Morice Watershed Monitoring Trust
Water Quality Monitoring Program
2019 Update

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Executive Summary

In 2019, the Morice Watershed Monitoring Trust (MWMT) dedicated their annual monitoring program to expanding seasonal representation of water quality surface samples collected from within the Morice Watershed Management Area. The goal was to increase the number of samples collected during previously underrepresented seasonal periods: "winter" (December-March) and "summer" (July-August). The MWMT conducted two sets of 5 water quality sampling events over 30-days, the first from February 19 to March 26, and the second from August 21 to September 18. A total of 76 surface water grab samples were collected at seven sites, including four sites previously monitored by the MWMT from 2015-2017, and three new sites. The number of samples representing the winter seasonal improved at all sites. Representation of samples for the summer seasonal period improved only slightly, largely due to the fact that sampling occurred late in the summer (August) and early fall (September), and therefore does not entirely reflect values during summer low flow conditions for the period previously defined as "summer". Results reflect similar trends in the range of variability and seasonality observed during 2015-2017 and most values from new sites are within the range measured at existing sites, although exceptions include certain metals and physicochemical parameters. On a seasonal basis, some seasonal periods exhibit consistent differences for certain parameters across all sites (e.g., temperature in summer was highest at all sites) or seasonal differences were specific to individual sites. Some parameters were also consistently higher at certain sites compared to others across all seasons. In respect to British Columbia Water Quality Guidelines, results from the MWMT efforts suggest relatively few contaminants of concern, however concentrations of certain metals (Al, Cu, Fe) as well as dissolved organic carbon (DOC) represented exceedances at certain sites across multiple sample periods from 2015-2019. Temperature and dissolved oxygen levels were also notably high or low, respectively, at many sites when compared to recommendations for various stages of salmonid life history. Overall, with the exception of the low flow summer period, seasonal representation improved during 2019. Future recommendations include increasing the number of mid-summer samples, and targeted monitoring approaches to address specific questions related to water quality and habitat protection or restoration. In light of various efforts in the Morice River watershed focused on salmon recovery and habitat protection, as well as future risk of impacts from increased development and climate change impacts, establishing water quality baseline information and water quality objectives is paramount.

1. The MWMT 2019 Water Quality Sampling Program

1.2 Sampling schedule in 2019

A summary report of the Morice Watershed Monitoring Trust (MWMT) water quality monitoring program from 2015-2018 (Oliver, 2018) identified winter (December-March) and summer (July-August) as underrepresented seasonal periods of water quality data in the Morice Watershed Management Area (MWMA). In 2019, the MWMT opted to expand the number of samples for these two seasonal periods by conducting two sets of 5 sampling events over 30-days, the first from February 19 to March 26, and the second from August 21 to September 18. This approach (i.e., five sampling events over 30-days) is consistent with the "5-in-30" approach conducted by the Province of British Columbia as a sampling approach for water quality monitoring programs where objectives include the development of Water Quality Guidelines (WQGs).

1.2 Sample collection and analysis

Surface water grab samples were collected at seven sites (Fig.1; Table 1). These sites represent four sites sampled from 2015-2018 and three new sites. Nado Creek (EMS ID: E260429) was discontinued in 2019 as flow at the site location was determined to be seasonally ephemeral and potentially influenced by localized runoff. The three new sites (Crystal Creek, Gosnell Creek, and Shea Creek) were also sampled in 2008 by the Office of the Wet'suwet'en, but were not included in the 2015-2018 MWMT monitoring program and therefore represent new sites for the MWMT in regards to investigating water quality dynamics in catchments northeast of Morice Lake.

Surface water grab samples were collected at each site five times within a 30-day period ("5-in-30"); from February 19 to March 26 (winter seasonal period) and from August 21 to September 18 (summer and fall seasonal periods). The exception was Shea Creek, where samples were only collected on two dates during the 30-day winter period (March). Sampling protocols follow those described in the *British Columbia Field Sampling Manual: Part E Water and Wastewater Sampling* (2013). Briefly, water samples were collected whole or filtered in the field and stored on ice and in the dark for transport to ALS Environmental Laboratories (Burnaby, B.C.). Samples were shipped same day or next day by air and received within 24-48 hours of collection. Additional samples were sent as QA/QC checks, including duplicates and field blanks. General physicochemical parameters (temperature, dissolved oxygen, specific conductivity, pH) were measured in the field using a pre-calibrated YSI Professional Plus hand held meter. Water samples were analyzed at ALS Environmental Laboratories for hardness, alkalinity, dissolved organic carbon (DOC), total and dissolved nutrients (total nitrogen, total dissolved nitrogen, total ammonium nitrogen, nitrate, nitrite, total Kjeldahl nitrogen, total phosphorus), microbiological parameters (E. coli, Enterococcus spp., and total coliform bacteria)[1], major ions, and dissolved and total metals. QA/QC was performed on all data and values outside of the range of expected values and expected to be erroneous (i.e., obvious errors in equipment measurements) were flagged and removed before analyses. Values less than or equal to the limit of detection (LOD) were adjusted to ½ the LOD. Statistical analyses was performed in R (R Core Team 2019). To further assess water quality, 2019 data were compared with approved Water Quality Guidelines for British Columbia.[2]

[1] Microbiological data will not be discussed in this report as hold times were often too long for reliable analysis.
[2] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines

Figure 1: The Morice River watershed and Morice Water Management Area.

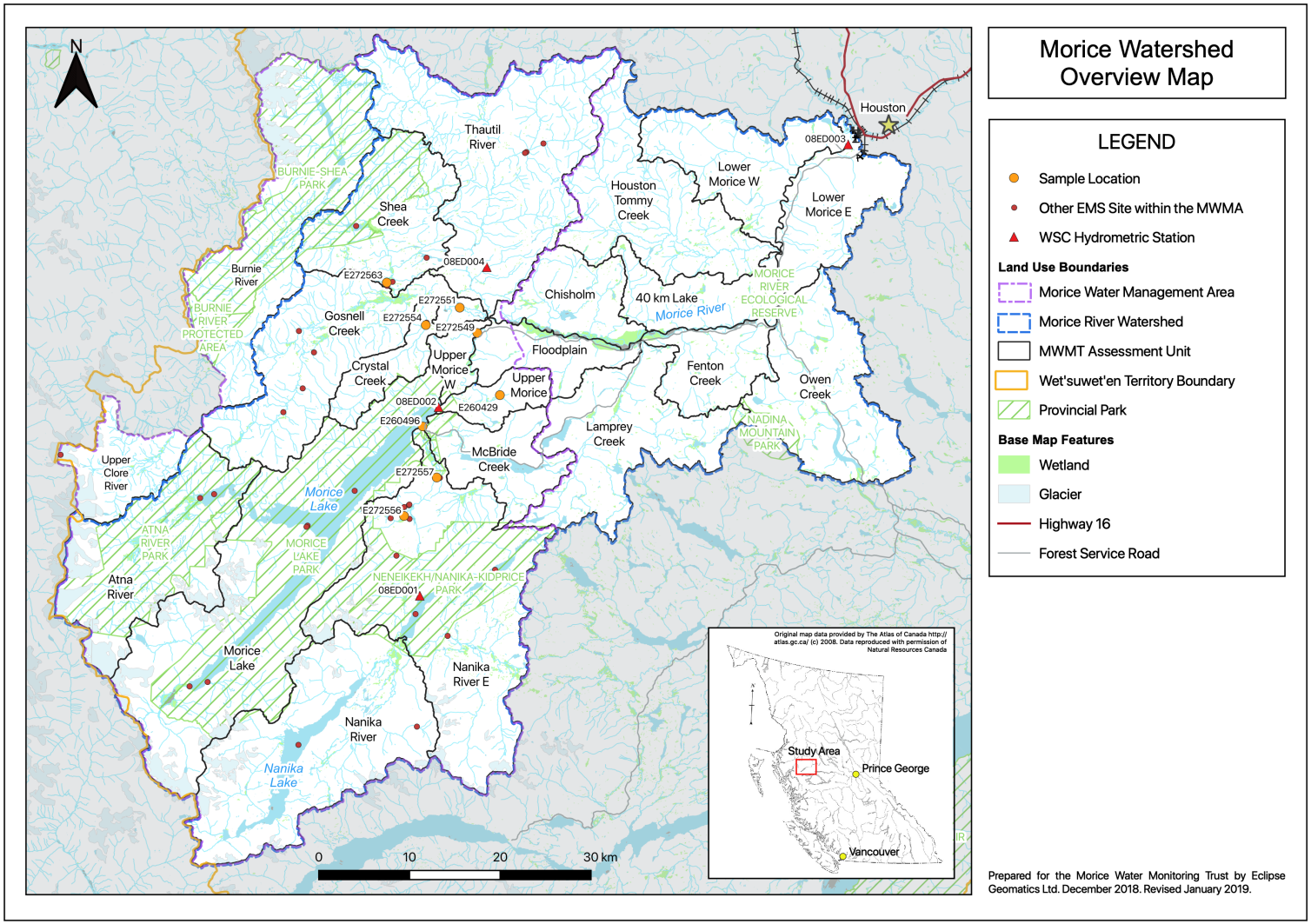


Figure 2: a) Number of samples per year collected in the MWMA, b) total number of samples and samples per season per site collected as part of the MWMT water monitoring program from 2015-2019, c) and total number of samples and samples per season collected from each watershed Assessment Unit within the MWMA.

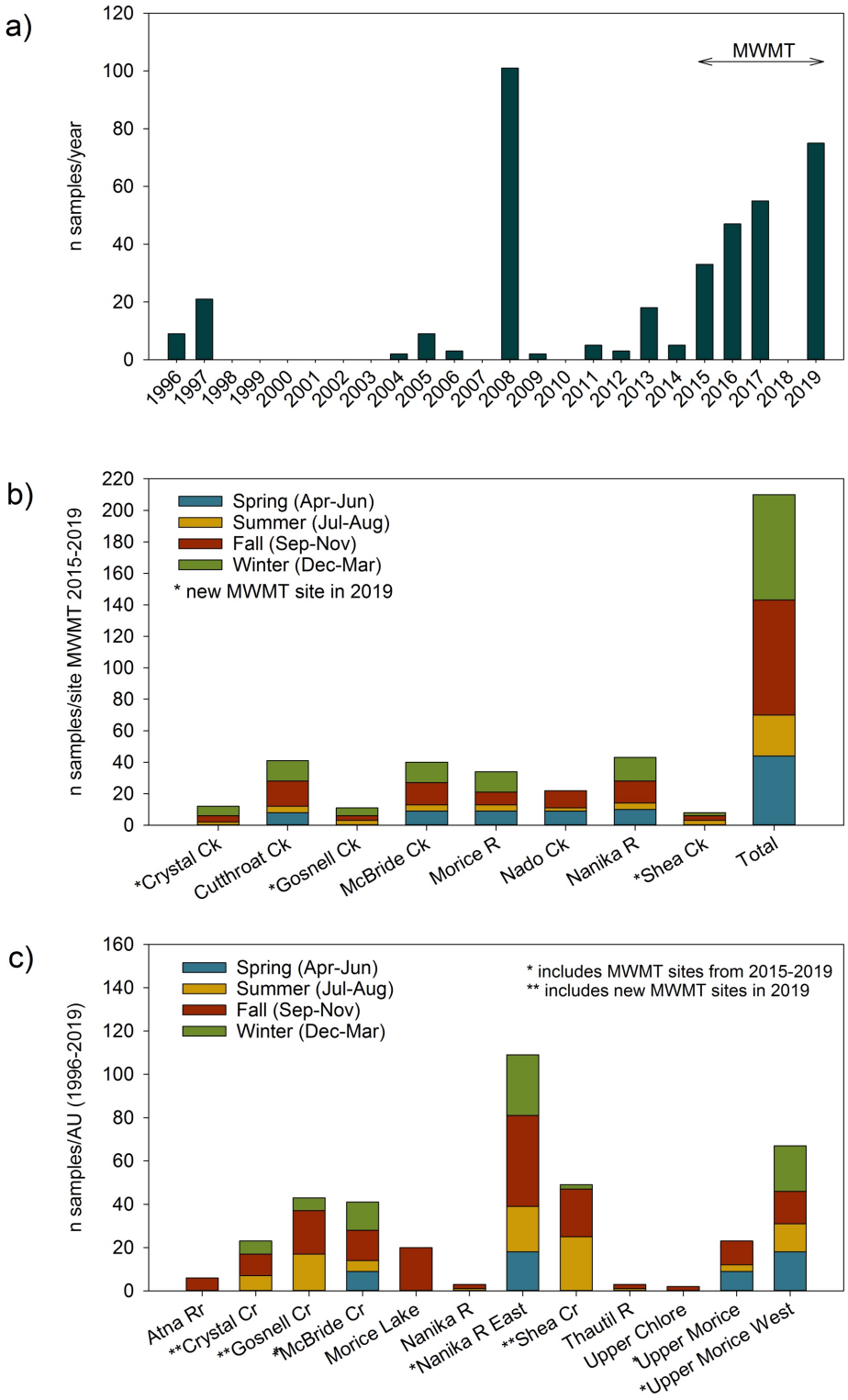


Table 1: Sites sampled as part of the MWMT sampling program. Stream order is based on 1:50,000 scale map.

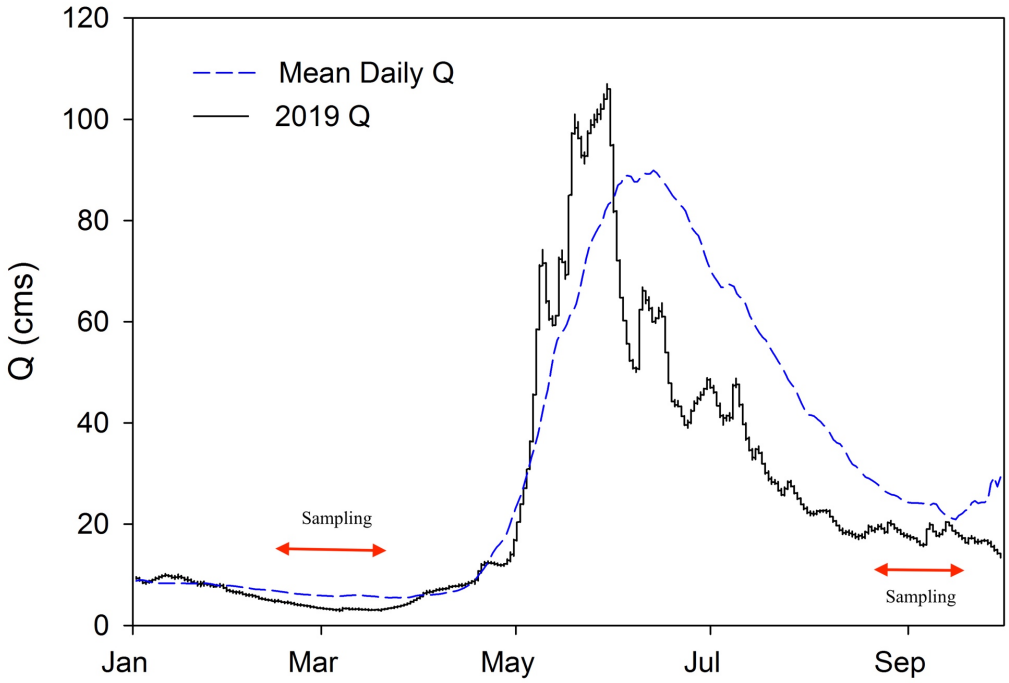
Site Name	EMS ID	Stream Order	Area (km^2)	Elev. (m)	Lat / (-) Long	AU	n (pre-2015)	n (2015-2017)	n (2019)
Crystal Creek	E272554	4	63	1,304	54.00875 127.48102	Crystal Cr	10	0	12
Cutthroat Creek	E272556	2	24	849	54.00875 127.48102	Nanika River E	8	29	12
Gosnell Creek	E272551	6	528	1,158	54.21540 127.39410	Gosnell Cr	10	0	11
McBride Creek	E260496	3	112	768	54.09749 127.45280	McBride Creek	1	29	11
Morice River	E272549	7	1,989	734	54.19075 127.36364	Upper Morice W	33	24	10
Nado Creek	E260429	2	19	814	54.12984 127.32343	Upper Morice	1	22	0
Nanika River	E272557	5	841	809	54.04733 127.42732	Nanika River E	6	31	12
Shea Creek	E272563	6	195	1,099	54.227273 127.50522	Shea Cr	10	0	8

2. Results

2.1 Sample collection

In 2019, 76 surface water samples were collected from seven sites within the MWMA, representing the second highest number of samples collected within a year (Fig. 2). This effort increased the total number of samples at each site and for each site's corresponding watershed Assessment Unit (AU). Notably, the representation of samples for the winter seasonal period (December-March), which previously had relatively poor or no winter representation, improved at all sites. The number of samples also slightly improved for the summer seasonal period (July-August) although the 5-in-30 sampling during that time spanned both the summer and fall (September-November) seasonal periods so not all samples can be considered collected during what we have defined as "summer" and therefore, the months of July and early August still have low representation. Overall, discharge in winter 2019 from the Nanika River (WSC Station ID: 08ED001) was slightly lower than the historical mean (based on years 1950-2019), with a higher and earlier freshet receding to lower summer and fall baseflow in comparison to the historical mean (Fig. 3).

Figure 3: Historical mean and daily discharge (Q) for January 1 – October 1, 2019 from WSC station 08ED001 (Nanika River at outlet Kidprice Lake). The range of sampling dates in 2019 are indicated by red arrows.



2.2 Water quality from 2015-2019

Time series (2015-2019) for a subset of selected constituents are presented in Fig. 4 and Fig. 5. In general, results reflected similar trends in the range of variability and seasonality observed from 2015-2017 (for additional information on data from 2015-2017, see Oliver 2018[3]). Summary statistics for selected constituents have been updated to reflect all samples collected from 2015-2019 and are provided in Appendix A, Tables A1-A3. These results also reflect the three new sites added in 2019. Overall, the range of most values from the new sites were within the range measured at existing sites. Several exceptions included dissolved oxygen measurements at Shea Creek and Crystal Creek, which were higher than previous measurements at existing sites, but within the range of values for all sites measured in 2019. However, it is worth noting that dissolved oxygen can exhibit large diel changes in concentration, and therefore caution is recommended when interpreting results for samples collected at different times throughout the day. Specific conductivity also exhibited a wider range across all sites than previously observed, with higher concentrations observed in 2019 at Shea Creek and Crystal Creek (both new sites). This was also the case for certain metals (e.g., total Zn), whereas other metals (e.g., dissolved Al), exhibited lower variability in 2019 when compared to previous years.

[3] Oliver, A.A. 2018. Analysis of water quality monitoring in the Morice Water Management Area. 69 pp. Prepared for the Morice Water Monitoring Trust, available online at http://moricetrust.ca/reports.php

Figure 4: Time series for physicochemical constituents collected as part of the MWMT water monitoring program from 2015-2019. The top panel represents mean daily discharge (Q) at WSC station 08ED001 (Nanika River at outlet Kidprice Lake). Dotted lines represent B.C. Water Quality Guidelines for protection of aquatic life.

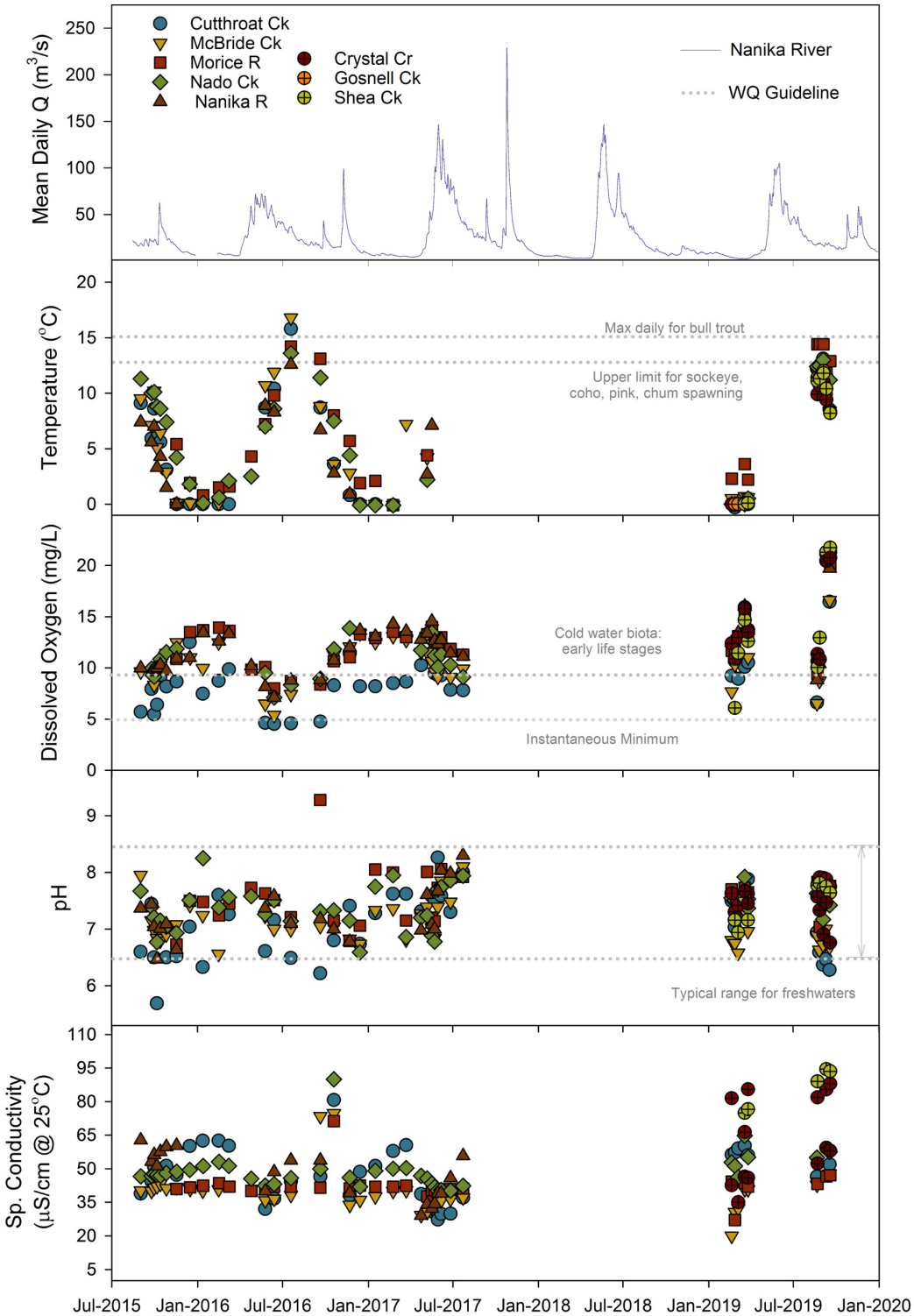
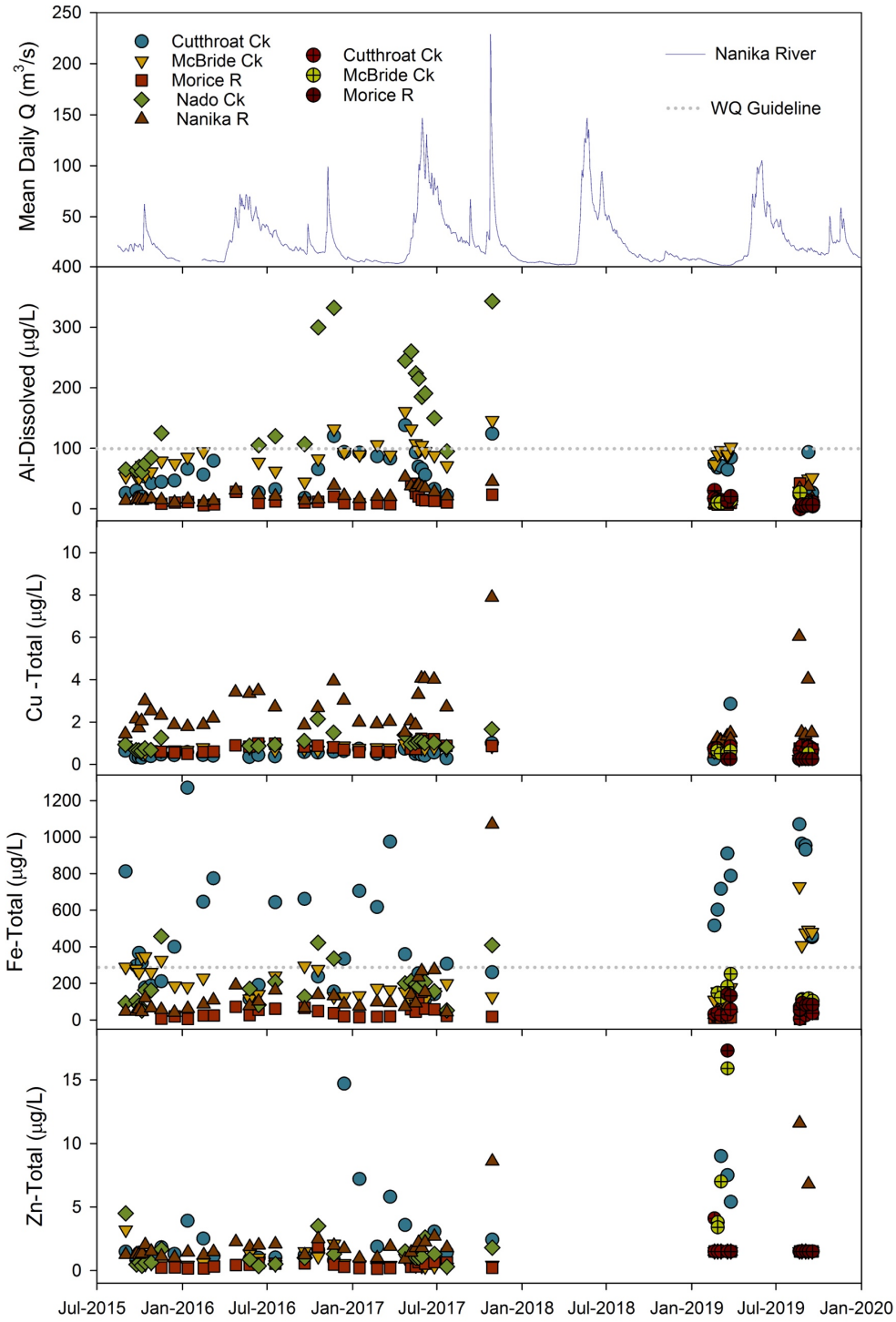


Figure 5: Time series for select metals collected as part of the MWMT water monitoring program from 2015-2019. The top panel represents mean daily discharge (Q) at WSC station 08ED001 (Nanika River at outlet Kidprice Lake). Dotted lines represent thresholds listed under the B.C. Water Quality Guidelines for protection of aquatic life.



2.3 Seasonal summaries of water quality from 2015-2019

Data for each seasonal period are summarized by site (Fig. 6 – Fig. 8). Seasonal periods are defined as "winter" (December-March), "spring" (April-June), "summer" (July-August), and "fall" (September-November) and are based on observations of long-term patterns in hydrometric characteristics. Some seasonal periods exhibit consistent differences for certain parameters across all sites (e.g., temperature in summer is higher at all sites) whereas other parameters exhibit seasonal differences specific to individual sites (e.g., turbidity and TP during summer in the Nanika River, dissolved Fe in Cutthroat Creek during summer and winter, or in McBride Creek during summer). In certain cases, this suggests that exceedance of WQGs may be expected more frequently during some seasonal periods than others. For example, concentrations of dissolved Fe within Cutthroat Creek appear to exceed BC WQGs more often in the summer and the winter than in the spring and the fall and likely reflect the strongly wetland-influenced characteristics of that system. Other examples include Gosnell Creek and Shea Creek, where some measurements of total Zn exceeded the BC WQG 30-day average in winter but all values in summer and fall were below the limit of analytical detection (note that no samples were collected at these sites during spring). In contrast, some parameters also had consistently higher values at some sites compared to others regardless of the season (e.g., total Cu in the Nanika River, dissolved Al in Nado Creek). Again, note that compared to other seasons, summer representation of water quality is low for all sites.

2.4 High resolution sampling in 2019

High resolution sampling ("5-in-30") was conducted during February-March and August-September of 2019. Weekly time series spanning these two time periods of sampling in 2019 are shown in Fig. 9 and Fig. 10. Corresponding summary statistics for the 5-in-30 sampling are presented in Appendix A, Tables A4-A6. The February-March sampling adequately captured relatively consistent, low flow winter conditions. The August-September sampling captured a more dynamic range of flow conditions and represents more of a transition from summer to fall conditions (e.g., cooler water, more precipitation, variable discharge). Few data points during either of the two month-long periods sampled were in exceedance of BC WQG either for short-term ("acute") or long-term ("30-day mean") values. Exceedances of WQGs at all sites from 2015-2019 are listed in Table 2. This table represents an update from the table provided in Oliver, 2018 as additional sites were sampled in 2019, and certain WQG criteria have changed since the previous report. There were several instances where temperature and dissolved oxygen were close to or exceeded recommended thresholds for various life-history stages of fish (e.g., sockeye or coho spawning, early life history stages) at various sites, most notably within the Morice River, McBride Creek, and Gosnell Creek. There were also several instances of dissolved organic carbon (DOC) exceeding WQGs (deviating more than 20% from the 30-day median) at Morice River, Nanika River, Cutthroat Creek, and Crystal Creek. Finally, total Cu exceeding recommended WQG for the majority of samples from the Nanika River as well as a subset of samples on Cutthroat Creek.[4]

[4] Based on results from the BC Ministry of Environment and Climate Change Strategies Biotic Ligand Model for calculating long-term and short-term chronic WQGs for Cu: 2019 BC BLM User's Manual. Water Quality Guideline Series, WQG-03-2. Prov. B.C., Victoria B.C.

Figure 6: Seasonal summaries for temperature, dissolved oxygen, and turbidity collected by the MWMT from 2015-2019.

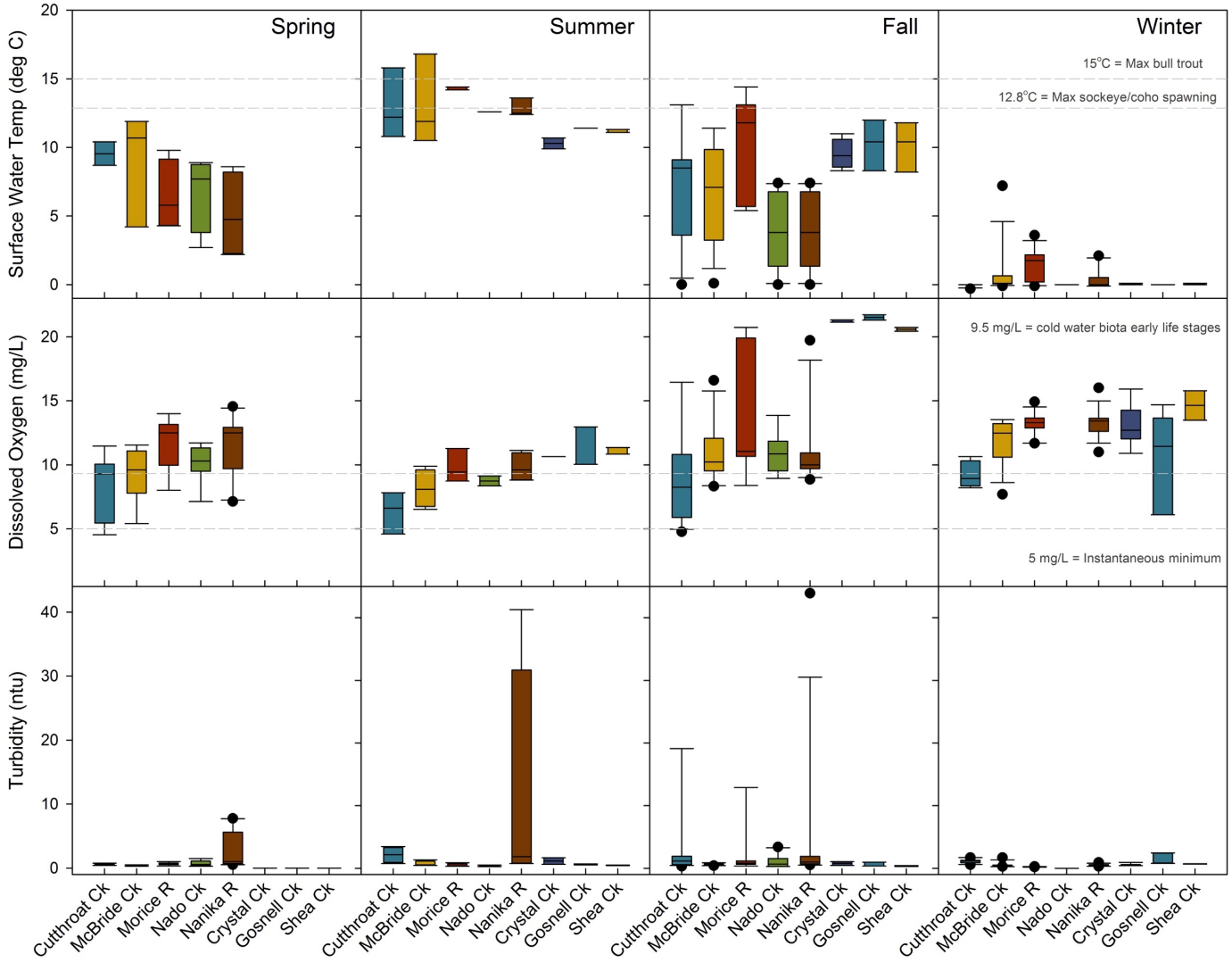


Figure 7: Seasonal summaries for TP, dissolved Al, and total Cu collected by the MWMT from 2015-2019. Note that the bar representing the dataset for Nanika River for Summer, Cu – Total (marked by *) had an outlier of 11.6 µg/L removed.

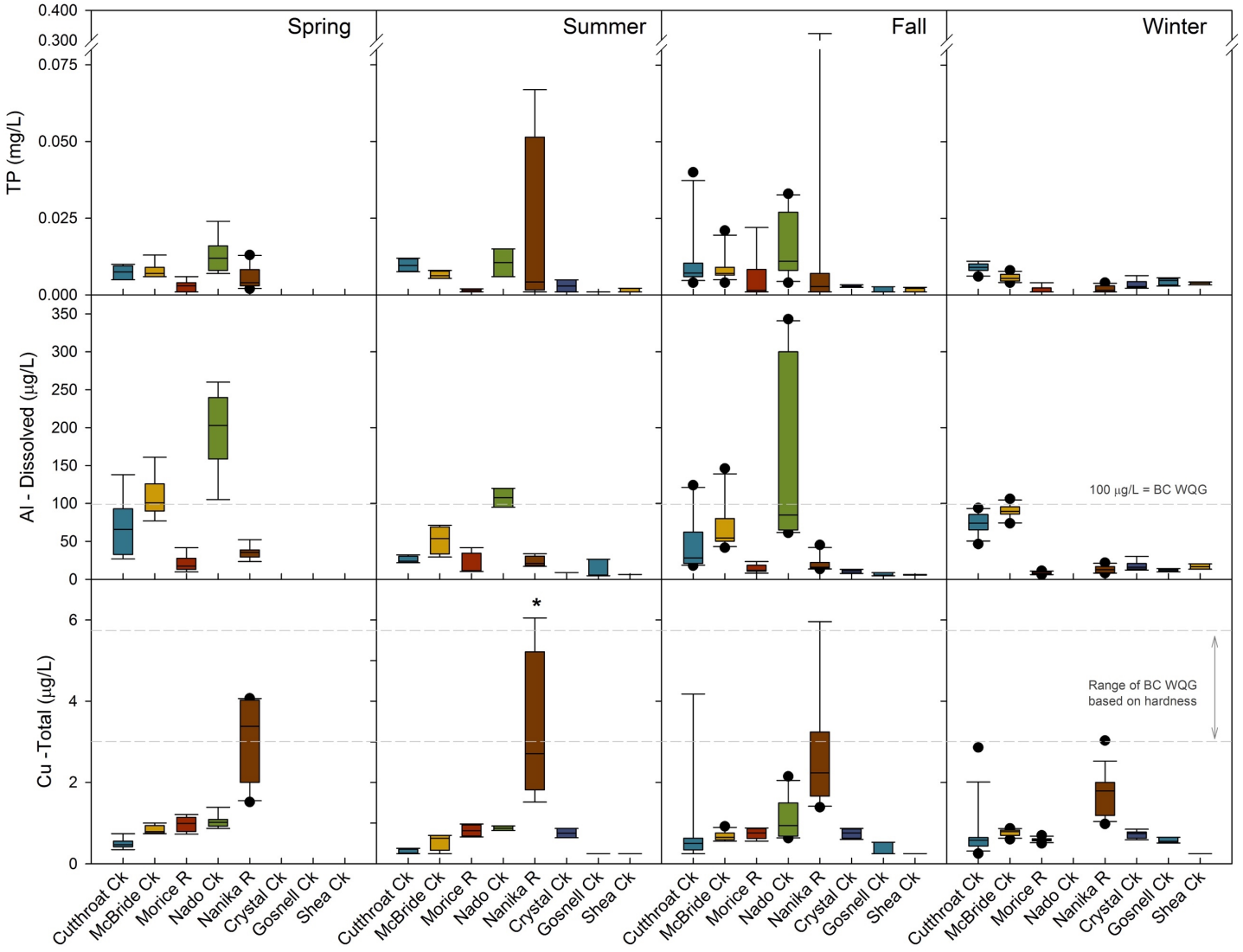


Figure 8: Seasonal summaries for dissolved Fe, and total Zn collected by the MWMT from 2015-2019.

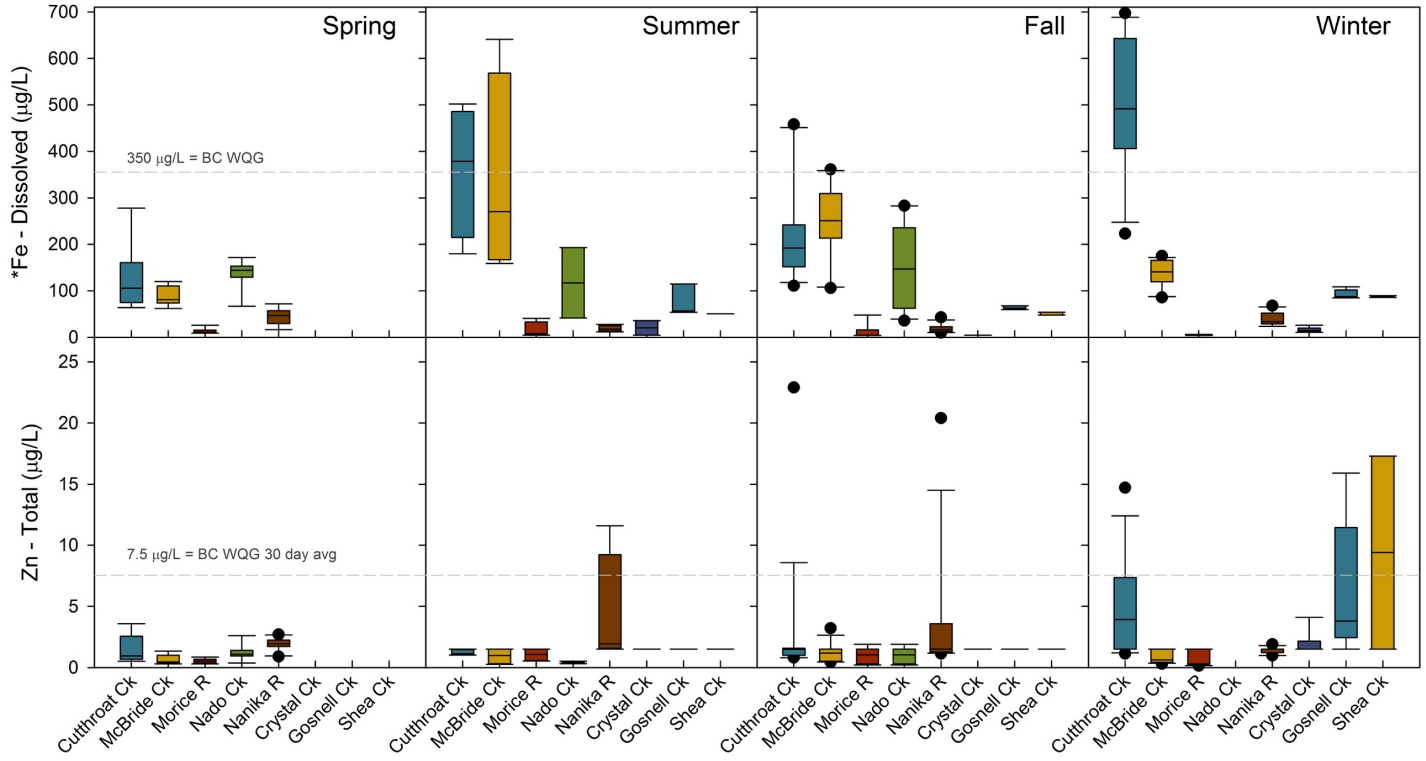


Figure 9: Select water quality data collected during “5 samples collected in 30 days” (5-in-30) for February-March (blue) and August-September (yellow) of 2019.

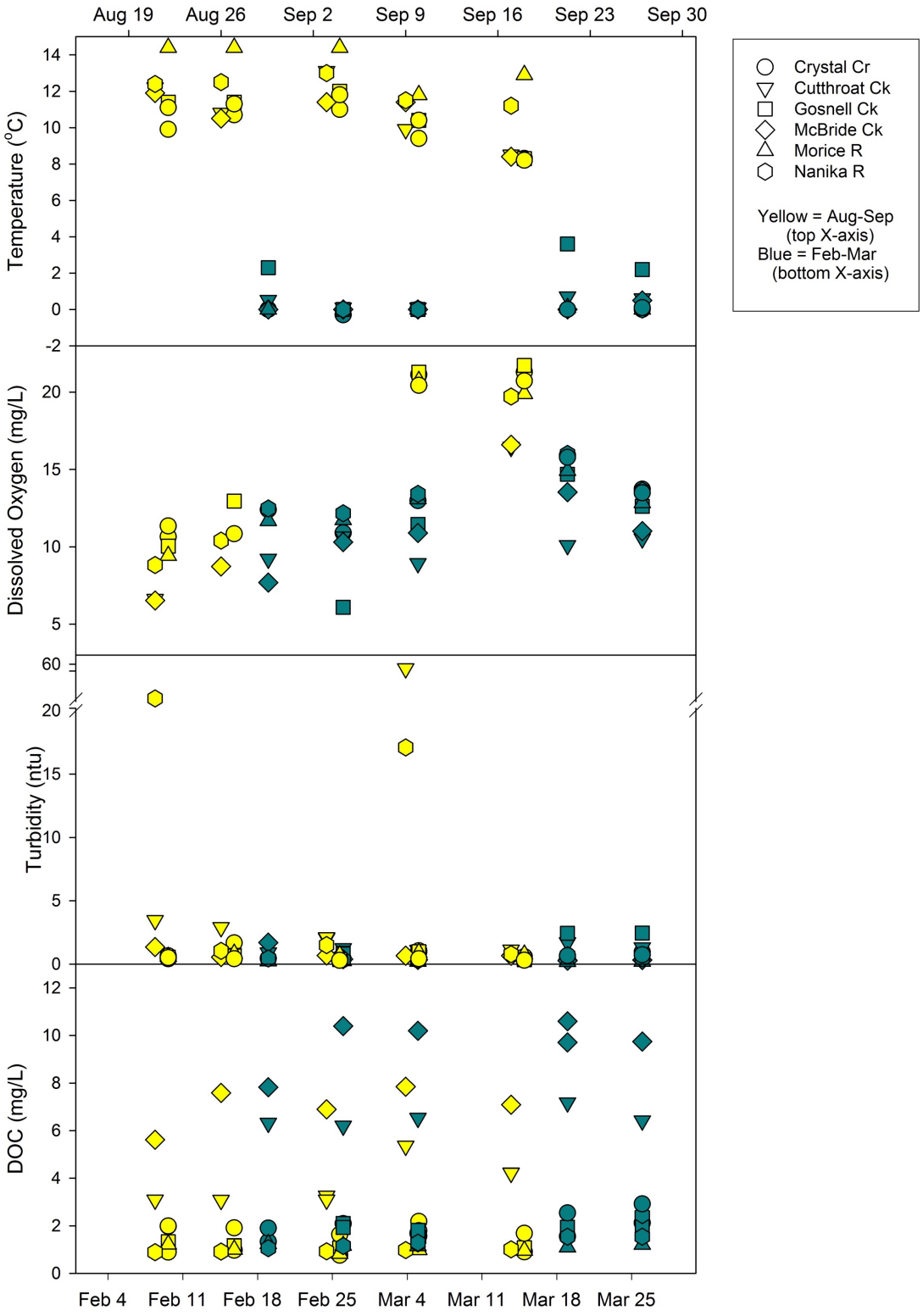


Figure 10: Select metals data collected during “5 samples collected in 30 days” for February-March (blue) and August-September (yellow) of 2019.

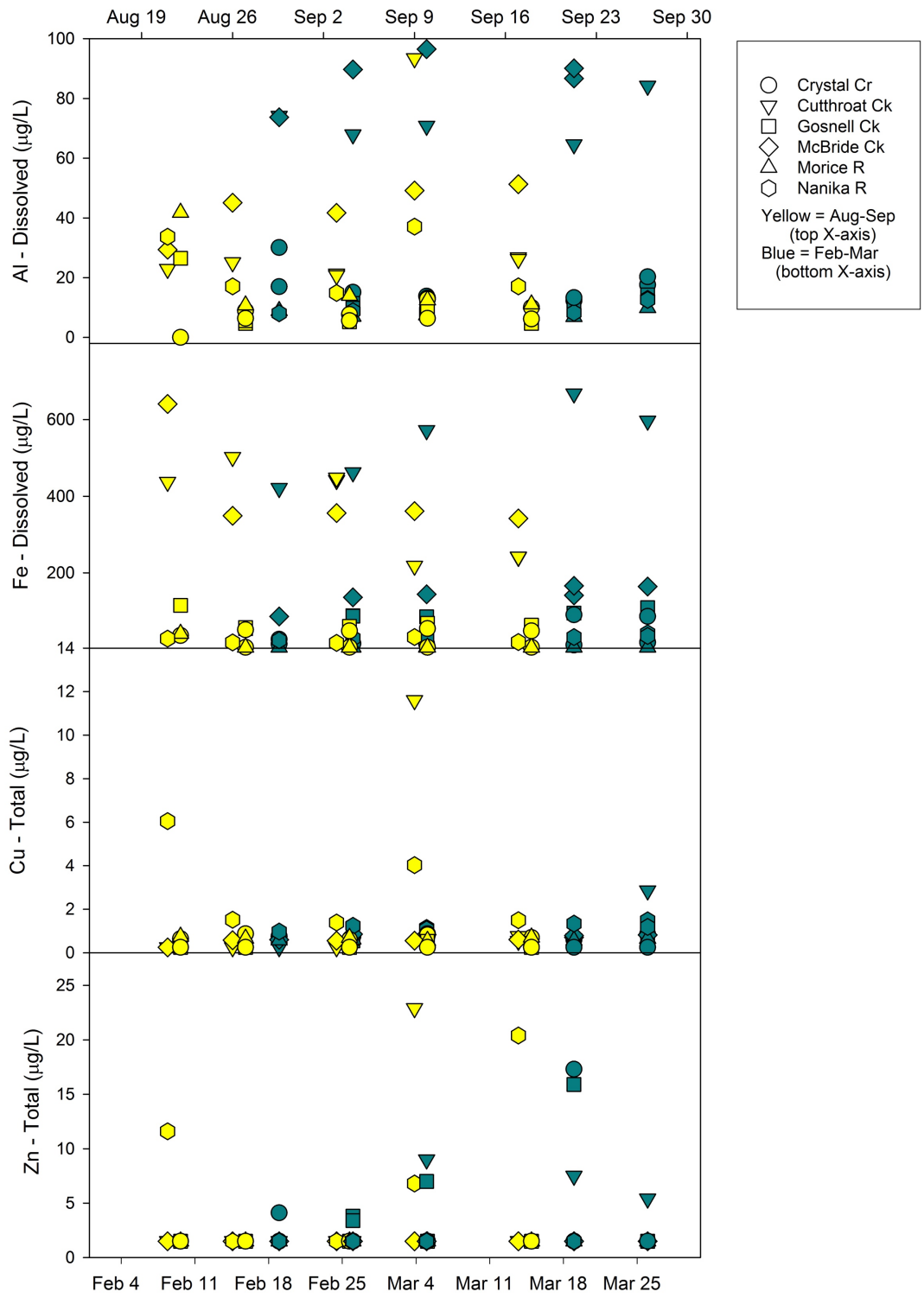


Table 2: Parameters collected in the Morice Water Management Area from 2015-2019 in exceedance of BC Water Quality Guidelines for the protection of aquatic life. Numbers indicate number of samples in exceedance/total number of samples analyzed.

	All Sites	Cutthroat Creek	McBride Creek	Morice River	Nado Creek	Nanika River	Crystal Creek	Gosnell Creek	Shea Creek
		E272556	E260496	E272549	E260429	E272557	E272554	E260493	E272563
Temperature	10[a], 2[b] /164	2[a], 1[b] /31	1[b]/31	6[a]/26	0/15	2[a]/33	0/10	0/10	0/8
Dissolved Oxygen	39[c], 10[d], 4[e] /187	16[c], 7[d], 4[e] /35	8[c], 2[d] /36	4[c] /31	5[c]/20	5[c]/38	0/10	1[d]/9	0/8
DOC*	7[f]/77	3[f]/12	0/11	1[f]/10	0/0	1[f]/12	2[f]/12	0/11	0/8
Al – Dissolved	25/204	3/40	8/39	0/33	14/21	0/42	0/12	0/11	0/6
Cu – Total[g]	32/153	4/31	0/28	5/24	0/14	24/31	0/10	0/8	0/7
Fe – Total	6/211	3/41	0/40	0/34	0/22	3/43	0/12	0/11	0/8
Fe – Dissolved	19/211	16/41	3/40	0/34	0/22	0/43	0/12	0/11	0/8

*only samples collected using the 5-in-30 day sampling approach in 2019 are included as WQG for these parameters are based on average or median values collected over 30 days

[a] exceed incubation temperature of 12.8°C for sockeye spawning
[b] exceeds max daily temperature of 15°C for bull trout
[c] exceeds minimum value of 9.5 mg/L for cold water biota early life stages
[d] exceeds minimum value of 6.5 mg/L for cold water biota other life stages
[e] exceeds site-specific instantaneous minimum concentration of 5 mg/L
[f] based on 20% deviation from the 30-day median at a specific site from either February-March 2019 or August-September 2019
[g] exceedances are based on the B.C. Ministry of ENV Biotic Ligand Model (BC BLM) software Version 1.11

3. Recommendations

3.1 Contaminants of concern and rationale

From 2015-2019 the MWMT collected water quality data from seven sites within the MWMA. In respect to BC WQGs, results from the MWMT efforts suggest relatively few contaminants of concern, however there are some constituents that warrant further discussion. Across all sites, high summer temperatures and (sometimes) low dissolved oxygen concentrations were observed in during certain times of the year and may be problematic for various life history stages of salmonids. Excessive sedimentation can also be an issue for aquatic habitats, and may be worth further investigating the magnitude and timing of sedimentation in certain catchments given that sediment mobilization, as evidenced by higher levels of turbidity and mobilization of particle-associated constituents such as total phosphorus and total metals during the higher rainfall periods, is observed at some MWMT sites. Routine monitoring as executed by MWMT sampling efforts to date will likely not capture the magnitude or dynamics of these flow-driven processes, and adequate sampling would require a more flow-weighted approach to sample collection.

Some metals (e.g., Cu, Fe, Al) appear to be elevated in certain catchments more frequently than in others. Cutthroat Creek tends to have higher concentrations of metals, often in the winter and summer when dissolved oxygen concentrations are also lower. This likely reflects the influence of proximal wetlands upstream from the sampling location and potentially seasonal anaerobic release of metals from those wetlands. In comparison to the other sites sampled by the MWMT, Cutthroat Creek appears to be the most directly influenced by upstream biogeochemical processing within wetlands. McBride Creek also exhibited periods of elevated metal concentrations (e.g., dissolved Fe and dissolved Al), particularly (but not exclusively) in spring and summer. This may also reflect underlying catchment geology as well as seasonal watershed processes and interactions with historical and modern disturbance and land use change.

The Nanika River site also has relatively unique catchment characteristics in comparison to the other MWMT sites; the Nanika River watershed is extensively underlaid by porphyry geologic formations, which are higher in metal composition. Likely as a result of this underlying geology, but also possibly as a result of seasonal watershed processes and interactions with historical and modern disturbance and land use change, the Nanika River tends to have higher concentrations of certain metals in its surface waters relative to surrounding catchments (e.g., total Cu). The Nanika River is also influenced upstream by glacial melt, and therefore exhibits a different hydrologic profile and sediment regime than the more snow/rainfall dominated systems. For example, the summer seasonal period is dominated by higher turbidity and more sediment-associated constituents, such as total phosphorus. Several samples with elevated Cu concentrations were also collected from the Morice River in 2016-2017 but none were collected in recent (2019) samples. The WQG for Cu is developed used the BC Biotic Ligand Model that uses an array of site chemistry to set sample and site-specific thresholds for both acute and chronic concentrations of Cu. It is possible that inputting different values or including/excluding information for certain parameters (e.g., ion ratios, specific ion concentrations, percent humic acid, etc.) could change the WQG produced for a particular site. Investigation of issues regarding Cu should require additional detailed exploration of results.

Overall, higher metals concentrations appear more common in catchments to the south/southeast of Morice Lake. There were no exceedances of WQG for metals in any catchments to the north/northeast of Morice Lake, suggesting broad scale differences in watershed characteristics or land use. Understanding the legacy of impacts across the landscape will help better elucidate the source of contaminants and how seasonal processes influence export from watersheds, which will further help aid the development of Water Quality Objectives.

3.2 Gaps and future work

The total number of samples for the summer seasonal period within the MWMA is still small and future monitoring may want to include targeted sampling during July-August, as this is generally a time of low flow and higher temperature and represents a critical period for salmon returning to spawn. If seasonal variability is of interest for all sites, additional sampling is warranted for Gosnell, Crystal, and Shea Creeks since temporal monitoring at these sites has not been as extensive. Some additional process-based monitoring would also be useful for understanding areas of critical habitat, such as *in situ* measurement of surface water thermal regimes. Targeted monitoring to address specific questions such as identifying areas potentially impacted by sedimentation, loss of canopy cover, and limnology could help identify potential for restoration or protection. In light of various efforts focused on salmon recovery and habitat protection, as well as future risk of impacts from increased development and climate change impacts, establishing water quality baseline information and Water Quality Objectives within the MWMA is paramount.

Morice Watershed Monitoring Trust
Water Quality Monitoring Program - 2019 Update

Appendix A

Table A1: Summary statistics for physiochemical and carbon data collected at MWMT sites from 2015-2019.

		Temp ˚C	pH	Specific Conductivity uS/cm	Dissolved Oxygen mg/L	DOC mg/L	Alkalinity mg/L $CaCO_3$	Total Hardness mg/L
All MWMT Sites	Count	170	200	183	191	207	211	204
	Mean	5.49	7.29	47.76	11.35	4.76	19.96	21.63
	Med	4.75	7.32	44.2	11.05	2.70	17.00	19.90
	Min	-0.3	5.69	8.0	4.54	0.30	10.00	11.70
	Max	16.8	9.28	94.5	21.73	22.80	42.50	40.40
	Std	4.96	0.49	14.05	3.31	4.47	7.42	6.13
	SE	0.38	0.03	1.04	0.24	0.31	0.51	0.43
	95 CI	0.75	0.07	2.05	0.47	0.61	1.01	0.85
	+95 CI	6.24	7.36	49.81	11.83	5.38	20.97	22.47
	-95 CI	4.74	7.22	45.71	10.88	4.15	18.96	20.78
Cutthroat Creek (E272556)	Count	32	40	36	36	41	41	40
	Mean	5.06	7.00	48.08	8.78	5.01	18.20	20.70
	Med	4.60	7.03	47.9	8.67	5.20	17.60	21.15
	Min	-0.3	5.69	27.3	4.54	1.90	10.00	12.60
	Max	15.8	8.26	80.7	16.45	11.40	26.30	28.10
	Std	5.15	0.58	12.02	2.74	2.01	4.51	4.23
	SE	0.91	0.09	2.00	0.46	0.31	0.70	0.67
	95 CI	1.86	0.18	4.07	0.93	0.63	1.42	1.35
	+95 CI	6.92	7.18	52.15	9.71	5.64	19.62	22.05
	-95 CI	3.20	6.82	44.01	7.86	4.37	16.78	19.35
Nanika River (E272557)	Count	34	41	39	40	42	43	42
	Mean	5.40	7.40	49.15	11.90	1.27	15.23	21.40
	Med	4.3	7.49	47.3	12.25	1.13	14.70	21.15
	Min	-0.1	6.59	40.2	7.13	0.30	12.60	18.00
	Max	13.6	8.25	90.0	19.72	3.10	21.50	26.40
	Std	5.02	0.36	8.47	2.36	0.72	1.85	2.20
	SE	0.86	0.06	1.36	0.37	0.11	0.28	0.34
	95 CI	1.75	0.11	2.75	0.75	0.22	0.57	0.68
	+95 CI	7.15	7.51	51.9	12.66	1.50	15.80	22.09
	-95 CI	3.65	7.29	46.4	11.15	1.05	14.67	20.72

Table A1 *cont.*: Summary statistics for physiochemical and carbon data collected at MWMT sites from 2015-2019.

		Temp ˚C	pH	Specific Conductivity uS/cm	Dissolved Oxygen mg/L	DOC mg/L	Alkalinity mg/L $CaCO_3$	Total Hardness mg/L
Morice River (E272549)	Count	26	33	31	31	33	34	33
	Mean	6.07	7.57	42.34	12.52	1.19	16.29	18.62
	Med	4.35	7.58	41.9	12.84	1.10	16.50	18.60
	Min	-0.1	6.73	27.1	8.01	0.30	14.00	15.00
	Max	14.4	9.28	71.3	20.74	3.00	18.00	21.00
	Std	5.27	0.47	6.25	2.74	0.65	0.87	0.93
	SE	1.03	0.08	1.12	0.49	0.11	0.15	0.16
	95 CI	2.13	0.17	2.29	1.00	0.23	0.30	0.33
	+95 CI	8.2	7.74	44.63	13.52	1.42	16.59	18.95
	-95 CI	3.94	7.40	40.05	11.52	0.96	15.98	18.29
McBride Creek (E260496)	Count	32	38	35	37	39	40	39
	Mean	5.12	7.08	40.18	10.49	9.15	18.29	16.76
	Med	3.9	7.00	40.0	10.31	9.30	17.45	16.80
	Min	-0.1	6.56	29.2	5.40	5.62	11.70	13.30
	Max	16.8	8.10	71.3	16.60	12.20	30.00	22.10
	Std	4.99	6.56	9.37	2.29	1.57	3.88	1.70
	SE	0.88	0.06	1.58	0.38	0.25	0.61	0.27
	95 CI	1.80	0.12	3.22	0.76	0.51	1.24	0.55
	+95 CI	6.92	7.20	43.4	11.26	9.66	19.53	17.31
	-95 CI	3.32	6.96	36.96	9.73	8.64	17.05	16.20
Crystal Creek (E272554)	Count	12	11	9	10	12	12	11
	Mean	4.9	7.68	72.41	15.26	1.50	35.97	36.28
	Med	4.2	7.66	81.9	13.36	1.56	36.15	36.00
	Min	0.0	7.30	35.0	10.65	0.76	33.80	34.60
	Max	11.0	7.91	88.0	21.31	2.18	38.80	38.90
	Std	5.14	0.19	20.15	4.35	0.52	1.56	1.56
	SE	1.48	0.06	6.72	1.38	0.15	0.45	0.47
	95 CI	3.27	0.13	15.49	3.11	0.33	0.99	1.05
	+95 CI	8.17	7.81	87.9	18.37	1.83	36.96	37.33
	-95 CI	1.63	7.55	56.92	12.14	1.16	34.97	35.23

Table A1 *cont.*: Summary statistics for physiochemical and carbon data collected at MWMT sites from 2015-2019.

		Temp ˚C	pH	Specific Conductivity uS/cm	Dissolved Oxygen mg/L	DOC mg/L	Alkalinity mg/L $CaCO_3$	Total Hardness mg/L
Gosnell Creek (E260493)	Count	11	9	6	10	11	11	9
	Mean	5.9	7.50	74.67	12.99	1.56	38.66	38.09
	Med	8.3	7.64	82.80	12.79	1.56	39.00	39.00
	Min	0.0	6.94	19.5	6.09	1.07	35.00	34.90
	Max	12.0	7.81	94.5	21.73	2.10	42.50	40.40
	Std	5.73	0.33	28.29	5.32	0.41	2.67	2.33
	SE	1.73	0.11	11.55	1.68	0.12	0.80	0.78
	95 CI	3.85	0.25	11.55	3.81	0.27	1.79	1.79
	+95 CI	9.75	7.75	86.22	16.80	1.83	40.46	39.88
	-95 CI	2.05	7.25	63.12	9.19	1.28	36.87	36.29
Shea Creek (E272563)	Count	8	7	6	7	8	8	8
	Mean	8.0	7.31	52.4	14.86	2.06	26.51	22.99
	Med	10.75	7.45	52.3	13.49	1.95	27.40	23.70
	Min	0.0	6.76	45.9	10.84	1.63	23.00	19.90
	Max	11.8	7.67	59.3	20.73	2.92	28.40	24.40
	Std	5.03	0.34	5.61	4.26	0.45	2.17	1.69
	SE	1.78	0.13	2.29	1.61	0.16	0.77	0.60
	95 CI	4.20	0.32	5.88	3.94	0.37	1.82	1.42
	+95 CI	12.2	7.63	58.3	18.80	2.43	28.33	24.40
	-95 CI	3.8	6.99	46.5	10.91	1.68	24.70	21.57

Table A2: Summary statistics for nutrient and solids data collected at MWMT sites from 2015-2019.

		TN	TAN	NO_3+NO_2	TP	ORP	TSS	TDS	Turbidity
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU
All MWMT Sites	Count	206	211	207	207	167	210	211	207
	Mean	0.199	0.021	0.019	0.010	0.0012	2.81	39.9	1.69
	Med	0.172	0.012	0.011	0.005	0.0005	2.00	38	0.62
	Min	0.030	0.003	0.001	0.001	0.0005	1.50	16	0.19
	Max	0.690	0.150	0.333	0.610	0.0150	66.9	102	57.6
	Std	0.140	0.026	0.035	0.043	0.0019	5.38	13.68	5.89
	SE	0.010	0.002	0.002	0.003	0.0001	0.37	0.94	0.41
	95 CI	0.019	0.004	0.005	0.006	0.0003	0.73	1.86	0.81
	+95 CI	0.218	0.025	0.024	0.015	0.0015	3.54	41.72	2.50
	-95 CI	0.180	0.017	0.014	0.004	0.0009	2.08	38.01	0.88
Cutthroat Creek (E272556)	Count	41	41	40	40	35	41	41	40
	Mean	0.232	0.026	0.009	0.010	0.0009	2.72	37.9	2.54
	Med	0.220	0.019	0.003	0.008	0.0005	2	36	0.95
	Min	0.110	0.003	0.001	0.004	0.0005	1.50	18	0.32
	Max	0.510	0.120	0.043	0.040	0.0045	16	70	57.6
	Std	0.078	0.028	0.013	0.007	0.0010	2.70	11.18	8.96
	SE	0.012	0.004	0.002	0.001	0.0002	0.42	1.75	1.42
	95 CI	0.025	0.009	0.004	0.002	0.0003	0.85	3.53	2.86
	+95 CI	0.256	0.035	0.013	0.012	0.0012	3.57	41.46	5.41
	-95 CI	0.207	0.017	0.005	0.007	0.0005	1.87	34.40	-0.32
Nanika River (E272557)	Count	42	43	42	42	35	42	43	42
	Mean	0.096	0.018	0.012	0.020	0.0013	4.75	33.5	3.66
	Med	0.078	0.011	0.011	0.003	0.0005	2.00	34	0.77
	Min	0.030	0.003	0.001	0.001	0.0005	1.50	20	0.30
	Max	0.330	0.077	0.039	0.610	0.0110	66.9	55	43.9
	Std	0.058	0.018	0.010	0.094	0.0020	11.19	8.50	9.30
	SE	0.009	0.003	0.001	0.014	0.0003	1.73	1.30	1.43
	95 CI	0.018	0.006	0.003	0.029	0.0007	3.49	2.62	2.90
	+95 CI	0.113	0.023	0.015	0.049	0.0020	8.24	36.15	6.55
	-95 CI	0.078	0.012	0.009	-0.009	0.0006	1.26	30.92	0.76

Table A2 *cont.*: Summary statistics for nutrient and solids data collected at MWMT sites from 2015-2019.

		TN	TAN	NO_3+NO_2	TP	ORP	TSS	TDS	Turbidity
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU
Morice River (E272549)	Count	32	34	33	33	27	34	34	33
	Mean	0.123	0.024	0.033	0.003	0.0012	2.40	28.82	0.90
	Med	0.090	0.014	0.036	0.002	0.0005	2.00	28.50	0.54
	Min	0.067	0.003	0.011	0.001	0.0005	1.50	16.0	0.19
	Max	0.370	0.130	0.046	0.022	0.0150	11.00	44.0	12.90
	Std	0.070	0.032	0.011	0.004	0.0028	1.93	7.11	2.17
	SE	0.012	0.005	0.002	0.001	0.0005	0.33	1.22	0.38
	95 CI	0.025	0.011	0.004	0.001	0.0011	0.67	2.48	0.77
	+95 CI	0.148	0.035	0.036	0.004	0.0023	3.08	31.30	1.67
	-95 CI	0.098	0.013	0.029	0.001	0.0001	1.73	26.34	0.13
McBride Creek (E260496)	Count	39	40	39	39	33	40	40	39
	Mean	0.282	0.022	0.006	0.007	0.0011	2.22	40.0	0.56
	Med	0.260	0.019	0.003	0.007	0.0005	2.00	40.0	0.46
	Min	0.174	0.003	0.001	0.004	0.0005	1.50	22.0	0.28
	Max	0.470	0.110	0.021	0.021	0.0040	13.40	87.0	1.69
	Std	0.071	0.022	0.006	0.003	0.0011	1.86	10.6	0.29
	SE	0.011	0.004	0.001	0.001	0.0002	0.29	1.67	0.05
	95 CI	0.023	0.007	0.002	0.001	0.0004	0.59	3.37	0.09
	+95 CI	0.305	0.030	0.008	0.008	0.0015	2.82	43.4	0.65
	-95 CI	0.259	0.015	0.004	0.006	0.0007	1.63	36.6	0.46
Crystal Creek (E272554)	Count	12	12	12	12	35	41	41	40
	Mean	0.062	0.003	0.015	0.003	0.0009	2.72	37.9	2.54
	Med	0.064	0.003	0.011	0.003	0.0005	2.0	36.0	0.95
	Min	0.035	0.003	0.003	0.001	0.0005	1.5	18.0	0.32
	Max	0.088	0.006	0.060	0.006	0.0045	16.0	70.0	57.6
	Std	0.014	0.001	0.017	0.001	0.0010	2.70	11.2	8.96
	SE	0.004	0.000	0.005	0.000	0.0002	0.42	1.75	1.42
	95 CI	0.009	0.001	0.011	0.001	0.0003	0.85	3.53	2.86
	+95 CI	0.071	0.003	0.026	0.004	0.0012	3.57	41.5	5.41
	-95 CI	0.053	0.002	0.004	0.002	0.0005	1.87	34.4	-0.32

Table A2 *cont.*: Summary statistics for nutrient and solids data collected at MWMT sites from 2015-2019.

		TN	TAN	NO_3+NO_2	TP	ORP	TSS	TDS	Turbidity
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU
Gosnell Creek (E260493)	Count	11	11	11	11	5	11	11	11
	Mean	0.094	0.004	0.022	0.003	<0.0005	1.50	57.8	0.99
	Med	0.089	0.003	0.003	0.003	-	1.50	58.0	0.80
	Min	0.057	0.003	0.003	0.001	-	1.50	51.0	0.36
	Max	0.149	0.011	0.052	0.006	-	1.50	67.0	2.43
	Std	0.034	0.003	0.023	0.002	-	0.00	6.15	0.73
	SE	0.010	0.001	0.007	0.001	-	0.00	1.85	0.22
	95 CI	0.023	0.002	0.015	0.001	-	0.00	4.13	0.49
	+95 CI	0.117	0.006	0.038	0.004	-	1.50	62.0	1.48
	-95 CI	0.071	0.002	0.007	0.001	-	1.50	53.7	0.50
Shea Creek (E272563)	Count	8	8	8	8	5	8	8	8
	Mean	0.088	0.003	0.016	0.002	<0.0005	3.05	40.75	0.47
	Med	0.087	0.003	0.010	0.002	-	1.50	41.00	0.42
	Min	0.065	0.003	0.003	0.001	-	1.50	32.00	0.30
	Max	0.103	0.006	0.041	0.004	-	13.90	48.00	0.73
	Std	0.013	0.001	0.014	0.001	-	4.38	5.04	0.15
	SE	0.004	0.001	0.005	0.000	-	1.55	1.78	0.05
	95 CI	0.010	0.001	0.012	0.001	-	3.67	4.21	0.13
	+95 CI	0.098	0.004	0.028	0.003	-	6.72	44.96	0.60
	-95 CI	0.078	0.002	0.004	0.001	-	-0.62	36.54	0.34

Table A3: Summary statistics for selected metals data collected at MWMT sites from 2015-2019.

		Dissolved					Total					
		Al µg/L	As µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe µg/L	Mn µg/L	Ni µg/L	Pb µg/L	Zn µg/L
All MWMT Sites	Count	204	211	211	211	211	211	211	211	211	211	211
	Mean	52	0.224	0.008	0.067	0.160	1.11	232	14.05	0.299	0.090	1.97
	Med	28.8	0.190	0.003	0.050	0.100	0.750	127	6.02	0.250	0.026	1.50
	Min	0	0.156	0.003	0.109	0.050	0.250	5	0.31	0.050	0.003	3.00
	Max	343	0.050	0.064	0.003	0.900	11.6	2700	220	1.77	4.41	0.21
	Std	58	1.25	0.010	1.15	0.162	1.23	337	25.3	0.256	0.355	0.14
	SE	4	0.011	0.001	0.007	0.011	0.085	23	1.74	0.018	0.024	22.9
	95 CI	8	0.021	0.001	0.015	0.022	0.167	46	3.43	0.035	0.048	0.41
	+95 CI	60	0.246	0.010	0.082	0.182	1.28	277	17.48	0.334	0.138	2.38
	-95 CI	44	0.203	0.007	0.053	0.138	0.946	186	10.61	0.264	0.042	1.56
Cutthroat Creek (E272556)	Count	40	41	41	41	41	41	41	41	41	41	41
	Mean	57.5	0.286	0.007	0.098	0.124	0.818	552	39.8	0.172	0.183	3.01
	Med	56.2	0.250	0.005	0.053	0.050	0.490	452	27.2	0.128	0.064	1.50
	Min	17.9	0.130	0.003	0.112	0.050	0.250	111	2.52	0.050	0.023	4.23
	Max	138	1.20	0.053	0.024	0.840	11.6	2440	220	0.840	4.41	0.66
	Std	32.3	0.172	0.009	0.590	0.143	1.77	435	42.8	0.130	0.678	0.51
	SE	5.1	0.027	0.001	0.017	0.022	0.277	68	6.68	0.020	0.106	22.9
	95 CI	10.3	0.054	0.003	0.035	0.045	0.560	137	13.5	0.041	0.214	1.34
	+95 CI	67.8	0.340	0.010	0.133	0.169	1.38	689	53.3	0.213	0.397	4.35
	-95 CI	47.2	0.231	0.004	0.063	0.079	0.258	414	26.3	0.131	-0.031	1.68
Nanika River (E272557)	Count	42	43	43	43	43	43	43	43	43	43	43
	Mean	21.4	0.227	0.022	0.111	0.122	2.507	208	13.34	0.294	0.180	2.56
	Med	16.8	0.180	0.018	0.050	0.050	2.050	77	7.35	0.230	0.060	1.50
	Min	8.1	0.110	0.008	0.203	0.050	0.980	29	2.14	0.117	0.008	3.44
	Max	52.3	1.250	0.064	0.016	0.850	7.890	2700	115.00	1.770	2.030	0.52
	Std	11.4	0.193	0.012	1.150	0.182	1.366	460	20.25	0.289	0.404	0.89
	SE	1.8	0.029	0.002	0.031	0.028	0.208	70	3.09	0.044	0.062	20.40
	95 CI	3.5	0.060	0.004	0.062	0.056	0.420	142	6.23	0.089	0.124	1.06
	+95 CI	24.9	0.287	0.025	0.174	0.178	2.927	350	19.57	0.383	0.304	3.62
	-95 CI	17.8	0.168	0.018	0.049	0.066	2.086	66	7.11	0.205	0.055	1.51

Table A3 *cont.*: Summary statistics for selected metals data collected at MWMT sites from 2015-2019.

		Dissolved					Total					
		Al µg/L	As µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe µg/L	Pb µg/L	Mn µg/L	Ni µg/L	Zn µg/L
Morice River (E272549)	Count	33	34	34	34	34	34	34	34	34	34	34
	Mean	14.0	0.085	0.005	0.030	0.053	0.755	37	0.027	2.23	0.144	0.77
	Med	10.8	0.090	0.006	0.029	0.050	0.705	25	0.025	1.84	0.114	0.56
	Min	5.9	0.050	0.003	0.019	0.050	0.500	5	0.003	0.31	0.058	0.57
	Max	41.8	0.120	0.010	0.003	0.140	1.210	154	0.101	9.66	0.250	0.10
	Std	9.0	0.024	0.002	0.076	0.015	0.193	31	0.021	1.98	0.074	0.14
	SE	1.6	0.004	0.0001	0.003	0.003	0.033	5	0.004	0.34	0.013	1.90
	95 CI	3.2	0.008	0.001	0.007	0.005	0.067	11	0.007	0.69	0.026	0.20
	+95 CI	17.2	0.093	0.006	0.037	0.058	0.823	47	0.034	2.92	0.170	0.97
	-95 CI	10.8	0.076	0.004	0.024	0.047	0.688	26	0.020	1.54	0.118	0.57
McBride Creek (E260496)	Count	39	40	40	40	40	40	40	40	40	40	40
	Mean	82.4	0.337	0.003	0.033	0.250	0.731	227	0.021	10.22	0.290	0.97
	Med	85.3	0.290	0.003	0.029	0.230	0.745	175	0.021	6.18	0.276	0.81
	Min	29.4	0.200	0.003	0.011	0.150	0.250	86	0.009	2.27	0.219	0.63
	Max	161	1	0.010	0.017	0.530	1	729	0.050	71.30	0.400	0.10
	Std	29.2	0.148	0.002	0.050	0.084	0.139	137	0.009	12.99	0.046	0.27
	SE	4.7	0.023	0.0001	0.002	0.013	0.022	22	0.002	2.05	0.007	3.20
	95 CI	9.5	0.047	0.001	0.004	0.027	0.044	44	0.003	4.15	0.015	0.20
	+95 CI	91.9	0.384	0.004	0.037	0.277	0.776	271	0.024	14.37	0.305	1.17
	-95 CI	73.0	0.289	0.003	0.029	0.223	0.687	183	0.018	6.06	0.275	0.76
Crystal Creek (E272554)	Count	12	12	12	12	12	12	12	12	12	12	12
	Mean	13.2	0.203	<0.003	<0.050	0.068	0.736	40	0.031	2.21	<0.250	1.72
	Med	13.0	0.215	-	-	0.050	0.745	34	0.025	1.79	-	1.50
	Min	0.0	0.150	-	-	0.050	0.590	5	0.025	1.26	-	0.75
	Max	30.1	0.250	-	-	0.140	0.870	106	0.102	5.10	-	0.22
	Std	7.1	0.033	-	-	0.034	0.103	25	0.022	1.06	-	1.50
	SE	2.1	0.009	-	-	0.010	0.030	7	0.006	0.31	-	4.10
	95 CI	4.5	0.021	-	-	0.021	0.065	16	0.014	0.68	-	0.48
	+95 CI	17.7	0.223	-	-	0.090	0.801	56	0.046	2.88	-	2.19
	-95 CI	8.7	0.182	-	-	0.047	0.670	24	0.017	1.53	-	1.24

Table A3 *cont.*: Summary statistics for selected metals data collected at MWMT sites from 2015-2019.

		Dissolved				Total						
		Al	As	Cd	Co	Cr	Cu	Fe	Pb	Mn	Ni	Zn
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Gosnell Creek (E260493)	Count	11	11	11	11	11	11	11	11	11	11	11
	Mean	10.3	0.156	0.010	<0.050	0.173	0.425	133	0.053	8.58	<0.250	3.69
	Med	9.8	0.170	0.003	-	0.120	0.510	117	0.025	6.48	-	1.50
	Min	4.7	0.120	0.003	-	0.050	0.250	69	0.025	5.46	-	4.40
	Max	26.5	0.190	0.049	-	0.460	0.650	251	0.147	14.30	-	1.33
	Std	6.3	0.025	0.014	-	0.137	0.173	49	0.049	3.29	-	1.50
	SE	1.9	0.008	0.004	-	0.041	0.052	15	0.015	0.99	-	15.90
	95 CI	4.2	0.017	0.009	-	0.092	0.116	33	0.033	2.21	-	2.96
	+95 CI	14.5	0.173	0.019	-	0.265	0.541	166	0.085	10.79	-	6.65
	-95 CI	6.1	0.139	0.001	-	0.080	0.308	100	0.020	6.37	-	0.73
Shea Creek (E272563)	Count	6	8	8	8	8	8	8	8	8	8	8
	Mean	9.7	0.151	<0.003	<0.050	0.058	<0.250	90	<0.025	6.96	<0.250	3.48
	Med	6.4	0.155	-	-	0.050	-	84	-	6.82	-	1.50
	Min	5.6	0.130	-	-	0.050	-	52	-	6.02	-	5.59
	Max	20.3	0.170	-	-	0.110	-	141	-	8.54	-	1.98
	Std	5.9	0.014	-	-	0.021	-	32	-	0.88	-	1.50
	SE	2.4	0.005	-	-	0.008	-	11	-	0.31	-	17.30
	95 CI	6.2	0.011	-	-	0.018	-	27	-	0.73	-	4.67
	+95 CI	15.9	0.163	-	-	0.075	-	117	-	7.69	-	8.15
	-95 CI	3.5	0.140	-	-	0.040	-	63	-	6.23	-	-1.20

Table A4: Summary statistics for "5 samples collected in 30 days" sampling (i.e., n= 5-6 at each site for each 30-day time period) at MWMT sites in February-March and August-September of 2019. Sites/parameters with < 5 samples are represented as NA.

	Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Hardness (mg/L $CaCO_3$)	Turbidity (ntu)	DOC (mg/L)
February - March 2019						
Cutthroat Ck	-0.06 ± 0.13 (-0.30 – 0.00)	9.89 ± 0.77 (8.93 – 10.65)	7.39 ± 0.32 (7.03 – 7.88)	25.7 ± 1.2 (24.6 – 26.8)	1.25 ± 0.30 (0.90 – 1.70)	6.53 ± 0.38 (6.20 – 7.18)
Crystal Ck	0.03 ± 0.05 (0.00 – 0.10)	13.45 ± 1.71 (10.90 – 15.92)	7.55 ± 0.14 (7.30 – 7.67)	32.2 ± 8.3 (19.9 – 38.9)	0.56 ± 0.19 (0.40 – 0.94)	2.02 ± 0.52 (1.33 – 2.92)
Gosnell Ck	0.00 ± 0.00 (0.00 – 0.00)	10.19 ± 3.92 (6.09 – 14.69)	7.21 ± 0.26 (6.94 – 7.56)	35.1 ± 0.3 (34.9 – 35.4)	1.46 ± 0.88 (0.80 – 2.43)	1.95 ± 0.11 (1.81 – 2.10)
McBride Ck	0.45 ± 0.28 (0.10 – 0.70)	11.17 ± 2.20 (7.69 – 13.54)	6.88 ± 0.28 (6.58 – 7.32)	17.7 ± 0.9 (16.8 – 19.0)	0.55 ± 0.56 (0.28 – 1.69)	9.75 ± 1.00 (7.83 – 10.60)
Morice R	1.62 ± 1.58 (0.00 – 3.60)	12.86 ± 1.32 (11.68 – 14.92)	7.64 ± 0.08 (7.54 – 7.73)	19.6 ± 1.0 (18.6 – 21.01)	0.22 ± 0.03 (0.19 – 0.26)	1.17 ± 0.05 (1.10 – 1.24)
Nanika R	0.14 ± 0.24 (0.00 – 0.50)	13.54 ± 1.23 (12.17 – 16.01)	7.58 ± 0.17 (7.49 – 7.92)	24.2 ± 1.2 (23.2 – 26.4)	0.44 ± 0.13 (0.30 – 0.69)	1.47 ± 0.47 (1.06 – 2.45)
August - September 2019						
Cutthroat Ck	10.9 ± 2.00 (8.50 – 13.10)	NA	6.47 ± 0.23 (6.28 – 6.94)	20.7 ± 1.6 (17.4 – 22.1)	10.05 ± 20.98 (1.13 – 57.60)	3.76 ± 0.88 (3.08 – 5.36)
Crystal Ck	9.78 ± 0.98 (8.30 – 11.0)	NA	7.84 ± 0.07 (7.75 – 7.91)	35.7 ± 1.0 (34.8 – 37.0)	0.89 ± 0.45 (0.44 – 1.67)	1.21 ± 0.55 (0.76 – 2.18)
Gosnell Ck	10.82 ± 1.34 (8.30 – 12.0)	15.80 ± 5.36 (10.04 – 21.73)	7.74 ± 0.06 (7.64 – 7.81)	39.6 ± 0.7 (38.6 – 40.4)	0.60 ± 0.23 (0.36 – 0.98)	1.23 ± 0.19 (1.01 – 1.56)
McBride Ck	10.72 ± 1.39 (8.40 – 11.9)	NA	6.78 ± 0.16 (6.63 – 7.00)	19.3 ± 1.6 (18.1 – 22.1)	0.79 ± 0.32 (0.56 – 1.35)	7.01 ± 0.86 (5.62 – 7.85)
Morice R	13.58 ± 1.19 (11.8 – 14.4)	NA	7.59 ± 0.32 (7.04 – 7.83)	18.7 ± 0.3 (18.5 – 19.3)	0.76 ± 0.12 (0.59 – 0.91)	1.00 ± 0.14 (0.83 – 1.22)
Nanika R	12.12 ± 0.75 (11.2– 13.0)	NA	7.49 ± 0.20 (7.17 – 7.63)	23.4 ± 2.4 (21.2 – 26.0)	12.35 ± 17.60 (0.79 – 41.30)	0.95 ± 0.05 (0.89 – 1.01)
Shea Ck	10.65 ± 1.28 (8.20 – 11.8)	NA	7.21 ± 0.35 (6.76 – 7.57)	23.9 ± 0.3 (23.5 – 24.4)	0.40 ± 0.08 (0.30 – 0.51)	1.83 ± 0.15 (1.63 – 1.99)

Table A5: Summary statistics for "5 samples collected in 30 days" sampling (i.e., n= 5 at each site for each 30-day time period) at MWMT sites in February-March and August-September of 2019. Sites/parameters with <5 samples are represented as NA.

	TN (mg/L)	TKN (mg/L)	TAN (mg/L)	NO_3^-+NO_2^- (mg/L)	TP (mg/L)
February - March 2019					
Cutthroat Ck	0.252 ± 0.023 (0.233 – 0.289)	0.204 ± 0.031 (0.170 – 0.254)	0.013 ± 0.003 (0.010 – 0.016)	0.036 ± 0.004 (0.034 – 0.043)	0.008 ± 0.001 0.007 – 0.011
Crystal Ck	0.073 ± 0.022 (0.044 – 0.103)	0.035 ± 0.018 (0.025 – 0.066)	0.003 ± 0.001 (0.003 – 0.005)	0.030 ± 0.015 (0.019 – 0.060)	0.003 ± 0.001 (0.002 – 0.006)
Gosnell Ck	0.126 ± 0.021 (0.098 – 0.149)	0.060 ± 0.027 (0.025 – 0.093)	0.003 ± 0.000 (–)	0.046 ± 0.004 (0.042 – 0.052)	0.004 ± 0.001 (0.003 – 0.006)
McBride Ck	0.237 ± 0.023 (0.199 – 0.260)	0.210 ± 0.033 (0.146 – 0.236)	0.003 ± 0.002 (0.003 – 0.007)	0.018 ± 0.002 (0.016 – 0.021)	0.005 ± 0.001 (0.004 – 0.006)
Morice R	0.075 ± 0.008 (0.067 – 0.087)	0.025 ± 0.000 (–)	0.003 ± 0.000 (–)	0.044 ± 0.002 (0.041 – 0.046)	0.002 ± 0.001 (0.001 – 0.002)
Nanika R	0.063 ± 0.019 (0.040 – 0.102)	0.031 ± 0.015 (0.025 – 0.064)	0.003 ± 0.000 (–)	0.026 ± 0.008 (0.019 – 0.039)	0.002 ± 0.001 (0.001 – 0.004)
August - September 2019					
Cutthroat Ck	0.192 ± 0.037 (0.136 – 0.248)	0.192 ± 0.037 (0.136 – 0.248)	0.005 ± 0.006 (0.003 – 0.019)	0.003 ± 0.000 (–)	0.013 ± 0.010 (0.007 – 0.036)
Crystal Ck	0.062 ± 0.015 (0.035 – 0.076)	0.060 ± 0.019 (0.025 – 0.076)	0.003 ± 0.001 (0.003 – 0.006)	0.003 ± 0.000 (–)	0.003 ± 0.001 (0.001 – 0.005)
Gosnell Ck	0.068 ± 0.012 (0.057 – 0.089)	0.068 ± 0.012 (0.057 – 0.089)	0.005 ± 0.004 (0.003 – 0.009)	0.003 ± 0.000 (–)	0.001 ± 0.001 (0.001 – 0.003)
McBride Ck	0.216 ± 0.038 (0.174 – 0.273)	0.216 ± 0.038 (0.174 – 0.273)	0.005 ± 0.004 (0.003 – 0.009)	0.003 ± 0.000 (–)	0.006 ± 0.001 (0.005 – 0.007)
Morice R	0.079 ± 0.016 (0.067 – 0.107)	0.052 ± 0.029 (0.025 – 0.093)	0.006 ± 0.006 (0.003 – 0.017)	0.018 ± 0.005 (0.014 – 0.026)	0.001 ± 0.001 (0.001 – 0.003)
Nanika R	0.074 ± 0.021 (0.050 – 0.099)	0.070 ± 0.017 (0.050 – 0.092)	0.004 ± 0.004 (0.003 – 0.012)	0.005 ± 0.004 (0.003 – 0.012)	0.022 ± 0.028 (0.002 – 0.067)
Shea Ck	0.083 ± 0.011 (0.065 – 0.097)	0.075 ± 0.014 (0.054 – 0.097)	0.003 ± 0.001 (0.003 – 0.006)	0.009 ± 0.004 (0.003 – 0.015)	0.002 ± 0.001 (0.001 – 0.003)

Table A6: Summary statistics for "5 samples collected in 30 days" sampling (i.e., n= 5 at each site for each 30-day time period) at MWMT sites in February-March and August-September of 2019. Sites/parameters with < 5 samples are represented as NA.

	Al – Dissolved (mg/L)	Fe – Dissolved (mg/L)	Cu – Total (mg/L)	Zn – Total (mg/L)
February - March 2019				
Cutthroat Ck	72.3 ± 7.5 (64.6 – 84.2)	544 ± 101 (421 – 668)	1.00 ± 1.05 (0.25 – 2.86)	5.0 ± 3.4 (1.5 – 9.0)
Crystal Ck	17.4 ± 5.7 (12.3 – 30.1)	34 ± 33 (11 – 90)	0.60 ± 0.23 (0.25 – 0.85)	3.8 ± 5.5 (1.5 – 17.3)
Gosnell Ck	11.5 ± 1.8 (9.8 – 14.2)	93 ± 10 (85 – 109)	0.58 ± 0.07 (0.51 – 0.65)	6.3 ± 5.7 (1.50 – 15.9)
McBride Ck	89.8 ± 9.6 (73.7 – 102)	140 ± 29 (86 – 166)	0.77 ± 0.10 (0.60 – 0.86)	1.5 ± 0.0 (–)
Morice R	8.0 ± 1.3 (6.9 – 9.9)	5 ± 0 (–)	0.59 ± 0.04 (0.55 – 0.65)	1.5 ± 0.0 (–)
Nanika R	9.7 ± 2.1 (8.1 – 12.9)	32 ± 6 (24 – 42)	1.21 ± 0.17 (0.98 – 1.49)	1.5 ± 0.0 (–)
August - September 2019				
Cutthroat Ck	33.8 ± 26.4 (20.8 – 93.4)	361 ± 122 (218 – 502)	1.99 ± 4.24 (0.25 – 11.6)	4.6 ± 8.1 (1.5 – 22.9)
Crystal Ck	8.8 ± 4.8 (0.0 – 13.2)	10 ± 13 (5 – 36)	0.75 ± 0.12 (0.60 – 0.87)	1.5 ± 0.0 (–)
Gosnell Ck	9.3 ± 8.6 (4.7 – 26.5)	70 ± 23 (54 – 115)	0.30 ± 0.11 (0.25 – 0.53)	1.5 ± 0.0 (–)
McBride Ck	43.3 ± 8.6 (29.4 – 51.3)	410 ± 129 (342 – 641)	0.51 ± 0.15 (0.25 – 0.61)	1.5 ± 0.0 (–)
Morice R	18.0 ± 13.3 (10.8 – 41.8)	12 ± 16 (5 – 41)	0.67 ± 0.07 (0.56 – 0.75)	1.5 ± 0.0 (–)
Nanika R	24.0 ± 10.5 (14.9 – 37.1)	23 ± 7 (17 – 32)	2.90 ± 2.08 (1.39 – 6.05)	8.4 ± 7.9 (1.5 – 20.4)
Shea Ck	6.2 ± 0.4 (5.6 – 6.4)	NA	0.25 ± 0.00 (–)	1.5 ± 0.0 (–)