metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

METRO VANCOUVER REGIONAL DISTRICT
WATER COMMITTEE

REGULAR MEETING

April 15, 2021
9:00 am
28th Floor Boardroom, 4730 Kingsway, Burnaby, British Columbia

A G E N D A[1]

1. ADOPTION OF THE AGENDA

1.1 April 15, 2021 Regular Meeting Agenda
That the Water Committee adopt the agenda for its regular meeting scheduled for April 15, 2021 as circulated.

2. ADOPTION OF THE MINUTES

2.1 March 11, 2021 Regular Meeting Minutes
That the Water Committee adopt the minutes of its regular meeting held March 11, 2021 as circulated.

3. DELEGATIONS

4. INVITED PRESENTATIONS

5. REPORTS FROM COMMITTEE OR STAFF

5.1 Water Services Capital Program Expenditure Update to December 31, 2020
That the Water Committee receive for information the report dated March 18, 2021, titled "Water Services Capital Program Expenditure Update to December 31, 2020".

5.2 GVWD 2020 Water Quality Annual Report
That the GVWD Board receive for information the report dated April 1, 2021, titled "GVWD 2020 Water Quality Annual Report".

[1] *Note: Recommendation is shown under each item, where applicable.*

5.3 Seymour Salmonid Society's 2020 Annual Report for Greater Vancouver Water District

That the GVWD Board receive for information the report dated April 1, 2021, titled "Seymour Salmonid Society's 2020 Annual Report for Greater Vancouver Water District".

5.4 Watering Regulations Communications and Regional Water Conservation Campaign for 2021

That the Water Committee receive for information the report dated March 9, 2021, titled "Watering Regulations Communications and Regional Water Conservation Campaign for 2021".

5.5 Manager's Report

That the Water Committee receive for information the report dated April 1, 2021 titled "Manager's Report".

6. INFORMATION ITEMS

7. OTHER BUSINESS

8. BUSINESS ARISING FROM DELEGATIONS

9. RESOLUTION TO CLOSE MEETING

Note: The Committee must state by resolution the basis under section 90 of the Community Charter on which the meeting is being closed. If a member wishes to add an item, the basis must be included below.

That the Water Committee close its regular meeting scheduled for April 15, 2021 pursuant to the *Community Charter* provisions, Section 90 (1) (e) and (g) as follows:

"90 (1) A part of the meeting may be closed to the public if the subject matter being considered relates to or is one or more of the following:

(e) the acquisition, disposition or expropriation of land or improvements, if the board or committee considers that disclosure could reasonably be expected to harm the interests of the regional district; and

(g) litigation or potential litigation affecting the regional district."

10. ADJOURNMENT/CONCLUSION

That the Water Committee adjourn/conclude its regular meeting of April 15, 2021.

Membership:

Brodie, Malcolm (C) – Richmond
Elford, Doug (VC) – Surrey
Asmundson, Brent – Coquitlam
Baird, Ken - Tsawwassen First Nation
Bell, Don - North Vancouver City
Bligh, Rebecca – Vancouver
Clark, Carolina – Belcarra
Dingwall, Bill - Pitt Meadows
Guichon, Alicia - Delta
Keithley, Joe – Burnaby
Martin, Gayle - Langley City
Svendsen, Ryan - Maple Ridge
Vagramov, Rob - Port Moody

METRO VANCOUVER REGIONAL DISTRICT
WATER COMMITTEE

Minutes of the Regular Meeting of the Metro Vancouver Regional District (MVRD) Water Committee held at 9:00 a.m. on Thursday, March 11, 2021 in the 28th Floor Boardroom, 4730 Kingsway, Burnaby, British Columbia.

MEMBERS PRESENT:
Chair, Mayor Malcolm Brodie*, Richmond
Vice Chair, Councillor Doug Elford*, Surrey
Councillor Brent Asmundson*, Coquitlam
Chief Ken Baird*, Tsawwassen
Councillor Don Bell*, North Vancouver City
Councillor Carolina Clark*, Belcarra
Mayor Bill Dingwall*, Pitt Meadows
Councillor Alicia Guichon*, Delta
Councillor Joe Keithley*, Burnaby
Councillor Gayle Martin*, Langley City
Councillor Ryan Svendsen*, Maple Ridge
Mayor Rob Vagramov*, Port Moody (arrived at 9:03 a.m.)

MEMBERS ABSENT:
Councillor Rebecca Bligh, Vancouver

STAFF PRESENT:
Marilyn Towill, General Manager, Water Services
Lauren Cichon, Legislative Services Coordinator, Board and Information Services

1. ADOPTION OF THE AGENDA

1.1 March 11, 2021 Regular Meeting Agenda

It was MOVED and SECONDED
That the Water Committee adopt the agenda for its regular meeting scheduled for March 11, 2021 as circulated.

CARRIED

*denotes electronic meeting participation as authorized by Section 3.6.2 of the *Procedure Bylaw*

2. ADOPTION OF THE MINUTES

2.1 February 11, 2021 Regular Meeting Minutes

It was MOVED and SECONDED
That the Water Committee adopt the minutes for its regular meeting held February 11, 2021 as circulated.

CARRIED

3. DELEGATIONS

No items presented.

4. INVITED PRESENTATIONS

No items presented.

5. REPORTS FROM COMMITTEE OR STAFF

5.1 GVWD Electrical Energy Use, Generation and Management

Report dated March 3, 2021, from Terry Hui, Division Manager, Technical Support Services, and Paul Kohl, Director, Operations and Maintenance, Water Services, providing the Committee with information on the water utility electricity use, generation, and energy management.

9:03 a.m. Mayor Vagramov arrived at the meeting.

It was MOVED and SECONDED
That the Water Committee receive for information the report dated March 3, 2021 titled "GVWD Electrical Energy Use, Generation and Management".

CARRIED

5.2 Corrosion Control Program: Copper Pipes Protection

Report dated February 25, 2021, from Inder Singh, Director, Interagency Projects and Quality Control, Water Services, providing the Committee an update on the status of Metro Vancouver's corrosion control program and public notification process.

Members were provided a presentation regarding the Corrosion Control Program: Copper Pipes Protection highlighting an overview of the program, benefits of raising pH and alkalinity, comparison of typical current pH and alkalinity levels with other North American cities, proposed adjustment to target levels, monitoring, and communication plan, potential impacts on key-end users including implications and a communication plan notifying key-end users, and implementation steps.

Presentation material titled "Corrosion Control Update: Copper Pipes Protection" is retained with the March 11, 2021 Water Committee agenda.

It was MOVED and SECONDED
That the GVWD Board receive for information the report dated February 25, 2021, titled "Corrosion Control Program: Copper Pipes Protection".

CARRIED

5.3 Drinking Water Management Plan Update

Report dated February 22, 2021, from Lucas Pitts, Acting Director, Policy, Planning and Analysis, Water Services, updating the Committee on the Drinking Water Management Plan.

It was MOVED and SECONDED
That the Water Committee receive for information the report dated February 22, 2021, titled "Drinking Water Management Plan Update".

CARRIED

5.4 Capital Funding Redirection for Water Services Projects

Report dated March 2, 2021, from Goran Oljaca, Director, Engineering and Construction, and Heidi Walsh, Director, Watershed and Environmental Management, Water Services, seeking GVWD Board authorization for all spending changes associated with capital budget projects for seven unfunded projects totaling $5.3 million to be funded from existing approved cash flow.

It was MOVED and SECONDED
That the GVWD Board approve the addition of seven Water Services projects to the 2021 Capital Budget, totaling $5.3 million, to be funded from existing approved cash flow.

CARRIED

5.5 Manager's Report

Report dated February 25, 2021, from Marilyn Towill, General Manager, Water Services, updating the Committee on the following:

- *Climate 2050* Water and Wastewater Infrastructure Discussion Paper
- virtual attendance at the 2021 Standing Committee Event AWWA Annual Conference taking place from June 13-16, 2021 and,
- the 2021 Committee Work Plan.

Members were requested to email the Committee Manager by March 15, 2021, if interested in attending the AWWA Annual Conference.

It was MOVED and SECONDED
That the Water Committee receive for information the report dated February 25, 2021 titled "Manager's Report".

CARRIED

6. INFORMATION ITEMS

6.1 Major Project Delivery Governance Update

Report dated February 22, 2021, from Cheryl Nelms, General Manager, Project Delivery, providing the Water Committee a governance update for the delivery of Metro Vancouver's major capital infrastructure projects and presenting the draft terms of reference for a new major project external expert advisory committee. The attached report was considered by the Finance and Intergovernment Committee on February 10, 2021, and received by the MVRD Board on February 26, 2021, and is being presented to the Water Committee for information only.

In response to questions, members were updated on the role and oversight of the external expert advisory committee.

It was MOVED and SECONDED

That the Water Committee receive for information the report dated February 22, 2021 titled "Major Project Delivery Governance Update".

CARRIED

7. OTHER BUSINESS

No items presented.

8. BUSINESS ARISING FROM DELEGATIONS

No items presented.

9. RESOLUTION TO CLOSE MEETING

It was MOVED and SECONDED

That the Water Committee close its regular meeting scheduled for March 11, 2021, pursuant to the *Community Charter* provisions, Section 90 (1) (g) as follows:

"90 (1) A part of the meeting may be closed to the public if the subject matter being considered relates to or is one or more of the following:

(g) litigation or potential litigation affecting the regional district."

CARRIED

10. ADJOURNMENT/CONCLUSION

It was MOVED and SECONDED
That the Water Committee adjourn its regular meeting of March 11, 2021.

CARRIED
(Time: 9:48 a.m.)

_____	_____
Lauren Cichon, Legislative Services Coordinator	Malcolm Brodie, Chair

metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

To: Water Committee

From: Goran Oljaca, Director, Engineering and Construction, Water Services

Date: March 18, 2021 Meeting Date: April 15, 2021

Subject: **Water Services Capital Program Expenditure Update to December 31, 2020**

RECOMMENDATION

That the Water Committee receive for information the report dated March 18, 2021, titled "Water Services Capital Program Expenditure Update to December 31, 2020".

EXECUTIVE SUMMARY

The capital expenditure reporting process as approved by the Board provides for regular status reports on capital expenditures three times per year. This is the year-end report for 2020 which includes both the overall capital program for Water Services with a multi-year view of capital projects and the actual capital spending for the 2020 fiscal year in comparison to the annual budget. In 2020 the annual capital expenditures for Water Services were $249.0 million to date compared to annual capital budget of $397.5 million. This shortfall is primarily due to project delays related to the timing of tenders, construction delays and issues relating to COVID-19.

Forecasted expenditures for the current Water Services capital program remain within the approved budgets through to completion.

PURPOSE

To report on the status of the Water Services capital program and financial performance for the 2020 fiscal year ending December 31, 2020.

BACKGROUND

The capital expenditure reporting process as approved by the Board provides for regular status reports on capital expenditures with interim reports sent to the Water, Liquid Waste, Zero Waste, and Performance and Audit Committees, in July and October, with a final year-end report to the Committees and the Boards in April of each year.

This is the third in a series of three reports for 2020 and looks at both the overall capital program for Water Services with a multi-year view of capital projects and the actual capital spending for the 2020 fiscal year to December 31, 2020 in comparison to the annual budget.

2020 CAPITAL EXPENDITURES

Capital Program Funding

The capital spending for Water Services is funded through the water operating budget by a combination of contribution to capital (pay-as-you-go funding) and debt service costs (principal and interest payments). As a result, the annual impact on the ratepayers is significantly less than the level of budgeted capital expenditures.

Overall Capital Program

The overall capital program for Water Services includes capital projects which require multiple years to complete. These projects are broken down into various phases such as project definition, pre-design, detailed design and construction. With the completion of each phase, more information is learned for the appropriate costing of subsequent phases.

It is expected that the capital spending on all Water Services capital projects completed in 2020 or ongoing at some point in 2020 will be under budget by approximately $76 million, or within 1.2% of total budget.

Table 1 in Attachment 1 provides a summary of Water Services capital expenditures for both ongoing and completed projects. Completed Projects include a summary of actual spending compared to the Board approved spending limits while the Ongoing Projects include a summary of projected spending to completion compared to Board approved spending limits. With the rare exception, projects tend to complete with actual spending below the approved limits predominantly due to savings on budgeted contingency amounts.

Attachment 2 provides the details behind the summary information including specific capital projects, summary financial information and notes where required. Attachment 3 provides additional project status information for some of the key projects included in Attachment 1 – Table 1.

2020 Capital Program Process

The Metro Vancouver financial planning process includes Board approval of both an annual Operating Budget (operations, contribution to capital and debt service) and an annual Capital Budget for the planned capital infrastructure projects. The annual Capital Budget comprises the projected spending for a list of capital projects either continuing or to be started within the calendar year.

In 2020, capital expenditures for Water Services are $249.0 million to December 31, 2020 compared to the total capital budget of $397.5 million.

The current underspend is due to several factors including delays in permitting and land acquisition, as well as COVID-19 impacts.

Forecasted expenditures for the current Water Services capital program remain within the approved budgets for 2020 and through to completion.

Table 2 in Attachment 1 provides a summary of the 2020 actual capital spending to December 31, 2020 compared to the Board approved capital budget.

Capital Program Impacts from COVID-19
During these unprecedented times of health and economic uncertainty, all departments have been monitoring the impacts of the pandemic on their operations. This includes capital program expenditures.

Overall, the impact to the Water Service's capital program has largely been schedule related, with some notable impacts to project expenditures confirmed to date. Staff are monitoring impacts on their projects regularly. Some impacts to project schedules or expenditures are included under the respective project section of Attachment 3.

ALTERNATIVES
This is an information report. No alternatives are presented.

FINANCIAL IMPLICATIONS
Capital expenditures are funded internally (pay-as-you-go) and through debt service costs (interest and principal payments). As capital expenditures are incurred, short-term financing is secured and converted twice per year to long-term debt through the Municipal Finance Authority.

CONCLUSION
This is the third in a series of three reports on capital expenditures for 2020. Water Services is projecting to be under budget for capital projects ongoing or completed in 2020.

Forecasted expenditures for the current Water Services capital program are anticipated to remain within the approved budgets through to completion.

Attachments
1. Capital Expenditure Summary – Water Services (44159178)
2. Detailed Water Services Capital Expenditure Summary (44133049)
3. Water Services Capital Project Status Information (44149421)

44155945

ATTACHMENT 1

Metro Vancouver

Capital Expenditure
Summary Water Services
As at December 31, 2020

Table 1 – Ongoing and Completed Project Summary

	Total Projected to Completion	Total Budget	Projected Variance
Water Services			
Ongoing	$ 6,408,837,000	$ 6,483,041,000	$ 74,204,000
Completed	4,912,000	6,700,000	1,788,000
Not Started	797,900,000	817,400,000	19,500,000
Cancelled	71,000	3,700,000	3,629,000
	$ 7,221,720,000	**$ 7,310,841,000**	**$ 99,121,000**

Table 2 – December 2020 Capital Spending Summary

	2020 Budget	Actual Expenditures to December 31, 2020	
Water Services			
Infrastructure Growth Capital	$ 129,700,000	$ 83,037,259	
Infrastructure Maintenance Capital	115,150,000	60,375,837	
Infrastructure Resilience Capital	132,550,000	90,458,443	
Infrastructure Upgrade Capital	19,100,000	15,121,101	
Opportunity Capital	1,000,000	-	
	$ 397,500,000	**$ 248,992,640**	**63%**

44159178

ATTACHMENT 2

Metro Vancouver
Water Services Capital Expenditures Summary
As of December 31, 2020

Project Name	Project Location	Lifetime									
		Total Project Budget	Total Expenditures to Date	Remaining Budget	Projected Expenditures	Projected Remaining Budget	Percent Complete	Status	Project on Schedule?	Note	Comments
Infrastructure Growth Capital											
Annacis Main No. 5 (Marine Crossing)	New West/Surrey	488,000,000	32,219,880	455,780,120	485,000,000	3,000,000	7%	Ongoing	Y		
Annacis Main No. 5 (North)	New Westminster	51,500,000	499,404	51,000,596	51,500,000	-	1%	Ongoing	Y		
Annacis Main No. 5 (South)	Surrey	56,400,000	2,834,504	53,565,496	56,400,000	-	5%	Ongoing	Y		
Cape Horn Pump Station No. 3	Coquitlam	56,950,000	680,534	56,269,466	56,950,000	-	1%	Ongoing	Y		
Coquitlam Intake No. 2 & Tunnel	Coquitlam	1,369,230,000	7,709,431	1,361,520,569	1,369,230,000	-	1%	Ongoing	Y		
Coquitlam Intake No. 2 (Water Treatment)	Coquitlam	957,000,000	511,971	956,488,029	957,000,000	-	1%	Ongoing	Y		
Coquitlam Main No. 4 (Cape Horn)	Coquitlam	149,600,000	1,229,562	148,370,438	149,600,000	-	1%	Ongoing	Y		
Coquitlam Main No. 4 (Central Section)	Coquitlam	297,470,000	3,545,346	293,924,654	297,470,000	-	1%	Ongoing	Y		
Coquitlam Main No. 4 (South Section)	Coquitlam	227,650,000	3,490,804	224,159,196	227,649,558	-	2%	Ongoing	Y		
Fleetwood Reservoir	Surrey	43,367,000	3,583,061	39,783,939	43,653,000	(286,000)	8%	Ongoing	N		Project delayed due to property approval.
Grandview Reservoir Unit No. 2	Surrey	26,000,000	-	26,000,000	26,000,000	-	0%	Not Started	Y		
Haney Main No. 4 (West Section)	Port Coquitlam	74,050,000	343,594	73,706,406	74,050,000	-	1%	Ongoing	Y		
Hellings Tank No. 2	Delta	29,411,000	5,214,386	24,196,614	29,411,000	-	18%	Ongoing	Y	(c) (j)	
Jericho Reservoir No. 1	Langley Township	38,065,000	35,301,445	2,763,555	40,225,000	(2,160,000)	93%	Ongoing	Y	(c) (j)	
Kennedy Newton Main	Surrey	164,300,000	36,004,296	128,295,704	114,700,000	49,600,000	30%	Ongoing	N	(b)	Route selection delays.
Newton Pump Station No. 2	Surrey	50,800,000	3,877,852	46,922,148	50,800,000	-	8%	Ongoing	N		Property acquisition delays.
Newton Reservoir Connection	Surrey	27,050,000	-	27,050,000	27,050,000	-	0%	Not Started	Y		
Port Mann Main No. 2 (South)	Surrey	44,800,000	29,229,111	15,570,889	33,050,000	11,750,000	95%	Ongoing	N	(h)	Alignment coordination delays with City of Surrey.
South Surrey Main No. 2	Surrey	145,700,000	86,012	145,613,988	145,700,000	-	1%	Ongoing	Y		
Whalley Kennedy Main No. 2	Surrey	96,000,000	-	96,000,000	96,000,000	-	0%	Not Started	Y		
Whalley Main	Surrey	33,300,000	25,733,186	7,566,814	31,800,000	1,500,000	90%	Ongoing	Y	(a)	
		4,426,643,000	**192,094,380**	**4,234,548,620**	**4,363,238,558**	**63,404,000**					
Infrastructure Maintenance Capital											
Annacis Main No. 2 - Queensborough Crossover Improvement	New Westminster	1,200,000	-	1,200,000	1,200,000	-	0%	Not Started	N	(f)	Likely not required. MOTI not planning on relocating Queensborough Main.
Annacis Main No. 3 BHP Potash Facility Pipe Protection	Surrey	600,000	-	600,000	600,000	-	0%	Ongoing	Y	(f)	
Annacis Main No. 3 Fraser Grain Terminal Pipe Relocation and Protection	Surrey	600,000	13,899	586,101	600,000	-	2%	Ongoing	Y		
Boundary Road Main No. 2 & No. 3 Decommissioning	Burnaby	1,500,000	26,558	1,473,442	1,500,000	-	2%	Ongoing	Y		
Burnaby Mountain Main No. 2	Burnaby	10,200,000	-	10,200,000	10,200,000	-	0%	Not Started	Y		
Burnaby Mountain Pump Station No. 2	Burnaby	23,000,000	242,082	22,757,918	23,000,000	-	1%	Ongoing	Y		
Capilano Main No. 4 Abandoning	Dist of North Van	700,000	559,530	140,470	700,000	-	80%	Ongoing	Y		
Capilano Main No. 5 (South Shaft to Lost Lagoon)	Vancouver	249,000,000	9,364,905	239,635,095	249,000,000	-	5%	Ongoing	N		Delayed due to project approval timelines.
Capilano Main No. 7 Line Valve & Swing Connection	Dist of North Van	2,100,000	1,709,228	390,772	2,100,000	-	81%	Ongoing	Y		
Capilano Main No. 7 MOTI Hwy 1 Main / Dollarton Interchange Pipe Protection	Dist of North Van	500,000	-	500,000	500,000	-	0%	Ongoing	Y	(f)	
Capilano Raw Water Pump Station Bypass PRV Upgrades	Dist of North Van	1,200,000	43,082	1,156,918	1,200,000	-	4%	Ongoing	Y		
Capilano Watershed Security Gatehouse	Dist of North Van	2,300,000	513,064	1,786,936	2,300,000	-	22%	Ongoing	Y		
Central Park Main No. 2 (10th Ave to Westburnco)	Burnaby	28,350,000	-	28,350,000	28,350,000	-	0%	Ongoing	N		Delayed due to project scope review.
Central Park Main No. 2 (Patterson to 10th Ave)	Burnaby	84,400,000	16,059,485	68,340,515	93,900,000	(9,500,000)	19%	Ongoing	Y	(i)	
Central Park PS Seismic Upgrade	Burnaby	3,700,000	-	3,700,000	71,000	3,629,000	2%	Cancelled	Y	(d)	Project not required due to design revisions.
Central Park Reservoir Structural Improvements	Burnaby	1,900,000	-	1,900,000	1,900,000	-	0%	Not Started	Y		
Central Park WPS Starters Replacement	Burnaby	8,000,000	922,556	7,077,444	8,000,000	-	12%	Ongoing	Y		
CLD & SFD Fasteners Replacement & Coating Repairs	Dist of North Van	900,000	679,435	220,565	900,000	-	75%	Ongoing	Y		
Cleveland Dam - Lower Outlet HBV Rehabilitation	Dist of North Van	5,900,000	720,793	5,179,207	5,900,000	-	12%	Ongoing	Y		
Cleveland Dam - Spillway Concrete Repairs	Dist of North Van	5,500,000	3,368,462	2,131,538	4,100,000	1,400,000	100%	Completed	N	(a)(b)	Project delayed due to operational considerations.
Cleveland Dam Drumgate Seal Replacement	Dist of North Van	1,250,000	269,208	980,792	1,250,000	-	22%	Ongoing	Y		
Cleveland Dam Elevator Decommissioning and Ladder Replacement	Dist of North Van	500,000	260,497	239,503	260,000	240,000	100%	Completed	Y	(a)(b)	
Coquitlam Pipeline Road Remediation	Coquitlam	2,000,000	325,642	1,674,358	2,000,000	-	16%	Ongoing	Y	(g)	
CWTP Ozone Sidestream Pump VFD Replacement	Coquitlam	1,400,000	15,095	1,384,905	1,400,000	-	1%	Ongoing	Y		
CWTP pH, Alkalinity Upgrades	Coquitlam	1,700,000	1,419,042	280,958	1,700,000	-	83%	Ongoing	Y		
Douglas Road Main No. 2 - Kincaid Section	Burnaby	12,300,000	9,705,838	2,594,162	12,300,000	-	79%	Ongoing	N		Alignment changes.
Douglas Road Main No. 2 (Vancouver Heights Section)	Burnaby	28,486,000	19,453,892	9,032,108	21,486,000	7,000,000	68%	Ongoing	N	(b)	Procurement delays.
Douglas Road Main No. 2 Still Creek	Burnaby	63,100,000	4,485,335	58,614,665	63,100,000	-	7%	Ongoing	N		Alignment changes.
Douglas Road Main Protection	Burnaby	1,500,000	-	1,500,000	1,500,000	-	0%	Not Started	Y	(f)	
E2 Shaft Phase 3	Dist of North Van	16,500,000	15,333,456	1,166,544	16,500,000	-	93%	Ongoing	Y		
First Narrows Tunnel Isolation Chamber Improvements	Dist of North Van	7,000,000	2,394,743	4,605,257	7,000,000	-	34%	Ongoing	Y		

Metro Vancouver
Water Services Capital Expenditures Summary
As of December 31, 2020

Project Name	Project Location	Lifetime									
		Total Project Budget	Total Expenditures to Date	Remaining Budget	Projected Expenditures	Projected Remaining Budget	Percent Complete	Status	Project on Schedule?	Note	Comments
Improvements to Capilano Mains No. 4 and 5	Dist of North Van	1,700,000	107,495	1,592,505	1,700,000	-	6%	Ongoing	Y		
Kersland Reservoir No. 1 Structural Improvements	Vancouver	5,750,000	351,847	5,398,153	5,750,000	-	6%	Ongoing	Y		
Little Mountain Reservoir Roof Upgrades	Vancouver	1,500,000	108,573	1,391,427	1,500,000	-	7%	Ongoing	Y		
Lulu Island - Delta Main - Scour Protection Phase 2	Richmond	3,550,000	-	3,550,000	3,550,000	-	0%	Not Started	N	(f)	
Lulu Island - Delta Main No. 2 (Marine Crossing)	Richmond	370,000,000	-	370,000,000	370,000,000	-	0%	Not Started	Y		
Maple Ridge Main West Lining Repairs	Maple Ridge	3,500,000	190,470	3,309,530	3,500,000	-	7%	Ongoing	N		Additional scope of work identified.
Newton Rechlorination Station No. 2	Surrey	5,000,000	-	5,000,000	5,000,000	-	0%	Not Started	N		Project delayed to coordinate with Newton Pump Station Project.
Port Mann Main No. 1 (Fraser River Crossing Removal)	Coq/Surrey	13,500,000	255,000	13,245,000	13,500,000	-	2%	Ongoing	Y		
Port Moody Main No. 1 Christmas Way Relocation	Coquitlam	2,350,000	-	2,350,000	2,350,000	-	0%	Not Started	Y	(f)	
Port Moody Main No. 3 Dewdney Trunk Rd Relocation	Coquitlam	2,700,000	(0)	2,700,000	2,700,000	-	1%	Ongoing	Y	(f)	
Port Moody Main No. 3 Scott Creek Section	Coquitlam	4,750,000	174,885	4,575,115	4,750,000	-	4%	Ongoing	Y		
Queensborough Main Royal Avenue Relocation	New Westminster	7,500,000	6,844	7,493,156	7,500,000	-	1%	Ongoing	Y		
Rechlorination Station SHS Storage Tank Replacement	Regional	1,200,000	71,064	1,128,937	1,200,000	-	6%	Ongoing	Y		
Rechlorination Station Upgrades	Regional	14,200,000	339,594	13,860,406	14,200,000	-	2%	Ongoing	Y		
Rehabilitation of AN2 on Queensborough Bridge	New West/Delta	2,500,000	2,831	2,497,169	2,500,000	-	0%	Ongoing	Y		
Relocation and Protection for MOTI Expansion Project Broadway	Vancouver	8,900,000	48,363	8,851,637	8,900,000	-	1%	Ongoing	Y	(f)	
Relocation and Protection for MOTI George Massey Crossing Replacement	Regional	2,450,000	-	2,450,000	2,450,000	-	0%	Not Started	N	(f)	
Relocation and Protection for Translink Expansion Project Surrey Langley SkyTrai	Surrey	6,600,000	-	6,600,000	6,600,000	-	0%	Not Started	N	(f)	
Sasamat Reservoir Joint Upgrades	UEL	700,000	552,264	147,736	552,000	148,000	100%	Completed	Y	(a)	
SCFP Clearwell Membrane Replacement	Dist of North Van	17,400,000	-	17,400,000	17,400,000	-	0%	Not Started	N		
SCFP Concrete Coatings	Dist of North Van	6,500,000	2,132,462	4,367,538	3,400,000	3,100,000	75%	Ongoing	N	(h)	Delays due to operational requirements. Project scope changed.
SCFP Filter Underdrain Repairs	Dist of North Van	29,000,000	22,764,736	6,235,264	23,000,000	6,000,000	99%	Ongoing	Y	(a) (b)	
SCFP OMC Building Expansion	Dist of North Van	2,450,000	7,671	2,442,329	2,450,000	-	1%	Ongoing	Y		
SCFP Polymer System Upgrade	Dist of North Van	2,950,000	406,933	2,543,067	2,950,000	-	14%	Ongoing	Y		
Second Narrows Crossing 1 & 2 (Burrard Inlet Crossing Removal)	Dist of North Van	21,500,000	-	21,500,000	21,500,000	-	0%	Not Started	Y		
South Delta Main No. 1 - Ferry Road Check Valve Replacement	Delta	600,000	47,878	552,122	600,000	-	8%	Ongoing	Y		
South Fraser Works Yard	Regional	32,000,000	155,096	31,844,904	32,000,000	-	0%	Ongoing	N		Property acquisition delays
South Surrey Main No. 1 Nickomekl Dam Relocation	Surrey	7,100,000	-	7,100,000	7,100,000	-	0%	Ongoing	N	(f)	Project delayed (City of Surrey)
Sunnyside Reservoir Unit 1 Upgrades	Surrey	8,050,000	7,685,553	364,447	8,050,000	-	95%	Ongoing	Y		
Tilbury Main North Fraser Way Valve Addition	Burnaby	3,100,000	263,946	2,836,054	3,100,000	-	9%	Ongoing	Y		
Westburnco Pump Station No. 2 VFD Replacements	New Westminster	2,550,000	81,431	2,468,569	2,550,000	-	3%	Ongoing	Y		
		1,158,836,000	**123,640,763**	**1,035,195,237**	**1,153,951,000**	**4,885,000**					
Infrastructure Resilience Capital											
Barnston/Maple Ridge Pump Station - Back-up Power	Pitt Meadows	9,000,000	227,906	8,772,094	9,000,000	-	3%	Ongoing	Y		
Burnaby Mountain Tank No. 2	Burnaby	21,650,000	45,415	21,604,585	21,650,000	-	1%	Ongoing	Y		
Burnaby Mountain Tank No. 3	Burnaby	21,400,000	-	21,400,000	21,400,000	-	0%	Not Started	Y		
Cambie Richmond Main No. 3 (Marine Crossing)	Richmond/Van	405,250,000	1,063,005	404,186,995	405,250,000	-	1%	Ongoing	Y		
Cape Horn Pump Station 2 - Back-Up Power	Coquitlam	8,000,000	77,874	7,922,126	8,000,000	-	1%	Ongoing	Y		
Capilano Mid-Lake Debris Boom	Dist of North Van	750,000	38,420	711,580	750,000	-	5%	Ongoing	N		Tendering delays
Capilano Raw Water Pump Station - Back-up Power	Dist of North Van	33,000,000	5,917,922	27,082,078	33,000,000	-	18%	Ongoing	N		Site selection delays.
Capilano Reservoir Boat Wharf	Dist of North Van	850,000	69,235	780,765	850,000	-	8%	Ongoing	N		Tendering delays
Clayton Langley Main No. 2	Surrey	36,400,000	-	36,400,000	16,900,000	19,500,000	0%	Not Started	Y	(h)	
Cleveland Dam Power Resiliency Improvements	Dist of North Van	1,700,000	13,947	1,686,053	1,700,000	-	1%	Ongoing	Y		
Coquitlam Intake Tower Seismic Upgrade	Coquitlam	25,500,000	1,064,055	24,435,945	25,500,000	-	4%	Ongoing	Y		
Critical Control Sites - Back-Up Power	Regional	1,800,000	-	1,800,000	1,800,000	-	0%	Not Started	Y		
CWTP Ozone Back-up Power	Coquitlam	7,450,000	-	7,450,000	7,450,000	-	0%	Not Started	Y		
Emergency Power Strategy for Regional Water Facilities	Regional	400,000	-	400,000	400,000	-	0%	Ongoing	N		Project terms of reference under development. Expected completion Q4 of 2021
Grandview Pump Station Improvements	Surrey	2,600,000	171,806	2,428,194	2,600,000	-	7%	Ongoing	Y		
Mackay Creek Debris Flow Mitigation	Dist of North Van	9,700,000	9,012,466	687,534	9,700,000	-	93%	Ongoing	N		Delays due to challenging ground conditions.
Pebble Hill Pump Station Seismic Upgrade	Delta	1,650,000	-	1,650,000	1,650,000	-	0%	Not Started	N	(e)	Coordinating with City of Delta.
Pebble Hill Reservoir No. 3 Seismic Upgrade	Delta	8,900,000	346,105	8,553,895	8,900,000	-	4%	Ongoing	Y		
Pebble Hill Reservoir Seismic Upgrade	Delta	14,800,000	377,506	14,422,494	14,800,000	-	3%	Ongoing	N		Design delays due to geotechnical conditions.
Reservoir Isolation Valve Automation	Regional	6,450,000	1,149,196	5,300,804	6,450,000	-	18%	Ongoing	N		Delayed due to scope refinement.
SCFP UPS Reconfiguration	Dist of North Van	1,270,000	1,027,253	242,747	1,070,000	200,000	99%	Ongoing	Y	(a)	
Second Narrows Crossing (Tunnel)	Burnaby/DNV	468,550,000	198,817,423	269,732,577	468,550,000	-	42%	Ongoing	N		Permitting and property acquisition delays.
Seymour Falls Boat Wharf	Dist of North Van	800,000	89,493	710,507	800,000	-	11%	Ongoing	N		Tendering delays
Seymour Lake Debris Boom	Dist of North Van	800,000	287,175	512,825	800,000	-	36%	Ongoing	Y		

Metro Vancouver
Water Services Capital Expenditures Summary
As of December 31, 2020

Project Name	Project Location	Lifetime Total Project Budget	Lifetime Total Expenditures to Date	Lifetime Remaining Budget	Lifetime Projected Expenditures	Lifetime Projected Remaining Budget	Lifetime Percent Complete	Status	Project on Schedule?	Note	Comments
Seymour Main No. 2 Joint Improvements	Dist of North Van	3,252,000	488,220	2,763,780	3,252,000	-	16%	Ongoing	N		Work delayed to coordinate with Second Narrows Crossing
Seymour Main No. 5 III (North)	Dist of North Van	236,900,000	3,955,518	232,944,482	236,900,000	-	2%	Ongoing	Y		
Seymour Reservoir Mid-Lake Debris Boom	Dist of North Van	2,300,000	154,094	2,145,906	2,300,000	-	8%	Ongoing	N		Project scope revised.
Sunnyside Reservoir	Surrey	17,300,000	7,310,853	9,989,147	17,300,000	-	42%	Ongoing	Y		
System Seismic Upgrade	Regional	116,400,000	-	116,400,000	116,400,000	-	0%	Not Started	Y		
Vancouver Heights System Resiliency Improvements	Burnaby	1,500,000	-	1,500,000	1,500,000	-	0%	Not Started	Y		
Westburnco Pump Station - Back-up Power	New Westminster	27,000,000	899,342	26,100,658	27,000,000	-	3%	Ongoing	N		Design delay, scope modification.
		1,493,322,000	**232,604,229**	**1,260,717,771**	**1,473,622,000**	**19,700,000**					
Infrastructure Upgrade Capital											
Burwell Alpine Reservoir Valve Improvements	Electoral Area A	650,000	519,049	130,951	650,000	-	80%	Ongoing	Y		
Cleveland Dam East Abutment Additional GV Series Pump Wells	Dist of North Van	750,000	624,678	125,322	750,000	-	83%	Ongoing	N		Coordinating with Regional Parks.
CWTP Ozone Generation Upgrades for Units 2 & 3	Coquitlam	12,000,000	2,663,669	9,336,331	8,000,000	4,000,000	22%	Ongoing	N	(b)	Delay due to operational requirements.
Lower Seymour Conservation Reserve Learning Lodge Replacement	Dist of North Van	5,000,000	593,884	4,406,116	5,000,000	-	12%	Ongoing	N		Delayed due to project scope review.
Online Chlorine Monitoring Stations	Regional	3,600,000	-	3,600,000	3,600,000	-	0%	Not Started	Y		
Sapperton Main No. 1 New Line Valve and Chamber	New Westminster	3,800,000	864,217	2,935,783	3,800,000	-	23%	Ongoing	N		Tie-ins delayed
SCFP Interior Lighting Efficiency Upgrade	Dist of North Van	500,000	216,788	283,212	500,000	-	43%	Ongoing	Y		
South Delta Main No. 1 - 28 Ave to 34B Ave	Delta	19,650,000	23,564,859	(3,914,859)	19,650,000	-	97%	Ongoing	N		Construction delays due to unforeseen environmental and geotechnical conditions.
South Delta Mains - 28 Ave Crossover	Delta	10,500,000	8,788,578	1,711,422	10,500,000	-	84%	Ongoing	N		Utility conflicts and additional scope of work.
Water Meter Upgrades	Regional	22,400,000	3,435,674	18,964,326	22,400,000	-	15%	Ongoing	N		Procurement delays.
Water Optimization - Flow Meters (Non-billing) Phase 1	Regional	16,500,000	-	16,500,000	16,500,000	-	0%	Not Started	Y		
Water Optimization - Flow Meters (Non-billing) Phase 2	Regional	18,000,000	-	18,000,000	18,000,000	-	0%	Not Started	Y		
Water Optimization - Instrumentation	Regional	9,900,000	-	9,900,000	9,900,000	-	0%	Ongoing	Y		
Water Optimization Automation & Instrumentation	Regional	9,540,000	7,384,458	2,155,542	9,540,000	-	77%	Ongoing	N		Procurement delays.
		132,790,000	**48,655,854**	**84,134,146**	**128,790,000**	**4,000,000**					
Opportunity Capital											
Capilano Hydropower	Dist of North Van	99,250,000	218,368	99,031,632	99,250,000	-	1%	Ongoing	N		Project is under review
		99,250,000	**218,368**	**99,031,632**	**99,250,000**	**-**					
Grand Total Water Services		**7,310,841,000**	**597,213,594**	**6,713,627,406**	**7,211,719,558**	**99,121,000**					

Notes:

(a) Contingency not required.
(b) Construction costs lower than estimated.
(c) City of Surrey share - 33.72%, Township of Langley share - 66.28%.
(d) Project cancelled.
(e) Cost sharing proposal with City of Delta
(f) Project start is dependent on a 3rd party. External agency yet to begin work.
(g) GVWD Cost Share City of Coquitlam, Fortis and BC Hydro
(h) Extent of construction scope less than originally anticipated.
(i) Budget approved by the Board
(J) Design change/consutant

ATTACHMENT 3

Capital Project Status Information
December 31, 2020

GREATER VANCOUVER WATER DISTRICT (Water Services)

Major GVWD capital projects are generally proceeding on schedule and within budget. The following capital program items and exceptions are highlighted:

Infrastructure Growth Program

- **Annacis Main No. 5 (Marine Crossing)** – A 2.3 km long, 4.5 m diameter water supply tunnel is required under the Fraser River to meet growing water demand south of the Fraser and to provide increased system resiliency. Detailed design, which was awarded to Hatch Corporation, is substantially complete. Property acquisition along the tunnel alignment is nearing completion, and construction management services have been awarded. The RFQ for construction was issued in 2020, and the shortlisted firms will be sent the RFP for construction in Q1 2021.

- **Annacis Main No. 5 (South)** – This project comprises approximately 3.0 km of 1.8 m diameter steel pipe connecting the south shaft of the Annacis Water Supply Tunnel to the Kennedy Reservoir in the City of Surrey. Preliminary design has been completed and detailed design is in progress and expected to be complete in May 2021.

- **Cape Horn Pump Station No. 3** – Cape Horn Pump Station No. 3 with a back-up power system, will supplement the existing pump station to deliver Coquitlam source water to meet growing demand in the municipalities south of the Fraser River. Preliminary design of the new station started Q1 2020 and is expected to be complete Q2 2021.

- **Coquitlam Intake No. 2** – A new intake, tunnel and treatment plant are proposed at the Coquitlam Reservoir to increase the supply and transmission capacity from this source. The Draft Project Definition Report was received in December 2019. A Value Engineering workshop was held in May 2020 to review options to reduce risks, confirm costs and improve the schedule. A Final Project Definition Report, which will incorporate suitable options identified in the Value Engineering, will be completed in Q2 2021.

- **Coquitlam Main No. 4** – This 12 km long steel water main, consisting of the Central, South and Cape Horn Sections, will increase the transmission capacity from the Coquitlam Water Treatment Plant to the Cape Horn Pump Station and Reservoir in the City of Coquitlam. This project is required to address capacity constraints in the existing Coquitlam transmission system and also provide additional transmission capacity for the Coquitlam Intake No. 2. Detailed design of the Central and South Sections continues. A Request for Proposal for the 2.3 km tunnel portion of the South Section will be issued in Q2 2021. Detailed design of the Central, South and Cape Horn sections is underway.

- **Fleetwood Reservoir** – Phase 1 of the Fleetwood Reservoir project includes a 13.6 ML reservoir, valve chamber, piping, access building and associated work located at Meagan Ann MacDougall Park in the City of Surrey. Detailed design is nearing completion, after the project was delayed due to property issues. The City of Surrey is finalizing the Property Lease Agreement and construction

is expected to commence in Q2 2021.

- **Jericho Reservoir** – Phase 1 of the Jericho Reservoir project includes a 20.6 ML reservoir, chambers, piping and associated work located at 20400 73A Avenue in the Township of Langley. Construction is approximately 95% complete. Tie-ins and commissioning of the valve chamber are complete. The reservoir is scheduled to enter service in June 2021.

- **Kennedy Newton Main** – This project comprises approximately 9.0 km of 1.8 m diameter steel water main between the Kennedy Reservoir and the Newton Reservoir in the City of Surrey and is divided into 3 phases. Construction of Phase 1, between 72nd Avenue and 84th Avenue, commenced in October 2019 and is anticipated to be complete in March 2021. Construction of Phase 2, between 72nd Avenue and Newton Reservoir commenced in September 2020. Design of the remaining Phase 3, from 84th Avenue to Kennedy Reservoir, is in progress and expected to be completed in April 2021.

- **Newton Pump Station No. 2** – This project, located at 6287 128th Street in the City of Surrey, comprises replacing the existing Newton Pump Station and includes full back-up power redundancy, connections to existing and future infrastructure, and installation of new outlets to the existing Newton Reservoir. The preliminary design phase was completed in December 2019 and detailed design is in progress with completion expected in May 2021.

- **Port Mann Main No. 2 (South)** – This 2.8 km long, 1.5 m diameter steel water main will twin the existing Port Mann Main No. 1 between the south shaft of the Port Mann Water Supply Tunnel and the Whalley Main in the City of Surrey. The project is required to meet growing water demand south of the Fraser River. The main installation construction contract was completed in July 2020 with final tie-ins and commissioning planned for summer/fall 2021. A portion of main connecting to the Whalley Reservoir at the Hjorth Road Elementary School has been postponed until the required property rights can be finalized.

- **Whalley Main** – This 2.0 km long, 1.5 m diameter steel main will twin the existing Whalley Clayton Main between the Whalley Reservoir and the Whalley Kennedy Link Main in the City of Surrey. The main installation construction contract commenced in June 2019 and is 95% complete with completion anticipated by March 2021. Tie-ins and commissioning are planned to commence in fall 2021.

<u>Infrastructure Maintenance Program</u>

- **Douglas Road Main No. 2 – Still Creek Section** - This project comprises approximately 2.5 km of 1.5 m diameter steel pipe with trenchless crossings of Highway 1, Still Creek and the BNSF rail line. The water main alignment has been finalized in consultation with the City of Burnaby. The detailed design phase is in progress and the required rights of ways are in the process of being finalized. The Project is planned to be constructed in three phases, with the North Open Cut Section commencing in March 2021. Design of the Trenchless Crossing Section is complete with construction planned to start in fall 2021. Design of the South Open Cut Section is still underway.

  Douglas Road Main No. 2 – Vancouver Heights Section - This project comprises approximately 2.0 km of 1.5 m diameter steel pipe connecting the Vancouver Heights Reservoir to the Douglas Road Main No. 2 at Beta Avenue and Albert Street in the City of Burnaby. The installation construction contract is expected to be complete in January 2021. Final tie-ins and commissioning is planned for fall 2021.

- **Central Park Main No. 2 – Patterson to 10th Ave** - This project comprises approximately 7.0 km of 1.2 m diameter steel pipe connecting the Central Park Pump Station in Burnaby to the existing Central Park Main in New Westminster at 10th Avenue. The water main is divided into three phases with the 500 m long Maywood Pre-build completed in December 2020. Design of Phase 1 of the project has been completed and the installation contract for this phase commenced in October 2020. Design of Phase 2 is underway and expected to be complete late summer 2021.

- **E2 Shaft Replacement** – The E2 Shaft, which has controlled ground water in the East Abutment of Cleveland Dam since the 1950's is nearing the end of its service life and needs to be replaced by a system of horizontal drains. A total of 6 horizontal drains have been completed, and continue to be monitored. The project consultants are analyzing the information and will provide a recommendation on whether additional work is required in Q1 2021.

- **Capilano Main No. 5 (Stanley Park Section)** – This 1.4 km long steel water main, in a tunnel, will replace the existing Capilano Main No. 4 through Stanley Park to meet growing water demand and provide increased system resiliency. Preliminary design has been completed. Detailed design has commenced and is anticipated to be complete in Q1 2021. The procurement phase for construction will commence in mid-2021, with construction anticipated to start in 2022.

- **SCFP Filter Underdrain Repair** – This project consists of a phased replacement of the existing underdrains in the 24 filters. New underdrains have been installed in all 24 filters and the filters returned to service. The project was substantially completed in October 2020.

- **Sunnyside Reservoir Unit No. 1 – Seismic Upgrade and Upgrades (Non-Seismic)** – The key components of the seismic upgrade work are external shear walls, replacement of existing roof slab and thickening of perimeter walls and footings. Other upgrades include drainage improvements, a new inlet pipe, underground valve chamber, access road and dechlorination system. Construction commenced early October 2019 and the contractor achieved substantial completion in January 2021.

<u>Infrastructure Resilience Program</u>

- **Mackay Creek Debris Flow Mitigation** – Detailed design and construction engineering services for this project were awarded to BGC Engineering Inc. The construction contract was awarded to BEL Contracting. Construction commenced in spring 2019 and was completed in March 2020. Site replanting began in Fall 2020 and is expected to be completed in 2021.

- **Second Narrows Water Supply Tunnel** – This project comprises a 1.1 km long, 6.5 m diameter water supply tunnel under Burrard Inlet, between North Vancouver and Burnaby, to increase the reliability of supply in the event of a major seismic event and provide additional long term supply capacity. The contract for construction was awarded to the Traylor-Aecon General Partnership in October 2018. Mobilization and site preparation commenced in early 2019. Construction of the north shaft is complete and construction of the south shaft is more than 80% complete. The Tunnel Boring Machine began tunnel excavation in the Fall of 2020 and is continuing to progress.

- **Capilano Raw Water Pump Station – Back-up Power** – This project consists of installing diesel generators to provide 8 MW's of back-up power to the pump station. Shop drawing submittals for the pre-purchased electrical equipment are ongoing, with the equipment anticipated to arrive in 2021. Construction is anticipated to start in 2021 with overall project completion in 2023.

- **Coquitlam Intake Tower Seismic Upgrade** – The Coquitlam Intake Tower is located in the southeast corner of the Coquitlam Reservoir. Constructed in 1913, the tower provides the GVWD its primary intake of water from Coquitlam Reservoir. The Tower is a 27 m high and 5.5 m diameter unreinforced concrete structure, founded on bedrock. Detailed design of the seismic upgrade is 60% complete. Completion of detailed design is expected in 2021. Due to coordination with BC Hydro work and water supply operations, construction will be completed over two winter periods 2023 to 2026.

- **Pebble Hill Reservoir No. 1, 2 and 3 Seismic Upgrade** – Pebble Hill Reservoir in south Delta is comprised of three units. Detailed design for the seismic upgrade is complete. Construction is scheduled to be completed in stages, taking only one unit out of service at any time. Construction of Units 1 and 2 will commence in 2021 and Unit 3 in 2023. All three units are expected to be completed by 2024.

- **Westburnco Pump Station – Back-up Power** – This project consists of installing diesel generators to provide 5 MW's of back-up power to the pump station. Preliminary design was completed in 2019 and detailed design continues in 2020 and 2021.

<u>Infrastructure Upgrade Program</u>

- **South Delta Main No. 1 Replacement – 28th Avenue to 34B Avenue** – This project consists of replacement of the existing South Delta Main No. 1 on 53rd Street from 28th Avenue to 34B Avenue, and on 28th Avenue between 52nd Street and 53rd Street. Phase 3 consists of approximately 1.6 km of 900 mm diameter welded steel pipe and a crossing of the BC Rail tracks at Deltaport Way. Phase 3 construction is complete with the new main commissioned in early July 2020. The work was coordinated with the City of Delta's storm drain installation project and road reconstruction.

- **Coquitlam Ozone Upgrade** – This project consists of upgrades to the ozone generators at the Coquitlam Water Treatment Plant. The generators for units 1 and 2 have been replaced and are in service. Unit 3 will be upgraded in 2021

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SERVICES AND SOLUTIONS FOR A LIVABLE REGION

To: Water Committee

From: Larry Chow, Program Manager, Quality Control, Interagency Projects and Quality Control

Date: April 1, 2021 Meeting Date: April 15, 2021

Subject: **GVWD 2020 Water Quality Annual Report**

RECOMMENDATION

That the GVWD Board receive for information the report dated April 1, 2021, titled "GVWD 2020 Water Quality Annual Report".

EXECUTIVE SUMMARY

The 2020 Greater Vancouver Water District (GVWD) Water Quality Annual Report is required, under the provincial *Drinking Water Protection Regulation* (DWPR), and is also a requirement of the *Drinking Water Management Plan* (DWMP). The annual report summarizes water quality analysis conducted on samples collected from the GVWD source reservoirs, in-system reservoirs and transmission system.

The annual report outlines Metro Vancouver's water quality monitoring program and continues to fulfill its role in confirming that the multiple protection barriers for drinking water, including watershed protection, water treatment and the ongoing operation of the water system, continue to deliver excellent water quality to the region.

In 2020, the water quality of the treated water was excellent. All water quality parameters analyzed met or exceeded water quality standards and the *Guidelines for Canadian Drinking Water Quality* (GCDWQ).

PURPOSE

To provide the Board with a summary of the 2020 GVWD Water Quality Annual Report.

BACKGROUND

Each year Metro Vancouver is required, under the provincial DWPR, to produce an annual report on drinking water quality. The annual report is also a requirement of Metro Vancouver's DWMP. The annual report provides the key results and findings associated with Metro Vancouver's program of continuous monitoring and assessment of drinking water quality in the region. The annual report also provides an assessment of drinking water quality relative to the existing drinking water standards and guidelines and highlights any unusual occurrences. Monitoring results for local government members are also discussed in the annual report where relevant.

In accordance with Section 11 of the DWPR, the annual report will be sent to the Chief Medical Health Officers of the Vancouver Coastal and Fraser Health Authorities.

Additionally, the annual report will be made accessible to the public through public libraries in the region, including Metro Vancouver's Library and Information Centre, and will be posted on Metro Vancouver's website.

This report is being brought forward at this time in order to enable Metro Vancouver, and its local government members, to meet the reporting timeline stipulated in the DWPR.

WATER QUALITY/TREATMENT HIGHLIGHTS

A summary of the main items relevant to water quality during 2020 are as follows:

1. Source Water Quality

- In 2020, the turbidity levels of the delivered water met the requirements of the GCDWQ.
- The Capilano reservoir was in service for the entire year. Heavy rainfall events early in the year resulted in Capilano source water turbidity peaking at 7.3 Nephelometric Turbidity Units (NTU). Even with the higher turbidity, the delivered filtered Capilano water was less than 0.1 NTU for the entire year.
- The Seymour reservoir was in service for the entire year. Heavy rainfall events early and late in the year resulted in the Seymour source water turbidity peaking at 22 NTU. The delivered filtered Seymour water was less than 0.1 NTU for the entire year.
- The Coquitlam reservoir was in service for the entire year. The turbidity of the unfiltered Coquitlam source water was greater than 1 NTU for 7 days and did not exceed 5 NTU throughout the year.
- The microbiological quality of the three source reservoirs was excellent in 2020. All three sources met the bacteriological requirements outlined in the GCDWQ.
- Results of the analyses of the source water for herbicides, pesticides, volatile organic compounds and radionuclides were all found to be below the recommended limits for these substances as listed in the GCDWQ.
- Reservoir limnology sampling occurred from June through November 2020 and confirmed little to no change in biological productivity levels and chemical parameters from previous years. All three reservoirs remain in an ultra-oligotrophic state and are providing excellent quality source water.

2. Water Treatment

- The Seymour Capilano Twin Tunnels enabled the Capilano source water to be treated at the Seymour Capilano Filtration Plant (SCFP) and subsequently returned to the Capilano transmission system throughout the entire year.
- The SCFP provided continuous filtration performance, producing excellent delivered water quality in 2020, specifically:
    - The daily average turbidity of the water leaving the clearwells and entering the GVWD transmission system was on average 0.09 NTU;
    - Turbidity levels for individual filters met the turbidity requirements of the GCDWQ;
    - Filtration consistently removed iron, colour and organics from Capilano and Seymour source waters;

  - Levels of total aluminum in filtered water were consistently below the GCDWQ operational guideline value of 0.2 mg/L for direct filtration plants using aluminum-based coagulants. The maximum value was 0.06 mg/L;
  - pH and alkalinity levels were 7.7 and 11 mg/L as $CaCO_3$, respectively, and met the GCDWQ; and
  - The targeted level of chlorine disinfection was 0.80 mg/L.
- The CWTP uses ultraviolet light treatment as the primary disinfectant, along with ozone pre-treatment and chlorine disinfection for water originating from the unfiltered Coquitlam source. Plant performance was excellent, specifically:
  - Ultraviolet light treatment consistently and effectively inactivated pathogens at a very high percentage (99.8%);
  - The average turbidity of the water leaving the plant and entering the GVWD transmission system was on average 0.41 NTU;
  - pH and alkalinity levels were 7.8 and 9 mg/L as $CaCO_3$, respectively, and met the GCDWQ; and
  - The targeted level of chlorine disinfection ranged from 1.2 to 1.5 mg/L.
- The eight secondary disinfection stations within the transmission system boosted chlorine levels where necessary and as required. All stations use sodium hypochlorite as a disinfectant and the targeted level of chlorine disinfection ranged from 0.80 to 1.5 mg/L.

3. Transmission and Distribution System Water Quality

- Bacteriological water quality in the GVWD transmission mains and in-system storage reservoirs was excellent in 2020. Of the approximately 7,600 regional samples collected for testing in 2020, none were positive for *E. coli*.
- Bacteriological water quality in the distribution systems of the local governments was excellent in 2020. Of the approximately 20,000 local government samples collected for testing in 2020, a high percentage (99.8%) were free of total coliforms, and no *E. coli* was detected.
- The running average levels of the trihalomethane group of chlorine disinfection by-products detected in the delivered water in the GVWD and municipal systems were below the Maximum Acceptable Concentration (MAC) specified in the GCDWQ. The running average levels for the haloacetic acid group of chlorine disinfection by-products in the GVWD system were below the MAC.

ALTERNATIVES

This is an information report; no alternatives are presented.

FINANCIAL IMPLICATIONS

Water quality analyses included in the annual report is incorporated within the annual operating budget of the Interagency Projects and Quality Control Division's Drinking Water Quality Control Program.

CONCLUSION

As outlined by the Greater Vancouver Regional District 2020 Water Quality Annual Report, Metro Vancouver's water quality monitoring program continues to fulfill its role in confirming that the

multiple protection barriers for drinking water, including watershed protection, water treatment and the ongoing operation of the water system, continue to deliver excellent water quality to the region. This monitoring is essential in assessing the performance of treatment technologies to ensure compliance with current regulations and guidelines, and potential treatment upgrade requirements for the future.

The drinking water provided by the GVWD to its local governments met or exceeded water quality standards and guidelines in 2020.

Attachment
"Greater Vancouver Regional District 2020 Water Quality Annual Report, Volume 1, dated February, 2021 *(43161759)*

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Greater Vancouver Water District

2020 Water Quality Annual Report

Volume 1 of 2

March 2021

Table of Contents

List of Tables

List of Figures

List of Appendices

EXECUTIVE SUMMARY

Source Water Quality

- In 2020, the turbidity levels of the delivered water met the requirements of the *Guidelines for Canadian Drinking Water Quality* (GCDWQ).
- The Capilano supply was in service for the entire year. Heavy rainfall events in early January and late September resulted in Capilano source water turbidity peaking at 7.3 Nephelometric Turbidity Unit (NTU). Even with the higher turbidity, the delivered filtered Capilano water was less than 0.1 NTU as measured by online instruments for the entire year.
- The Seymour supply was in service for the entire year. Heavy rainfall events in January resulted in Seymour source water turbidity peaking at 23 NTU. The delivered filtered Seymour water was less than 0.1 NTU as measured by online instruments for the entire year.
- The Coquitlam supply was in service for the entire year. The unfiltered Coquitlam source water was greater than 1 NTU for 7 days in 2020 and did not exceed 5 NTU throughout the year.
- The microbiological quality of the three source waters was excellent in 2020. The levels of bacteria and protozoa detected were low and indicative of high quality source water.
- Coquitlam source water quality met the bacteriological requirements for avoiding filtration outlined in the turbidity section of the GCDWQ.
- Results of the analyses of the source water for herbicides, pesticides, volatile organic compounds and radionuclides were all found to be below the recommended limits for these substances as listed in the GCDWQ.

Water Treatment

- The Seymour Capilano Filtration Plant (SCFP) performance, as measured by the quality of the delivered water, was excellent in 2020. The daily average turbidity of water leaving the clearwells to enter the Greater Vancouver Water District (GVWD) transmission system was an average of 0.09 NTU in 2020.
- Turbidity levels for Individual Filter Effluent (IFE) met the turbidity requirements of the GCDWQ.
- Filtration consistently removed iron, colour and organics from the Capilano and Seymour source water.
- Levels of total aluminum in filtered water were consistently below the GCDWQ operational guideline value of 0.2 mg/L for direct filtration plants using aluminum-based coagulants. The maximum value for 2020 was 0.06 mg/L.
- There were no outages of ultraviolet treatment at the SCFP and the Coquitlam Water Treatment Plant (CWTP).
- The SCFP and CWTP operated the full year using sodium hypochlorite for chlorination.
- The secondary disinfection stations boosted chlorine when required.

Transmission/Distribution System Water Quality

- Bacteriological water quality was excellent in the GVWD transmission mains.
- No *E. coli* was detected. The detection of an *E. coli* triggers a protocol which involves immediate notification to health and local government officials, re-sampling, and a thorough investigation into the possible causes.
- Bacteriological water quality was excellent in the GVWD in-system storage reservoirs. There was no *E. coli* detected in any of the associated samples.

- Bacteriological water quality was excellent in the distribution systems of the local governments. Of approximately 20,000 local government samples collected for testing in 2020, a high percentage (99.8%) were free of total coliforms, which was the same as 2019 (99.8%). No *E. coli* were detected in any of the samples taken in 2020.
- The running average levels of the Trihalomethane (THM) group of chlorine disinfection by-products detected in the delivered water in the GVWD and local government systems were below the Maximum Acceptable Concentration (MAC) in the GCDWQ of 100 µg/L (0.1 mg/L). The running average levels for the Haloacetic Acid (HAA) group of chlorine disinfection by-products were below the GCDWQ Maximum Acceptable Concentration (MAC) of 80 µg/L (0.08 mg/L).

ACRONYMS

ACU	Apparent Color Unit
AO	Aesthetic Objective (characteristics such as taste, colour, appearance, temperature that are not health related)
BCDWPR	*British Columbia Drinking Water Protection Regulation*
BHT	Break Head Tank
BTEX	Benzene, Ethylbenzene, Toluene, Xylene
CALA	Canadian Association for Laboratory Accreditation
CRWPS	Capilano Raw Water Pump Station
CFE	Combined Filter Effluent
CFU	Colony Forming Units
CO_2	Carbon Dioxide
CTD	Conductivity, Temperature, Depth
CWTP	Coquitlam Water Treatment Plant
DS	Distribution System
DBP	Disinfection By-product
DOC	Dissolved Organic Carbon
DWTP	*Drinking Water Treatment Program*
DWTO	*Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies in British Columbia*
E. coli	*Escherichia coli*
ERF	Energy Recovery Facility
EPA	Environmental Protection Agency (USA)
ESWTR	*Enhanced Surface Water Treatment Rule* (USA)
GCDWQ	*Guidelines for Canadian Drinking Water Quality*
GVWD	Greater Vancouver Water District
HAA	Haloacetic Acid
HPC	Heterotrophic Plate Count
IFE	Individual Filter Effluent
MAC	Maximum Acceptable Concentration
MCL	Maximum Contaminant Level
MDA	Minimum Detectable Activity
MDL	Method Detection Limit
mg/L	Milligram per liter (0.001 g/L)
µg/L	Microgram per litre (0.000001 g/L)
mL	Milliliter
MF	Membrane Filtration
mJ/cm^2	Millijoule per centimeter squared
MPN	Most Probable Number
N/A	Not Available
NTU	Nephelometric Turbidity Unit
PAH	Polycyclic Aromatic Hydrocarbons
PFOA	Perfluorooactanoic Acid

PFOS	Perfluorooctane Sulfonate
pH	Measure of acidity or basicity of water; pH 7 is neutral
ppb	Parts per Billion (Equivalent of microgram per litre)
ppm	Parts per Million (Equivalent of microgram per litre)
RCW	Recycled Clarified Water
RWT	Raw Water Tunnel
SCADA	Supervisory Control and Data Acquisition
SCFP	Seymour Capilano Filtration Plant
TS	Transmission System
$THAA_5$	Total $Haloacetic_5$ Acids
THM	Trihalomethane
TOC	Total Organic Carbon
TTHM	Total Trihalomethane
TWT	Treated Water Tunnel
UV_{254}	Ultraviolet Absorbance at 254 nm
WHO	World Health Organization
WQMRP	*Water Quality Monitoring and Reporting Plan for Metro Vancouver (GVWD) and Local Government Members*

WATER SAMPLING AND TESTING PROGRAM

Water Type	Parameter	Frequency
Untreated, Source Water	Total coliform and *E. coli*	Daily
	Turbidity	Daily
	Giardia and *Cryptosporidium*	Monthly at Capilano and Coquitlam
	Ammonia, colour, iron, organic carbon, pH	Weekly
	Alkalinity, chloride, calcium, hardness, magnesium, manganese, nitrate, potassium, phosphate, sulphate	Monthly
	Aluminum, copper, sodium, total and suspended solids	Bi-monthly
	Trihalomethanes, haloacetic acids	Quarterly
	Antimony, arsenic, barium, boron, cadmium, cyanide, chromium, lead, mercury, nickel, phenols, selenium, silver, zinc	Semi-annually
	Pesticides and herbicides	Annually
	PAHs, BTEXs	Annually
	VOC	Annually
	Radioisotopes	Annually
Treated water	Total coliform and *E. coli*	Daily
	Turbidity	Daily
	Temperature	Daily
	Ammonia, colour, iron, organic carbon, pH, aluminum at SCFP	Weekly
	Aluminum, copper, sodium, total and suspended solids	Bi-Monthly
	Trihalomethanes, haloacetic acids	Quarterly at selected sites
	Antimony, arsenic, barium, boron, cadmium, cyanide, chromium, lead, mercury, nickel, phenols, selenium, silver, zinc	Semi-annually
GVWD Water Mains	Total coliform and *E. coli*	Weekly per site
	Heterotrophic plate count	Weekly per site
	Free chlorine	Weekly per site
	Trihalomethanes, haloacetic acids, pH	Quarterly at selected sites
	PAHs, BTEXs	Semi-annually at selected sites
GVWD Reservoirs	Total coliform and *E. coli*	Weekly per site
	Heterotrophic plate count	Weekly per site
	Free chlorine	Weekly per site
Local Government Distribution System	Total coliform and *E. coli*	Weekly per site
	Heterotrophic plate count	Weekly per site
	Free chlorine	Weekly per site
	Turbidity	Weekly per site
	Trihalomethanes, haloacetic acids, pH	Quarterly at selected sites

1.0 SOURCE WATER QUALITY

The first barrier in place to protect the quality of drinking water supply is the protection of the watershed to ensure the best quality source water. Source water monitoring provides ongoing confirmation that the barrier is effective, identifies seasonal changes and provides the monitoring information necessary to adjust the level of water treatment that is in place. Regular monitoring of the water sources is also a requirement of the *Water Quality Monitoring and Reporting Plan for Metro Vancouver (GVWD) and Local Government Members (WQMRP)*.

1.1. Bacteriological Quality of the Source Water

The bacteriological quality of the source water is an important indicator of the degree of contamination, and the treatment required to ensure a safe water supply. *The Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies in British Columbia* (DWTO) Section 4.3 states *"The number of E. coli in raw water does not exceed 20/100 mL (or if E. coli data are not available less than 100/100 mL of total coliform) in at least 90% of the weekly samples from the previous six months. Treatment target for all water systems is to contain no detectable E. coli or fecal coliform per 100 ml."*

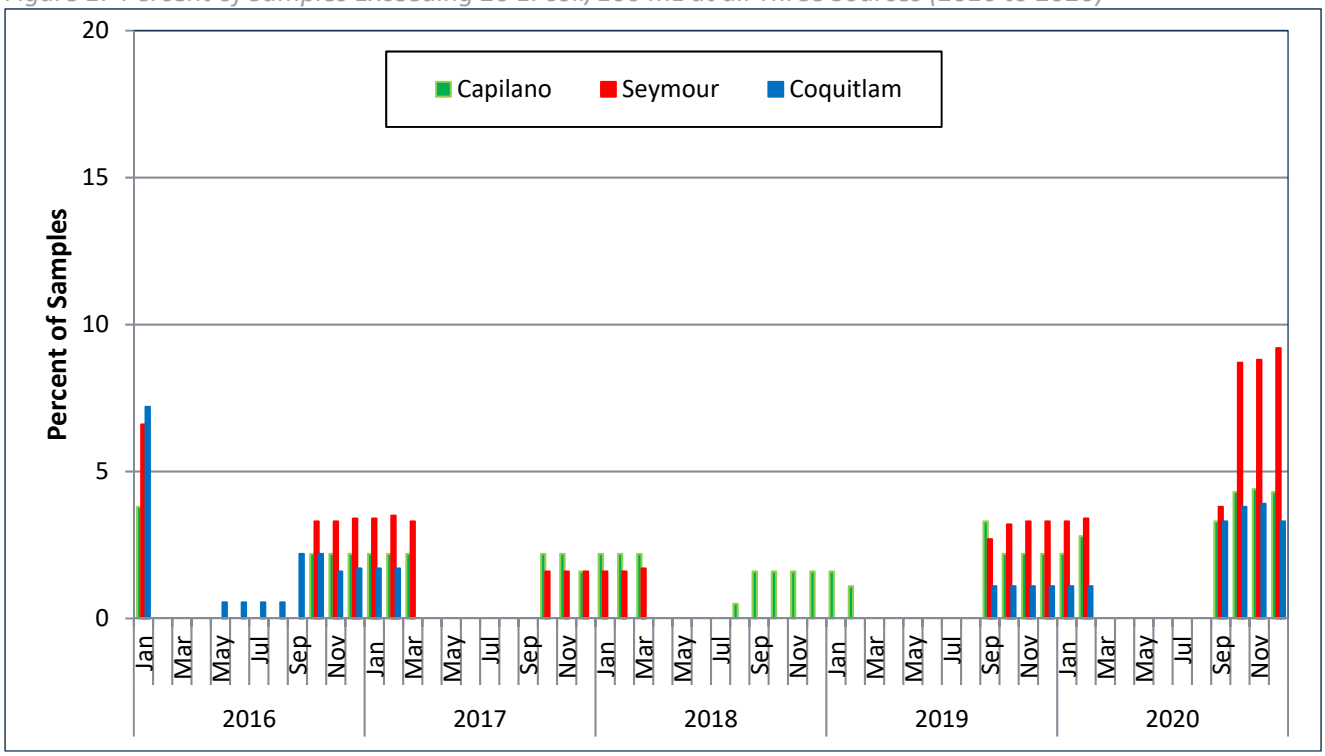
Table 1 summarizes *E. coli* data for all three GVWD water supply sources. The levels of *E. coli* for all three sources were below the 10% limit in the provincial turbidity guideline.

Table 1: Percent of Samples in Six Continual Months with E. coli/100 mL Exceeding 20

	Percent of samples (daily) in a six month period ending on the last day of the month named where *E. coli* is greater than 20/100 mL		
Month	**Capilano**	**Seymour**	**Coquitlam**
Jan	2.2	3.3	1.1
Feb	2.8	3.4	1.1
Mar	0	0	0
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	3.3	3.8	3.3
Oct	4.3	8.7	3.8
Nov	4.4	8.8	3.9
Dec	4.3	9.2	3.3

Figure 1 shows the results of the analysis of the source water from 2016 to 2020 at all three intakes compared to the limits for source water bacterial levels in the DWTO. As in previous years, all three sources met the limit of not more than 10% exceeding 20 *E.coli*/100mL. As was also the case in previous years, samples collected at the intakes in the fall and winter had the highest *E.coli* levels. Typically, these *E.coli* can typically be traced back to high flow levels at the main tributaries of the supply lakes and a first flush phenomenon after a period of dry weather.

Figure 1: Percent of Samples Exceeding 20 E. coli/100 mL at all Three Sources (2016 to 2020)



Note: Metro Vancouver has protected watersheds and therefore the source of *E.coli* is most likely originating from endemic animals in the watersheds.

1.2. Source Water Monitoring for *Giardia* and *Cryptosporidium*

Unfiltered surface water supplies have the potential of containing the protozoan pathogens *Giardia* and *Cryptosporidium*. Outbreaks of *Giardiasis* occurred in a number of locations in B.C. and Washington State in the late 1980s, and Metro Vancouver has been monitoring raw water for *Giardia* since 1987. Since 1992, Metro Vancouver has participated in a program with the BC Centre of Disease Control Enhanced Water Testing Laboratory, to gather more information about the number and nature of cysts found in the GVWD water supplies. The program involves collecting samples from the Capilano and Coquitlam supplies upstream of disinfection.

At the SCFP, monitoring for *Giardia* and *Cryptosporidium* has focused on the recycled water returning to the head of the plant and this monitoring has confirmed that the procedures in place effectively control the levels of *Giardia* and *Cryptosporidium* in the recycled wash water from the filters.

The results of the 2020 testing program are contained in the "Report to Metro Vancouver – *Giardia* and *Cryptosporidium* Annual Report January – December, 2020", which was prepared by the BC Public Health Microbiology & Reference Laboratories, Environmental Microbiology, and can be found in Appendix D. Four of twelve (33%) samples collected at Capilano and three of the twelve (25%) collected at Coquitlam were positive for *Giardia* (Table 2).

As discussed previously, Seymour samples for 2020 are all process control samples and not Seymour source water, as they were prior to 2011 (shown as N/A in the table).

Table 2: Percent of Samples Positive for Giardia

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Capilano	50	75	50	18	18	50	58	33	33	33
Seymour	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA	NA	NA
Coquitlam	51	50	23	8	0	17	67	8	25	25

Zero of twelve (0%) samples collected at Capilano were positive for *Cryptosporidium*, and 0 of twelve (0%) were positive at Coquitlam (Table 3). As discussed in the section on *Giardia* above, Seymour samples for 2020 are all process control samples and not Seymour source water, as they were prior to 2011 (shown as N/A in the table).

Table 3: Percent of Samples Positive of Cryptosporidium

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Capilano	6	16	9	9	9	25	17	8	0	0
Seymour	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA	NA	NA
Coquitlam	3	8	9	0	0	0	0	0	0	0

Year to year fluctuations are demonstrated for *Giardia* and *Cryptosporidium* and there has always been considerable variation in the results.

1.3. Turbidity

GVWD water sources have been susceptible to turbidity upsets due to high runoff from storms which can cause slides and stream scouring in the watersheds, or from re-suspension of sediment from the edges of the lakes during periods of low water levels. The DWTO allows a utility to be exempt from filtration if the turbidity does not exceed specific water quality parameters requirements and provided that a number of other provisions, including source water protection and two forms of water treatment requirements, are in place. Historically the turbidity levels on both the Capilano and Seymour sources would not meet these criteria, therefore plans were developed and implemented to filter both supplies.

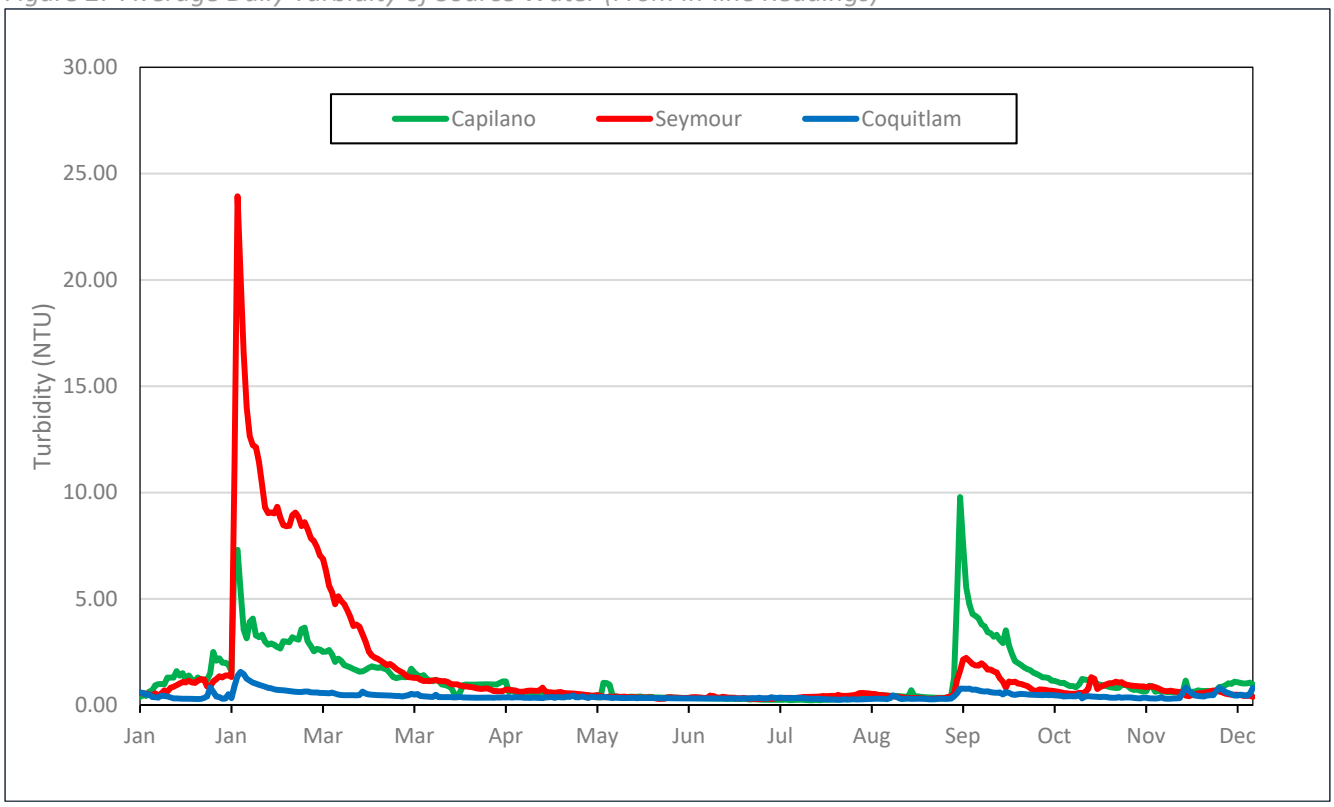
Filtration of 100% of the Seymour supply began in January 2010, and filtration and distribution of the Capilano supply through the Twin Tunnels connecting the Capilano and Seymour source supplies commenced in February 2015. Both the raw and treated water tunnels were fully operational in April 2015.

Section 4.4 of the DWTO (Version 1.1, November 2012) contains the following provision for filtration exemption:

"For nonfiltered surface water to be acceptable as a drinking water source supply, average daily turbidity levels should be established through sampling at equal intervals (at least every four hours) immediately before the disinfectant is applied. Turbidity levels of around 1.0 NTU but not exceeding 5.0 NTU for more than two days in a 12-month period should be demonstrated in the absence of filtration. In addition, source water turbidity also should not show evidence of harbouring microbiological contaminants in excess of the exemption criteria."

Capilano and Seymour water is filtered so these source water criteria don't apply to the delivered water. Coquitlam, which is unfiltered, was in service for all of 2020 in accordance with the DWTO.

Figure 2: Average Daily Turbidity of Source Water (From In-line Readings)



1.4. Chemistry

1.4.1. Chemical and Physical Characteristics of Source Water

The chemical and physical characteristics of the GVWD source water are summarized in Appendix A of this report; detailed analytical results are provided in Volume II. The results from the chemical and physical analyses of the source water in 2020 were similar to those for other years.

1.4.2. Herbicides, Pesticides, Volatile Organic Compounds, Radioactivity, and Uranium

Analyses of the source water for a variety of organic compounds, including all of the compounds with an specified MAC in the *Guidelines of Drinking Water Quality* (GCDWQ), is carried out on an annual basis in accordance with the WQMRP. The results are contained in Appendix B of this report and in Volume II. Uranium was the only parameter detected and it was below the applicable GCDWQ health based limits; these levels are indicative of erosion of natural deposits, meaning the contribution to total radiation exposure from our drinking water is low.

1.4.3. PFOS and PFAS

The GCDWQ have added the parameters of Perfluorooctane Sulfonate(PFOS) and Perfluorooactanoic Acid (PFAS) for testing of the source and treated waters. The results are in Appendix B of this report and in Volume II. None of the chemicals in these categories were detected. Common sources of these synthetic chemicals are from consumer products and fire-fighting foam for their water and oil repellant properties.

1.4.4. Limnology

The *Reservoir Water Quality Monitoring Program* was started in 2014 as a sampling and analysis structure for the limnology (physical, chemical, and biological parameters) of the Capilano, Seymour and Coquitlam Reservoirs. Reservoir monitoring information is important in the proactive management of the GVWD reservoirs, as water quality could be impacted by environmental variability and climate change. This program assists in ensuring that variation and trends in reservoir quality are scientifically tracked over time.

Water sampling of the primary source reservoirs and inflow rivers is conducted between April and November each year. Biological productivity that can influence water quality is the highest during this time of year, making it an important time for sampling and measurements. Monthly sampling of the source water is conducted by Metro Vancouver staff and sample analysis is undertaken by accredited laboratories. Water quality measurements are compiled by arrays of scientific instruments in each reservoir.

The GVWD employs the services of a limnology consultant to review the annual program data, interpret physical, chemical, and biological conditions and examine long term trends. Results in 2020, as in previous years, confirmed the three reservoirs are ultra-oligotrophic (see Appendix C), which means they have low levels of available nutrients and low levels of biological production. This ultra-oligotrophic classification is highly desirable for source drinking water supply and shows that the GVWD watersheds and reservoirs continue to provide a high quality raw water source.

In many parts of North America there is interest in blue green algae (also known as cyanobacteria) in water reservoirs. These algae can produce toxins that are collectively known as microcystins. A common cyanobacterium in GVWD source reservoirs is called *Merismopedia* spp., which is thought to produce these microcystins.

Despite the presence of cyanobacteria, the concentration of microcystins in GVWD source reservoirs remains well below levels known to affect human health and are far below the GCDWQ. This desirable condition is due to the ultra-oligotrophic status of the reservoirs (low nutrient availability to fuel algal growth). Algae blooms have not been observed in the source water supply reservoirs. Metro Vancouver continues to monitor cyanobacteria, including *Merismopedia* spp. as well as processes in the reservoirs that control the growth of cyanobacteria and other algae. This data is used to help predict changes to water quality over time related to climatic and environmental change and aid in making proactive decisions about ongoing reservoir management strategies.

2.0 QUALITY CONTROL ASSESSMENT OF WATER TREATMENT

Water treatment is the second barrier (after source water protection) relied on to assure the quality of the water supply.

Completion of the Twin Tunnels Project in 2015 successfully concluded GVWD's regional long-range water treatment enhancement plans which spanned more than ten years. Each tunnel is 3.8 meters in diameter, 7.1 kilometers long, and 160 to 640 meters below ground level, running beneath Grouse Mountain and Mount Fromme. The water from the Raw Water Tunnel (RWT) is filtered and treated alongside the Seymour source water at the Seymour Capilano Filtration Plant (SCFP). Both treated sources enter the Clearwell at the SCFP for further treatment before the blended water is distributed to the region. Blended treated water returns to Capilano through the Treated Water Tunnel (TWT) and provides high quality drinking water to the Capilano area while the remainder is distributed through the Seymour system.

2.1. Seymour Capilano Filtration Plant

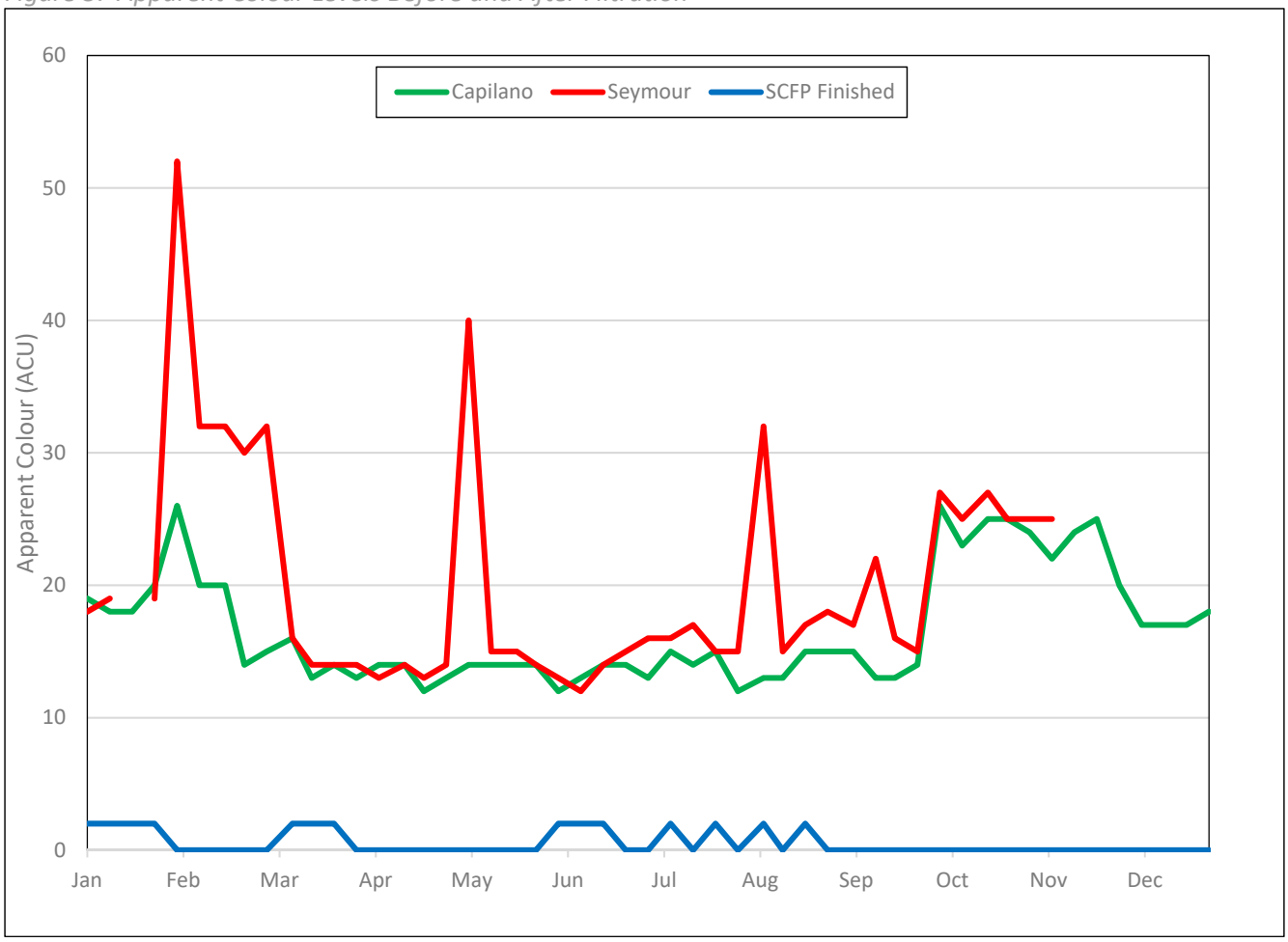
The SCFP is a chemically assisted direct filtration plant which uses poly aluminum chloride as a coagulant with polymers to improve particle removal. These substances help aggregate particles to form visible floc. The flocculated particles are removed by passing this water through a filter medium of anthracite and sand. The result is the production of filtered water which is then exposed to ultraviolet light as the water leaves each filter. Post ultraviolet filtered water has sodium hypochlorite (chlorine) and lime added before the water enters the Clearwells. The West and East Clearwells are large water storage reservoirs that store and allow controlled passage of water with some mixing (or blending) of the lime and chlorine that have been added. Clearwells allow sufficient retention (or contact time) with chlorine to provide any further disinfection required after filtration and ultraviolet light treatment. Carbon dioxide (CO_2) in solution is added to trim pH once the desired alkalinity is reached. After stabilization of the filtered water in the Clearwells, the finished water enters the transmission system at the Seymour Treated Water Valve Chamber. The SCFP has been operational since January 2010 and the quality of the water produced has been excellent.

2.1.1. Filtration

As a result of filtration treatment of the Capilano and Seymour water sources, there have been a number of changes to the characteristics of the delivered water. Some of these changes are visible, and some are not. The most obvious visible change in the water is the decrease in colour and increase in clarity. There is a total loss of brown hue that can sometimes characterize Capilano and Seymour waters before filtration. This improvement in colour is a result of removal of the natural components that cause the brown hue by the filtration process. Suspended particles in water that cause light to scatter (turbidity) are also removed. The end product is water that is very clear. Due to the purity of the water, it may have a slight bluish tinge.

Figure 3 compares the apparent colour of SCFP filtered water and Capilano and Seymour source waters for 2020. During the fall rainfall events, the apparent colour of the Seymour source water feeding the SCFP had a reading over 50 ACU. After the removal of the organic material through filtration, the colour of the filtered water delivered to the public was never greater than 2 ACU.

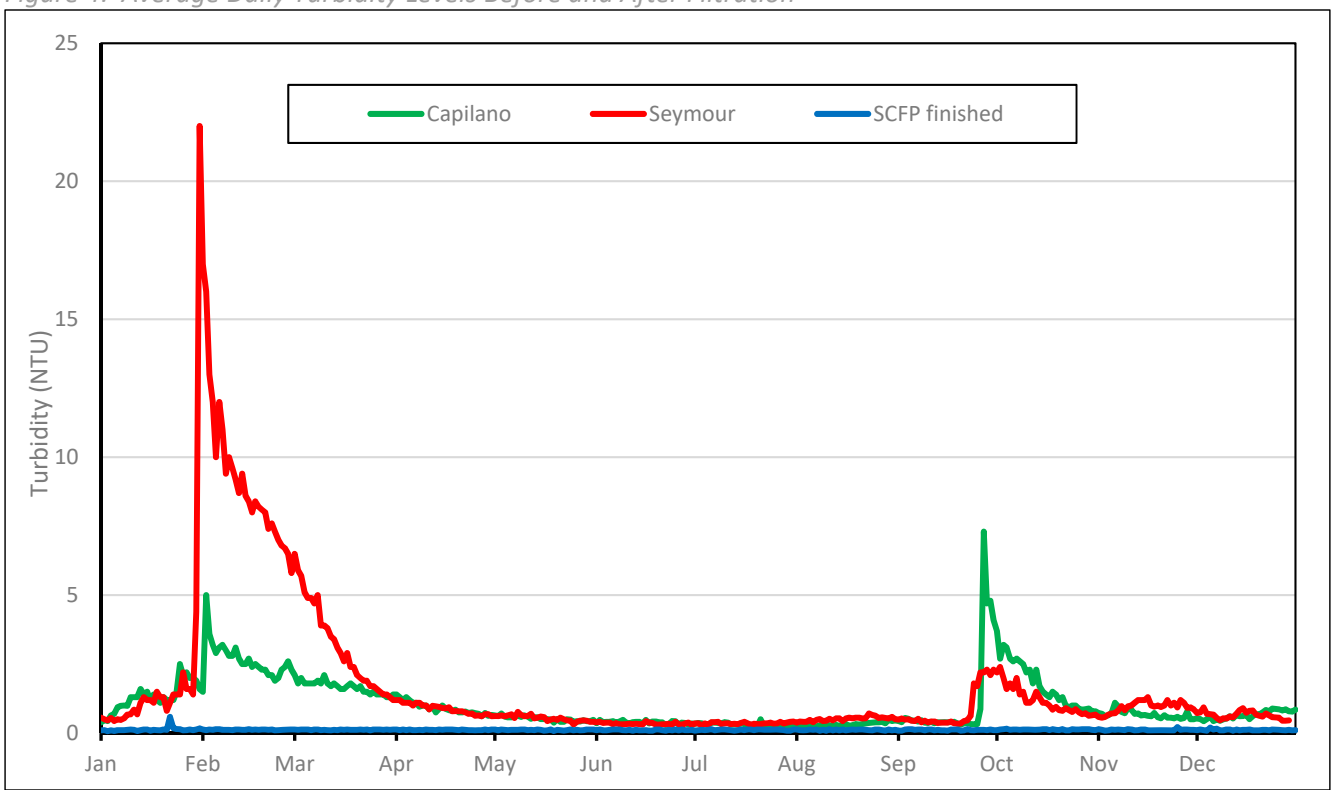
Figure 3: Apparent Colour Levels Before and After Filtration



Note: The Seymour intake sampling site was unavailable due to maintenance from November until year end.

Figure 4 compares turbidity of the two source waters that feed the SCFP to the turbidity level of the finished water. The Seymour source experienced an average daily turbidity greater than 1 NTU for 116 days. The Capilano source exceeded 1 NTU on 114 days. Since both sources were filtered at the SCFP, the maximum average daily turbidity of the delivered water was 0.19 NTU and the average was 0.09 NTU.

Figure 4: Average Daily Turbidity Levels Before and After Filtration



Removal of turbidity in the source water improves the aesthetic qualities of the water, but it also has the benefit of removing certain types of pathogenic microorganisms that may be present. At a minimum, properly run direct filtration plants such as the SCFP will remove up to 2.5 log (two log is a 99% reduction) of *Giardia* and *Cryptosporidium* plus 1 log of viruses. To ensure this removal, it is critical that the performance of each filter determined by the turbidity of its effluent is monitored on a continuous basis.

The GCDWQ (2019) states: "*For conventional and direct filtration, less than or equal to 0.3 nephelometric turbidity units (NTU) in at least 95% of measurements either per filter cycle or per month and never to exceed 1.0 NTU.*"

Ideally the turbidity from each filter would never exceed 0.1 NTU; however, there are rare occurrences of turbidity readings that exceed this ideal level. The turbidity performance of all 24 filters is measured by examining the percent of time that the turbidity of each Individual Filter Effluent (IFE) met the turbidity guidelines of not greater than 1.0 NTU and at least 95% of time less than 0.3 NTU. This is summarized in Table 4. In 2020, there were no incidents where the IFE was greater than 1.0 NTU and the few incidences of filter turbidity readings that were greater than 0.3 NTU, were well within the 95% limit.

Table 4: Monthly Filter Effluent Turbidity Summary

Month	Occurrence of IFE Turbidity greater than 1.0 NTU (None Allowed)	Percent of Time IFE Turbidity was less than 0.3 NTU (Minimum 95% Required)
January	0	99.99%
February	0	99.72%
March	0	99.94%
April	0	100%
May	0	100%
June	0	100%
July	0	100%
August	0	100%
September	0	99.99%
October	0	100%
November	0	100%
December	0	100%

A water treatment facility such as the SCFP should be able to produce a filter effluent that is less than 0.1 NTU. Under normal operating conditions the turbidity of the filtered water at SCFP is less than 0.09 NTU.

All water that flows through the filters immediately passes through the ultraviolet units. The intensity of the ultraviolet lamps automatically increases when there is an increase in turbidity of the water exiting each filter. After ultraviolet treatment, the water is chlorinated as it enters the clearwell, where more than one hour of contact time is provided.

2.1.2. Ultraviolet Treatment

The effluent from each filter is treated with ultraviolet light as the water exits the filter. Ultraviolet treatment is effective in altering the DNA structure of *Giardia* and *Cryptosporidium.* thus rendering cysts and oocysts, respectively, of these parasites non-infectious. Other disinfectants, especially chlorine, are ineffective against *Cryptosporidium* oocysts at reasonable dosages. In the unlikely event of a breakthrough of *Cryptosporidium* oocysts, especially at the end of a filter run, ultraviolet light is present to render any parasites that may be present as non-infectious. Oocysts are not able to proliferate inside the intestines of human hosts to cause illness after a sufficient dose of ultraviolet light. The target dosage for ultraviolet light is to achieve 2-Log (99%) *Giardia* and *Cryptosporidium* inactivation is 21 mJ/cm^2.

Under normal operating conditions, two rows of lamps operating at 75% power provide sufficient ultraviolet light to meet the dosage requirement for 2-log reduction of *Giardia* and *Cryptosporidium*

Table 5 summarizes the performance of the SCFP ultraviolet system in 2020.

Table 5: Percent of Volume Meeting Ultraviolet Dosage Requirements at SCFP

Month	Percent of Monthly Volume ≥ 2-log of *Giardia* and *Cryptosporidium* Inactivation (95% of monthly volume required)
January	99.82%
February	99.89%
March	99.90%
April	99.84%
May	99.91%
June	99.95%
July	99.97%
August	99.95%
September	99.89%
October	99.92%
November	99.92%
December	99.62%

2.1.3. Chlorination

Chlorination is used for secondary disinfection at the source as well as at secondary disinfection stations to minimize bacterial regrowth in the GVWD transmission and local government distribution systems. Chlorination provides 4-log virus inactivation with liquid sodium hypochlorite.

2.2. Coquitlam Water Treatment Plant

The Coquitlam Water Treatment Plant (CWTP) uses ozonation, ultraviolet treatment, soda ash and chlorination to treat water from the Coquitlam source.

Ozonation provides pre-treatment and helps remove micro-organisms from the water, reduces disinfection by-products and improves water clarity, which increases the efficiency of the subsequent ultraviolet process. Ozonation provides an additional 4-log virus inactivation to chlorination. Soda ash is then added for pH and alkalinity adjustment for corrosion control, followed by chlorination.

2.2.1. Ultraviolet Treatment

Ultraviolet treatment (operational since 2014) provides for primary disinfection, and achieves 3-log inactivation of chlorine-resistant micro-organisms for *Giardia* and *Cryptosporidium*. The water is directed into 8 ultraviolet units, each containing 40 ultraviolet lamps encased in protective sleeves. Ultraviolet light emitted from the lamps passes through the water. The US Environmental Protection Agency (USEPA) requires that the ultraviolet disinfection process results in target *Giardia* and *Cryptosporidium* inactivation in at least 95% of the treated water volume on a monthly basis, which is summarized in Table 6. The USEPA standard is used because there is no Canadian standard.

Table 6: Percent of Volume Meeting Ultraviolet Dosage Requirements at CWTP

Month	Percent of Monthly Volume ≥ 3-log *Giardia* and *Cryptosporidium* Inactivation (Minimum 95% Required)
January	99.87%
February	99.88%
March	99.89%
April	99.85%
May	99.87%
June	99.85%
July	99.85%
August	99.81%
September	99.81%
October	99.90%
November	99.82%
December	99.91%

2.2.2. Chlorination

Chlorination is used for secondary disinfection at the source as well as at secondary disinfection stations to minimize bacterial regrowth in the GVWD transmission and local government distribution systems. Chlorination provides 4-log virus inactivation with liquid sodium hypochlorite, which replaced the compressed chlorine gas system in 2017. Table 7 summarizes the performance of all the Coquitlam disinfection systems in 2020.

Table 7: Performance of Coquitlam Disinfection Facilities

Facility	Performance	Discussion
Ozonation	Operated 99.6% of time	Acts as a pretreatment, enhancing the removal of organics and increasing the UV Transmittance making Ultraviolet treatment more effective. Ozone outages were due to electrical or instrument maintenance, ozone outage test, or ozone generator faults.
Ultraviolet	No loss of ultraviolet in 2020. 99.86 % of volume was treated to ultraviolet specifications	UV performance met USEPA requirements. (95% of monthly volume required).
Chlorination	100% of water was chlorinated	This facility uses chlorine as a secondary disinfectant except during an outage of the ultraviolet system when it is used for primary disinfection.

2.3. Secondary Disinfection

There are 8 secondary disinfection stations operated by Metro Vancouver. The purpose of these stations is to increase the chlorine residual in the water transmission and distribution systems to meet a target residual based on a number of factors, including source water turbidity, the amount of bacterial regrowth detected in the local government distribution system samples and the chlorine demand in the water. The rate of chlorine decay is lower in the areas receiving filtered water from the SCFP and consequently, lower chlorine dosage levels are required to maintain desired chlorine residual levels. The target chlorine dose leaving the secondary facilities receiving SCFP water is 0.8 mg/L. These facilities frequently have an incoming chlorine residual high enough that boosting is not required. The target chlorine dose leaving the secondary facilities receiving CWTP water ranges from 1.20 to 1.50 mg/L.

Table 8 summarizes the performance of the secondary disinfection facilities in 2020.

Table 8: Performance of Secondary Disinfection Facilities

Facility	Branch Main	Average Free Chlorine (mg/L)	Range of Free Chlorine (mg/L)	Discussion
Clayton	Whalley/Clayton	1.22	1.09-1.36	Supplied by Coquitlam water.
	Jericho/Clayton	1.24	1.11-1.38	Jericho/Clayton was out of service commencing November 3 for the Jericho Reservoir Tie-In. Will be returned to service in 2021.
Chilco/Alberni	Capilano No. 4 and 5	0.74	0.67-0.84	Supplied by SCFP water. No operational issues.
Pitt River	Haney Main No.2	1.20	0.88-1.39	Supplied by Coquitlam water. March through June, in and out of service due to replacement of pipes and instruments in various sections of the station.
	Haney Main No.3	1.24	1.00-1.38	
Newton	Surrey Hickleton Main	0.88	0.58-1.18	Primarily supplied by SCFP water. No operational issues.
Kersland	Capilano No. 4 and 5	0.89	0.83-0.96	Supplied by SCFP water. No operational issues.
Central Park	South Burnaby Main No.1	0.82	0.65-0.96	Primarily supplied by SCFP water.
	South Burnaby Main No.2	0.91	0.74-1.14	No operational issues.
Cape Horn	Coquitlam Main No.2	1.25	1.10-1.36	Supplied by Coquitlam water.
	Coquitlam Main No.3	1.25	1.10-1.36	No operational issues.
Vancouver Heights	Boundary Road Main No. 5	0.84	0.75-0.92	Supplied by SCFP water. No operational issues.

2.4. Corrosion Control

Metro Vancouver's Corrosion Control Program began in the 1990s and involves several steps to reduce pipe corrosion. As part of the current Corrosion Control Program: Copper Pipes Protection initiative, further proposed changes in pH and alkalinity in 2021 will reduce pipe corrosion through the addition of natural minerals.

The untreated water from all three sources had a pH lower than the aesthetic limit of the GCDWQ of pH 7.0.

In the SCFP process, filtered water is dosed with hydrated lime (calcium bicarbonate) to raise its pH and alkalinity before it enters the clearwells. To achieve the desired alkalinity, the resultant pH is trimmed using CO_2 to bring it down to target levels. Since 2015, by way of the Twin Tunnels, Capilano raw source water is transferred to the SCFP for treatment.

At the Coquitlam source, the commissioning of the CO_2 system at the CWTP began in 2019 and continued in 2020. When it is fully operational, the CO_2 system with the addition of soda ash will allow the GVWD to meet new target pH and alkalinity values across the entire system. Similar to the SCFP, the CO_2 system is used to trim the resultant pH to desired target levels.

The average pH of the treated water leaving Seymour Capilano and Coquitlam Water Treatment Plants was 7.7 and 7.8, respectively, during 2020, which met the aesthetic objective of the GCDWQ.

Performance of the corrosion control facilities is summarized in Table 9.

Table 9: Performance of Corrosion Control Facilities

Facility	Performance	Discussion
SCFP Corrosion Control	pH ranged from 6.9 – 9.0	The annual average pH was 7.7 and was continually monitored with online instrumentation. The pH fluctuated in March from 6.9 to 9. During this time one clearwell was being bypassed for maintenance resulting in pH fluctuations while bringing this clearwell back into service.
CWTP Corrosion Control	pH ranged from 6.8 – 9.6	The annual average pH was 7.8. On a couple of occasions in January the pH was <7.0 for a short period due to a soda ash equipment fault. In January and also in June the pH was > 9 for a short period related to testing of the soda ash system.

The chemical and physical characteristics of the GVWD treated water are summarized in Appendix A of this report and detailed analytical results are provided in Volume II.

3.0 TRANSMISSION/DISTRIBUTION SYSTEM WATER QUALITY

Schedule A of the *BC Drinking Water Protection Regulation* (BCDWPR) contains standards for the bacteriological quality of potable water in the Province. There are three components of this standard that apply to large utilities such as GVWD and its members. These are:

Part 1: No sample should be positive for E. coli.

Part 2: Not more than 10% of the samples in a 30-day period should be positive for total coliform bacteria when more than 1 sample is collected.

Part 3: No sample should contain more than 10 total coliform bacteria per 100 mL.

The BCDWPR does not contain any water standards other than the three limits for *E. coli* and total coliform bacteria. Information on the significance of the detection of these organisms can be found in the GCDWQ – Supporting Documents, specifically:

"E. coli is a member of the total coliform group of bacteria and is the only member that is found exclusively in the faeces of humans and other animals. Its presence in water indicates not only recent faecal contamination of the water but also the possible presence of intestinal disease-causing bacteria, viruses and protozoa."

"The presence of total coliform bacteria in water in the distribution system (but not in water leaving the treatment plant) indicates that the distribution system may be vulnerable to contamination or may simply be experiencing bacterial regrowth."

To summarize, the detection of an *E. coli* bacteria in a sample of treated water is an indication of a potentially serious risk. The detection of total coliform bacteria may indicate intrusion into the system, or it may indicate that these bacteria are growing in the distribution system itself (regrowth).

The number of *E. coli* detected in both the GVWD and the local government drinking water samples is typically very low. Out of more than 27,000 samples collected from the GVWD and local government systems analyzed in 2020, no samples were positive for *E. coli*. The detection of an *E. coli* triggers a protocol which involves immediate notification to health and local government officials, re-sampling, and a thorough investigation into the possible causes.

In the GVWD transmission system, only 27 out of the approximately 7,100 samples collected, tested positive for total coliforms. Only 38 of the approximately 20,000 samples collected from the local government distribution systems tested positive for total coliforms in 2020. The majority of the coliforms (67%) in the local government system appeared in the warmer water months of June through October.

The most likely source of these organisms can be attributed to bacterial regrowth. It should be emphasized that 99.8% of the samples in 2020 had no coliforms present, which is a good indicator of effective water treatment and good transmission/distribution system water quality.

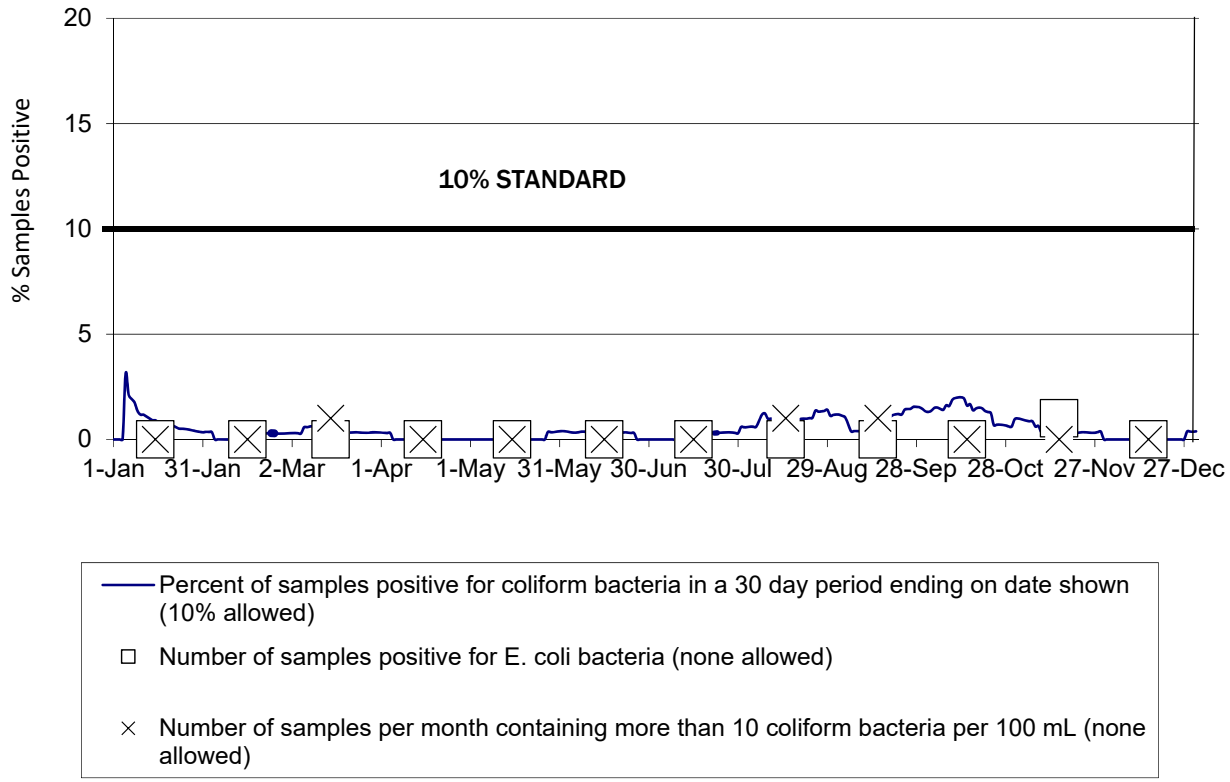
3.1. Microbiological Water Quality in the GVWD System

3.1.1. GVWD Water Mains

Water quality in water mains is monitored from the point leaving the source and throughout the transmission system. In 2020 there were approximately 5,080 samples collected and tested for the presence of indicator bacteria. The percentage of samples from the GVWD water mains that were positive for total coliform bacteria was very low, well below the 10% standard. Of the approximately 5080 samples processed, only 21 samples tested positive for total coliforms and no samples were positive for *E. coli* bacteria. The compliance of monitoring results from GVWD transmission mains with the criteria in the BCDWPR is shown in Figure 5.

There were another 540 samples collected from stations where only chlorine residuals are measured. In addition, there are inline stations collecting data every 10-minutes after chlorination at each source, but these samples are not included in the calculations for compliance monitoring.

Figure 5: Bacteriological Quality of Water in GVWD Mains

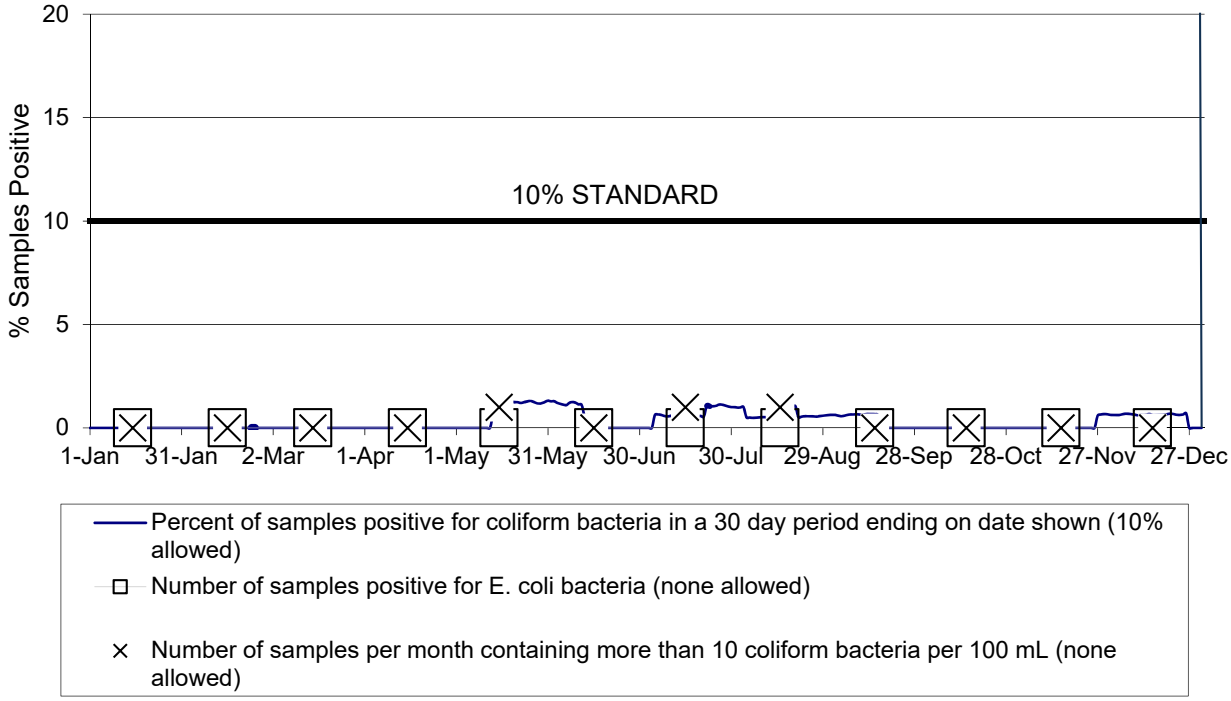


3.1.2. GVWD Reservoirs

In 2020, over 2,000 samples were collected from 21 reservoirs and tanks that are located throughout the GVWD water system. Only 6 samples were positive for total coliforms. No sample from a reservoir was positive for *E. coli*.

The compliance of 2020 monitoring results from GVWD reservoirs with the criteria in the BCDWPR is shown in Figure 6.

Figure 6: Bacteriological Quality of Water in GVWD Reservoirs



Reservoir water quality is optimized by the use of secondary disinfection coupled with an active reservoir exercising program that includes a minimum of weekly monitoring of chlorine residuals and bacteriology results, which can result in changes to filling levels, if necessary.

Table 10 provides an overview of the status of the GVWD reservoirs from 2017 to 2020. During certain times of the year, it is not possible to cycle reservoirs as much as would be desired due to operational constraints. Despite these constraints, water quality as determined by coliform bacteria, was satisfactory in all reservoirs.

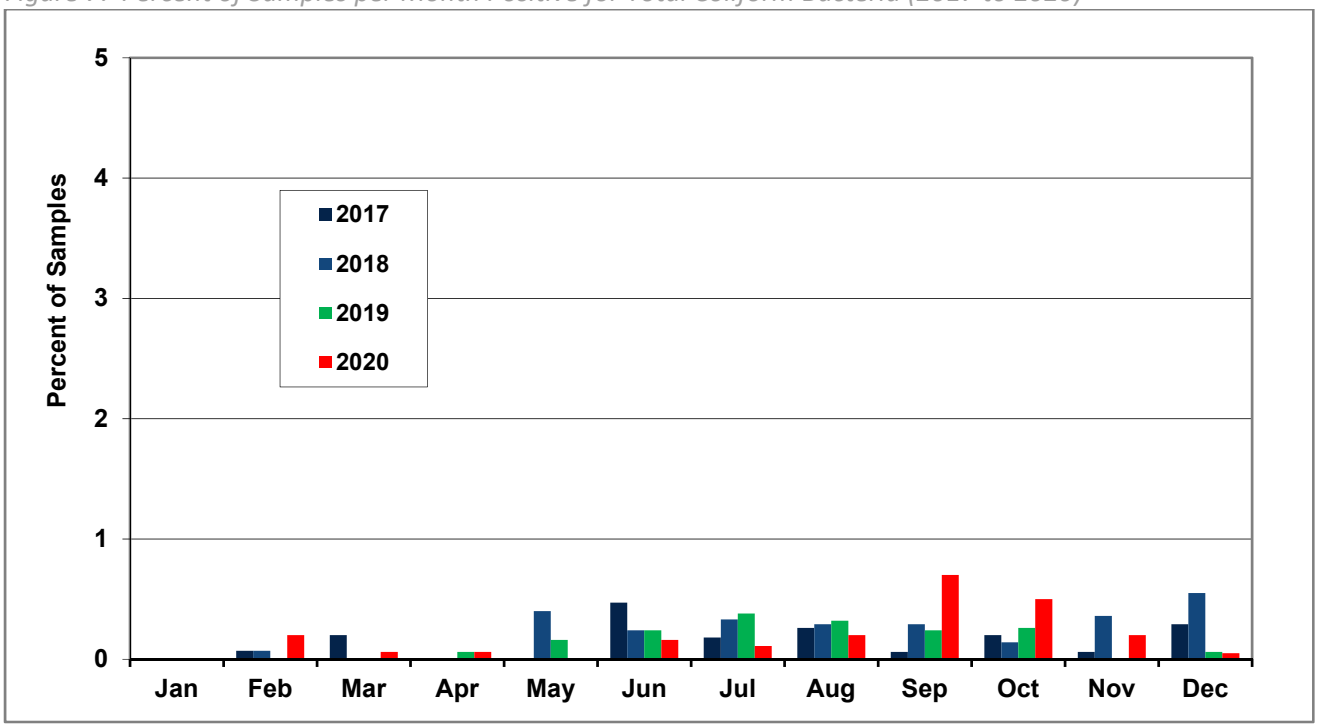
Table 10: Status of GVWD Reservoirs (2017-2020)

Reservoir (Capacity in Million Litres)	Average Free Chlorine (mg/L)				Discussion
	2017	2018	2019	2020	
Burnaby Mtn. Reservoir (14.1)	0.44	0.49	0.53	0.57	No operational issues
Burnaby Tank (2.4)	0.53	0.54	0.58	0.60	The tank was cleaned March 30-April 3 while remaining in service.
Cape Horn Reservoir (42.2)	0.53	0.78	0.61	0.78	No operational issues
Clayton Reservoir (22.4)	N/A	1.1	1.02	1.08	Drainage improvement project was completed in January. Cell 1 removed from service in the fall to reduce low use season storage.
Central Park Reservoir (37.0)	0.54	0.53	0.51	0.66	No operational issues
Glenmore Tanks (1.0)	0.64	0.66	0.68	0.77	No operational issues
Grandview Reservoir (14.3)	0.71	0.71	0.73	0.80	No operational issues
Greenwood Reservoir (9.2)	0.63	0.66	0.68	0.75	No operational issues
Hellings Tank (4.4)	0.45	0.47	0.48	0.54	No operational issues
Kennedy Reservoir (17.3)	0.52	0.56	0.52	0.58	No operational issues
Kersland Reservoir (78.7)	0.56	0.55	0.55	0.66	No operational issues
Little Mountain Reservoir (177.4)	0.66	0.64	0.67	0.72	No operational issues
Maple Ridge Reservoir (24.2)	0.52	0.53	0.52	0.44	New sampling kiosk installed in July.
Newton Reservoir (33.6)	0.56	0.45	0.46	0.55	No operational issues
Pebble Hill Reservoir (44.8)	0.64	0.63	0.60	0.66	Cell 1 taken out of service in the fall to reduce low use season storage.
Prospect Reservoir (4.6)	0.63	0.64	0.66	0.76	No operational issues
Sasamat Reservoir (27.6)	0.52	0.54	0.54	0.65	No operational issues
Sunnyside Reservoir (28.8)	0.65	0.58	0.47	0.73	Upgrade work on cell 1 and 2 throughout the year.
Vancouver Heights Reservoir (45.6)	0.68	0.66	0.75	0.82	No operational issues
Westburnco Reservoir (77.1)	0.50	0.58	0.58	0.64	No operational issues
Whalley Reservoir (35.7)	0.46	0.60	0.59	0.73	No operational issues

3.2. Microbiological Water Quality in Local Government Systems

For samples collected from local government systems, the percent positive per month for total coliform bacteria from 2017-2020 is shown in Figure 7.

Figure 7: Percent of Samples per Month Positive for Total Coliform Bacteria (2017 to 2020)



The percentage of samples positive for total coliform bacteria in 2020 remained relatively similar as compared to 2019.

Schedule A of the BCDWPR contains standards for the bacteriological quality of potable water in the Province. There are three components of this standard that apply to local governments:

Part 1: No sample should be positive for *E. coli.*

Part 2: Not more than 10% of the samples in a 30-day period should be positive for total coliform bacteria when more than 1 sample is collected.

Part 3: No sample should contain more than 10 total coliform bacteria per 100 mL.

For samples from local government systems, this requirement was met in 2020 with the following exceptions:

- Two samples in June contained more than 10 total coliform bacteria.
- Three samples in September contained more than 10 total coliform bacteria.
- Two samples in October contained more than 10 total coliform bacteria.

Table 11 shows the compliance with the bacteriological standards (3 parts) in the BCDWPR for samples taken within the distribution systems of the 20 local governments that are supplied with GVWD water.

Table 11: Local Government Water Quality Compared to the Provincial Bacteriological Standards

Month	Number that met Part 1	Number that met Part 2	Number that met Part 3	Number that met all requirements
January	20	20	20	20
February	20	20	20	20
March	20	20	20	20
April	20	20	20	20
May	20	20	20	20
June	20	20	18	18
July	20	20	20	20
August	20	20	20	20
September	20	20	17	17
October	20	20	18	18
November	20	20	20	20
December	20	20	20	20

3.3. Disinfection By-Products in the Transmission/Distribution Systems

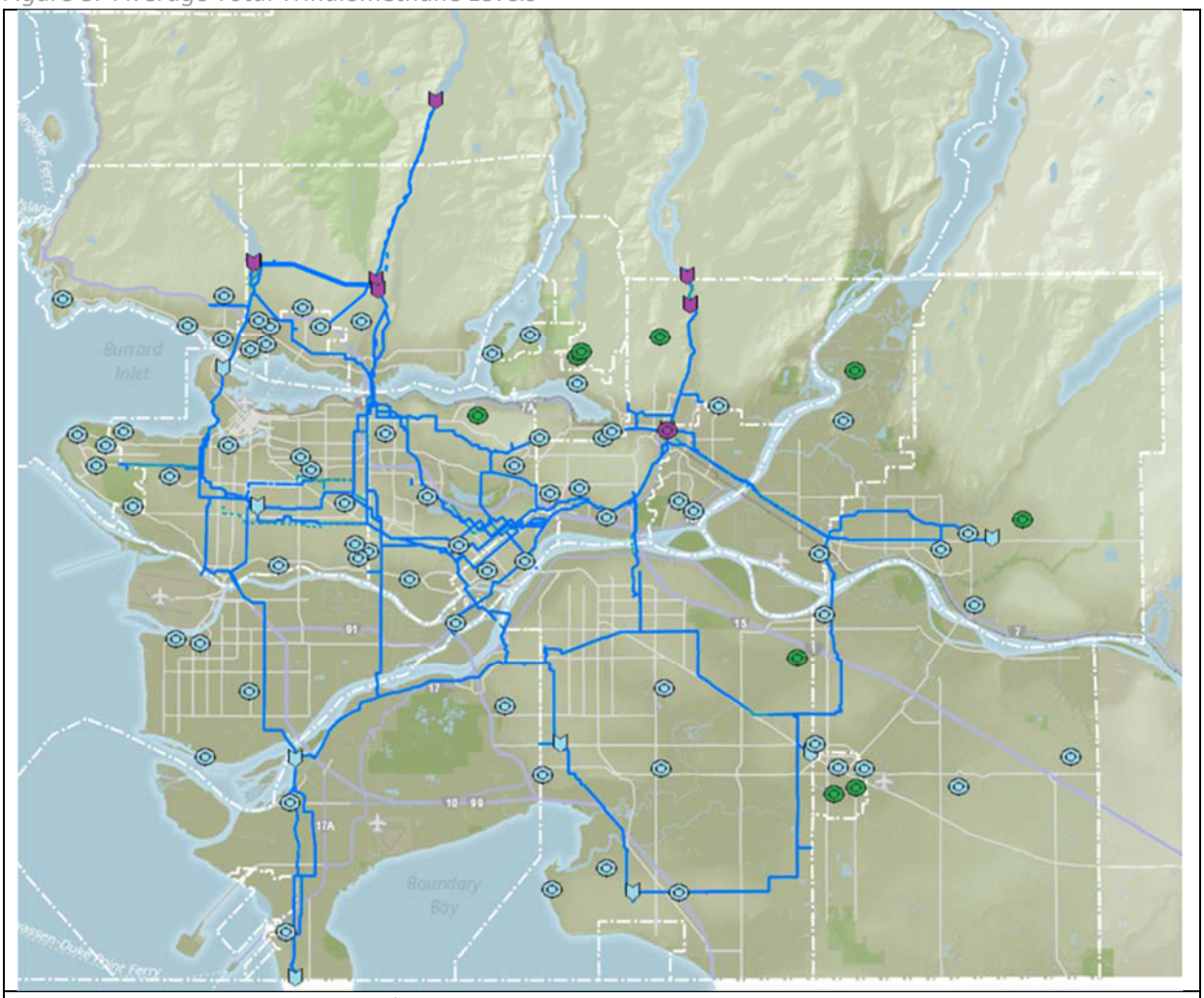
As the treated water moves through the GVWD Transmission system and into the local government distribution system infrastructure of pipes and reservoirs. Changes in water quality occur mainly due to the reaction between the chlorine in the water (added during primary and secondary disinfection) and naturally occurring organic matter in the water.

One of the most significant changes is the production of chlorinated disinfection by-products (DBPs). DBPs is a term used to describe a group of organic and inorganic compounds formed during water disinfection.

Reactions between dissolved natural organic matter and chlorine can lead to the formation of a variety of halogenated DBPs. There are two major groups of chlorinated DBPs: The Total Trihalomethanes (TTHMs) and the Total Haloacetic Acids ($THAA_5$). Factors that affect DBP formation include: amount of chlorine added to water, reaction time, concentration and characteristics of dissolved organic materials (precursors), water temperature, and water pH. In general, DBPs continue to form as long as chlorine and reactive DBP precursors are present in water.

The Maximum Acceptable Concentration (MAC) in the GCDWQ for TTHMs is a locational yearly running average of 100 µg/L (0.1 mg/L) based on quarterly samples. A comparison of TTHM levels in the GVWD and local government systems in 2020 is shown in Figure 8. All THM results from GVWD water mains and local government systems were below the MAC of 100 µg/L.

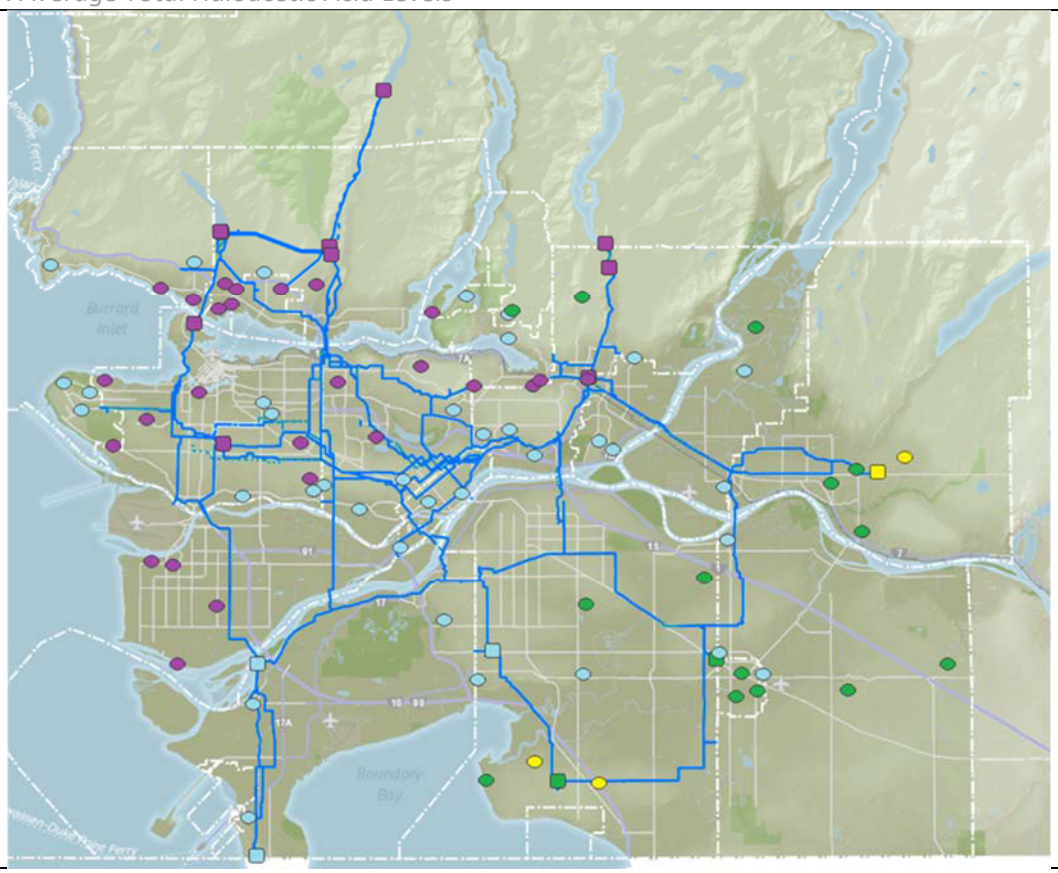
Figure 8: Average Total Trihalomethane Levels



2020 Average GVWD TTHM = 22 µg/L
2020 Average Local Governments TTHM = 31 µg/L

The other group of disinfection by-products of interest is the Total Haloacetic Acid ($THAA_5$) group. Comparison of $THAA_5$ in the GVWD and local government systems in 2020 is shown in Figure 9. In 2020, eight locations had a single quarterly sample with $THAA_5$ readings above 80 µg/L. The MAC is calculated on a locational yearly running average based on quarterly samples and despite the higher single readings, no location exceeded the yearly 80 µg/L MAC.

Figure 9: Average Total Haloacetic Acid Levels



2020 Average GVWD THAA = 24 µg/L
2020 Average Local Governments THAA = 30 µg/L

4.0 QUALITY CONTROL/QUALITY ASSURANCE

In 1994, as required by a new BC Ministry of Health program, the bacteriology section of the GVWD Laboratory received approval from the Provincial Medical Health Officer to perform bacteriological analysis of potable water as required in the BCDWPR. An ongoing requirement of this approval is successful participation in the provincial Clinical Microbiology Proficiency Testing Program or its equivalent. Representatives of the Approval Committee for Bacteriology Laboratories have carried out an inspection of the GVWD Laboratory facilities at the Lake City Operations Centre in February 2019 as part of the process leading up to approval of the laboratory by the Provincial Health Officer. The next inspection is scheduled for 2022.

In addition to the approval process discussed above, the GVWD Laboratory is accredited by the Canadian Association for Laboratory Accreditation (CALA) for the analysis of parameters for which the laboratory

has requested certification. The GVWD Laboratory has been inspected by representatives from CALA bi-annually since 1995.

Accreditation for the laboratory from the Standards Council of Canada was first received early in 1996 and continued until the middle of 2005, when accreditation was granted by CALA directly.

The most recent on-site audit took place in November 2019, and CALA issued accreditation approval in February 2020. The next CALA inspection will take place in the fall of 2021.

APPENDIX A — CHEMICAL AND PHYSICAL ANALYSIS SUMMARIES

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Physical and Chemical Analysis of Water Supply

2020 – Capilano Water System

Parameter	Untreated	Treated		Canadian Guideline		
	Average	Average	Range	Days Exceeded	Limit	Reason Established
Alkalinity as CaCO3 (mg/L)	2.9	10	5.8-12		none	
Aluminum Dissolved (µg/L)	81	29	20-48		none	
Aluminum Total (µg/L)	143	29	18-58		none	
Antimony Total (µg/L)	<0.5	<0.5	<0.5	0	6	Health
Arsenic Total (µg/L)	<0.5	<0.5	<0.5	0	10	Health
Barium Total (µg/L)	2.7	2.9	2.1-3.6	0	1000	Health
Boron Total (µg/L)	<10	<10	<10	0	5000	Health
Bromate (mg/L)	<0.01	<0.01	<0.01	0	0.1	Health
Bromide (mg/L)	<0.01	<0.01	<0.01		none	
Cadmium Total (µg/L)	<0.2	<0.2	<0.2	0	5	Health
Calcium Total (µg/L)	1160	4180	2460-4640		none	
Carbon Organic - Dissolved (mg/L)	1.9	0.7	0.4-1.0		none	
Carbon Organic - Total (mg/L)	1.9	0.7	0.5-1.0		none	
Chlorate (mg/L)	<0.01	0.02	0.02-0.03	0	1	Health
Chloride (mg/L)	<0.5	2.5	2.0-3.2	0	≤250	Aesthetic
Chromium Total (µg/L)	<0.07	<0.05	<0.05	0	50	Health
Cobalt Total (µg/L)	<0.5	<0.5	<0.5		none	
Color - Apparent (ACU)	17	<2	<2-2		none	
Color - True (TCU)	12	<1	<1-1	0	≤15	Aesthetic
Conductivity (µmhos/cm)	10	32	22-37		none	
Copper Total (µg/L)	3.1	<0.5	<0.5	0	≤1000	Aesthetic
Cyanide Total (mg/L)	<0.02	<0.02	<0.02	0	0.2	Health
Fluoride (mg/L)	<0.05	<0.05	<0.05	0	1.5	Health
Hardness as CaCO3 (mg/L)	3.6	11.1	6.7-12.3		none	
Iron Dissolved (µg/L)	34	<5	<5-8		none	
Iron Total (µg/L)	91	<5	<5-14	0	≤300	Aesthetic
Lead Total (µg/L)	<0.5	<0.5	<0.5	0	5	Health
Magnesium Total (µg/L)	167	171	122-200		none	
Manganese Dissolved (µg/L)	3.8	1.7	0.9-3.7		none	
Manganese Total (µg/L)	5.1	2.9	1.9-5.2	0	≤120	Health
Mercury Total (µg/L)	<0.05	<0.05	<0.05	0	1	Health
Molybdenum Total (µg/L)	<0.5	<0.5	<0.5		none	
Nickel Total (µg/L)	<0.5	<0.5	<0.5		none	
Nitrogen - Ammonia as N (mg/L)	<0.02	<0.02	<0.02		none	
Nitrogen - Nitrate as N (mg/L)	0.07	0.06	0.03-0.12	0	45	Health
Nitrogen - Nitrite as N (mg/L)	<0.01	<0.01	<0.01	0	1	Health
pH (pH units)	6.5	7.4	7.2-7.7	0	7.0 to 10.5	Aesthetic
Phenol (mg/L)	<0.005	<0.005	<0.005		none	
Phosphorus Dissolved (µg/L)	<10	<10	<10		none	
Phosphorus Total (µg/L)	<10	<10	<5-<10		none	
Potassium Total (µg/L)	159	170	153-200		none	
Residue Total (mg/L)	18	28	23-32		none	
Residue Total Dissolved (mg/L)	10	20	20-30	0	≤500	Aesthetic
Residue Total Fixed (mg/L)	8	20	14-24		none	
Residue Total Volatile (mg/L)	10	8	6-11		none	
Selenium Total (µg/L)	<0.5	<0.5	<0.5	0	50	Health
Silica as SiO2 (mg/L)	3.4	3.4	2.5-3.9		none	
Silver Total (µg/L)	<0.5	<0.5	<0.5		none	
Sodium Total (µg/L)	595	1580	1290-1800	0	≤200000	Aesthetic
Sulphate (mg/L)	0.7	1	0.7-1.4	0	≤500	Aesthetic
Turbidity (NTU)	1	0.12	0.08-0.21		none	
Turbidity IFE (NTU)	-	-	-	0	≤ 1.0	Health
UV Absorbance 254 nm (Abs/cm)	0.08	0.011	0.008-0.021		none	
Zinc Total (µg/L)	<3	<3	<3	0	≤5000	Aesthetic

These figures are averaged values from a number of laboratory analyses done throughout the year. Where the range is a single value no variation was measured for the samples analyzed. Average values containing one or more results below the detection limit are preceded with "<" symbol. Minimum range values than "<" denotes not detectable with the technique used for determination. Methods and terms are based on those of the most current on-line version of "Standard Methods for the Examination of Water and Waste Water". Untreated water is from the intake prior to the raw water tunnel, treated water is from a single site in the GVWD distribution system after the treated water tunnel and before the breakhead tank. Guidelines are taken from the most current Guidelines for Canadian Drinking Water Quality summary table updated in September 2020. Capilano Source was operational for 365 days in 2020.
[1]Treated turbidity guideline and the number of exceedances applies to Individual Filter Effluent readings; measured in events and not days.

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Physical and Chemical Analysis of Water Supply

2020 – Seymour Water System

Parameter	Untreated	Treated		Canadian Guideline		
	Average	Average	Range	Days Exceeded	Limit	Reason Established
Alkalinity as CaCO3 (mg/L)	3.6	10	5.9-12		none	
Aluminum Dissolved (µg/L)	70	30	19-57		none	
Aluminum Total (µg/L)	199	29	18-66		none	
Antimony Total (µg/L)	<0.5	<0.5	<0.5	0	6	Health
Arsenic Total (µg/L)	<0.5	<0.5	<0.5	0	10	Health
Barium Total (µg/L)	3.7	3	2.1-3.5	0	1000	Health
Boron Total (µg/L)	<10	<10	<10	0	5000	Health
Bromate (mg/L)	<0.01	<0.01	<0.01	0	0.1	Health
Bromide (mg/L)	<0.01	<0.01	<0.01		none	
Cadmium Total (µg/L)	<0.2	<0.2	<0.2	0	5	Health
Calcium Total (µg/L)	1670	4210	2420-4820		none	
Carbon Organic - Dissolved (mg/L)	1.7	0.7	0.5-1.0		none	
Carbon Organic - Total (mg/L)	1.7	0.7	0.5-1.0		none	
Chlorate (mg/L)	<0.01	0.02	0.02-0.03	0	1	Health
Chloride (mg/L)	<0.5	2.5	2.0-3.2	0	≤250	Aesthetic
Chromium Total (µg/L)	0.06	<0.05	<0.05	0	50	Health
Cobalt Total (µg/L)	<0.5	<0.5	<0.5		none	
Color - Apparent (ACU)	19	<2	<2-2		none	
Color - True (TCU)	12	<1	<1-1	0	≤15	Aesthetic
Conductivity (µmhos/cm)	13	32	22-36		none	
Copper Total (µg/L)	19.9	<0.5	<0.5-0.7	0	≤1000	Aesthetic
Cyanide Total (mg/L)	<0.02	<0.02	<0.02	0	0.2	Health
Fluoride (mg/L)	<0.05	<0.05	<0.05	0	1.5	Health
Hardness as CaCO3 (mg/L)	4.9	11.2	6.6-12.9		none	
Iron Dissolved (µg/L)	80	<5	<5-7		none	
Iron Total (µg/L)	214	<6	<5-11	0	≤300	Aesthetic
Lead Total (µg/L)	<0.5	<0.5	<0.5	0	5	Health
Magnesium Total (µg/L)	182	173	121-204		none	
Manganese Dissolved (µg/L)	5.5	3.9	2.4-7.8		none	
Manganese Total (µg/L)	11.4	4.6	3.4-8.4	0	≤120	Health
Mercury Total (µg/L)	<0.05	<0.05	<0.05	0	1	Health
Molybdenum Total (µg/L)	<0.5	<0.5	<0.5		none	
Nickel Total (µg/L)	<0.5	<0.5	<0.5		none	
Nitrogen - Ammonia as N (mg/L)	<0.02	<0.02	<0.02		none	
Nitrogen - Nitrate as N (mg/L)	0.06	0.06	0.03-0.12	0	45	Health
Nitrogen - Nitrite as N (mg/L)	<0.01	<0.01	<0.01	0	1	Health
pH (pH units)	6.5	7.4	7.2-7.6	0	7.0 to 10.5	Aesthetic
Phenol (mg/L)	<0.005	<0.005	<0.005		none	
Phosphorus Dissolved (µg/L)	<10	<10	<10		none	
Phosphorus Total (µg/L)	<10	<10	<5-<10		none	
Potassium Total (µg/L)	188	175	142-203		none	
Residue Total (mg/L)	20	25	23-27		none	
Residue Total Dissolved (mg/L)	10	20	10-20	0	≤500	Aesthetic
Residue Total Fixed (mg/L)	12	17	14-20		none	
Residue Total Volatile (mg/L)	9	8	5-11		none	
Selenium Total (µg/L)	<0.5	<0.5	<0.5	0	50	Health
Silica as SiO2 (mg/L)	3.4	3.3	2.5-3.9		none	
Silver Total (µg/L)	<0.5	<0.5	<0.5		none	
Sodium Total (µg/L)	571	1580	1300-1810	0	≤200000	Aesthetic
Sulphate (mg/L)	1.2	1	0.7-1.4	0	≤500	Aesthetic
Turbidity (NTU)	1.6	0.12	0.07-0.59		none	
Turbidity IFE (NTU)	-	-	-	0	≤ 1.0	Health
UV Absorbance 254 nm (Abs/cm)	0.074	0.011	0.008-0.016		none	
Zinc Total (µg/L)	<3	<3	<3	0	≤5000	Aesthetic

These figures are averaged values from a number of laboratory analyses done throughout the year. Where the range is a single value no variation was measured for the samples analyzed. Average values containing one or more results below the detection limit are preceded with "<" symbol. Minimum range values than "<" denotes not detectable with the technique used for determination. Methods and terms are based on those of the most current on-line version of "Standard Methods for the Examination of Water and Waste Water". Untreated water is from a sample site prior to coagulation, treated water is from a sample site downstream of the SCFP clearwell. Guidelines are taken from the most current Guidelines for Canadian Drinking Water Quality summary table updated in September 2020. Seymour Source was operational for 365 days in 2020.

[1]Treated turbidity guideline and the number of exceedances applies to Individual Filter Effluent readings; measured in events and not days.

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SERVICES AND SOLUTIONS FOR A LIVABLE REGION

Physical and Chemical Analysis of Water Supply

2020 – Coquitlam Water System

	Untreated	Treated		Canadian Guideline		
Parameter	**Average**	**Average**	**Range**	**Days Exceeded**	**Limit**	**Reason Established**
Alkalinity as CaCO3 (mg/L)	2	8.6	7.5-11		none	
Aluminum Dissolved (µg/L)	63	62	59-66		none	
Aluminum Total (µg/L)	100	96	77-166		none	
Antimony Total (µg/L)	<0.5	<0.5	<0.5	0	6	Health
Arsenic Total (µg/L)	<0.5	<0.5	<0.5	0	10	Health
Barium Total (µg/L)	2.4	2.3	2.1-2.5	0	1000	Health
Boron Total (µg/L)	<10	<10	<10	0	5000	Health
Bromate (mg/L)	<0.01	<0.01	<0.01	0	0.1	Health
Bromide (mg/L)	<0.01	<0.01	<0.01		none	
Cadmium Total (µg/L)	<0.2	<0.2	<0.2	0	5	Health
Calcium Total (µg/L)	837	834	799-873		none	
Carbon Organic - Dissolved (mg/L)	1.6	1.5	0.2-2.1		none	
Carbon Organic - Total (mg/L)	1.8	1.5	1.3-2.1		none	
Chlorate (mg/L)	<0.01	0.06	0.04-0.08	0	1	Health
Chloride (mg/L)	<0.5	2.2	1.8-2.5	0	≤250	Aesthetic
Chromium Total (µg/L)	<0.05	<0.05	<0.05	0	50	Health
Cobalt Total (µg/L)	<0.5	<0.5	<0.5		none	
Color - Apparent (ACU)	14	<2	<2-3		none	
Color - True (TCU)	10	<1	<1-1	0	≤15	Aesthetic
Conductivity (µmhos/cm)	8	27	25-33		none	
Copper Total (µg/L)	4.2	<0.5	<0.5	0	≤1000	Aesthetic
Cyanide Total (mg/L)	<0.02	<0.02	<0.02	0	0.2	Health
Fluoride (mg/L)	<0.05	<0.05	<0.05	0	1.5	Health
Hardness as CaCO3 (mg/L)	2.5	2.5	2.3-2.6		none	
Iron Dissolved (µg/L)	21	23	15-43		none	
Iron Total (µg/L)	52	52	35-97	0	≤300	Aesthetic
Lead Total (µg/L)	<0.5	<0.5	<0.5	0	5	Health
Magnesium Total (µg/L)	98	97	84-109		none	
Manganese Dissolved (µg/L)	4.1	2.3	1.5-3.0		none	
Manganese Total (µg/L)	4.6	3.2	2.4-4.6	0	≤120	Health
Mercury Total (µg/L)	<0.05	<0.05	<0.05	0	1	Health
Molybdenum Total (µg/L)	<0.5	<0.5	<0.5		none	
Nickel Total (µg/L)	<0.5	<0.5	<0.5		none	
Nitrogen - Ammonia as N (mg/L)	<0.02	<0.02	<0.02		none	
Nitrogen - Nitrate as N (mg/L)	0.07	0.07	0.04-0.09	0	45	Health
Nitrogen - Nitrite as N (mg/L)	<0.01	<0.01	<0.01	0	1	Health
pH (pH units)	6.3	7.6	7.1-8.1	0	7.0 to 10.5	Aesthetic
Phenol (mg/L)	<0.005	<0.005	<0.005		none	
Phosphorus Dissolved (µg/L)	<10	<10	<10		none	
Phosphorus Total (µg/L)	<10	<10	<5-<10		none	
Potassium Total (µg/L)	113	114	106-122		none	
Residue Total (mg/L)	14	26	21-30		none	
Residue Total Dissolved (mg/L)	10	20	8-30	0	≤500	Aesthetic
Residue Total Fixed (mg/L)	7	16	11-22		none	
Residue Total Volatile (mg/L)	7	10	7-12		none	
Selenium Total (µg/L)	<0.5	<0.5	<0.5	0	50	Health
Silica as SiO2 (mg/L)	2.6	2.6	2.4-2.9		none	
Silver Total (µg/L)	<0.5	<0.5	<0.5		none	
Sodium Total (µg/L)	470	5100	4640-5650	0	≤200000	Aesthetic
Sulphate (mg/L)	0.5	<0.6	<0.5-0.6	0	≤500	Aesthetic
Turbidity (NTU)	0.49	0.42	0.19-1.4		none	
UV 254 - Apparent (Abs/cm)	0.073	0.023	0.014-0.059		none	
UV Absorbance 254 nm (Abs/cm)	0.067	0.019	0.015-0.024		none	
Zinc Total (µg/L)	<3	<3	<3	0	≤5000	Aesthetic

These figures are averaged values from a number of laboratory analyses done throughout the year. Where the range is a single value no variation was measured for the samples analyzed. Average values containing one or more results below the detection limit are preceded with "<" symbol. Minimum range values than "<" denotes not detectable with the technique used for determination. Methods and terms are based on those of the most current on-line version of "Standard Methods for the Examination of Water and Waste Water". Untreated water is from the intake prior to treatment, treated water is from a single site in the GVWD distribution system downstream of CWTP. Guidelines are taken from the most current Guidelines for Canadian Drinking Water Quality summary table updated in September 2020. Recommended turbidity guidelines applies to finished treated water from an un-filtered source. Coquitlam source was operational for 365 days in 2020.

APPENDIX B — ANALYSIS OF WATER FOR ORGANIC/INORGANIC COMPONENTS AND RADIONUCLIDES

Analysis of Source Waters for Herbicides, Pesticides, Volatile Organic Compounds and Uranium

	Units	Date Sampled	MAC	AO	Capilano	Seymour	Coquitlam
Atrazine	µg/L	27-Oct-20	5		<0.50	<0.50	<0.50
Azinphos-Methyl	µg/L	27-Oct-20	20		<1.0	<1.0	<1.0
Benzene	µg/L	11-Dec-20	5		<0.50	<0.50	<0.50
Benzo(a)pyrene	µg/L	16-Jun-20	0.04		<0.0050	<0.0050	<0.0050
Bromoxynil	µg/L	27-Oct-20	5		<0.50	<0.50	<0.50
Carbaryl	µg/L	27-Oct-20	90		<5.0	<5.0	<5.0
Carbofuran	µg/L	27-Oct-20	90		<5.0	<5.0	<5.0
Carbon Tetrachloride	µg/L	11-Dec-20	2		<0.50	<0.50	<0.50
Cyanobacterial toxins—Microcystin-LR	µg/L	Apr–Nov-20	1.5		<0.20	<0.20	<0.20
Chlorpyrifos	µg/L	27-Oct-20	90		<2.0	<2.0	<2.0
Diazinon	µg/L	27-Oct-20	20		<2.0	<2.0	<2.0
Dicamba	µg/L	27-Oct-20	120		<1.0	<1.0	<1.0
Dichlofop-Methyl	µg/L	27-Oct-20	9		<0.90	<0.90	<0.90
Dichlorobenzene, 1,2-	µg/L	11-Dec-20	200	≤ 3	<0.50	<0.50	<0.50
Dichlorobenzene, 1,4-	µg/L	11-Dec-20	5	≤ 1	<0.50	<0.50	<0.50
Dichloroethane, 1,2-	µg/L	11-Dec-20	5		<0.50	<0.50	<0.50
Dichloroethylene, 1,1-	µg/L	11-Dec-20	14		<0.50	<0.50	<0.50
Dichloromethane	µg/L	11-Dec-20	50		<1.0	<1.0	<1.0
Dichlorophenol, 2,4-	µg/L	27-Oct-20	900	≤ 0.3	<0.33	<0.10	<0.10
Dichlorophenoxyacetic acid, 2,4-(2,4-D)	µg/L	27-Oct-20	100		<1.0	<1.0	<1.0
Dimethoate	µg/L	27-Oct-20	20		<2.0	<2.0	<2.0
Diquat	µg/L	27-Oct-20	70		<7.0	<7.0	<7.0
Diuron	µg/L	27-Oct-20	150		<10.0	<10.0	<10.0
Ethylbenzene	µg/L	11-Dec-20	140	≤ 1.6	<0.5	<0.5	<0.5
Glyphosate	µg/L	27-Oct-20	280		<10.0	<10.0	<10.0
Malathion	µg/L	27-Oct-20	190		<2.0	<2.0	<2.0
2-Methyl-4-chlorophenoxyacetic acid (MCPA)	µg/L	27-Oct-20	100		<2.0	<2.0	<2.0
Methyl t-butyl ether (MTBE)	µg/L	11-Dec-20	None	≤ 15	<0.50	<0.50	<0.50
Metolachlor	µg/L	27-Oct-20	50		<5.0	<5.0	<5.0
Metribuzin	µg/L	27-Oct-20	80		<5.0	<5.0	<5.0
Monochlorobenzene	µg/L	11-Dec-20	80	≤ 30	<0.50	<0.50	<0.50
N-Nitroso dimethylamine (NDMA)	µg/L	27-Oct-20	0.04		<0.0021	<0.0021	<0.0021
Nitrilotriacetic Acid (NTA)	µg/L	27-Oct-20	400		<50.0	<50.0	380
Paraquat (as Dichloride)	µg/L	27-Oct-20	10		<1.0	<1.0	<1.0
Pentachlorophenol	µg/L	27-Oct-20	60	≤30	<0.33	<0.10	<0.10

	Units	Date Sampled	MAC	AO	Capilano	Seymour	Coquitlam
Phorate	µg/L	27-Oct-20	2		<1.0	<1.0	<1.0
Picloram	µg/L	27-Oct-20	190		<5.0	<5.0	<5.0
Simazine	µg/L	27-Oct-20	10		<2.0	<2.0	<2.0
Terbufos	µg/L	27-Oct-20	1		<1.0	<1.0	<1.0
Tetrachloroethylene	µg/L	11-Dec-20	10		<0.50	<0.50	<0.50
Tetrachlorophenol, 2,3,4,6-	µg/L	27-Oct-20	100	≤ 1	<0.33	<0.10	<0.10
Toluene	µg/L	11-Dec-20	60	24	<0.50	<0.50	<0.50
Trichloroethylene	µg/L	11-Dec-20	5		<0.50	<0.50	<0.50
Trichlorophenol, 2,4,6-	µg/L	27-Oct-20	5	≤ 2	<0.33	<0.10	<0.10
Trifluralin	µg/L	27-Oct-20	45		<5.0	<5.0	<5.0
Uranium (Total)	µg/L	27-Oct-20	20		0.0298	0.0231	0.0489
Vinyl Chloride	µg/L	11-Dec-20	2		<1.0	<1.0	<1.0
Xylene (Total)	µg/L	11-Dec-20	90	≤ 20	<1.0	<1.0	<1.0

Monitoring of Selected GVWD Water Mains for BTEXs

Parameters	Units	MAC	AO	Maple Ridge Main at Reservoir		Barnston Island Main at Willoughby PS		Jericho-Clayton Main		South Burnaby Main #2	
				15-Jun	23-Nov-	17-Jun	25-Nov	17-Jun	25-Nov	18-Jun	25-Nov
Benzene	µg/L	5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	µg/L	140	1.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	µg/L	60	24	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes Total)	µg/L	90	20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Analysis of Source Water for PAH's

Parameters	Units	Capilano		Seymour		Coquitlam	
		16-Jun	24-Nov	16-Jun	24-Nov	16-Jun	24-Nov
Acenaphthene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Acenaphthylene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Acridine	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Anthracene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)anthracene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene[1]	µg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Benzo(b+j)fluoranthene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b+j+k)fluoranthene	µg/L	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Benzo(g,h,i)perylene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenzo(a,h)anthracene	µg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
methylnaphthalene, 1-	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
methylnaphthalene, 2-	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	µg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Phenanthrene	µg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Pyrene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Quinoline	µg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

Analysis of Selected GVWD Mains for PAHs

Parameters	Units	Coquitlam Main #2	Westburnco Reservoir		Barnston Island		Queensborough		Whalley Kennedy Link Main		Haney Main #2		36th Ave Main
		16-Jun	25-Nov	17-Jun	25-Nov	18-Jun	24-Nov	16-Jun	23-Nov	15-Jun	23-Nov	17-Jun	26-Nov
Acenaphthene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Acenaphthylene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Acridine	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Anthracene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)anthracene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene[1]	µg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Benzo(b+j)fluoranthene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b+j+k)fluoranthene	µg/L	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Benzo(g,h,i)perylene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenzo(a,h)anthracene	µg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.020	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	µg/L	<0.010	<0.010	<0.010	<0.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
methylnaphthalene, 1-	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
methylnaphthalene, 2-	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	µg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Phenanthrene	µg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Pyrene	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Quinoline	µg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

[1]Benzo(a)pyrene is the only PAH compound that has guideline limit. Maximum Acceptable Concentration of Benzo(a)pyrene is 0.04µg/L

Monitoring of Source Waters for PFOS and PFOA [1]

Parameters	Units	MAC	Capilano	Seymour	Coquitlam
PFOS	ng/L	600	<0.765	<0.756	<0.757
PFOA	ng/L	200	<0.765	<0.756	<0.757

ANALYTE	Capilano	Seymour	Coquitlam
PFBA	<3.06	<3.03	<3.03
PFPeA	<1.53	<1.51	<1.51
PFHxA	<0.765	<0.756	<0.757
PFHpA	<0.765	<0.756	<0.757
PFOA	<0.765	<0.756	<0.757
PFNA	<0.765	<0.756	<0.757
PFDA	<0.765	<0.756	<0.757
PFUnA	<0.765	<0.756	<0.757
PFDoA	<0.765	<0.756	<0.757
PFTrDA	<0.765	<0.756	<0.757
PFTeDA	<0.765	<0.756	<0.757
PFBS	<0.765	<0.756	<0.757
PFPeS	<0.765	<0.756	<0.757
PFHxS	<0.765	<0.756	<0.757
PFHpS	<0.765	<0.756	<0.757
PFOS	<0.765	<0.756	<0.757
PFNS	<0.765	<0.756	<0.757
PFDS	<0.765	<0.756	<0.757
PFDoS	<0.765	<0.756	<0.757
4:2 FTS	<3.06	<3.03	<3.03
6:2 FTS	<2.75	<2.72	<2.73
8:2 FTS	<3.06	<3.03	<3.03
PFOSA	<0.765	<0.756	<0.757
N-MeFOSA	<0.88	<0.87	<0.871
N-EtFOSA	<1.91	<1.89	<1.89
MeFOSAA	<0.765	<0.756	<0.757
EtFOSAA	<0.765	<0.756	<0.757
N-MeFOSE	<7.65	<7.56	<7.57
N-EtFOSE	<5.74	<5.67	<5.68
HFPO-DA	<2.91	<2.87	<2.88
ADONA	<3.06	<3.03	<3.03
9Cl-PF3ONS	<3.06	<3.03	<3.03
11Cl-PF3OUdS	<3.06	<3.03	<3.03

[1]Samples analyzed on April 27th.

Analysis of Source Water for Radioactivity

Radioactivity	Units	Date Sampled	MAC[1]	Capilano	Seymour	Coquitlam
				Activity	Activity	Activity
Gross Alpha	Bq/L	06-Oct-20	<0.5	<0.10	<0.10	<0.10
Gross Beta	Bq/L	06-Oct-20	<1.0	<0.10	<0.10	<0.10
Cobalt-60	Bq/L	06-Oct-20	2	<1	<1	<1
Cesium-134	Bq/L	06-Oct-20	7	<1	<1	<1
Cesium-137	Bq/L	06-Oct-20	10	<1	<1	<1
Iodine-131	Bq/L	06-Oct-20	6	<1	<1	<1
Lead-210	Bq/L	06-Oct-20	0.2	<0.10	<0.10	<0.10
Radium-226	Bq/L	06-Oct-20	0.5	<1.0	<1.0	<1.0
Radon-222	Bq/L	06-Oct-20	None	16	<10	<10
Strontium-90	Bq/L	06-Oct-20	5	<0.10	<0.10	<0.10
Tritium (H-3)	Bq/L	06-Oct-20	7000	<20	<20	<20
Radon-222 Repeat[1]	Bq/L	15-Dec-20	None	<10	<10	<10

[1]The October 6, 2020 Radon-222 result for the Capilano Source was unusual. A repeat of the test was done with a sample taken on December 15, 2020.

APPENDIX C — ANALYSIS OF SOURCE WATERS FOR THE RESERVOIR MONITORING PROGRAM

Comparison of Water Quality in Metro Vancouver Reservoirs to Standard Water Quality Classifications

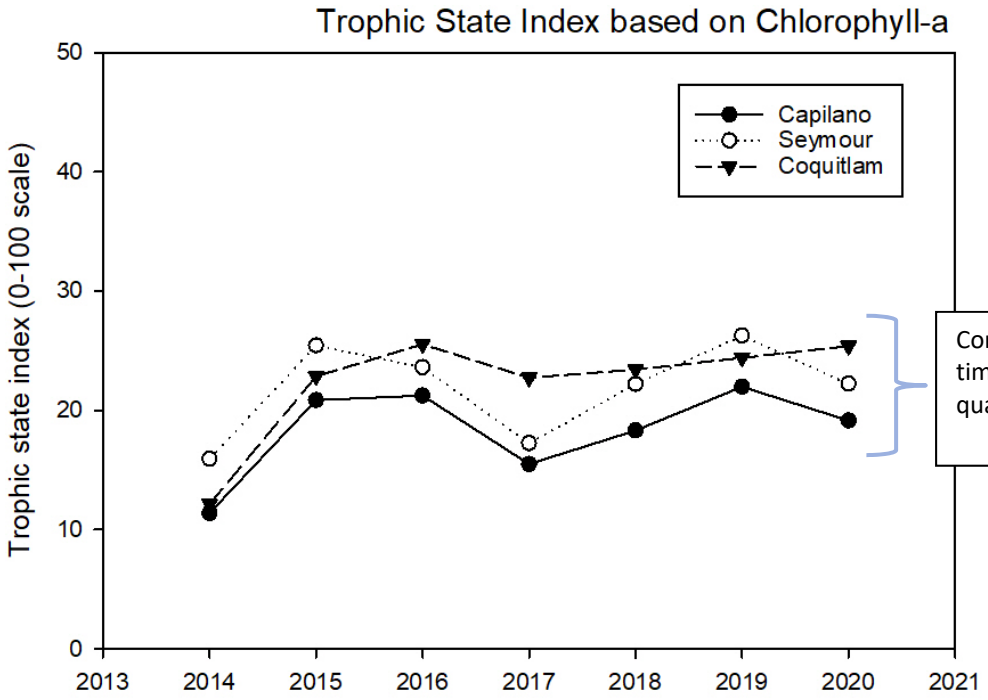
Chemical measurement[2]	Average value[3]					Status of Reservoirs
	Ultra-oligotrophic status defined in the scientific literature[1]	Oligotrophic status defined in the scientific literature[1]	Capilano Reservoir 2014 – 2020 (2020 only in brackets)	Seymour Reservoir 2014 – 2020 (2020 only in brackets)	Coquitlam Reservoir 2014 – 2020 (2020 only in brackets)	
Total phosphorus (parts per billion)	5	8.0	3.0 (3.0)	3.0 (3.0)	2.0 (2.0)	Ultraoligotrophic (very high water quality)
Total Nitrogen (parts per billion)	250	661	126 (118)	130 (116)	129 (119)	Ultraoligotrophic (very high water quality)
Phytoplankton biomass (parts per billion of chlorophyll-a)	0.5	1.7	0.42 (0.39)	0.56 (0.49)	0.53 (0.64)	Ultraoligotrophic (very high water quality)

[1]e.g. Wetzel, R.G. 2001 River Ecosystems. 3rd edition. Academic Press. New York.
Ultraoligotrophic means very low nutrient content and very low biological production: very high water quality
Oligotrophic means low nutrient content and low biological production (low risk of algal blooms): high water quality

[2]Chemical measurements are defined as follows:

- Phosphorus and nitrogen are nutrients that primarily control the growth of algae, including cyanobacteria.
- Phytoplankton biomass includes cells of all algae and cyanobacteria species in a reservoir.

[3]Values are averages from all water depths during April through November of all years. Values in brackets are average values only from 2020.



Consistently low TSI values over time show sustained high water quality

APPENDIX D — REPORT TO METRO VANCOUVER ON *GIARDIA* AND *CRYPTOSPORIDIUM* STUDY

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Metro Vancouver
Detection of Waterborne *Giardia* and *Cryptosporidium*

January - December, 2020
Annual Report

January 2021

Dr. Natalie Prystajecky, Program Head
Christine Tchao, Team Lead
Tracy Chan, Technical Coordinator
Daisy Yu, Technical Coordinator

Environmental Microbiology
BCCDC Public Health Laboratory
Provincial Health Services Authority

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Metro Vancouver
Detection of Waterborne *Giardia* and *Cryptosporidium*
January - December, 2020 Annual Report

Purpose

To detect and quantify *Giardia* cysts and *Cryptosporidium* oocysts from Metro Vancouver reservoirs: Capilano and Coquitlam, as well as from the Recycled Clarified Water from Seymour-Capilano Filtration Plant (SCFP-RCW).

Introduction

Giardia and *Cryptosporidium* species are parasites that infect the intestinal tracts of a wide range of warm-blooded animals. In humans, infection with *Giardia lamblia* or *Cryptosporidium* species can cause gastroenteritis. As the cyst and oocyst forms of *Giardia* and *Cryptosporidium* are resistant to chlorination, they are of great concern for drinking water purveyors (1-3). On behalf of Metro Vancouver, the Environmental Microbiology Laboratory at BCCDC Public Health Laboratory (BCCDC PHL) examined the source water of Capilano and Coquitlam reservoirs, as well as Recycled Clarified Water (RCW) at the Seymour Capilano Filtration Plant (SCFP) for the presence of *Giardia* cysts and *Cryptosporidium* oocysts. All sample collection, testing, analysis and reporting occurred on a monthly basis using a validated method.

Methods

The Environmental Microbiology Laboratory at BCCDC PHL follows the United States Environmental Protection Agency (USEPA) Method 1623.1: *Cryptosporidium* and *Giardia* in Water by Filtration/IMS/FA (4) for the detection of oocysts and cysts in water. As stated by Method 1623.1, the performance is based on the method applicable for the quantitation of *Cryptosporidium* and *Giardia* in aqueous matrices. It requires the filtration of a large volume of water and immunomagnetic separation (IMS) to concentrate and purify the oocysts and cysts from sample material captured. After the IMS purification, immunofluorescence microscopy was performed to identify and enumerate oocysts and cysts. 4'-6-diamidino-2-phenylindole staining (DAPI) and differential interference contrast microscopy (DIC) are used to confirm internal structures of the cysts and oocysts.

Raw water samples were collected by the Metro Vancouver staff at specific sampling sites at the reservoirs and filtration plants. Samples were filtered in the field using Pall Life Science Envirochek HV filters. After collection, filters were then transported to the Environmental Microbiology Laboratory at BCCDC PHL by Metro Vancouver staff, where they were processed and analysed within 96 hours. Negative and positive controls were included for the entire process to assess the performance of the method. Matrix spike testing was also performed at scheduled collection periods, annually for baseline assessment.

Results & Discussions

In 2020, a total of 36 filters were examined (excluding matrix spikes). These included:

- 12 Envirochek filters from the Capilano reservoir
- 12 Envirochek filters from the Coquitlam reservoir
- 12 Envirochek filters from SCFP-RCW

The summary of our findings are presented in Figures 1 - 3 and Tables 1 - 5. An average of 50.0L of raw water was filtered for both the Capilano and Coquitlam reservoirs per month. The average detection limit for Capilano and Coquitlam were <2.0 (oo)cysts per 100L for both reservoirs. The average volume of water filtered and detection limit for SCFP-RCW was 604.2L and <0.41(oo)cysts per 100L, respectively (Appendix A, Tables A1-A3).

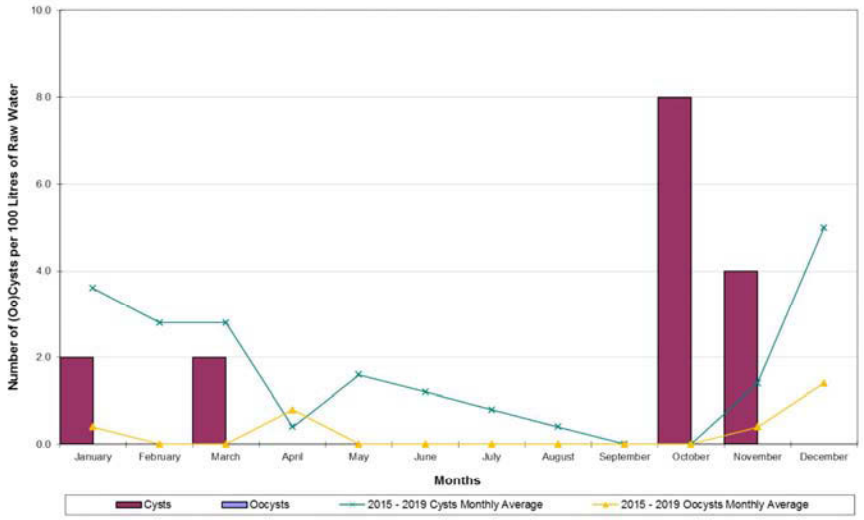

Figure 1: 2020 Capilano Reservoir *Cryptosporidium* Oocysts and *Giardia* Cysts Counts per 100 Litres of Raw Water

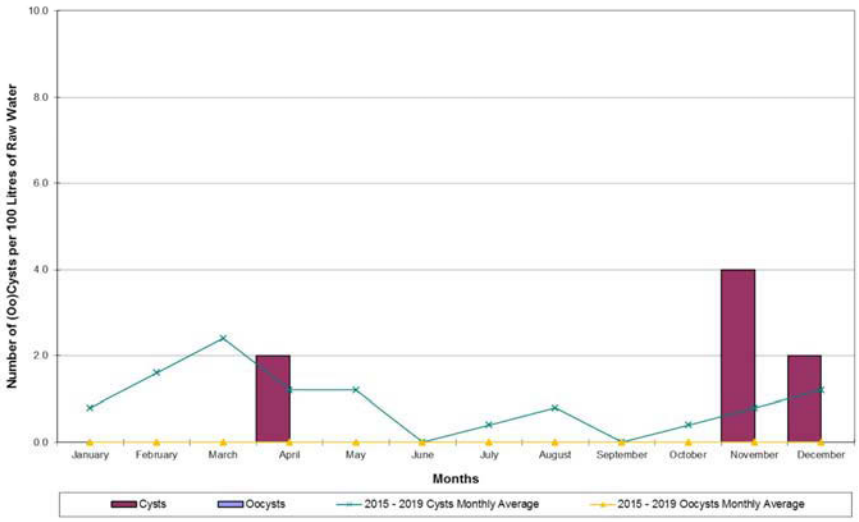

Figure 2: 2020 Coquitlam Reservoir *Cryptosporidium* Oocysts and *Giardia* Cysts Counts per 100 Litres of Raw Water

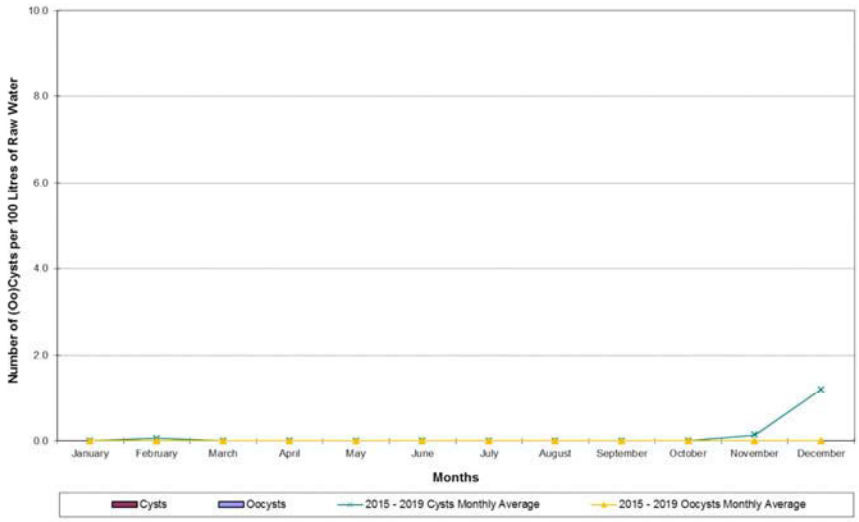

Figure 3: 2020 Seymour Capilano Filtration Plant – Recycled Clarified Water *Cryptosporidium* Oocysts and *Giardia* Cysts Counts per 100 Litres of Raw Water

Overall, similar trends were observed for both *Cryptosporidium* and *Giardia* in 2020, in comparison to historical data.

	Capilano Reservoir	Coquitlam Reservoir	SCFP - RCW
Number of Water Filter Tested	12	12	12
% Filters – *Giardia* Positive	33.3%	25.0%	0.0%
% Filters – *Cryptosporidium* Positive	0.0%	0.0%	0.0%

Table 1: 2020 *Giardia* and *Cryptosporidium* Percent Positives for Metro Vancouver Water Filters

Sampling Sites	# of Water Filters Tested	Average Detection Limit (oo)cysts/ 100 L	Max Detection (oo)cysts/ 100L	Min Detection (oo)cysts/ 100L	# of *Giardia* Positive Filters	Max # of *Giardia* cysts/ 100L	# of *Crypto* Positive Filters	Max # of *Crypto* oocysts/ 100L
All Sites	36	<1.47	5.0	1.5	2.3	4.0	0.0	0.0
Capilano Reservoir	12	<2.0	8	2	4	8	0	0
Coquitlam Reservoir	12	<2.0	2	2	3	4	0	0
SCFP - RCW	12	<0.41	NPD*	0.41	0	0	0	0

*NDP = No Parasites Detected

Table 2: 2020 *Giardia* Cyst and *Cryptosporidium* Oocyst Concentrations for Positive Water Filters

Results for staining by IFA, DAPI and internal morphology, as determined through DIC microscopy, for every identified cyst and oocyst were recorded and summarized in Tables A4 – A9 in the Appendix A.

DAPI staining is used as part of the confirmation of the internal structure of *Giardia* cysts and *Cryptosporidium* oocysts; it is used as an indicator of nuclei integrity by staining the DNA. It can also approximate cysts/oocysts integrity; the absence of nuclei is indicative of an aged, damaged or non-infective cell. A number of cysts (Table 3, 5) and oocysts (Table 4, 5) observed across all sites had no visible nuclei indicating that they were aged and likely subjected to environmental degradation. However, they were likely in previous infective state.

Likewise, DIC microscopy is used primarily for *Giardia* cyst and *Cryptosporidium* oocyst confirmation but it can also serve as an indicator of cysts/oocysts cytoplasm and cell wall integrity. While no median body (or axoneme) was observed for all *Giardia* cysts detected, the cytoplasm was observed indicating that the cysts were not empty and could be viable.

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Site	Total number of cysts	DAPI -	DAPI +		D.I.C.				
		Light blue internal staining, no distinct nuclei, green rim	Intense blue internal staining	Nuclei stained sky blue	Empty cysts (no cytoplasm)	Cysts with amorphous structure	Cysts with internal structure		
							Nuclei	Median body	Axoneme
Capilano	8	7 (87.5%)	0 (0.0%)	1 (14.3%)	0 (0.0%)	8 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Coquitlam	4	2 (50.0%)	0 (0.0%)	2 (50.0%)	0 (0.0%)	4 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
SCFP-RCW	0	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 3: 2020 Summary of morphological results for *Giardia* cysts observed under fluorescence microscope

Site	Total number of oocysts	DAPI -	DAPI +		D.I.C.		
		Light blue internal staining, no distinct nuclei, green rim	Intense blue internal staining	Nuclei stained sky blue	Empty oocysts	Oocysts with amorphous structure	Oocysts with internal structure
							Number of sporozoites
Capilano	0	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Coquitlam	0	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
SCFP-RCW	0	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 4: 2020 Summary of morphological results for *Cryptosporidium* oocysts observed under fluorescence microscope

Number of Nuclei	*Giardia* Cysts			*Cryptosporidium* Oocysts		
	Capilano	Coquitlam	SCFP-RCW	Capilano	Coquitlam	SCFP-RCW
0*	7 (87.5%)	2 (50.0%)	-	-	-	-
1	-	-	-	-	-	-
2	1 (12.5%)	-	-	-	-	-
3	-	2 (50.0%)	-	-	-	-
4	-	-	-	-	-	-
Total # of (oo)cysts	8	4	0	0	0	0

* DAPI negative or only intense blue internal staining of cytoplasm.

Table 5: 2020 Comparisons of number of nuclei in each *Giardia* cysts and *Cryptosporidium* Oocysts between different sites

Due to the variations of water chemistry and organic matters between geographical area and temporally within each sampling sites, a matrix spike is performed annually to provide recovery rate estimation from each site. The results of the matrix spike recovery (2007-2020) are compiled in Table 6. Matrix recovery rates fluctuate from year-to-year, even within each site. This variation is not uncommon for the test and has been noted in USEPA's Method 1623.1.

Matrix testing in 2020 was successful on a single sampling event at each site. 50L were filtered from each site and the percentage recovery for *Giardia* cysts and *Cryptosporidium* oocysts were noted.

Year	Capilano		Coquitlam		SCFP-RCW	
	Cysts	Oocysts	Cysts	Oocysts	Cysts	Oocysts
2007	37.4%	27.6%	54.0%	28.0%	-	-
2008	55.0%	25.0%	39.0%	28.0%	-	-
2009	40.0%	10.0%	37.0%	16.0%	-	-
2010	43.0%	28.0%	49.0%	26.0%	13.0%	17.0%
2011	44.0%	27.0%	47.0%	22.0%	0.0%	1.0%
2012	76.5%	38.4%	49.0%	35.0%	13.7%	7.0%
2013	59.4%	22.4%	64.4%	16.3%	14.9%	6.12%
2014	-	-	39.4%	55.0%	14.1%	18.0%
2015	40.4%	26.3%	60.6%	2.0%	26.5%	9.1%
2016	47.5%	35.4%	50.5%	22.2%	14.0%	9.1%
2017	38.4%	20.2%	21.2%	22.2%	2.0%	0.0%
2018	75.8%	43.4%	59.6%	17.1%	11.1%	1.0%
2019	43.0%	0.0%	55.0%	1.0%	4.1%	0.0%
2020	37.4%	5.1%	59.8%	8.1%	4.0%	0.0%

- No matrix sample collected

Table 6: Matrix water results from 2007 - 2020

Summary

In brief, we reported that:

1. Overall, a steady positivity rate was observed across all sites for both cysts and oocysts.

2. *Giardia* cysts were detected in filters from Capilano and Coquitlam but not from SCFP-RCW. 33.3% of all filters received from Capilano were positive for *Giardia*, and 25% of all filters received from Coquitlam were positive for *Giardia*, and there were no *Giardia* cysts detected for SCFP-RCW.

3. *Cryptosporidium* oocysts were not detected in Capilano reservoir, Coquitlam reservoir and SCFP-RCW.

4. The highest concentration of *Giardia* cysts detected in 2020 was from Capilano reservoir in January (6 cysts per 100 L).

5. Most of the *Giardia* cysts detected showed evidence of environmental degradation.

6. Matrix recovery for *Cryptosporidium* oocyst continued to be low, which is consistent with previous years. Performing an additional matrix collection to understand the effects of matrix spike recovery when collected in a different season (i.e. spring/ summer) is recommended.

These *semi-quantitative* data (reported oocyst and cyst levels) should be interpreted in the context of, and with the understanding that the current standard laboratory method, USEPA Method 1623.1, used for detecting and analysing parasites in water matrices has its limitations, with variable recovery rates depending on the water matrix and environmental conditions.

Acknowledgements

The BCCDC Public Health Laboratory thanks Metro Vancouver for their ongoing support of this program and other related projects. In particular, the assistance of Larry Chow, Vila Goh, Eileen Butler, and Melody Sato of the Metro Vancouver, Water Quality Department are greatly appreciated.

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Appendix A

	Water Filter #	Site Location	Sampling Date	Month	Detection Limit (per 100L)	No. of Cysts per 100L	No. of Oocysts per 100L	Volume of Water Filtered (L)	2015 - 2019 Monthly Average	
									No. of Cysts per 100L	No. of Oocysts per 100L
1	8075	Capilano Reservoir	January 12, 2020	January	<2.0	2.0	0.0	50.0	3.6	0.4
2	8080	Capilano Reservoir	February 9, 2020	February	<2.0	0.0	0.0	50.0	2.8	0.0
3	8085	Capilano Reservoir	March 15, 2020	March	<2.0	2.0	0.0	50.0	2.8	0.0
4	8090	Capilano Reservoir	April 19, 2020	April	<2.0	0.0	0.0	50.0	0.4	0.8
5	8095	Capilano Reservoir	May 10, 2020	May	<2.0	0.0	0.0	50.0	1.6	0.0
6	8100	Capilano Reservoir	June 14, 2020	June	<2.0	0.0	0.0	50.0	1.2	0.0
7	8111	Capilano Reservoir	July 19, 2020	July	<2.0	0.0	0.0	50.0	0.8	0.0
8	8116	Capilano Reservoir	August 16, 2020	August	<2.0	0.0	0.0	50.0	0.4	0.0
9	8121	Capilano Reservoir	September 20, 2020	September	<2.0	0.0	0.0	50.0	0.0	0.0
10	8126	Capilano Reservoir	October 18, 2020	October	<2.0	8.0	0.0	50.0	0.0	0.0
11	8136	Capilano Reservoir	November 15, 2020	November	<2.0	4.0	0.0	50.0	1.4	0.4
12	8144	Capilano Reservoir	December 13, 2020	December	<2.0	0.0	0.0	50.0	5.0	1.4
				Averages	<2.0	1.3	0.0	50.0		

Table A1: 2020 Metro Vancouver Capilano Reservoir Monthly Filter Results

	Water Filter #	Site Location	Sampling Date	Month	Detection Limit (per 100L)	No. of Cysts per 100L	No. of Oocysts per 100L	Volume of Water Filtered (L)	2015 - 2019 Monthly Average	
									No. of Cysts per 100L	No. of Oocysts per 100L
1	8076	Coquitlam Reservoir	January 12, 2020	January	<2.0	0.0	0.0	50.0	0.8	0.0
2	8081	Coquitlam Reservoir	February 9, 2020	February	<2.0	0.0	0.0	50.0	1.6	0.0
3	8086	Coquitlam Reservoir	March 15, 2020	March	<2.0	0.0	0.0	50.0	2.4	0.0
4	8091	Coquitlam Reservoir	April 19, 2020	April	<2.0	2.0	0.0	50.0	1.2	0.0
5	8096	Coquitlam Reservoir	May 10, 2020	May	<2.0	0.0	0.0	50.0	1.2	0.0
6	8101	Coquitlam Reservoir	June 14, 2020	June	<2.0	0.0	0.0	50.0	0.0	0.0
7	8112	Coquitlam Reservoir	July 19, 2020	July	<2.0	0.0	0.0	50.0	0.4	0.0
8	8117	Coquitlam Reservoir	August 16, 2020	August	<2.0	0.0	0.0	50.0	0.8	0.0
9	8122	Coquitlam Reservoir	September 20, 2020	September	<2.0	0.0	0.0	50.0	0.0	0.0
10	8127	Coquitlam Reservoir	October 18, 2020	October	<2.0	0.0	0.0	50.0	0.4	0.0
11	8137	Coquitlam Reservoir	November 15, 2020	November	<2.0	4.0	0.0	50.0	0.8	0.0
12	8145	Coquitlam Reservoir	December 13, 2020	December	<2.0	2.0	0.0	50.0	1.2	0.0
				Averages	<2.0	0.7	0.0	50.0		

Table A2: 2020 Metro Vancouver Coquitlam Reservoir Monthly Filter Results

	Water Filter #	Site Location	Sampling Date	Month	Detection Limit (per 100L)	No. of Cysts per 100L	No. of Oocysts per 100L	Volume of Water Filtered (L)	2015 - 2019 Monthly Average	
									No. of Cysts per 100L	No. of Oocysts per 100L
1	8077	SCFP - Recycled Clarified Water	January 12, 2020	January	<0.07	0.0	0.0	1460.1	0.0	0.0
2	8082	SCFP - Recycled Clarified Water	February 11, 2020	February	<0.19	0.0	0.0	525.3	0.1	0.0
3	8087	SCFP - Recycled Clarified Water	March 17, 2020	March	<0.36	0.0	0.0	280.4	0.0	0.0
4	8092	SCFP - Recycled Clarified Water	April 21, 2020	April	<1.6	0.0	0.0	63.9	0.0	0.0
5	8097	SCFP - Recycled Clarified Water	May 12, 2020	May	<0.6	0.0	0.0	177.0	0.0	0.0
6	8102	SCFP - Recycled Clarified Water	June 16, 2020	June	<0.04	0.0	0.0	2608.3	0.0	0.0
7	8113	SCFP - Recycled Clarified Water	July 21, 2020	July	<0.29	0.0	0.0	350.4	0.0	0.0
8	8118	SCFP - Recycled Clarified Water	August 18, 2020	August	<0.17	0.0	0.0	580.3	0.0	0.0
9	8123	SCFP - Recycled Clarified Water	September 22, 2020	September	<0.3	0.0	0.0	338.0	0.0	0.0
10	8128	SCFP - Recycled Clarified Water	October 20, 2020	October	<0.2	0.0	0.0	499.0	0.0	0.0
11	8138	SCFP - Recycled Clarified Water	November 17, 2020	November	<0.64	0.0	0.0	155.3	0.1	0.0
12	8146	SCFP - Recycled Clarified Water	December 15, 2020	December	<0.47	0.0	0.0	212.5	1.2	0.0
				Averages	<0.41	0.0	0.0	604.2		

Table A3: 2020 Metro Vancouver Seymour Capilano Filtration Plant – Recycled Clarified Water (SCFP-RCW) Monthly Filter Results

			Giardia										
			Giardia			DAPI -	DAPI +		DIC				
Lab #	Site name	Date sampled	Object located by FA	Shape (oval or round)	Size L x W (µm)	Light blue internal staining, no distinct nuclei, green rim	Intense blue internal staining	Number of nuclei stained sky blue	Empty cysts	Cysts with amorphous structure	Number of nuclei	Median Body	Axoneme
8075	Capilano Reservoir	January 12, 2020	1	Oval	14x7	P				P			
8080	Capilano Reservoir	February 9, 2020	0										
8085	Capilano Reservoir	March 15, 2020	1	Oval	15x10	P				P			
8090	Capilano Reservoir	April 19, 2020	0										
8095	Capilano Reservoir	May 10, 2020	0										
8100	Capilano Reservoir	June 14, 2020	0										
8111	Capilano Reservoir	July 19, 2020	0										
8116	Capilano Reservoir	August 16, 2020	0										
8121	Capilano Reservoir	September 20, 2020	0										
8126	Capilano Reservoir	October 18, 2020	1	Oval	10x7	P				P			
8126	Capilano Reservoir	October 18, 2020	2	Oval	10x7	P				P			
8126	Capilano Reservoir	October 18, 2020	3	Oval	11x10	P				P			
8126	Capilano Reservoir	October 18, 2020	4	Oval	11x10	P				P			
8136	Capilano Reservoir	November 15, 2020	1	Oval	11x10	P				P			
8136	Capilano Reservoir	November 15, 2020	2	Oval	12x10			2		P			
8144	Capilano Reservoir	December 13, 2020	0										

P = Present

Table A4: 2020 Metro Vancouver Capilano Reservoir Slide Examination *Giardia* Results

			Giardia										
			Giardia			DAPI -	DAPI +		DIC				
Lab #	Site name	Date sampled	Object located by FA	Shape (oval or round)	Size L x W (µm)	Light blue internal staining, no distinct nuclei, green rim	Intense blue internal staining	Number of nuclei stained sky blue	Empty cysts	Cysts with amorphous structure	Number of nuclei	Median Body	Axoneme
8076	Coquitlam Reservoir	January 12, 2020	0										
8081	Coquitlam Reservoir	February 9, 2020	0										
8086	Coquitlam Reservoir	March 15, 2020	0										
8091	Coquitlam Reservoir	April 19, 2020	1	Oval	13x7			3		P			
8096	Coquitlam Reservoir	May 10, 2020	0										
8101	Coquitlam Reservoir	June 14, 2020	0										
8112	Coquitlam Reservoir	July 19, 2020	0										
8117	Coquitlam Reservoir	August 16, 2020	0										
8122	Coquitlam Reservoir	September 20, 2020	0										
8127	Coquitlam Reservoir	October 18, 2020	0										
8137	Coquitlam Reservoir	November 15, 2020	1	Oval	15x10	P				P			
8137	Coquitlam Reservoir	November 15, 2020	2	Oval	14x9			3		P			
8145	Coquitlam Reservoir	December 13, 2020	1	Oval	18x6	P				P			

P = Present

Table A5: 2020 Metro Vancouver Coquitlam Reservoir Slide Examination *Giardia* Results

			Giardia										
			Giardia			DAPI -	DAPI +		DIC				
Lab #	Site name	Date sampled	Object located by FA	Shape (oval or round)	Size L x W (µm)	Light blue internal staining, no distinct nuclei, green rim	Intense blue internal staining	Number of nuclei stained sky blue	Empty cysts	Cysts with amorphous structure	Number of nuclei	Median Body	Axoneme
8077	SCFP - Recycled Clarified Water	January 12, 2020	0										
8082	SCFP - Recycled Clarified Water	February 11, 2020	0										
8087	SCFP - Recycled Clarified Water	March 17, 2020	0										
8092	SCFP - Recycled Clarified Water	April 21, 2020	0										
8097	SCFP - Recycled Clarified Water	May 12, 2020	0										
8102	SCFP - Recycled Clarified Water	June 16, 2020	0										
8113	SCFP - Recycled Clarified Water	July 21, 2020	0										
8118	SCFP - Recycled Clarified Water	August 18, 2020	0										
8123	SCFP - Recycled Clarified Water	September 22, 2020	0										
8128	SCFP - Recycled Clarified Water	October 20, 2020	0										
8138	SCFP - Recycled Clarified Water	November 17, 2020	0										
8146	SCFP - Recycled Clarified Water	December 15, 2020	0										

P=Present

Table A6: 2020 Metro Vancouver Seymour Capilano Filtration Plant – Recycled Clarified Water Slide Examination *Giardia* Results

			Cryptosporidium								
			Cryptosporidium			DAPI -	DAPI +		DIC		
Lab #	Site name	Date sampled	Object located by FA2	Shape (oval or round)2	Size L x W (µm)2	Light blue internal staining, no distinct nuclei, green rim2	Intense blue internal staining2	Number of nuclei stained sky blue2	Empty oocysts	Oocysts with amorphous structure	Oocysts with internal structure, Number of sporozoites
8075	Capilano Reservoir	January 12, 2020	0								
8080	Capilano Reservoir	February 9, 2020	0								
8085	Capilano Reservoir	March 15, 2020	0								
8090	Capilano Reservoir	April 19, 2020	0								
8095	Capilano Reservoir	May 10, 2020	0								
8100	Capilano Reservoir	June 14, 2020	0								
8111	Capilano Reservoir	July 19, 2020	0								
8116	Capilano Reservoir	August 16, 2020	0								
8121	Capilano Reservoir	September 20, 2020	0								
8126	Capilano Reservoir	October 18, 2020	0								
8136	Capilano Reservoir	November 15, 2020	0								
8144	Capilano Reservoir	December 13, 2020	0								

Table A7: 2020 Metro Vancouver Capilano Reservoir Slide Examination *Cryptosporidium* Results

BC Centre for Disease Control
An agency of the Provincial Health Services Authority

Provincial Health Services Authority
Province-wide solutions. Better health.

LM LABS

			Cryptosporidium								
			Cryptosporidium			DAPI -	DAPI +		DIC		
Lab #	Site name	Date sampled	Object located by FA2	Shape (oval or round)2	Size L x W (µm)2	Light blue internal staining, no distinct nuclei, green rim2	Intense blue internal staining2	Number of nuclei stained sky blue2	Empty oocysts	Oocysts with amorphous structure	Oocysts with internal structure, Number of sporozoites
8076	Coquitlam Reservoir	January 12, 2020	0								
8081	Coquitlam Reservoir	February 9, 2020	0								
8086	Coquitlam Reservoir	March 15, 2020	0								
8091	Coquitlam Reservoir	April 19, 2020	0								
8096	Coquitlam Reservoir	May 10, 2020	0								
8101	Coquitlam Reservoir	June 14, 2020	0								
8112	Coquitlam Reservoir	July 19, 2020	0								
8117	Coquitlam Reservoir	August 16, 2020	0								
8122	Coquitlam Reservoir	September 20, 2020	0								
8127	Coquitlam Reservoir	October 18, 2020	0								
8137	Coquitlam Reservoir	November 15, 2020	0								
8145	Coquitlam Reservoir	December 13, 2020	0								

Table A8: 2020 Metro Vancouver Coquitlam Reservoir Slide Examination *Cryptosporidium* Results

			Cryptosporidium								
			Cryptosporidium			DAPI -	DAPI +		DIC		
Lab #	Site name	Date sampled	Object located by FA2	Shape (oval or round)2	Size L x W (µm)2	Light blue internal staining, no distinct nuclei, green rim2	Intense blue internal staining2	Number of nuclei stained sky blue2	Empty oocysts	Oocysts with amorphous structure	Oocysts with internal structure, Number of sporozoites
8077	SCFP - Recycled Clarified Water	January 12, 2020	0								
8082	SCFP - Recycled Clarified Water	February 11, 2020	0								
8087	SCFP - Recycled Clarified Water	March 17, 2020	0								
8092	SCFP - Recycled Clarified Water	April 21, 2020	0								
8097	SCFP - Recycled Clarified Water	May 12, 2020	0								
8102	SCFP - Recycled Clarified Water	June 16, 2020	0								
8113	SCFP - Recycled Clarified Water	July 21, 2020	0								
8118	SCFP - Recycled Clarified Water	August 18, 2020	0								
8123	SCFP - Recycled Clarified Water	September 22, 2020	0								
8128	SCFP - Recycled Clarified Water	October 20, 2020	0								
8138	SCFP - Recycled Clarified Water	November 17, 2020	0								
8146	SCFP - Recycled Clarified Water	December 15, 2020	0								

Table A9: 2020 Metro Vancouver Seymour Capilano Filtration Plant – Recycled Clarified Water Slide Examination *Cryptosporidium* Results

metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

To: Water Committee

From: Jesse Montgomery, Division Manager, Environmental Management, Water Services

Date: April 1, 2021 Meeting Date: April 15, 2021

Subject: **Seymour Salmonid Society's 2020 Annual Report for Greater Vancouver Water District**

RECOMMENDATION

That the GVWD Board receive for information the report dated April 1, 2021, titled "Seymour Salmonid Society's 2020 Annual Report for Greater Vancouver Water District".

EXECUTIVE SUMMARY

The Seymour Salmonid Society (the Society) is a non-profit organization that operates the Seymour River Hatchery on GVWD land at the base of the Seymour Falls Dam. GVWD and the Society have been partners since 1989 constructing fisheries enhancement projects and raising public awareness on water and fisheries issues in the Seymour Valley. The partnership has influenced thousands of people through special events, K-12 programs and area visitors in the Lower Seymour Conservation Reserve. The Society has raised and released millions of salmon into the Seymour River and has worked collaboratively with GVWD on promoting stewardship of the Seymour River system. The GVWD has a current three-year (2021 – 2023) Contribution Agreement with the Society for $125,000 annually. The funding provides for core hatchery and education program operating expenses.

The *Seymour Salmonid Society's 2020 Annual Report for Greater Vancouver Water District* (attachment) provides an overview of the program in 2020.

PURPOSE

To provide the Committee and Board with the Seymour Salmonid Society's 2020 Annual Report in accordance with the Contribution Agreement between GVWD and the Society.

BACKGROUND

In 2014, the first 3-year Contribution Agreement was drafted to formalize a funding arrangement between the GVWD and the Society. At its October 2, 2020 meeting, the GVWD Board adopted the following resolution to renew the agreement for a third consecutive three-year term:

> *That the GVWD Board approve the renewal of the Contribution Agreement between the Greater Vancouver Water District and the Seymour Salmonid Society for a three-year term, and annual contribution amount of $125,000, commencing on January 1, 2021 and ending on December 31, 2023.*

A requirement of the Contribution Agreement is for the Society to submit an annual report on its activities to the GVWD on or before January 31 of the following year. This report provides the Society's annual update as identified in the 2021 Water Committee Work Plan. It should be noted

that hatchery operations were affected by COVID-19 restrictions resulting in cancellation of many operational events and K-12 educational programming.

SOCIETY HISTORY

The Seymour River Hatchery is located on GVWD land at the base of the Seymour Falls Dam. The hatchery commenced operations in 1977 in response to declining fish stocks in the Seymour River and Burrard Inlet. The hatchery was managed by the British Columbia Institute of Technology (BCIT) for the first decade of operation. The Society was formed in 1987 to oversee hatchery operations, volunteer activities and educational programming. Initially, solely funded by Fisheries and Oceans Canada (DFO), the GVWD began contributing to the Society's core funding in 1996. The relationship between GVWD, DFO and the Society has been highly collaborative since the hatchery facility was established.

The Society has been an effective advocate for environmental education and stewardship on the North Shore. Their mission statement is "To enhance Seymour River salmon and educate the public about the importance of the river as a resource for drinking water, wildlife, and the forest." Hatchery initiatives and education programs support goals and strategies in the Board Strategic Plan, Drinking Water Management Plan and Joint Water Use Plan as they pertain to the Seymour Watershed.

Contribution Agreement

The Contribution Agreement specifies six key Society services, supported by GVWD. They are:

1) Provide a sustainable hatchery program in the production of fry and smolts to be released into the Seymour system targeting numbers and species as directed by DFO;
2) Monitor and collect data on adult fish returns and out-migrating smolts;
3) Deliver educational school programs to classes that are effectively linked to current school curriculum and to GVWD's *Drinking Water Management* Plan and *Joint Water Use Plan*;
4) Leverage GVWD's contribution of $125,000 by: applying for relevant grants to assist in funding general services, sourcing and applying for funding for Seymour River Estuary Restoration and Rockslide Mitigation Projects, and continuing to secure core funding from DFO;
5) Host public special events and participate in public outreach showcasing the Society's work in the Seymour System, and;
6) Create stewardship links with local NGOs and school districts.

Annual Reporting Highlights

The 2020 Annual Report is provided as an attachment and is summarized as follows:

1) Hatchery Program - The Society is contracted by DFO to raise coho, chum, and pink salmon, as well as steelhead trout. The Society released 142,088 coho, 56,841 chum, and 29,284 steelhead into the Seymour River system in 2020. Releases decreased from 2019 due to lower broodstock returns and challenges with egg incubation. River seines (netting) and broodstock angling resulted in the capture of 294 adult fish. Unfortunately, the lower river fish fence used to capture returning adult salmon was destroyed by a high flow event in February 2020 and not replaced.

2) Education Program - In a typical year approximately 65 school classes visit the hatchery to experience salmon habitat, life cycles and the surrounding watershed. Both spring and fall sessions were cancelled in 2020 due to COVID-19 restrictions. The Society has now developed a virtual program that will be offered in 2021 until COVID-19 restrictions are lifted.

3) Monitoring and Enhancement Projects - In 2020, the Society continued to monitor fish returns through the rockslide in partnership with BCIT, Squamish Nation, and Tsleil-Waututh Nation. A proportion of fish have been successfully able to pass through to the upper river. Due to changes in the rockfall stability during the 2020 freshet, rock breaking activities were continued in 2020 and are expected to continue in 2021 until long term fish passage is confirmed.

4) Stewardship and Public Outreach - Due to COVID-19 the hatchery closed to the public in March and reopened with restrictions in July. Annual community events such as Family Fishing Day and Fall Open House were cancelled, however a small stewardship event conducted at the Seymour Estuary on World Rivers Day went ahead. Only 190 people visited the hatchery directly in 2020, a considerable decrease from the 3600 visitors in 2019. Volunteer hours (1300) were also reduced almost in half of the normal hours contributed for previous years. The Society did however, reach some new audiences through social media, increasing both Facebook and Instagram followers.

5) Funding - The Society utilized core funding from GVWD and DFO to administer regular hatchery operations in 2020. They also leveraged an additional $372,646 in revenue used primarily towards infrastructure upgrades including expansion of the egg incubation room and plumbing improvements from the aeration tower. Significant funding was also utilized to continue rock breaking activities at the rockslide site. Although some education funding was utilized for administrative purposes prior to March, the remainder was used to develop online programming, a series of interpretive videos, and a new outdoor classroom area with interpretive signage.

ALTERNATIVES
This is an information report. No alternatives are presented.

FINANCIAL IMPLICATIONS
GVWD is a primary contributor to the Society, providing $125,000 annually through 2023, within the Watershed & Environmental Management Program budget.

CONCLUSION
Under the terms of the Contribution Agreement with GVWD, the Society is required to submit an annual report on its activities. The Society was not able to achieve all the goals set out in the Contribution Agreement due to the COVID-19 pandemic, however they did continue to operate successfully in 2020 and have plans in place to increase operation in 2021 primarily through new virtual education programming and improved broodstock collection in 2020.

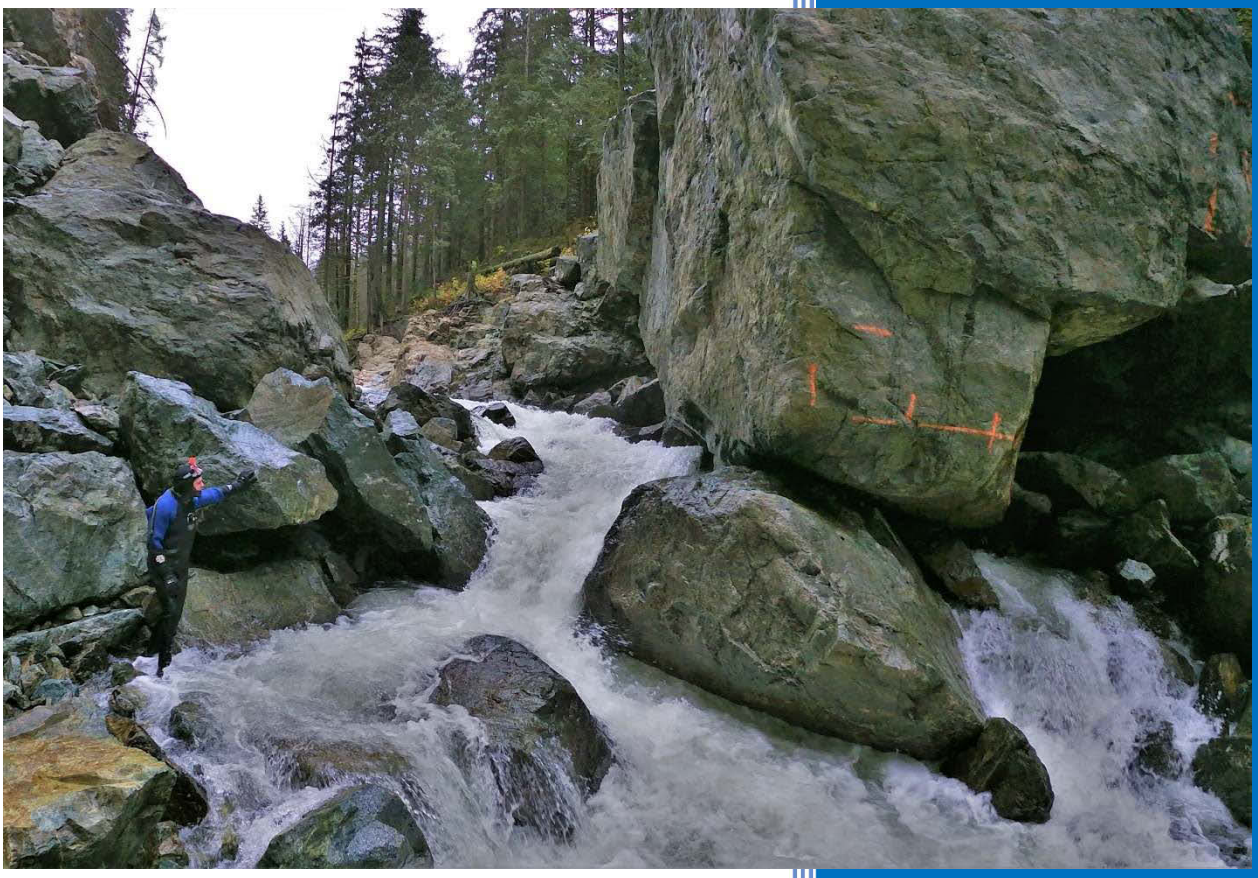
Attachment
Seymour Salmonid Society's 2020 Annual Report for Greater Vancouver Water District *(42880358)*

42893875

ATTACHMENT

2020

Seymour Salmonid Society's Annual Report For Metro-Vancouver



Seymour Salmonid Society

PO Box 52221, North Vancouver, V7J 3V5

1/1/2021

Water Committee

SEYMOUR
SALMONID
SOCIETY

Mission Statement

To enhance Seymour River salmon and educate the public about the importance of the river as a resource for drinking water, wildlife and the forest.

Water Committee

SEYMOUR SALMONID SOCIETY

Table of Contents

Water Committee

List of Figures

List of Tables

Water Committee

Executive Summary

Acknowledgements

The Seymour Salmonid Society (SSS) would like to recognize the significant contribution by Metro Vancouver for supporting enhancement and education efforts at the Seymour Hatchery. We would like to thank Metro Vancouver for renewing the Contribution Agreement between the MV and the SSS for a further three years, which includes an annual contribution of $125,000 for the period to December 31, 2023. The money that Metro Vancouver contributes to the hatchery operations allows the SSS to leverage monies from other sources, including Fisheries and Oceans Canada (DFO) and other external funding sources. These contribute to a significant proportion of our annual operating budget.

We would also like to thank significant financial contributions from BC Salmon Restoration and Innovation Fund (BCSRIF), the Pacific Salmon Foundation (PSF), the Canadian Wildlife Federation (CWF). These significant funds were provided for the Rockslide Mitigation Project, along with hatchery operations equipment improvements. We are also grateful for the ongoing support by the District of North Vancouver Firefighters, Neptune Terminals and Loblaws for our Gently Down the Seymour (GDS) education program. We are also grateful for the many community donations provided by local individuals and stakeholders during 2020.

We would also like to thank Metro Vancouver, DFO and the District of North Vancouver for their ongoing support with staff hours or in-kind contributions during our daily activities within the watershed. We are also most grateful for the contribution by our over 900 registered volunteers, who are an integral part of the operation of the hatchery and SSS. This includes Megan Samson, Melanie Moore and Nikola Marlin-Conrad from BCIT who worked on our radio telemetry monitoring program in the lower river as part of their second year Fish, Wildlife and Recreational Management diploma program. Without the significant community involvement, our staff would not be able to accomplish a fraction of what is completed at the hatchery or the work we do in the watershed.

COVID-19

The pandemic introduced significant constraints on our normal hatchery operations or stewardship activities within the watershed. Following Provincial/Federal health guidelines the Seymour hatchery facility was closed to the public on March 16, 2020. The pandemic resulted in cancellation of our annual community events, including Blueridge Days Festival, the chum fry release at Maplewood Farm, O.W.L Community Event, Family Fishing Day, Hatchery Open House and the Coho Festival. The hatchery was opened again for restricted access to the public and volunteers on July 2, 2020, subject to appropriate health and safety protocols to ensure everyone was kept safe. The four steps we took included self monitoring prior to arrival at the hatchery, physical distancing while at the hatchery or assisting in activities in the watershed, regular hand hygiene and use of personal protective equipment.

Education

This year due to the COVID-19 pandemic the SSS had to cancel our Spring and Fall education program under our Gently Down the Seymour (GDS) program. As such, we were not able to welcome and educate students from the greater Vancouver area. We are hopeful that 2021 will provide the opportunity to run our GDS program again for Grade 2-6 students.

Water Committee

Watershed Health

There are several obstacles to conserving the sustainable salmon and steelhead populations within the Seymour River watershed, the most significant of which is the rockslide that occurred in December 2014 and blocked passage of migrating fish to the middle spawning reaches of the river. The SSS and its partners have continued to work hard to mitigate the effects of the rockslide in 2020 and have confirmed that out-migrating fry and smolts are able to move downstream past the slide. In addition, we also confirmed that adult salmon and steelhead are continuing to successfully migrate through the 'rockslide' and 'the Well' areas to spawn within the river upstream, albeit at certain flow conditions. We are now monitoring the higher flows during the fall 2020 and spring freshet flows in 2021 to move material from the summer rock breaking activities. Our hope is that passage may be further improved for the 2021 returning adult salmonids. Despite this natural challenge and thanks to Metro Vancouver's continued support, fish populations on the Seymour River have a realistic long-term future within the watershed.

Community Outreach

Due to the restrictions associated with the COVID-19 pandemic, the SSS had to cancel our community outreach activities, such as Family Fishing Day, chum fry release at Maplewood Farm and our annual hatchery Open House. In addition, community events such as the Blueridge Days festival, O.W.L community event, the Coho Festival among others were also cancelled for 2020. In addition, while the District of North Vancouver Firefighters were able to hold their annual Fishing Derby on September 25, 2020 in a socially reduced capacity, we were unable to attend the weigh in event at the end of the day.

The only community event we were able to hold in 2020 was to celebrate International Rivers Day, where we organised an estuary clean-up and replanting at the river mouth on September 27, 2020. With help from Metro Vancouver staff, Ken Ashley of the River's Institute at BCIT and volunteers from the SSS, a significant volume of invasive plant species was removed and replaced with native shrubs and tree species. A large volume of trash was also removed from the estuary area on the day.

Stewardship Initiatives and Hatchery Activities

This year saw a continuation of our conservation activities within the watershed despite the restrictions imposed by COVID-19. Instream activities associated with the rockslide mitigation project were ongoing during the summer and initiatives resulting from this including rock drilling and breaking in the Seymour canyon area, radio telemetry monitoring. We also continued our river fertilization program, along with our ongoing broodstock fish production program for coho and chum salmon and steelhead. Habitat enhancement activities were also undertaken in the watershed, including supporting Metro Vancouver with the repairs to the berm at the Coho Creek compensation site.

Ongoing maintenance was also undertaken at the mid-valley habitat enhancement area via removal of a beaver dam that is blocking access for adult and juvenile salmonids from the enhancement area. It is important to note that the mid-valley enhancement area is man-made and was established over 20 years ago to provide significant salmonid juvenile rearing and adult spawning habitat. This enhancement area augments for aquatic habitat lost in the watershed via historical human activities. This area also benefits the watershed by providing valuable habitat for other aquatic species such as amphibians, birds, insects and invertebrates. In addition,

Water Committee

beavers were not present in the area for the 15 years following construction of the mid-valley enhancement area, or in the area prior to construction. Thus, while it was unfortunate the beaver dam had to be removed, the benefit of re-establishing significant aquatic habitat for salmonids and other aquatic species is considered to out weight the presence of one beaver.

We also reviewed the Junior Creek enhancement area during summer low flows, including the man-made channel that flows between Paton Creek and the juvenile rearing ponds in the enhancement area. The bank along a small section of this man-made channel has degraded over time and requires additional works to ensure it maintains sufficient flow to the Junior Creek ponds. However, our review during summer low flows indicated that the man-made channel would continue to operate at a sufficient capacity to ensure water will continue to flow into the enhancement area. Nonetheless, we anticipate further works ay be required during summer 2021 to ensure the channel continues to operate effectively into the future.

We also continued our ongoing infrastructure improvements at the hatchery, including upgrades to our incubation room and water supply plumbing, replacing some of our office equipment, along with regular replacement of our health and safety equipment.

Water Committee

Board of Directors

President	Shaun Hollingsworth
Treasurer	Darren Radons
Secretary	Graeme Budge
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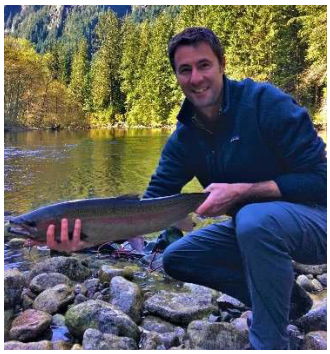
	Nick Martinovic
	Dee-Dee Soychuke
	Brian Halabourda
	Naomi Yamamoto
	Kyla Jeffrey
	Glen Parker
	Mark Whorrall
	Sean Ramsden
	Derek James

Society Staff

Marc Guimond: Executive Director & Hatchery Manager

Marc grew up in Toronto and attended the University of Guelph, earning a degree in Biological Sciences in 1995. In 1997 he moved to Vancouver and volunteered at the Vancouver Aquarium teaching students about marine invertebrates. The following year, Marc joined the SSS and has been overseeing all aspects of salmonid production and monitoring for over 20 years.



Reece Fowler: Environmental Coordinator

Reece was born and raised on the banks of the Whanganui River in New Zealand. He attended Massey University in Palmerston North (NZ), gaining a Bachelor of Science (BSc) in 1995, before completing a Doctorate in Freshwater Ecology in 2000. After university, Reece went on to work in the environmental consultancy sector for over 16 years, before volunteering at the hatchery in 2017 and joining the SSS in May 2018.

Water Committee

Sasha Gale: Program Coordinator

Sasha grew up on the BC Coast. She obtained a diploma in Environmental Studies from Langara College in 2009 and continued her studies at BCIT in 2010 in the Fish, Wildlife and Recreational Management program. After receiving her diploma she went on to complete a Bachelor of Science in Ecological Restoration in 2015. She worked on the Estuary Projects on the North Shore and as an Environmental Consultant for the City of Richmond prior to being hired at the Seymour Hatchery in January 2016.

Sam Pritchard: Seasonal Fisheries & Monitoring Technician

Sam was born and raised in Tsawwassen and pursued his interest in science at UBC. He completed his BSc in Biology in 2019 and joined the SSS for eight months as a Seasonal Technician. After spending some time working on conservation initiatives in New Brunswick and Fort St. John, Sam rejoined the team in September 2020 to assist with hatchery operations and radio telemetry monitoring.

Water Committee

COVID-19 Pandemic

The COVID-19 pandemic has introduced significant constraints on our normal operations at the hatchery and our works sites within the watershed. Due to the pandemic and following Provincial/Federal health guidelines the Seymour hatchery facility was closed to the public on March 16, 2020. Following the hatchery closure the SSS initiated a 'working solo' protocol for all hatchery staff to ensure that only one staff member was present at the hatchery on any given day. Staff undertook a check-in procedure with Rice Lake Gate Security staff while working along at the hatchery. In addition to this, the hatchery truck surfaces were sprayed daily with +70% alcohol to disinfect surfaces between drivers. Staff not attending the hatchery worked from home.

The pandemic resulted in cancellation of the following annual community events and activities that the SSS would attend and/or enlist volunteer support:

- Blueridge Days Festival – May
- Chum fry release Maplewood Farm – May
- O.W.L Community Event – May
- Family Fishing Day – June
- Hatchery Open House - August
- Coho Festival – September

The hatchery was opened again for restricted access to the public and volunteers on July 2, 2020, subject to appropriate health and safety protocols to ensure everyone was kept safe. The four steps we took included **self monitoring** prior to arrival at the hatchery, **physical distancing** while at the hatchery or assisting in activities in the watershed, regular **hand hygiene** and use of **personal protective equipment**. Each volunteer was required to fill out and sign our COVID form before beginning activities to allow for contact tracing. These forms were kept on file for 90 days then be destroyed. The following activities were undertaken this year following our established COVID-19 health and safety protocols:

- Nutrient release project (annual in-river placement of nutrients– July 2
- Fin Clipping of juvenile coho and steelhead – August to September
- River seining for adult broodstock collection – August to October
- World Rivers Day estuary cleanup and re-planting – September 27

The following sections provide further information regarding the four steps SSS staff adhered to while undertaking activities in the watershed:

Self Monitoring

Pre-mitigation, including reporting and self-screening, to help pre-screen possible COVID-19 positive volunteers and pro-actively remove risk that they could inadvertently introduce the virus into the workplace. Before coming to the hatchery or onto a SSS worksite, and throughout the day, volunteers would self-monitor for symptoms associated with COVID-19 by using the COVID-19 Symptom Self-Assessment Tool: https://ca.thrive.health/covid19/en. Before coming onto a SSS worksite, employees and volunteers would self-screen by answering the following questions:

1. Are you experiencing symptoms consistent with COVID-19 (see the link above for the most up to date list of symptoms)?
2. In the past 14 days have you been outside of Canada?

Water Committee

3. In the past 14 days have you been in close contact with anyone who is symptomatic or has been diagnosed with COVID-19

If someone answered yes to any of the above questions the volunteers would inform the staff member in charge and must stay at home and not visit the hatchery or work site. Volunteers that have experienced COVID symptoms could not come to the hatchery or work site for at least 10 days after symptoms have resolved.

Physical Distancing

Physical distancing reduces the potential that the virus can be transmitted through airborne droplets. There is a possibility that even non-symptomatic carriers of the virus may transmit the active virus in this manner, so social distancing should always be observed, even in cases when people do not display symptoms of COVID-19. Physical distancing was maintained by:

- Keeping a distance of at least two arms-length (i.e., 2m) from other people. This involved reconfiguring workspaces to allow employees and volunteers to maintain safe distances
- Restricting the number of staff and volunteers present, and restricting the presence of visitors to the hatchery to limit close personal contact
- Volunteers needed to drive their own vehicle to the hatchery
- Volunteers would wear a mask and other personal protective equipment
- For staff and volunteers working in the field maintain distancing where possible from other team members and any member of the public during all activities

Hand Hygiene

Necessary good personal hygiene practices were undertaken during work activities involving staff or volunteers as follows:

- Stay home if you are sick to avoid spreading illness to others
- Wash your hands often with soap and water for at least 20 seconds using soap and water
- If soap and water are not available, alcohol-based hand rubs (ABHR) to be used so long as hands are not visibly soiled. If they are visibly soiled, use a wipe then ABHR
- Wash your hands each time gloves are changed or discarded. SSS provided gloves, mask and a hand washing station
- Avoid touching your face, including eyes, nose or mouth with unwashed or gloved hands
- Cover your mouth and nose with a disposable tissue or the crease of your elbow when you sneeze or cough
- If you use a tissue, dispose of it as soon as possible and wash your hands afterwards
- Use outhouse located just outside the hatchery gates
- Avoid going into the hatchery building unless required, if inside avoid touching surfaces
- Wash your hands or sanitize upon entering and exiting public spaces

Personal Protective Equipment

If physical distancing could not be maintained, a risk assessment was performed, and approved face masks were used to limit the potential for airborne transmission of virus particles. Volunteers were asked to bring their own masks whenever possible; however, masks were provided by hatchery staff if volunteers did not have one.

Summary of Seymour River Health

General

The Seymour River currently has a range of restrictions that impact the natural processes within the watershed, including a water supply dam in the upper reaches, a natural rockslide in the lower reaches, along with urbanisation in the lower reaches and estuary. The impoundments impede access to the most valuable salmonid spawning habitat in the upper and middle reaches of the river. In addition, the lower reaches flow through the urbanised area of North Vancouver, which contribute to the loss of riparian habitat, increased hard surface water runoff, bank modifications and instream habitat changes. However, despite these impacts the Seymour watershed is in good health and provides significant habitat for aquatic and terrestrial flora and fauna so close to a large metropolitan area.

As part of the Seymour rockslide mitigation project, funding was secured from the Pacific Salmon Foundation (PSF) and DFO in 2016 to install a temporary fish fence and fish trap. This fence continued to operate until a significant flow event on February 1, 2020 peaking at 473m^3/s resulted in irreversible damage to the fish fence, such that it had to be removed during March 2020 and is no longer in place. Returning salmonids used within our broodstock program are now being captured either via river seine events at the hatchery pool, or through broodstock fishing within the river.

This year saw the re-establishment of in-river seine netting activities at the hatchery pool, just a short distance from the hatchery itself. This year was the first year since 2014 that fish have been seined upstream of the rockslide and demonstrates that at least some adults are successfully migrating through the canyon area to the upper river. Significant broodstock fishing activities were also undertaken in 2020 primarily below the rockslide and the fish were either transported to the hatchery for broodstock or were radio telemetry tagged and released below the rockslide for monitoring purposes. Combined, these efforts have enabled collection of 247 returning coho, 40 chum and 7 steelhead adults for use in our broodstock program, or releases into the river above the rockslide. In addition, we secured an additional 178 pairs of chum (500,000 eggs) from the Alouette River.

In addition, this year for the second time in over 80 years we successfully translocated returning adult coho salmon to the available river habitat upstream of the Seymour Falls dam. Hatchery, Metro Vancouver and DFO staff successfully moved 20 early run adult coho salmon above the dam on October 22. These early run coho were captured via seine netting at the hatchery pool. The plan is to continue these adult releases above the dam in 2021 and beyond.

It is the ongoing efforts by the SSS, volunteers from the local community, staff from Metro Vancouver and DFO, along with the Squamish Nation and the Tsleil-Waututh Nation, that are instrumental in maintaining viable salmonid populations in the Seymour River.

Seymour Rockslide Mitigation Project

The objective of the 2020 work was to continue rock breaking activities to create a continuous channel around the “house” boulder and through the rockslide area, with the aim of reducing the in-river gradient and fill the large interstitial spaces. However, given the social distancing mechanisms in placed due to COVID, we did not hold a formal opening ceremony for the rockslide

Water Committee

mitigation project this year. Nonetheless, contractors worked through the summer/fall period and are expected to finish by Christmas 2020. Mitigation works within the canyon comprised two primary work areas, these being the Rockslide site and the Well site, which is approximately 300m downstream, of the Rockslide. The following provides an overview of activities at each work site during 2020.

Rockslide Site

Rock breaking activities began in summer 2020 with works focusing on the 'house rock', with the aim of breaking this rock in the fall (Figure 1). The rock-breaking process used pneumatic drills (mechanical drills powered by compressed air) to create drill-holes for the Nxburst agents' use. All equipment for the rock breaking activities was sourced via the professional engineers commissioned on the project. The house rock was broken during the week of November 26. Following this breaking the engineers concluded that additional drilling and breaking down of the smaller pieces of the house rock would be beneficial before the winter period.

As of December 9, approximately 467 metres (m) of rock has been drilled within 206 new drill holes. Approximately 700 cubic metres (m^3) of rock was blasted on nine separate blast days. Additional drilling and rock breaking events are continuing at the site to further break down the remaining house rock boulders and will continue until Christmas 2020, or until river flows and/or weather conditions prevent further work activities.

FIGURE 1 THE HOUSE ROCK BEFORE (LEFT) AND AFTER (RIGHT) ROCK BREAKING

The Well Site

On February 1, 2020, a high flow event occurred on the Seymour River. Flows peaked at 473m^3/s at Grantham Bridge and resulted in a significant volume of blasted rock material from the slide area redistributing downstream through the canyon. The SSS staff visited the canyon area following the high flow event and noted a significant volume of blasted rock had deposited through the Seymour Canyon, including an area called 'the Well'.

Water Committee

This pool is approximately 300m downstream of the rockslide (49°20'6.94"N; 123° 0'12.37"W). Figure 2 shows the Well pool area during May 2019 and March 2020 to give an idea of the change in river structure and the impoundment area before and after the significant February 2020 flow event.

FIGURE 2 THE WELL WATERFALL IN MAY 2019 (LEFT) AND MARCH 2020 (RIGHT)

The Well impoundment was approximately two metres high and had a double drop onto large boulders, before entering the Well pool downstream (Figure 3). This human-made blast rock inadvertently caused a fish passage barrier to returning adult salmonids, including coho, pink and vchum salmon, along with summer and winter run steelhead. It is this rock material that is causing a fish passage barrier to returning adult salmonids and is the subject of funding from the Canadian Wildlife Federation (CWF).

FIGURE 3 THE WELL WATERFALL DURING MARCH 2020 WITH PERSON FOR SCALE

Water Committee

Following the 2020 rock breaking activities and monitoring surveys (i.e., visual observations and radio telemetry monitoring of returning adults), we confirm that passage for adult coho salmon and summer run steelhead is possible through the rockslide at certain river flows. Although we are yet to confirm the actual number of fish that successfully moved through the canyon in 2020 (i.e., as carcass recovery counts continue into January 2021), we successfully seine netted 175 coho and 1 summer run steelhead from the hatchery pool this year. In addition, broodstock fishing contributed an additional 72 coho, 40 chum and 6 summer run steelhead for the broodstock program. We are continuing our carcass recovery operations with the aim of improving our estimate of fish successfully migrating into the upper river to spawn naturally.

Our observations this year suggest that the number of adult coho and summer run steelhead moving through the rockslide was lower this year than in 2019 and likely due to natural annual variations in fish returns rather than fish passage restrictions through the canyon area. In addition, we were unable to trap and truck coho in as great numbers as 2019 from the lower river due to the removal of the fish fence. In comparison, given that chum salmon traditionally use the lower reaches of the Seymour river below the rockslide for spawning purposes, the Rockslide and the Well sites did not influence the spawning ability of this species. We successfully broodstocked 20 pairs of chum salmon from the Seymour River for use on our broodstock program. In addition, we observed reasonable number chum spawning in the lower river, along with tributary streams in the lower watershed.

Once water levels recede in spring 2021, geotechnical engineers will again survey the canyon area to understand the movement of debris over the 2020/21 winter period. Following this, a work plan will be established for any instream activities that may be required during the summer 2021.

Fish Above Seymour Falls Dam Project

Coho salmon once migrated up the Seymour River to habitat that is now isolated upstream of Seymour Falls dam. In 2019 the SSS, DFO and Metro Vancouver successfully collaborated on an agreement to enable transport of adult salmon above the dam, so that they can once again spawn and rear in the upper watershed. The aim of the project is to focus transport on the early run coho, since it is this portion of the adult returns that would have likely migrated above the Seymour Falls as the higher freshet flows were most likely to enable passage above the falls. Of note, the former Seymour falls now form part of the existing Seymour dam.

The agreement seeks the release of up to 400 adults above the dam each year. This figure is based on the Bradford's bio-standard of 85 smolts/female and a target of producing 17,000 wild smolts from natural habitat above dam each year. The wild spawned fry would be augmented by release of 40,000 hatchery fed fry above the dam annually until we are able to release more than 200 adults above the dam each year. After which the plan would be to reduce hatchery fed fry releases above the dam as adult transport increases above 200 adults per year. Ultimately, we would like to reach a point where 400 adults are transported above the dam annually, thereby negating the need for hatchery fed fry releases above the dam.

Planting adult coho in their ancestral habitat to spawn in the wild would partially mitigate the historic impact of dam construction. It would also re-establish wild salmonid stocks in a pristine area that is more resilient to future stressors such as climate change. The number of adult coho being transported above the dam annually is determined by the number of adult fish returning to the river, along with the number of fish we can collect as part of our broodstock program.

Water Committee

The aim is to release the returning salmonids to enable wild spawning in the gravels upstream of the dam, so their offspring could eventually replace the hatchery fed fry that are currently being stocked above the dam. Salmon are a positive influence on overall watershed health and will benefit aquatic and terrestrial ecosystems in the upper Seymour watershed.

On October 22 with the assistance of Metro Vancouver and DFO, the SSS transported 20 adult early run coho salmon to the Seymour River above the dam. These fish were captured during river seining events at the hatchery pool a short distance downstream of the dam. These early run coho were retained at the hatchery until sufficient fish were secured for our broodstock program and the 20 fish released above the dam were surplus to the hatchery broodstock requirements. The translocation took approximately 1.5 hours to move the fish between the hatchery and release location at Jamieson Bridge in the upper watershed. Each fish was lowered via bucket and hand from the bridge and released to the river (Figure 4).

FIGURE 4 COHO RELEASE ABOVE THE SEYMOUR FALLS DAM IN 2020

Radio Telemetry Monitoring Project

As part of the rockslide mitigation project, radio telemetry studies commenced to monitor adult coho salmon migration through the Rockslide and the Well area. In partnership with BCIT and Instream Fisheries Research, the SSS continued the adult monitoring program to determine when and if fish can migrate through the canyon where the rockslide occurred. Monitoring of the upstream migration of tagged adult coho salmon has continued into 2020 to understand the progress of the rockslide mitigation project and successful passage of returning adults to the spawning grounds.

A total of 20 adult coho salmon had gastric radio tags installed on the riverbank before being released downstream of the Rockslide and the Well areas. No steelhead were tagged in 2020 due to insufficient numbers of returning fish being captured to enable tagging. The fish were released downstream of the Rockslide and the Well areas within one hour of radio tag insertion (Figure 5).

Water Committee

FIGURE 5 INSERTING A RADIO TAG INTO A COHO SALMON

The tagged fish were monitored using two primary identification approaches, these being four fixed receiver telemetry stations and mobile telemetry tracking. The fixed receivers are set up along the river, one at Spur 4 (above the rockslide), one at Twin Bridges (above the rockslide), the third at Pool 91 (below the rockslide) and the fourth at the fish fence (below the rockslide 1km from the river mouth). These fixed receivers record if any of the radio tagged fish pass by them.

Mobile tracking was undertaken at least once per week from August until December 2020. We would like to thank Megan Samson, Melanie Moore and Nikola Marlin-Conrad from BCIT's second year Fish, Wildlife and Recreational Management diploma program for their invaluable radio tracking efforts during this period. All the tagged adults were detected at one of the fixed stations downstream of the rockslide, while one tagged fish was also detected at the Twin Bridge and Spur 4 fixed stations upstream of the rockslide. The tagged fish upstream of the rockslide was a wild male coho and was first detected at Twin Bridges on October 8th at a flow of 3.6m^3/s. This fish has been regularly detected above the rockslide since and was last detected adjacent to the Junior Creek enhancement area on November 19th.

In comparison, juvenile monitoring undertaken in 2017 and 2018 during the period of outmigration for juvenile salmon confirmed successful fish passage for out-migrating juveniles. The results of the juvenile telemetry monitoring revealed that tagged juvenile coho salmon were able to migrate downstream through the rockslide following releases in 2017 (between April 28 to June 1) and during 2018 (April 28 to May 25). The juvenile telemetry work confirmed a high downstream passage rate (84%) among radio tagged juvenile fish and highlight that the environmental conditions during the smolt outmigration period appeared to permit safe and timely passage of the rockslide. As such, juvenile monitoring has not been required since 2018.

Water Committee

Further to the radio telemetry project on the Seymour River, we have been in ongoing contact with DFO staff managing the Big Bar telemetry program on the Fraser River. To assist in the Big Bar project the SSS provided 30 radio tags during summer 2020 to augment the tags they required for their monitoring.

Habitat Projects

A review of the habitat enhancement areas as undertaken during summer lows flows to understand the current condition of the enhancement sites and any maintenance activities that may be required to ensure the areas maintained their effectiveness. Hatchery staff supported Metro Vancouver to undertake remedial works at the Coho Creek compensation site, which included repairs to the berm hat holds the water in the Coho Creek ponds.

Ongoing maintenance was also undertaken at the mid-valley habitat enhancement area via removal of a beaver dam that is blocking access for adult and juvenile salmonids from the enhancement area. It is important to note that the mid-valley enhancement area is man-made and was established over 20 years ago to provide significant salmonid juvenile rearing and adult spawning habitat. This enhancement area augments for aquatic habitat lost in the watershed via historical human activities. This area also benefits the watershed by providing valuable habitat for other aquatic species such as amphibians, birds, insects and invertebrates. In addition, beavers were not present in the area for the 15 years following construction of the mid-valley enhancement area, or in the area prior to construction. Thus, while it was unfortunate the beaver dam had to be removed, the benefit of re-establishing significant aquatic habitat for salmonids and other aquatic species is considered to out weight the presence of one beaver.

We also reviewed the Junior Creek enhancement area during summer low flows, including the man-made channel that flows between Paton Creek and the juvenile rearing ponds in the enhancement area. The bank along a small section of this man-made channel has degraded over time and requires additional works to ensure it maintains sufficient flow to the Junior Creek ponds. However, our review during summer low flows indicated that the man-made channel would continue to operate at a sufficient capacity to ensure water will continue to flow into the enhancement area. Nonetheless, we anticipate further works ay be required during summer 2021 to ensure the channel continues to operate effectively into the future.

Carcass Recovery Project

As a compliment to the radio telemetry monitoring project, hatchery staff began carcass recovery operations in October 2020 and will continue through until January 2021. Carcass recovery requires hatchery staff to walk side channel streams where coho typically spawn to record the number of fish that are either actively spawning or have spawned in the system already. Staff are looking to differentiate between fish that have made their own way into the upper watershed to spawn (i.e., fish with no operculum punch), with those that have been released into the upper watershed as part of our broodstock capture program (i.e., fish with operculum punches).

A total of 25 fish that were captured during our broodstock program had their right operculum punched with a small circular hole before being released at Spur 7 in the middle reaches of the watershed. This carcass recovery provides us with a ratio of coho gaining passage of the slide on their own compared to the trapped and trucked. During the carcass recovery, each fish counted is cut in two and deposited in the forest to distinguish them week to week. This survey was undertaken twice per week between October and December to maximise the number of fish

Water Committee

identified. This will enable us to formulate an accurate estimate of coho numbers that migrated through the rockslide during the Fall of 2020.

Gently Down the Seymour Education Program

A field trip to the Seymour Hatchery expands student learning of the salmon life cycle to include experience and observation of salmon habitat and the surrounding watershed ecosystem. Students, teachers and parents have an opportunity to connect with their local ecosystem and gain a greater understanding of how urban development impacts natural resources. We hope visitors become greater stewards for salmon, ensuring there will be salmon in our region for generations to come.

The Gently Down the Seymour (GDS) program has a lasting impact on participants as shown by the considerable volume of thank you letters received from the students, along with teachers regularly commenting on how students recall details and experiences from the field trip many years later.

Unfortunately, due to the restrictions associated with the COVID-19 pandemic, the SSS had to cancel our GDS education program for 2020. We hope to re-start out education program in 2021 once social distancing restrictions ease as a COVID vaccine is rolled out across British Columbia.

Community Outreach

Unfortunately, due to the restrictions associated with the COVID-19 pandemic, the SSS had to close the hatchery facility to the public on March 16, 2020. We also had to cancel our community outreach activities, such as Family Fishing Day, chum fry release at Maplewood Farm and our annual hatchery Open House. In addition, the community events such as the Blueridge Days festival, O.W.L. community event, the Coho Festival among others were also cancelled for 2020. In addition, while the District of North Vancouver Firefighter were able to hold their annual Fishing Derby on September 25, 2020 in a socially reduced capacity, we were unable to attend the weigh in event at the end of the day.

The hatchery was opened again for restricted access to the public and volunteers on July 2, 2020, subject to appropriate health and safety protocols to ensure everyone was kept safe. The four steps we took included self monitoring prior to arrival at the hatchery, physical distancing while at the hatchery or assisting in activities in the watershed, regular hand hygiene and use of personal protective equipment. Further information relating to COVID-19 is provided earlier in this report.

Thus, although 2020 has been a difficult year for community outreach and hatchery visitors, we were able to provide access to over 190 people at our hatchery and education centre via the Coho Trail (Figure 6). This is significantly fewer than the 3,729 visitors in 2019 and is undoubtedly a result of the COVID-19 pandemic and access restrictions within the Lower Seymour Conservation Reserve (LSCR).

Water Committee

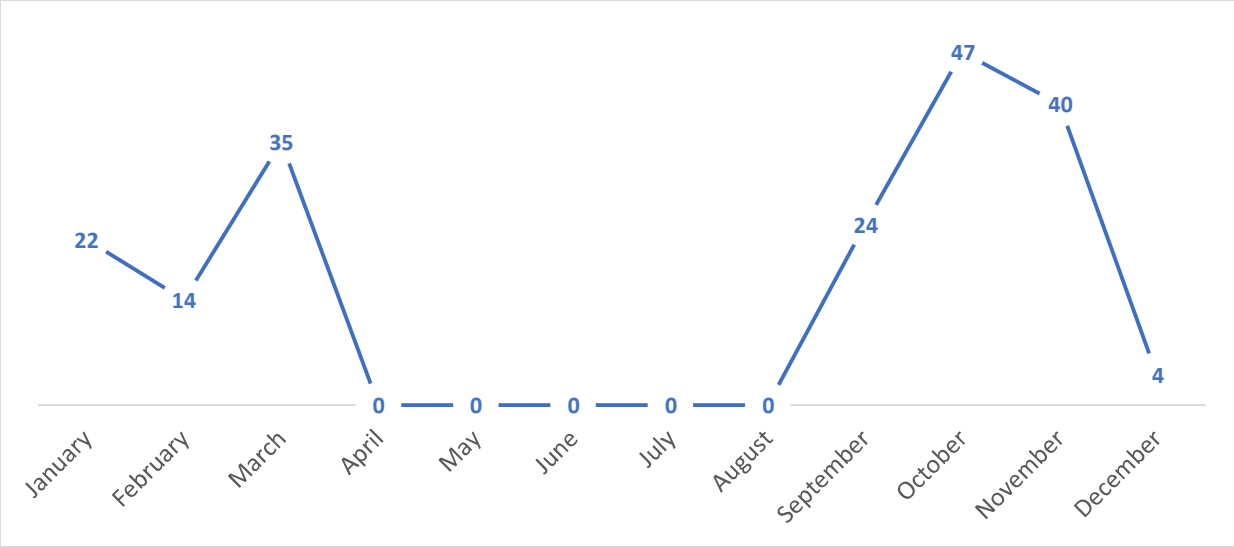


FIGURE 6 NUMBER OF VISITORS TO THE SEYMOUR RIVER FISH HATCHERY IN 2020

The only community event we were able to hold in 2020 was to celebrate International Rivers Day, where we organised an estuary clean-up and replanting at the river mouth on September 27th. With help from Metro Vancouver staff, Ken Ashley of BCIT's River's Institute and volunteers from the SSS, we were able to undertake a considerable volume of replanting and cleanup work (Figure 7). The replanting activities saw the following species planted at the estuary during the day:

- Red osier dogwood
- Snowberry
- Oregon grape
- Salmonberry
- Red flowering currant
- Pacific ninebark

A significant volume of invasive plant species was removed and replaced with native shrubs and tree species, while many bags of trash were also removed from the site. We would also like to acknowledge the District of North Vancouver for collecting and disposing of the invasive plants and trash from the day.

Water Committee

FIGURE 7 REPLANTING ACTIVITIES AT THE SEYMOUR ESTUARY ON RIVERS DAY 2020

Seymour Roundtable Technical Group

The SSS initiates biannual meetings with DFO, Metro Vancouver and stakeholders across the North Shore as part of the roundtable technical group. Topics include discussion on stewardship initiatives, potential enhancement projects and coordinated dialogue amongst government agencies and local stewardship groups. The current focus of the group is the ongoing funding for mitigation works within the Seymour Canyon rockslide to ensure the returning salmonids can access habitat in the upper watershed. However, as we moved into 2021 and beyond our focus will shift back to the habitat and enhancement activities within the watershed above the rockslide.

Social Media

The SSS continues to operate our website (www.seymoursalmon.com), with the assistance of Rudy Kehler (The Simplify Company). The SSS also continues to communicate though social media via our Instagram and Facebook internet platforms. The SSS Facebook page has gone from 747 followers in 2018 to over 1,000 followers in 2020, while our Instagram site has increased from 256 followers in 2018 to over 750 followers in 2020. These social media platforms are two effective ways for members of the community to see what we are doing on a weekly basis.

Water Committee

Volunteering

Volunteers are an integral aspect of the operation of the hatchery and SSS. Without the high level of public involvement, the staff would not be able to accomplish a fraction of what is completed at the Hatchery or SSS events. The SSS currently has over 900 volunteers registered to assist with the ongoing activities at the hatchery or within the watershed.

Given the restrictions associated with the COVID-19 pandemic, the SSS had to close the hatchery facility to volunteer activities on March 16, 2020. However, a small number of volunteers were able to provide support during our river seine events at the hatchery pool, fin clipping of juvenile coho and steelhead, along with our rivers' day event at the estuary. The hatchery was opened again for restricted access to the public and volunteers on July 2, 2020, subject to appropriate health and safety protocols to ensure everyone was kept safe.

In summary, our activities were supported by over 1,300 volunteer working hours during 2020 (Figure 8). We are most grateful for the volunteer assistance we receive each year and would not be able to undertake all the work we do in the watershed without their help.

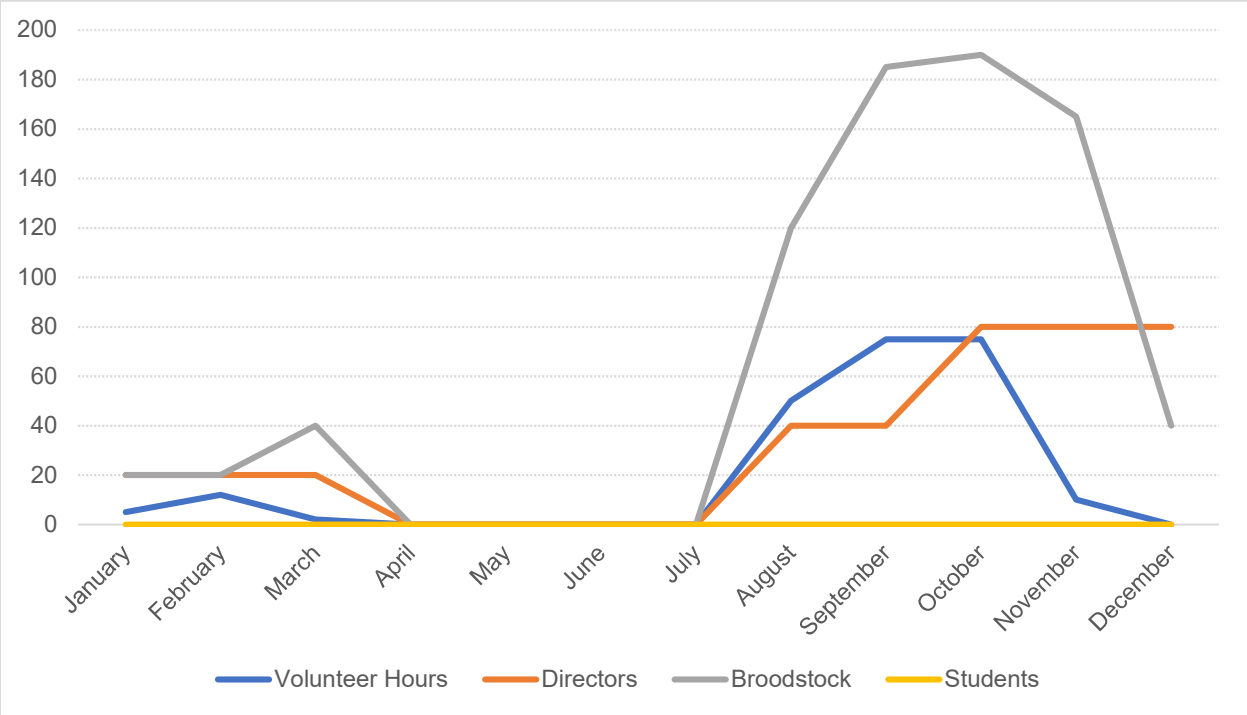


FIGURE 8 VOLUNTEER WORKING HOURS DURING 2020

Water Committee

Stewardship Initiatives and Activities

The following provides an overview of the stewardship activities undertaken within the Seymour watershed during 2020. Table 1 provides a summary of the fish collected for the Seymour Hatchery broodstock program.

Hatchery Pool Seines

During the summer period coho salmon began congregating in the hatchery pool, which is approximately 500m downstream of the Seymour Falls dam and approximately 11km upstream of the rockslide area. The SSS undertook nine successful seine events between September and October to capture fish for use in our broodstock program. Some of these captured fish were also used for fish releases above the dam. The river seining activities ended on October 30 due to higher river flows and unfavourable environmental conditions.

As part of the river seining activities, a total of 176 fish, comprising 175 coho and 1 summer run steelhead were captured and transported to the hatchery (Table 1). Of these captured fish we punched the right operculum of 25 coho and released these to the mid-reaches of the river to spawn naturally. The operculum punches will be used within our carcass recovery program to provide an estimate of the total coho return for 2020. River seine events were not undertaken in the lower river this year given the successful seine events at the hatchery pool, along with the lower numbers of fish holding in the pool adjacent to Maplewood Farm (i.e., due to the fish fence no longer operating immediately upstream) (Figure 9).

FIGURE 9 SETTING THE SEINE NET DURING A HATCHERY POOL SEINE EVENT

Broodstock Fishing

Our registered broodstock anglers were out regularly during the May to December period for summer run steelhead fishing, along with the January to April period for winter run steelhead fishing. In addition, our broodstockers were fishing during the August to December period for the returning coho salmon. The aim of the broodstock fishing was to capture as many returning fish in the river and begin to capture the winter and summer run steelhead (Figure 10). To date we have collected 118 fish, comprising 72 coho, 40 chum and 6 summer run steelhead via our broodstock angling program (Table 1).

Water Committee

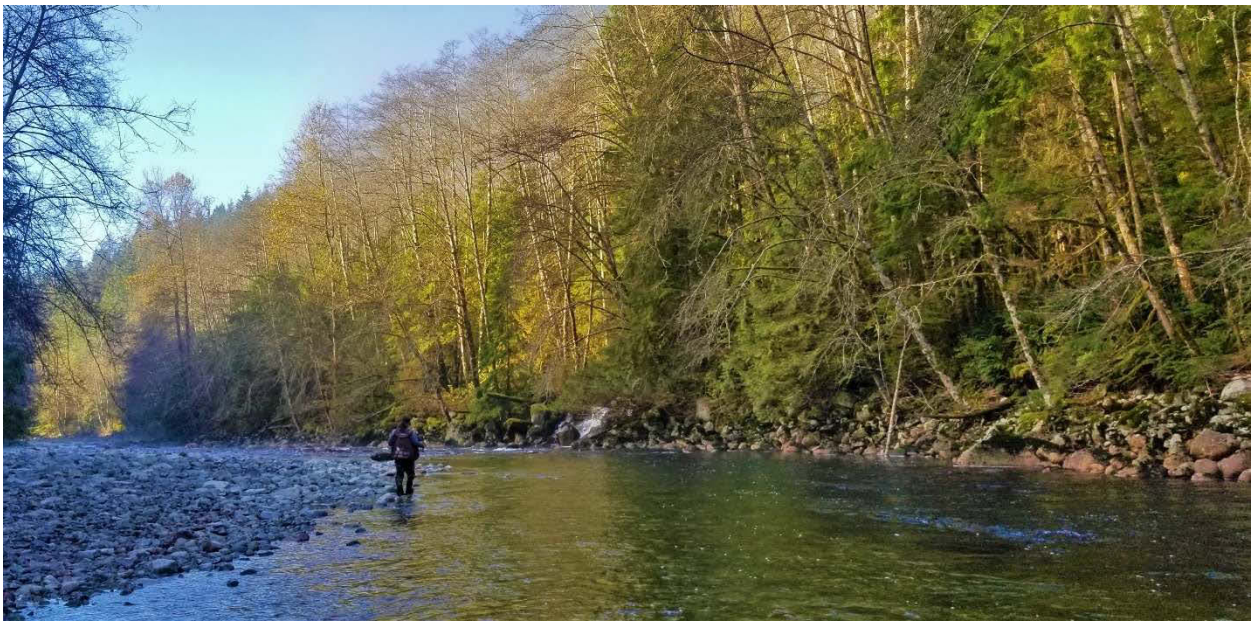


FIGURE 10 BROODSTOCK FISHING THE MID-VALLEY AREA FOR SUMMER RUN STEELHEAD

Alouette River Chum Egg Collection

Further to our ongoing broodstock collection within the Seymour River, each Fall hatchery staff visit the Alouette River with DFO to collect additional broodstock to continue rebuilding the chum salmon population in the Seymour. During the Fall of 2020 we collected an additional 178 pairs of chum (~500,000 eggs) from the Alouette River for this purpose (Table 1). Broodstock collection for pink salmon also occurs via support from DFO at Tenderfoot Hatchery (Squamish); however, as this only occurs during odd numbered years there are no pink salmon eggs under incubation at the Seymour hatchery in 2020.

TABLE 1 BROODSTOCK COLLECTION FOR THE SEYMOUR RIVER HATCHERY IN 2020

Species	Seine Netting	Broodstock Fishing	Other
Coho salmon (early and late run)	175	72	N/A
Steelhead (2021 summer run broodyear)	1	6	N/A
Steelhead (2021 winter run broodyear)	-	-	N/A
Chum salmon (Seymour River)	-	40	N/A
Chum salmon (Alouette River)	N/A	N/A	178
Pink salmon (Seymour River)*	-	-	-
Pink salmon (Tenderfoot Creek)*	N/A	N/A	-

***Note**: N/A - not applicable as fish are either not sourced from other rivers, or the method of capture is not via seine netting or broodstock fishing; * - odd numbered years only.*

Water Committee

River Fertilization

The fertilization program continues to be led by Metro Vancouver and SSS hatchery staff. Hatchery staff and volunteers support the program by filling the fertilizer bags and placing them in three locations in the river each spring.

The Program was originally initiated by the Province to mitigate for the possible impacts of the Seymour Falls Dam on the downstream habitat of summer-run juvenile steelhead, and to make up for poor ocean conditions for salmon resulting in reduced adult returns. The prevailing thought is that the over-wintering period for juvenile steelhead is a population bottleneck in the Seymour River. Thus, making the fry bigger and (presumably) healthier during the Summer/Fall months because of greater food availability, would improve over-winter survival of the juvenile steelhead population, resulting in a greater number of smolts that would then out-migrate to the ocean in the Spring (with the assumption that sending more fish to the ocean would result in more fish coming back).

The use of fertilizer seeks to increase fish size by increasing food availability and is achieved by increasing aquatic primary productivity and ultimately increasing food availability for fish. The current method of nutrient enrichment includes the placement of jute bags filled with slow-release pellet fertilizer at multiple locations downstream of the dam and upstream of Spur 7.

The fertiliser was installed by hatchery staff in 2020 due to the COVID restrictions; however, we were most grateful for the support of two volunteers who assisted in filling the nutrient bags and deployment into the river (Figure 11). Concurrent with this fertiliser installation, Metro Vancouver performed monthly water quality samples during the summer growth period (June to October) at locations upstream and downstream of the fertiliser release sites.

FIGURE 11 INSTALLING NUTRIENT BAGS NEAR THE HATCHERY POOL

Water Committee

Mosquito Creek Chum Egg Implanting

During 2020 North Shore Streamkeepers undertook significant habitat enhancement of lower Mosquito Creek, specifically within the estuarine/tidal area (Figure 12). Works included installation of large woody debris and other structures to diversify habitat and improve useability for returning salmonids. Monitoring of the returning salmon was undertaken in 2020 following these enhancement works to understand fish returns within the creek and how this may change over time with the new habitat in place.

The spawning counts during the fall of 2020 showed that approximately 20 chum salmon entered and spawned within Mosquito Creek, suggesting that between 50,000 and 65,000 wild chum eggs may have been laid in redds within Mosquito Creek.

As part of this work, DFO implemented a protocol to implant an additional 20,000 hatchery fertilised chum salmon eggs into the creek gravels to further augment the wild egg spawning. This implantation as undertaken in areas where wild redds were not observed during spawner surveys performed by North Shore streamkeeper volunteers. The aim of this protocol is to increase the imprinting potential of the eggs by two to three months and improve the return potential for the system being implanted.

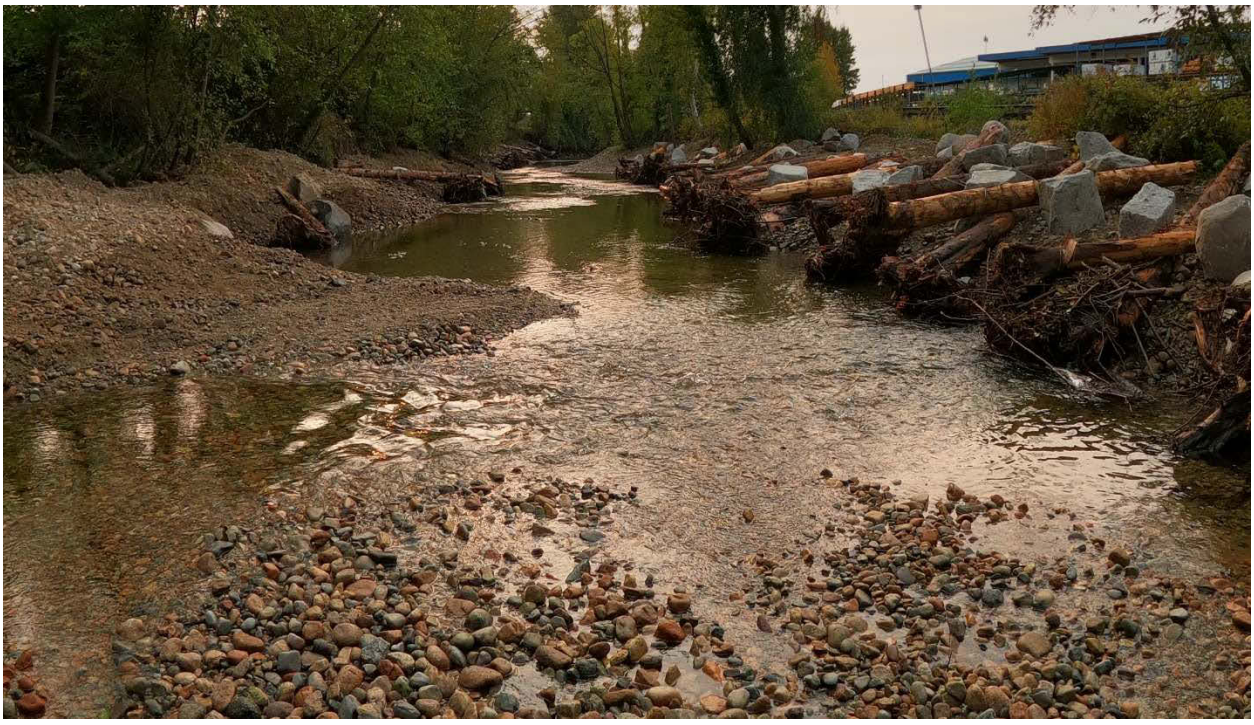


FIGURE 12 MOSQUITO CREEK AFTER HABITAT ENHANCEMENT WORKS

Water Committee

The process to implant these eggs was as follows:

- An empty 10-gallon bucket with the bottom cut off is circled back and forth into the river gravels to establish an artificial redd area. The bucket is inserted 20 to 30cm into the river gravels;
- The gravel material inside the bucket is then removed by hand down to the base of the bucket creating the artificial red. Three or more larger rocks are then placed into the bucket to add structure to the artificial redd;
- Approximately 1,700 hatchery fertilised eggs are then place into the artificial red before smaller gravels are carefully placed over the top to cover the eggs. The bucket acts as a flow barrier to prevent eggs being washed away before gravels are placed on top to bury the eggs;
- The bucket is then carefully removed from the river gravels and the artificial redd is now in-situ to allow egg incubation to be completed within the creek

On December 14th DFO staff visited the hatchery and collected 20,000 incubating chum eggs for placement into lower Mosquito Creek (Figure 13). These eggs were sourced from the Alouette River during fall 2020, before being fertilised and incubated at the Seymour River hatchery before implantation into Mosquito Creek.

FIGURE 13 MOSQUITO CREEK SHOWING ARTIFICIAL CHUM REDDS (PALE GRAVELS)

Floating Fish Fence

The floating fish fence was an effective method for low stress fish capture between 2016 and 2019. It allowed SSS staff to trap fish in the lower river and move them above the slide or to the hatchery. The fish fence was located adjacent to Maplewood Farm in the lower river and was operational until January 2020. However, a high flow event peaking at 473m^3/s on February 1, 2020 resulted in irreversible damage to the fish fence, such that it had to be removed during March 2020 and is no longer in place (Figure 14). Returning salmonids for our broodstock program are now being captured either via river seining events at the hatchery pool (as was the case prior to the rockslide), or through broodstock fishing within the river.

Water Committee

FIGURE 14 DAMAGED FISH FENCE FOLLOWING HIGH FLOW EVENT

Fish Production

The SSS is contracted by DFO to produce three salmonid species: coho and chum annually, and pink salmon every odd numbered year. The SSS also has an agreement with the BC Ministry of Forests, Lands, and Natural Resource Operations and Rural Development (FLNRORD) to produce summer and winter run steelhead smolts. The SSS's goal is to enhance toward and maintain salmonid populations to historical levels.

The 2020 fry releases will be undertaken into the mid-reaches of the river and side channel habitat to augment the numbers of adult coho that made their own way through the rockslide in 2020. Given the adult returns and number of fish spawning naturally in the river, we will maintain our fry releases to pre-rockslide production levels. The 2019 brood will then be released as fry in selected habitats throughout the LSCR and above the Seymour Reservoir in Spring 2020. Every year the SSS engages families with children with an event at Maplewood Farm where up to 25,000 chum fry are released into Maplewood Creek. Table 2 illustrates the fry and smolts that were released in 2020.

TABLE 2 SMOLTS AND FRY RELEASES FROM THE SEYMOUR HATCHERY IN 2020

Species	Broodyear	Number
Coho salmon fry	2019	100,703
Coho salmon smolts	2018	41,385
Summer Steelhead smolts	2019	15,955
Winter Steelhead smolts	2019	13,329
Chum Salmon fry (Seymour River)	2019	34,817
Chum Salmon fry (Alouette River)	2019	22,024
Pink Salmon fry (Tenderfoot Creek)	2019	100,000*

***Note**: * - there was an extreme die-off of our pink fry within the Pallant boxes with approximately 50% loss due to unknown causes. Possible causes could include drastic temperature swings and uneven flow. DFO veterinarian visited in January 2020 and saw signs of bacteria and fungus. Chloramine T treatments were undertaken but this did not have a significant impact on increased survival rate.*

Water Committee

Hatchery Infrastructure Renewal

We undertook multiple facility upgrades during 2020, the most significant of which was removal of the three outdoor egg incubation tanks (i.e., Pallant boxes) and the expansion of the incubation room to accommodate six new egg incubation tanks (i.e., Atkins boxes), along with additional egg stack capacity. Concurrent with these works, the water supply plumbing from the aeration tower and the groundwater pond were upgraded to ensure uninterrupted supply of water for the hatchery. The water supply upgrades included installation of separate water lines to the outdoor circulation tanks to provide cooler groundwater during the summer period in the outdoor storage tanks. This supply of cooler groundwater during the higher summer temperatures seek to maintain cooler water (and thus higher oxygen content) and reduce mortality of the adult salmon and steelhead while at the hatchery.

This significant infrastructure improvement was undertaken by certified building contractors between August and October. The hatchery now has the capacity to bulk incubate 1,000,000 salmon eggs (i.e., pink and chum), incubate a further 1,000,000 eggs in vertical stacks (i.e., depending on species - coho, pink, chum or steelhead) (Figure 15; Figure 16; Figure 17).

FIGURE 15 REMOVAL OF PALLANT BOXES AND SITE CLEARANCE

Water Committee

FIGURE 16 INTERNAL RENOVATION OF THE INCUBATION AND WADER ROOMS

FIGURE 17 THE NEW BULK INCUBATORS COMPLETE WITH OUR 500,000 CHUM EGGS

The second hatchery upgrade included repainting the hatchery office and replacement of our office equipment, including computers, a printer and writing desks. The third facility upgrade involved installation of a roof over the new backup power supply generator to reduce snow and water damage during inclement conditions. Other upgrades or replacements included waders and wet weather gear for hatchery staff, along with waders for volunteer use at the hatchery or our works sites within the watershed.

Water Committee

Financials

The following sections provide an overview of the funding approvals, revenue and expenditure for the SSS during 2020. Please note that the SSS's fiscal year runs between April 1, 2020 to March 31, 2021.

Significant 2020 Funding Approvals

Multiple funding proposals were prepared by hatchery staff and submitted for consideration of funding for the hatchery and education centre, along with our conservation activities within the watershed. Successful funding agreements outside of our annual contribution agreements from DFO and Metro Vancouver are summarised in the following sections.

BC Salmon Restoration and Innovation Fund (BCSRIF)

The final contract was agreed on July 9, 2020 for funding from the BCSRIF totalling $258,365 for the 2020/21 fiscal year. These funds are allocated for the Rockslide Mitigation project, radio telemetry monitoring and other habitat enhancement proposals within the watershed. The SSS are continuing to work at the Rockslide until Christmas 2020, while radio telemetry monitoring work will continue into January 2021. We are grateful to BCSRIF for this significant funding agreement, without which mitigation and monitoring works would not have been possible for the rockslide.

Pacific Salmon Foundation (PSF)

The proposals were approved on April 21, 2020 for funding totalling $60,424 to be used by December 2020. These funds were secured for the hatchery infrastructure renewal project and included the expansion of our incubation room to accommodate new egg incubation tanks, along with upgrading the water supply plumbing from the aeration tower and the groundwater pond to the hatchery facility. The SSS completed the incubation room and water supply upgrades and we most appreciate PSF's funding support, without which the incubation room and water supply works would not have been possible.

Canadian Wildlife Federation (CWF)

The proposal was approved on May 8, 2020 for funding up to $70,000 to be used by December 31, 2020. These funds were secured for the rock drilling and breaking works at the Well impoundment (an area ~300m downstream of the Rockslide site). The SSS completed the Works at the Well during August 2020 and the costs for these works was $53,100. We are most appreciative for the funding support from CWF, without which works would not have been possible within the Well impoundment area.

District of North Vancouver Firefighers

The Firefighters charity generously contributed towards our GDS education program, as part of their annual Firefighters Fishing Derby on September 25, 2020. Funding from the firefighters has been an annual funding contribution and this year the contribution was $20,000. The SSS have allocated these funds to help operate the GDS program and we are most appreciative for this funding support, without which the GDS education program would not be possible.

Neptune Terminals

Neptune Terminals generously contributed $10,000 towards the Gently Down the Seymour education program. Funding from the Neptune Terminals is based on a three-year funding contribution for GDS and this years' fund represents the third year of this agreement.

Water Committee

Seymour Salmonid Society 2020 Revenue

Table 3 provides a summary of the SSS revenue for 2020.

TABLE 3 SEYMOUR SALMONID SOCIETY OPERATIONS REVENUE 2020

Funding Partner	Allocations	Funding Amount
Metro Vancouver	Hatchery Operations	$125,000
Fisheries & Oceans Canada	Hatchery Operations	$100,000
Additional Revenue'	Education/Projects	$372,646
	Total Revenue	**$597,646**

Additional 2020 Revenue Summary* (from 'Additional Revenue' in Table 3)

The funds provided by Metro Vancouver enabled SSS staff to accrue supplementary monies for specific projects and programs. Table 4 provides a summary of these amounts and allocations.

TABLE 4 SEYMOUR SALMONID SOCIETY ADDITIONAL REVENUE 2020

Source	Project	Amount
BC Salmon Restoration & Innovation Fund (BCSRIF)	SWRP (Restoration)	$160,000*
Pacific Salmon Foundation	Capital Improvements	$109,824
Canadian Wildlife Federation (CWF)	The Well Mitigation Project	$53,100
District North Shore Fire Fighters	Education Programs	$22,500
Neptune Terminals	Education Programs	$10,000
Canada Summer Jobs Fund	Seasonal staff wages	$9,189
Public Events/Donations/Memberships	General Society business	$4,855
Vancouver Firefighters Union	General Society business	$1,886
Loblaws Inc.	General Society business	$1,292
	Total Revenue	**$372,646**

***Note**: * - this is the revenue received in 2020 as of December 1, 2020; however, the total funds allocated by BCSRIF for the fiscal year to March 31, 2021 is $258,365. The remaining BCSRIF funds will be expended by March 31, 2021.*

Water Committee

Seymour Salmonid Society 2020 Expenditures

Table 5 provides a summary of the SSS expenditure for 2020.

TABLE 5 SEYMOUR RIVER HATCHERY OPERATIONAL EXPENDITURE 2020

Expenditure Type	Expenditure
Wages	$187,165
Overhead	$36,750
Fish Food	$7,269
Vehicle Maintenance / Fuel	$3,251
Fish Culture Equipment	$2,486
Operations / Maintenance	$2,255
Mileage	$1,577
Safety and Training	$1,575
Communications (Mobile Phone / Internet)	$1,324
Additional Expenditure	$251,035
Total Expenditure	**$494,687**

Additional 2020 Expenditure Summary (from 'Additional Expenditure' in Table 5)

Table 6 provides a summary of the additional expenditure incurred by the SSS that is secured via external funding applications.

TABLE 6 SEYMOUR SALMONID SOCIETY ADDITIONAL EXPENDITURE 2020

Expenditure Type	Expenditure
Facility Upgrade / Equipment	$110,064
Rockslide Mitigation Project	$81,198*
The Well Mitigation Project	$53,100
Environmental Education	$5,173**
Landscaping Upgrade Concept Drawings	$1,500
Total Additional Expenditure	**$251,035**

***Note**: * - this is the expenditure for the 2020 as of December 1, 2020; however, the total costs associated with BCSRIF funded projects until March 31, 2021 is $258,365 so the remaining funds will be expended by March 31, 2021. ** - expenditure was significantly lower in 2020 as the GDS program was cancelled due to COVID-19 so expenditure is for GDS administration costs before COVID-19 restrictions.*

Water Committee

A Year in Review

Much has been accomplished in 2020 despite the significant restrictions imposed on the Society and wider volunteer community through the COVID-19 pandemic. The Rockslide mitigation project, including the works at the Well, continued successfully during the summer; the SSS released adult coho salmon above the Seymour Falls dam for a second year in a row; we updated capital operations equipment including expansion to our egg incubation facilities and water supply for the hatchery; the broodstock program provided sufficient fish for the hatchery broodstock program and to release a small number of fish above the rockslide and to the middle reaches of the river (Figure 18); fundraising was successfully completed. We also secured significant funding from the BCSRIF for our works towards the Rockslide mitigation project and other habitat works within the watershed for 2020.

Other significant accomplishments were the confirmation that some returning coho and steelhead adults are successfully making their way through the Rockslide and the Well areas, without human intervention. We were able to begin in-river seining events at the hatchery pool again, which has not occurred since summer/fall 2014 and we were successful on spawning and raising the next generation of steelhead, coho and chum salmon fry for the watershed. Thus, although at the time of writing this report the final counts and data have yet to be completed, we are optimistic for future returns given that the rockslide is now passable to some returning adults, and/or during certain river flows.

FIGURE 18 ADULT SALMON CAPTURED VIA BROODSTOCKING IN THE SEYMOUR RIVER

Year five of the rockslide mitigation project was completed on budget and on time with major works ending on November 26th when the house rock was broken. Additional works are continuing at the rockslide to further break down the remaining house rock boulders until Christmas 2020. We are now awaiting the increased flows in Spring of 2021 to move the broken rock, before planning for required works in 2021.

The SSS was unable to host our GDS education program this year, nor were we able to attend our usual community events during 2020 due to the COVID-19 pandemic; however, we did manage to run our annual World Rivers day estuary cleanup event in September. We hope to re-establish our community event presence in 2021 as COVID-19 restrictions are lifted.

Water Committee

The hatchery facility upgrades also provided safe, warm and visually appealing facilities for our hatchery staff, volunteers and visitors coming to the hatchery in 2020, while also reducing the health and safety risks to the hatchery staff. We were able to upgrade our incubation room and expand our incubation capacity for the 2020 spawning cycle and for 2021 and beyond. We were also able to replace some of our office equipment (via 2019 funding from PSF), along with continue our ongoing equipment maintenance and replacement program.

This year we spawned 20 pairs of Seymour River chum, along with an additional 500,000 fertilised eggs collected from the Alouette River. Coho spawning is now well underway, with a maximum of 75 pairs to be spawned at the hatchery by the end of January 2021. Thus far, no steelhead have been spawned, but we are targeting at least eight pair of summer steelhead and five pairs of winter steelhead to be spawning during March/April 2021.

Looking Forward

The year ahead is expected to be as busy as the last, with the most significant major projects we will be focusing on are as follows:

- **The Rockslide Mitigation** – works required subject to review in Spring 2021 following freshet
- **GDS Education Program** – subject to COVID-19 restrictions; we would like to re-start our GDS program to provide potentially a Fall 2021 program at least
- **Adult Radio Telemetry Tracking** – for returning adult salmon to monitor movement through the rockslide
- **Adult Carcass Recovery** - within the river and tributaries to better understand the number of coho migrating through the rockslide to spawn naturally
- **Restoration Activities** – for existing and new aquatic habitat for both juvenile rearing and adult spawning activities as part of our BCSRIF project
- **Community Events and Enhancement Program** – subject to COVID-19 restrictions; we would welcome the ability to host and/or attend community events in 2021
- **Ongoing Hatchery Infrastructure Renewal** – to secure the hatchery and education facility for the next generation of community volunteers, elementary school children and and fisheries scientists.

The juvenile steelhead and coho will continue rearing in the ponds over the winter and released during June 2021. The steelhead smolts will be released into Burrard Inlet at DFO's Centre for Aquaculture and Environmental Research in West Vancouver, while the coho smolts will be released from the hatchery. Some coho smolts will also be held for approximately three weeks in DFO net pens, before being released to provide a recreational fishery within the Port Moody area during June 2021. In addition, coho fry will be released upstream of the dam, along with off channel habitat between the dam and the rockslide during Spring 2021. The chum salmon fry will also be released to the lower river during Spring 2021. Some of the chum eggs will also be used within DFO's Salmonids in the Classroom program.

Engineers from Northwest Hydraulics consultants and BGC Consultants will assess the rockslide area after Spring 2021 freshet, when water levels drop. Once they have determined the amount of movement that occurred over the high-flow winter months a plan of action will be established for 2021. Any in-river work is anticipated to run during summer 2021, water flow dependent. Funding is in place to accommodate a small work schedule where needed; however, if significant works are required additional funding will need to be negotiated.

Water Committee

metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

To: Water Committee

From: Larina Lopez, Division Manager Corporate Communications, External Relations
Amy Weiss, Project Coordinator, External Relations

Date: March 9, 2021 Meeting Date: April 15, 2021

Subject: **Watering Regulations Communications and Regional Water Conservation Campaign for 2021**

RECOMMENDATION

That the Water Committee receive for information the report dated March 9, 2021, titled "Watering Regulations Communications and Regional Water Conservation Campaign for 2021".

EXECUTIVE SUMMARY

Water conservation is a major component of Metro Vancouver's planning to ensure the sustainable use of water resources. To support understanding of and compliance with water conservation policies and programs, as well as encourage personal pride in reduced water use, Metro Vancouver delivers annual region-wide water conservation campaigns. Metro Vancouver will communicate the May 1 – October 15 watering regulations starting April 26 via social media, and promotional materials distributed to Member Jurisdictions for public education and enforcement throughout the summer season. The annual We Love Water campaign will emphasize water source and system awareness starting May 17, and will promote outdoor water conservation information from July 5 – September 5. A targeted media buy will include television, radio, outdoor, and digital promotions all leading to the website.

PURPOSE

To update the Water Committee on watering regulations communications and the annual regional water conservation campaign.

BACKGROUND

Metro Vancouver undertakes several communications initiatives to ensure water resources are conserved and efficiently used throughout the region. Communication of the region-wide watering regulations supports the *Drinking Water Conservation Plan* (which helps manage the use of drinking water during periods of high demand and largely impacts the watering of lawns and landscapes). A regional communications campaign — the We Love Water campaign — is now in its sixth year. The campaign increases awareness of Metro Vancouver's water sources, system, and the need for residential water conservation, and provides residents with tips for using less water through the dry summer season.

The We Love Water Campaign also reinforces how and why water conservation is a key component in managing the drinking water system over the coming decades. Increased conservation and lower per

capita demand can potentially work to delay capital infrastructure, lower operational costs and address challenges related to climate change.

This report provides an update on communications around the 2021 watering regulations and the 2021 regional water conservation campaign as identified in the 2021 Water Committee work plan.

WATER CONSERVATION COMMUNICATIONS

2021 Watering Regulations Communications

Metro Vancouver collaborates with Members to determine the most effective messaging and methods for consistently communicating the regional watering regulations contained within the *Drinking Water Conservation Plan* to residents and businesses.

Communication will begin April 26 with Lawn Watering Regulations in effect May 1 - October 15.

In 2021, Metro Vancouver will undertake the following activities to create awareness:

- Develop and distribute communications materials to support Members' education and enforcement programs, including translated materials upon request;
- Distribute information on the regulations via mailed communication material to residents, targeted to homes most likely to have lawns (detached, duplexes and townhomes);
- Notify public of regulations via targeted social media and digital advertising; and
- Issue a media release and conduct interviews.

Communications will direct residents to Metro Vancouver's lawn watering regulations webpage. This page also features water-efficient lawn care and gardening content, including links to Metro Vancouver's Grow Green Guide, and a simplified schedule to help the user determine what watering activities are allowed on a given day.

Examples of communications materials to support the regional watering regulations are included in Attachment 1.

Regional Water Conservation Campaign Communications

The regional 'We Love Water' conservation campaign encourages mindful and responsible use of drinking water and increased awareness and pride for Metro Vancouver's water sources and system.

The campaign will be sequenced to emphasize water source and system awareness beginning May 17, then incorporates outdoor water conservation information from July 5 - September 5. By teaching residents about where their drinking water comes from, and the amount of work it takes to reach their taps, they will better understand the importance of using less of our treated drinking water for discretionary purposes. Information about Metro Vancouver's water system will target the 18 – 34 age group (the least likely group to know where their water comes from), while outdoor conservation topics will target home owners with lawns who are most likely to use water outdoors.

Campaign components to be considered in 2021 to generate awareness and encourage conservation will include:

- Television broadcast partnership, featuring commercials and segments endorsed by media personalities, as well as branded online content;
- Commercials on additional television networks;
- Radio broadcast partnership featuring dry weather alerts from media personalities;
- Weather-triggered digital billboards on major transportation routes throughout Metro Vancouver;
- Targeted social media advertising;
- Online banner, YouTube video, search engine advertising targeting users' interests (e.g., gardening, lawns, car washing), and weather forecast-activated digital advertising; and
- New virtual event opportunities at water facilities via Facebook Live.

The 2021 campaign will build on the creative concept established in previous years, with a unified 'pipe' theme linking features of the water system with conservation messaging. The campaign will continue to emphasize the people and roles involved in providing clean, safe drinking water; Metro Vancouver staff will be featured in promotions to show the level of care and responsibility they provide to the different stages of the process, from the watersheds to delivering water to residents. By putting a relatable, human face on the water system, the approach helps residents understand why they should also care about their drinking water, attach value to it, and not waste it.

Examples of communication materials and draft concepts to support the regional conservation campaign are included in Attachment 2. All materials lead to the website for conservation tips and information about Metro Vancouver's water sources and system. All materials will be shared with Members for display and distribution through localized opportunities.

ALTERNATIVES

This is an information report. No alternatives are presented.

FINANCIAL IMPLICATIONS

The 2021 watering regulations communications and regional water conservation campaign have a total budget of $270,000. These costs are included in the 2021 Water Services communications program budget managed by External Relations.

CONCLUSION

Metro Vancouver will communicate the annual regional watering regulations starting April 26 via social media, digital advertising, and promotional materials distributed to Members for public education and enforcement throughout the summer season. The We Love Water regional water conservation campaign will begin May 17, with a mix of television, radio, outdoor, and digital advertising, and will emphasize water resource education and incorporate conservation messaging from July 5 - September 5. Creative materials and collateral will be shared with Members so they can support the campaign through their own communications channels.

Attachments:

1. 2021 Watering Regulations Communications Materials and Draft Creative
2. 2021 'We Love Water' Draft Creative Concepts

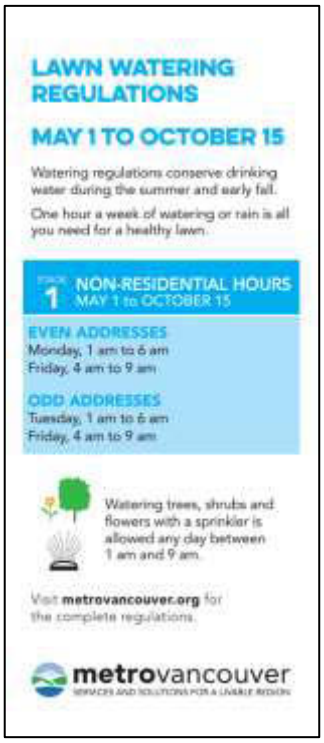
44445415

2021 Watering Regulations Communications Materials

Direct mail postcard:

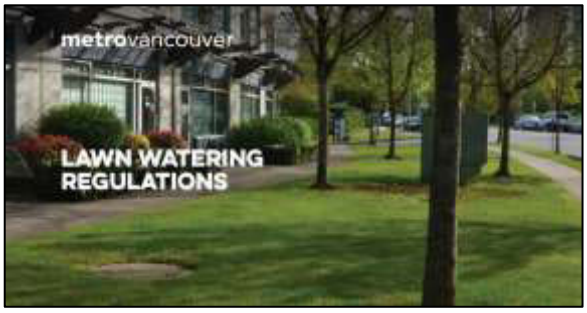
Residential education leaflet:

Non-residential education leaflet:

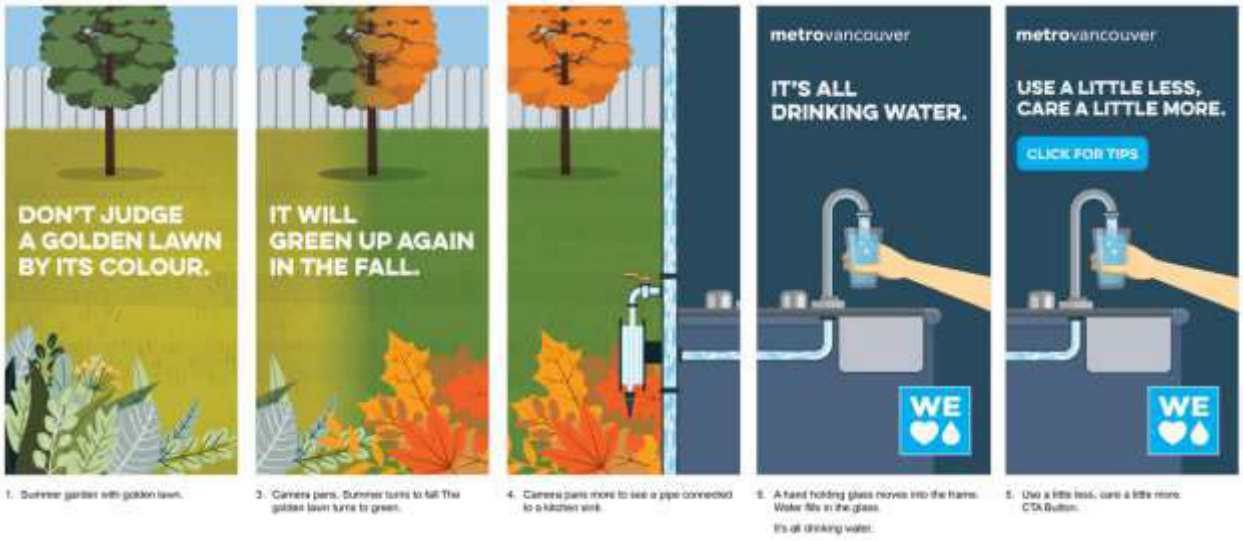


Waterwise irrigation and lawn care brochures, including translated version:

Social media image examples:



Draft concepts – animated banner ads for social media and digital advertising:



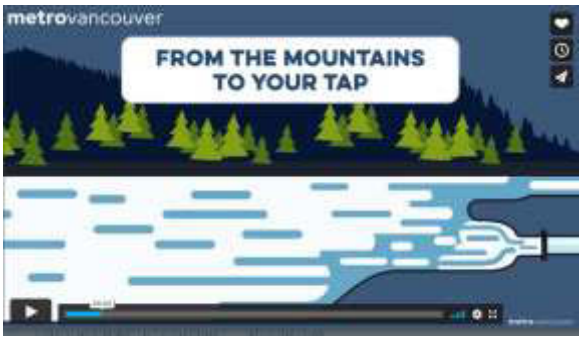
ATTACHMENT 2

2021 'We Love Water' Communications Materials

Print and digital poster examples:

Social media image examples:

Videos – water source and system education and awareness examples:



Draft concept – animated banner ads for social media and digital advertising:

metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

To: Water Committee

From: Marilyn Towill, General Manager, Water Services

Date: April 1, 2021 Meeting Date: April 15, 2021

Subject: **Manager's Report**

RECOMMENDATION

That the Water Committee receive for information the report dated April 1, 2021 titled "Manager's Report".

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1. Current Watershed Snowpack

Snow survey data from the watershed snow courses on April 1 showed a heavy snowpack with levels at 124% of average historical snow depth, and 121% of average snow water equivalent. In comparison, last year the April 1 data showed the snow depth and snow water equivalent at 102% and 98% respectively. A La Nina weather pattern has resulted in a winter with average precipitation, but with cooler than normal temperatures for January through March. For this period, it rarely rained to mountaintop elevations which has helped maintain and build through the end of March. The outlook for the next 2 weeks continues to show a high likelihood of below normal temperatures and average precipitation, resulting in continued snowpack accumulation through early April. Additionally, it is expected that these cooler conditions will keep snow in place for longer that we experienced in both 2019 and 2020. The best estimate for the May, 2021 snow survey, is for heavy conditions of over 125% of the normal range.

2. Capilano Hydropower Update

As part of the 2020 work plan, Water Services planned to undertake a follow-up analysis on a 2017 study on the potential for installing hydropower at the Cleveland Dam. This planned work included feasibility and preliminary design for both the hydropower component and improvements to fish passage past the dam. Unfortunately, BC Hydro cancelled their power buyback program making the projected return on investment for the hydropower project at the Cleveland Dam unachievable. As part of the 2021 work plan, the study will move forward with a change in scope to focus on improvements to fish passage and to consider whether it would be cost-effective for the GVWD to sell the power externally. The improvements to fish passage are an important component of the Joint Water Use Plan agreements the GVWD has signed with the Province of BC.

3. Beneficial Use of Drinking Water Treatment Residuals at Lafarge Cement Plant

The Seymour-Capilano Filtration Plant (SCFP) generates drinking water treatment residuals that consist of sediments, naturally occurring organic matter, and treatment chemicals. Since 2017, the residuals have been beneficially used at Lafarge Canada Inc.'s Richmond Cement Plant as a replacement for red shale, one of the raw materials in cement manufacturing. This recovery of resources from water operations diverts material from landfill and has resulted in over $1.8M of savings to Metro Vancouver compared to landfill disposal of the residuals.

Due to a shutdown of the Lafarge plant after an industrial accident, Metro Vancouver sent drinking water treatment residuals to Vancouver Landfill for disposal between November 19, 2020 and March 18, 2021. Landfill disposal of the residuals resulted in additional expenditures of approximately $110,000 in 2020 and $120,000 in 2021, compared to the cost of beneficial use. Delivery of drinking water treatment residuals to Lafarge for beneficial use resumed on March 19, 2021.

4. Work Plan

Attachment
Water Committee 2021 Work Plan

44293254

ATTACHMENT

Water Committee 2021
Work Plan

Priorities

1st Quarter	Status
Annual Energy Management Program Update	Complete
Capilano Hydropower Project Business Case Update	Pending
Corrosion Control Program – Copper Pipes Protection	Complete
Long Term Financial Plan	Pending
Residential Water Metering – Overview of Local Experience	Pending
Water Meter Replacement Program	Complete
Contract Approvals – Contracts > $5 Million (as applicable)	Complete
Water Policies (as applicable)	Complete
2nd Quarter	
Coquitlam Lake Water Supply Project Update	Pending
Drinking Water Customer Information Guide	Pending
Drinking Water Management Plan Update	Complete
First Nation Engagement Updates	Pending
GVWD Water Quality Annual Report	In Progress
Lawn Water Regulations Communication & Regional Water Conservation Campaign	In Progress
Seymour Salmonid Society 2020 Annual Report	In Progress
Status of GVWD Capital Expenditures	In Progress
Water Services Wildfire Preparedness Update	Pending
Water Supply Update for Summer 2021	Pending
Water Use-by-Sector Report	Pending
Contract Approvals – Contracts > $5 Million (as applicable)	Pending
Water Policies (as applicable)	Pending
3rd Quarter	
Annual Dam Safety Program Update	Pending
Status of GVWD Capital Expenditures	Pending
Quality Management System for Drinking Water Update	Pending
Contract Approvals – Contracts > $5 Million (as applicable)	Pending
Water Policies (as applicable)	Pending
4th Quarter	
Annual Budget and 5-year Financial Plan – Water Services	Pending
Environmental Management Framework	Pending
Regional Water Conservation Campaign and Water Regulations Communications 2021	Pending
Regional Water Supply System Seismic Resiliency Study	Pending
Status of GVWD Capital Expenditures	Pending
Summer 2021 Water Supply Performance	Pending
Watershed Fisheries Initiatives Annual Update	Pending
Contract Approvals – Contracts > $5 Million (as applicable)	Pending
Water Policies (as applicable)	Pending