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# Similkameen and Tulameen Rivers Water Quality Assessment

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Ministry of Environment and Climate Change Strategy

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## Executive Summary

In August 2022, water quality was assessed at eight locations in the Similkameen and Tulameen Rivers in and around Princeton, BC. Parameters were selected to examine the effects on water quality in the Similkameen River from a) the town of Princeton, b) different urban land uses, including residential, commercial, and industrial, and c) the mixing of the two rivers. Water quality in both rivers was good, with only water temperature and microbial indicators exceeding water quality guidelines. The town of Princeton and the different land uses had no noticeable effect on water quality. The joining of the two rivers affected water quality within the Similkameen River as estimated through use of a simple mixing model.

## Similkameen and Tulameen Rivers

The Similkameen River extends approximately 190 km from its headwaters in Manning Park, BC to its confluence with the Okanagan River near Oroville, Washington, USA. The Similkameen watershed encompasses approximately 9,190 km<sup>2</sup> within BC (Phippen 2002), and upstream of Princeton, the Similkameen drains approximately 1,810 km<sup>2</sup> (Government of Canada 2022c). The Tulameen River joins the Similkameen River east of the Town of Princeton and drains approximately 1,780 km<sup>2</sup> (Government of Canada 2022c). Typical of snowmelt-driven systems, flows in the Similkameen and Tulameen Rivers peak in late spring (i.e., May/June) and have their lowest flows in late summer (i.e., August/September). In addition, the Tulameen River is prone to flooding during rain-on-snow events during wet winter months (Ecora 2021), including the atmospheric river in November 2021. Evaluation of the effects of the 2021 flooding can be found on the BC Flood Water

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Quality Monitoring Task Force Hub <https://fwqmtf-bcgov03.hub.arcgis.com/pages/princeton>

The Similkameen and Tulameen Rivers support populations of several fish species, including rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), reidside shiner (*Richardsonius balteatus*), dace (*Rhinichthys* spp.), northern pikeminnow (*Ptychocheilus oregonensis*), mountain whitefish (*Prosopium williamsoni*), sucker (*Castostomus* spp.) and sculpin (*Cottus* spp.). Anadromous species are precluded from the Canadian portion of the Similkameen River by the Enloe Dam in Washington State (State of Washington 2021).

## Princeton, BC

Princeton encompasses approximately 59 km<sup>2</sup> at the foothills of the Coast Mountains in southern BC, and lies within the ancestral, traditional, and unceded territory of the Sməlq'míx People. The town of Princeton sits near the confluence of the Similkameen and Tulameen Rivers within the Ponderosa Pine biogeoclimatic zone, a zone common within the dry valleys of the southern interior of BC. Due to the rain shadow effect of the Coast Mountains, Princeton's average annual precipitation is only 346.9 mm and the average daily temperatures are moderate typically ranging between -5.6 and 17.9°C (Government of Canada 2022a).

Most nearby residential, commercial, and industrial land uses occur within the town of Princeton (hereafter, the 'Townsite'), which is flanked by the Similkameen River to the south and Tulameen River to the north.

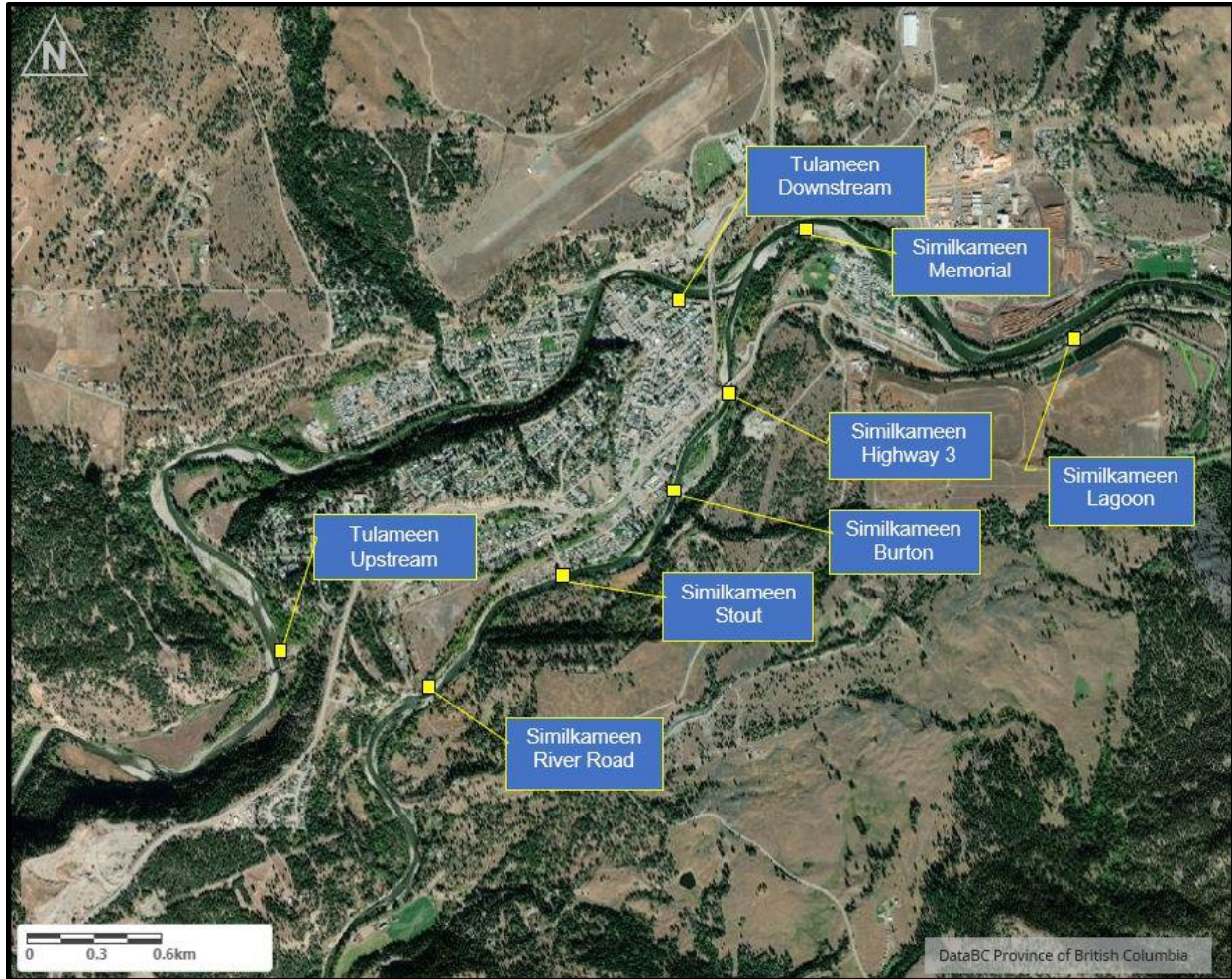
## 2022 Sampling Program

In August 2022, the Regional Operations Branch of the Environmental Protection Division within the British Columbia Ministry of Environment and Climate Change Strategy (ENV) completed a water quality sampling program on the Similkameen and Tulameen Rivers in Princeton, BC. The objectives of the sampling program were to:

1. Improve the understanding of potential effects from the Townsite to water quality of both the Tulameen and Similkameen Rivers;

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2. Provide insight into potential water quality effects in the Similkameen River originating from specific residential, commercial, and industrial land uses within the Townsite;
  3. Assess the influence of Tulameen River on Similkameen River water quality; and
  4. Collect current water quality information to inform future water quality assessments.

Water quality samples were collected and *in situ* water quality measurements were obtained at eight locations on the Similkameen and Tulameen Rivers in the vicinity of the Princeton Townsite (Figure 1). Each site was selected to address one or more of the sampling program's objectives (Table 1). As water quality parameters were selected to address individual objectives, not all parameters were measured at every site. Sampling site metadata and sampled parameters are provided in Appendix A. Sample site photographs are provided in Appendix B.



**Figure 1.** Water quality sampling locations in the Similkameen and Tulameen Rivers near Princeton, BC.

**Table 1.** Sampling Objectives by Location. Data on each site can be found in Appendix A

Sampling Objective		Sample Sites	
		Upstream	Downstream
1	Improve understanding of the potential effects of the Princeton Townsite on downstream water quality in the Tulameen and Similkameen Rivers.	Tulameen Upstream  Similkameen u/s Sites <sup>a</sup>	Tulameen Downstream  Similkameen d/s Sites <sup>b</sup>
2	Provide insight into potential water quality effects on Similkameen River originating from adjacent land uses.	Industrial Land Use	Similkameen River Road  Similkameen Stout
		Residential Land Use	Similkameen Stout  Similkameen Burton
		Commercial Land Use	Similkameen Burton  Similkameen Downstream
		Mixed Land Use	Similkameen Memorial  Similkameen Lagoon
3	Assess the influence of Tulameen River on Similkameen River water quality.	Similkameen u/s Sites <sup>b</sup>	Similkameen Memorial
4	Collect background water quality information to inform future water quality assessments.	All Sites	

<sup>a</sup> includes four sites in the Similkameen that are upstream of the confluence (see Appendix A).

<sup>b</sup> includes two sites in the Similkameen that are downstream of the confluence (see Appendix A).

Samples were collected on August 16 and 17, 2022. Weather at the time of sampling was sunny, with ambient temperatures exceeding 30°C. In the month prior to sampling, measurable precipitation in Princeton was recorded on only two days: August 12 (2 mm) and July 18 (1.1 mm) (Government of Canada 2022b). Average discharge for the Tulameen and Similkameen Rivers over the 48-hour

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period commencing August 16, 2022 was 2.66<sup>1</sup> and 6.35<sup>2</sup> m<sup>3</sup>/s, respectively. These discharges represent approximately 12 percent of the annual average discharge of the Tulameen (22 m<sup>3</sup>/s) and approximately 26 percent of the annual average discharge of the Similkameen (24 m<sup>3</sup>/s) Rivers<sup>3</sup>. Both rivers were at or near low flow condition at time of sampling.

Sampling followed procedures described in the British Columbia Field Sampling Manual (ENV 2013). Briefly, surface water samples were collected in laboratory-supplied sample bottles specific to the parameter being tested. Field personnel wore disposable nitrile gloves that were changed between each location. Samples were collected by wading a short distance from the shore to ensure the sample was collected in the flow and was representative of the river. Where required to meet laboratory standards, samples were filtered and preserved in the field. All samples were stored in coolers with ice and shipped as soon as possible to the laboratory. Specific conductivity, dissolved oxygen, pH, temperature, and turbidity were measured *in situ* with a YSI EXO Multiparameter Water Quality Sonde.

To evaluate field sampling procedures and environmental variability, replicate samples were collected at both the Tulameen Upstream and Similkameen Memorial sites and field blank samples were collected at the Tulameen Upstream and Similkameen Highway 3 sites.

Concentrations of all measured parameters were screened against the following water quality guidelines and objectives if available: provincial water quality guidelines (BCWQG) for aquatic life, wildlife, livestock, and irrigation uses (ENV 2021a, ENV 2021b); Health Canada Guidelines for Canadian Drinking Water Quality (CDWQG) (Health Canada 2020a, 2020b); Health Canada Guidelines for Recreational Water Quality (RWQG) (Government of Canada 2012); and Ambient Water Quality Objectives for the Similkameen River Okanagan Area - 1990 Update (Swain 1990). Where a guideline was more current and protective than an objective, the result was screened against the guideline. Water quality guidelines and objectives are provided in Appendix C.

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<sup>1</sup> [https://wateroffice.ec.gc.ca/report/real\\_time\\_e.html?stn=08NL024](https://wateroffice.ec.gc.ca/report/real_time_e.html?stn=08NL024)

<sup>2</sup> [https://wateroffice.ec.gc.ca/report/real\\_time\\_e.html?stn=08NL007](https://wateroffice.ec.gc.ca/report/real_time_e.html?stn=08NL007)

<sup>3</sup> <https://kwt.bcwatertool.ca/streamflow>

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As this was one-time 'snapshot' sampling effort, only maximum concentrations and short-term water quality criteria were applicable. Consideration of long-term criteria typically requires a larger data set collected over multiple weeks (i.e., five samples over 30-day period). Accordingly, caution should be used when extrapolating water quality results or inferring long-term water quality conditions from a single sampling event.

## Results and Discussion

Concentrations for all parameters at all sampling sites are provided in Appendices D and E. Overall, both the Tulameen and Similkameen Rivers had good water quality at all sampling sites except for water temperature and microbial indicators. All other parameters met applicable water quality criteria. Replicate and blank results also met the acceptability criteria (ENV 2013).

Elevated water temperature can directly affect aquatic organisms by increasing their metabolic demands, altering the properties of the water (e.g., reducing the amount of dissolved oxygen), and increasing the toxicity of some parameters. The BCWQG for aquatic life defines a daily maximum temperature of 19°C for streams with “unknown” fish distribution. The aquatic life temperature guideline was exceeded at four of the eight sampling sites (i.e., Similkameen Burton, Similkameen Stout, Similkameen Lagoon, Similkameen Memorial). All four sampling sites that showed temperature exceedances were sampled in the afternoon between 1215 and 1525 hours. At sites sampled in the morning (1000 to 1130), water temperature (17.2 to 18.1°C) was below the guideline. These exceedances in temperature were likely not a result of water inputs from the Townsite but the result of hot afternoon air temperatures, enhanced by low flows, and limited riparian cover. Historically, afternoon water temperatures in the Similkameen have routinely exceeded the BCWQG maximum temperature guideline (Phippen 2002).

Where fish distribution is known, the BCWQGs identify optimal water temperature ranges for several cold-water fish species and life stage with the guideline specifying that temperature should not vary more than 1°C outside of the optimal range of the most sensitive species/life stage. While fish distributions in the Princeton study area were not assessed for the purposes of this report, mountain whitefish has been documented within the Similkameen system. If these fish are

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present in the study area, all recorded water temperatures exceeded the 13°C maximum temperature guideline for rearing mountain whitefish.

Microbial indicators are used to assess the presence of fecal contamination in a waterbody. This contamination could result from sewage or other animal waste including wildlife and waterfowl entering the river from a variety of sources. *E. coli* counts ranged between 2 and 9 CFU/100mL and Enterococci counts ranged between 120 and 350 CFU/100mL, which were unexpectedly high. Due to long transport times, sample holding times for microbial analyses (30 hours) were exceeded for all samples, which can result in lower coliform counts (Thapa *et al.* 2022, US Environmental Protection Agency 2006) as *E. coli* cannot multiply outside of the organism. Given these handling time exceedances, these microbial results should be viewed with caution until additional data is collected.

The highest Enterococci counts in each river were observed at sites upstream of the Townsite. For example, the Similkameen River Rd. site (upstream) had Enterococci counts of 350 CFU, compared to the downstream sites that had counts of less than 221 CFU (Appendix D). Typically, microbial indicators increase in urban areas due to pet waste, failing septic systems, and/or sanitary system leaks, but during this assessment, the high counts for microbial indicators measured at the upstream sampling locations suggests the Townsite is not a large source of fecal contamination. Upstream of the Townsite, nearby land uses include undeveloped forested areas, agricultural fields, and low-density residential development.

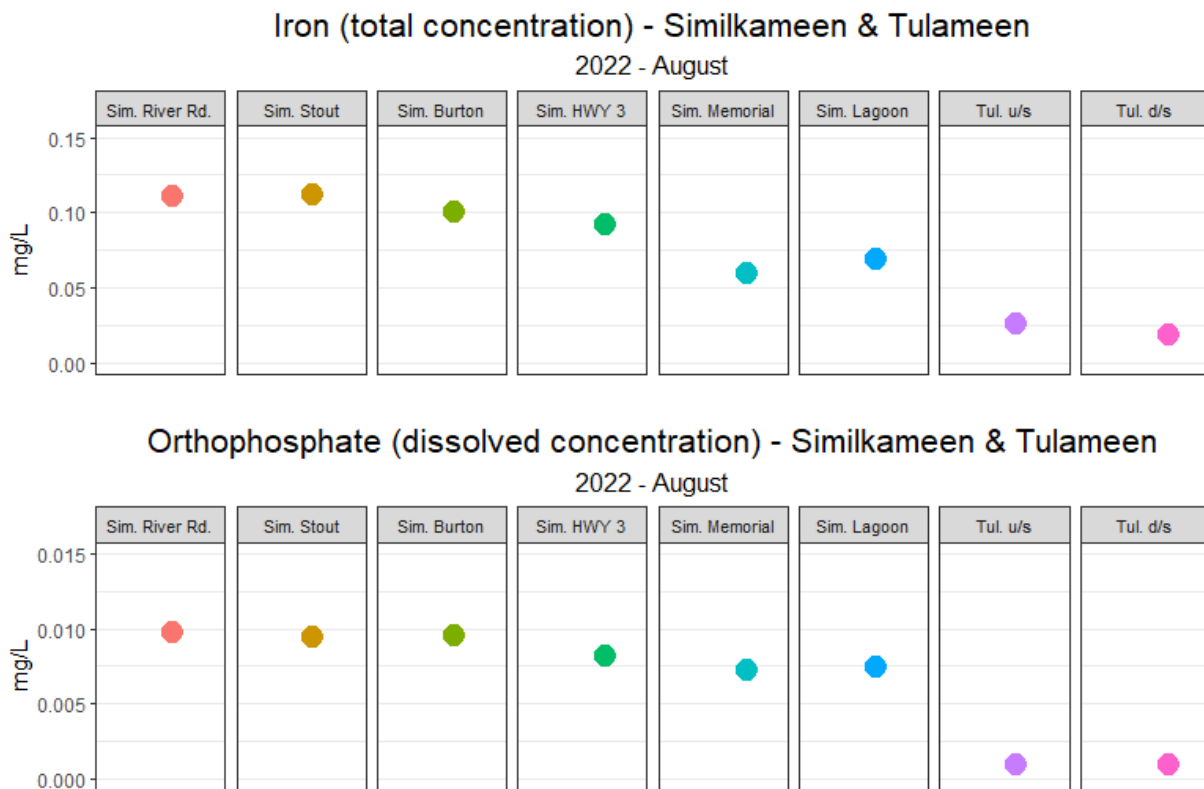
As single samples, these microbial counts cannot be compared to existing water quality guidelines. To obtain microbial indicator counts suitable for comparison with guidelines requires multiple samples collected over time. While comparison with guidelines cannot be conducted, the *E. coli* and Enterococci counts observed during this assessment support earlier findings (Swain 1990) that the waters from neither river should be used as drinking water without proper treatment.

The influence of land use on water quality is often detected through changes in water quality parameters such as metals, nutrients, turbidity, total suspended solids, and microbial indicators. No meaningful differences in water quality were observed between upstream and downstream sites on the Tulameen and Similkameen Rivers (Objective 1) except for high microbial indicators at the upstream location.



In addition to the more standard metals and nutrients, the sampling program included analyses for over 30 hydrocarbon and volatile organic compounds (VOCs), which are often associated with urban land use features such as vehicles, pavement, and industrial activities. All hydrocarbons and VOCs results were below the laboratory detection limits, and other parameters varied little among the Similkameen locations adjacent to the Townsite (Figure 2). No effect of different land uses on water quality in the Similkameen River was found (Objective 2).

Objective 3 was to assess the influence of the Tulameen River on water quality in the Similkameen River. Water quality varied between the two rivers. In general, concentrations of most metals and nutrients tended to be higher in the Similkameen compared to the Tulameen River, so it was expected that concentrations of these parameters would decline in the Similkameen River below

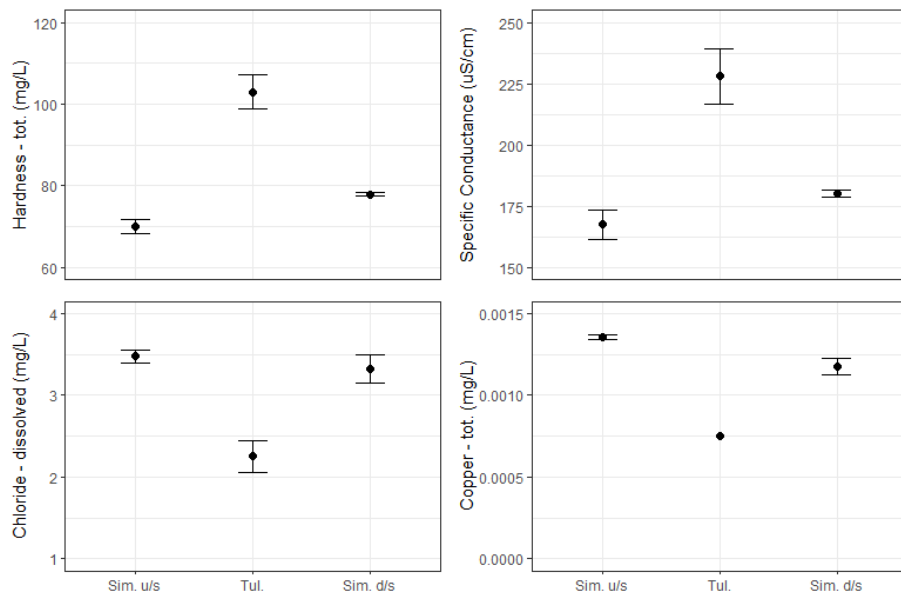


**Figure 2.** Concentrations (mg/L) of total iron and orthophosphate at eight locations in the Similkameen and Tulameen Rivers near Princeton, B.C. These two parameters are representative of the general relationship of parameter concentrations among the sites.

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the confluence due to mixing. A simple mixing model<sup>4</sup> was used to show how thoroughly mixed the two rivers are by predicting parameter concentrations in the Similkameen River downstream of the confluence. Values measured 100 meters downstream of the confluence (Figure 3; Appendix F) were consistent with the model's predictions showing good mixing.

The data collected in this assessment augments the baseline information currently available for the Similkameen and Tulameen Rivers within the vicinity of Princeton



**Figure 3.** Results of averaged hardness, specific conductance, chloride, and total copper in the Tulameen River and upstream and downstream of the confluence in the Similkameen River. “Sim u/s” includes Similkameen River Road, Similkameen Stout, Similkameen Burton, and Similkameen Highway 3 sites; “Tul” includes Tulameen Upstream and Tulameen Downstream sites; “Sim d/s” includes Similkameen Memorial and Similkameen Lagoon sites.

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<sup>4</sup> Using a simple mixing model, the concentration of a parameter in the Similkameen downstream of the confluence would be a volume-weighted average of the parameter concentrations in the Tulameen and the Similkameen upstream of the confluence. Assuming similar cross-sectional areas for each river, river volumes would be proportional to their discharges of 2.66 and 6.35m<sup>3</sup>/s for the Tulameen and Similkameen Rivers, respectively.

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BC (Objective 4). In addition to adding to sampling results at the existing Similkameen at Highway 3 and Similkameen Lagoon locations, the addition of four new sampling locations creates more spatial resolution of the water quality information now available on the Similkameen River.

## Conclusions

This assessment found generally good water quality in the Tulameen and Similkameen Rivers near Princeton. While temperatures were above those preferred by some fish species, this was likely due to environmental factors such as solar heating and were not a result of warm water inputs from the Townsite. Microbial indicators support earlier findings that river water should not be used as drinking water without proper treatment. Microbial results also indicate the Townsite is likely not contributing a significant amount of fecal contamination to the Tulameen or Similkameen Rivers.

## Recommendations

- While analytical results represent a snapshot of conditions at the time of sampling and provide important background information for future assessments, a more intensive sampling effort would be needed to better assess impacts of adjacent land uses. Accordingly, a minimum of five samples collected over a 30-day period (i.e., a 5-in-30 program) is recommended during high and low flow periods on the Tulameen and Similkameen Rivers.
- In addition, sampling that captures the first precipitation event following an extended period of dry weather (i.e., "first flush") and a sample collected following a period of extended precipitation would provide insight into potential non-point (e.g., runoff from road surfaces, agricultural fields, lawns, etc.) influences on water quality.
- The BC Water Resource Atlas shows active water licenses for domestic and irrigation purposes on the Similkameen and Tulameen Rivers within the sampled area. It is unknown if these active water licenses are being used, but we recommended that water quality information be provided to water license managers for sharing with water license holders.

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**APPENDIX A**

**Sample Locations and Parameters**

	<b>EMS<sup>1</sup> Site Name</b>	<b>EMS Site Number</b>	<b>Latitude, Longitude</b>	<b>Location Name</b>	<b>Date/Time Sampled</b>	<b>Sample Type(s)</b>	<b>Parameters</b>	
Similkameen u/s Sites	Similkameen R at River Road	E329512	49.446588° -120.522726°	Similkameen River Road	Aug 16/22 @1130	REG	-Phys. properties -Gen. chemistry -Metals (T & D) -Cyanide	-Nutrients -Microbial indicators -VOCs -Hydrocarbons
	Similkameen River at Stout Street	E329411	49.451305° -120.514084°	Similkameen Stout	Aug 16/22 @1215	REG	-Phys. properties -Gen. chemistry -Metals (T & D) -Nutrients	-Microbial indicators -VOCs -Hydrocarbons
	Similkameen River at Burton Avenue	E329491	49.455143° -120.507211°	Similkameen Burton	Aug 16/22 @1330	REG	-Phys. properties -Gen. chemistry -Metals (T & D) -Nutrients	-Microbial indicators -VOCs -Hydrocarbons
	Similkameen River @ Princeton	0500629	49.458440° -120.503690°	Similkameen Highway 3	Aug 17/22 @1115	REG BLF	-Phys. properties -Gen. chemistry -Metals (T & D) -Nutrients	-Microbial indicators -VOCs -Hydrocarbons

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Similkameen d/s Sites	Similkameen R at Memorial Park	E329393	49.465124° -120.499941°	Similkameen Memorial	Aug 17/22 @1215	REG REP	-Phys. properties -Gen. chemistry -Metals (T & D) -Nutrients	-Microbial indicators -VOCs -Hydrocarbons
	Similkameen R U/S Princeton Lagoon- PE1236	0500724	49.460324° -120.484769°	Similkameen Lagoon	Aug 16/22 @1525	REG	-Phys. properties -Gen. chemistry -Metals (T & D) -Nutrients	-Microbial indicators -VOCs -Hydrocarbons
Tulameen	Tulameen River Near Princeton	E281838	49.448014° -120.531774°	Tulameen Upstream	Aug 16/22 @1000	REG REP BLF	-Phys. properties -Gen. chemistry -Metals (T & D) -Nutrients	-Microbial indicators -Cyanide -Chlorophyll a
	Tulameen R Near Mouth @ Princeton	0500083	49.462640° -120.506968°	Tulameen Downstream	Aug 17/22 @1020	REG	-Phys. properties -Gen. chemistry -Metals (T & D)	-Nutrients -Microbial indicators

<sup>1</sup> Environmental Monitoring System

REG = Regular; REP = Replicate; BLF = Field Blank.

Metals (T & D) = total and dissolved metals (assessed separately); VOCs = Volatile Organic Compounds.

**APPENDIX B**  
**Location Photographs**



Photo 1. Similkameen River at River Road (E329512).



Photo 1. Similkameen River at Stout St. (E329411).



Photo 2. Similkameen River at Burton Ave (E329491).



Photo 3. Similkameen River at Princeton (0500629).



**APPENDIX B**  
**Location Photographs**



Photo 4. Similkameen River at Memorial Park (E329393).



Photo 5. Similkameen R u/s Princeton Lagoon (0500724).



Photo 6. Tulameen River near Princeton (E281838).



Photo 7. Tulameen R. near mouth at Princeton (0500083).

**APPENDIX C**  
**Water Quality Guidelines and Objectives**

Guidelines <sup>1</sup>	BC WQG - Fresh Water Aquatic Life		BC WQG - Wildlife		CDWQG		Canadian Recreational Water Quality		BC WQG- Ag - Irrigation		BC WQG - Ag - Livestock		Similkameen WQO <sup>2</sup>  DOWNSTREAM LOCATIONS: Sim. Memorial & Sim. Lagoon	Similkameen WQO <sup>3</sup>  UPSTREAM SITES: Sim U/S, Sim. Stout, Sim. Burton, & Sim. River Rd
	Short Term	Long Term//	Short Term	Long Term//	Max Conc.	AO	Prim. Contact	Sec. Contact	Short Term	Long Term//	Short Term	Long Term//		
<b>Parameters:</b>														
<b>Field Tests (Matrix: Water)</b>														
conductivity, field										700^				
oxygen, dissolved, field (µS/cm)	≥5												8.0 mg/L min. (July to March) 11.0 mg/L min. (April to June)	
pH, field (pH units)		6.5 to 9*				7 to 10.5	5 to 9			5 to 9.5	5 to 9.5		6.5 to 8.5 maximum or 0.2 unit change if BG is outside this range	
temperature, field (°C)	18 ////	>19		6.8 to 8.8*		>15				6.8 to 8.8*	6.8 to 8.8*			
turbidity, field (NTU)													1 NTU max. inc. when u/s is ≤5 NTU 5; NTU max. inc. when u/s is ≤50 NTU; 10 % max inc. when u/s is >50 mg/L	
<b>Physical Tests (Matrix: Water)</b>														
pH (pH units)		6.5 to 9 (pH<6.5 no sign. decrease)				7 to 10.5	5 to 9			5 to 9.5	5 to 9.5		6.5 to 8.5 maximum or 0.2 unit change if BG is outside this range	

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Guidelines <sup>1</sup>	BC WQG - Fresh Water Aquatic Life		BC WQG - Wildlife		CDWQG		Canadian Recreational Water Quality		BC WQG- Ag - Irrigation		BC WQG - Ag - Livestock		Similkameen WQO <sup>2</sup>	Similkameen WQO <sup>3</sup>
	Short Term	Long Term//	Short Term	Long Term//	Max Conc.	AO	Prim. Contact	Sec. Contact	Short Term	Long Term//	Short Term	Long Term//	DOWNSTREAM LOCATIONS: Sim. Memorial & Sim. Lagoon	UPSTREAM SITES: Sim U/S, Sim. Stout, Sim. Burton, & Sim. River Rd
<b>Parameters:</b>														
		from BG.*)												
solids, total suspended [TSS] (mg/L)		46.5*		56.5*						56.5*		46.5*	10 mg/L max. inc. when u/s is ≤100 mg/L; 10 % max. inc. when u/s is >100 mg/L	
Turbidity (NTU)		29.7*		34.7*	TO		50			34.7*		29.7*		
<b>Anions and Nutrients (Matrix: Water)</b>														
ammonia, total (as N) (mg/L)	**	**				TO								
chloride (mg/L)	600	150		600		250				100		600		
nitrate (as N) (mg/L)	32.8	3	100		10		10				100			
nitrite (as N) (mg/L)	***	***	10		1						10			
phosphorus, total (mg/L)	applies to lakes	applies to lakes												
<b>Cyanides (Matrix: Water)</b>														
cyanide, weak acid dissociable (mg/L)													≤0.005 mg/L average; 0.010 mg/L max.	
<b>Microbiological Tests (Matrix: Water)</b>														

**APPENDIX C**  
**Water Quality Guidelines and Objectives**

Guidelines <sup>1</sup>	BC WQG - Fresh Water Aquatic Life		BC WQG - Wildlife		CDWQG		Canadian Recreational Water Quality		BC WQG- Ag - Irrigation		BC WQG - Ag - Livestock		Similkameen WQO <sup>2</sup>  DOWNSTREAM LOCATIONS: Sim. Memorial & Sim. Lagoon	Similkameen WQO <sup>3</sup>  UPSTREAM SITES: Sim U/S, Sim. Stout, Sim. Burton, & Sim. River Rd
	Short Term	Long Term//	Short Term	Long Term//	Max Conc.	AO	Prim. Contact	Sec. Contact	Short Term	Long Term//	Short Term	Long Term//		
<b>Parameters:</b>														
Enterococcus (CFU/100mL)					3 <sup>^</sup> <sup>^</sup> <sup>^</sup> <sup>^</sup> <sup>^</sup> <sup>^</sup>		35 (geom. mean of 5 samples) 70 (single sample max.)		20 <sup>^^</sup>		50 <sup>^^^</sup>		≤3/100 mL 90th percentile #	
Escherichia coli [E. coli] (CFU/100mL)					0		200 (geom. mean of 5 samples) 400 (single sample max.)	1000		77 <sup>^^</sup>		200~	≤10/100 mL 90th percentile #	
<b>Total Metals (Matrix: Water)</b>														
aluminum, total (mg/L)			5			TO			5		5			
antimony, total (mg/L)		0.009			0.006									
arsenic, total (mg/L)	0.005		0.025		0.010				0.1		0.025		0.05 mg/L max. or no sign. Inc. from u/s if u/s is greater	
barium, total (mg/L)		1			2									
beryllium, total (mg/L)		0.00013								0.1		0.1		
boron, total (mg/L)		1.2		5	5					1		5		



**APPENDIX C**  
**Water Quality Guidelines and Objectives**

Guidelines <sup>1</sup>	BC WQG - Fresh Water Aquatic Life		BC WQG - Wildlife		CDWQG		Canadian Recreational Water Quality		BC WQG- Ag - Irrigation		BC WQG - Ag - Livestock		Similkameen WQO <sup>2</sup>  DOWNSTREAM LOCATIONS: Sim. Memorial & Sim. Lagoon	Similkameen WQO <sup>3</sup>  UPSTREAM SITES: Sim U/S, Sim. Stout, Sim. Burton, & Sim. River Rd
	Short Term	Long Term//	Short Term	Long Term//	Max Conc.	AO	Prim. Contact	Sec. Contact	Short Term	Long Term//	Short Term	Long Term//		
<b>Parameters:</b>														
tin, total (mg/L)		*****										0.25		
uranium, total (mg/L)		0.0085			0.02					0.01		0.2	0.01 max	
vanadium, total (mg/L)										0.1		0.1		
zinc, total (mg/L)	**	**				5				*****		2	0.03 max	
<b>Dissolved Metals (Matrix: Water)</b>														
aluminum, dissolved (mg/L)	**	**											0.10 mg/L max. no sign. inc. over u/s if u/s is greater (WQG calc. is 0.1mg/L)	
cadmium, dissolved (mg/L)	**	**												
calcium, dissolved (mg/L)												1000		
copper, dissolved (mg/L)	BLM	BLM												when hardness is >50 mg/L (usually August to April) 0.008 mg/L max. or 20% max. inc., whichever is greater ///
iron, dissolved (mg/L)	0.35													
zinc, dissolved (mg/L)														when hardness is >50 mg/L (typ. Aug to April), 0.18 mg/L



**APPENDIX C**  
**Water Quality Guidelines and Objectives**

Guidelines <sup>1</sup>	BC WQG - Fresh Water Aquatic Life		BC WQG - Wildlife		CDWQG		Canadian Recreational Water Quality		BC WQG- Ag - Irrigation		BC WQG - Ag - Livestock		Similkameen WQO <sup>2</sup>	Similkameen WQO <sup>3</sup>
	Short Term	Long Term//	Short Term	Long Term//	Max Conc.	AO	Prim. Contact	Sec. Contact	Short Term	Long Term//	Short Term	Long Term//	DOWNSTREAM LOCATIONS: Sim. Memorial & Sim. Lagoon	UPSTREAM SITES: Sim U/S, Sim. Stout, Sim. Burton, & Sim. River Rd
<b>Parameters:</b>														
phenanthrene (µg/L)		0.3												
<b>Plant Pigments (Matrix: Water)</b>														
Chlorophyll a (µg/L)		≤100 (mg/m <sup>2</sup> )												

<sup>1</sup> only parameters with guidelines or objectives are listed

<sup>2</sup> drinking water, aquatic life, wildlife, recreation, livestock, irrigation

<sup>3</sup> drinking water, aquatic life, wildlife, recreation, livestock, irrigation, industrial-mining

**NOTES:**

\* guideline is dependant on change from background conditions.

\*\* guideline is dependant on pH, hardness, and/or temperature. Guideline is calculated based on site-specific parameters and compared to concentrations, see Appendix E

**NOTES:**

\*\*\* guideline is dependant on chloride. Requires 30 day average. Guideline is for chloride concentration > 2 mg/L.

\*\*\*\* guideline is for chromium VI (except in the case for irrigation, which the most stringent is for chromium III)

\*\*\*\*\* guidelines available are for tributyltin and tricyclohexyltin. Not applicable to the tin analysis completed.

\*\*\*\*\* guideline is based on soil pH. Can not be calculated at this time.

^ crop dependent based on tolerance (see below). Most stringent guideline shown. For conductivity: Low tolerance crops 700 µS/cm; Slightly tolerant crops 1200 µS/cm; Moderately tolerant crops 2200 µS/cm; Tolerant crops 3600 µS/cm; Very tolerant crops 5000 µS/cm; For TDS: Low tolerance crops 500 mg/L; Slightly tolerant crops 800 mg/L; Moderately tolerant crops 1500 mg/L; Tolerant crops 2500 mg/L; Very tolerant crops 3500 mg/L

^^ crop dependent. Most stringent guideline shown. Requires geometric mean. For E. coli -Irrigation sprayed onto crops eaten raw = 77 CFU/100mL irrigation for livestock access = 385 CFU/100mL irrigation for general irrigation use = 1000 CFU/100mL For fecal coliforms - Irrigation sprayed onto crops eaten raw = 200 CFU/100mL irrigation for livestock access = N/A irrigation for general irrigation use = 1000 CFU/100mL

^^^ irrigation: 20 for spray onto crops raw eaten, 100 for livestock access, 250 for general irrigation, used 20

^^^ for general livestock use

^^^ BC Water Quality Guideline/Health Canada 2012

~ dependent on livestock use. Most stringent shown. Livestock - general use = 200 CFU/100mL; Livestock - closely confined with no water treatment = 0 CFU/100mL; Livestock closely confined with disinfection only = 10 CFU/100mL; Livestock closely confined with partial water treatment = 100 CFU/100mL



**APPENDIX C**  
**Water Quality Guidelines and Objectives**

- # calculated from at least 5 samples taken weekly in a period of 30 days.
- // long-term not applicable to Princeton as single sample
- /// BLM acute values are equally or more protective (i.e. 0.0048 - 0.0082 mg/L) than WQO, used BLM values
- //// species and life history dependent (18C for rearing rainbow trout)
- + aesthetic objective is taste and odour concerns only
- BLM Biotic Ligand Model - pH, DOC and hardness are needed to calculate Cu WQGs using BC BLM. See Appendix E
- TO guideline is for treated water only and is not included



**APPENDIX D**  
**Water Sample Results**

Sample Sites	EMS ID	E329491	E329512	E329411	500724	E281838			500083	500629		E329393	
	Location	Sim. Burton	Sim. River Rd.	Sim. Stout	Sim. Lagoon	Tul. U/S			Tul. D/S	Sim. HWY 3		Sim. Memorial	
	Type	REG	REG	REG	REG	REG	REP	BLF	REG	REG	BLF	REG	REP
alkalinity, total (as CaCO3)	mg/L	64.0	63.7	64.6	73.5	96.0	95.4	<1.0					
hardness (as CaCO3), dissolved	mg/L	72.8	71.4	72.5	82.3	104	104	<0.50	109	73.5	<0.50	76.7	79.4
hardness (as CaCO3), from total Ca/Mg	mg/L	68.5	69.2	69.7	77.7	100	99.6	<0.50	106	72.4	<0.50	78.2	78.2
pH	pH units	8.11	8.05	8.05	8.17	8.19	8.19	5.35	8.23	8.09	5.46	8.1	8.1
solids, total suspended [TSS]	mg/L	3.5	3.6	4.2	1.6	1.1	2.4	<1.0	<1.0	2.8	<1.0	3.7	2.7
turbidity	NTU	1.72	2.00	2.10	1.21	0.99	0.53	<0.10	0.23	0.44	<0.10	0.38	0.39
<b>Anions and Nutrients (Matrix: Water)</b>													
ammonia, total (as N)	mg/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
chloride	mg/L	3.49	3.36	3.50	3.20	2.11	2.11	<0.50	2.39	3.55	<0.50	3.44	3.42
nitrate (as N)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0051	<0.0030	<0.0030	<0.0030	<0.0030
nitrate + nitrite (as N)	mg/L	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	0.0051	<0.0050	<0.0050	<0.0050	<0.0050
nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
nitrogen, total	mg/L	0.072	0.063	0.066	0.069	0.040	0.041	<0.030	0.042	0.037	<0.030	0.039	0.037
phosphate, ortho-, dissolved (as P)	mg/L	0.0095	0.0097	0.0094	0.0074	<0.0010	<0.0010	<0.0010	<0.0010	0.0082	<0.0010	0.0072	0.0073
phosphorus, total	mg/L	0.0157	0.0183	0.0189	0.0152	0.0045	0.0048	<0.0020	0.0054	0.0171	<0.0020	0.0144	0.0143
phosphorus, total dissolved	mg/L	0.0103	0.0123	0.0103	0.0078	0.0038	0.0036	<0.0020	0.0036	0.0117	<0.0020	0.0107	0.0106



**APPENDIX D**  
**Water Sample Results**

Sample Sites	EMS ID	E329491	E329512	E329411	500724	E281838			500083	500629		E329393	
	Location	Sim. Burton	Sim. River Rd.	Sim. Stout	Sim. Lagoon	Tul. U/S			Tul. D/S	Sim. HWY 3		Sim. Memorial	
	Type	REG	REG	REG	REG	REG	REP	BLF	REG	REG	BLF	REG	REP
calcium, total	mg/L	20.7	21.0	21.1	23.6	30.7	30.6	<0.050	32.9	21.8	<0.050	24.2	24.0
chromium, total	mg/L	0.00028	0.00029	0.00028	0.00018	0.00017	0.00016	<0.00010	0.00017	0.00023	<0.00010	0.00020	0.00018
cobalt, total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
copper, total	mg/L	0.00133	0.00136	0.00136	0.00114	0.00075	0.00076	<0.00050	0.00182	0.00137	<0.00050	0.00121	0.00120
iron, total	mg/L	0.100	0.111	0.112	0.0689	0.0263	0.023	<0.0050	0.0189	0.092	<0.0050	0.060	0.058
lead, total	mg/L	0.000053	0.000059	0.000055	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000053	<0.000050	<0.000050	<0.000050
magnesium, total	mg/L	4.08	4.06	4.14	4.55	5.73	5.64	<0.0050	5.93	4.36	<0.0050	4.33	4.43
manganese, total	mg/L	0.00940	0.0103	0.0118	0.00718	0.00320	0.00291	<0.00010	0.00268	0.00972	<0.00010	0.00705	0.00715
molybdenum, total	mg/L	0.00139	0.00134	0.00134	0.00118	0.000977	0.000940	<0.000050	0.00103	0.00124	<0.000050	0.00120	0.00122
nickel, total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
phosphorus, total	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
potassium, total	mg/L	0.975	0.937	0.957	0.973	1.03	1.02	<0.050	1.08	0.994	<0.050	1.02	1.04
selenium, total	mg/L	0.000107	0.000140	0.000156	0.000157	0.000224	0.000222	<0.000050	0.000237	0.000124	<0.000050	0.000144	0.000179
silicon, total	mg/L	5.46	5.60	5.54	5.28	4.90	4.93	<0.10	5.34	5.67	<0.10	5.49	5.44
silver, total	mg/L	0.000015	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
sodium, total	mg/L	4.67	4.41	4.60	4.22	3.73	3.78	<0.050	4.36	5.09	<0.050	4.58	4.57
strontium, total	mg/L	0.153	0.149	0.153	0.154	0.166	0.162	<0.00020	0.170	0.149	<0.00020	0.155	0.157
sulfur, total	mg/L	4.13	3.99	4.28	3.92	4.63	4.56	<0.50	5.28	4.66	<0.50	4.59	4.82
thallium, total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
tin, total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
titanium, total	mg/L	<0.00300	0.00355	0.00319	0.00175	0.00064	0.00045	<0.00030	0.00051	0.00254	<0.00030	0.00169	0.00178
uranium, total	mg/L	0.000192	0.000180	0.000192	0.000209	0.000242	0.000235	<0.000010	0.000257	0.000182	<0.000010	0.000206	0.000206

**APPENDIX D**  
**Water Sample Results**

Sample Sites	EMS ID	E329491	E329512	E329411	500724	E281838			500083	500629		E329393	
	Location	Sim. Burton	Sim. River Rd.	Sim. Stout	Sim. Lagoon	Tul. U/S			Tul. D/S	Sim. HWY 3		Sim. Memorial	
	Type	REG	REG	REG	REG	REG	REP	BLF	REG	REG	BLF	REG	REP
vanadium, total	mg/L	0.00095	0.00094	0.00096	0.00084	0.00066	0.00060	<0.00050	0.00066	0.00088	<0.00050	0.00090	0.00092
zinc, total	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
<b>Dissolved Metals (Matrix: Water)</b>													
aluminum, dissolved	mg/L	0.0125	0.0118	0.0125	0.0132	0.0124	0.0114	<0.0010	0.0099	0.0115	<0.0010	0.0105	0.0096
antimony, dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
arsenic, dissolved	mg/L	0.00071	0.00069	0.00071	0.00062	0.00030	0.00030	<0.00010	0.00031	0.00070	<0.00010	0.00064	0.00062
barium, dissolved	mg/L	0.0283	0.0272	0.0281	0.0323	0.0430	0.0441	<0.00010	0.0438	0.0279	<0.00010	0.0292	0.0300
beryllium, dissolved	mg/L	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100
bismuth, dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
boron, dissolved	mg/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
cadmium, dissolved	mg/L	<0.000005 0	<0.000005 0	<0.000005 0	<0.000005 0	<0.000005 0	<0.000005 0	<0.000005 0	<0.000005 0	<0.000005 0	<0.000005 0	<0.000005 0	<0.000005 0
calcium, dissolved	mg/L	22.3	22.2	22.2	25.5	32.6	32.4	<0.050	34.2	22.5	<0.050	23.6	24.5
chromium, dissolved	mg/L	<0.00010	<0.00010	0.00033	0.00012	0.00015	0.00016	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010
cobalt, dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
copper, dissolved	mg/L	0.00092	0.00087	0.00093	0.00089	0.00065	0.00066	<0.00020	0.00065	0.00097	<0.00020	0.00089	0.00092
iron, dissolved	mg/L	0.0080	0.0082	0.0105	0.0062	<0.0050	<0.0050	<0.0050	<0.0050	0.0082	<0.0050	0.0060	0.0062
lead, dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
magnesium, dissolved	mg/L	4.17	3.89	4.15	4.53	5.47	5.68	<0.0050	5.79	4.21	<0.0050	4.31	4.43



**APPENDIX D**  
**Water Sample Results**

Sample Sites	EMS ID	E329491	E329512	E329411	500724	E281838			500083	500629		E329393	
	Location	Sim. Burton	Sim. River Rd.	Sim. Stout	Sim. Lagoon	Tul. U/S			Tul. D/S	Sim. HWY 3		Sim. Memorial	
	Type	REG	REG	REG	REG	REG	REP	BLF	REG	REG	BLF	REG	REP
dissolved metals filtration location		Field	Field	Field	Field	Field	Field	Field	Field	Field	Field	Field	Field
<b>Volatile Organic Compounds Surrogates (Matrix: Water)</b>													
bromofluorobenzene, 4-	%	79.7	78.3	79.8	79.9					89.2	87.9	91.2	92.5
difluorobenzene, 1,4-	%	97.7	97.0	98.0	96.8					99.6	99.3	102	96.6
<b>Volatile Organic Compounds [Fuels] (Matrix: Water)</b>													
benzene	µg/L	<0.50	<0.50	<0.50	<0.50					<0.50	<0.50	<0.50	<0.50
ethylbenzene	µg/L	<0.50	<0.50	<0.50	<0.50					<0.50	<0.50	<0.50	<0.50
methyl-tert-butyl ether [MTBE]	µg/L	<0.50	<0.50	<0.50	<0.50					<0.50	<0.50	<0.50	<0.50
styrene	µg/L	<0.50	<0.50	<0.50	<0.50					<0.50	<0.50	<0.50	<0.50
toluene	µg/L	<0.50	<0.50	<0.50	<0.50					<0.50	<0.50	<0.50	<0.50
xylene, m+p-	µg/L	<0.40	<0.40	<0.40	<0.40					<0.40	<0.40	<0.40	<0.40
xylene, o-	µg/L	<0.30	<0.30	<0.30	<0.30					<0.30	<0.30	<0.30	<0.30
xylenes, total	µg/L	<0.50	<0.50	<0.50	<0.50					<0.50	<0.50	<0.50	<0.50
BTEX, total	µg/L	<1.0	<1.0	<1.0	<1.0					<1.0	<1.0	<1.0	<1.0
<b>Hydrocarbons (Matrix: Water)</b>													
EPH (C10-C19)	µg/L	<250	<250	<250	<250								
EPH (C19-C32)	µg/L	<250	<250	<250	<250								
LEPHw	µg/L	<250	<250	<250	<250					<250	<250	<250	<250
HEPHw	µg/L	<250	<250	<250	<250					<250	<250	<250	<250
<b>Hydrocarbons Surrogates (Matrix: Water)</b>													



**APPENDIX D**  
**Water Sample Results**

Sample Sites	EMS ID	E329491	E329512	E329411	500724	E281838			500083	500629		E329393	
	Location	Sim. Burton	Sim. River Rd.	Sim. Stout	Sim. Lagoon	Tul. U/S			Tul. D/S	Sim. HWY 3		Sim. Memorial	
	Type	REG	REG	REG	REG	REG	REP	BLF	REG	REG	BLF	REG	REP
bromobenzotrifluoride, 2- (EPH surr)	%	82.5	89.8	88.0	77.6					67.4	85.1	72.7	68.0
<b>Polycyclic Aromatic Hydrocarbons (Matrix: Water)</b>													
acenaphthene	µg/L	<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
acridine	µg/L	<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
benz(a)anthracene	µg/L	<0.010	<0.010	<0.010	<0.010					<0.010	<0.010	<0.010	<0.010
benzo(a)pyrene	µg/L	<0.0050	<0.0050	<0.0050	<0.0050					<0.010	<0.010	<0.010	<0.010
benzo(b+j)fluoranthene	µg/L	<0.010	<0.010	<0.010	<0.010					<0.0050	<0.0050	<0.0050	<0.0050
benzo(b+j+k)fluoranthene	µg/L	<0.015	<0.015	<0.015	<0.015					<0.010	<0.010	<0.010	<0.010
benzo(g,h,i)perylene	µg/L	<0.010	<0.010	<0.010	<0.010					<0.015	<0.015	<0.015	<0.015
benzo(k)fluoranthene	µg/L	<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
dibenz(a,h)anthracene	µg/L	<0.0050	<0.0050	<0.0050	<0.0050					<0.010	<0.010	<0.010	<0.010
fluoranthene	µg/L	<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
indeno(1,2,3-c,d)pyrene	µg/L	<0.010	<0.010	<0.010	<0.010					<0.010	<0.010	<0.010	<0.010

**APPENDIX D**  
**Water Sample Results**

Sample Sites	EMS ID	E329491	E329512	E329411	500724	E281838			500083	500629		E329393	
	Location	Sim. Burton	Sim. River Rd.	Sim. Stout	Sim. Lagoon	Tul. U/S			Tul. D/S	Sim. HWY 3		Sim. Memorial	
	Type	REG	REG	REG	REG	REG	REP	BLF	REG	REG	BLF	REG	REP
methylnaphthalene, 1-	µg/L	<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
naphthalene	µg/L	<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
pyrene	µg/L	<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
<b>Polycyclic Aromatic Hydrocarbons Surrogates (Matrix: Water)</b>													
chrysene-d12	%	105	105	98.2	100					119	113	104	107
naphthalene-d8	%	90.3	92.1	90.0	87.6					93.3	75.4	85.9	87.8
phenanthrene-d10	%	100.0	102	98.2	97.6					110	95.0	99.6	101
<b>Plant Pigments (Matrix: Water)</b>													
chlorophyll a	µg/L					0.216	0.213	<0.010					

**NOTES:**

REG = regular sample

REP = replicate sample

BLF = field blank sample

a - Exceedance of Canadian Drinking Water Quality Guideline Temperature Aesthetic Objective (15°C)

b - Exceedance of BC Water Quality Aquatic Life Daily Maximum Temperature Quality Guideline (19°C)

**APPENDIX E**  
**Results for Location-Specific Guidelines**

EMS ID	E329491	E329512	E329411	500724	E281838		500083	500629	E329393	
Site Name	Sim. Burton	Sim. River Rd.	Sim. Stout	Sim. Lagoon	Tul. U/S		Tul. D/S	Sim. HWY 3	Sim. Lagoon	
Sample Type	REG	REG	REG	REG	REG	REP	REG	REG	REG	REP
Date	16-Aug-2022	16-Aug-2022	16-Aug-2022	16-Aug-2022	16-Aug-2022	16-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022
Time	13:30	11:30	12:15	15:25	10:00	10:05	10:20	11:15	12:15	12:20
<b>Site Water Chemistry</b>										
pH	8.38	7.99	8.37	8.44	7.88	7.88	7.69	7.68	7.84	7.84
Temperature	20.60	18.10	19.50	22.20	17.20	17.20	17.40	17.90	19.30	19.30
Hardness (mg/L)	72.8	71.4	72.5	82.3	104	104	109	73.5	76.7	79.4
Chloride (mg/L)	3.49	3.36	3.50	3.20	2.11	2.11	2.39	3.55	3.44	3.42
Dissolved Organic Carbon (mg/L)	1.46	2.06	2.09	1.73	1.63	1.68	1.68	1.65	1.62	1.52
<b>Parameter and Guidelines (all results mg/L)</b>										
<b>Total Ammonia</b>										
Result	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Acute Guideline	2.46	5.71	2.51	2.17	6.91	6.91	9.34	9.46	7.34	7.34
Chronic Guideline	0.417	1.1	0.438	0.368	1.42	1.42	1.86	1.79	1.3	1.3
<b>Nitrite</b>										
Result	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Acute Guideline	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Chronic Guideline	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
<b>Total Lead</b>										
Result	0.000053	0.000059	0.000055	<0.00005	<0.00005	<0.00005	<0.00005	0.000053	<0.00005	<0.00005
Acute Guideline	0.0545	0.0532	0.0542	0.0637	0.0858	0.0858	0.0911	0.0552	0.0582	0.0609
Chronic Guideline	0.0054	0.0054	0.0054	0.0058	0.0067	0.0067	0.0069	0.0055	0.0056	0.0057

**APPENDIX E**  
**Results for Location-Specific Guidelines**

EMS ID	E329491	E329512	E329411	500724	E281838		500083	500629	E329393	
Site Name	Sim. Burton	Sim. River Rd.	Sim. Stout	Sim. Lagoon	Tul. U/S		Tul. D/S	Sim. HWY 3	Sim. Lagoon	
Sample Type	REG	REG	REG	REG	REG	REP	REG	REG	REG	REP
<b>Total Manganese</b>										
Result	0.0094	0.0103	0.0118	0.00718	0.0032	0.00291	0.00268	0.00972	0.00705	0.00715
Acute Guideline	1.34	1.33	1.34	1.45	1.69	1.69	1.74	1.35	1.39	1.41
Chronic Guideline	0.93	0.92	0.92	0.97	1.06	1.06	1.08	0.93	0.94	0.95
<b>Total Nickel</b>										
Result	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Acute Guideline (hardness < 60)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acute Guideline (hardness 60-180)	0.075	0.074	0.075	0.082	0.098	0.098	0.102	0.076	0.078	0.080
<b>Total Silver</b>										
Result	0.000015	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Acute Guideline (Hardness<100)	0.0001	0.0001	0.0001	0.0001	NA	NA	NA	0.0001	0.0001	0.0001
Chronic Guideline (Hardness<100)	0.00005	0.00005	0.00005	0.00005	NA	NA	NA	0.00005	0.00005	0.00005
Acute Guideline (Hardness>100)	NA	NA	NA	NA	0.003	0.003	0.003	NA	NA	NA
Chronic Guideline (Hardness>100)	NA	NA	NA	NA	0.0015	0.0015	0.0015	NA	NA	NA
<b>Total Zinc</b>										
Result	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Acute Guideline (Hardness< 90)	0.033	0.033	0.033	0.033	NA	NA	NA	0.033	0.033	0.033

**APPENDIX E**  
**Results for Location-Specific Guidelines**

EMS ID	E329491	E329512	E329411	500724	E281838		500083	500629	E329393	
Site Name	Sim. Burton	Sim. River Rd.	Sim. Stout	Sim. Lagoon	Tul. U/S		Tul. D/S	Sim. HWY 3	Sim. Lagoon	
Sample Type	REG	REG	REG	REG	REG	REP	REG	REG	REG	REP
Chronic Guideline (Hardness < 90)	0.0075	0.0075	0.0075	0.0075	NA	NA	NA	0.0075	0.0075	0.0075
Acute Guideline (Hardness>90)	NA	NA	NA	NA	0.0435	0.0435	0.04725	NA	NA	NA
Chronic Guideline (Hardness>90)	NA	NA	NA	NA	0.018	0.018	0.02175	NA	NA	NA
<b>Dissolved Aluminum</b>										
Result	0.0125	0.0118	0.0125	0.0132	0.0124	0.0114	0.0099	0.0115	0.0105	0.0096
Acute Guideline (pH<6.5)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chronic Guideline (pH<6.5)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acute Guideline (pH>6.5)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Chronic Guideline (pH>6.5)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
<b>Dissolved Cadmium</b>										
Result	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Acute Guideline	0.0004	0.0004	0.0004	0.0005	0.0006	0.0006	0.0006	0.0004	0.0004	0.0005
Chronic Guideline	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
<b>Dissolved Copper (Biotic Ligand Model)</b>										
Result	0.00092	0.00087	0.00093	0.00089	0.00065	0.00066	0.00065	0.00097	0.00089	0.00092
Acute Guideline	0.0062	0.0064	0.0082	0.0068	0.0048	0.0048	0.0053	0.0049	0.0059	0.0059
Chronic Guideline	0.0011	0.0011	0.0014	0.0012	0.0008	0.0008	0.0009	0.0008	0.001	0.001

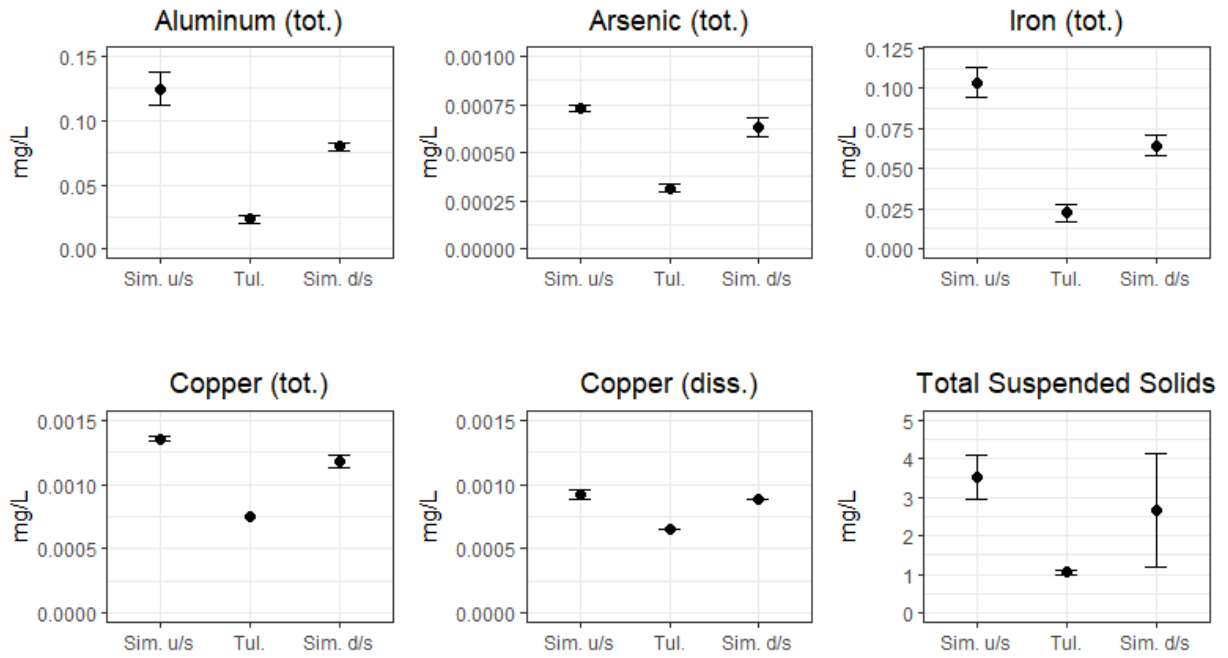
**NOTE:** No guideline exceedances observed for parameters with site-specific guidelines

# APPENDIX F

## Additional Parameters

### Average concentrations for selected water quality parameters, August 16 & 17, 2022

Metals of general interest in the Tulameen and Similkameen Rivers near Princeton

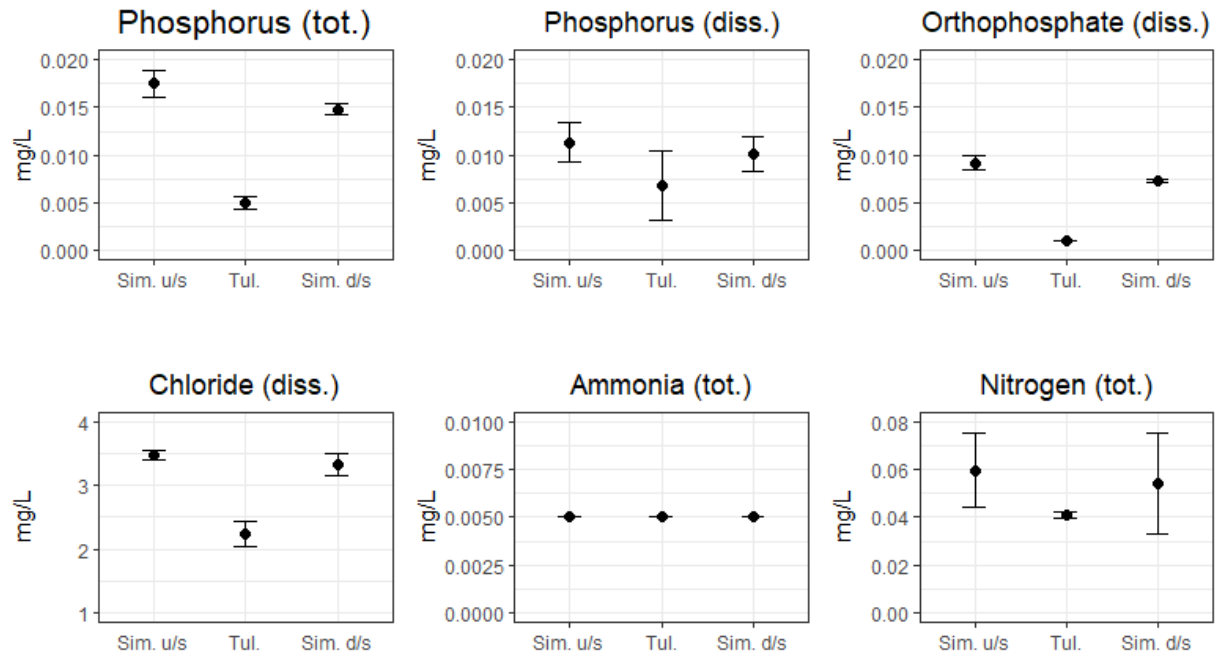


note: there were no exceedances of BC WQGs for these parameters in August 2022

## APPENDIX F Additional Parameters

Average concentrations for selected water quality parameters, August 16 & 17, 2022

Nutrients and anions in the Tulameen and Similkameen Rivers near Princeton

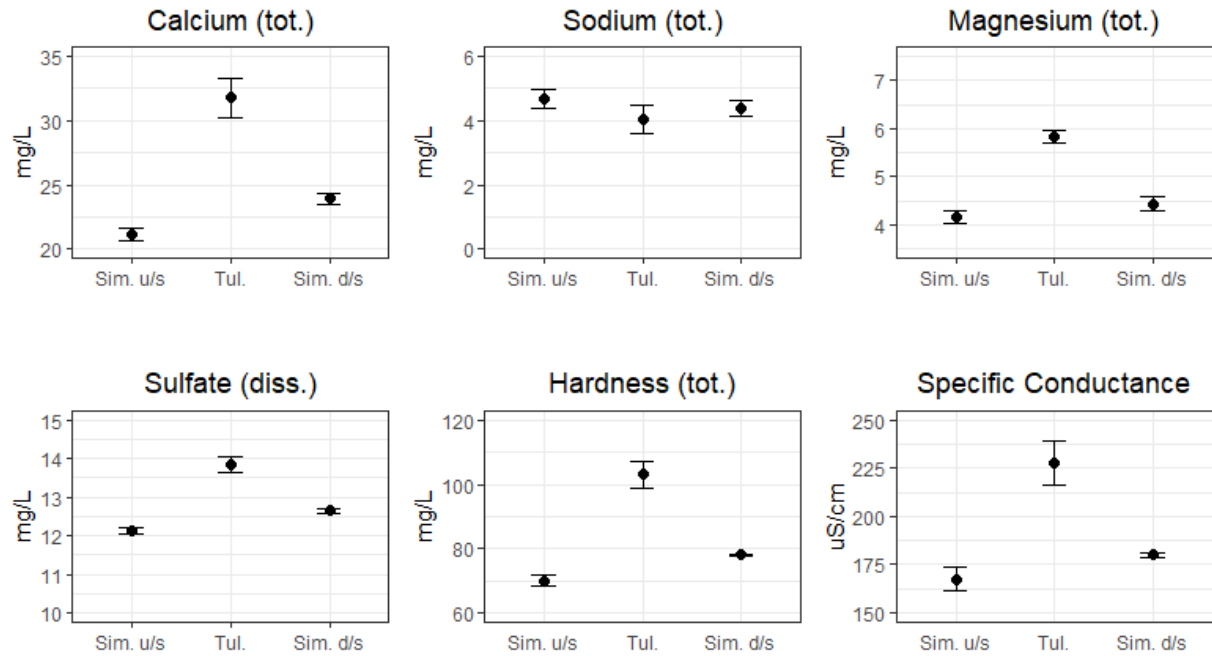


note: there were no exceedances of BC WQGs for these parameters in August 2022

## APPENDIX F Additional Parameters

Average concentrations for selected water quality parameters, August 16 & 17, 2022

Hardness and related parameters in the Tulameen and Similkameen Rivers near Princeton



note: there were no exceedances of BC WQGs for these parameters in August 2022