Additional Services, or in the event the cost of certain Standard Services exceed those budgeted due to factors outside the control of EPCOR, EPCOR will be permitted not to perform certain Additional Services which the Parties agreed should be performed and/or add to the list of Additional Services. In the event that a change is required, the Party seeking the change shall provide the other Party with notice of a change to be made in the Additional Services as soon as it is practicable to do so. As soon as practicable the Parties will discuss the change and, acting reasonably, determine if it can be implemented. In the event of a change to the Additional Services agreed to by the Parties, the budgeted fees for the Additional Services will not change and the District shall remain responsible for the entire budget amount initially agreed upon by the Parties.

Standards

Standards covered by this Agreement including its Schedules shall be the industry standards as defined by the American Water Works Association, and other standards mutually adopted by the Parties from time to time.

Term (11)

This Agreement will become effective on the Effective Date and subject only as hereafter provided and to Section 11, will terminate on December 31, 2020.

Notice Period for Termination (1)

This Agreement for Services as specified may be terminated upon six (6) months written notice, given by either Party, or upon mutual agreement of both Parties.

Schedule “B”

FEES AND TERMS OF PAYMENT

1. Standard Services Fee

i) In its regular rates filings with the Comptroller of Water Rights of British Columbia (the “Comptroller”), EPCOR sets out the costs that EPCOR intends to attribute to Standard Services over the course of the period for which approval of the Comptroller is being sought. Also included in these costs are costs to be paid by the District in connection with the provision of fire protection services infrastructure. Upon approval by the Comptroller, EPCOR will convert such costs into a per Hydrant amount (the “Individual Hydrant Fee”), which amount the District will be solely responsible for paying for the length of time for which the costs were approved by the Comptroller (and the aggregate of the Individual Hydrant Fee for each Hydrant is referred to herein as the “Standard Services Fee”).

ii) The Parties agree that the Standard Services Fee and the Individual Hydrant Fee will be reviewed by EPCOR and the District prior to EPCOR submitting a regular rate filing with the Comptroller. In addition, the Parties acknowledge that depending on the approval provided by the Comptroller, the Standard Services Fee and the Individual Hydrant Fee may change from year-to-year notwithstanding the fact the Comptroller has approved EPCOR’s costs for a multi-year period.

iii) The Standard Services Fee shall be paid annually by the District to EPCOR. Once annually EPCOR shall invoice the District for such Standard Services Fee and such invoice shall set out the number of Hydrants in EPCOR’s inventory and the Standard Services Fee payable by the District for the 365 day period immediately prior to the date of the invoice.

iv) In the event that Hydrants are added or removed from EPCOR’s inventory during the year of a term, the Standard Services Fee will be pro rated on a per diem basis with respect to any added or removed Hydrant, such that the District shall only be required to pay the Standard Service Fee with respect to a Hydrant for the period of time in which the Hydrant formed part of EPCOR’s inventory.

v) If this Agreement commences or is terminated on other than the calendar year end, the Standard Services Fee shall be pro-rated as if earned on a per diem basis equally throughout that calendar year.

Additional Services Fees

i) EPCOR shall invoice the District for any amounts owing with respect to the Additional Services (the “Additional Service Fees”). Each monthly invoice shall set out the Additional Services Fees for the invoiced month.

ii) On or prior to the Effective Date, the District will establish a maintenance reserve fund (the “Maintenance Reserve Fund”) which Maintenance Reserve Fund will be the sole source for payment by the District of the Additional Services. The District will establish the Maintenance Reserve Fund by depositing or transferring into a bank account on or before the Effective Date, in trust for the satisfaction of the Additional Service Fee, $20,000.00. After the first year of the Term, on January 1 of each year of the Term, the District will deposit into the Maintenance Reserve Fund that amount required to return the balance in the Maintenance Reserve Fund to $20,000.00. For clarity, if the Maintenance Reserve Fund is exhausted in one calendar year, the District will not be responsible for payment of any Additional Service Fees for that calendar year unless the Parties agree in writing that such Additional Service Fees in excess of the funds in the Maintenance Reserve Fund shall be paid by the District.

iii) The Parties agree that a minimum of one (1) time each calendar year, or at any time if a need to do so is identified by one of the Parties, they will discuss increasing the size of the Maintenance Reserve Fund. Throughout the Term, at any time the Parties shall, by written agreement, be permitted to increase the size of the Maintenance Reserve Fund. In the event that the Parties increase the size of the Maintenance Reserve Fund, the District shall deposit or transfer such additional amounts into the Maintenance Reserve Fund in accordance with (ii) immediately above, or such other time frame as agreed to by the Parties in writing.

Schedule “C”

CONTACTS

<u>For the Regional District of Nanaimo</u>

Facsimile Number: 250-390-1542

Address: The Regional District of Nanaimo
6300 Hammond Bay Road
Nanaimo, BC
V9T 6N2

Attention: Manager of Water Services

<u>EPCOR Water (West) Inc.</u>

Facsimile Number: (250) 954-0361

Address: EPCOR Water (West) Inc.
#10D – 1343 Alberni Hwy
Parksville, British Columbia
V9P 2B9

Attention: Manager, Operations, French Creek

Schedule “D”

SPECIAL TERMS

1. During the Term of this Agreement both Parties agree to review, *inter alia*, service levels, operation and maintenance costs, the allocation of extra capacity costs to fire protection, and the allocation of capital costs associated with the over-sizing of the water system.

2. EPCOR and District agree to share information on the Hydrant infrastructure and the servicing of the Hydrants, as well as any other information pertinent to the operations of EPCOR and District.

3. Services outlined in Schedule “A” will be performed in accordance with EPCOR's documented procedures for each Service. EPCOR shall supply details on Services rendered at the request of the District.

REGIONAL
DISTRICT
OF NANAIMO

STAFF REPORT

TO:	Committee of the Whole	**MEETING:**	November 20, 2018
FROM:	Julie Pisani Drinking Water & Watershed Protection Program Coordinator	**FILE:**	5600-07

SUBJECT: Final Report – 10 Year Action Plan Review for Drinking Water and Watershed Protection

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RECOMMENDATIONS

That the Board receive the final report on the 10 Year Action Plan Review for the Drinking Water and Watershed Protection program for information.

SUMMARY

A status review on the implementation of the RDN's Drinking Water and Watershed Protection (DWWP) Action Plan was performed by third-party water strategy experts – Victoria-based consultants Econics. The purpose of the review, given that 2018 is the 10th year of program implementation, was to assess the program implementation against the commitments identified in the DWWP Action Plan (www.rdn.bc.ca/action-plan). The final September 2018 report from Econics, entitled *Regional District of Nanaimo Drinking Water & Watershed Protection Program: 10 Year Action Plan Implementation Review* (Attachment 1) will inform the upcoming comprehensive update to the DWWP Action Plan, scheduled to take place in 2019

BACKGROUND

Since the early 2000s, the Regional District of Nanaimo (RDN) Board has identified drinking water and watershed protection as key factors for the long term resilience and prosperity of the region. The current RDN Drinking Water and Watershed Protection (DWWP) Action Plan was adopted by the RDN Board in 2008, and first implemented in 2009 with a 10-year scope. In 2018, the RDN initiated a third-party review of the DWWP program implementation to examine the achievements of DWWP against the actions outlined in the Plan and evaluate program effectiveness in the first decade. Econics, the external consultant, gathered data via in-depth interviews, workshops, literature review, meetings and discussions with staff and stakeholders.

Program implementation has been characterized by numerous accomplishments, as documented in the review. The focus has generally advanced from an initial emphasis on education and outreach, proceeding to expanded effort in water science and data collection. More recently, as the program has progressed, policy and planning and refining science processes and data management has been given more attention.

The review identified the key accomplishments and challenges in the three main program areas of water resource awareness and education, water monitoring and science, and water policy and planning support. The table below summarizes the findings, directly quoted from the consultant report. For further important details and relevant context, please refer to the final report in full (Attachment 1).

Program Area	**Accomplishments**	**Challenges**
Water Education and Outreach	✓ Impressive water conservation and sustainability resources ✓ Innovation in regionally relevant education programs ✓ Successful partnerships for regional service delivery	❖ Outreach campaigns are often highly information intensive ❖ Branding review ❖ Market research and program evaluation ❖ Opportunities for innovative demand management program delivery
Water Monitoring and Science	✓ Many data gaps have been filled ✓ Vulnerable water sources and systems have been prioritized	❖ Improving data management ❖ Further attention to operationalizing data
Water Policy and Planning	✓ Foundation laid for future success ✓ Specific successes in land use planning and informing policy	❖ Land use and watershed planning objectives have not yet been fully realized

The review revealed opportunities for the DWWP program to evolve and improve in the next operational period. These findings will serve as a useful springboard to the Plan update scheduled to take place in 2019. The Econics report concluded in summation that “the work of the program to date has been nothing less than remarkable and highly successful” (p.34). That is attributed in large part to the vital partnerships with other agencies, industry and not-for-profit sector, the sustainable funding model in place for the program and the unique and integrated nature of the program.

ALTERNATIVES

1. That the Board receive this report for information.
2. That the Board provide alternate direction.

FINANCIAL IMPLICATIONS

There are no financial implications of this staff report.

STRATEGIC PLAN IMPLICATIONS

The RDN Drinking Water and Watershed Protection program is a strategic function. It aligns with and acts upon the key Board Strategic Plan Focus Areas including the following strategic priorities:

Focus On Economic Health- We Recognize The Importance Of Water In Supporting Our Economic And Environmental Health

Focus On The Environment- We Will Have A Strong Focus On Protecting And Enhancing Our Environment In All Decisions

Focus On The Environment- We Will Include Conservation Of Resources As A Planning factor

Focus On Relationships- We Look For Opportunities To Partner With Other Branches Of Government/Community Groups To Advance Our Region

Focus On Relationships- We Will Facilitate/Advocate For Issues Outside Of Our Jurisdiction

The 10 Year Action Plan Review of the DWWP Program provides valuable insight to ensure the RDN can best direct the delivery of the program into the next decade and effectively continue to build on the foundational work implemented to date.

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Oct. 29, 2018

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Attachment

1. Econics – Drinking Water and Watershed Protection Program: 10 Year Action Plan Implementation Review

Regional District of Nanaimo
Drinking Water & Watershed Protection Program: 10 Year Action Plan Implementation Review

September 2018

Prepared for

REGIONAL DISTRICT OF NANAIMO

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Final (25 Sept 2018)

Executive Summary

The Regional District of Nanaimo (RDN) began implementing of the Drinking Water and Watershed Protection Program in 2009. Since then, the organization and its partners have made tremendous strides towards fulfilling the initiatives' objectives.

The purpose of this report is to inventory these many successes, as well as some of the challenges the program has faced over the past decade. It considers actions laid out in the 2007 *Drinking Water and Watershed Protection Action Plan* and takes stock of what has been completed, initiated or advanced, and what has not. Along the way, it identifies what partnerships and resources have made implementation possible. Where appropriate, the report also identifies opportunities that could be addressed in a planned update to the *Action Plan*, scheduled for 2019.

The review commenced in the last week of June 2018. We gathered data through: a number of meetings and discussions with program staff, a literature review, in-depth interviews with key staff and stakeholders and two workshops.

Overview of the Drinking Water and Watershed Protection Program

In 2007, the Drinking Water-Watershed Protection Stewardship Committee, a stakeholder advisory group, oversaw preparation of the *Drinking Water and Watershed Protection Action Plan*. This seminal document laid out the parameters of implementation that continue through to today. This *Action Plan* was adopted by the RDN Board in 2008. Implementation commenced in 2009 following a referendum of electoral area residents that approved creation of a new service and cost recovery through a parcel tax.

Drinking Water and Watershed Protection is functionally administered by RDN's Regional and Community Utilities Division, although several other departments are also involved. The RDN Board is ultimately responsible for program governance. However, the Board is supported by a Technical Advisory Committee that advises on implementation. By 2012, local municipalities across the region had successively signed on to participate. This included financial support. The City of Nanaimo, District of Lantzville, City of Parksville, and Town of Qualicum Beach are now active partners. Their residents enjoy the same access to program benefits as residents in electoral areas.

Success of the Drinking Water and Watershed Protection Program is due in great part to the contributions of partners in government, industry and not-for-profit sectors. The criticality of these partnerships was emphasized again and again by the people we interviewed. Other agencies and stakeholder groups contribute in many ways, including direct funding, in-kind staff effort, providing pools of volunteers for watershed monitoring, and offering low or no-cost specialized expertise.

In broad terms, implementation has been characterized by numerous major accomplishments. RDN has generally proceeded from an initial focus on education and outreach, moving on to increasing effort in water science and data collection. More recently, attention has shifted more towards policy and planning and to refining science processes and data management.

Program Review

Our program review is categorized under the following three themes:

1. water science: data collection & monitoring;
2. water education & outreach; and,
3. water policy advocacy & planning support.

Water Science: Data Collection & Monitoring

The starting goal for the water science theme was to improve information about the region's water resources in support of better land use decisions and public understanding (Lanarc, 2007). Key objectives include compiling and mapping existing information, improving stream monitoring systems, improving groundwater monitoring, and making information readily available and understandable to decision-makers.

Major accomplishments over the past decade include the following:

- ✓ many data gaps have been filled;
- ✓ vulnerable water sources and systems have been prioritized; and,
- ✓ data has been acquired and interpreted robustly and resourcefully.

Key challenges going forward include the following:

- there are opportunities to improve data management; and,
- in the future, further attention will need to be devoted to operationalizing data for purposes of informing land use planning and policy decisions.

Our investigation left us with little doubt that, directly as a result of the program’s work, there is already a much better understanding of aquifers and streams in the region than elsewhere on Vancouver Island or much of the province. There are also indicators that this is already leading to more informed decision making in areas of RDN’s jurisdiction and the decisions of other authorities. Going forward, with the more refined data collection that is already underway and greater attention to operationalizing it, work under this theme has a very promising future.

Water Education & Outreach

The central goals for the education and outreach theme are: 1) to promote awareness and stewardship of the watersheds and drinking water resources in the Region; and, 2) to promote efficient water use in all sectors (Lanarc, 2007). Related objectives include improving public awareness of where water comes from and why it is important to protect watersheds, changing water consumption patterns, and improving coordination among other stakeholders who also provide information.

Major accomplishments over the past decade include the following:

- ✓ the program has created and disseminated an impressive array of water conservation and sustainability resources;

- ✓ there has been innovation in developing unique and regionally relevant education programs; and,
- ✓ partnerships for regional service delivery have been highly successful.

Cumulatively, these accomplishments and other program efforts have contributed to a 31% reduction in per capita water consumption in RDN between 2004 and 2017.

Key challenges going forward include the following:

- outreach campaigns are often highly information intensive;
- it may be time for a review of program branding and collateral;
- new effort in market research with residents and further program evaluation is recommended; and,
- by learning from programs in leading jurisdictions in North America, there are opportunities for further innovation in how demand management programs are delivered.

RDN's water education and outreach efforts are highly valued by stakeholders. In comparison with many similar British Columbian and Canadian communities we have assisted, this body of work is exemplary. Since the inception of the program, momentum has continued to build. With continuing effort, the Regional District has an opportunity to entrench a position as a provincial and even national leader in this space.

Water Policy Advocacy & Planning Support

Key goals under the policy advocacy and planning support theme are: 1) to use the information gathered through the water science program to protect watersheds and water resources in land use planning and development decisions; and, 2) to prioritize and protect watersheds according to their ecological and drinking water values (Lanarc, 2007).

Major accomplishments over the past decade include the following:

- ✓ a foundation has been laid for future success; and,
- ✓ there have been a number of specific successes in land use planning and informing policy.

Key challenges going forward include the following:

- land use and watershed planning objectives set out in the 2007 *Action Plan* have not yet been fully realized.

Attention to policy advocacy and planning support will no doubt remain a key focus in the future. The science-based approach of the program, the fact that it brings together multiple agencies, and the foundation built on data and information and public support lead us to believe that the true potential of the program in this area is yet to be seen.

Other Observations

Our research uncovered several other observations about the impact of the Drinking Water and Watershed Protection Program that merit brief attention.

First, we see opportunities to more actively engage with First Nations on a government-to-government basis to identify how they would like to participate in implementation in the future.

Second, it is important to recognize that there are key intersections with other RDN programs, most notably Liquid Waste Management Plan implementation and Emergency Services. As such, the program supports not just enhanced drinking water and watershed protection, but also other environmental and community sustainability goals.

Third, we noted some opportunities to improve organizational coordination on watershed protection. For example, this might include more use of interdepartmental working groups and temporary staff cross-appointments. This may be a concept for further consideration in the next operational period.

Finally, a number of informants told us that they believe more effort needs to be invested in communicating the value of the program more broadly, to stakeholders, elected officials and the public. The program does a very good job of explaining the “what” (what kind of toilet should I buy? what is the water quality situation in the stream? what should I do about my well?). Going forward, we suggest much more effort should go into explaining the “why” (why should I care about watershed protection? why do particular development patterns need to change? why does the parcel tax represent outstanding value?).

Conclusion

While we have identified a number of opportunities for the next operational period, it must be restated in summation that the work of the program to date has been nothing less than remarkable and highly successful. We see at least three key contributing factors.

- First, the vital importance of partnerships with other agencies, industry and the not-for-profit sector needs to be reemphasized. The program offers a necessary point of connection for different groups and agencies around the region and the collaboration it facilitates was cited by many as absolutely key to success.

- Second, the importance of the sustainable funding model for watershed protection, in the form of RDN’s annual parcel tax, also needs to be stressed. While the budget demand is actually relatively modest, RDN staff do very well with what they have. In fact, they are able to leverage this to attain significant additional funding and volunteer efforts to support watershed protection.

- Finally, the unique nature of this initiative compared to similar ones elsewhere in the Province must be underscored. To the best of our knowledge, no other regional district has a watershed protection function with taxation authority comparable in scope or longevity, putting RDN very far ahead of other communities. Other jurisdictions look to RDN as a model and remark on the success.

In closing, despite the challenges we have outlined, like every one of the informants we spoke to during the review, we see great prospects for the Drinking Water and Watershed Protection Program. There is clear and strong support for this initiative both inside and outside the organization, support that has been well maintained for a decade. The foundation is laid for very bright future in the next operational period.

1.0 Introduction

The Regional District of Nanaimo (RDN) began implementing the Drinking Water and Watershed Protection Program in 2009. Since then, the organization and its partners have made tremendous strides towards fulfilling the initiatives' objectives, which include water resource awareness and public education, monitoring and science, and policy and planning support.

The purpose of this report is to inventory these many successes, as well as some of the challenges the program has faced over the past decade. It considers actions laid out in the 2007 *Drinking Water and Watershed Protection Action Plan* and takes stock of what has been completed, initiated or advanced, and what has not. Along the way, it identifies what partnerships and resources have made implementation possible. Where appropriate, the report also identifies opportunities that could be addressed in a planned update to the *Action Plan*, scheduled for 2019.

Econics is a Victoria-based firm that specializes in supporting governments' work to sustain water systems and the communities that depend on them. We were selected to complete this review through a competitive procurement process based on our experience with similar programs across Canada and previous water protection and conservation program evaluation projects.

Following this introduction, the report has four main sections, as follows:

- Section 2 sets out the research methodology used to complete this work;
- Section 3 provides a broad overview of the Drinking Water and Watershed Protection Program including history, budget and governance;
- Section 4 provides our review of the program, organized around four general themes: water education & outreach; water science: data collection & monitoring; water policy advocacy & planning support; and, other observations;
- Section 5 provides a summary and recommendations.

1.1 Limitations

The reader should be aware of several limitations. First, due to scope constraints our work is not intended to be a formal audit of the Drinking Water and Watershed Protection Program. Rather, it is a general review informed by interactions with a group of key stakeholders and examination of resources largely directed to us by RDN staff. Despite this, we are confident the report provides an objective and well-informed assessment of implementation to date.

Second, the summary in the body of the report focuses on program highlights – major achievements and identified challenges. It should be noted that a great deal of work has been completed over the past ten years by RDN staff and partners, far more than what can be detailed here.

Finally, while the report does identify key gaps and opportunities that could be addressed in the next operational period, this is not the primary goal. Rather, the focus of this project is primarily retrospective rather than forward looking. That is, it is concerned with assessing implementation to date. It is intended to support the pending 2019 *Action Plan* update, rather than prejudging or dictating its direction.

2.0 Project Methodology

The review kicked-off in the last week of June 2018. In July and August, we gathered data through: a number of meetings and discussions with program staff, a literature review, in-depth interviews with key staff and stakeholders and two workshops. Descriptions of these steps are provided in this section.

2.1 Literature Review

We reviewed several dozen documents directed to us by RDN program staff. These included: Board reports and budget memos spanning the past decade; business plans; presentations; educational collateral prepared under the Team WaterSmart brand; several key technical reports completed by consultants; and, various other miscellaneous documents. A bibliography of literature reviewed is included in Appendix 1. This literature review provided context for the program review and served as a source of information referenced throughout this report.

2.2 Stakeholder Interviews

The methodology for the interview portion of the research started with RDN staff identifying and contacting candidates. These people included both RDN staff and external stakeholders from the Provincial Government, industry, academia, member municipalities, and water stewardship groups, all of whom are heavily involved in program implementation or oversight. Interview appointments were booked ahead of time, generally a week in advance. The interviewee was sent a copy of a project overview and discussion guide (found in Appendix 2) in advance via email. In total, ten interviews were conducted involving 13 informants (one session included three people). Six were conducted by phone and four were conducted in person in Nanaimo. Interviews were semi-structured in nature, typically lasting about an hour. They generally followed the questions set out in the discussion guide, but the interviewer was free to follow new topics in the context of the discussion. Afterwards, a copy of our notes was sent to each informant for validation. Some individuals provided additional feedback, which was incorporated into revisions. A list of interviewees can be found in Appendix 3.

2.3 Workshops

Two workshops were held to engage with individuals involved in program implementation. The first was held on 16 July 2018 and included nine RDN staff members employed in Long Range Planning, Geographic Information System Support, Regional and Community Utilities, and Drinking Water and Watershed Protection. The second was held on 26 July and included 16 people including select members of the stakeholder Technical Advisory Committee and some additional RDN staff. Formats for the events were similar. Both were held at RDN's offices in Nanaimo over a single afternoon. They started with an overview presentation by RDN's Program Coordinator and then moved into plenary and breakout group discussions. Both were actively facilitated by Econics staff. Sessions were designed to elicit feedback on successes and challenges. Information was collected in several formats including notetaking, template worksheets, and flipcharts. This information was subsequently digitized, compiled, and analyzed to inform the evaluation in this report. Workshop agendas and attendee lists can be found in Appendix 4.

3.0 Overview of the Drinking Water and Watershed Protection Program

This section provides a broad overview of the program, including historical milestones, governance, funding and partners. The intent is to provide background for the reader less informed about program administration and implementation.

3.1 Program Inception

The genesis of the program dates back to the early 2000s when a series of reports and discussions led to the creation of the Drinking Water-Watershed Protection Stewardship Committee, a stakeholder group with broad representation of organizations and sectors with an interest in water sustainability in the RDN. This committee oversaw preparation of the *Drinking Water and Watershed Protection Action Plan* by Lanarc consultants, completed in October 2007. This seminal document laid out the parameters of implementation that continue through to today. The *Action Plan* was adopted by the RDN Board in 2008 with direction to hold a referendum for service area establishment across all electoral areas. Following many public meetings by staff with community groups and other efforts to build support, in 2008, regional district residents approved creation of a new service and cost recovery through a parcel tax. Drinking Water and Watershed Protection was established as a regional service by RDN Bylaw 1556-0 in 2008,[1] and implementation commenced in 2009 with these objectives:

- increase water efficiency in our communities to avoid the costs of expanding water supply infrastructure;
- track local water resources to ensure adequate water supply now and in the future;
- enable better water management and land use decisions, to protect property values and ecological values in the region.

3.2 Program Geographic Scope

The geographic scope of the program encompasses the entire RDN municipal boundary including all electoral areas and, since 2012, all four local municipalities. For example, benefits such as rebates are offered to all region residents. Implementation of science and data-related initiatives generally aligns with watershed and aquifer boundaries (see Figure 1). In some cases these boundaries overlap with surrounding regional districts.

Figure 1: RDN Water Regions
Source: RDN website

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[1] Copies of this bylaw and subsequent amendments can be found at https://www.rdn.bc.ca/action-plan.

3.3 Program Administration and Governance

Drinking Water and Watershed Protection is functionally administered by RDN's Regional and Community Utilities Division, although several other departments are also involved. The RDN Board is ultimately responsible for program governance. However, the Board is supported by a Technical Advisory Committee that advises on implementation (RDN, 2012a). The Technical Advisory Committee includes 21 members representing a broad range of interests and geographic locations.[2] Members are selected by the Board either through an application process or by appointment through the member's organization.

By 2012, local municipalities across the region had successively signed on to participate. This included financial support. City of Nanaimo, District of Lantzville, City of Parksville, and Town of Qualicum Beach are now active partners. Their residents enjoy the same access to program benefits as residents in electoral areas. Notably, Team WaterSmart outreach resources and incentives such as rebates are offered to municipal residents and streams in urban areas are monitored through the regional Community Watershed Monitoring Network. Municipalities are involved in governance through staff seats on the Technical Advisory Committee and indirectly through their elected official representation on the RDN Board.

3.4 Program Budget

The 2008 referendum authorized levying up to $25 per parcel annually. A parcel tax instrument was selected rather than an assessment as this was seen as fairer given that water sustainability impacts residents equally (Donnelly, 2015). However, the actual tax has never exceeded $10 per parcel. Affordability has been supported by phased in contributions from local municipalities so that, at present, all parcels in the region are taxed equally.

For at least the past five years, the budget has consistently been about $500,000 annually ($513,488 was requisitioned in 2018; (RDN, 2017a)). Staffing costs account for a large portion of this, presently including one coordinator and two or three project assistants as well as some management overhead.

It is important to note that this investment enables leveraging significant additional resources that greatly magnify the program impact. This has included cash investments from the Federal Government (through the Geological Survey of Canada), the Provincial Government, private forestry companies and others. As well, the RDN benefits from regular in-kind contributions from these same organizations as well as local not-for-profit organizations, academia and other local interest groups.

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[2] Current TAC membership can be found at https://www.rdn.bc.ca/action-plan.

3.5 Program Partners

Success of the Drinking Water and Watershed Protection Program is due in great part to the contributions of partners in government, industry and not-for-profit sectors. The criticality of these partnerships was emphasized again and again by the people we interviewed. Other agencies and stakeholder groups contribute in many ways, including direct funding, in-kind staff effort, providing pools of volunteers for watershed monitoring, and offering low or no-cost specialized expertise. Table 1, below, lists just some of these key partners:

Table 1: Key Partners in Drinking Water and Watershed Protection Implementation

Federal Government
- Department of Fisheries and Oceans
- Geological Survey of Canada

Provincial Government
- Ministry of Environment
- Ministry of Forest, Lands, Natural Resource Operations and Rural Development
- Ministry of Transportation and Infrastructure

First Nations
- Qualicum First Nation
- Snaw-naw-as First Nation
- Snuneymuxw Nation
- Other First Nations with overlapping traditional territories

Local Government
- City of Nanaimo
- District of Lantzville
- City of Parksville
- Town of Qualicum Beach

Academia
- Vancouver Island University
- University of Victoria (POLIS Project)
- Simon Fraser University

Other Agencies
- Cowichan Valley Regional District
- Comox Valley Regional District
- Islands Trust
- Island Health
- Regional Water Purveyors and Improvement Districts
- Okanagan Basin Water Board
- School Districts 68 and 69

Industry
- Island Timberlands
- TimberWest
- Vancouver Island Real Estate Board
- Hydrogeologist and hydrologist sector
- Water well drilling sector
- Irrigation and landscaping sector

Not-for-Profit Sector
- Coastal Water Suppliers Association
- Mid Vancouver Island Habitat Enhancement Society
- Partnership for Water Sustainability in BC
- Nanaimo and Area Land Trust
- Over 12 local stewardship and stream keeper groups

The role of partners in the program will be a recurring theme throughout the remainder of the report. As well, some of the challenges that RDN has had with effective engagement with First Nations remains an issue, which is dealt with specifically in section 4.4 below.

3.6 Program History and Timeline

A more extensive account of events of the past ten years is provided below in section 4.0, where we look at specific achievements and challenges. In broad terms, however, implementation has been characterized by numerous major accomplishments. RDN has generally proceeded from an initial focus on education and outreach, moving on to increasing effort in water science and data collection. More recently, attention has shifted more towards policy and planning and to refining science processes and data management. Table 2 on the following page is a timeline of major occasions, though this is not a comprehensive list of all activities.

Table 2: Drinking Water and Watershed Protection Timeline

2003	- RDN Board identified watershed protection as a priority in *2003-2005 Strategic Plan*
2006	- Drinking Water-Watershed Protection Stewardship Committee established
2007	- *Drinking Water and Watershed Protection Action Plan* released (in October)
2008	- Board approves *Drinking Water and Watershed Protection Action Plan* - Electoral area referendum approved by a narrow margin; elector assent to establish a service and funding mechanism through parcel tax established - RDN Bylaw 1556-0 passed by RDN Board - *Innovative Options and Opportunities for Sustainable Water Use* report completed
2009	- Drinking Water and Watershed Protection Program implementation commences - Full time coordinator position staffed - Inaugural Technical Advisory Committee held (December) - Toilet rebate program commences
2010	- Team WaterSMART program continues under the new program - First WellSMART workshop - Irrigation Check-up Service first offered - Water Purveyor Working Group established - First submission to the Province's Water Act Modernization consultation process
2011	- Expansion of the BC Observation Well Network commences - *South Wellington-Cassidy Groundwater Quality Study* completed - Community Watershed Monitoring Network (CWMN) surface water quality sampling program established
2012	- Local municipalities become implementation partners - Phase 1 Water Budget Project commences (in February) - Yellow Point Development Permit Area requirements passed, requiring rainwater harvesting in new development - Rainwater harvesting rebate program commences, offered to all region residents
2013	- Toilet rebate program wraps up after issuing 1532 rebates to residents - Expansion of BC Observation Well Network concludes - Water conservation plans completed in City of Nanaimo and RDN's water service areas - Legislative proposal response to *Water Sustainability Act* provided to the Province - Phase 1 Water Budget completed; presented to public via series of open houses
2014	- School field trip program commences - Volunteer observation well network first implemented - Wellhead upgrade and well water quality testing rebate programs commence - Agricultural Water Demand Model completed - New Liquid Waste Management Plan adopted, including commitments linking to DWWP rainwater management program
2015	- *Climate and Hydrometric Monitoring Network Scoping Study* completed (April) - *State of our Streams 2015* report sent to all electoral area residents - Nanaimo lowlands aquifer characterization completed through GSC funding
2016	- Stewardship group seed funding program commences - Harmonized Watering Restrictions Framework established - *Water Monitoring Plan for Nanoose* (Electoral Area E) completed
2017	- *State of our Aquifers* 2017 report issued - Irrigation upgrades & soil improvements rebate programs commence - Hydrogeological Assessment for Area H Official Community Plan update completed - Water monitoring network equipment (tool lending) library launched - New GIS Water Map interface launched - RDN becomes referral agency for provincial groundwater licence applications - Major expansion of monitoring in priority locations under Water Budget - Phase 2
2018	- Irrigation Check-up Service impact evaluation completed - Analysis of trends and trajectories from 2013 Water Conservation Plan completed - Surface water quality trend analysis of 2011 to 2017 CWMN data completed

3.7 Program Organization and Categorization

The 2007 *Drinking Water and Watershed Protection Action Plan* was organized around seven program themes with 26 discrete actions. The seven themes are:

1. public awareness and involvement;
2. water resources inventory and monitoring;
3. management of land use and development;
4. watershed management planning;
5. management of water use;
6. management of water quality; and
7. adapting to climate change.

Over the past decade, implementation has remained true to these seven themes, for example by tracking performance against them and reporting to the RDN Board in this structure. Operationally, however, work tends to be organized under a simpler format with three broad categories, as follows:

1. water science: data collection & monitoring;
2. water education & outreach; and,
3. water policy advocacy & planning support.

For convenience, we follow this simpler organization in this remainder of this report. However, Table 3 enables easy mapping back to the original *Action Plan* so the reader can see how progress has been made against the foundational program design.

Table 3: Drinking Water and Watershed Protection Program Organization

RDN Theme	2007 *Action Plan* Program	2007 *Action Plan* Actions
Water Education & Outreach	Program 1: Public Awareness and Involvement	1A: The "WaterSmart" Program
		1B: Coordinated Information and Education Resources
		1C: Demonstration Projects
		1D: Support for Volunteers and Non-profit Organizations
	Program 5: Water Use Management	5A: Water Conservation Plans
		5B. Cooperation among Community Water Supply Systems
		5C: Rainwater and Graywater Use
		5D: Incentive Programs
	Program 6: Water Quality Management	6B: Agriculture and Forestry
		6C: Private Water Well Safety
		6D: On Site Sewage Disposal
Water Science: Data Collection & Monitoring	Program 1: Public Awareness and Involvement	1D: Support for Volunteers and Non-profit Organizations
	Program 2: Water Resources Inventory and Monitoring	2A: Compilation and Mapping of Existing Data
		2B: Additional or New Data Collection
		2C: Water Quality Monitoring
		2D: Data Response Systems
	Program 6: Water Quality Management	6A: Contaminant Management
		6C: Private Water Well Safety
	Program 7: Climate Change	7A: Follow the Science
		7C: Assessing Local Hydro-climatic Balance
Water Policy Advocacy & Planning Support	Program 3: Land Planning and Development	3A: Land Development (Engineering) Standards
		3B: Development Application Review
		3C: Development Charges
		3D: Planning Tools
	Program 4: Watershed Management Planning	4A: Watershed Prioritization
		4B: Watershed Management Planning
		4C: Support Local Food Production
	Program 5: Water Use Management	5E: Water Use Regulation
	Program 6: Water Quality Management	6B: Agriculture and Forestry
	Program 7: Climate Change	7B: Land and Water Use Adaptation

4.0 Program Review

This section outlines our findings from the program review based on the methodology set out in section 2.0.

4.1 Water Science: Data Collection & Monitoring

The starting goal for the water science theme was to improve information about the region's water resources in support of better land use decisions and public understanding (Lanarc, 2007). Key objectives included compiling and mapping existing information, improving stream monitoring systems, improving groundwater monitoring, and making information readily available and understandable to decision-makers.

This emphasis on operationalizing information — that is, making it useful for decision making — was prominent in the original *Action Plan* and clearly in the minds of its architects. At the same time, the informants we spoke with for this project repeatedly reminded us that long time frames are required to compile and analyze water quality and quantity data in a robust and scientifically defensible way. This creates a pressure point within the program. On the one hand, the end game for data collection and monitoring is to influence policy and land use. On the other hand, doing so effectively takes many years and is resource intensive. This tension is discussed later in this section.

4.1.1 Relevant Programs and Actions in the 2007 *Action Plan*

Most of the initiatives for this theme sit under Program 2 of the 2007 *Action Plan* (Water Resources Inventory and Monitoring), which recommended the following actions:

- 2A: Compilation and Mapping of Existing Data
- 2B: Additional or New Data Collection
- 2C: Water Quality Monitoring
- 2D: Data Response Systems

Also under this theme are elements of Program 6 (Water Quality Management) and Program 7 (Climate Change), as follows:

- 6A: Contaminant Management
- 6C: Private Water Well Safety
- 7A: Follow the Science
- 7C: Assessing Local Hydro-climatic Balance

As well, as discussed more below, RDN's approach to monitoring leans heavily on contributions from volunteers and non-profit organizations, so an aspect of Program 1 (Public Awareness and Involvement) is also pertinent:

- 1D: Support for Volunteers and Non-profit Organizations

4.1.2 Highlights from the Past Decade

Water data collection and monitoring has been an area of intense effort during the period under review, particularly in the second five years as public education and outreach programs matured, allowing attention and resources to shift. Some key outcomes include the following:

- In 2013, completion of Phase 1 of the Regional Water Budget project provided a preliminary indication of the level of stress on seven water regions and mapped aquifers.[3] Phase 2 of this project is now underway, and is resulting in enhanced monitoring and water budget development for priority watersheds (see Piteau Associates, 2016 and Golder Associates, 2016).
- In partnership with local stewardship groups, the Community Watershed Monitoring Network was established in 2011 to sample water quality across the region's creeks and streams at over 60 sites.
- A *State of our Streams* publication was distributed to all electoral area residents in 2015, providing a snapshot of streams in the region. This was followed by a *State of our Aquifers* report for residents in 2017, which focused on groundwater resources.
- A *Climate and Hydrometric Monitoring Network Scoping Study* was completed, which identified and prioritized locations and potential partnerships to support additional climate and hydrometric (streamflow) stations around the region (Kerr Wood Leidal, 2015).
- Aquifer and stream monitoring were expanded, including:
  - support for addition of 16 new wells to the BC Observation Well network (managed by the Provincial Government and partly funded by RDN);
  - additional data collection from 34 volunteer observation wells; and,
  - the addition of four new streamflow and two new climate monitoring sites.

4.1.3 Major Accomplishments

This section sets out some of the major accomplishments under the water science theme since 2009.

- ✓ **Many Data Gaps Have Been Filled**

Our literature review and consultation activities all point to significant strides towards better monitoring and understanding of local water resources, particularly among decision making agencies, that are directly attributable to the program. This improved understanding encompasses water quality and quantity, and to some extent aquatic ecosystem management.

This is evident with both surface water and groundwater. In the case of surface water, the Province has traditionally focused on monitoring larger systems, such as Englishman River. The addition of new monitoring stations on smaller systems through the program is providing different insights, broader reach, and greater granularity than would otherwise be possible given Provincial Government resource limitations.

Similar is the case of groundwater. The expansion of the Provincial observation well network, supplemented by volunteer monitoring and efforts to map aquifers through the Geological

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[3] See http://rdnwaterbudget.ca/

Survey of Canada (2016) has provided site specific graduations of vulnerability beyond what was previously obtainable.
The impact of this information is experienced in various ways. For example, there is evidence that it is already affecting Provincial water allocation decision making. As an informant from the Province told us, “at end of the day, we have a much better understanding of the aquifers in the area than we do elsewhere. This is because of the monitoring and work that is taking place sponsored by RDN.” (Lapcevic, 2018).

RDN is beginning to have enough information at its disposal to see trends, which in turn informs where additional monitoring is required in the future. Results can be used to communicate with senior managers, decision makers and let the Province know what is happening on a regional scale, bringing sharper focus to water issues in the mid-island.

Attendees at the Technical Advisory Committee workshop also stressed that there are still large areas where understanding of water quantity and quality remain very limited and much remains to be done to define aquifer characteristics. However, testimony of numerous interviewees confirms that the region is much further along now than it was before the Drinking Water and Water Protection Program commenced.

✓ Vulnerable Water Sources and Systems Have Been Prioritized

Key technical projects carried out over the last ten years have clarified which watersheds and aquifers in the region are most stressed. Enhanced monitoring in these areas has commenced.

This is perhaps most evident in the water budget work that began in 2012. In Phase 1 of this project, the region as a whole was canvassed and a preliminary indication of the level of stress on seven water regions and mapped aquifers was completed. Phase 2, starting after 2013, focuses on introducing enhanced monitoring and refining water budgets for priority watersheds (specifically French Creek, Cedar-Yellowpoint (see Piteau Associates, 2016) and Nanoose (see Golder Associates, 2016). Additional instrumentation went into these areas in 2017, and additional data collection is now underway.

There is also evidence that enhanced monitoring has led to more effective drought response compared to elsewhere on Vancouver Island, particularly in 2015 and 2017 (and, we would expect, 2018). Provincial staff report that supplementary monitoring on smaller systems has provided better information to support water shortage responses under the *BC Drought Response Plan* (Lapcevic, 2018).

Finally, enhanced groundwater monitoring, supported in part by voluntary observation wells and data submission through the well testing rebate program has enabled more detailed aquifer characterization. This in turn is already uncovering areas of vulnerability. Presence of increased nitrates in aquifers in Electoral Area F was cited as one example, which is enabling provincial health authorities to better understand the water quality protection issues they face (Magee, 2018).

✓ Data Has Been Acquired and Interpreted Robustly and Resourcefully

Several aspects of RDN’s approach to collect data were lauded by observers, particularly the use of “citizen science” to support low cost acquisition, combined with reliance on third party experts to aid with analysis.

For example, the use of volunteers to collect surface water quality data through the Community Watershed Monitoring Network has proven cost effective, boosted the capacity of community groups, and fostered positive relationships between members of civil society.

Since 2011, some 13 stewardship groups have undertaken "boots on the creek" monitoring efforts in 24 different watersheds (RDN, 2018b). RDN supports this work by providing an equipment library, coordination, relationship brokering between stream keeper groups and the Ministry of Environment and by facilitating transfer of water quality data to appropriate Provincial repositories (i.e., the EMS database). Quality control is maintained by using a general suite of indicators following provincial methods and protocols for water quality sampling. Put succinctly, simple data collection methods are used, making it hard to get it wrong (Law, 2018).

Similarly, enabling private well owners to share water quality testing results through the incentive of rebates has significantly expanded the number of data points to characterize aquifers, again at very low cost.

While data is often collected by volunteers, interpretation is typically left to the experts. RDN has elected to rely on either consultants or senior government staff. For example, water budget work has been carried out by reputable, third party hydrogeologists. Other prominent examples are referenced in section 4.1.2, above (see, for example, Golder Associates, 2016; Piteau Associates, 2016; Kerr Wood Leidal, 2015). This avoids the need to hire highly specialized staff internally and largely eliminates any potential perception of bias in the analysis.

Finally, the way that RDN has leveraged additional funding for monitoring work is worth noting. For example, the forest industry helps fund laboratory validation of data collected by volunteers (Epps, 2018). This novel arrangement and the other examples provided above demonstrate a creative and parsimonious, yet robust approach to data collection and analysis.

4.1.4 Challenges

- **Improving Data Management**

While it is clear that data collection has been quite successful, it is also apparent that there are opportunities to better manage data once it has been acquired.

RDN staff have attempted to address data capture and storage over time through various solutions, but in general, have employed three different strategies.

First, in some cases it has partnered with the Provincial Government to host data in maintained and centralized databases. For example, surface water quality information collected through the Community Watershed Monitoring Network is uploaded to the Ministry of Environment's Environmental Monitoring System (EMS), where it is readily accessible to all.[4] This approach seems to be a good, logical, long term solution that provides open access to information, but obviously hinges on the capabilities of the senior government partner.

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[4] See https://a100.gov.bc.ca/pub/ems/indexAction.do

Second, in at least one case, RDN has invested in implementing a stand-alone, local third party application. WaterTrax houses well water quality data sourced from voluntary submissions through the water testing rebate program. It also has the capability to accommodate data from RDN's water supply wells and from the voluntary observation well network. WaterTrax consolidates information from various sources, and can produce map outputs by area and aquifer. However, it requires ongoing management and support from RDN. As well, it is isolated from the centralized information systems run by the Province and information is not open and accessible.

Third, in the case of some groundwater and lake level data, information is still housed on RDN's internal servers in Microsoft Excel. Staff acknowledge that, while still a valid way to manage data, this is a less than ideal solution. It creates various vulnerabilities including risk of loss of knowledge in the event of staff turnover and the fact that information is not publically accessible. As well, there are all of the various limitations of Excel's user interface, data processing speed and ease of use. As a result, participants in the staff workshop, for example, expressed a desire for one platform to manage all groundwater data. In the short term, plans are underway to move some of this data (e.g., lake levels, some groundwater data) to the Province's Aquarius database through a third-party data sharing agreement.

The various information systems, data sources and their owners are summarized in Table 4, below.

Table 4: Water Data Sources, Platforms and Ownership

Data Type	Source	Platform	Database Owner	Access
Surface Water Flow and Level; Groundwater Quantity	Provincial monitoring network	Aquarius	Province	Open
Lake Levels	Holden and Quennell	Excel[5]	RDN	Internal only
Surface Water Quality	Community Watershed Monitoring Network	EMS	Province	Open
Well Quality	Voluntary submission through rebate scheme RDN water supply wells	WaterTrax	RDN	Internal only
Climate	1 station at upper Nanoose Creek	GOES	RDN	Open
Groundwater Elevation	Voluntary observation wells	- Excel - Aquarius (pending for 11/16 wells)	RDN (Excel) Province (Aquarius)	Internal only (RDN systems) Open (Provincial system)

In general, the approach to data management to date is perhaps best characterized as a*d hoc*. RDN staff lacked tools and personnel to manage data at the start of the collection process, and we heard several times that they are now in a "catch up" mode in this area.

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[5] The intent is to move this data to the Province's Aquarius database in the near future.

Moving forward, more attention to data management is recommended. RDN already started down this path by engaging Golder Associates (2017) to develop a Water Monitoring Data Management Framework. This high-level framework provides recommendations for developing a robust data management system for the program. In addition, staff have some tactical plans for improved data management that they were able to share with us. In general, these entail continued migration to open provincial systems (ideally) or developing more robust internal systems where necessary.

We suggest that this should be an area of continued attention, and that these plans should be incorporated into the update of the *Action Plan* for the next operational period.

It should be noted that the fact that this challenge exists for RDN is in many ways a direct result of the Provincial Government's incapacity to provide necessary centralized infrastructure for all water datasets. However, the Province is currently in the process of reviewing its own approach under the *Water Information Stewardship Project*. The goal of this multi-year business transformation initiative is to develop integrated and coordinated water information systems to support timely and durable resource decisions for British Columbia.[6] This project and the existing partnerships with Provincial staff indicates that there are opportunities to collaborate on more robust solutions to these challenges in the next operational period of the Drinking Water and Watershed Protection Plan.

Finally, it is worth mentioning that this issue is by no means unique to RDN. We have witnessed similar situations in many water management agencies across Canada at both the local and senior levels of government, so it may be a consolation that the Region is not alone.

- **Further Attention to Operationalizing Data**

As the volume of data collected for both surface and groundwater grows, the program continues to enjoy growing success in aquifer and surface water characterization. However, it also seems that greater attention (and budget resources) will need to be devoted to analysis in the future and to turning data into useful knowledge that can inform decision making.

Some of this work requires highly technical, specialized skill sets. To date, much of this has been either outsourced to expert consulting firms, or undertaken through partnerships with appropriate organizations such as Vancouver Island University or the Province. However, relying on partners to complete such analysis will always be challenging due to their own resource constraints.

RDN is already addressing the issue on specific fronts. For example, there are the various major consultant reports cited in section 4.1.2 above. Similarly, seven years of streamflow data from the Community Watershed Monitoring Network and other sources is currently being assessed through a new consultant contract. This important initiative, led by Ecoscape Environmental Consultants, is scheduled for completion in 2018 and will provide important insights into trends, incidences of data exceeding standards, and potentially causation. The intent is that this will help direct future outreach and policy efforts.

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[6] In the interest of disclosure, please note that Econics has been involved in the *Water Information Stewardship Project* in a project management capacity since 2017.

As well, the program is currently budgeting to analyze expanded data collection from key watersheds identified in Phase 1 of the water budget study. Under Phase 2, additional monitoring was deployed in 2017 and the first year of results are now coming in, mostly focused on groundwater data. This will set the context for developing numerical water budget models in a pending third phase. As one interviewee noted, however, the real challenge will be how the results are used to set objectives for managing watershed risk that can be adhered to in the face of changing and use activities.

As the analytical workload continues to grow, it is not clear whether the somewhat *ad hoc* approach used to date will continue to be sufficient, or whether a more comprehensive, long term research plan developed with partners in academia and the Province would be preferable.

Attendees at both workshops expressed concern that there is a growing risk that at least some of the data collected across the program will lose currency if not analyzed in a timely manner (though it will maintain value as baseline or historic data). We recommend that attention to how to leverage data collected through the program should be a key focus of an updated *Action Plan*, and budgeted for accordingly. This planning can likely be done in conjunction with planning for improved data management discussed above.

4.1.5 Summary

Our investigation left us with little doubt that, directly as a result of the program's work, there is already a much better understanding of aquifers and streams in the region than elsewhere on Vancouver Island or much of the province. As we will discuss further in section 4.3, there are indicators that this is already leading to more informed decision making in areas of RDN's jurisdiction and the decisions of other authorities. Going forward, with the more refined data collection that is already underway and greater attention to operationalizing it, work under this theme has a very promising future.

Opportunities for the next operational period of the program include the following:

- Continue to implement the water monitoring data management framework and associated internal staff work plans and ensure this is incorporated into the *Action Plan* update.
- Continue efforts to move water monitoring data to open, centralized Provincial databases.
- Where Provincial Government capacity and infrastructure gaps around water data management exist, work with and encourage the Province to fill them.
- Ensure that operationalizing data attained in the past decade is a key focus of the update to the *Action Plan*; that is, ensure the new plan gives explicit attention not just to data collection but to identifying, in practical terms, what information products are required, what skill sets are needed to produce them, and how they will be used to set objectives for and monitor watershed management.

4.2 Water Education & Outreach

The central goals for the education and outreach theme are: 1) to promote awareness and stewardship of the watersheds and drinking water resources in the Region; and, 2) to promote efficient water use in all sectors (Lanarc, 2007). Related objectives include improving public awareness of where their water comes from and why it is important to protect watersheds, changing public water consumption patterns to reduce wastage, and improving coordination among other stakeholders who also provide information.

Creation of Team WaterSmart as a unifying brand and banner for water conservation across the region pre-dates the Drinking Water and Watershed Protection Program. Continued implementation of the outreach and education under the Drinking Water and Watershed Program resulted in early success. In fact, this area continues to account for a disproportionate amount of staff time and budget resources compared to the other two program themes.

The end result is that a broad range of impressive projects and initiatives have been made available to residents. Indeed, based on our experience working on similar initiatives with many other similar Canadian communities, the work can only be characterized as exemplary.

At the same time, as information resources and branded publications continue to proliferate, we see some evidence of the program beginning to become a “victim of its own success”. We see opportunities to rationalize and refocus education and outreach efforts in the next operational period. These are discussed later in this section.

4.2.1 Relevant Programs and Actions in the 2007 *Action Plan*

Water education and outreach initiatives link back to the original *Action Plan* mainly through three programs with corresponding actions, as follows:

Program 1: Public Awareness and Involvement
- 1A: The “WaterSmart” Program
- 1B: Coordinated Information and Education Resources
- 1C: Demonstration Projects
- 1D: Support for Volunteers and Non-profit Organizations

Program 5: Water Use Management
- 5A: Water Conservation Plans
- 5B. Cooperation among Community Water Supply Systems
- 5C: Rainwater and Graywater Use
- 5D: Incentive Programs

Program 6: Water Quality Management
- 6B: Agriculture and Forestry
- 6C: Private Water Well Safety
- 6D: On Site Sewage Disposal

As well, some elements of Program 7 (Climate Change) are also relevant, in particular the need to educate officials, planners, engineers, developers, and forestry and agricultural professionals about the changing local hydro-climatic balance.

4.2.2 Major Accomplishments

This section sets out some of the major accomplishments under the water education and outreach theme since 2009.

✓ **Impressive Water Conservation and Sustainability Resources**

RDN's efforts to create and disseminate resources to help people reduce their water use and be good stewards are both extensive and impressive. Many end-uses (indoor and outdoor) are targeted and many communication channels are employed. This is most prominent with Team WaterSmart initiatives, and include print material, web resources, community events, rebates, workshops, school education and much more. As stated above, in comparison with many similar British Columbian and Canadian communities we have assisted, this body of work is exemplary. This view was widely shared by participants in both the interviews and workshops. As one person put it, "Team WaterSmart has been a very effective model in bringing water education to the general public" (Law, 2018).

Key examples include the following, but this list is by no means comprehensive:

- numerous information brochures and publications, with notable illustrations including the *Landscape Guide to Water Efficiency* and a suite of consistently branded brochures covering various end uses of water inside and outside the home (a list of the collateral we looked at can be found in Appendix 1);
- a deep program website that captures literally dozens of different water conservation and sustainability resources, some features having sophisticated user interfaces (for example the regional watering restrictions map and the Our Watershed map tool);[7]
- student watershed field trips and teacher curriculum resources for grade 4 and 5 classes in School Districts 68 and 69;
- the Residential Irrigation System Check-Up program, which incorporates elements of water conservation best practice because it is highly targeted at both specific users (high volume residential customers) and at specific end uses (outdoor irrigation via in-ground automatic systems);
- Team WaterSmart summer events involving interactive, staffed booths at community gatherings across the region (see Table 5, below); and,
- a range of water stewardship rebates available to all region residents including those in member municipalities (uptake over time is summarized in Table 6, below).

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[7] In fact, the program website has become so information heavy that we see some risk of it becoming inaccessible from the point of view of the layperson user. This is discussed further in section 4.2.4.

Table 5: RDN Water Sustainability Outreach Occurrences (2011 to 2018)

	2011	2012	2013	2014	2015	2016	2017	2018	Total	Average
School Field Trips				7	14	11	6	6	44	9
Youth Education	0	0	0	1	11	3	4	2	21	3
Workshops	8	6	9	9	10	15	10	7	74	9
Other Events	20	19	21	21	25	29	38	38	211	26
Irrigation Check-ups	79	35	49	28	30	17	18	12	268	34
wellSMART	5	3	4	4	3	2	2	2	25	3
	112	63	83	70	93	77	78	67	599	80

Table 6: RDN Water Sustainability Rebates (2013 to Present)

	2013	2014	2015	2016	2017	2018*	Total Rebates	Average /Year ◆	Average Rebate	Average $/year	Total $
Rainwater Harvesting (2013-present)	52	37	42	46	39	11	227	43	$732	$27,936	$167,618
Wellhead Upgrades (2014-present)		10	10	9	11	5	45	10	$250	$2,137	$10,685
Well Quality Testing (2014-present)		175	103	112	119	80	589	127	$95	$54,642	$10,928
Irrigation Upgrade/ Soil Improvement					11	26	37	11	$214	$3,278	$6,556
ENERGY STAR Clothes Washer (2016)*				50			50	50	$50	$2,500	$2,500
TOTAL	52	222	155	217	180	122	948	165			$198,289

Notes:

- * 2018 data is for partial year to August.
- ◆ Excludes 2018 data.
- Rebate program pilot years were not included due to incomplete data.
- The ENERGY STAR Clothes Washer rebate was only available in 2015 and 2016. In 2015 it was administered by the RDN Sustainability Department and only available to RDN Electoral Area and Lantzville residents; data for that year is not readily available. This program was delivered jointly with BC Hydro as a rebate "top up".
- RDN also offered a Toilet Replacement Rebate program between Oct 2009 and Nov 2013. Under this program 1532 toilets were replaced and $95,700 in rebate dollars were granted.

With respect to the impact of these and other initiatives, a study was completed in 2018, which found that average water demand per connection in RDN operated Water Service Areas decreased by 31% between 2004 and 2017, putting the region on track to achieve targets set in 2008 and 2013. This study also found that maximum month water production (again in in RDN Water Service Areas) remained below a 2004 reference level from 2011 to 2017 (McSorley, 2018b).[8]

✓ Innovation in Regionally Relevant Education Programs

RDN has developed several "niche" water sustainability programs that merit specific recognition. In part this is because they are quite relevant uniquely to the region because of its distinctive hydrological and social situation. These examples are also consistent with water

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[8] It is important to qualify that RDN cannot take full credit for these savings, as most communities across North America have sustained dramatic water use reductions over the same period due to natural uptake of more efficient appliances and fixtures and changing outdoor water use trends.

sustainability program best practice because they are highly targeted and use a variety of policy instruments to incentivize participation.

Three examples serve to illustrate. First, the wellSMART initiative couples workshops, wellhead upgrade rebates, and water testing incentives with educational resources and auditing offered by trained Provincial Government staff. Through wellSMART, people now have ready access to information on well construction, maintenance, water testing, and groundwater protection. While large volume users may receive more targeted support from the Province, in the past small well owners were more likely to be overlooked. RDN's program acknowledges that they are important and supports their unique needs (Lapcevic, 2018). We are unaware of a comparable program in other groundwater dependent communities in BC.

Second, work to promote rainwater harvesting has included the *Rainwater Harvesting Best Practices Guidebook* (RDN, 2012b) a robust design and installation resource, as well as workshops, rebates and online advice.[9]

Third, the Water Purveyor Working Group was launched through RDN's leadership in 2010 and has met at least annually ever since, bringing together improvement districts and other small suppliers for education symposiums and to discuss issues of mutual interest. In light of the limited capacity of many small purveyors despite their significant responsibilities, this initiative underscores RDN's emergence as a water management leader locally and provincially.

✓ Successful Partnerships for Regional Service Delivery

While the breadth of water conservation and sustainability outreach efforts is impressive on its own, the way that they have been implemented compounds their impact. RDN staff have done an extraordinary job of developing strong partnerships with other agencies to promote stewardship. These partners include the Province, member municipalities, small water purveyors, industry, community groups and others (see section 3.4, above, for a fuller list).

An example is delivery of Team WaterSmart on behalf of Nanaimo, Parksville, Lantzville, and Qualicum Beach. Under this banner, RDN provides water conservation education on behalf of these partners, speaking to all residents with a unified voice. As one interviewee put it, "we are all one big happy family" (Sims, 2018). For instance, coordination of rebates for water sustainable goods and services means that incentives are provided seamlessly across municipal boundaries. A noteworthy success here was negotiation of a regionally-consistent outdoor watering restriction framework in 2016, which now simplifies communications during the summer period.

Another example is delivery of watershed field trips to elementary school classes, delivered through a partnership between RDN, member municipalities and forestry companies (specifically, Island Timberlands and TimberWest). Industry provides safe and controlled access to the watershed, and RDN provides tour guidance and resources for teachers.

Yet another excellent example of successful collaboration is delivery of the wellSMART workshops through a partnership between RDN, the Ministry of Forest, Lands, Natural

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[9] To give a sense of the uniqueness of this publication, we were well aware of this guidebook before we started working with RDN on the current project and have referred other communities, including some outside British Columbia, to it a number of times.

Resource Operations and Rural Development, Island Health and the well drilling industry. RDN provides the venue and promotion, whereas the other organizations provide technical expertise to train residents in well maintenance, operation, testing and protecting their water source. Supporters see this work as highly successful (cf. Magee, 2018).

An example that provides value specifically for municipalities has been the Community Watershed Monitoring Network. The stream monitoring and engagement with stewardship groups on urban creeks provides data of interest from a municipal stormwater management perspective.

Partnerships such as these dramatically leverage the resources RDN brings to bear and contribute to a shared community stewardship ethic.

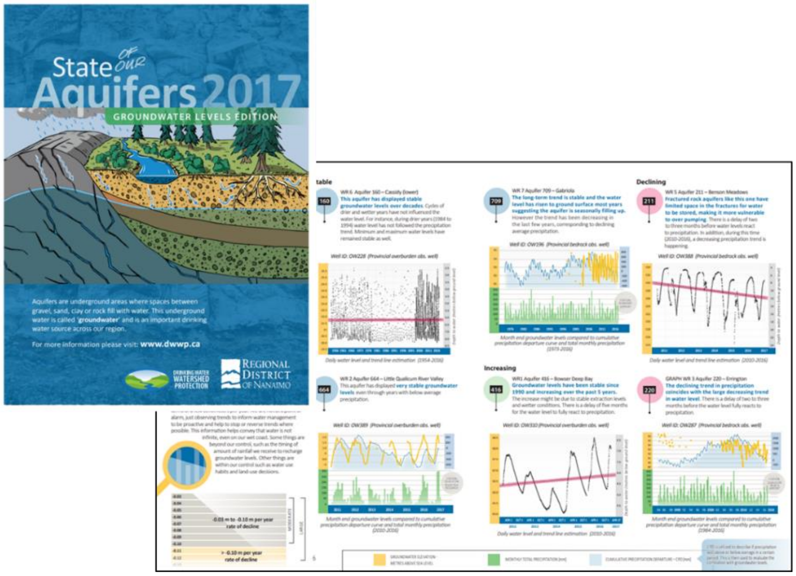
4.2.3 Challenges

- **Outreach Campaigns are Often Highly Information Intensive**

As noted above, RDN's educational resources are inarguably both far-reaching and impressive. However, they are often also very information intensive. Communications products and messaging often contain considerable, tightly packed technical content.

In some cases, detailed technical content is wholly appropriate. For example, the rainwater best practices manual (RDN, 2012) and the landscape guidebook (RDN, nd) would be sought by audiences seeking highly prescriptive advice in order to complete specific projects.

However, in other cases we see distinct symptoms of what one interviewee called "information overload". A number of examples can be cited. The program website, taken as a whole, though quite well organized and rich in content, may be overwhelming from the perspective of the casual visitor. Similarly, the 2015 *State of our Streams* and 2017 *State of our Aquifers* newsletter are both highly detailed and technical, to a level that we suspect would be beyond even well-educated readers, despite the fact that we understand that both of these documents were distributed by mail to most households in the region (see Figure 2).



State of our Aquifers 2017

GROUNDWATER LEVELS EDITION

Aquifers are underground areas where spaces between gravel, sand, clay or rock fill with water. This underground water is called '**groundwater**' and is an important drinking water source across our region.

For more information please visit: **www.dwwp.ca**

DRINKING WATER WATERSHED PROTECTION

REGIONAL DISTRICT OF NANAIMO

Figure 2: Excerpt from State of our Aquifers 2017 Newsletter

Research from fields such as environmental psychology and marketing tell us that information alone rarely leads to sustainable behaviour change (cf Mckenzie-Mohr, 2011). RDN has an opportunity in the future to transition to more "best-in-class" outreach methods. For example, it could make more use of well-established community-based social marketing techniques such as social norms, commitments and more vivid marketing communications. As we discuss further in section 4.4, below, we also see the opportunity to shift more from factual information to more messaging about why watershed protection matters.

- **Branding Review**

In our review of Drinking Water and Watershed Protection print and web-based communications collateral, we discovered an issue that we have seen before with other well developed outreach programs – the phenomena of "brand creep". This occurs when branding is done inconsistently or when the messages you are trying to communicate do not come across vividly and clearly. If this issue is left unattended, the risk is that the brand will no longer have clarity and residents become confused about who you are, what you offer, and why you exist. This problem can also dilute attention away from the entity that should usually be at the centre of communications — the Regional District of Nanaimo (and in some cases partner local governments).

To illustrate, so far we have observed use of at least ten different logos and wordmarks in program communications (see Figure 3). In one instance, eight different logos were used on a single page. In a couple of cases (e.g., the wellSMART program) it is not immediately clear why a separate brand identify is required at all. This challenge is compounded by the fact that the logos of five different local governments including RDN must sometimes be incorporated into design.

Figure 3: Logos Used in Drinking Water and Watershed Protection Communications

Beyond logo proliferation, we also see other opportunities to improve brand consistency more generally (e.g., consistent use of colour, style elements, fonts, etc.). From the staff workshop, we also understand that this observation is consistent with the direction that RDN's

Corporate Services department is taking in their efforts to curb the proliferation of program sub-brands across the organization. As a result, to address this emerging concern, we recommend that RDN undertake a review of program branding and perhaps consider developing corporate style guidance specifically for the program.

- **Market Research and Program Evaluation**

Within the past year, RDN staff have completed several internal quantitative studies to begin to assess the impact that education and outreach to date have had on water use behaviour. For example, analysis of metered consumption data for participants in the Irrigation Check-up program found that he majority (65%) of participants reduced their summer water-use in the years following participation (McSorely, 2018b).

The fact that this analysis is beginning to happen is encouraging, but we see more opportunities. In particular, to the best of our knowledge RDN has not yet undertaken any formal market research studies. These kinds of studies provide key insights into resident attitudes towards water sustainability and conservation and answer applied questions about penetration rates of water efficient fixtures and appliances and outdoor water use behaviour (e.g., lawn watering habits).

Leading jurisdictions typically complete such studies with a reputable market research firm regularly, every three to five years as a good rule-of-thumb. An ideal research design combines a large telephone survey (500 to 800 people) with focus groups (two to four groups), with scope driven by budget availability. A standardized survey questionnaire is used to allow comparison of results across time (i.e., you ask some of the same questions every time you do the research to see if results change).

This kind of market research as well as other quantitative projects like the one completed for the Irrigation Check-up help target efforts and provide metrics of success that inform program evaluation and budget allocation.

We note that, while this contention is made based on our experience working with other jurisdictions, it was mirrored by staff and partners several times in the workshops. For example, participants noted that no work has been done to date to monitor how well print publications are received, and that little work has been done to quantify how effective programs are from a cost/benefit perspective.

Finally, a side-benefit of this kind of research is that it often uncovers high-levels of support from the community for water and watershed protection (cf, RBC Blue Water Project, 2017). It may be useful to have localized results to assist with ongoing justification of the program.

- **Opportunities for Innovative Demand Management Program Delivery**

To reiterate the message stated above several times, by the standards of other comparable BC and Canadian communities of similar size, the demand management work being done by RDN is exemplary. However, if we apply the much higher standards of the most prominent and successful water conservation programs, for example from the Southern US or Ontario, there are many opportunities to innovate and improve performance.

Much of RDN's work to date focuses narrowly on education and incentive (i.e., rebates) policy instruments.[10] As well, most attention goes to the single-family residential sector. Going forward, we see opportunities to employ techniques that are more targeted at specific user groups, specific end uses of water, and other sectors (such as non-residential customers). Some specific examples may include:

- greater attention to non-revenue water and control of system loss, which is often the lowest per unit cost source of water savings;
- use of local regulatory measures such as once-through cooling system bans or water efficient landscape standards in new development;
- greater use of community based social marketing techniques (cf Mckenzie-Mohr, 2011);
- targeted incentives for developers who implement "above code" water sustainability practices;
- targeting specific end users;[11] and,
- greater attention to the commercial, industrial and institutional sectors.[12]

In some cases, new measures such as these will be more difficult to implement because they will require working through partners. For example, in RDN's case, system loss control and outreach to non-residential customers are typically within the purview of member municipalities. It may take some convincing to show partners that these kinds of measures offer lower cost water savings than traditional, broad market, information-intensive education campaigns.

At the same time, we do not recommend abandoning measures that are already in place and working well. For example, Team WaterSmart participation in community events brings many benefits, not the least of which is maintaining the profile of the program among key stakeholders and partners. Here, however, there may be opportunities to do the same things in more effective ways. The approach that leading jurisdictions take to community events is to use active rather than passive methods, such as systematically collecting information from residents while on-site, or using events to promote specific initiatives in a very targeted and persuasive way. This includes having specific, quantitative goals for events that are measured and evaluated after.

The list above is really only the tip of the iceberg. We recommend that further attention to opportunities for innovation in demand management program delivery be an explicit focus of the planned update to RDN's Water Conservation Plan (Aquavic, 2013) in the next operational period.

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[10] This is very much a general observation, as there are certainly good examples of use of other techniques to be found.

[11] For example, in the US there is emerging interest in water conservation programs for low income households. Evidence is beginning to show that, on average, this group tends to lag behind in adoption of water efficient fixtures and appliances in the home and so may have above average per capita water use. Programs targeted to them provide the additional benefit that they may help these households better control their water costs.

[12] For example, many leading jurisdictions target the hospitality sector (hotels and restaurants) with measures to retrofit niche technologies such as once-through cooling systems and pre-rinse spray valves in food preparation facilities.

4.2.4 Summary

RDN's water education and outreach efforts are highly valued by stakeholders and seem to be universally seen as successful. Since the inception of the program, momentum has continued to build. With continuing effort and by borrowing from best practice experience in other jurisdictions, the Regional District has an opportunity to claim a position as a provincial and even national leader in this space.

Opportunities for the next operational period include the following:

- Reduce the information intensity of communications, focusing more on simpler messages that emphasize why watershed protection and conservation are important.
- Complete a review of branding and consider developing corporate style guidance specifically for the program.
- Conduct market research with residents to understand their attitudes towards water sustainability and conservation and to seek answers to applied questions about matters such as penetration of water efficient fixtures and appliances and outdoor water use behaviour.
- Continue to conduct analysis to quantify the impact of the program and its specific initiatives on per capita water demand.
- Update the RDN water conservation plan with attention to best practices from leading North American jurisdictions; plan to employ demand management techniques that are more targeted at specific user groups, specific end uses of water, and less frequently engaged sectors (such as non-residential customers).
- Support member municipalities with adoption and implementation of innovative best practice water conservation practices in areas of their domain.
- Review implementation of initiatives that cross *Drinking Water and Watershed Protection Action Plan* and the *Liquid Waste Management Plan* (specifically rainwater management) to ensure that any potential administrative overlaps are addressed and that organizational responsibilities are clear.

4.3 Water Policy Advocacy & Planning Support

Key goals under the policy advocacy and planning support theme are: 1) to use the information gathered through the water science program to protect watersheds and water resources in land use planning and development decisions; and, 2) to prioritize and protect watersheds according to their ecological and drinking water values (Lanarc, 2007).

A myriad of specific objectives fall under these goals including: protecting drinking water through the Regional Growth Strategy, Official Community Plan policies and designations, and zoning bylaws; ensuring that new development provides proof of adequate drinking water; and undertaking watershed management planning on a priority basis.

While the original *Action Plan* charted a decidedly ambitious course for reformed land use planning and watershed management, thus far this area has proved to be the most challenging and controversial amongst stakeholders. This is detailed in this section.

4.3.1 Relevant Programs and Actions in the 2007 *Action Plan*

Mapping back to the *Action Plan*, key policy and planning initiatives link to Program 3 (Land Planning and Development), which recommended the following actions:

- 3A: Land Development (Engineering) Standards
- 3B: Development Application Review
- 3C: Development Charges
- 3D: Planning Tools

There are also linkages with Program 4 (Watershed Management Planning), which recommended the following actions:

- 4A: Watershed Prioritization
- 4B: Watershed Management Planning
- 4C: Support Local Food Production

Other relevant areas in the *Action Plan* include influencing decision making in provincial water allocation decision making (Program 5, Action 5E), in the agriculture and forestry sectors (Program 6, Action 6B), and adapting land and water use in the face of climate change (Program 7, Action 7B).

4.3.2 Major Accomplishments

This section sets out some of the major accomplishments under the policy advocacy and planning support theme since 2009.

- ✓ **Foundation Laid for Future Success**

Almost all the informants we spoke to reminded us of the very long time frames needed to build a sufficient information base to adequately characterize watersheds and aquifers, and the challenges of building lasting public support for these endeavors. Over the past ten years, RDN has sought to create a strong foundation with data, partnerships, education, and program identity. While it is important to understand that the situation remains in the data building stage and that much analysis remains to be done, there are good indicators that this foundation is falling into place.

Much of the work described in section 4.1, above, is highly relevant here. For example, a group of participants in the Technical Advisory Committee workshop characterized the efforts to prioritize watersheds under the water budget project as the "greatest success" of the program to date. Since it identifies varying stress levels in different water regions, emerging sentiment is that it now has the real potential to influence land use decision making. Similarly, enhanced monitoring of aquifer stress levels is now providing guidance on where additional planning work or studies should be done.

As detailed in section 4.2.3, little work has been done to date to quantify resident attitudes towards watershed protection. However, based on anecdotal reports from interviewees and the considerable investment in education and outreach, we would also expect that progress has also been made to build necessary public support for water sustainable land use planning and policy.

✓ **Specific Successes in Land Use Planning and Informing Policy**

Particularly from the last several years, we found specific examples of the program influencing land use decision making and allocation policy. These include the following:

- The program supported a technical review that examined aquifer characteristics in Area H, including investigating aquifer recharge areas. This work directly influenced the Area H Official Community Plan update, which sets clear objectives and policies to protect freshwater resources.

- Program staff also supported RDN's Planning Department with creation of the Yellowpoint Aquifer Protection Development Permit Area in amendments to the Area A Official Community Plan (RDN, 2011a). This requires that new development in that permit area must have additional rainwater storage to protect the sensitive aquifer.

- The *Agricultural Area Plan* (Upland Consulting, 2012) was adopted by the RDN Board in 2012 and includes aspirational goals and objectives to improve opportunities for on-farm water resource management.

- More strategically, through the program, the RDN also offered the Province comments and feedback on *Water Sustainability Act* development (see RDN, 2015a; RDN, 2013; RDN, 2010). We understand from contacts in the Province that this type of stakeholder feedback had a meaningful impact on shaping public policy and legislation in the new Act and its regulations.

4.3.3 Challenges

- **Land Use and Watershed Planning Objectives Have Not Yet Been Fully Realized**

While we can look with optimism at these several accomplishments in supporting land use planning, it is also clear that there is a general consensus among staff and stakeholders alike that ambitions of the 2007 *Action Plan* in this realm have not yet been fully met. Our reading of the plan was that it intended to see comprehensive reforms toward water-based land use planning. Partially as a result of this vision, some stakeholders have heightened expectations of what watershed protection should mean, for example, when a development is approved near a stream. However, despite the obvious effort to assemble necessary information and public support, setting progressive, water-driven objectives for land use management and policy remains a challenge, and the original vision remains elusive.

We have observed that the reasons for this are complex, involving an array of organizational and regulatory considerations. First, there are multiple actors and agencies involved including provincial approving authorities in several ministries, local municipalities, industry, developers and others.

Second, planners and decision makers face historical constraints including jurisdictional and regulatory limitations. For example, the current Regional Growth Strategy (RDN, 2011b) was largely developed before Drinking Water and Watershed Protection implementation fully commenced, as were most Electoral Area Official Community Plans. As well, RDN can only intervene in land use where it has legislative authority to do so. For example, it has limited authority over existing water rights, private forest land matters, rural road drainage, or existing zoning provisions.

Third, as noted above, it takes a great deal of time to gather data and create robust knowledge on aquifers and streams, in some cases decades. It also takes time to develop community support for watershed protection. Several informants stated that they did not believe that RDN had the foundation of sufficient information to support substantially different decision making in this area until very recently. Even where data and information has been attained, this typically provides indicators only. This nuance and the limitations of applying information to specific uses, such as land use planning, is not well understood by the public.

Finally, there is the plain reality that land use decision making is simply very difficult and influenced by many factors. The process is intensely political because there can be winners and losers and certain kinds of development may be hindered. Simply put, educational efforts and scientific data collection are much easier, so it is not at all surprising that more progress has been made in those areas to date.

There are undeniable benefits to being aspirational in strategic planning because it engenders sustained interest and excitement. However, more than one informant suggested that the 2007 *Action Plan* may have over-reached to some extent in its ambitions around planning and policy. It is not immediately clear that RDN could achieve the full breadth of what was called for in a span as short as ten years. This is particularly so with respect to the watershed management planning recommendations under Program 4, where involvement and buy-in from a broad range of stakeholders would be demanded, including the Provincial Government.

At the same time, there is also much evidence that the stage is now set for different results in the next operational period. As noted above, operationalization of data is underway, and there are specific, recent instances where we see this influencing decisions. Analysis is now available that shows water quality or quantity constraints. This has been provided for consideration in development referrals and to external agencies (for example, to subdivision approving officers at the Ministry of Transpiration and Infrastructure and to regional water managers in the Ministry of Forests, Lands, Natural Resource Operations and Rural Development).

Within RDN, work is currently underway on a policy that will identify and standardize the technical information required for rezoning applications to confirm that the potable water needs of proposed parcels or use can be met where community water service is not available. This will provide consistency in the review of development proposals and ensure greater assessment of impacts of rezoning on aquifers and streams.

We also heard from staff in both the Drinking Water and Watershed Protection and in Strategic and Community Development that they are already turning their minds to the importance of water sustainability in planned updates to the Official Community Plans for Electoral Areas A, C, F and G.

As a critical mass of data and information becomes available to influence decision making, we suggest that a key task for the update to the *Action Plan* is to set clear and attainable goals for land use planning in the next operational period. This would include clarifying how technical expertise (e.g., in hydrology) will be procured and what new and different regulatory authorities will be needed. A collaborative, inter-departmental effort will be required to ensure that this updated plan reflects attainable and universally supportable goals that strike the right balance between protecting water resources and enabling community growth and development.

4.3.4 Summary

Attention to policy advocacy and planning support will no doubt remain a key focus in the future. The science-based approach of the program, the fact that it brings together multiple agencies, and the foundation built on data and information and public support lead us to believe that the full potential of the program in this area is yet to be realized.

Opportunities for the next operational period include the following:

- Set clear and attainable goals for land use planning support and water policy advocacy in the next operational period, including clarification of what technical expertise and information products will be required. Specifically, identify what will be required to set water-driven objectives for land use management in scheduled updates to official community plans and the Regional Growth Strategy.

4.4 Other Observations

Our research uncovered several other opportunities to improve the impact of the Drinking Water and Watershed Protection Program that merit brief attention here.

4.4.1 Stronger First Nations Engagement

RDN staff concede that more work needs to be done to engage with the Qualicum, Snaw-naw-as, Snuneymuxw and other area First Nations on program implementation and there appear to be many promising opportunities to do so. For example, while we understand invitations have been extended in the past, there are no First Nations representatives on the Technical Advisory Committee. First Nations could be key partners in watershed monitoring activities (the Qualicum First Nation has assisted with site selection in the past). Traditional ecological knowledge can enhance science-based knowledge created through the program. First Nations communities could be more frequent recipients of outreach support from Team WaterSmart (similar to support already received by municipal governments).

However, individual First Nations will certainly have their own perspectives on how (or whether) they want to participate in the program and regional governance generally.[13] We recommend that RDN make it a priority to more actively engage with First Nations on a government-to-government basis to identify the ways in which they would like to participate in program implementation in the future.

4.4.3 Recognize Key Integrations with Other RDN Programs Including *Liquid Waste Management Plan* Implementation and Emergency Services

The relationship between the Action Plan and 2014 amendments to RDN's Liquid Waste Management Plan (LWMP) requires brief attention because of several areas of integration. This is because the Drinking Water and Watershed Protection Program now delivers on regulatory requirements under the LWMP related to rainwater management and watershed management/protection.

The LWMP is a component of RDN's legal authorization to discharge wastewater under the Environmental Management Act. The BC Ministry of Environment and Climate Change requires RDN, as a discharger, to meet these specific commitments and implement the rainwater management and watershed protection programs. As such, implementation now addresses not just drinking water and watershed protection goals, but is also a progressive and effective part of meeting wastewater discharge requirements. We understand from staff that, without this, extensive and costly additional regulatory requirements would have likely been imposed under the LWMP.

The LWMP commits to implement all seven Action Plan programs including integrated watershed management planning. More specifically, it calls for continued implementation of the RDN Water Conservation Plan and refinement of the water budget program to assist in land use decisions. As well, it requires continuation and evolution of water education and incentive programs and watershed monitoring partnerships (RDN, 2014). It also calls for action

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[13] In other regions on Vancouver Island, First Nations have articulated a preference to be represented at the decision-making level, and in fact have successfully secured seats at the Board level in the Alberni-Clayoquot Regional District.

on rainwater management, in particular developing a specific strategy with targets and standards to mitigate impacts of land development.

In a similar vein, as the program has matured, it is increasingly making important contributions to RDN's Emergency Services Program. For example, monitoring stations established through the program (in addition to pre-existing stations) provide real time climate and stream water level data. DWWP staff compile and report this to the Emergency Operations Centre and/or Emergency Program staff in support of flood or fire response.

We recommend that these important inter-relations be recognized and incorporated in the upcoming Action Plan update.

4.4.3 Enhanced Inter-Departmental Coordination

Organizationally, there are many benefits and synergies to situating the program within the Regional and Community Utilities Department. However, going forward, if the program is to continue to evolve into a more strategic role and become more focused on land use and planning, we see benefits to enhancing coordination with other departments, particularly Strategic and Community Development. We would not immediately recommend reorganization, and in any case, such considerations are beyond the scope of our work. However, we suggest considering other means to improve coordination including mechanisms such as inter-departmental working groups and temporary staff cross-appointments. This may result in stronger collaboration and broader organizational focus for the program.

4.4.4 Increase Effort to Communicate the Value of the Program

A number of informants told us that they believe more effort needs to be invested in communicating the value of the program more broadly. The program does a very good job of explaining the “what” (what kind of toilet should I buy? what is the water quality situation in the stream? what should I do about my well?). Going forward, we suggest much more effort should go into explaining the “why” (why should I care about watershed protection? why do particular development patterns need to change? why does the parcel tax represent outstanding value?). Integral to this is explaining clearly and concisely why watershed protection matters, not just in terms of ecosystem values, but also community, financial, and infrastructure values. As discussed above, this is another reason to refine communications through all channels, make it less information intensive, and become more focused on pre-meditated key messages. We also anticipate a need to create more opportunities to communicate with RDN Board members and elected officials in member municipalities about the many benefits that the Drinking Water and Watershed Protection Program creates. This in turn will enable them to more actively champion it and ensure community support is maintained.

4.5 Reconciliation against the 2007 *Action Plan*

At this point in the report, it will be clear to the reader that significant progress has been made against the 2007 *Action Plan*. Staff, partners and the RDN Board have remained faithful to this original source document and tangible advancement is demonstrable against all programs and goals, though unevenly. As documented above, more evolution can be observed in outreach, education, science and monitoring, and notably less in planning and policy goals.

For the reader wanting a more direct comparison of progress against the *Action Plan*, see Table 7, below. This table is based on one provided to us by RDN staff, which they use for internal tracking purposes. It is largely unedited except for some simplification for ease of readability and to provide consistent terminology. Based on our evaluation, we cannot see much reason to challenge RDN's internal evaluations. In other words, their self-assessment of progress is, on the whole, accurate. However, four clarifying notes may be useful.

First, progress against Actions 3A (Land Development Standards) and 3C (Development Charges) are both labelled "Not Initiated", in red. We understand that this is symptomatic of the more general delays in progress against key planning initiatives that are fully documented in section 4.3, above. However, more tactically, we also understand that these actions were deferred fairly early in the implementation history as a result of internal discussions by staff in Regional and Community Utilities and Strategic and Community Development Services. This resulted in a conclusion that effort would be better directed at influencing other planning processes and activities, such as OCP revisions.

Second, progress against Action 6B (Agriculture and Forestry) has been limited. In the Action Plan, it was envisioned that the program would find ways to influence farming and forestry operations to protect water sources from contamination and to steward watersheds. We see several reasons for hindered progress here. One is simple resource constraints. With limited budgets, it is hard to see that all actions could be fully implemented in as few as ten years. Another is that, unlike the very concrete goals elsewhere in the Action Plan, the prescribed actions in this area are comparatively vague, so it is hard to know by what standard to measure advancement. Finally, it must be pointed out that RDN's authority in this area is quite limited. Both sectors are regulated by the Provincial Government, and both largely take place on private lands in the region.

However, it is also important to point out that some measurable progress has taken place under this action. For example, the forestry sector actively participates on the Technical Advisory Committee and enthusiastically and measurably supports RDN's monitoring and outreach efforts. As well, RDN's *Agricultural Area Plan* (Upland Consulting, 2012) includes aspirational goals and objectives for on-farm water resource management.

Third, in at least one area, on-site sewage disposal (Action 6D), the commitments in the Action Plan are now largely implemented by Wastewater Services through their SepticSmart outreach program.[14] This initiative provides workshops and toolkits to residents to ensure that on-site systems are functioning properly. It also provides rebates for septic system maintenance, contact information for certified professionals, and we understand that Wastewater Services coordinates with Island Health on regulatory functions. This, however, is largely a matter of administrivia rather than a statement about implementation status.

Finally, how the area of climate change (Program 7) in the Action Plan has been treated and tracked is interesting. The context here has changed remarkably since the plan was originally penned. Climate change was still a relatively new concept a decade ago, whereas it is evolved to now be accepted as simply an operational context, in much the same way as other issues such as land use pressures or population growth. As such, staff no longer consider this a separate issue, but instead view it as something that must simply be integrated into implementation generally. We see this as an entirely appropriate approach.

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[14] See https://www.rdn.bc.ca/septicsmart

Table 7: Reconciliation of Progress against the 2007 Action Plan

Action Plan Program	Action Plan Action	Status	Key Initiatives
1 - Public Awareness and Involvement	1A: The WaterSmart Program	Ongoing	DWWP and Team WaterSmart website Water Saver Contest & Watershed Friendly Lawn Campaign Publications and Media Coverage “State of” reports Irrigation Check Ups
	1B: Coordinated Information and Education Resources	Ongoing	DWWP TAC School field trips and presentations Educational outreach display booth wellSMART workshops Team WaterSmart workshops and events
	1C: Demonstration Projects	Partial	Innovative water conservation technologies tour
	ID: Support for Volunteers and Non-profit Organizations	Ongoing	Surface Water Quality Monitoring CWMN annual training CWMN monitoring equipment sign-out Stewardship seed funding Annual CWMN results session meeting
2- Water Resources Inventory and Monitoring	2A: Compilation and Mapping of Existing Data	Ongoing	GIS Water Map Phase 1 Water Budget Study
	2B: Additional or New Data Collection	Ongoing	BC Obs Well Network expansion Volunteer Observation Well Network Community Watershed Monitoring Network (CWMN) Hydrometric and climate monitoring Well water quality - voluntary results submission Phases 2 & 3 of Water Budget Analysis Physical Stream Assessments - USHP Nanaimo lowlands aquifer characterization Wetland mapping and inventory
	2C: Water Quality Monitoring	Ongoing	Community Watershed Monitoring Network (CWMN) Well water quality - voluntary results submission South Wellington- Cassidy Groundwater Quality Study
	2D: Data Response Systems	Underway	Phase 1 --> Phase 2 Water Budget
		Underway	Water Quality Objectives
		Ongoing	Support for Emergency Operations Centre (EOC)
3- Land Planning and Development	3A: Land Development (Engineering) Standards	Not Initiated	N/A
	3B: Development Application Review	Ongoing	Policy B1.21 Revision Policy (groundwater requirements for rezoning unserviced lands) Yellow Point Aquifer DPA - requires rainwater harvesting DPA Review - updating language and best practices
	3C: Development Charges	Not Initiated	N/A
	3D: Planning Tools	Ongoing	Hydrogeological Assessment for Area H OCP update

Action Plan Program	Action Plan Action	Status	Key Initiatives
4 - Watershed Management Planning	4A: Watershed Prioritization	Partial	Phase 1 Water Budget
	4B: Watershed Management Planning	Not as Described	Working through OCP process; new Water Sustainability Plans will be investigated for priority areas.
	4C: Support Local Food Production	Partial	Agricultural Water Demand Model
5- Water Use Management	5A: Water Conservation Plans	Ongoing	RDN WSA Water Conservation Plan - completed alongside City of Nanaimo's Plan Evaluation of RDN WSA Water Conservation Targets, Trends, Trajectory
	5B: Cooperation among Community Water Supply Systems	Ongoing	Water Purveyor Working Group Harmonized Watering Restrictions Framework & comms coordination Region-wide incentive programs Collaboration with Ops dept; some items to come out of upcoming Water System Risk Plan
	5C: Rainwater and Greywater Use	Ongoing	Rainwater Harvesting Best Practices Guidebook Rainwater harvesting, Greywater workshops Info session for building inspectors Lobbying senior government via UBCM - rainwater for potable use Build off MoH Greywater Manual - best practices for residents (upcoming)
	5D: Incentive Programs	Ongoing	Toilet, rainwater, wellhead upgrade, well water testing, irrigation upgrades, soil improvements
	5E: Water Use Regulation	Ongoing	Provided comments to Province during consultation period for new *Water Sustainability Act* Organized info sessions on new groundwater regulations Review license applications as agency on Water Licenses
6- Water Quality Management	6A: Contaminant Management	Partial	Info not distributed directly, but requirements exist at rezoning stage Done at a provincial level with Well Protection Tool Kit; not mapped beyond zoning maps.
	6B: Agriculture and Forestry	Partial	Forestry reps participate on TAC; DWWP has interacted with Agricultural Advisory Committee on occasion
	6C: Private Water Well Safety	Ongoing	Well water quality testing - rebate and data submission
	6D: On Site Sewage Disposal	Ongoing	This is implemented via Septic Smart - administered by the WWS department as part of the LWMP commitments
7- Climate Change	7A: Follow the Science 7B: Land and Water Use Adaptation 7C: Assessing Local Hydro-climatic Balance	Partial	Actions are integrated into ongoing initiatives

Source: based on RDN (2018a)

5.0 Conclusion and Consolidated List of Opportunities

This report has attempted to inventory these many successes, as well as some of the challenges the Drinking Water and Watershed Protection Program has faced over the past decade in comparison to the goals and actions set in the 2007 *Action Plan*.

While we have identified a number of opportunities for improvement in the next operational period, it must be restated in summation that the work of the program to date has been nothing less than remarkable and highly successful.

More specifically, the vital importance of partnerships with other agencies, industry and the not-for-profit sector needs to be reemphasized. As one staff member put it, "it is an effort of everyone in the community working together and this is a key benefit of the program. You need that to implement change" (Fegan, 2018). The program offers a necessary point of connection for different groups and agencies around the region and the collaboration it facilities was cited by many as absolutely key to success.

The importance of the sustainable funding model in RDN for watershed protection, in the form of the annual parcel tax, also needs to be stressed. While the budget demand is actually relatively modest, the program does very well with what they have. In fact, they are able to leverage this to attain significant additional funding and volunteer efforts to support watershed protection. Based on our experience working with other jurisdictions around the country, we see this stable funding as key and a major differentiator from similar programs. Because there is a stable revenue source, RDN is not in a cycle of always looking for operating dollars and so can focus on implementation. As one observer put it, "I think the community has had really good value for their money" (Lapcevic, 2018).

Finally, the unique nature of this initiative compared to similar ones elsewhere in the Province must be underscored. To the best of our knowledge, no other regional district has a watershed protection function with taxation authority comparable in scope or longevity, putting RDN very far ahead of other communities. Other jurisdictions look to RDN as a model and remark on the success. This can be a source of pride for the organization.

In closing, despite the challenges we have outlined, like every one of the informants we spoke to during the review, we see great prospects for the Drinking Water and Watershed Protection Program. There is clear and strong support for this initiative both inside and outside the organization, support that has been well maintained for a decade. The result has been a long list of accomplishments in science and data attainment, education and outreach, and improved land use planning and policy. People recognize that RDN has a tremendous asset in the program staff and that there are very productive partnerships enabling ongoing implementation. The foundation is laid for very bright future in the next operational period.

5.1 Consolidated List of Opportunities

1. Continue to implement the water monitoring data management framework and associated internal staff work plans and ensure this is incorporated into the *Action Plan* update.

2. Continue efforts to move water monitoring data to open, centralized Provincial databases.

3. Where Provincial Government capacity and infrastructure gaps around water data management exist, work with and encourage the Province to fill them.

4. Ensure that operationalizing data attained in the past decade is a key focus of the update to the *Action Plan*; that is, ensure the new plan gives explicit attention not just to data collection but to identifying, in practical terms, what information products are required, what skill sets are needed to produce them, and how they will be used to set objectives for and monitor watershed management.

5. Reduce the information intensity of communications, focusing more on simpler messages that emphasize why watershed protection and conservation are important.

6. Complete a review of branding and consider developing corporate style guidance specifically for the program.

7. Conduct market research with residents to understand their attitudes towards water sustainability and conservation and to seek answers to applied questions about matters such as penetration of water efficient fixtures and appliances and outdoor water use behaviour.

8. Continue to conduct analysis to quantify the impact of the program and its specific initiatives on per capita water demand.

9. Update the RDN water conservation plan with attention to best practices from leading North American jurisdictions; plan to employ demand management techniques that are more targeted at specific user groups, specific end uses of water, and less frequently engaged sectors (such as non-residential customers).

10. Support member municipalities with adoption and implementation of innovative best practice water conservation practices in areas of their domain.

11. Set clear and attainable goals for land use planning support and water policy advocacy in the next operational period, including clarification of what technical expertise and information products will be required. Specifically, identify what will be required to set water-driven objectives for land use management in scheduled updates to official community plans and the Regional Growth Strategy.

12. As a priority, actively engage with First Nations on a government-to-government basis to identify how they would like to participate in implementation in the future.

13. Recognize and incorporate key integrations with other RDN programs including Liquid Waste Management Plan implementation and support for Emergency Services in the pending Action Plan update.

14. Investigate options to improve interdepartmental coordination on watershed protection in the next operational period.

15. Increase efforts to communicate the value of the program and watershed protection to residents, elected officials, and stakeholders, focusing on the “why”.

6.0 References

Aquavic Water Solutions (2013). Water Conservation Plan. Prepared for RDN, October 2013.

Donnelly, M. (2015). Drinking Water & Watershed Protection Program Overview. Presentation to the Sustainable Watershed Governance Funding Workshop, 24 June 2015.

Epps, K. (2018). Strategic Forester. Island Timberlands. Personal Interview, interviewed on 12 July, 2018.

Fegan, L. (2018). Special Projects Assistant. Regional District of Nanaimo. Personal Interview, interviewed on 23 July, 2018.

Geological Survey of Canada (2016). Nanoose Bay – Deep Bay Area, Nanaimo Lowland Groundwater Study Atlas. Open File 7877, prepared for RDN, compiled by H.A.J. Russell and N. Benoit, Natural Resources Canada.

Golder Associates (2017). Water Monitoring Data Management Framework for the RDN DWWP Program. Prepared for RDN, prepared by B. Waller, 11 September 2017.

Golder Associates. (2016). Water Monitoring Plan for Nanoose (Electoral Area E), District of Nanaimo, BC. Report to RDN, December, 2016.

Kerr Wood Leidal (2015). Regional Climate and Hydrometric Monitoring Network Scoping Study. Report prepared for RDN, prepared by C. Sutherland.

Lanarc (2007). Drinking Water and Watershed Protection Action Plan. Prepared for the Drinking Water-Watershed Protection Stewardship Committee, Nanaimo BC, October 2007.

Lapcevic, P. (2018). Water Protection Section Head, West Coast Region. Forests, Lands, Natural Resource Operations & Rural Development. Personal interview, interviewed on 9 July, 2018.

Law, P. (2018). Community/Stewardship Representative. Mid Vancouver Island Habitat Enhancement Society. Personal Interview, interviewed on 23 July, 2018.

McKenzie-Mohr, D. (2011). *Fostering Sustainable Behavior: An Introduction to Community-Based Social Marketing*. 3rd ed. New Society, Gabriola Island.

Magee, L. (2018). Regional Drinking Water Coordinator. Island Health. Personal Interview, interviewed on 26 July, 2018.

McSorely, H. (2018a). Team WaterSmart Free Irrigation Check-Up Service: Conservation Program Impact Evaluation. Report prepared for Team WaterSmart, Drinking Water & Watershed Protection Program, Regional District of Nanaimo, March 2018.

McSorely, H. (2018b). Water Conservation Evaluation: Targets, Trends and Trajectories. Report prepared for Team WaterSmart, Drinking Water & Watershed Protection Program, Regional District of Nanaimo, June 2018.

Piteau Associates. (2016). Scoping for Phase 2 Water Budgets in Priority Areas in French Creek and Cedar-Yellowpoint. Report to RDN Water Service, December 2016.

RBC Blue Water Project (2017). 2017 RBC Canadian Water Attitudes Study. Accessed at http://www.rbc.com/community-sustainability/environment/rbc-blue-water/water-attitude-study.html. Accessed on 20 September 2018.

RDN (2018a). DWWP Action Plan – Program Status Tracking. Excel spreadsheet. Updated 16 July 2018.

RDN (2018b). RDN's Drinking Water & Watershed Protection Action Plan - Retrospective: Looking Back So We Can Plan Ahead. Presentation to Staff and TAC Workshops. Prepared by J. Pisani, July 2018.

RDN (2017a). 2018 Budget Highlights Memo - Drinking Water and Watershed Protection. Prepared by J. Pisani, 9 October 2017.

RDN (2017b). State of Our Aquifers 2017. Newsletter for residents.

RDN (2015a). Comments on Proposed Policies under the BC Water Sustainability Act. Prepared by J. Pisani, 19 October 2015.

RDN (2015b). State of Our Streams 2015. Newsletter for residents.

RDN (2014). Liquid Waste Management Plan Update. File No 5340-20, January 2014.

RDN (2013). Water Sustainability Act – Legislative Proposal Response. Prepared by M. Donnelly, 1 November 2013.

RDN (2012a). Drinking Water & Watershed Protection - Technical Advisory Committee Terms of Reference. Prepared January 2012, updated April 2016. Accessed at https://www.rdn.bc.ca/cms/wpattachments/wpID2501atID7826.pdf Accessed on 16 September 2018.

RDN (2012b). Rainwater Harvesting Best Practices Guidebook: Design and Installation. Nanaimo, BC.

RDN (2011a). Yellowpoint Aquifer Protection Development Permit Area. Section 12.9. Excerpt.

RDN (2011b). Shaping Our Future – Regional Growth Strategy, Bylaw No. 1615, 22 November 2011.

RDN (2010). Water Act Modernization – Discussion Paper Submission. Prepared by M. Donnelly, 22 April 2010.

RDN (2008). Drinking Water and Watershed Protection Service Establishing Bylaw No. 1556. Prepared by M. Donnelly, File # 0360-20-DWWP 5500-22-25, 14 August 2008.

RDN (nd). Landscape Guide to Water Efficiency. Accessed at https://www.rdn.bc.ca/cms/wpattachments/wpID2155atID3697.pdf. Accessed on 16 September 2018.

Sims, B. (2018). Director of Engineering & Public Works. Regional District of Nanaimo. Personal Interview, interviewed on 16 July, 2018.

Upland Consulting (2012). Growing our Future Together: RDN Agricultural Area Plan. Prepared for RDN, August 2012. Accessed at https://www.rdn.bc.ca/cms/wpattachments/wpID2520atID5166.pdf. Accessed on 16 September 2018.

Regional District of Nanaimo
Drinking Water & Watershed Protection Program:
10 Year Action Plan Implementation Review

Appendix Package
September 2018

Prepared for

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Appendices

Appendix 1

Bibliography

Bibliography

The following bibliography itemizes the documents provided to us by RDN that were reviewed in the course of the program review. A number of these are also referenced in the main report.

Aquavic Water Solutions (2013). Water Conservation Plan. Prepared for RDN, October 2013.

Donnelly, M. (2015). Drinking Water & Watershed Protection Program Overview. Presentation to the Sustainable Watershed Governance Funding Workshop, 24 June 2015.

Geological Survey of Canada (2016). Nanoose Bay – Deep Bay Area, Nanaimo Lowland Groundwater Study Atlas. Open File 7877, prepared for RDN, compiled by H.A.J. Russell and N. Benoit, Natural Resources Canada.

Golder Associates (2017). Water Monitoring Data Management Framework for the RDN DWWP Program. Prepared for RDN, prepared by B. Waller, 11 September 2017.

Golder Associates. (2016). Water Monitoring Plan for Nanoose (Electoral Area E), District of Nanaimo, BC. Report to RDN, December, 2016.

HB Lanarc Consultants Ltd. (2010). Watershed Snapshot Report 2010. Report prepared for Regional District of Nanaimo, November 2010.

HB Lanarc Consultants Ltd. (2008). Innovative Options and Opportunities for Sustainable Water Use. Report prepared for Regional District of Nanaimo, May 2008.

Kerr Wood Leidal (2015). Regional Climate and Hydrometric Monitoring Network Scoping Study. Report prepared for RDN, prepared by C. Sutherland.

Lanarc (2007). Drinking Water and Watershed Protection Action Plan. Prepared for the Drinking Water-Watershed Protection Stewardship Committee, Nanaimo BC, October 2007.

McSorely, H. (2018). Team WaterSmart Free Irrigation Check-Up Service: Conservation Program Impact Evaluation. Report prepared for Team WaterSmart, Drinking Water & Watershed Protection Program, Regional District of Nanaimo, March 2018.

McSorely, H. (2018). Water Conservation Evaluation: Targets, Trends and Trajectories. Report prepared for Team WaterSmart, Drinking Water & Watershed Protection Program, Regional District of Nanaimo, June 2018.

Piteau Associates. (2016). Scoping for Phase 2 Water Budgets in Priority Areas in French Creek and Cedar-Yellowpoint. Report to RDN Water Service, December 2016.

RDN (2018). DWWP Action Plan – Program Status Tracking. Excel spreadsheet. Updated 16 July 2018.

RDN (2018). RDN's Drinking Water & Watershed Protection Action Plan - Retrospective: Looking Back So We Can Plan Ahead. Presentation to Staff and TAC Workshops. Prepared by J. Pisani, July 2018.

RDN (2018). 2018 Business Plan: Drinking Water and Watershed Protection Program.

RDN (2017). Drinking Water & Watershed Protection Program. Presentation to the Provincial Water Working Group. Prepared by J. Pisani, 9 November 2017.

RDN (2017). Staff Report: September 2017 Drinking Water and Watershed Protection Program Update. Prepared by J. Pisani, File #5600-0, 12 September 2017.

RDN (2017). State of Our Aquifers 2017. Newsletter for residents.

RDN (2017). 2018 Budget Highlights Memo - Drinking Water and Watershed Protection. Prepared by J. Pisani, 9 October 2017.

RDN (2017). 2017 Business Plan: Drinking Water and Watershed Protection Program.

RDN (2016). Drinking Water & Watershed Protection - Technical Advisory Committee Terms of Reference.

RDN (2016). Team WaterSmart: Nominate Your Neighbour Who's a Water Saver! Prepared by D. McGillivray, May/June 2016.

RDN (2016). 2017 Budget Highlights Memo - Water Services and Asset Management. Prepared by C. Midgley, 24 October 2016.

RDN (2016). 2016 Business Plan: Drinking Water and Watershed Protection Program.

RDN (2015). Comments on Proposed Policies under the BC Water Sustainability Act. Prepared by J. Pisani, 19 October 2015.

RDN (2015). Drinking Water & Watershed Protection Program. Presentation to the RDN Board, March 2015.

RDN (2015). State of Our Streams 2015. Newsletter for residents.

RDN (2015). 2016 Budget Highlights Memo - Water & Utility Services. Prepared by M. Donnelly, 5 November 2015.

RDN (2015). 2015 Business Plan: Drinking Water and Watershed Protection Program.

RDN (2014). Liquid Waste Management Plan Update. File No 5340-20, January 2014.

RDN (2014). 2015 Budget Highlights Memo - Water & Utility Services. Prepared by M. Donnelly, 9 October 2014.

RDN (2014). 2014 Business Plan: Drinking Water and Watershed Protection Program.

RDN (2013). Newsletter – Drinking Water and Watershed Protection Program. May 2013.

RDN (2013). Water Sustainability Act – Legislative Proposal Response. Prepared by M. Donnelly, 1 November 2013.

RDN (2013). 2014 Annual Budget Discussion - Water & Utility Services. Prepared by M. Donnelly, 25 October 2013.

RDN (2013). 2013 Business Plan: Drinking Water and Watershed Protection Program.

RDN (2012). Drinking Water & Watershed Protection - Technical Advisory Committee Terms of Reference. Prepared January 2012, updated April 2016. Accessed at https://www.rdn.bc.ca/cms/wpattachments/wpID2501atID7826.pdf Accessed on 16 September 2018.

RDN (2012). Rainwater Harvesting Best Practices Guidebook: Design and Installation. Nanaimo, BC.

RDN (2012). 2012 Business Plan: Drinking Water and Watershed Protection Program.

RDN (2012). 2011 – 2012 Budget Overview, Water Services. Prepared by M. Donnelly, 3 November 2011.

RDN (2011). Shaping Our Future – Regional Growth Strategy, Bylaw No. 1615, 22 November 2011.

RDN (2011). Yellowpoint Aquifer Protection Development Permit Area. Section 12.9. Excerpt.

RDN (2011). 2011 Business Plan: Drinking Water and Watershed Protection Program.

RDN (2010). Water Act Modernization – Discussion Paper Submission. Prepared by M. Donnelly, 22 April 2010.

RDN (2010). 2010 Business Plan: Drinking Water and Watershed Protection Program.

RDN (2009). 2009 Business Plan: Water, Sewer, Stormwater, Street Lighting Utility Services & Drinking Water and Watershed Protection.

RDN (2008). Drinking Water and Watershed Protection Service Establishing Bylaw No. 1556. Prepared by M. Donnelly, File # 0360-20-DWWP 5500-22-25, 14 August 2008.

RDN (2008). Proposed Drinking Water Watershed Protection Action Plan. Prepared by M. Donnelly, File # 0360-20-DWWP, 30 January 2008.

RDN (nd). Landscape Guide to Water Efficiency. Accessed at https://www.rdn.bc.ca/cms/wpattachments/wpID2155atID3697.pdf. Accessed on 16 September 2018.

Upland Consulting (2012). Growing our Future Together: RDN Agricultural Area Plan. Prepared for RDN, August 2012. Accessed at https://www.rdn.bc.ca/cms/wpattachments/wpID2520atID5166.pdf. Accessed on 16 September 2018.

List of Collateral

The following list itemizes the marketing and communications material provided to us by RDN that were reviewed in the course of the program review.

RDN. (2018). Irrigation Upgrades & Soil Improvements [Fact sheet].

RDN. (2018). 2018 Rainwater Harvesting Rebate Information [Fact sheet].

RDN. (2018). 2018 Well Water Testing Information [Fact sheet].

RDN. (2018). 2018 Wellhead Upgrades Rebate Information [Fact sheet].

RDN. (2017). State of our Aquifers 2017 – Groundwater Levels Edition [Newsletter].

RDN. (2015). State of our Streams 2015 – Water Quality Edition [Newsletter].

RDN. (2015). wellSMART workshop [PowerPoint presentation]. Retrieved from https://www.rdn.bc.ca/cms/wpattachments/wpID2284atID7237.pdf

RDN. (n.d.) Exploring our Watersheds and Discovering Connections: Teacher Planning & Activity Guide.

RDN. (n.d.). How to Check For a Leak [Handout].

RDN. (n.d.) Irrigation Upgrades & Soil Improvements Rebate [Pamphlet].

RDN. (n.d.) Rainwater Harvesting Rebate [Pamphlet].

RDN. (n.d.). [Advertisement for RDN].

Team WaterSmart. (2018). Community Watershed Monitoring Network [Fact sheet].

Team WaterSmart. (2018). Enter the Water Saver Contest [Entry Form].

Team WaterSmart. (2018). Free Irrigation Check-up Service [Letter].

Team WaterSmart. (2018). Healthy Lawn Care [Brochure].

Team WaterSmart. (2018). Irrigation Check-up Summary Report. Nanaimo, BC: Regional District of Nanaimo.

Team WaterSmart. (2018). Let’s all reduce water use! [Yard Sign].

Team WaterSmart. (2018). Water Wise Gardening [Brochure].

Team WaterSmart. (2016). Alternatives to Pesticides [Brochure].

Team WaterSmart. (2016). Top 10 Irrigation Tips [Brochure].

Team WaterSmart. (2016). Utilizing Rain Barrels [Brochure].

Team WaterSmart. (2013). Efficient Appliances – Bathroom, Kitchen & Laundry [Brochure].

Team WaterSmart. (2013). Identifying Leaks [Brochure].

Team WaterSmart. (2013). Installing a New Showerhead [Brochure].

Team WaterSmart. (2013). Water Efficient Toilets [Brochure].

Team WaterSmart. (n.d.). Alternatives to Synthetic Pesticides [Handout].

Team WaterSmart. (n.d.). General Irrigation System Programming Guidelines [Fact sheet].

Team WaterSmart. (n.d.). Frequently Asked Questions [Fact sheet].

Team WaterSmart. (n.d.). Landscape Guide to Water Efficiency [Program Guide].

Team WaterSmart. (n.d.). Native Plants [Fact sheet].

Team WaterSmart. (n.d). Rain Gardens [Fact sheet].

Team WaterSmart. (n.d.). We practice watersmart irrigation [Bumper sticker].

Team WaterSmart. (n.d.). What is saltwater intrusion [Handout]. Retrieved from https://www.getinvolved.rdn.ca/4530/documents/10754.

Team WaterSmart. (n.d.). 2016 Watering Restrictions [Sticker].

Appendix 2

Interview Discussion Guide

Regional District of Nanaimo
Drinking Water & Watershed Protection Program
10 Year Action Plan Implementation Review
Project Overview

The RDN Drinking Water and Watershed Protection Action Plan was adopted by the RDN Board in 2008 to achieve three objectives:

- increase the level of knowledge regarding drinking water sources and the challenges to their long-term sustainability with respect to development and land use pressures;
- coordinate efforts of Provincial and Local governments and non-governmental organizations; and,
- increase the level of public awareness regarding drinking water and watershed protection issues and RDN activities.

Implementation of the 10-year Action Plan began in 2009. It identifies seven key programs with 26 discreet actions that fall into three general categories: 1) water education & outreach; 2) water science: data collection & monitoring; and, 3) water policy advocacy and planning support.

Many actions under these categories have been successfully implemented and several are ongoing. As we approach the 10-year mark of implementation, a program review is required to evaluate the effectiveness of the Action Plan, and to ensure planning for future programming is informed by past performance and current priorities.

To this end, following a competitive bidding process, RDN hired Victoria-based Econics to conduct an independent review of the implementation of the Drinking Water & Watershed Protection Action Plan. Econics works exclusively in the area of water sustainability in BC and across Canada. Lead consultants Kirk Stinchcombe and Rebecca Mersereau bring both process expertise and deep subject matter knowledge in water resource management.

Methodologically, Econics' program review will draw information from the following sources, working closely with the Drinking Water and Watershed Protection Program Coordinator:

- a literature review of relevant documentation;
- RDN staff interviews and a staff workshop;
- a workshop with the Program Technical Advisory Committee; and,
- interviews with select stakeholders.

The review kicked off in late June and will take place over the summer. Results will be compiled and presented to the RDN Board in September 2018, followed by the project wrap up in late October. The intent is that this project will pave the way for a larger scope of work, the Drinking Water and Watershed Protection Action Plan *Update* project, expected to take place in 2019.

10 Year Action Plan Implementation Review
Interview Discussion Guide

The questions below are intended to guide our scheduled interview, which will take about one hour to complete. More information about the project and how your input will be used will be provided at the start of the interview. Meanwhile, if you have any questions or concerns, please contact Kirk Stinchcombe at kirk@econnics.com or +1 250 588 6851.

1. When and how did you become involved with the Drinking Water & Watershed Protection Program? What has your experience with the program been like so far?

2. Thinking about your specific area of specialization, what benefits has the Drinking Water & Watershed Protection Program produced over the past decade?

3. Thinking again about your specific area of specialization, has program implementation been technically robust? For example, has management of data and information been effective? Has water and watershed science been effectively applied?

4. Thinking about project management, do you think that RDN has done a good job of managing the implementation of the program? Has work been completed on time? On budget? Where has RDN been most successful when it comes to project management? Where are the main areas for future improvement?

5. In your view, how effective has the Technical Advisory Committee been in fulfilling their role of advising RDN board and staff on implementation of the Program?

6. Thinking about interagency coordination and communication (with other local governments, First Nations, the Province and the Federal Government), do you think program implementation has been successful in this area? Are roles clearly defined and understood? What are the main areas for future improvement?

7. Thinking about communications with stakeholders and the public, do you think that RDN has done a good job in this area? Where has RDN been most successful in this area? Where are the main areas for future improvement?

8. Overall, has implementation of the Drinking Water & Watershed Protection Program been successful in your opinion? Why or why not?

9. What significant challenges have come up over the course of your experience with the Drinking Water & Watershed Protection Program? How were these managed by the program team and RDN?

10. What area is most in need of improvement when it comes to implementation of the Drinking Water & Watershed Protection Program? Why?

11. What is your vision for water sustainability in the region? How has the Drinking Water & Watershed Protection Program helped move this vision forward in the 10 years since implementation commenced?

12. Is there anything else you would like to comment on regarding the program?

Appendix 3

List of Interviewees

List of Interviewees

Alexander, R. (2018). General Manager, Regional & Community Utilities. Regional District of Nanaimo. Personal Interview, 30 July, 2018

Chapman, P. (2018). Executive Director. Nanaimo & Area Land Trust. Personal Interview, interviewed on 25 July, 2018.

Epps, K. (2018). Strategic Forester. Island Timberlands. Personal Interview, interviewed on 12 July, 2018.

Fegan, L. (2018). Special Projects Assistant. Regional District of Nanaimo. Personal Interview, interviewed on 23 July, 2018.

Finnie, J. (2018). Former General Manager of Engineering and Utilities. Regional District of Nanaimo (Retired). Personal Interview, interviewed on 30 July, 2018.

Garbutt, G. (2018). General Manager, Strategic & Community Development. Regional District of Nanaimo. Personal Interview, interviewed on 25 July, 2018.

Holm, J. (2018). Manager of Planning. Regional District of Nanaimo. Personal Interview, interviewed on 25 July, 2018.

Lapcevic, P. (2018). Water Protection Section Head, West Coast Region. Forests, Lands, Natural Resource Operations & Rural Development. Personal interview, interviewed on 9 July, 2018.

Law, P. (2018). Community/Stewardship Representative. Mid Vancouver Island Habitat Enhancement Society. Personal Interview, interviewed on 23 July, 2018.

Magee, L. (2018). Regional Drinking Water Coordinator. Island Health. Personal Interview, interviewed on 26 July, 2018.

Pisani, J. (2018). Program Coordinator, Drinking Water & Watershed Protection, Regional District of Nanaimo. Personal Interview, interviewed on 5 and 25 August.

Sims, B. (2018). Director of Engineering & Public Works. Regional District of Nanaimo. Personal Interview, interviewed on 16 July, 2018.

Thompson, P. (2018). Manager of Long-Range Planning. Regional District of Nanaimo. Personal Interview, interviewed on 25 July, 2018.

Appendix 4

Workshop Agendas and Attendee Lists

Agenda

What: RDN Staff Workshop for the DWWP Action Plan Implementation Review

When: 16 July, 2018
1:00PM to 4:00PM PDT

Where: Committee Room, RDN

Why:

- To assess the effectiveness of the DWWP program
- To review what DWWP Action Plan elements have been completed and initiated, to what extent, and why
- To begin identifying potential improvements to DWWP program implementation to inform an updated plan

Preliminary Schedule	
1:00pm	Introductions & Workshop Overview
1:15pm	Drinking Water and Watershed Protection Plan Overview Presentation (Julie)
1:35pm	Focus Groups Session 1: Debrief on Specific DWWP Programs & Actions
2:15pm	Pulling it All Together: Full-group Exercise to Evaluate DWWP Action Plan Implementation
2:45pm	Break
3:00pm	Focus Groups Session 2: Lessons Learned and Opportunities to Move Forward
3:30pm	Full-group Exercise: Sharing, Sorting & Prioritizing Opportunities to Move Forward
4:00-4:15pm	Closing comments and next steps

Notes:

Agenda

What: Technical Advisory Committee Workshop for the DWWP Action Plan Implementation Review

When: 26 July, 2018
12:00PM to 4:00PM PDT (lunch provided)

Where: Board Chambers, RDN Admin Office, 6300 Hammond Bay Rd

Why:

- To assess the effectiveness of the DWWP program
- To review what DWWP Action Plan elements have been completed and initiated, to what extent, and why
- To begin identifying potential improvements to DWWP program implementation to inform an updated plan

Schedule	
12:00pm	Introductions & Workshop Overview (concurrent lunch provided)
12:20pm	Drinking Water and Watershed Protection Plan Overview Presentation (Julie)
12:45pm	Focus Group Session: Debrief on Specific DWWP Programs & Actions
1:45pm	Group Discussion: DWWP Successes and Opportunities for Improvement
2:15pm	Break
2:30pm	Group Discussion: Identifying and Applying Lessons Learned
3:00pm	Looking Ahead: Group Exercise to Prioritize Program Goals
3:15pm	Looking Ahead: Group Discussion of Opportunities to Move Drinking Water and Watershed Protection Forward
3:45-4:00pm	Closing comments and next steps

Notes:

List of Workshop Attendees

Regional District of Nanaimo Staff Workshop Attendees List (16 July, 2018)

Name	Title	Organization
Julie Pisani	DWWP Program Coordinator	Regional District of Nanaimo
Sean DePol	Director, Water and Wastewater	Regional District of Nanaimo
Paul Thompson	Manager, Long Range Planning	Regional District of Nanaimo
Gerald St. Pierre	Project Engineer, Water Services	Regional District of Nanaimo
Deborah Churko	Engineering Technologist, Water Services	Regional District of Nanaimo
Shelley Norum	Wastewater Program Coordinator	Regional District of Nanaimo
Lisa Moilanen	Communications Coordinator	Regional District of Nanaimo
Kevin Robillard	GIS Coordinator	Regional District of Nanaimo
Pamela Newton	GIS Technician	Regional District of Nanaimo

Drinking Water and Watershed Protection Technical Advisory Group
Workshop Attendees List (26 July, 2018)

Name	Title	Organization
Lauren Fegan	DWWP Special Projects Assistant, RDN	Regional District of Nanaimo
Alan Gilchrist	Professor	Vancouver Island University
Ken Epps	Stand Management Forester	Island Timberlands
Antonio Barroso	Hydrogeologist	GW Solutions
William Shulba	Senior Freshwater Specialist	Islands Trust
Joe McCallum	DWWP Special Projects Assistant	Regional District of Nanaimo
Capri Brugge	DWWP Special Projects Assistant	Regional District of Nanaimo
Leon Cake	Director	Coastal Water Suppliers Association
Pam Jorgenson	Land Use Forester	TimberWest Forest Co.
Murray Walters	Manager of Water Services	Regional District of Nanaimo
Julie Pisani	DWWP Program Coordinator	Regional District of Nanaimo
Kate Miller	Manager, Environmental Sciences	Cowichan Valley Regional District
Harriet Rueggeberg	General Public Representative	District 68
Sylvia Barroso	Regional Hydrogeologist	Ministry of Forests, Lands and Natural Resource Operations
Lynne Magee	Drinking Water Coordinator	Vancouver Island Health Authority

STAFF REPORT

TO:	Committee of the Whole	**MEETING:**	November 20, 2018
FROM:	Julie Pisani Drinking Water & Watershed Protection Program Coordinator	**FILE:**	5600-07

SUBJECT: Surface Water Quality Trend Analysis for RDN Community Watershed Monitoring Network Data (2011-2017)

RECOMMENDATION

That the Board endorse presentations to the City of Nanaimo, the City of Parksville, the Town of Qualicum Beach and the District of Lantzville councils to provide the results of the Surface Water Quality Trend Analysis for RDN Community Watershed Monitoring Network Data (2011-2017) report.

SUMMARY

In 2011, the Regional District of Nanaimo implemented the Community Watershed Monitoring Network (CWMN) to initiate water quality data collection in many of the region's creeks and streams. This initiative is led by the RDN Drinking Water and Watershed Protection program, and was developed in close partnership with the BC Ministry of Environment. The objective of the CWMN is to better understand and track water quality to inform efforts to preserve, enhance and protect the health of the region's surface waterbodies. The long term goal is to identify trends in water quality to assist in regional land use planning, infrastructure, stewardship and restoration decisions.

Consulting water quality biologists Ecoscape Environmental Consultants Ltd. (Ecoscape) analyzed the 2011-2017 water quality data from the Community Watershed Monitoring Network (Attachment 1). Key findings from the analysis are summarized follows:

- The majority (79%) of sites with sufficient data demonstrated stable water quality that did not change over time.
- 12 out of the 34 sites with sufficient data demonstrated frequent exceedances of Provincial water quality objectives or guidelines over the 2011-2017 period.
- Seven of these 12 sites have high agricultural use in the watershed, two of the 12 have upstream stormwater outfalls, and three are not well understood.
- Watersheds that were less than 60% forest use are associated with changes in water quality.
- Watersheds with greater than 20% agricultural use are associated with higher turbidity and lower dissolved oxygen.
- Watersheds with high paved road densities are associated with increased conductivity and higher water temperatures.

The key recommendations from Ecoscape's analysis included: improving streamside vegetation at priority locations; sampling for additional parameters to learn more about the source of water quality changes or issues; using the findings to direct targeted outreach and education on stormwater management and agricultural practices; updating mapping of land cover; and performing future trend analysis as more data becomes available. The DWWP Technical Advisory Committee will be consulted on how best to implement recommendations from this analysis into the ongoing CWMN program activities through the regular operational budget of the DWWP program in the coming years.

BACKGROUND

The RDN's Drinking Water and Watershed Protection program is mandated to improve information about the Region's water resources in support of better land use decisions and public understanding. In particular, the DWWP Action Plan provides direction to coordinate and support volunteers in monitoring surface water sites, and to collaborate with the Ministry of Environment (MOE) to identify water quality indicators and support the establishment of water quality objectives for important waterways.

By partnering with MOE, stewardship volunteers, and timber companies for land access, the RDN DWWP has successfully established a surface water quality monitoring network (the Community Watershed Monitoring Network or CWMN) to sample for dissolved oxygen, temperature, turbidity and conductivity. Sampling is performed at over 60 surface water sites by trained volunteers from 13 stewardship groups. This takes place annually during the summer low flow period and the fall flush period. Data has been collected since 2011, with 34 sites sampled for at least six years in both the summer and fall monitoring periods, which is considered sufficient for trend analysis. Data has been collected to provincial standards with quality assurance and quality control measures. Consulting water quality biologists, Ecoscape Environmental Ltd., performed trend analysis and statistical analysis on this dataset to provide interpretation and begin to more comprehensively answer the question – what does the data tell us?

Findings from the analysis

1. Comparison to the BC Water Quality Guidelines and Objectives to identify sites of concern

Ecoscape found that out of the 34 sites with sufficient data, 27 sites demonstrated stable water quality and changes over time were not observed. Five of the 34 sites experienced increases in mean summer and fall turbidity over the six year period. One site (Cat Stream in City of Nanaimo) experienced an increase in conductivity, while another site (Beach Creek in Town of Qualicum Beach) displayed decreasing conductivity from 2011-2017.

2. Trend analysis to detect changes in water quality over time

Frequent exceedances of the BC Water Quality Guidelines and Objectives over the 2011- 2017 period were observed at 12 sites over the study period. Seven of these 12 have high agricultural use within the watershed, two of the twelve have upstream stormwater outfalls, and three are not well understood. Ecoscape suggests that these three anomalies are likely related to annual differences in rainfall and temperature at the sites.

3. Statistical modelling to determine if watershed characteristics and land uses affect water temperature, dissolved oxygen, turbidity and conductivity.

Statistical models used by Ecoscape in the analysis showed that land use types linked with human disturbance are important indicators of water quality. To build the models, Ecoscape generated key factors that could affect water quality, also referred to as predictors or land use variables. Both human-caused and natural predictors were considered including watershed slope, watershed % impervious etc. The modelled water quality effects of each predictor were not linear, meaning that effects were more apparent as certain thresholds were reached. Watersheds – the catchment area that drains to a sample point on a stream – were used as the spatial scale for the analysis. Watersheds that were less than 60% forest use are associated with changes in turbidity and conductivity. Watersheds with greater than 20% agricultural use are associated with higher turbidity and lower dissolved oxygen. Watersheds with paved road densities greater than 0.002m per square meter are associated with increased conductivity and higher water temperatures.

<u>Recommendations from the analysis</u>

Ecoscape's analysis generated recommendations for each site, water region and the program as a whole. General recommendations include:

- Improve streamside vegetation at seven key sites[1] with prescribed riparian planting.
- Conduct biological monitoring for aquatic invertebrates (benthics) as an additional indicator of water quality, sensitive to human disturbances.
- Target public education on good stormwater management practices.
- Work with partner agencies responsible for stormwater infrastructure to examine opportunities for rain gardens or swales to slow and infiltrate run-off at locations with outfalls above sites with noted water quality concerns.
- Sample for Chloride as an indicator to determine if road-run off is the source of elevated conductivity at sites in watersheds with high road densities.
- Sample for Phosphorus during the summer and fall sampling periods in watersheds that have high agricultural land use or evidence of excessive algae growth.
- Refine and improve land cover mapping every 5-10 years to accurately identify changes in the extent of impervious surface, tree cover and other relevant components of the landscape. Recommend working with Vancouver Island University and RDN Planning department.

<u>Next steps for the CWMN initiative</u>

The DWWP Technical Advisory Committee will be consulted on how best to integrate Ecoscape's recommendations into the CWMN program activities and other DWWP supported initiatives as part of the ongoing DWWP operational plan and budget. A phased implementation of additional efforts will be required due to resource constraints and partnerships will be sought at all opportunities in order to best utilize limited resources. The findings of the Ecoscape analysis provide valuable information on the sites of concern, the trends over time and the

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[1] Annie Creek (Area H), French Creek (Area F), Grandon Creek (Town of Qualicum Beach), Shelley Creek x2 (City of Parksville), Cat Stream (City of Nanaimo).

influencing factors. This information can be then used to support targeted education, restoration, land-use planning and infrastructure decisions that aim to address water quality issues.

While sampling is currently performed at over 60 surface water sites, only 34 sites had datasets sufficient for including in Ecoscape's trend analysis – i.e. at least six years of sample data for both the summer and fall monitoring periods. Sufficient data for the majority of the remaining sites should be available to proceed with additional trend analysis in 2020 or after, and is planned for the DWWP operating budget and work plan.

The results from this analysis will be shared with key decision makers and influencers so the findings can direct interventions where water quality improvements are needed. With this in mind, presenting this report to municipal councils at the City of Nanaimo, City of Parksville, Town of Qualicum Beach and District of Lantzville, the RDN Agricultural Advisory Committee and other interested stakeholder groups is recommended.

ALTERNATIVES

1. That the Board endorse presentations to the City of Nanaimo, the City of Parksville, the Town of Qualicum Beach and the District of Lantzville councils to provide the results of the Surface Water Quality Trend Analysis for RDN Community Watershed Monitoring Network Data (2011-2017) report.

2. Provide alternate direction to RDN staff.

FINANCIAL IMPLICATIONS

This trend analysis was completed at a cost of $19,843 from the operational budget of the Drinking Water and Watershed Protection (DWWP) program. Budget to address the recommendations presented in the study and future additional trend analysis is captured within the 5-Year Financial Plan for DWWP and will be delivered through ongoing program operations as guided by the DWWP Technical Advisory Committee.

STRATEGIC PLAN IMPLICATIONS

The water quality data collected by trained volunteers through the RDN's Community Watershed Monitoring Network and the recent analysis summarized in this report aligns with and supports the following 2016-2020 Board Strategic Priorities:

Focus On The Environment- We Will Have A Strong Focus On Protecting And Enhancing Our Environment In All Decisions

Focus On Relationships- We Look For Opportunities To Partner With Other Branches Of Government/Community Groups To Advance Our Region

Focus On Relationships- We Recognize All Volunteers As An Essential Component Of Service Delivery. We Will Support The Recruitment And Retention Of Volunteers

Focus On Relationships- We Look For Opportunities To Partner With Other Branches Of Government/Community Groups To Advance Our Region

Focus On Economic Health- We Recognize The Importance Of Water In Supporting Our Economic And Environmental Health

Julie P

Julie Pisani
jpisani@rdn.bc.ca
October 29, 2018

Reviewed by:
- M. Walters, Manager, Water Services
- S. De Pol, Director, Water and Wastewater Services
- R. Alexander, General Manager, Regional and Community Utilities
- P. Carlyle, Chief Administrative Officer

Attachments
1. Ecoscape – Surface Water Quality Trend Analysis for Regional District of Nanaimo Community Watershed Monitoring Data (2011-2017)

Surface Water Quality Trend Analysis for Regional District of Nanaimo Community Watershed Monitoring Network Data (2011-2017)

Prepared For:

Regional District of Nanaimo

Prepared By:

Ecoscape Environmental Consultants Ltd.

July 2018

Surface Water Quality Trend Analysis for Regional District of Nanaimo Community Watershed Monitoring Network Data (2011-2017)

Prepared For:
Regional District of Nanaimo
Regional and Community Utilities
6300 Hammond Bay Road
Nanaimo, B.C. V9T 6N2

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July, 2018
File No. 18-2484

ACRONYMS AND ABBREVIATIONS

~	Approximately
BCCF	BC Conservation Foundation
B-IBI$_{10-50}$	Benthic Index of Biological Integrity
cm	centimeter
CABIN	Canadian Aquatic Biomonitoring Network
CWMN	Community Watershed Monitoring Network
CART	Classification and Regression Tree
D/S	downstream
D8	Deterministic-8
DEM	Digital Elevation Model
DO	dissolved oxygen
DRA	Digital Road Atlas
km	kilometer
L	litre
m	metre
m.a.s.l.	metres above sea level
mg	milligrams
µs	microsiemens
MoE	Ministry of Environment
MSE	Mean Squared Error
n	sample size
NTU	Nephelometric Turbidity Unit
QA/QC	Quality assurance, quality control
r	Spearman’s rank correlation coefficient
R^2	Coefficient of Variation
RDN	Regional District of Nanaimo
SAGA	System for Automated Geoscientific Analyses
SD	Standard Deviation
tau	Kendall’s tau coefficient
U/S	upstream

SUGGESTED CITATION

Plewes, R., H. Larratt, and J. Schleppe. (2018). Surface Water Quality Trend Analysis for Regional District Nanaimo Community Watershed Monitoring Network Data (2011-2017). Report prepared for Regional District of Nanaimo. Report prepared by: Ecoscape Environmental Consultants Ltd. 63 pgs + Appendices.

ACKNOWLEDGEMENTS

Ecoscape would like to express our appreciation to Julie Pisani, Drinking Water & Watershed Protection Program Coordinator and Lauren Fegan, Special Projects Assistant with the Regional District of Nanaimo. They provided key background information to facilitate the data analysis and reporting. Carmen Chelick and Robert Wagner of Ecoscape assisted in mapping and data analysis.

EXECUTIVE SUMMARY

The Regional District of Nanaimo (RDN) and the British Columbia Ministry of Environment (MoE) started the Community Watershed Monitoring Network (CWMN) program in 2011 with the long-term goal of identifying trends in water quality to assist in regional land use planning and restoration decisions. The CWMN program consists of annual sampling in both the summer low flow period (August – September) and fall flush period (October – November) and has been conducted from 2011 to present, with some sites added or removed during that period. The program includes sampling of dissolved oxygen, temperature, turbidity and specific conductivity at 73 sites; as of 2018 there are 62 active sites. This sampling is done by trained volunteers from 13 stewardship groups in partnership with RDN, BC MoE, and Island Timberlands. These co-ordinated efforts have resulted in an excellent database that supported the statistical analysis presented in this report.

Ecoscape analyzed the 2011-2017 data using:

1. comparison to BC water quality Guidelines and Objectives to identify sites of concern,
2. trend analysis using seasonal Mann-Kendall to detect changes in water quality over time,
3. statistical modelling using Random Forest to determine if watershed characteristics and land uses affect water temperature, dissolved oxygen, conductivity and turbidity.

Forty-seven percent of the CWMN sampling sites had been sampled for at least six years in both summer and fall to allow a seasonal Mann-Kendall trend analysis to determine if a water quality parameter was stable, increasing, or decreasing in the fall and summer sample periods from 2011-2017. Twenty-seven of the 34 sites had stable water quality and changes over time were not observed. There were five sites that experienced increases in mean summer and fall turbidity from 2011-2017. The Cat Stream site in Water Region 5 experienced an increase in mean summer and fall conductivity from 2012-2017, whereas the Beach Creek site near Hemsworth had decreasing summer and fall conductivity from 2011-2017. Increasing water temperature at three sites and decreasing DO at two sites is probably associated with annual variations in air temperature.

All available CWMN data was examined to expose sites with water quality concerns. Sites with frequent exceedances of water quality guidelines or objectives, with depleted oxygen concentrations and/or with adverse trends in water quality over time were identified as sites of concern. Twelve sites of concern were identified of which seven sites have high agricultural use within the watershed, a land use frequently involving ditching and lack of riparian vegetation cover through disturbance. Two sites of concern have upstream stormwater outfalls, and three sites of concern should be closely monitored because the cause of poor water quality is not well understood and are likely related to annual differences in rainfall and temperature that directly affect the monitored parameters. The sites of concern or interest are summarized in Table 1-1.

Statistical modelling of water quality in the summer and fall sampling periods indicated that land use types associated with human disturbance were important predictors of dissolved oxygen, water temperature, specific conductivity, and turbidity. Turbidity and conductivity models for both sampling periods indicated that when watersheds were <60% forested changes in turbidity and conductivity were apparent. Summer turbidity and dissolved oxygen models also indicated watersheds with >20% agricultural use generally have higher turbidity and lower dissolved oxygen. Increased turbidity levels and depleted dissolved oxygen are likely the result of increased sediment loads due to a lack of riparian vegetation, stream channelization, and nutrient enrichment. Adverse effects on water quality in watersheds with high agricultural land use are well documented in the literature.

Both the summer and fall conductivity models suggested that when paved road densities increase above 0.002m/m^2, impacts on water quality were evident in the CWMN data. The increased conductivity in urbanized watersheds is possibly the result of point source salinized discharges. The summer and fall temperature models indicate that watercourses with less shading due to increased imperviousness associated with urbanization have higher water temperatures than watersheds with less intensive urban land use. These results are also common in the literature and further support the importance of riparian vegetation for temperature moderation and bank stability in the Nanaimo region.

Based on the water quality analysis and modelling of the CWMN surface water quality 2011-2017 dataset, general recommendations include:

- Sample every 2-5 years during the summer and fall sampling periods for ultra-low detection (0.002 mg/L RDL) Total and Dissolved Phosphorous in watersheds that have >20% agricultural land use or show evidence of excessive algae growth
- Sample for chloride during the summer low flow period at sites that have road densities >0.002 m/m^2 or that have adjacent stormwater outfalls
- Conduct riparian plantings at the seven identified sites to help with bank stability and provide shading for water quality and habitat improvement
- Completion of benthic invertebrate sampling within watersheds using the CABIN methods would be useful to add another indicator of watershed health. These samples could be collected every 2 to 5 years depending upon budget, and are most useful if done as part of a long-term monitoring program.
- Trend analysis using Mann-Kendall test should be repeated after there is a suitable continuous dataset. At least seven years is needed to look for sampling period specific trends.

- Refine and improve the current land use layer by using remote sensing techniques. We recommend working with the Vancouver Island University to create a land use/cover layer that accurately maps the extent of impervious surface, tree cover and other relevant components of the landscape. This analysis could be done every 5-10 years as an effective way to keep track of land cover changes.

This research confirms the importance of intact riparian corridors and undisturbed forested lands to stream health in the Nanaimo region. It identified water quality exceedances and that adverse trends in the monitored parameters were rare at the sample sites. None the less, impacts from agriculture, roads, urban residential were identified using statistical modelling. This study concurs with the remedial prescriptions provided in earlier habitat assessment reports.

Table 1-1: CWMN Sites of Interest or Concern

Water Region	Site of Interest (EMS)	Sites of Concern			Watershed Impacts					
		WQ exceedances	Adverse trends	Low DO	Storm water	>20% agri	>30% resid.	<60% forest	>0.002 m/m² paved rd	Un known
Big Qualicum	Annie Creek (E290474)	✓		✓		✓		✓	✓	
Little Qualicum	Little Qualicum at intake (E256394)		✓							✓
French Ck	French Ck at Grafton Rd (E243024)	✓	✓	✓			✓			
French Ck	Grandon Ck at Laburnum Rd (E288091)	✓		✓		✓		✓	✓	
French Ck	Grandon Ck at W Crescent (E288090)					✓		✓	✓	
French Ck	Beach Ck Near Chester Rd at Hemsworth Rd (E288092)	✓	✓			✓			✓✓	
French Ck	Beach Ck Near Memorial Golf Pond (E288093)					✓			✓	
Englishman R	Shelly Ck at Hamilton Rd (E287131)	✓		✓				✓	✓	✓
Englishman R	Shelly Ck at end of Blower Rd (E290452)	✓		✓		✓		✓	✓	✓
Englishman R	Swane Ck (E308186)	✓		✓		✓				
S Wellington to Nanoose	Walley Ck D/S of Hammond Bay (E306256)	✓			✓		✓		✓✓	
S Wellington to Nanoose	Walley Ck @ Morningside Dr (E306257)						✓		✓✓	
S Wellington to Nanoose	Walley Ck 20 m u/s Beach (E306434)						✓		✓✓	
S Wellington to Nanoose	Cat Stream (E290486)	✓	✓		✓		✓	✓	✓✓	
S Wellington to Nanoose	Departure Ck @ Neyland Rd (E290469)						✓	✓	✓✓	
S Wellington to Nanoose	Departure Ck off Netwon St (E290470)						✓	✓	✓✓	
S Wellington to Nanoose	Departure Ck at Lower End of Woodstream Park (E290471)						✓	✓	✓✓	
S Wellington to Nanoose	Departure Creek at Outlet (E290472)						✓	✓	✓✓	
S Wellington to Nanoose	Cottle Creek at Landalt Rd (E290476)					✓	✓	✓	✓✓	
S Wellington to Nanoose	Bloods Ck u/s of Dickenson (E294010)					✓		✓	✓✓	
Nanaimo R	Lower Holden Creek (E309281)	✓		✓		✓		✓	✓	
Nanaimo R	Holden Creek (E310147)	✓				✓	✓	✓	✓	
Nanaimo R	Nanaimo R. u/s Haslam Ck (E287699)		✓							

✓exceeds threshold ✓✓ exceeds threshold by >3x

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APPENDICES

1 INTRODUCTION

Ecoscape Environmental Consultants Ltd. (Ecoscape) was retained by the Regional District of Nanaimo (RDN) to conduct trend analyses on the Community Watershed Monitoring Network (CWMN) surface water quality dataset. The RDN and the British Columbia Ministry of Environment (MoE) started the CWMM program in 2011. The CWMN program trains volunteers from over 13 stewardships groups to conduct water quality sampling. The long-term goal of the program is to identify watershed trends to assist in land use planning and restoration decisions (Barlak et al. 2012).

The CWMN program consists of annual sampling in both the summer low flow period (August – September) and fall flush period (October – November). There are 73 sites that have been sampled for dissolved oxygen, temperature, turbidity and specific conductivity. However, as of 2018 there are 62 active sites. In 2015, 11 sites had additional water quality parameters sampled because they were previously identified as sites of concern due to high turbidity values (Barlak and Pisani 2017). The additional water quality sampling included: E. coli, Total Phosphorous, lab and in-situ turbidity, and total metals. The monitoring program is designed to calculate the BC 30-day average guidelines (five weekly grab samples taken within 30 days during each sampling period) (Barlak et al. 2015).

Ecoscape conducted a comprehensive trend and water quality model analysis of the CWWN water quality dataset using data from 2011-2017 sampling events. Trend analysis was used to determine whether watershed health (measured by dissolved oxygen, temperature, turbidity and specific conductivity) is stable or changing, either through improvement or decline in water quality parameters. Water quality models were used to identify potential effects of varying land use on water quality. Statistical models of dissolved oxygen, temperature, turbidity and specific conductivity provide a better understanding of the relationships between water quality and observed changes in the surrounding watershed. Recommendations for improvements to the water quality sampling and future management actions are provided for current monitoring program using the results of the trend and modelled water quality analysis.

1.1 Report Objectives and Study Questions

To provide a better understanding of the watershed health in the streams and rivers of the RDN, Ecoscape set out to perform:

Trend analysis for each site to help address the following questions:

- Are fall flush turbidity levels increasing, decreasing or stable?
- Are summer low flow water temperatures increasing, decreasing or stable?

- Are summer low flow levels of dissolved oxygen increasing, decreasing or stable?

Statistical models to help address the following questions:

- Does turbidity increase within a watershed from upstream to downstream sites?
- Is there a relationship between turbidity and land use changes, streamflow and/or climate?
- If there are any trends in water temperature, is there a correlation between lands use changes, climate, or stream flows?

General Questions

- Are observed dissolved oxygen levels consistent with saturation based on water temperature or are they depleted?

2 METHODS

RDN and Ecoscape worked together to gather climate, land use, geospatial data, and water quality data. Ecoscape conducted Quality Assurance/ Quality Control (QA/QC) on 2011-2017 datasets to identify data gaps and errors. The geospatial data included information about watercourses, waterbodies, and elevations were used to delineate watersheds for the CWMN sites. These watersheds and the zoning information were used to calculate the land use composition of each watershed. Statistical analysis was used to identify temporal trends in water quality parameters and to determine effects of land use on water quality.

2.1 CWMN Water Quality Sampling Program

The CWMN partnership collects water temperature, dissolved oxygen, conductivity and turbidity for streams throughout the RDN. The RDN and MoE train volunteers from various stewardship groups. The RDN provides the trained volunteers with equipment and overall program support, while Island Timberlands provides land access and safety gear to the volunteers (Barlak 2012). The trained volunteers conduct water quality sampling five times in summer low flows and 5 times in fall flush flows. The RDN and MoE work together to ensure accurate data is uploaded into the Environmental Monitoring System (EMS). Each water quality parameter sampled by the program is described below:

WATER TEMPERATURE: Water temperature can alter the physical and chemical properties of water, notably dissolved oxygen and carbon dioxide concentrations, pH, conductivity, and compound solubilities. Additionally, water temperature can directly affect the metabolic rates of aquatic organisms.

DISSOLVED OXYGEN: The solubility of oxygen and other gases will decrease as temperature increases. So, for example, if stream water is too warm, it will not hold enough oxygen for fish and other aquatic organisms to survive. Many other factors also affect the oxygen concentration in water, including photosynthesis, water turbulence and the oxygen demand within the water. Thus, oxygen within water can be either above or below saturation, or the maximum concentration at any given temperature Thus, oxygen within water can be either above or below saturation, or the maximum concentration at any given temperature. Oxygen super-saturation (rarely a problem for aquatic life) can occur during intense photosynthesis while dissolved oxygen below 5 mg/L can stress fish. Most pristine coastal streams would average >8 mg/L.

CONDUCTIVITY: Conductivity is a measure of the amount of dissolved material in water. It is affected by the concentration, charge and mobility of dissolved ions. Conductivity is affected by water temperature, so specific conductance was measured (conductivity corrected to 25°C). Warm water can dissolve several minerals and salts more easily than cold water, so conductivity usually increases with water temperature. Common causes of high conductivity in streams include: inflows of hard (high calcium carbonate) ground water and salinity from roads and fertilizers. Most pristine coastal stream with no groundwater influence average <80 µS/cm.

TURBIDITY: Turbidity is the amount of suspended solids in water. Increased turbidity will also increase water temperature because suspended particles absorb heat from the sun more efficiently than clear water. Turbidity is variable in pristine coastal streams, but is generally <2 NTU.

2.2 Database Management and Analytical Methods

Water quality data was retrieved from the Environmental Monitoring System (EMS) which included in situ data collected by trained volunteers during 2011-2017. EMS numbers for the 73 sites samples as part of the CWMN program are listed in Table 2-1. Gaps and data entry errors in the EMS dataset were identified and corrected by Ecoscape. Due to incomplete data, eight sites (Bloods Creek u/s of Aulds Rd, Slogar Brook, Heikkela Brook, and Knarston Creek at Hydro Bridge, the three Bonnell Creek sites, Nanoose Creek just u/s 142 main (km 4)) that are part of the CWMN program were not included in water quality and subsequent analysis. Data exploration techniques including descriptive statistics (mean, minimum, maximum, standard deviation, etc.) and simple graphs such as boxplots were used to compare sites. Box plots were prepared to visually display the results, and provide an understanding of the mean, median, and range in data or variability. Figure 2-1 shows how to interpret a boxplot.

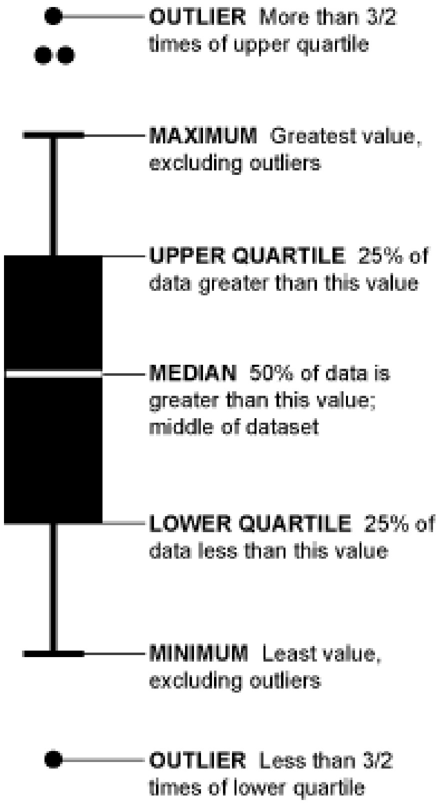


Figure 2-1: How to interpret a boxplot.

The water quality data was compared to applicable BC guidelines (BC MoE) or to specific water quality objectives for the Englishman River. The Englishman Water

Quality Objectives turbidity objective of 5 NTU was used for the fall flush period and 2 NTU was used for the summer low flow period. The Englishman River Objective was compared to each individual turbidity measurement. For temperature, the Englishman River has a short-term objective of 17°C and a long-term objective of 15°C. Thirty-day mean temperature averages over a sampling period were compared to the long-term objective, whereas single measurements were compared to the short-term. For dissolved oxygen, the BC Water Quality guidelines protective of aquatic life were used. The 30 day average is 8 mg/L and the instantaneous minimum is 5 mg/L. There is no guideline for specific conductivity but typically coastal streams have conductance less than 80 µS/cm. If a stream has higher conductivity, it is usually indicative of ground water or ocean influence.

Table 2-1: List of CWMN sites by Water Region with EMS numbers.

Water Region	Water Region Code	EMS.ID	Location Description
Big Qualicum	WR1	E240141	Annie Creek
Big Qualicum	WR1	E286549	Thames Creek 200m u/s Old Island Hwy
Big Qualicum	WR1	E286550	Thames Creek 100m u/s Inland Island Hwy
Big Qualicum	WR1	E286551	Upper Nile Creek at Cochrane Main
Big Qualicum	WR1	E286552	Nile Creek 25m u/s hatchery
Big Qualicum	WR1	E286553	Nile Creek 50m u/s Old Island Hwy
Big Qualicum	WR1	E298597	Big Qualicum u/s site
Big Qualicum	WR1	E298598	Big Qualicum River about 700m d/s hatchery
Big Qualicum	WR1	E306374	Rosewall Creek @ Rosewall Creek Park
Big Qualicum	WR1	E306375	Deep Bay Creek
Big Qualicum	WR1	E309086	Cook Creek at Old Island Hwy Connector
Little Qualicum	WR2	E220635	Cameron River (near the highway)
Little Qualicum	WR2	E256394	Little Qualicum River at Intake
Little Qualicum	WR2	E268993	Little Qualicum River 1.2 km d/s Cameron Lake
Little Qualicum	WR2	E285669	Upper Cameron River
Little Qualicum	WR2	E287697	Whiskey Creek on Hwy 4, TB Ave Save on Gas
Little Qualicum	WR2	E299853	Little Qualicum River 20m u/s hwy 19A
French Creek	WR3	E243021	French Creek at new highway
French Creek	WR3	E243022	French Creek at Barclay Bridge
French Creek	WR3	E243024	French Creek at Grafton Road
French Creek	WR3	E288090	Grandon Creek at West Crescent (Caissons)
French Creek	WR3	E288091	Grandon Creek at Laburnum Road
French Creek	WR3	E288092	Beach Creek near Chester Road at Hemsworth Road
French Creek	WR3	E288093	Beach Creek near Memorial Golf Course Pond
Englishman River	WR4	121580	Englishman River at Highway 19A

Water Region	Water Region Code	EMS.ID	Location Description
Englishman River	WR4	E248834	Englishman River U/S from Morison Creek
Englishman River	WR4	E248835	Morison Creek U/S from Englishman River
Englishman River	WR4	E248836	South Englishman River U/S from Englishman River
Englishman River	WR4	E252010	Englishman River U/S from Allsbrook Canyon
Englishman River	WR4	E282969	Upper Englishman River u/s Centre Fork Creek
Englishman River	WR4	E287131	Shelly Creek @ Hamilton Road
Englishman River	WR4	E290452	Shelly Creek @ end of Blower Rd
Englishman River	WR4	E299852	Centre Creek
Englishman River	WR4	E308186	Swane Creek d/s of Errington Road
South Wellington to Nanoose	WR5-1	E290473	Cottle Creek @ Nottingham
South Wellington to Nanoose	WR5-1	E290474	North Cottle Creek 100 m d/s from Burma Rd.
South Wellington to Nanoose	WR5-1	E290475	Cottle Creek @ Stephenson Pt Rd
South Wellington to Nanoose	WR5-1	E290476	Cottle Creek @ Landalt Rd
South Wellington to Nanoose	WR5-1	E294010	Bloods Creek just u/s Dickenson Rd
South Wellington to Nanoose	WR5-1	E294013	Knarston Ck just u/s Lantzville Rd
South Wellington to Nanoose	WR5-1	E294017	Craig Creek just u/s Northwest Bay Rd
South Wellington to Nanoose	WR5-1	E294019	Nanoose Creek @ Nanoose Campground
South Wellington to Nanoose	WR5-1	E294020	Nanoose Creek @ Matthew Crossing
South Wellington to Nanoose	WR5-1	E306255	Knarston Ck @ Superior Rd
South Wellington to Nanoose	WR5-1	E306256	Walley Ck d/s Hammond Bay
South Wellington to Nanoose	WR5-1	E306257	Walley Ck @ Morningside Dr
South Wellington to Nanoose	WR5-1	E306434	Walley Creek 20m u/s beach
South Wellington to Nanoose	WR5-1	E309186	Cottle Creek downstream of Hammond Bay Rd
South Wellington to Nanoose	WR5-2	E290469	Departure Ck @ Neyland Rd
South Wellington to Nanoose	WR5-2	E290470	Departure Ck off Newton St
South Wellington to Nanoose	WR5-2	E290471	Departure Ck at lower end of Woodstream Park
South Wellington to Nanoose	WR5-2	E290472	Departure Ck @ outlet
South Wellington to Nanoose	WR5-2	E290477	Benson Creek @ Biggs Road

Water Region	Water Region Code	EMS.ID	Location Description
South Wellington to Nanoose	WR5-2	E290478	Millstone River @ Biggs Road
South Wellington to Nanoose	WR5-2	E290479	McGarrigle Ck @ Jingle Pot Rd
South Wellington to Nanoose	WR5-2	E290480	Millstone River @ East Wellington
South Wellington to Nanoose	WR5-2	E290481	Millstone River in Barsby Park
South Wellington to Nanoose	WR5-2	E290482	Northfield Creek @ outlet
South Wellington to Nanoose	WR5-2	E290483	Chase River @ Aebig
South Wellington to Nanoose	WR5-2	E290484	Chase River @ Howard
South Wellington to Nanoose	WR5-2	E290485	Chase River @ Park Ave
South Wellington to Nanoose	WR5-2	E290486	Cat Stream
South Wellington to Nanoose	WR5-2	E306254	Upper McGarrigle Ck
South Wellington to Nanoose	WR5-2	E306294	Millstone River @ Jingle Pot Road
South Wellington to Nanoose	WR5-2	E309187	McClure Creek at Montessori School
South Wellington to Nanoose	WR5-2	E309280	Chase River at Estuary Park
Nanaimo River	WR6	E215789	Nanaimo River at Cedar Rd bridge
Nanaimo River	WR6	E287699	Nanaimo River u/s Haslam Ck
Nanaimo River	WR6	E287700	Haslam Ck u/s Nanaimo River
Nanaimo River	WR6	E290487	Beck Creek @ Cedar Rd
Nanaimo River	WR6	E309281	Lower Holden Creek at Maughan Rd
Nanaimo River	WR6	E310147	Upper Holden Creek at Lazo Lane
Gabriola Island	WR7	E304070	Mallett Creek.

2.2.1 Rainfall and Discharge Data

Rainfall, temperature and flow data were aggregated from multiple sources to provide insights into the linkage between water quality and climate. Correlation tests determine the magnitude and direction of the trend between two variables. A Spearman rank correlation test was used to compare the total rainfall three days prior to the sampling date and including the sampling date with a single water quality measure in the fall flush period. Comparisons were done on a site-specific basis and only sites that had more than 25 fall samples were included in the analysis. The rainfall data for the rain gauge that was closest to the site of interest was used. There were fourteen rain gauge stations used for this analysis and they are shown in Figure 2-2. To identify peak flows and storm events, flow and rainfall graphs were generated for the summer and fall sampling periods for 2011-2017. There are active Water Survey of Canada hydrometric stations on Nile Creek, Little Qualicum River, Englishman River, Millstone River, and Nanaimo River (Figure 2-2). BC Conservation Foundation (BCCF) operates hydrometric stations on Grandon and Rosewall creeks.

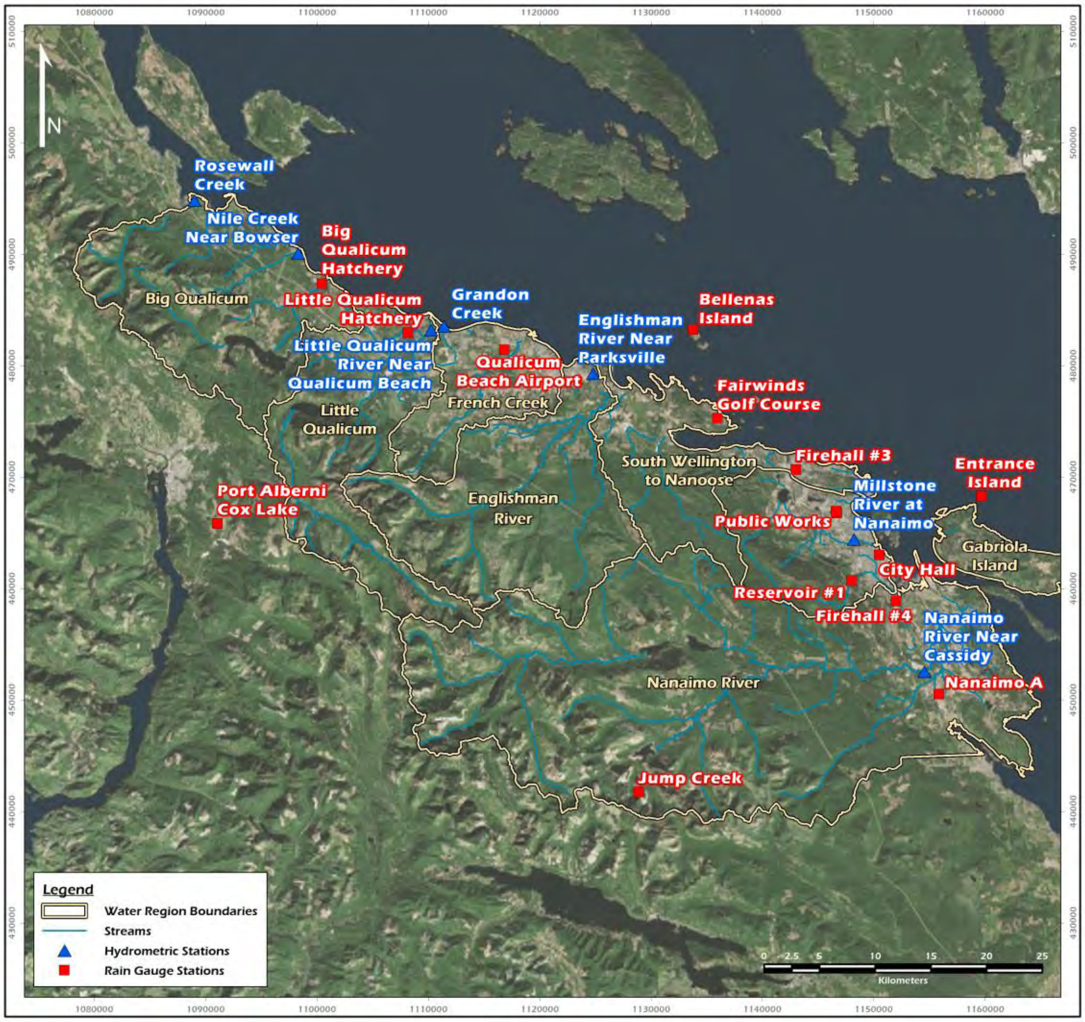


Figure 2-2: Map of hydrometric and rain gauge stations used for analysis.

2.2.2 Trend Analysis

Seasonal Mann-Kendall tests were used to identify and assess the direction and statistical significance of trends in water quality measurements over time (2011-2017). Mann-Kendall is a robust non-parametric regression analysis because it is easy to meet the assumptions needed for an accurate analysis and this test yields a result that is easy to interpret as either increasing, decreasing, or not changing. Further, seasonal Mann-Kendall tests account for seasonal variability by only comparing the same months from different years. Only sites that were sampled for at least six years in both summer and fall were included in trend analysis. Water quality measures that had significant trends over time were graphed with locally weighted scatterplot smoothing (LOWESS) trend lines, which help readers understand how the data is changing over time. Tests were performed using the “Kendall” package version 2.2 in R (McLeod, 2011).

2.3 GIS Methods

Available contour data and stream centerlines were used to determine watershed boundaries. Since the analyses required an understanding of the drainage area above each sampling point, the data were used to accurately determine the upstream drainage area for each sampling location. ArcHydro tools were used in ArcGIS Desktop version 10.6 (Environmental Systems Research Institute, 2018).

The following were the general tasks completed to achieve delineation of watershed boundaries. A Digital Elevation Model (DEM) with 2 m resolution was obtained from the RDN. Watercourse and waterbody data was also received from RDN. The DEM was resampled by bilinear interpolation to a resolution of 5 m. The watercourse data from the RDN was modified to remove rivers that had a right and left bank line and were replaced with a river centerline. The modified watercourse data was used as the stream network to burn into the DEM and then sinks were filled. To burn in the stream network ensures the flow direction is congruent with existing watercourses. This reconditioned DEM was used to determine flow direction by the Deterministic-8 (D8) flow algorithm and flow accumulation. Some of the CWMN sampling points were moved to be on the stream. Watersheds were then delineated for the adjusted CWMN sampling points. Some watersheds for sites in coastal areas were not delineated accurately. These watersheds were manually delineated using contours, watercourses, waterbodies, and other available watershed boundaries as accurately as possible. A list of watersheds that were manually delineated or adjusted is in Table 2-2.

Table 2-2: List of watersheds that were manually adjusted or delineated.

Water Region	LOCATION.NAME	EMS.ID
1 -Big Qualicum	ANNIE CREEK	E240141
1- Big Qualicum	DEEP BAY CREEK	E306375
4 -Englishman River	SOUTH ENGLISHMAN RIVER JUST U/S ENGLISHMAN RIVER	E248836
4 -Englishman River	SHELLY CREEK AT HAMILTON RD	E287131
4 -Englishman River	SHELLY CREEK @ END OF BLOWER RD	E290452
5 -South Wellington to Nanoose	MILLSTONE RIVER @ BIGGS ROAD	E290478
5 - South Wellington to Nanoose	MILLSTONE RIVER IN BARSBY PARK	E290481
5 -South Wellington to Nanoose	CHASE RIVER @ AEBIG RD	E290483
5- South Wellington to Nanoose	CHASE RIVER @ PARK AVE	E290485
5- South Wellington to Nanoose	CATSTREAM @ PARK ABOVE CONFLUENCE WITH CHASE RIVER	E290486
5 - South Wellington to Nanoose	BLOODS CK JUST U/S DICKENSON RD	E294010
5 - South Wellington to Nanoose	MILLSTONE R @ JINGLE POT ROAD	E306294
5 - South Wellington to Nanoose	NANAIMO CHASE RIVER AT ESTUARY PARK (RDN CWMN)	E309280
6 - Nanaimo River	NANAIMO RIVER AT CEDAR RD BRIDGE	E215789
6 - Nanaimo River	NANAIMO RIVER U/S HASLAM CK ~500 M D/S HWY 1 BRIDGE	E287699
6 - Nanaimo River	NANAIMO LOWER HOLDEN CREEK (RDN CWMN)	E309281
6- Nanaimo River	BECK CREEK @ CEDAR RD	E290487

Watershed land use is a very important parameter that can directly affect water quality. To assess the effects of different land use types, land use data for the all Water Regions was obtained from each local government and the total area of each land use within the watershed was determined. Zoning information was obtained from Town of Qualicum Beach, City of Nanaimo, Regional District of Nanaimo, Comox Valley Regional District, Cowichan Valley Regional District and City of Parksville. Spatial gaps and missing zoning codes were manually filled in by aerial image interpretation. Land uses were categorized into broad land use types that were similar in form and function. The land use classes provided generally included: Agricultural, Commercial, Comprehensive, Conservation, Forestry, Industrial, Institutional, Multi-Family Residential, Recreation, Rural Residential, Single Family Residential, Transportation, Water and Wetland. These generalized groups were further sub-categorized into more general, broad land use categories in six classes that were similar in form and function. Table 2-3 describes how land use classes were combined to yield the final broad land use classes used in the analysis. Once the land use classes were identified, they were converted to percentages for the water regions, noting that we did not attempt to rectify actual land use versus land use obtained from the data (e.g., an industrial land use type that is currently undeveloped and is closer to residential as an example).

The percentage of the watershed for any given broad land use type was determined at two different scales. The first scale was the watershed as a whole, while the second scale considered a region within 500 m of the sampling point. The 500 m upstream buffer was determined by buffering each CWMN site by 500 m and then clipping the resultant 500 m buffer polygon with the watershed of that site. The 500 m upstream buffer zones were only determined for areas upstream of the sampling site within 500 m because these are the only areas that can directly impact water quality at any given sampling location.

Table 2-3: Summary of land use classes combined from zoning information.

Class	Calculation
Agricultural	Rural Residential+Agricultural
Forested	Forestry+Conservation
Impervious	Commercial+Industrial+Transportation
Recreation	Institutional+Recreation
Residential	Comprehensive+Multi-Family Residential+Single Family Residential
Water	Water+Wetland

To better understand specific trends due to urbanization, the density of paved and unpaved roads was also determined. Road density is a common parameter used to assess potential effects in watersheds, and is determined by dividing the total road length (m) within the watershed by the watershed area (m^2), yielding a variable with units (m/m^2) which means the total length of road (m) within the area (m^2) of the watershed. Paved and unpaved road densities were determined for the entire watershed and for the 500 m upstream buffer. Data for roads was obtained from the Digital Road Atlas (DRA).

The maximum flow or water travel distance and percent slope for each watershed were also determined. The elevation of each monitoring site and percent slope was determined to understand if watershed position and morphometry (size and shape) had an effect on water quality. The maximum flow path length tool in System for Automated Geoscientific Analyses (SAGA) GIS version 2.1.4 was used to calculate the flow distance to the ocean (Conrad et al 2015). Percent slope was calculated in ArcGIS Desktop using the 5 m resampled DEM. The mean slope of each watershed was calculated using zonal statistics in RSAGA (Brenning 2008). The elevation of a sample site was determined from the 5 m resampled DEM.

2.4 Water Quality Models

Water quality in streams can be affected by multiple factors, which are both natural and anthropogenic. Any factor that affects water quality operates on a different spatial or temporal scale. These natural and human factors were grouped into three categories by Soranno et al. 2010, which were freshwater, terrestrial and human landscape (Figure 2-3). Statistical models that compared each water quality parameter (e.g., DO) were developed where the models defined a mathematical relationship between the water quality parameter and variables that were grouped into each of these categories. Thus, the goal of the water quality models was to take a holistic approach and consider as many potential factors as possible, whether factors were anthropogenic or natural, using available spatial data. The analysis allows us to better understand how water quality in each of the watersheds may respond to natural and/or anthropogenic factors, and help facilitate better management decisions (Figure 2-3). It must be recognized that these analyses are used to better understand how the stream water quality in the CWMN sites may be influenced by watershed characteristics by using spatial data that is readily available for the watershed, but is constrained by available data (i.e., models can always be improved if more data is added). The variables that were included attempt to quantify the catchment morphology such as watershed slope and flow distance and consider the position of the sample site in the drainage network. A primary focus of our analysis was to include land use variables, with available road infrastructure data (i.e., roads) to determine if a land use type or urban density may be influencing water quality. The suite of variables selected were chosen because they have been used to describe watershed effects in other studies, and because a complete data set was available (both spatially and temporally), meaning we could develop the watershed characteristics (land use, catchment morphology, land cover) at a spatial scale necessary to complete the analysis.

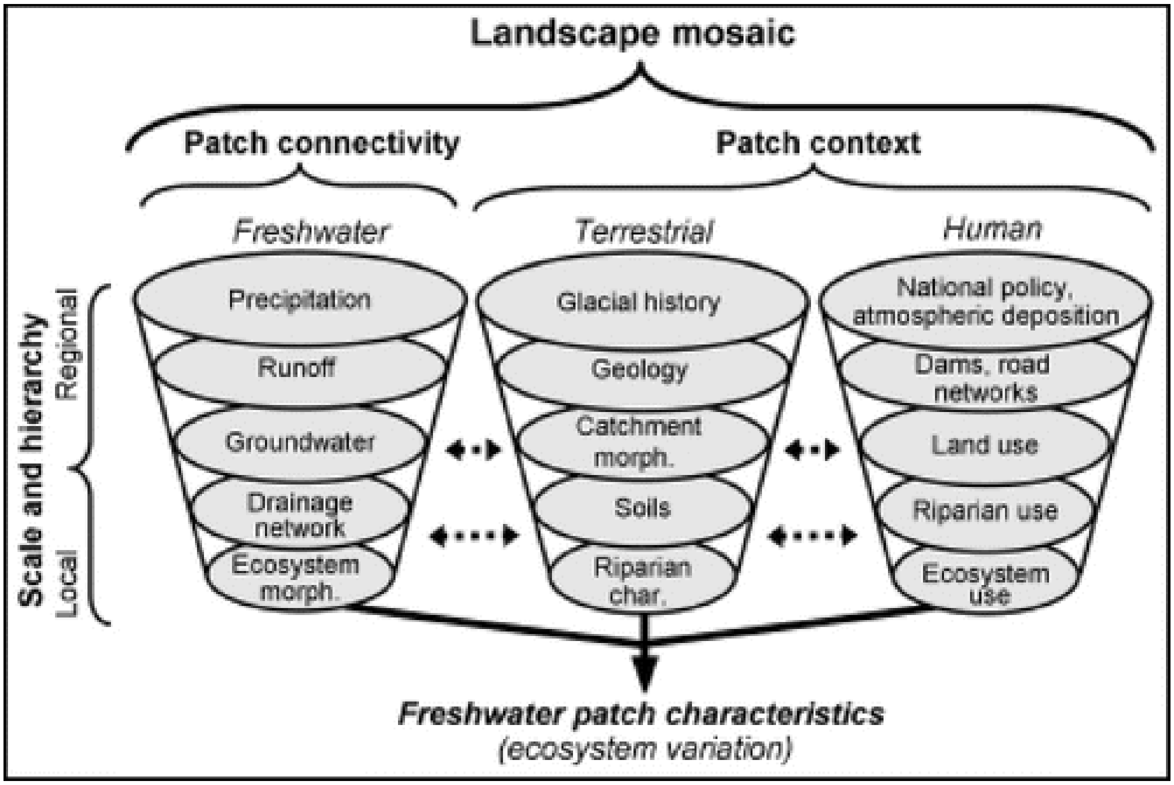


Figure 2-3: The different freshwater, terrestrial, and human characteristics that can affect stream water quality from Soranno et al. 2010.

We used the statistical models from Random Forest to model water quality in the RDN CWMN watersheds. These models were chosen because Random Forest successfully modelled water quality in streams and lakes in the US and Canada (Read et al. 2015; Jones et al. 2017). Random Forest can accommodate predictor variables that are correlated with one another and have non-normal distributions (Read et al. 2015). Non-normal distributions are common with land use variables.

A water quality model was defined in both seasons for dissolved oxygen, turbidity, water temperature and specific conductivity, for eight models in all. They were modelled using the 20 predictor variables listed in Table 2-4. The median of each water quality variable for all summer and fall available data was used as the response variable in each model. The median was used because it is not sensitive to outliers like the mean is. Some sites were excluded from models because they were determined as outliers. The list of sites excluded is in Table 2-5.

Table 2-4: Predictors used in random forest water quality models.

Predictor	Units
Watershed Paved Road Density	m/m2
Watershed Unpaved Road Density	m/m2
Watershed % Water	%
Flow Distance to Ocean (m)	m
Watershed Slope	% Slope
Elevation (m.a.s.l.)	m.a.s.l.
Watershed Area (m2)	m2
500m Upstream Buffer Paved Road Density	m/m2
500m Upstream Buffer Unpaved Road Density	m/m2
500m Upstream Buffer % Water	%
Watershed % Residential	%
500m Upstream Buffer % Residential	%
Watershed % Impervious	%
500m Upstream Buffer % Impervious	%
Watershed % Forested	%
500m Upstream Buffer % Forested	%
Watershed % Agricultural	%
500m Upstream Buffer % Agricultural	%
Watershed % Recreation	%
500m Upstream Buffer % Recreation	%

Table 2-5: Summary of sites removed from fall and summer water quality models.

Model	Sites Removed	EMS ID	Reason for Removal
Fall Temperature	North Cottle Creek @ Landalt Rd	E290474	Only sampled 2012-2014
Summer and Fall Temperature	Upper Cameron River	E285669	At high elevation relative to other sites
Summer and Fall Temperature	Thames Creek 100 u/s of Inland Island Highway	E286550	Low temperatures due to groundwater influence
Fall Temperature	Chase River at Estuary Park	E309280	Only sampled in 2017, had low temperature
Summer and Fall Turbidity	Mallett Creek	E304070	Outlier (very high turbidity)
Summer and Fall Turbidity	Lower Holden Creek	E309281	Outlier (very high turbidity)
Fall Turbidity	Annie Creek	E240141	Outlier (very high turbidity)
Fall Turbidity	Swane Creek	E308186	Outlier (very high turbidity)
Fall Conductivity	Lower Holden Creek	E309281	Suspected ocean influence
Summer and Fall Conductivity	Chase River at Aebig Rd	E290483	Suspected ocean influence
Summer and Fall Conductivity	Chase River at Estuary Park	E309280	Suspected ocean influence
Summer and Fall Conductivity	Lower Holden Creek	E309281	Suspected ocean influence

Random Forest determines the importance of each predictor variable and the relationships between each predictor variable and response variable (water quality). The variable importance measure for each predictor is calculated by calculating the mean decrease in prediction error (Mean Squared Error), if the predictor is dropped from the model (Liaw and Wiener, 2002). Predictor variables that have a strong relationship with the water quality response variable should have large variable importance. Dropping these predictors from the model causes a large increase in prediction error. Variable importance plots for the top 10 predictors of each model were generated to help identify potential land use types associated with the water quality variables. Partial dependence plots were generated to better understand the effect of the top five predictors on each water quality variable. These partial dependence plots provide the relationship between the selected predictor and the response variable while considering the effects of the other variables in the Random Forest model (Liaw and Wiener, 2002).

Random Forest is a complex machine-learning algorithm that uses Classification and Regression Tree (CART) models as the base model. CART is a non-parametric tree-based method that splits data into separate groups based on the response variable (De'ath and Fabricus 2000; Jun 2013). CART initially partitions the data into two groups based on a split point and splitting variable that minimizes the sum of squares of the response variable of each group (De'ath and Fabricus 2000; Hastie et al. 2001). A recursive algorithm is used to search through every possible combination of explanatory variables and values to determine the best splitting variable and split point (Hastie et al. 2001). The CART algorithm continues to make binary splits at each tree node until a stopping criterion is reached (Jun, 2013).

Random Forest builds different CART models by bagging (using a subset) the data and the explanatory variables tried at each split. Each CART model only uses a random subset of the dataset in the model and at each split in the tree only a random subset of predictor variables is tried as a potential splitting variable (Jones and Linder, 2015). The default setting used in the R package Random Forest were used for the water quality models. The Random Forest models contain 500 trees (CART models) and in our case, six of the predictor variables were tried at each split (Liaw and Wiener, 2002).

3 RESULTS

Detailed results for each Water Region are presented in Appendix D. Results include all water quality data collected as part of the valuable CWMN program. These data are displayed as boxplots compared to relevant water quality guidelines or objectives. The sections below include an overview of the study's findings and relevant discussion.

The sections below include a description of the percent land use in each watershed. The land use categories are described in 2.3. Please note, the term forested refers to land that is zoned for forestry or conservation use. This can include mature forest or forest that has been recently harvested.

3.1 Water Region 1- Big Qualicum

Water Region 1 is the most northerly Water Region and has an area of approximately 292 km^2. Most of this Water Region resides in RDN Electoral Area H. A small portion of this Water Region includes Comox Valley Electoral Area A. The two hydrometric stations in this Water Region are Nile Creek near Bowser and Rosewall Creek near Hwy 19a bridge. The Rosewall Creek hydrometric station is operated by BCCF and started collecting data in October 2012. Mean daily temperatures from 1981 to 2010 were 16.7°C for August and 13.6°C for September within the water region. For the fall sampling period, mean daily temperatures from 1981 to 2010 were 9.1°C for October and 5.6°C for November. Water Region 1 receives the most rainfall according to the rainfall data from Big Qualicum Hatchery. The mean total rainfall from 1981 to 2010 was 34.6 mm, 46.3 mm, 146.8 mm and 214.0 mm for August- November, respectively.

3.1.1 Overview of Watersheds

Water Region 1 contains the Big Qualicum River watershed and seven smaller watersheds. The creeks that are sampled by the CWMN program include Rosewall Creek, Cook Creek, Nile Creek, Thames Creek, and Annie Creek. Big Qualicum River has two sites that are sampled as part of CWMN program. The Fanny Bay Salmonid Enhancement Society started sampling Rosewall, Cook and Deep Bay creek in 2016. The Nile Creek Enhancement Society samples the remainder of the CWMN sites in Water Region 1 and started some sites in 2011.

Both Big Qualicum sites (u/s of Hwy 19 Bridge- E298597 and 700m d/s Hatchery-E298598) have watersheds that are primarily forested and include Horne Lake in the headwaters (Appendix A).

Nile Creek has three sites that are sampled as part of CWMN program. The Upper Nile site (E286551), which is the furthest upstream, has a watershed that is entirely forested (99.9%). The two downstream sites, u/s of hatchery (E286552) and Old Island Hwy (E286553), are primarily forested with some land that is zoned recreational but appears vacant (Figure 3-1). The furthest downstream site near Old Island Hwy has a watershed with approximately one percent residential development.

The Thames Creek watershed is south of the Nile Creek watershed. Thames Creek has two sites that are sampled as part of the CWMN program. The furthest upstream site near Inland Island Highway (E286550) is primarily forested with some vacant land that is zoned for recreational/institutional use. The watershed of the Thames Creek u/s of Old Highway site (E286549) is primarily forested (forest and vacant land) and has small wetlands. Two-percent of this watershed has land use associated with commercial development (Figure 3-1).

Cook Creek, Rosewall Creek, Deep Bay Creek and Annie Creek each have one site included as part of the CWMN program. Rosewall Creek (E306374) is the furthest north watershed in Water Region 1, whereas Annie Creek (E240141) is the furthest south (Appendix A). The watersheds of Cook (E309086) and Rosewall Creek are primarily forested. The Deep Bay Creek watershed (E306375) is small and flat with approximately 60% rural residential and 36% commercial and other residential development (Figure 3-1). The Annie Creek watershed is primarily rural residential and agricultural with 8% of associated with commercial development (a Bed and Breakfast) and roads. Annie Creek originates from groundwater and shallow wetlands and is ditched in its headwaters (Clough 2017a).

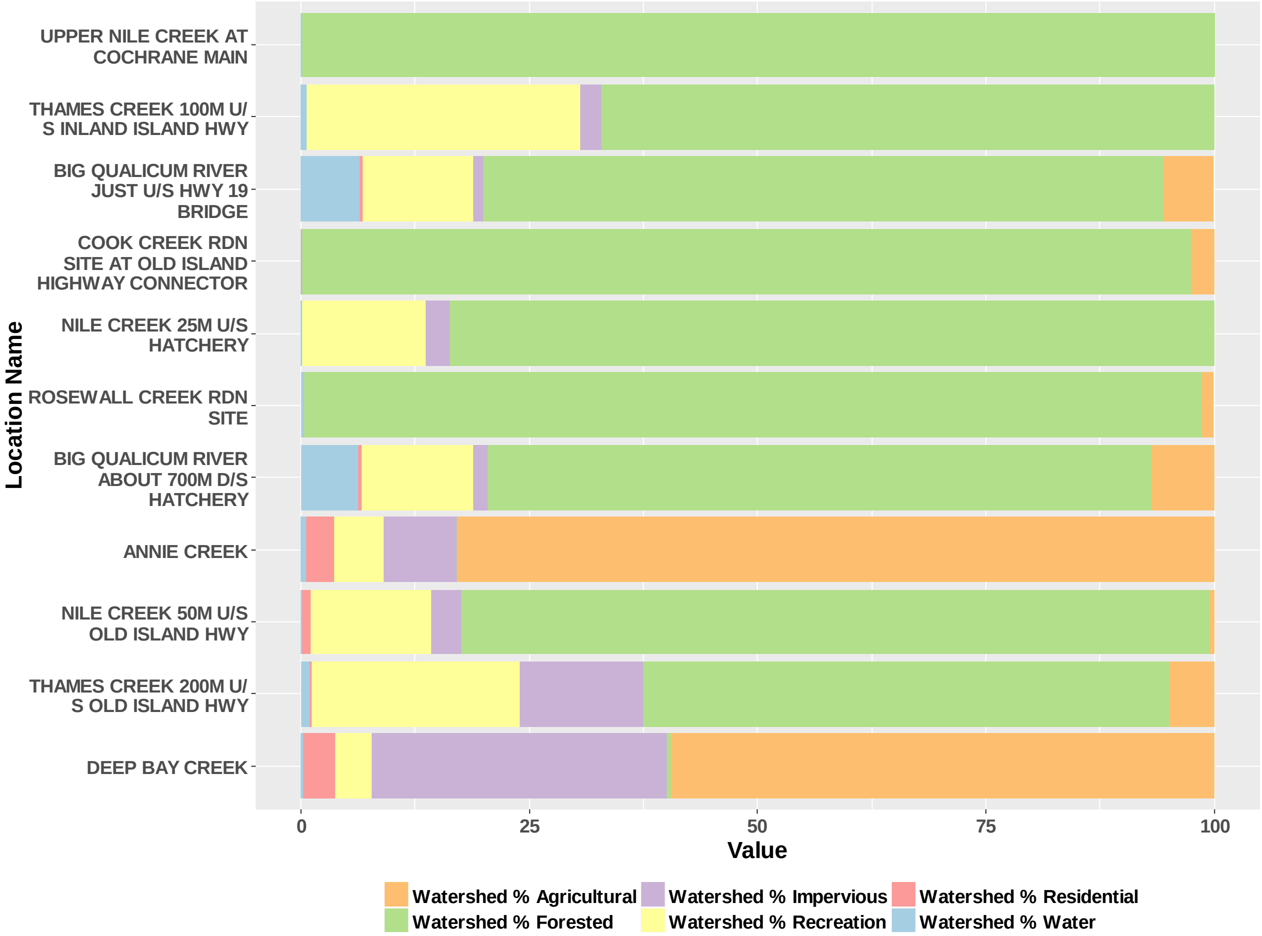


Figure 3-1: Percent land use composition for CWMN site watersheds of Water Region 1 (Big Qualicum River).

3.1.2 Water Quality Summary and Trends

Please refer to section 2.1 for a description of the parameters that were sampled and their value.

3.1.2.1 Temperature

All samples sites in the Big Qualicum water region had suitable water temperatures for aquatic life during the fall flow period (Figure A13). However, during summer low flows, water temperatures were consistently above the 15°C target at Rosewall and Cook Creek despite the relatively undeveloped nature of these watersheds (Figure A9). Thames Creek, approximately 200m u/s Old Island Highway, and the Annie Creek sample stations occasionally exceeded these guidelines during the summer period.

3.1.2.2 Dissolved Oxygen

The dissolved oxygen concentration in water is directly related to the water temperature, where cooler waters have greater concentrations of oxygen than warmer waters. In Figure A129, the concentration of oxygen is shown for each site, where points above the grey shaded area represent super-saturation (rarely a problem for aquatic life) and those points falling below the shaded area are below 5 mg/L and stress to fish or other aquatic species is probable.

The Annie Creek site usually had depleted dissolved oxygen in the summer months (Figure A10). The Cook Creek site had low DO but had DO concentrations close to saturation. All measured dissolved oxygen concentrations in the Big Qualicum region were suitable for aquatic life in the fall (Figure A14).

3.1.2.3 Conductivity

Within the Big Qualicum water region, Annie Creek had the highest specific conductance, averaging >100 µS/cm in fall and >150 µS/cm in summer, suggesting groundwater influence (Figure A11). Upper watershed sites had lower conductivity, generally below 50 µS/cm in fall and below 70 µS/cm during summer low flows (Figure A15).

3.1.2.4 Turbidity

In the Big Qualicum water region, turbidity spikes were most common at Deep Bay and Annie Creek sampling stations. At Thames Creek approximately 200m u/s of the Old Island Highway, and at Rosewall Creek, occasional turbidity spikes were observed. The Englishman River water quality Objective for turbidity is 2 NTU for low flow periods such as the summer and 5 NTU for higher flow periods. Individual measurements >5 NTU were recorded at Annie and Rosewall creeks in the fall and >2 NTU at Annie and Deep Bay creeks in the summer (Figure A12 and Figure A16). Elevated turbidity during summer low flows can be indicative of watershed disturbances such as the rural residential or agricultural development. Land used for agriculture frequently has less riparian vegetation and has altered drainage patterns. As a result soils and sediments can be easily mobilized from the riparian area into the stream. The primary cause of sediment mobilization is erosion which can be caused by livestock grazing and unstable stream banks due to lack of vegetation. Watersheds with a high agricultural land use often have altered drainage systems because of drain tile and ditching (Choquette 2014). These altered drainage patterns result in more runoff that causes an increase in sediment loads to streams. The Annie Creek watershed has high agricultural land use and known bank stability issues (Clough 2017a). Similarly, there is 91% rural residential/agricultural and commercial land use in the Deep Bay Creek watershed that could be contributing to its elevated turbidity.

3.1.3 Rainfall, Flows, and Water Quality

Thames Creek upstream of Inland Island Hwy and Nile Creek upstream of Old Island Road were the only sites in this Water Region that had enough fall data to test correlations between fall rainfall and water quality. Both of these sites had a positive association between temperature and rainfall in fall. This correlation may be a result of annual variations in air temperature. For example, the fall of 2014 was warm and also had some high intensity rainfall events (Figure A96 and Figure A111).

Rainfall and turbidity were positively associated, whereas conductivity was negatively associated with rainfall at Thames Creek upstream of Inland Island Hwy (Table A1). Thames Creek upstream of Inland Island Hwy experienced a spike in turbidity on October 23, 2014 which was associated with a rainfall event. The increases in turbidity during rainfall events is expected and is a result of increased mobilization of sediment in the watershed due to more runoff and increases in discharge which causes more bank erosion. The decrease in conductivity during rainfall events is a result of dilution of stream flows (Girardi et al. 2016).

During the low flow summer period, Nile Creek near Bowser had high flows in September of 2015-2016 (Figure A124). On September 1, 2015 high flows of 0.35 m^3/s were likely associated with a rainfall event on August 29th, 2015 (Figure A74). There were five sites in Water Region 1 sampled on September 1, 2015. However, Big Qualicum d/s of hatchery was the only site that experienced a spike in turbidity on this day.

3.1.4 Trend Analysis

Nile Creek upstream of Old Island Highway was the only site in Water Region 1 that had a suitable continuous dataset for trend analysis. Trend analysis indicated that conductivity, DO, temperature and turbidity were relatively stable from 2011-2017 for both the summer and the fall sampling periods at the Nile Creek site (Table A2).

3.1.5 Sites of Concern in Water Region 1

Annie Creek was added to the CWMN monitoring program in 2014. This is a site that was previously identified as needing restoration works. Our analysis supports the need for restoration, given its depleted dissolved oxygen levels, high summer temperatures and high summer turbidity. In addition, Annie Creek has high fisheries values and the lower portions of Annie Creek are known to support Coho Fry and Cutthroat Trout (Clough 2017a). Annie Creek's turbid waters are linked to eroding muddy stream banks (Clough 2017a). There were several remedial actions recommended in Clough (2017a). We agree with these recommendations and emphasize the need to plant native riparian vegetation to stabilize banks and provide more shade.

3.2 Water Region 2- Little Qualicum

Water Region 2 has an area of approximately 259 km^2, and includes parts of RDN Electoral Areas F, G and H. There is a Water Survey of Canada hydrometric station on Little Qualicum River near Qualicum Beach. There is a climate station at the Little Qualicum Hatchery and mean daily temperatures from 1981 to 2010 were 16.4°C for August and 13.3°C for September. For the fall sampling period, mean daily temperatures from 1981 to 2010 were 8.8°C for October and 5.2°C for November. The mean total rainfalls at the Little Qualicum Hatchery from 1981 to 2010 were 31.8 mm, 40.7 mm, 112.9 mm and 177.0 mm for August to November, respectively.

3.2.1 Overview of Watersheds

The Little Qualicum watershed includes Cameron and Little Qualicum rivers. Whiskey Creek is a major tributary of the Little Qualicum River. Cameron River has two sites and Little Qualicum River has three sites sampled by the CWMN. The Qualicum Beach Streamkeepers sample all the CWMN sites in Water Region 2. The headwaters of Cameron River start in the Beaufort Mountain Range. The Upper Cameron River site (E285669) has the highest elevation of any site sampled in the CWMN program. This site is at ~463 m.a.s.l. and has a watershed that is 96% forested and includes Labour Day Lake (Figure 3-2). The watershed of the Cameron River site (E220635) is also primarily forested. The most upstream Little Qualicum River site is 1.2 km downstream of Cameron Lake (E268993) and has a watershed that is 84% forested. The Little Qualicum site at intake (E256394) and u/s of Hwy 19A (E299853) have watersheds that are 65% forested but have 7-9% agricultural and rural land with 1% residential land use. The Whiskey Creek sample site (E287697) is located near Hwy 4 and has a mix of forested land, rural and agricultural land with 9% of the watershed associated with industrial land use and roads.

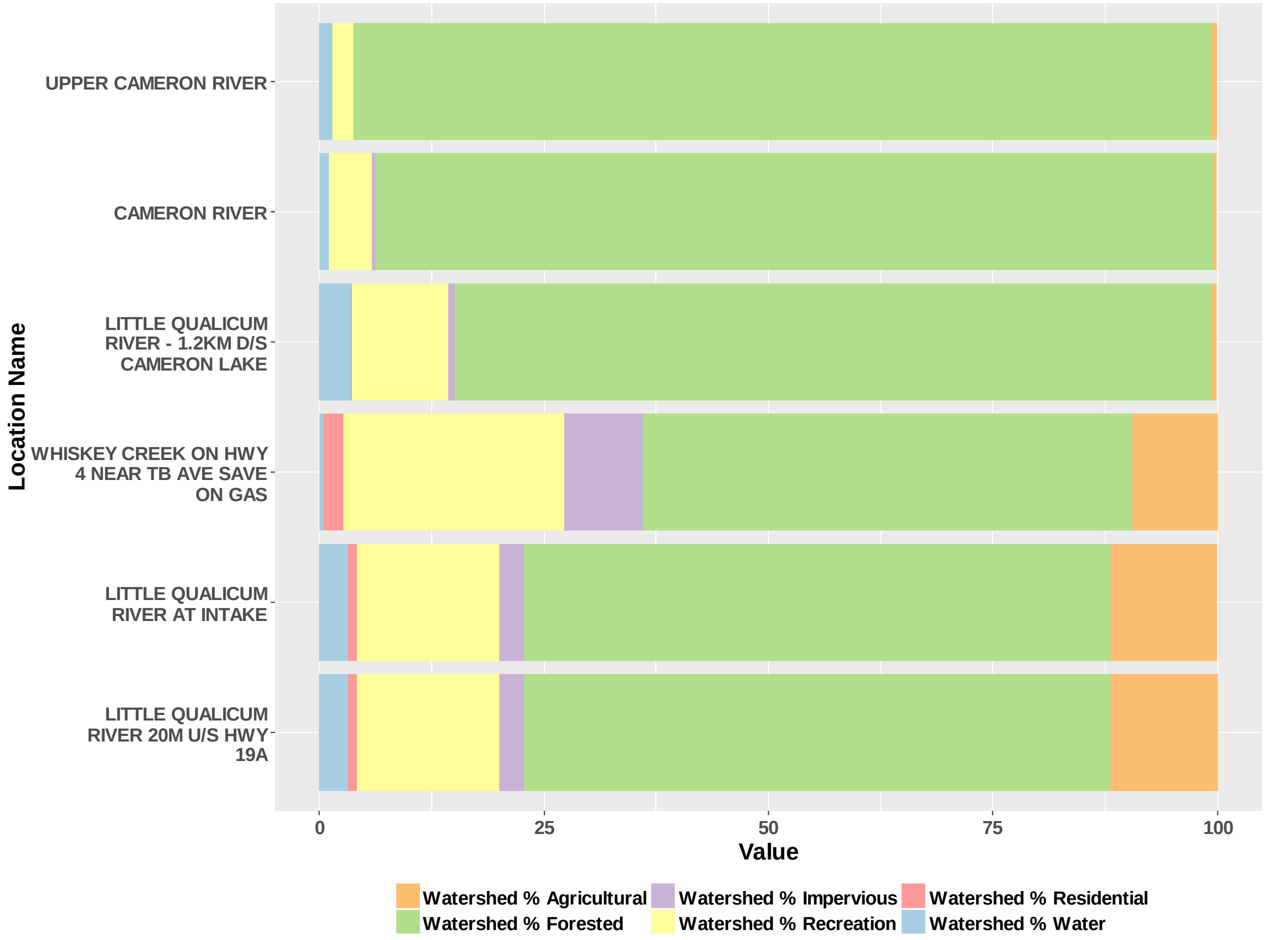


Figure 3-2: Percent land use composition for CWMN site watersheds of Water Region 2 (Little Qualicum River).

3.2.2 Water Quality Summary and Trends

3.2.2.1 Temperature

All samples sites in the Little Qualicum water region had suitable water temperatures for aquatic animals in the fall (Figure A21). However, during summer low flows, water temperatures consistently exceeded the 15°C drinking water aesthetic target and the 17°C coho rearing target in all Little Qualicum River sampling stations (Figure A17). Little Qualicum River is fed by warm surface discharges from Cameron Lake in summer; that can contribute to this observed exceedance. Additionally, these sampling sites had open canopies and low flows in summer, both of which contributed to the sun penetrating to the stream bed substrate and increasing the water temperature.

3.2.2.2 Dissolved Oxygen

All sites in the Little Qualicum watershed had DO concentrations suitable for aquatic life in both fall and spring sample seasons (Figure A18 and Figure A22).

3.2.2.3 Conductivity

Within the Little Qualicum water region, all sites ranged between 60 µS/cm and 160 µS/cm in fall, and 80 µS/cm to 160 µS/cm in summer low flows, both typical ranges for this ecoregion (Figure A19 and Figure A23). Conductivity generally increased as water travelled through the watershed, again a typical finding.

3.2.2.4 Turbidity

Turbidity exceedances were rare in the Little Qualicum watershed. Turbidity spikes >5 NTU were recorded on Whiskey Creek and at Little Qualicum River at intake in the fall on <10% of sample dates (Figure A24). Turbidity exceedances also occurred at Little Qualicum River 20m u/s HWY 19A during summer low flows, but were rare (<10% of sample dates). In all cases, average turbidity levels were far below the 2 NTU guideline (Figure A20).

3.2.3 Rainfall, Flows, and Water Quality

Fall conductivity, turbidity and temperature all had significant relationships with rainfall in Water Region 2. Fall conductivity was negatively correlated with rainfall at the Upper Cameron River site and the Little Qualicum site downstream of Cameron Lake. This means that as rainfall increases, the conductivity of the water decreases through rainwater dilution of stream flows. The Cameron River sites had a positive association between fall water temperatures and rainfall (Table A1). However, this association had moderate strength and it thought to be a result of annual variability in fall air temperatures.

Fall turbidity was positively correlated to rainfall at the Upper Cameron River site and Little Qualicum River at intake. A Turbidity spike on November 8, 2016 at Upper Cameron River was associated with heavy rainfall from November 5- 8, 2016 (Figure A102). The Little Qualicum River site at intake also experienced a turbidity spike on November 21, 2017 which was associated with heavy rainfall from November 18-21, 2017 (Figure A99). The turbidity spike on November 8, 2016 was probably associated with high flows >50 m^3/s on Little Qualicum River (Figure A122). High flows have more energy and as a result can erode river banks and mobilize sediments. During the low flow summer period, Little Qualicum River near Qualicum Beach had high flows from September 1-9, 2015 (Figure A122), these high flows were associated with a rainfall event. On September 1, 2015 both Little Qualicum River sites had turbidity >1 NTU, which is the highest turbidity recorded for these sites during the summer (Figure A20).

3.2.4 Trend Analysis

Five of the six sites sampled in Water Region 2 had suitable continuous datasets for trend analysis. Trend analysis indicated that conductivity, DO, temperature and turbidity were stable from 2011-2017 for both the summer and fall sampling periods at the Upper Cameron and Cameron River, Little Qualicum River1.2 km d/s of Cameron Lake, and Whiskey Creek. However, fall and summer turbidity at Little Qualicum River at Intake have increased in recent years (Figure A137).

3.2.5 Sites of Concern in Water Region 2

Because turbidity has been increasing at Little Qualicum River, we recommend that the reach directly upstream of the Little Qualicum River at Intake site (E256394) be inspected for potential bank stability issues.

3.3 Water Region 3- French Creek

Water Region 3 has an area of approximately 121 km^2 and includes the Town of Qualicum Beach, part of RDN Electoral Areas F and G, and part of the City of Parksville. There are no active hydrometric stations with a long-term dataset in Water Region 3, However, there is a hydrometric station run by BC Conversation Foundation (BCCF) established in August of 2012 on Grandon Creek 35 m upstream of Old Island Highway 19a. Also a hydrometric station was added on French Creek in July 2018. In Water Region 3here are climate stations at the Qualicum Beach Airport and at Coombs. Mean total rainfalls and daily temperatures from 1981-2010 are not available for Qualicum Beach Airport because monitoring started in 2006. Coombs mean daily temperatures from 1981 to 2010 were 17.1°C for August and 13.8°C for September. For the fall sampling period, mean daily temperatures from 1981 to 2010 were 8.9°C for October and 4.7°C for November. The mean total rainfall at Coombs from 1981 to 2010 was 34.5 mm, 39.3 mm, 113.2 mm and 180.7 mm for August-November, respectively.

3.3.1 Overview of Watersheds

Water Region 3 has three creeks that are sampled by the CWMN program. French Creek is the largest creek in Water Region 3. French Creek has been sampled by the Friends of French Creek since 2011. Grandon and Beach are small creeks that drain into the Strait of Georgia and are sampled by the Qualicum Beach Streamkeepers.

French Creek has three sites sampled by the CWMN. The furthest upstream site at Grafton Rd (E243024) has a watershed that is primarily forested with 15% rural and agricultural land (Figure 3-3). The French Creek site at New Highway (E243021) is downstream of Hamilton Marsh and has a watershed with 30% rural/agricultural and 58% forested. The watershed of the Barclay bridge site (E243022) is similar to the New Highway site with a mix of forested and rural/agricultural land use. However, the

Barclay site watershed has 13% of its watershed associated with residential land, the Qualicum Beach Airport and roads.

Beach and Grandon creeks have watersheds with high agricultural use and have two sites each sampled by the CWMN. Both Grandon Creek sites have >50% agricultural upstream land use. The watershed of the furthest downstream site at West Crescent (E288090) is more developed with 5% residential land, compared to 1% at the Laburnum Rd site (E288091). Similar to Grandon Creek, the two Beach Creek sites have highly disturbed watershed with only 6% forested (Figure 3-3). The Beach Creek site at Hemsworth Rd (E288092) has a watershed that includes large wetlands, a golf course, 50% agricultural and rural land and 6% residential land. The watershed of Beach Creek near memorial golf pond (E288093) has more residential development (18%) than the Hemsworth site (6%).

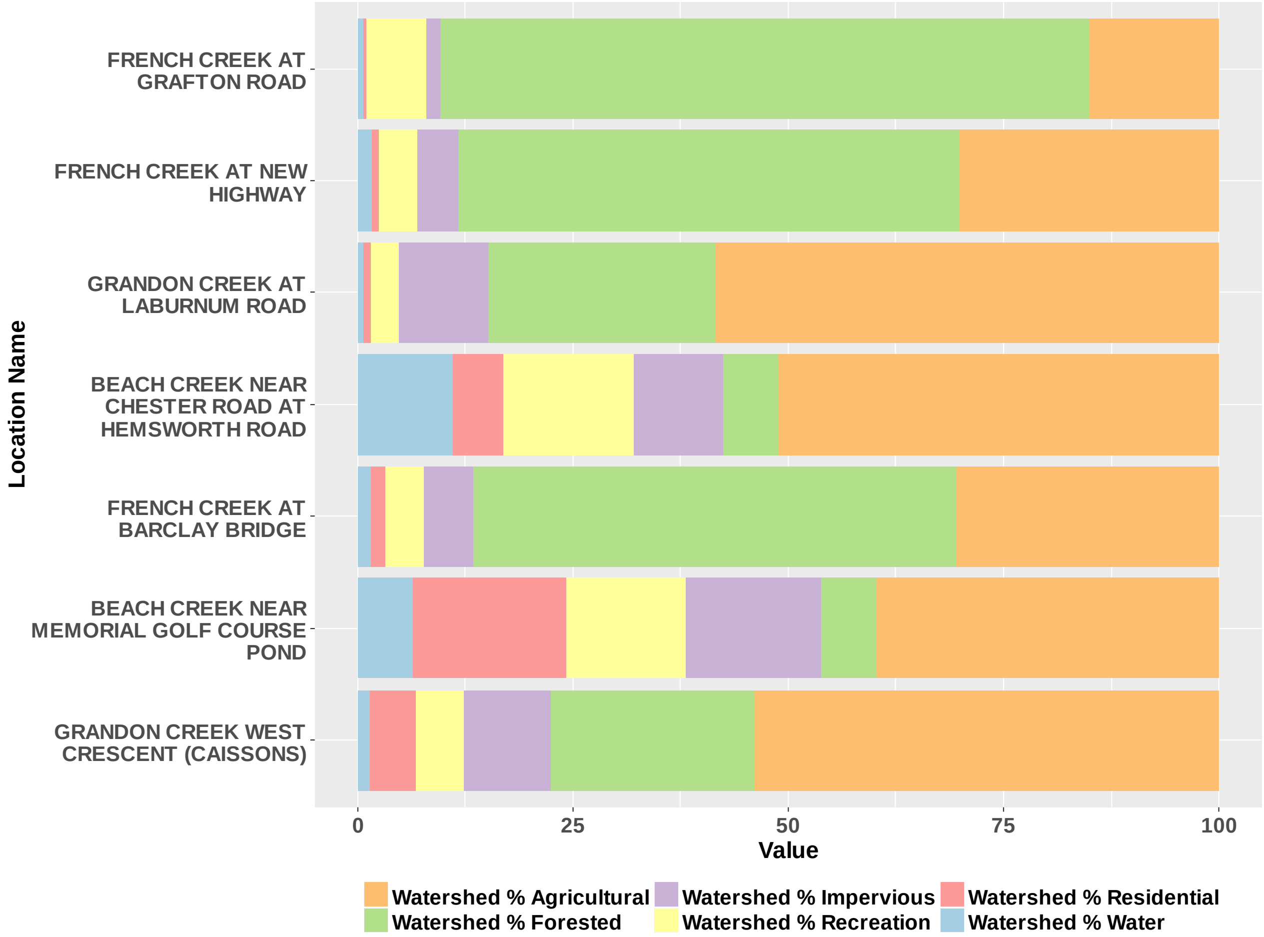


Figure 3-3: Percent land use composition for CWMN site watersheds of Water Region 3 (French Creek).

3.3.2 Water Quality Summary and Trends

3.3.2.1 Temperature

All samples sites in the French Creek water region had suitable water temperatures for aquatic animals in the fall flush period (Figure A21). However, in the summer months, water temperatures consistently exceeded the 15°C target at Grandon Creek at West Crescent, Grandon Creek at Laburnum Rd., French Creek Barclay Bridge and French Creek Grafton Rd sample stations (Figure A25).

3.3.2.2 Dissolved Oxygen

All sites in the French Creek watershed region had DO concentrations suitable for aquatic life in the fall except Grandon Creek at Laburnum Rd (Figure A30). Two stations with warm summer water temperatures also had low DO - Grandon Creek at Laburnum Rd, and French Creek Grafton Rd. Both these sites had summer DO concentrations well below saturation limits (Figure A131). All mean summer DO measurements at. Grandon Creek at Laburnum Rd were below 5.0 mg/L, whereas French Creek at Grafton Rd mean summer DO were below 8 mg/L (Figure A26). The Grandon Creek site at Laburnum Rd has very slow flow which limits the mixing of DO. This site also has mixed land uses including 58% rural/agriculture in watershed and 79% within the 500m upstream buffer (Figure A3).

3.3.2.3 Conductivity

French Creek has the lowest specific conductance observed in this Water Region, averaging >75 µS/cm in fall; in the summer only the French Creek at Grafton Rd remained that low (Figure A27 and Figure A31). The remaining sites averaged conductivities exceeding 160 µS/cm during summer low flows, suggesting groundwater influence or salinized inflow from adjacent lands.

3.3.2.4 Turbidity

Infrequent turbidity objective exceedances occurred throughout this water region. These spikes may relate to agriculture or road corridor stormwater. In the fall, turbidity >5 NTU was periodically measured (<10% of sample dates) at all sites except French Creek at Grafton Rd (Appendix D). In the summer months, turbidity spikes were recorded at Grandon Creek Laburnum Rd that averaged >2 NTU, while the two Beach Creek sites, Grandon Creek at West Crescent and French Creek at Barclay Bridge averaged just under 2 NTU. Seventy-five percent of the exceedances at Grandon Creek at West Crescent were likely associated with rainfall events.

3.3.3 Rainfall, Flows, and Water Quality

Rainfalls in fall were correlated to conductivity and turbidity in Water Region 3. Fall conductivity had a negative correlation with rainfall at all Grandon Creek sites, Beach Creek Near Memorial Golf Course Pond, and two French Creek sites (Grafton Rd and Barclay Bridge). All sites that are sampled in Water Region 3 had a positive correlation between rainfall and fall turbidity. Peaks in turbidity at Grandon, Beach and French creeks were observed on November 14 and 21, 2017. Both these sampling events coincided with heavy rainfall. The increases in turbidity during rainfall events is expected and is a result of increased mobilization of sediment in the watershed due to more runoff and increases in discharge which causes more bank erosion.

Fall temperature and DO also had some correlations in Water Region 3. Fall water temperatures were positively correlated with rainfall at both Grandon Creek sites, two French Creek sites (Grafton Rd and Barclay Bridge), and Beach Creek near Chester Rd at Hemsworth Rd. However, these correlations had moderate strength and it thought to be a result of annual variability in fall air temperatures. DO at French Creek at New Highway and Barclay Bridge was negatively correlated with rainfall (Table A1). A rainfall event adds water to the stream that is under saturated in DO, rainwater typically has depleted oxygen levels (Komabayasi 1959).

During the low flow summer period, Grandon Creek 35 m upstream of Old Island Highway 19a had high flows at the end of August in 2013-2015 (Figure A123). On September 2, 2014 the Grandon Creek site at West Crescent had a turbidity of 4.02 NTU. This spike in turbidity was associated with a rainfall event (Figure A78).

3.3.4 Trend Analysis

All seven sites in Water Region 3 had suitable continuous datasets for trend analysis. Trend analysis identified that summer and fall turbidity are increasing at Beach Creek near Hemsworth and French Creek at Grafton Rd (Table A2). Mean summer and fall turbidity at French Creek at Grafton Rd are well below the Objectives. However, in 2017 mean summer turbidity at Beach Creek near Hemsworth exceeded the >2 NTU objective (Figure A140). In 2017, the mean fall turbidity was approaching the fall objective of 5 NTU at Beach Creek near Hemsworth.

Beach Creek at Hemsworth Road was the only site in Water Region 3 that had trends in conductivity and temperature. The mean summer and fall specific conductivity at Beach Creek at Hemsworth Rd decreases from 2011-2017 while the mean water temperature in fall and summer have been increasing. The trend observed with water temperature is explained by annual differences in air temperature. The fall sampling period of 2014-2016 had warmer temperatures at Qualicum Beach Airport compared to the fall of 2011-2013 (Appendix E).

3.3.5 Sites of Concern in Water Region 3

The three sites of concern in Water Region 3 have >78% agricultural land use within the 500 m upstream buffer. French Creek at Grafton Road has low DO, high water temperatures and an increasing turbidity trend. Remedial planting was conducted at this site because it has compromised bank stability due to lack of riparian vegetation (Clough 2015a). Grandon Creek at Laburnum Rd has depleted DO, high summer water temperatures and high summer turbidity. A large portion of Grandon Creek upstream of the Laburnum Rd site is ditched and has very little riparian vegetation. Hilliers Estate farm planted trees as part of restoration efforts, and more tree planting is recommended along the agricultural portion of Grandon Creek (Clough 2015b). Beach Creek at Hemsworth is a site of concern because turbidity has increased and conductivity has decreased from 2011-2017. The reasons for these changes should be investigated because the Beach Creek watershed has both a golf course and agricultural land use.

3.4 Water Region 4- Englishman River

Water Region 4 covers approximately 322 km^2 and includes the City of Parksville and parts of RDN Electoral Areas F and G. The upper part of Englishman River Water Region was historically logged (Barlak et al. 2010). There is a hydrometric station on Englishman River near Parksville. The closest climate station to Water Region 4 is the Nanaimo Airport. Mean daily temperatures from 1981 to 2010 were 18.2°C for August and 14.9°C for September. For the fall sampling period, mean daily temperatures from 1981 to 2010 were 9.9°C for October and 5.6°C for November. The mean total rainfall at the Nanaimo Airport from 1981 to 2010 was 28.4 mm, 35.8 mm, 101.2 mm and 186.5 mm for August- November, respectively.

3.4.1 Overview of Watersheds

The major tributaries of the Englishman River that are sampled as part of the CWMN program include the Upper Englishman River, Morison Creek, Centre Creek, South Englishman River and Shelly Creek. Swane Creek is also sampled and is a tributary of Morison Creek. The Mid Vancouver Island Habitat Enhancement Society have sampled ten sites in Water Region 4 from 2011-2017.

The Upper Englishman River site (E282969) and Englishman River site upstream of Morison Creek (E248834) are the furthest upstream. The watersheds of the Upper Englishman River and Englishman River site upstream of Morison Creek are primarily forested with some recreational land use. The watershed of Morison Creek site (E248835) includes the Swane Creek watershed. The Swane Creek (E308186) and Morison Creek sites have unnamed lakes in their headwaters (Appendix A). The Swane Creek watershed has 19% agricultural/rural land, whereas the Morison Creek

Watershed has 30% agricultural/rural land (Figure 3-4). The purpose of the Morison Creek sample site was to monitor the effects of timber harvesting and agriculture on water quality (Barlak et al 2010).

Centre Creek and the South Englishman River are both tributaries of the Englishman River and each have one site sampled as part of the CWMN program. The South Englishman River site (E248836) has an upstream watershed that is primarily forested with some wetlands and small lakes. The Centre Creek site (E299852) has a watershed is 100% forested. The downstream Englishman River sites near Allsbrook Canyon (E252010) and Highway 19A (0121580) are downstream of an unnamed lake and are primarily forested with 4% rural/agricultural and recreational land use (Figure 3-4).

Shelly Creek is the furthest downstream tributary to the Englishman River and has two sample sites that are sampled as part of the CWMN program. The two sites are in close proximity and therefore have watersheds with similar land use compositions. The Shelly Creek site at Blower Rd (E290452) is approximately 350 m downstream from the site at Hamilton Rd (E287131). The watershed of the Shelly Creek site at Hamilton Rd has 18% forested and large wetlands. The lower portion of the Shelly Creek watershed is 35% rural residential with 10% single family development and recreational land use (Figure 3-4).

Figure 3-4: Percent land use composition for CWMN site watersheds of Water Region 4 (Englishman River).

3.4.2 Water Quality Summary and Trends

3.4.2.1 Temperature

All samples sites in the Englishman River water region had suitable water temperatures for aquatic animals in the fall (Figure A37). However, during summer low flows, water temperatures consistently exceeded the 15°C target and occasionally the 17°C target at all sites except the Upper Englishman River site (Figure A33). This higher water temperatures are likely a result of wide and shallow nature of the river in the lower reaches (Barlak et al. 2010).

3.4.2.2 Dissolved Oxygen

All sites in the Englishman watershed had DO concentrations suitable for aquatic life in the fall except Swane Creek and both Shelly Creek sites (Figure A38). These three sites also had water temperatures exceeding 17°C in summer low flows, when they also averaged DO below the 8 mg/L 30-day guideline (Figure A34). Average summer DO at Swane Creek was below 2.5 mg/L – a lethal threshold for most fish and many benthic invertebrates. A large portion of Swane Creek is ditched resulting in high oxygen consumption and very little turbulent mixing in this creek, both of which contribute to very low DO concentrations.

3.4.2.3 Conductivity

In the Englishman River water region results, Shelly Creek and Center Creek had the highest specific conductance, averaging >150 µS/cm in fall and >200 µS/cm in summer, suggesting groundwater influence (Figure A35). Additionally, Swane Creek has a large groundwater component with subsurface flows. Upper Englishman River had lower conductivity, generally below 70 µS/cm in both fall and summer flows, indicating a comparatively small groundwater contribution Figure A35 and Figure A39).

3.4.2.4 Turbidity

Turbidity exceedances occurred throughout this water region. In the fall, high turbidity was measured at all sites except those in the Upper Englishman River, and was >5 NTU at Swane and Shelly creeks (Figure A40). During summer low flows, turbidity exceedances >2 NTU were particularly evident at Swane and Shelly Creek sites, the same ones with frequent temperature and DO exceedances (Figure A36). Infrequent turbidity spikes were recorded at the Morison Creek and Englishman River sites. No turbidity spikes were detected at the upper watershed Englishman River sample sites.

3.4.3 Rainfall, Flows, and Water Quality

Fall conductivity, water temperature and turbidity were the only water quality variables that had significant relationships with rainfall in Water Region 4. Fall conductivity was negatively correlated to rainfall at the Upper Englishman River site, Englishman River upstream of Morison Creek, and Englishman River at Hwy 19A. When streams receive rainwater from runoff or rainfall the concentration of ions (conductance) get diluted. Fall turbidity was positively correlated to rainfall at the Upper Englishman River site, Morison Creek site, Englishman River upstream of Morison Creek, South Englishman River site, and Englishman River at Hwy 19A (Table A1). These five sites experienced spikes in turbidity on November 14, 2017 which was associated with heavy rainfall from November 11-14, 2017 (Figure A103). The increases in turbidity during periods of heavy rainfall is expected and is a result of increased mobilization of sediment in the watershed due to more runoff and increases in discharge which causes more bank erosion. Fall water temperature was positively correlated to rainfall at the Upper Englishman River site, Morison Creek site, South Englishman River site, and Englishman River upstream of Morison Creek (Table A1). However, these correlations had moderate strength and it thought to be a result of annual variability in fall air temperatures.

Englishman River at Parksville experienced a peak flow of 8.7 m^3/s on September 1 2015 this high flow event was associated with a rainfall event (Figure A118). There were six sites in the Englishman River Water Region sampled on this day. The turbidity of these sites on September 1 2015 was not elevated compared to other summer samples.

3.4.4 Trend Analysis

Five of seven sites in Water Region 4 had had suitable continuous datasets for trend analysis. These five sites are Englishman River at Highway 19A, Englishman River upstream of Morison Creek, Morison Creek, South Englishman River and Upper Englishman River. Trends were identified for turbidity at the Englishman River at Hwy 19A and DO for Englishman River Upstream of Morison from 2011-2017 (Table A2). Data from 2007-2017 was available for Englishman River at Hwy 19A and Englishman River upstream of Morison sites from another monitoring program. DO was stable at Englishman River upstream of Morison from 2007-2017. At Englishman River at Hwy 19A turbidity was also stable from 2007-2017.

3.4.5 Sites of Concern in Water Region 4

Three sites of concern identified for Water Region 4 were added to the CWMN program in 2014. Both Shelly Creek sites and the Swane Creek site are a concern because they have low and depleted DO, high summer temperatures and high turbidity. The reach upstream of the two Shelly Creek samples sites has a high percentage of fines and the channel banks are eroding (Law et al. 2016). Swane Creek is ditched and has limited riparian shading. However, restoration works were conducted from 2000-2007 along Swane Creek and were successful at reducing sediment sources from agricultural activities (Barlak et al. 2010).

3.5 Water Region 5 South Wellington to Nanoose

Water Region 5 covers approximately 322 km^2 and includes the City of Nanaimo and the District of Lantzville and parts of RDN Electoral Areas C, E and G. There is a hydrometric station on Millstone River south of Bowen Road in Nanaimo. There are rain gauges at Fairwinds Golf Course, City Hall, Nanaimo City Yard, Firehall #3 and Reservoir. The mean total rainfall at the Nanaimo City Yard from 1981 to 2010 was 28.8 mm, 37.0 mm, 99.2 mm and 179.1 mm for August- November, respectively.

3.5.1 Overview of Watersheds

Water Region 5 includes Millstone River, Chase River, Bonnell Creek, Craig Creek, Nanoose Creek and many smaller creeks. Nanoose Creek, Bonnell Creek, and Craig Creek are in the northern part of Water Region 5 and these creeks all drain into the ocean (Appendix B). The Lantzville Nanoose Streamkeepers, Island Water Fly Fishers, Departure Creek Streamkeepers, Walley Creek Streamkeepers, Vancouver Island Research Lab sample sites throughout Water Region 5. The Millstone River Watershed is north of the Chase River watershed. Catstream is a tributary of the Chase River while McGarrigle Creek and McClure Creek are both tributaries of the Millstone River. Walley Creek, Cottle Creek, Departure Creek, and Northfield Creek have small watersheds within the City of Nanaimo boundary. Knarston Creek and Bloods Creek also have small watersheds and are west of the City of Nanaimo boundary.

The Northern part of Water Region 5 is less developed than the Southern part of Water Region 5 and includes Craig Creek, and Nanoose Creek (Appendix B). The Craig Creek watershed borders the Englishman River watershed. Craig Creek has one site (E294017) that was sampled as part of the CWMN program. This site is upstream of Northwest Bay Rd and has a watershed with 49% forest and 37% rural agricultural (Figure 3-6). The Nanoose Creek watershed is south of Craig Creek. Nanoose Creek has two sites that are sampled as part of the CWMN monitoring program. The Matthew Crossing site (E294020) is also primarily forested with 1% rural/agricultural land. The furthest downstream site at Nanoose Campground (E294019) has a watershed that is also primarily forested with 16% rural/agricultural land.

Millstone River is in the middle of Water Region 5 and has four sample sites in the CWMN monitoring program. Brannen Lake is within the watershed of the four sites. Benson Creek flows into Brannen Lake and has one site at Biggs Road (E290477) that was sampled as part of the CWMN. The watershed is 84% forested and 13% agricultural/rural land and vacant industrial land (Figure 3-5). The nearby Biggs Road site on Millstone River (E290478) is 53% forested with 25% rural/agricultural land use. The Jingle Pot Rd (E306294) and East Wellington Road (E290480) sites have watersheds with 34% and 45% rural/agricultural and residential land. The furthest downstream site in Barsby Park (E290481) is similar to the East Wellington site; its watershed is composed of 36% forest, 35% rural/agricultural land and 11% impervious (Figure 3-5). The Barsby site has 2% more residential cover compared to the East Wellington Site.

McGarrrigle Creek has two sites and McClure Creek has one site that are sampled as part of the CWMN program. These creeks drain into Millstone River between the Jingle Pot Rd and East Wellington Road sites (Appendix A). The Upper McGarrigle site (E306254) is approximately 770 m upstream of the McGarrigle site at Jingle Pot Rd (E290479). The two McGarrigle sites have watersheds with a 62-63% rural/agricultural land and have some forested land with a portion that is zoned for recreation (Figure 3-5). Similarly, the McClure Creek watershed (E309187) is 63% agricultural and 34% forested.

Chase River is south of Millstone River and has four sites that are sampled as part of the CWMN monitoring program. The furthest upstream site is below the Colliery Dam (E290484). The watershed of the Colliery Dam site is 69% forested with 23% rural/agricultural land use and the remaining land use is a mix of residential, recreation, roads and water (Figure 3-5). Cat Stream flows into Chase River between the Chase River sites at Colliery Dam and Park Ave. Cat Stream has one site (E290486) that is sampled as part of the CWMN monitoring program. The Cat Stream watershed is primarily residential with some parkland. The three Chase River sites at Park Ave (E290485), Aebig Rd (E290483), and Estuary Park (E309280) are close together and hence have a similar land use percentages at the watershed level. These three sites have watersheds with approximately 14% residential, 55% forested, 18% Agricultural/Rural, and 8% impervious (roads, commercial, and industrial).

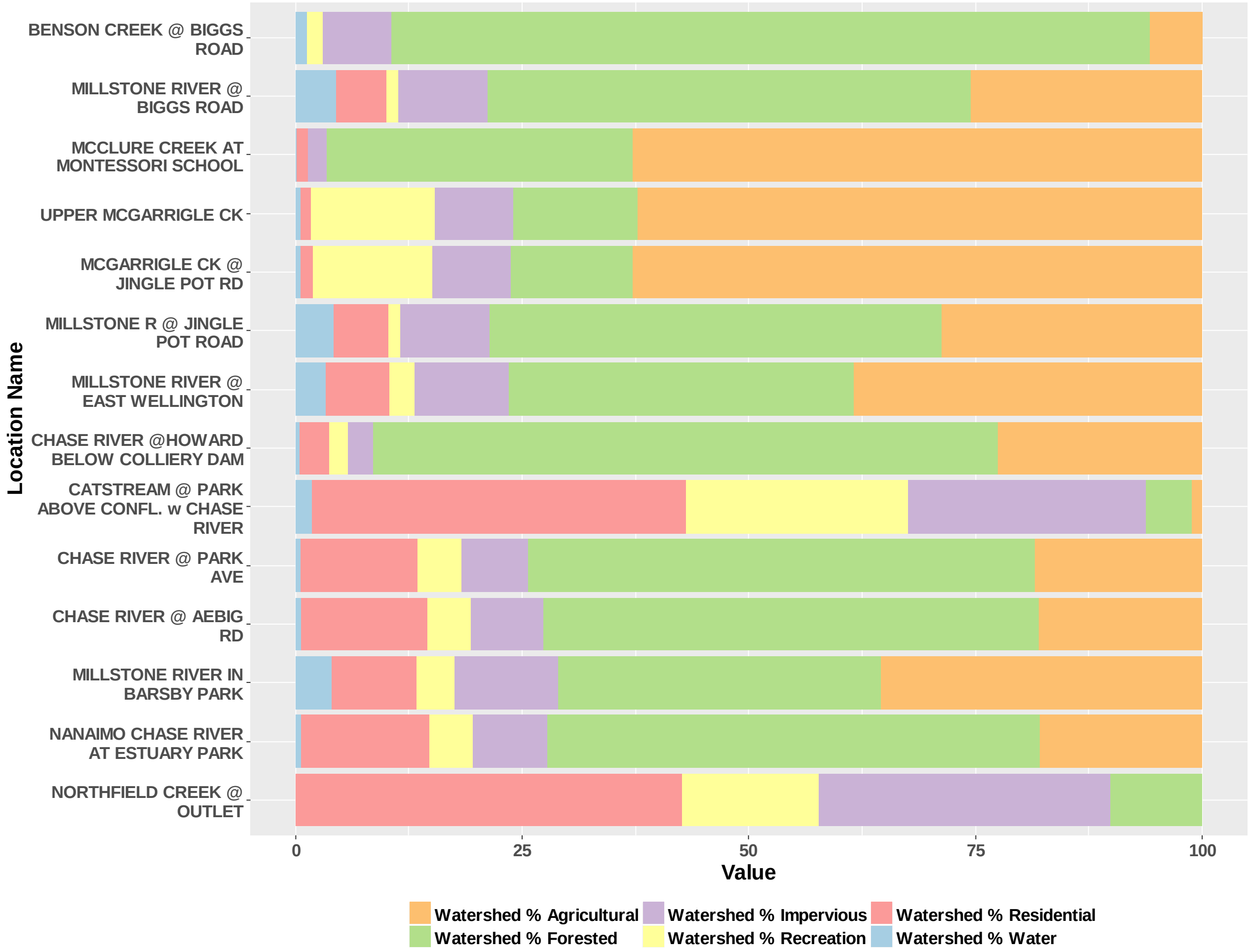


Figure 3-5: Percent land use composition for CWMN site watersheds of Water Region 5-2 (South Wellington to Nanoose).

Walley Creek, Departure Creek and Northfield Creek have the most developed watersheds. Walley Creek watershed includes three sites and Departure Creek includes four sites that are sampled as part of the CWMN monitoring program. All of the Walley Creek sites and the Departure Creek site at Neyland Rd (E290469) have watersheds that are characteristic of single family subdivisions. These watersheds are primarily residential land use (65-73%), with some park land and schools (recreation) and have a high density of paved roads (Figure 3-6). The Departure Creek site off Newton St (E290470) is on Joseph's Creek and has a watershed that is 78% residential. The lower two Departure Creek sites, at Woodstream Park (E290471) and Outlet (E290472, have less residential land use (48-59%) and more commercial and industrial land use. The Nanaimo Golf Club is within the watershed of Departure Creek. The watershed of Northfield Creek at Outlet (E290482) is primarily residential and impervious (roads, commercial and industrial). There are also some schools and park land within the Northfield Creek watershed.

The Cottle Creek watershed is most developed in the upper and lower reaches and has four sites that are sampled as part of the CWMN monitoring program. The furthest upstream site at Landalt Road (E290476) has a watershed that is primarily residential at 69%, with 2% parkland and a wetland (Figure 3-6). The North Cottle Creek site (E290474) is downstream from Lost Lake and has a watershed that is 72% rural residential. The three Cottle Creek sites at Nottingham (E290473), Hammond Bay Rd (E309186) and Stephenson Pt Rd (E290475) are a mix of single family and rural residential with some forested conservation land. The conservation land is between the Landalt Rd site and the Nottingham Rd site. The watershed of the Cottle Creek site at Nottingham has 28% single family residential compared to 31-32% at the two downstream sites at Hammond Bay Road and Stephenson Pt Rd.

The watersheds of Knarston Creek and Bloods Creek have moderate levels of development. Knarston Creek has two sites sampled by the CWMN program. The watershed of the Knarston Creek at Superior Rd (E306255) site is primarily forest with 17% rural and agricultural land (Figure 3-6). There is a large wetland and a golf course within the Superior Rd site watershed. The further downstream site near Lantzville Road (E294013) has the same dominant land uses. However, the Lantzville Road watershed has 22% rural and agricultural land and 2% residential land. Bloods Creek- has one sample site that is regularly sampled as part of the CWMN program. The Dickenson Rd site (E294010) has a watershed that is a mixture of rural residential, single family residential and commercial land use.

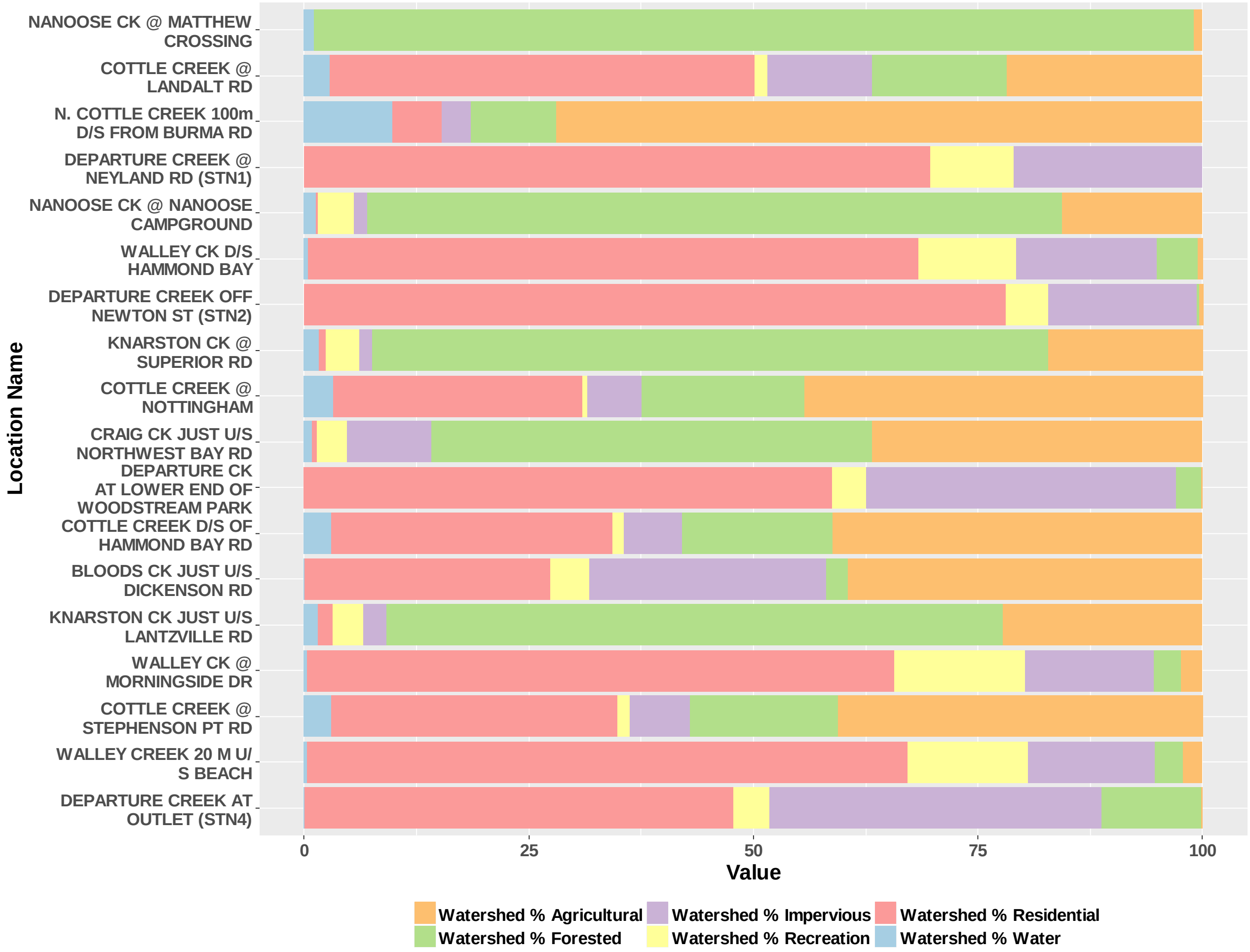


Figure 3-6: Percent land use composition for CWMN site watersheds of Water Region 5-1 (South Wellington to Nanoose).

3.5.2 Water Quality Summary and Trends

3.5.2.1 Temperature

All samples sites in Water Region 5 had suitable water temperatures for aquatic animals in the fall (Figure A49 and Figure A50). However, during summer low flows, water temperatures regularly exceeded the 15°C target at all but 6 sites; these were Benson Creek, Nanoose Creek at Matthews Crossing, Craig Creek, Knarston Creek at Superior, and Departure at Neyland Rd. (Figure A41 and Figure A42). The watersheds of Benson Creek, Nanoose Creek at Matthew Crossing and Knarston Creek at Superior are >75% forested with <20% agricultural and rural land use. However, the watersheds at Departure Creek at Neyland Rd and Craig Creek are more developed. Therefore, lower summer water temperatures cannot be linked to development.

The sites with the warmest average summer water temperatures that exceeded the 17oC coho rearing guideline included: Millstone River at Biggs Rd., Millstone River at East Wellington –(both of which receive warm lake water) Chase River below Colliery Dam, Chase River at Park Ave, Chase River at Estuary Park, and Cat Stream (Figure A42). The Millstone River site at Biggs Road is fed by the warm surface water of Brannen Lake. Both the Millstone River sites at Biggs Rd and East Wellington Rd lack riparian tree and shrub cover (Clough 2016a). The Chase River sites are all below the Colliery Dam. Surface releases from this dam elevate water temperatures during low flow periods. Cat Stream had an upstream wetland in Robins Park with minimal tree canopy, resulting in elevated water temperatures. The hottest summer water temperatures averaged 21°C at Chase River at Estuary Park. To attain those temperatures, this site was likely unshaded, shallow and slow flowing.

3.5.2.2 Dissolved Oxygen

All sites in the Water Region 5 had DO measurements suitable for aquatic life in the fall except Walley Creek downstream of Hammond Bay (E306256), however it averaged >8 mg/L DO overall (Figure A51). This site was added to the monitoring program in 2016 and has a stormwater outfall directly upstream. During summer low flows, sites with average DO below 5.0 mg/L include Benson Creek, Nanoose Creek at Matthew Crossing, and Cottle Creek at Nottingham (Figure A43 and Figure A44). These three sites all had DO values that were well below saturation for their respective water temperatures (Figure A133 and Figure A134). The causes of depleted DO at Nanoose Creek at Mathew Crossing are unknown. However, depleted oxygen levels at the Benson Creek site may be a result of sedimentation from nearby sand and gravel industry. It is suspected the DO at Cottle Creek at Nottingham site is being impacted by the nearby residential home construction that has been ongoing in recent years. Increased sediment loads from construction or other industrial activities can reduce the available light in the water column and increase the water temperature. Less available light results in a reduction of photosynthesis from aquatic plants and algae and hence less DO. DO levels become further depleted because warm water holds less DO.

A large number of sites had mean summer DO below 8.0 mg/L and had DO >20% below saturation (Figure A133 and Figure A134). The sites with low mean summer DO are influenced by groundwater, which has low concentrations of DO. However, sites that were the closest to the ocean (i.e. furthest downstream) are less influenced by groundwater and had higher mean summer DO and had DO close to saturation. These sites included Chase River at Aebig and Estuary Park, Millstone at Barsby, Walley Creek at Morningside and upstream of Beach, Knarston Creek near Lantzville, Bloods Creek, and all the Departure Creek sites.

3.5.2.3 Conductivity

Average specific conductance in Water Region 5 varied widely between 35 to 400 µS/cm in the fall and between 75 to 500 µS/cm during summer low flows (Figure A53 and Figure A54). The outlier occurred at the Nanaimo Chase R site where average summer conductivity exceeded 1000 µS/cm, suggesting saline influence (Figure A46). Conductivity in Nanoose, Departure, Cottle and Walley creeks indicates a significant groundwater component to their low summer flows (Figure A45). High conductance in Departure, Cottle and Walley creeks could also be associated with stormwater as these creeks are in developed areas. The high conductance at the three Chase River sites (Park Avenue, Aebig Rd and Estuary Park) are probably associated with ocean spray.

3.5.2.4 Turbidity

Turbidity exceedances occurred throughout Water Region 5 in both seasons. In the fall flush, turbidity >5 NTU was measured infrequently at most sites (Figure A55 and Figure A56). Northfield Creek frequently exceeded the 2 NTU guideline during the summer sampling period (Figure A48). During summer low flows, turbidity exceedances were particularly evident at Northfield Creek, Walley Creek d/s Hammond Bay, at McClure Creek, and Millstone River at Jingle Pot Rd, and Cat Stream (Figure A47 and Figure A48). The Northfield Creek site was dropped from the monitoring program in 2015, whereas Walley Creek d/s Hammond Bay was added in 2016 and McClure Creek was added in 2017. The Northfield site is known to receive stormwater runoff from an industrial area and is now understood to be monitored by a separate City of Nanaimo program. High summer turbidity at the Millstone River site at Jingle Pot Rd is likely a result of bank erosion occurring near Biggs Rd and lack of riparian cover (Clough, 2016a). On September 2, 2014, Northfield Creek and Walley Creek d/s Hammond Bay very high turbidity values (>20 NTU) were associated with a rainfall event. Another rainfall event, on September 2, 2016 resulted in turbidity >20 NTU at Walley Ck d/s Hammond Bay and Departure Creek at Woodstream Park.

3.5.3 Rainfall, Flows, and Water Quality

Fall turbidity and conductivity had the strongest relationships with rainfall in Water Region 5. Fall conductivity had a negative correlation with rainfall at the Chase River at Aebig Rd, Craig Creek, Nanoose Creek at Matthew Crossing, Departure Creek at Neyland Road and McGarrigle Creek sites. The negative correlation is the result of a dilution effect because rainfall has lower conductance. The three upper Chase River sites, the two lower Cottle Creek sites, the three lower Departure Creek sites, the two lower Millstone River site, the two Nanoose Creek sites, the Craig Creek site, the McGarrrigle Creek site, and Cat Stream site had a positive correlation with rainfall and fall turbidity. The two lower Cottle Creek sites experienced turbidity spikes on November 3, 2015 and November 17, 2017. Both these turbidity spikes were associated with heavy rainfall. On November 14, 2017 three lower Departure Creek sites, two Chase River sites, two Millstone River sites and the McGarrrigle Creek site also had spikes in turbidity associated with heavy rainfall. From November 11-14, 2017 there was ~120 mm of rainfall (Figure A101). These turbidity spikes support that heavy rainfall increases the mobilization of sediment in the watershed. During intense rainfall events the ground becomes saturated in places and the amount of runoff increases. Fall temperature was negatively correlated with rainfall at Departure Creek off Newton St (Table A1). However, this correlation had moderate strength and it thought to be a result of annual variability in fall air temperatures.

At the Millstone River hydrometric station (south of Bowen Road) there were flows greater than 0.1 m^3/s in the summer low flow sampling periods of 2014 and 2016 (Figure A119). The 0.17 m^3/s flow on August 2, 2016 and 0.13 m^3/s flow on August 2, 2014 were associated with a rainfall event (Figure A80). There were 23 sites in Water Region 5 sampled on August 2, 2016. Some of these sites had very turbidity levels on this date.

3.5.4 Trend Analysis

Fourteen of 37 sites in Water Region 5 had suitable continuous datasets for trend analysis. These sites included the four Departure Creek sites, the Cottle Creek sites at Nottingham and Stephenson Pt Rd, the four Millstone River sites, the three upper Chase River sites, and Cat Stream. Conductivity data showed an increasing trend over the sample years at Cat Stream (Figure A144), possibly due to a combination of stormwater runoff and garden waste dumped in a nearby wetland (Clough 2017b). This site was also identified as a concern for high total phosphorus on August 25, 2015, and that TP may have resulted from an isolated runoff event (Barlak and Pisani, 2017).

3.5.5 Sites of Concern in Water Region 5

The two sites of concern in Water Region 5 are Cat Stream and Walley Creek at Hammond Bay and both are adjacent to stormwater outlets. Walley Creek at Hammond Bay was added to the CWMN program in 2016. In 2016 and 2017, this site had low DO and high turbidity. However, the two downstream Walley Creek sites had lower turbidity and high DO. This suggests the stormwater outlet is a source of suspended sediment and possibly nutrients. The other site of concern, Cat Stream, has high turbidity, warm summer water temperatures and conductivity has been increasing from 2012-2017. Robbins Park is upstream of the Cat Stream site and is thought to be a heat source because the stream flows through a ball field wetland (Clough 2017b). We agree that riparian planting should occur around the ball field as prescribed by Clough (2017b).

3.6 Water Region 6 Nanaimo River

Water Region 6 is the largest water region and covers approximately 939 km^2. The Nanaimo River water region includes a portion of the City of Nanaimo and RDN Electoral Areas A and C. There is a hydrometric station on Nanaimo River near Cassidy downstream of the climate station at the Nanaimo Airport. The South Nanaimo River also has hydrometric station. There are additional rain gauges at Firehall #4 and Jump Creek. The Jump Creek and South Nanaimo River results have not been presented because these sites were far from any CWMN site. Mean daily temperatures from 1981 to 2010 were 18.2°C for August and 14.9°C for September. For the fall sampling period, mean daily temperatures from 1981 to 2010 were 9.9°C for October and 5.6°C for November. The mean total rainfall at the Nanaimo Airport from 1981 to 2010 was 28.4 mm, 35.8 mm, 101.2 mm and 186.5 mm for August-November, respectively.

3.6.1 Overview of Watersheds

The Nanaimo River is the largest river within the studied Water Regions. The five sites that are sampled as part of the CWMN program are concentrated in the lower portion of the Nanaimo River Water Region and have an elevation <30 m (Appendix D). The Nanaimo and Area Land Trust samples all sites except for Beck Creek. The Vancouver Island University Research Lab samples Beck Creek. The regulation of flows from distant upstream dams have a limited influence on these sites (Butler et al. 2014). Haslam Creek is the major tributary to the Nanaimo River in the sampling area and it flows into the Nanaimo River north of Nanaimo Airport. Both Beck and Holden Creek flow into the Nanaimo River Estuary.

The upper part of the Nanaimo River watershed includes the four Nanaimo lakes and is primarily forested. The Nanaimo River site downstream of Haslam Creek (E287699) has a watershed that is 83% forested with 7% agricultural/rural land (Figure 3-7). There is industrial land use associated with an asphalt plant, and sand and gravel in the lower portion of this site's watershed. The further downstream, the Nanaimo River site at Cedar Rd Bridge (E215789) is 80% forested but has more rural and residential development in its lower watershed (10%).

Haslam and Beck creeks each have one site that is sampled as part of the CWMN program. The Beck Creek watershed includes a few large wetlands along with Beck Lake. The Beck Creek site (E290487) has a watershed that is a mixture of 47% single family and rural residential development, 41% agricultural land and 32% land zoned for industrial use (Figure 3-7). A large portion of the land zoned for industrial use in this watershed is in the process of being rezoned as part of the Sandstone Development (Northwest Properties 2009). The Haslam Creek watershed (E287700) includes Michael Lake and a large portion of Nanaimo Airport. The watershed is 74% forested with 19% agricultural land use.

There are two sites on Holden Creek that are sampled by the CWMN program. The Holden Creek watershed contains Holden Lake and Quennell Lake and has over 50% rural and agricultural land use (Appendix A). The watershed of the Lower Holden Creek is more developed then the Holden Creek watershed (E310147). The Lower Holden Creek watershed (E309281) has development associated with land that is zoned for industrial use (currently vacant).

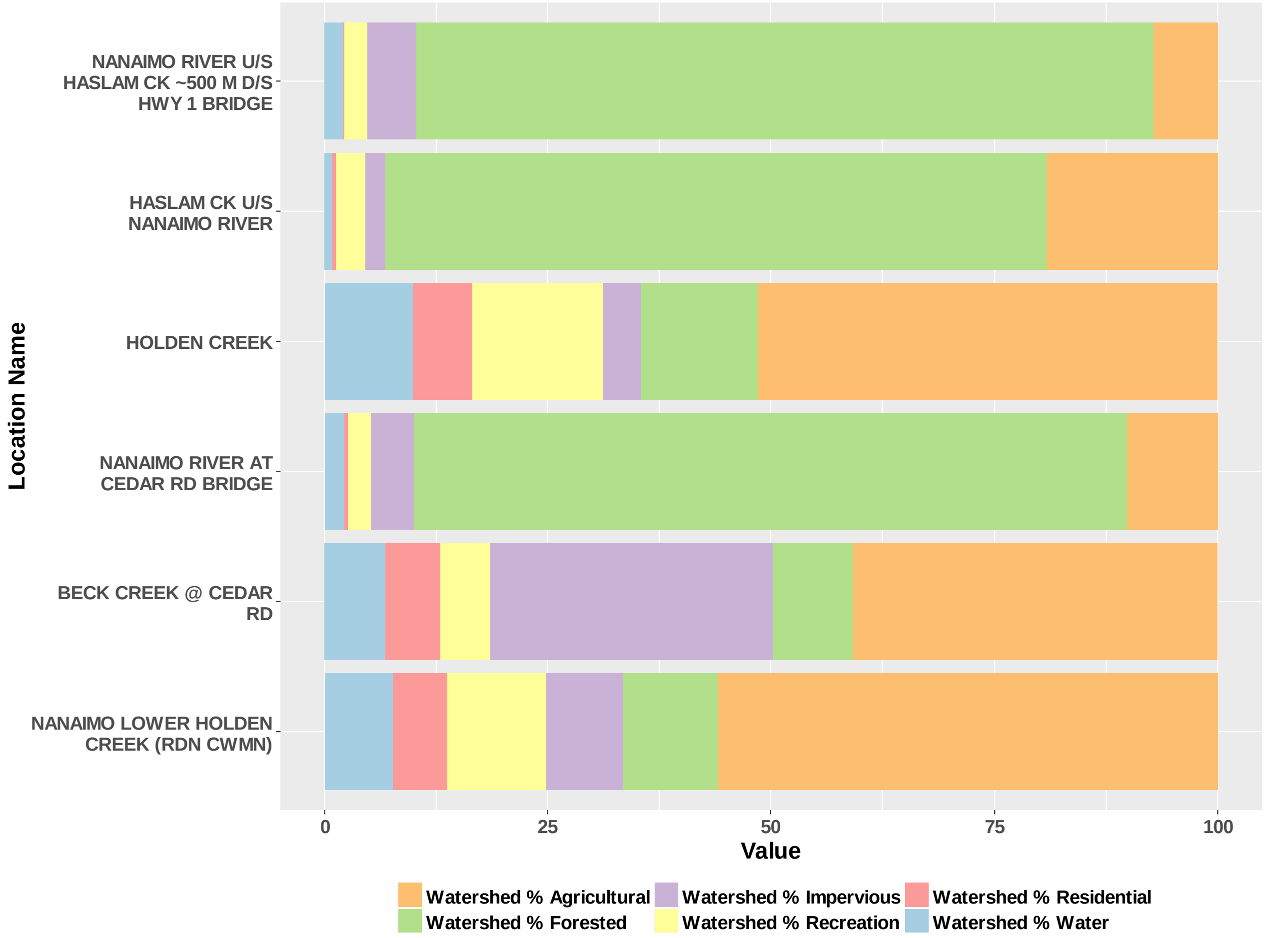


Figure 3-7: Percent land use composition for CWMN site watersheds of Water Region 6 (Nanaimo River).

3.6.2 Water Quality Summary and Trends

3.6.2.1 Temperature

All samples sites in the Nanaimo River Water Region 6 had suitable water temperatures for aquatic animals in the fall (Figure A61). However, during summer low flows, water temperatures consistently exceeded the 15°C target and 17°C coho rearing guideline at all Nanaimo River sites and the Lower Holden Creek site (Figure A57). The Lower Holden Creek site receives warm surface flows from Holden Lake. The higher water temperatures at the Nanaimo River sites are likely a result of wide and shallow nature of the river.

3.6.2.2 Dissolved Oxygen

All sites in Water Region 6 had DO concentrations suitable for aquatic life in the fall except for the Lower Holden site that averaged 7.9 mg/L (Figure A62). The Lower Holden Creek site was added in 2017 to the CWMN program and is ditched. During summer low flows, Nanaimo River sample stations with consistent high water temperature also had DO below 8 mg/L, while Haslam Creek and Holden Creek had the lowest DO, averaging 7.2 and 4.6 mg/L DO, respectively (Figure A58). Holden Creek drains warm surface water from Holden Lake and the Holden Creek site was added in fall 2017. It was rated as having poor bank stability due to historic forestry, farming and residential practises, however, recovery is underway (Clough 2016b).

3.6.2.3 Conductivity

Specific conductance readings in the Nanaimo River water region were higher than in the other water regions at several sites in both seasons. For example, during summer low flows, Beck Creek averaged 500 µS/cm, possibly due to historical coal mining in this watershed, and Lower Holden Creek averaged 20,000 µS/cm, the later indicating its intertidal habitat (estuary) influence (Figure A59 and Figure A63).

3.6.2.4 Turbidity

Turbidity exceedances occurred consistently at the Lower Holden Creek site and periodically at Beck Creek during both seasons. Otherwise turbidity spikes were rare in Water Region 6, resulting in average values of <2 NTU throughout (Figure A60 and Figure A64).

3.6.3 Rainfall, Flows, and Water Quality

The Nanaimo River upstream of Haslam Creek and the Beck Creek site had some significant correlations between fall rainfall and water quality (Table A1). Fall turbidity was positively associated with rainfall at the Nanaimo River and Beck Creek sites. High turbidity values at the Nanaimo River site upstream of Haslam Creek and Beck Creek on November 14 and 21, 2017 were associated with heavy rainfall (Figure A100). Fall conductivity was negatively associated with rainfall at Beck Creek. Rainfall causes mobilization of sediments which increases turbidity, whereas decreases in conductivity are a result of stream flow dilution.

The Nanaimo River hydrometric station at Cassidy experienced a peak flow of 27.9 m^3/s on September 2 2015 (Figure A120). No sites in Water Region 6 were sampled on this day or the two days following the high flow event.

3.6.4 Trend Analysis

The Nanaimo River upstream of Haslam and Beck Creek were the only sites in Water Region 6 that had suitable continuous datasets for trend analysis. Trend analysis identified that Nanaimo River has increasing turbidity and water temperature trends and decreasing DO trends over the 2011-2017 dataset. These trends may be amplified by high values associated with rainfall events and should be further investigated. For example, two very high turbidity values of ~3.5 NTU were recorded on November 11 and 21, 2017. These dates were associated with high flows and rainfall events. The increasing water temperature trend is likely related to annual differences in air temperature. The average summer temperature of the Nanaimo River was below 20°C from 2011-2013 but was above 20°C from 2016-2017. Summer dissolved oxygen concentrations show the effect of water temperature, with average summer DO at this site above 8 mg/L from 2011-2013 and below 8 mg/L from 2016-2017(Figure A148).

3.6.5 Sites of Concern in Water Region 6

The three sites of concern in Water Region 6 are Nanaimo River upstream of Haslam Creek, Lower Holden Creek, and Holden Creek. Lower Holden and Holden Creek were added to CWMN program in 2017. The 2017 data for these sites suggest depleted DO in the summer. Lower Holden Creek was previously identified as having nutrient loading from adjacent agriculture and from limited riparian vegetation (Clough 2016b). Recommended restoration actions for Lower Holden Creek included tree planting along riparian area and culvert repairs (Clough 2016b). However, some of water quality trends at Nanaimo River upstream of Haslam Creek can be explained by annual variation. We recommend that this site be closely monitored because of its proximity to the Nanaimo Airport and to agriculture, both of which are known contributors of water with periodic excessive oxygen demand (Canadian Council of Ministers of the Environment 1999).

3.7 Water Region 7 Gabriola Island

Water Region 7 includes all of Gabriola Island and has an area of 52.6 km^2. Only one creek with one site was sampled on Gabriola Island – Mallett Creek (E304070). The Gabriola Streamkeepers started sampling this site in 2015. The Mallett Creek watershed is primarily rural residential and agricultural and includes a wetland (Figure 3-8). The CWMN sample site on Mallett Creek is approximately 50 m east of Taylor Bay Rd and at only 2 m.a.s.l. The closest climate station to Gabriola Island is Entrance Island. Mean total rainfalls and daily temperatures from 1981-2010 are not available for

Entrance Island because monitoring started in 2006. However, Water Region 7 has a similar climate to Water Region 5.

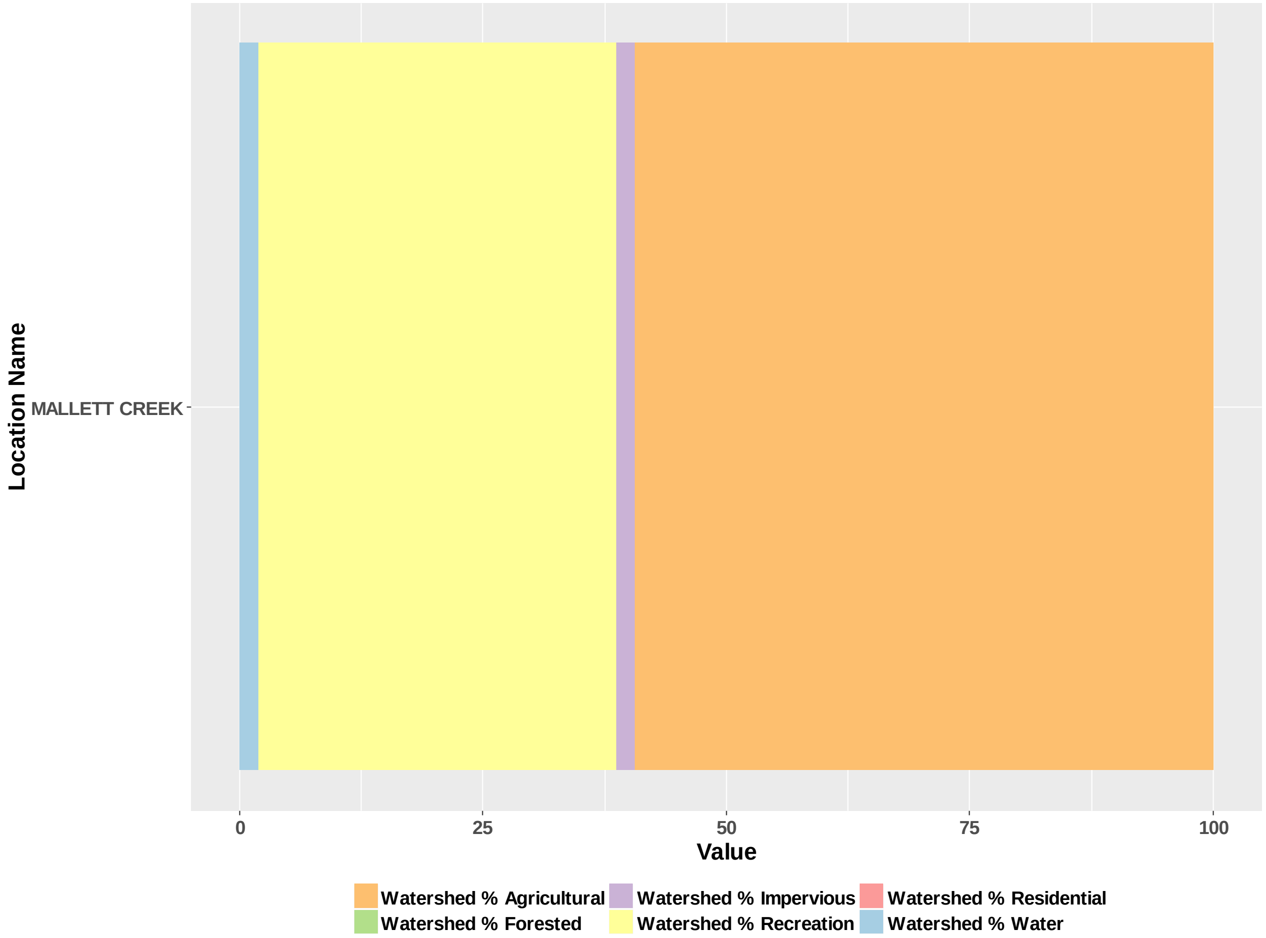


Figure 3-8: Percent land use composition for Mallett Creek watershed in Water Region 7 (Gabriola Island).

3.7.1 Water Quality Summary and Trends

3.7.1.1 Temperature

The Mallett Creek sample site had suitable water temperatures for aquatic animals in the fall (Figure A69). However, during summer low flows, water temperatures consistently exceeded the 15˚C target but rarely exceeded the 17˚C target, averaging 15.5˚C (Figure A65).

3.7.1.2 Dissolved Oxygen

Mallett Creek had DO concentrations suitable for aquatic life in the fall, while summer low flows had low DO in 60% of samples, and averaged 7.8 mg/L over the 2015 -2017 dataset (Figure A70 and Figure A66).

3.7.1.3 Conductivity

Mallett Creek averaged 110 µS/cm specific conductance in the fall and 142 µS/cm during summer low flows, suggesting groundwater influence (Figure A71 and Figure A67).

3.7.1.4 Turbidity

Turbidity values in Mallett Creek exceeding 5 NTU were common, with average values >6 NTU over the dataset in both seasons, suggesting impaired watershed functions (Figure A68 and Figure A72).

3.7.2 Sites of Concern in Water Region 7

The Mallett Creek site is a site of concern because of its high turbidity levels.

3.8 Water Quality Statistical Models

Random Forest statistical models were used to identify if watershed position or land use has an effect on temperature, dissolved oxygen, conductivity and turbidity. Random Forest models are an ensemble learning method, meaning they use multiple learning algorithms to improve predictive performance and are a useful tool to consider multiple criteria that may affect water quality simultaneously. Turbidity, dissolved oxygen, conductivity and temperature are water quality parameters referred to as responses in a statistical model. To build the models, key factors that could affect water quality, referred to as predictors, were generated. Predictors are things such as the percent coverage of land use, either within the 500 upstream buffer, or within the watershed as a whole, that could have an effect on water quality. For the models, both natural and urban variables were considered as potential predictors. Thus, for each modelled response (e.g., Turbidity or Oxygen), numerous different human-caused and natural (e.g., elevation) predictors were considered. Figure 3-9 and Figure 3-10 identify the top ten predictors or factors that affect each water quality parameter, meaning that these variables were the most important criteria in predicting water quality. The larger the variable importance the better the predictor is to explain water quality. Typically, the top two or three parameters are the most reliable predictors or factors.

The modelled effects of each predictor (land use variable) and the predictive accuracy of each model are presented in Appendix H. Most predictors did not affect water quality in a linear fashion because the water quality parameters modelled were curves, meaning that effects were more apparent as certain thresholds were reached. This type of response is well documented in the literature, where specific effects are not readily apparent until a threshold is met, at which point, change is observable. Specific details for each different response are found below.

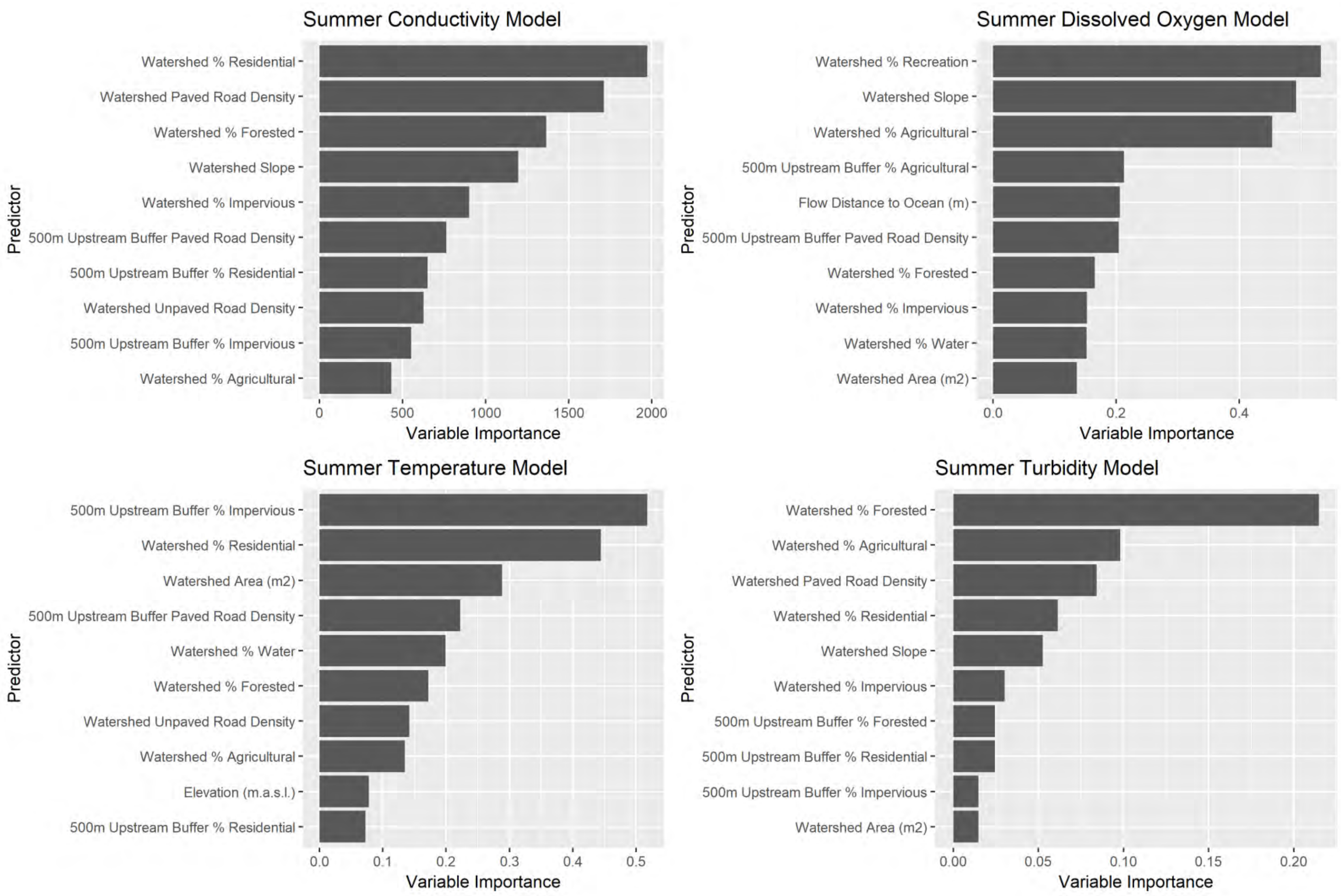
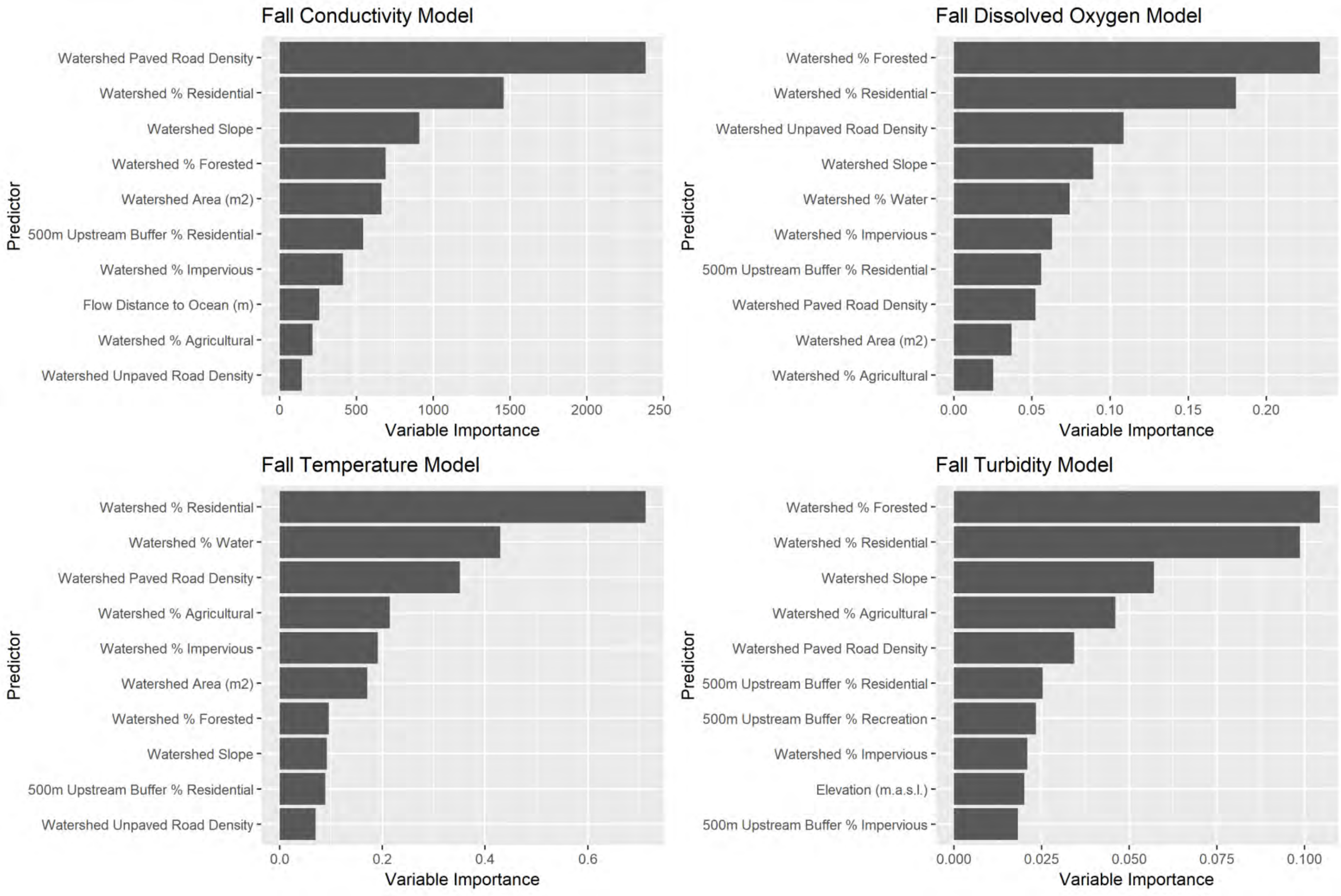


Figure 3-9: Variable importance plots for summer water quality models.



Fall Conductivity Model

Fall Dissolved Oxygen Model

Fall Temperature Model

Fall Turbidity Model

Figure 3-10: Variable importance plots for fall water quality models.

3.8.1 Temperature Models

The summer water temperature model suggests that a more developed watershed with more residential, industrial, and commercial land use has watercourses with warmer summer water temperatures (Figure 3-9 and Figure A149). In addition, rivers with large watershed areas such as the Nanaimo River, Englishman River, and Little Qualicum River have warmer summer water temperatures. These sites with bigger watershed areas are found at lower elevations and have less shading because they are wider watercourses. Warmer water temperatures in the fall are associated with watersheds with higher residential and paved road densities, and with upstream lakes (Figure 3-10 and Figure A150). In the fall, streams cool down faster than lakes, indicating that the larger upland lakes supply warmer water to downstream watercourses. Thus, the models suggest that both natural and anthropogenic factors affect water temperatures within the watershed.

3.8.2 Dissolved Oxygen Models and Turbidity Models

The summer Dissolved Oxygen model suggests that watershed with steeper slopes and those with lower densities of agricultural land and more green space have streams with higher dissolved oxygen concentrations (Figure 3-9 and Figure A151). Most of the streams in watersheds with high agricultural use in the RDN are ditched and lack riparian vegetation. These ditches are prone to slow-moving waters that are highly productive and warm, resulting in DO depletion. For the fall DO model, higher dissolved oxygen concentrations are associated with streams that have forested watersheds with steep slopes and unpaved roads, and a low density of residential development (Figure 3-10 and Figure A152). Watersheds with steeper gradients have greater DO because the turbulence within a stream increases with increasing grades and this turbulence acts to introduce more oxygen into the stream. Additionally, the steeper watersheds tended to occur at higher elevations, where cooler water temperatures maintain higher DO.

Both the fall and summer turbidity models indicate that streams in watersheds that have a higher density of paved roads and residential development, and those that have more agricultural land uses, tend to have higher turbidity (Figure 3-9 and Figure 3-10) than watersheds dominated by forest cover. Additionally, agricultural land use in the watershed was more important in the summer turbidity model compared to the fall turbidity model, likely because the effects of agriculture were more apparent during the low flow period. Streams that are in agricultural or urban areas often have less riparian vegetation, and are frequently channelized or straightened. Less riparian vegetation results in increased bank erosion, releasing more suspended sediment (Quinn et al. 2010). Watersheds that have more agricultural or urban land use also contribute higher suspended sediment loads to streams (Lenat and Crawford 1994). In contrast to these impacted watersheds, forested watersheds commonly have low water turbidity because the stream banks of these watersheds are stable and release less sediment to the system than developed streamside areas.

Like turbidity, the effect of agricultural land use on DO was stronger in the summer models. In the warmer low flow periods the effects of sedimentation, lack of riparian shading and enrichment are greater in watersheds with high agricultural land use. For example, during low- moderate flow periods, agriculture has been found to contribute large sediment loads to streams (Lenat and Crawford 1994). The lack of riparian shading in warmer summer month's results in increased stream water temperatures that hold less dissolved oxygen (Quinn et al. 2010). The warmer water temperatures also facilitate higher rates of decomposition that lead to further dissolved oxygen depletion. Additionally, watersheds with high agricultural land use contribute more nutrients to streams that induce higher primary production (Henderson et al. 2014), with greater day-to-night DO oscillations.

3.8.3 Conductivity Models

Both the fall and summer conductivity models suggest that streams with watersheds that are developed with high densities of paved roads and residential development have higher conductivities (Figure 3-9 and Figure 3-10). The direct relationship between development and conductivity is complex. Figure A155 shows conductivity increases substantially when residential development is greater than 0%. Residential development is likely accounting for conductivity differences in Water Regions. For example, Water Region 1 is the least developed Water Region and also has sites with the lowest conductivity relative to other Water Regions. Some sites in Water Region 1 have moderately developed watersheds but have low conductances. For example, Deep Bay Creek has a median summer conductivity of 68 µs/cm and has 32% of land use associated with impervious surfaces. This suggests Water Region 1 may have lower conductances naturally that are probably associated with soil type and surficial material, and more rainfall is this water region. However, we suspect that agricultural, residential, industrial and commercial land uses are sources of fertilizers and other pollutants which increase the conductance of streams. The positive relationship between urban land use (impervious surfaces) and stream conductivity has been reported in many regions (Kaushal et al. 2005; Morgan et al. 2012; Wang and Yin, 1997; Jones et al. 2017). The effect of impervious surfaces on stream conductivity is thought to be a threshold effect (Morgan et al. 2012) meaning once a certain level of urbanization or road density has been reached, there is little change in conductivity. However, before the threshold is reached, large changes in stream conductivity can occur. Figure 3-11 indicates that the threshold for paved road density is ~0.002 m/m2.

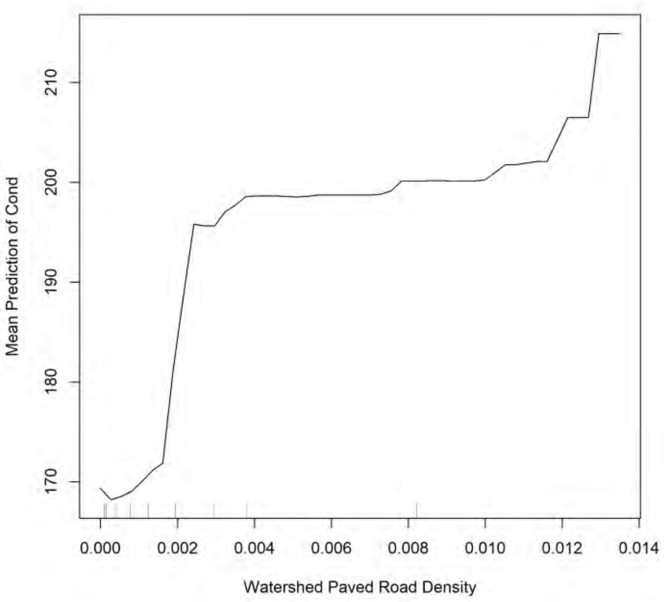


Figure 3-11: Partial Dependence plot for summer conductivity model shows paved road density has a threshold effect on conductivity.

3.8.4 Land Use Thresholds

The water quality models support that there are threshold effects of percent forested, percent agricultural, and paved watershed densities at the watershed level. The fall DO model, and all turbidity and conductivity models indicate that when forest cover is reduced to less than 60%, changes in turbidity, conductivity and DO become apparent (Figure 3-12). All turbidity and conductivity models indicate when watershed paved road densities are greater than 0.002 m/m^2 there are large changes in turbidity and conductivity (Figure 3-11). There are large changes in summer turbidity when the percent agricultural/rural land use in the watershed are greater than 20% (Figure 3-13).

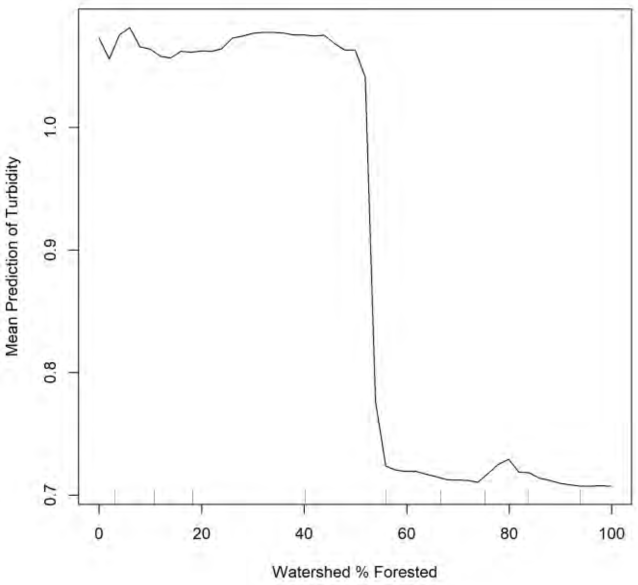


Figure 3-12: Partial Dependence plot for summer turbidity model shows percent forested has a threshold effect on turbidity.

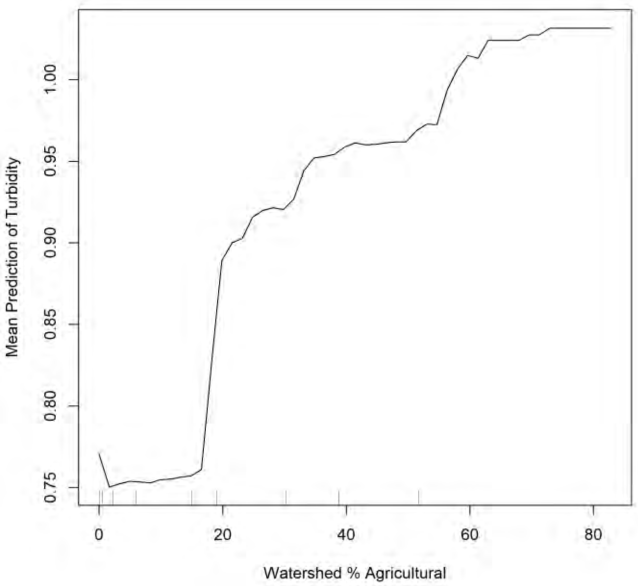


Figure 3-13: Partial Dependence plot for summer turbidity model shows percent agricultural/rural has a threshold effect on turbidity.

4 SUMMARY

Long term monitoring programs are integral to an adaptive management strategy, and are particularly important when conditions are ever changing. Data collection and analysis is the only method to ensure that appropriate information is available to make informed land use decisions. Continuing the CWMN monitoring program is important to meet these objectives and will help with identifying long-term trends in water quality of the watercourses of RDN, particularly those associated with land use change. Trend analysis was conducted for 35 of the 62 active sites. We suspect some of the trends identified were a result of annual variations in air temperature and rainfall because conductivity and turbidity are sensitive to changes in flow associated with rainfall in the fall flush period. Ongoing data collection ensures that the observed trends and interpretation are not erroneous or the result of extreme years (i.e. record rainfall such as November 2017).

Our analytical approach was to consider the entire watershed to facilitate a better understanding of both natural and anthropogenic factors that may affect water quality in the RDN. It is critically important to understand factors that affect the natural variability of stream water because this provides a baseline understanding of natural patterns in water quality. Once the natural patterns are known, the influence of anthropogenic effects can then be determined. Our results suggest some differences in water quality are a result of upstream lakes, watershed slope, channel width, ocean influence and climate (rainfall), which are all natural factors that vary and that variability is largely beyond the control of the RDN or member municipalities. However, the statistical models implemented in this report show that the extent of development or urbanization in a watershed are the most important factor in explaining differences in water quality among watercourses in the RDN. Thus, it is clear that the RDN or member municipalities play an integral role in water quality in the watershed, and the land use decisions should be carefully considered. For instance, the removal of riparian vegetation results generally results in streams that have lower DO and warmer water temperature as an example. Other changes such as stream channelization and agricultural activities can also cause depletion of DO. Land use ultimately influences all aspects of the watershed, and watershed disturbances such as agricultural activities or changes from rural / natural areas to urban space has the potential to mobilize sediments and further affect water quality. Once portions of a watershed become urban in nature, it is nearly impossible, or at the very minimum, extremely expensive to return to a natural state. Thus, urban changes such as storm water discharges, which have the potential to increase the conductivity of streams by the contribution of pollutants, must be carefully considered.

While our analyses do not answer all questions, they do suggest that certain thresholds may be present and that water quality impacts increase once the threshold is reached. This result is common in the literature, and is not overly surprising. The importance of this result supports the need for an adaptive management framework that includes ongoing data collection occur, and adjustments to answer key questions regarding how changes in land use may affect water quality. Further collection of data and subsequent analysis will allow the RDN or member municipalities to make more informed land use decisions, and help avoid future degradation of water quality. If ongoing data collection does not occur, key thresholds or risks may become apparent, but at a point that is too late or extremely costly to reverse.

5 RECOMMMEDATIONS

The CWMN monitoring program provides useful water quality data for key watercourses in the RDN. The program has been well designed to help understand factors that affect water quality during different flow periods. Maintaining this valuable program allows the detection of water quality trends. Our recommendations focus on identifying factors that can negatively impact watershed health and on identifying opportunities for stream restoration.

The water quality parameters of DO, specific conductivity, turbidity and water temperature are sensitive to changes in weather, agricultural activities and urban land use. These can be augmented by other water quality indicators and biological metrics to better understand watershed health and aid in making better land management/restoration decisions. However, the sustainable financing of the cost of these additional parameters should be evaluated. Some parameters such as chloride are relatively inexpensive while biological metrics are labor-intensive and more expensive.

The following is a summary of recommendations for the Regional District of Nanaimo Community Watershed Monitoring Network Program as a whole:

- Do not sample sites in the summer within 3 days of a rainfall event or until flows have returned to a near base flow condition. RATONALE: The existing data show outliers attributable to storm events, and these can complicate statistical analyses.

- Sample during the summer and fall sampling periods for ultra-low detection (0.002 mg/L RDL) Total and Dissolved Phosphorous for watersheds that have high agricultural land use or show evidence of excessive algae growth. These samples could be collected every 2 to 5 years depending upon budget. Nine sites were selected for Phosphorous sampling and these sites are listed in Table 5-1. RATIONALE The high agricultural use and depleted DO in some watersheds suggest high phosphorous concentrations. Sampling for total phosphorous in these streams will help to confirm potential causes of low DO.

- Sample for Chloride (Cl) during the summer low flow period for sites that are suspected to have high Cl based on elevated conductivity and on road densities. Ten sites were selected for Cl sampling because they have high paved road densities, >30% of impervious surface and/or high conductivity (Table 5-1). RATIONALE CConductivity values greater than 230 µS/cm have been shown to alter fish communities (Morgan et al. 2012). There are 22 sites in the CWMN monitoring program that have median summer conductance higher than 230 µS/cm. Some of these sites may be naturally high due to estuary or groundwater influence. However, it is important to identify if urban activities are causing high levels of conductivity and potential impairment of the stream ecosystem.

- Soil survey data from the Ministry of Environment online Soil Information Finder Tool should be utilized to better understand the natural variance in conductivity. It is expected that sites with watersheds that have more gleysols will have higher conductances, naturally. Gleysols typically have higher groundwater tables. RATIONALE: This analysis will help better understand natural differences between water regions.

- There are seven sites that need riparian plantings (Table 5-1). We recommend using red osier dogwood and willow live stakes or other available native riparian vegetation. Many of these sites already have restoration prescriptions provided by their habitat overview reports. RATIONALE: We concur with the authors of the habitat overview reports – riparian integrity is key to improved habitat values.

- Conduct benthic invertebrate sampling (B-IBI) before and after restoration works. The Benthic Index of Biological Integrity B-IBI is a measure of biological condition and is calibrated for coastal areas such as Seattle and Vancouver. We suggest evaluating the biological condition of streams before and after restoration works to assess the effectiveness of restoration actions (Table 5-1). We recommend using a similar methodology to Greater Vancouver’s research where 3 replicate samples are collected at each site during a low flow period. RATIONALE: While many water quality indicators are sensitive to annual variation in flows, rainfall and temperature, B-IBI is sensitive to changes in human disturbances and has limited inter-annual variability (Page et al. 2008).

- Completion of benthic invertebrate sampling using the CABIN methods would be useful to add another watershed-level indicator of overall watershed health. These samples could be collected every 2 to 5 years depending upon budget, and are most useful if done as part of a long-term monitoring program. RATIONALE: The addition of this sampling would provide additional markers of change, either positive or negative, and allow trend analysis over time

- Trend analysis using the seasonal Mann-Kendall test should be repeated once there is a suitable, continuous dataset for the recently added sites. At least seven years is needed to look for sampling period specific trends. RATIONALE: As the years of data increase at all sites, the accuracy of the trend analyses improves.

- Targeted public education could be offered for areas where stormwater impacts are indicated. This could involve an info mailer, adding a stencilled fish symbol to stormwater grates that report to fish-bearing streams, incentives for rain-gardens, etc. Many programs are outlined on the internet RATIONALE: The public may not realize that washing paint cleaners down the storm drains, and over-watering/overfertilizing their landscapes can damage the receiving stream habitats. They can be encouraged to make simple changes that benefit their region’s stream health

- Consider the construction of rain gardens to reduce the amount of stormwater reporting from impervious surfaces such as roofs and parking lots. Residential rain gardens can be easily constructed and maintained by the homeowners on their properties. There are many guidance documents publicly available including: http://www.saanich.ca/assets/Community/Documents/Rain%20Garden.pdf RATIONALE: Rain gardens are an easy way to reduce the stormwater inputs to surrounding waterbodies and provide an aesthetically appealing garden that helps conserve water (Figure A157). Rain gardens at the municipal scale can include swales. Swales can gather and slow the infiltration of stormwater to the surrounding area. Additionally, swales can be used to direct water to rain gardens or other gardens. Rain gardens at commercial and industrial properties are also viable. Swales can be used to adsorb or redirect runoff from large parking lots (Figure A158). Rain gardens can be constructed close to parking lots or roofs in industrial and commercial areas.

- Refine and improve the current land use layer by using remote sensing techniques. We recommend working with the Vancouver Island University to create a land use/cover layer that accurately maps the extent of impervious surface, tree cover and other relevant components of the landscape. RATIONALE: This analysis could be done every 5-10 years as an effective way to keep track of land cover changes.

Table 5-1: Summary of recommendations for CWMN sites. Sites that are in bold were identified as sites of concern.

Water Region	Site (EMS)	TP	Cl	B-IBI	Riparian Planting	Prescription Available	Previous Restoration	Targeted Public Education
Big Qualicum	**Annie Creek (E290474)**	✓		✓	✓	✓		
French Creek	**French Creek at Grafton Road (E243024)**	✓		✓	✓	✓	✓	✓
French Creek	**Grandon Creek at Laburnum Rd (E288091)**	✓		✓	✓	✓		✓
French Creek	Grandon Creek at West Crescent (E288090)	✓						✓
French Creek	**Beach Creek Near Chester Rd at Hemsworth Rd (E288092)**	✓						✓
French Creek	Beach Creek Near Memorial Golf Pond (E288093)	✓						✓
Englishman River	**Shelly Creek at Hamilton Rd (E287131)**			✓	✓			
Englishman River	**Shelly Creek at End of Blower Rd (E290452)**			✓	✓			
Englishman River	**Swane Creek (E308186)**	✓					✓	
South Wellington to Nanoose	**Walley Creek D/S of Hammond Bay (E306256)**		✓					✓
South Wellington to Nanoose	Walley Creek @ Morningside Dr (E306257)		✓					
South Wellington to Nanoose	Walley Creek 20 m u/s Beach (E306434)		✓					
South Wellington to Nanoose	**Cat Stream (E290486)**		✓	✓	✓	✓		✓
South Wellington to Nanoose	Departure Creek @ Neyland Rd (E290469)		✓					
South Wellington to Nanoose	Departure Creek off Newton St (E290470)		✓					

Water Region	Site (EMS)	TP	Cl	B-IBI	Riparian Planting	Prescription Available	Previous Restoration	Targeted Public Education
South Wellington to Nanoose	Departure Creek at Lower End of Woodstream Park (E290471)		✓					
South Wellington to Nanoose	Departure Creek at Outlet (E290472)		✓					
South Wellington to Nanoose	Cottle Creek at Landalt Rd (E290476)		✓					
South Wellington to Nanoose	Bloods Creek just u/s of Dickenson (E294010)		✓					
Nanaimo River	**Lower Holden Creek (E309281)**	✓		✓	✓	✓		
Nanaimo River	**Holden Creek (E310147)**	✓						

5.1 Water Region and Site Specific Recommendations

5.1.1 Big Qualicum

- Given the high fisheries value of Annie Creek it is recommended another CWMN site be added. The recommended location of the site is at Van Isle Road. This site should be sampled for summer and fall of 2019 and the data should be reviewed to determine if this site should be a long-term CWMN site.

5.1.2 Little Qualicum

- The reach immediately upstream of Little Qualicum River at Intake should be inspected for potential erosion issues

5.1.3 French Creek

- Given the high agricultural use in the French Creek watershed, we recommend that resources be provided to farmers to encourage sustainable practices and restoration efforts. Examples include ensuring that all farmers are aware of the Provincial Environmental Farms Program, where farmers can gain access to funding for fencing riparian areas, seeding, and planting programs, etc.
- At minimum, policies for land use should consider ensuring effective implementation of agricultural buffers to separate farms from streams, where the buffers are based upon the risks associated with the farm type. For example, a minimum 5 m buffer is often recommended between streams and cropland and a 15 m buffer for grazing.
- Closely monitor changes in turbidity and conductivity at the Beach Creek site near Hemsworth. We recommend that the trend analysis be re-run after the 2018 data is available.
- Conduct a stream mapping exercise, such as Fisheries and Oceans Canada Sensitive Habitat Inventory and Mapping (SHIM) to determine and document all extreme erosion cases. This mapping is also useful for determining the quantity and quality of fish habitat and it provides a useful tool for effective long term adaptive management.

5.1.4 Englishman River

- Continue to monitor Swane Creek and the effectiveness of restoration works established there in 2007.
- Identify any stormwater outlets near the Shelly Creek sample site to see if stormwater is contributing to poor water quality.

5.1.5 South Wellington to Nanoose

- Educate the residents of the Cat Stream and Walley Creek watersheds storm water contaminants and how it can impact aquatic ecosystems.

5.1.6 Nanaimo River

- Closely monitor changes in turbidity and DO at the Nanaimo River site upstream of Haslam Creek. It is recommended to re-run trend analysis once 2018 data is available.
- Continue to monitor Lower Holden and Holden Creek sites to better understand baseline conditions.

5.1.7 Gabriola Island

- Continue to monitor the Mallett Creek site and investigate potential sources of suspended sediment.

6 REFERENCES

Barlak, R., Epps, D., & Phippen, B. (2010). Water quality assessment and objectives for the Englishman river community watershed. Environmental Protection Division, British Columbia Ministry of Environment, Nanaimo, BC

Barlak, R., & Fegan, L. (2012). Regional District of Nanaimo Community Watershed Monitoring Network 2011 Data Summary. Environmental Protection Division British Columbia Ministry of Environment. Nanaimo, BC.

Barlak, R., & Pisani, J. (2017). Regional District of Nanaimo Community Watershed Monitoring Network 2015 Lab Analysis Sumary Southern Groups. Environmental Protection Division British Columbia Ministry of Environment. Nanaimo, BC.

Brenning, A. (2008). Statistical geocomputing combining R and SAGA: The example of landslide susceptibility analysis with generalized additive models. SAGA–Seconds Out.Hamburger Beiträge Zur Physischen Geographie Und Landschaftsökologie, 19, 23-32.

Butler, G., P. Chapman, R.E. Gullison, M. Kellow, S. Walker and J. Wolf (Editors). (2014). Nanaimo River Baseline Report: social, environmental and economic values of the Nanaimo River and watershed. 2 nd Edition. Unpublished report prepared for the Nanaimo & Area Land Trust. 312 pp.

Canadian Council of Ministers of the Environment. (1999). Canadian water quality guidelines for the protection of aquatic life: Glycols—Ethylene glycol, propylene glycol, and diethylene glycol. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Choquette, A. (2014). Sediment Mobilization in Ravines Draining Minnesota Cropland (Undergraduate dissertation, Gustavus Adolphus College).

Clough, D. (2017a). Annie Creek Habitat Overview Survey. Prepared for Regional District of Nanaimo, Nanaimo, British Columbia. Prepared by: D.R. Clough Consulting.

Clough, D. (2017b). Cat Stream Habitat Overview Survey. Prepared for Regional District of Nanaimo, Nanaimo, British Columbia. Prepared by: D.R. Clough Consulting.

Clough, D. (2015a). French Creek Stream Survey-2015. Prepared for Regional District of Nanaimo, Nanaimo, British Columbia. Prepared by: D.R. Clough Consulting.

Clough, D. (2015b). Grandon Creek Stream Survey-2015. Prepared for Regional District of Nanaimo, Nanaimo, British Columbia. Prepared by: D.R. Clough Consulting.

Clough, D. (2016a). Millstone River Habitat Survey-2016. Prepared for Regional District of Nanaimo, Nanaimo, British Columbia. Prepared by: D.R. Clough Consulting.

Clough, D. (2016b). Holden Creek Habitat Survey-2016. Prepared for Regional District of Nanaimo, Nanaimo, British Columbia. Prepared by: D.R. Clough Consulting.

Conrad, O., Bechtel, B., Bock, M., Dietrich, H., Fischer, E., Gerlitz, L., Wehberg, J., Wichmann, V., and Boehner, J. (2015): System for Automated Geoscientific Analyses (SAGA) v. 2.1.4. Geosci. Model Dev., 8, 1991-2007, doi:10.5194/gmd-8-1991-2015

De'ath, G., & Fabricius, K. (2000). Classification and regression trees: A powerful yet simple technique for ecological data analysis. Ecology, 81(11), 3178-3192. doi:10.1890/0012-9658(2000)081[3178:CARTAP]2.0.CO;2

ESRI. (2018). Release 10.6: ArcGIS Desktop. Redlands, CA: Environmental Systems Research Institute.

Hastie, T., Tibshirani, R., & Friedman, J. (2001). The elements of statistical learning: data mining, inference and prediction. New York: Springer-Verlag, 1(8), 371-406.

Henderson, L., Mahoney, C., McCelland, C., & Myers, A. (2014). The affect of land use and land cover on water quality in urban environments. Prepared by Natural Resources and Environmental Sciences Kansas State University.

Jones, F. C., Plewes, R., Murison, L., MacDougall, M. J., Sinclair, S., Davies, C., ... & Gunn, J. (2017). Random forests as cumulative effects models: A case study of lakes and rivers in Muskoka, Canada. Journal of Environmental Management, 201, 407-424.

Jun, S. (2013). Boosted regression trees and random forests. (Statistical Consulting Report). Vancouver, BC: Department of Statistics, UBC.

Kaushal, S. S., Groffman, P. M., Likens, G. E., Belt, K. T., Stack, W. P., Kelly, V. R., ... & Fisher, G. T. (2005). Increased salinization of fresh water in the northeastern United States. Proceedings of the National Academy of Sciences, 102(38), 13517-13520.

Law, P., Smith, F. & Riordan, B. (2016). Shelly Creek Stream Assessment and Fish Habitat Survey (2014 and 2015) Report. Prepared for Mid Vancouver Island Habitat Enhancement Society (MVIHES).

Lenat, D. R., & Crawford, J. K. (1994). Effects of land use on water quality and aquatic biota of three North Carolina Piedmont streams. Hydrobiologia, 294(3), 185-199.

Liaw, A., & Wiener, M. (2002). Classification and regression by randomForest. R news, 2(3), 18-22.

Komabayasi, M. (1959). Dissolved oxygen in rainwater and its relation to the raincloud structure (I). Precipitation from September to March. Journal of the Meteorological Society of Japan. Ser. II, 37(1), 22-34.

McLeod, A. I. 2011. R Package 'Kendall': Kendall rank correlation and Mann-Kendall trend test.

Morgan, R. P., Kline, K. M., Kline, M. J., Cushman, S. F., Sell, M. T., Weitzell Jr, R. E., & Churchill, J. B. (2012). Stream conductivity: relationships to land use, chloride, and fishes in Maryland streams. North American journal of fisheries management, 32(5), 941-952.

Northwest Properties. (2009). Sandstone Master Plan. Prepared for City of Nanaimo, Nanaimo, British Columbia. Prepared by: Northwest Properties.

Page, N.A., L.S., Fore, M. Eymann, and C. Johnston. 2008. Assessment of the use of B-IBI in Greater Vancouver streams (2003-2006). Report prepared for Metro Vancouver. 58 pp. + appendices.

Quinn, J. M., Cooper, A. B., Davies-Colley, R. J., Rutherford, J. C., & Williamson, R. B. (1997). Land use effects on habitat, water quality, periphyton, and benthic invertebrates in Waikato, New Zealand, hill-country streams. New Zealand journal of marine and freshwater research, 31(5), 579-597.

R Core Team. 2017. "R: A Language and Environment for Statistical Computing." Vienna, Austria: R Foundation for Statistical Computing. http://www.R-project.org/.

Read, E. K., Patil, V. P., Oliver, S. K., Hetherington, A. L., Brentrup, J. A., Zwart, J. A., ... & Dugan, H. A. (2015). The importance of lake-specific characteristics for water quality across the continental United States. Ecological Applications, 25(4), 943-955.

Soranno, P. A., Cheruvelil, K. S., Webster, K. E., Bremigan, M. T., Wagner, T., & Stow, C. A. (2010). Using Landscape Limnology to Classify Freshwater Ecosystems for Multi-ecosystem Management and Conservation. Bioscience, 60(6), 440-454. doi:10.1525/bio.2010.60.6.8

Wang, X., & Yin, Z. Y. (1997). Using GIS to assess the relationship between land use and water quality at a watershed level. Environment International, 23(1), 103-114.

Appendix A Land Use Maps by Watershed

Appendix B Water Region Maps

Appendix C Land Use Summaries for 500m Upstream Buffer

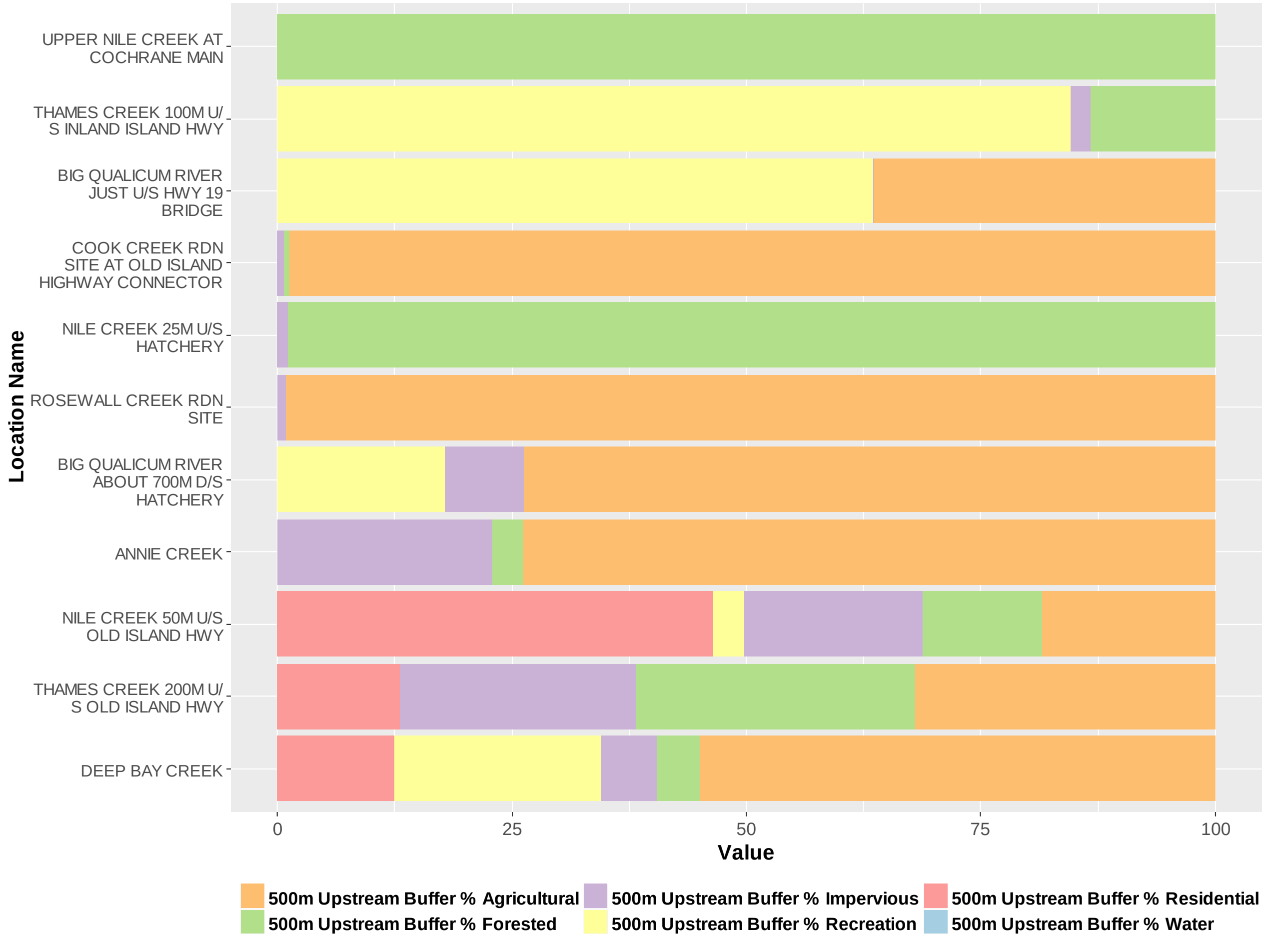


Figure A1. Percent land use composition for CWMN site 500m Upstream Buffer of Water Region 1 (Big Qualicum River).

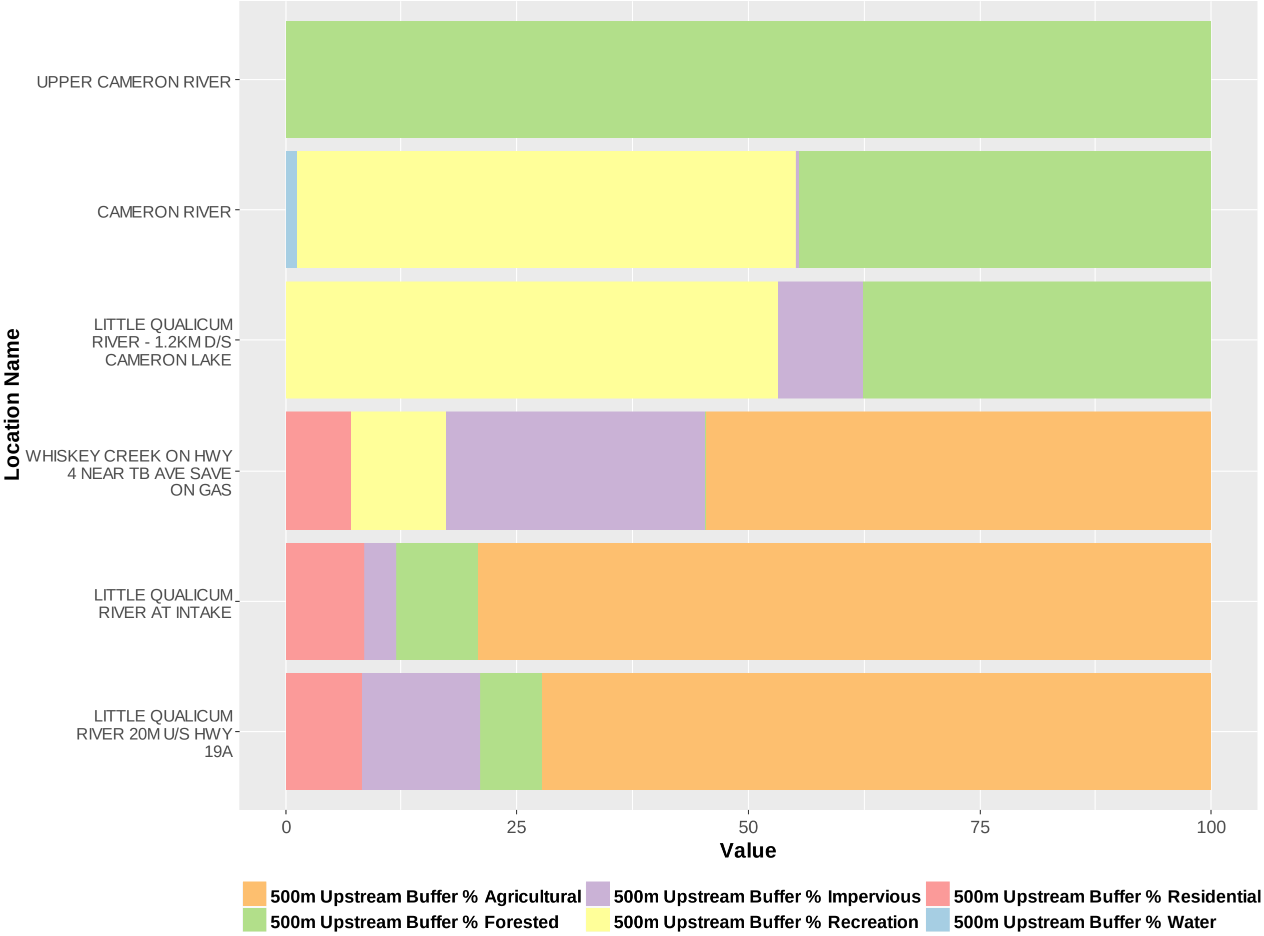


Figure A2. **Percent land use composition for CWMN site 500m Upstream Buffer of Water Region 2 (Little Qualicum River).**

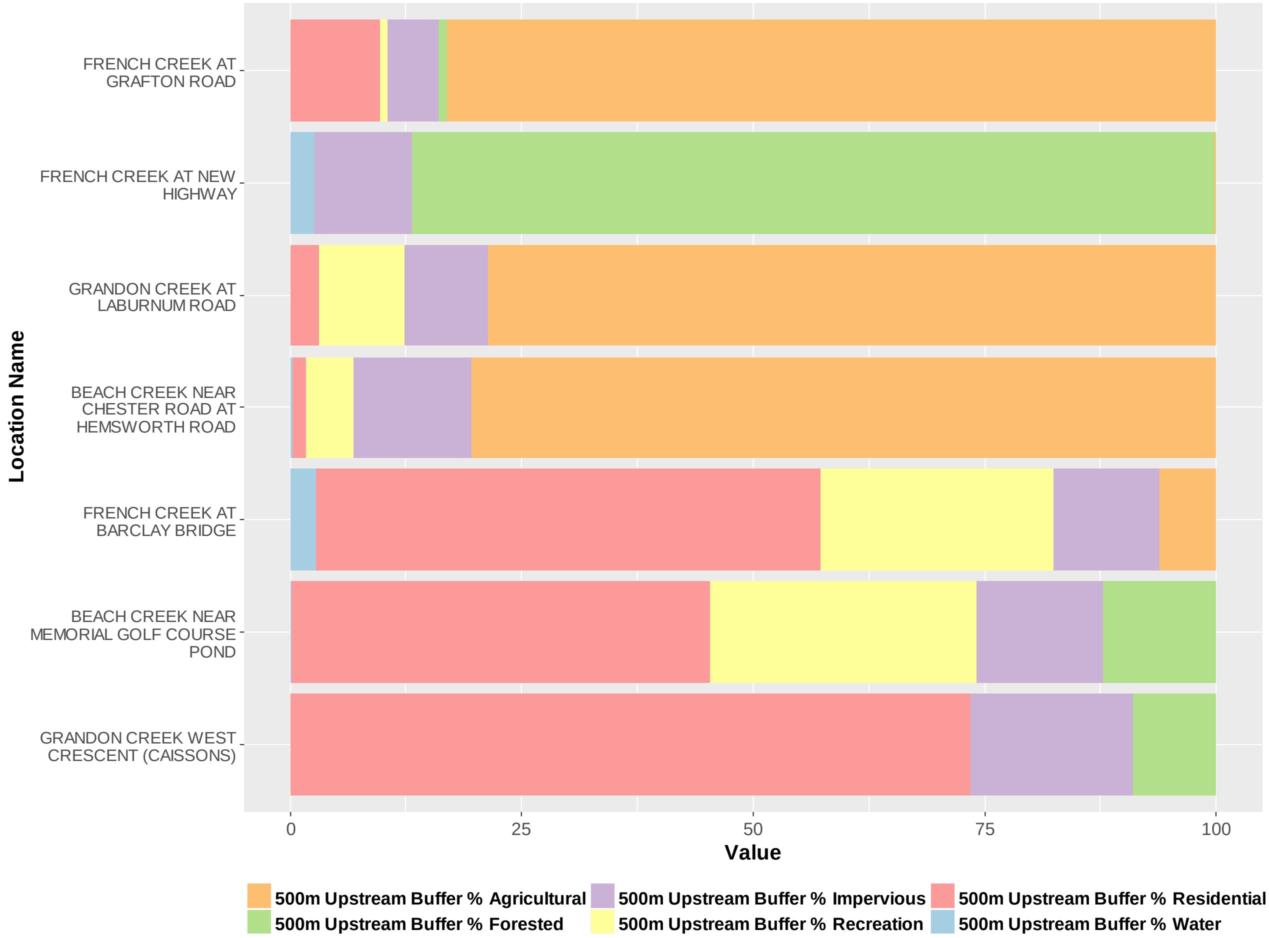


Figure A3. Percent land use composition for CWMN site 500m Upstream Buffer of Water Region 3 (French Creek).

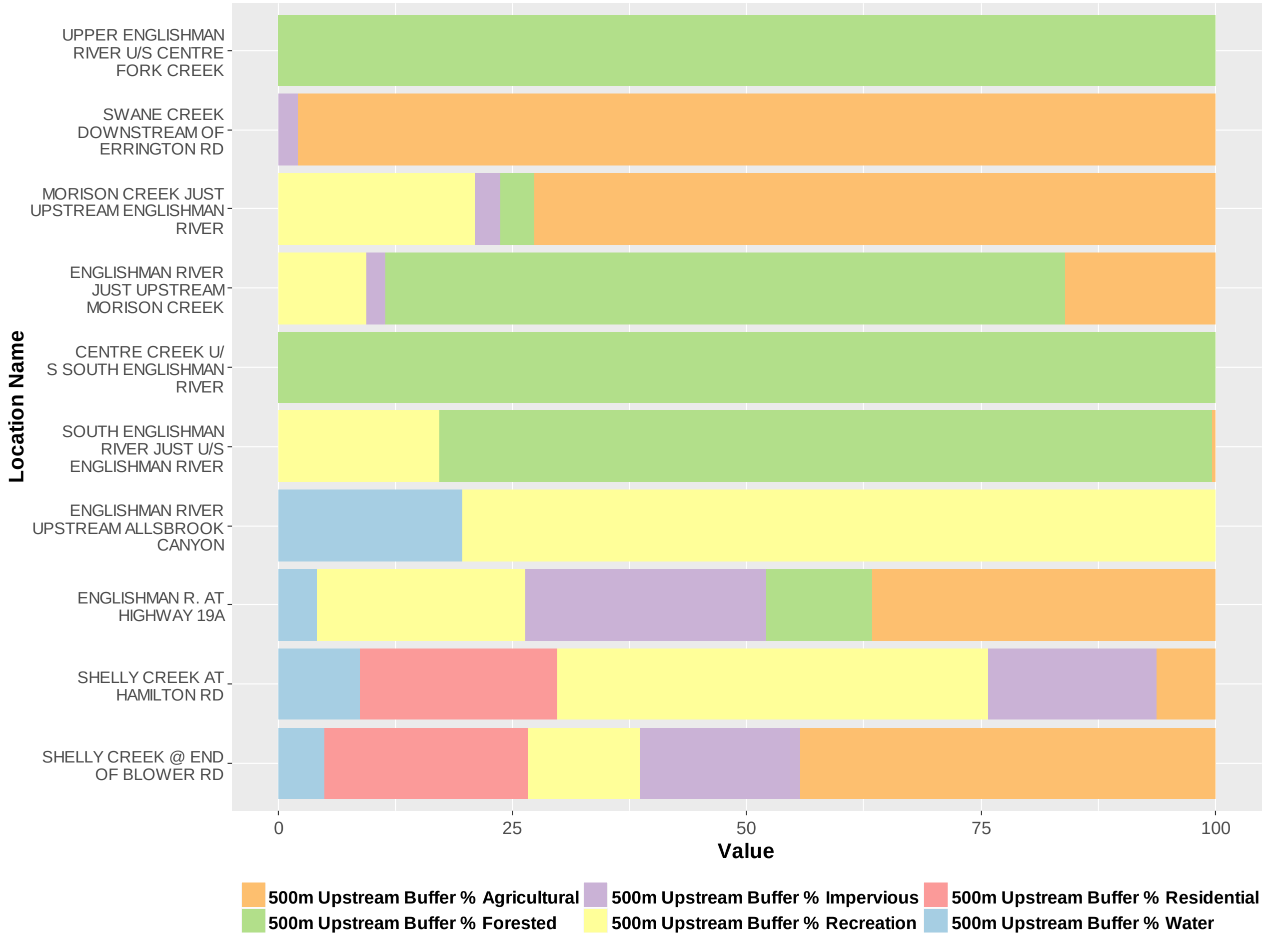


Figure A4. Percent land use composition for CWMN site 500m Upstream Buffer of Water Region 4 (Englishman River).

Figure A5. **Percent land use composition for CWMN site 500m Upstream Buffer of Water Region 5-1 (South Wellington to Nanoose).**

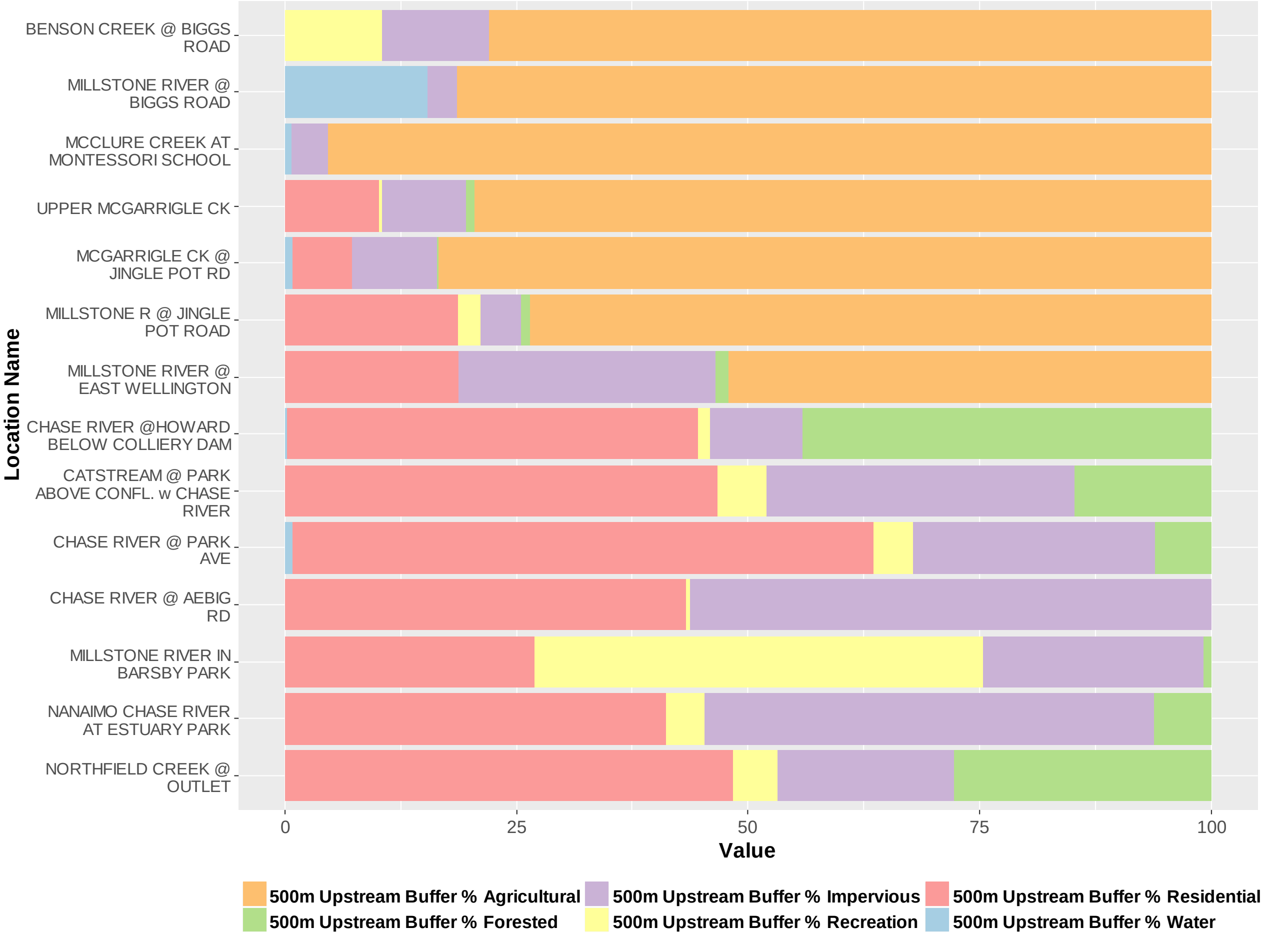


Figure A6. **Percent land use composition for CWMN site 500m Upstream Buffer of Water Region 5-2 (South Wellington to Nanoose).**

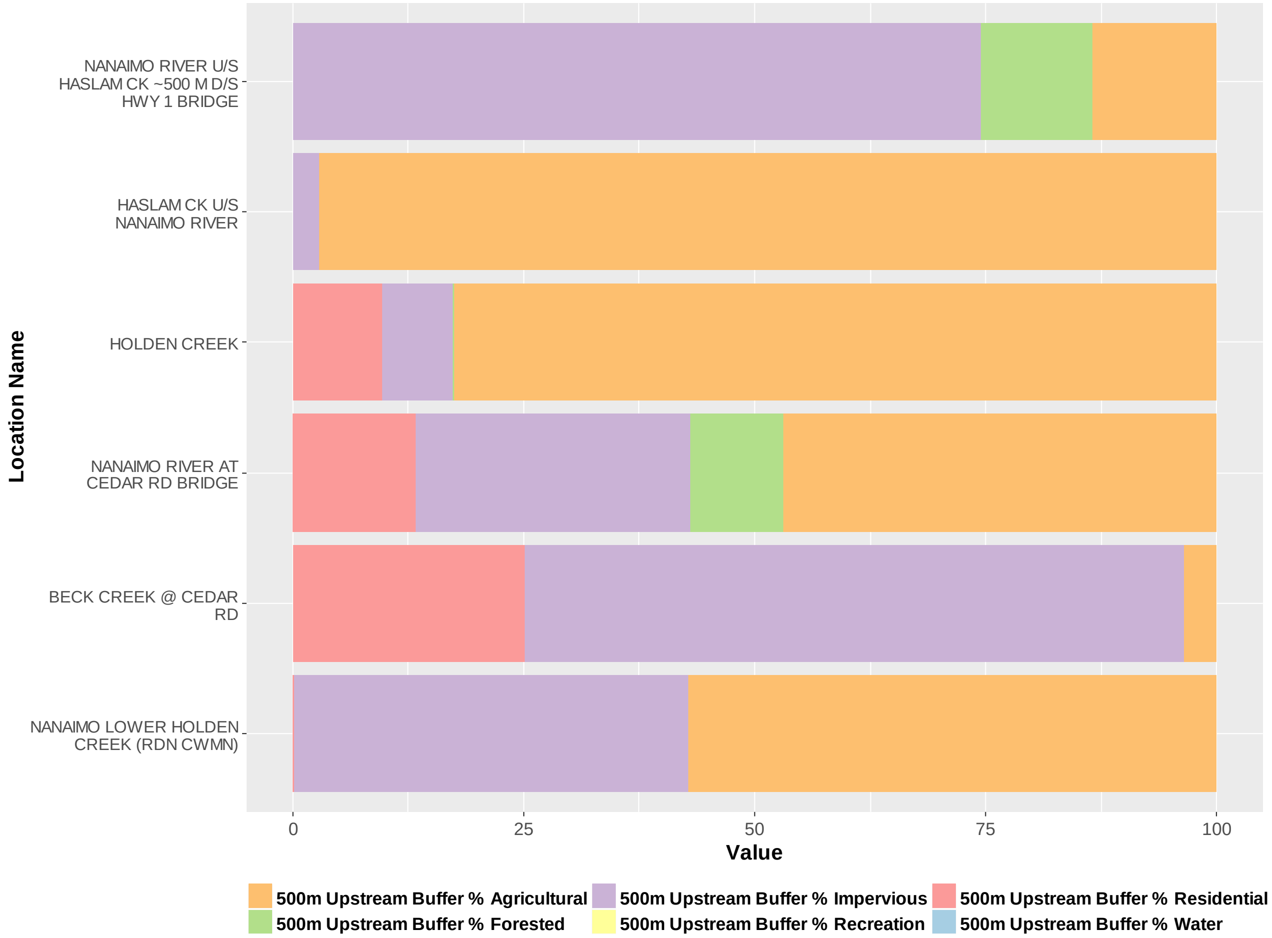


Figure A7. Percent land use composition for CWMN site 500m Upstream Buffer of Water Region 6 (Nanaimo River).

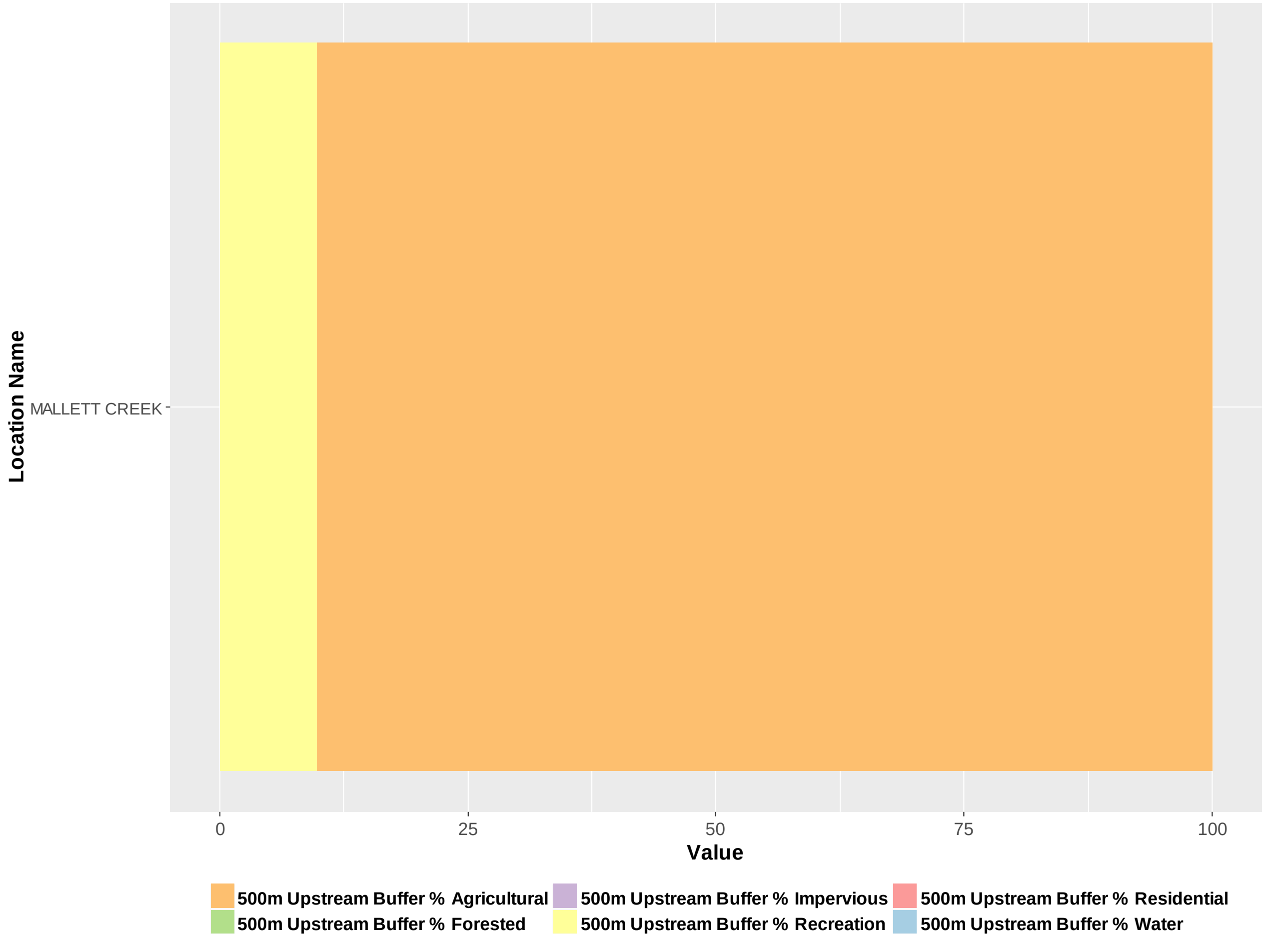


Figure A8. Percent land use composition for CWMN site 500m Upstream Buffer of Water Region 7 (Gabriola Island).

Appendix D Water Quality Summaries

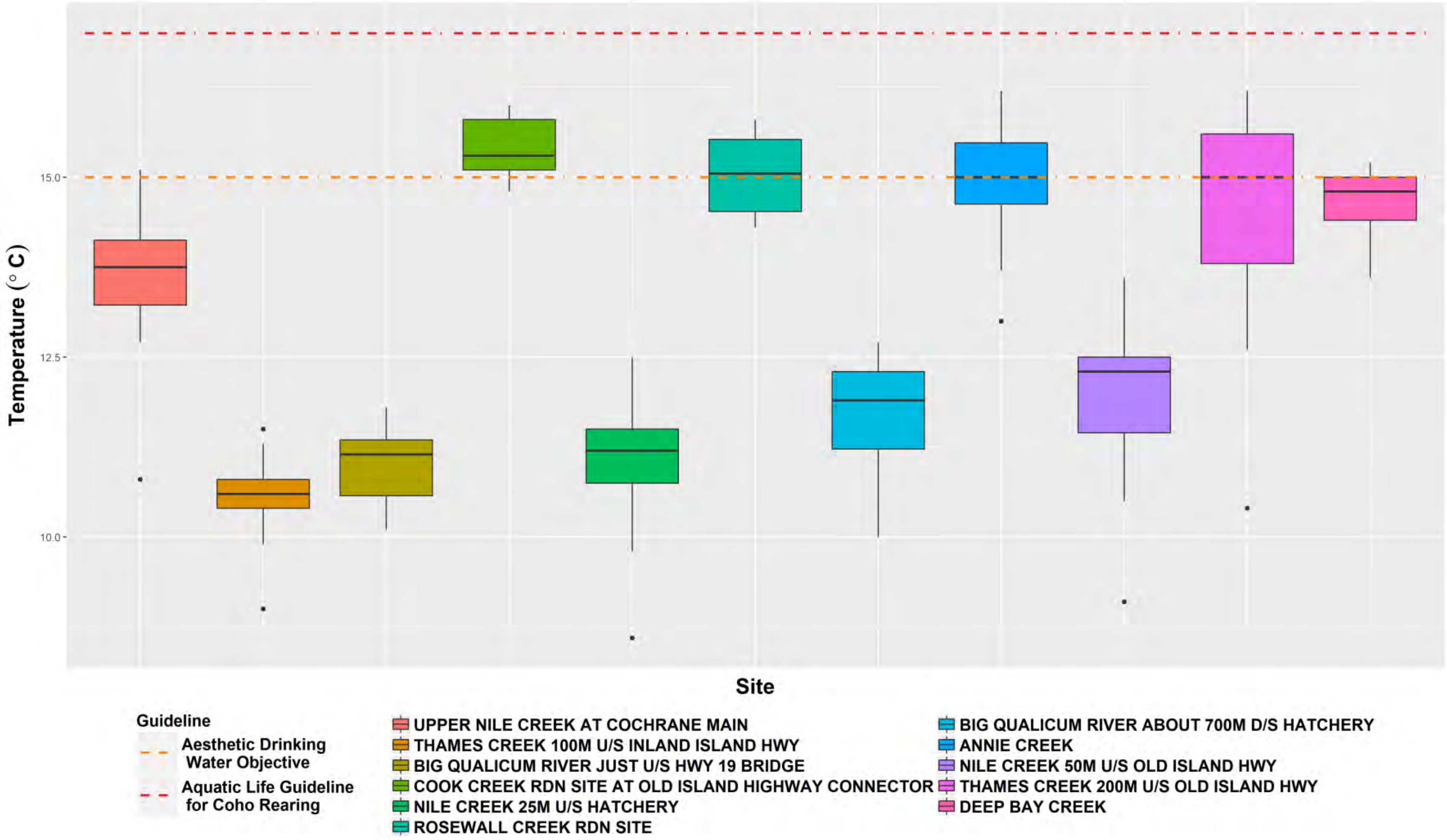


Figure A9. Summer 2011-2017 water temperature of CWMN sites in Water Region 1 (Big Qualicum) with Englishman River water quality objectives. See Figure 2-1 for how to interpret a boxplot.

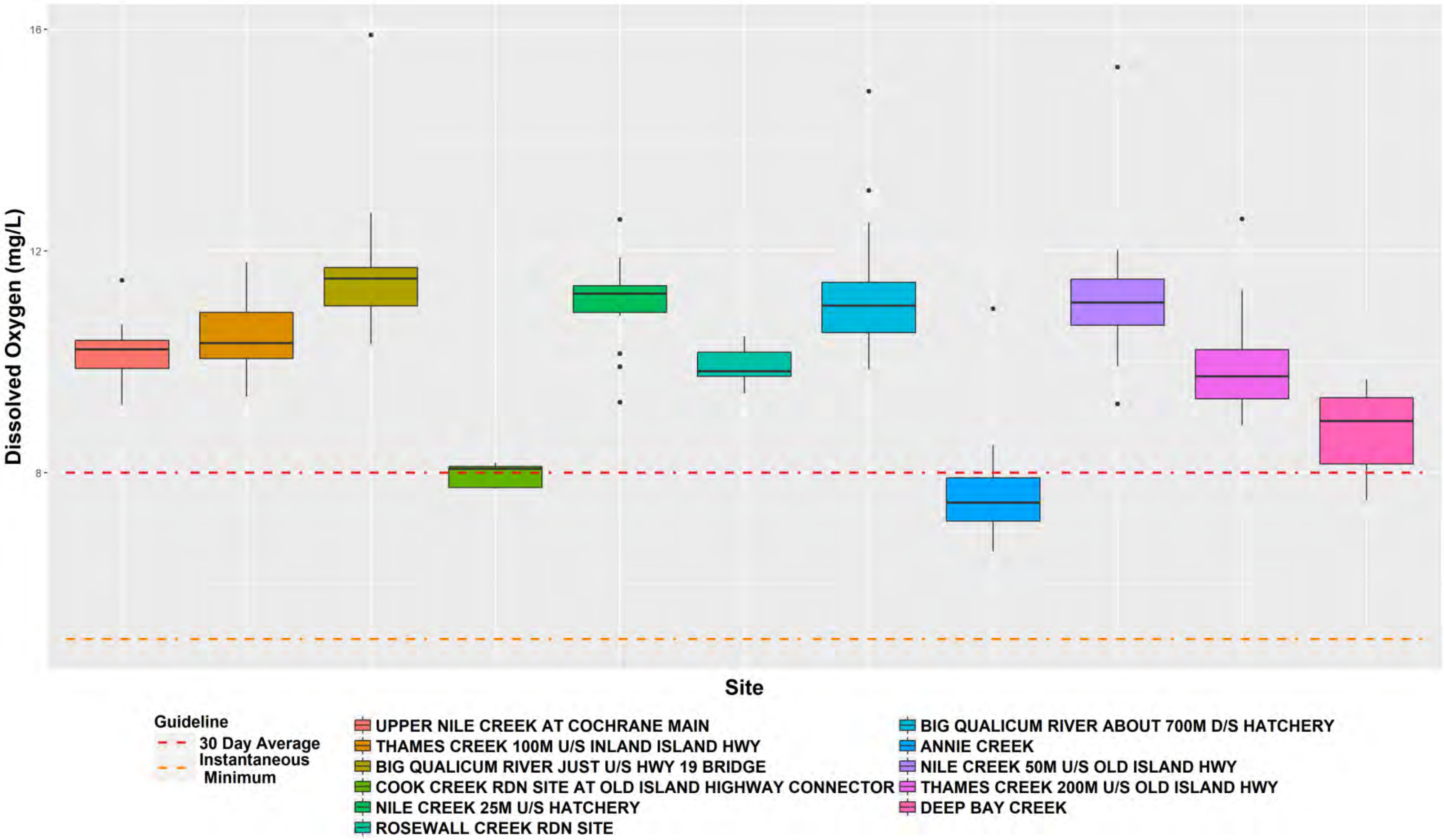


Figure A10. **Summer 2011-2017 DO of CWMN sites in Water Region 1 (Big Qualicum) with BC Water Quality guidelines for Aquatic Life.**

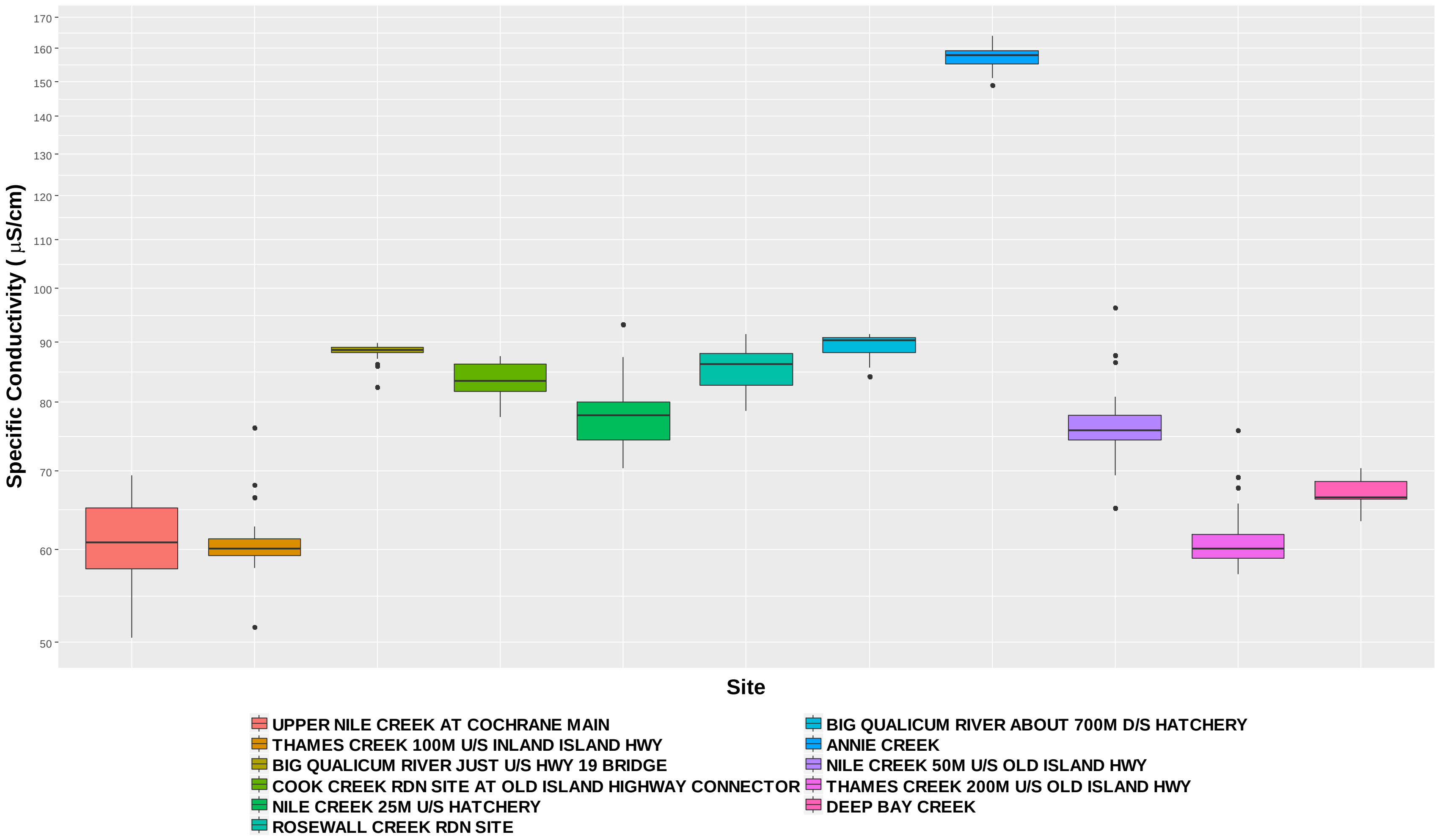


Figure A11. **Summer 2011-2017 specific conductivity of CWMN sites in Water Region 1 (Big Qualicum).**

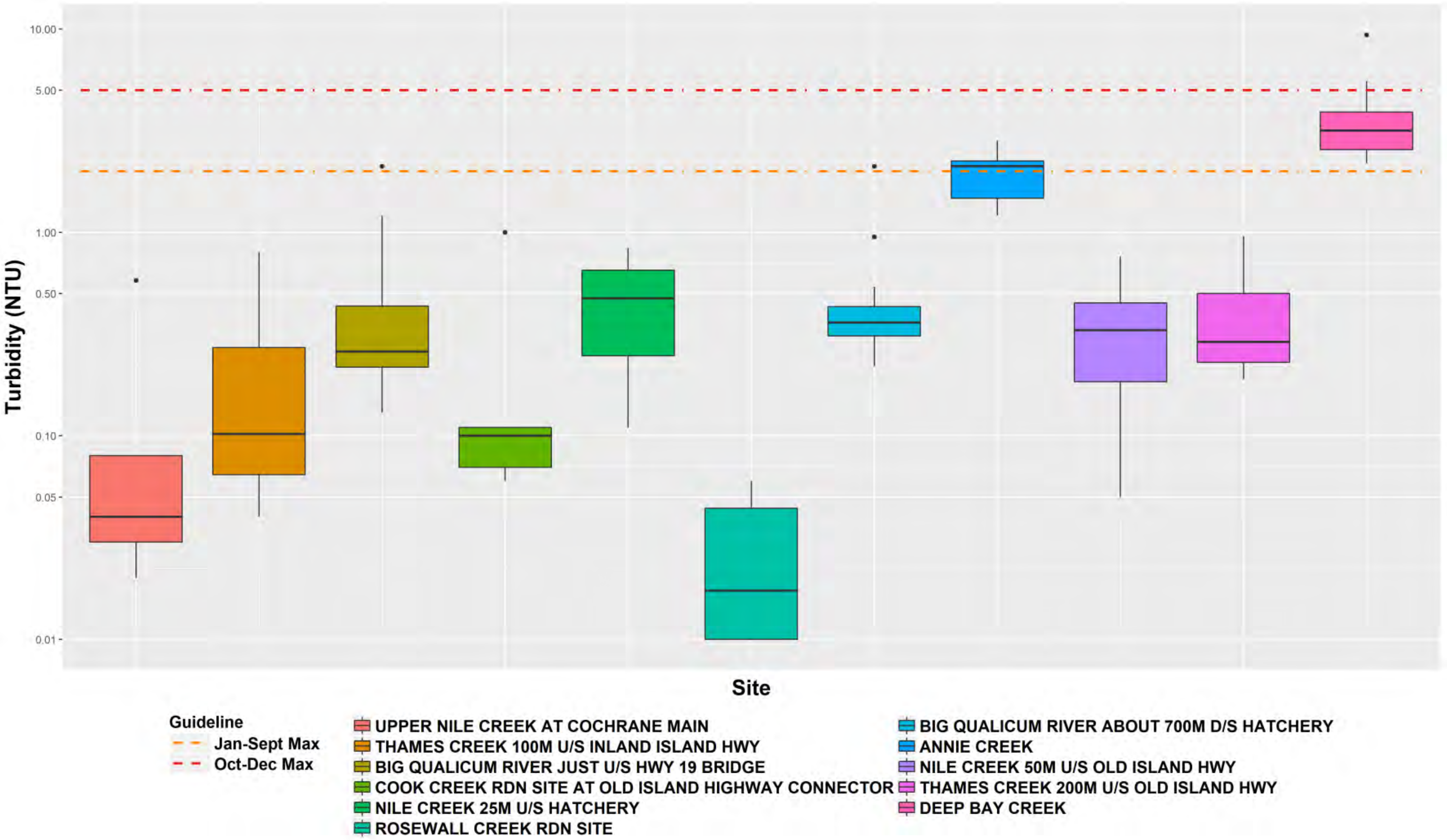


Figure A12. **Summer 2011-2017 turbidity of CWMN sites in Water Region 1 (Big Qualicum) with Englishman River water quality objectives.**

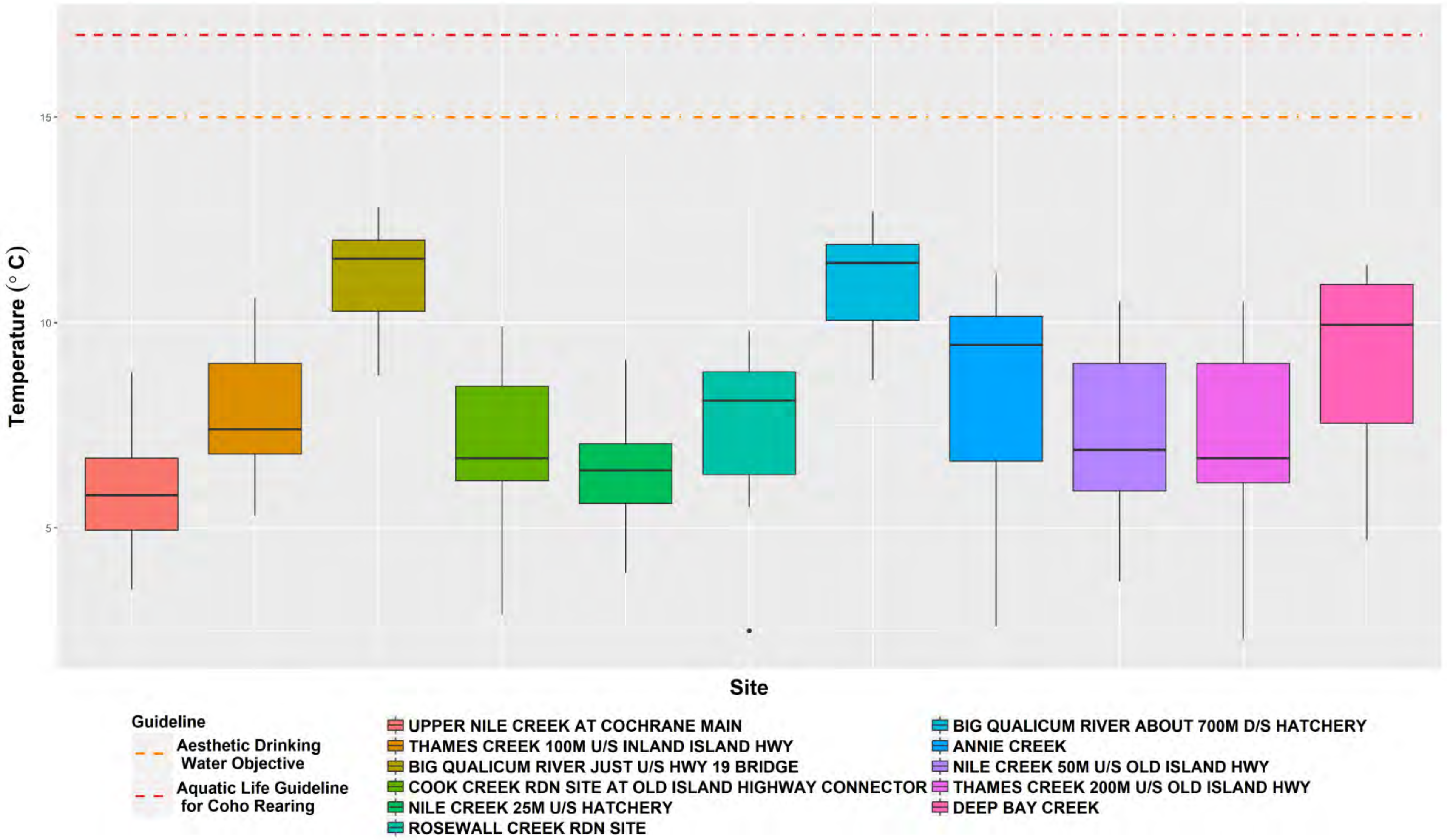


Figure A13. **Fall 2011-2017 water temperature of CWMN sites in Water Region 1 (Big Qualicum) with Englishman River water quality objectives.**

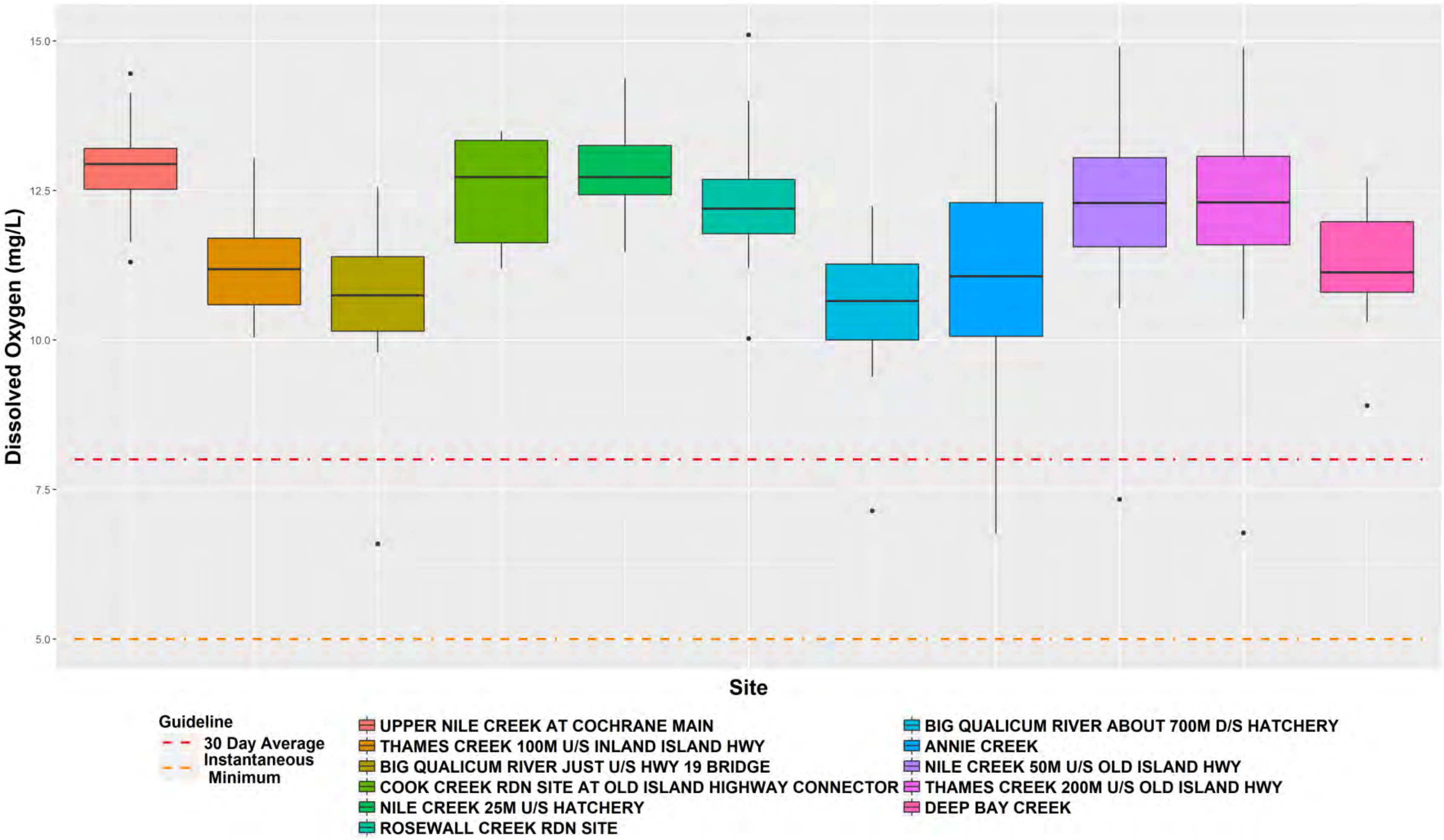


Figure A14. Fall 2011-2017 DO of CWMN sites in Water Region 1 (Big Qualicum) with BC Water Quality guidelines for Aquatic Life.

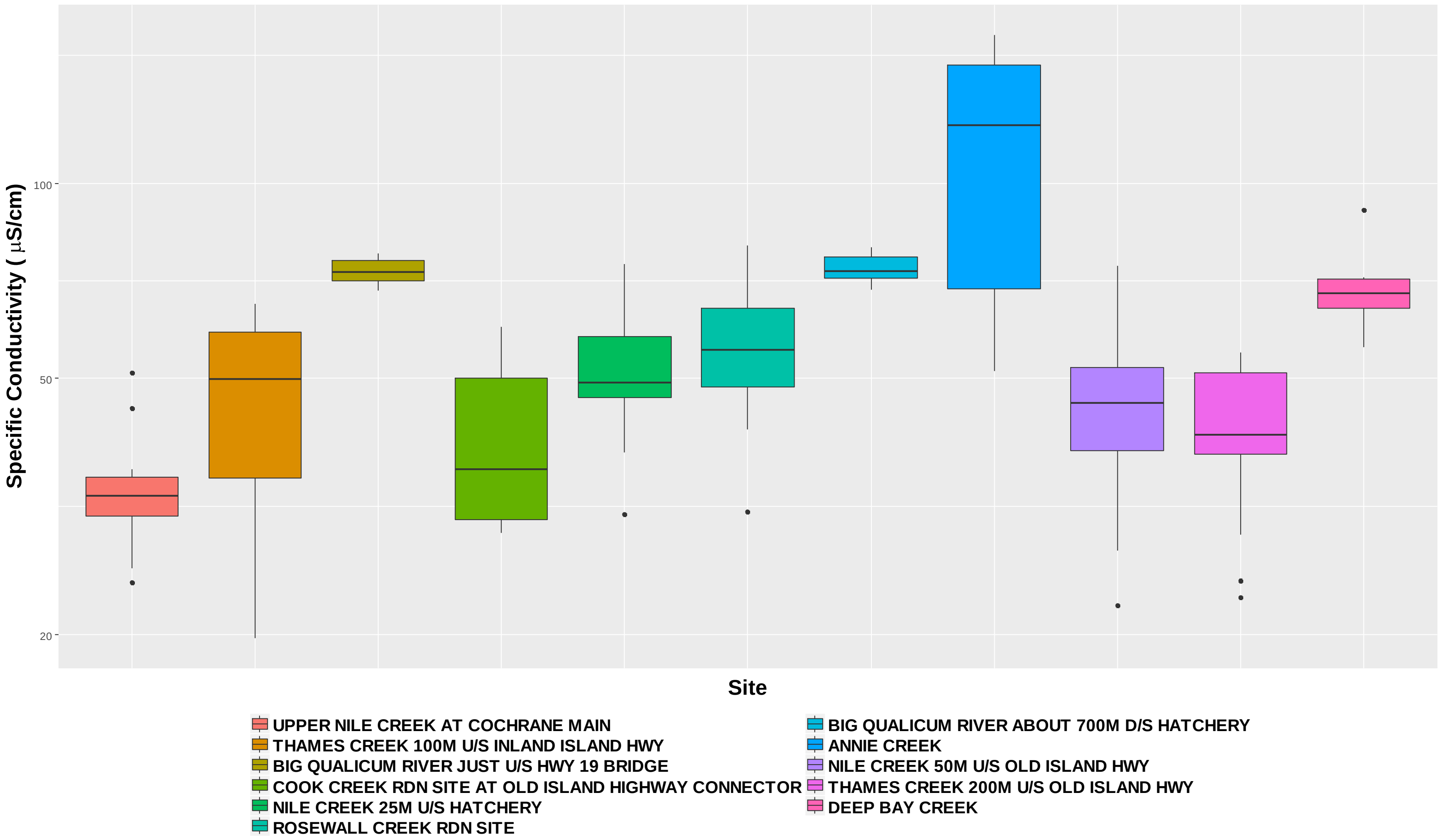


Figure A15. **Fall 2011-2017 specific conductivity of CWMN sites in Water Region 1 (Big Qualicum).**

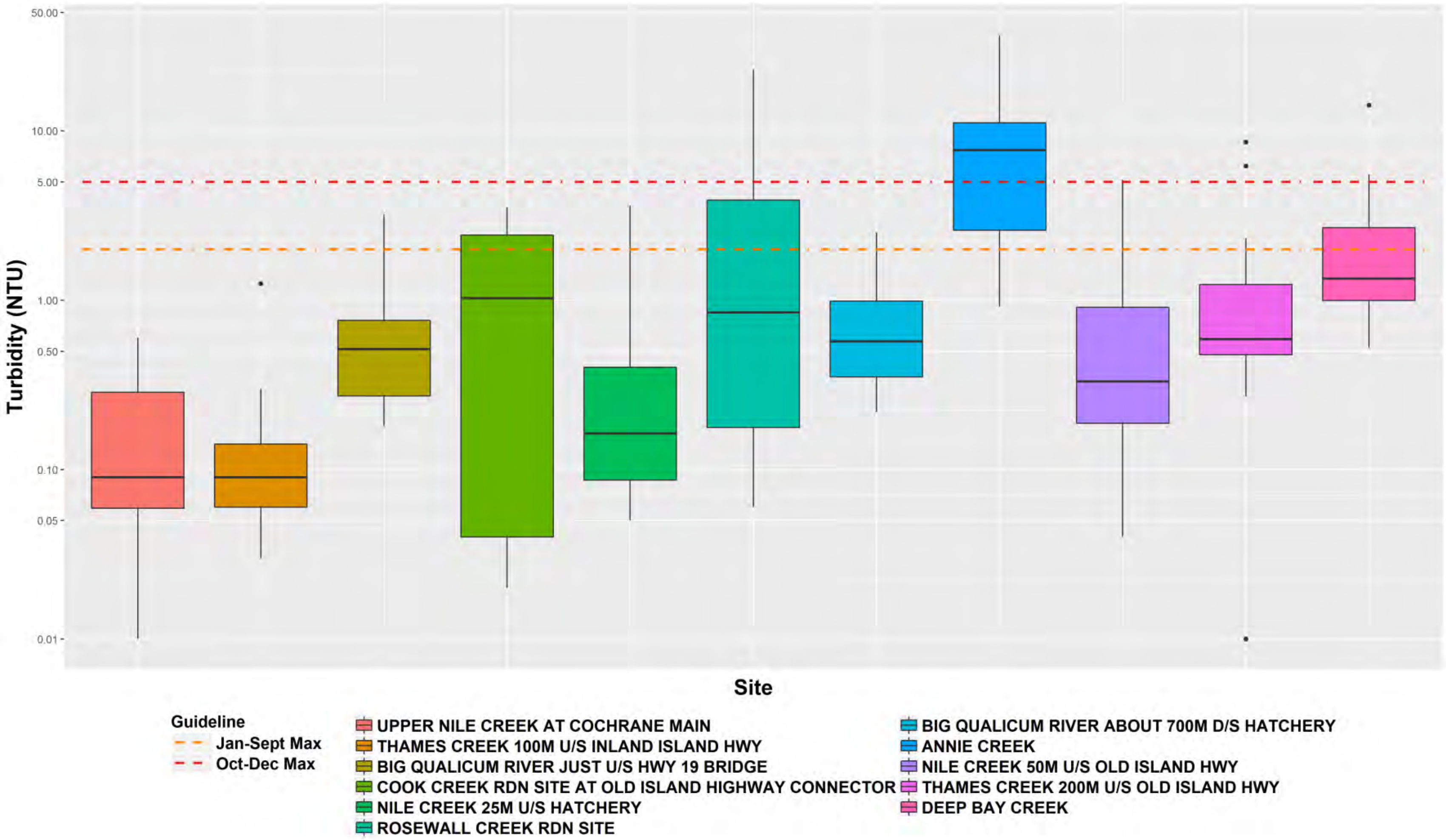


Figure A16. **Fall 2011-2017 turbidity of CWMN sites in Water Region 1 (Big Qualicum) with Englishman River water quality objectives.**

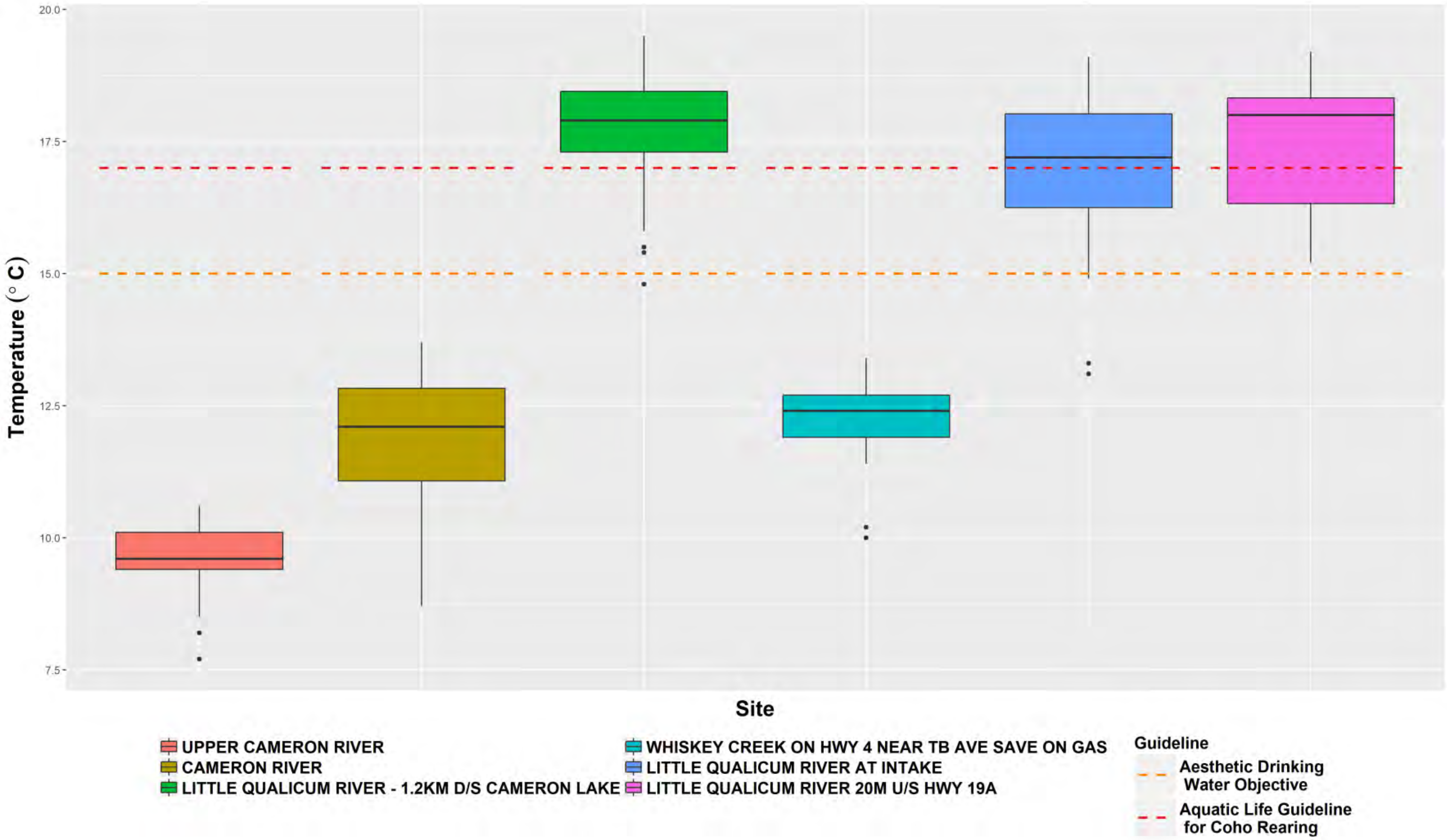


Figure A17. **Summer 2011-2017 water temperature of CWMN sites in Water Region 2 (Little Qualicum) with Englishman River water quality objectives.**

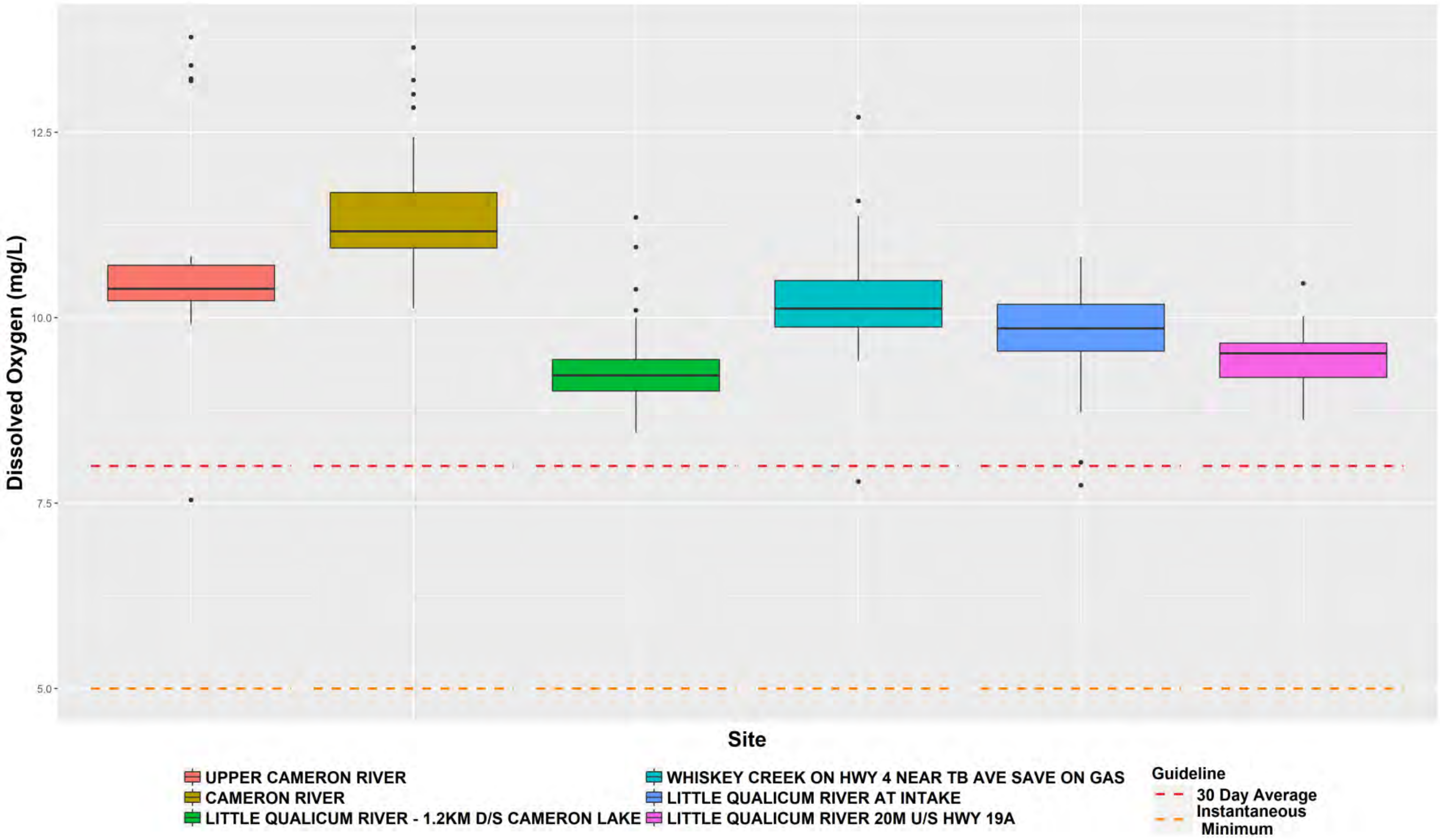


Figure A18. Summer 2011-2017 DO of CWMN sites in Water Region 2 (Little Qualicum) with BC Water Quality guidelines for Aquatic Life.

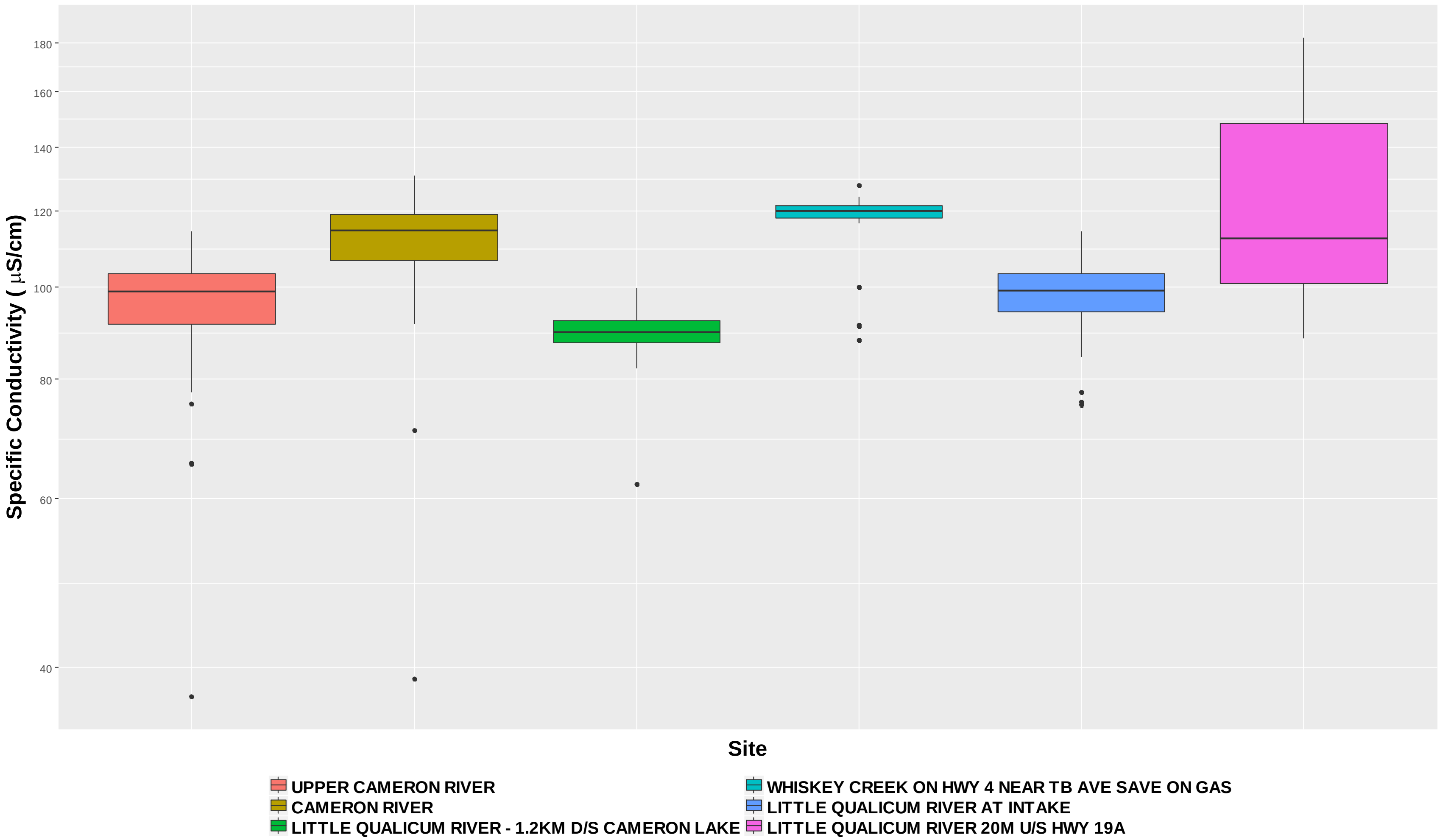


Figure A19. **Summer 2011-2017 specific conductivity of CWMN sites in Water Region 2 (Little Qualicum).**

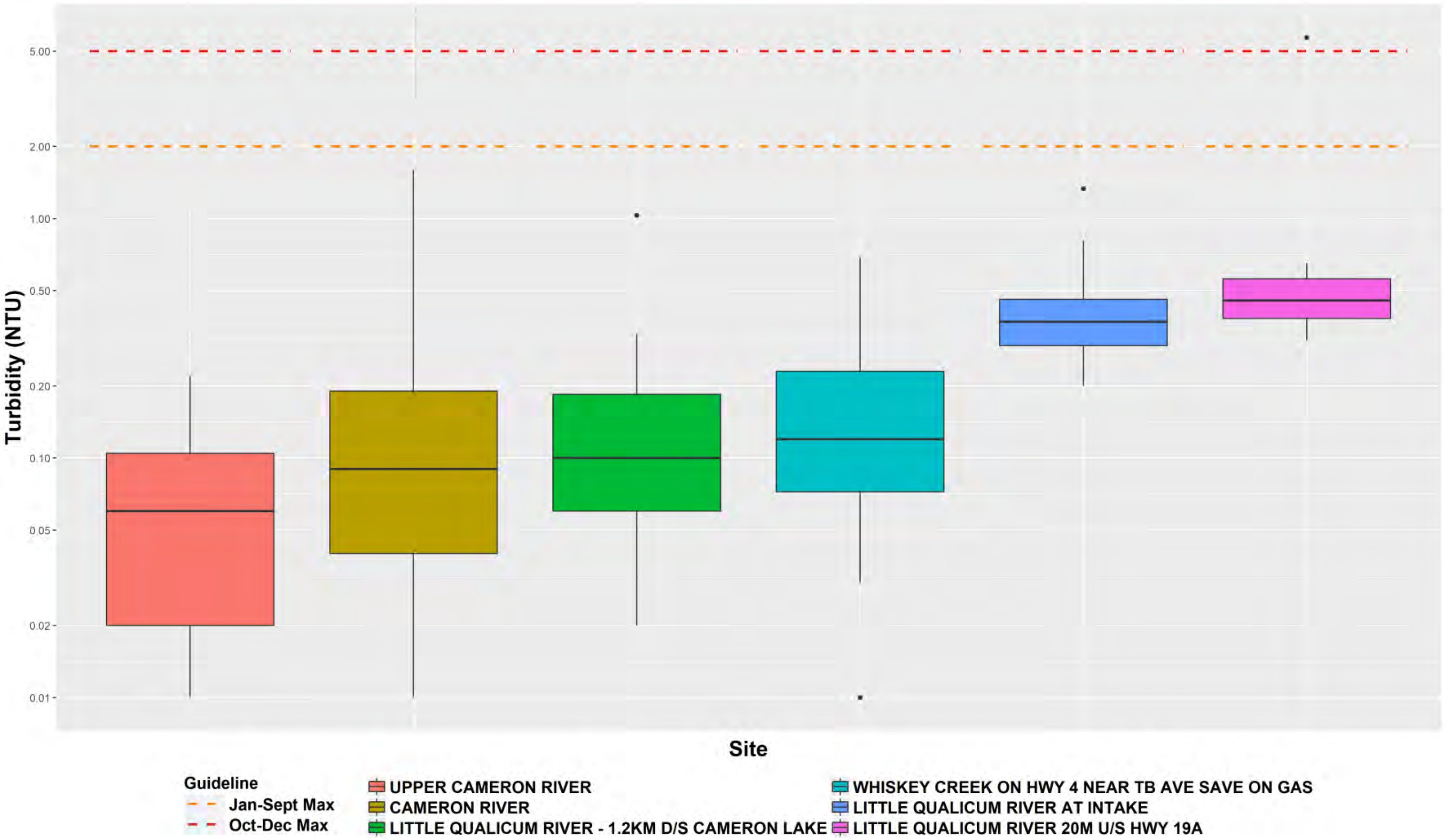


Figure A20. Summer 2011-2017 turbidity of CWMN sites in Water Region 2 (Little Qualicum) with Englishman River water quality objectives.

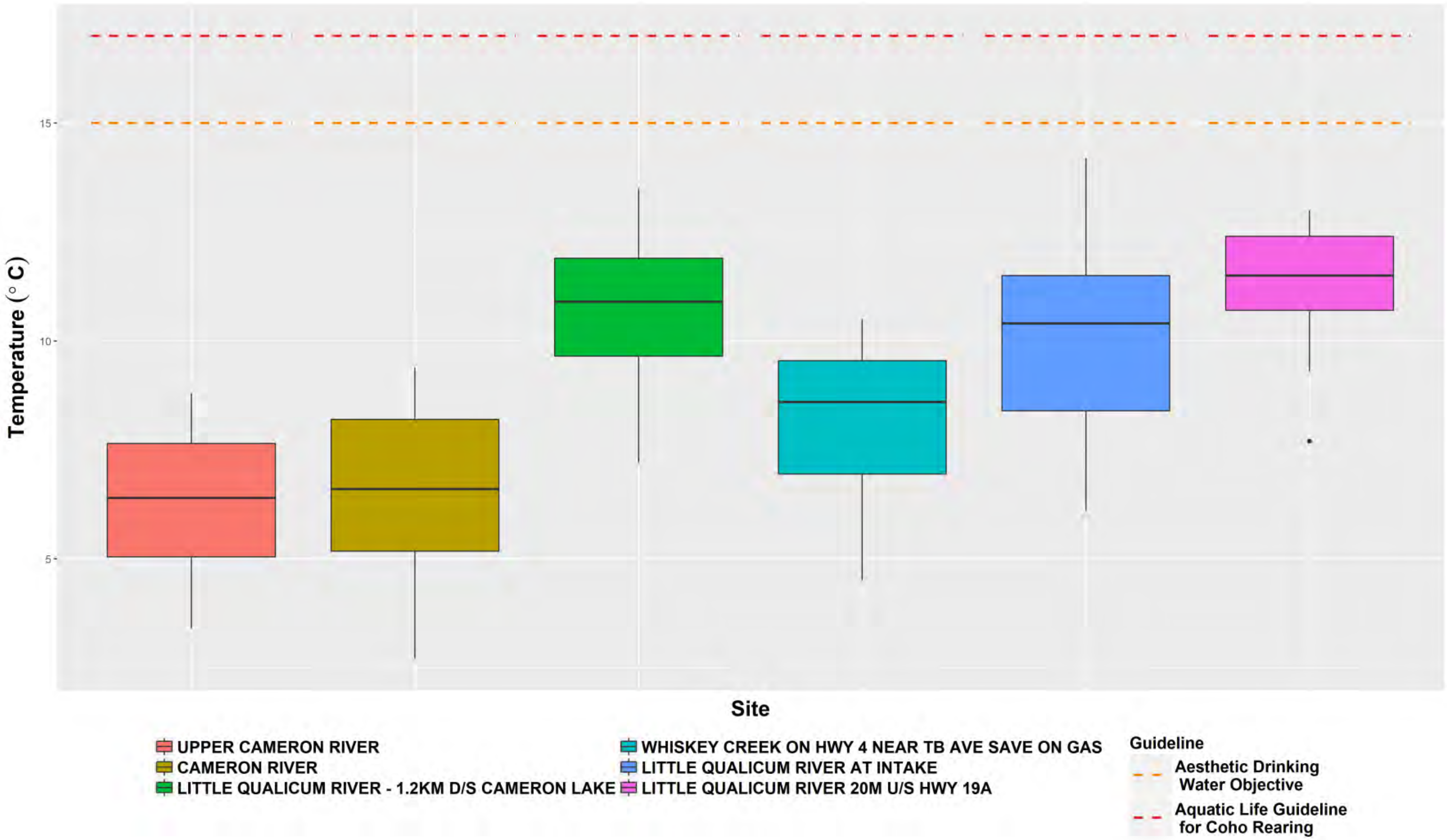


Figure A21. Fall 2011-2017 water temperature of CWMN sites in Water Region 2 (Little Qualicum) with Englishman River water quality objectives.

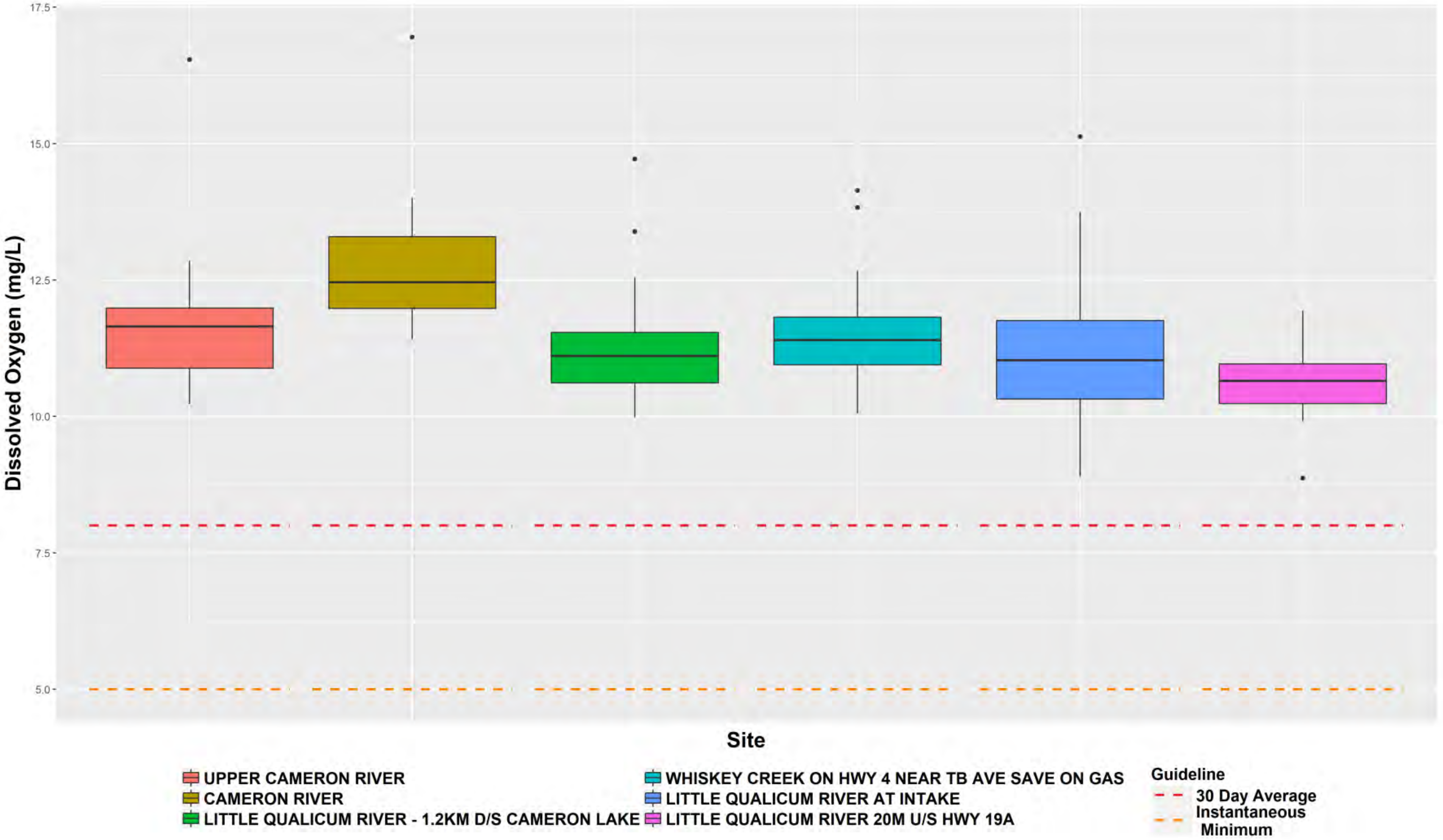


Figure A22. Fall 2011-2017 DO of CWMN sites in Water Region 2 (Little Qualicum) with BC Water Quality guidelines for Aquatic Life.

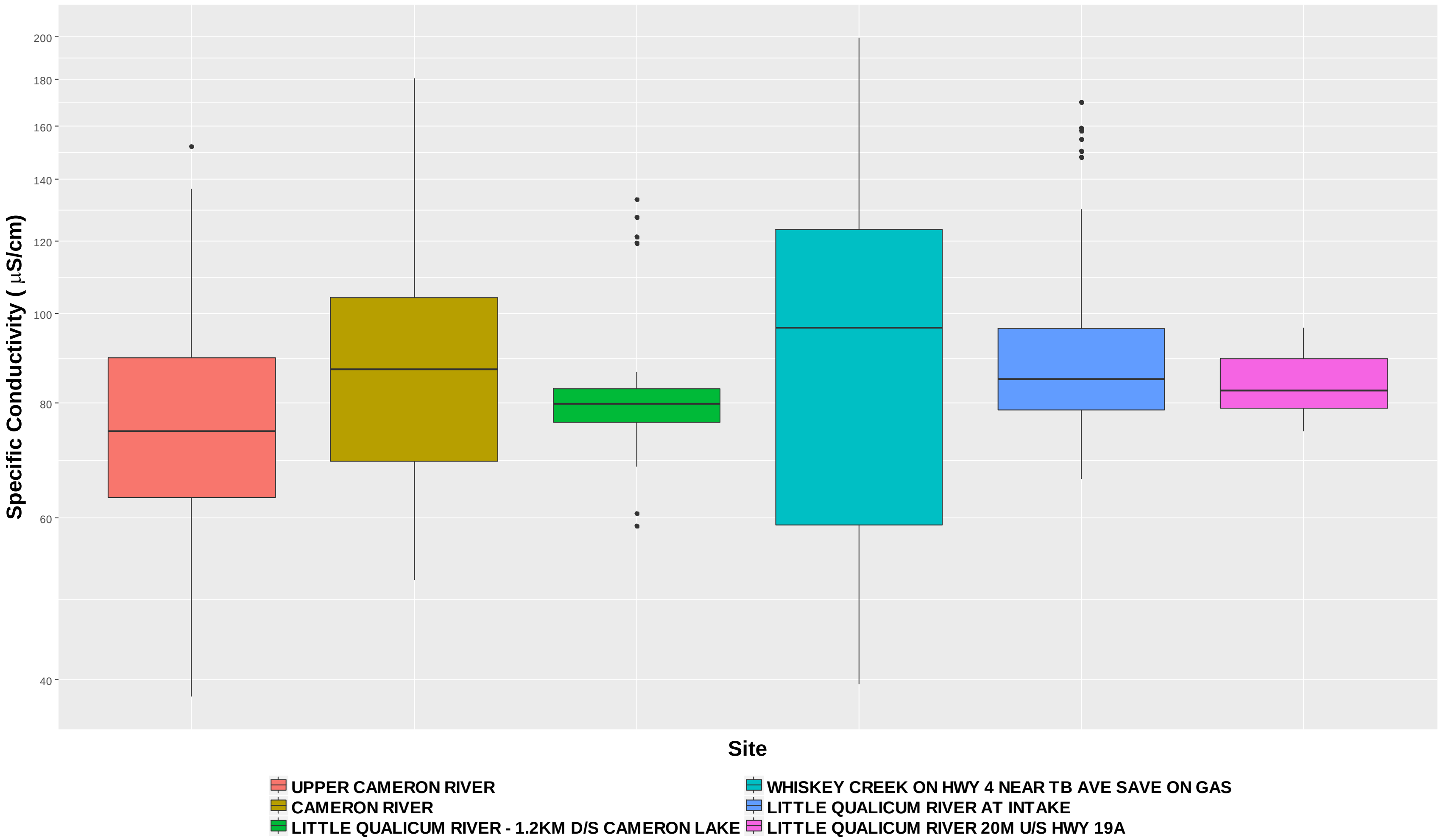


Figure A23. **Fall 2011-2017 specific conductivity of CWMN sites in Water Region 2 (Little Qualicum).**

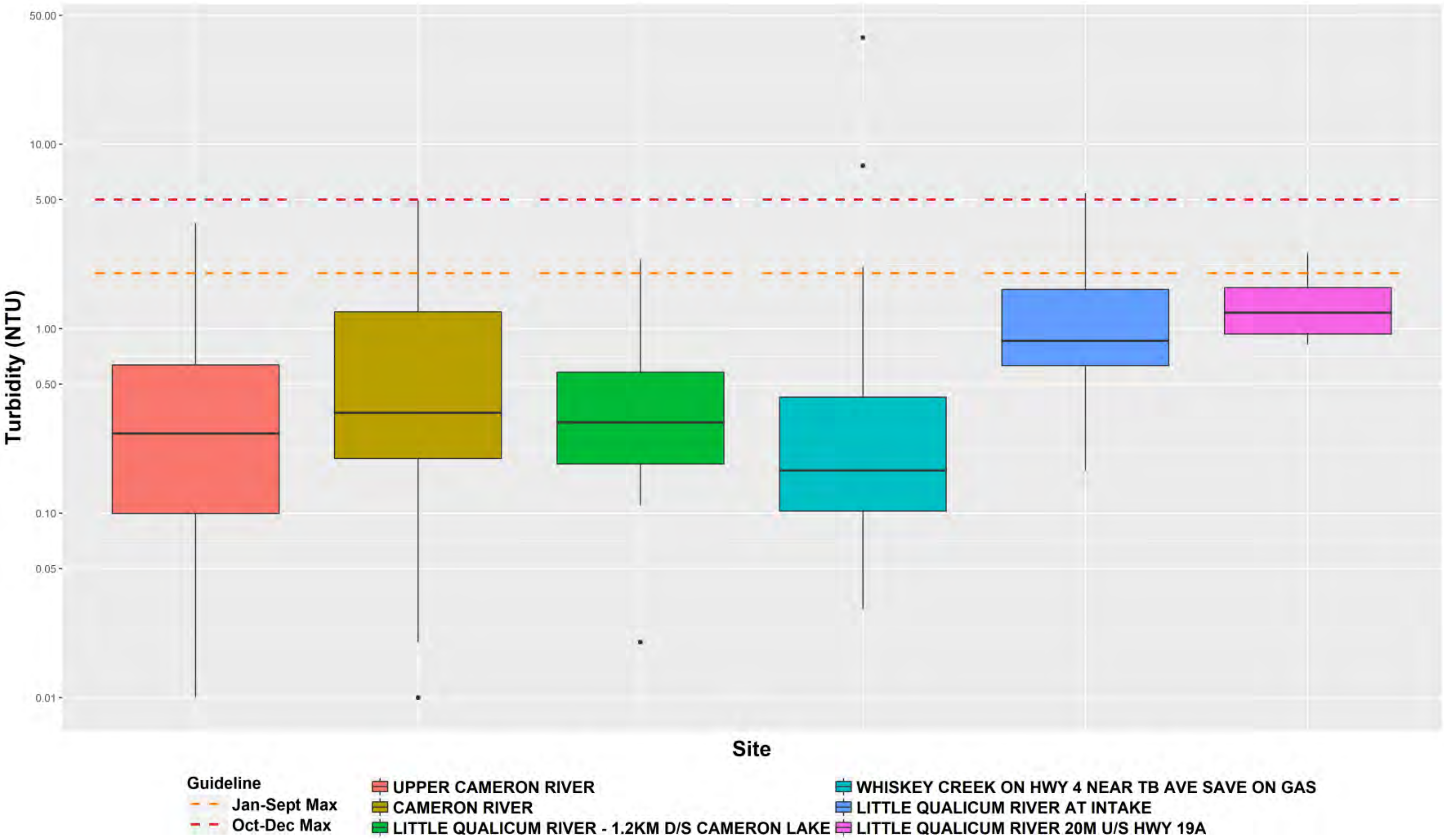


Figure A24. **Fall 2011-2017 turbidity of CWMN sites in Water Region 2 (Little Qualicum) with Englishman River water quality objectives.**

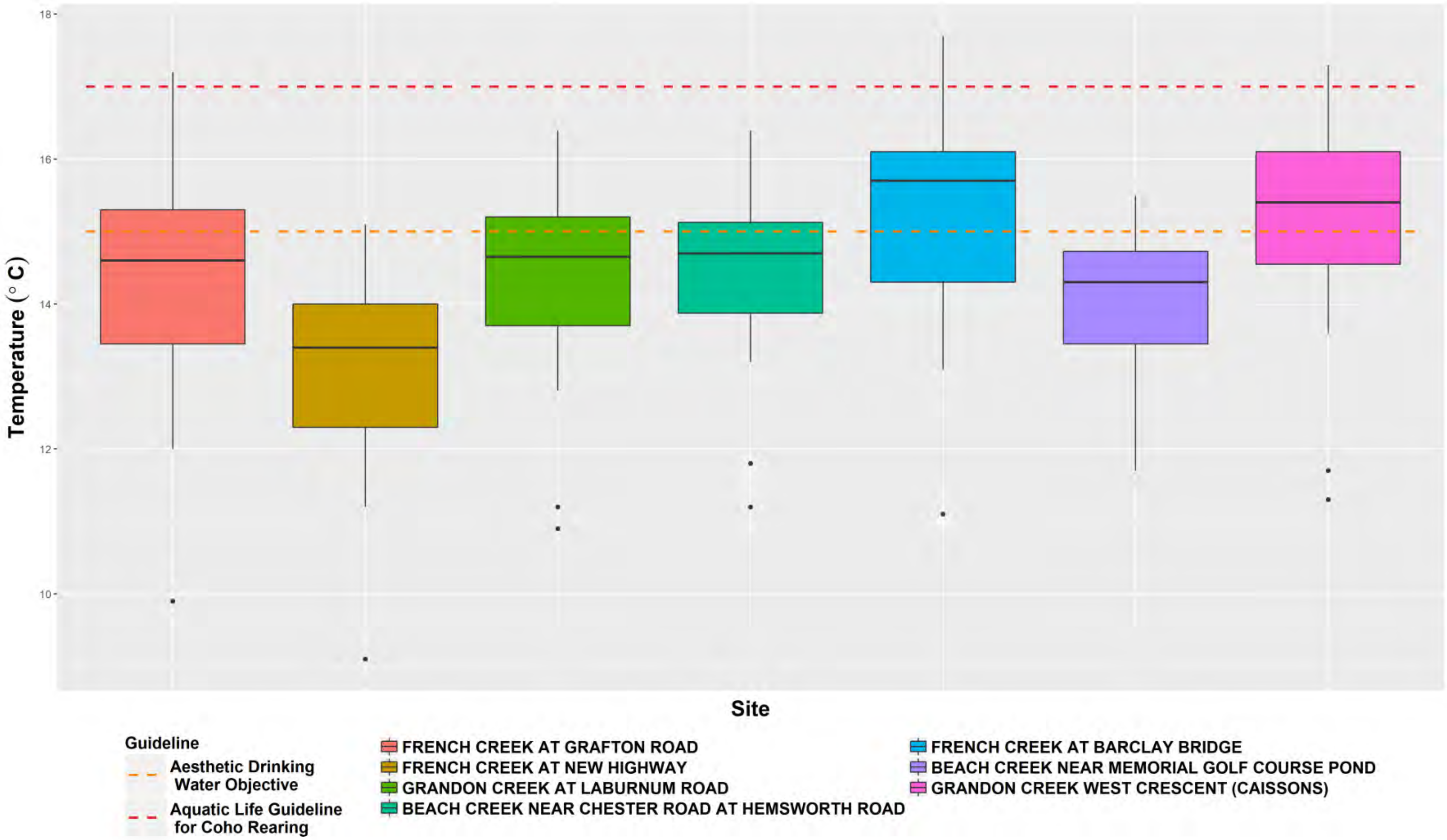


Figure A25. **Summer 2011-2017 water temperature of CWMN sites in Water Region 3 (French Creek) with Englishman River water quality objectives.**

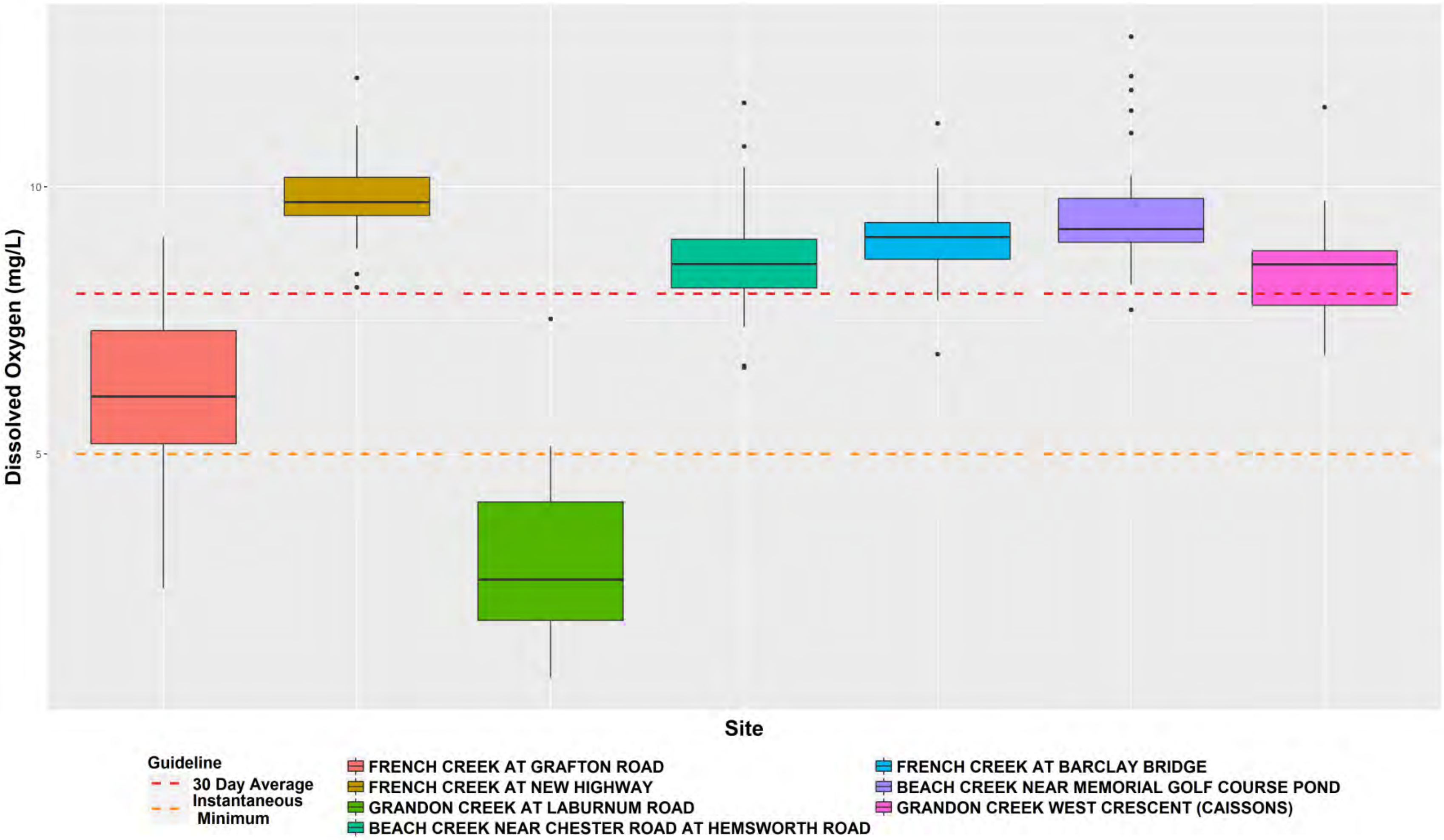


Figure A26. **Summer 2011-2017 DO of CWMN sites in Water Region 3 (French Creek) with BC Water Quality guidelines for Aquatic Life.**

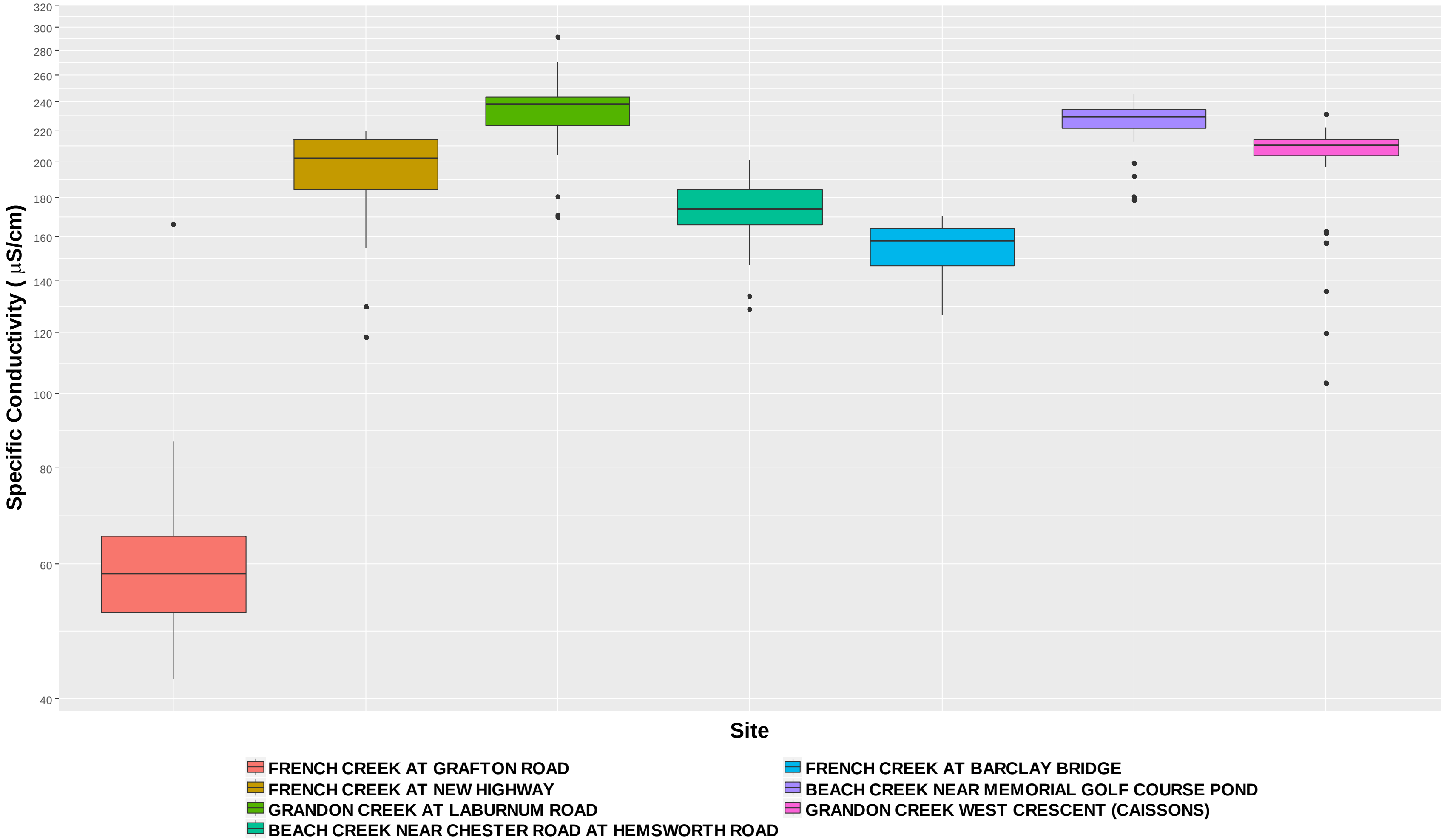
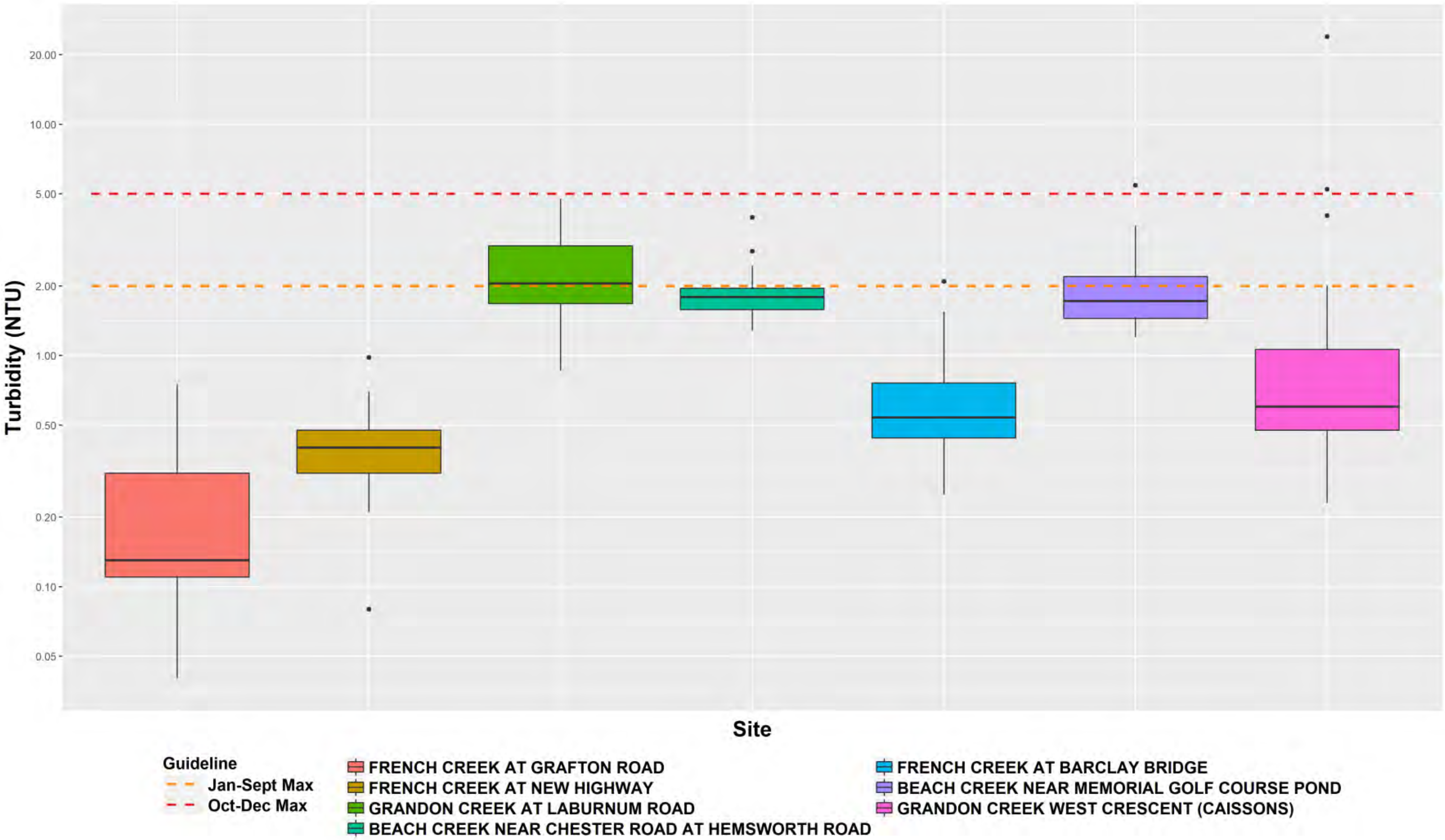


Figure A27. **Summer 2011-2017 specific conductivity of CWMN sites in Water Region 3 (French Creek).**



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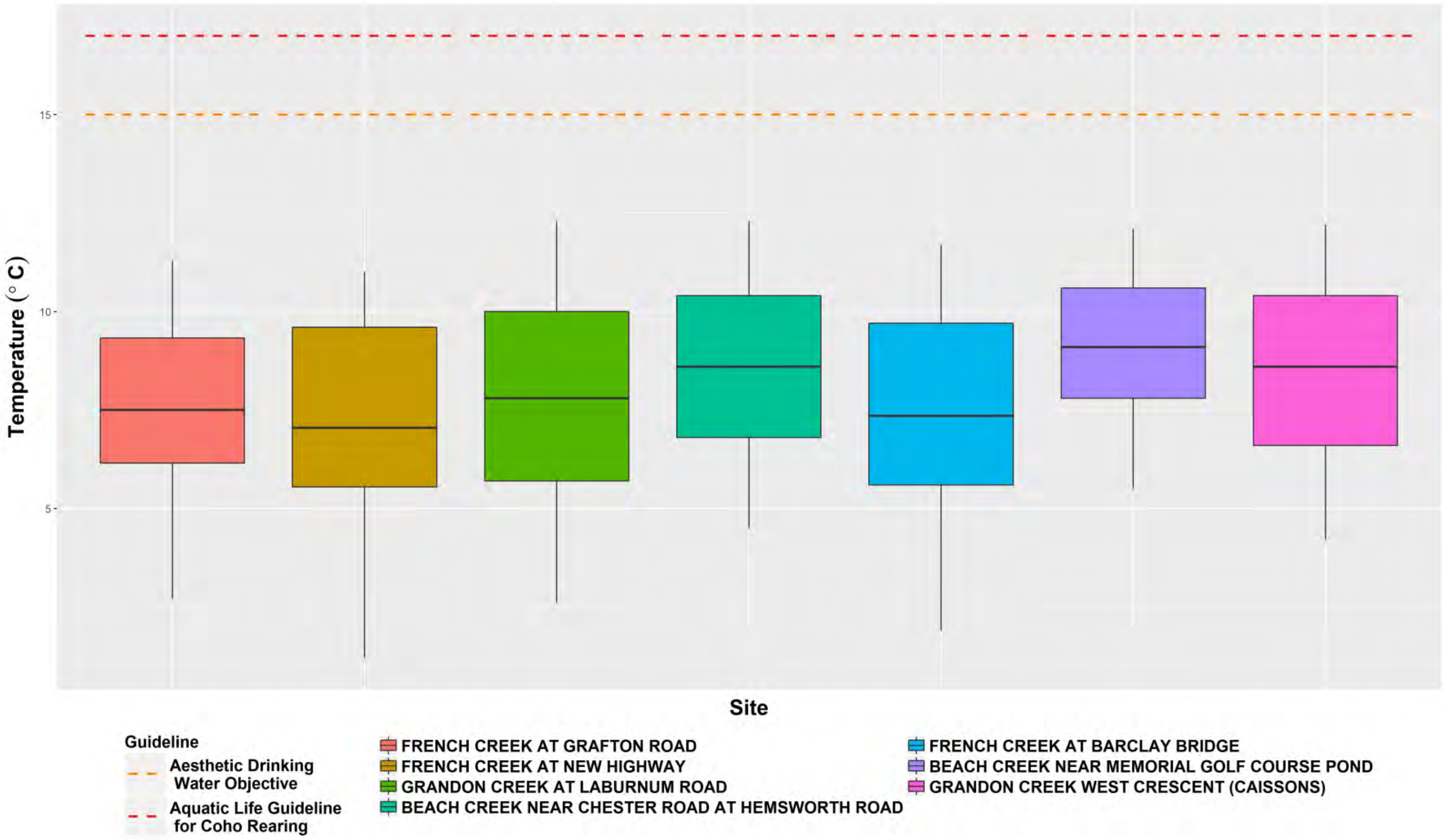
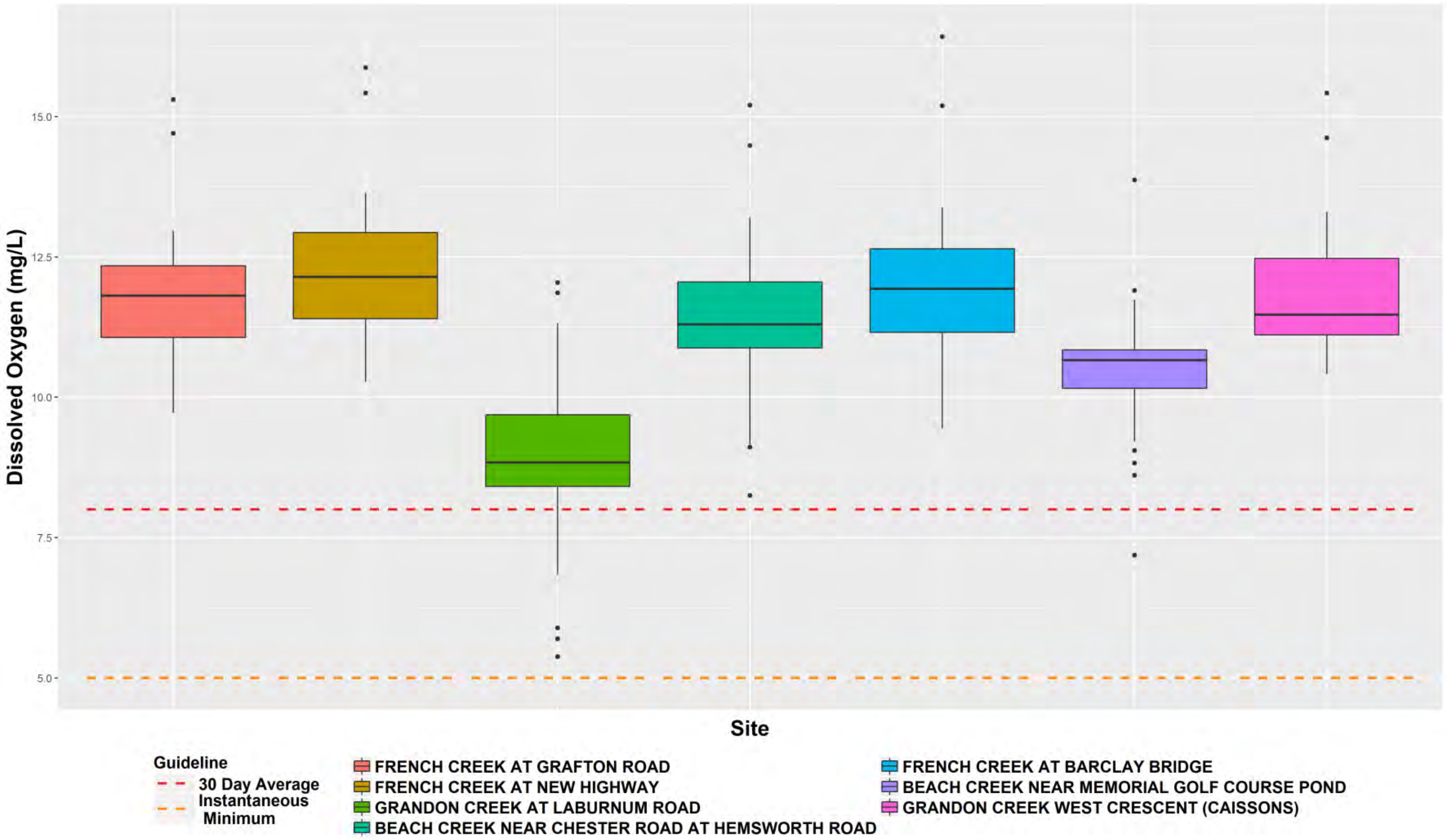


Figure A29. **Fall 2011-2017 water temperature of CWMN sites in Water Region 3 (French Creek) with Englishman River water quality objectives.**



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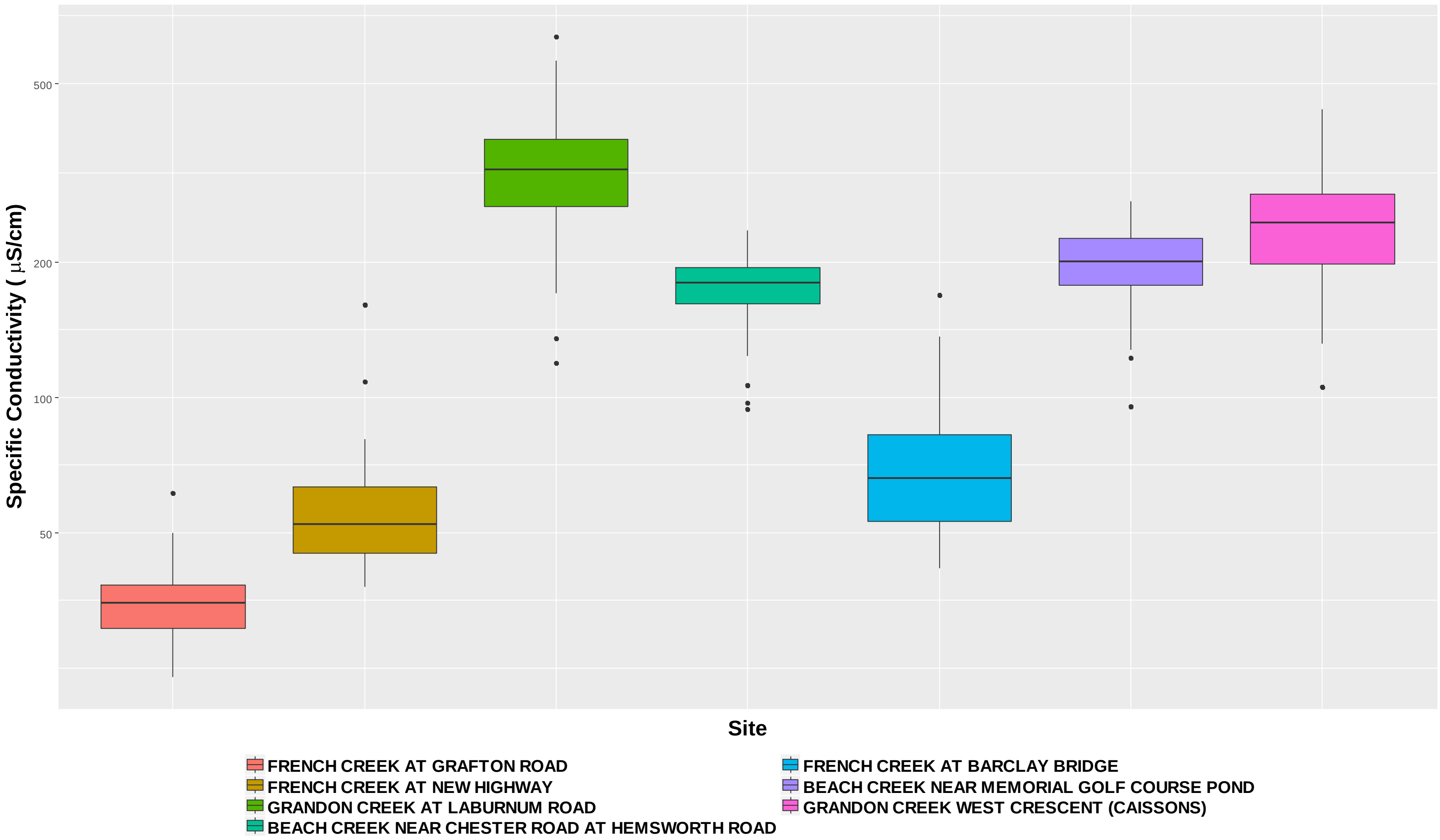


Figure A31. **Fall 2011-2017 specific conductivity of CWMN sites in Water Region 3 (French Creek).**

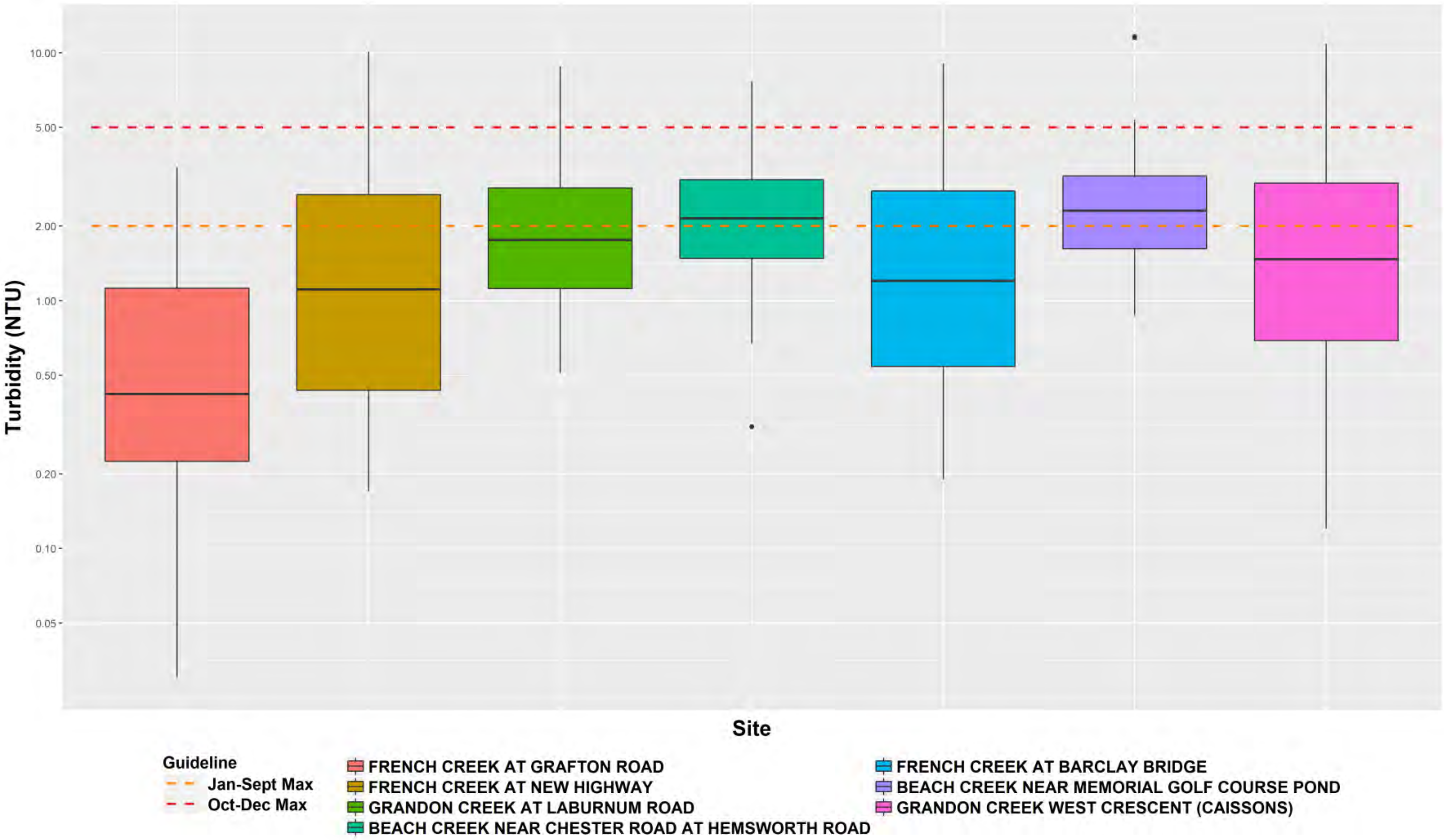


Figure A32. **Fall 2011-2017 turbidity of CWMN sites in Water Region 3 (French Creek) with Englishman River water quality objectives.**

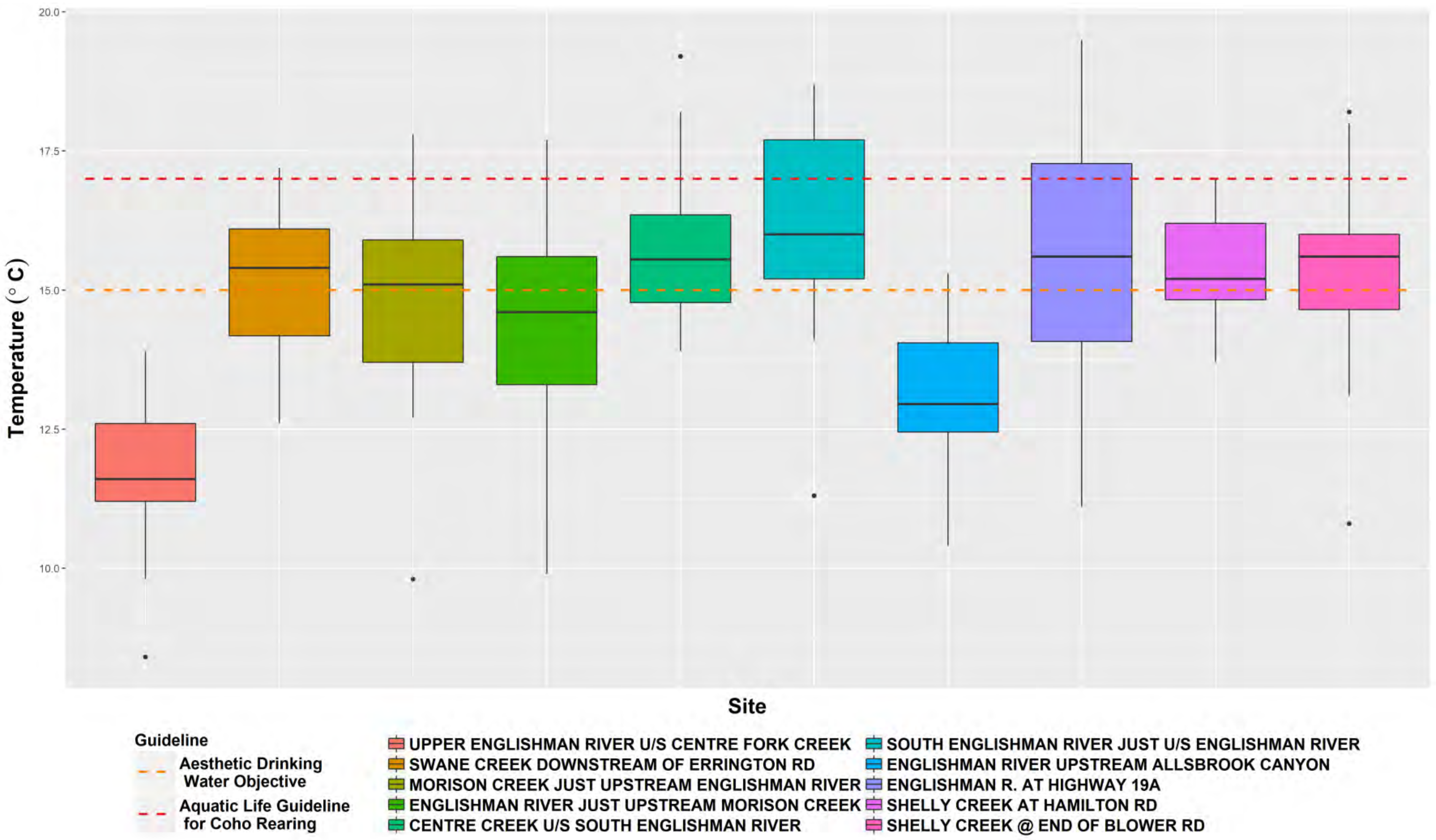


Figure A33. Summer 2011-2017 water temperature of CWMN sites in Water Region 4 (Englishman River) with Englishman River water quality objectives.

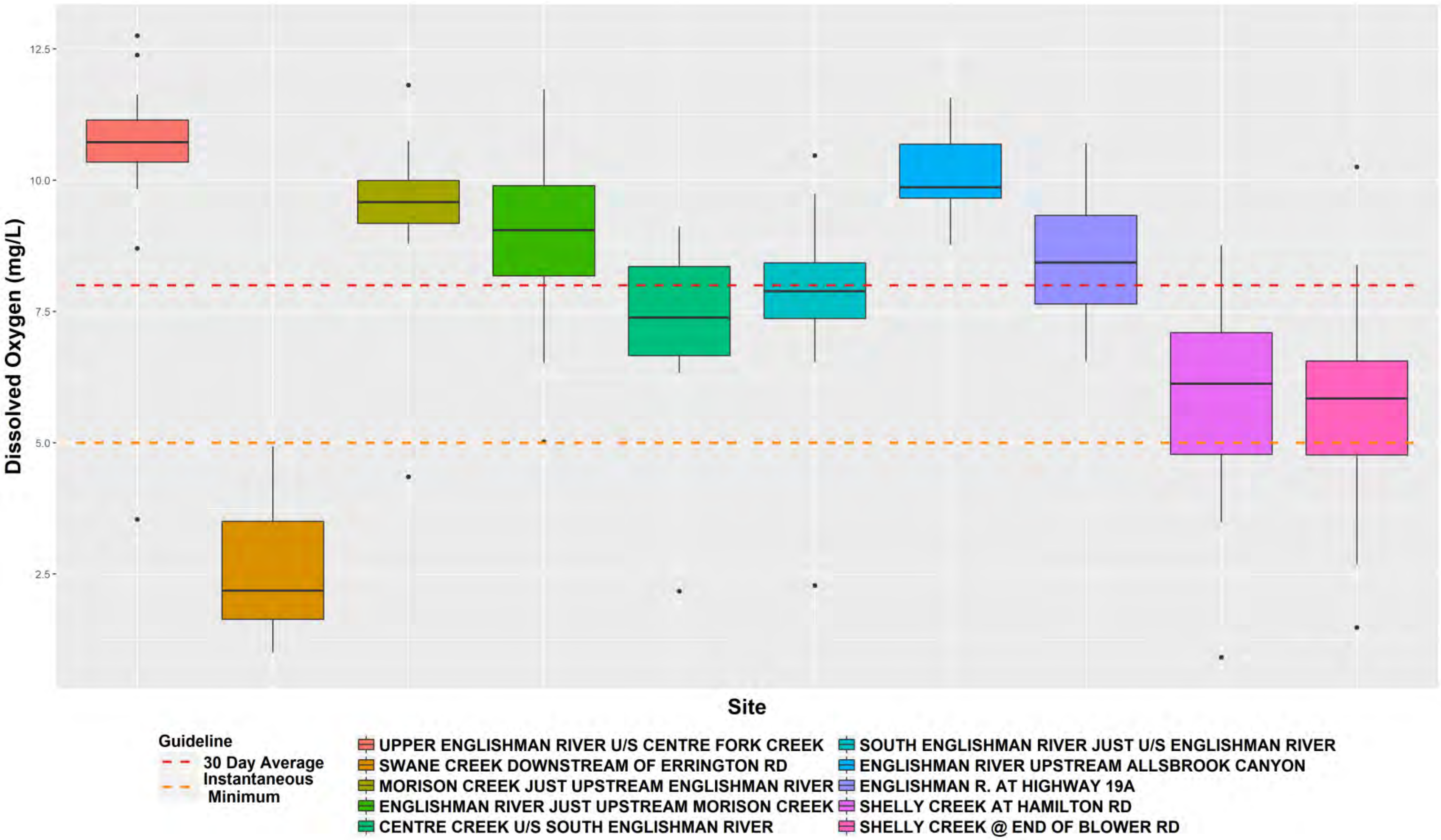


Figure A34. **Summer 2011-2017 DO of CWMN sites in Water Region 4 (Englishman River) with BC Water Quality guidelines for Aquatic Life.**

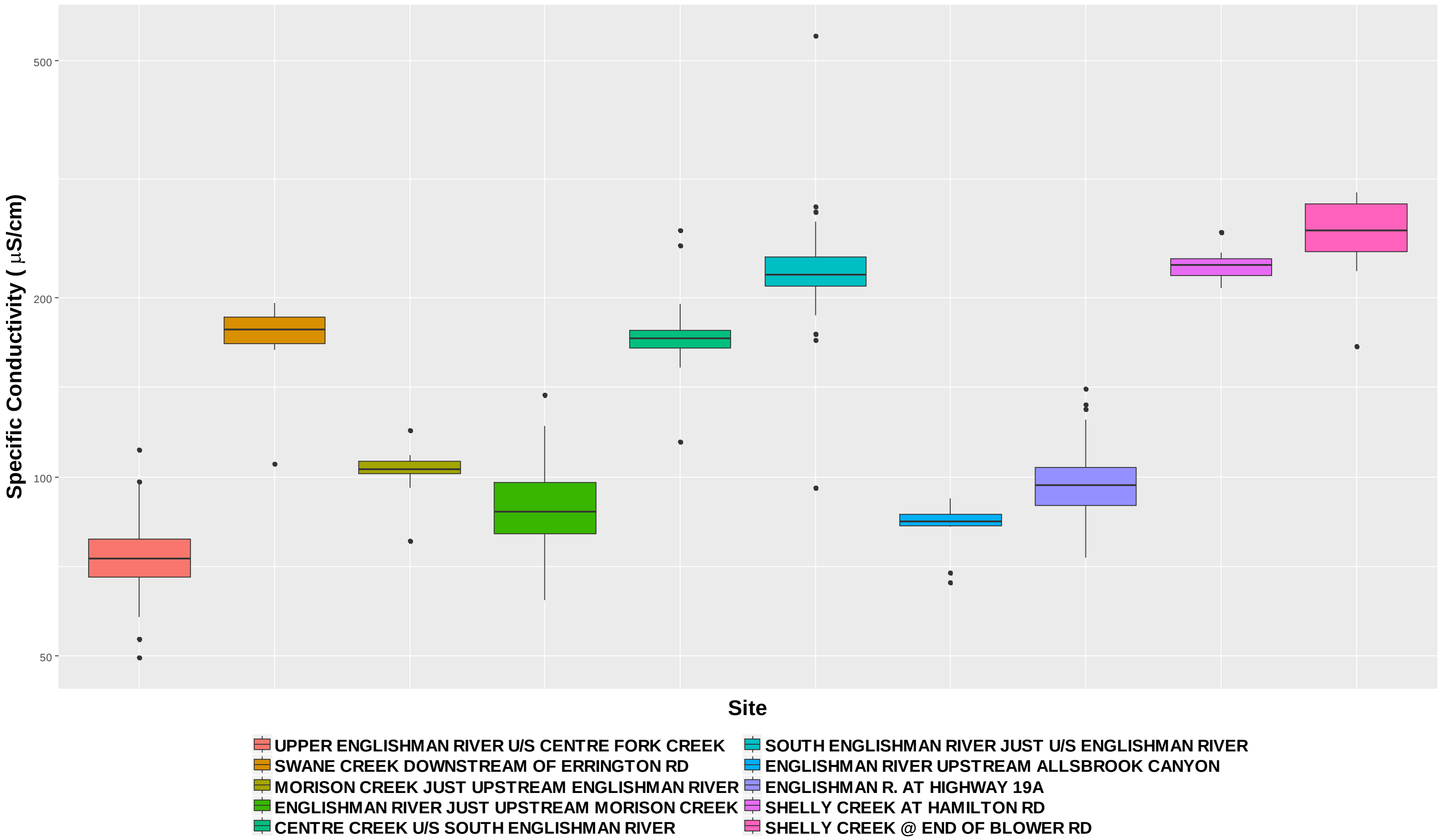


Figure A35. **Summer 2011-2017 specific conductivity of CWMN sites in Water Region 4 (Englishman River).**

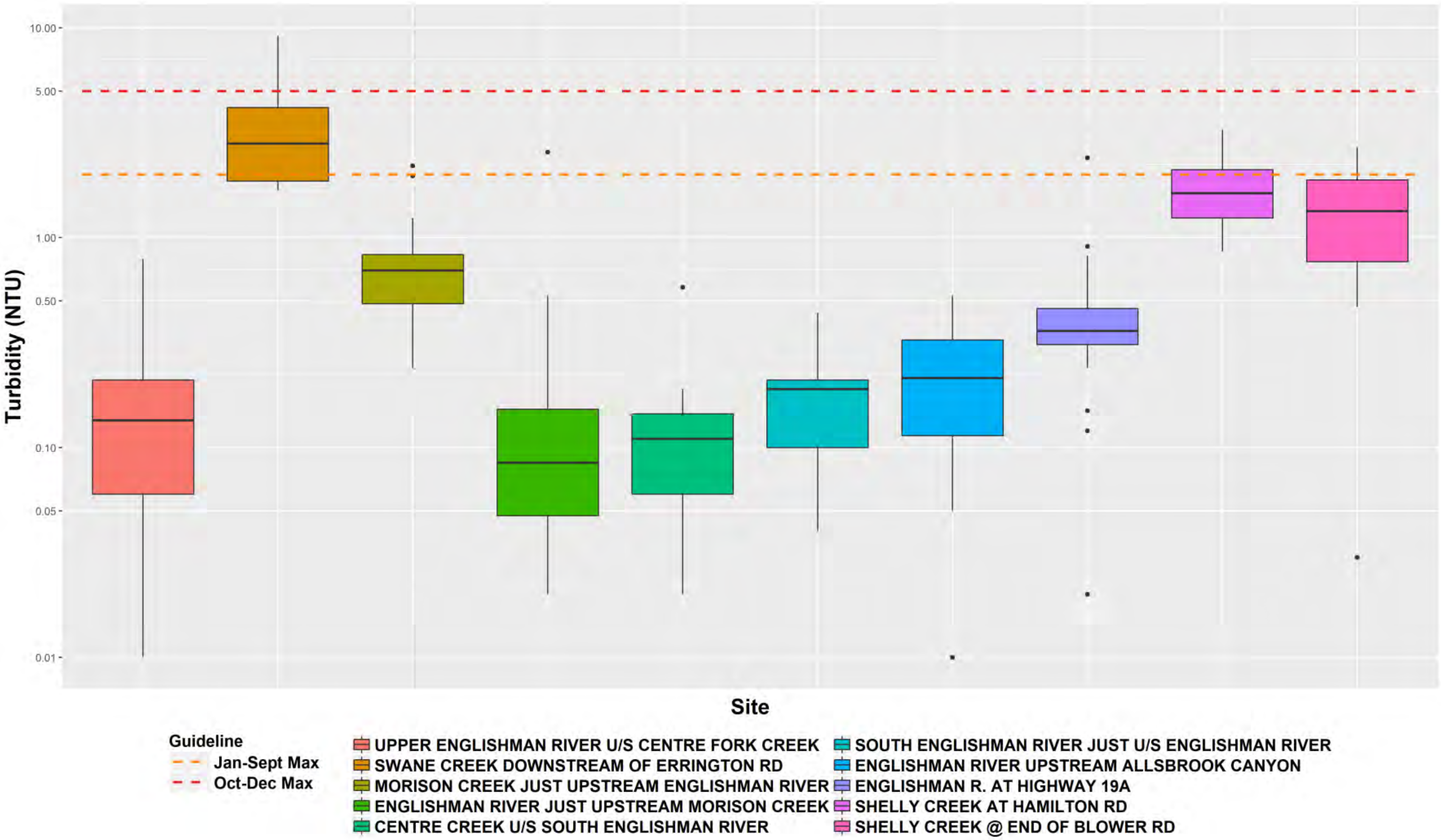


Figure A36. Summer 2011-2017 turbidity of CWMN sites in Water Region 4 (Englishman River) with Englishman River water quality objectives.

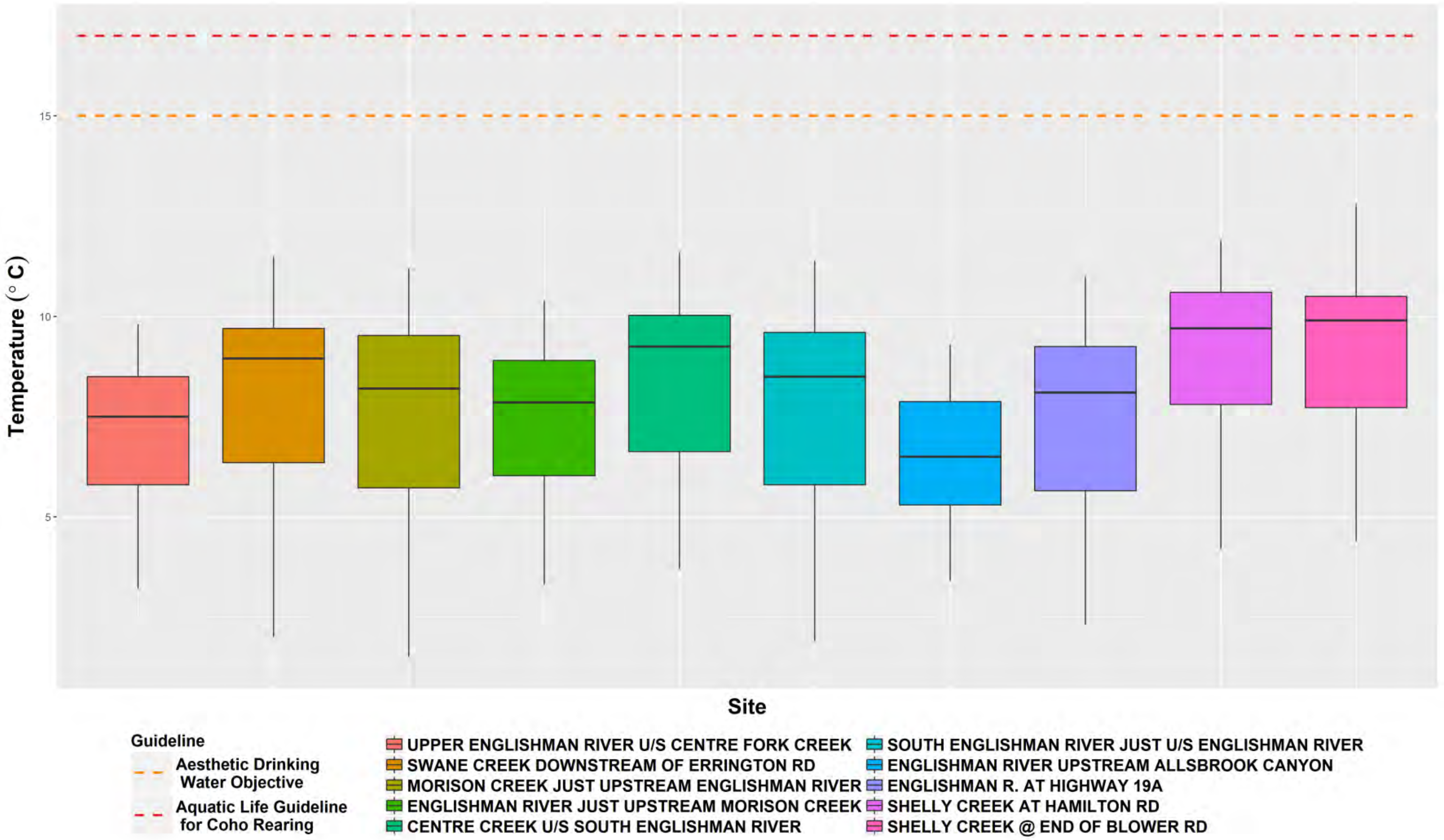


Figure A37. Fall 2011-2017 water temperature of CWMN sites in Water Region 4 (Englishman River) with Englishman River water quality objectives.

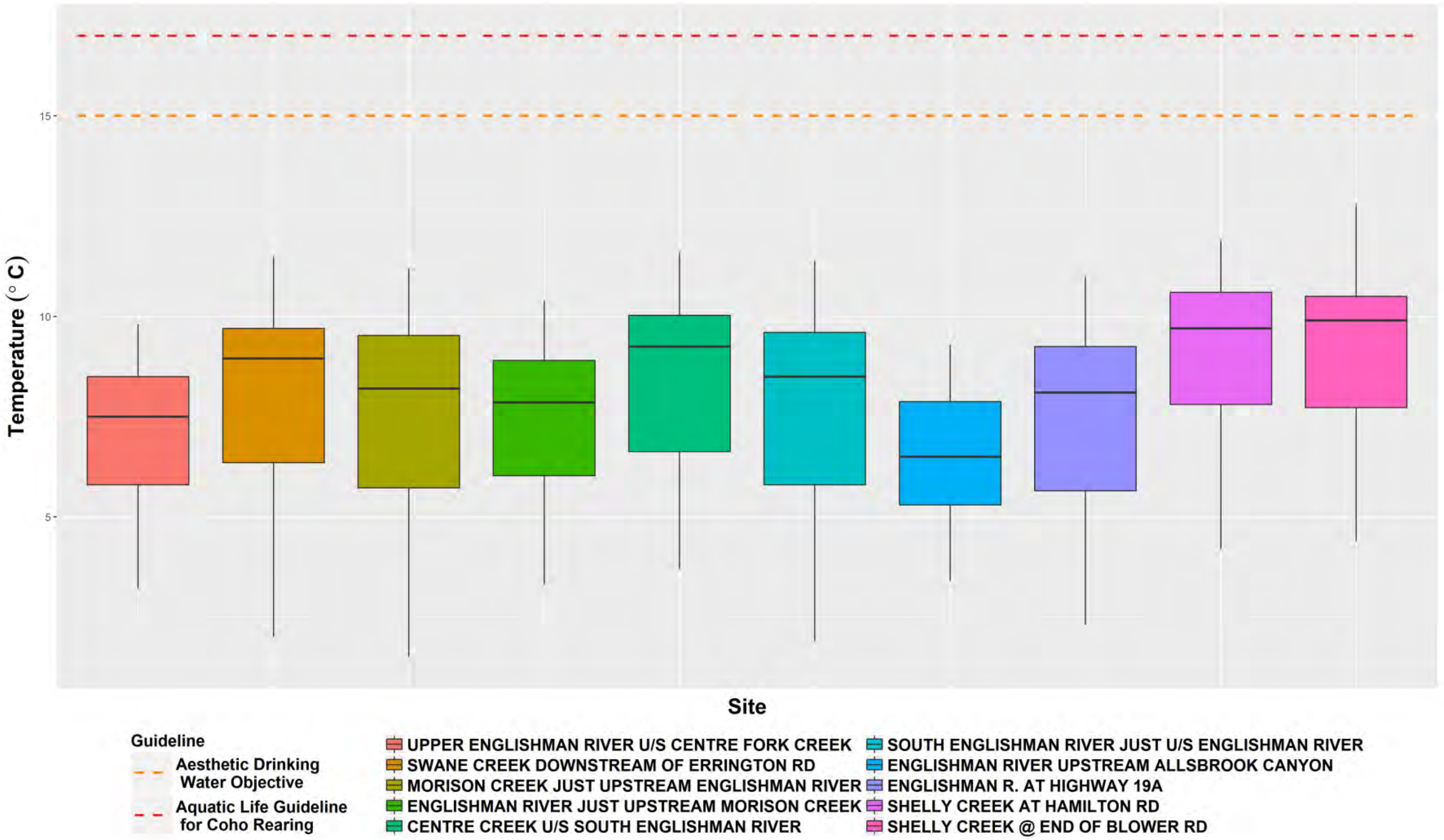


Figure A38. **Fall 2011-2017 DO of CWMN sites in Water Region 4 (Englishman River) with BC Water Quality guidelines for Aquatic Life.**

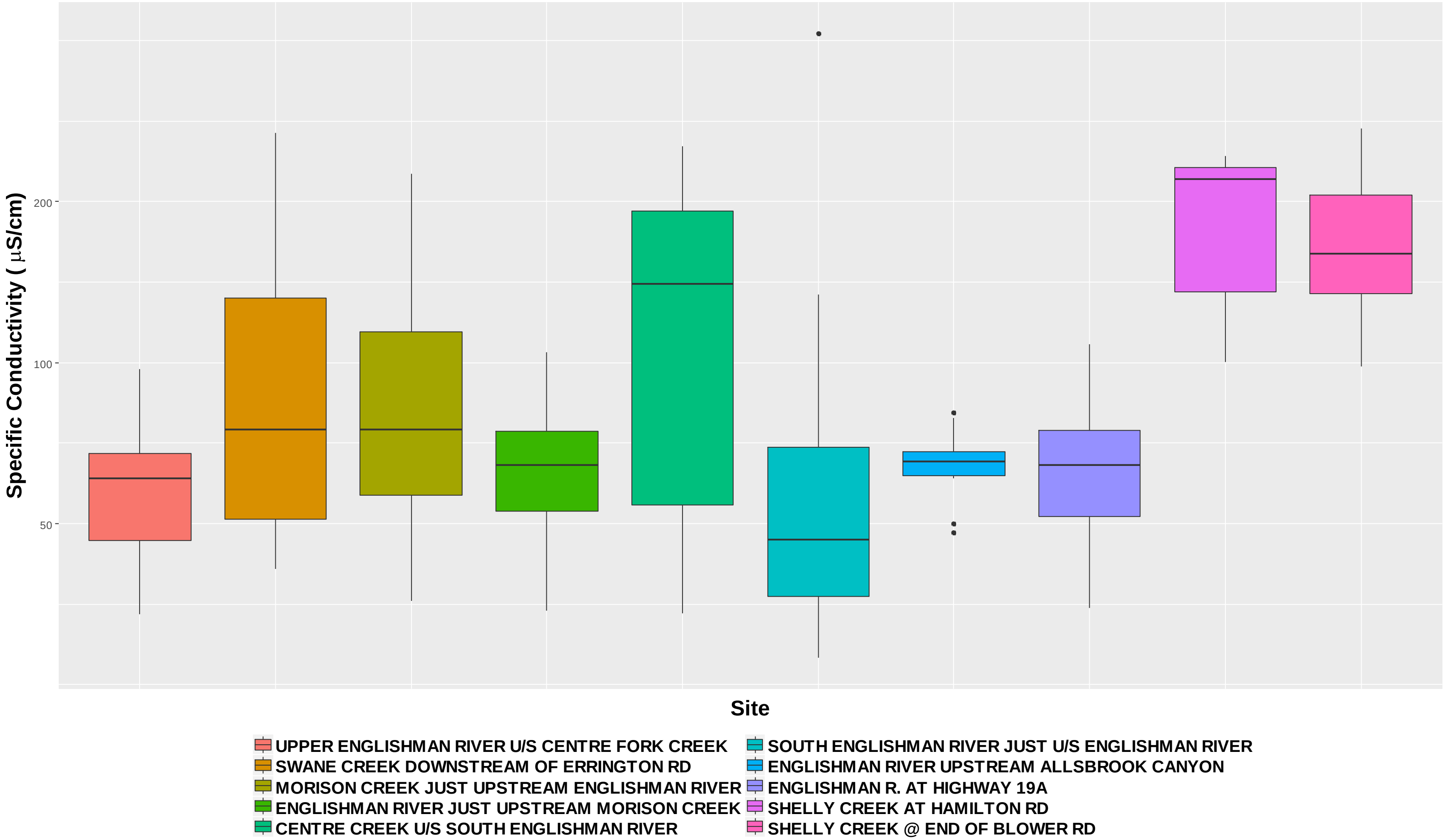


Figure A39. Fall 2011-2017 specific conductivity of CWMN sites in Water Region 4 (Englishman River).

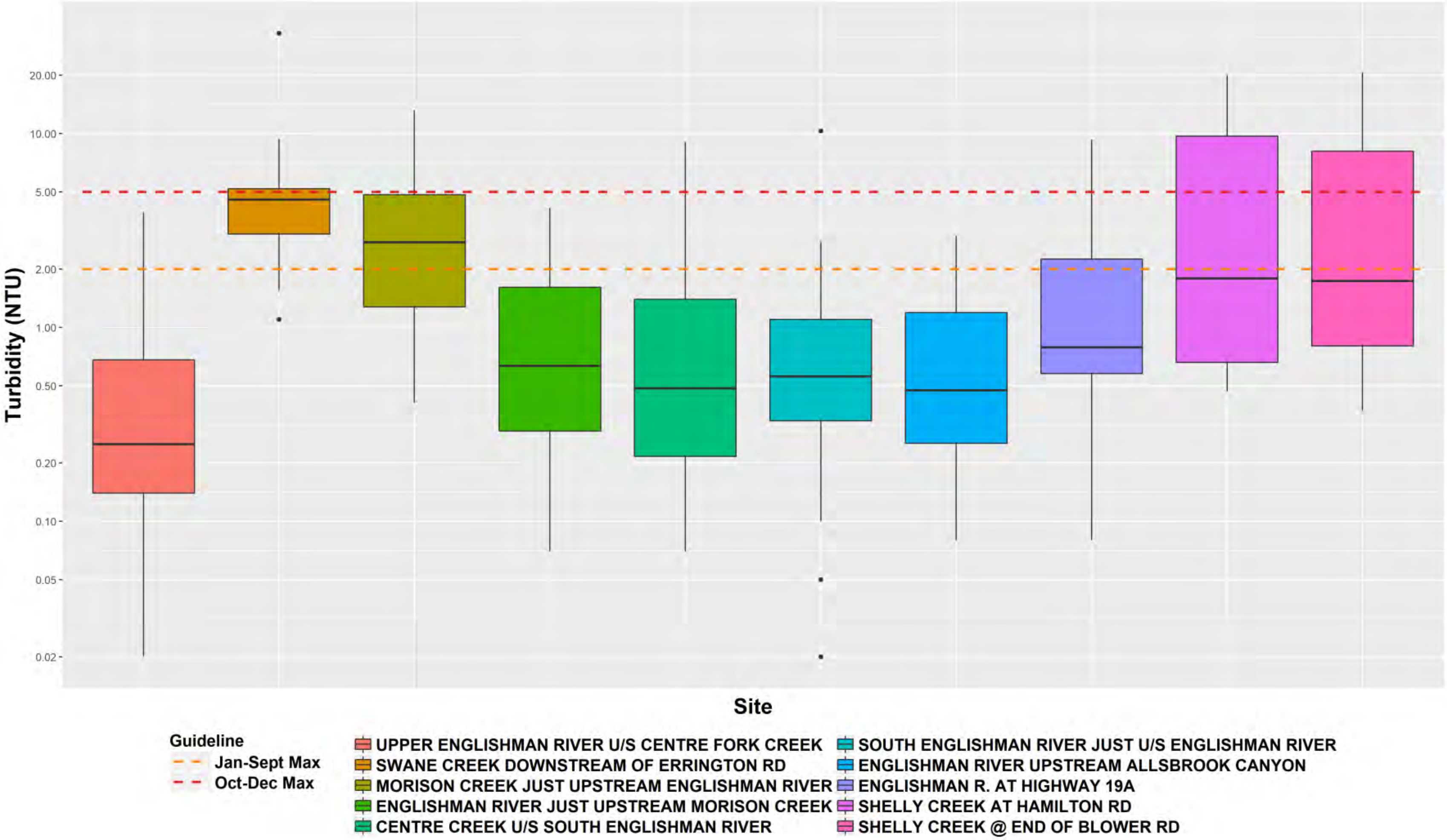


Figure A40. Fall 2011-2017 turbidity of CWMN sites in Water Region 4 (Englishman River) with Englishman River water quality objectives.

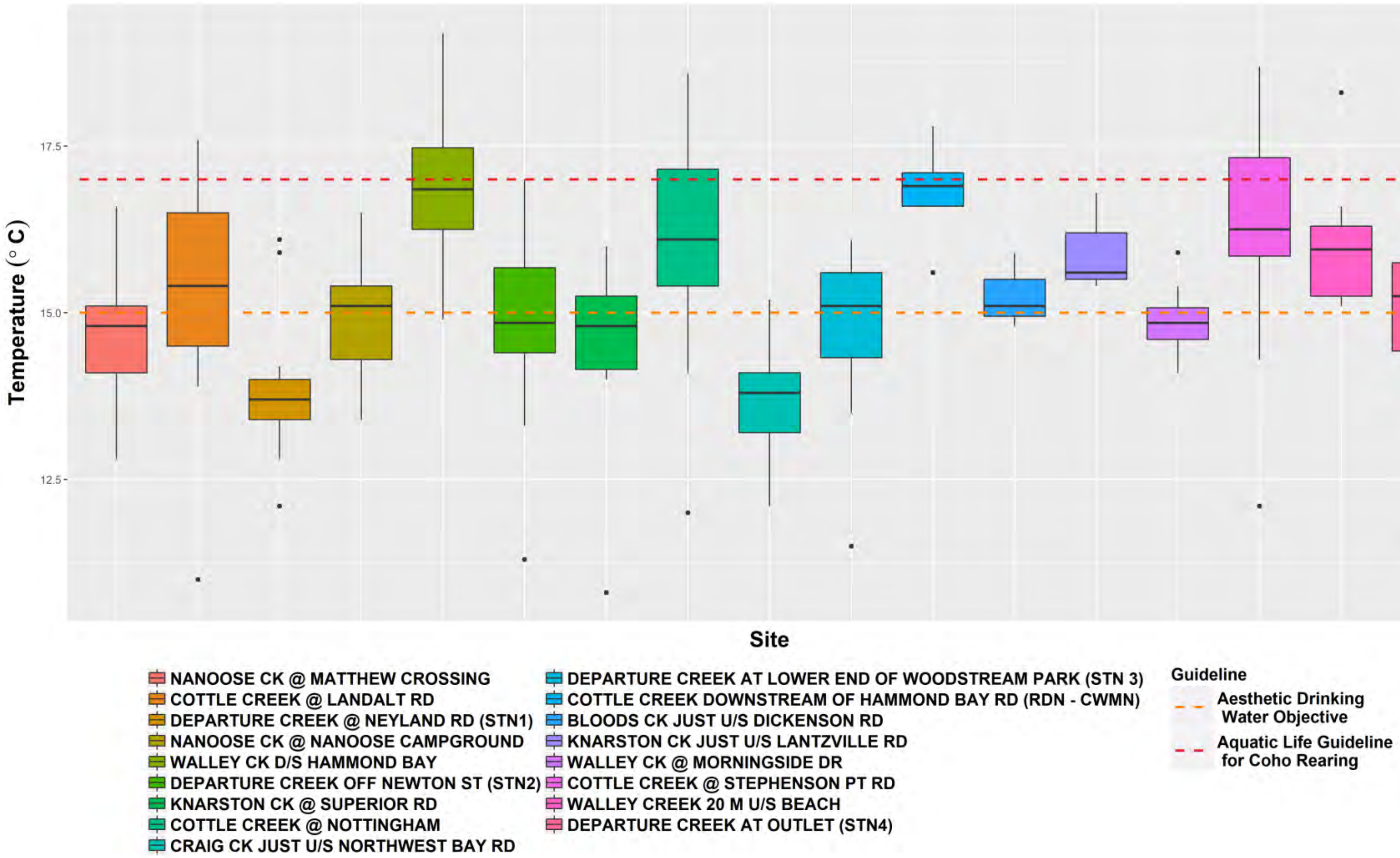


Figure A41. Summer 2012-2017 water temperature of CWMN sites in Water Region 5-1 (South Wellington to Nanoose) with Englishman River water quality objectives.

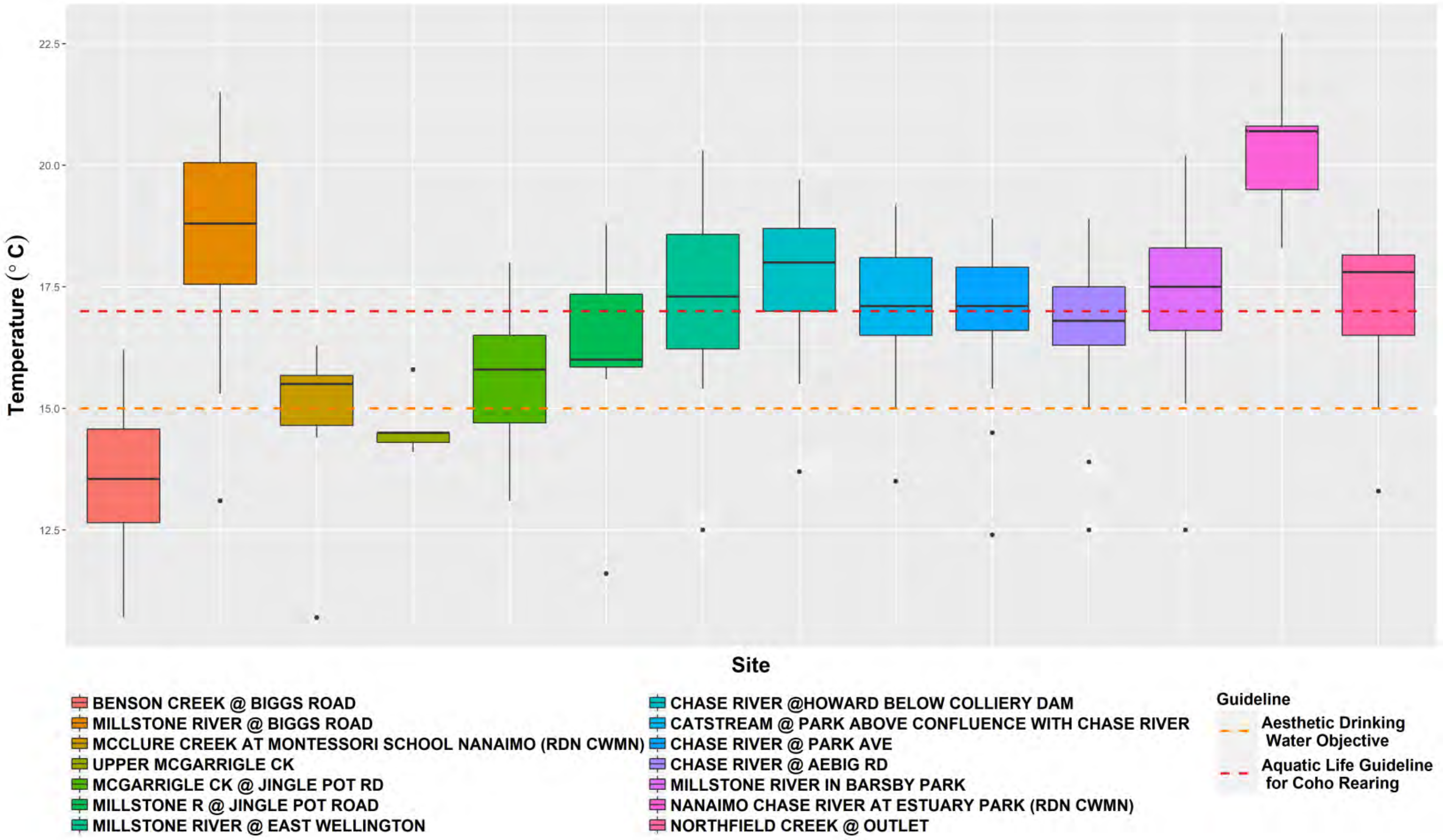


Figure A42. **Summer 2012-2017 water temperature of CWMN sites in Water Region 5-2 (South Wellington to Nanoose) with Englishman River water quality objectives.**

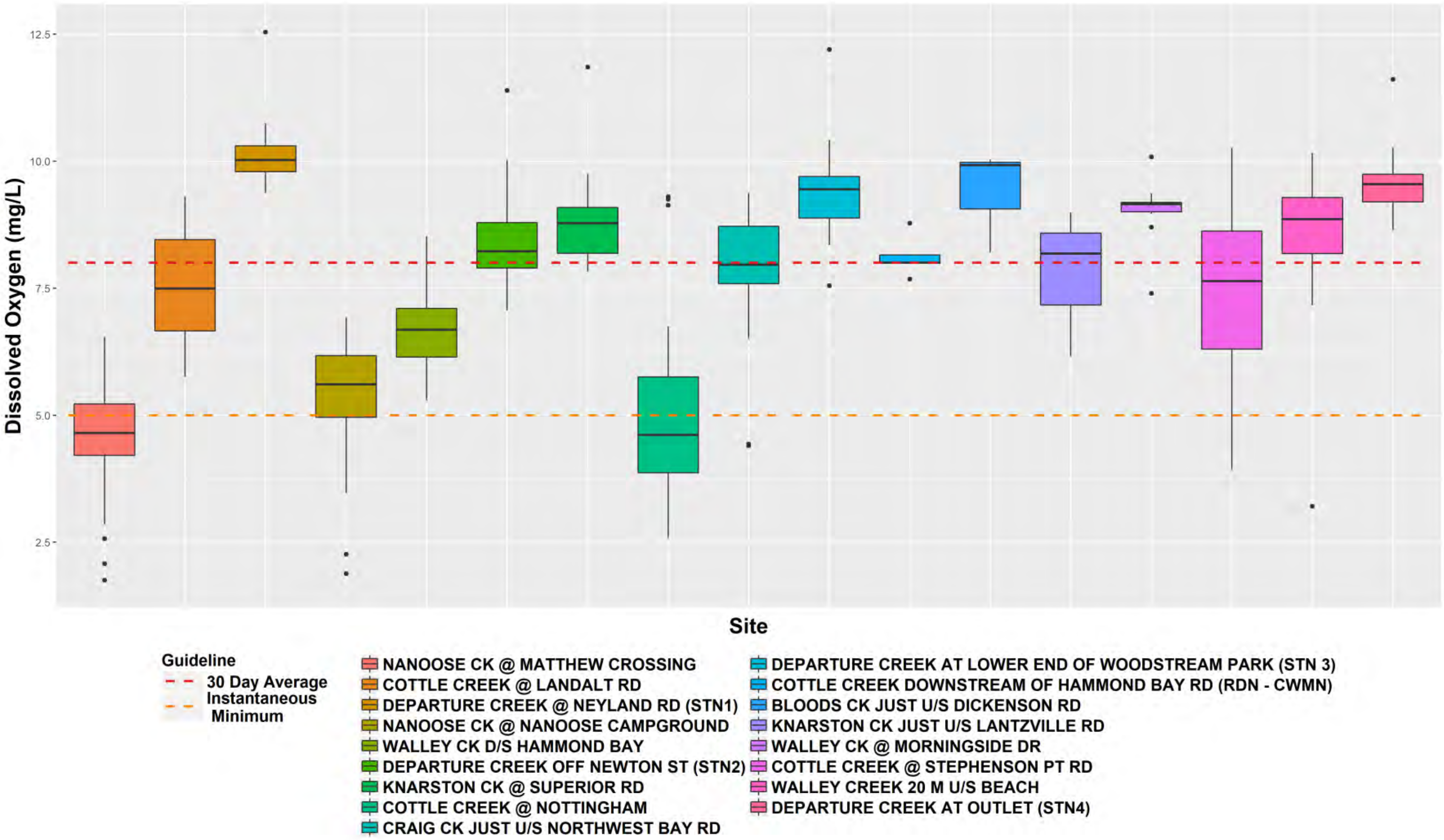
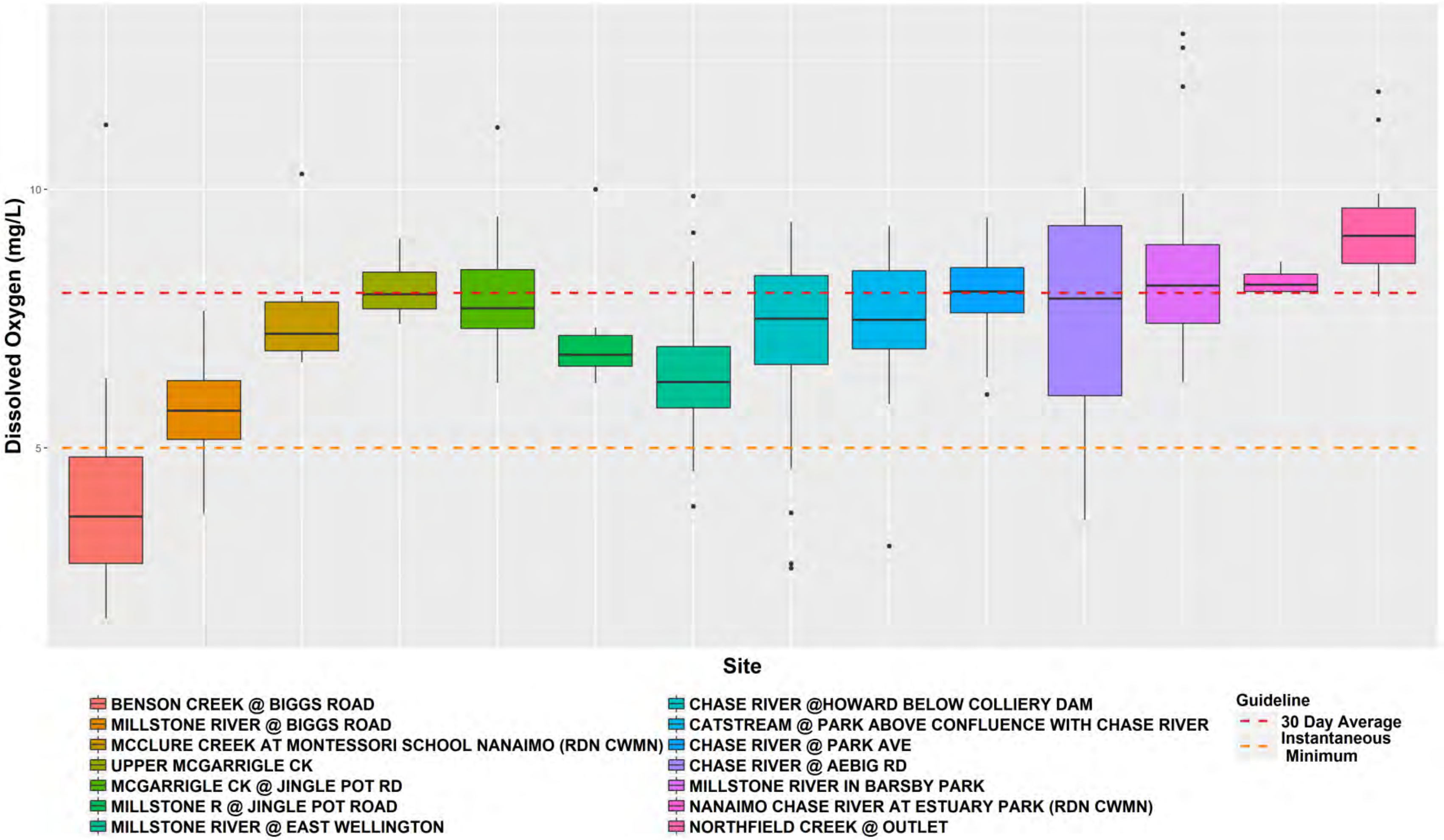


Figure A43. **Summer 2012-2017 DO of CWMN sites in Water Region 5-1 (South Wellington to Nanoose) with BC Water Quality guidelines for Aquatic Life.**



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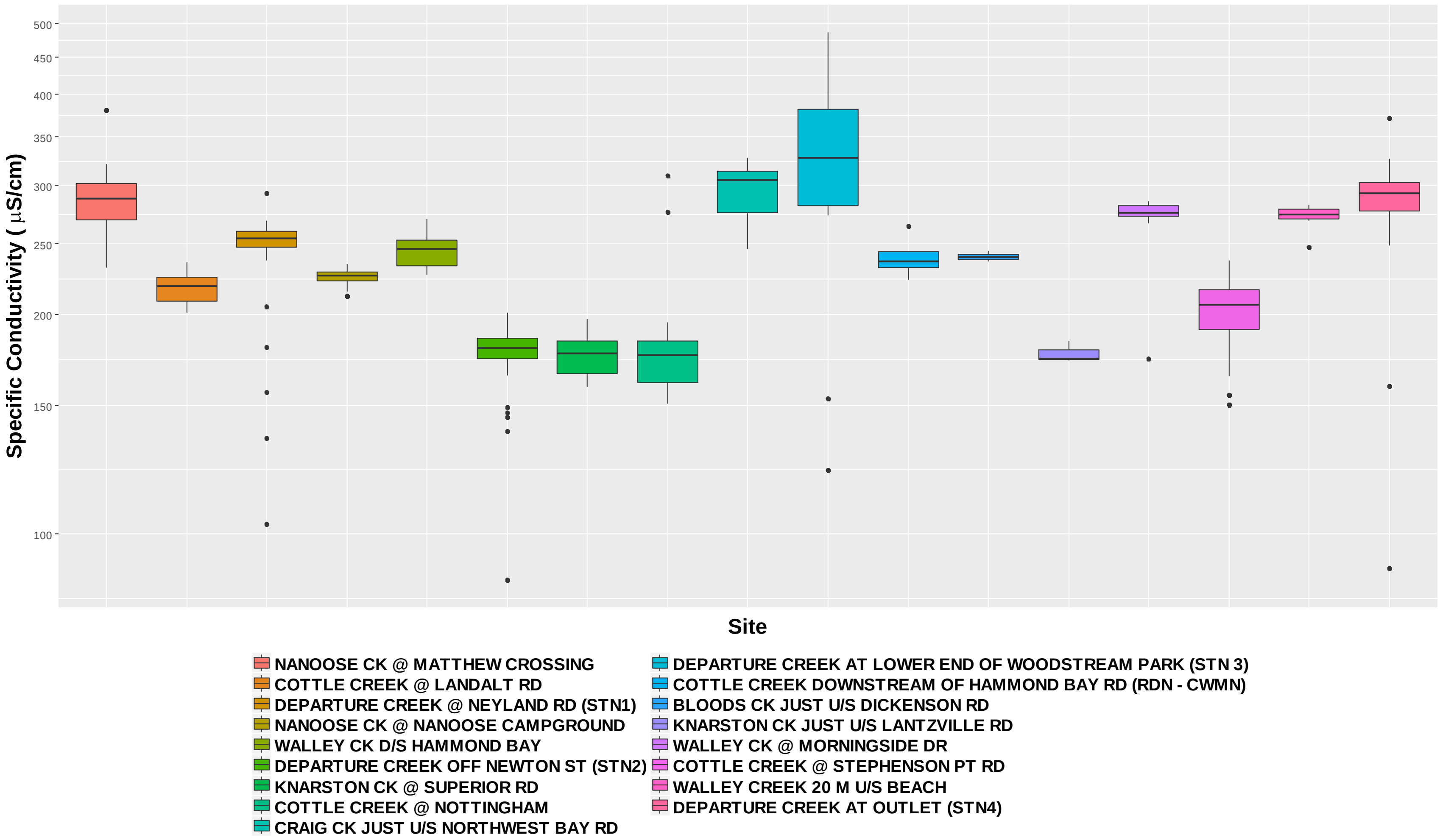

Figure A45. **Summer 2012-2017 specific conductivity of CWMN sites in Water Region 5-1 (South Wellington to Nanoose).**

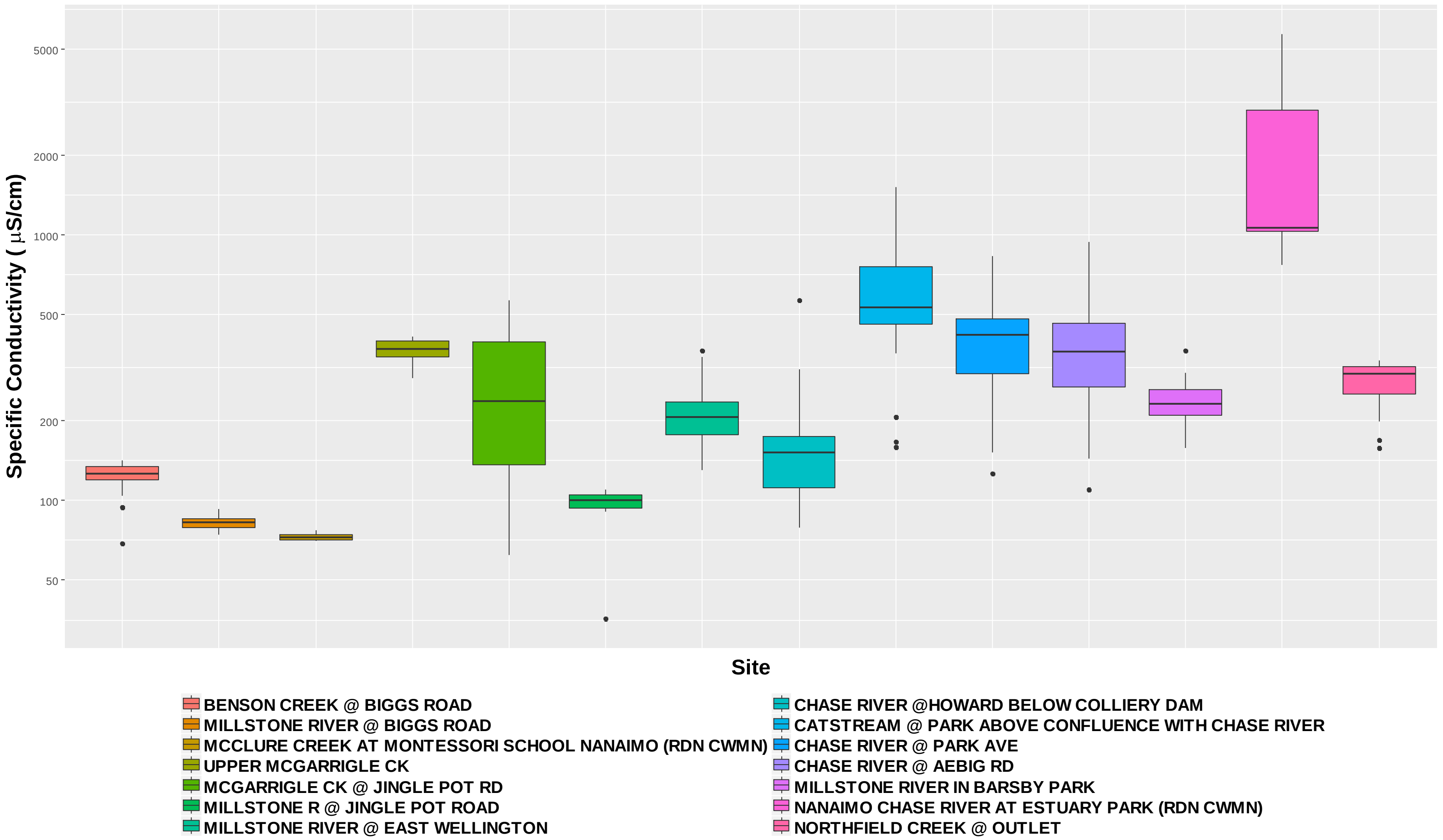

Figure A46. Summer 2012-2017 specific conductivity of CWMN sites in Water Region 5-2 (South Wellington to Nanoose).

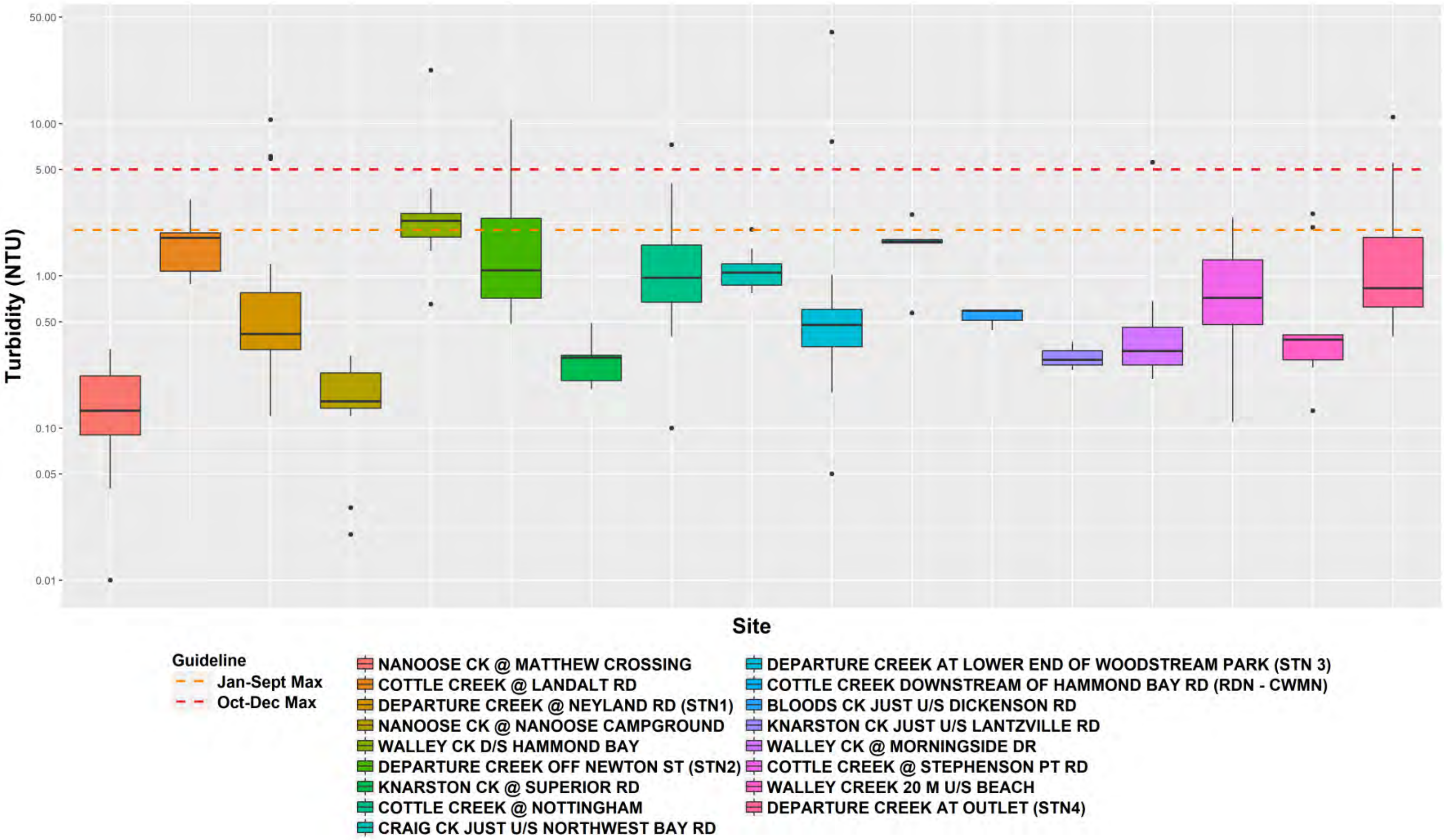

Figure A47. **Summer 2012-2017 turbidity of CWMN sites in Water Region 5-1 (South Wellington to Nanoose) with Englishman River water quality objectives.**

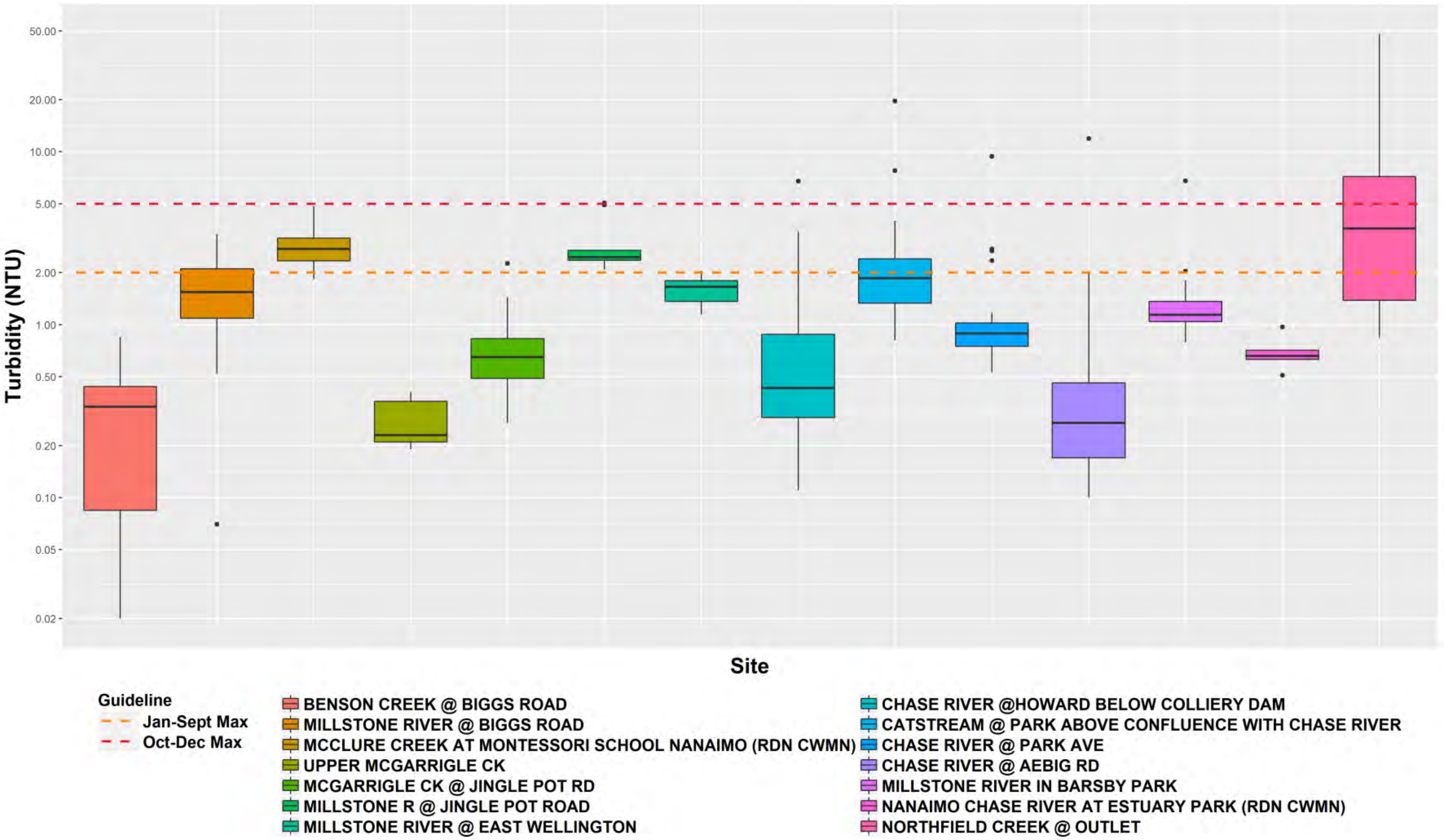

Figure A48. Summer 2012-2017 turbidity of CWMN sites in Water Region 5-2 (South Wellington to Nanoose) with Englishman River water quality objectives.

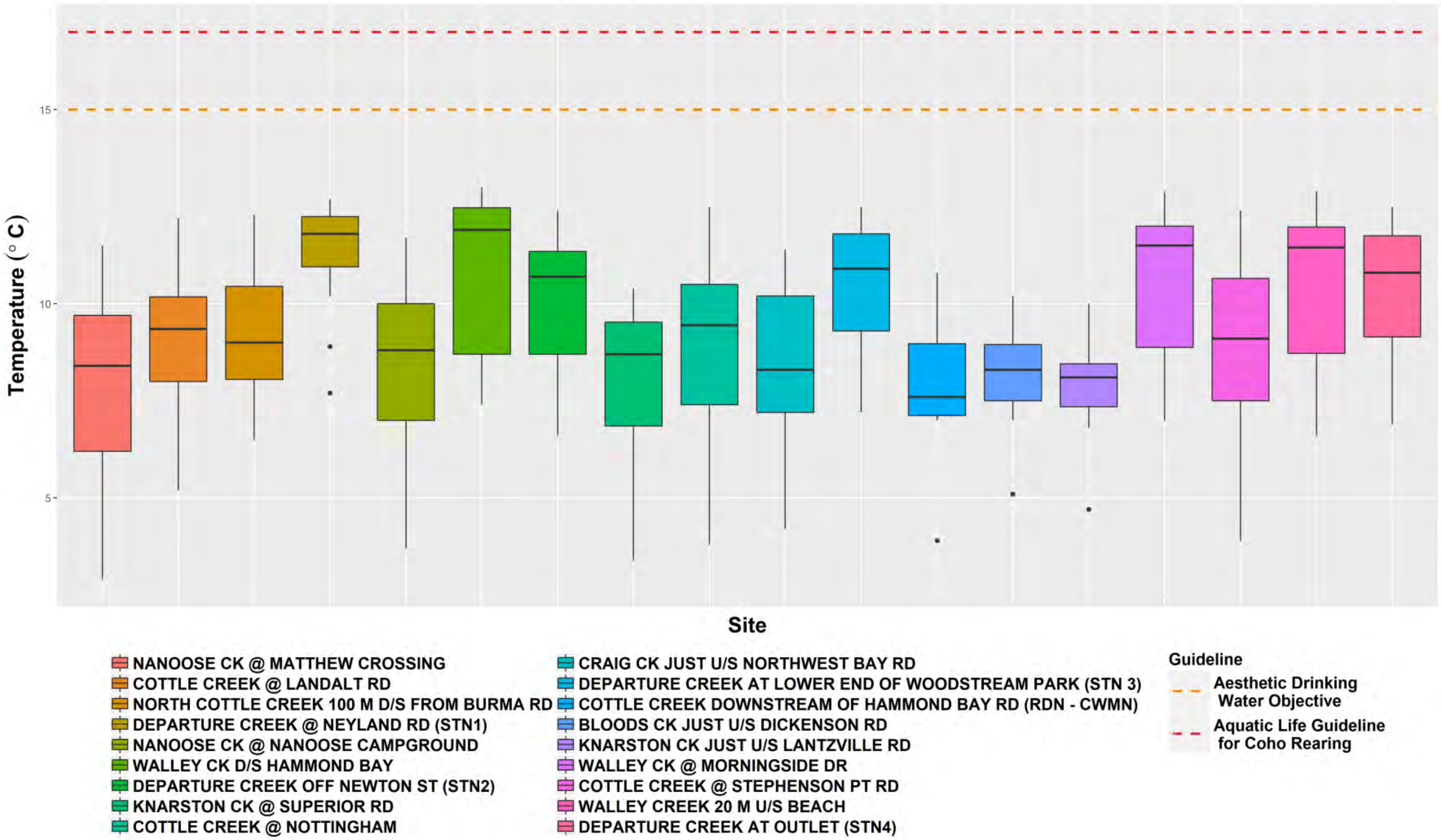

Figure A49. Fall 2012-2017 water temperature of CWMN sites in Water Region 5-1 (South Wellington to Nanoose) with Englishman River water quality objectives.

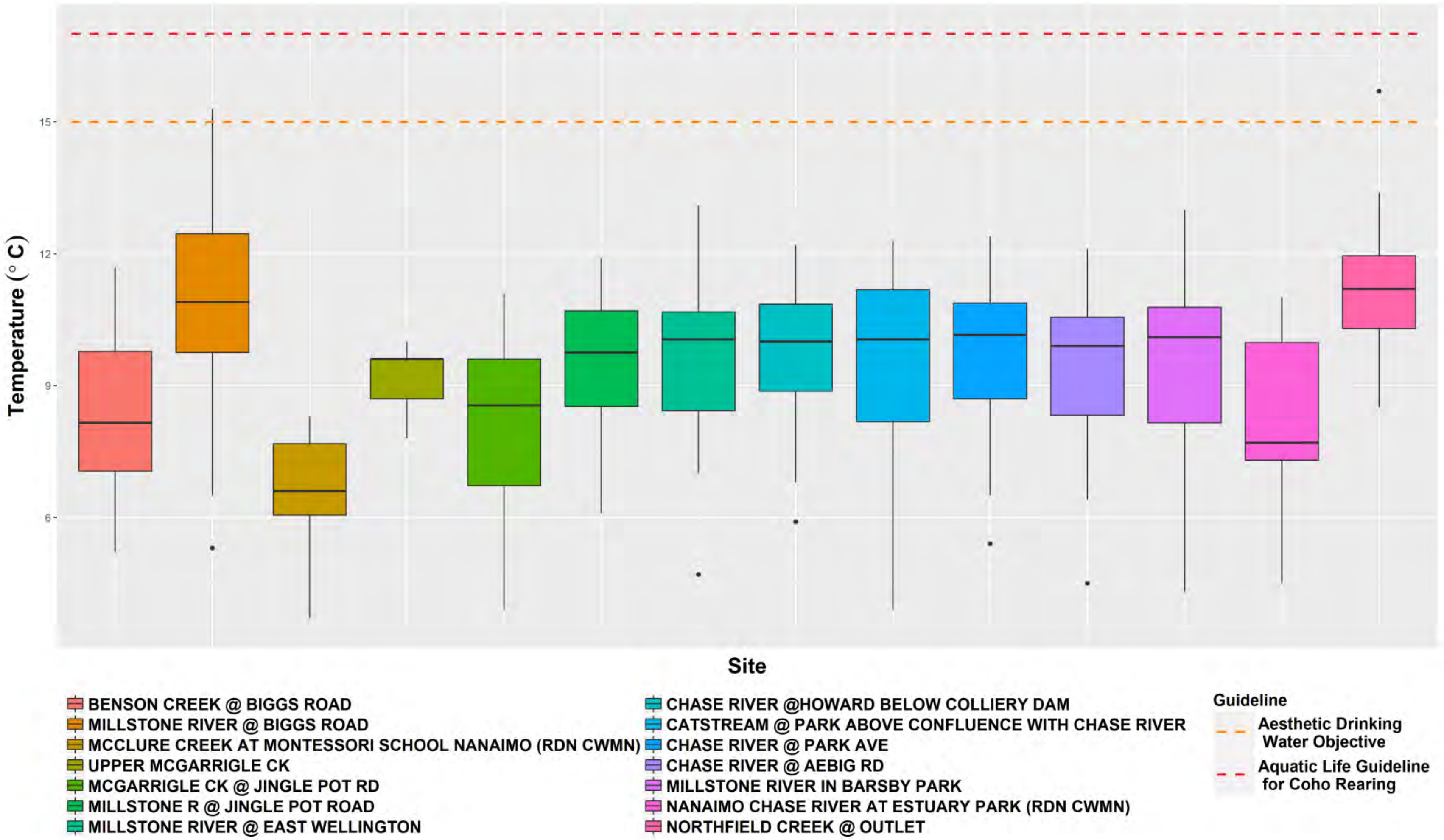

Figure A50. Fall 2012-2017 water temperature of CWMN sites in Water Region 5-2 (South Wellington to Nanoose) with Englishman River water quality objectives.

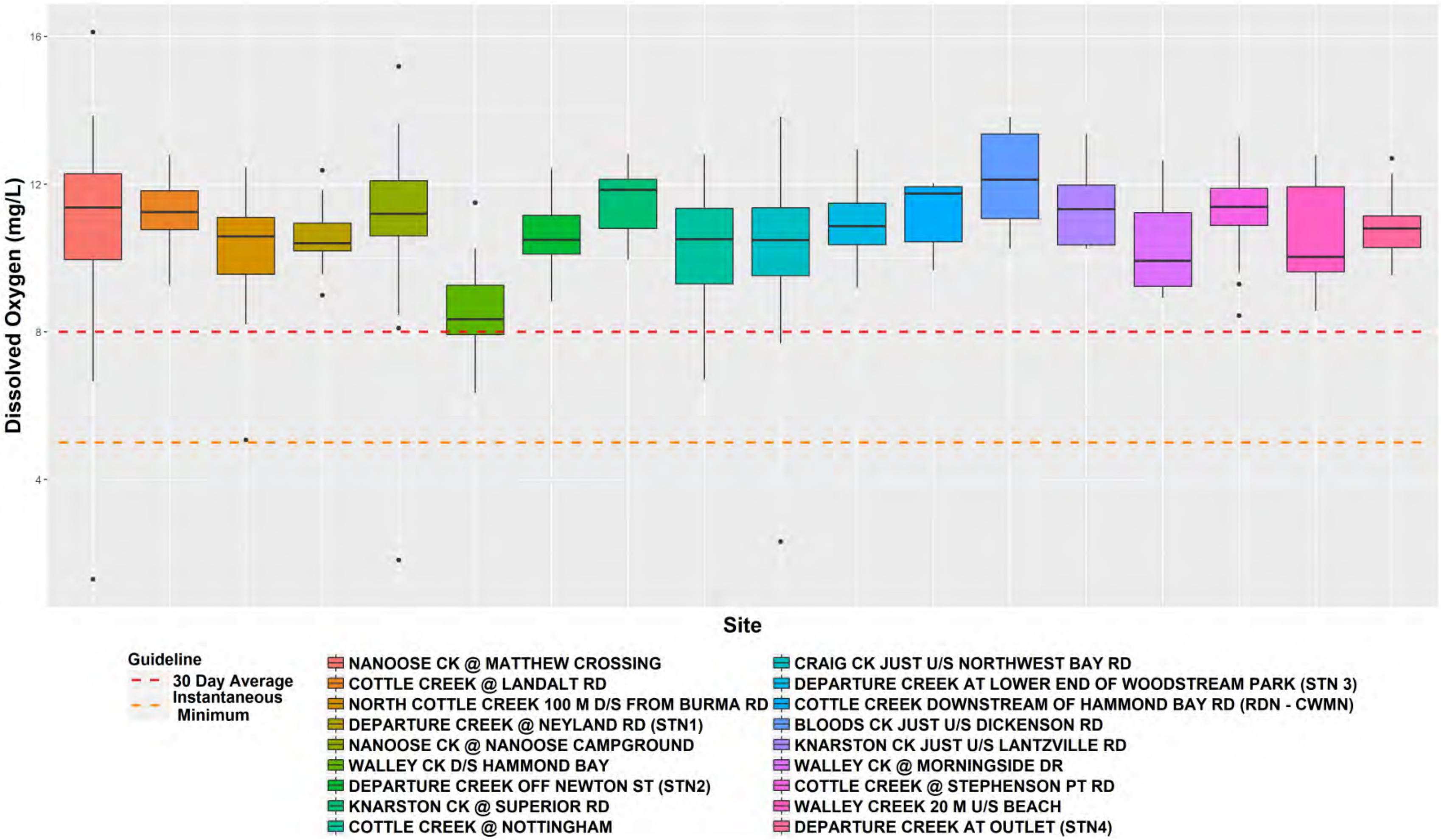

Figure A51. **Fall 2012-2017 DO of CWMN sites in Water Region 5-1 (South Wellington to Nanoose) with BC Water Quality guidelines for Aquatic Life.**

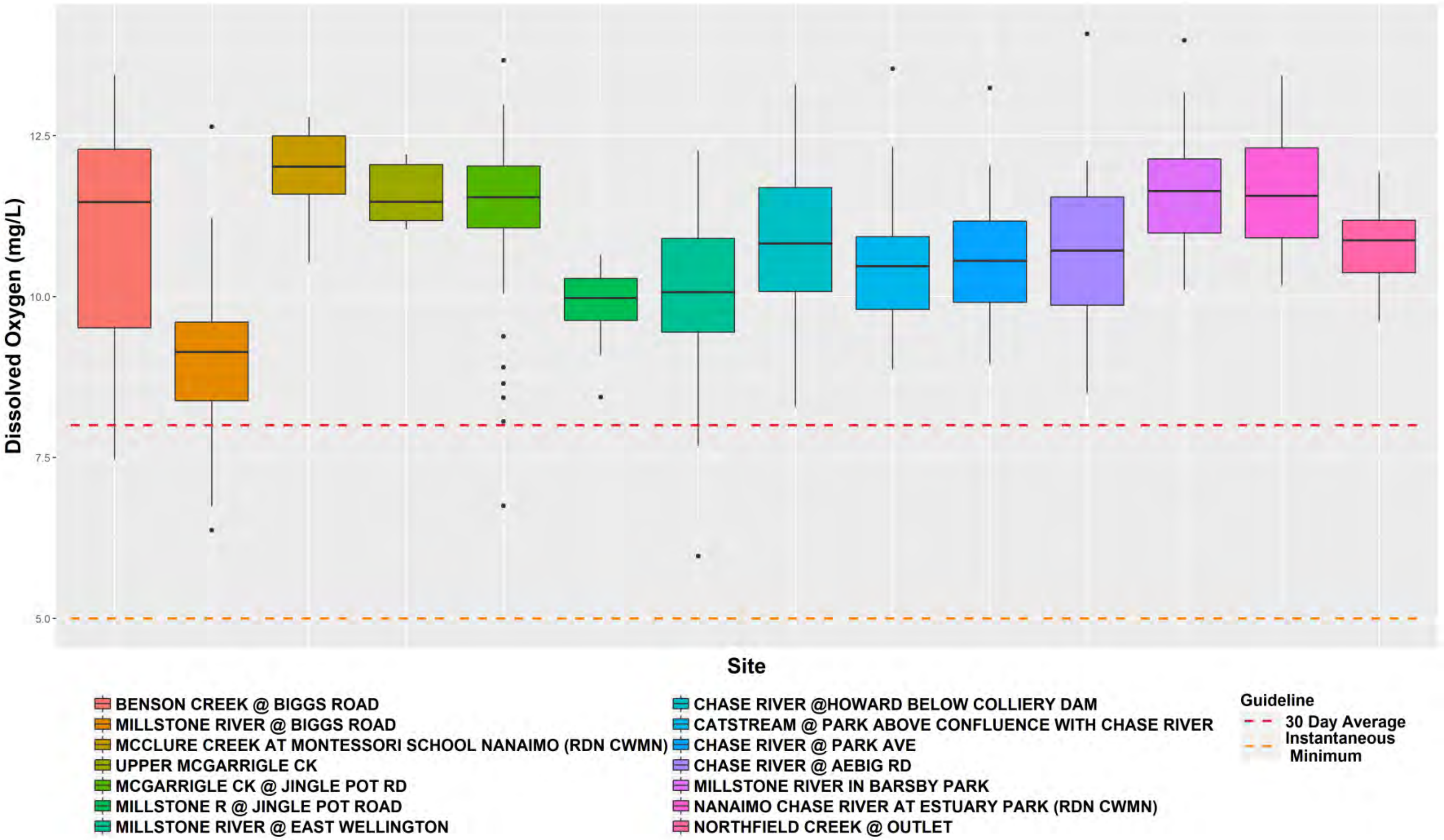

Figure A52. **Fall 2012-2017 DO of CWMN sites in Water Region 5-2 (South Wellington to Nanoose) with BC Water Quality guidelines for Aquatic Life.**

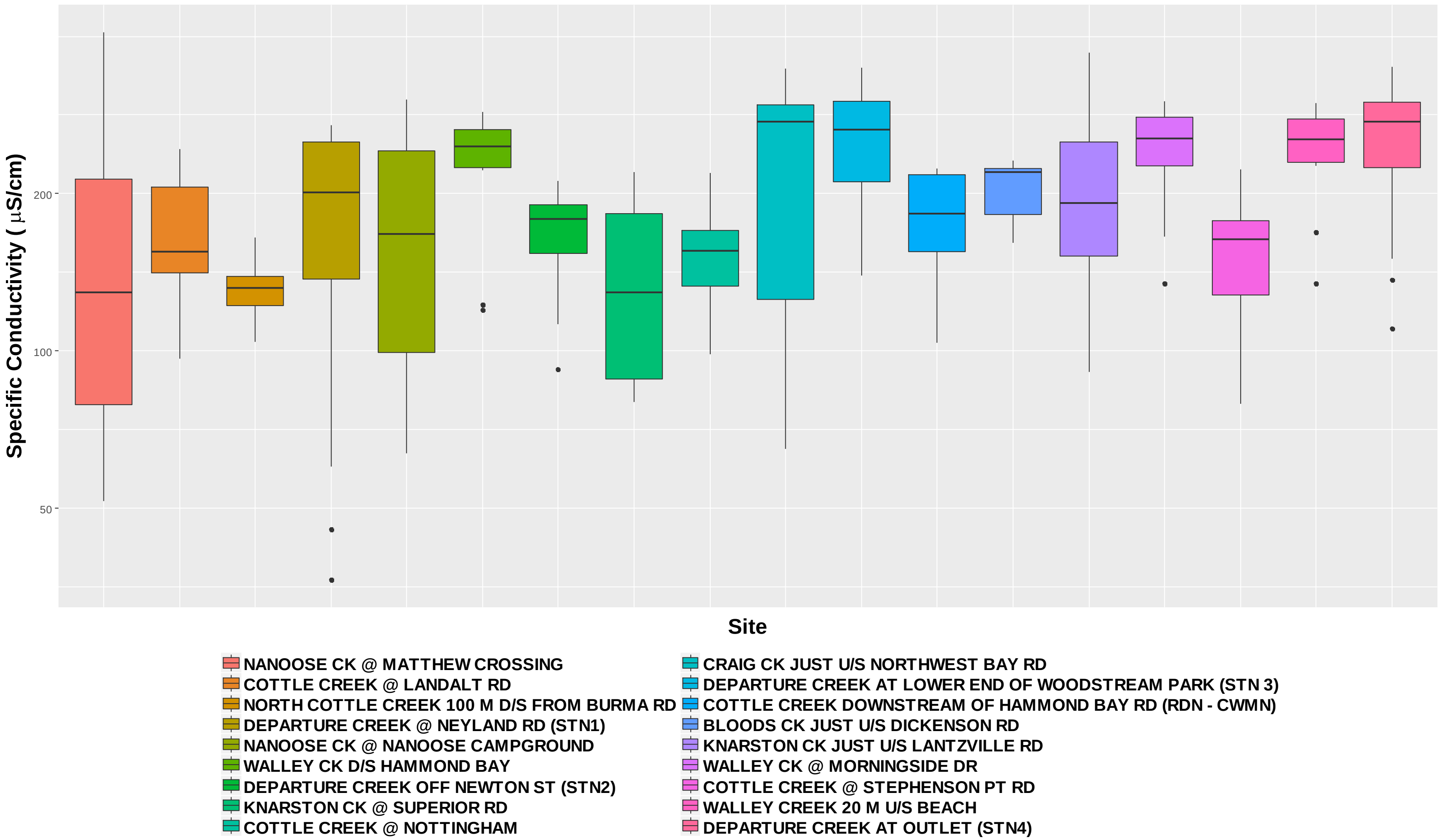

Figure A53. **Fall 2012-2017 specific conductivity of CWMN sites in Water Region 5-1 (South Wellington to Nanoose).**

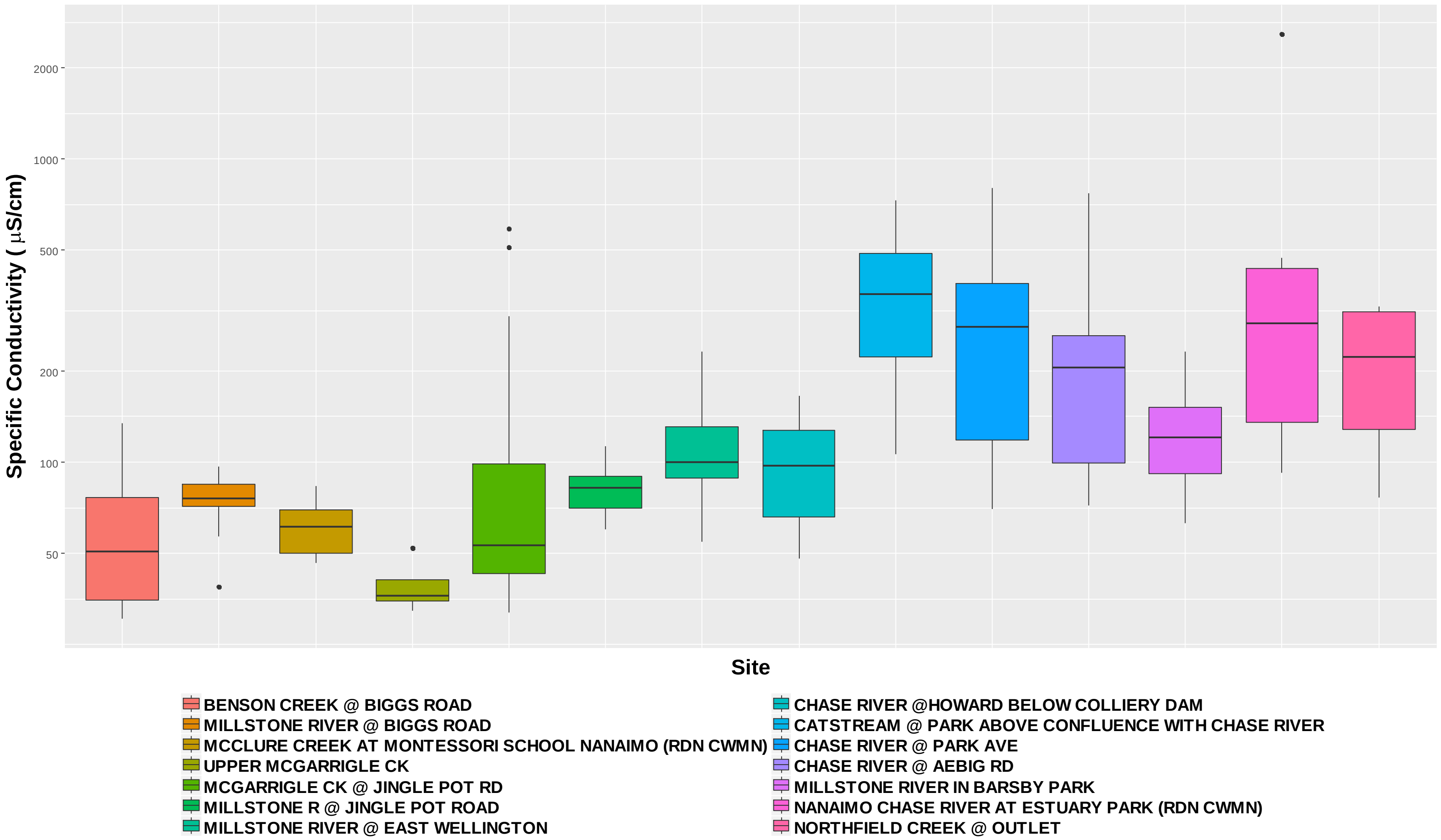

Figure A54. Fall 2012-2017 specific conductivity of CWMN sites in Water Region 5-2 (South Wellington to Nanoose).

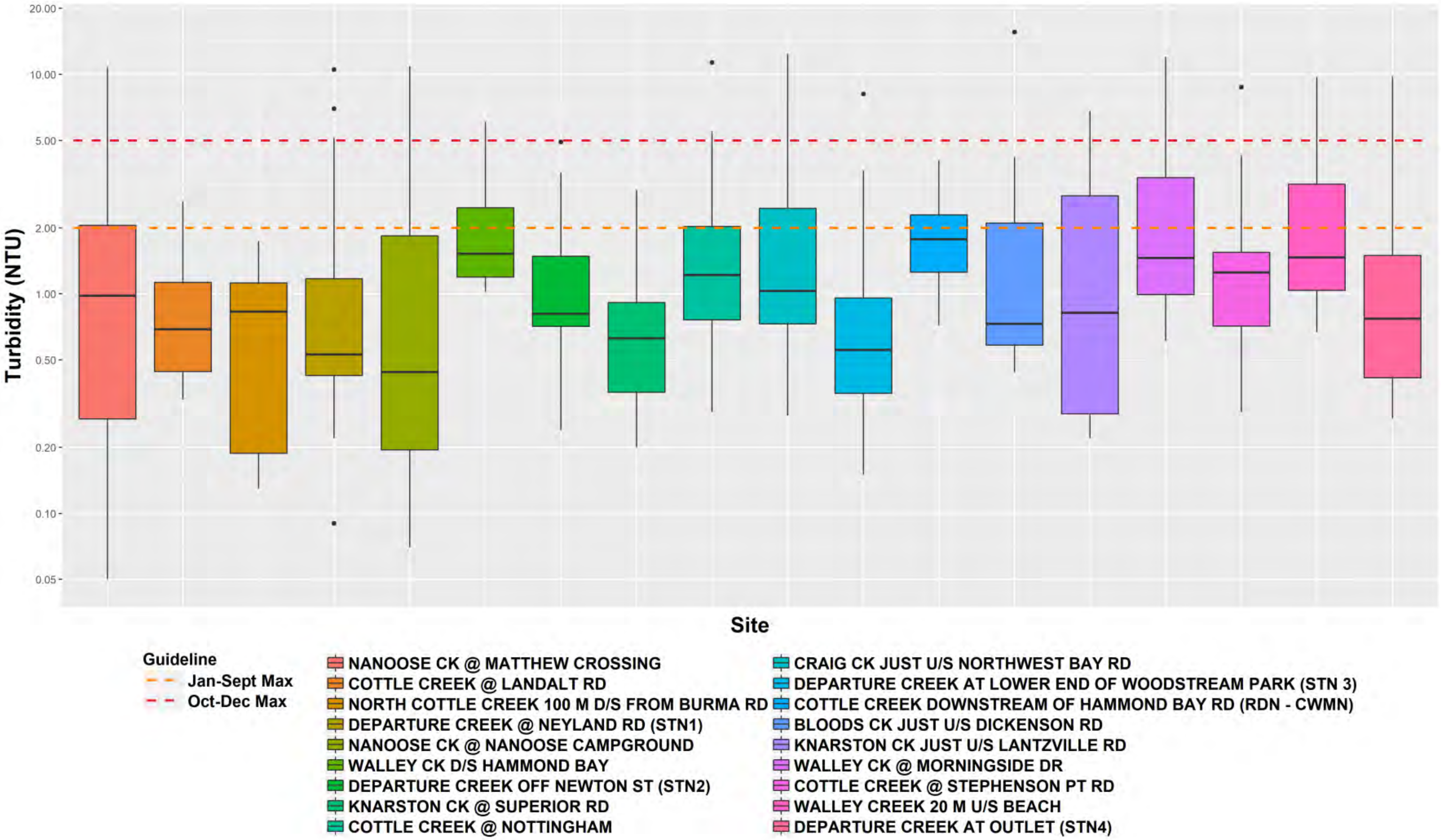

Figure A55. **Fall 2012-2017 turbidity of CWMN sites in Water Region 5-1 (South Wellington to Nanoose) with Englishman River water quality objectives.**

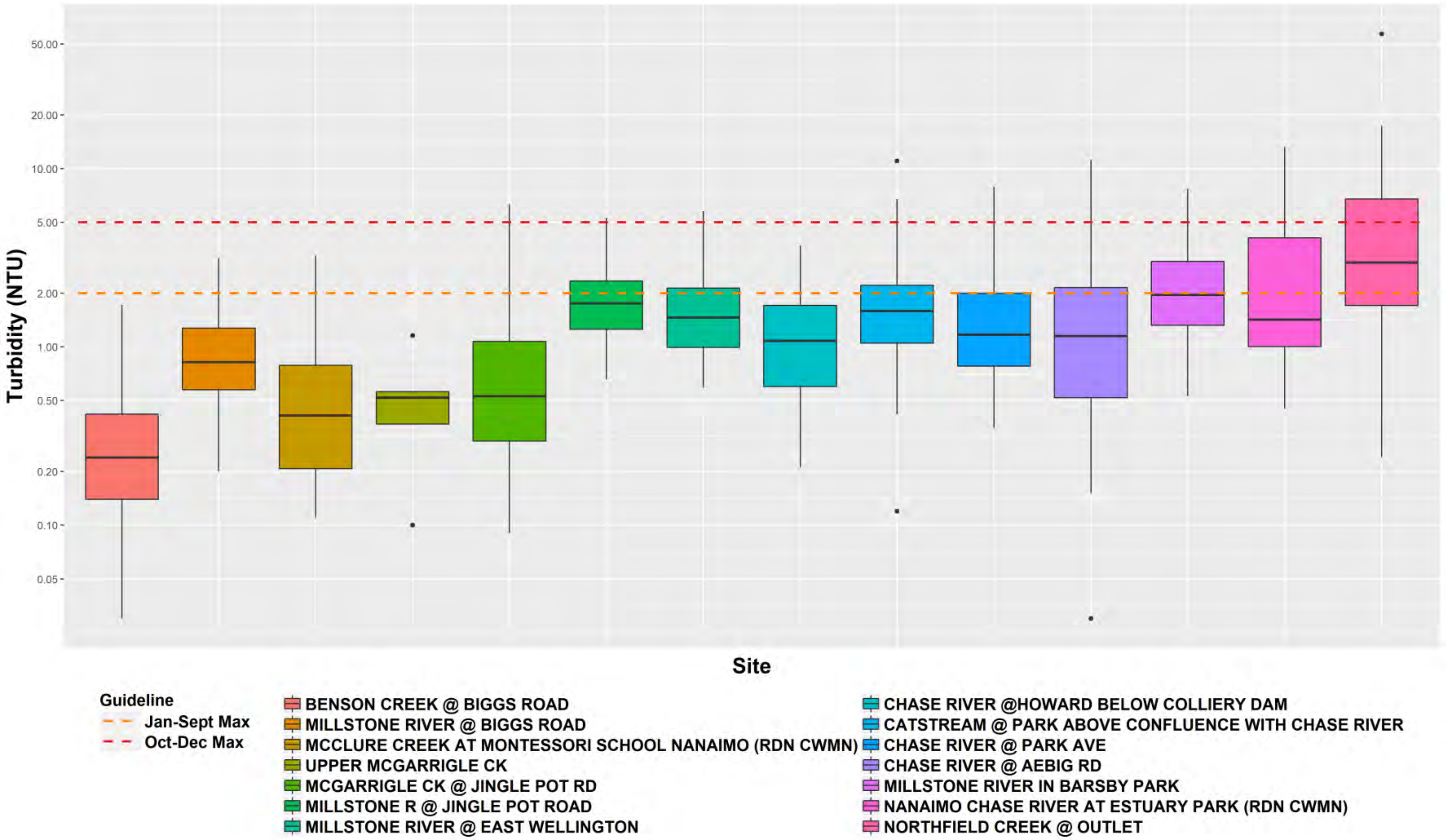

Figure A56. Fall 2012-2017 turbidity of CWMN sites in Water Region 5-2 (South Wellington to Nanoose) with Englishman River water quality objectives.

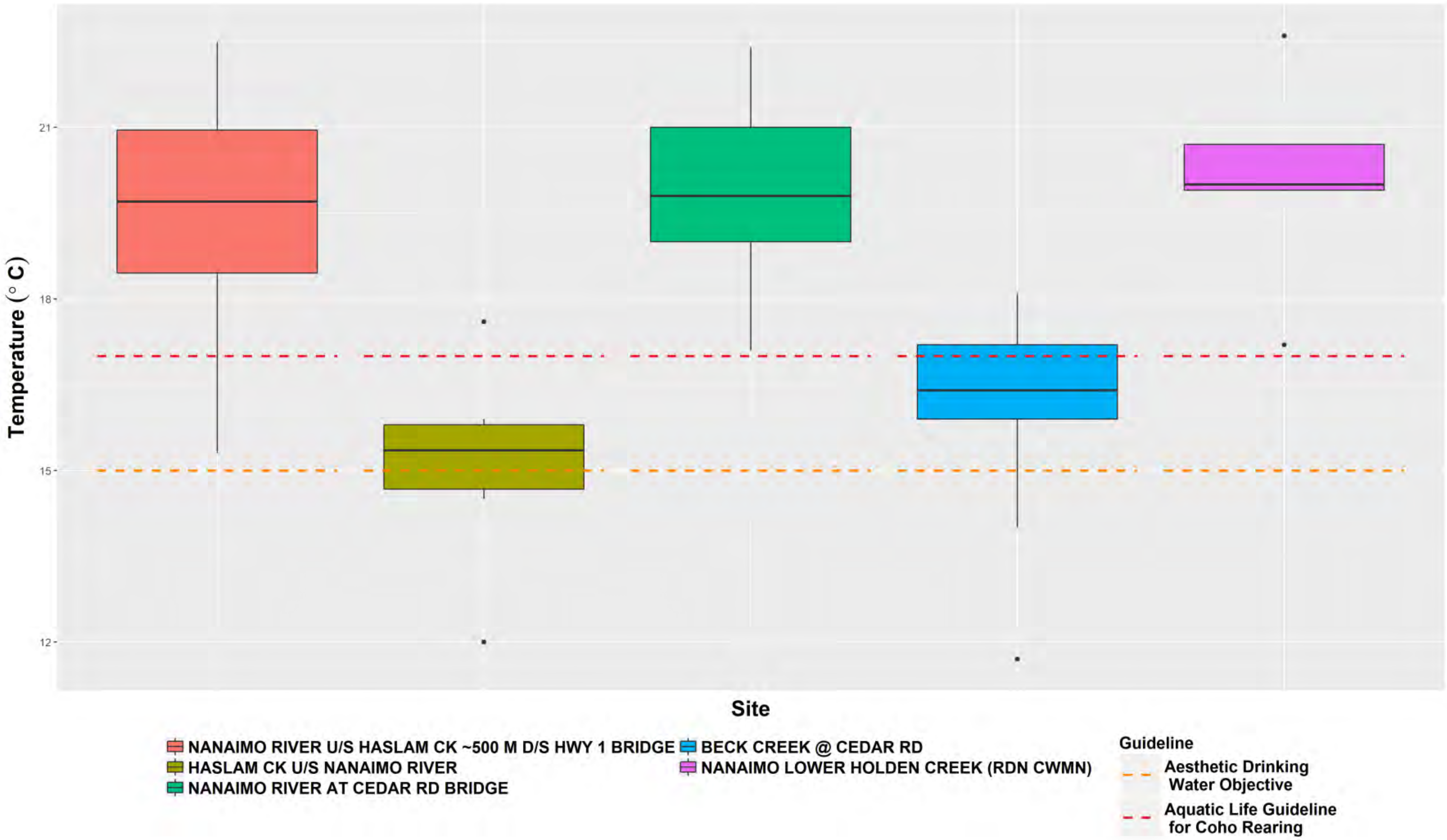

Figure A57. Summer 2011-2017 water temperature of CWMN sites in Water Region 6 (Nanaimo River) with Englishman River water quality objectives.

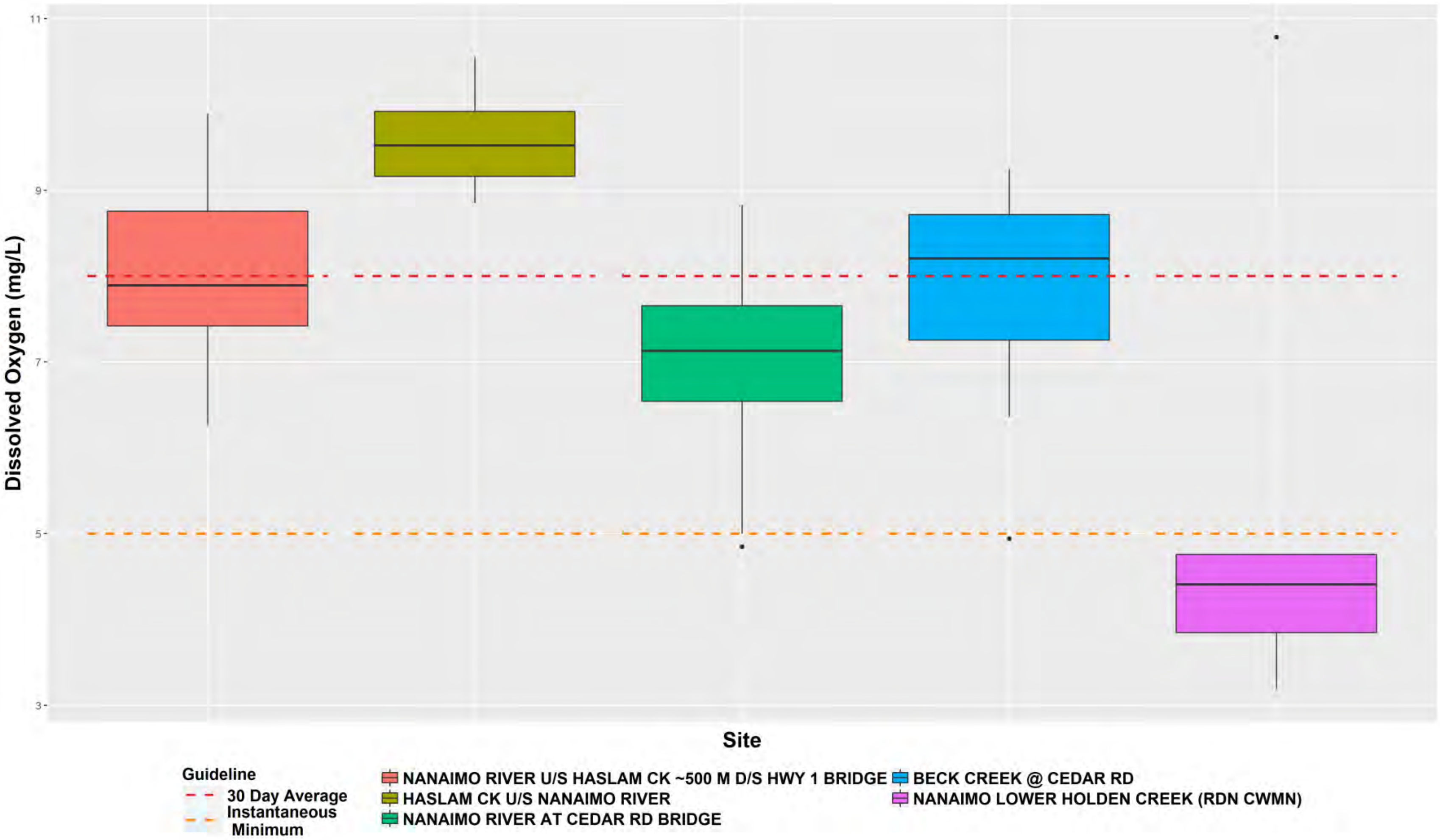

Figure A58. Summer 2011-2017 DO of CWMN sites in Water Region 6 (Nanaimo River) with BC Water Quality guidelines for Aquatic Life.

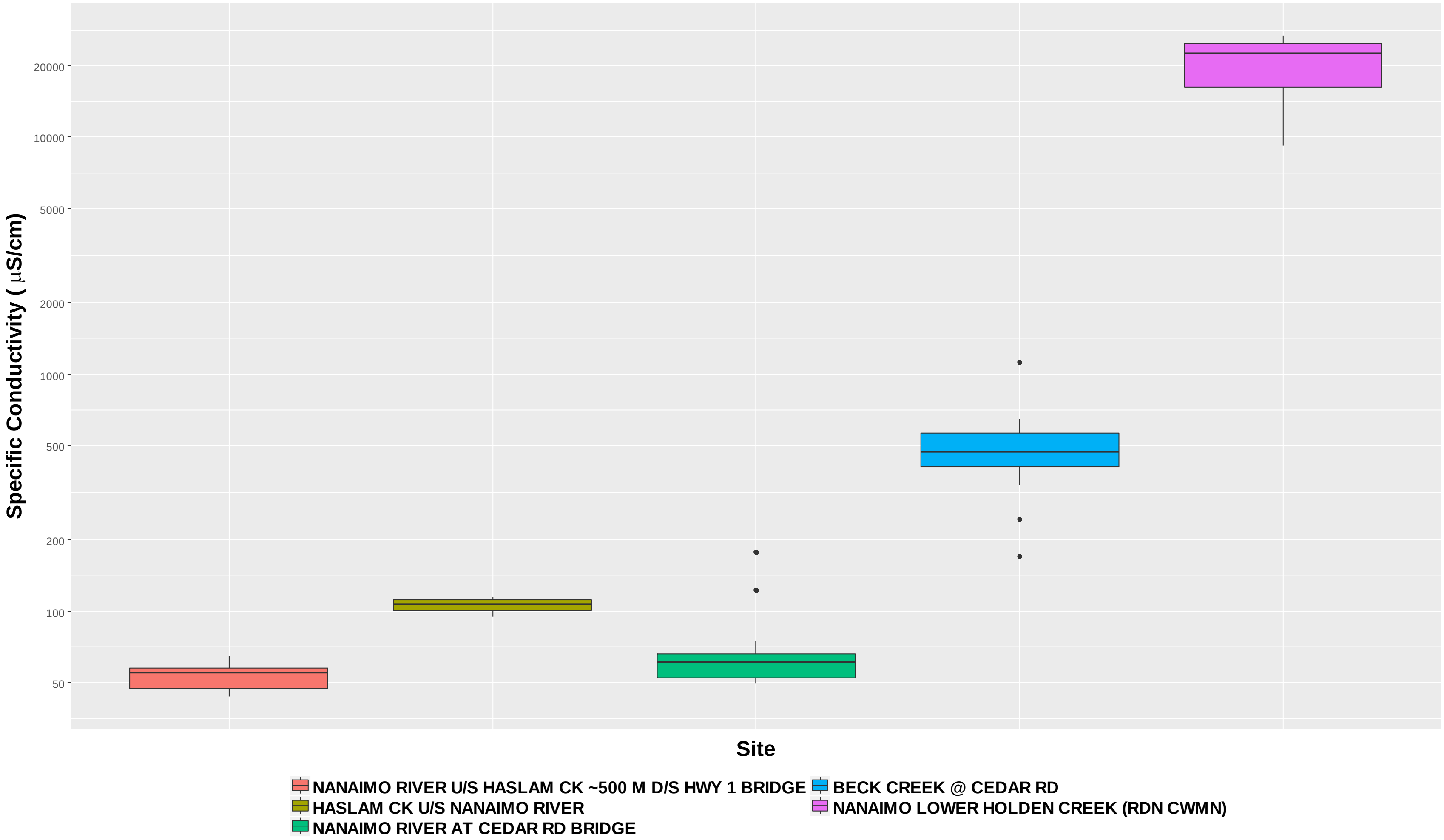

Figure A59. Summer 2011-2017 specific conductivity of CWMN sites in Water Region 6 (Nanaimo River).

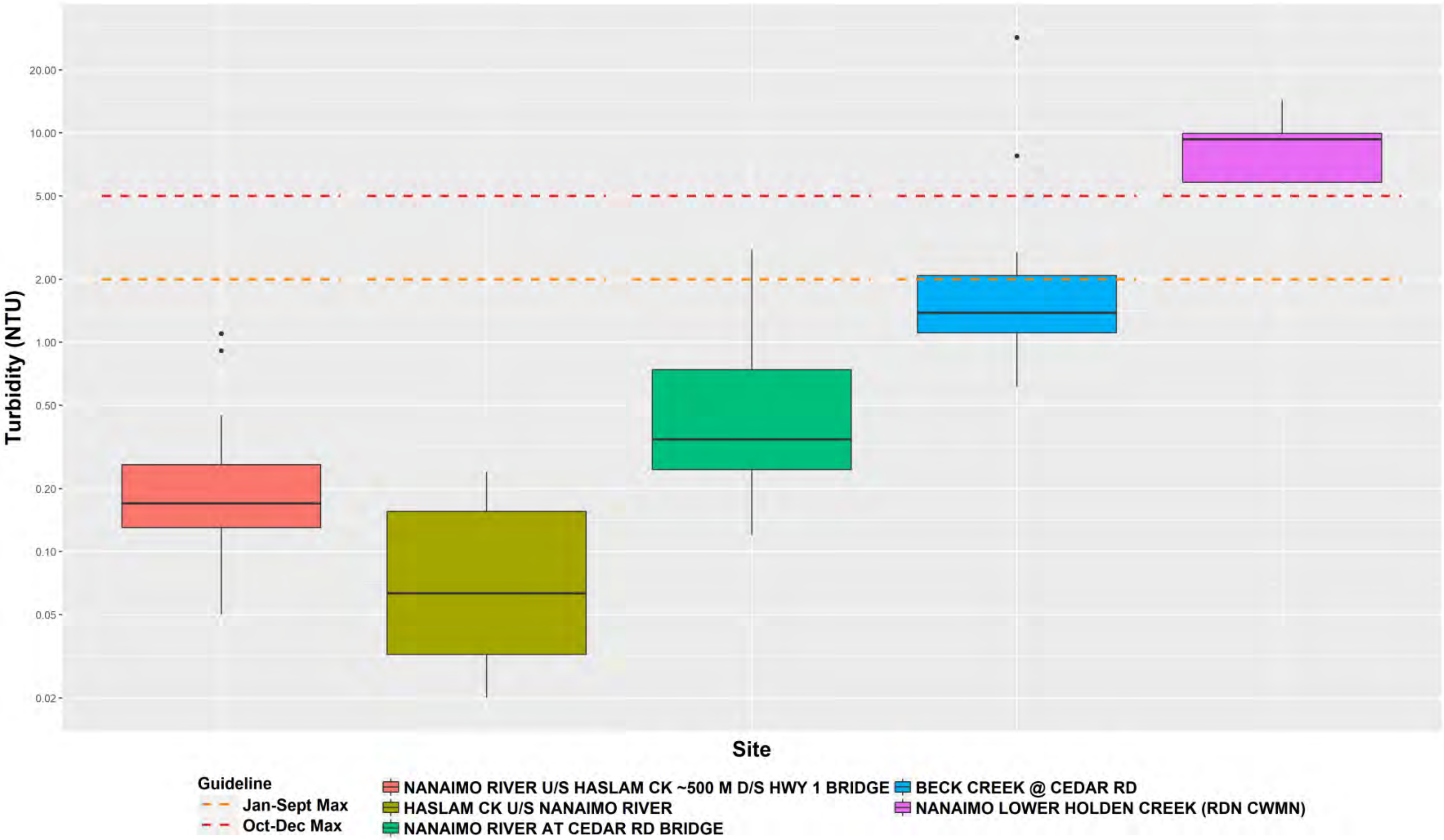

Figure A60. Summer 2011-2017 turbidity of CWMN sites in Water Region 6 (Nanaimo River) with Englishman River water quality objectives.

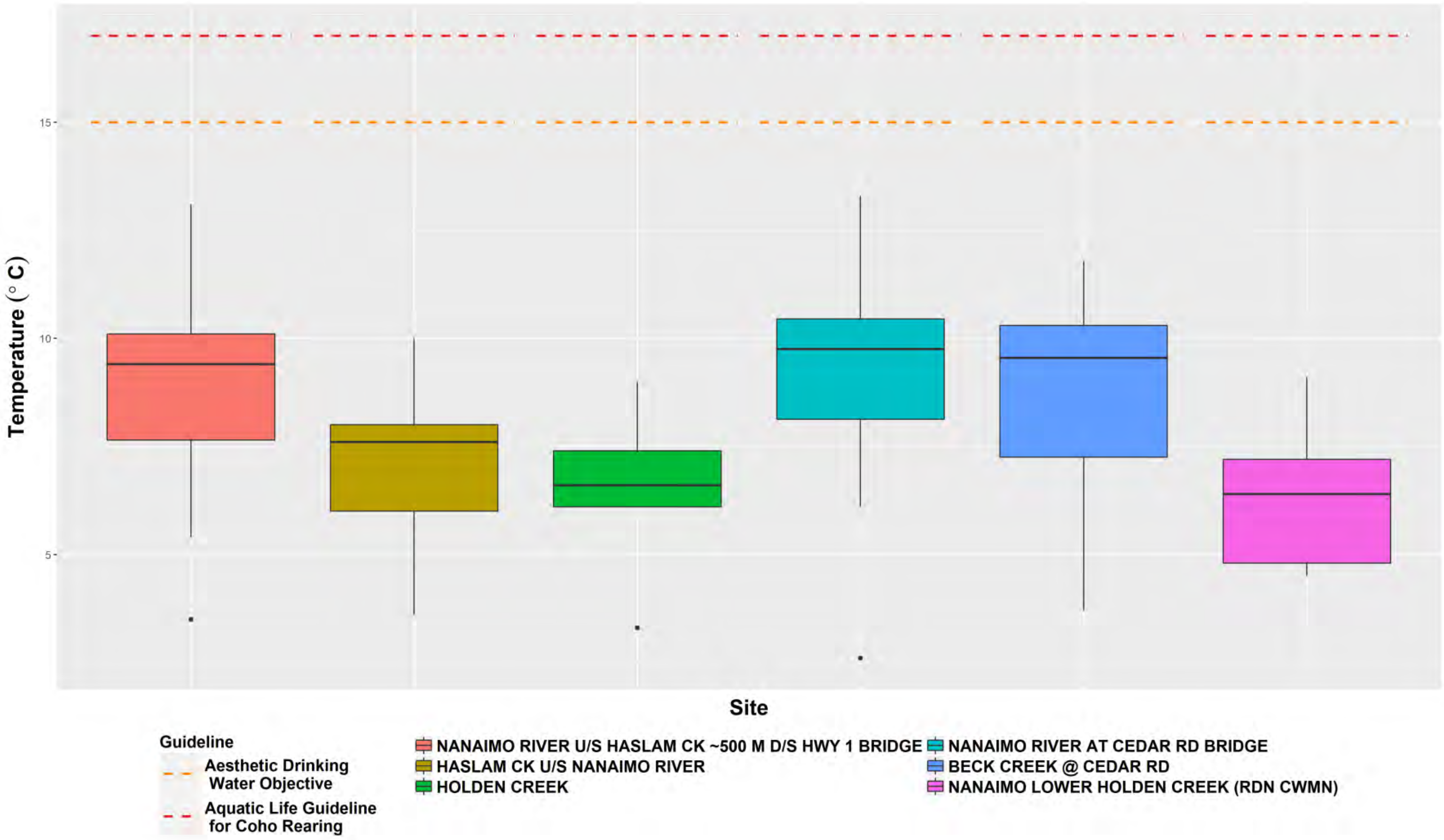

Figure A61. Fall 2011-2017 water temperature of CWMN sites in Water Region 6 (Nanaimo River) with Englishman River water quality objectives.

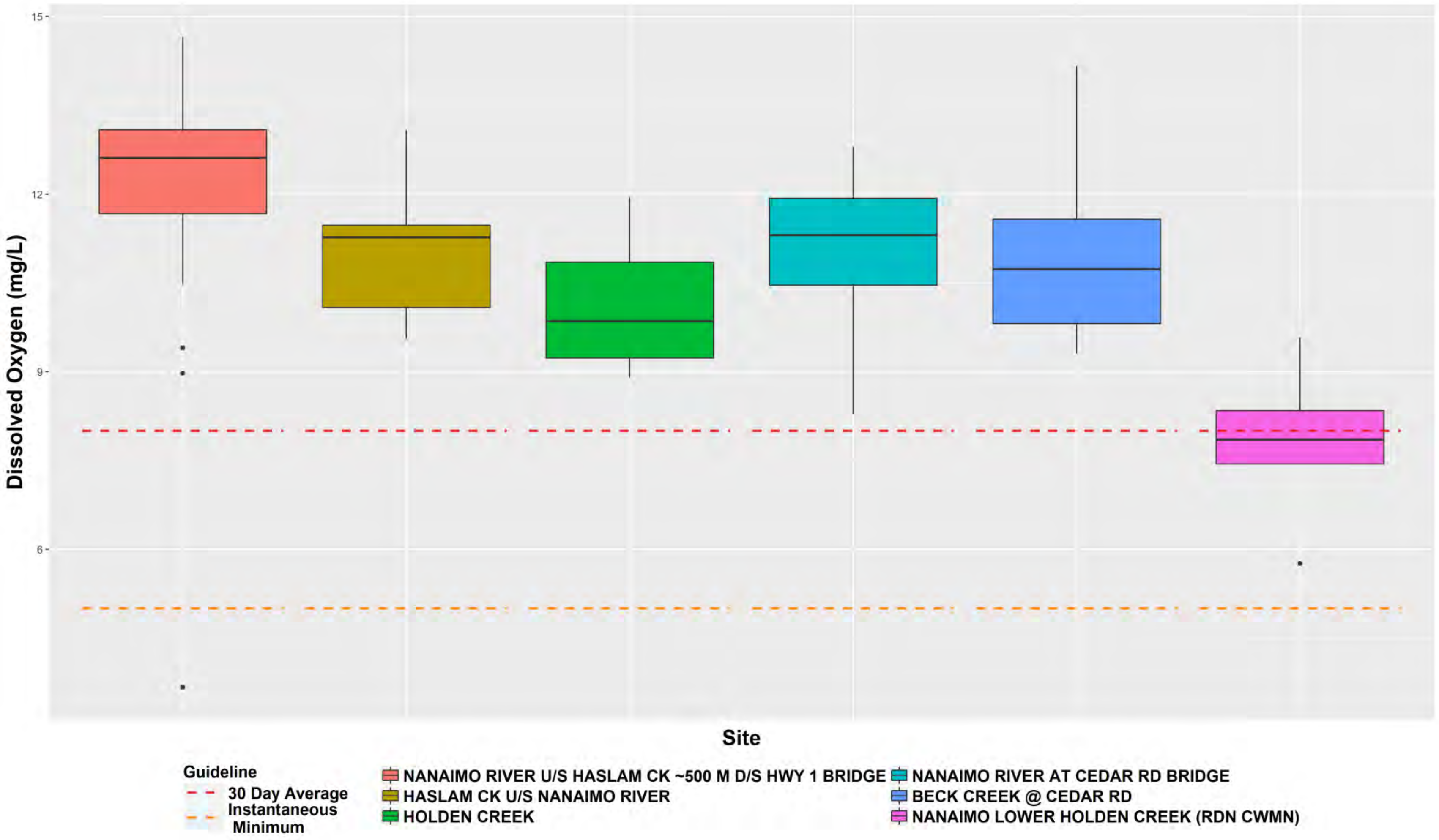

Figure A62. **Fall 2011-2017 DO of CWMN sites in Water Region 6 (Nanaimo River) with BC Water Quality guidelines for Aquatic Life.**

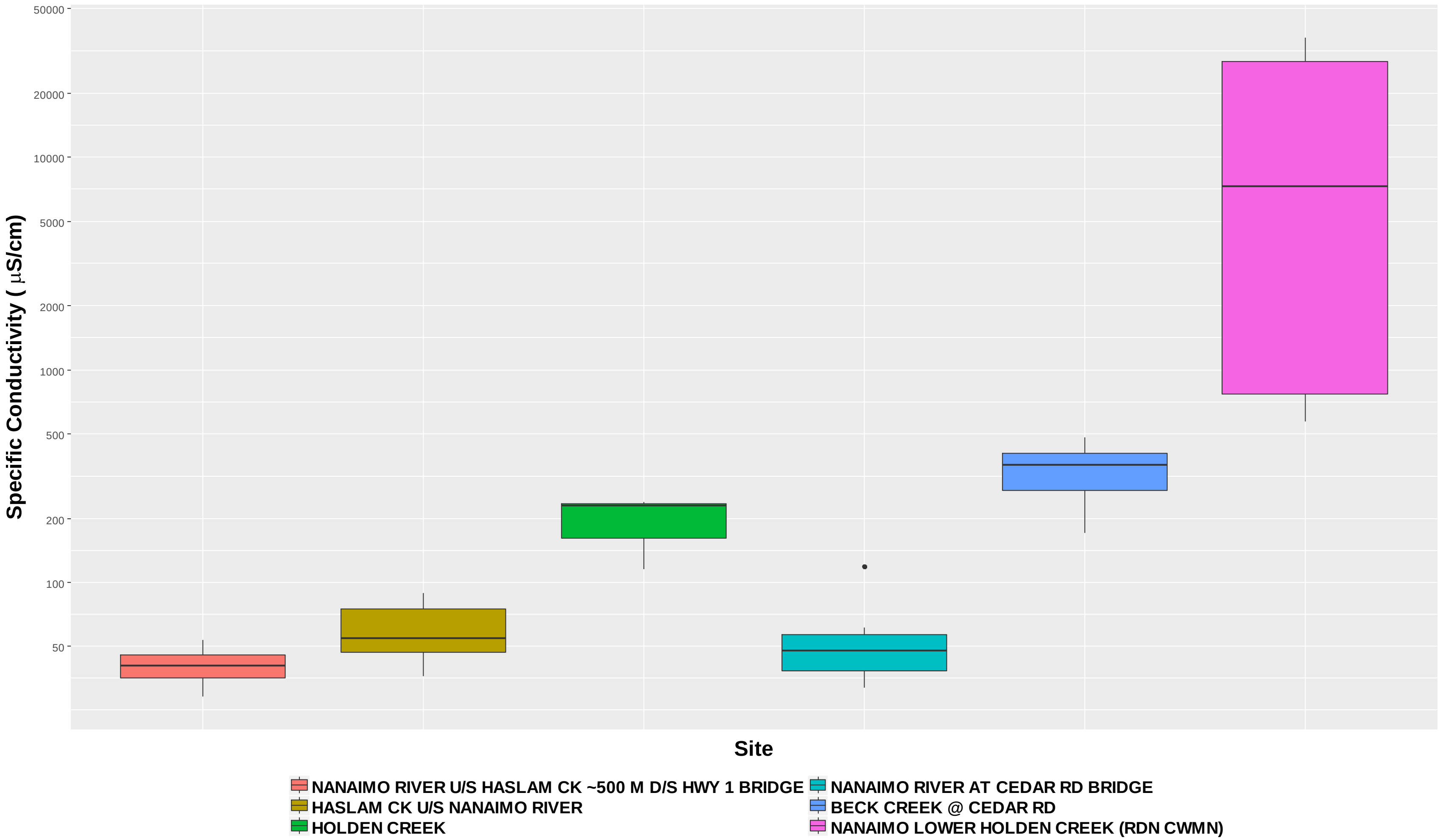

Figure A63. **Fall 2011-2017 specific conductivity of CWMN sites in Water Region 6 (Nanaimo River).**

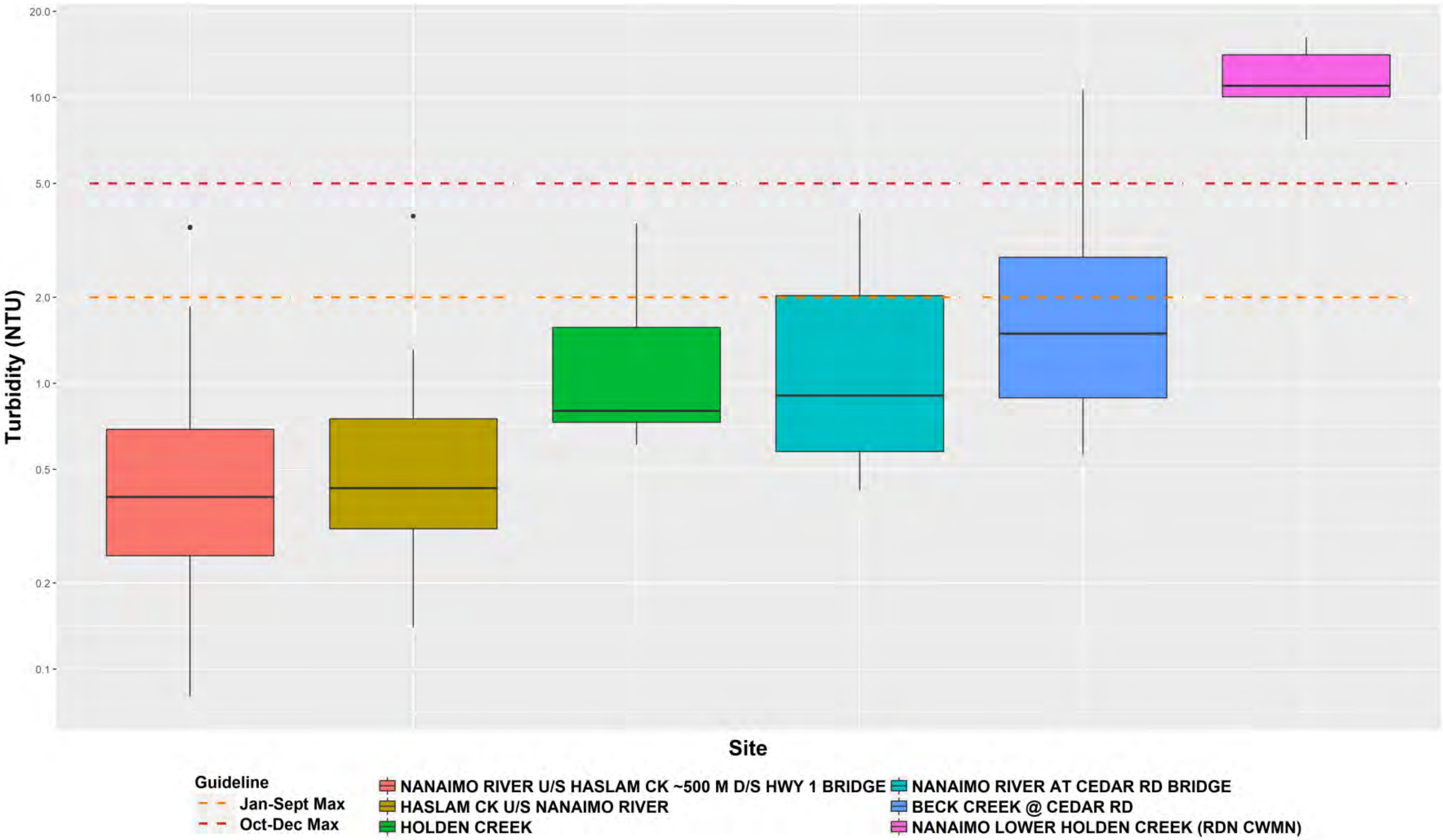

Figure A64. **Fall 2011-2017 turbidity of CWMN sites in Water Region 6 (Nanaimo River) with Englishman River water quality objectives.**

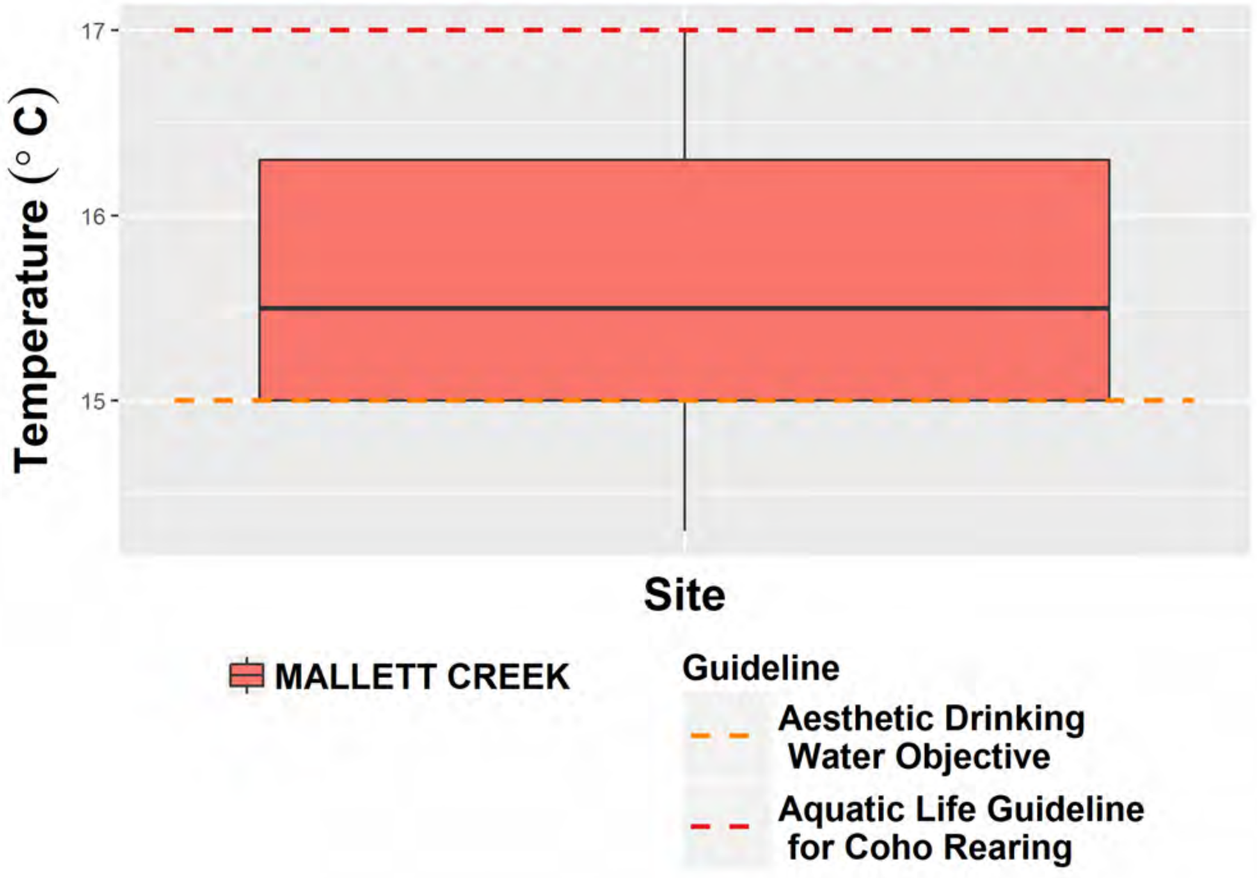

Figure A65. **Summer 2015-2017 water temperature of CWMN sites in Water Region 7 (Gabriola Island) with Englishman River water quality objectives.**

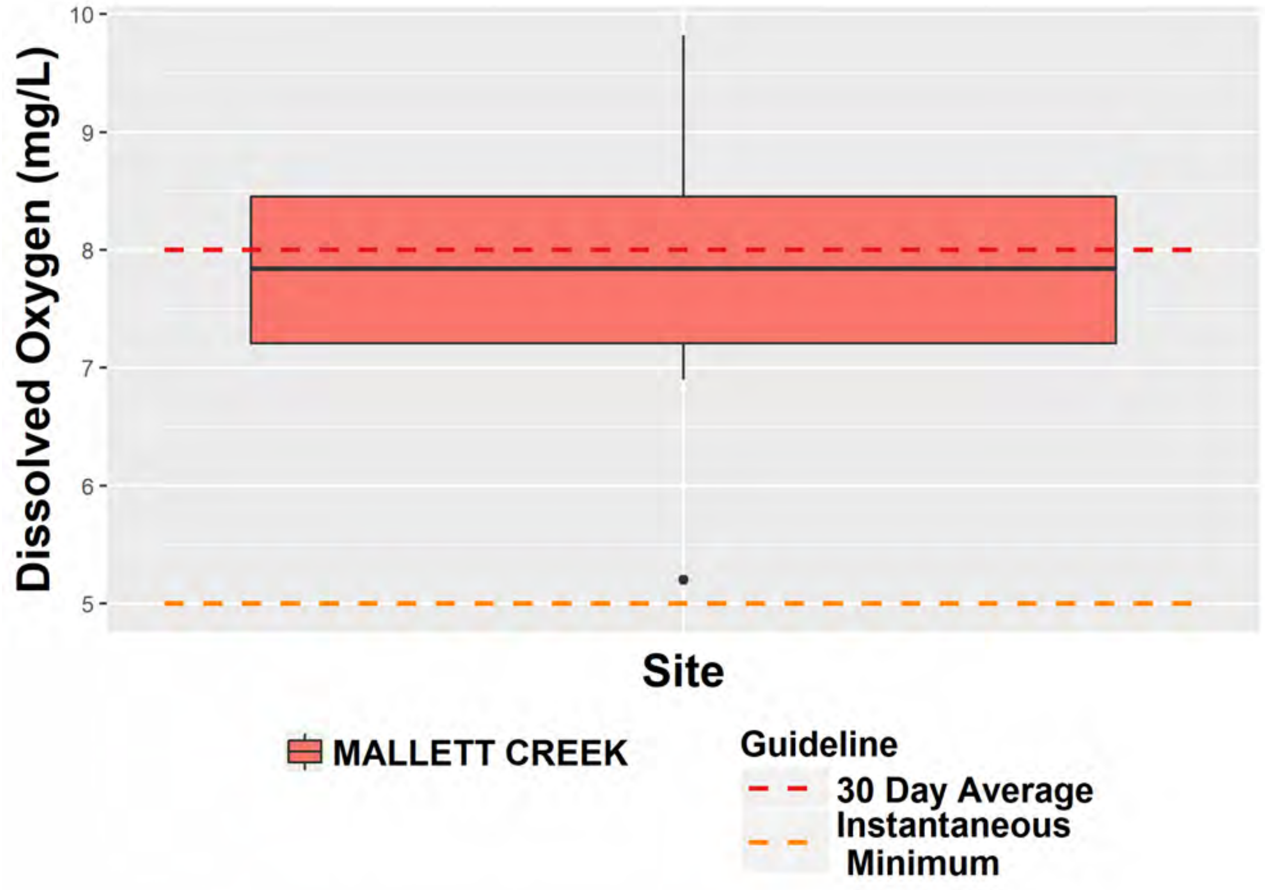

Figure A66. Summer 2015-2017 DO of CWMN sites in Water Region 7 (Gabriola Island) with BC Water Quality guidelines for Aquatic Life.

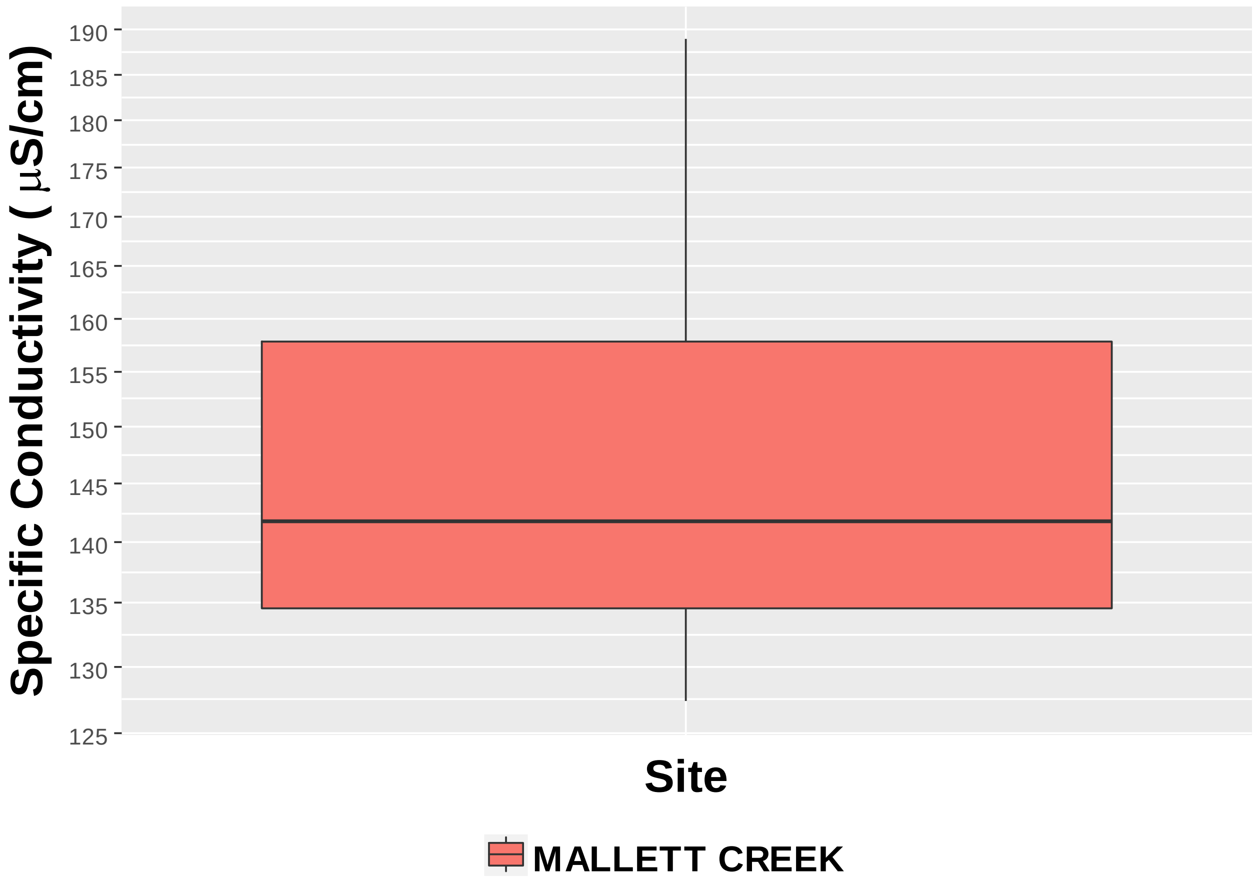

Figure A67. Summer 2015-2017 specific conductivity of CWMN sites in Water Region 7 (Gabriola Island).

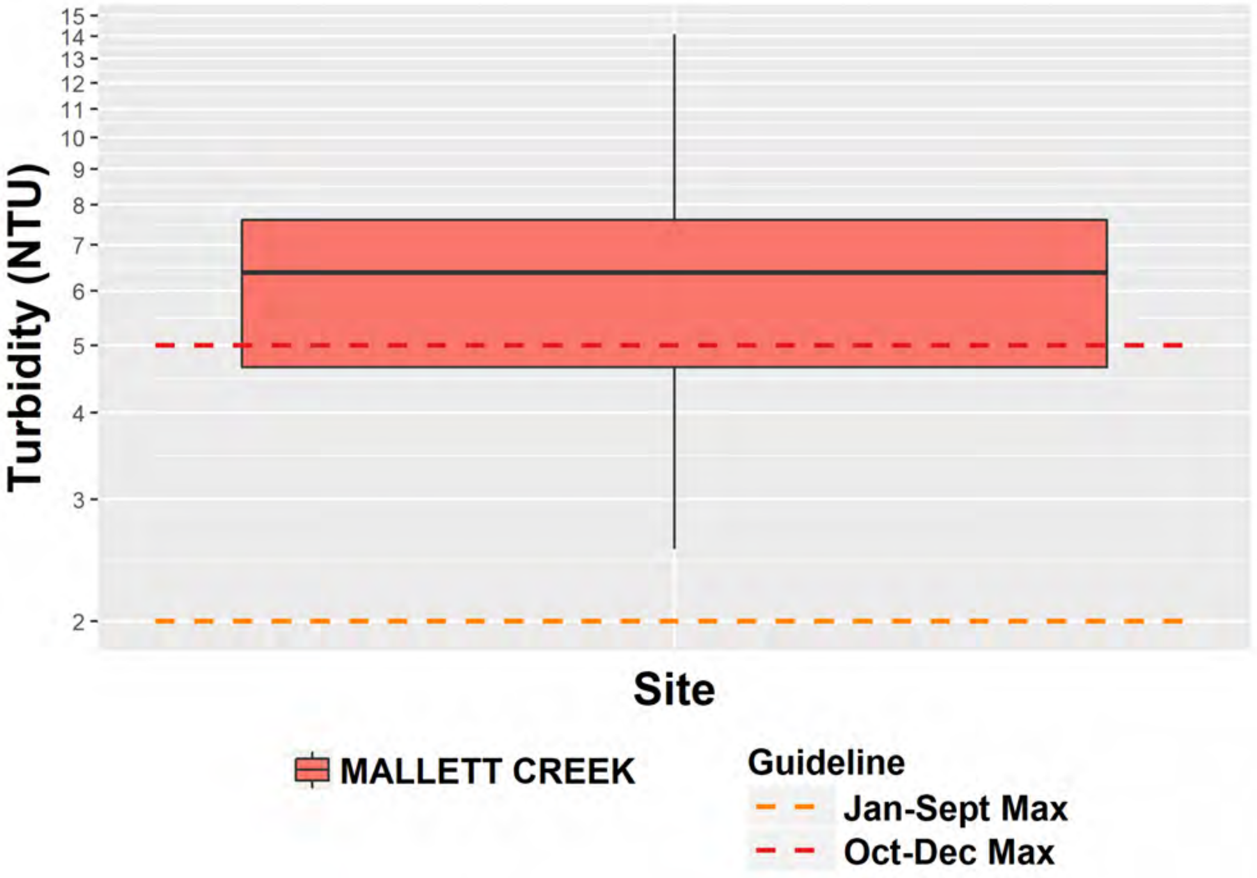

Figure A68. **Summer 2015-2017 turbidity of CWMN sites in Water Region 7 (Gabriola Island) with Englishman River water quality objectives.**

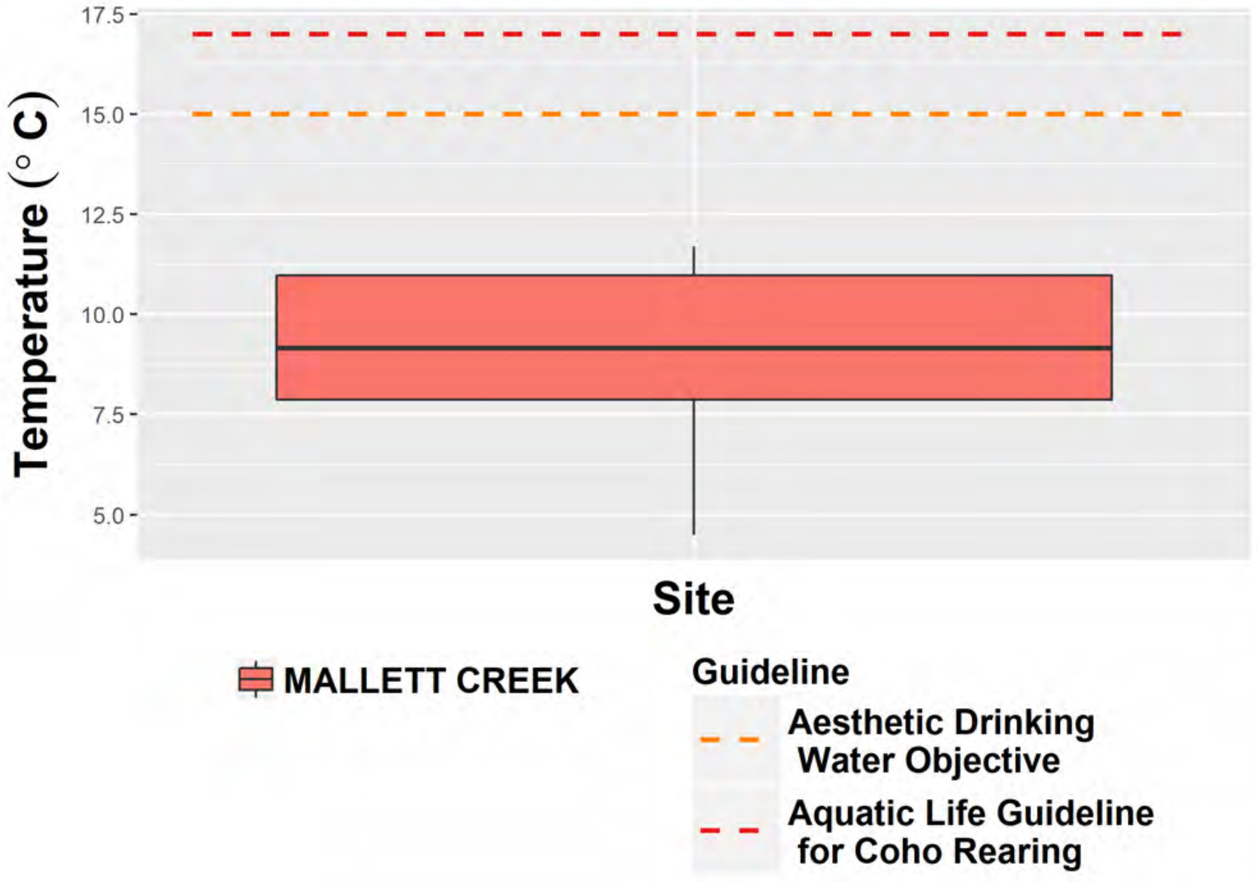

Figure A69. Fall 2015-2017 water temperature of CWMN sites in Water Region 7 (Gabriola Island) with Englishman River water quality objectives.

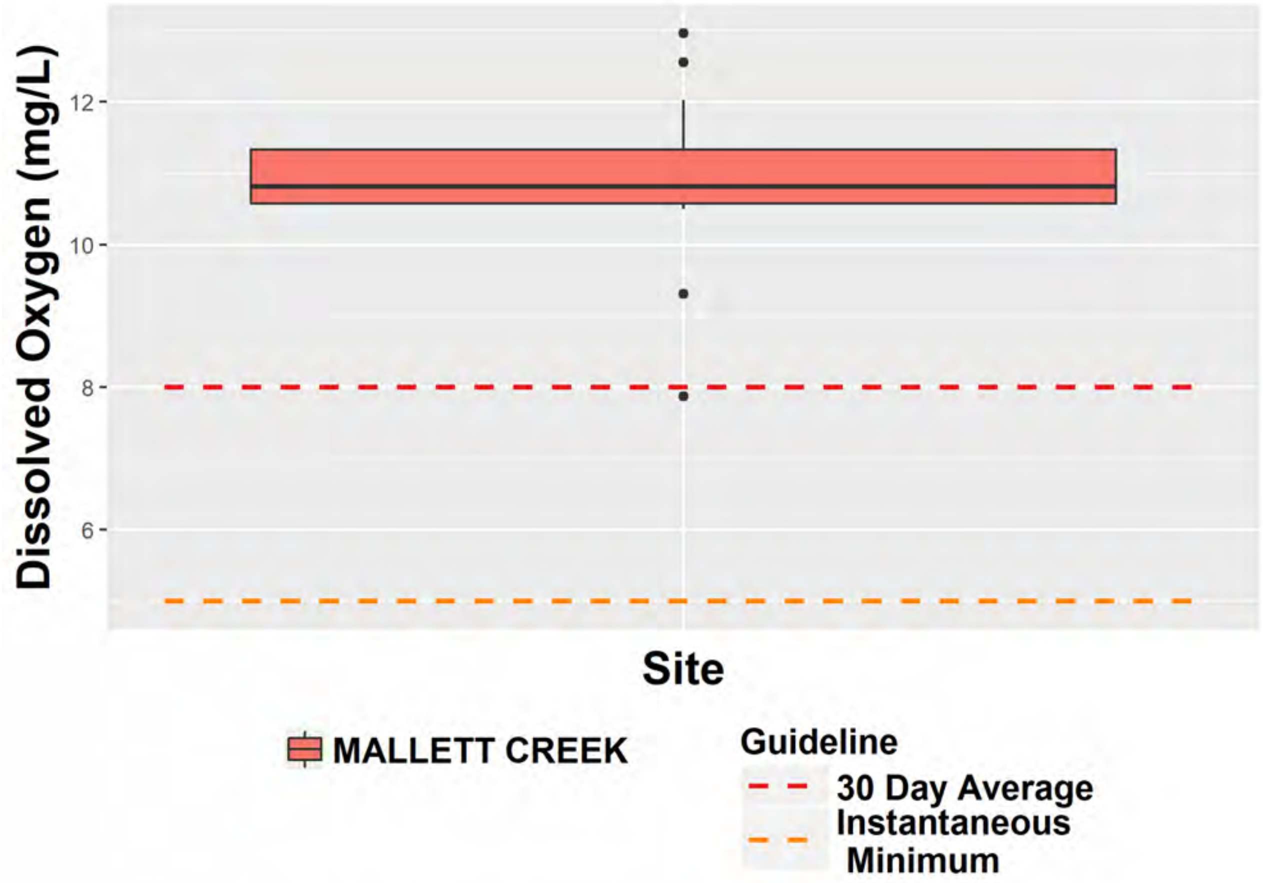

Figure A70. **Fall 2015-2017 DO of CWMN sites in Water Region 7 (Gabriola Island) with BC Water Quality guidelines for Aquatic Life.**

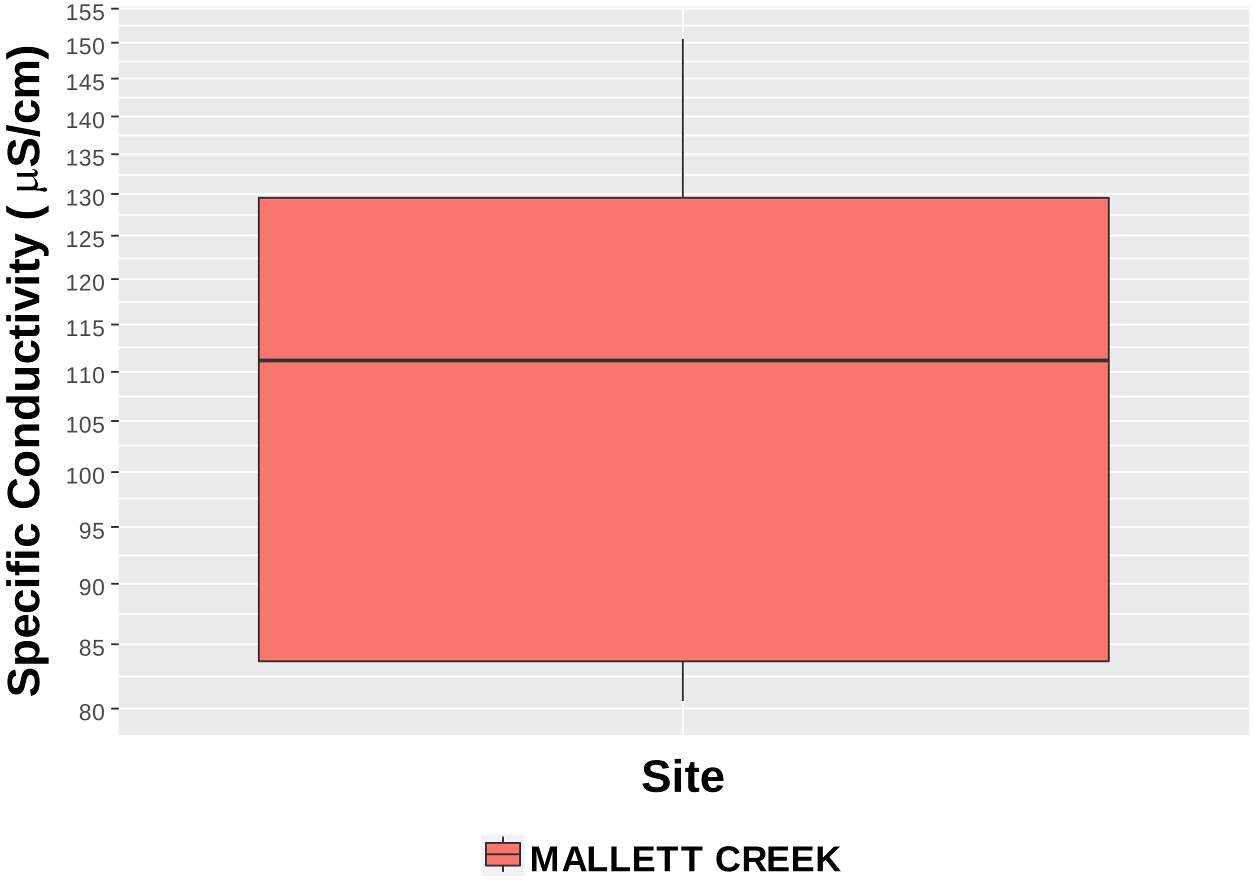

Figure A71. **Fall 2015-2017 specific conductivity of CWMN sites in Water Region 7 (Gabriola Island).**

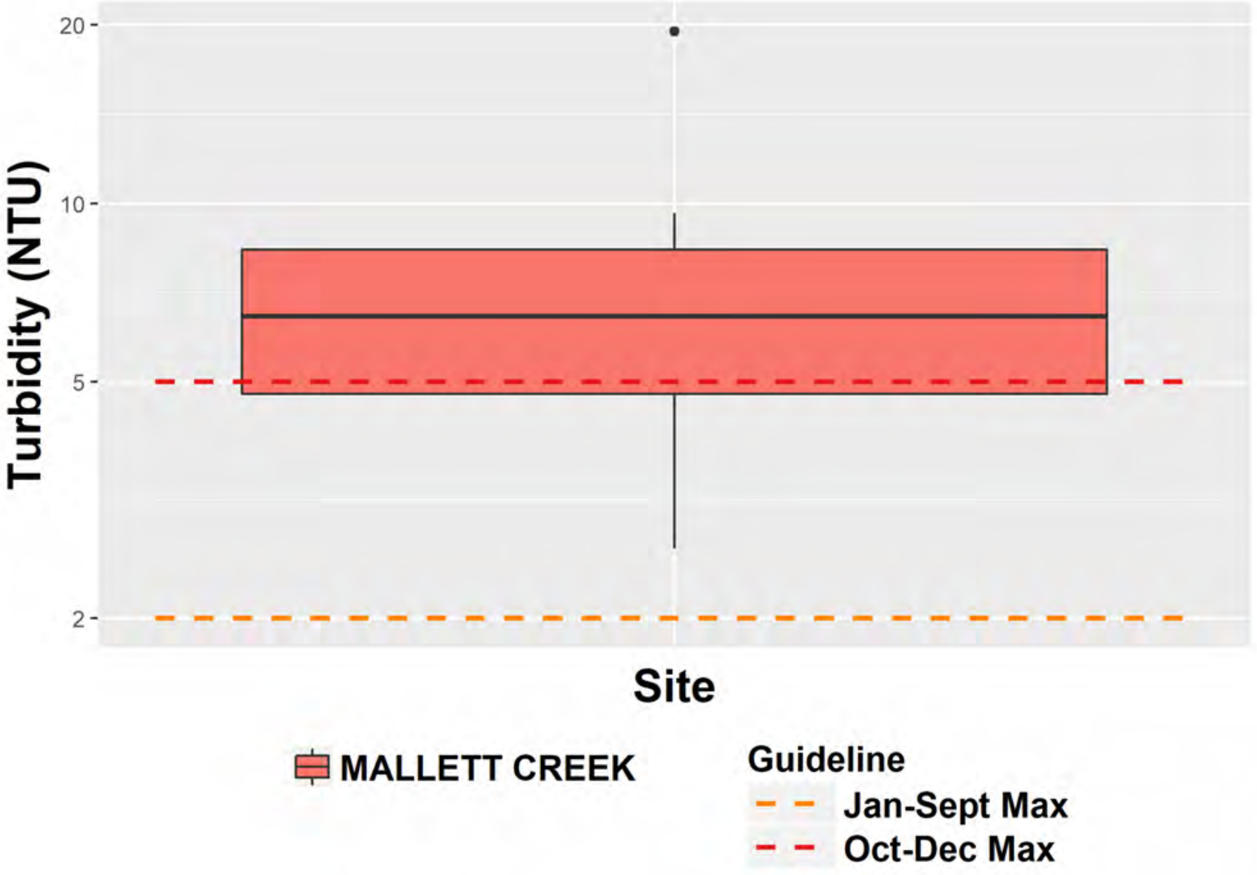

Figure A72. **Fall 2015-2017 turbidity of CWMN sites in Water Region 7 (Gabriola Island) with Englishman River water quality objectives.**

Appendix E Flow, Rainfall and Temperature Analysis

Table A1 Summary of Spearman rank correlation test for rainfall by Water Region and site including Spearman's rank correlation coefficient (strength and direction of relationship), p-value (<0.05 is statistically significant) and sample size (n).

EMS.ID	analyte	tau	p-value	n	LOCATION.NAME	WaterRegion
E286550	Cond	-0.56	0.00	25	THAMES CREEK 100M U/S INLAND ISLAND HWY	Big Qualicum
E286550	Temp	0.46	0.02	25	THAMES CREEK 100M U/S INLAND ISLAND HWY	Big Qualicum
E286553	Temp	0.35	0.04	35	NILE CREEK 50M U/S OLD ISLAND HWY	Big Qualicum
E286550	Turbidity	0.41	0.04	25	THAMES CREEK 100M U/S INLAND ISLAND HWY	Big Qualicum
E286553	Turbidity	0.31	0.07	35	NILE CREEK 50M U/S OLD ISLAND HWY	Big Qualicum
E286553	DO	-0.28	0.11	35	NILE CREEK 50M U/S OLD ISLAND HWY	Big Qualicum
E286553	Cond	-0.26	0.13	35	NILE CREEK 50M U/S OLD ISLAND HWY	Big Qualicum
E286549	Cond	0.23	0.28	25	THAMES CREEK 200M U/S OLD ISLAND HWY	Big Qualicum
E286549	Turbidity	-0.19	0.36	25	THAMES CREEK 200M U/S OLD ISLAND HWY	Big Qualicum
E286549	Temp	0.05	0.80	25	THAMES CREEK 200M U/S OLD ISLAND HWY	Big Qualicum
E286550	DO	0.04	0.84	25	THAMES CREEK 100M U/S INLAND ISLAND HWY	Big Qualicum
E286549	DO	-0.01	0.97	25	THAMES CREEK 200M U/S OLD ISLAND HWY	Big Qualicum
E285669	Turbidity	0.51	0.00	35	UPPER CAMERON RIVER	Little Qualicum
E256394	Turbidity	0.41	0.01	37	LITTLE QUALICUM RIVER AT INTAKE	Little Qualicum
E268993	Cond	-0.43	0.02	31	LITTLE QUALICUM RIVER - 1.2KM D/S CAMERON LAKE	Little Qualicum
E285669	Cond	-0.37	0.03	35	UPPER CAMERON RIVER	Little Qualicum
E220635	Temp	0.36	0.03	36	CAMERON RIVER	Little Qualicum
E220635	Turbidity	0.30	0.07	36	CAMERON RIVER	Little Qualicum
E285669	Temp	0.30	0.08	35	UPPER CAMERON RIVER	Little Qualicum
E256394	Cond	-0.29	0.09	37	LITTLE QUALICUM RIVER AT INTAKE	Little Qualicum
E287697	Turbidity	0.31	0.10	30	WHISKEY CREEK ON HWY 4 NEAR TB AVE SAVE ON GAS	Little Qualicum
E220635	DO	-0.27	0.11	36	CAMERON RIVER	Little Qualicum
E287697	Cond	-0.26	0.17	30	WHISKEY CREEK ON HWY 4 NEAR TB AVE SAVE ON GAS	Little Qualicum

EMS.ID	analyte	tau	p-value	n	LOCATION.NAME	WaterRegion
E287697	Temp	0.25	0.18	30	WHISKEY CREEK ON HWY 4 NEAR TB AVE SAVE ON GAS	Little Qualicum
E268993	Turbidity	0.21	0.25	31	LITTLE QUALICUM RIVER - 1.2KM D/S CAMERON LAKE	Little Qualicum
E256394	DO	0.10	0.54	37	LITTLE QUALICUM RIVER AT INTAKE	Little Qualicum
E256394	Temp	0.09	0.61	37	LITTLE QUALICUM RIVER AT INTAKE	Little Qualicum
E268993	DO	-0.09	0.62	31	LITTLE QUALICUM RIVER - 1.2KM D/S CAMERON LAKE	Little Qualicum
E285669	DO	-0.06	0.72	35	UPPER CAMERON RIVER	Little Qualicum
E287697	DO	0.04	0.84	30	WHISKEY CREEK ON HWY 4 NEAR TB AVE SAVE ON GAS	Little Qualicum
E268993	Temp	-0.04	0.84	31	LITTLE QUALICUM RIVER - 1.2KM D/S CAMERON LAKE	Little Qualicum
E220635	Cond	-0.03	0.88	36	CAMERON RIVER	Little Qualicum
E243024	Turbidity	0.80	0.00	36	FRENCH CREEK AT GRAFTON ROAD	French Creek
E288092	Turbidity	0.75	0.00	37	BEACH CREEK NEAR CHESTER ROAD AT HEMSWORTH ROAD	French Creek
E288091	Turbidity	0.71	0.00	37	GRANDON CREEK AT LABURNUM ROAD	French Creek
E243022	Turbidity	0.72	0.00	36	FRENCH CREEK AT BARCLAY BRIDGE	French Creek
E288093	Turbidity	0.71	0.00	37	BEACH CREEK NEAR MEMORIAL GOLF COURSE POND	French Creek
E243021	Turbidity	0.71	0.00	36	FRENCH CREEK AT NEW HIGHWAY	French Creek
E288090	Turbidity	0.65	0.00	37	GRANDON CREEK WEST CRESCENT (CAISSONS)	French Creek
E288093	Cond	-0.62	0.00	37	BEACH CREEK NEAR MEMORIAL GOLF COURSE POND	French Creek
E243021	DO	-0.46	0.01	36	FRENCH CREEK AT NEW HIGHWAY	French Creek
E288091	Cond	-0.44	0.01	37	GRANDON CREEK AT LABURNUM ROAD	French Creek
E243021	Temp	0.43	0.01	36	FRENCH CREEK AT NEW HIGHWAY	French Creek
E243022	Temp	0.41	0.01	36	FRENCH CREEK AT BARCLAY BRIDGE	French Creek
E243022	DO	-0.40	0.02	36	FRENCH CREEK AT BARCLAY BRIDGE	French Creek
E288090	Cond	-0.40	0.02	37	GRANDON CREEK WEST CRESCENT (CAISSONS)	French Creek
E243024	Cond	-0.40	0.02	36	FRENCH CREEK AT GRAFTON ROAD	French Creek

EMS.ID	analyte	tau	p-value	n	LOCATION.NAME	WaterRegion
E288092	Temp	0.37	0.02	37	BEACH CREEK NEAR CHESTER ROAD AT HEMSWORTH ROAD	French Creek
E243024	Temp	0.35	0.03	36	FRENCH CREEK AT GRAFTON ROAD	French Creek
E288091	Temp	0.34	0.04	37	GRANDON CREEK AT LABURNUM ROAD	French Creek
E243022	Cond	-0.34	0.05	36	FRENCH CREEK AT BARCLAY BRIDGE	French Creek
E288093	Temp	0.32	0.06	37	BEACH CREEK NEAR MEMORIAL GOLF COURSE POND	French Creek
E243021	Cond	-0.31	0.06	36	FRENCH CREEK AT NEW HIGHWAY	French Creek
E243024	DO	-0.27	0.11	36	FRENCH CREEK AT GRAFTON ROAD	French Creek
E288090	Temp	0.26	0.12	37	GRANDON CREEK WEST CRESCENT (CAISSONS)	French Creek
E288093	DO	0.25	0.13	37	BEACH CREEK NEAR MEMORIAL GOLF COURSE POND	French Creek
E288092	Cond	-0.14	0.43	37	BEACH CREEK NEAR CHESTER ROAD AT HEMSWORTH ROAD	French Creek
E288091	DO	0.08	0.62	37	GRANDON CREEK AT LABURNUM ROAD	French Creek
E288092	DO	0.06	0.71	37	BEACH CREEK NEAR CHESTER ROAD AT HEMSWORTH ROAD	French Creek
E288090	DO	0.02	0.91	37	GRANDON CREEK WEST CRESCENT (CAISSONS)	French Creek
E248835	Cond	-0.03	0.90	30	MORISON CREEK JUST UPSTREAM ENGLISHMAN RIVER	Englishman River
121580	DO	-0.02	0.91	31	ENGLISHMAN R. AT HIGHWAY 19A	Englishman River
E248836	Temp	0.50	0.01	29	SOUTH ENGLISHMAN RIVER JUST U/S ENGLISHMAN RIVER	Englishman River
121580	Turbidity	0.68	0.00	31	ENGLISHMAN R. AT HIGHWAY 19A	Englishman River
E248836	Cond	-0.20	0.30	29	SOUTH ENGLISHMAN RIVER JUST U/S ENGLISHMAN RIVER	Englishman River
E248834	DO	-0.38	0.04	30	ENGLISHMAN RIVER JUST UPSTREAM MORISON CREEK	Englishman River
E248834	Temp	0.47	0.01	30	ENGLISHMAN RIVER JUST UPSTREAM MORISON CREEK	Englishman River
E248834	Turbidity	0.62	0.00	30	ENGLISHMAN RIVER JUST UPSTREAM MORISON CREEK	Englishman River
E290452	Cond	-0.22	0.28	26	SHELLY CREEK @ END OF BLOWER RD	Englishman River
E248835	DO	-0.37	0.05	30	MORISON CREEK JUST UPSTREAM ENGLISHMAN RIVER	Englishman River

EMS.ID	analyte	tau	p-value	n	LOCATION.NAME	WaterRegion
E248835	Temp	0.42	0.02	30	MORISON CREEK JUST UPSTREAM ENGLISHMAN RIVER	Englishman River
E282969	Turbidity	0.59	0.00	30	UPPER ENGLISHMAN RIVER U/S CENTRE FORK CREEK	Englishman River
E248834	Cond	-0.44	0.01	30	ENGLISHMAN RIVER JUST UPSTREAM MORISON CREEK	Englishman River
E248836	DO	-0.21	0.28	29	SOUTH ENGLISHMAN RIVER JUST U/S ENGLISHMAN RIVER	Englishman River
E282969	Temp	0.38	0.04	29	UPPER ENGLISHMAN RIVER U/S CENTRE FORK CREEK	Englishman River
E248836	Turbidity	0.59	0.00	29	SOUTH ENGLISHMAN RIVER JUST U/S ENGLISHMAN RIVER	Englishman River
121580	Cond	-0.52	0.00	31	ENGLISHMAN R. AT HIGHWAY 19A	Englishman River
E282969	DO	-0.15	0.44	30	UPPER ENGLISHMAN RIVER U/S CENTRE FORK CREEK	Englishman River
121580	Temp	0.35	0.05	31	ENGLISHMAN R. AT HIGHWAY 19A	Englishman River
E248835	Turbidity	0.38	0.04	30	MORISON CREEK JUST UPSTREAM ENGLISHMAN RIVER	Englishman River
E282969	Cond	-0.61	0.00	30	UPPER ENGLISHMAN RIVER U/S CENTRE FORK CREEK	Englishman River
E290452	DO	0.09	0.65	26	SHELLY CREEK @ END OF BLOWER RD	Englishman River
E290452	Temp	0.23	0.26	26	SHELLY CREEK @ END OF BLOWER RD	Englishman River
E290452	Turbidity	0.31	0.13	26	SHELLY CREEK @ END OF BLOWER RD	Englishman River
E290483	Cond	-0.63	0.00	30	CHASE RIVER @ AEBIG RD	South Wellington to Nanoose
E290469	DO	0.05	0.78	31	DEPARTURE CREEK @ NEYLAND RD (STN1)	South Wellington to Nanoose
E290470	Temp	0.38	0.03	31	DEPARTURE CREEK OFF NEWTON ST (STN2)	South Wellington to Nanoose
E290484	Turbidity	0.76	0.00	29	CHASE RIVER @HOWARD BELOW COLLIERY DAM	South Wellington to Nanoose
E290469	Cond	-0.50	0.00	31	DEPARTURE CREEK @ NEYLAND RD (STN1)	South Wellington to Nanoose
E290470	DO	0.09	0.64	31	DEPARTURE CREEK OFF NEWTON ST (STN2)	South Wellington to Nanoose
E290471	Temp	0.36	0.05	31	DEPARTURE CREEK AT LOWER END OF WOODSTREAM PARK (STN 3)	South Wellington to Nanoose
E290483	Turbidity	0.70	0.00	29	CHASE RIVER @ AEBIG RD	South Wellington to Nanoose
E290479	Cond	-0.49	0.01	30	MCGARRIGLE CK @ JINGLE POT RD	South Wellington to Nanoose

EMS.ID	analyte	tau	p-value	n	LOCATION.NAME	WaterRegion
E290471	DO	-0.07	0.72	31	DEPARTURE CREEK AT LOWER END OF WOODSTREAM PARK (STN 3)	South Wellington to Nanoose
E290472	Temp	0.33	0.07	31	DEPARTURE CREEK AT OUTLET (STN4)	South Wellington to Nanoose
E290475	Turbidity	0.67	0.00	31	COTTLE CREEK @ STEPHENSON PT RD	South Wellington to Nanoose
E294017	Cond	-0.42	0.03	25	CRAIG CK JUST U/S NORTHWEST BAY RD	South Wellington to Nanoose
E290472	DO	-0.25	0.17	31	DEPARTURE CREEK AT OUTLET (STN4)	South Wellington to Nanoose
E290473	Temp	0.31	0.09	30	COTTLE CREEK @ NOTTINGHAM	South Wellington to Nanoose
E290481	Turbidity	0.65	0.00	30	MILLSTONE RIVER IN BARSBY PARK	South Wellington to Nanoose
E294020	Cond	-0.41	0.04	25	NANOOSE CK @ MATTHEW CROSSING	South Wellington to Nanoose
E290473	DO	0.15	0.43	30	COTTLE CREEK @ NOTTINGHAM	South Wellington to Nanoose
E290475	Temp	0.28	0.13	31	COTTLE CREEK @ STEPHENSON PT RD	South Wellington to Nanoose
E290485	Turbidity	0.62	0.00	29	CHASE RIVER @ PARK AVE	South Wellington to Nanoose
E290485	Cond	-0.37	0.05	30	CHASE RIVER @ PARK AVE	South Wellington to Nanoose
E290475	DO	-0.04	0.81	31	COTTLE CREEK @ STEPHENSON PT RD	South Wellington to Nanoose
E290469	Temp	0.18	0.34	31	DEPARTURE CREEK @ NEYLAND RD (STN1)	South Wellington to Nanoose
E290471	Turbidity	0.60	0.00	31	DEPARTURE CREEK AT LOWER END OF WOODSTREAM PARK (STN 3)	South Wellington to Nanoose
E290470	Cond	-0.34	0.06	31	DEPARTURE CREEK OFF NEWTON ST (STN2)	South Wellington to Nanoose
E290478	DO	-0.01	0.94	32	MILLSTONE RIVER @ BIGGS ROAD	South Wellington to Nanoose
E290481	Temp	0.14	0.45	30	MILLSTONE RIVER IN BARSBY PARK	South Wellington to Nanoose
E290473	Turbidity	0.59	0.00	30	COTTLE CREEK @ NOTTINGHAM	South Wellington to Nanoose
E290484	Cond	-0.33	0.07	30	CHASE RIVER @HOWARD BELOW COLLIERY DAM	South Wellington to Nanoose
E290479	DO	0.16	0.41	30	MCGARRIGLE CK @ JINGLE POT RD	South Wellington to Nanoose
E294019	Temp	0.15	0.48	25	NANOOSE CK @ NANOOSE CAMPGROUND	South Wellington to Nanoose

EMS.ID	analyte	tau	p-value	n	LOCATION.NAME	WaterRegion
E290472	Turbidity	0.58	0.00	31	DEPARTURE CREEK AT OUTLET (STN4)	South Wellington to Nanoose
E290475	Cond	-0.31	0.09	31	COTTLE CREEK @ STEPHENSON PT RD	South Wellington to Nanoose
E290480	DO	0.22	0.24	30	MILLSTONE RIVER @ EAST WELLINGTON	South Wellington to Nanoose
E294020	Temp	0.13	0.54	25	NANOOSE CK @ MATTHEW CROSSING	South Wellington to Nanoose
E290480	Turbidity	0.56	0.00	30	MILLSTONE RIVER @ EAST WELLINGTON	South Wellington to Nanoose
E290486	Cond	-0.30	0.11	29	CATSTREAM @ PARK ABOVE CONFLUENCE WITH CHASE RIVER	South Wellington to Nanoose
E290481	DO	0.03	0.88	30	MILLSTONE RIVER IN BARSBY PARK	South Wellington to Nanoose
E290484	Temp	-0.12	0.54	30	CHASE RIVER @HOWARD BELOW COLLIERY DAM	South Wellington to Nanoose
E294019	Turbidity	0.60	0.00	25	NANOOSE CK @ NANOOSE CAMPGROUND	South Wellington to Nanoose
E294019	Cond	-0.32	0.12	25	NANOOSE CK @ NANOOSE CAMPGROUND	South Wellington to Nanoose
E290483	DO	0.07	0.72	30	CHASE RIVER @ AEBIG RD	South Wellington to Nanoose
E294017	Temp	0.09	0.66	25	CRAIG CK JUST U/S NORTHWEST BAY RD	South Wellington to Nanoose
E294017	Turbidity	0.55	0.00	25	CRAIG CK JUST U/S NORTHWEST BAY RD	South Wellington to Nanoose
E290480	Cond	-0.29	0.12	30	MILLSTONE RIVER @ EAST WELLINGTON	South Wellington to Nanoose
E290484	DO	0.25	0.18	30	CHASE RIVER @HOWARD BELOW COLLIERY DAM	South Wellington to Nanoose
E290478	Temp	0.07	0.70	32	MILLSTONE RIVER @ BIGGS ROAD	South Wellington to Nanoose
E290470	Turbidity	0.48	0.01	31	DEPARTURE CREEK OFF NEWTON ST (STN2)	South Wellington to Nanoose
E290471	Cond	-0.26	0.16	31	DEPARTURE CREEK AT LOWER END OF WOODSTREAM PARK (STN 3)	South Wellington to Nanoose
E290485	DO	0.28	0.14	30	CHASE RIVER @ PARK AVE	South Wellington to Nanoose
E290483	Temp	0.04	0.85	30	CHASE RIVER @ AEBIG RD	South Wellington to Nanoose
E294020	Turbidity	0.52	0.01	25	NANOOSE CK @ MATTHEW CROSSING	South Wellington to Nanoose
E290481	Cond	-0.22	0.25	30	MILLSTONE RIVER IN BARSBY PARK	South Wellington to Nanoose

EMS.ID	analyte	tau	p-value	n	LOCATION.NAME	WaterRegion
E290486	DO	-0.11	0.57	30	CATSTREAM @ PARK ABOVE CONFLUENCE WITH CHASE RIVER	South Wellington to Nanoose
E290479	Temp	0.02	0.91	30	MCGARRIGLE CK @ JINGLE POT RD	South Wellington to Nanoose
E290486	Turbidity	0.46	0.01	29	CATSTREAM @ PARK ABOVE CONFLUENCE WITH CHASE RIVER	South Wellington to Nanoose
E290472	Cond	-0.14	0.46	31	DEPARTURE CREEK AT OUTLET (STN4)	South Wellington to Nanoose
E294017	DO	0.29	0.17	25	CRAIG CK JUST U/S NORTHWEST BAY RD	South Wellington to Nanoose
E290486	Temp	0.02	0.91	30	CATSTREAM @ PARK ABOVE CONFLUENCE WITH CHASE RIVER	South Wellington to Nanoose
E290479	Turbidity	0.45	0.01	30	MCGARRIGLE CK @ JINGLE POT RD	South Wellington to Nanoose
E290473	Cond	-0.12	0.51	30	COTTLE CREEK @ NOTTINGHAM	South Wellington to Nanoose
E294019	DO	0.25	0.22	25	NANOOSE CK @ NANOOSE CAMPGROUND	South Wellington to Nanoose
E290485	Temp	0.02	0.93	30	CHASE RIVER @ PARK AVE	South Wellington to Nanoose
E290469	Turbidity	0.30	0.10	31	DEPARTURE CREEK @ NEYLAND RD (STN1)	South Wellington to Nanoose
E290478	Cond	0.00	0.99	32	MILLSTONE RIVER @ BIGGS ROAD	South Wellington to Nanoose
E294020	DO	0.25	0.22	25	NANOOSE CK @ MATTHEW CROSSING	South Wellington to Nanoose
E290480	Temp	0.01	0.96	30	MILLSTONE RIVER @ EAST WELLINGTON	South Wellington to Nanoose
E290478	Turbidity	0.25	0.16	32	MILLSTONE RIVER @ BIGGS ROAD	South Wellington to Nanoose
E290487	Temp	-0.02	0.91	30	BECK CREEK @ CEDAR RD	Nanaimo River
E290487	DO	0.08	0.66	30	BECK CREEK @ CEDAR RD	Nanaimo River
E287699	Temp	0.11	0.53	35	NANAIMO RIVER U/S HASLAM CK ~500 M D/S HWY 1 BRIDGE	Nanaimo River
E287699	Cond	-0.28	0.10	35	NANAIMO RIVER U/S HASLAM CK ~500 M D/S HWY 1 BRIDGE	Nanaimo River
E287699	DO	0.28	0.10	35	NANAIMO RIVER U/S HASLAM CK ~500 M D/S HWY 1 BRIDGE	Nanaimo River
E290487	Cond	-0.39	0.03	30	BECK CREEK @ CEDAR RD	Nanaimo River
E290487	Turbidity	0.41	0.03	29	BECK CREEK @ CEDAR RD	Nanaimo River
E287699	Turbidity	0.67	0.00	35	NANAIMO RIVER U/S HASLAM CK ~500 M D/S HWY 1 BRIDGE	Nanaimo River

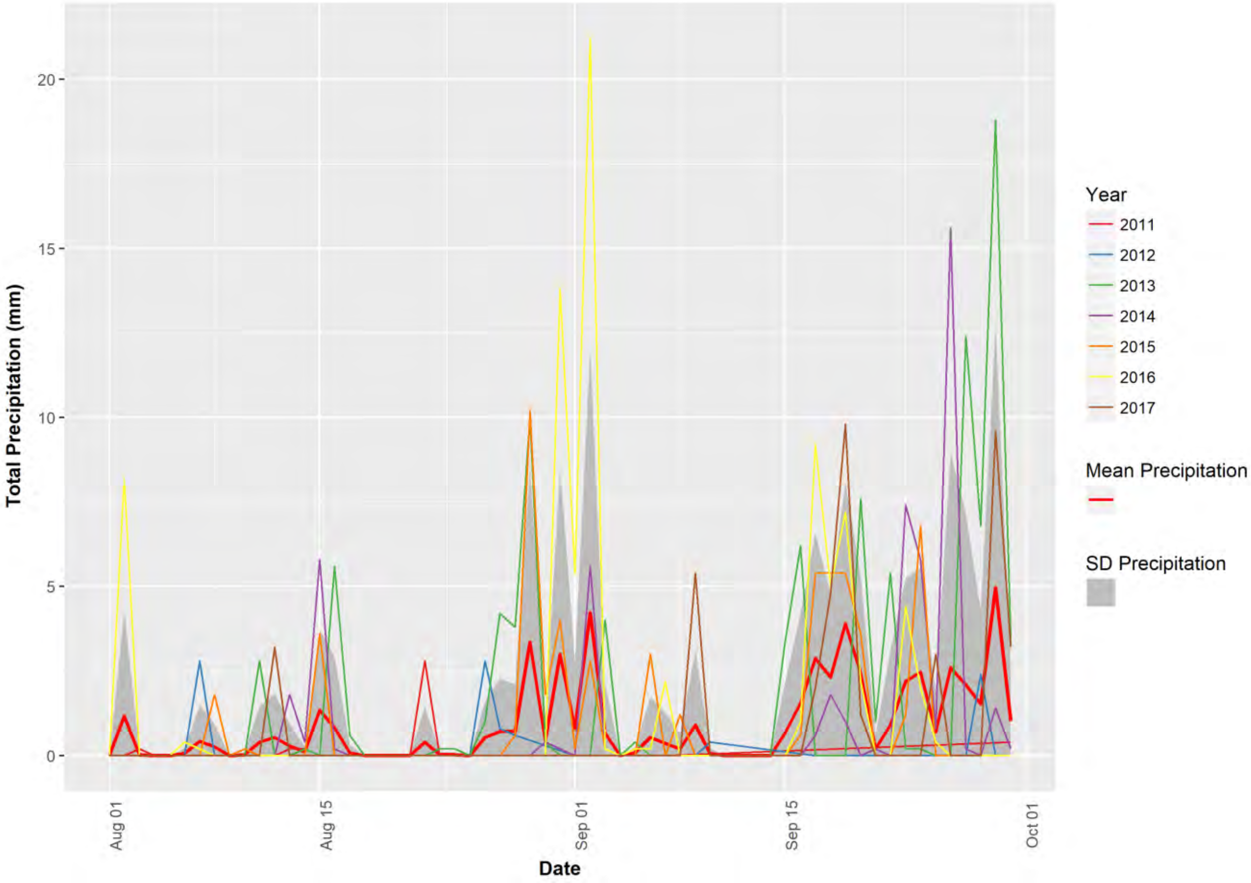

Figure A73. **Summer rainfall at Ballenas Island.**

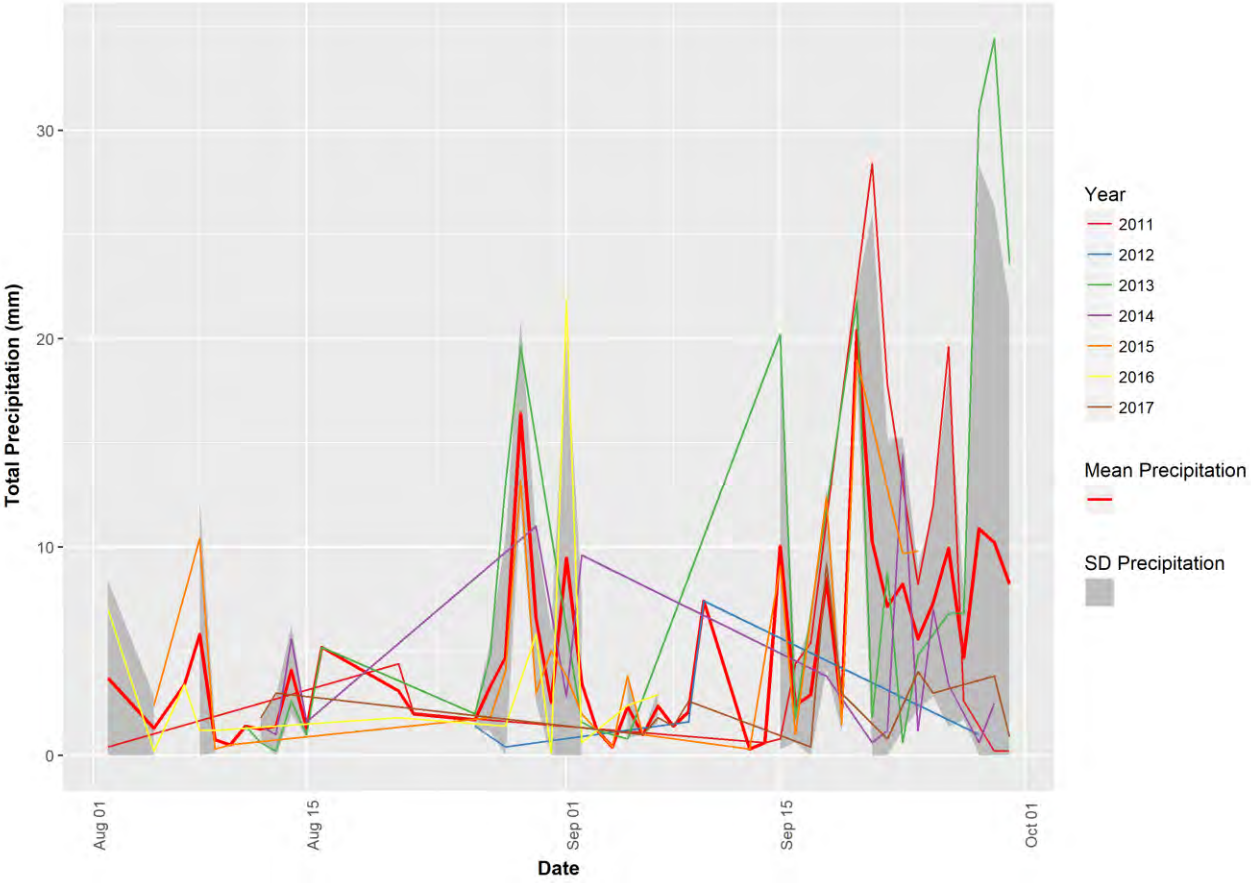

Figure A74. **Summer rainfall at Big Qualicum Hatchery.**

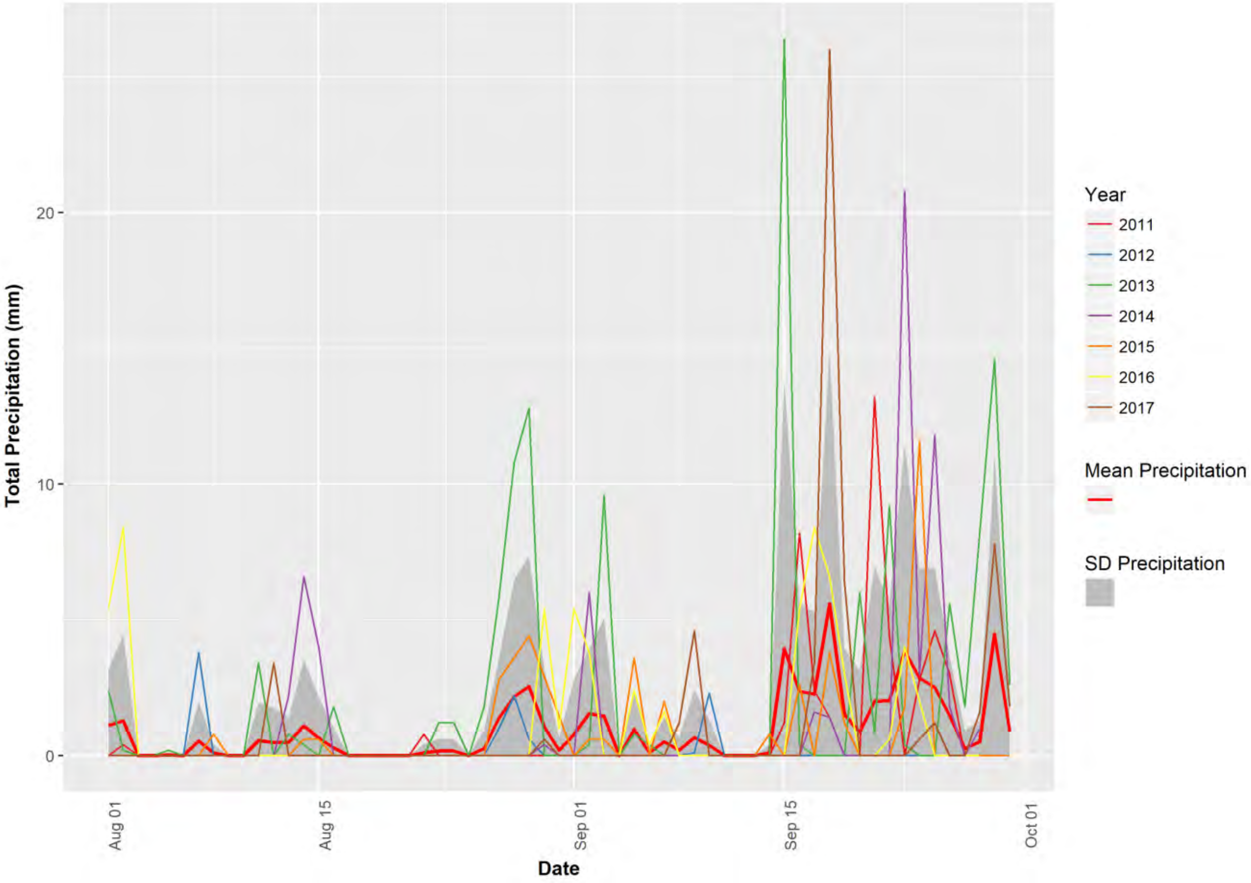

Figure A75. **Summer rainfall at Entrance Island.**

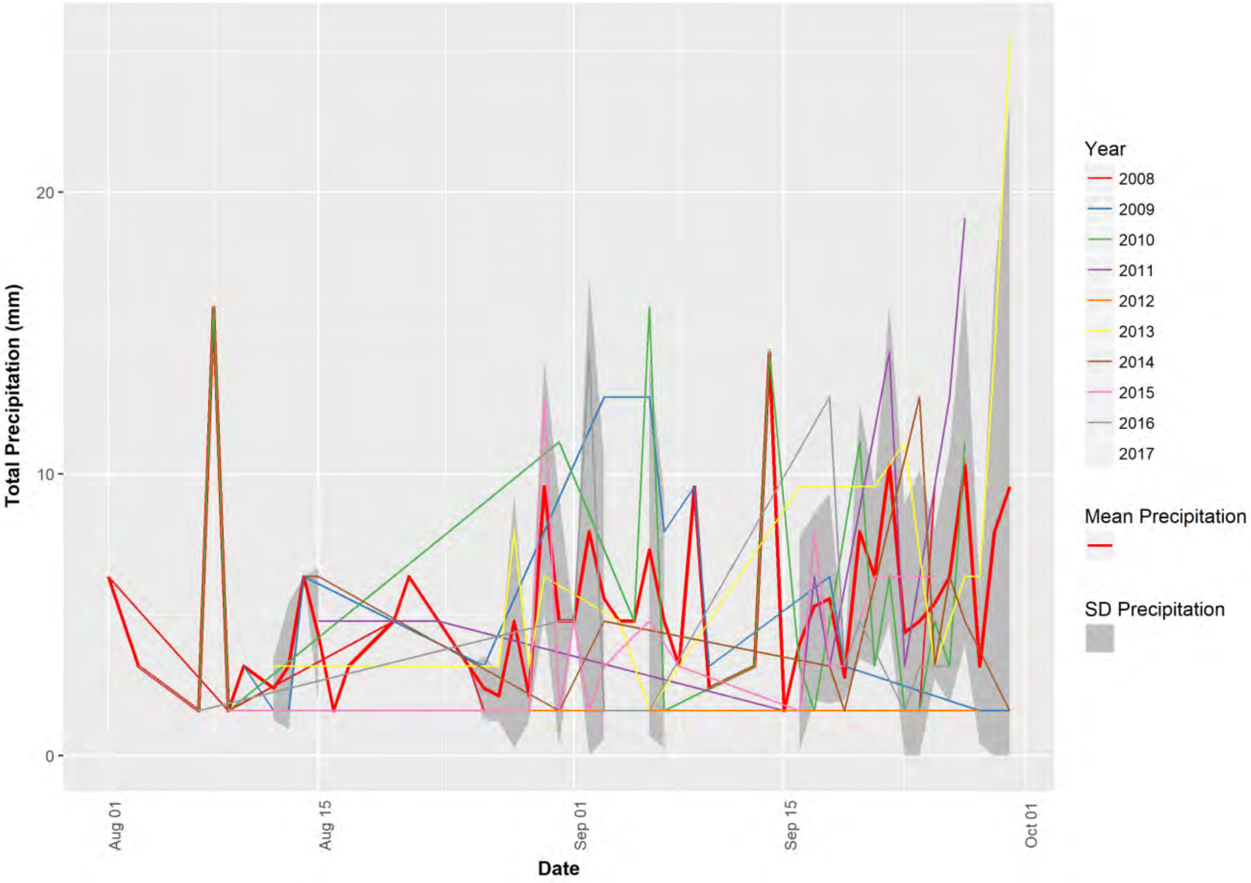

Figure A76. **Summer rainfall at Fair Winds Golf Course.**

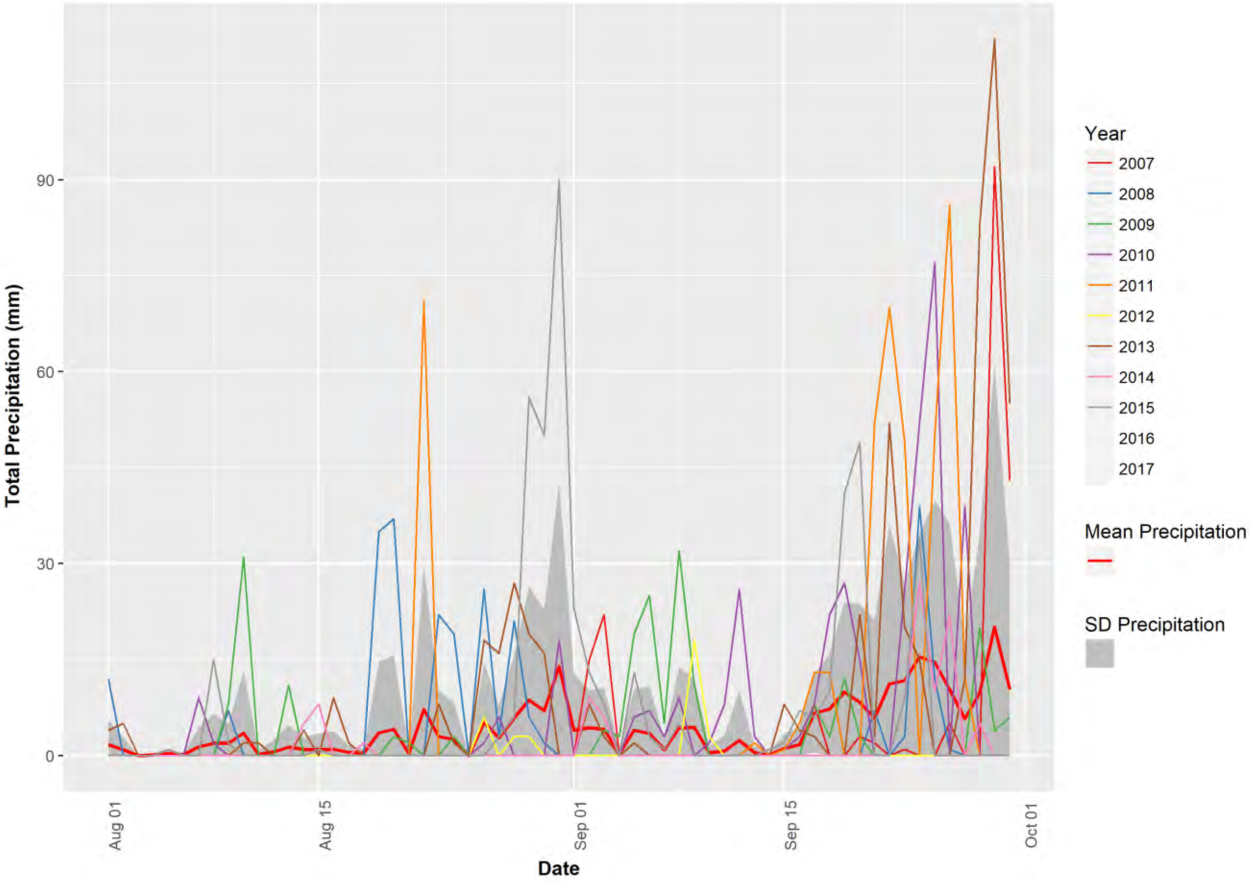

Figure A77. **Summer rainfall at Jump Creek.**

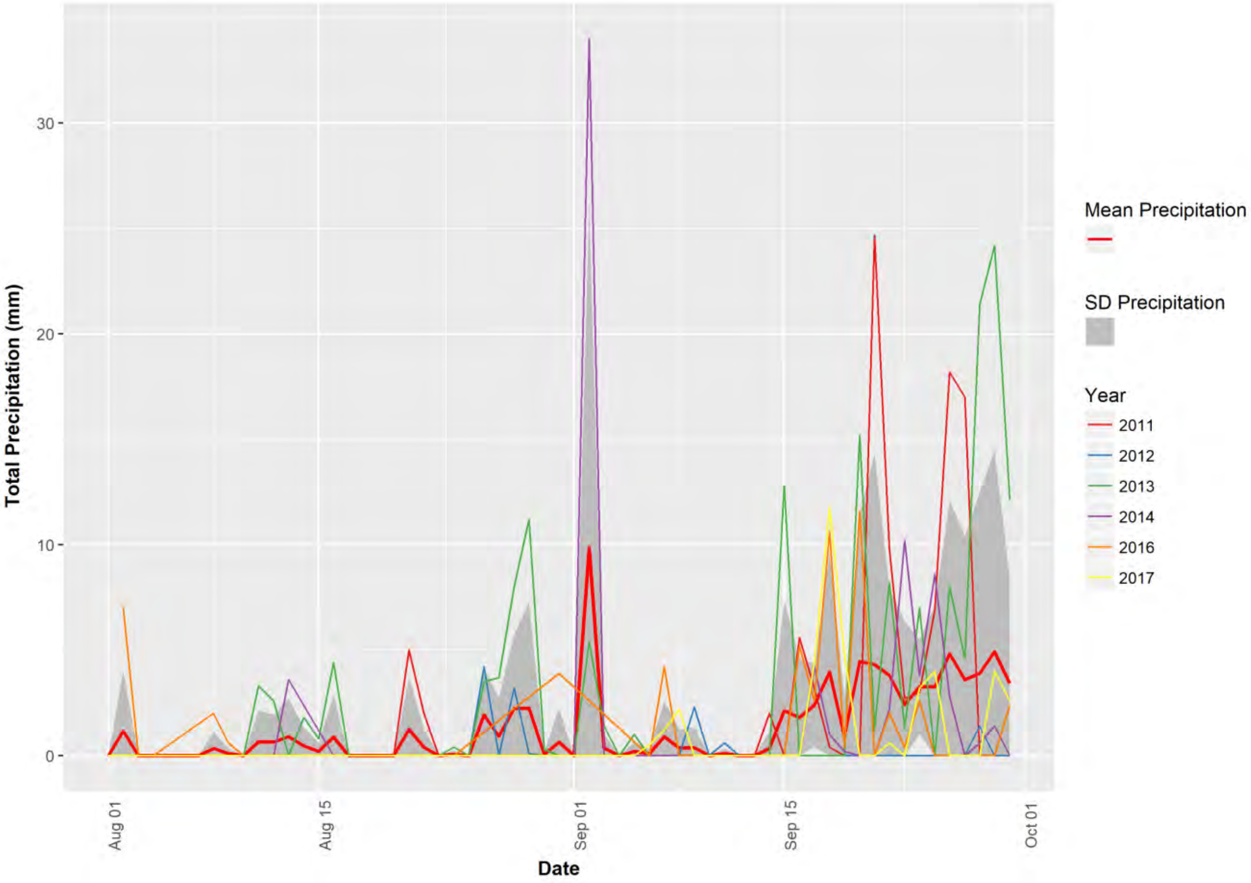

Figure A78. **Summer rainfall at Little Qualicum Hatchery.**

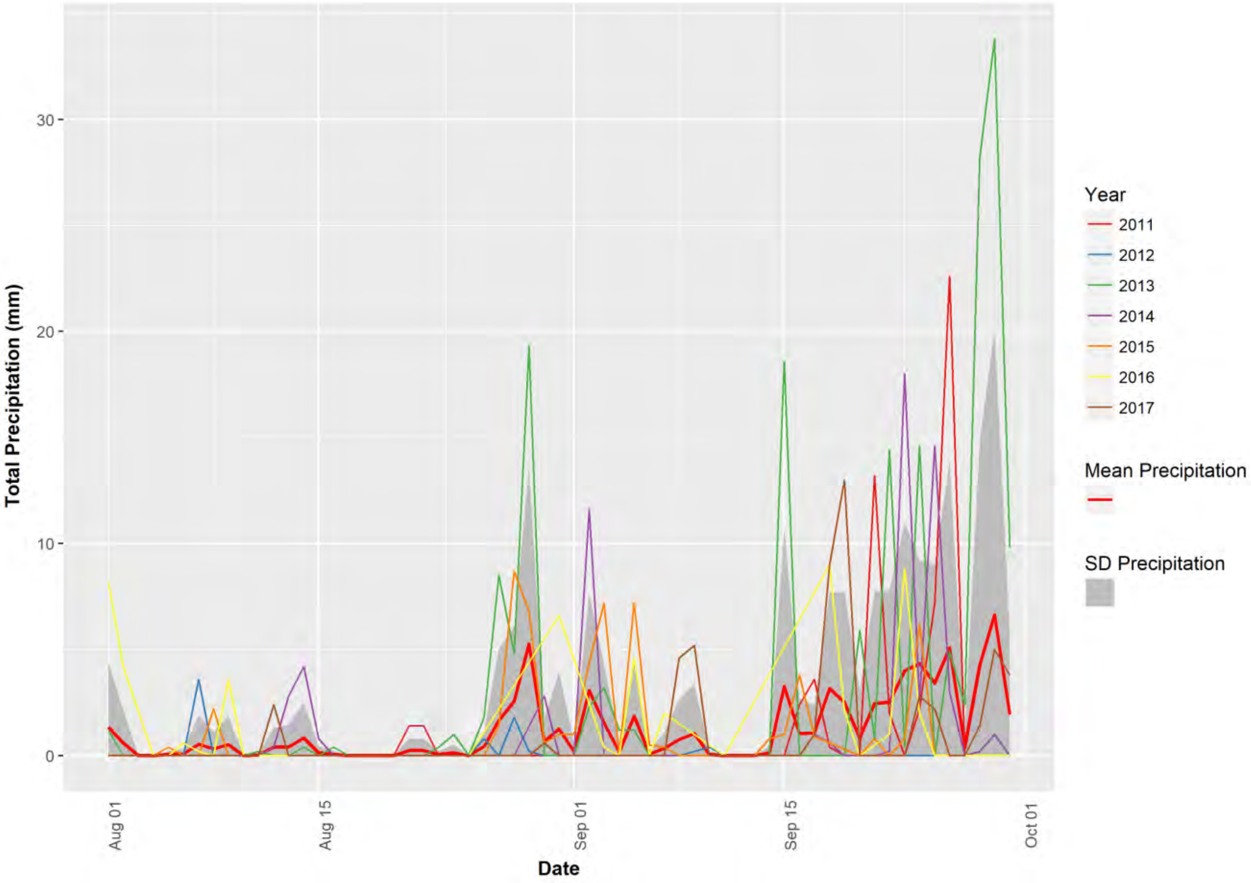

Figure A79. **Summer rainfall at Nanaimo A.**

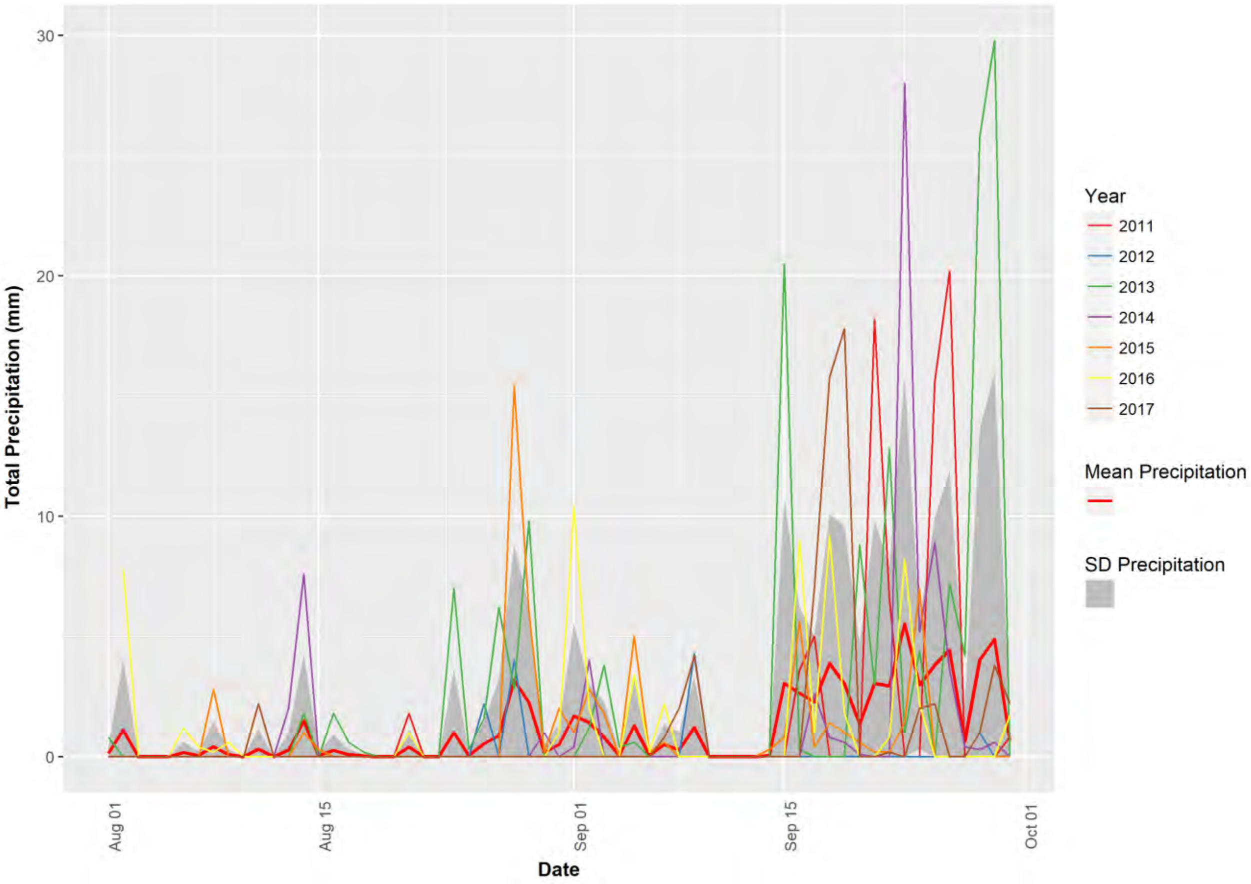

Figure A80. Summer rainfall at Nanaimo City Yard.

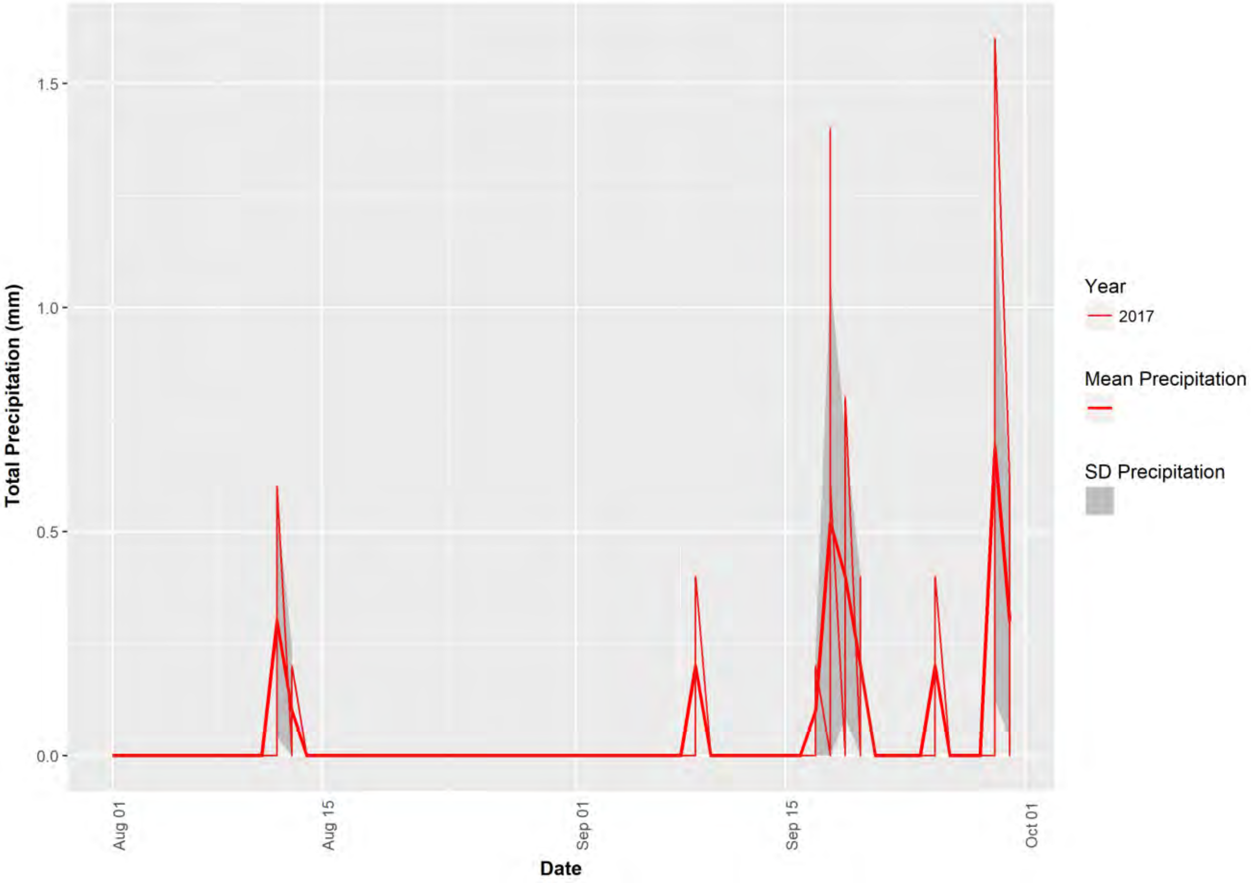

Figure A81. **Summer rainfall at Parksville.**

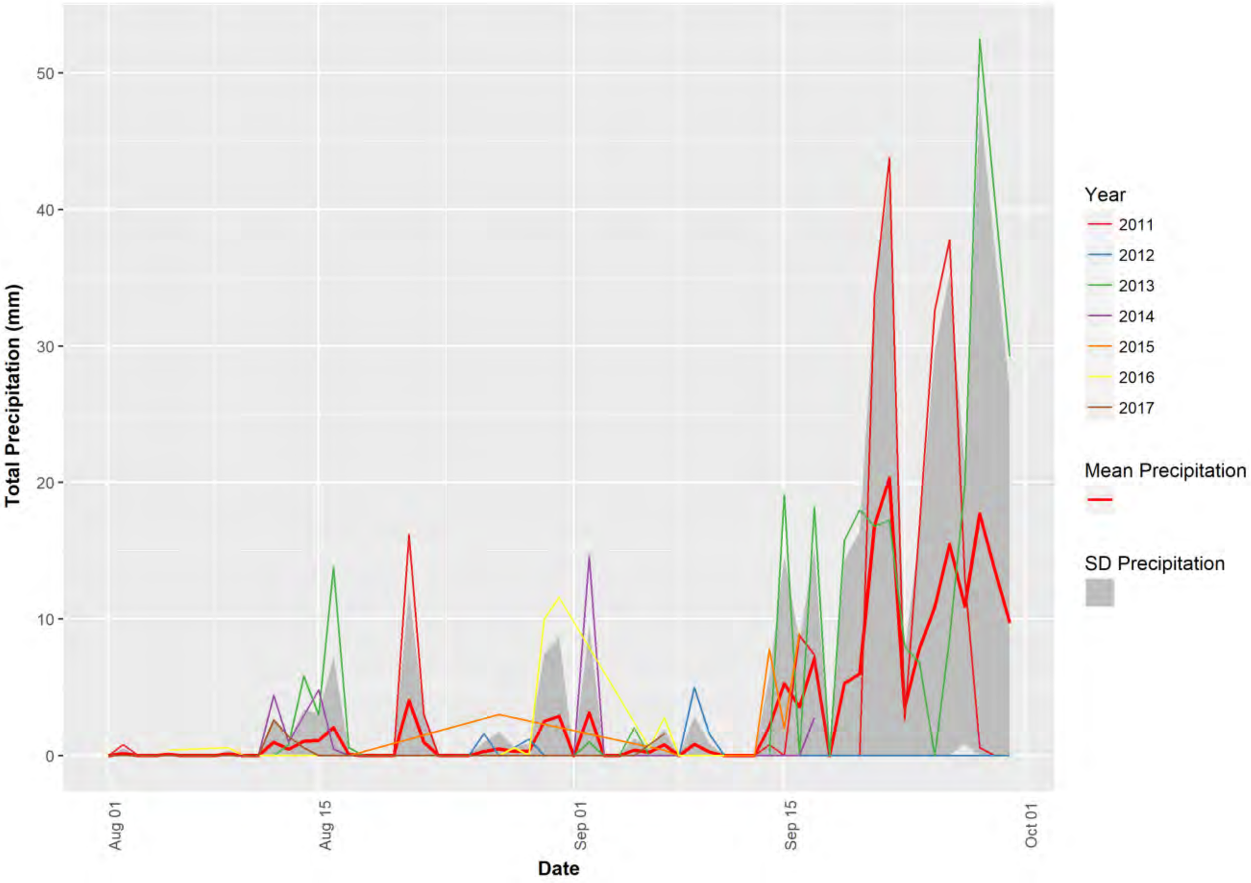

Figure A82. Summer rainfall at Cox Lake, Port Alberni.

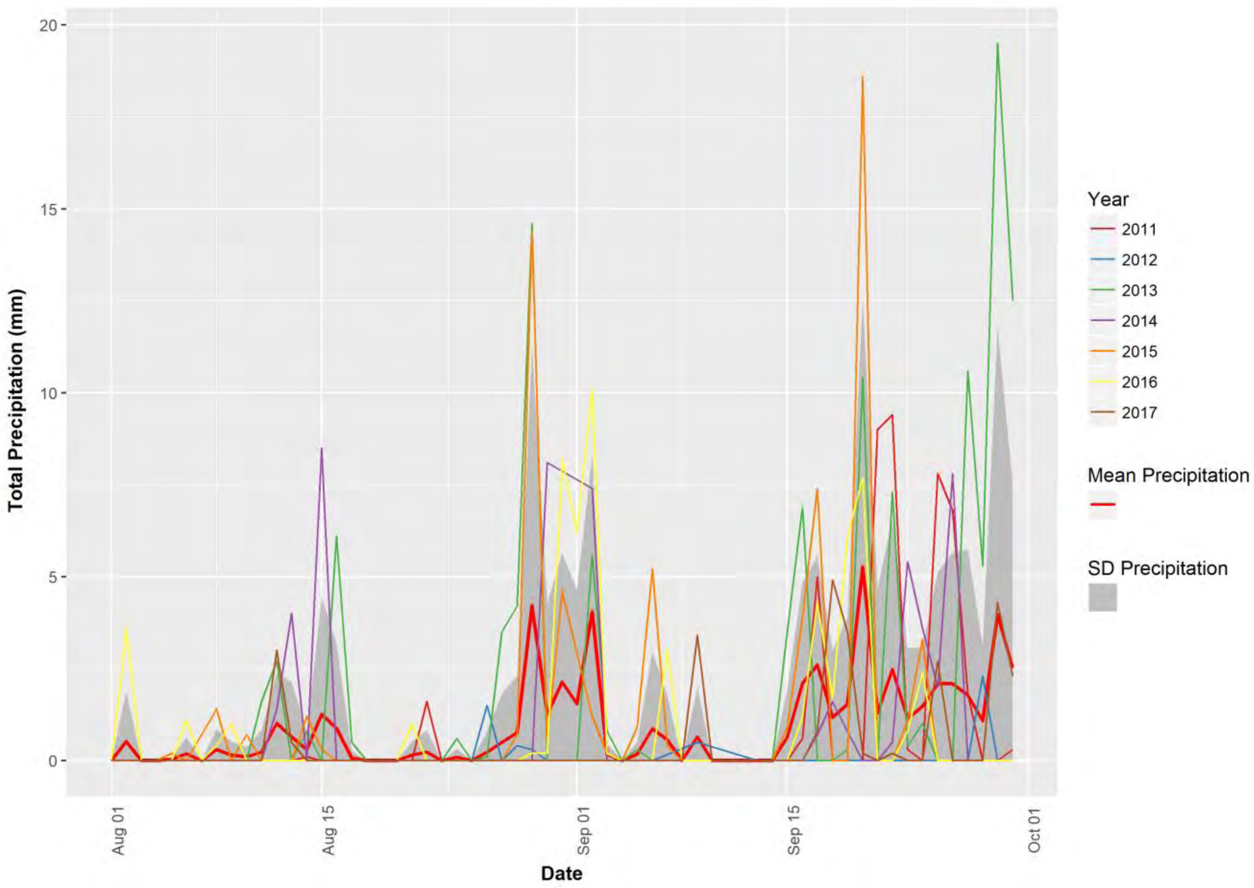

Figure A83. Summer rainfall at Qualicum Beach Airport.

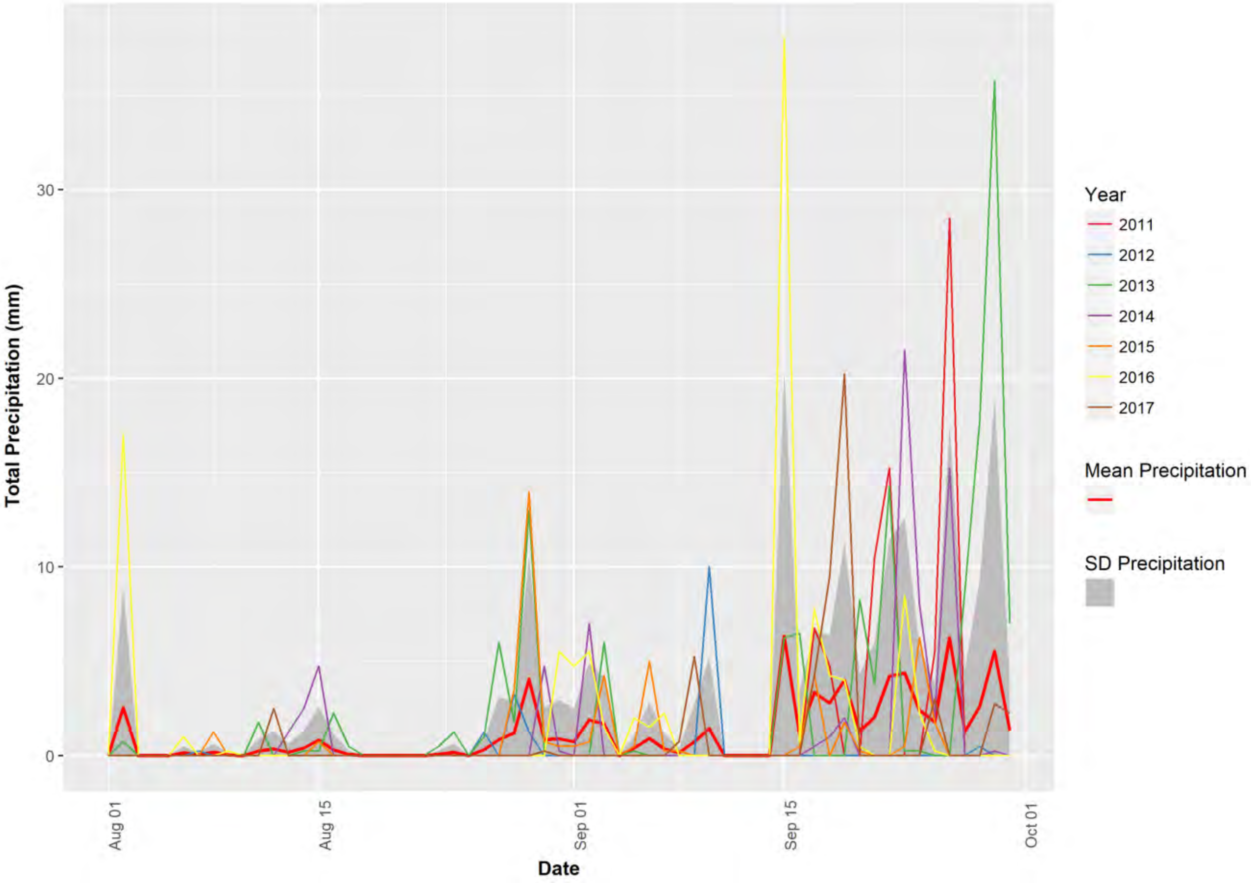

Figure A84. **Summer rainfall at RG City Hall.**

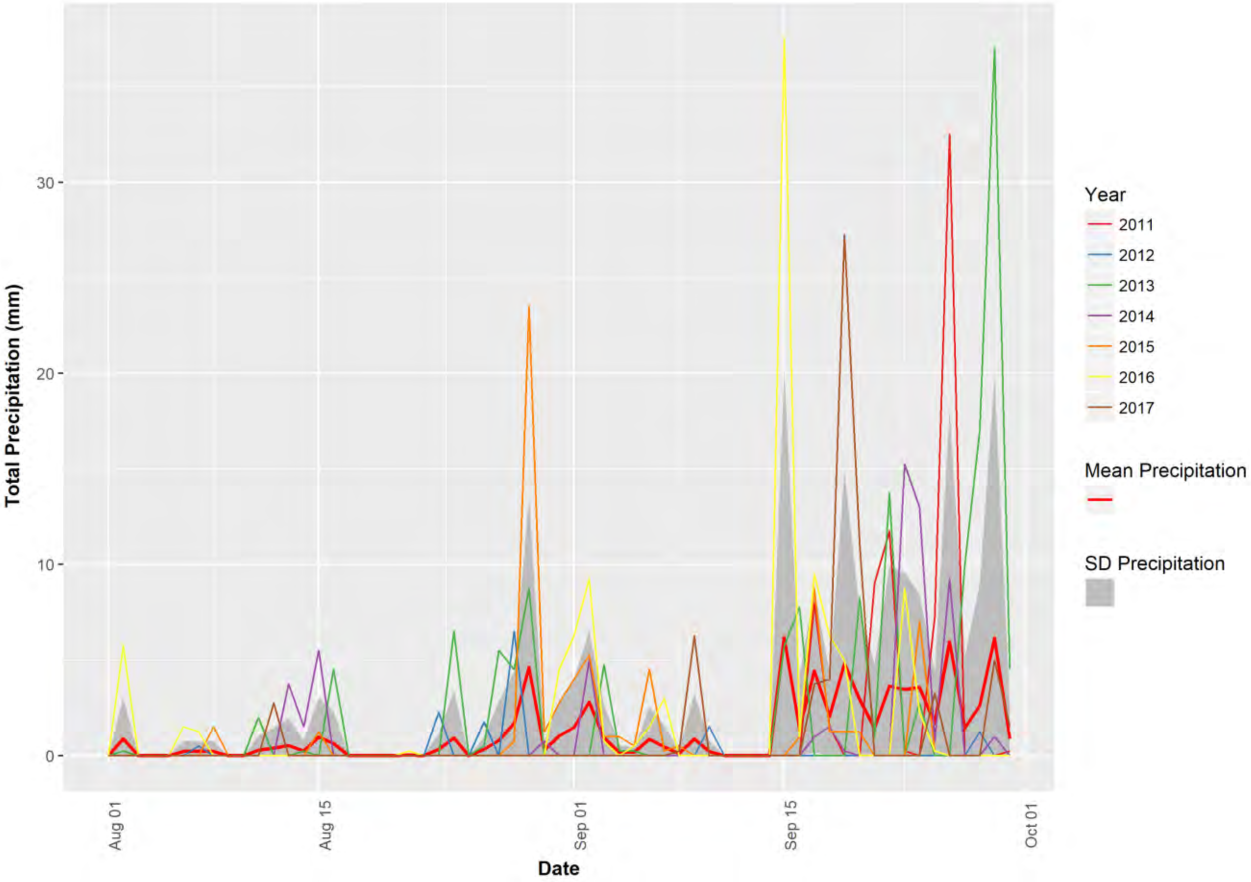

Figure A85. **Summer rainfall at RG Fire hall.**

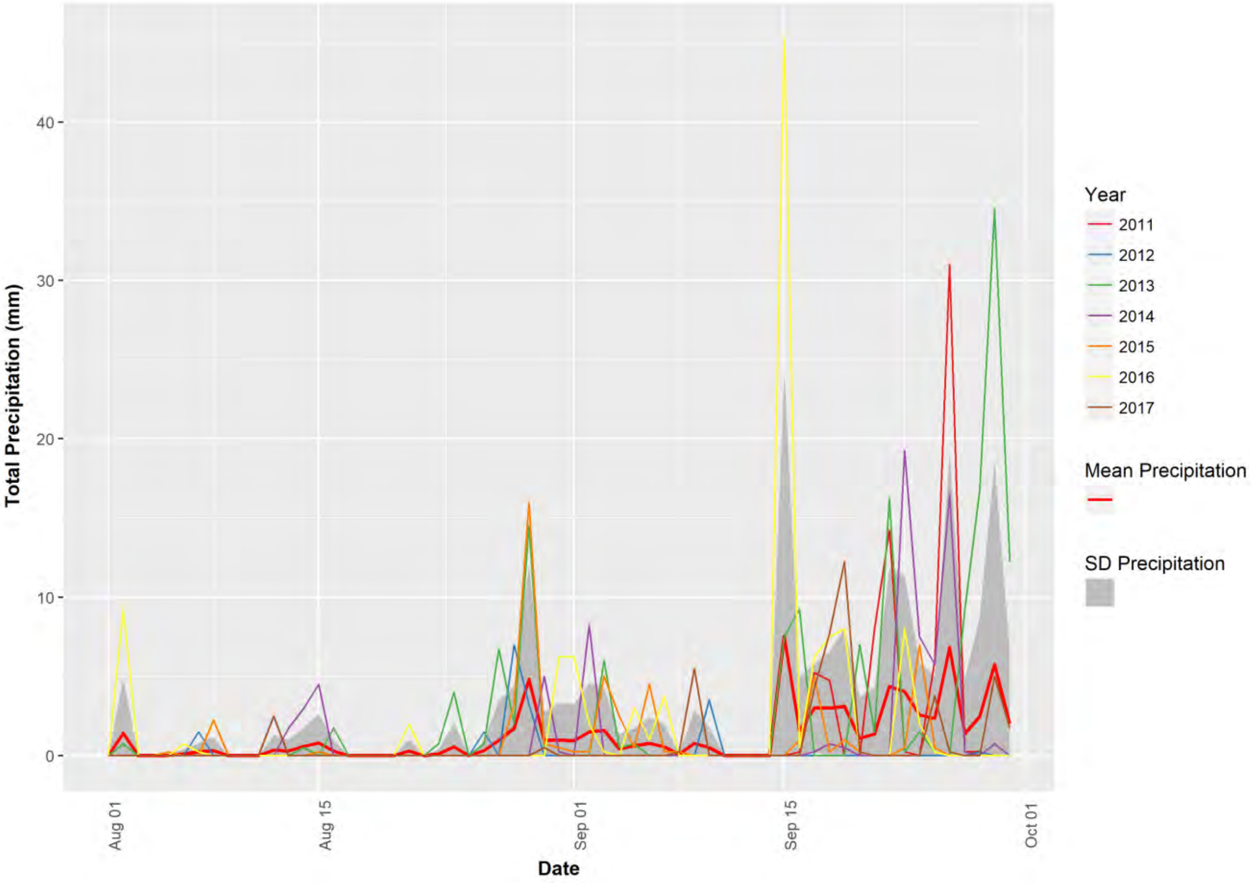

Figure A86. **Summer rainfall at RG Fire hall 4.**

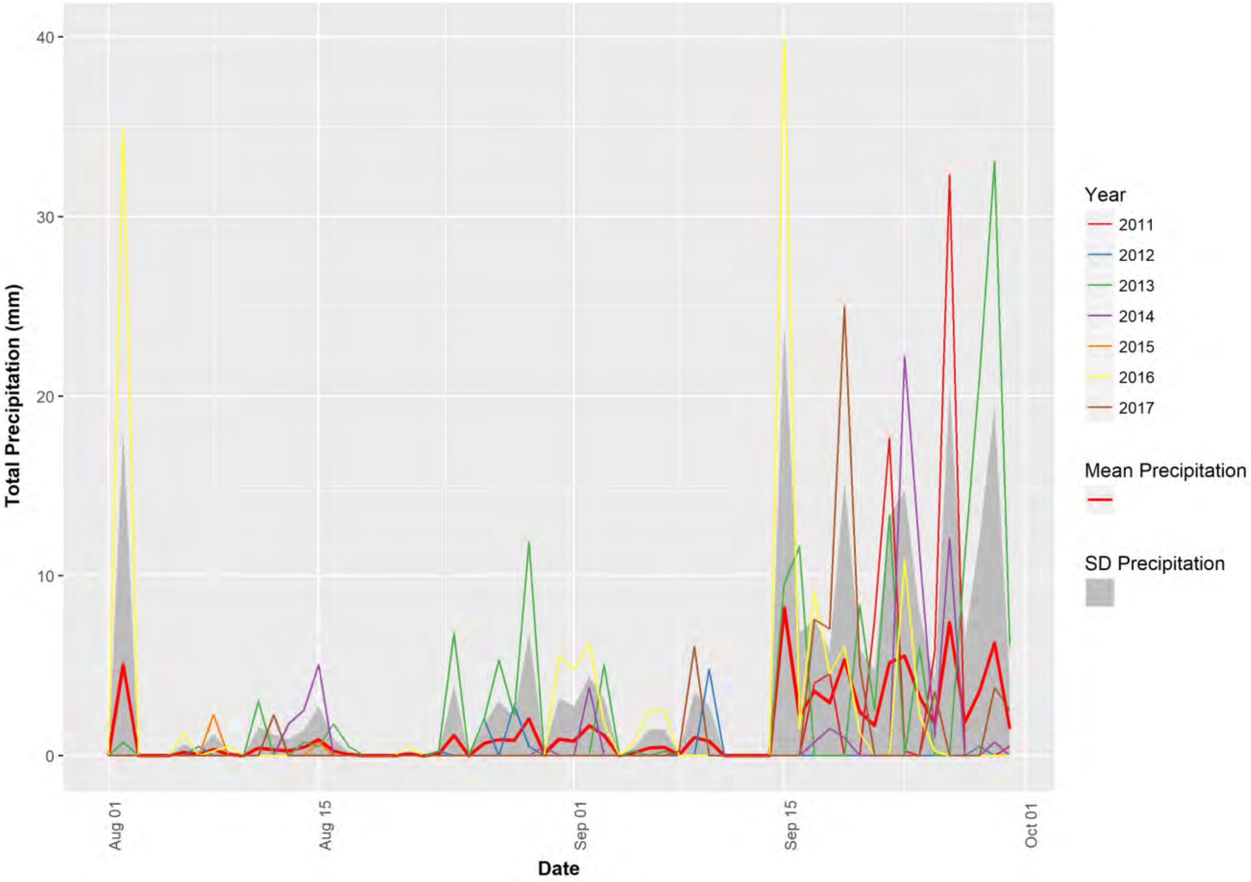

Figure A87. **Summer rainfall at RG Public Works.**

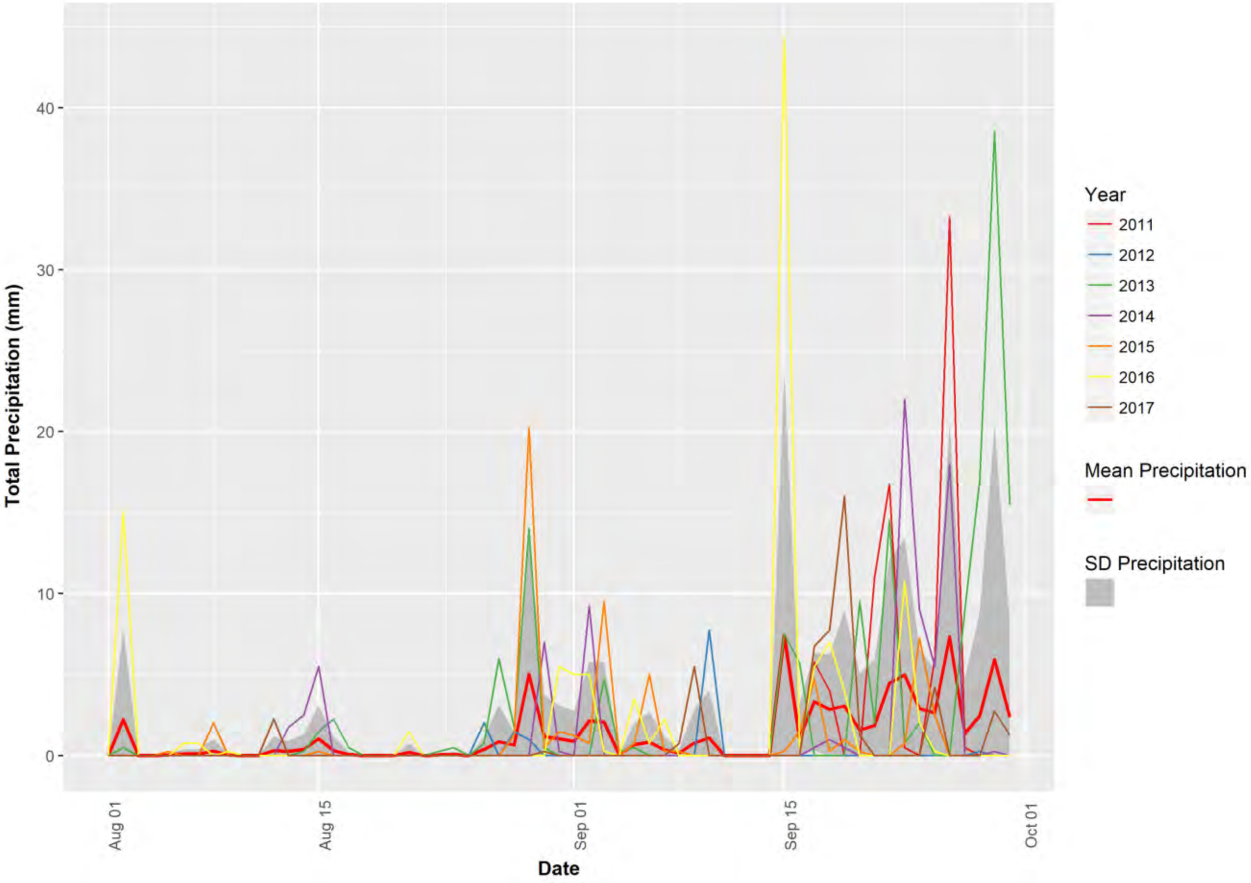

Figure A88. **Summer rainfall at RG Reservoir.**

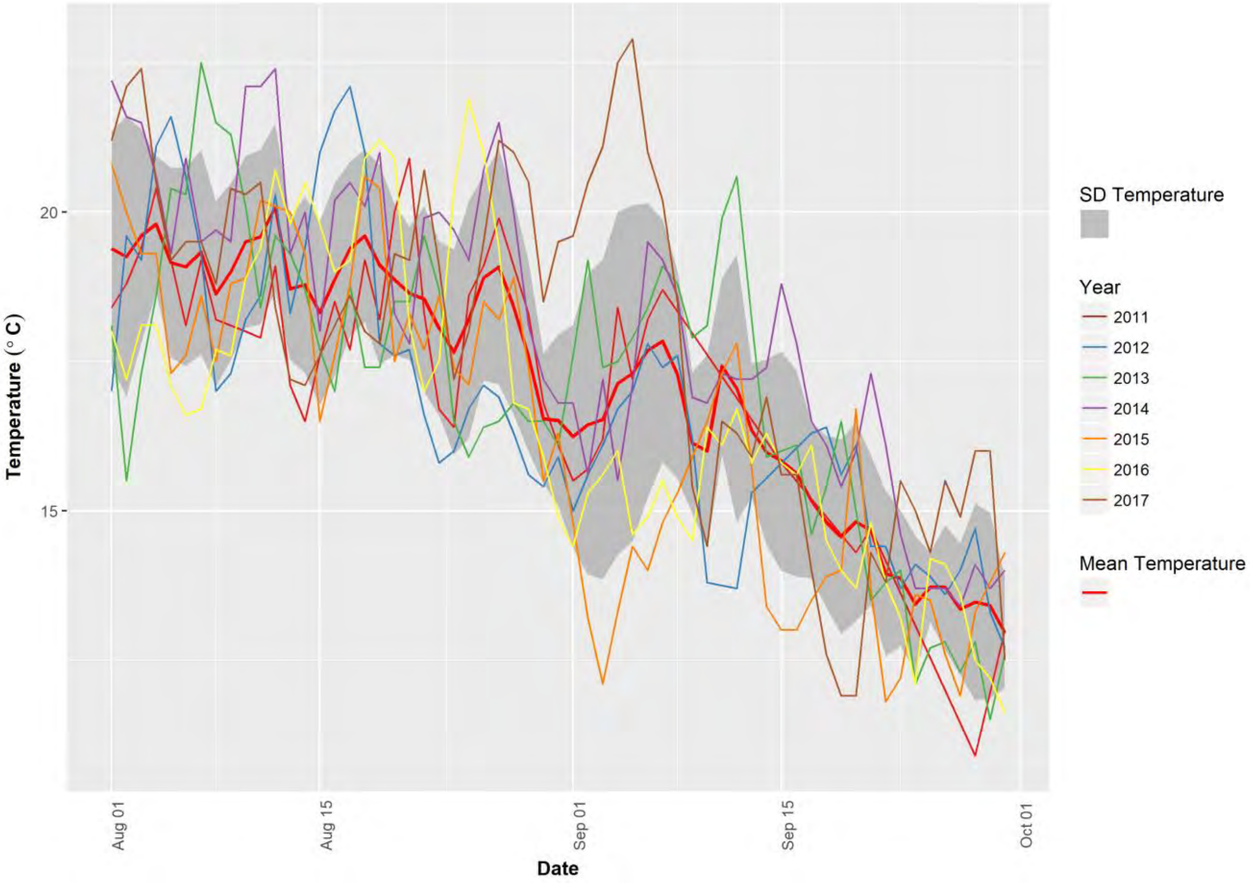

Figure A89. **Summer temperature at Ballenas Island.**

Figure A90. **Summer temperature at Entrance Island.**

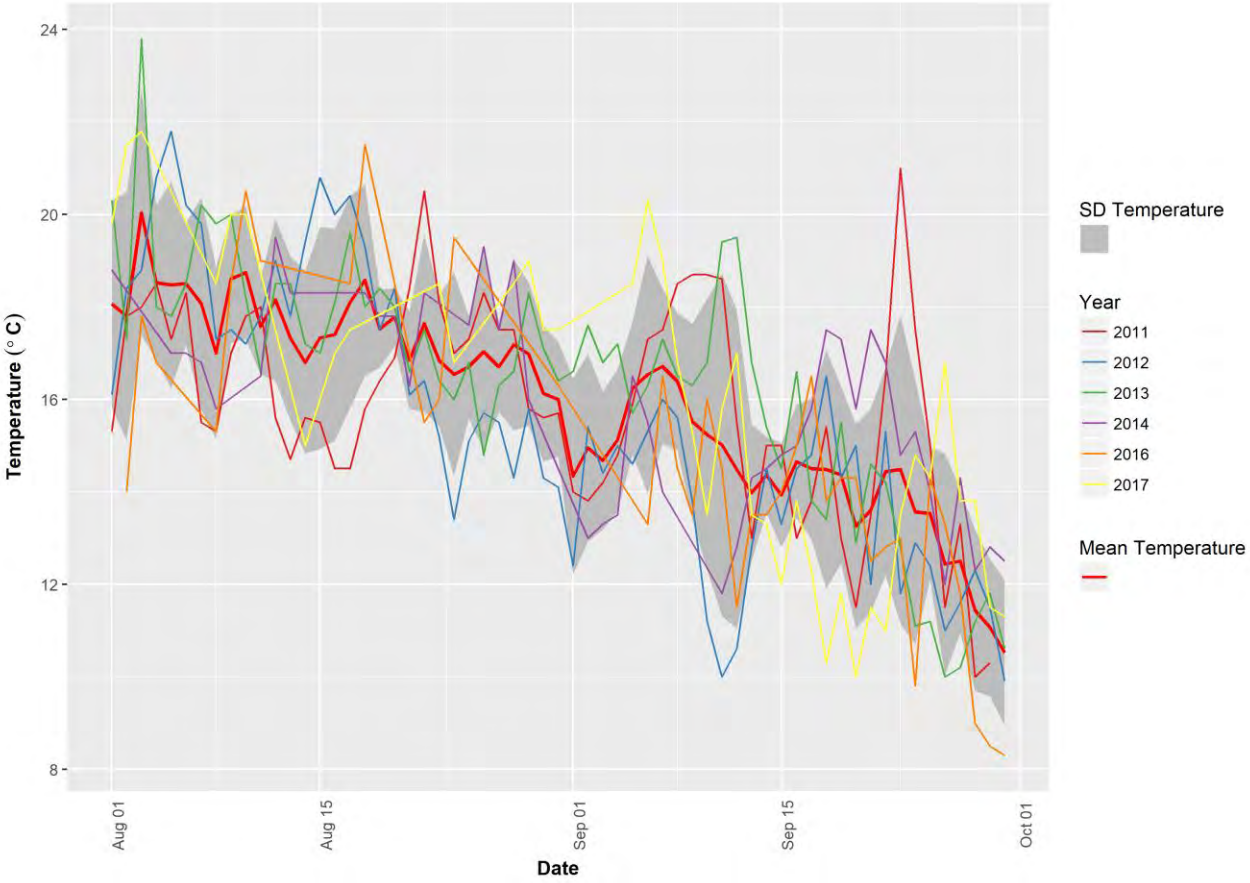

Figure A91. **Summer temperature at Little Qualicum Hatchery.**

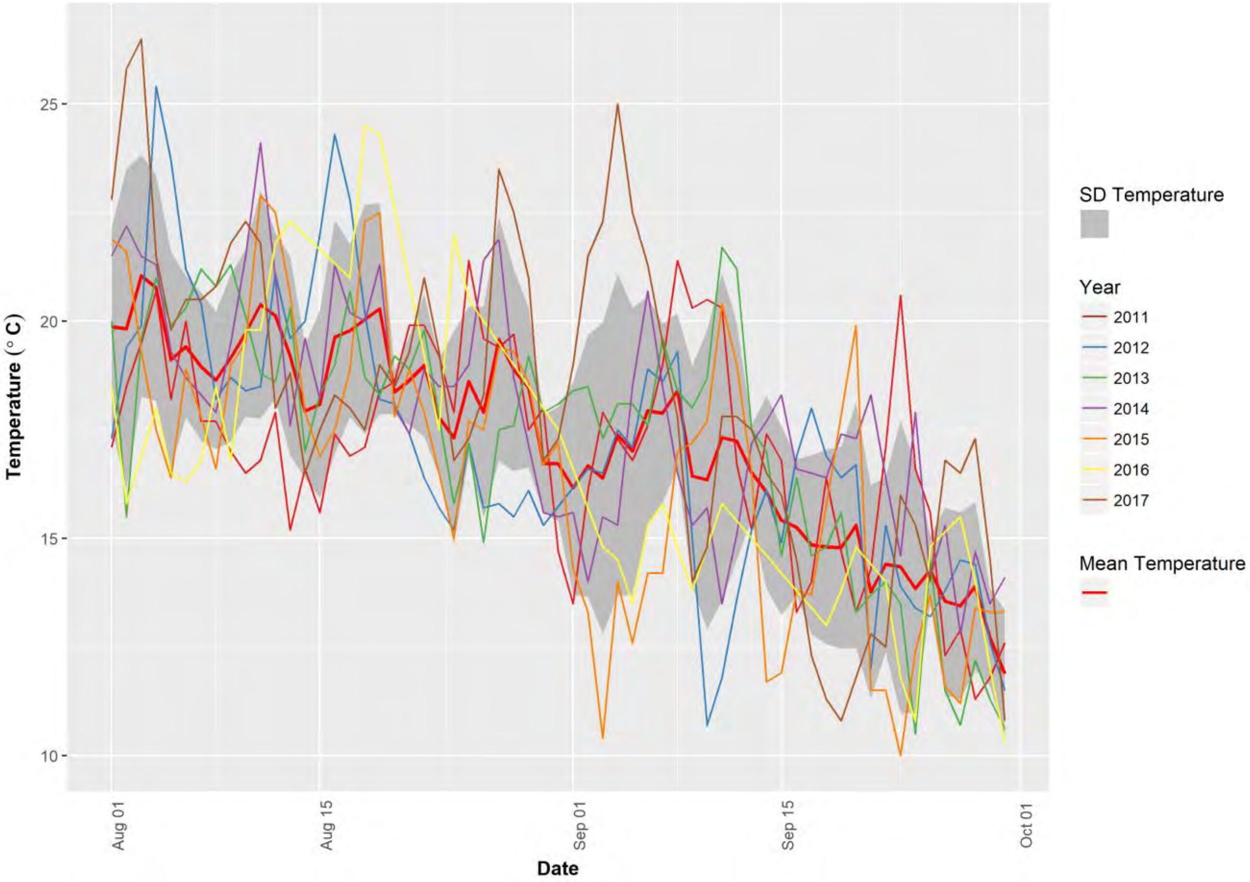

Figure A92. **Summer temperature at Nanaimo A.**

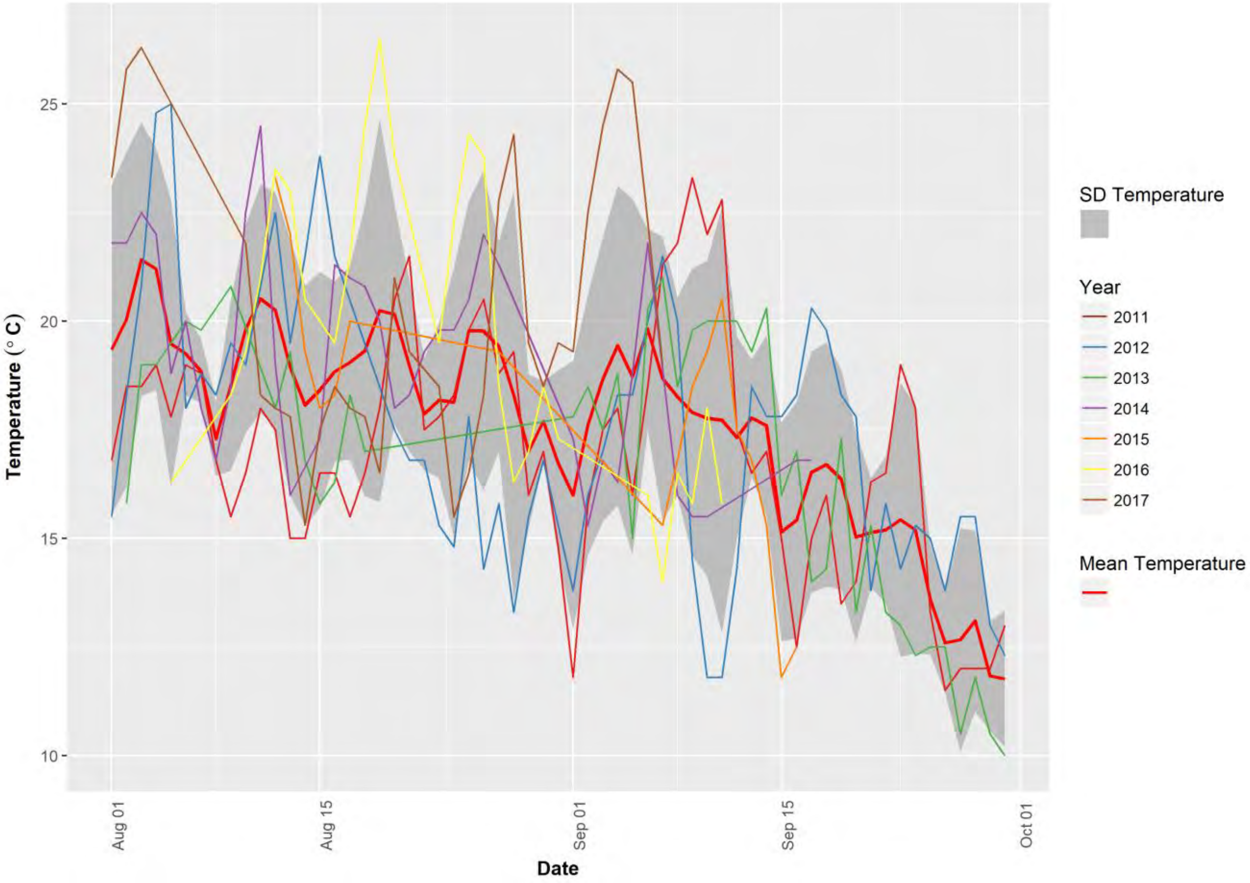

Figure A93. **Summer temperature at Cox Lake, Port Albernie.**

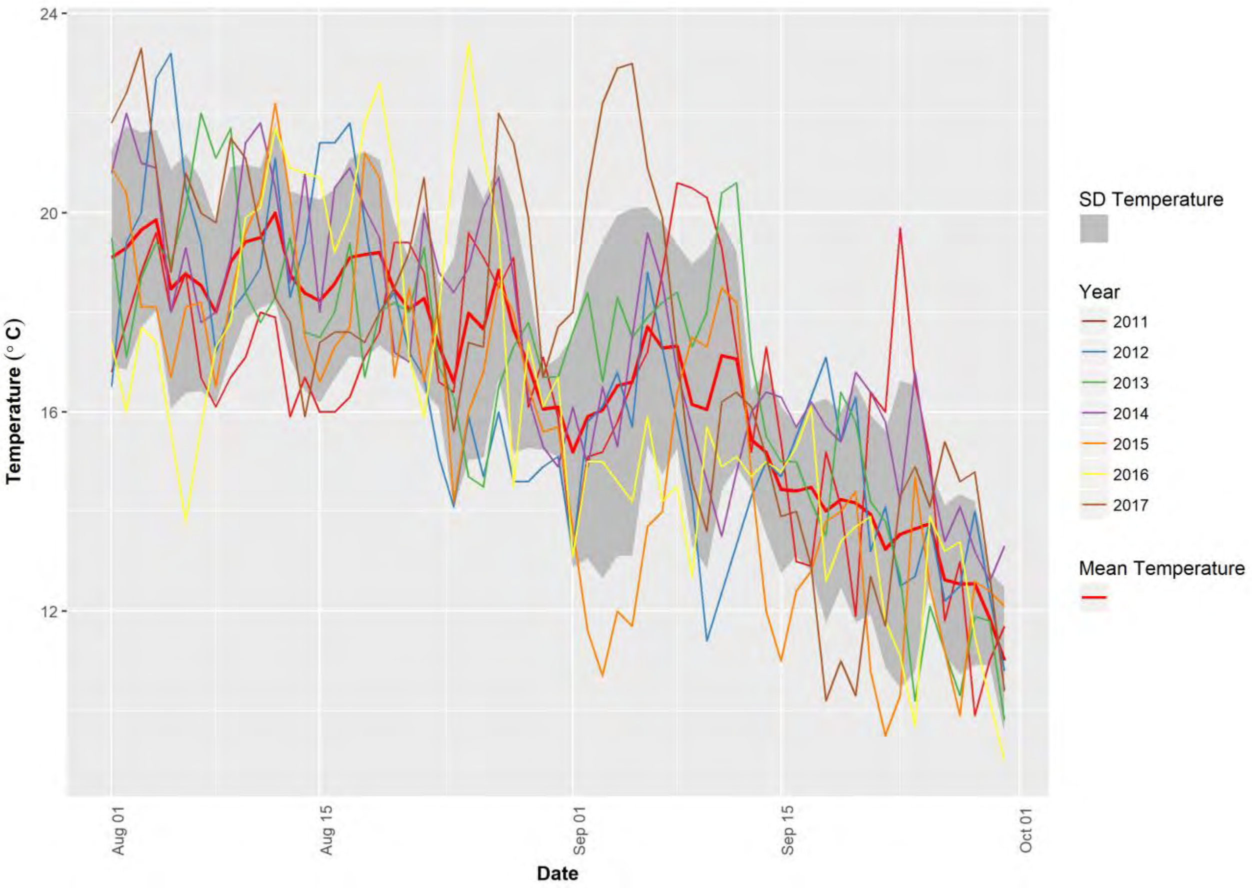

Figure A94. Summer temperature at Qualicum Beach Airport.

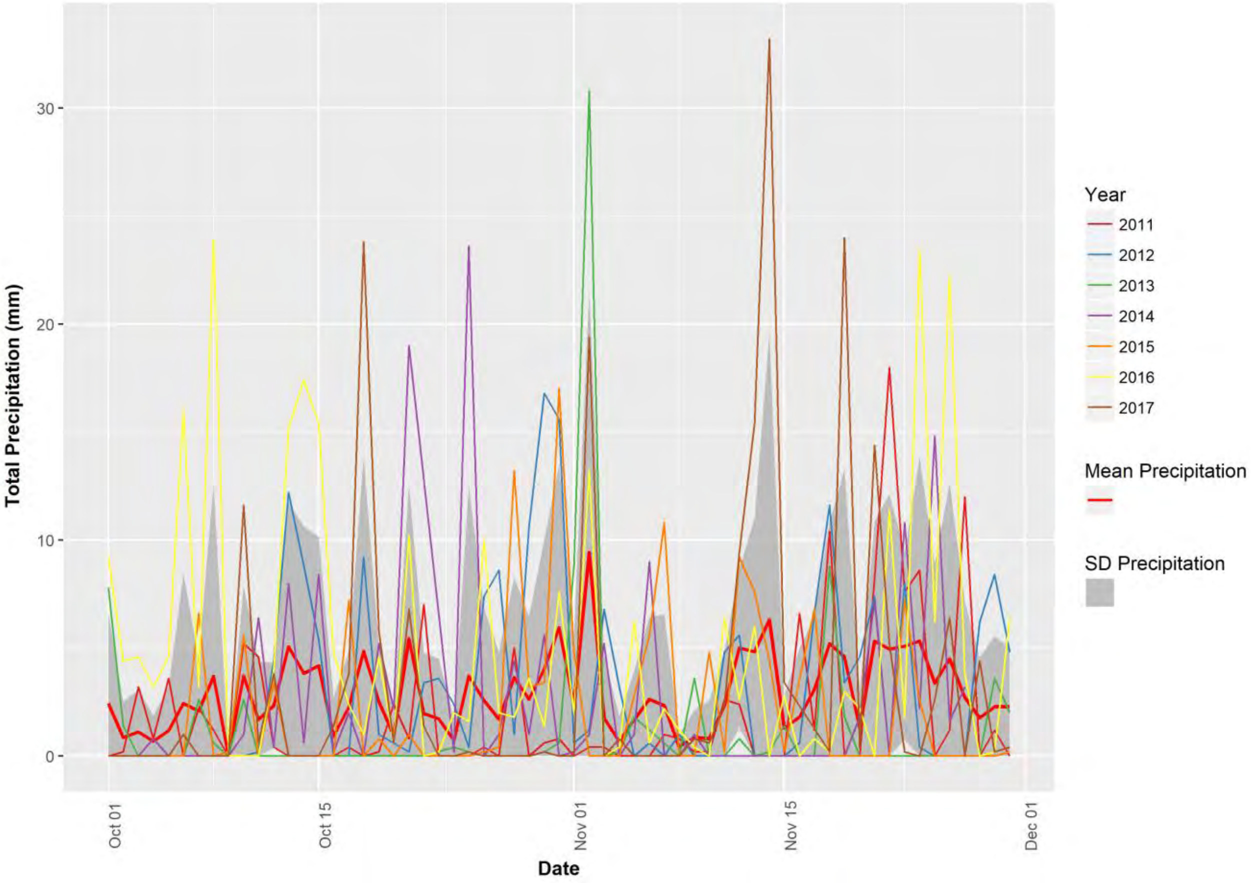

Figure A95. **Fall Rainfall at Ballenas Island.**

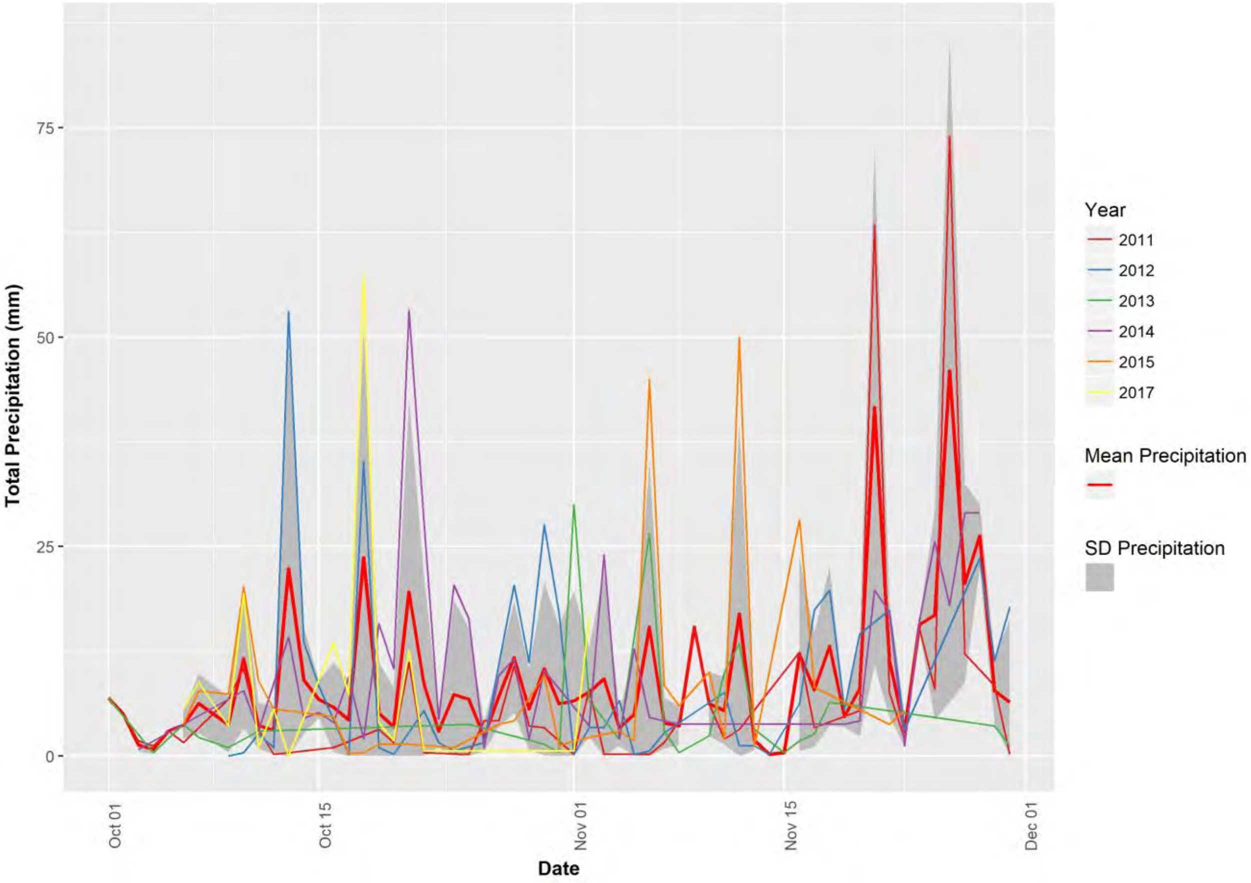

Figure A96. **Fall Rainfall at Big Qualicum Hatchery.**

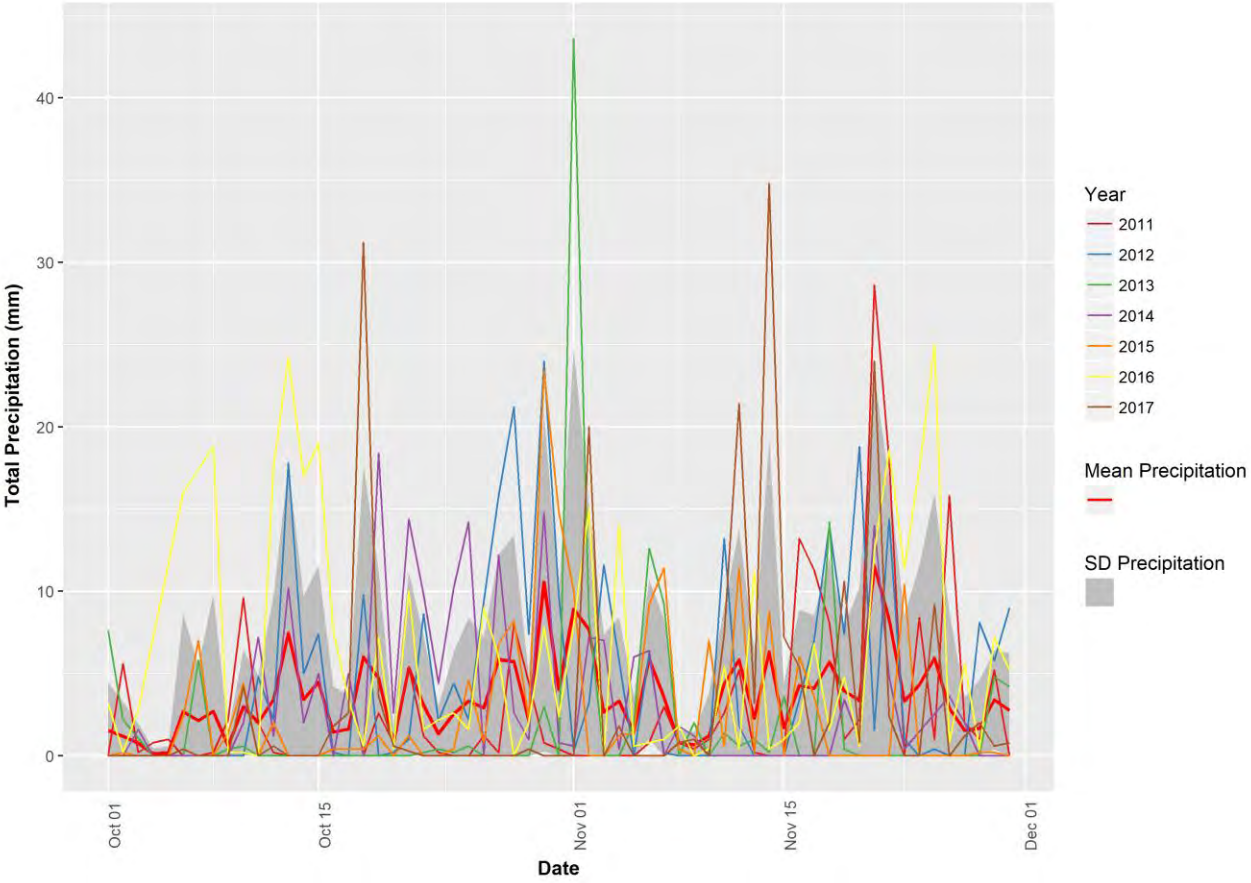

Figure A97. **Fall Rainfall at Entrance Island.**

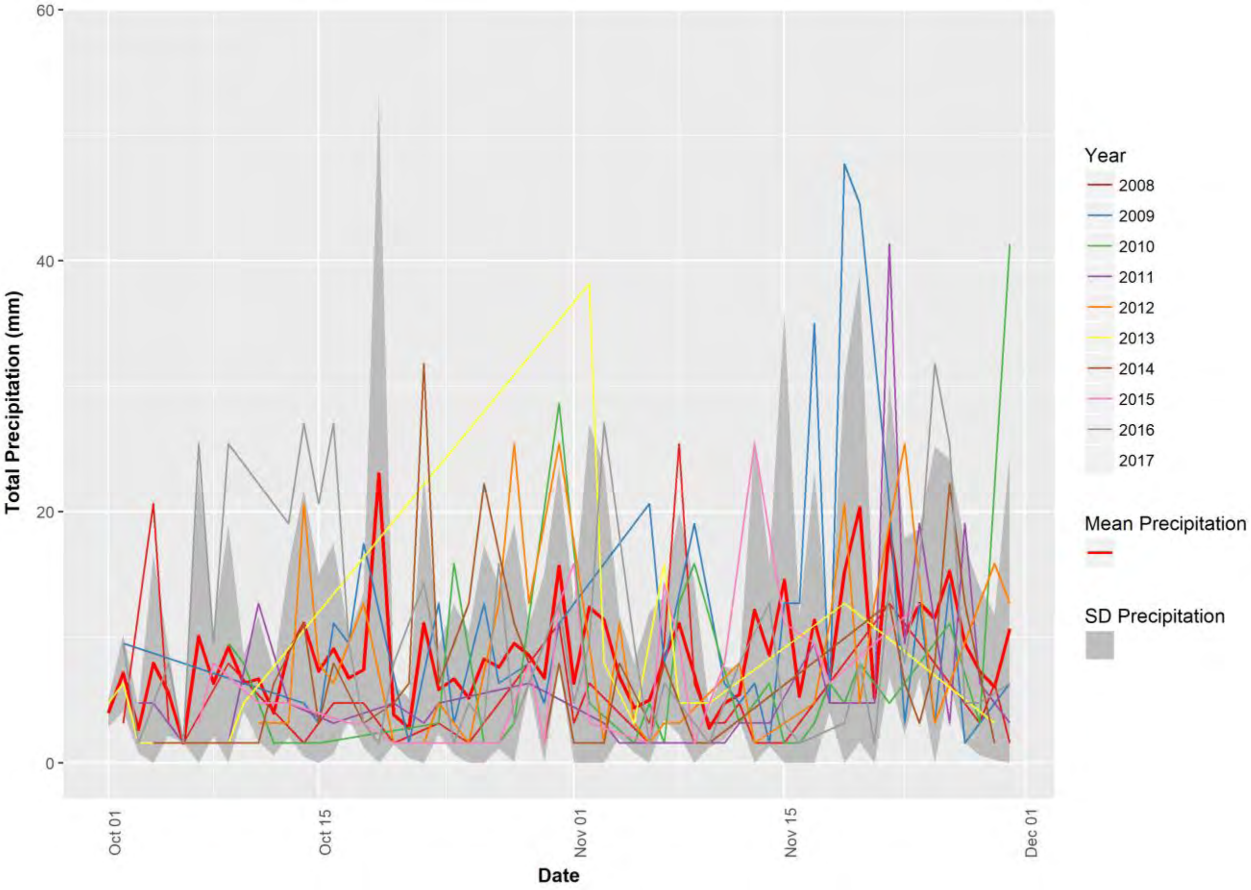

Figure A98. **Fall Rainfall at Fairwinds Golf Course.**

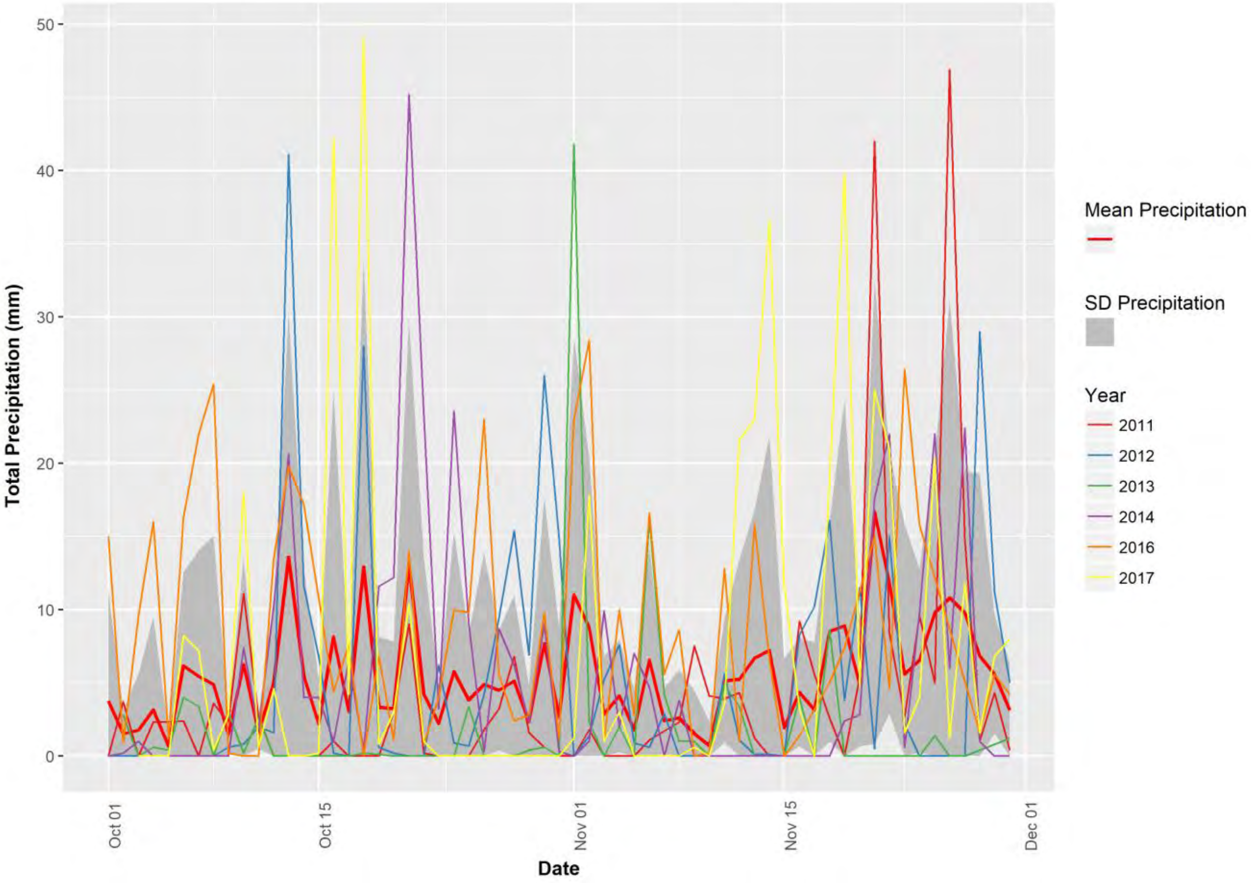

Figure A99. **Fall Rainfall at Little Qualicum Hatchery.**

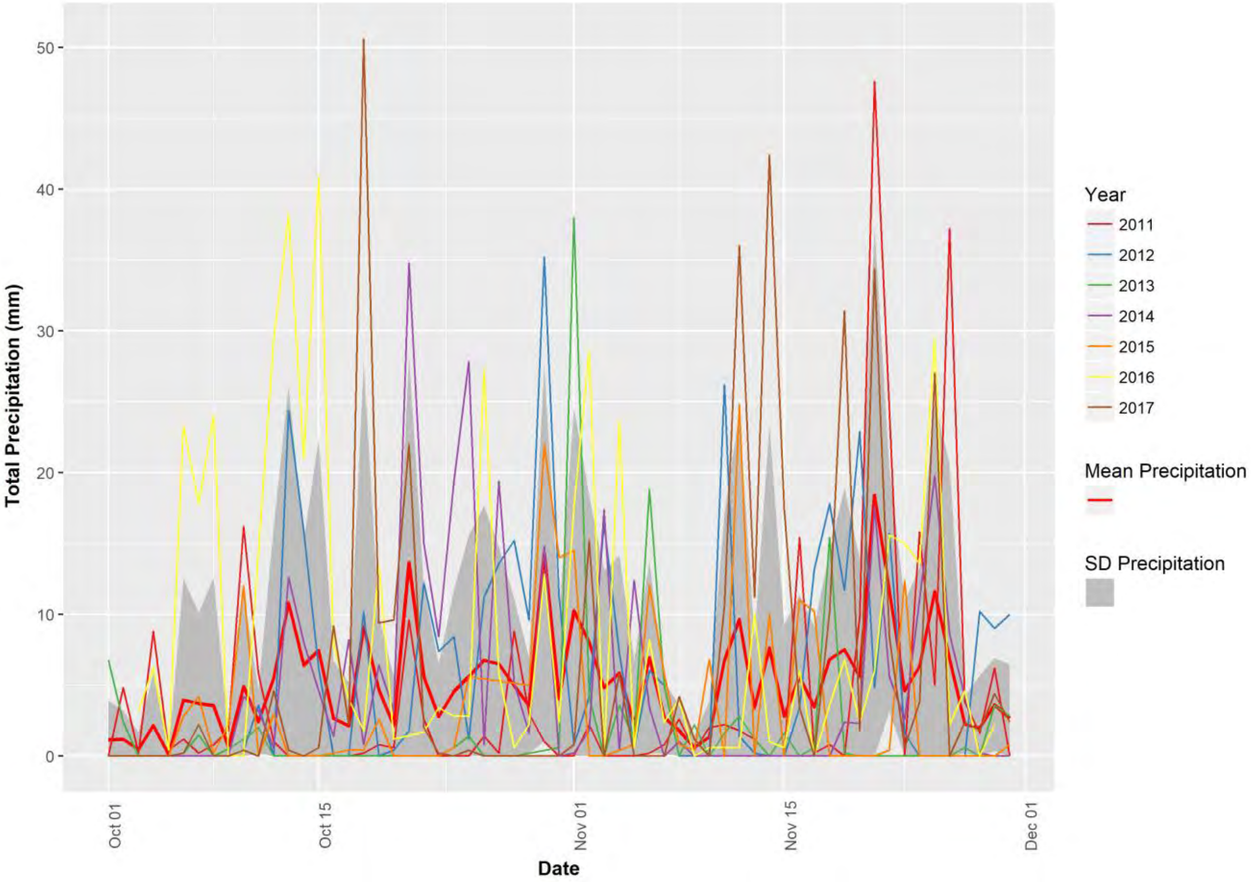

Figure A100. **Fall Rainfall at Nanaimo A.**

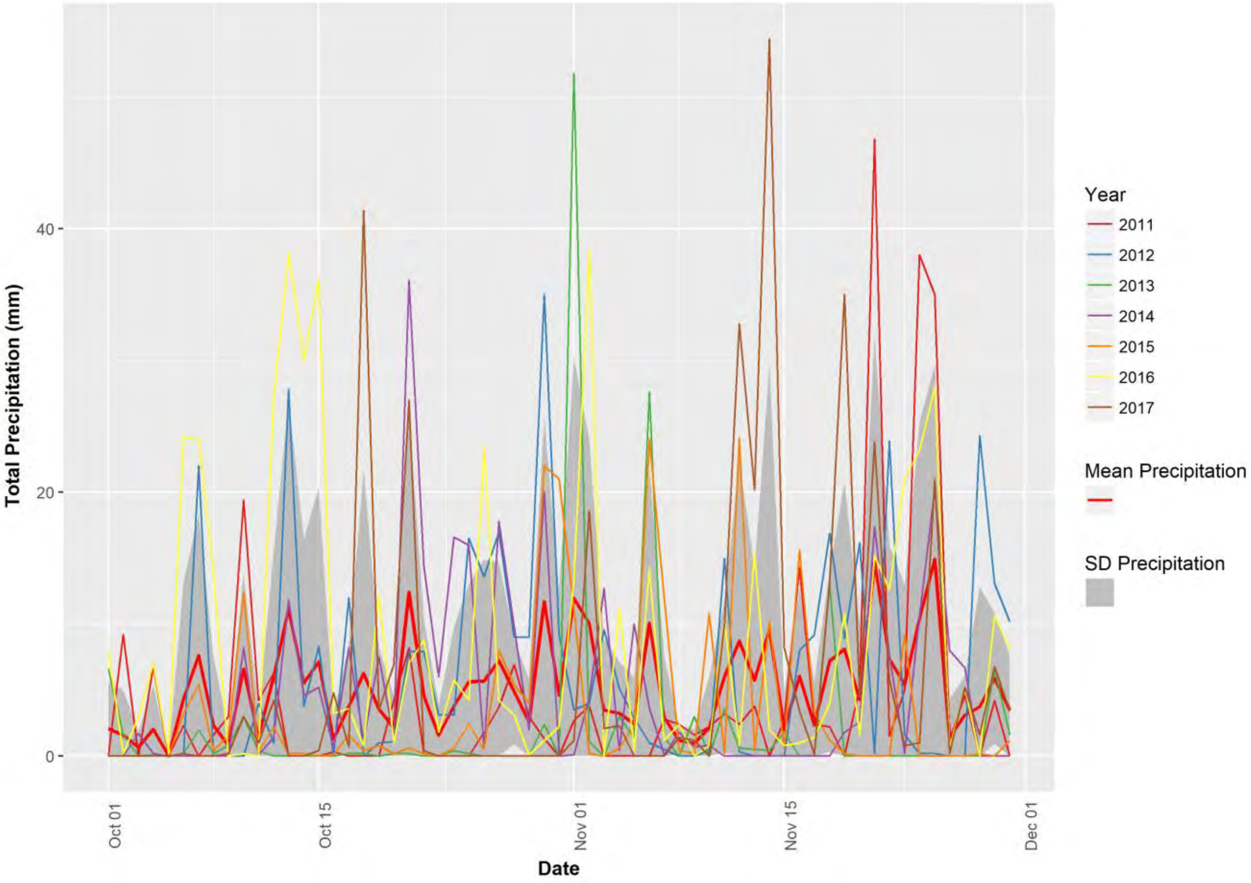

Figure A101. **Fall Rainfall at Nanaimo City Yard.**

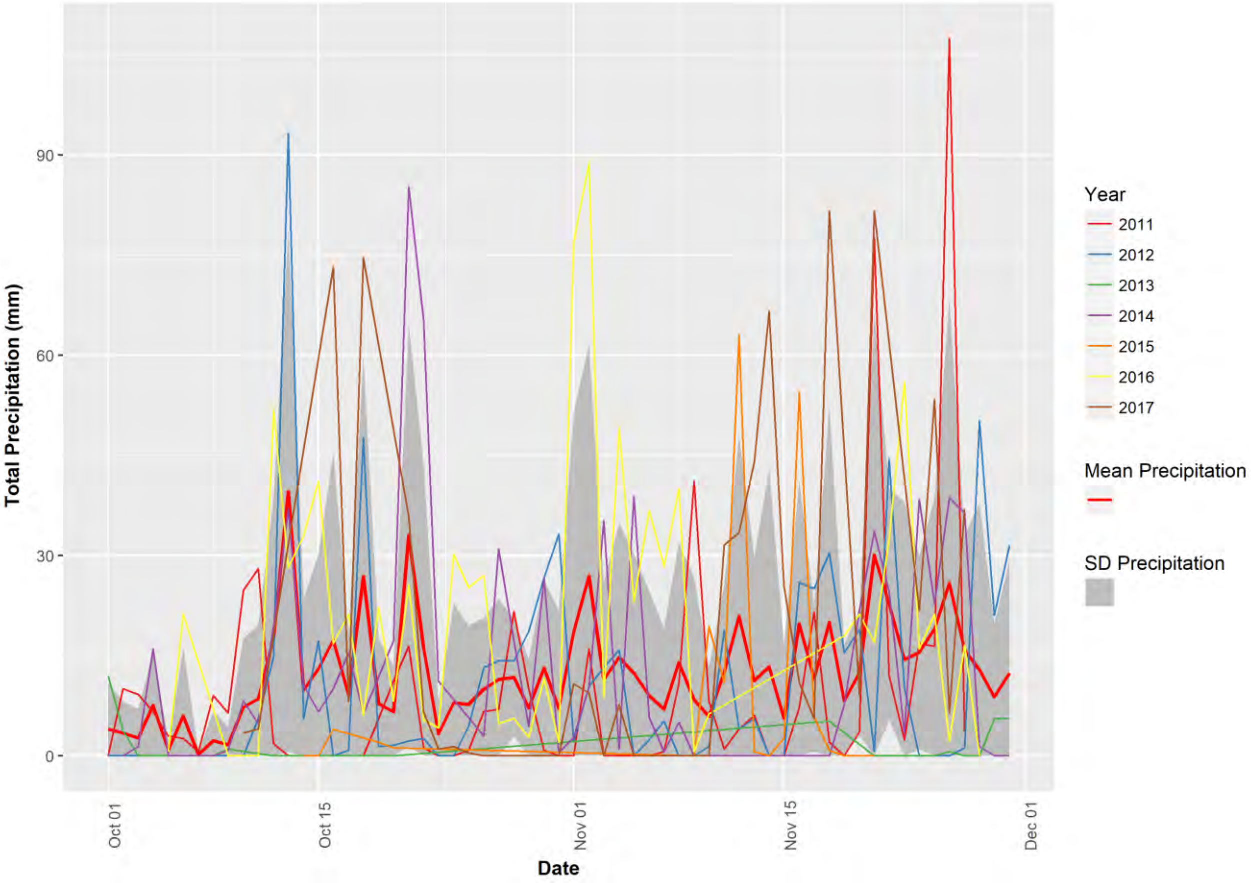

Figure A102. **Fall Rainfall at Cox Lake, Port Alberni.**

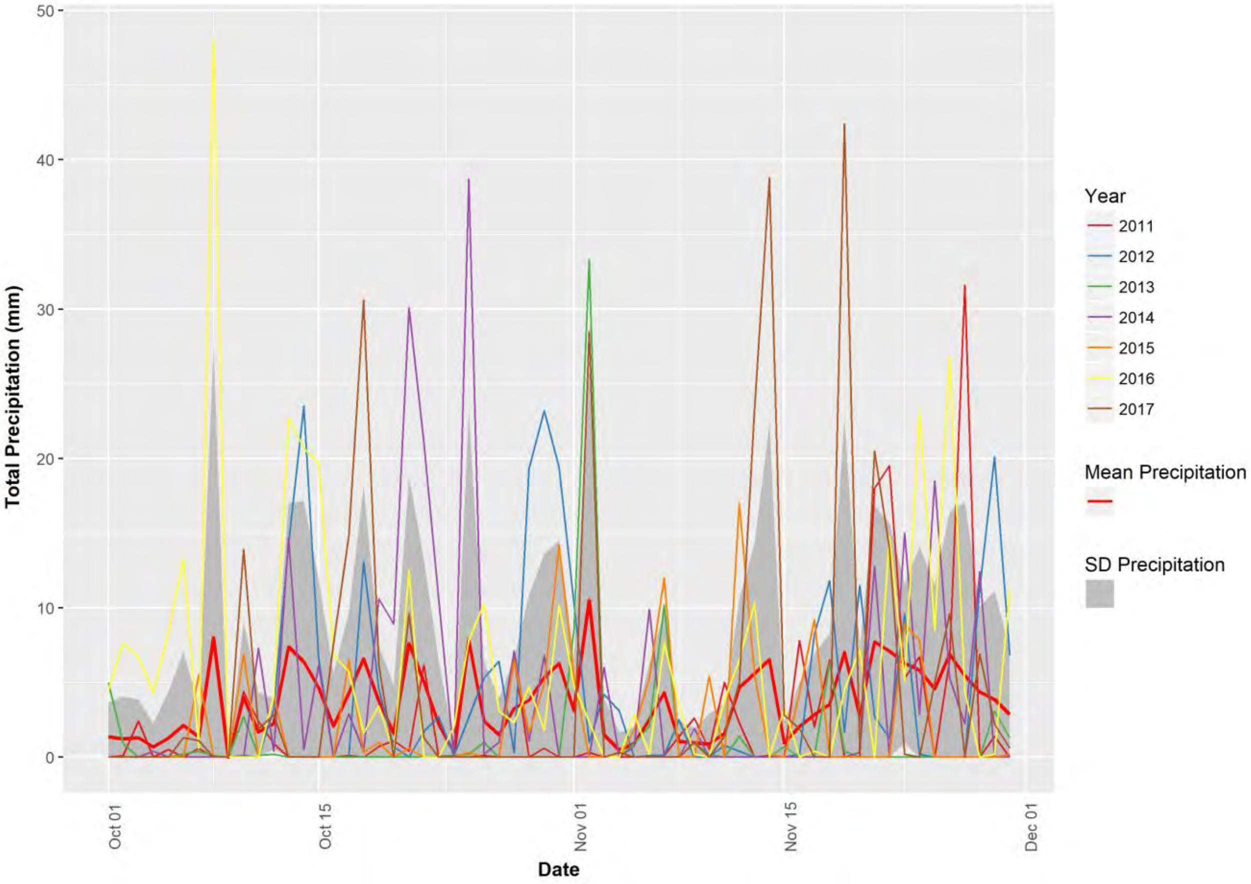

Figure A103. **Fall Rainfall at Qualicum Beach Airport.**

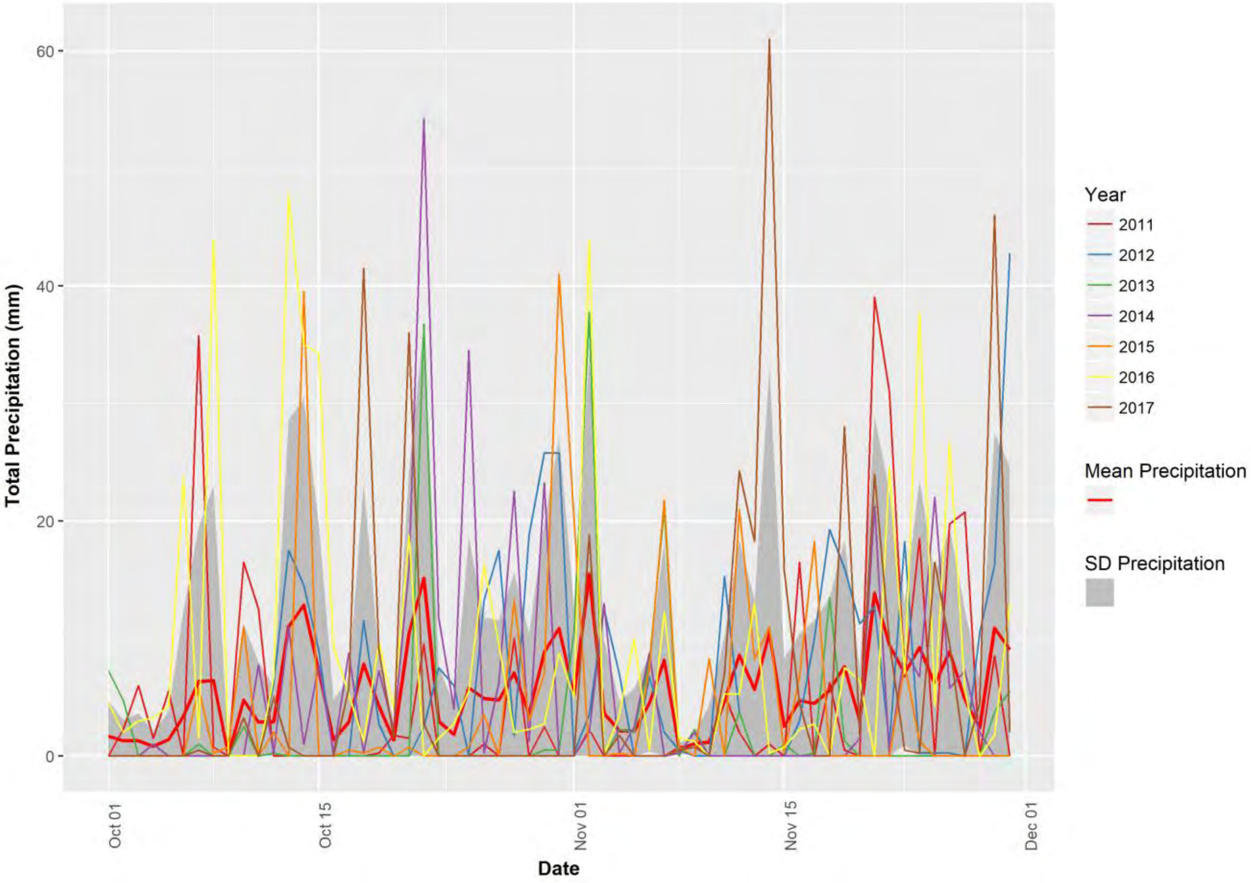

Figure A104. Fall Rainfall at RG City Hall.

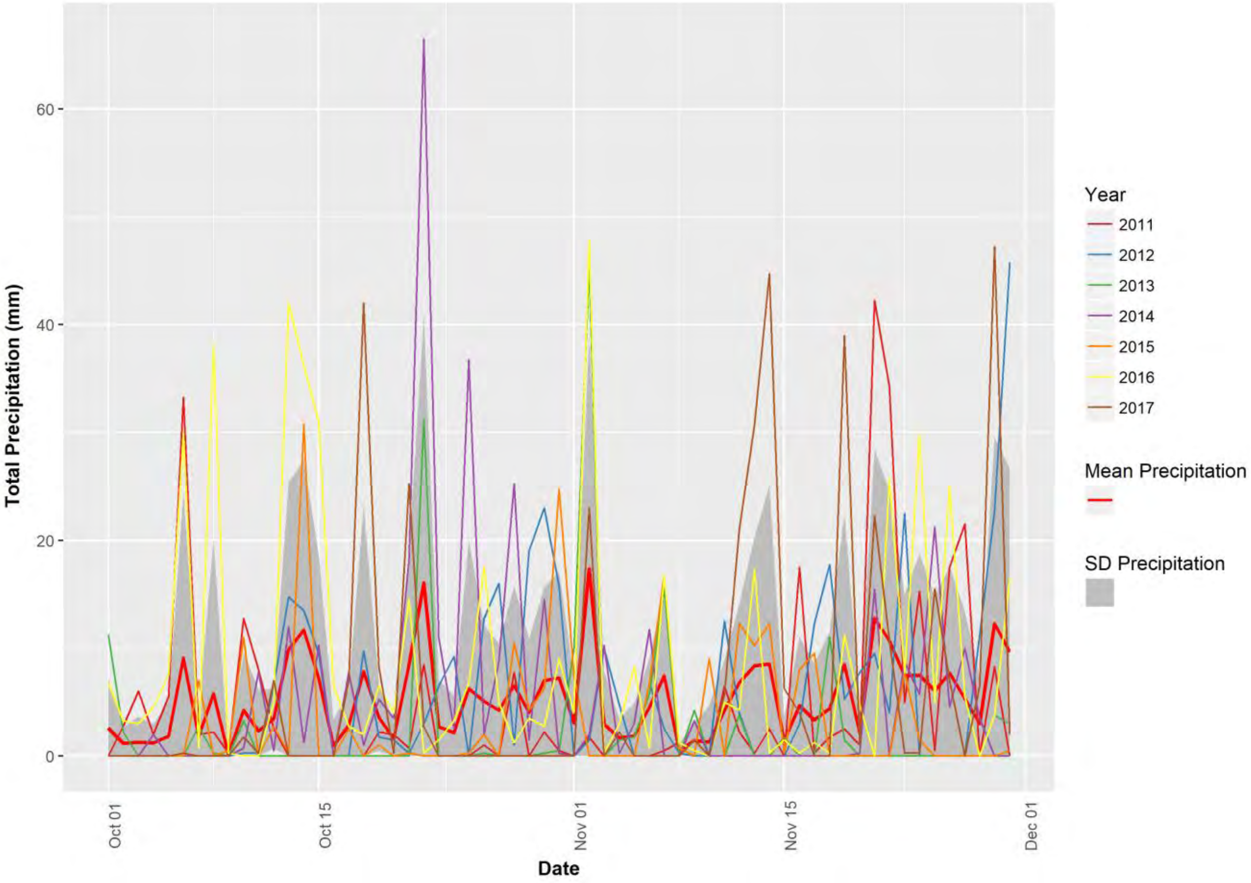

Figure A105. **Fall Rainfall at RG Fire hall 3.**

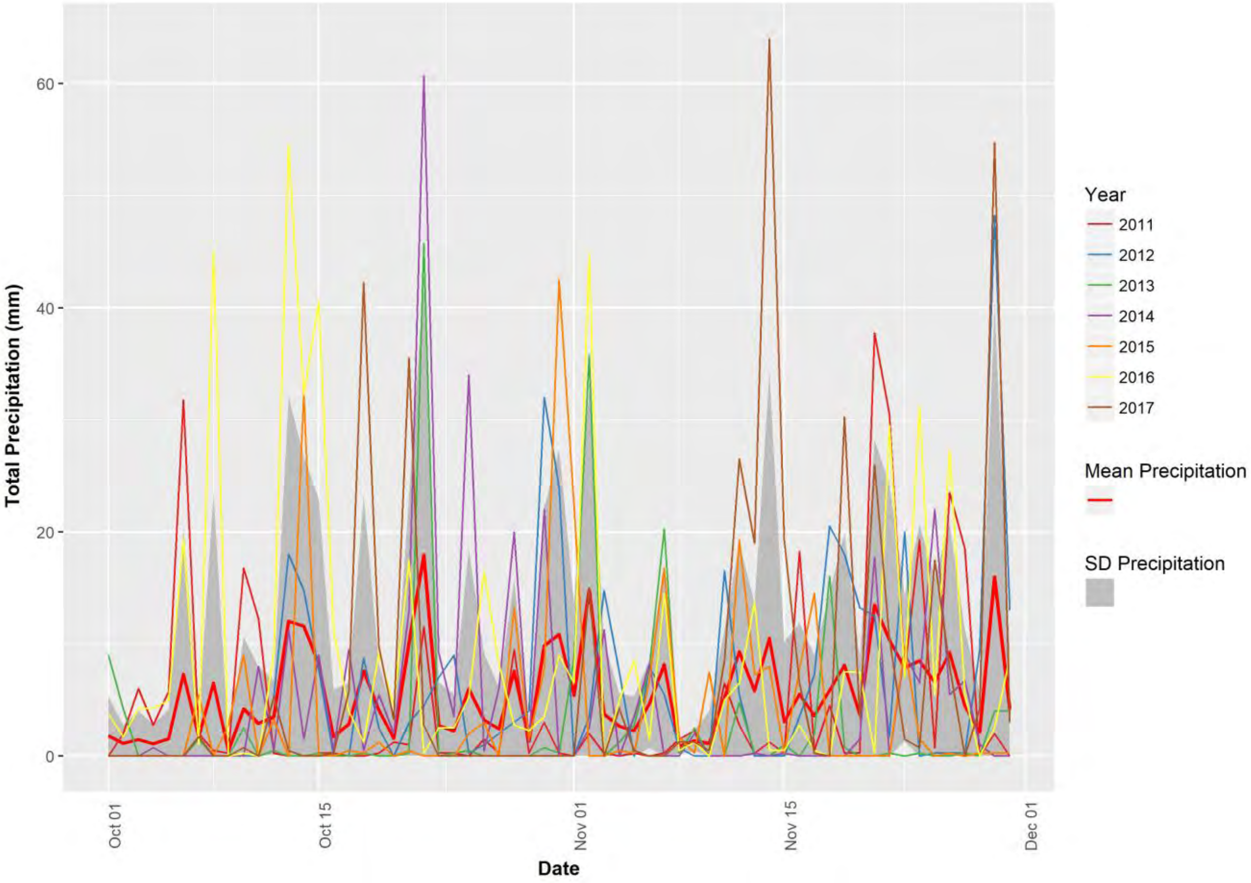

Figure A106. **Fall Rainfall at RG Fire hall 4.**

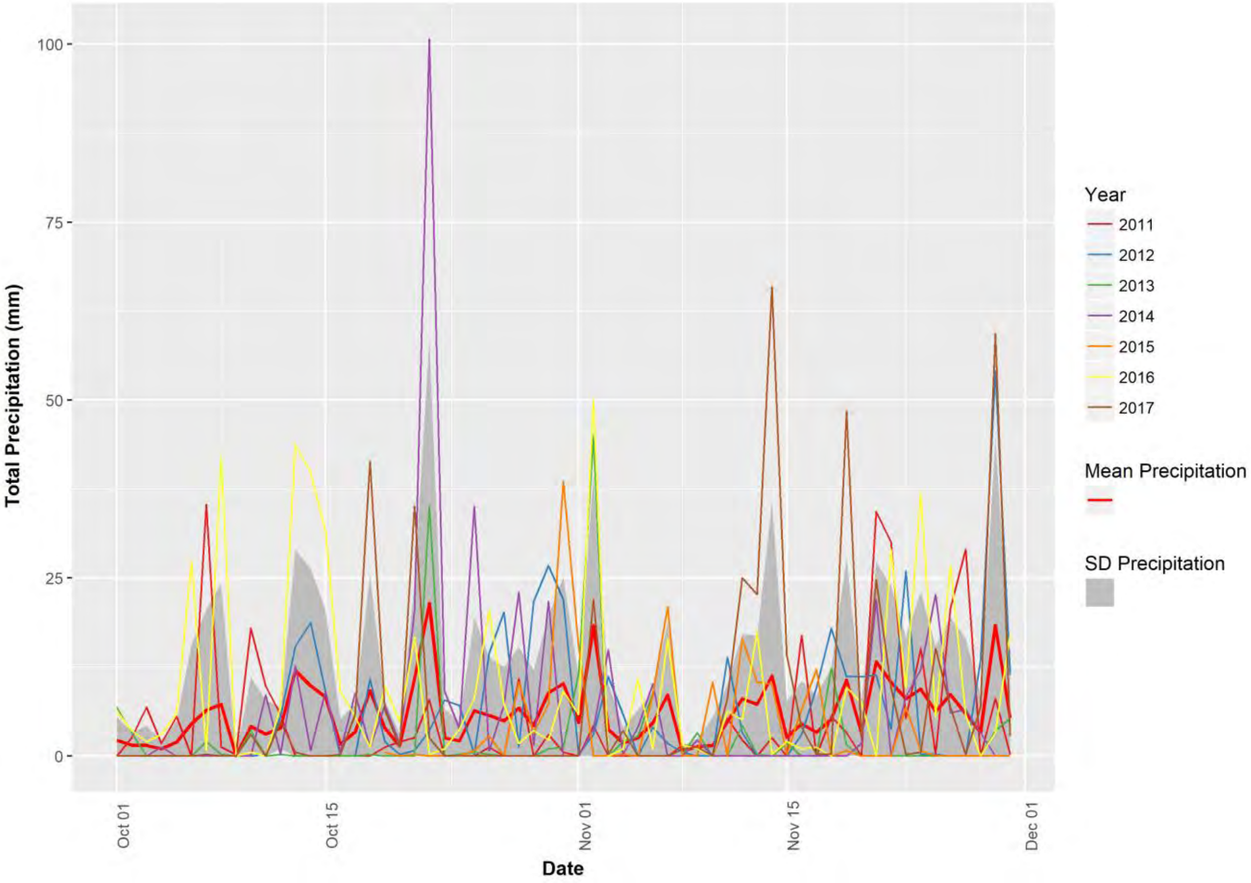

Figure A107. **Fall Rainfall at RG Public Works.**

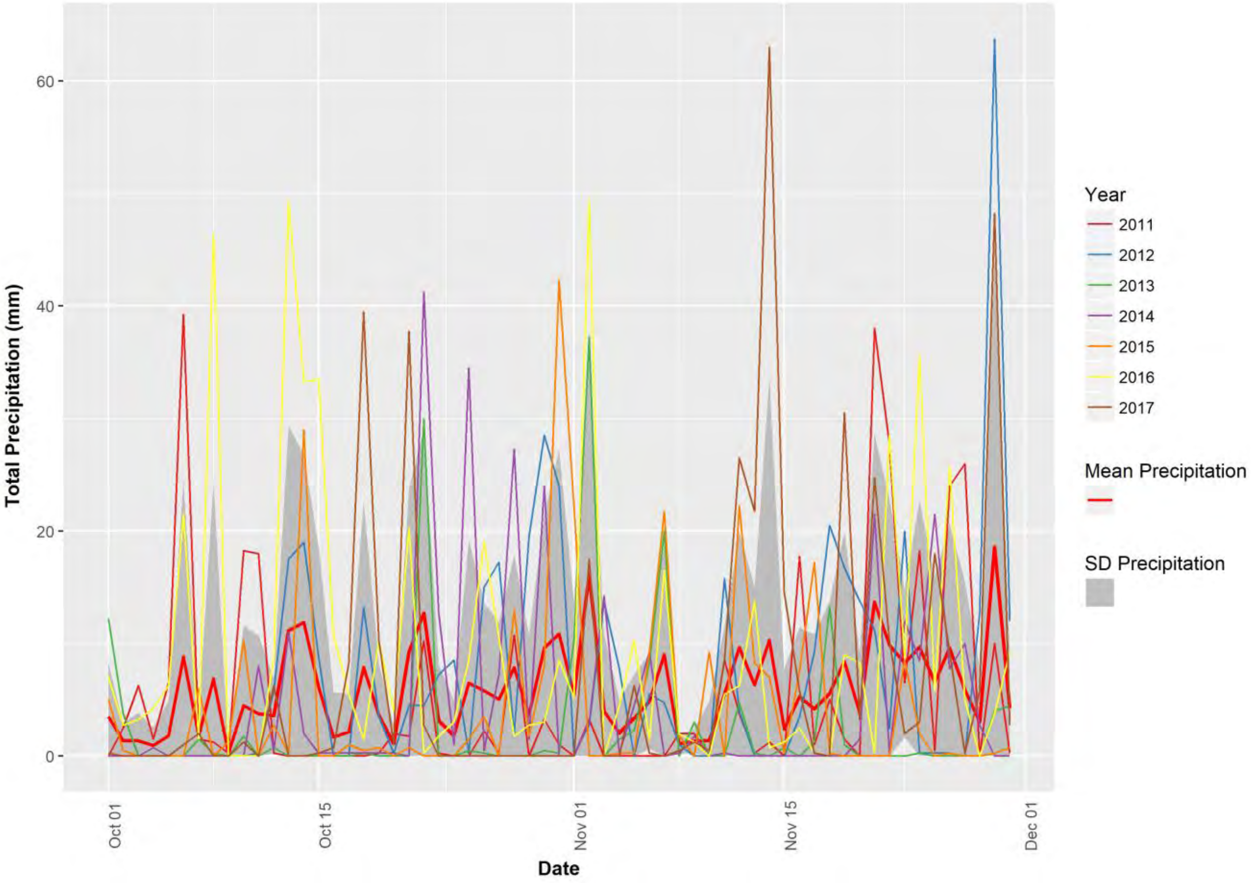

Figure A108. Fall Rainfall at RG Reservoir.

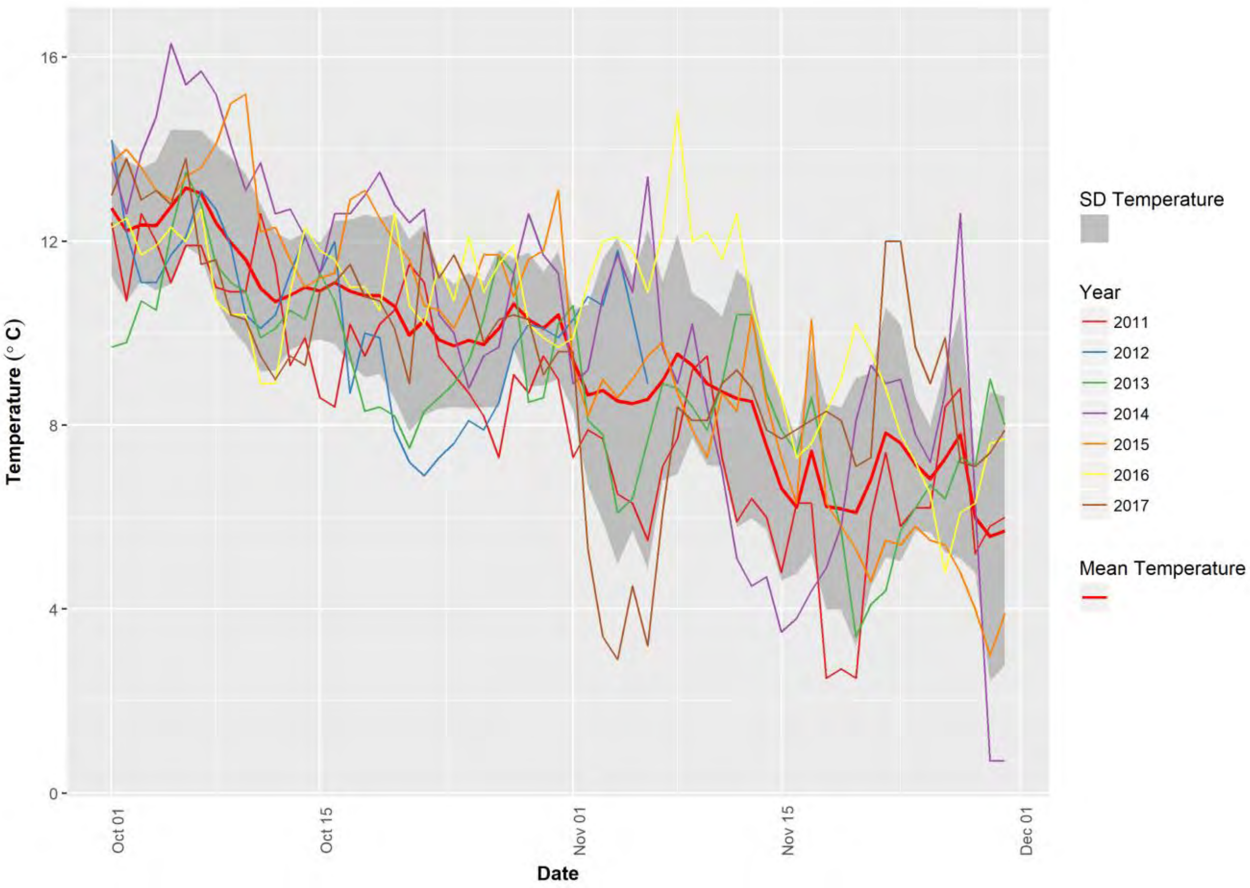

Figure A109. **Fall Temperature at Ballenas Island.**

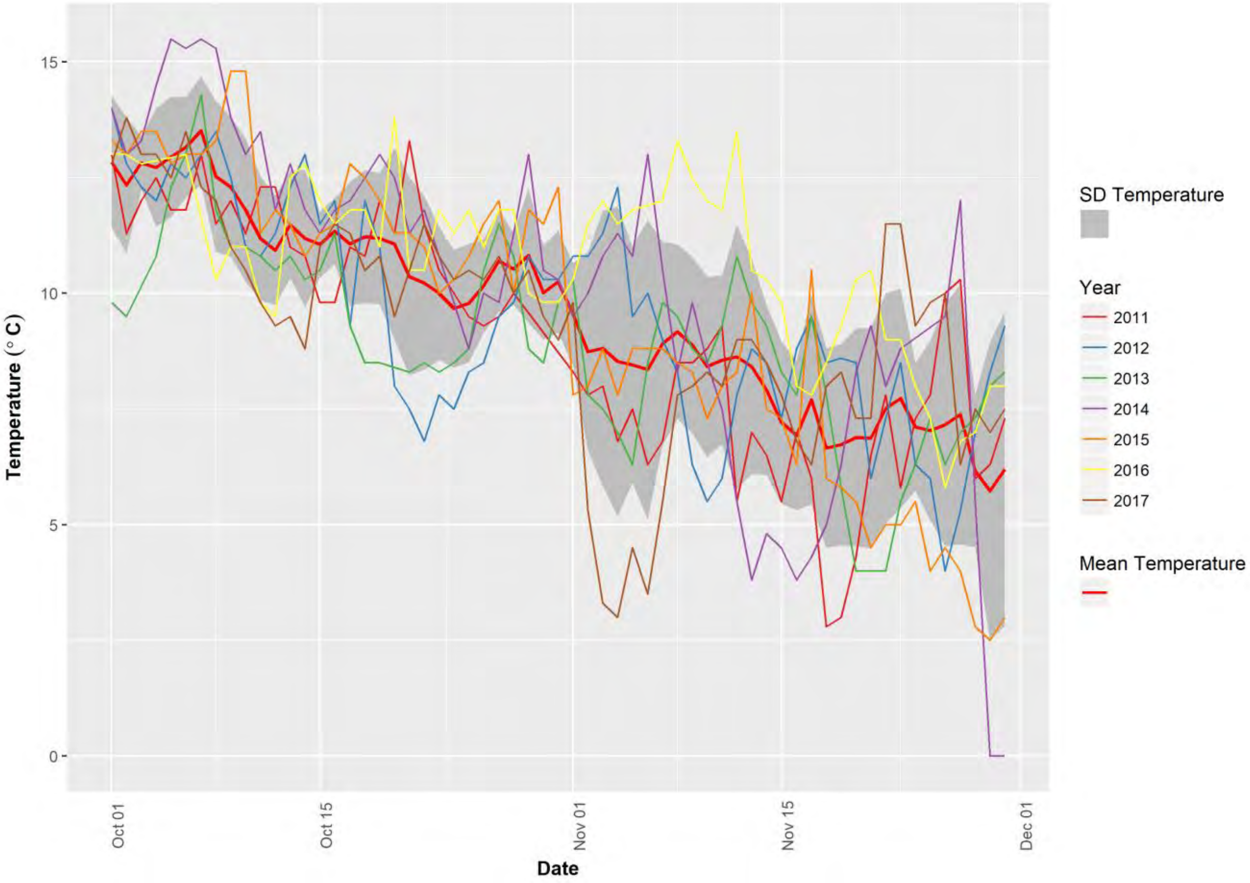

Figure A110. **Fall Temperature at Entrance Island.**

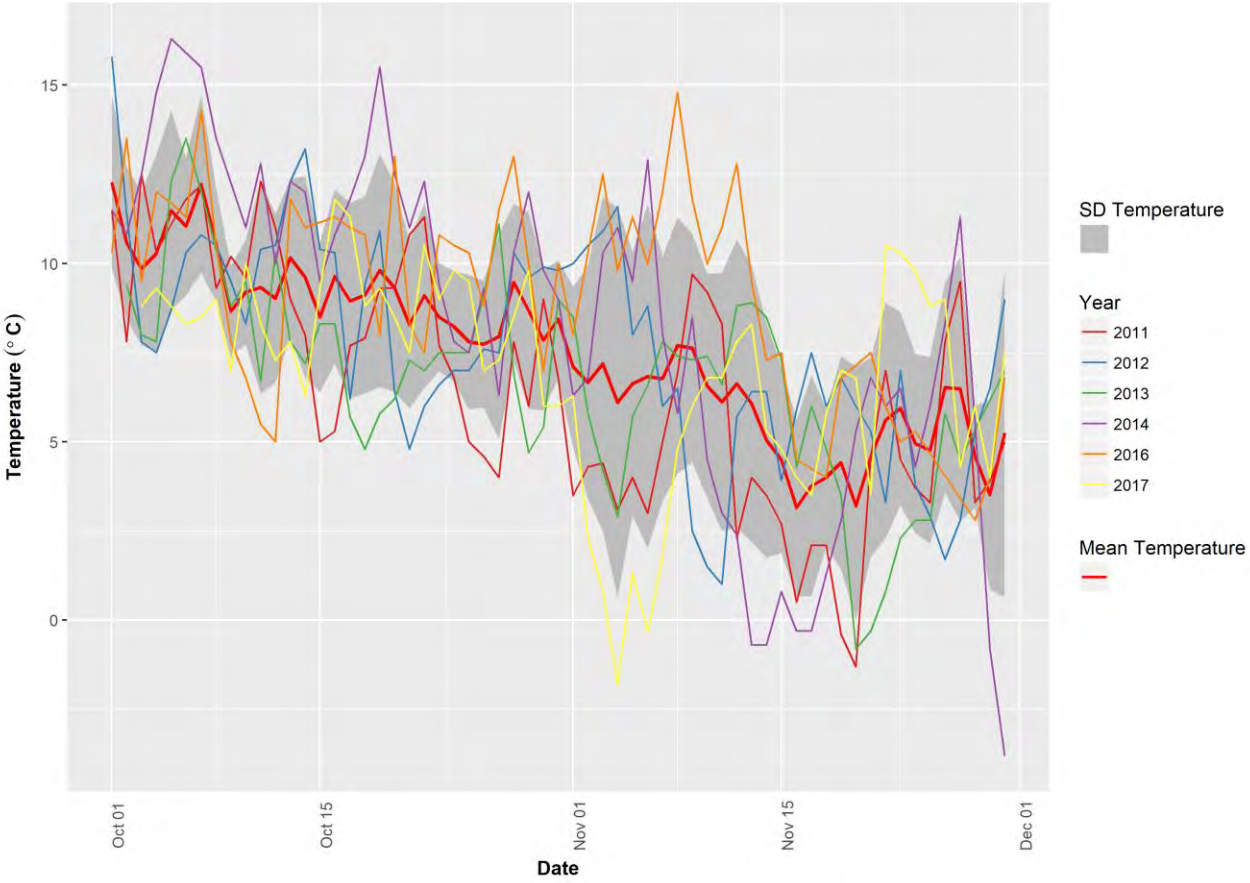

Figure A111. **Fall Temperature at Little Qualicum Hatchery.**

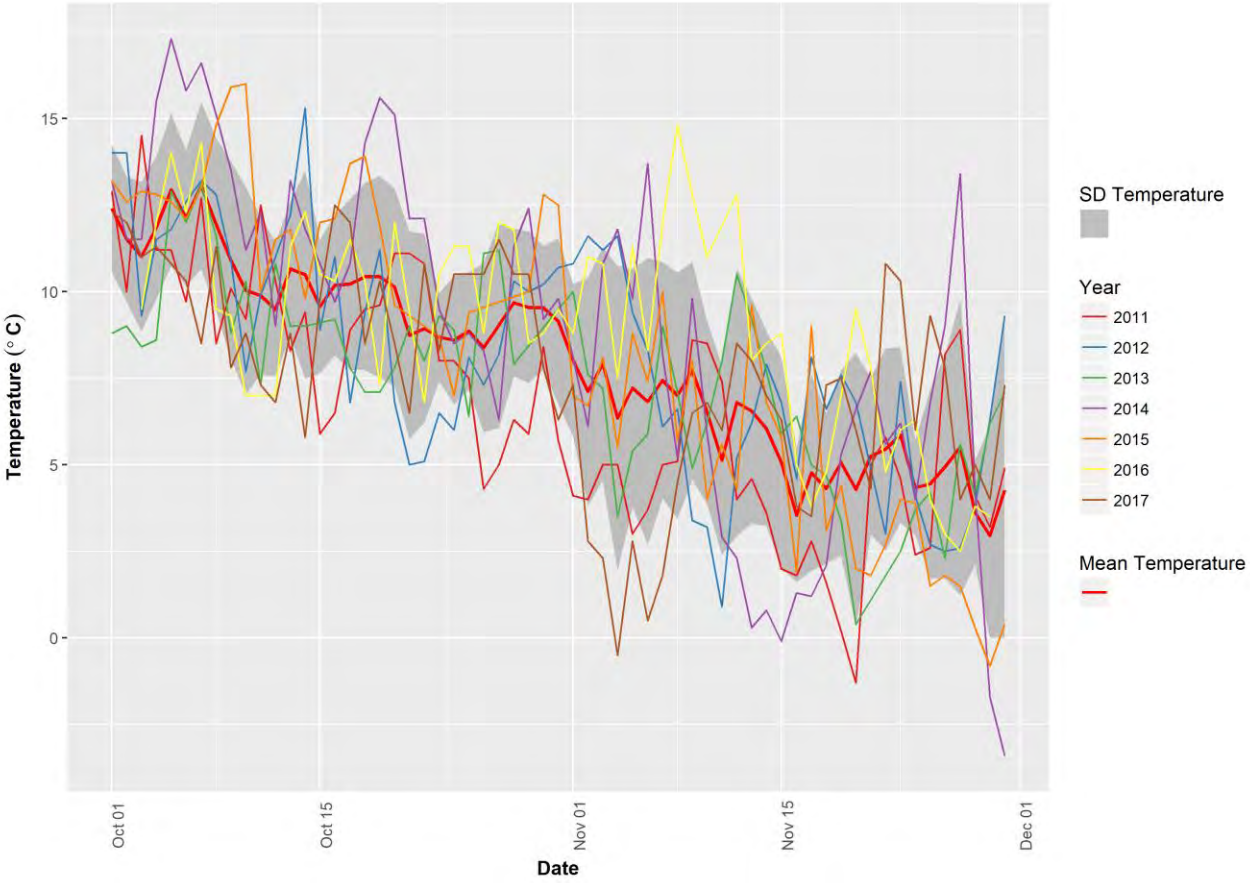

Figure A112. **Fall Temperature at Nanimo A.**

Figure A113. **Fall Temperature at Cox Lake, Port Alberni.**

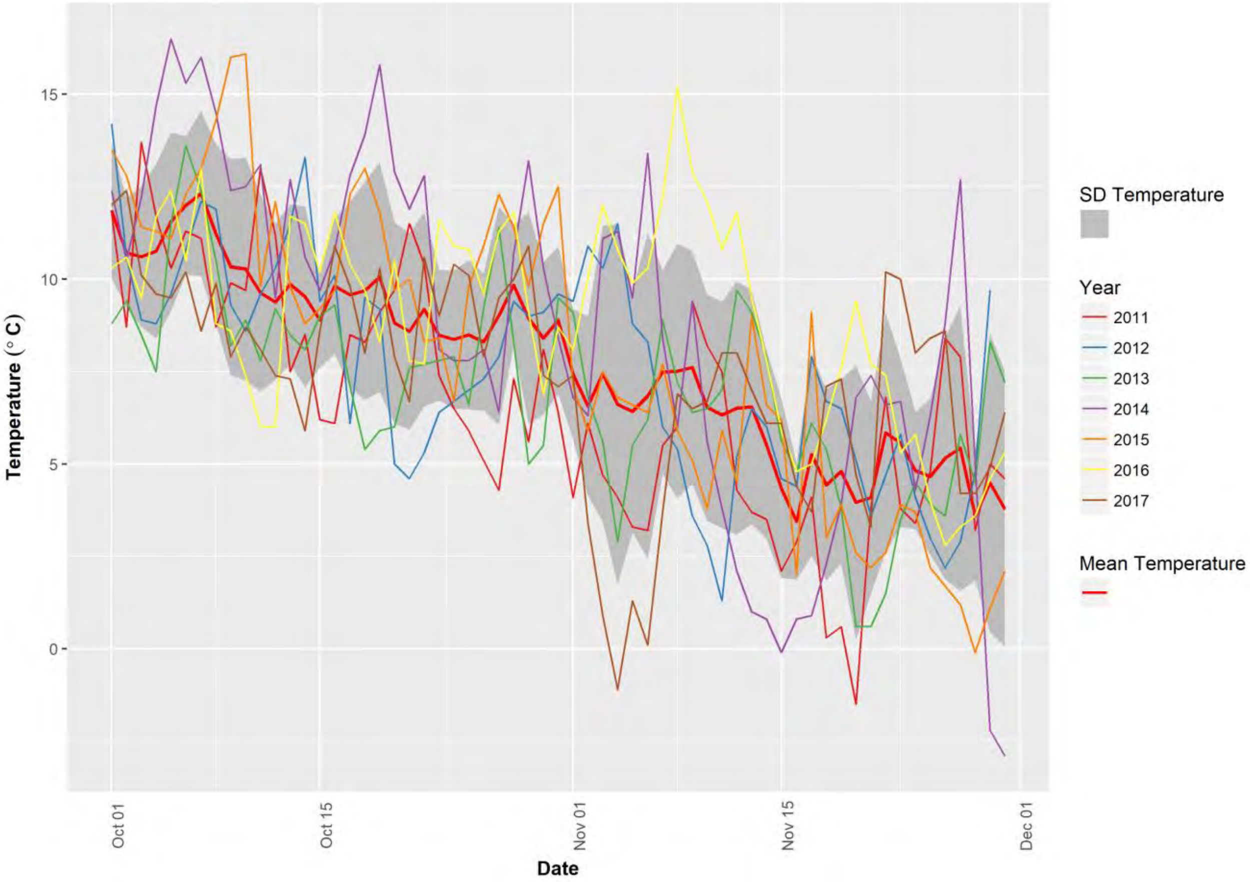

Figure A114. **Fall Temperature at Qualicum Beach Airport.**

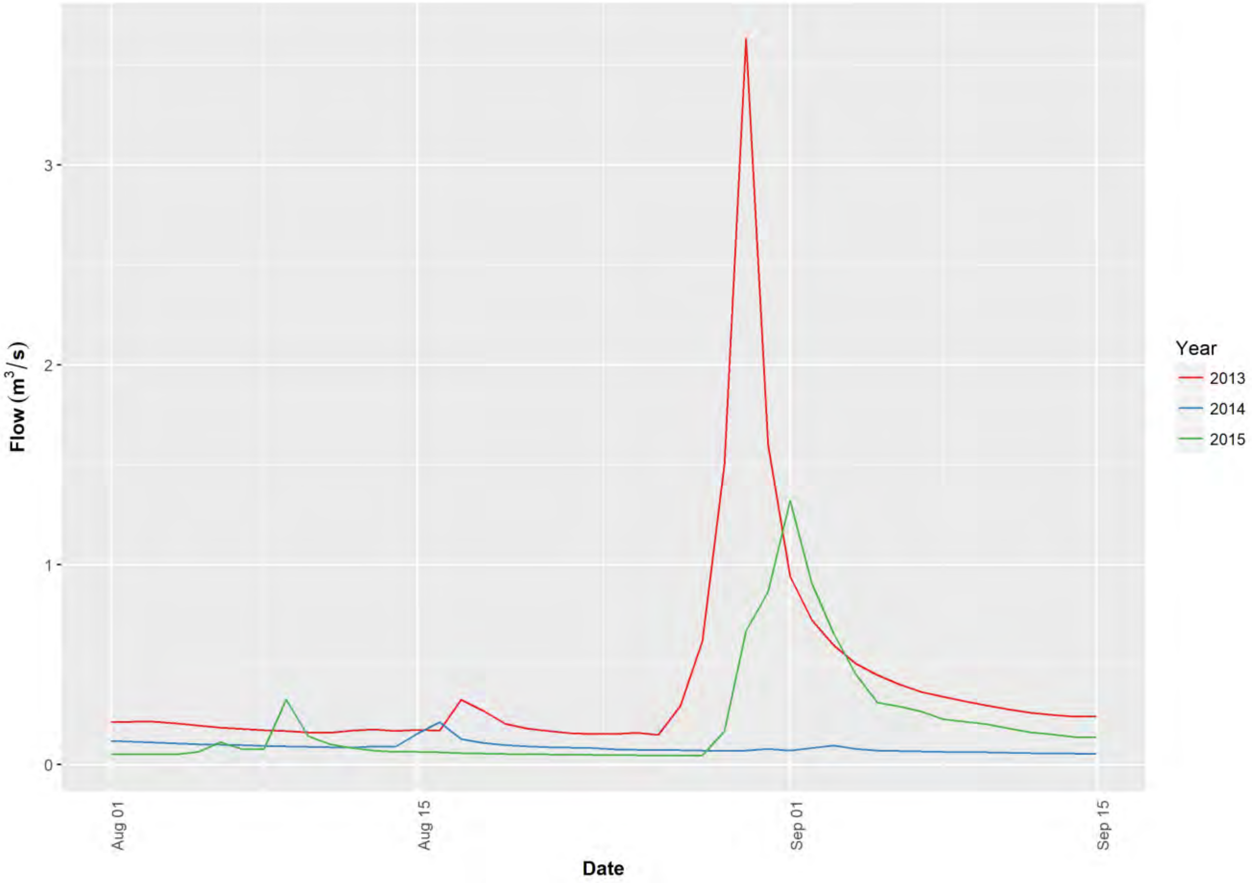

Figure A115. **Summer Flow data from Rosewall Creek 75 m downstream of Hwy 19a Bridge.**

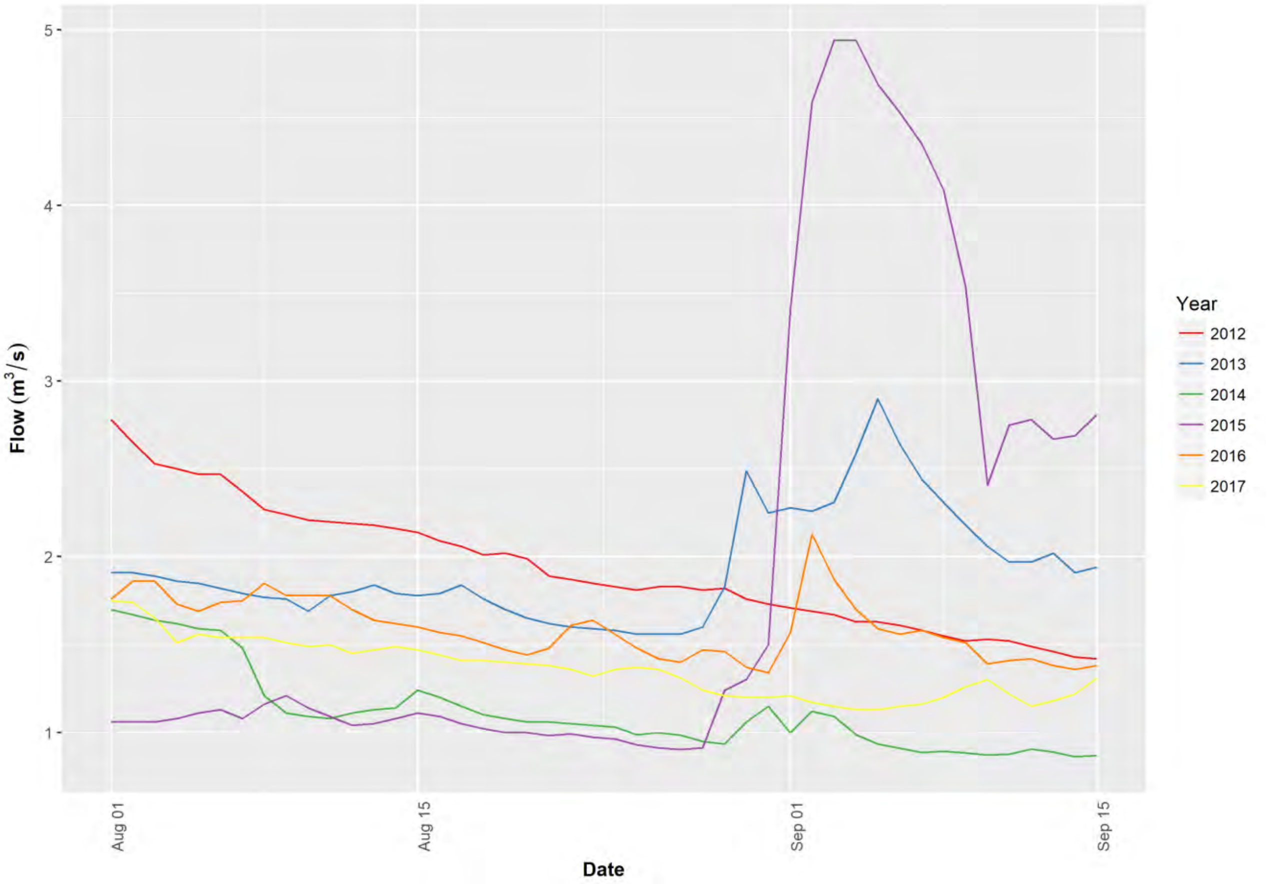

Figure A116. Summer Flow data from Little Qualicum River near Qualicum Beach.

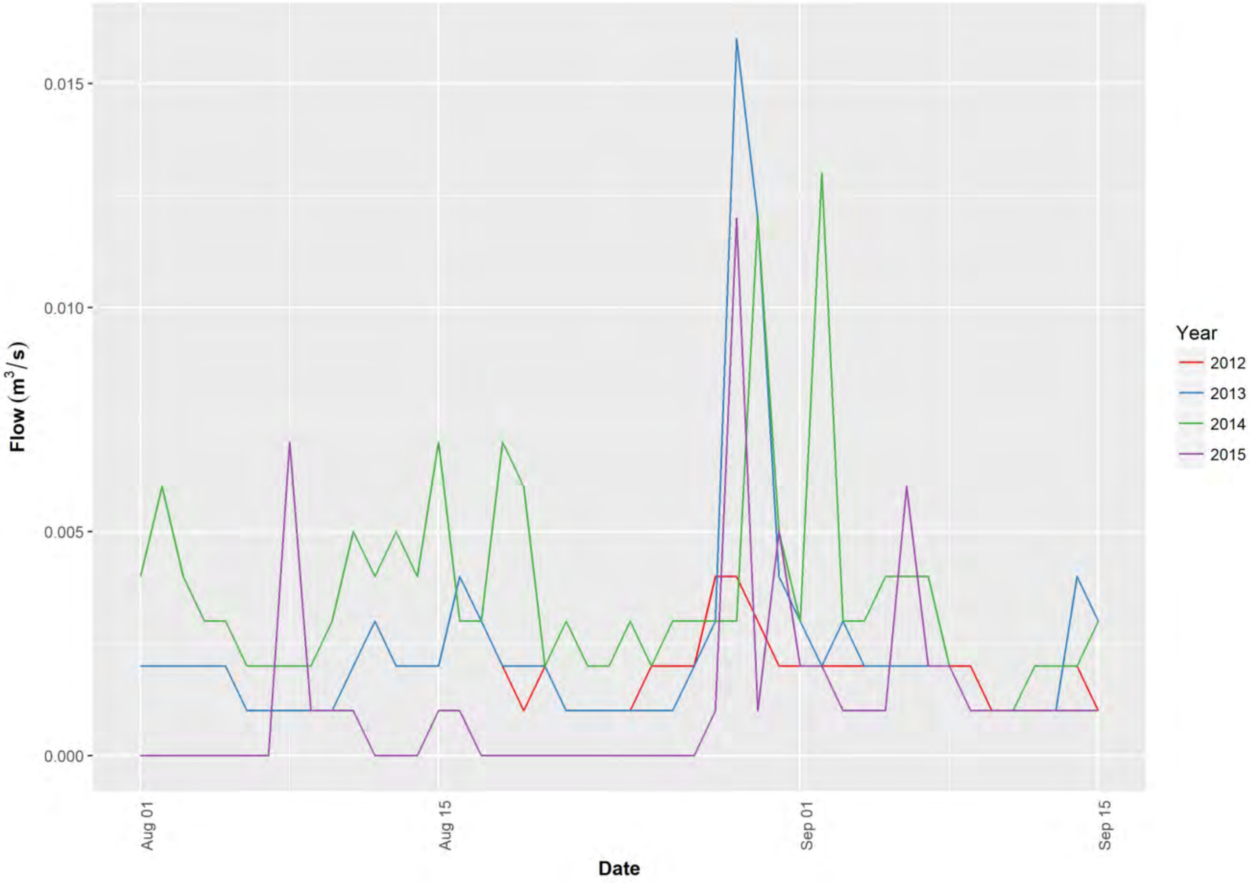

Figure A117. Summer Flow data from Grandon Creek 35 m upstream of Old Island Highway 19a.

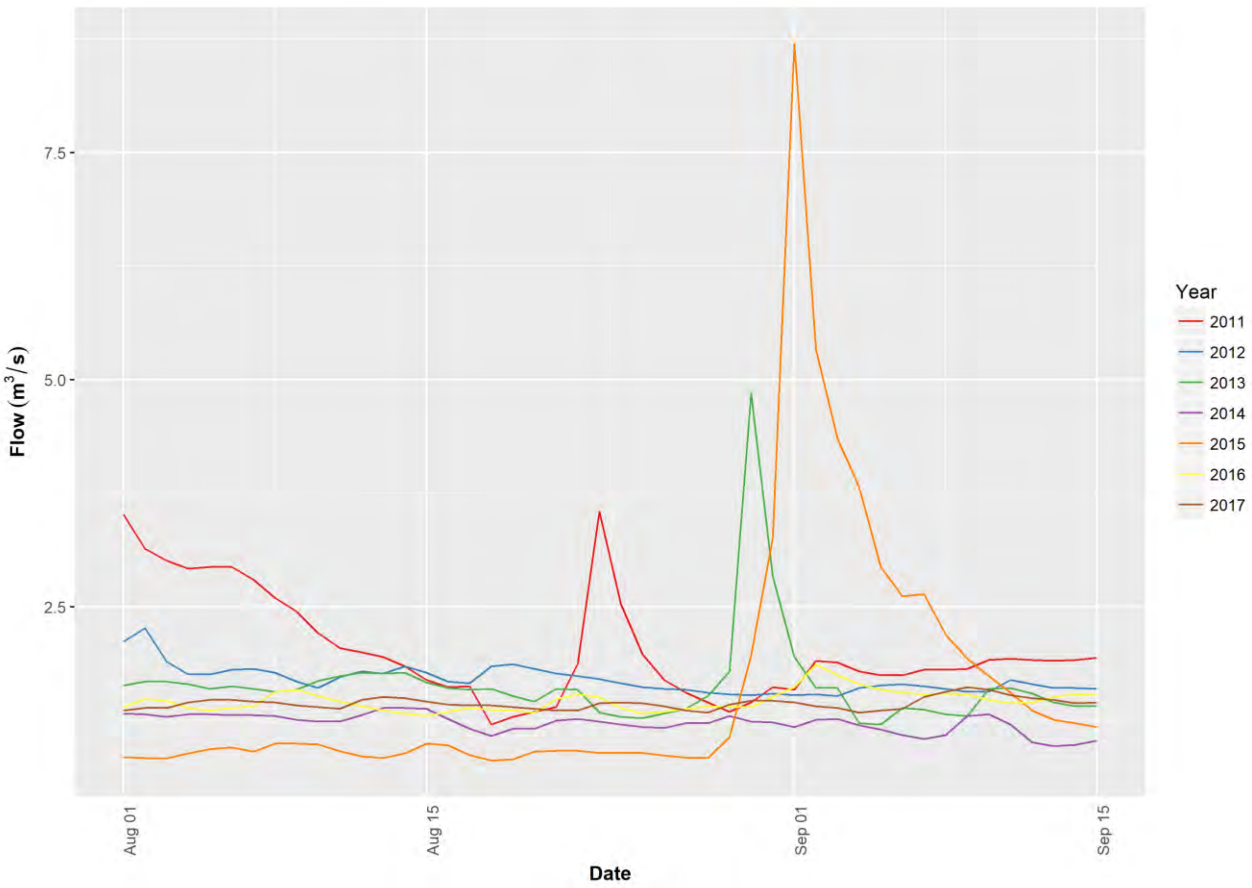

Figure A118. **Summer Flow data from Englishman River Near Parksville.**

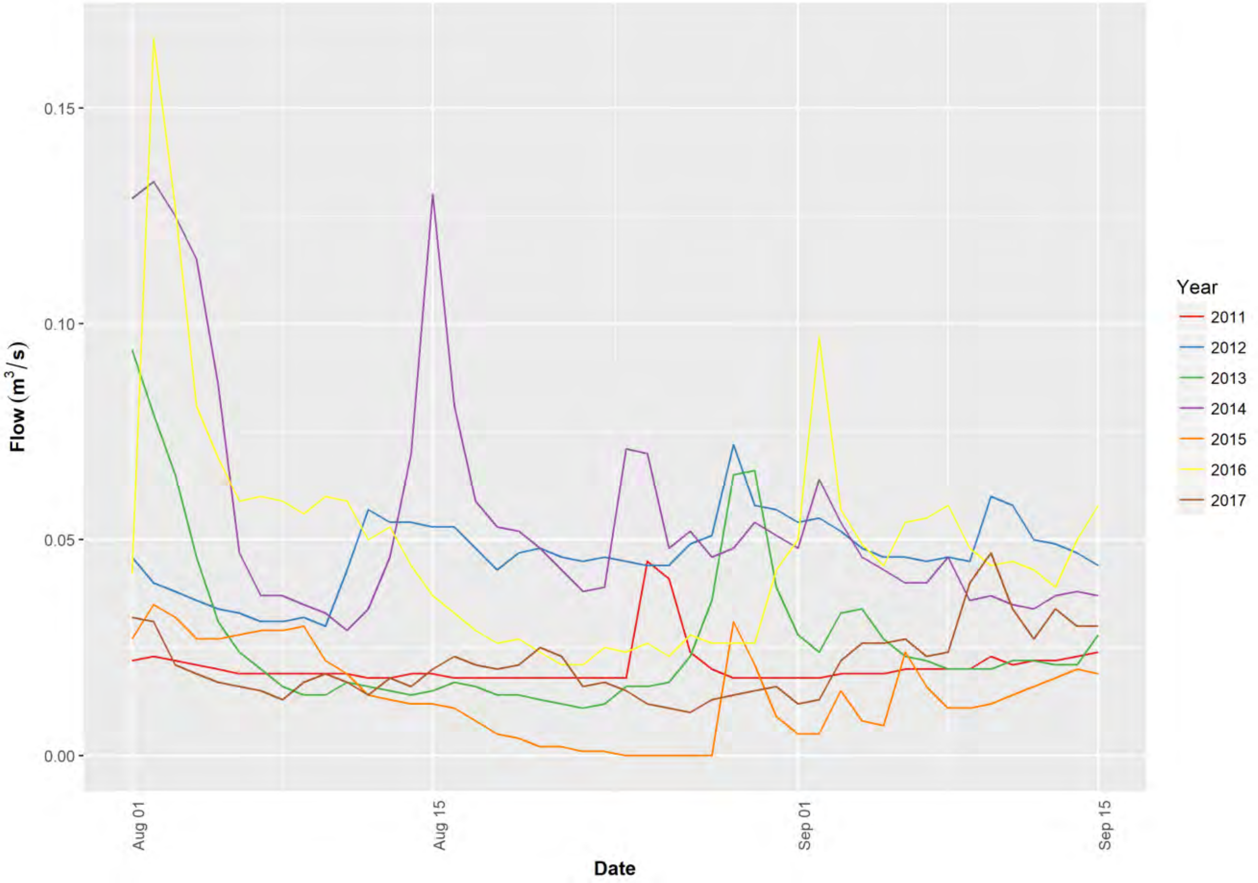

Figure A119. **Summer Flow data from Millstone River at Nanaimo.**

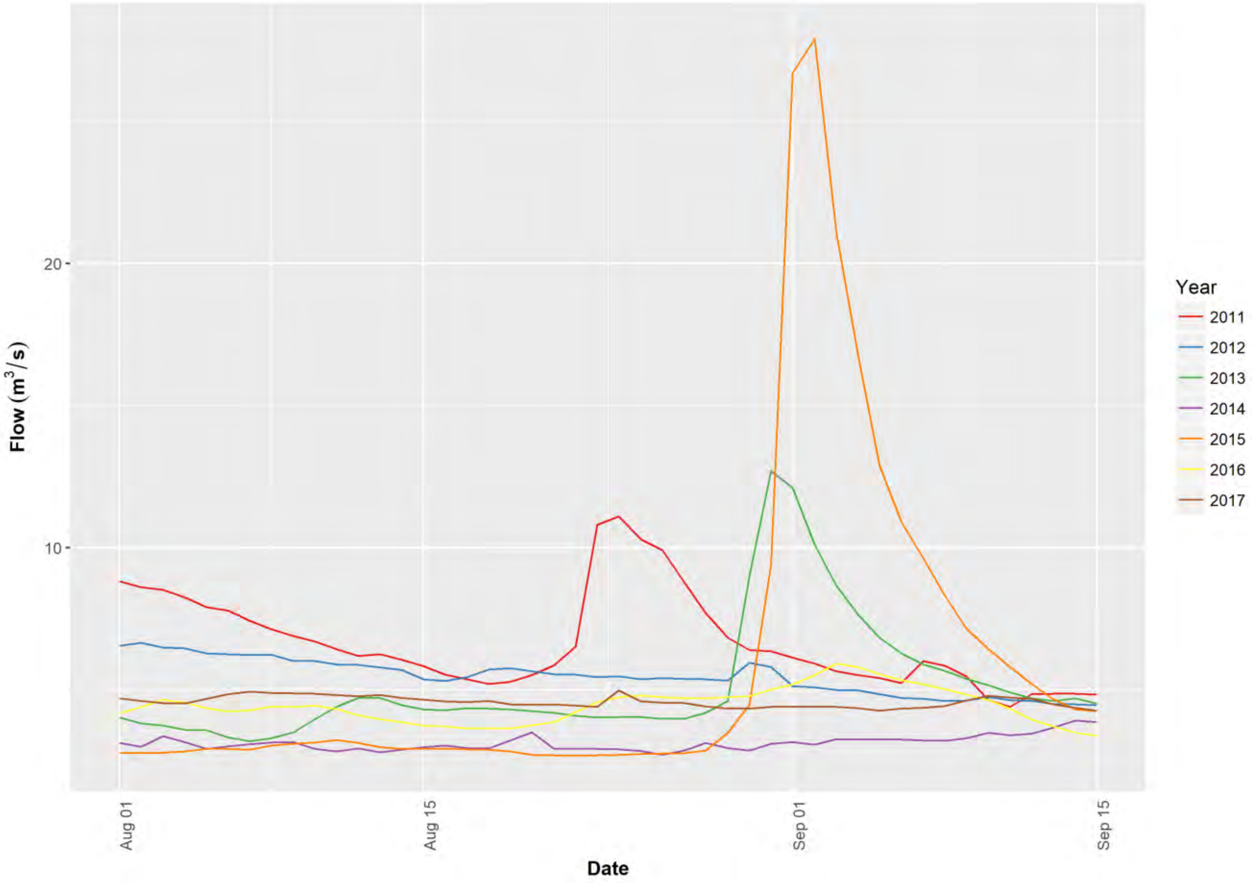

Figure A120. **Summer Flow data from Nanaimo River Near Cassidy.**

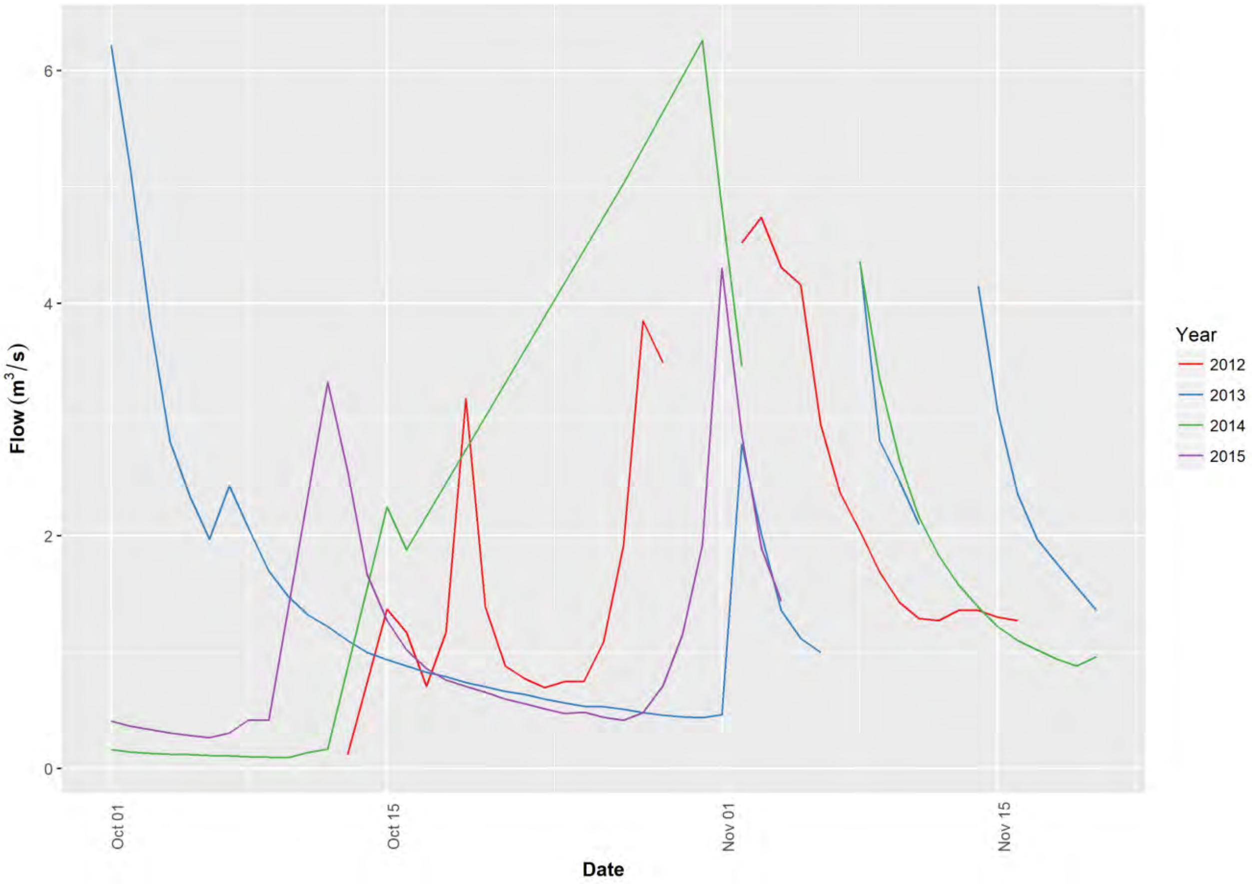

Figure A121. **Fall Flow data from Rosewall Creek 75 m downstream of Hwy 19a Bridge.**

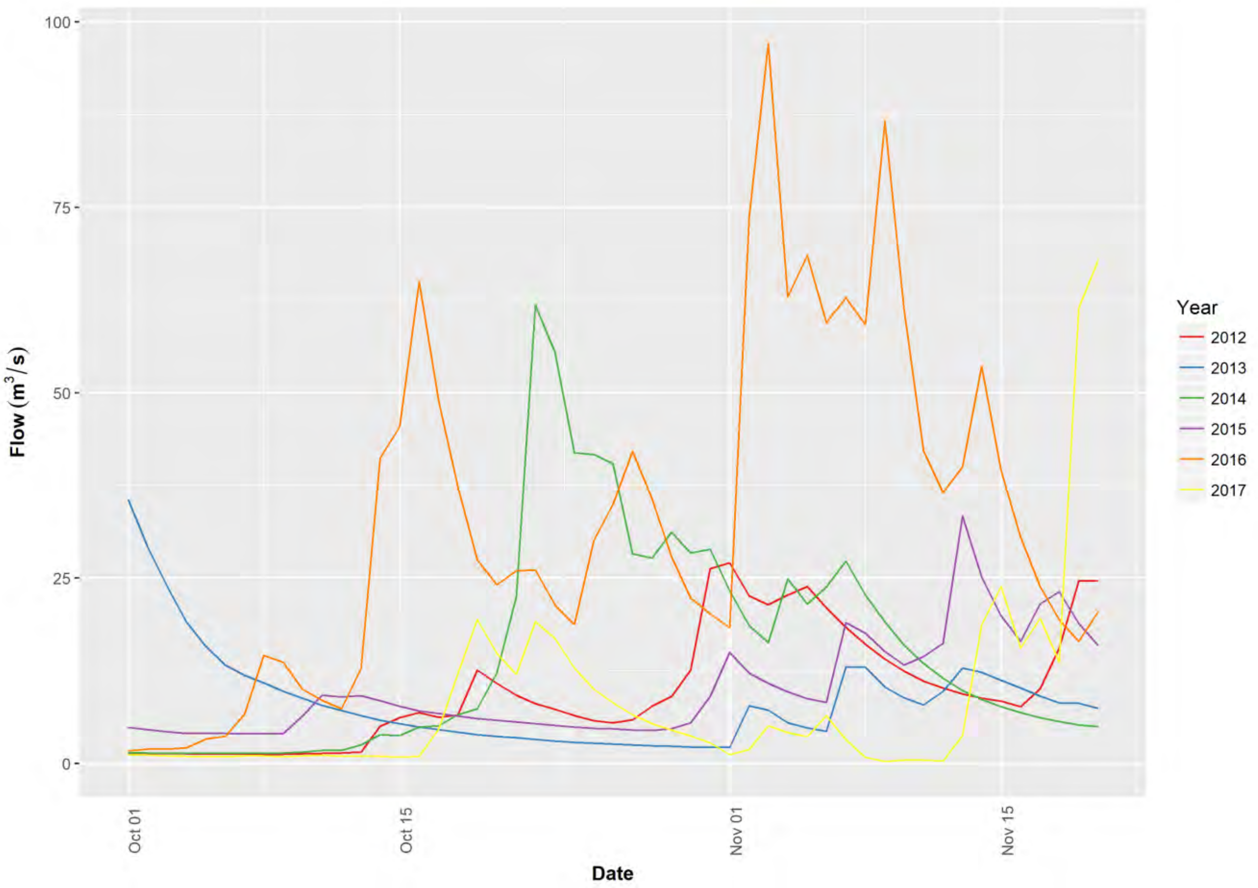

Figure A122. Fall Flow data from Little Qualicum River near Qualicum Beach.

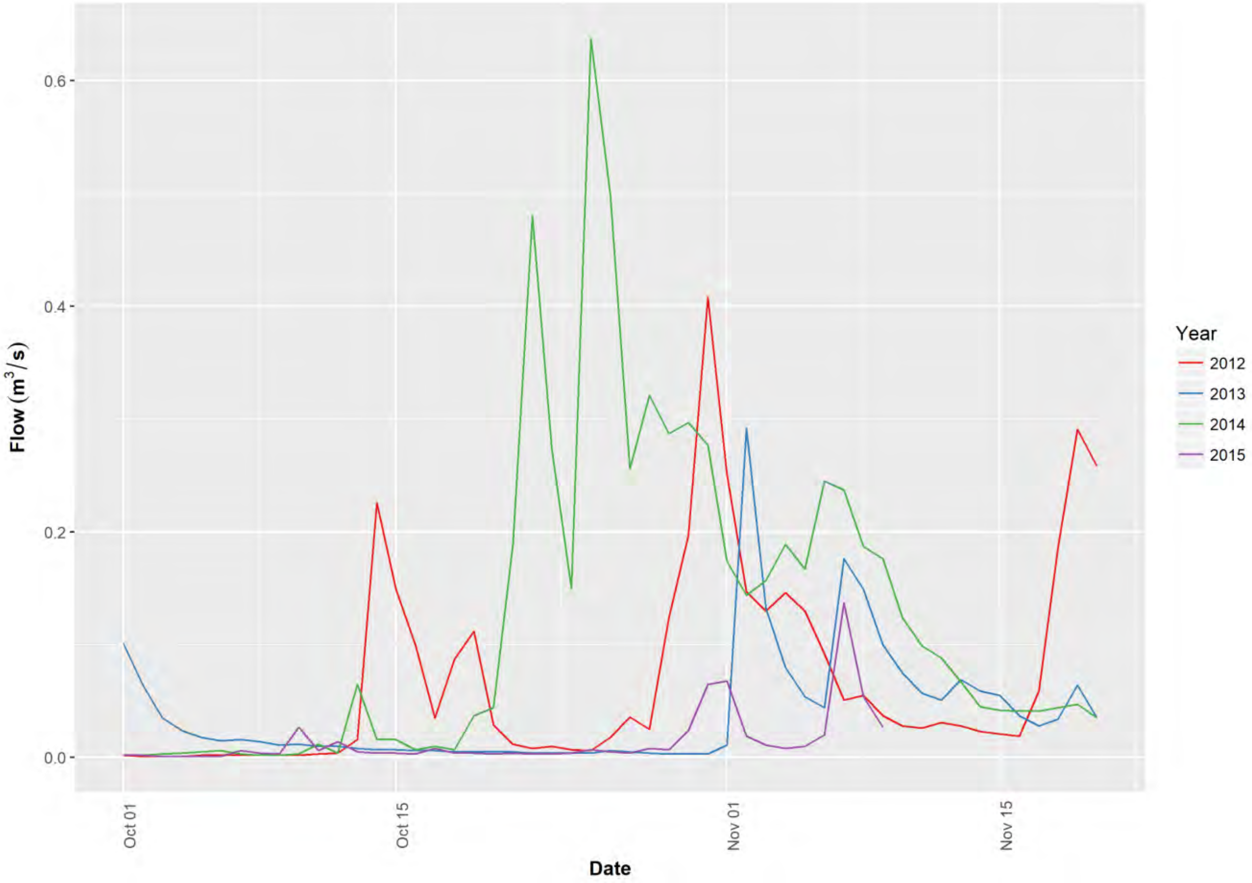

Figure A123. Fall Flow data from Grandon Creek 35 m upstream of Old Island Highway 19a.

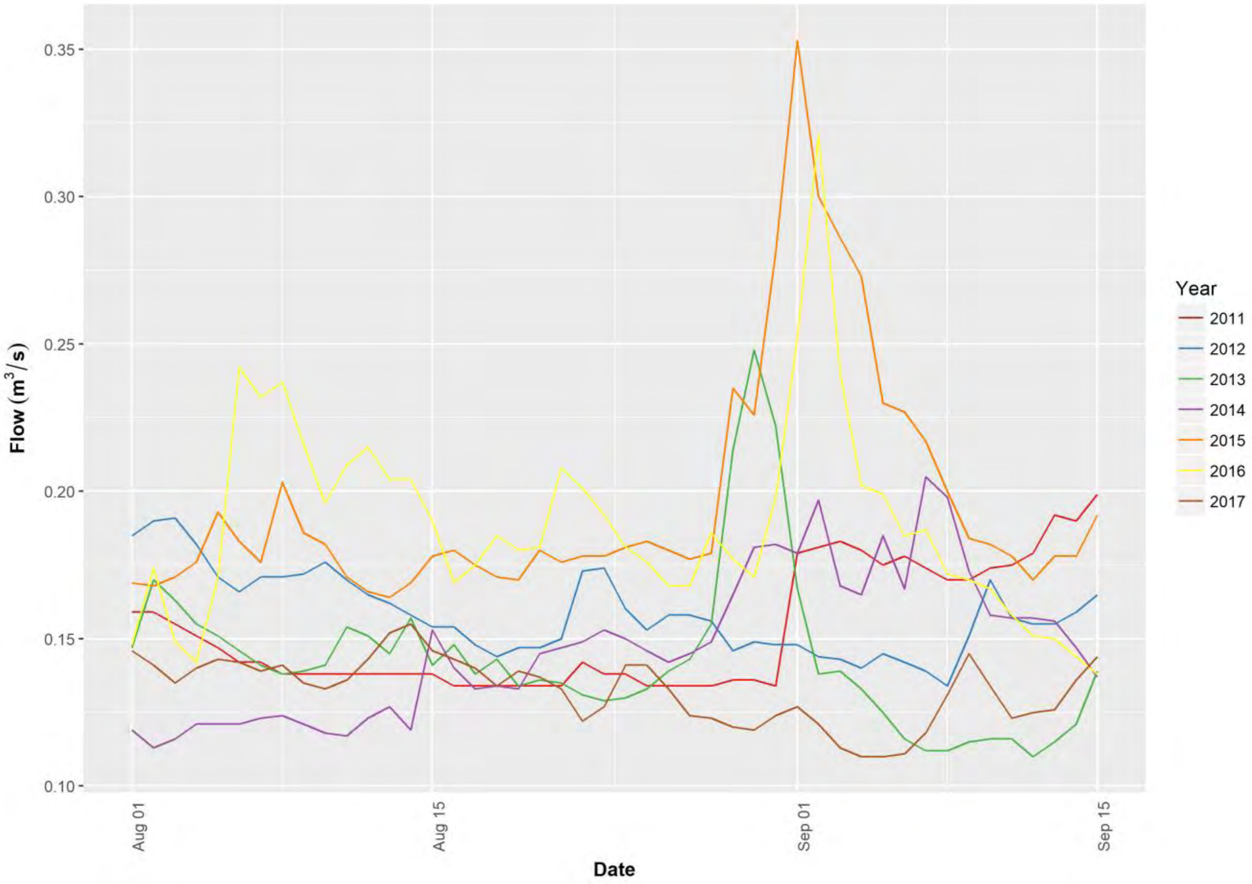

Figure A124. **Summer Flow data from Nile River Near Bowser.**

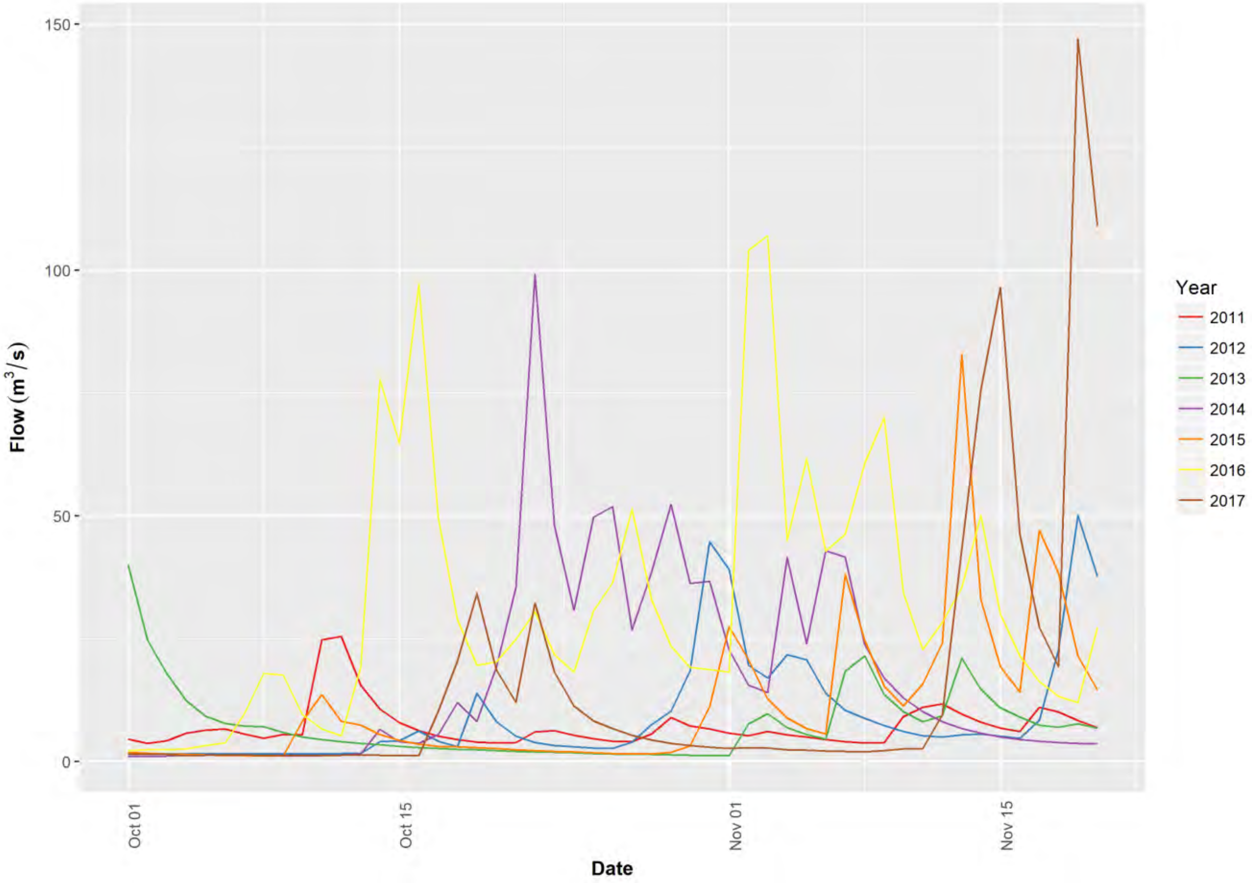

Figure A125. Fall Flow data from Englishman River Near Parksville.

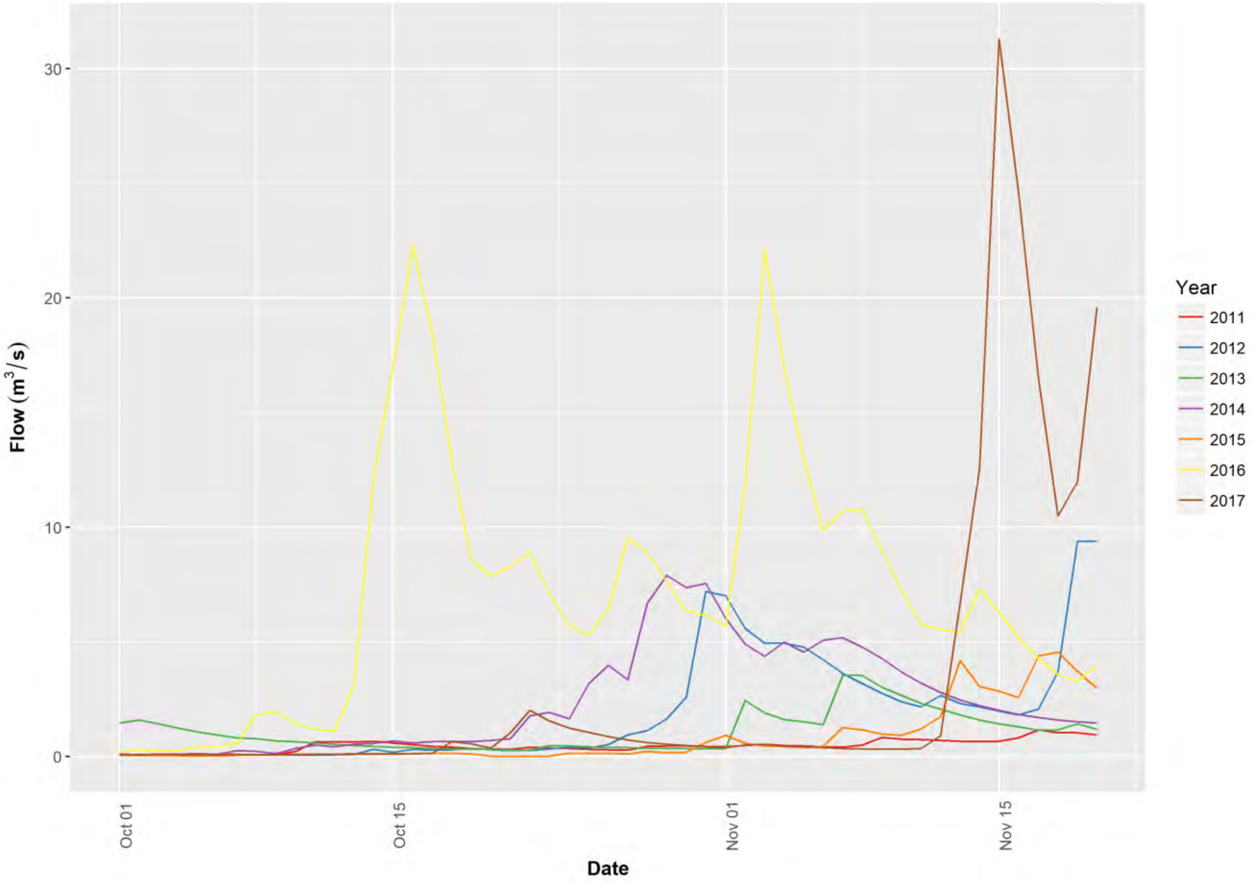

Figure A126. **Fall Flow data from Millstone River Near Nanaimo.**

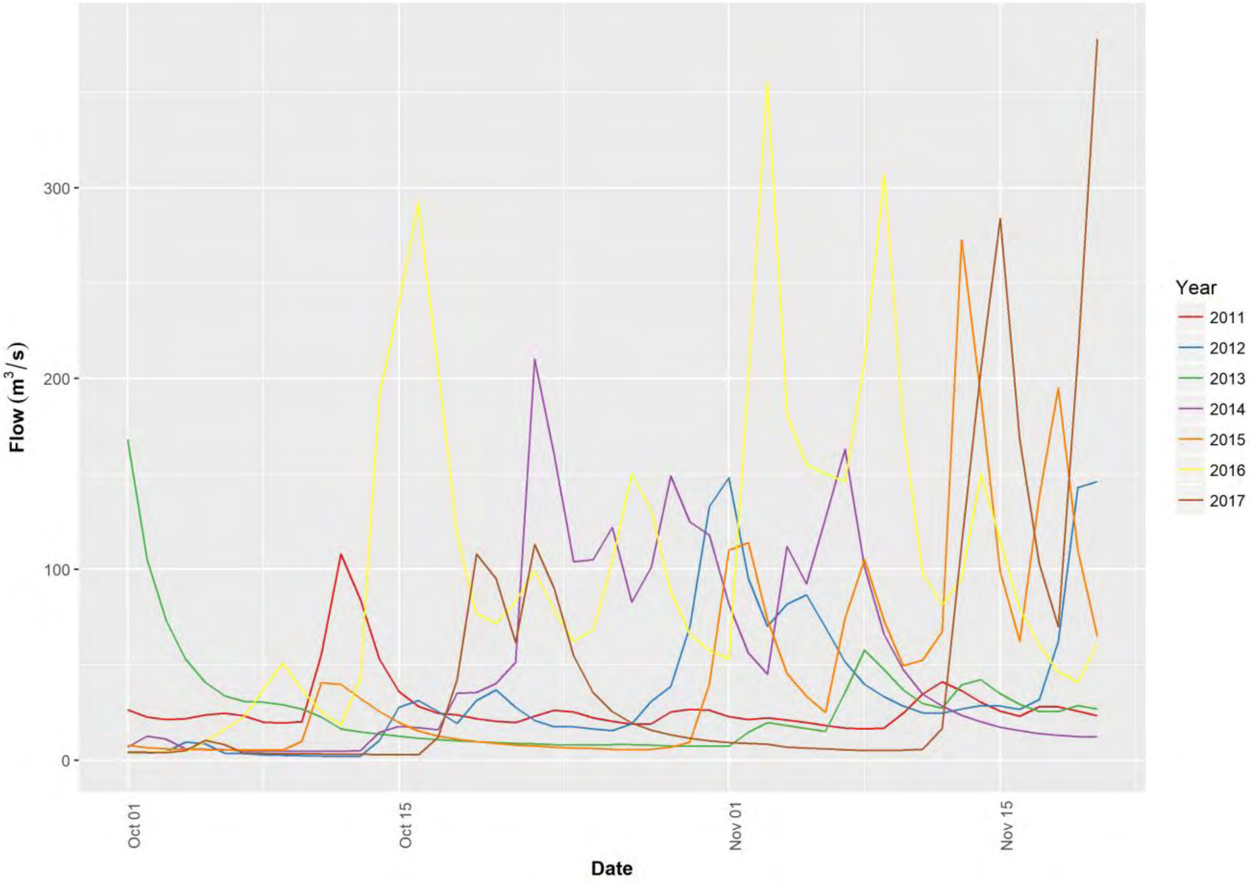

Figure A127. **Fall Flow data from Nanaimo River Near Cassidy.**

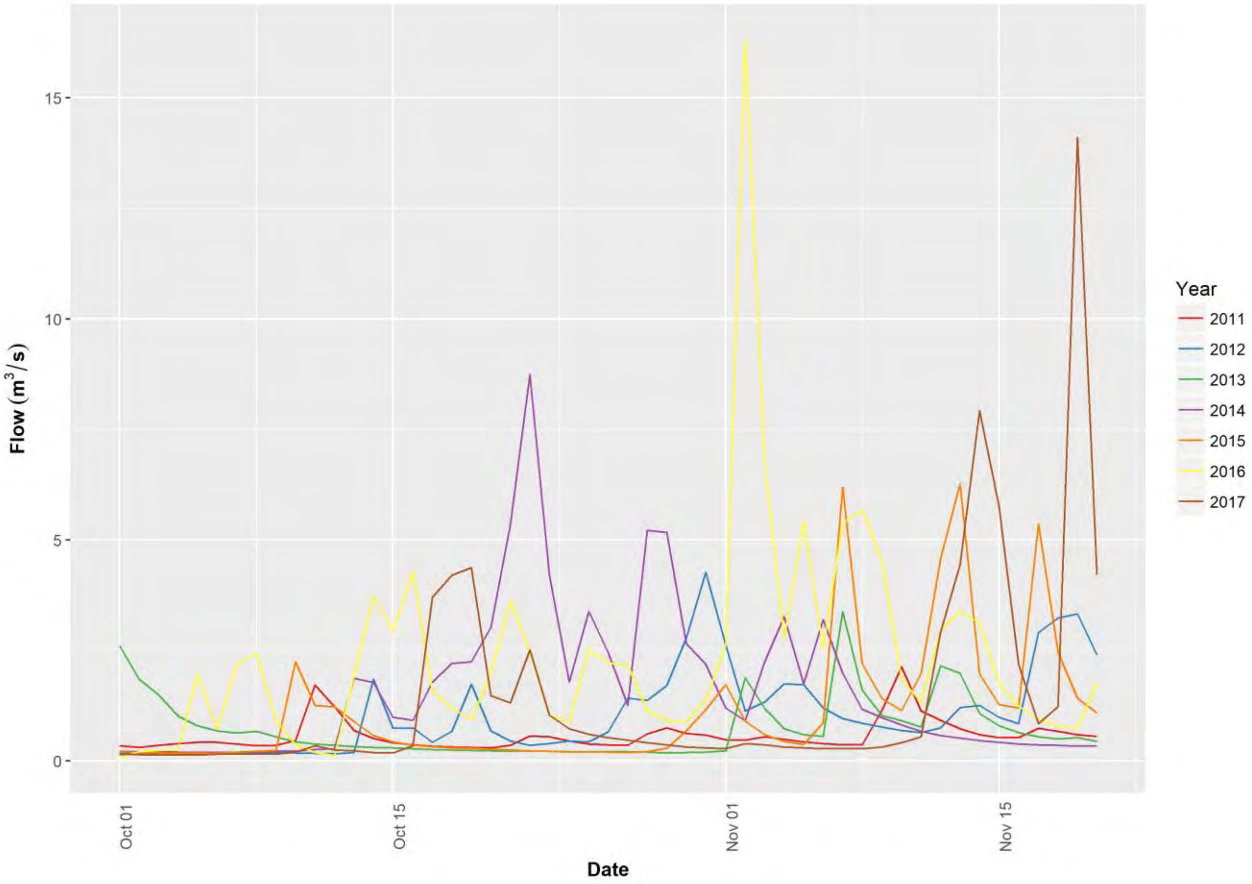

Figure A128. **Fall Flow data from Nile Creek Near Bowser.**

Appendix F Dissolved Oxygen and Temperature Graphs

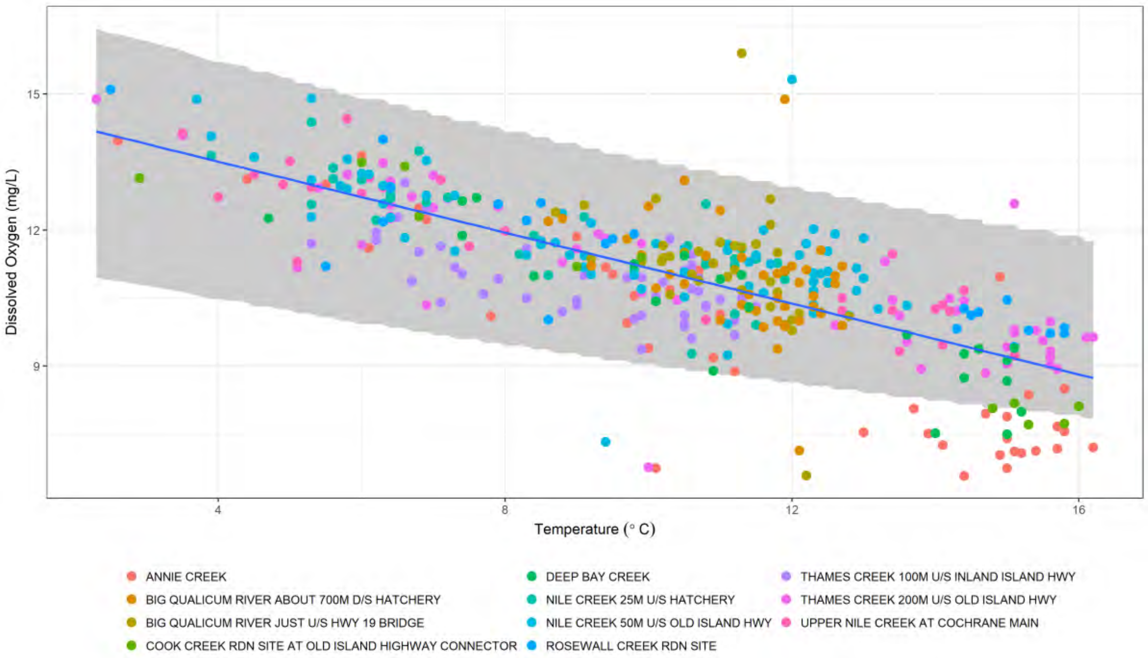

Figure A129. Big Qualicum Water Region Dissolved Oxygen and Water Temperature data for all available CWMN data. The grey shaded areas depicts ±20% of oxygen saturation.

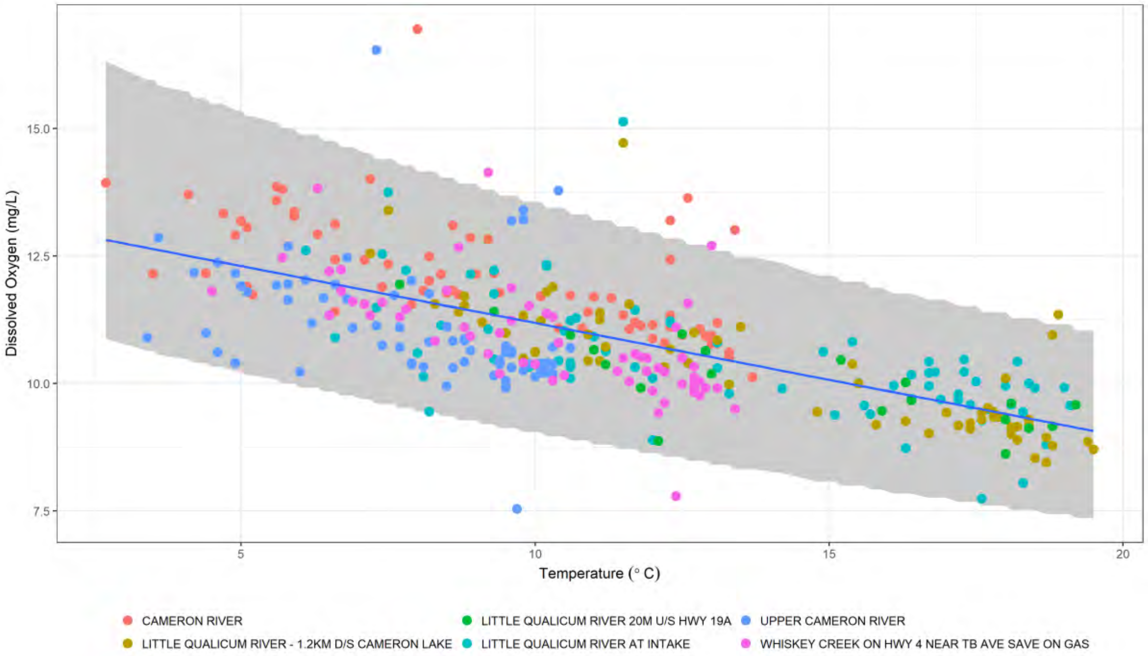

Figure A130. Little Qualicum Water Region Dissolved Oxygen and Water Temperature data for all available CWMN data. The grey shaded areas depicts ±20% of oxygen saturation.

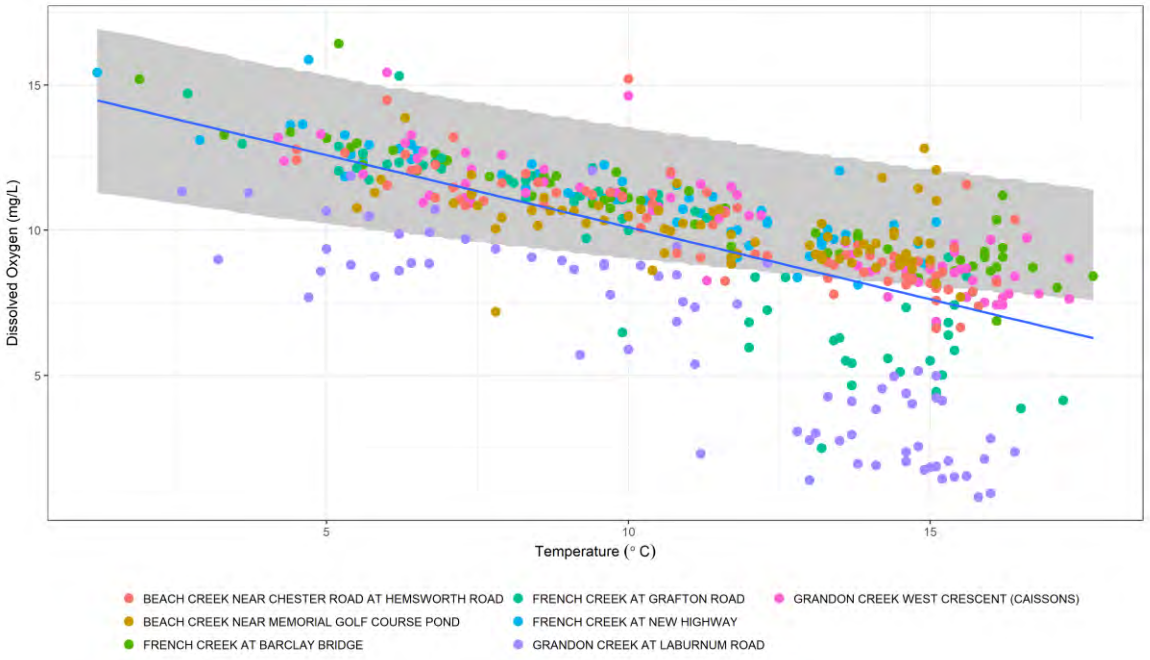

Figure A131. French Creek Water Region Dissolved Oxygen and Water Temperature data for all available CWMN data. The grey shaded areas depicts ±20% of oxygen saturation.

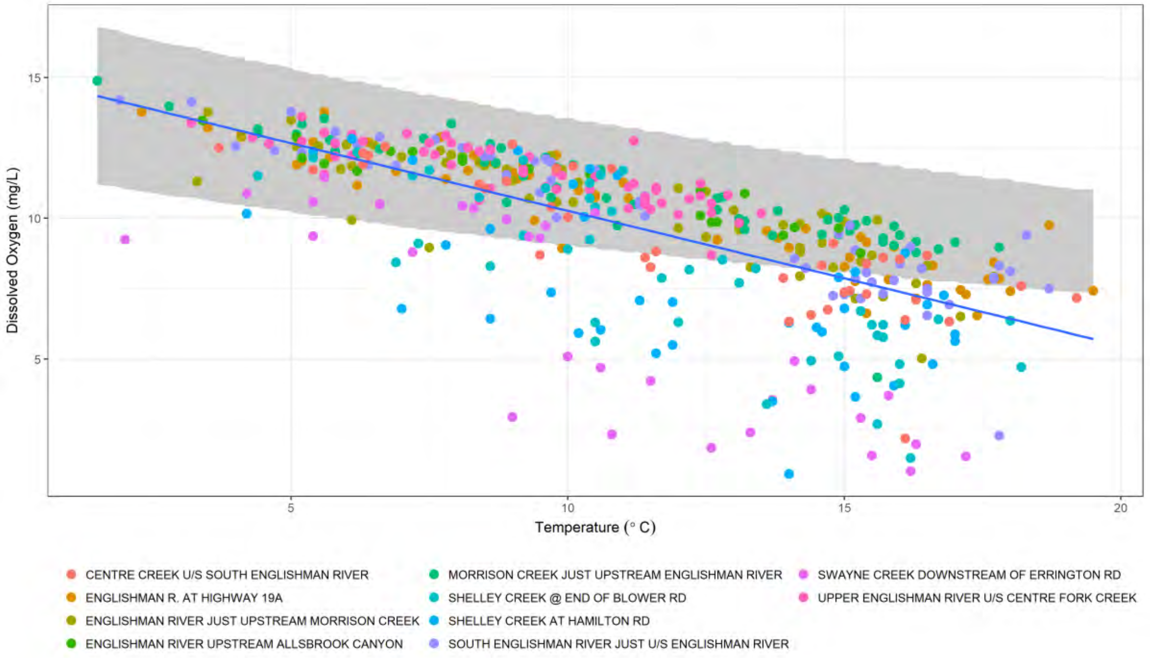

Figure A132. Englishman River Water Region Dissolved Oxygen and Water Temperature data for all available CWMN data. The grey shaded areas depicts ±20% of oxygen saturation.

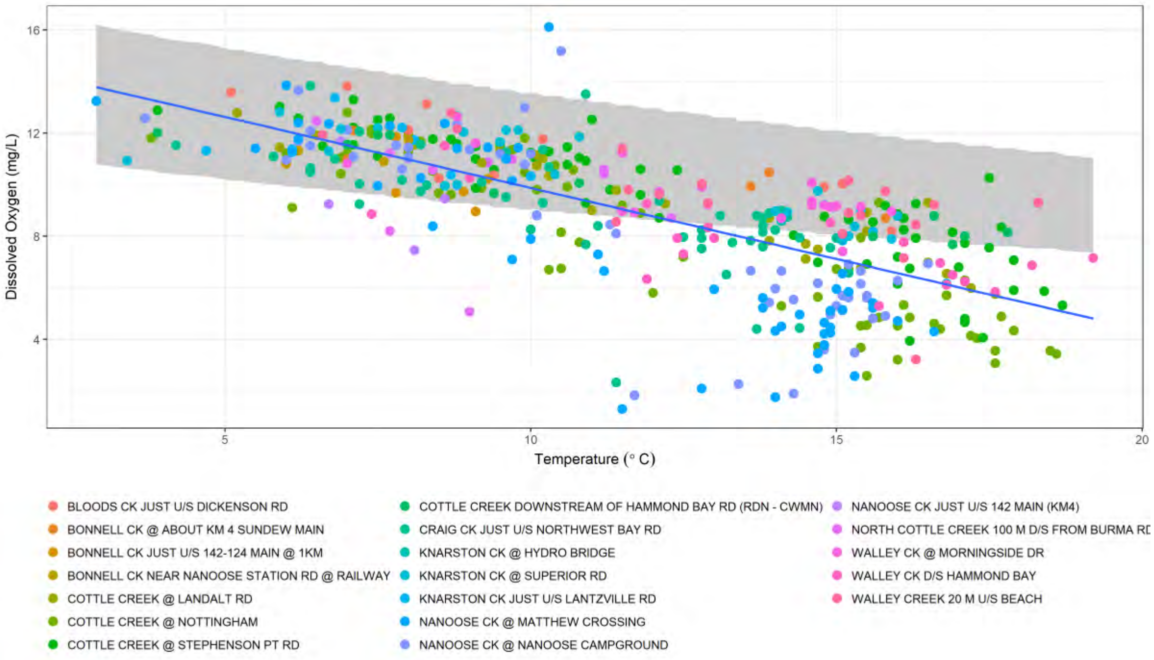

Figure A133. South Wellington to Nanoose Water Region (1 of 2) Dissolved Oxygen and Water Temperature data for all available CWMN data. The grey shaded areas depicts ±20% of oxygen saturation.

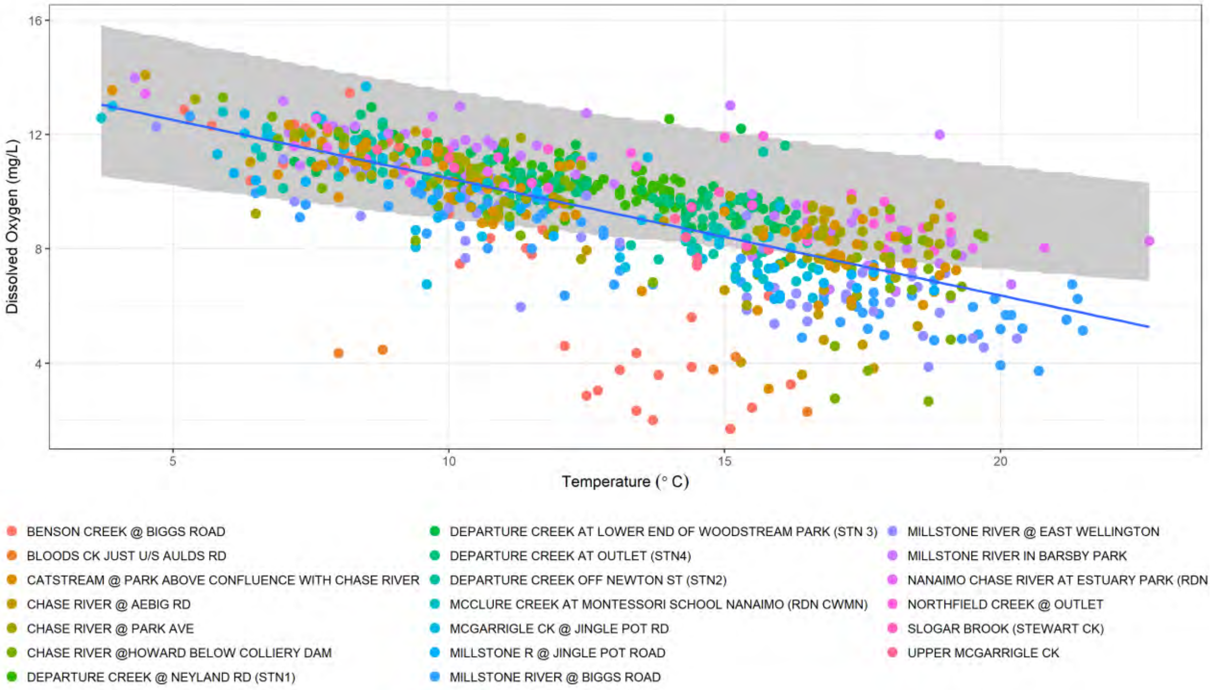

Figure A134. South Wellington to Nanoose Water Region (2 of 2) Dissolved Oxygen and Water Temperature data for all available CWMN data. The grey shaded areas depicts ±20% of oxygen saturation.

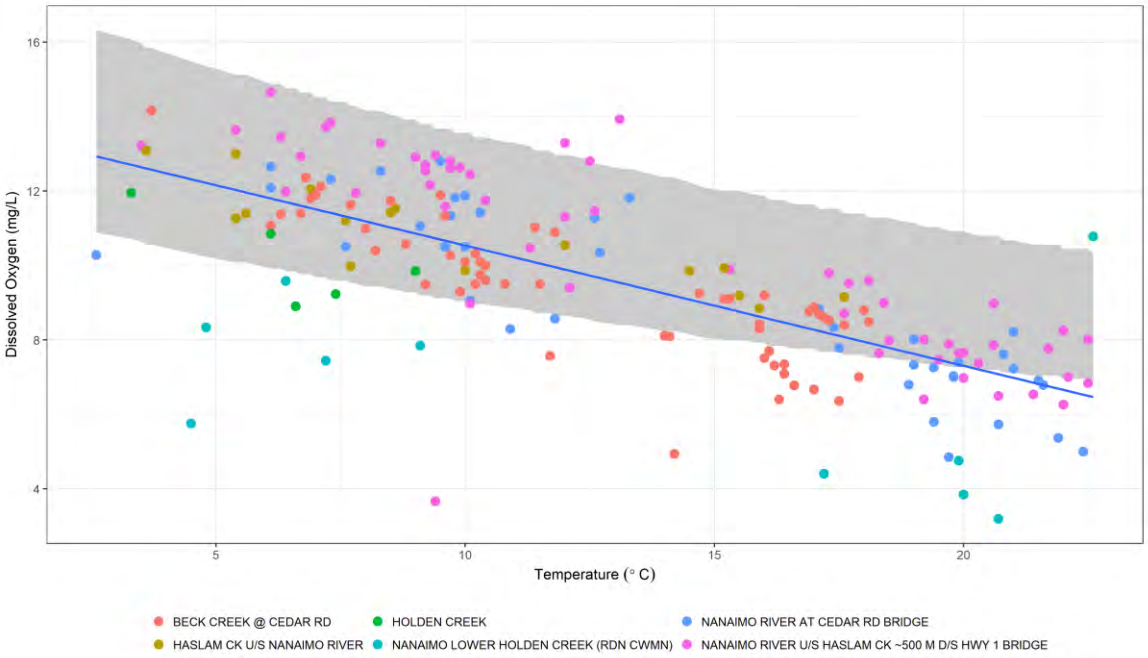

Figure A135. Nanaimo River Water Region Dissolved Oxygen and Water Temperature data for all available CWMN data. The grey shaded areas depicts ±20% of oxygen saturation.

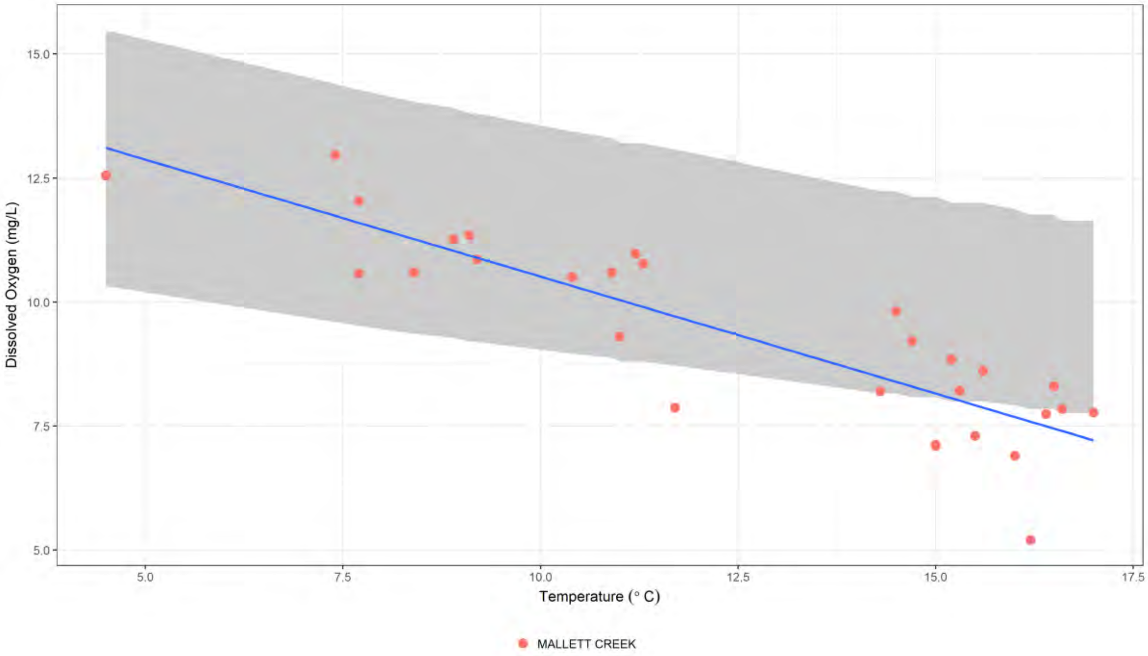

Figure A136. Gabriola Island Water Region Dissolved Oxygen and Water Temperature data for all available CWMN data. The grey shaded areas depicts ±20% of oxygen saturation.

Appendix G Trend Analysis Results

Table A2 Summary of seasonal Mann-Kendall trend analysis by Water Region and site including Kendall's tau coefficient (strength and direction of relationship), p-value (<0.05 is statistically significant) and sample size (n).

EMS.ID	analyte	tau	pvalue	n	LOCATION.NAME	WaterRegion
E286553	Cond	-0.19	0.396	14	NILE CREEK 50M U/S OLD ISLAND HWY	Big Qualicum
E286553	DO	-0.143	0.524	14	NILE CREEK 50M U/S OLD ISLAND HWY	Big Qualicum
E286553	Temp	0.333	0.137	14	NILE CREEK 50M U/S OLD ISLAND HWY	Big Qualicum
E286553	Turbidity	0.19	0.396	14	NILE CREEK 50M U/S OLD ISLAND HWY	Big Qualicum
E220635	Cond	-0.19	0.396	14	CAMERON RIVER	Little Qualicum
E220635	DO	0.0952	0.671	14	CAMERON RIVER	Little Qualicum
E220635	Temp	0.381	0.0893	14	CAMERON RIVER	Little Qualicum
E220635	Turbidity	0.19	0.396	14	CAMERON RIVER	Little Qualicum
E256394	Cond	-0.238	0.288	14	LITTLE QUALICUM RIVER AT INTAKE	Little Qualicum
E256394	DO	-0.238	0.288	14	LITTLE QUALICUM RIVER AT INTAKE	Little Qualicum
E256394	Temp	0.333	0.137	14	LITTLE QUALICUM RIVER AT INTAKE	Little Qualicum
E256394	Turbidity	0.714	0.00144	14	LITTLE QUALICUM RIVER AT INTAKE	Little Qualicum
E268993	Cond	-0.467	0.0629	12	LITTLE QUALICUM RIVER - 1.2KM D/S CAMERON LAKE	Little Qualicum
E268993	DO	0.333	0.184	12	LITTLE QUALICUM RIVER - 1.2KM D/S CAMERON LAKE	Little Qualicum
E268993	Temp	0	1	12	LITTLE QUALICUM RIVER - 1.2KM D/S CAMERON LAKE	Little Qualicum
E268993	Turbidity	0.0667	0.79	12	LITTLE QUALICUM RIVER - 1.2KM D/S CAMERON LAKE	Little Qualicum
E285669	Cond	-0.333	0.137	14	UPPER CAMERON RIVER	Little Qualicum
E285669	DO	0.286	0.203	14	UPPER CAMERON RIVER	Little Qualicum
E285669	Temp	0.333	0.137	14	UPPER CAMERON RIVER	Little Qualicum
E285669	Turbidity	-0.143	0.524	14	UPPER CAMERON RIVER	Little Qualicum
E287697	Cond	-0.0667	0.79	12	WHISKEY CREEK ON HWY 4 NEAR TB AVE SAVE ON GAS	Little Qualicum
E287697	DO	0.133	0.595	12	WHISKEY CREEK ON HWY 4 NEAR TB AVE SAVE ON GAS	Little Qualicum
E287697	Temp	0.0667	0.79	12	WHISKEY CREEK ON HWY 4 NEAR TB AVE SAVE ON GAS	Little Qualicum
E287697	Turbidity	0.133	0.595	12	WHISKEY CREEK ON HWY 4 NEAR TB AVE SAVE ON GAS	Little Qualicum

EMS.ID	analyte	tau	pvalue	n	LOCATION.NAME	WaterRegion
E243021	Cond	0.286	0.203	14	FRENCH CREEK AT NEW HIGHWAY	French Creek
E243021	DO	-0.0952	0.671	14	FRENCH CREEK AT NEW HIGHWAY	French Creek
E243021	Temp	0	1	14	FRENCH CREEK AT NEW HIGHWAY	French Creek
E243021	Turbidity	0.429	0.0559	14	FRENCH CREEK AT NEW HIGHWAY	French Creek
E243022	Cond	0.238	0.288	14	FRENCH CREEK AT BARCLAY BRIDGE	French Creek
E243022	DO	-0.333	0.137	14	FRENCH CREEK AT BARCLAY BRIDGE	French Creek
E243022	Temp	0.333	0.137	14	FRENCH CREEK AT BARCLAY BRIDGE	French Creek
E243022	Turbidity	-0.0476	0.832	14	FRENCH CREEK AT BARCLAY BRIDGE	French Creek
E243024	Cond	0.19	0.396	14	FRENCH CREEK AT GRAFTON ROAD	French Creek
E243024	DO	-0.429	0.0559	14	FRENCH CREEK AT GRAFTON ROAD	French Creek
E243024	Temp	0.333	0.137	14	FRENCH CREEK AT GRAFTON ROAD	French Creek
E243024	Turbidity	0.476	0.0337	14	FRENCH CREEK AT GRAFTON ROAD	French Creek
E288090	Cond	-0.286	0.203	14	GRANDON CREEK WEST CRESCENT (CAISSONS)	French Creek
E288090	DO	0.286	0.203	14	GRANDON CREEK WEST CRESCENT (CAISSONS)	French Creek
E288090	Temp	0.381	0.0893	14	GRANDON CREEK WEST CRESCENT (CAISSONS)	French Creek
E288090	Turbidity	0.429	0.0559	14	GRANDON CREEK WEST CRESCENT (CAISSONS)	French Creek
E288091	Cond	-0.429	0.0559	14	GRANDON CREEK AT LABURNUM ROAD	French Creek
E288091	DO	0.333	0.137	14	GRANDON CREEK AT LABURNUM ROAD	French Creek
E288091	Temp	0.0241	0.915	14	GRANDON CREEK AT LABURNUM ROAD	French Creek
E288091	Turbidity	0.19	0.396	14	GRANDON CREEK AT LABURNUM ROAD	French Creek
E288092	Cond	-0.524	0.0195	14	BEACH CREEK NEAR CHESTER ROAD AT HEMSWORTH ROAD	French Creek
E288092	DO	-0.0952	0.671	14	BEACH CREEK NEAR CHESTER ROAD AT HEMSWORTH ROAD	French Creek
E288092	Temp	0.458	0.0424	14	BEACH CREEK NEAR CHESTER ROAD AT HEMSWORTH ROAD	French Creek
E288092	Turbidity	0.571	0.0108	14	BEACH CREEK NEAR CHESTER ROAD AT HEMSWORTH ROAD	French Creek
E288093	Cond	-0.238	0.288	14	BEACH CREEK NEAR MEMORIAL GOLF COURSE POND	French Creek

EMS.ID	analyte	tau	pvalue	n	LOCATION.NAME	WaterRegion
E288093	DO	0.143	0.524	14	BEACH CREEK NEAR MEMORIAL GOLF COURSE POND	French Creek
E288093	Temp	0.238	0.288	14	BEACH CREEK NEAR MEMORIAL GOLF COURSE POND	French Creek
E288093	Turbidity	0.0476	0.832	14	BEACH CREEK NEAR MEMORIAL GOLF COURSE POND	French Creek
121580	Cond	0	1	12	ENGLISHMAN R. AT HIGHWAY 19A	Englishman River
121580	DO	-0.2	0.425	12	ENGLISHMAN R. AT HIGHWAY 19A	Englishman River
121580	Temp	0.4	0.111	12	ENGLISHMAN R. AT HIGHWAY 19A	Englishman River
121580	Turbidity	0.667	0.00789	12	ENGLISHMAN R. AT HIGHWAY 19A	Englishman River
E248834	Cond	0.133	0.595	12	ENGLISHMAN RIVER JUST UPSTREAM MORISON CREEK	Englishman River
E248834	DO	-0.533	0.0335	12	ENGLISHMAN RIVER JUST UPSTREAM MORISON CREEK	Englishman River
E248834	Temp	0.467	0.0629	12	ENGLISHMAN RIVER JUST UPSTREAM MORISON CREEK	Englishman River
E248834	Turbidity	0.333	0.184	12	ENGLISHMAN RIVER JUST UPSTREAM MORISON CREEK	Englishman River
E248835	Cond	-0.0667	0.79	12	MORISON CREEK JUST UPSTREAM ENGLISHMAN RIVER	Englishman River
E248835	DO	-0.17	0.503	12	MORISON CREEK JUST UPSTREAM ENGLISHMAN RIVER	Englishman River
E248835	Temp	0.4	0.111	12	MORISON CREEK JUST UPSTREAM ENGLISHMAN RIVER	Englishman River
E248835	Turbidity	0.4	0.111	12	MORISON CREEK JUST UPSTREAM ENGLISHMAN RIVER	Englishman River
E248836	Cond	0.133	0.595	12	SOUTH ENGLISHMAN RIVER JUST U/S ENGLISHMAN RIVER	Englishman River
E248836	DO	-0.267	0.288	12	SOUTH ENGLISHMAN RIVER JUST U/S ENGLISHMAN RIVER	Englishman River
E248836	Temp	0.2	0.425	12	SOUTH ENGLISHMAN RIVER JUST U/S ENGLISHMAN RIVER	Englishman River
E248836	Turbidity	0.267	0.288	12	SOUTH ENGLISHMAN RIVER JUST U/S ENGLISHMAN RIVER	Englishman River
E282969	Cond	0.0667	0.79	12	UPPER ENGLISHMAN RIVER U/S CENTRE FORK CREEK	Englishman River
E282969	DO	0	1	12	UPPER ENGLISHMAN RIVER U/S CENTRE FORK CREEK	Englishman River
E282969	Temp	0.267	0.288	12	UPPER ENGLISHMAN RIVER U/S CENTRE FORK CREEK	Englishman River
E282969	Turbidity	0.333	0.184	12	UPPER ENGLISHMAN RIVER U/S CENTRE FORK CREEK	Englishman River
E290469	Cond	0.2	0.425	12	DEPARTURE CREEK @ NEYLAND RD (STN1)	South Wellington to Nanoose

EMS.ID	analyte	tau	pvalue	n	LOCATION.NAME	WaterRegion
E290469	DO	0	1	12	DEPARTURE CREEK @ NEYLAND RD (STN1)	South Wellington to Nanoose
E290469	Temp	0.2	0.425	12	DEPARTURE CREEK @ NEYLAND RD (STN1)	South Wellington to Nanoose
E290469	Turbidity	0.2	0.425	12	DEPARTURE CREEK @ NEYLAND RD (STN1)	South Wellington to Nanoose
E290470	Cond	-0.133	0.595	12	DEPARTURE CREEK OFF NEWTON ST (STN2)	South Wellington to Nanoose
E290470	DO	-0.133	0.595	12	DEPARTURE CREEK OFF NEWTON ST (STN2)	South Wellington to Nanoose
E290470	Temp	0.305	0.228	12	DEPARTURE CREEK OFF NEWTON ST (STN2)	South Wellington to Nanoose
E290470	Turbidity	-0.267	0.288	12	DEPARTURE CREEK OFF NEWTON ST (STN2)	South Wellington to Nanoose
E290471	Cond	-0.2	0.425	12	DEPARTURE CREEK AT LOWER END OF WOODSTREAM PARK (STN 3)	South Wellington to Nanoose
E290471	DO	-0.0667	0.79	12	DEPARTURE CREEK AT LOWER END OF WOODSTREAM PARK (STN 3)	South Wellington to Nanoose
E290471	Temp	0.133	0.595	12	DEPARTURE CREEK AT LOWER END OF WOODSTREAM PARK (STN 3)	South Wellington to Nanoose
E290471	Turbidity	0.2	0.425	12	DEPARTURE CREEK AT LOWER END OF WOODSTREAM PARK (STN 3)	South Wellington to Nanoose
E290472	Cond	-0.133	0.595	12	DEPARTURE CREEK AT OUTLET (STN4)	South Wellington to Nanoose
E290472	DO	-0.133	0.595	12	DEPARTURE CREEK AT OUTLET (STN4)	South Wellington to Nanoose
E290472	Temp	0.305	0.228	12	DEPARTURE CREEK AT OUTLET (STN4)	South Wellington to Nanoose
E290472	Turbidity	-0.267	0.288	12	DEPARTURE CREEK AT OUTLET (STN4)	South Wellington to Nanoose
E290473	Cond	0.267	0.288	12	COTTLE CREEK @ NOTTINGHAM	South Wellington to Nanoose
E290473	DO	-0.267	0.288	12	COTTLE CREEK @ NOTTINGHAM	South Wellington to Nanoose
E290473	Temp	0.2	0.425	12	COTTLE CREEK @ NOTTINGHAM	South Wellington to Nanoose
E290473	Turbidity	0.0667	0.79	12	COTTLE CREEK @ NOTTINGHAM	South Wellington to Nanoose
E290475	Cond	0.267	0.288	12	COTTLE CREEK @ STEPHENSON PT RD	South Wellington to Nanoose
E290475	DO	-0.0667	0.79	12	COTTLE CREEK @ STEPHENSON PT RD	South Wellington to Nanoose
E290475	Temp	0.2	0.425	12	COTTLE CREEK @ STEPHENSON PT RD	South Wellington to Nanoose
E290475	Turbidity	0	1	12	COTTLE CREEK @ STEPHENSON PT RD	South Wellington to Nanoose

EMS.ID	analyte	tau	pvalue	n	LOCATION.NAME	WaterRegion
E290478	Cond	0.0667	0.79	12	MILLSTONE RIVER @ BIGGS ROAD	South Wellington to Nanoose
E290478	DO	-0.2	0.425	12	MILLSTONE RIVER @ BIGGS ROAD	South Wellington to Nanoose
E290478	Temp	-0.0667	0.79	12	MILLSTONE RIVER @ BIGGS ROAD	South Wellington to Nanoose
E290478	Turbidity	0.4	0.111	12	MILLSTONE RIVER @ BIGGS ROAD	South Wellington to Nanoose
E290479	Cond	0.4	0.111	12	MCGARRIGLE CK @ JINGLE POT RD	South Wellington to Nanoose
E290479	DO	-0.133	0.595	12	MCGARRIGLE CK @ JINGLE POT RD	South Wellington to Nanoose
E290479	Temp	0.0667	0.79	12	MCGARRIGLE CK @ JINGLE POT RD	South Wellington to Nanoose
E290479	Turbidity	0.333	0.184	12	MCGARRIGLE CK @ JINGLE POT RD	South Wellington to Nanoose
E290480	Cond	-0.133	0.595	12	MILLSTONE RIVER @ EAST WELLINGTON	South Wellington to Nanoose
E290480	DO	0.2	0.425	12	MILLSTONE RIVER @ EAST WELLINGTON	South Wellington to Nanoose
E290480	Temp	0.2	0.425	12	MILLSTONE RIVER @ EAST WELLINGTON	South Wellington to Nanoose
E290480	Turbidity	0	1	12	MILLSTONE RIVER @ EAST WELLINGTON	South Wellington to Nanoose
E290481	Cond	0.133	0.595	12	MILLSTONE RIVER IN BARSBY PARK	South Wellington to Nanoose
E290481	DO	-0.0667	0.79	12	MILLSTONE RIVER IN BARSBY PARK	South Wellington to Nanoose
E290481	Temp	0.267	0.288	12	MILLSTONE RIVER IN BARSBY PARK	South Wellington to Nanoose
E290481	Turbidity	-0.0667	0.79	12	MILLSTONE RIVER IN BARSBY PARK	South Wellington to Nanoose
E290483	Cond	0.267	0.288	12	CHASE RIVER @ AEBIG RD	South Wellington to Nanoose
E290483	DO	0.133	0.595	12	CHASE RIVER @ AEBIG RD	South Wellington to Nanoose
E290483	Temp	0.305	0.228	12	CHASE RIVER @ AEBIG RD	South Wellington to Nanoose
E290483	Turbidity	0.0667	0.79	12	CHASE RIVER @ AEBIG RD	South Wellington to Nanoose
E290484	Cond	0.4	0.111	12	CHASE RIVER @HOWARD BELOW COLLIERY DAM	South Wellington to Nanoose
E290484	DO	0.133	0.595	12	CHASE RIVER @HOWARD BELOW COLLIERY DAM	South Wellington to Nanoose

EMS.ID	analyte	tau	pvalue	n	LOCATION.NAME	WaterRegion
E290484	Temp	0.0667	0.79	12	CHASE RIVER @HOWARD BELOW COLLIERY DAM	South Wellington to Nanoose
E290484	Turbidity	0.2	0.425	12	CHASE RIVER @HOWARD BELOW COLLIERY DAM	South Wellington to Nanoose
E290485	Cond	-0.0667	0.79	12	CHASE RIVER @ PARK AVE	South Wellington to Nanoose
E290485	DO	0.333	0.184	12	CHASE RIVER @ PARK AVE	South Wellington to Nanoose
E290485	Temp	0.2	0.425	12	CHASE RIVER @ PARK AVE	South Wellington to Nanoose
E290485	Turbidity	0.0667	0.79	12	CHASE RIVER @ PARK AVE	South Wellington to Nanoose
E290486	Cond	0.6	0.0168	12	CATSTREAM @ PARK ABOVE CONFLUENCE WITH CHASE RIVER	South Wellington to Nanoose
E290486	DO	-0.267	0.288	12	CATSTREAM @ PARK ABOVE CONFLUENCE WITH CHASE RIVER	South Wellington to Nanoose
E290486	Temp	0.267	0.288	12	CATSTREAM @ PARK ABOVE CONFLUENCE WITH CHASE RIVER	South Wellington to Nanoose
E290486	Turbidity	0.333	0.184	12	CATSTREAM @ PARK ABOVE CONFLUENCE WITH CHASE RIVER	South Wellington to Nanoose
E287699	Cond	0.143	0.524	14	NANAIMO RIVER U/S HASLAM CK ~500 M D/S HWY 1 BRIDGE	Nanaimo River
E287699	DO	-0.476	0.0337	14	NANAIMO RIVER U/S HASLAM CK ~500 M D/S HWY 1 BRIDGE	Nanaimo River
E287699	Temp	0.476	0.0337	14	NANAIMO RIVER U/S HASLAM CK ~500 M D/S HWY 1 BRIDGE	Nanaimo River
E287699	Turbidity	0.476	0.0337	14	NANAIMO RIVER U/S HASLAM CK ~500 M D/S HWY 1 BRIDGE	Nanaimo River
E290487	Cond	-0.267	0.288	12	BECK CREEK @ CEDAR RD	Nanaimo River
E290487	DO	0.133	0.595	12	BECK CREEK @ CEDAR RD	Nanaimo River
E290487	Temp	0.333	0.184	12	BECK CREEK @ CEDAR RD	Nanaimo River
E290487	Turbidity	-0.2	0.425	12	BECK CREEK @ CEDAR RD	Nanaimo River

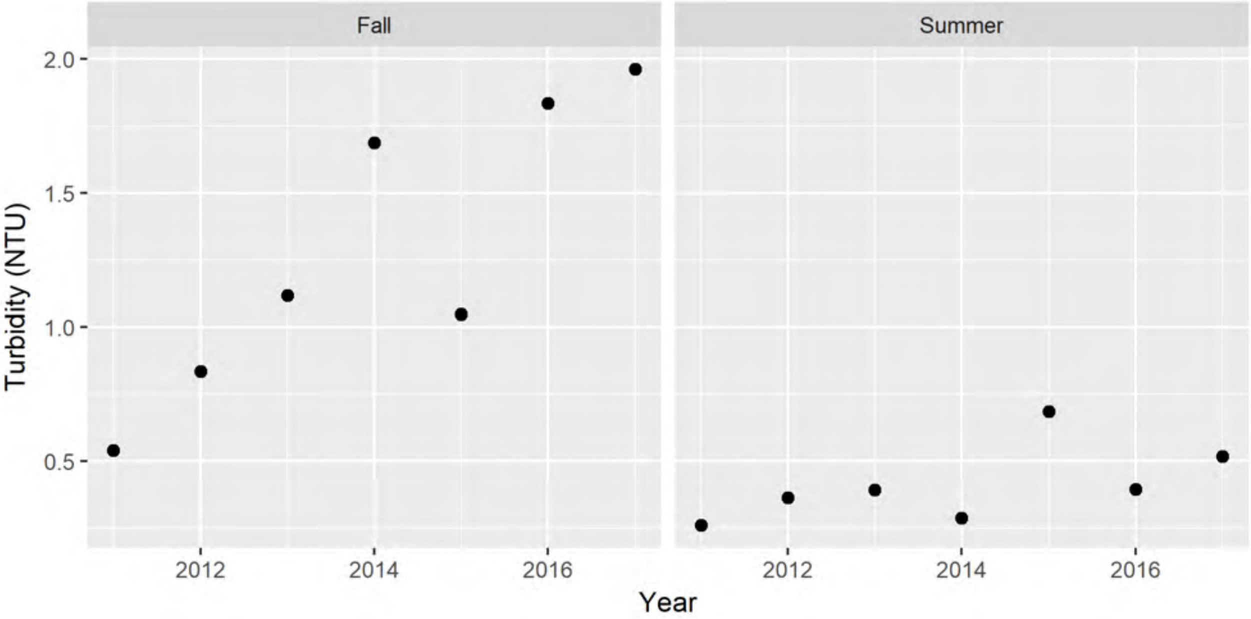

Figure A137. Mean fall and summer turbidity from 2011-2017 for Little Qualicum River at Intake.

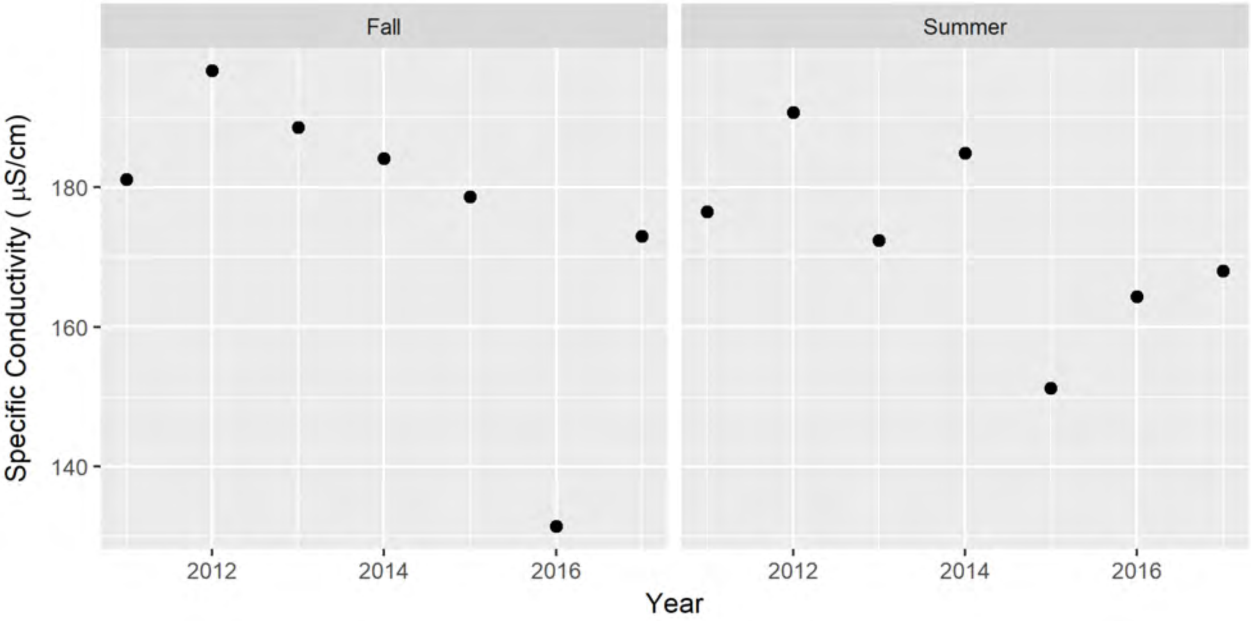

Figure A138. Mean fall and summer conductivity from 2011-2017 for Beach Creek near Chester Road at Hemsworth Rd.

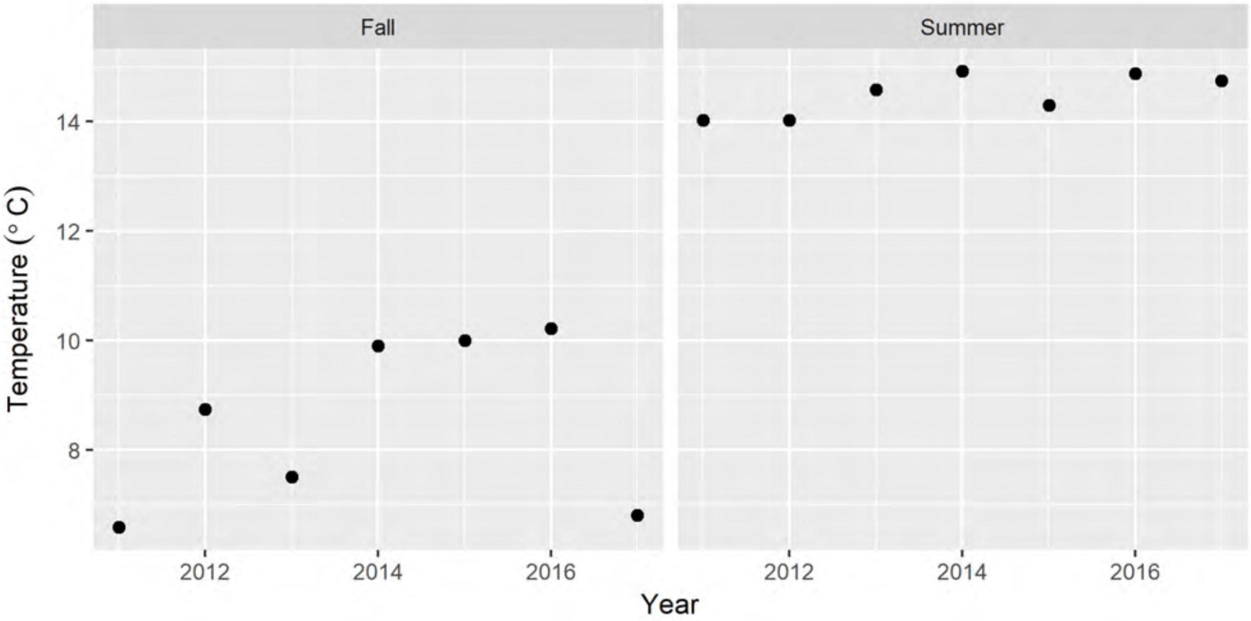

Figure A139. **Mean fall and summer water temperature from 2011-2017 for Beach Creek near Chester Road at Hemsworth Rd.**

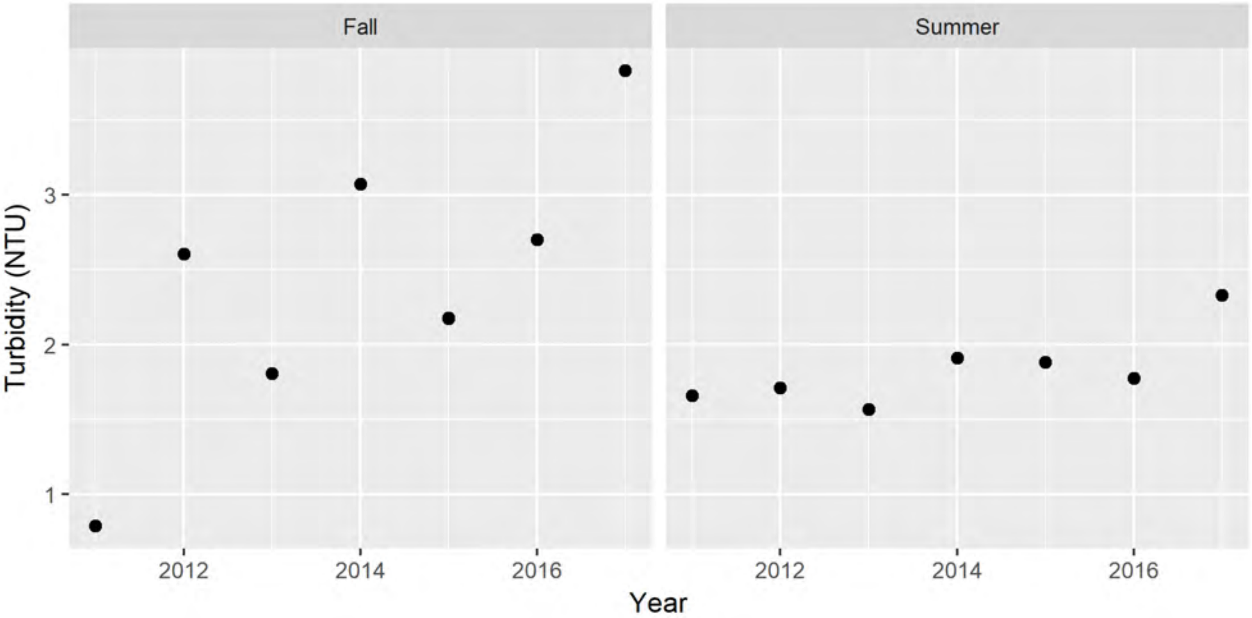

Figure A140. **Mean fall and summer water turbidity from 2011-2017 for Beach Creek near Chester Road at Hemsworth Rd.**

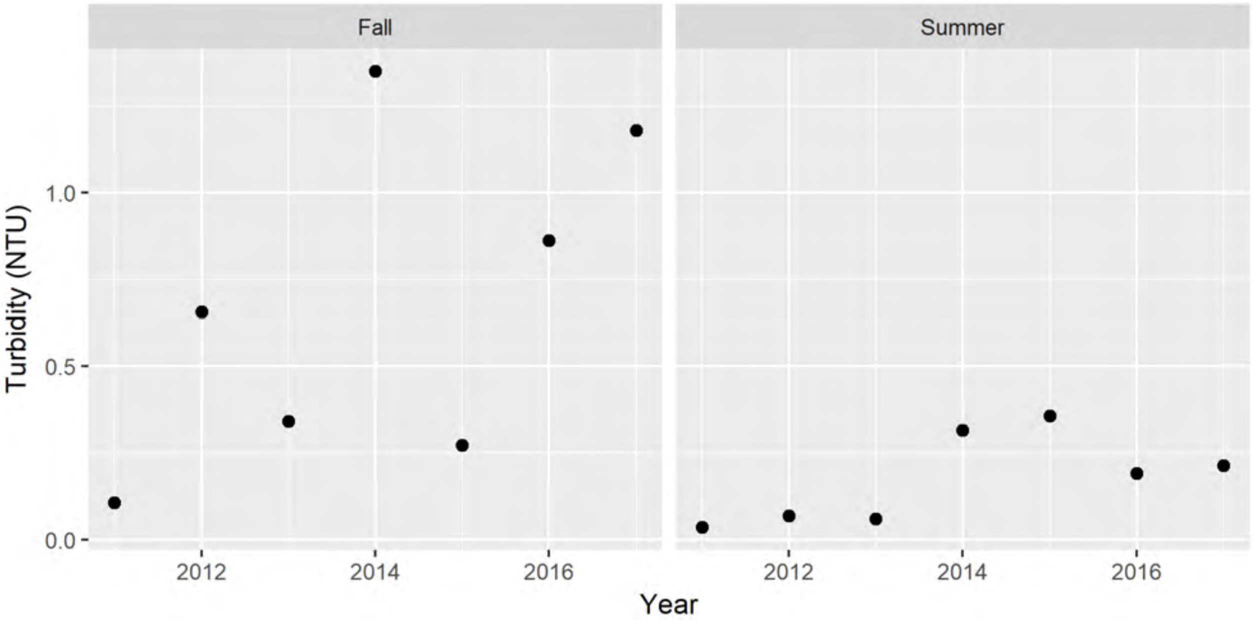

Figure A141. Mean fall and summer water turbidity from 2011-2017 for French Creek at Grafton Rd.

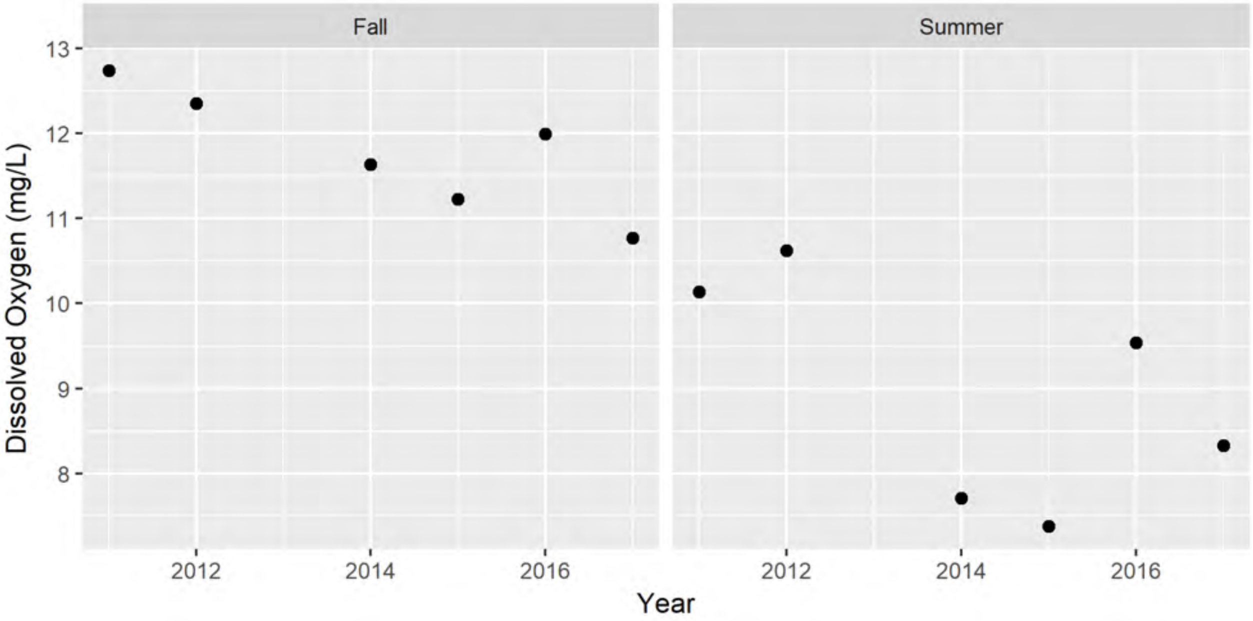

Figure A142. Mean fall and summer DO from 2011-2017 for Englishman River Upstream of Morison Creek.

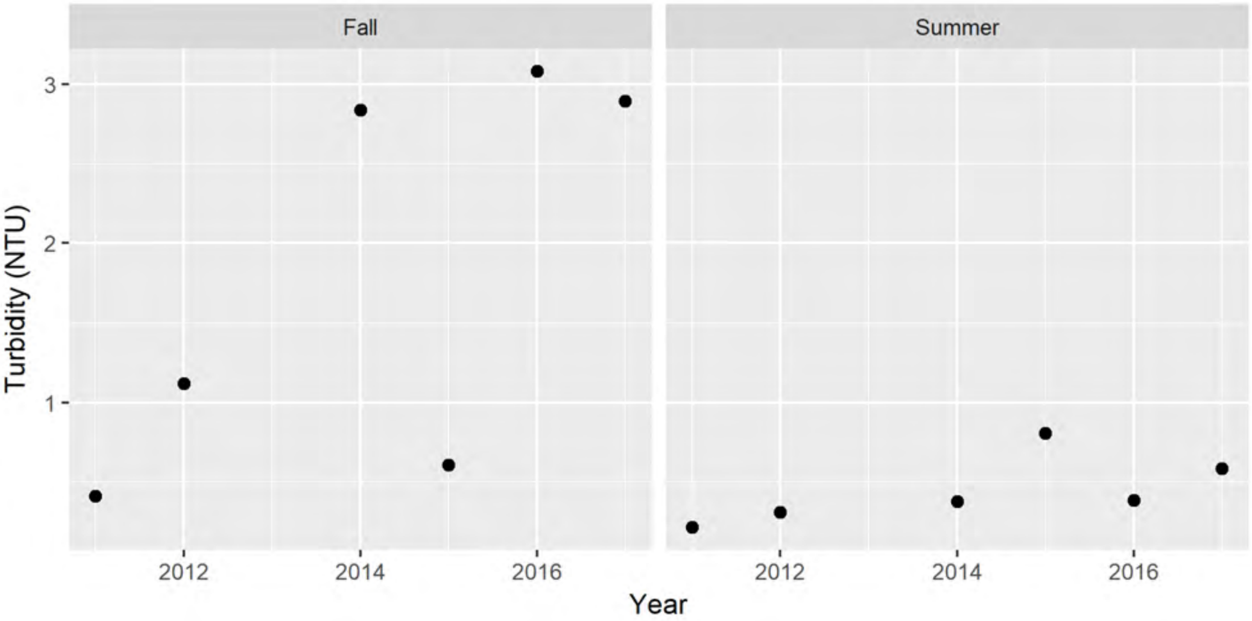

Figure A143. Mean fall and summer turbidity from 2011-2017 for Englishman River at Highway 19A.

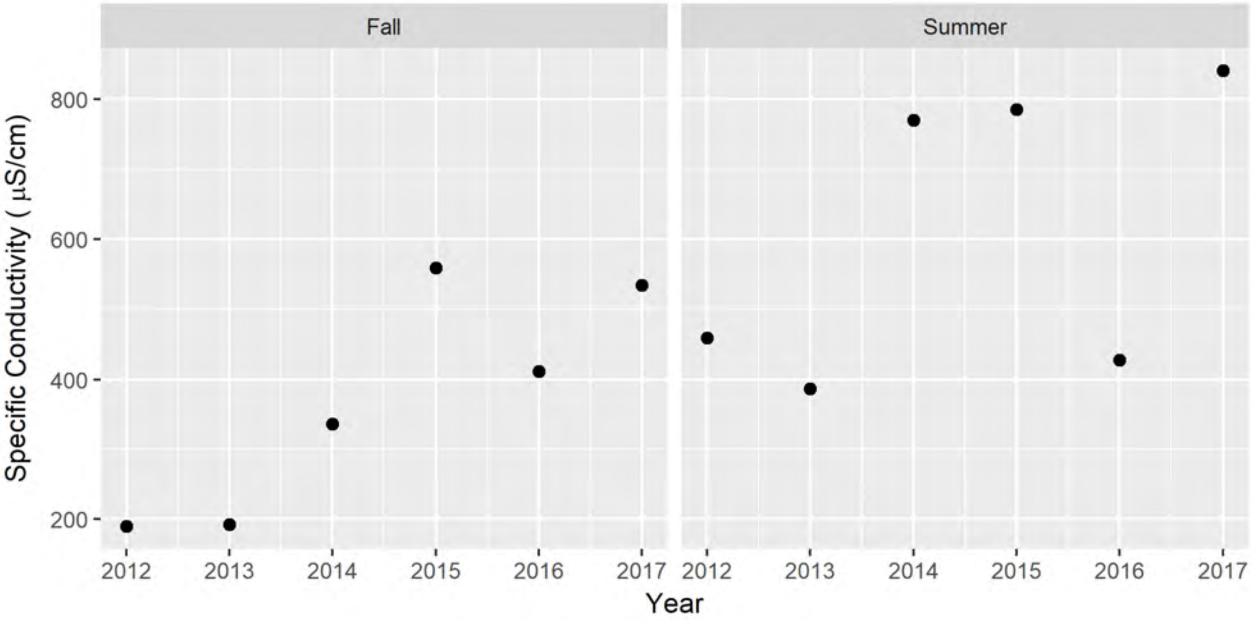

Figure A144. Mean fall and summer conductivity from 2011-2017 for Cat Stream.

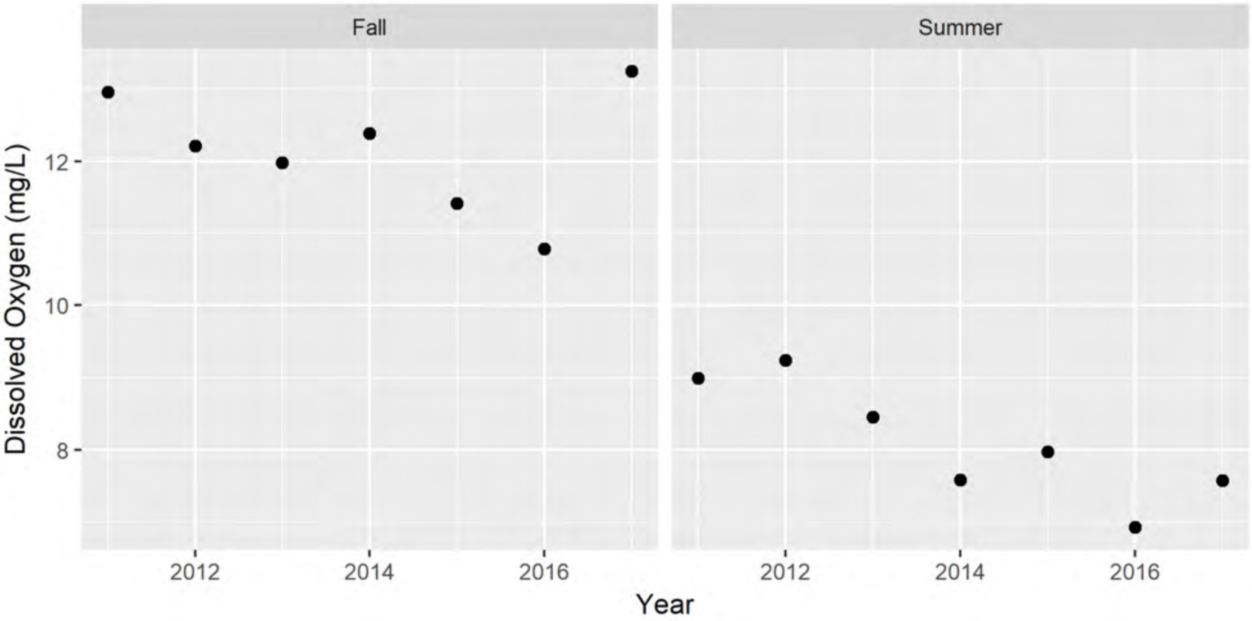

Figure A145. Mean fall and summer DO from 2011-2017 for Nanaimo River Upstream of Haslam Creek.

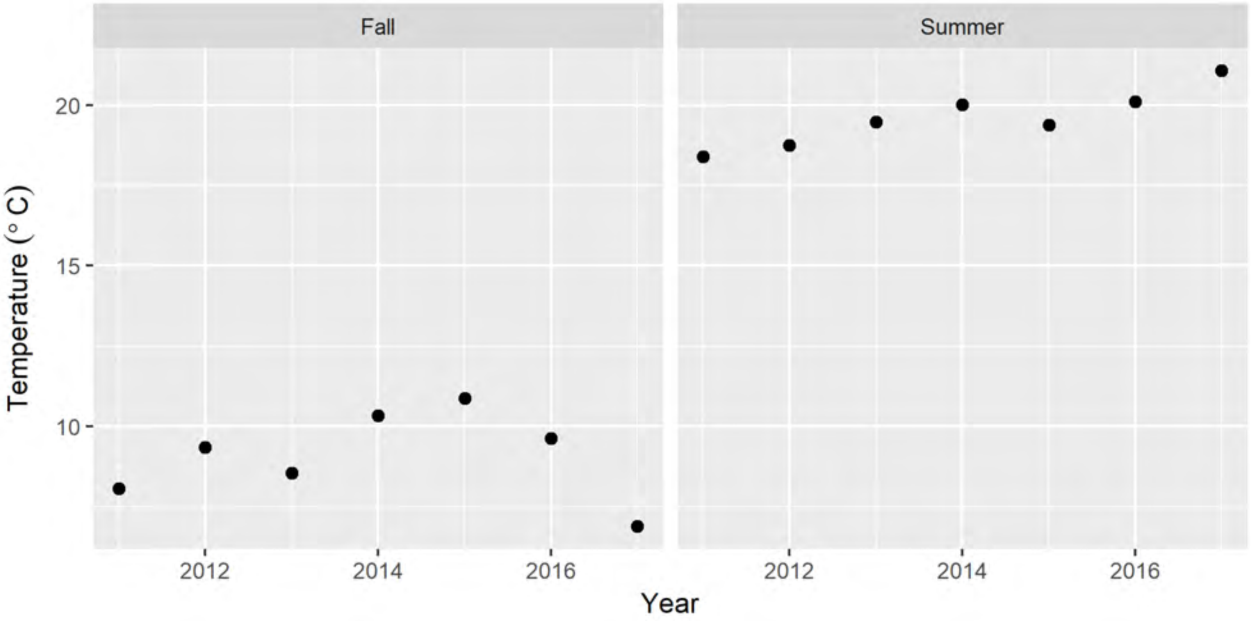

Figure A146. Mean fall and summer water temperature from 2011-2017 for Nanaimo River Upstream of Haslam Creek.

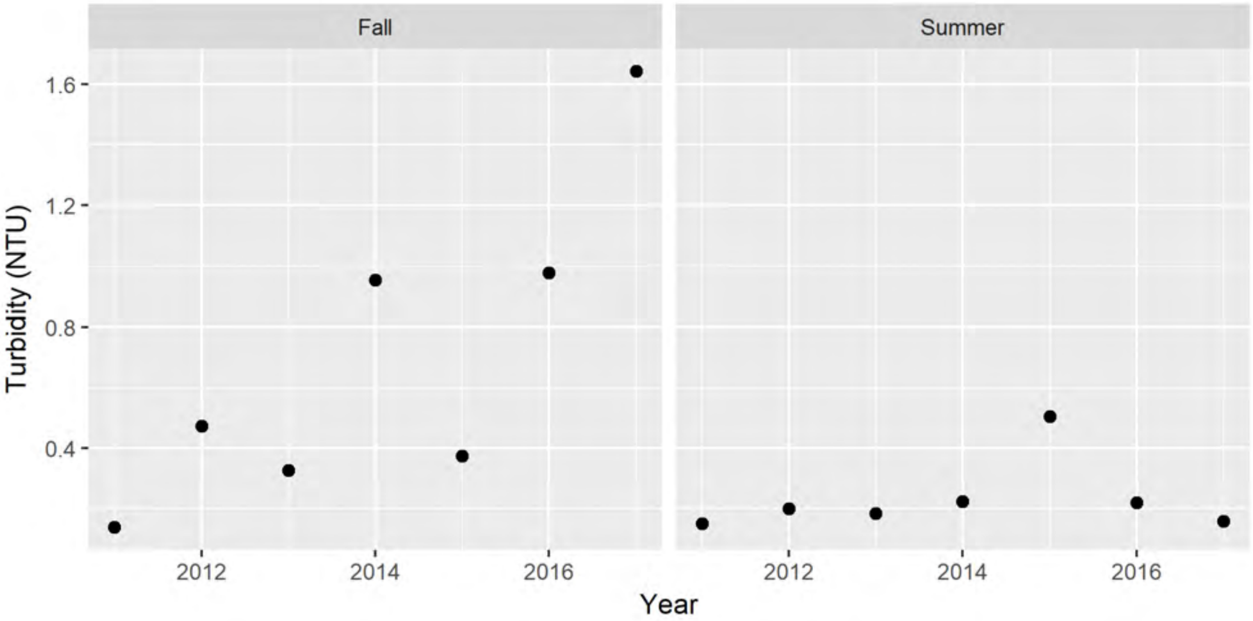

Figure A147. **Mean fall and summer turbidity from 2011-2017 for Nanaimo River Upstream of Haslam Creek.**

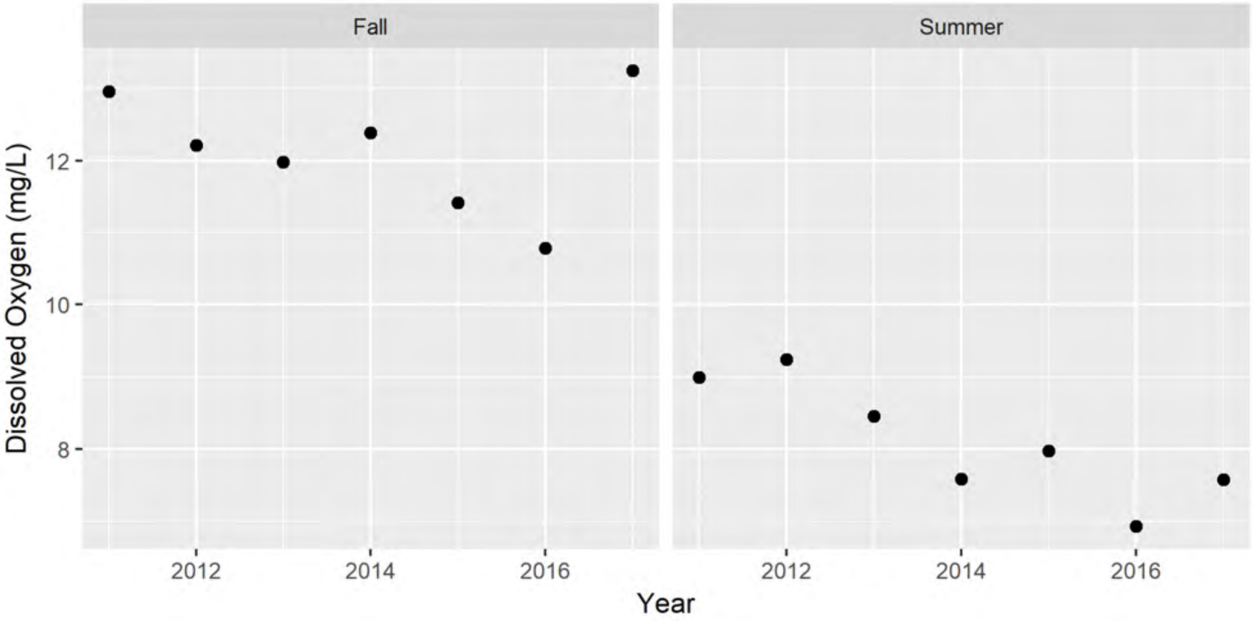

Figure A148. **Mean fall and summer DO from 2011-2017 for Nanaimo River Upstream of Haslam Creek.**

Appendix H Water Quality Models Supplemental Results

Table A3 Summary of water quality models with mean variance explained (R^2) and Mean Squared Error (MSE).

Model	R^2	MSE
Summer Conductivity	0.42	6116.77
Summer DO	0.25	2.89
Summer Temperature	0.13	3.42
Summer Turbidity	0.21	0.58
Fall Conductivity	0.53	3471.65
Fall DO	0.28	0.75
Fall Temperature	0.39	1.5
Fall Turbidity	0.37	0.25

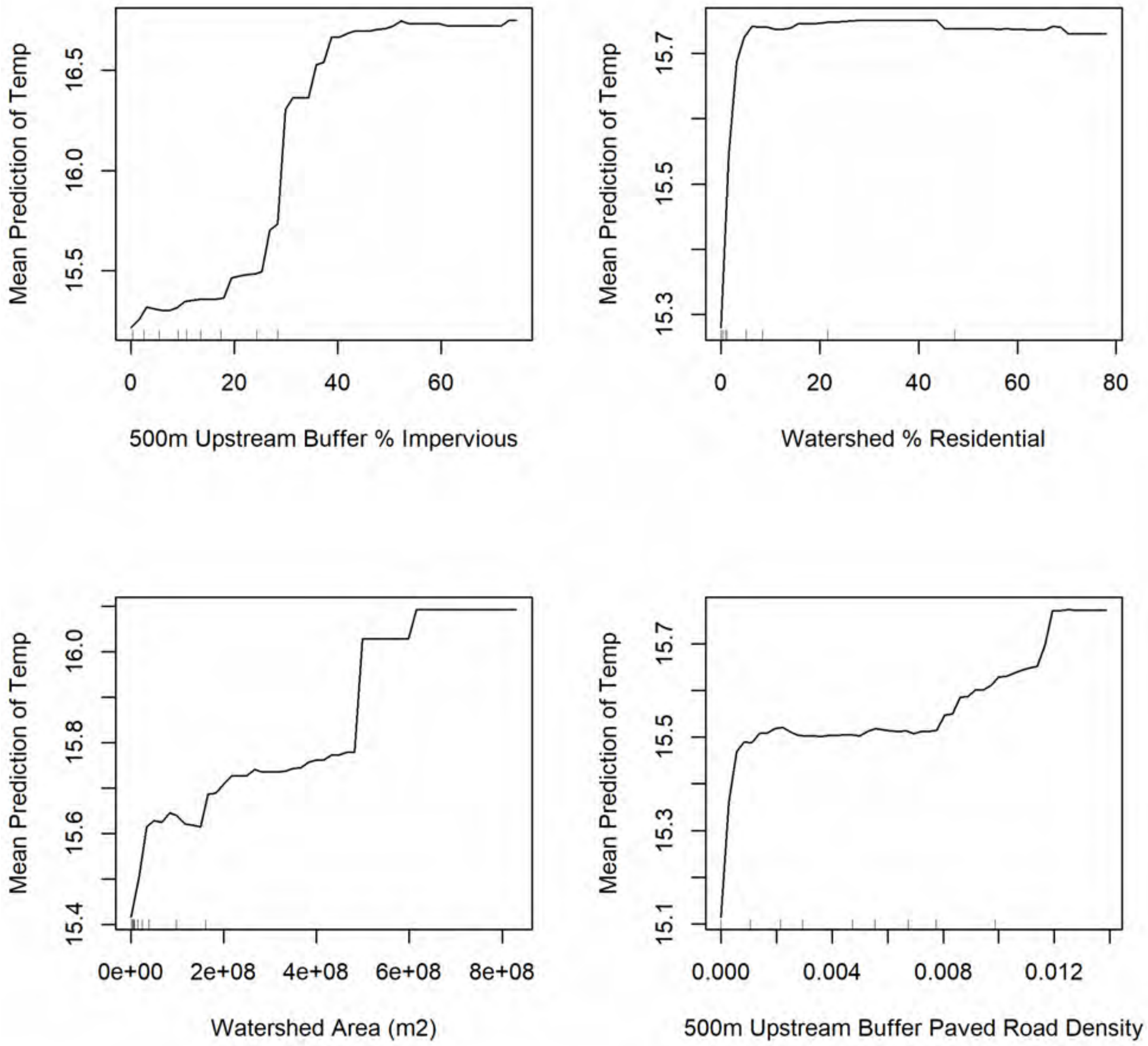

Figure A149. **Partial Dependence plots for top four predictors of summer water temperature model.**

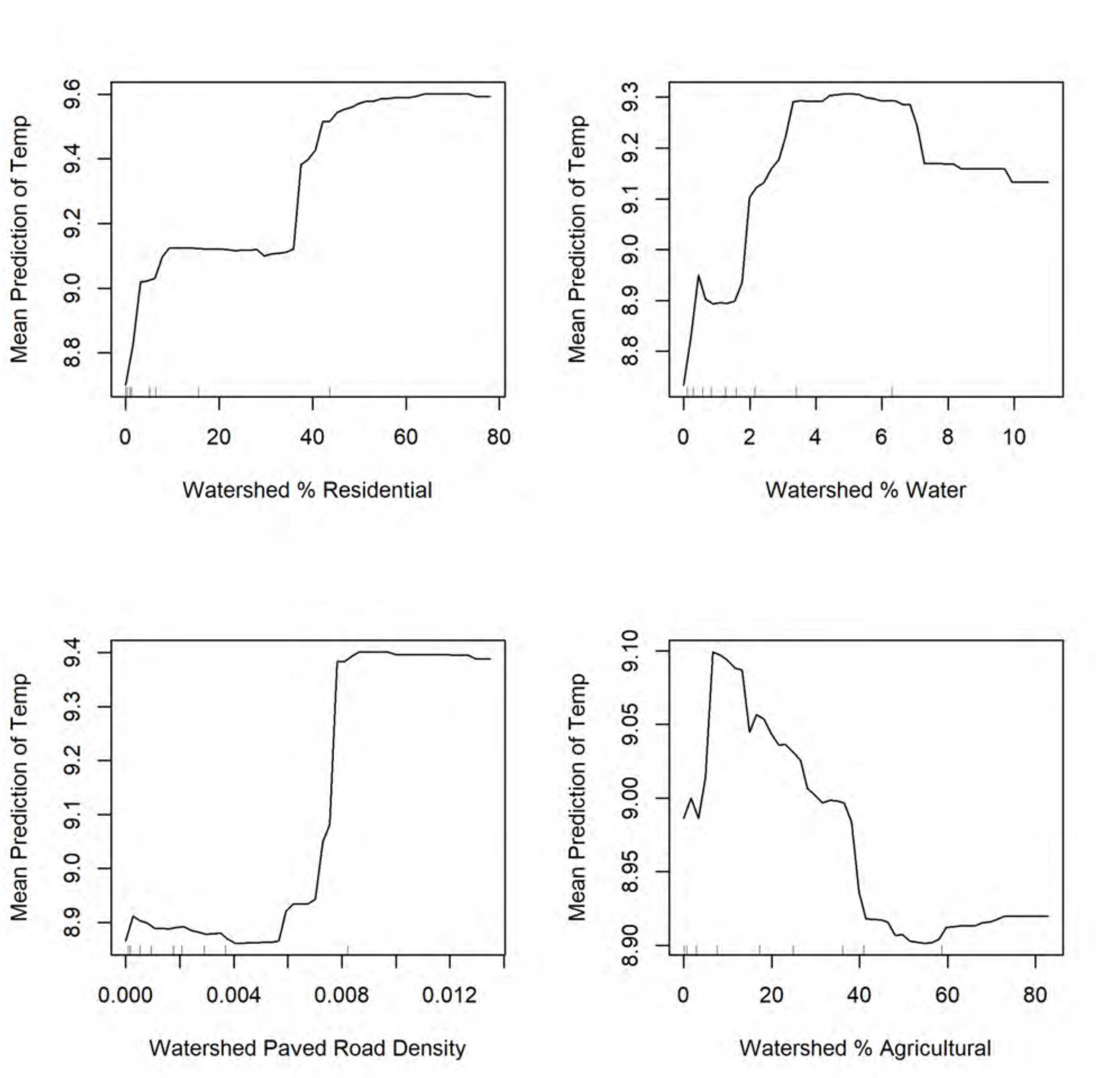

Figure A150. Partial Dependence plots for top four predictors of fall water temperature model.

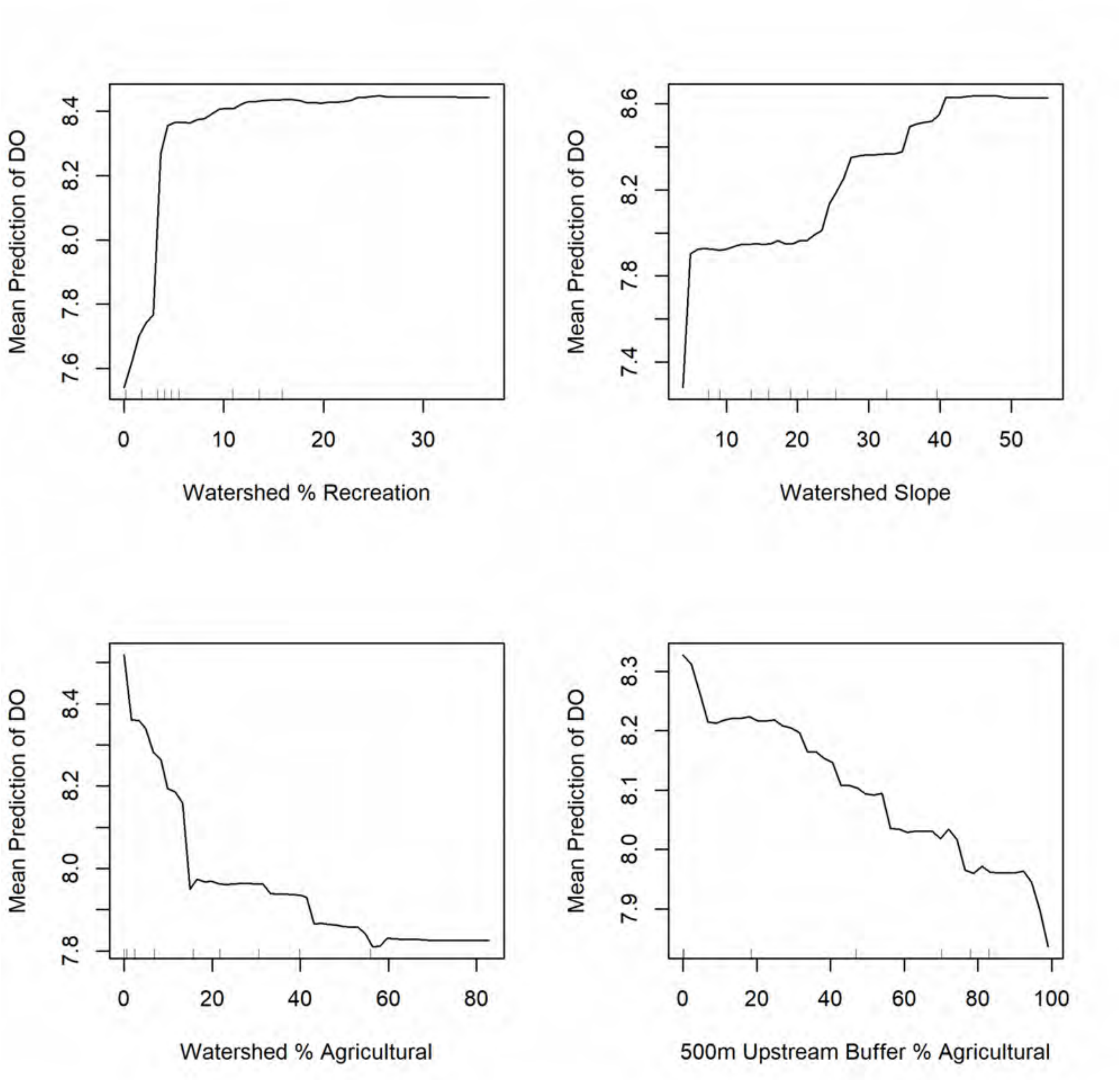

Figure A151. **Partial Dependence plots for top four predictors of summer DO model.**

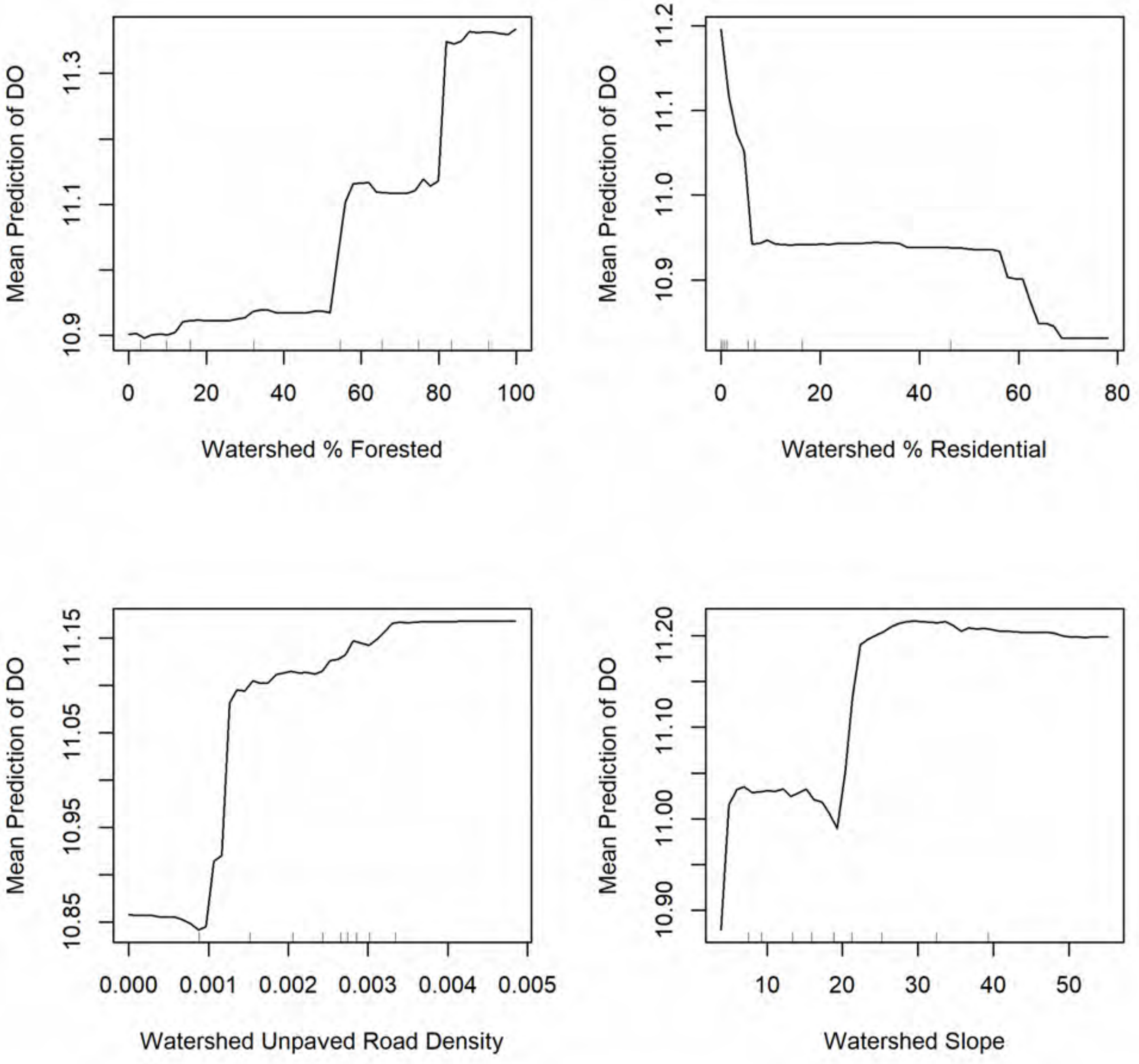

Figure A152. **Partial Dependence plots for top four predictors of fall DO model.**

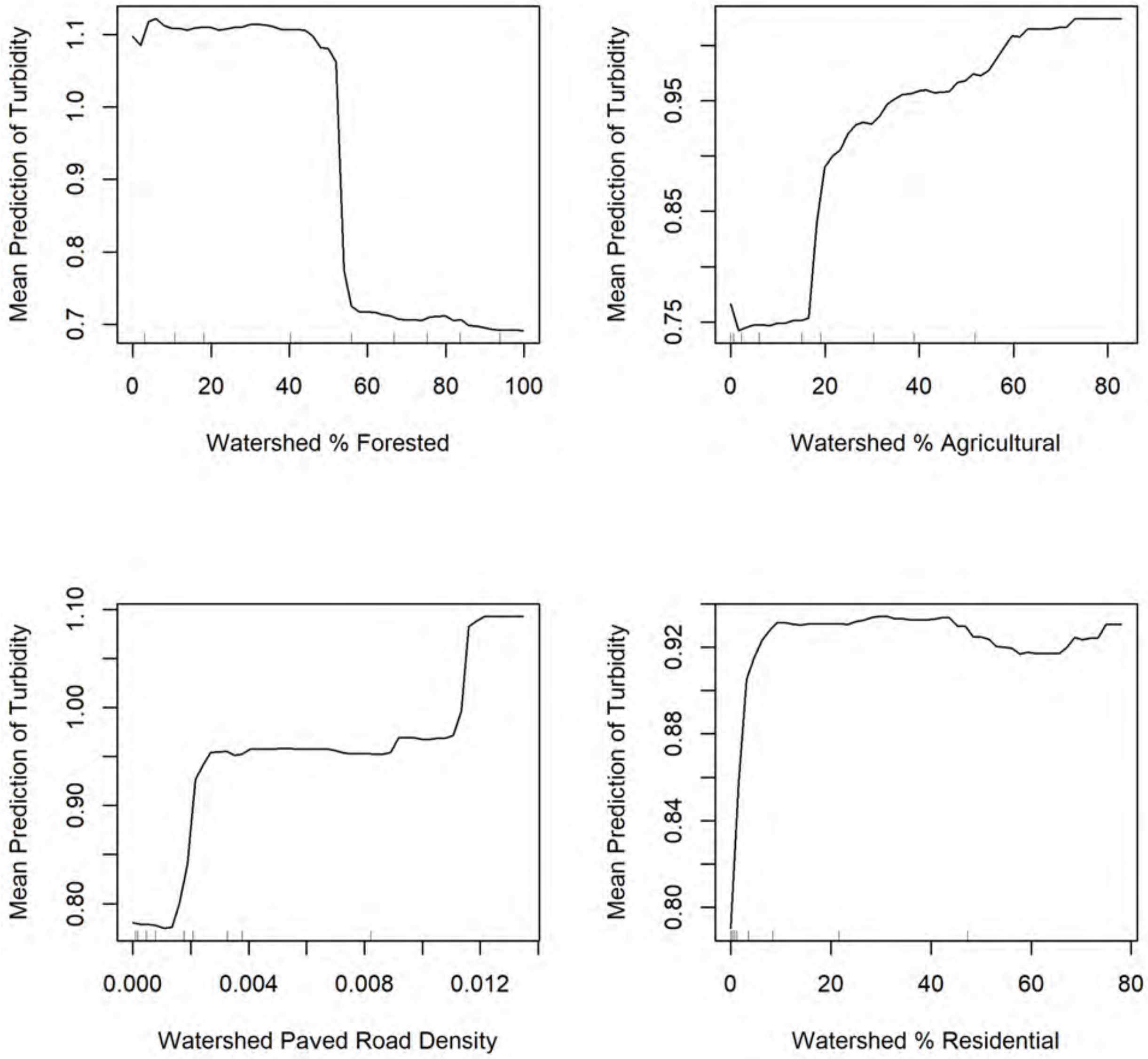

Figure A153. **Partial Dependence plots for top four predictors of summer turbidity model.**

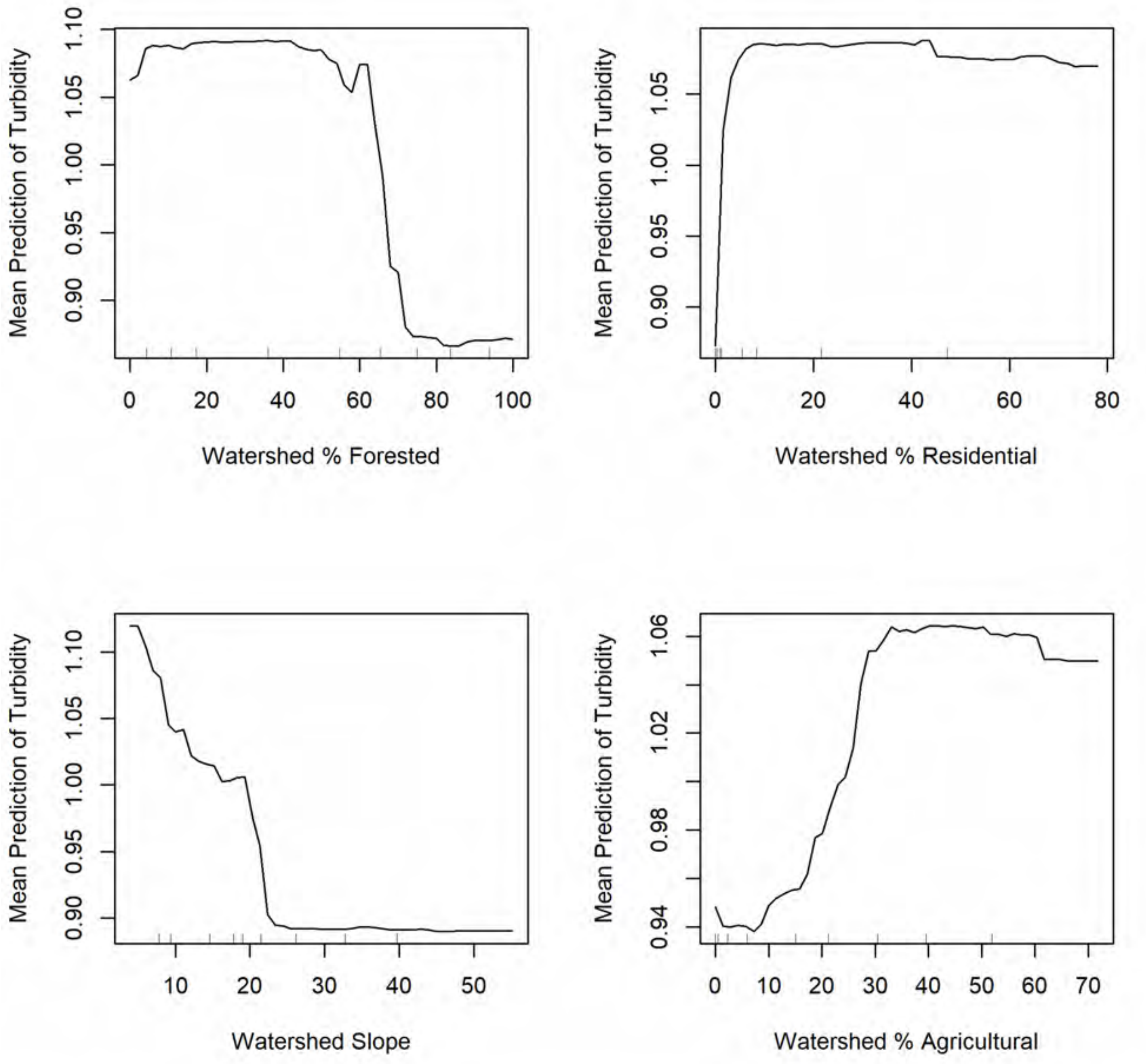

Figure A154. Partial Dependence plots for top four predictors of fall turbidity model.

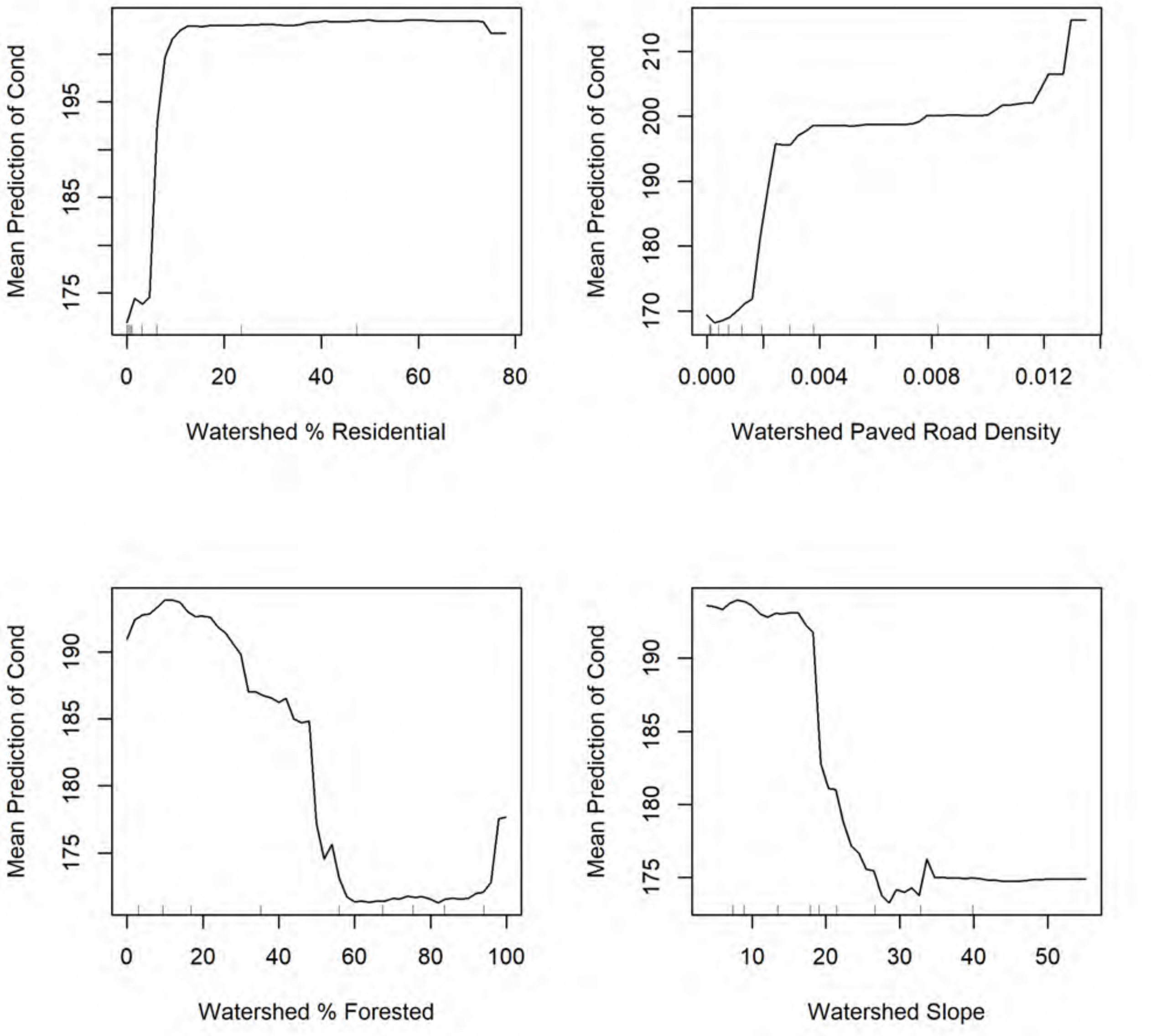

Figure A155. **Partial Dependence plots for top four predictors of summer conductivity model.**

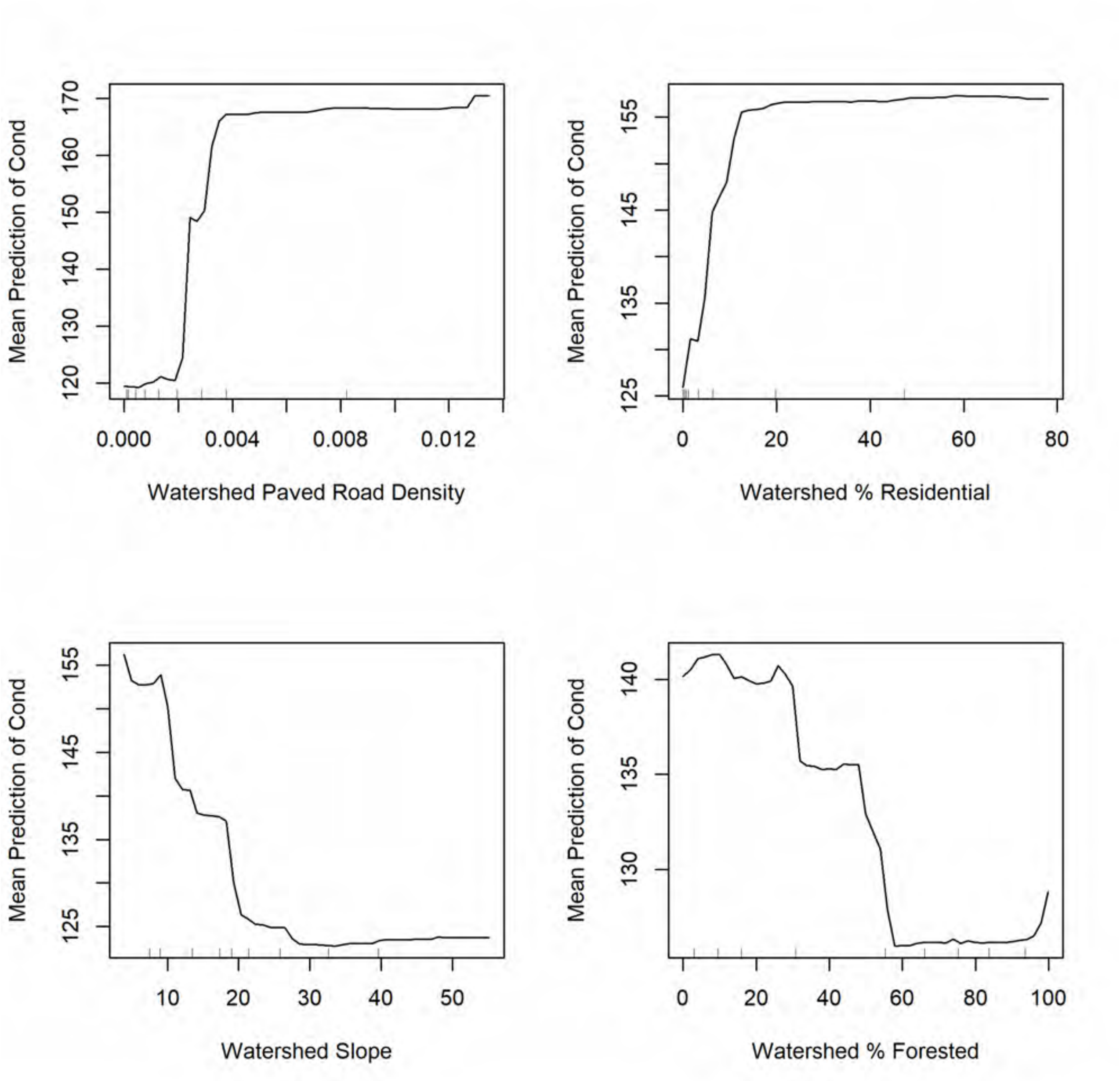

Figure A156. **Partial Dependence plots for top four predictors of fall conductivity model.**

Appendix I Rain Garden and Swale Figures

Figure A157. **A well designed residential property with rain gardens and swale. Drawing provided by Larratt Aquatic Consulting and illustrated by Rebekah Massey.**

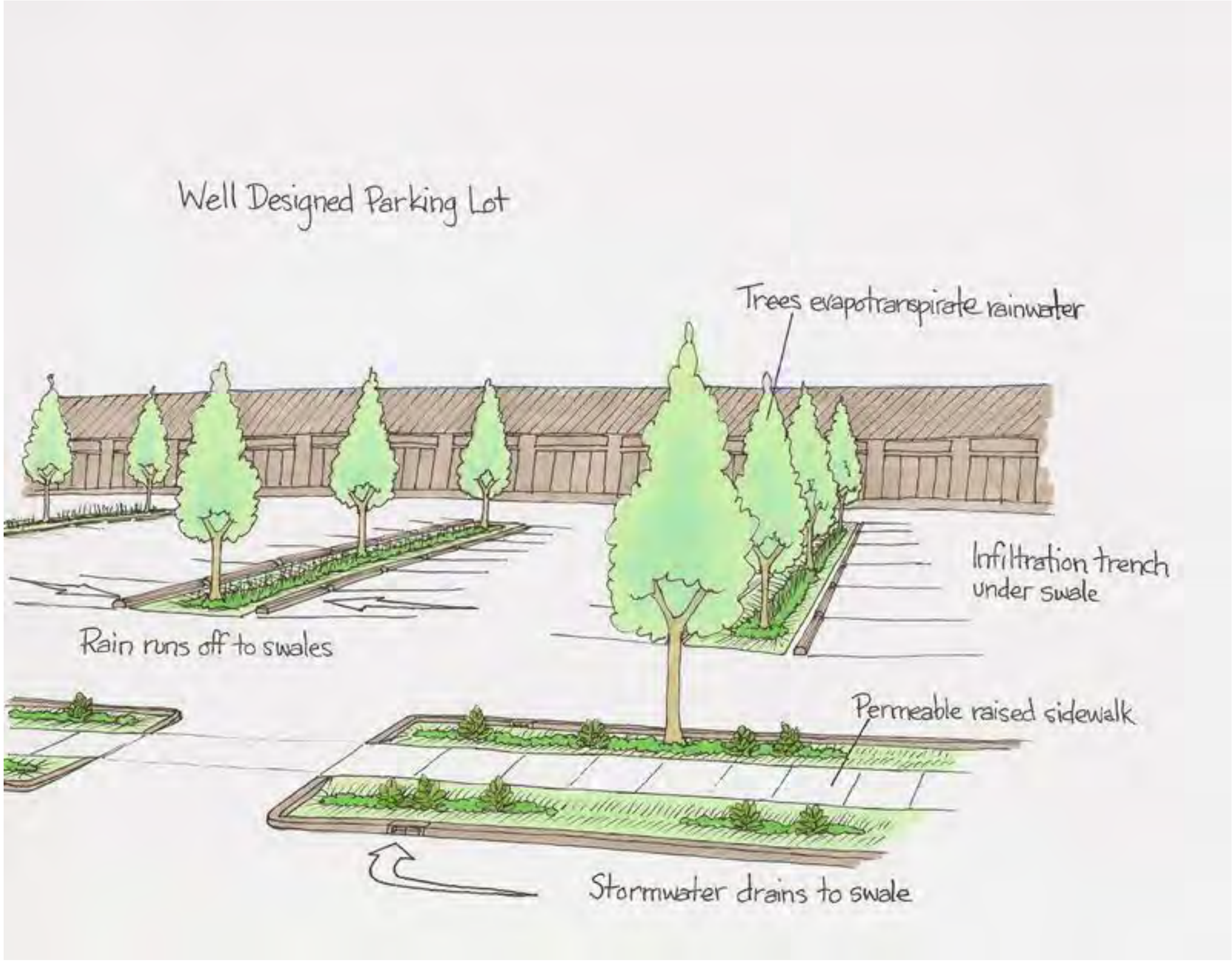

Figure A158. A well designed parking lot with swales. Drawing provided by Larratt Aquatic Consulting and illustrated by Rebekah Massey.

REGIONAL
DISTRICT
OF NANAIMO

STAFF REPORT

TO:	Committee of the Whole	**MEETING:**	November 20, 2018
FROM:	Catherine Morrison Manager, Emergency Services	**FILE:**	2240-20 ARA
SUBJECT:	Fire Services Automatic Response Agreement Renewal		

RECOMMENDATION

That the Automatic Response Agreement for a five-year term from March 1, 2018 to March 1, 2023 be approved.

SUMMARY

The current Automatic Response Agreement expires on November 30, 2018, and is between the City of Parksville, Town of Qualicum Beach and the Regional District of Nanaimo (RDN), representing various fire department societies. There are two additional fire societies, Nanoose Bay and Bow Horn Bay, proposed to become parties to the agreement. There are no other changes to the agreement.

The fire department societies representing the following fire departments: Errington, Coombs/Hilliers, Dashwood, Nanoose Bay, Bow-Horn Bay; the City of Parksville and the Town of Qualicum have executed the agreement.

BACKGROUND

Since 2008, the Automatic Response Agreement has been in place to ensure that sufficient initial resources are deployed to an emergency incident. ‘Automatic Response’ means the immediate dispatching of resources to emergency incidents; the guidelines for the dispatch of these resources are outlined in the attached agreement. The agreement includes a list of locations that trigger an automatic response, as well as a specific list of resources required for each incident.

Automatic Response Agreements assist each department in being able to respond with the appropriate resources as recommended by the Fire Underwriters Survey. This response is especially important during daytime responses when there are limited members available to respond to the initial emergency call.

As part of the agreement, a representative from each fire department makes up ‘The Operating Committee’ as outlined in Section 2 and is tasked with ensuring the Schedules identifying resources and automatic response locations are kept updated.

ALTERNATIVES

1. That the Automatic Response Agreement Renewal with the addition of two fire departments, Nanoose Bay Volunteer Fire Department and Bow Horn Bay Volunteer Fire Department, for a five-year term from March 1, 2018 to March 1, 2023, be approved.

2. That alternate direction be provided.

FINANCIAL IMPLICATIONS

It is anticipated the overall cost of implementing this agreement will remain fairly revenue neutral as RDN Fire Departments would be responding to incidents in other areas and vice versa.

If the agreement were to be amended, legal costs and resource time would need to be allotted to make changes, complete the review and secondary signing process. The Nanoose Bay and Bow Horn Bay Volunteer Fire Departments would continue to work under the Mutual Aid Agreement until a new Automatic Response Agreement was ready. There could be potential delays in additional equipment and resources being requested depending on the experience level of the Duty Officer at the time of the incident.

If the agreement is not renewed, each department would revert to the use of the Mutual Aid Agreement which has similar cost recovery requirements. The Mutual Aid Agreement however, would create a potential time delay in additional equipment being requested. Depending on the nature of the incident, a delayed initial response of adequate equipment to the emergency location could have a significant impact on the outcome of the incident.

STRATEGIC PLAN IMPLICATIONS

Focus On Service And Organizational Excellence - We View Our Emergency Services As Core Elements Of Community Safety

Catherine Morrison
cmorrison@rdn.bc.ca
October 25, 2018

Reviewed by:

- D. Pearce, Director, Transportation and Emergency Services
- P. Carlyle, Chief Administrative Officer

Attachment

1. Attachment 1 – 2018-23 Automatic Response Agreement RDN, Parksville, QB, Fire Department Societies

AUTOMATIC RESPONSE AGREEMENT

THIS AGREEMENT made this 1 day of March 2018

AMONG

THE CITY OF PARKSVILLE

AND

THE TOWN OF QUALICUM BEACH

AND

THE REGIONAL DISTRICT OF NANAIMO

AND

ERRINGTON FIRE DEPARTMENT

AND

COOMBS/HILLIERS FIRE DEPARTMENT

AND

DASHWOOD FIRE DEPARTMENT

AND

NANOOSE BAY FIRE DEPARTMENT

AND

BOW-HORN BAY FIRE DEPARTMENT

WHEREAS the City of Parksville and the Town of Qualicum Beach operate and maintain municipal fire departments and the Regional District of Nanaimo, in accordance with service contracts with the Coombs Hilliers Fire Department, the Errington Fire Department, the Dashwood

Fire Department, the Nanoose Bay Fire Department and the Bow-Horn Bay Fire Department provides fire protection and emergency response to portions of Electoral Areas F, G, H and E within School District 69;

AND WHEREAS the parties have entered into a Mutual Aid Agreement and this Agreement is in addition to that Mutual Aid Agreement;

AND WHEREAS the parties consider it to be of mutual benefit to respond automatically to Emergency Incidents within the jurisdictions of the City of Parksville, the Town of Qualicum Beach and the fire service areas of Coombs Hilliers, Errington, Dashwood, Nanoose Bay and Bow-Horn Bay;

AND WHEREAS the parties to this Agreement agree and acknowledge that the fire chief of each of the Fire Departments shall in his/her sole discretion, determine resource allocation requirements for their areas and the ability of the Fire Department to respond automatically to Emergency Incidents as outlined in this Agreement;

NOW THEREFORE the parties wish to describe the terms and conditions for Automatic Response to Emergency Incidents within the jurisdictions of the City of Parksville, the Town of Qualicum Beach and the fire service areas of Coombs Hilliers, Errington, Dashwood, Nanoose Bay and Bow-Horn Bay.

DEFINITIONS:

Automatic Response means the immediate dispatching of resources to Emergency Incidents as outlined in this Agreement.

Emergency Incident means a fire or fire related incident occurring at the locations identified in Schedule A

Fire Department means the fire departments operated by the City of Parksville and the Town of Qualicum Beach and the Regional District of Nanaimo volunteer fire departments of Coombs-Hilliers, Errington, Dashwood, Nanoose Bay, and Bow-Horn Bay, and each of them.

Local Government means the City of Parksville, the Town of Qualicum Beach and the Regional District of Nanaimo.

Operating Committee means the committee established under Section 2.1 of this Agreement.

Mutual Aid Agreement means the Mutual Aid agreement the most recent agreement currently in effect between the Bow-Horn Bay Fire Department, Coombs-Hilliers Fire Department, Errington Fire Department, Dashwood Fire Department, Nanoose Bay Fire Department, Deep Bay Fire Department, Regional District of Nanaimo, City of Parksville, Town of Qualicum Beach and the District of Lantzville.

North Island 911 Dispatch Center means the fire dispatch center operated by the North Island 911 Corporation.

North Island 911 Dispatch Center Manager means the person designated from time to time to oversee the operations of the North Island 911 Dispatch Center.

Party means the City of Parksville, the Town of Qualicum Beach, the Regional District of Nanaimo, the Coombs Hilliers Fire Department, the Errington Fire Department, the Dashwood Fire Department, the Nanoose Bay Fire Department, the Bow-Horn Bay, and each of them.

1.0 PURPOSES:

1.1 To ensure Automatic Response to certain types and classes of emergency in order to supplement the resources of the local jurisdiction or service area where the Emergency Incident is occurring.

1.2 To ensure adequate personnel and apparatus are activated, and arrive at the Emergency Incident in a timely manner.

1.3 To provide for an enhanced, effective and economical level of rescue, fire extinguishment and mitigation services for residents or occupants who live in high rise structures, care facilities, schools, hospitals or other more complex developments.

1.4 To ensure the Fire Departments identified in this Agreement make available operational guidelines that address resource requirements and actions necessary to respond to Emergency Incidents in accordance with this Agreement.

2.0 OPERATING COMMITTEE:

2.1 An Operating Committee shall be established, and will consist of at least one fire officer or designate from each of the participating Fire Departments. The Operating Committee will designate one of its members as the primary contact for communications between the Parties arising through the course of this Agreement and shall immediately advise each Party in writing of the name of such contact person or any changes to the name of such contact person. The Chair of the Operating Committee shall rotate on an annual basis and decisions of the committee will be by simple majority. A quorum of members must be present. A quorum is four (4) members of the committee.

2.2 The Operating Committee is authorized to make amendments to Schedules A, B and C to this Agreement and the primary contact of the Operating Committee designated under Section 2.1 shall be responsible for ensuring that all changes are communicated in writing in a timely manner to the North Island 911 Fire Dispatch Center Manager and to each Party.

2.3 The Operating Committee shall meet not less than two times each year and shall meet at such other times as may reasonably be requested by either Party or any of the Fire Chiefs.

2.4 The Operating Committee shall establish and agree upon Uniform Operational Guidelines governing Automatic Aid activations and responses, attached as Schedule C to this Agreement, and each Fire Department shall adopt and train its Firefighters to the standards specified in such guidelines.

2.5 The Operating Committee shall be responsible for establishing the operational requirements and processes for Automatic Aid activations and responses, including:

a. identifying what constitutes an Emergency Incident;
b. establishing the appropriate responses from the Requesting Department and Responding Departments to each Emergency Incident;
c. expanding or limiting the coverage area for Automatic Aid;
d. establishing the necessary Uniform Operational Guidelines to cover Automatic Aid activations and responses;
e. working with the Dispatch Centre to ensure appropriate dispatching of Automatic Aid to Emergency Incidents;
f. setting training standards and requirements, including a reliable method for rapidly identifying the training levels of personnel from each of the Responding Departments;
g. organizing regular joint training exercises among the Fire Departments and with the Dispatch Centre;
h. establishing or confirming communication protocols at the scenes of Emergency Incidents;
i. annually collating the insurance policies and certificates of insurance of each of the Fire Departments and circulating same in accordance with section 19;
j. recommending revisions to the governing bylaws of each Fire Department to ensure the objectives of this Agreement can be fully realized;
k. making recommendations to update or amend the Mutual Aid Agreement to correspond with this Agreement and vice versa; and
l. reviewing and analyzing Automatic Aid activations and responses and any issues arising in connection with such responses.

3.0 INDEMNITY

3.1 Where a Party to this Agreement (hereinafter called the “Supplying Party”) supplies another Party to this Agreement (hereinafter called the “Assisted Party”) with Automatic Response pursuant to this Agreement, the Assisted Party shall indemnify and save harmless the Supplying Party from and against any and all claims, causes of action, suits, demands and expenses whatsoever arising out of or related to the Automatic Response rendered by the Supplying Party, its servants, employees or agents, their failure to respond to a request for Automatic Response pursuant to this Agreement or their failure to render adequate assistance.

3.2 The indemnity provided for in section 3.1 shall not apply:

a. to gross negligence or willful misconduct by any Supplying Party in connection with operations at the scene of an Emergency Incident; or

b. in connection with any damage caused or injury suffered mustering Firefighters to a Supplying Department's fire hall(s) in connection with an Automatic Aid activation, or caused by the Supplying Department travelling to the scene of an Emergency Incident; or

c. any costs associated with Workers Compensation Claims, which shall be dealt with in accordance with section 3.3.

3.3 This Agreement does not constitute the Assisted Department as the employer of any Firefighter of a Responding Department. Any Workers Compensation Claims by any Firefighters of a Supplying Department arising out of or related to an Automatic Aid activation or response, shall be the responsibility of the Supplying Department and the Party who controls such Supplying Department, and made under that Supplying Department's policies with WorkSafe BC.

4.0 OBLIGATIONS OF THE PARTIES TO THIS AGREEMENT

Upon entering this Agreement, each Party shall provide the other Parties to this Agreement with its applicable operational guidelines and pre-incident plans for the locations outlined in Schedule A to this Agreement.

5.0 OBLIGATIONS FOR AUTOMATIC RESPONSE

5.1 Automatic Response will be available twenty-four (24) hours per day, seven days per week, 365 days per year to the locations outlined in Schedule A as amended from time to time in accordance with this Agreement.

5.2 The North Island 911 Fire Dispatch Center Manager shall have a copy of this Agreement at all times and shall be entitled to rely on the most up to date version of this Agreement in his/her possession for dispatching resources required under this Agreement.

5.3 It is agreed that each Party's principal responsibility for life safety and property protection is to the people and properties within their respective jurisdiction or service area. Each fire chief or designate of a Fire Department shall in his/her sole discretion determine resource allocation requirements for his/her respective jurisdiction or service area.

5.4 It is agreed and acknowledged by each Party that the commitment to provide Automatic Response under this Agreement is contingent upon a Fire Department not being involved in support of another emergency event or Emergency Incident whether inside or outside of its jurisdiction or service area.

5.5 The Fire Department of the jurisdiction or service area in which the Emergency Incident occurs is required to respond to such Emergency Incident firstly with its own resources available at the time of such Emergency Incident and must ensure it is capable of arriving at the Emergency Incident in a timely fashion.

5.6 Each Fire Department responding to a request for Automatic Response under this Agreement shall do so in accordance with the agreed upon Uniform operational guidelines and Schedule B.

5.7 The Incident Command System will be used at all emergencies involving the activation of Automatic Aid. The following principles shall apply:

- Firefighters, apparatus, and equipment provided by a Responding Department shall be under the direction of the Incident Commander of the Requesting Department for the duration of the Emergency Incident. The Incident Commander shall adhere to recognized principles of the Incident Command System, including accountability for personnel safety, in accordance with the Uniform Operational Guidelines.
- In the event that a Responding Department is first to arrive at an Emergency Incident, the senior ranking member of the first arriving crew will assume the role of Incident Commander. The role of Incident Commander will be transferred, as soon as practicable, to the first qualified officer arriving from the Requesting Department.
- At any Emergency Incident, the Requesting Department shall release the resources of the Responding Departments before releasing its own resources, except as otherwise may be provided for in the Uniform Operational Guidelines.
- An Incident Commander shall, as quickly as practicable in the circumstances, release any resources recalled by a Fire Chief (or designate) of a Responding Department.

6.0 COST RECOVERY

6.1 Where the Supplying Party provides resources pursuant to an Automatic Response request under this Agreement, the Assisted Party requesting assistance agrees to pay, the Supplying Party for resources utilized or replace the same, as the case may be, as follows:

a) for replacement costs of all consumables requested to be supplied by the Supplying Party and used during the Emergency Incident including, without limitation foam and absorbents;
b) for the costs of damage to or loss of any equipment, tools, hoses, ladders, clothing or any other such items to a maximum value of $5,000 per Emergency Incident ; and
c) with respect to vehicles, to a maximum of $5,000 per vehicle for vehicle damage or destruction.

6.2 Each Party involved in an Emergency Incident will maintain sufficient records to enable them to verify the use of items outlined under Section 6.1 above. The records shall be maintained for two years and shall be made available to the other Parties involved in such Emergency Incident, upon request.

6.3 Where a Party intends to request reimbursement for items under Paragraphs 6.1(a), (b) or (c) the request must be made within 90 calendar days of the date of the Emergency Incident

6.4 On or about February 1 of each year, the Operating Committee will meet to review the reconciliation of each Party's accounts for items under Section 6.1(a) above for the previous calendar year.

6.5 A Party shall be entitled to be reimbursed for amounts identified under 6.4 above where the difference between any two Parties exceeds three thousand dollars. The amount eligible to be reimbursed is the portion that exceeds three-thousand dollars.

6.6 Any amount invoiced for reimbursement under Section 6.5 above shall be payable within 30 days of being invoiced.

7.0 DISPUTE RESOLUTION

7.1 Should a dispute arise regarding any matter involving this Agreement it will be adjudicated by a panel of one appropriately qualified staff person designated by each of the Local Government Parties to this Agreement. The decision of the panel will be by simple majority.

7.2 Notwithstanding Section 7.1, all disputes arising out of or in connection with this Agreement, or in respect of any defined legal relationship associated therewith or derived therefrom, may at the instance of any party, be referred to a Court of competent jurisdiction or to arbitration by delivery of a Notice of Arbitration in writing. If the parties cannot agree on a choice of arbitrator then each party may appoint an arbitrator and the two arbitrators so appointed must appoint a third arbitrator failing which the third arbitrator must be appointed by a Judge of the Supreme Court of British Columbia. Arbitration will be governed by the *Commercial Arbitration Act (British Columbia)*. The place of arbitration shall be Nanaimo, British Columbia, Canada and the costs shall be borne equally by the parties.

8.0 GENERAL

8.1 This Agreement enhances and is in addition to and does not derogate from the Mutual Aid Agreement.

8.2 In addition to Section 2.2, this Agreement shall be amended only with the written consent of the Parties.

8.3 Nothing in this Agreement shall be interpreted as prejudicing or affecting the rights and powers of the Parties in the exercise of their functions under any public and private statutes, bylaws, orders and regulations, all of which may be fully and effectively exercised as if this Agreement had not been executed.

8.4 This Agreement shall ensure to the benefit of and be binding upon the parties hereto and their respective heirs, administrators, executors, successors and permitted assignees.

8.5 The waiver by a Party of any failure on the part of the other party to perform in accordance with any of the terms or conditions of this Agreement shall not be construed as a waiver of any future or continuing failure, whether similar or dissimilar.

8.6 The headings in this Agreement are inserted for convenience and reference only and in no way define, limit or enlarge the scope or meaning of this Agreement or any provision of it.

8.7 Wherever the singular masculine and neuter are used throughout this Agreement, the same shall be construed as meaning the plural or the feminine or the body corporate or politic as the context so requires.

8.8 No remedy under this Agreement shall be deemed exclusive but shall, where possible, be cumulative with all other remedies at law or in equity.

8.9 This Agreement shall be construed in accordance with and governed by the laws applicable in the Province of British Columbia.

9.0 NOTICES

All notices and demands required or permitted to be given hereunder shall be in writing and may be delivered personally, sent by facsimile, e-mail or may be mailed by first class, prepaid registered mail to the addresses set forth below. Any notice delivered or sent by facsimile shall be deemed to have been given and received at the time of delivery. Any notice mailed as aforesaid shall be deemed to have been given and received on the expiration of 5 business days after it was posted, addressed as follows:

The Town of Qualicum Beach
PO Box 130
Qualicum Beach, BC V9K 1S7

Attention: Administrator

The City of Parksville
100 Jensen Avenue East
Parksville, BC V9P 2H3

Attention: Administrator

Regional District of Nanaimo
6300 Hammond Bay Rd.
Nanaimo, BC V9T 6N2

Attention: General Manager Finance & Information Services

Coombs Hilliers Fire Department
PO Box 40,
Coombs, BC V0R 1M0

Attention: Fire Chief

Errington Fire Department
PO Box 110
Errington, BC V0R 1V0

Attention: Fire Chief

Dashwood Fire Department
230 Hobbs Rd.
Qualicum Beach, BC V9K 2B2

Attention: Fire Chief

Nanoose Bay Fire Department
2471 Nanoose Rd
Nanoose Bay, BC V9P 9E6

Attention: Fire Chief

Bow-Horn Bay Fire Department
220 Lions Way
Qualicum Bay, BC V9K 2E2

Attention Fire Chief

10.0 TERM

The term of this agreement shall be for five years commencing on the 1 day of March, 2018 and ending on the 1 day of March, 2023.

11.0 TERMINATION

Any party to this Agreement may terminate its participation by giving notice in writing to all of the other Parties notice of termination, not less than six months in advance of the date on which it wishes to terminate its participation.

IN WITNESS WHEREOF the parties hereto have set their hands as of the day and year first above written.

FOR THE CITY OF PARKSVILLE

MARC LEFEBVRE
Mayor

Mayor

Sign

CAOIMHE KEHLER
Corporate Officer

Corporate Officer

Sign Caoimhe Kehler

FOR THE TOWN OF QUALICUM BEACH

Teunis Westbroek
Mayor

Sign

Daniel Sailland
CAO

Sign

FOR THE REGIONAL DISTRICT OF NANAIMO

Chair

Sign

Jacquie Hill, Corporate Officer
Corporate Administration

Sign

FOR THE ERRINGTON FIRE DEPARTMENT

GERRARD BING
Chairperson

Sign

PEARL F. McBRIDE
Secretary

Sign Pearl McBride

FOR THE COOMBS / HILLIERS FIRE DEPARTMENT

DAVID NEDEN Apr. 9/18
Chairperson
Sign

RICHARD DE CANDOLE
Secretary
Sign

FOR THE DASHWOOD FIRE DEPARTMENT

JULY 9/18
Chairperson
Sign DAN ALBERO

JULY 9/18
Secretary
Sign HARVEY TWIDALE

FOR THE NANOOSE BAY FIRE DEPARTMENT

John
Chairperson
Sign John Jacobsen

Secretary
Sign F.J. (Bud) McFARLAND

FOR THE BOW-HORN BAY FIRE DEPARTMENT

Rodney Luck
Chairperson
Sign

Simone Mynen
Secretary
Sign

AUTOMATIC RESPONSE AGREEMENT - SCHEDULE "A"

LOCATIONS AND RESOURCES FOR AUTOMATIC RESPONSE TO EMERGENCY INCIDENTS

Jurisdiction	Civic Address Number	Street Name	Geographic Zone/Building Name	Coombs Hilliers	Errington	Parksville	Qualicum Beach	Dashwood
Qualicum Beach	650	Berwick Road North	The Gardens	Engine		Ladder		Engine
Qualicum Beach	124	Fourth Ave East	Qualicum Manor	Engine		Ladder		Engine
Qualicum Beach	777	Jones Street	Eagle Park	Engine		Ladder		Engine
Qualicum Beach	750	Memorial Ave	Hawthorne Manor	Engine		Ladder		Engine
QualicumBeach	130	Sunningdale East	Sunningdale Apartments	Engine		Ladder		Engine
QualicumBeach	744	Primrose Street	Qualicum Elementary	Engine		Ladder		Engine
Qualicum Beach	650	Bennett Road	Arrowview Elementary	Engine		Ladder		Engine
QualicumBeach	134	East Fifth Avenue	5th Avenue Estates	Engine		Ladder		Engine
QualicumBeach	699	Claymore Road	QBMS	Engine		Ladder		Engine
Parksville	All confirmed Structure Fires in the following geographic area							
Parksville			Fourneau Rd		Tender		Tender	
Parksville			Wildgreen Way		Tender		Tender	
Parksville			Hodges Rd		Tender		Tender	
Parksville			400 Blk Lowrys' Rd		Tender		Tender	
Parksville			300-600 Blk Martindale Rd including Levirs & Wain Rd's.		Tender		Tender	
Parksville	250	Craig Street	Stanford Place		Engine		Engine	
Parksville	401	Moilliet St. (South)	Trillium Lodge				Engine	
Parksville	266	Moilliet St. (South)	Cokely Manor				Engine	
Parksville	181	Beachside Drive	The Beach Club				Engine	
Parksville	188	McCarter Street	Halliday House				Engine	

AUTOMATIC RESPONSE AGREEMENT -- -SCHEDULE “A”

LOCATIONS AND RESOURCES FOR AUTOMATIC RESPONSE TO EMERGENCY INCIDENTS

Coombs/Hilliers	All confirmed Structure Fires – Duty Officer plus the following:				Tender	Ladder	Engine	Tender
Coombs/Hilliers	861	Hilliers Rd	Morning Glory School		Tender	Ladder	Engine	Tender
Coombs/Hilliers	2350	Alberni Hwy	French Creek School		Tender	Ladder	Engine	Tender
Coombs/Hilliers	1020	Virginia Rd	Arrowsmith Heli Service		Tender	Ladder	Engine	Tender
Coombs/Hilliers	1225	Clarke Rd	Long Hoh Enterprises		Tender	Ladder	Engine	Tender
Dashwood	All confirmed Structure Fires – Duty Officer plus the following:			Tender			Engine/Tender	
Dashwood	2250	Fowler Road	Arrowsmith Golf Course	Tender			Engine/Tender	
Dashwood	3377	Highway 19A	Fairdale Tires	Engine			Engine	
Dashwood	3506	Highway 19A	Riverside Resort	Engine			Ladder	

AUTOMATIC RESPONSE AGREEMENT - SCHEDULE B

REQUESTS FOR AUTOMATIC RESPONSE ASSISTANCE AND GUIDELINES ON RESPONSE AND RESOURCES

Requests for Assistance

Requests for Automatic Response assistance will occur for the locations or specified incident types identified in this agreement.

Automatic Response Resources and Response Procedures

1. The Fire Department requesting Automatic Response is responsible to attend to the Emergency Incident in its jurisdiction in accordance with its own operational guidelines and, upon arrival on scene, will make every effort to release the Automatic Response responder in a timely manner.

2. Firefighters responding to an Automatic Response dispatch will assemble at their home fire station prior to responding in the designated fire apparatus as outlined on Schedule A. The responding Fire Department's operational guidelines will determine the manpower for the requested responding apparatus shown in Schedule A.

3. Firefighters who have responded to their fire station to support an Automatic Response dispatch and which are not immediately required for response, will remain at the fire station on standby, or until officially released from duty by their Fire Chief or designate.

4. The Incident Command System will be used at all emergencies involving the activation of Automatic Response. The senior officer of the Fire Department in whose jurisdiction or service area the Emergency Incident is occurring will be in command of all responding personnel and will communicate and provide direction in a manner to ensure coordinated operations.

AUTOMATIC RESPONSE AGREEMENT – SCHEDULE C

UNIFORM OPERATIONAL GUIDELINES

List of Uniform Operational Guidelines

Evacuation Procedures	Rapid Intervention Teams	Incident Command Procedures	Accountability Systems	Radio Procedures
Rehab Procedures				
Withdraw/Abandon				
Training Standard				