Mary River Project 2018
Core Receiving Environment Monitoring Program Report

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March 2019

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Core Receiving Environment
Monitoring Program Report

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EXECUTIVE SUMMARY

The Mary River Project is an operating high-grade iron mine located in the Qikiqtani Region of northern Baffin Island, Nunavut. Owned and operated by Baffinland Iron Mines Corporation (Baffinland), the mine began commercial operation in 2015. Mining activities at the Mary River Project include open pit ore extraction, ore haulage, stockpiling, crushing, and screening, followed by transport by truck to Milne Port for subsequent seasonal loading onto bulk carrier ships for transfer to international markets. No milling or additional processing of the ore is conducted on-site and therefore no tailings are produced at the Mary River Project. Mine waste management facilities at the Mary River Project thus consist simply of a mine rock dump and surface runoff collection/sedimentation ponds currently situated near the mine rock dump and ore stockpile areas. In addition to periodic discharge of treated effluent from the mine waste rock disposal area, other potential mine inputs to aquatic systems located adjacent to the mine include runoff and dust from ore (crusher) stockpiles, discharge of treated sewage effluent, runoff and explosives residue from quarry operations, deposition of fugitive dust generated by mine activities, and general mine site runoff.

Under the terms and conditions of the Project’s Type ‘A’ Water Licence issued by the Nunavut Water Board, Baffinland was required to develop and implement an Aquatic Effects Monitoring Plan (AEMP) at the Mary River Project. In order to meet the AEMP objectives for the Mary River Project, Baffinland developed a Core Receiving Environment Monitoring Program (CREMP) to provide a basis for the evaluation of mine-related influences on water quality, sediment quality, and/or aquatic biota (including phytoplankton, benthic invertebrates, and fish). The primary receiving systems that serve as the focus for the CREMP include the Camp Lake system (i.e., Camp Lake tributaries 1 and 2, Camp Lake), the Sheardown Lake system (i.e., Sheardown Lake tributaries 1, 9 and 12; Sheardown Lake NW and Sheardown Lake SE), and the Mary River and Mary Lake system. The CREMP has implemented an effects-based approach using standard environmental effects monitoring techniques as the basis for the evaluation of potential mine-related effects within the mine primary receiving systems on an annual frequency since the commencement of commercial mine production/operation in 2015.

The results of the 2018 CREMP indicated some mine-related influences on water and sediment quality of a few of the mine primary receiver systems, but no ecologically significant, adverse, mine-related effects to biota were identified based on comparisons to applicable reference conditions or baseline data. Within the Camp Lake system, mine-related effects on water quality were apparent as elevated concentrations of copper at the CLT1 north branch only, chloride, manganese, molybdenum, nitrate, potassium, sodium, sulphate, and uranium at the CLT1 main stem, and chloride, manganese, molybdenum, sodium, sulphate, and uranium at Camp Lake, based on comparisons to reference conditions and/or to baseline data. Arsenic and manganese concentrations were elevated within littoral sediment of Camp Lake compared to reference lake sediments and to Camp Lake baseline data. Active quarrying (QMR2 Quarry) in the watershed was a possible source of these parameters to waterbodies of the Camp Lake system. Nevertheless, no adverse effects to phytoplankton, benthic invertebrates, or arctic charr (*Salvelinus alpinus*) were indicated at mine-exposed areas of the Camp Lake system in 2018, which was consistent with concentrations of most metals being below the applicable water and sediment quality guidelines (WQG and SQG, respectively) at these waterbodies.

Within the Sheardown Lake system, mine-related effects on water quality were apparent only at Sheardown Lake Tributary 1 (SDLT1) and both basins of Sheardown Lake. At SDLT1, aqueous concentrations of manganese, nickel, nitrate, sodium, strontium, sulphate, total dissolved solids, and uranium were elevated compared to concentrations at reference areas and during applicable baseline studies, but only copper concentrations were above WQG in 2018. At Sheardown Lake NW, aqueous concentrations of chloride, manganese, molybdenum, sulphate, and uranium were elevated compared to Reference Lake 3 in 2018 and/or to baseline data, whereas at Sheardown Lake SE, copper and molybdenum concentrations were elevated compared to reference conditions in 2018 and/or to baseline data. However, no parameters were elevated above WQG at either basin of Sheardown Lake in 2018. Metal concentrations in sediment at littoral and profundal habitats of the Sheardown Lake basins were very similar to concentrations observed for the same habitat types at Reference Lake 3 in 2018, suggesting no marked mine-related influences on sediment metal concentrations. No ecologically significant and/or adverse effects to phytoplankton, benthic invertebrates, or arctic charr were indicated at mine-exposed areas of Sheardown Lake Tributaries 1, 9, and 12, Sheardown Lake NW, or Sheardown Lake SE in 2018, which was consistent with concentrations of most metals being below the applicable WQG and SQG at these waterbodies.

Within the Mary River/Mary Lake system, mine-related effects on water quality were apparent only as slightly elevated concentrations of manganese and sulphate at mine-exposed areas of Mary River. Similarly, mine-related effects on sediment quality only included slight elevation of manganese concentrations at littoral habitat of Mary Lake. However, no adverse effects to phytoplankton, benthic invertebrates, or arctic charr were indicated at mine-exposed areas of Mary River and/or Mary Lake in 2018 which, similar to the other mine receiving systems, was consistent with concentrations of most metals being below the applicable WQG and SQG.

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ACRONYMS AND ABBREVIATIONS

AEMP – Aquatic Effects Monitoring Plan

ANCOVA – Analysis of Covariance

ANOVA – Analysis of Variance

CES – Critical Effect Size

CPUE – Catch Per Unit Effort

CREMP – Core Receiving Environment Monitoring Program

CSQG – Canadian Sediment Quality Guidelines

CWQG – Canadian Water Quality Guidelines

DOC –Dissolved Organic Carbon

EEM – Environmental Effects Monitoring

FFG – Functional Feeding Group

GPS – Global Positioning System

HPG – Habitat Preference Group

HSD – Honestly Significant Difference

KS –Kolmogorov-Smirnov

MRTF – Mary River Tributary-F

NW – Northwest

PEL – Probable Effect Level

PSQG – Provincial Sediment Quality Guideline

PWQO – Provincial Water Quality Objective

QA/QC – Quality Assurance / Quality Control

SE – Southeast

SEL – Severe Effect Level

SQG – Sediment Quality Guideline

TDS – Total Dissolved Solids

TKN – Total Kjeldahl Nitrogen

TOC – Total Organic Carbon

TSS – Total Suspended Solids

UTM – Universal Transverse Mercator

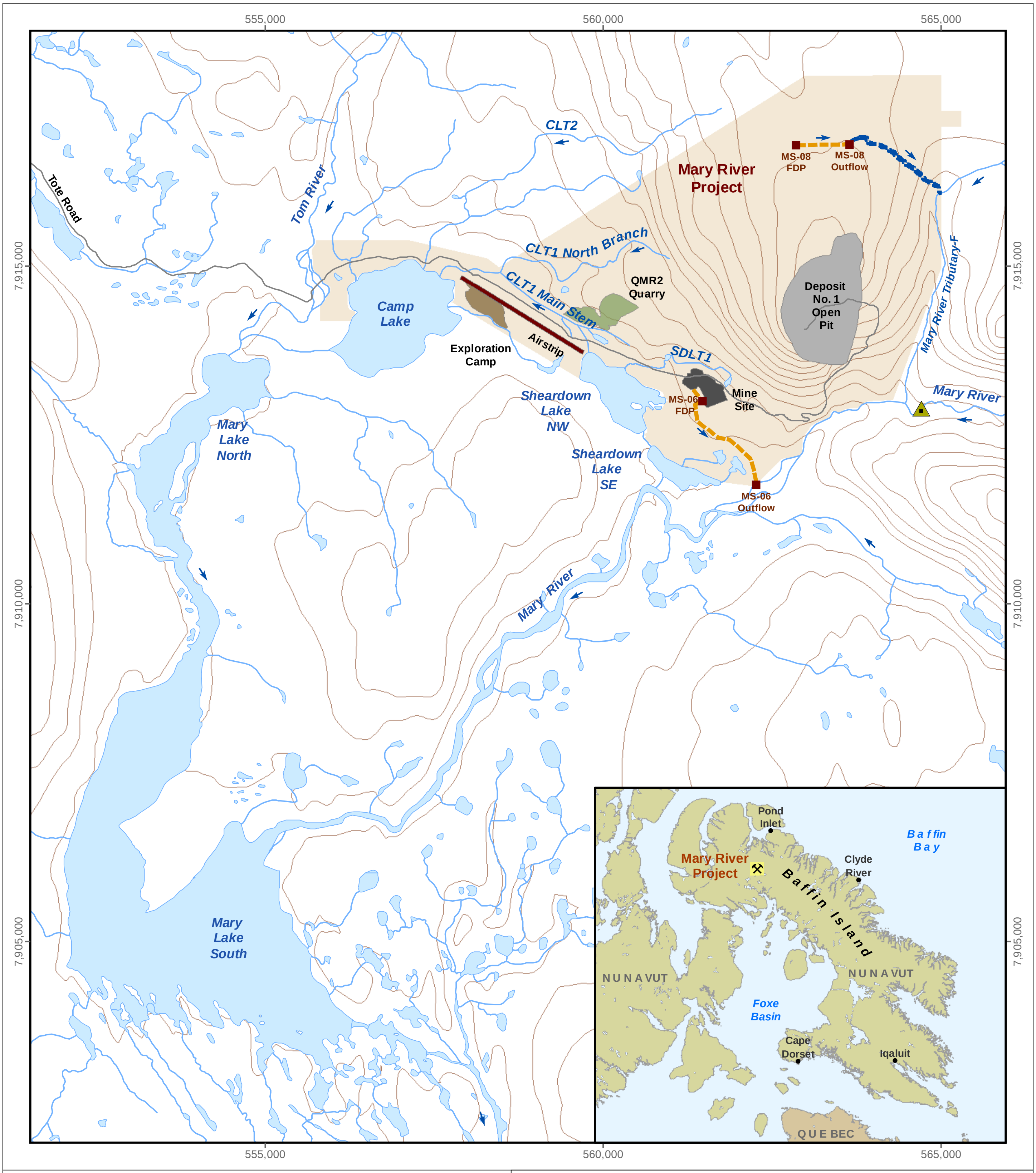
WQG – Water Quality Guideline

YOY –Young of the Year

1 INTRODUCTION

The Mary River Project, owned and operated by Baffinland Iron Mines Corporation (Baffinland), is a high-grade iron ore mining operation located in the Qikiqtani Region of northern Baffin Island, Nunavut (Figure 1.1). Open pit mining, including pit bench development, ore haulage and stockpiling, and the crushing and screening of high-grade iron ore, commenced at the Mary River Project in mid-September 2014. For the initial mining stages, as much as 4.2 million tonnes (Mt) of crushed/screened ore generated at the Project's mine site is transported annually by truck to Milne Port, which is located approximately 100 km north of the mine site. At Milne Port, the ore is stockpiled before being loaded onto bulk carrier ships for transport to international markets during the summer ice-free period. No milling or additional ore processing is conducted on-site, and thus no tailings are produced at the Mary River Project. All waste rock generated at the Project is deposited at a waste rock stockpile facility at the mine site (Figure 1.1). Ore processing areas and the waste rock stockpile facility are equipped with surface water management ponds to control and analyze runoff prior to discharge. Potential inputs to aquatic systems from Project operations at the mine site include effluent discharges from surface water management ponds (MS-06, MS-08) and sewage treatment plants, fugitive dust emissions from mining, crushing, and trucking operations, explosives residue, and sediment deposition from general mine site runoff.

Under terms and conditions of a Type 'A' Water Licence issued by the Nunavut Water Board (No. 2AM-MRY1325 Amendment No. 1), Baffinland developed an Aquatic Effects Monitoring Plan (AEMP) for the Mary River Project. A key objective of the AEMP was to provide data and information to allow the evaluation of short- and long-term effects of the Project on aquatic ecosystems. To meet this objective, Baffinland developed a Core Receiving Environment Monitoring Program (CREMP) to assess potential mine-related influences on water quality, sediment quality and biota (including phytoplankton, benthic invertebrates and fish) at aquatic environments located near the mine (Baffinland 2015; KP 2014; NSC 2014). The primary receiving systems that are the focus for the CREMP include the Camp Lake system (Tributaries 1 and 2, Camp Lake), the Sheardown Lake system (Tributaries 1, 9 and 12; Sheardown Lake NW and Sheardown Lake SE), Mary River, and Mary Lake (Figure 1.1). Over the initial three years of mine operation, the CREMP studies indicated some effects of the Mary River Project mine operations on water quality and sediment quality of receiving waterbodies, but these effects were confined to single tributaries feeding into each of Camp and Sheardown lakes, as well as near the immediate outlets of these tributaries to each respective lake (Minnow 2016a, 2017, 2018). No adverse mine-related effects to phytoplankton, benthic invertebrate, or fish were indicated at any of the Camp, Sheardown, or Mary lake systems in 2015, 2016, or 2017 based on comparisons



LEGEND

- ■ Final Discharge Point (FDP)
- ▲ Mary River Cascade Barrier
- ▬ ▬ Discharge Line
- ▬ ▬ Overland Effluent Channel
- 🟩 QMR2 Quarry
- 🟥 Airstrip
- ▨ Exploration Camp
- ■ Mine Site
- ■ Open Pit
- ▨ Mary River Project

Baffinland Iron Mines Corporation, Mary River Project Location

0 1.25 2.5 5 km

N E S W

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Figure 1.1

Document Path: S:\Projects\187202\187202.0025 - Baffinland 2018 AEMP\4 - GIS\CREMP Study\18-25 Figure 1.1 Location.mxd to representative reference waterbodies and to available pre-mine baseline data for each lake system (Minnow 2016a, 2017, 2018).

This report presents the methods and results of the 2018 CREMP, including an evaluation of potential Mary Lake Project-related influences on chemical and biological conditions at mine-exposed waterbodies through the fourth full year of mine operation. As in the three previous studies, the 2018 Mary River Project CREMP included water quality monitoring, sediment quality monitoring, phytoplankton monitoring, benthic invertebrate community assessment, and an arctic charr (*Salvelinus alpinus*) fish population assessment. The 2018 CREMP was implemented in accordance with the original study design (Baffinland 2015) with the exception of the continued use of a reference creek benthic invertebrate community study area that was originally added in 2016 to improve the program's ability to evaluate mine-related influences on stream biota (Minnow 2016b, 2017, 2018).

2 METHODS

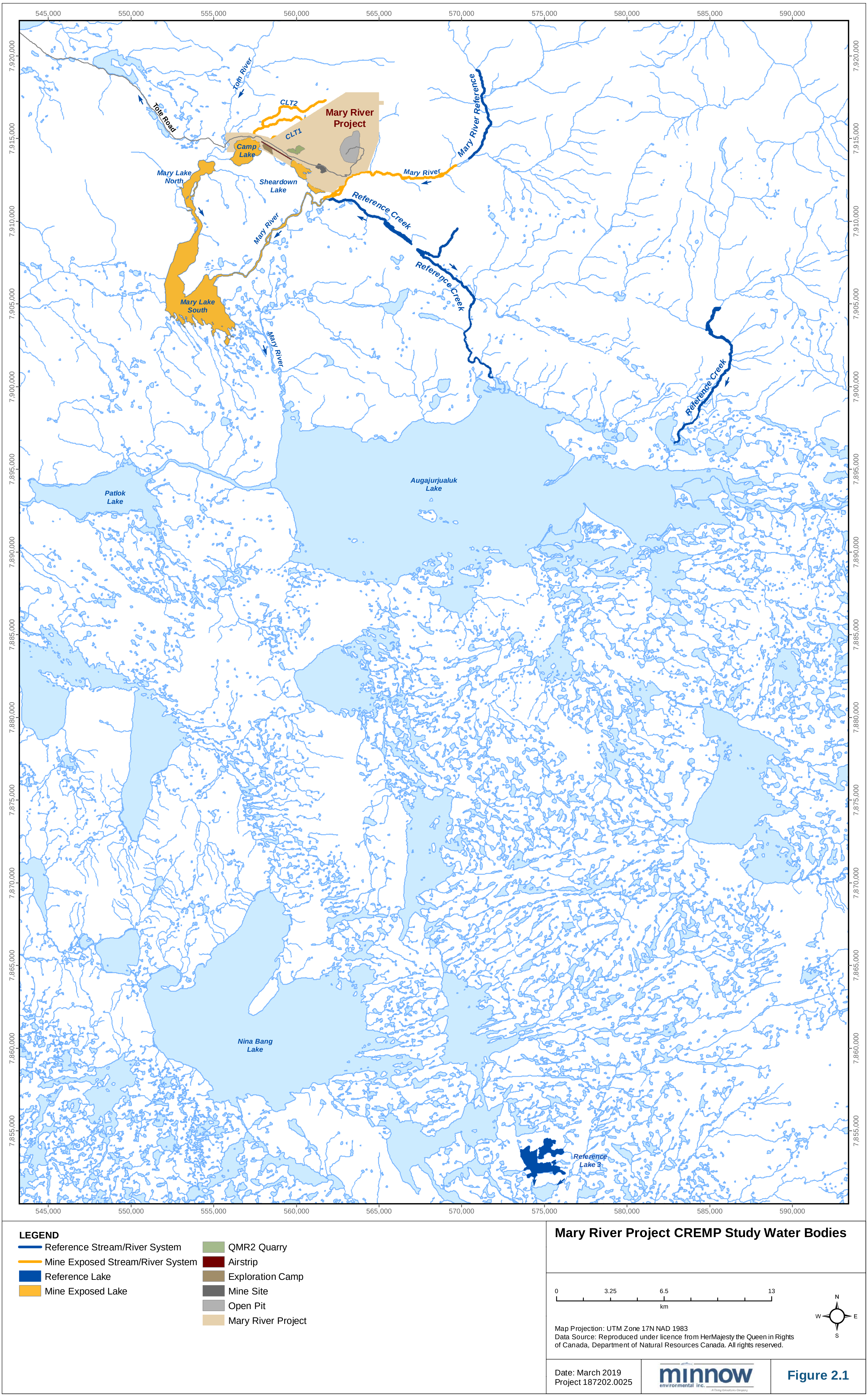
2.1 Overview

The Mary River Project CREMP includes water quality monitoring, sediment quality monitoring, phytoplankton (chlorophyll-a) monitoring, benthic invertebrate community assessment, and fish population assessment (Baffinland 2015). In 2018, water quality and phytoplankton monitoring was conducted by Baffinland environment department personnel over four separate sampling events, including a lake ice-cover event (April 13th to 23rd) and open-water season events corresponding to Arctic spring (freshet), summer, and autumn (June 30th to July 3rd, July 29th to August 12th, and August 19th to 27th, respectively). Sediment quality, benthic invertebrate community, and fish population sampling was conducted by Minnow Environmental Inc. (Minnow) personnel with assistance from Baffinland environment department staff from August 15th to 29th 2018, the seasonal timing of which was consistent with monitoring conducted for previous baseline (2005 to 2013), mine construction (2014), and mine operational (2015, 2016, 2017) studies. Similar to previous CREMP studies, the 2018 study included field sampling and standard laboratory quality assurance/quality control (QA/QC) for individual water quality, sediment quality, and benthic invertebrate community study components to allow for an assessment of the overall quality of each respective data set (Appendix A).

The 2018 CREMP study areas included the same mine-exposed and reference waterbodies established in the original design documents (Baffinland 2015; KP 2014; NSC 2014) and the same reference creek and lake that was added to the program in 2015 (Figure 2.1). To simplify the discussion of results, the mine-exposed study areas were separated by lake catchment as follows:

- the Camp Lake system (Camp Lake Tributaries 1 and 2, and Camp Lake);
- the Sheardown Lake system (Sheardown Lake Tributaries 1, 9, and 12, Sheardown Lake Northwest [NW], and Sheardown Lake Southeast [SE]); and,
- the Mary River/Mary Lake system.

Reference Lake 3, which served as a reference waterbody for lentic (lake) environments beginning in the 2015 CREMP study, was again used as the reference lake for the 2018 study. Reference Lake 3 is located approximately 62 km south of the Mary River Project (Figure 2.1), and is well outside the area of mine influence. Streams used as reference areas in the current and previous CREMP included an unnamed tributary to the Mary River and two unnamed tributaries to Angajurjuatuk Lake, all of which are located southeast of the mine (Figure 2.1). As in the previous CREMP studies, an area of Mary River located well upstream of current Baffinland



Mary River Project CREMP Study Water Bodies

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Figure 2.1

Document Path: S:\Projects\187202\187202.0025 - Baffinland 2018 AEMP\4 - GIS\CREMP Study\18-25 Figure 2.1 Study Waterbodies.mxd mine activity (i.e., GO-09) served as a reference area for the mine-exposed portion of Mary River in the 2018 study (Figure 2.1).

2.2 Water Quality

2.2.1 General Design

Surface water quality monitoring was conducted by Baffinland environment department personnel at the sampling locations and frequencies stipulated in the Mary River Project CREMP design (Baffinland 2015; KP 2014). The surface water sampling was conducted at as many as 57 stations per sampling period (Table 2.1; Figures 2.2 and 2.3), and included collection of *in situ* measurements and water chemistry data.

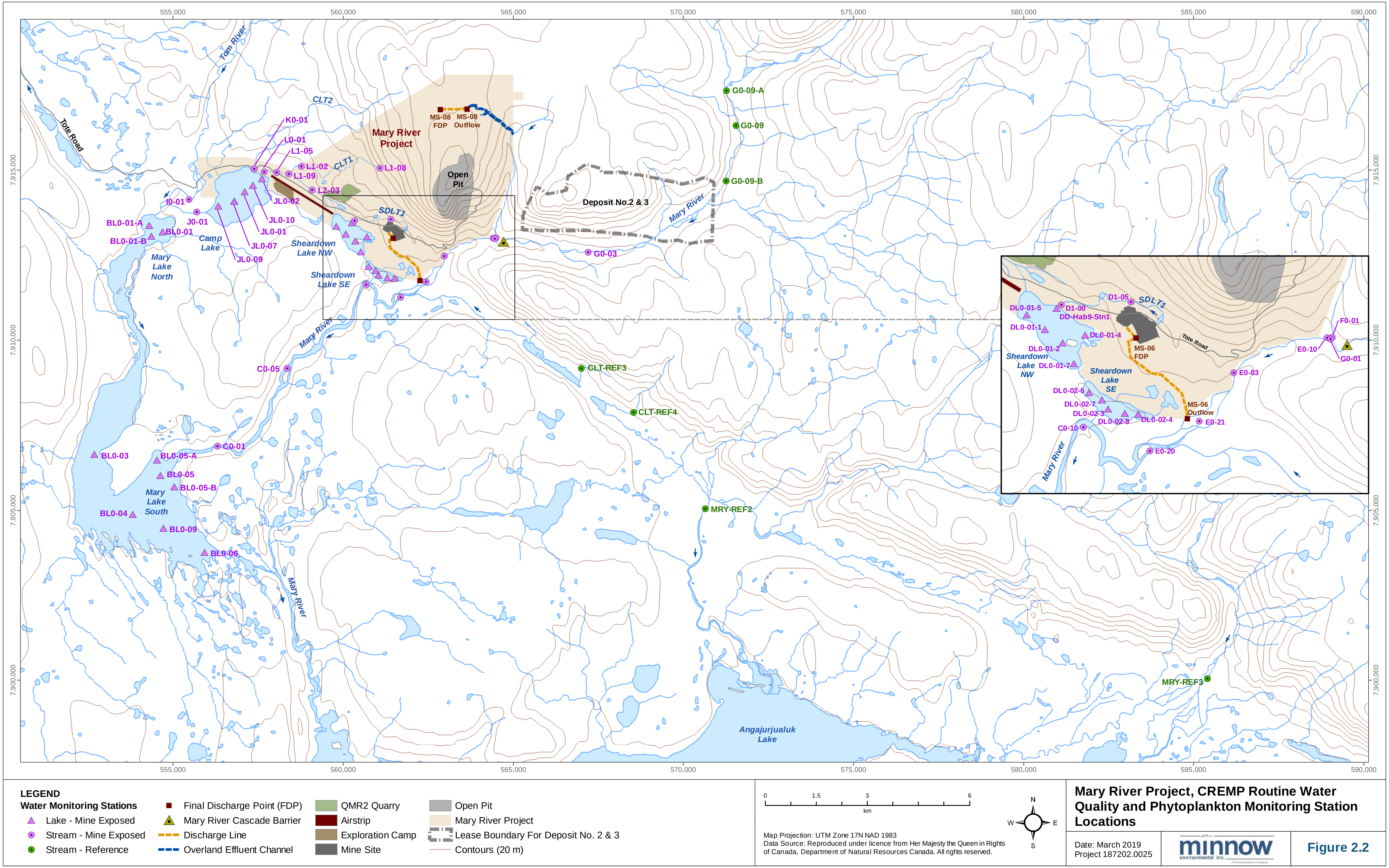
2.2.2 In situ Water Quality Measurement Data Collection and Analysis

In situ measurements of water temperature, dissolved oxygen, pH, specific conductance (i.e., temperature standardized measurement of conductivity), and turbidity were taken at the bottom of the water column at all lotic (i.e., creek, river) stations and as a vertical profile at one metre intervals at each lentic (i.e., lake) water quality monitoring station during routine monitoring conducted by Baffinland. These *in situ* measurements were also collected at the surface and bottom (i.e., approximately 30 cm above the water-sediment interface) at all lake benthic invertebrate community (benthic) stations during the fall biological sampling completed by Minnow, with the exception of turbidity measurements. The *in situ* measurements were collected using one of three YSI ProDSS (Digital Sampling System) meters equipped with a 4-Port sensor (YSI Inc., Yellow Springs, OH). Meter readings for pH, specific conductance, and turbidity were checked against standard solutions and calibrated as necessary in the morning on the day in which sampling was to be completed, prior to field sampling. Dissolved oxygen concentration readings were checked and calibrated at a greater frequency through each sampling day in response to changing sampling conditions (e.g., changes in elevation, barometric pressure, and/or ambient temperature). During the winter ice-cover sampling event, a gas-powered, 15 centimetre (6-inch) diameter ice auger was used to access the water column at all lake water quality monitoring stations. All ice shavings were removed from the auger hole prior to the collection of *in situ* measures. To avoid confounding influences associated with snow/ice melt in the auger hole, the *in situ* measurements were collected beginning just below the ice layer. Additional supporting observations of water colour and clarity were recorded at the time of water quality and biological sampling at all benthic stations, and Secchi depth was measured at all lake stations during ice-free periods using the methods outlined in Wetzel and Likens (2000).

Table 2.1: Mary River Project CREMP Water Quality and Phytoplankton Monitoring Station Coordinates and Annual Sampling Schedule

Study System	Water Body	Station ID	UTM Zone 17N, NAD83		Ref. Data Set [a]	Sampling Season			
			Easting	Northing		Winter (Apr. - May)	Spring (June)	Summer (July)	Fall (Aug. - Sept.)
Reference Areas	Creek Reference	CLT-REF3	567004	7909174	na	-	✓	✓	✓
		CLT-REF4	568533	7907874		-	✓	✓	✓
		MRY-REF3	585407	7900061		-	✓	✓	✓
		MRY-REF2	570650	7905045		-	✓	✓	✓
	Reference Lake 3	REF-03-W1	575642	7852666	na	-	-	✓	✓
		REF-03-W2	574836	7852744		-	-	✓	✓
		REF-03-W3	574158	7853237		-	-	✓	✓
	Mary River Reference	G0-09-A	571264	7917344	na	-	✓	✓	✓
		G0-09	571546	7916317		-	✓	✓	✓
		G0-09-B	571248	7914682		-	✓	✓	✓
Camp Lake System	Camp Lake Tributaries	I0-01	555470	7914139	a	-	✓	✓	✓
		J0-01	555701	7913773		-	✓	✓	✓
		K0-01	557390	7915030		-	✓	✓	✓
		L0-01	557681	7914959		-	✓	✓	✓
		L1-02	558765	7915121		-	✓	✓	✓
		L1-05	558040	7914935		-	✓	✓	✓
		L1-08	561076	7915068		-	✓	✓	✓
		L1-09	558407	7914885		-	✓	✓	✓
		L2-03	559081	7914425		-	✓	✓	✓
	Camp Lake	JL0-01	557108	7914369	b	✓	-	✓	✓
		JL0-02	557615	7914750		✓	-	✓	✓
		JL0-07	556800	7914094		✓	-	✓	✓
		JL0-09	556335	7913955		✓	-	✓	✓
		JL0-10	557346	7914562		✓	-	✓	✓
Sheardown Lake System	Sheardown Tributary 1	D1-00	560329	7913512	a	-	✓	✓	✓
		D1-05	561397	7913558		-	✓	✓	✓
	Sheardown Lake NW	DD-Hab9-Stn1	560259	7913455	b	✓	-	✓	✓
		DL0-01-1	560080	7913128		✓	-	✓	✓
		DL0-01-2	560353	7912924		✓	-	✓	✓
		DL0-01-4	560695	7913043		✓	-	✓	✓
		DL0-01-5	559798	7913356		✓	-	✓	✓
		DL0-01-7	560525	7912609		✓	-	✓	✓
	Sheardown Lake SE	DL0-02-3	561046	7911915	b	✓	-	✓	✓
		DL0-02-4	561511	7911832		✓	-	✓	✓
		DL0-02-6	560756	7912167		✓	-	✓	✓
		DL0-02-7	560952	7912054		✓	-	✓	✓
		DL0-02-8	561301	7911846		✓	-	✓	✓
Mary River and Mary Lake System	Mary River	G0-03	567204	7912587	c	-	✓	✓	✓
		G0-01	564459	7912984		-	✓	✓	✓
		F0-01	564483	7913015		-	✓	✓	✓
		E0-21	562444	7911724		-	✓	✓	✓
		E0-20	561688	7911272		-	✓	✓	✓
		E0-10	564405	7913004		-	✓	✓	✓
		E0-03	562974	7912472		-	✓	✓	✓
		C0-10	560669	7911633		-	✓	✓	✓
		C0-051	558352	7909170		-	✓	✓	✓
		C0-01	556305	7906894		-	✓	✓	✓
	Mary Lake (North Basin)	BL0-01	554691	7913194	b	✓	-	✓	✓
		BL0-01-A	554300	7913378		✓	-	✓	✓
		BL0-01-B	554369	7913058		✓	-	✓	✓
	Mary Lake (South Basin)	BL0-03	552680	7906651	b	✓	-	✓	✓
		BL0-04	553817	7904886		✓	-	✓	✓
		BL0-05	554632	7906031		✓	-	✓	✓
		BL0-06	555924	7903760		✓	-	✓	✓
		BL0-05-A	554530	7906478		✓	-	✓	✓
		BL0-05-B	555034	7905692		✓	-	✓	✓
		BL0-09	554715	7904479		✓	-	✓	✓

[a] Reference data applicable to indicated study area include a - lotic reference stations; b - lentic reference stations; and, c - Mary River upstream stations.



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Mary River Project, CREMP Routine Water Quality and Phytoplankton Monitoring Station Locations

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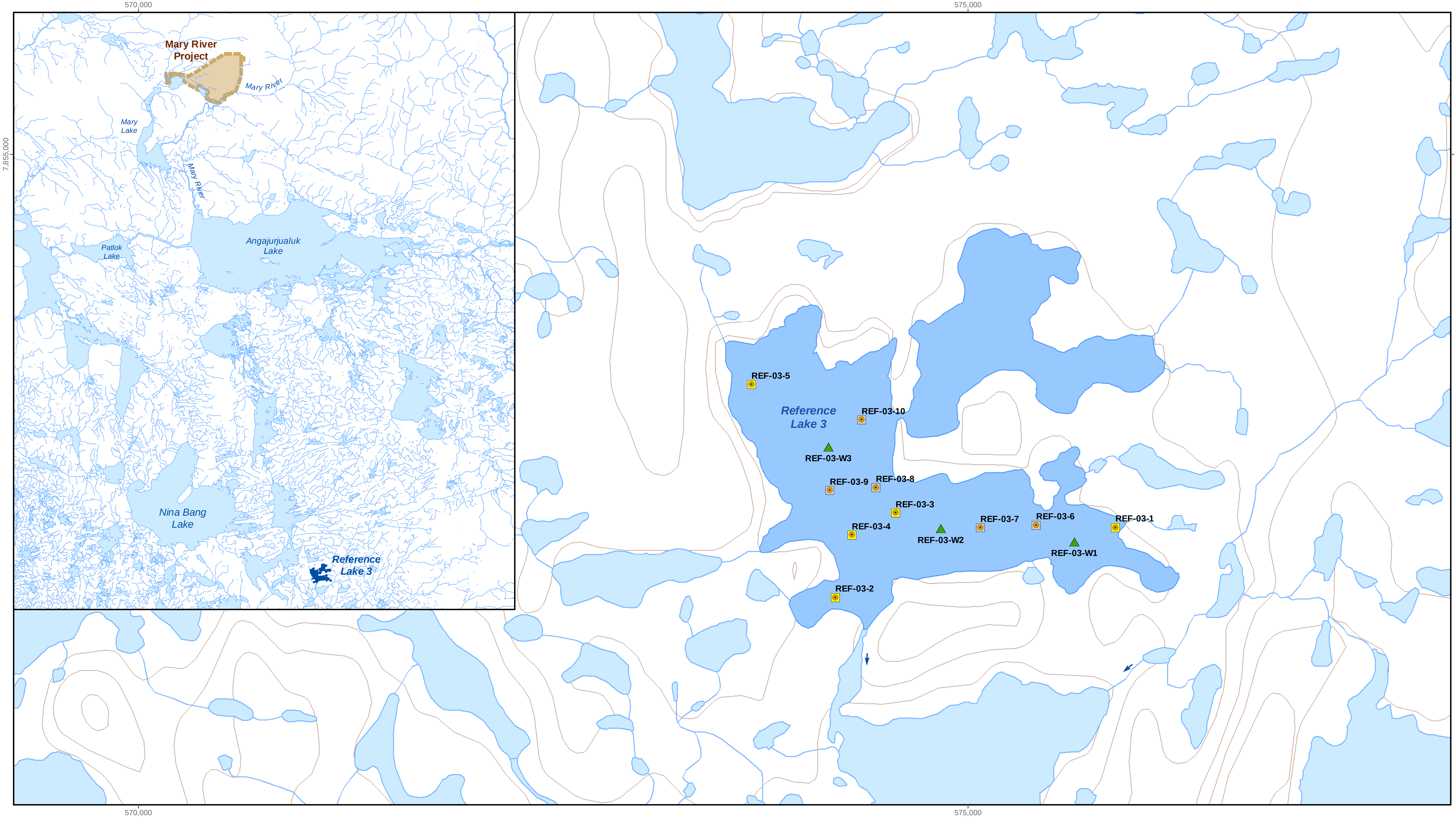
Figure 2.2

Document Path: S:\Projects\187202\187202.0025 - Baffinland 2018 AEMP\4 - GIS\CREMP Study\18-25 Figure 2.2 Water Quality and Phyto.mxd



LEGEND

- ● Sediment and Benthic Monitoring Location
- ☐ Littoral Sampling Depth
- ☐ Profundal Sampling Depth
- ▲ Water Quality and Phytoplankton Monitoring Station
- 🟦 Reference Lake

0 0.35 0.7 1.4
km

N
W E
S

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Mary River Project CREMP Reference Lake 3 Monitoring Station Locations

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Figure 2.3

Document Path: S:\Projects\187202\187202.0025 - Baffinland 2018 AEMP\4 - GIS\CREMP Study\18-25 Figure 2.3 Reference Lake 3.mxd

In situ water quality data collected at the mine-exposed study streams, rivers and lakes were compared to respective reference area data, to applicable water quality guidelines (WQG[1]; dissolved oxygen concentrations and pH only), and, for pH and conductivity, to baseline data. *In situ* water quality data were compared spatially within each system (i.e., from upstream- to downstream-most stations) using both qualitative and statistical approaches. For the statistical analysis, raw data and log-transformed data were assessed for normality and homogeneity of variance prior to conducting comparisons between (pair-wise) or among (multiple-group) applicable like-habitat mine-exposed and reference study area groups using Analysis-of-Variance (ANOVA). The selection of whether untransformed or log-transformed data were used for the ANOVA tests was determined based on which data best met the assumptions of ANOVA. In instances where normality could not be achieved through data transformation, non-parametric Mann-Whitney U-test and Kruskal-Wallis H-test statistics were applied using the raw data to validate the pair-wise and multiple-group ANOVA statistical results, respectively. Similarly, in instances in which variances of normal data could not be homogenized by transformation, Student's t-tests assuming unequal variance were applied using either raw or log-transformed data to validate the pair-wise ANOVA statistical results. In cases in which multiple-group comparisons were conducted, Tukey's Honestly Significant Difference (HSD) and Tamhane's pair-wise *post hoc* tests were implemented for homogenous and non-homogenous data, respectively All statistical comparisons were conducted using SPSS Version 12.0 software (SPSS Inc., Chicago, IL).

Vertical profiles of the *in situ* measurements taken from lake stations were plotted and visually assessed to evaluate potential thermal or chemical (i.e., using specific conductance) stratification and the corresponding depths associated with any distinct layering. The occurrence of a thermocline was conservatively assessed as a ≥0.5˚C change in temperature per 1 m incremental change in depth[2]. The vertical profile data collected at the mine-exposed study lakes were compared to that of Reference Lake 3 for each seasonal monitoring event using profile data averaged for each incremental depth below the water surface at each lake. At each study lake, spatial and seasonal differences in the vertical profile plots were evaluated to provide a better understanding of natural conditions and/or mine-related influences on within-lake water quality. Additional evaluation of the *in situ* dissolved oxygen concentration and pH data included comparisons to water quality guidelines (WQG)[1].

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[1] Canadian Environmental Quality Guidelines (CCME 1999, 2017) were used as the primary source for WQG, including those for pH and dissolved oxygen concentrations.

[2] Wetzel (2001) defines the thermocline as a ≥1˚C change in temperature per 1 m incremental change in depth, and thus a ≥0.5˚C change in temperature per 1 m incremental change in depth was considered highly conservative.

2.2.3 Water Chemistry Sampling and Data Analysis

Surface water chemistry samples were collected from both lotic and lentic environments (Table 2.1). At lotic stations, the water chemistry samples were collected from approximately mid-water column by hand directly into pre-labeled sample bottles which, for those requiring preservation, were pre-dosed or dosed in the field with required chemical preservatives. At lentic stations, two water chemistry samples were collected, one approximately 1 m below the surface (or just below the ice layer for the winter sampling event) and the other from approximately 1 m above the bottom, using a vertically-oriented 2.2 L TT Silicon Kemmerer bottle (Wildco Supply Co., Yulee, FL). During the winter sampling event, the water column was accessed at the same time and using the same methods as described above for the *in situ* measurements. Lake water collected using the beta-bottle was transferred directly into sample bottles that had been either pre-dosed or were subsequently dosed with the required chemical preservatives. In cases in which filtration was required (e.g., for dissolved metals), filtration was conducted in the field using methods consistent with AEMP standard operating procedures (Baffinland 2015).

Following collection, the water chemistry samples were placed into coolers in the field and maintained at cool temperatures for shipment to the analytical laboratory. Field water chemistry sampling QA/QC included trip blanks, field blanks, and the collection of equipment blanks and field duplicates with replication conducted on as many as 10% of the total samples collected for each CREMP sampling event (Appendix A). The water chemistry samples were shipped on ice to ALS Canada Ltd. (ALS; Waterloo, ON) for analysis of pH, conductivity, hardness, total suspended solids (TSS), total dissolved solids (TDS), anions (alkalinity, bromide, chloride, sulphate), nutrients (ammonia, nitrate, nitrite, total Kjeldahl nitrogen [TKN], total phosphorus), dissolved and total organic carbon (DOC and TOC, respectively), mercury, total and dissolved metals, and phenols using standard laboratory methods.

The water chemistry data were compared: i) among mine-exposed and reference areas for each study lake catchment (Table 2.1); ii) spatially and seasonally at each mine-exposed waterbody; iii) to applicable WQG for the protection of aquatic life (Table 2.2); iv) to site specific water quality benchmarks developed for the Mary River Project AEMP (Intrinsik 2014); and, v) to baseline water quality data. For data screening, and to simplify discussion of results, the magnitude of elevation in parameter concentrations was calculated as the mine-exposed area mean concentration divided by the respective reference station/area mean concentration. Similarly, for temporal comparisons, the magnitude of elevation in parameter concentrations was calculated by dividing the individual mine-exposed station/area 2018 mean concentrations by the baseline (2005 to 2013 data) mean concentration for each parameter. The resulting magnitude of elevation in

Table 2.2: Water Quality Guidelines Used for the Mary River Project 2015 to 2018 CREMP Studies

Parameters		**Units**	**Water Quality Guideline (WQG)**[a]	**Criteria Source**[a]	**Supporting Information and/or Calculations Used to Derive Hardness Dependent Criteria**
Conventionals	pH (lab)	pH	6.5 - 9.0	CWQG	-
Nutrients and Organics	Nitrate	mg/L	13	CWQG	-
	Nitrite	mg/L	0.06	CWQG	-
	Total Phosphorus	mg/L	0.020	PWQO	Total phosphorus objective is 0.030 mg/L for lotic (rivers, streams) environments, and 0.020 mg/L for lentic (lake) environments.
	Phenols	mg/L	0.001	PWQO	-
Anions	Chloride (Cl)	mg/L	120	CWQG	-
	Sulphate (SO_4)	mg/L	218	BCWQG	Sulphate guideline is hardness (mg/L $CaCO_3$) dependent as follows: 128 mg/L at 0 - 30 hardness, 218 mg/L at 31 - 75 hardness, 309 mg/L at 76 - 180 hardness, and 429 mg/L at 181 - 250 hardness. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with 75 mg/L hardness.
Total Metals	Aluminum (Al)	mg/L	0.100	CWQG	-
	Antimony (Sb)	mg/L	0.020	PWQO	-
	Arsenic (As)	mg/L	0.005	CWQG	-
	Beryllium (Be)	mg/L	0.011	PWQO	-
	Boron (B)	mg/L	1.5	CWQG	-
	Cadmium (Cd)	mg/L	0.00012	CWQG	Cadmium guideline is hardness (mg/L $CaCO_3$) dependent. For hardness between 17 and 280 mg/L, the cadmium guideline is calculated using the equation Cd (ug/L) = $10^{(0.83[\log(\text{hardness}] -2.46)}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with 75 mg/L hardness.
	Chromium (Cr)	mg/L	0.0089	CWQG	-
	Cobalt (Co)	mg/L	0.001	PWQO	-
	Copper (Cu)	mg/L	0.002	CWQG	Copper guideline is hardness (mg/L $CaCO_3$) dependent. At hardness <82 mg/L and >180 mg/L, the copper guideline is 2 and 4 ug/L, respectively. For hardness ranging from 82 - 180 mg/L, the copper guideline (ug/L) = $0.2 * e^{(0.8545[\ln(\text{hardness}] - 1.463)}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with 75 mg/L hardness.
	Iron (Fe)	mg/L	0.30	CWQG	-
	Lead (Pb)	mg/L	0.002	CWQG	Lead guideline is hardness (mg/L $CaCO_3$) dependent. At hardness <60 mg/L and >180 mg/L, the lead guideline is 1 and 7 ug/L, respectively. For hardness ranging from 60 - 180 mg/L, the lead guideline (ug/L) = $e^{(1.273[\ln(\text{hardness}] - 4.705)}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with 75 mg/L hardness.
	Manganese (Mn)	mg/L	0.935	BCWQG	Manganese guideline is hardness (mg/L $CaCO_3$) dependent, and calculated using the equation Mn (ug/L) = 0.0044 * (hardness) + 0.605. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with hardness of 75 mg/L.
	Mercury (Hg)	mg/L	0.000026	CWQG	-
	Molybdenum (Mo)	mg/L	0.073	CWQG	-
	Nickel (Ni)	mg/L	0.077	CWQG	Nickel guideline is hardness (mg/L $CaCO_3$) dependent. At hardness <60 mg/L and >180 mg/L, the nickel guideline is 25 and 150 ug/L, respectively. For hardness ranging from 60 - 180 mg/L, the nickel guideline (ug/L) = $e^{(0.76[\ln(\text{hardness}] + 1.06)}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with 75 mg/L hardness.
	Selenium (Se)	mg/L	0.001	CWQG	-
	Silver (Ag)	mg/L	0.00025	CWQG	-
	Thallium (Tl)	mg/L	0.0008	CWQG	-
	Tungsten	mg/L	0.030	PWQO	-
	Uranium (U)	mg/L	0.015	CWQG	-
	Vanadium (V)	mg/L	0.006	PWQO	-
	Zinc (Zn)	mg/L	0.030	CWQG	-

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME1999, 2017) was selected where a CCME guideline exists. Where no CCME guideline exists, the selected criteria is the lowest of either the Ontario Provincial Water Quality Objective (PWQO; OMOE 1994) or the British Columbia Water Quality Guideline (BCWQG; BCMOE 2013), as available.

parameter concentrations was qualitatively assigned as slightly, moderately, or highly elevated compared to reference and/or baseline conditions using the categorization described in Table 2.3.

Table 2.3: Magnitude of Elevation Categorizations for Water and Sediment Chemistry Comparisons

Categorization	Magnitude of Elevation Criterion
Slightly elevated	Concentration 3-fold to 5-fold higher at mine-exposed area versus the reference area or baseline data, as applicable.
Moderately elevated	Concentration 5-fold to 10-fold higher at mine-exposed area versus the reference area or baseline data, as applicable.
Highly elevated	Concentration ≥ 10-fold higher at effluent-exposed area versus the reference area or baseline data, as applicable.

Applicable WQG included the Canadian Water Quality Guidelines (CWQG; CCME 1999, 2017) or, for parameters with no CWQG, the most conservative (i.e., lowest) criterion available from established Ontario Provincial Water Quality Objectives (PWQO; OMOEE 1994) or British Columbia Water Quality Guidelines (BCWQG; BCMOE 2006, 2017). The water quality guidelines are abbreviated simply as 'WQG' in this report, although it is recognized that in certain cases the values presented may represent water quality 'objectives'. For those water quality guidelines that are hardness dependent, the hardness of the individual sample was used to calculate the water quality guideline for the specific parameter according to established formulae (Table 2.2). The water chemistry data were also compared to site specific water quality benchmarks developed for the Mary River Project AEMP (Intrinsik 2014). The Mary River Project AEMP water chemistry benchmarks were derived using an evaluation of background (i.e., baseline) water chemistry data together with existing generic water quality guidelines that consider aquatic toxicity thresholds. The AEMP benchmarks were developed to inform management decisions under the AEMP assessment approach and management response framework (Baffinland 2015). An elevation in parameter concentration above the respective AEMP benchmark may trigger various actions (e.g., sampling design modifications, additional statistical assessment, considerations for mitigation, etc.) to better understand and potentially mitigate effects resulting from elevated concentrations of the parameter of concern (Baffinland 2015). Water chemistry data for key parameters (i.e., parameters with concentrations that were notably higher at mine-exposed areas compared to reference areas, that were historically identified as site-specific parameters of concern, and/or that were above WQG and/or AEMP benchmarks) were plotted to evaluate changes in concentrations in 2018 compared to baseline (2005 to 2013 data) and previous mine construction (2014) and operational (2015, 2016, 2017) studies.

2.3 Sediment Quality

2.3.1 General Design

Sediment quality monitoring under the Mary River Project CREMP focuses primarily on assessing potential mine-related effects to the sediment of lake environments based on a gradient design (Baffinland 2015; KP 2014, 2015). Sediment quality sampling was conducted at five to ten stations per study lake for physical and chemical characterization as outlined under the CREMP, with additional characterization of physical sediment properties conducted at four to six stations per study lake to support the benthic invertebrate community analysis (Table 2.4; Figure 2.4). The lake sediment stations were designated as littoral or profundal based on a sample collection cut-off depth of 12 m, which was used to define lake zonation during the baseline characterization studies (KP 2014, 2015). Sediment quality sampling of lotic (stream and river) habitats is conducted once every three years under the CREMP[3], and because sediment quality sampling of lotic habitat was last conducted in 2017, no sediment was collected at stream and river habitats in 2018.

2.3.2 Sample Collection and Laboratory Analysis

Sediment at study lakes was collected for physical and chemical characterization using a gravity corer (Hoskin Scientific Ltd., Model E-777-00) outfitted with a clean 5.1 cm inside-diameter polycarbonate tube. From each retrieved core sample containing an intact, representative sediment-water interface, the surficial two centimetres of sediment was manually extruded upwards into a graded core collar, sectioned with a stainless steel core knife, and placed into a pre-labeled plastic sample bag. Samples from three to four cores treated in this manner were composited to create a single sample at each station. Supporting measurements of total core sample length and depths of visually-apparent redox boundaries/horizons, as well as notes regarding sediment texture and colour for each visible horizon, general sediment odour (e.g., hydrogen sulphide), and presence of algae or plants on or in the sediment, were recorded for each core sample. For QA/QC purposes, a field duplicate ‘split’ sample was collected at all study lakes using the same coring methods discussed above but eight rather than four replicate core samples were taken to create the split sample (Table 2.4; Appendix A). Following collection, all sediment samples were placed into a cooler, transported to the mine, and stored under cool conditions until shipment to the analytical laboratory.

Upon completion of the biological monitoring field program, sediment samples were shipped to ALS (Waterloo, ON). Physical characterization of samples included percent moisture and particle

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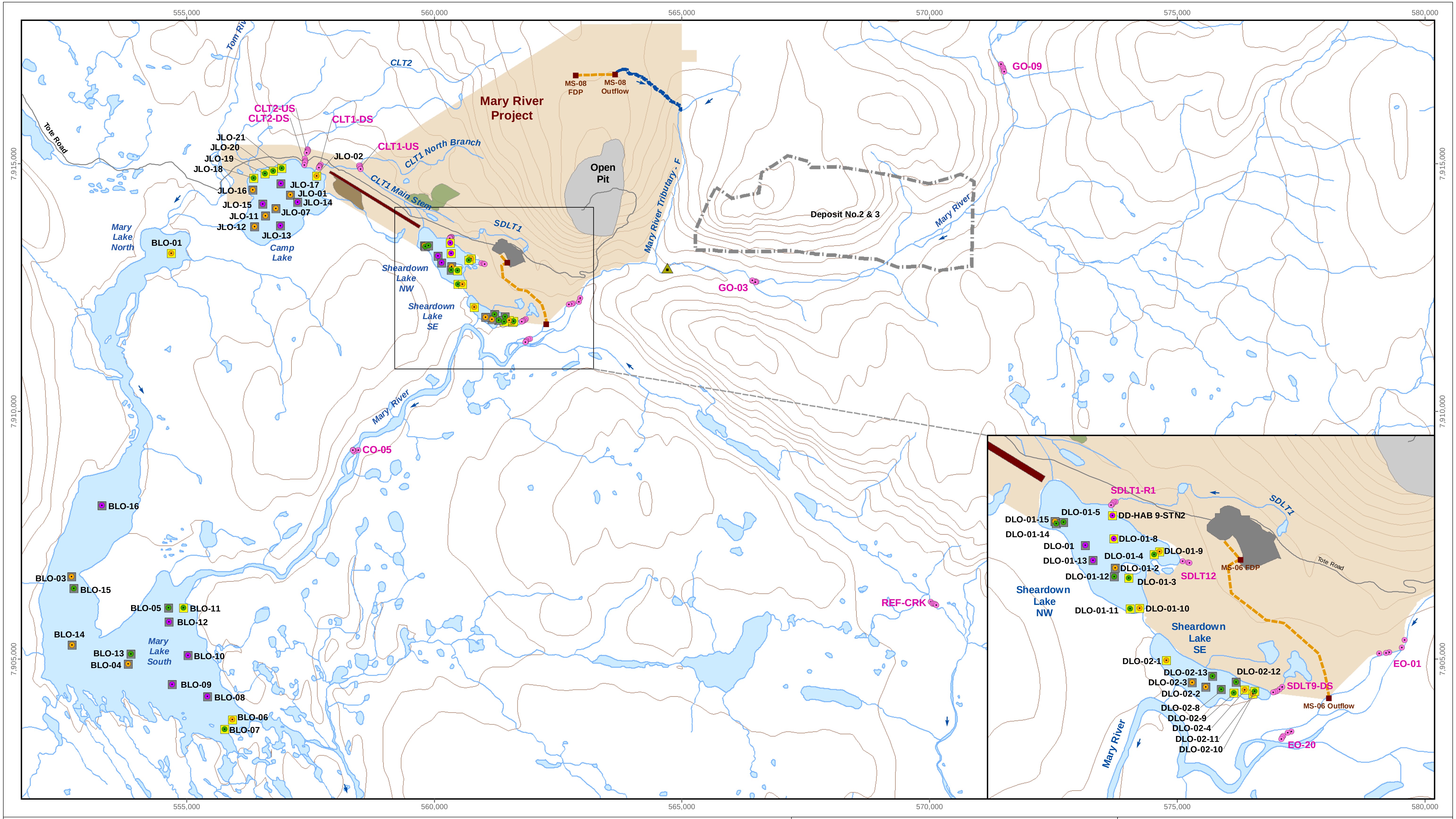
[3] The three year schedule for sampling of sediment at lotic habitat was based on a recommendation by regulators following the submission of the 2016 CREMP.

Table 2.4: Lake Sediment Quality and Benthic Invertebrate Community Monitoring Station Coordinates Used for the Mary River Project CREMP 2018 Study

Waterbody	Station Code	UTM Zone 17W		Sampling Habitat	Sample Type		
		Easting	Northing		Sediment Core[a]	Sediment petite-Ponar[a]	Benthic Invertebrate
Reference Lake 3	REF-03-1	575992	7852992	littoral	✓	-	✓
	REF-03-2	574200	7852330	littoral	✓	-	✓
	REF-03-3	574564	7852840	littoral	✓	-	✓
	REF-03-4	574301	7852705	littoral	✓	-	✓
	REF-03-5	573694	7853613	littoral	✓	-	✓
	REF-03-6	575411	7852766	profundal	✓	-	✓
	REF-03-7	575076	7852750	profundal	✓	-	✓
	REF-03-8	574445	7852992	profundal	✓	-	✓
	REF-03-9	574168	7852975	profundal	✓	-	✓
	REF-03-10[b]	574358	7853400	profundal	✓	-	✓
Camp Lake	JLO-02	557627	7914748	littoral	✓	-	✓
	JLO-01[b]	557092	7914370	profundal	✓	-	✓
	JLO-14	557246	7914224	profundal	✓	-	-
	JLO-17	556900	7914594	profundal	✓	-	-
	JLO-21	556926	7914911	littoral	-	✓	✓
	JLO-20	556750	7914850	littoral	-	✓	✓
	JLO-19	556587	7914801	littoral	-	✓	✓
	JLO-07	556803	7914095	profundal	✓	-	✓
	JLO-18	556357	7914706	littoral	-	✓	✓
	JLO-16	556335	7914470	profundal	✓	-	✓
	JLO-15	556542	7914184	profundal	✓	-	-
	JLO-11	556594	7913946	profundal	✓	-	✓
	JLO-13	556896	7913751	profundal	✓	-	-
	JLO-12	556378	7913728	profundal	✓	-	✓
Sheardown Lake Northwest (NW)	DLO-01-5	559806	7913348	profundal	✓	-	✓
	DLO-01-14	559821	7913328	profundal	-	✓	✓
	DLO-01-15	559884	7913340	profundal	-	✓	✓
	DD-HAB 9-STN2	560325	7913400	littoral	✓	-	-
	DLO-01-8	560338	7913192	littoral	✓	-	-
	DLO-01	560079	7913132	profundal	✓	-	-
	DLO-01-13	560151	7912997	profundal	✓	-	-
	DLO-01-2[b]	560350	7912927	profundal	✓	-	✓
	DLO-01-12	560339	7912852	profundal	-	✓	✓
	DLO-01-9	560746	7913076	littoral	✓	-	✓
	DLO-01-4	560696	7913049	littoral	-	✓	✓
	DLO-01-3	560471	7912838	littoral	-	✓	✓
	DLO-01-11	560482	7912563	littoral	-	✓	✓
	DLO-01-10	560570	7912566	littoral	✓	-	✓
Sheardown Lake Southeast (SE)	DLO-02-1[b]	560807	7912099	littoral	✓	-	✓
	DLO-02-11	561585	7911799	littoral	✓	-	✓
	DLO-02-10	561602	7911821	littoral	-	✓	✓
	DLO-02-4	561512	7911833	littoral	✓	-	✓
	DLO-02-12	561433	7911905	profundal	-	✓	✓
	DLO-02-9	561414	7911806	littoral	-	✓	✓
	DLO-02-8	561300	7911839	profundal	-	✓	✓
	DLO-02-13	561222	7911958	profundal	-	✓	✓
	DLO-02-2	561161	7911858	profundal	✓	-	✓
	DLO-02-3	561039	7911898	profundal	✓	-	✓
Mary Lake	BLO-01	554690	7913186	littoral	✓	-	✓
	BLO-16	553289	7908092	profundal	✓	-	-
	BLO-03	552679	7906660	profundal	✓	-	✓
	BLO-15	552723	7906419	profundal	-	✓	✓
	BLO-14	552688	7905282	profundal	✓	-	✓
	BLO-05	554635	7906033	profundal	-	✓	✓
	BLO-11	554942	7906033	littoral	-	✓	✓
	BLO-12	554644	7905742	profundal	✓	-	-
	BLO-13	553879	7905094	profundal	-	✓	✓
	BLO-04[b]	553820	7904893	profundal	✓	-	✓
	BLO-10	555033	7905065	profundal	✓	-	-
	BLO-09	554707	7904486	profundal	✓	-	-
	BLO-08	555424	7904239	profundal	✓	-	-
	BLO-07	555767	7903583	littoral	-	✓	✓
	BLO-06	555925	7903771	littoral	✓	-	✓

[a] Sediment core samples analyzed for particle size, TOC and total metals. Petite-ponar sediment grab samples analyzed for particle size only.

[b] Duplicate sediment core sample collected for quality control/quality assurance (QA/QC).



LEGEND

- ● Lake - Benthic Only Sampling Location
- ● Lake - Sediment Only Sampling Location
- ● Lake - Sediment and Benthic Sampling Location
- ▪ Littoral Sampling Depth
- ▪ Profundal Sampling Depth
- ● Stream - Sediment and Benthic Sampling Location
- ■ Final Discharge Point (FDP)
- ▲ Mary River Cascade Barrier
- --- Discharge Line
- --- Overland Effluent Channel
- 🟩 QMR2 Quarry
- 🟥 Airstrip
- ▨ Exploration Camp
- ▨ Mine Site
- ▨ Open Pit
- ▨ Mary River Project
- — Contours (20 m)

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Map Projection: UTM Zone 17N NAD 1983
Data Source: Reproduced under licence from Her Majesty the Queen in Rights of Canada, Department of Natural Resources Canada. All rights

Mary River Project 2018 CREMP Mine Area Sediment Quality and Benthic Station Locations

Date: March 2019
Project 187202.0025

Figure 2.4

Document Path: S:\Projects\187202\187202.0025 - Baffinland 2018 AEMP\4 - GIS\CREMP Study\18-25 Figure 2.4 Sediment and Benthic.mxd size analyses, and chemical characterization included analyses of total organic carbon (TOC) and total metals including mercury. Standard laboratory methods were used for all physical and chemical sediment analyses.

2.3.3 Data Analysis

Sediment quality data from the mine-exposed lakes were compared to reference lake data, to applicable sediment quality guidelines/AEMP benchmarks and, where applicable, to baseline sediment quality data. Sediment physical characteristics (i.e., moisture, particle size) and TOC data were statistically summarized based on separate calculation of mean, standard deviation, standard error, minima, and maxima for littoral and profundal habitat at each study lake. These data were compared statistically between applicable mine-exposed and reference lakes using the same tests, transformations (with the exception that logit transformations were conducted for dependent proportional data rather than log transformations), assumptions, and software described previously for the statistical evaluation of *in situ* water quality (see Section 2.2.3).

The sediment chemistry data from the mine-exposed lakes were initially assessed to identify potential gradients in sediment metal concentrations with distance from known or suspected sources of mine-related deposits to the lake. For each sediment chemistry parameter, the data were separately averaged for littoral and profundal habitat at each lake and then compared between each respective mine-exposed and reference lake based on proportional elevation in parameter concentrations. The magnitude of elevation in average parameter concentrations between the mine-exposed and reference lakes was calculated and compared as described previously (Section 2.2.3; Table 2.3).

Sediment chemistry data collected at lake environments were compared to applicable Canadian Sediment Quality Guidelines (CSQG; CCME 1999) probable effect levels (PEL) or, for parameters with no CSQG, to Ontario Provincial Sediment Quality Guidelines (PSQG; OMOE 1993) severe effect levels (SEL). The sediment quality guidelines used for the 2018 CREMP were abbreviated simply as ‘SQG’, although it is recognized that the values presented may represent either national PEL or Ontario provincial SEL guidelines. The 2018 lake environment sediment chemistry data analyses also included comparisons to Mary River Project AEMP sediment quality benchmarks that were derived using baseline sediment chemistry data for each mine-exposed lake and existing generic CSQG interim or PSQG lowest effect level sediment quality guidelines (Intrinsik 2014, 2015). As indicated previously, the AEMP benchmarks were developed to inform management decisions under the AEMP assessment approach and management response framework (Baffinland 2015). An elevation in parameter concentration above the AEMP benchmark may trigger various actions to better understand and potentially mitigate effects resulting from elevated concentrations of the parameter of concern (Baffinland 2015).

Sediment chemistry data for key parameters (i.e., parameters with concentrations that were notably higher at mine-exposed areas compared to the reference area, that have been identified as site-specific parameters of concern in previous studies, and/or those with concentrations above SQG and/or AEMP benchmarks) were plotted to evaluate potential changes in parameter concentrations among the 2018 data, baseline data (2005 to 2013), and previous 2015 to 2017 mine operation period data. In addition, as described previously, the magnitude of elevation was calculated for all parameters using the 2018 data and baseline data for each individual study lake using the same calculation (and categorization description) as described previously (Section 2.2.3; Table 2.3).

2.4 Biological Assessment

2.4.1 Phytoplankton

The Mary River Project CREMP uses measures of aqueous chlorophyll-a concentrations to assess potential mine-related influences to phytoplankton. Because chlorophyll-a is the primary pigment of phytoplankton (i.e., algae and other photosynthetic microbiota suspended in the water column), aqueous chlorophyll-a concentrations are often used as a surrogate for evaluating the amount of photosynthetic microbiota in aquatic environments (Wetzel 2001). Chlorophyll-a samples were collected by Baffinland environmental department staff at the same stations and same time, as well as with the same methods and equipment, as described for the collection of water chemistry samples (Table 2.1; Figures 2.2 and 2.3; Section 2.2.3). The chlorophyll-a samples were collected into 1 L glass amber bottles and maintained in a cool and dark environment prior to submission to ALS (Mary River On-Site Laboratory, NU). On the same day of collection, the laboratory filtered the samples through a 0.45 micron cellulose acetate membrane filter assisted by a vacuum pump. Following filtration, the membrane filter was wrapped in aluminum foil, inserted into a labelled envelope, and then frozen. At the completion of field collections for the seasonal sampling event, the filters were shipped frozen to ALS in Waterloo, ON for chlorophyll-a analysis using standard methods. The field QA/QC applied during chlorophyll-a sampling was similar to that described for water chemistry sampling (see Section 2.2.3).

The CREMP study design also stipulates the collection of phytoplankton community samples for archiving (NSC 2014, 2015). In the event that water quality, chlorophyll-a, and/or other biological components indicate potential mine-related effects to primary productivity at a specific mine-exposed waterbody, the phytoplankton community samples may be processed to further investigate the nature of mine-related effects to phytoplankton biomass and community structure (e.g., taxonomic composition, richness, density). To date, none of the archived phytoplankton community samples have been processed (2006 to 2017). In 2018, phytoplankton community samples were collected using the same methods described in the CREMP (NSC 2014) and, as in the past, these samples were not processed, but were archived for potential future analysis.

The analysis of aqueous chlorophyll-a concentrations closely mirrored the approach used to evaluate the water quality data. Briefly, chlorophyll-a concentrations were compared: i) between respective mine-exposed and reference areas; ii) spatially and seasonally at each mine-exposed waterbody; iii) to AEMP benchmarks; and, iv) to baseline data. Comparisons of chlorophyll-a concentrations between the mine-exposed and reference areas were based on both qualitative and statistical approaches, the latter of which used the same parametric and/or non-parametric statistics, as appropriate, as described previously for statistical analysis of *in situ* water quality data (Section 2.2.2). An AEMP benchmark chlorophyll-a concentration of 3.7 µg/L was established for the Mary River Project (NSC 2014), and therefore the 2018 chlorophyll-a concentration data were compared to this benchmark to assist with the determination of potential mine-related enrichment effects at waterbodies influenced by mine operations. A mine-related effect on the productivity of a waterbody of interest was assessed as a chlorophyll-a concentration above the AEMP benchmark, the representative reference area, and/or the respective waterbody baseline condition.

2.4.2 Benthic Invertebrate Community

2.4.2.1 General Design

The Mary River Project CREMP benthic invertebrate community (benthic) survey outlines a habitat-based approach for characterizing potential mine-related effects to benthic biota of lotic (stream/river) and lentic (lake) environments (NSC 2014). Lotic areas sampled for benthic invertebrates included Camp Lake Tributaries 1 and 2 at historically established areas located upstream and downstream of the Milne Inlet Tote Road, Sheardown Lake Tributaries 1, 9 and 12 near their respective outlets, and Mary River upstream (two areas) and downstream (three areas) of the mine site (Table 2.5; Figure 2.4). Benthic samples were also collected at a reference creek located within the same unnamed tributary to Angajurjualuk Lake that is used for reference water quality sampling (Stations CLT-REF4 and MRY-REF2) as part of the 2018 CREMP to augment the original study design (Table 2.5; Figure 2.4). This reference creek, referred to as Unnamed Reference Creek herein, was initially sampled as part of the benthic invertebrate community assessment in the 2016 CREMP (see Minnow 2017). Consistent with the federal Environmental Effects Monitoring (EEM) program (Environment Canada 2012), five stations were sampled at each lotic study area with the exception of Sheardown Lake Tributary 12, where only three stations were sampled due to limited habitat available for sampling using conventional gear suitable for erosional habitat. As in 2015, 2016, and 2017, the level of replication used for lotic benthic sampling in 2018 was greater than specified under the original CREMP design in order to

Table 2.5: **Stream and River Benthic Invertebrate Community Monitoring Station Coordinates Used for the Mary River Project CREMP 2018 Study**

Lake System	Waterbody	Station Code	Station Type	UTM Zone 17W, NAD83	
				Easting	Northing
Angajurjualuk Lake	Unnamed Tributary	REF-CRK-B1	Reference	570025	7906148
		REF-CRK-B2	Reference	570060	7906115
		REF-CRK-B3	Reference	570093	7906110
		REF-CRK-B4	Reference	570121	7906099
		REF-CRK-B5	Reference	570137	7906086
Camp Lake	Camp Lake Tributary 1	CLT1-US-B1	Reference	558502	7914967
		CLT1-US-B2	Reference	558488	7914963
		CLT1-US-B3	Reference	558494	7914930
		CLT1-US-B4	Reference	558509	7914903
		CLT1-US-B5	Reference	558517	7914890
		CLT1-DS-B1	Mine-Exposed	557710	7914978
		CLT1-DS-B2	Mine-Exposed	557693	7914957
		CLT1-DS-B3	Mine-Exposed	557686	7914944
		CLT1-DS-B4	Mine-Exposed	557678	7914932
		CLT1-DS-B5	Mine-Exposed	557672	7914917
	Camp Lake Tributary 2	CLT2-US-B1	Reference	557441	7915291
		CLT2-US-B2	Reference	557451	7915275
		CLT2-US-B3	Reference	557450	7915251
		CLT2-US-B4	Reference	557441	7915237
		CLT2-US-B5	Reference	557423	7915215
		CLT2-DS-B1	Mine-Exposed	557392	7915104
		CLT2-DS-B2	Mine-Exposed	557398	7915053
		CLT2-DS-B3	Mine-Exposed	557400	7915032
		CLT2-DS-B4	Mine-Exposed	557997	7915008
		CLT2-DS-B5	Mine-Exposed	557377	7914971
Sheardown Lake Northwest (NW)	Sheardown Lake Tributary 1 (Reach 1)	SDLT1-R1-B1	Mine-Exposed	560352	7913522
		SDLT1-R1-B2	Mine-Exposed	560338	7913520
		SDLT1-R1-B3	Mine-Exposed	560328	7913507
		SDLT1-R1-B4	Mine-Exposed	560320	7913497
		SDLT1-R1-B5	Mine-Exposed	560313	7913493
	Sheardown Lake Tributary 12	SDLT12-B1	Mine-Exposed	560953	7912988
		SDLT12-B2	Mine-Exposed	561003	7912975
		SDLT12-B3	Mine-Exposed	561016	7912971
Sheardown Lake Southeast (SE)	Sheardown Lake Tributary 9	SDLT9-DS-B1	Mine-Exposed	561848	7911860
		SDLT9-DS-B2	Mine-Exposed	561825	7911838
		SDLT9-DS-B3	Mine-Exposed	561798	7911824
		SDLT9-DS-B4	Mine-Exposed	561785	7911816
		SDLT9-DS-B5	Mine-Exposed	561767	7911812
Mary Lake	Mary River	GO-09-B1	Reference	571447	7917010
		GO-09-B2	Reference	571479	7916946
		GO-09-B3	Reference	571489	7916919
		GO-09-B4	Reference	571499	7916883
		GO-09-B5	Reference	571503	7916858
		GO-03-B1	Mine-Exposed	566489	7912626
		GO-03-B2	Mine-Exposed	566509	7912616
		GO-03-B3	Mine-Exposed	566491	7912605
		GO-03-B4	Mine-Exposed	566425	7912630
		GO-03-B5	Mine-Exposed	566425	7912642
		EO-01-B1	Mine-Exposed	562944	7912281
		EO-01-B2	Mine-Exposed	562922	7912214
		EO-01-B3	Mine-Exposed	562806	7912171
		EO-01-B4	Mine-Exposed	562778	7912165
		EO-01-B5	Mine-Exposed	562717	7912158
		EO-20-B1	Mine-Exposed	561930	7911460
		EO-20-B2	Mine-Exposed	561895	7911447
		EO-20-B3	Mine-Exposed	561858	7911420
		EO-20-B4	Mine-Exposed	561848	7911408
		EO-20-B5	Mine-Exposed	561841	7911393
		CO-05-B1	Mine-Exposed	558465	7909208
		CO-05-B2	Mine-Exposed	558387	7909183
		CO-05-B3	Mine-Exposed	558365	7909214
		CO-05-B4	Mine-Exposed	558355	7909224
		CO-05-B5	Mine-Exposed	558359	7909209

provide consistency with EEM standards (Minnow 2016a). To the extent possible, previously established lotic benthic stations were incorporated into the 2018 sampling program to provide comparability to historical baseline information.

At lentic environments, benthic sampling was conducted at the 40 previously established CREMP stations among the four mine-exposed study lakes (i.e., ten stations in each of Camp, Sheardown NW, Sheardown SE and Mary lakes), as well as at the same ten stations established at Reference Lake 3 during the 2015 study (Table 2.5; Figures 2.3 and 2.4). Analysis of benthic data collected at Reference Lake 3 from 2015 to 2017 indicated that, similar to temperate lakes (Ward 1992), depth-related influences on benthic invertebrate community structure (e.g., density and richness) occurs naturally in lakes of the region (Minnow 2016a, 2017, 2018). Analysis of benthic data collected from Reference Lake 3 in 2018 provided on-going confirmation of the occurrence of natural depth-related influences on benthic invertebrate community structure in area lakes (Appendix B). Because of the occurrence of natural depth-related differences in benthic invertebrate communities, the benthic stations at each mine-exposed and reference lake were categorized as littoral zone (2 to 12 m depth) or profundal zone (>12 m depth) stations based on station depth (Table 2.5). To the extent possible, five littoral and five profundal stations were designated for each study lake based on the previously established suite of CREMP lentic benthic stations[4] in order to provide temporal continuity with the baseline studies and the original CREMP design (Table 2.4; Figure 2.4), as well as to allow data analysis in accordance with EEM standards. Specifically, the sampling of five stations from each zone at each study area ensures adequate statistical power to detect ecologically meaningful differences in benthic metrics of ± two standard deviations of a comparable reference area mean at an α and β of 0.10 (Environment Canada 2012).

2.4.2.2 Sample Collection and Laboratory Analysis

Two types of sampling equipment and methods were employed during the 2018 CREMP benthic survey to reflect different habitat types as follows:

- at **lotic (stream/river) stations** (i.e., predominantly cobble and/or gravel substrate in flowing waters), benthic samples were collected using a Surber sampler (0.0929 m^2 sampling area) outfitted with 500 µm mesh. At each erosional station, one sample representing a composite of three Surber sampler grabs (i.e., 0.279 m^2 area) was collected to ensure that each sample was representative of habitat conditions. A concerted effort

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[4] At Sheardown Lake SE, depths greater than 12 m deep are spatially limited, and thus the five deepest CREMP stations were designated as profundal despite one of the five being less than 12 m deep. At Mary Lake, six of the CREMP stations occurred at depths well greater than 12 m and thus were all designated as profundal, with the four remaining stations designated as littoral.

was made to ensure that water velocity and substrate characteristics were comparable among respective lotic mine-exposed and reference study area stations to minimize natural influences on community variability. Once all three sub-samples were collected at each respective station, all material gathered in the Surber sampler net was transferred to a plastic sampling jar to which both external and internal station identification labels were affixed.

- at **lentic (lake) stations** (i.e., predominantly soft silt-sand, silt and/or clay substrates with variable amounts of organics), benthic sampling was conducted using a Petite Ponar grab sampler (15.24 x 15.24 cm; 0.023 m^2 sampling area). A single sample, consisting of a composite of five grabs (i.e., 0.115 m^2 sampling area) was collected at each station with care taken to ensure that each grab was acceptable (i.e., that the grab captured sufficient surface material and was full to each edge). Any incomplete grabs were discarded. For each acceptable grab, the Petite Ponar was thoroughly rinsed and the material then field-sieved through 500 µm mesh. Following sieving of all five grabs, the retained material was carefully transferred into a plastic sampling jar to which both external and internal station identification labels were affixed.

Following collection, the benthic samples were preserved to a level of 10% buffered formalin in ambient water. Supporting measurements and information collected at each replicate grab location for lotic stations included sampling depth, water velocity, and description of aquatic vegetation/algae presence. In addition, *in situ* water quality at the bottom of the water column and global positioning system (GPS) coordinates was collected and recorded at each lotic benthic station. Supporting information recorded at each lake benthic station included substrate description, presence of aquatic vegetation/algae, sampling depth, *in situ* water quality measurements near the water column surface and bottom, and GPS coordinates. All GPS coordinates were collected in Universal Transverse Mercator (UTM) units using a hand-held portable Garmin GPS72 (Garmin International Inc., Olathe, KS) device based on 1983 North America Datum (NAD 83).

Benthic samples were submitted to and processed by Zeas Inc. (Nobleton, ON) using standard sorting methods. Upon arrival at the laboratory, a biological stain was added to each benthic sample to facilitate greater sorting accuracy. The samples were washed free of formalin in a 500 µm sieve and the remaining sample material was then examined under a stereomicroscope at a magnification of at least ten times by a technician. All benthic invertebrates were removed from the sample debris and placed into vials containing 70% ethanol according to major taxonomic groups (i.e., order or family levels). A senior taxonomist later enumerated and identified the benthic organisms to the lowest practical level (typically genus or species) utilizing up-to-date taxonomic keys. Quality assurance/quality control (QA/QC) conducted during the laboratory processing of benthic samples included organism recovery and sub-sampling checks on as many as 10% of the total samples collected for the 2018 CREMP (Appendix A).

2.4.2.3 Data Analysis

Benthic data were evaluated separately for lotic, lentic littoral, and lentic profundal habitat data sets. Benthic invertebrate communities were evaluated using summary metrics of mean invertebrate abundance (or "density"; average number of organisms per m^2), mean taxonomic richness (number of taxa, as identified to lowest practical level), Simpson's Evenness Index (E), and the Bray-Curtis Index of Dissimilarity. Simpson's Evenness was calculated using the Krebs method (Smith and Wilson 1996) and Bray-Curtis Index was calculated using the formula provided in Environment Canada (2012). Additional comparisons were conducted using percent composition of dominant/indicator taxa, functional feeding groups, and habitat preference groups (calculated as the abundance of each respective group relative to the total number of organisms in the sample). Dominant/indicator taxonomic groups were defined as those groups representing, on average, greater than 5% of total organism abundance for a study area or any groups considered important indicators of environmental stress. Functional feeding groups (FFG) and habitat preference groups (HPG) were assigned based on Pennak (1989), Mandaville (2002), and/or Merritt et al. (2008) descriptions/designations for each taxon.

Statistical comparisons of all applicable benthic invertebrate community indices and community composition endpoints were conducted using the same tests described for the *in situ* water quality comparisons (see Section 2.2.2). Pair-wise differences between the mine-exposed and reference areas were preferentially tested using ANOVA on untransformed, normally distributed data. However, in the event that data were determined to be non-normal, a suite of transformations[5] including $\log_{10}$, square root, and fourth root was applied to the data and evaluated for normality. The transformation that resulted in normal data with lowest skew and kurtosis values was then used for statistical testing using ANOVA. In instances where normality could not be achieved through data transformation, non-parametric Mann-Whitney U-tests were used to validate the statistical results from pair-wise ANOVA tests. All statistical comparisons were conducted using R programming (R Foundation for Statistical Computing, Vienna, Austria).

An effect on benthic invertebrate communities was defined as a statistically significant difference between any paired mine-exposed and reference areas at a p-value of 0.10. For each endpoint showing a significant difference, a magnitude of difference was calculated between study area

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[5] Non-normal dependent proportional benthic data were subject to a modified probit transformation that better accounted for nil (or near-zero) values in the statistical analysis than the other indicated transformations.

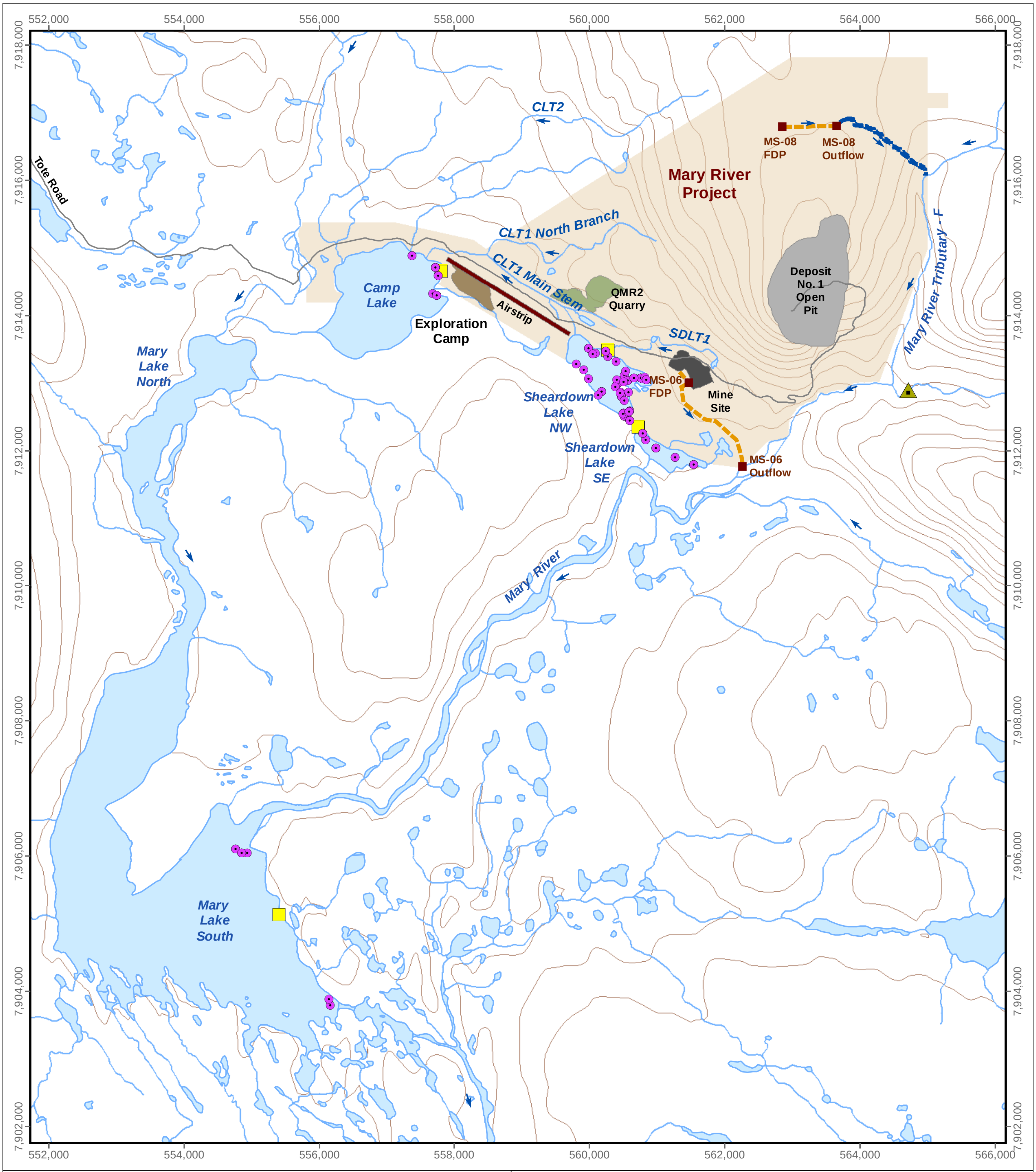
means. Because the benthic survey was designed to have sufficient power to detect a difference (effect size) of ± two standard deviations (SD), the magnitude of the difference was calculated to reflect the number of reference mean standard deviations (SD_{REF}) using equations provided by Environment Canada (2012). A Critical Effect Size for the benthic invertebrate community study (CES_{BIC}) of ± 2 SD_{REF} was used to define ecologically relevant 'effects', which is analogous to differences beyond those expected to occur naturally between two areas that are uninfluenced by anthropogenic inputs (i.e., between pristine reference areas; see Munkittrick et al. 2009, Environment Canada 2012).

Temporal comparisons included statistical evaluations among the baseline and 2015 to 2018 data for primary benthic metrics (i.e., density, richness, Simpson's Evenness), dominant invertebrate groups, and FFG using uni-variate tests (e.g., ANOVA) and pair-wise *post hoc* tests, as appropriate. The temporal statistical comparisons were conducted using the same tests, transformations, assumptions, and software described above for the *in situ* water quality comparisons (see Section 2.2.2). For study areas that contained data for multiple years (i.e., 3 or more), Tukey's HSD *post hoc* tests were used in instances in which normal data showed equal variance, and Tamhane's *post hoc* tests were used in instances in which normal data showed unequal variance. Similar to the 2018 within-year statistical analyses, the magnitude of difference was calculated for endpoints that differed significantly between years in the *post hoc* tests and was compared to the benthic survey CES_{BIC} of within two standard deviations of the baseline year mean (abbreviated as ±2 $SD_{BL\text{-}year}$).

2.4.3 Fish Population

2.4.3.1 General Design

The Mary River Project CREMP fish population survey outlines a non-lethal sampling design to evaluate potential mine-related effects to the fish population (e.g., age structure, growth, condition) at the mine-exposed lakes (NSC 2014, 2015). The fish population survey targeted arctic charr (*Salvelinus alpinus*) primarily because this species is the only abundant fish common to all of the mine's regional lakes, sufficient baseline catch and measurement data is available for this species to allow application of a before-after statistical evaluation, and because of this species importance as an Inuit subsistence food source. The approach employed for the CREMP fish population survey closely mirrored the recommended EEM approach for non-lethal sampling (Environment Canada 2012). Specifically, the fish population survey targeted the collection of approximately 100 arctic charr from nearshore lake habitat and 100 arctic charr from littoral/profundal lake habitat. The four mine-exposed study lakes used for the fish population survey were the same as those used to document baseline conditions, namely Camp, Sheardown NW, Sheardown SE, and Mary lakes (Figure 2.5). Unlike in previous CREMP studies, a sufficient



LEGEND

Fishing Sampling Location

- 🟨 Electrofishing
- ● Gill Net
- ■ Final Discharge Point (FDP)
- ▲ Mary River Cascade Barrier
- ━ Discharge Line
- ━ Overland Effluent Channel

Mary River Project 2018 CREMP Fish Survey Sampling Locations

0 1.25 2.5 5 km

Map Projection: UTM Zone 17N NAD 1983
Data Source: Reproduced under licence from Her Majesty the Queen in Rights of Canada, Department of Natural Resources Canada. All rights reserved.

Date: March 2019
Project 187202.0025

minnow environmental inc.

Figure 2.5

Document Path: S:\Projects\187202\187202.0025 - Baffinland 2018 AEMP\4 - GIS\CREMP Study\18-25 Figure 2.5 Fish Survey Sampling Locations.mxd number of arctic charr were captured at Reference Lake 3 nearshore and littoral/profundal areas to statistically evaluate of potential health effects on arctic charr populations at the mine-exposed lakes. Therefore, the 2018 CREMP fish population survey included separate comparison of arctic charr collected at nearshore and littoral profundal habitats in 2018 between the mine-exposed and reference lakes, as well as comparisons of fish captured at nearshore and littoral/profundal zones of individual mine-exposed lakes before-and-after the commencement of the Mary River Project commercial mine operations.

2.4.3.2 Sample Collection

Nearshore areas of the study lakes used for the CREMP study were sampled for arctic charr using a battery powered backpack electrofishing unit (Model LR-24, Smith-Root Inc., Vancouver, WA). An electrofishing team, consisting of the backpack electrofisher operator and a single netter, conducted a single fishing pass at one shoreline reach of each study lake and three to five reaches at each lotic study area. The number of passes conducted at each lake/lotic study area was dependent upon catch success, with more passes required in instances in which target numbers were not cumulatively attained. All fish captured during each pass were retained in buckets of aerated water. At the conclusion of each pass, total fishing effort (i.e., electrofishing seconds) was recorded to allow calculation of time-standardized catch. All captured fish were identified to species and enumerated, with any non-target species subsequently released alive at the area of capture. All captured arctic charr were temporarily retained for processing using methods described below (Section 2.4.3.3). Additional supporting information collected for each electrofishing pass included recording the GPS coordinates at the points of commencement and completion of electrofishing activities and a description of the sampled habitat.

Littoral/profundal areas of the study lakes were sampled for arctic charr using experimental (gang index) gill nets. Multiple-panel, 2 m high gill nets with total lengths ranging from 61 to 91 m (200’ to 300’) and bar mesh sizes ranging from 38 to 76 mm (1.5” to 3”) were set on the bottom for short durations (approximately 0.8 to 3.3 hours per set; mean of 1.9 hours) during daylight hours only. Upon retrieval of each net, all captured fish were identified to species, enumerated, and processed (see below) separately for each individual gill net panel mesh size. For each gill net set, information including mesh sizes, duration of sampling, sampling depth range, GPS coordinates, and habitat descriptions were recorded.

2.4.3.3 Field and Laboratory Processing

Following completion of each electrofishing pass and retrieval of each individual gill net panel, all captured arctic charr were subject to processing in the field. For all live captures, the external condition of each individual was assessed visually for the presence of any deformities, erosions, lesions, and tumors (DELT), in addition to evidence of external and/or internal parasites. All observations were recorded on field sheets, with supporting photographs taken as appropriate. Each fish was then subject to measurement of fork and total length to the nearest millimetre using a standard measuring board. Following length measurements, fish captured using the electrofishing unit were individually weighed to the nearest milligram using an Ohaus Model 123 Scout-Pro analytical balance (Ohaus Corp., Pine Brook, NJ) with a surrounding draft shield. For arctic charr captured in gill nets, individuals were weighed using Pesola™ spring scales (Pesola AG, Baar Switzerland) demarcated at intervals of 1 to 2% of the total scale range and providing accuracy of ±0.3% of the fish mass. The Pesola™ spring scale for individual weight measurement of gill-net captured fish was selected so that the fish weight was near the top of the scale's range to ensure that measurements achieved a resolution near 1%. All live arctic charr captured by electrofishing and gill netting methods that were not selected for the collection of aging structures were released near the location of capture following these individual measurements of length and weight.

As specified for EEM non-lethal fish population surveys (see Environment Canada 2012), approximately 10% of the targeted number of arctic charr captured using electrofishing methods were sacrificed for collection of aging structures. Otoliths were removed from all sacrificed individuals and incidental mortalities for age determination. Upon removal, these aging structures were wrapped in wax paper, placed inside envelopes labelled with the fish identification, and then dried for storage. Age structures (otoliths) were shipped to North Shore Environmental Services (NSES; Thunder Bay, ON) for age determination. At the laboratory, otoliths were prepared for aging using a "crack and burn" method. The prepared otolith samples were mounted on a glass slide using a mounting medium and examined under a compound microscope using transmitted light to determine fish age. For each structure, the age and edge condition was recorded along with a confidence rating for the age determination.

2.4.3.4 Data Analysis

Fish community data from the mine-exposed and reference study areas were compared based on total catch and catch-per-unit-effort (CPUE) for each sampling method. Electrofishing CPUE was calculated as the number of fish captured per electrofishing minute for each lake nearshore or lotic study area, and gill netting CPUE was calculated as the number of fish captured per 100 metre·hours of net used for each study lake. Temporal comparison of fish community assemblage was conducted using electrofishing CPUE and gill netting CPUE to evaluate relative changes in fish catches at mine area lakes between mine baseline and through the years of mine operation.

Arctic charr population health was assessed separately for electrofishing and experimental gill netting data sets. Initial data analysis included the plotting of length frequency distributions so that, together with appropriate aging data, young-of-the-year (YOY) individuals could be distinguished from the older juvenile/adult life stages (electrofishing data set), or various size/age classes could be distinguished from one another (gill netting data set). Where sample sizes allowed, the YOY age class was assessed separately from the older juvenile/adult age classes for fish survey endpoints between the individual mine-exposed lakes and Reference Lake 3. Fish size endpoints of fork length and fresh body weight were summarized by separately reporting mean, median, minimum, maximum, standard deviation, standard error, and sample size by size class (if possible) for each study area. The recorded measurement endpoints were used as the basis for evaluating four response categories (survival, growth, reproduction and energy storage; Table 2.6) according to the procedures outlined for EEM by Environment Canada (2012). Length-frequency distributions were compared between mine-exposed and reference lakes or between lotic study areas for data collected in 2018, and for before-after analysis using data collected in 2018 and the combined baseline period, using a non-parametric two-sample Kolmogorov-Smirnov (KS) test. Potential differences in reproductive success between paired study areas were based on evaluation of the relative proportion of arctic charr YOY between the mine-exposed and reference areas, and by comparing the results of KS tests conducted with and without YOY individuals included in the data sets.

Mean fork length and body weight were compared between mine-exposed and reference study areas in 2018, and between 2018 and the mine baseline period, using ANOVA, with data evaluated for normality and homogeneity of variance before applying parametric statistical procedures. In cases where data did not meet the assumptions of ANOVA despite log-transformation, a non-parametric Mann-Whitney U-test was also performed to test for/validate significant differences between study areas or study periods indicated by the ANOVA tests, as appropriate. Fork length, body weight, and body weight adjusted to a designated fork length, were plotted using boxplots. In the boxplots, the box represents the 25th percentile, median, and 75th percentile values, and the whiskers represent the minimum and maximum values. However, values that were 1.5 times the height of the box beyond the 25th percentile or 75th percentile were plotted as individual points and the whiskers were truncated to the next observation in the dataset.

Body weight at fork length (condition) was compared using Analysis-of-Covariance (ANCOVA). Prior to conducting the ANCOVA tests, scatter plots of all variable and covariate combinations were examined to identify outliers, leverage values or other unusual data. The scatter plots were also examined to ensure there was adequate overlap between the 2018 mine-exposed and reference/mine-exposed baseline data sets, and that there was a linear relationship between the variable and the covariate. In order to verify the existence of a linear relationship, each

Table 2.6: Fish Population Survey Endpoints Examined for the Mary River Project CREMP 2018 Study

Response Category	Endpoint	Statistical Procedure[c,d,e]	Critical Effect Size
Survival	Length-frequency distribution[a]	K-S Test	not applicable
	Age[a,f]	ANOVA	not applicable
Energy Use (size)	Size (fresh body weight)[b]	ANOVA	25%
	Size (fork length)[b]	ANOVA	25%
Energy Use (growth)	Size-at-age (body weight against age)[a,f]	ANCOVA	25%
	Size-at-age (fork length against age)[b,f]	ANCOVA	25%
Energy Use (reproduction)	Relative abundance of YOY (% composition)[b]	K-S Test	not applicable
Energy Storage	Condition (body weight against length)[a]	ANCOVA	10%

[a] Endpoints used for determining "effects" as designated by statistically significant difference between mine-exposed and reference areas (Environment Canada 2012).

[b] These analyses are for informational purposes and significant differences between exposure and reference areas are not necessarily used to designate an effect (Environment Canada 2012).

[c] ANOVA (Analysis of Variance) used except for non-normal data, where Mann Whitney U-test may have been used.

[d] ANCOVA (Analysis of Covariance). For the ANCOVA analyses, the first term in parentheses is the endpoint (dependent variable Y) that is analyzed for an effluent effect. The second term in parentheses is the covariate, X (age, weight, or length).

[e] K-S Test (Kolmogorov-Smirnov test).

[f] Endpoints which were applied to reduced data sets, including sacrificed fish and/or mortalities.

relationship was tested using linear regression analysis by area and evaluated at an alpha level of 0.05. If it was determined that there was no significant linear regression relationship between the variable and covariate for the 2018 mine-exposed and/or reference/mine-exposed baseline data sets, then the ANCOVA was not performed. Once it was determined that ANCOVA could be used for statistical analysis of the data, the first step in the ANCOVA analysis was to test whether the slopes of the regression lines for the 2018 mine-exposed and reference/baseline data sets were equal. This was accomplished by including an interaction term (dependent × covariate) in the ANCOVA model and evaluating if the interaction term was significantly different, in which case the regression slopes would not be equal between data sets and the resulting ANCOVA would provide spurious results. In such cases, two methodologies were employed to assess whether a full ANCOVA could proceed. In order of preference these were: 1) removal of influential points using Cook's distance and re-assessment of equality of slopes; and, 2) Coefficients of Determination that considered slopes equal regardless of an interaction effect (Environment

Canada 2012). For the Coefficients of Determination, the full ANCOVA was completed to test for main effects, and if the r^2 value of both the parallel regression model (interaction term) and full regression model were greater than 0.8 and within 0.02 units in value, the full ANCOVA model was considered valid (Environment Canada 2012). If both methods proved unacceptable, the magnitude of effect was estimated at both the minimum and maximum overlap of covariate variables between areas (Environment Canada 2012). This results in a statistically significant interaction effect (slopes are not equal), but the calculation of the magnitude of difference at the minimum and maximum values of covariate overlap is not assigned statistical difference as it would for a full ANCOVA model. If the interaction term was not significant (i.e., homogeneous slopes between the two populations), then the full ANCOVA model was run without the interaction term to test for differences in adjusted means between the two data sets. The adjusted mean was then used as an estimate of the population mean based on the value of the covariate in the ANCOVA model.

For endpoints showing significant data set differences, the magnitude of difference between 2018 mine-exposed and reference data or the baseline data was calculated as described by Environment Canada (2012) using mean (ANOVA), adjusted mean (ANCOVA with no significant interaction) or predicted values (ANCOVA with significant interaction). The anti-log of the mean, adjusted mean, or predicted value was used in the equations for endpoints that were $\log_{10}$-transformed. In addition, the magnitude of difference for ANCOVA with a significant interaction was calculated for each of the minimum and maximum values of the covariate. If there was no significant difference indicated between data sets, the minimum detectable effect size was calculated as a percent difference from the reference mean/mine-exposed baseline mean for ANOVA or adjusted reference mean/mine-exposed baseline mean for ANCOVA at alpha = beta = 0.10 using the square root of the mean square error (generated during either the ANOVA or ANCOVA procedures) as a measure of variability in the sample population based on formulae provided by Environment Canada (2012). Finally, if outliers or leverage values were observed in a data set (or sets) upon examination of scatter plots and residuals, then the values were removed and ANOVA or ANCOVA tests were repeated and presented only for the reduced data sets. Similar to the Critical Effect Sizes (CES) applied to the benthic invertebrate community survey, a fish population survey CES magnitude of difference of ± 25% was applied to general endpoints (CES_G) of survival, growth, reproduction and relative liver size, and a magnitude of difference of ± 10% was applied for condition (CES_C) to define any ecologically relevant differences, consistent with those recommended for EEM (Table 2.6; Munkittrick et al. 2009; Environment Canada 2012).

Finally, an *a priori* power analysis was completed to determine appropriate fish sample sizes for future surveys as recommended by Environment Canada (2012). These analyses were completed based on the mean square error values generated during the ANOVA or ANCOVA procedures and were calculated with alpha and beta set equally at 0.10 for the analysis. Two main assumptions served as the basis for the power analysis. The first assumption was that the fish caught in each of the effluent-exposed and reference areas were representative of the population at large (i.e., similar distribution and variance with respect to the parameters examined). The second assumption was that the characteristics of the populations as a whole would not change substantially prior to the next study. The power analysis results were reported as the minimum sample size (number of fish/area) required to detect a given magnitude of difference (effect size) between the mine-exposed and reference area/baseline populations for each endpoint. The magnitude of difference was presented as a percentage decrease or increase of the reference area/baseline mean for each endpoint as measured during the fish population study using the observed pooled standard deviation of the residuals from the t-test or parallel slope ANCOVA model.

3 CAMP LAKE SYSTEM

3.1 Camp Lake Tributary 1 (CLT1)

3.1.1 Water Quality

Camp Lake Tributary 1 (CLT1) dissolved oxygen (DO) concentrations were consistently at or above saturation at the north branch and main stem stations during all spring, summer, and fall monitoring events (Appendix Tables C.1 to C.3). Dissolved oxygen concentration and percent saturation at the CLT1 north branch and lower main stem stations were higher than at the reference creek, and well above the WQG lowest acceptable concentration for early life stages of cold-water biota (i.e., 9.5 mg/L), at the time of biological sampling in August 2018 (Figure 3.1; Appendix Table C.13). No consistent spatial patterns in pH were shown with progression downstream through the CLT1 north branch (Stations L1-08 to L1-02) and main branch (Stations L2-03 to L0-01) stations during all spring, summer, and fall monitoring events (Appendix Tables C.1 to C.3). Although pH was significantly lower at the CLT1 north branch and lower main stem study areas compared to Unnamed Reference Creek, no significant differences in pH were indicated between the two CLT1 study areas in August 2018, suggesting no substantial influence of the Milne Inlet Tote Road on in-stream pH (Figure 3.1; Appendix Table C.13). The pH at all CLT1 stations/study areas was also consistently within WQG limits, suggesting adverse effects on biota were unlikely as a result of the slight difference in pH between CLT1 and Unnamed Reference Creek.

Specific conductance within CLT1 was generally highest in the upper main stem (Station L2-03) and lowest in the north branch (Stations L1-02 and -08), with intermediate values observed at the lower main stem stations reflecting mixing of these two branches and suggesting a mine-related source affecting water quality of the CLT1 upper main stem (Appendix Tables C.1 to C.3, C.14). Specific conductance was consistently higher at the CLT1 north branch and main stem stations compared to the CREMP lotic reference stations over the spring, summer, and fall sampling events (Appendix Tables C.1 to C.3), and was also significantly higher at the CLT1 study areas compared to Unnamed Reference Creek during the August 2018 biological study (Figure 3.1). In addition, specific conductance was significantly higher at the CLT1 lower main stem than at the north branch (Appendix Table C.13). These results further corroborated the occurrence of a mine-related source affecting water quality of CLT1, primarily in the main stem of the tributary.

Water chemistry of the CLT1 north branch was similar to the reference creek stations in 2018 with the exception of moderately higher (i.e., 5- to 10-fold) sulphate concentrations and slightly higher (i.e., 3- to 5-fold) total molybdenum and potassium concentrations during the spring sampling event (Table 3.1; Appendix Tables C.14 and C.15). Parameter concentrations were below

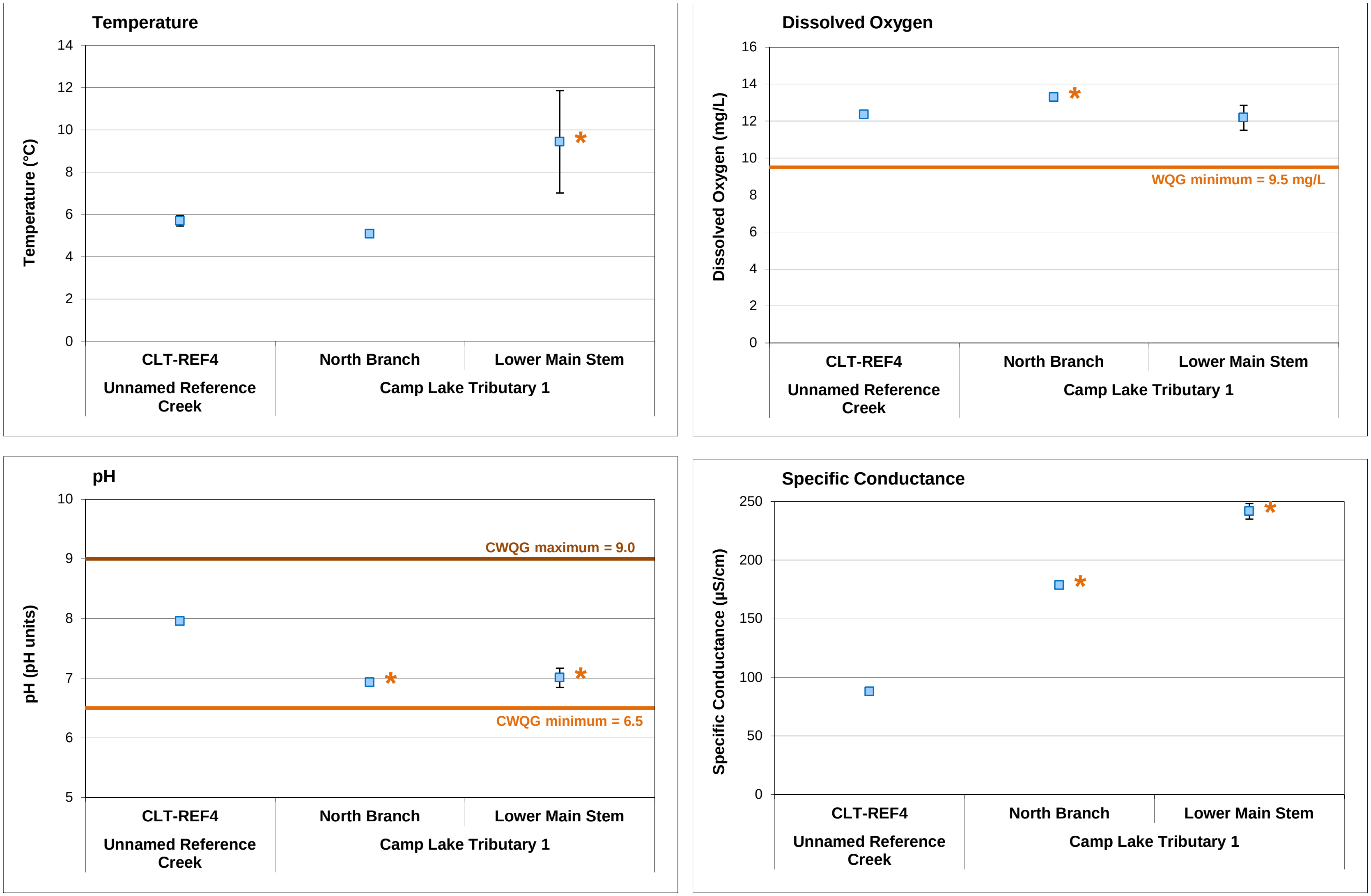


Figure 3.1: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Camp Lake Tributary 1 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Note: An asterisk (*) next to data point indicates mean value differs significantly from the Unnamed Reference Creek mean.

Table 3.1: Water Chemistry at Camp Lake Tributary (CLT) Monitoring Stations During Fall (late August and September) Sampling, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Reference Creek Average (n=4)	North Branch CLT1		Upper Main Stem	Lower Main Stem CLT1			CLT-2
						L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01
					Fall 2018	25-Aug-2018	25-Aug-2018	26-Aug-2018	25-Aug-2018	18-Aug-2018	18-Aug-2018	19-Aug-2018
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	97	107	171	350	218	204	218	195
	pH (lab)	pH	6.5 - 9.0	-	7.88	8.06	8.07	8.03	8.26	8.20	8.19	8.23
	Hardness (as $CaCO_3$)	mg/L	-	-	47	62	89	146	103	104	108	108
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	3.2	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	53	60	76	195	110	90	105	124
	Turbidity	NTU	-	-	2.4	0.3	0.2	5.6	1.1	1.4	1.3	1.8
	Alkalinity (as $CaCO_3$)	mg/L	-	-	43	58	83	122	92	92	90	104
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.021	0.045	<0.020	0.508	0.059	0.106	0.147	<0.020
	Nitrate	mg/L	13	13	<0.020	0.025	0.022	3.530	0.625	0.629	0.571	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	0.0224	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	0.66	<0.15	0.21	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.5	3.0	2.6	5.5	3.4	2.9	2.8	3.6
	Total Organic Carbon	mg/L	-	-	2.0	2.9	3.3	5.9	4.0	4.4	4.1	2.4
	Total Phosphorus	mg/L	0.020^{α}	-	0.0035	<0.0030	<0.0030	0.0067	<0.0030	<0.0030	<0.0030	<0.0030
	Phenols	mg/L	0.004^{α}	-	<0.0010	<0.0010	0.0012	0.0045	<0.0010	<0.0010	<0.0010	0.0011
Anions	Bromide (Br)	`	-	-	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.6	1.2	1.3	21.7	7.2	7.6	8.1	2.2
	Sulphate (SO_4)	mg/L	218^{β}	218	2.7	4.0	3.8	13.8	5.6	6.2	6.2	4.5
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.054	0.013	0.007	0.108	0.031	0.033	0.035	0.052
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0059	0.0086	0.0103	0.0144	0.0120	0.0118	0.0100	0.0113
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	0.027	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	0.000035	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	9.8	12.1	18.6	29.1	23.0	21.2	21.2	22.0
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.0040	<0.00010	<0.00010	<0.00010	0.00031	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.0009	0.0022	0.0021	0.0014	0.0019	0.0019	0.0016	0.0015
	Iron (Fe)	mg/L	0.30	0.326	0.046	<0.030	<0.030	0.314	0.077	0.077	0.073	0.054
	Lead (Pb)	mg/L	0.001	0.001	0.00008	<0.000050	<0.000050	0.00021	<0.000050	0.00005	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	0.0030	0.0015	0.0018	0.0017	0.0014
	Magnesium (Mg)	mg/L	-	-	5.3	7.5	10.8	18.0	12.3	12.3	11.1	13.2
	Manganese (Mn)	mg/L	0.935^{β}	-	0.0007	0.0004	0.0004	0.0250	0.0053	0.0041	0.0032	0.0016
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00029	0.00078	0.00065	0.00300	0.00109	0.00089	0.00082	0.00032
	Nickel (Ni)	mg/L	0.025	0.025	0.00053	<0.00050	0.00064	0.00139	0.00088	0.00087	0.00079	0.00063
	Potassium (K)	mg/L	-	-	0.6	1.8	1.7	3.3	2.0	2.2	1.9	1.5
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.8	0.8	0.8	1.2	0.9	0.9	0.9	1.0
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.2	0.5	1.2	13.8	4.0	4.1	3.4	1.7
	Strontium (Sr)	mg/L	-	-	0.0094	0.0078	0.0092	0.0289	0.0202	0.0189	0.0182	0.0127
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0019	0.0023	0.0018	0.0201	0.0052	0.0051	0.0042	0.0014
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Camp Lake tributary system.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

applicable WQG and watercourse-specific AEMP benchmarks at the CLT1 north branch in 2018 except for copper, which was marginally above only the WQG during the summer and fall sampling events (Table 3.1; Appendix Table C.14). Temporal comparisons indicated that parameter concentrations at the CLT1 north branch in fall 2018 were within the range of those measured during the mine baseline (2005 to 2013) period with the exception of higher total copper concentrations, which were consistently greater at the CLT1 north branch stations in all years of commercial mine production, since 2015, than during mine baseline studies (Figure 3.2; Appendix Figure C.2). Overall, only a minor influence on water quality, reflected mainly by a slight elevation in copper concentrations, was indicated at the CLT1 north branch following the commencement of commercial mine production.

Hardness and concentrations of total dissolved solids (TDS), total ammonia, nitrate, nitrite, total Kjeldahl nitrogen (TKN), chloride, sulphate, and several metals including iron, manganese, molybdenum, potassium, sodium, strontium, and uranium, were slightly to highly elevated (i.e., 3-fold to ≥10-fold higher, respectively) at the upstream-most CLT1 main stem station (L2-03) compared to average reference creek station water chemistry in at least two of the three seasonal sampling events (Table 3.1; Appendix Tables C.14 and C.15). On average, concentrations of nitrate, chloride, and sulphate, as well as total concentrations of manganese, molybdenum, potassium, and sodium, were elevated at the CLT1 lower main stem (i.e., stations L1-09, L1-05 and L0-01) compared to respective average concentrations at the reference creek stations (Appendix Table C.14). Notably, the magnitude of elevation in concentrations of the above parameters compared to the reference creek stations was substantially lower at the lower main stem stations compared to the upper main stem, reflecting the influence of CLT1 main stem dilution from the north branch (Appendix Table C.14).

Within the CLT1 upper main stem (i.e., Station L2-03), total aluminum and iron concentrations were above respective WQG and watercourse-specific AEMP benchmarks during the spring sampling event, and in addition to total uranium and phenol concentrations, were also above WQG during one or both of the summer and fall sampling events in 2018 (Table 3.1; Appendix Table C.14). Total aluminum concentrations were also above WQG and/or AEMP benchmarks at the MRY-REF3 lotic reference station during the spring and summer 2018 sampling events (Appendix Table B.2). Notably, higher turbidity was evident at the CLT1 main stem and MRY-REF 3 lotic reference stations than at the other mine-exposed and reference creek stations, which in turn suggested that elevation in total aluminum and iron concentrations compared to WQG/AEMP benchmarks reflected association of these metals with suspended particulate matter (Appendix Tables B.2 and C.14). This was corroborated by evaluation of the dissolved concentrations of aluminum and iron, which showed similar average concentrations between CLT1 stations and the reference creek stations and suggested that the key source(s) of aluminum

Figure 3.2: **Temporal Comparison of Water Chemistry at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2018) Periods During Fall**

Notes: Values represent mean ± SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Camp Lake Tributaries.

and iron may not be mine-related (Appendix Tables C.4, C.16, and C.17). In contrast, dissolved concentrations of uranium were elevated at the CLT1 upper main stem compared to the lotic reference creek station average despite elevated turbidity, suggesting a mine-related source of uranium to CLT1 (Appendix Table C.17).[6]

Temporal comparisons of CLT1 main stem water chemistry data indicated that, of the parameters shown to be elevated relative to the reference creek stations in 2018, hardness and concentrations of TDS, chloride, and total strontium were comparable to or only slightly higher than concentrations recorded during the baseline period (Figure 3.2; Appendix Figure C.2). However, nitrate, TKN, and sulphate concentrations, as well as total iron, manganese, molybdenum, sodium, and uranium concentrations, were consistently higher during the mine operational years, including 2018, compared to the mine baseline period at the CLT1 upper main stem and at least one of the three CLT1 lower main stem stations (Figure 3.2; Appendix Figure C.2). Higher parameter concentrations at the CLT1 main stem stations following the initiation of commercial mine production potentially reflected blasting/excavating activity (including associated dust generation) at mine quarry QMR2[7], as well as fugitive dust generation from increased truck usage on the Milne Inlet Tote Road, compared to the baseline period. Notably higher concentrations of nitrogen-based compounds (e.g., ammonia, nitrate, nitrite, TKN) in 2018 at CLT1 were consistent with the deposition of explosives residue from the QMR2 quarry. Overall, mine-related influences on water quality of the CLT1 main stem were primarily evidenced by elevated specific conductance and hardness, as well as concentrations of nitrate, TKN, chloride, sulphate, and total metals including manganese, molybdenum, potassium, sodium, and uranium, at the upper main stem, though with the exception of uranium, none were elevated above applicable WQG or AEMP benchmarks. Although aluminum and iron concentrations were elevated above WQG and AEMP benchmarks at CLT1, similar occurrence at the reference areas suggested that these elevations were likely natural.

3.1.2 Phytoplankton

Chlorophyll-a concentrations at the upper-most CLT1 north branch station (Station L1-08) were lower than the average concentration among reference creek stations for spring, summer, and fall sampling events in 2018 (Figure 3.3). However, chlorophyll-a concentrations further downstream at the CLT1 north branch, nearer to the mine (i.e., Station L1-02), were generally

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[6] On average, dissolved concentrations of manganese, molybdenum, potassium, sodium, and strontium were also elevated at CLT1 upper and/or lower main stem stations compared to respective averages from the lotic reference creek stations, supporting the analysis of total metal concentrations that suggested a mine-related source of these metals.

[7] The QMR2 quarry is used to provide material for mine infrastructure projects (e.g., road construction).

comparable to reference creek chlorophyll-a concentrations for each individual sampling event, suggesting no marked differences in phytoplankton abundance between the CLT1 north branch and the reference creek stations (Figure 3.3).

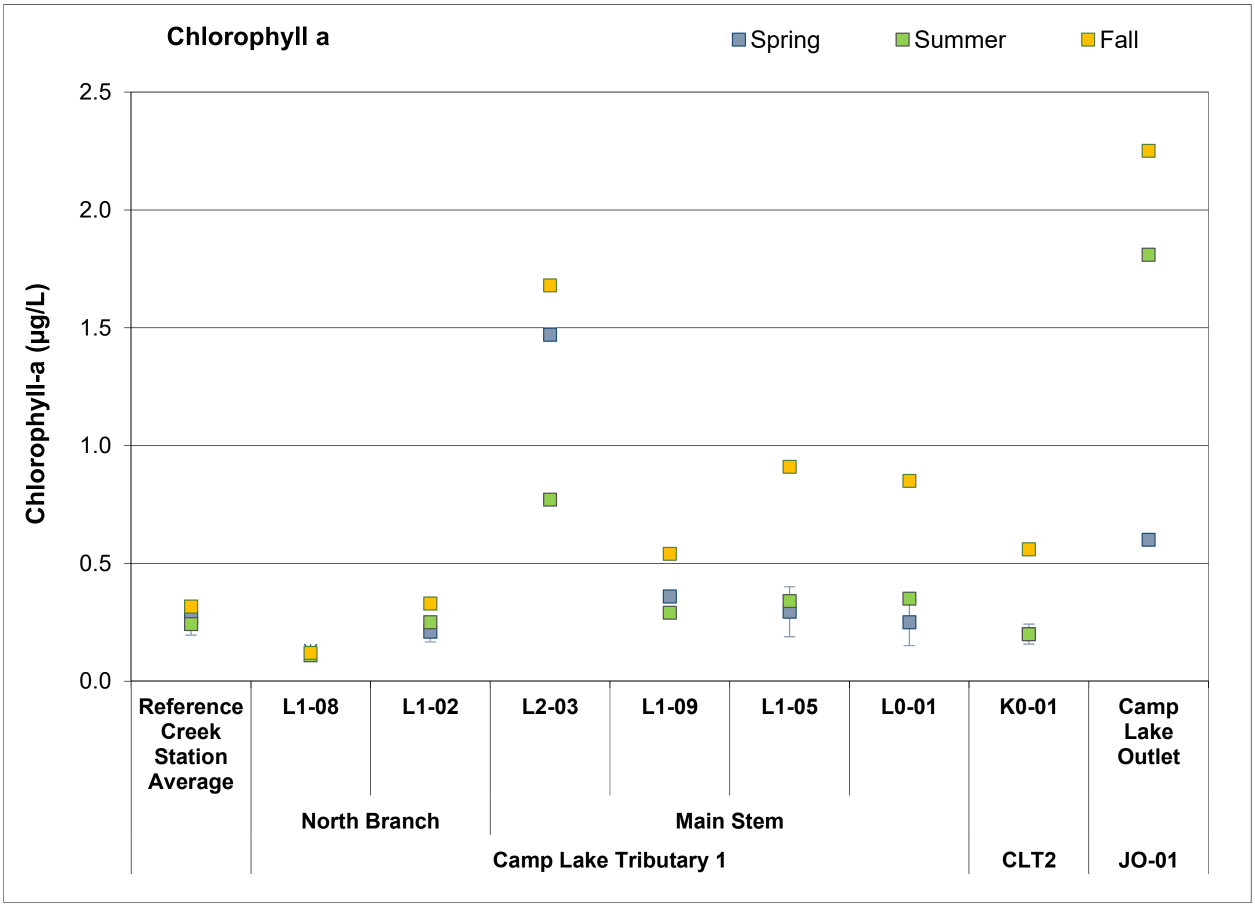

Figure 3.3: **Chlorophyll-a Concentrations at Camp Lake Tributary 1 (CLT1) and Tributary 2 (CLT2) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2018**

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

Within the CLT1 main stem, chlorophyll-a concentrations were highest at upstream-most Station L2-03 during spring, summer, and fall sampling events in 2018 (Figure 3.3). On average, chlorophyll-a concentrations were significantly higher at the CLT1 main stem stations compared to the reference creek stations during the fall sampling event, but not during the spring and summer sampling events (Appendix Table E.2). Relatively high chlorophyll-a concentrations at Station L2-03 and in the CLT1 lower main stem during fall sampling potentially reflected higher nutrient (e.g., nitrate) concentrations compared to average concentrations under reference conditions (Appendix Tables C.14 and C.15). Nevertheless, chlorophyll-a concentrations at all CLT1 north branch and main stem monitoring stations were well below the AEMP benchmark of 3.7 µg/L for all seasonal sampling events in 2018 (Figure 3.3). Similar to the reference creek stations, chlorophyll-a concentrations observed at all CLT1 stations in 2018 suggested low (i.e., oligotrophic) phytoplankton productivity based on Dodds et al. (1998) trophic status classification for stream environments (i.e., chlorophyll-a < 10 µg/L). This trophic status classification was also consistent with an ultra-oligotrophic to oligotrophic WQG categorization (CCME 2017) for CLT1 based on aqueous total phosphorus concentrations typically less than 10 µg/L at each CLT1 north branch and main stem station during all spring, summer, and fall sampling events (Appendix Table C.14).

Temporal comparisons of the CLT1 chlorophyll-a data indicated that concentrations at the North Branch Stations L1-08 and L1-02 in fall 2018 were similar to, or lower than, those observed in the fall during the baseline period (i.e., 2005 to 2013; Figure 3.4). At the CLT1 main stem, chlorophyll-a concentrations were higher in mine operational years from 2015 to 2018 than during the mine baseline period with the exception of at the CLT1 mouth (Station L0-01; Figure 3.4). In addition, among the years of mine operation, chlorophyll-a concentrations were highest in either 2017 or 2018 at CLT1 lower main stem stations, but nevertheless were continuously lower than the AEMP benchmark of 3.7 µg/L (Figure 3.4). Overall, spatial and temporal analyses of chlorophyll-a concentrations suggested that the mine operation may have contributed to slightly higher phytoplankton abundance at CLT1 main stem stations, but not at the north branch or at the mouth of the main stem, compared to reference conditions. As indicated above, higher phytoplankton abundance within the CLT1 main stem was consistent with the occurrence of higher nutrient concentrations (e.g., nitrate) compared to the reference creeks. This suggested that slightly greater phytoplankton abundance at the CLT1 main stem was the result of current mine operations. Despite slightly greater phytoplankton abundance at CLT1 over time, the watercourse has remained oligotrophic since the commencement of commercial mine operation.

3.1.3 Benthic Invertebrate Community

3.1.3.1 Upstream North Branch (CLT1 US)

Benthic invertebrate density was significantly higher, and Simpson's Evenness significantly lower, at the CLT1 upstream (north branch) study area compared to the Unnamed Reference Creek at magnitudes that were ecologically significant (Table 3.2). Lower evenness at the CLT1 upstream study area reflected disproportionately high densities of a number of Chironomidae (non-biting midges) genera, including *Cricotopus* and *Pseudokieferiella* (Appendix Table F.5). In addition to these differences, differences in benthic invertebrate community assemblage were suggested between study areas based on significant differences in Bray-Curtis Index (Table 3.2). The main differences in dominant benthic invertebrate groups included significantly lower relative

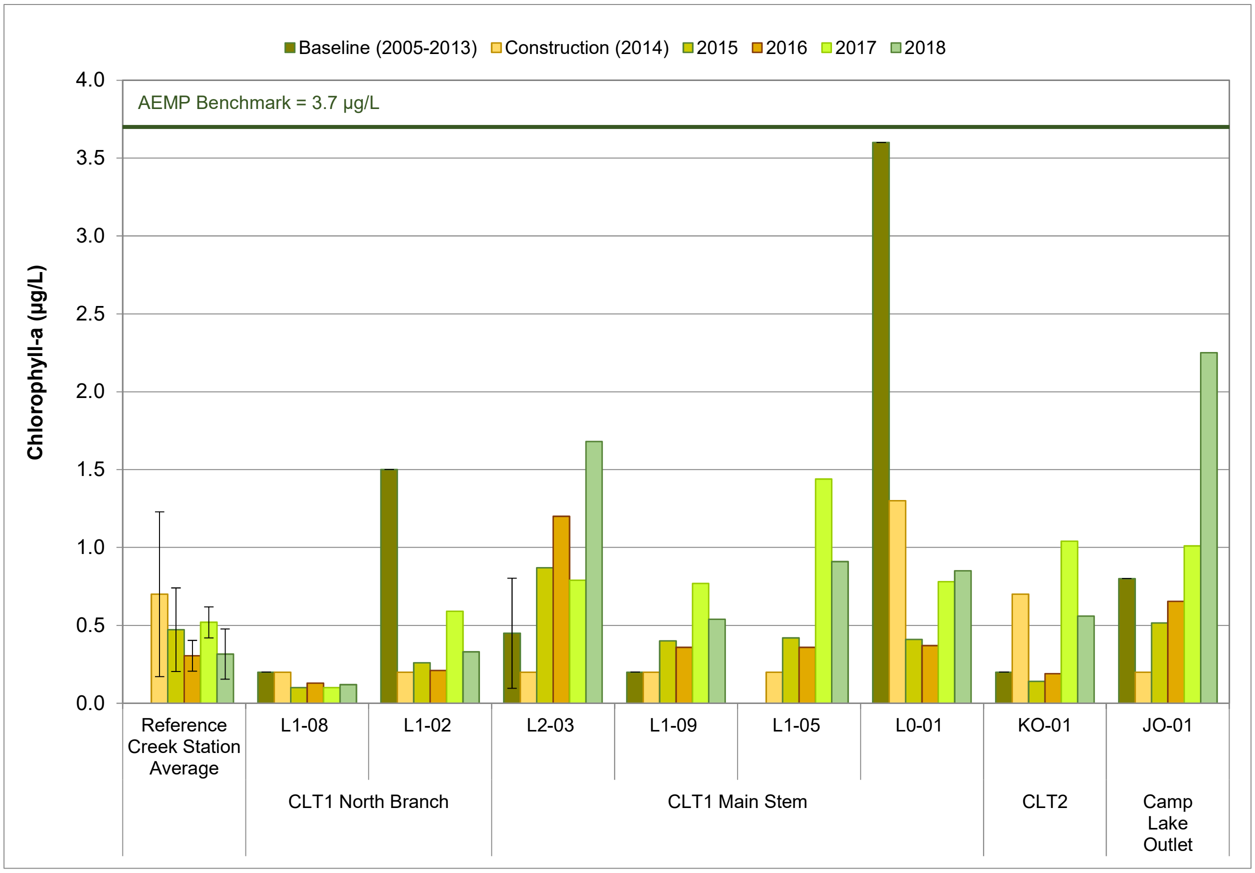

Figure 3.4: **Temporal Comparison of Chlorophyll-a Concentrations at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2018) Periods during Fall**

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

Table 3.2: Benthic Invertebrate Community Metric Statistical Comparison Results among Camp Lake Tributary 1 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2018

Metric	Data Transform-ation	Overall 3-Area Comparison		Pair-wise, *post hoc* comparisons[a]				
		Significant Difference Among Areas?	P-value	Study Area	Mean	Standard Deviation (SD)	Magnitude of Difference (SD)	Pairwise Comparison
Density (No. per m^2)	none	YES	0.008	Reference Creek	526	152	-	a
				CLT1 Upstream	1,410	536	5.8	b
				CLT1 Downstream	787	316	1.7	a
Richness (No. of Taxa)	log	YES	0.003	Reference Creek	19.8	3.0	-	a
				CLT1 Upstream	17.2	1.5	-0.9	a
				CLT1 Downstream	14.4	1.1	-1.8	b
Simpson's Evenness	none	YES	0.007	Reference Creek	0.960	0.011	-	a
				CLT1 Upstream	0.877	0.058	-7.4	b
				CLT1 Downstream	0.856	0.050	-9.3	b
Bray-Curtis Index	none	YES	< 0.001	Reference Creek	0.208	0.092	-	a
				CLT1 Upstream	0.766	0.042	6.1	b
				CLT1 Downstream	0.772	0.035	6.1	b
Nemata (% of community)	square root	YES	0.003	Reference Creek	6.0	2.0	-	a
				CLT1 Upstream	1.6	0.7	-2.3	b
				CLT1 Downstream	2.6	1.8	-1.7	b
Oligochaeta (% of community)	rank	YES	0.017	Reference Creek	0.0	0.0	-	a
				CLT1 Upstream	1.2	0.6	nc	b
				CLT1 Downstream	1.2	1.0	nc	b
Hydracarina (% of community)	log	NO	0.101	Reference Creek	3.3	1.3	-	a
				CLT1 Upstream	5.3	1.3	1.6	a
				CLT1 Downstream	3.6	1.5	0.3	a
Ephemeroptera (% of community)	fourth root	YES	0.006	Reference Creek	5.7	2.1	-	a
				CLT1 Upstream	1.2	1.1	-2.1	b
				CLT1 Downstream	0.4	0.7	-2.5	b
Chironomidae (% of community)	log	YES	< 0.001	Reference Creek	60.4	4.5	-	a
				CLT1 Upstream	86.8	4.2	5.9	b
				CLT1 Downstream	85.9	4.1	5.7	b
Metal Sensitive Chironomids (% of community)	none	YES	0.041	Reference Creek	12.4	4.2	-	a,b
				CLT1 Upstream	17.8	4.8	1.3	a
				CLT1 Downstream	8.6	6.0	-0.9	b
Simuliidae (% of community)	rank	YES	0.008	Reference Creek	15.9	4.6	-	a
				CLT1 Upstream	0.5	0.5	-3.4	b
				CLT1 Downstream	0.4	0.5	-3.4	b
Tipulidae (% of community)	fourth root	NO	0.377	Reference Creek	2.8	1.5	-	a
				CLT1 Upstream	2.9	2.3	0.1	a
				CLT1 Downstream	4.9	3.1	1.4	a
Collector-Gatherer FFG (% of community)	none	YES	0.040	Reference Creek	71.5	4.0	-	a
				CLT1 Upstream	54.6	13.5	-4.2	b
				CLT1 Downstream	59.5	8.3	-3.0	a,b
Filterer FFG (% of community)	square root	YES	< 0.001	Reference Creek	16.0	4.5	-	a
				CLT1 Upstream	0.5	0.5	-3.4	b
				CLT1 Downstream	0.4	0.5	-3.5	b
Shredder FFG (% of community)	log	YES	< 0.001	Reference Creek	4.8	2.8	-	a
				CLT1 Upstream	39.3	13.2	12.5	b
				CLT1 Downstream	35.5	7.7	11.1	b
Clinger HPG (% of community)	fourth root	YES	0.006	Reference Creek	22.6	5.0	-	a
				CLT1 Upstream	42.4	12.7	4.0	b
				CLT1 Downstream	35.6	7.2	2.6	b
Sprawler HPG (% of community)	square root	YES	0.091	Reference Creek	66.2	5.0	-	a
				CLT1 Upstream	51.9	13.9	-2.8	b
				CLT1 Downstream	55.8	6.7	-2.1	a,b
Burrower FFG (% of community)	0.0000	YES	0.028	Reference Creek	11.2	1.9	-	a
				CLT1 Upstream	5.7	2.6	-2.8	b
				CLT1 Downstream	8.6	3.5	-1.3	a,b

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Blue shaded values indicate significant difference (ANOVA p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD$_{REF}$, indicating that the difference between the mine-exposed area and reference area was ecologically meaningful.

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

abundance of Ephemeroptera (mayflies), Nemata (roundworms), and Simuliidae (blackflies), and conversely, significantly higher relative abundance of Chironomidae (non-biting midges), at the CLT1 north branch compared to the reference creek based on magnitudes of difference outside of the benthic invertebrate community critical effect size (CES_{BIC}) of ±2 reference area standard deviations (SD_{REF}; Table 3.2). Notably, the relative abundance of metal-sensitive chironomids did not differ significantly between the CLT1 north branch and the reference creek (Table 3.2), suggesting that the community composition differences between watercourses were unrelated to differing metal concentrations.

Assessment of benthic invertebrate functional feeding groups (FFG) indicated significantly higher relative abundance of shredders and significantly lower relative abundance of collector-gatherers and filterers at the CLT1 north branch compared to Unnamed Reference Creek (Table 3.2). The differences in FFG composition potentially reflected differences in the type or amount of in-stream vegetation between watercourses. For instance, a greater density of shredders (including *Cricotopus* midges) at the CLT1 north branch may have reflected greater abundance of bryophytes, which serve as a food source for shedders, compared to the reference creek where greater abundance of periphyton may have contributed to a greater relative abundance of collector-gatherer and filterer FFG (Table 3.2; Appendix Table F.1). Collectively, the data suggested that the differences in benthic invertebrate community assemblage between the CLT1 north branch and Unnamed Reference Creek were unrelated to metal concentrations, and likely reflected differences in the types and/or abundance of in-stream vegetation between these study areas.

Temporal comparisons of the CLT1 north branch benthic invertebrate community data indicated that density, Simpson's Evenness, and the relative abundance of key dominant taxonomic groups and FFG did not show any consistent type and/or direction of significant differences for years of mine operation, including 2018, compared to baseline data collected in both 2007 and 2011 (Figure 3.5; Appendix Tables F.7 and F.8). Notably, richness was the only endpoint that differed significantly in years of mine operation (2017 and 2018 only) compared to both years in which baseline data were collected (i.e., 2007 and 2011), but because higher richness was indicated at the CLT1 north branch in 2017 and 2018, this difference was not consistent with an influence typically associated with mine operation (Figure 3.5; Appendix Tables F.7 and F.8). Overall, the temporal evaluation indicated no adverse mine-related influences on benthic invertebrates of the CLT1 north branch since the commencement of commercial mine operations in 2015.

3.1.3.2 Downstream Lower Main Stem (CLT1 DS)

The benthic invertebrate community at the lower main stem of Camp Lake Tributary (CLT1 DS), downstream of the Tote Road crossing, showed significantly lower richness and Simpson's

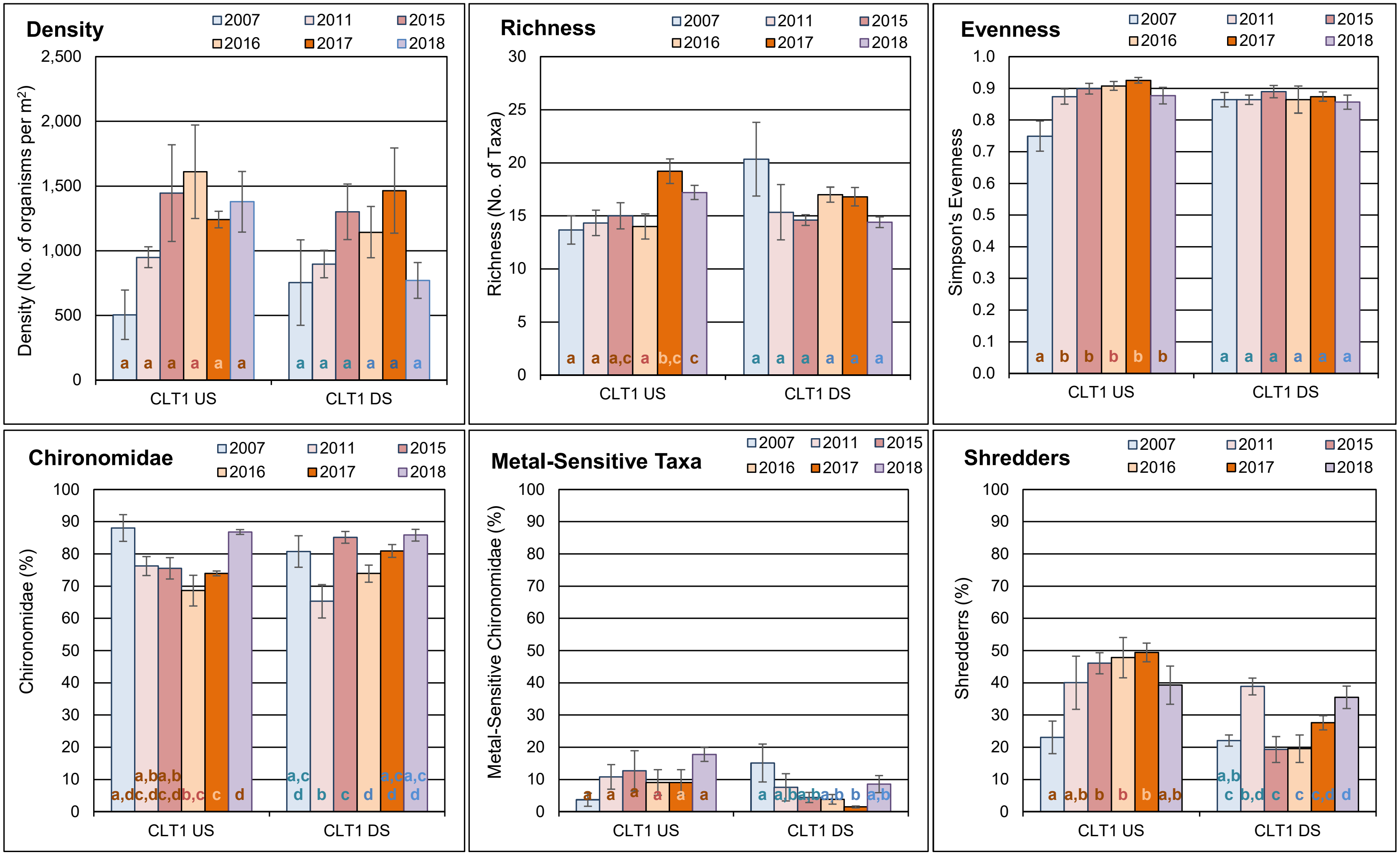

Figure 3.5: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Camp Lake Tributary 1 Study Areas among Mine Baseline (2007, 2011) and Operational (2015 to 2018) Periods

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

Evenness compared to Unnamed Reference Creek in 2018 (Table 3.2). In addition, the benthic invertebrate community assemblage at the CLT1 lower main stem differed from the reference creek as suggested by significant differences in Bray-Curtis Index and composition of dominant taxonomic groups and FFG (Table 3.2). Because no significant difference in the relative abundance of metal-sensitive chironomids was indicated between the CLT1 lower main stem and reference area (Table 3.2), the community composition differences between these study areas did not appear to be related to differences in metal concentrations. The key differences in benthic invertebrate dominant group and FFG composition between the CLT1 lower main stem and reference creek study areas were very similar to those shown between the CLT1 north branch and reference creek study areas, suggesting a similar mechanism for the differences in benthic invertebrate community composition at the CLT1 north branch and lower main stem study areas compared to the reference creek. Specifically, the differences in benthic invertebrate community composition between the CLT1 lower main stem and reference area likely reflected higher and lower abundance of bryophytes and periphyton, respectively, at CLT1 (Appendix Table F.1). No significant differences in water depth or substrate embeddedness were shown between CLT1 and Unnamed Reference Creek study areas (Appendix Tables F.2 and F.3) and therefore differing types and/or abundance of in-stream vegetation was the most plausible habitat variable contributing to differences in the benthic invertebrate community between CLT1 and the reference creek.

Benthic invertebrate density, richness, and the relative abundance of metal-sensitive chironomids were significantly lower at the CLT1 lower main stem compared to north branch study areas (Table 3.2), but the magnitude of these differences were within a CES_{BIC} of ±2 SD of the north branch mean indicating that these differences were not ecologically meaningful. Other metrics, including Simpson’s Evenness, the relative abundance of all dominant groups except metal-sensitive chironomids, all FFG, and all habitat preference groups (HPG), did not differ significantly between the lower main stem and north branch study areas of CLT1 (Table 3.2). In turn, this indicated no substantial influences to the benthic invertebrate community of CLT1 associated with the Tote Road crossing (BG01).

Temporal comparison of the CLT1 lower main stem data indicated no significant differences in benthic invertebrate density, richness, Simpson’s Evenness, or the proportion of metal-sensitive chironomids during individual years of mine operation (2015 to 2018) compared to both years in which mine baseline data were collected (i.e., 2007 and 2011; Figure 3.5; Appendix Tables F.9 and F.10). In addition, no consistent types and/or direction of differences in the relative abundance of dominant groups or FFG were indicated between 2018 and years in which baseline data were collected at the CLT1 lower main stem (Figure 3.5; Appendix Tables F.9 and F.10).

Overall, these results suggested no substantial changes in benthic invertebrate community features between the mine operational and mine baseline periods at the CLT1 lower main stem.

3.1.4 Integrated Summary

3.1.4.1 Upstream North Branch (CLT1 US)

Potential mine-related effects on water quality of the CLT1 north branch in 2018 included elevated molybdenum, potassium, and sulphate concentrations compared to average concentrations at the reference creek, but only during the spring sampling event. Although total copper concentrations were not particularly elevated at the CLT1 north branch compared to reference conditions, concentrations at the CLT1 north branch were marginally above WQG in the summer and fall of 2018. Total copper concentrations at the CLT1 north branch were also consistently elevated in each of the four years of commercial mine operation (2015 to 2018) compared to concentrations shown during mine baseline studies, indicating a mine-related source of copper to the CLT1 north branch. No substantial mine development has occurred in the CLT1 north branch watershed, and therefore sources of copper, molybdenum, potassium, and sulphate to the watercourse potentially included fugitive dust from the mine and/or natural minerology of the bedrock/overburden in the region of the mine.

Chlorophyll-a concentrations (a surrogate for phytoplankton abundance) at the CLT1 north branch were comparable to concentrations at the reference creek stations in 2018, and to concentrations recorded at the north branch during mine baseline studies. Chlorophyll-a concentrations at the CLT1 north branch were also consistently well below the AEMP benchmark in 2018, and were indicative of oligotrophic conditions typical of Arctic watercourses. Benthic invertebrate density was significantly greater, and Simpson's Evenness significantly lower, at the CLT1 north branch compared to the reference creek in 2018. However, these differences appeared to be related to differing habitat conditions between watercourses that included greater amounts of in-stream vegetation at the CLT1 north branch. This was supported by no ecologically significant differences in the relative abundance of metal-sensitive chironomids between the CLT1 north branch and reference creek in 2018, and by no significant differences in density, Simpson's Evenness, and relative abundance of any dominant taxonomic groups or FFG between mine operational (2015 to 2018) and baseline periods. Therefore, despite total copper concentrations above WQG, no adverse effects on phytoplankton and benthic invertebrates were indicated at the CLT1 north branch since the commencement of commercial mine operations in 2015.

3.1.4.2 Downstream Main Stem (CLT1 DS)

At the CLT1 main stem, mine-related influences on water quality were evident as elevated conductivity, hardness, and concentrations of chloride, nitrate, sulphate, TKN, and total metals including manganese, molybdenum, potassium, sodium, and uranium, based on comparisons to reference creek water quality data and to CLT1 main stem baseline study data. Of these, uranium was the only parameter observed at concentrations elevated above WQG and AEMP benchmarks specific to the Camp Lake Tributaries that appeared to be related to the mine operations. The occurrence of higher parameter concentrations at the CLT1 main stem stations since the initiation of commercial mine production was likely mainly attributable to blasting/excavating activity (including associated dust generation) at mine quarry QMR2, but also to fugitive dust generation from increased truck usage on the Project roads since the mine baseline period.

Despite evidence of continued mine-related influence on water quality of the CLT1 main stem, including nitrate and TKN concentrations, chlorophyll-a concentrations at the CLT1 main stem were generally higher than at the reference creek in 2018, and within the CLT1 main stem, were also higher in all years of mine operation from 2015 to 2018 than during the mine baseline period. The occurrence of relatively high chlorophyll-a concentrations at the CLT1 main stem not only suggested that metal concentrations including uranium were not highly bioavailable to phytoplankton, but that elevated nitrate/TKN concentrations may have contributed to a slight biological enrichment of the watercourse. Nevertheless, chlorophyll-a concentrations at the CLT1 main stem were well below the AEMP benchmark and were reflective of oligotrophic conditions typical of Arctic watercourses. Although benthic invertebrate community richness, Simpson's Evenness, and general composition differed significantly between the CLT1 lower main stem and Unnamed Reference Creek communities in 2018, the weight-of-evidence indicated that natural differences in in-stream bryophyte (moss) growth between watercourses largely accounted for these differences. This was supported by no ecologically significant differences in relative abundance of metal-sensitive chironomids between the CLT1 main stem and reference creek benthic invertebrate communities in 2018, and by no consistent type and/or direction of differences in benthic invertebrate community endpoints between mine operational (2015 to 2018) and baseline studies. Notably, no ecologically significant differences in benthic invertebrate community endpoints were indicated between the CLT1 north branch (upstream) and main stem (downstream) study areas, suggesting no substantial influences to the benthic invertebrate community of CLT1 related to the Milne Inlet Tote Road water crossing (BG01). Overall, no adverse mine-related effects to phytoplankton or benthic invertebrates were indicated within the CLT1 lower main stem since the commencement of commercial mine operation in 2015.

3.2 Camp Lake Tributary 2 (CLT2)

3.2.1 Water Quality

Camp Lake Tributary 2 (CLT2) DO saturation levels were consistently high at Station KO-01 in 2018, and were similar to mean DO saturation observed among the reference creek stations during all seasonal sampling events (Appendix Tables C.1 to C.3). *In situ* DO concentrations were higher at the CLT2 upstream and downstream study areas than at Unnamed Reference Creek, and were well above the WQG lowest acceptable concentration for the protection of sensitive stages of cold-water biota, at the time of biological sampling in August 2018 (Figure 3.6). Aqueous pH at the CLT2 upstream and downstream study areas was generally slightly higher (i.e., more alkaline) than at the reference creeks, but consistently well within WQG limits during the spring, summer, and fall water sampling events (Appendix Tables C.1 to C.3). However, during biological sampling in August 2018, pH at the CLT2 study areas was significantly lower than at Unnamed Reference Creek, and near the WQG lower limit (Figure 3.6). No significant difference in pH was indicated between CLT2 study areas located upstream and downstream of the Milne Inlet Tote Road suggesting that this road crossing did not markedly influence pH of CLT2 (Figure 3.6). *In situ* specific conductance was significantly higher at CLT2 compared to Unnamed Reference Creek, and was also significantly higher downstream compared to upstream of the Milne Inlet Tote Road at CLT2 during August 2018 biological sampling (Figure 3.6; Appendix Table C.19), suggesting a Tote Road related influence on water quality at CLT2.

The CLT2 (Station KO-01) water chemistry exhibited highly elevated (i.e., ≥10-fold) sulphate concentrations and slightly elevated (i.e., 3- to 5-fold) hardness, alkalinity, and concentrations of TDS and potassium compared to the average from reference creek stations during the spring 2018 sampling event (Appendix Tables B.2, C.14, and C.15). However, water chemistry was similar at CLT2 and the reference creek stations during the summer and fall sampling events in 2018 with the exception of only a moderate elevation (i.e., 5- to 10-fold) in the concentration of sulphate at CLT2 in summer 2018 (Appendix Table C.15). Despite elevation of the parameters indicated above at CLT2, aqueous concentrations of all parameters, including sulphate, were consistently well below WQG and AEMP benchmarks at the CLT2 monitoring station in 2018 (Table 3.1; Appendix Table C.14). Temporal comparisons of CLT2 water chemistry data indicated that conductivity and all parameter concentrations in fall 2018 were generally within the range of those that occurred during the mine baseline period (2005 to 2013; Appendix Tables C.15 and C.18) and within the range of those shown over the 2015 to 2017 mine operation period (Figure 3.2; Appendix Figure C.2). In consideration of all spatial and temporal data, the 2018 water chemistry data suggested only a minor mine-related influence on aqueous conductivity within the CLT2 system compared to applicable reference and mine baseline conditions.

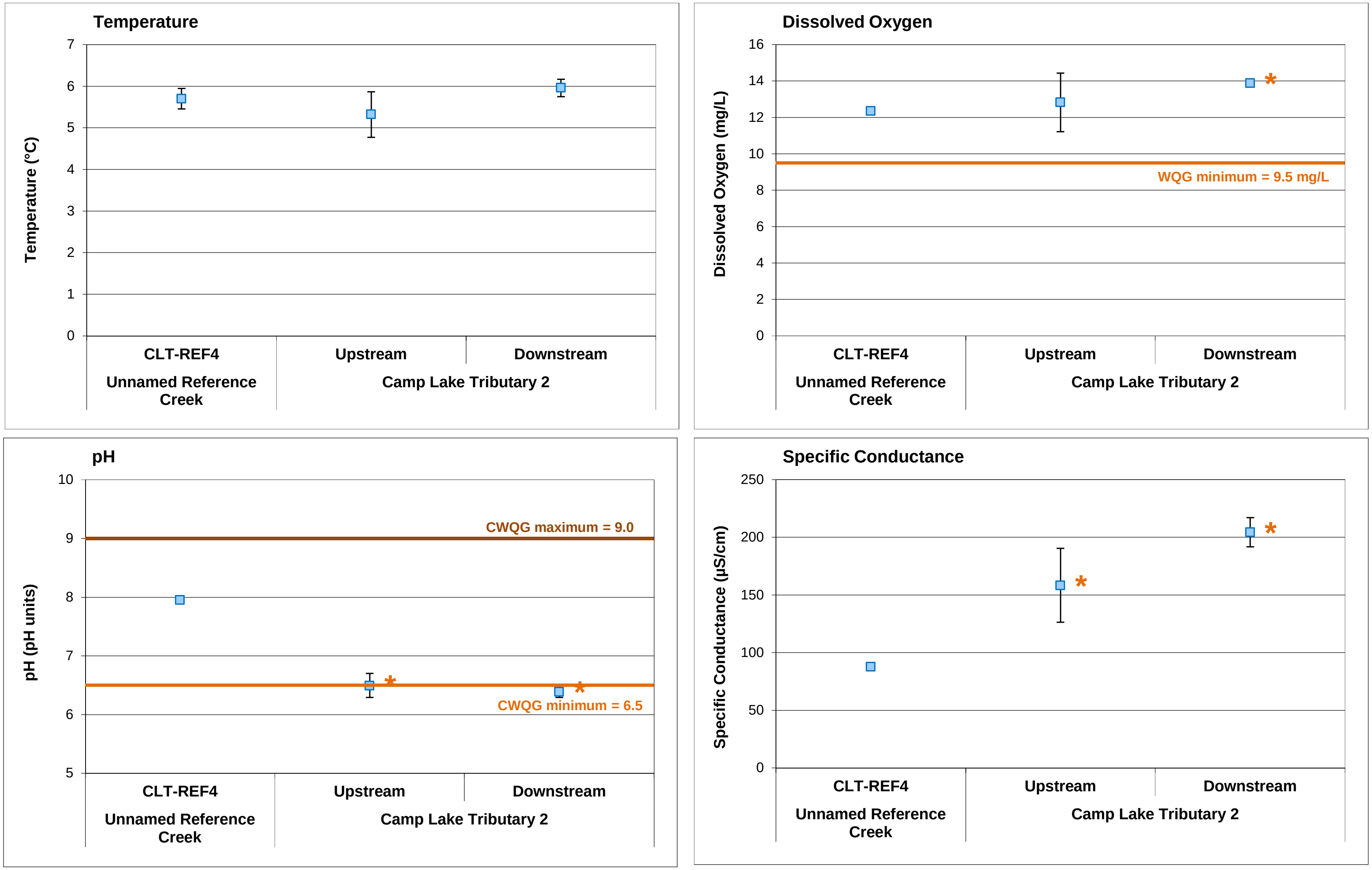

Figure 3.6: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Camp Lake Tributary 2 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Note: An asterisk (*) next to data point indicates mean value differs significantly from the Unnamed Reference Creek mean.

3.2.2 Phytoplankton

Chlorophyll-a concentrations at CLT2 (Station KO-01) were slightly lower than average concentrations observed at the reference creeks during spring and summer sampling events, but higher than concentrations at the reference creeks during the fall sampling event in 2018 (Figure 3.3). Concentrations of nutrients, including total ammonia, nitrate, and total phosphorus, showed no marked differences between CLT2 and the reference creek stations during the fall sampling event (Appendix Tables C.14 and C.15), and therefore the occurrence of higher chlorophyll-a concentrations within lower CLT2 in fall 2018 did not appear to be related to a nutrient enrichment influence. Notably, chlorophyll-a concentrations were well below the AEMP benchmark of 3.7 µg/L during each of the 2018 sampling events at CLT2. Low phytoplankton productivity, indicative of oligotrophic conditions, was also suggested at CLT2 based on comparison of chlorophyll-a concentrations to Dodds et al (1998) trophic status classification for creek environments. This productivity classification was supported by a WQG categorization of ultra-oligotrophic to oligotrophic based on mean aqueous total phosphorus concentrations below 10 µg/L at CLT2 during all spring, summer, and fall sampling events (Table 3.1; Appendix Table C.14). Temporal comparisons indicated higher chlorophyll-a concentrations in 2018 compared to the mine baseline period and, similar to the CLT1 lower main stem, higher chlorophyll-a concentrations in 2017 and 2018 compared to the two previous years of commercial mine operation, at lower CLT2 during fall sampling (Figure 3.4). For the reasons indicated above, higher chlorophyll-a concentrations at CLT2 in fall 2018 did not appear to be associated with a mine-related change in nutrient concentrations over time, and thus may have simply reflected natural seasonal/temporal variation in chlorophyll-a concentrations

3.2.3 Benthic Invertebrate Community

At Camp Lake Tributary 2 (CLT2), sampling was conducted upstream and downstream of the Tote Road (areas CLT2 US and CLT2 DS, respectively) to assess potential mine-related influences to the benthic invertebrate community. Benthic invertebrate density and richness were significantly lower at the CLT2 study areas compared to Unnamed Reference Creek, the differences of which were generally ecologically meaningful (Table 3.3). Differences in community composition were also indicated between the CLT2 and Unnamed Reference Creek study areas based on significantly higher Bray-Curtis Index at both CLT2 study areas (Table 3.3). Similar to CLT1, the key differences in community dominant group composition included significantly lower relative abundance of mayflies, roundworms, and blackflies, and conversely, a significantly higher relative abundance of Chironomidae, at the CLT2 study areas compared to

Table 3.3: Benthic Invertebrate Community Metric Statistical Comparison Results among Camp Lake Tributary 2 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2018

Metric	**Data Transform-ation**	**Overall 3-Area Comparison**		**Pair-wise, *post hoc* comparisons[a]**				
		Significant Difference Among Areas?	**P-value**	**Study Area**	**Mean**	**Standard Deviation (SD)**	**Magnitude of Difference (REF_{SD})**	**Pairwise Comparison**
Density (No. per m^2)	fourth root	YES	< 0.001	Reference Creek	526	152	-	a
				CLT2 Upstream	169	66	-2.3	b
				CLT2 Downstream	128	53	-2.6	b
Richness (No. of Taxa)	none	YES	0.002	Reference Creek	19.8	3.0	-	a
				CLT2 Upstream	15.0	3.7	-1.6	b
				CLT2 Downstream	11.2	1.9	-2.8	b
Simpson's Evenness	rank	NO	0.185	Reference Creek	0.960	0.011	-	a
				CLT2 Upstream	0.923	0.046	-3.3	a
				CLT2 Downstream	0.904	0.091	-5.0	a
Bray-Curtis Index	fourth root	YES	< 0.001	Reference Creek	0.208	0.092	-	a
				CLT2 Upstream	0.661	0.084	4.9	b
				CLT2 Downstream	0.713	0.093	5.5	b
Nemata (% of community)	square root	YES	0.028	Reference Creek	6.0	2.0	-	a
				CLT2 Upstream	1.1	1.6	-2.5	b
				CLT2 Downstream	2.7	3.0	-1.7	a,b
Oligochaeta (% of community)	rank	NO	0.266	Reference Creek	0.0	0.0	-	a
				CLT2 Upstream	2.4	3.4	-2.7	a
				CLT2 Downstream	1.1	2.5	-1.9	a
Hydracarina (% of community)	square root	NO	0.808	Reference Creek	3.3	1.3	-	a
				CLT2 Upstream	4.7	4.4	1.1	a
				CLT2 Downstream	3.5	4.0	0.2	a
Ephemeroptera (% of community)	rank	YES	0.001	Reference Creek	5.7	2.1	-	a
				CLT2 Upstream	0.0	0.0	-2.7	b
				CLT2 Downstream	0.0	0.0	-2.7	b
Chironomidae (% of community)	log	YES	< 0.001	Reference Creek	60.4	4.5	-	a
				CLT2 Upstream	80.2	3.9	4.4	b
				CLT2 Downstream	84.1	6.0	5.3	b
Metal Sensitive Chironomids (% of community)	square root	NO	0.364	Reference Creek	12.4	4.2	-	a
				CLT2 Upstream	9.5	5.0	-0.7	a
				CLT2 Downstream	8.0	7.0	-1.0	a
Simuliidae (% of community)	none	YES	< 0.001	Reference Creek	15.9	4.6	-	a
				CLT2 Upstream	6.6	5.5	-2.0	b
				CLT2 Downstream	0.9	2.1	-3.3	b
Tipulidae (% of community)	none	NO	0.908	Reference Creek	2.8	1.5	-	a
				CLT2 Upstream	2.3	1.5	-0.3	a
				CLT2 Downstream	2.6	2.4	-0.1	a
Collector-Gatherer FFG (% of community)	none	YES	0.030	Reference Creek	71.5	4.0	-	a
				CLT2 Upstream	73.2	8.6	0.4	a
				CLT2 Downstream	83.4	6.5	3.0	b
Filterer FFG (% of community)	none	YES	< 0.001	Reference Creek	16.0	4.5	-	a
				CLT2 Upstream	6.6	5.5	-2.1	b
				CLT2 Downstream	0.9	2.1	-3.3	b
Shredder FFG (% of community)	none	YES	< 0.095	Reference Creek	4.8	2.8	-	a
				CLT2 Upstream	12.9	5.3	2.9	b
				CLT2 Downstream	7.7	7.3	1.0	a,b
Clinger HPG (% of community)	square root	YES	0.036	Reference Creek	22.6	5.0	-	a
				CLT2 Upstream	24.2	8.2	0.3	a
				CLT2 Downstream	12.5	6.9	-2.0	b
Sprawler HPG (% of community)	none	YES	0.023	Reference Creek	66.2	5.0	-	a
				CLT2 Upstream	69.6	6.5	0.7	a
				CLT2 Downstream	79.5	8.4	2.6	b
Burrower FFG (% of community)	log	YES	0.026	Reference Creek	11.2	1.9	-	a
				CLT2 Upstream	6.2	2.5	-2.6	b
				CLT2 Downstream	8.0	2.8	-1.7	a,b

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Blue shaded values indicate significant difference (ANOVA p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference between the mine-exposed area and reference area was ecologically meaningful.

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

the reference creek based on magnitudes of difference outside of the CES_{BIC} of ±2 SD_{REF} (Table 3.3). However, no significant difference in the relative abundance of metal-sensitive chironomids was indicated between the CLT2 and reference creek study areas (Table 3.3), suggesting that the community composition differences between watercourses were unlikely related to metal concentrations. Notably, no significant differences in density, richness, Simpson's Evenness, or the relative abundance of dominant invertebrate groups were indicated between the CLT2 upstream and downstream study areas, indicating no substantial influences to the benthic invertebrate community of CLT2 associated with the Tote Road water crossing (CV225; Table 3.3).

Temporal comparisons indicated no consistent ecologically significant differences in any benthic invertebrate community endpoints at the CLT2 upstream and downstream study areas during years of mine operation (2015 to 2018) compared to 2007 baseline data with the exception of Simpson's Evenness (Figure 3.7; Appendix Tables F.14 and F.15). Because high Simpson's Evenness is normally associated with a diverse, healthy benthic invertebrate community, the occurrence of significantly higher Simpson's Evenness at the CLT2 upstream study area from 2015 to 2018 compared to 2007 was not consistent with an adverse influence related to recent mine operations. In turn, this suggested no adverse mine-related influences on the benthic invertebrate community of CLT2 since the commencement of commercial mine operations in 2015.

3.2.4 Integrated Summary

Potential mine-related effects on water quality of CLT2 in 2018 included slightly elevated conductivity and sulphate concentrations compared to average reference area conditions. However, water chemistry at CLT2 was comparable between 2018 and the mine baseline period, suggesting that natural regional variability in water chemistry among lotic environments likely accounted for differing conductivity and sulphate concentrations between CLT2 and the reference creek stations. Aqueous concentrations of all parameters were consistently well below applicable WQG and site-specific AEMP benchmarks at CLT2 in all years of mine operation from 2015 to 2018.

Chlorophyll-a concentrations at CLT2 varied seasonally from those observed at reference creek stations in 2018, but were consistently well below the AEMP benchmark and were indicative of oligotrophic conditions characteristic of Arctic watercourses. Although chlorophyll-a concentrations at CLT2 were higher in 2018 than during the mine baseline period, nutrient concentrations within CLT2 were comparable between 2018 and the mine baseline studies. This suggested that the differences in chlorophyll-a concentrations between 2018 and the baseline studies likely reflected natural seasonal/temporal variation. The benthic invertebrate community

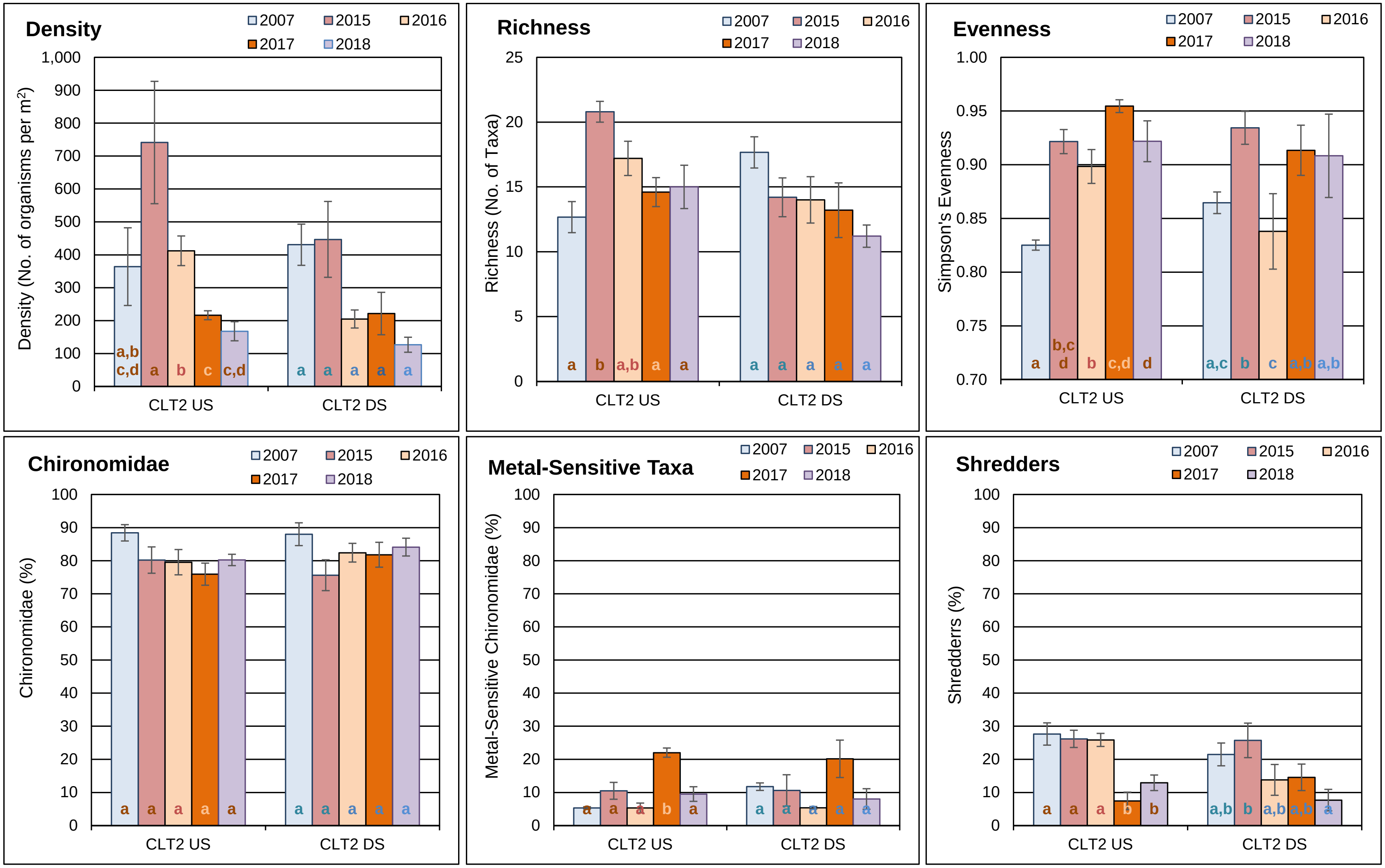

Figure 3.7: **Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Camp Lake Tributary 2 Study Areas among Mine Baseline (2007) and Operational (2015 to 2018) Periods**

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

of CLT2 exhibited significantly lower density and richness, and significantly different composition, than Unnamed Reference Creek in 2018. However, no significant difference in the relative abundance of metal-sensitive chironomids was indicated at CLT2 compared to the reference creek in 2018. In addition, no ecologically significant differences in any benthic invertebrate community endpoints were consistently indicated between the mine operational and baseline studies at CLT2 with the exception of higher Simpson's Evenness following commencement of commercial mine operation. Because high Simpson's Evenness is normally associated with a more diverse, healthy benthic invertebrate community, the occurrence of significantly higher Simpson's Evenness at the CLT2 in years of mine operation was not indicative of an adverse influence related to the mine. Notably, no significant differences in benthic invertebrate community endpoints occurred between the CLT2 upstream and downstream study areas, indicating no substantial influences to the benthic invertebrate community of CLT2 associated with the Tote Road water crossing (CV225). Overall, similar to the findings of the three previous CREMP studies, the chlorophyll-a and benthic invertebrate community data indicated no adverse mine-related effects to biota of CLT2 since commercial mine operations commenced in 2015.

3.3 Camp Lake (JLO)

3.3.1 Hydraulic Retention Time

A hydraulic retention time of 416 ± 184 days was estimated by Minnow (2018) for Camp Lake using mean annual watershed runoff extrapolated from CLT1 and CLT2 flow monitoring stations and a lake volume of 27.5 million cubic metres.

3.3.2 Water Quality

In situ water quality profiles conducted at Camp Lake showed no substantial spatial differences in water temperature, dissolved oxygen, pH or specific conductance with progression from the CLT1 inlet to the lake outlet during any of the winter, summer or fall seasonal sampling events in 2018 (Appendix Figures C.3 to C.6). The 2018 Camp Lake water column profiles indicated a slight increase in temperature from surface to bottom (i.e., <2˚C) during the winter sampling event, but no changes in temperature with depth, including no indication of thermal stratification, during the summer and fall sampling events (Figure 3.8). The average temperature profile at Camp Lake closely mirrored that observed at Reference Lake 3 for the summer and fall sampling events in 2018 (Figure 3.8). No significant differences in water temperature near the bottom of the water column were indicated between Camp Lake and Reference Lake 3 for littoral and profundal stations sampled during August 2018 biological monitoring (Figure 3.9; Appendix Tables C.24 and C.25).

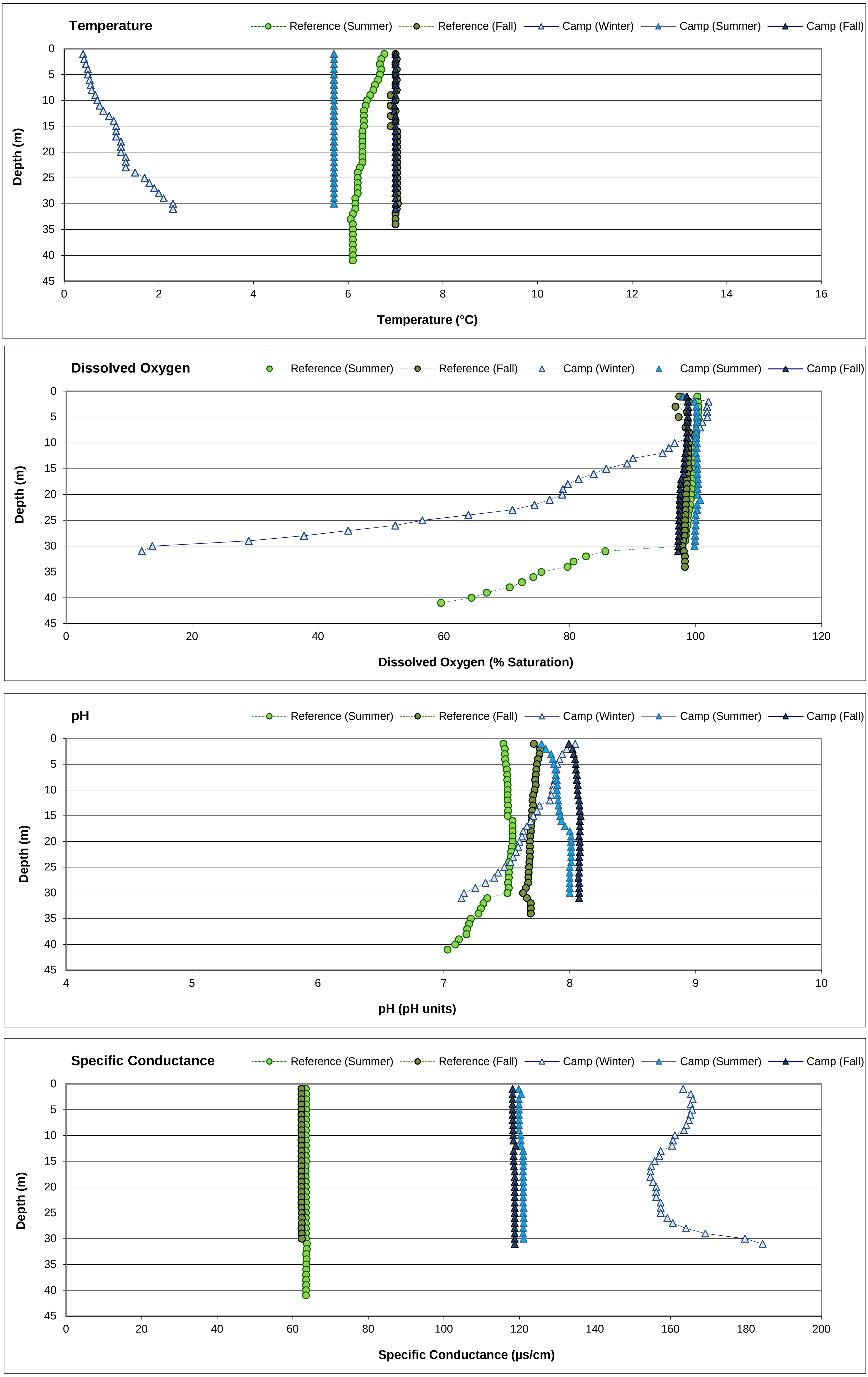

Figure 3.8: Average *In Situ* Water Quality with Depth from Surface at Camp Lake (JLO) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2018

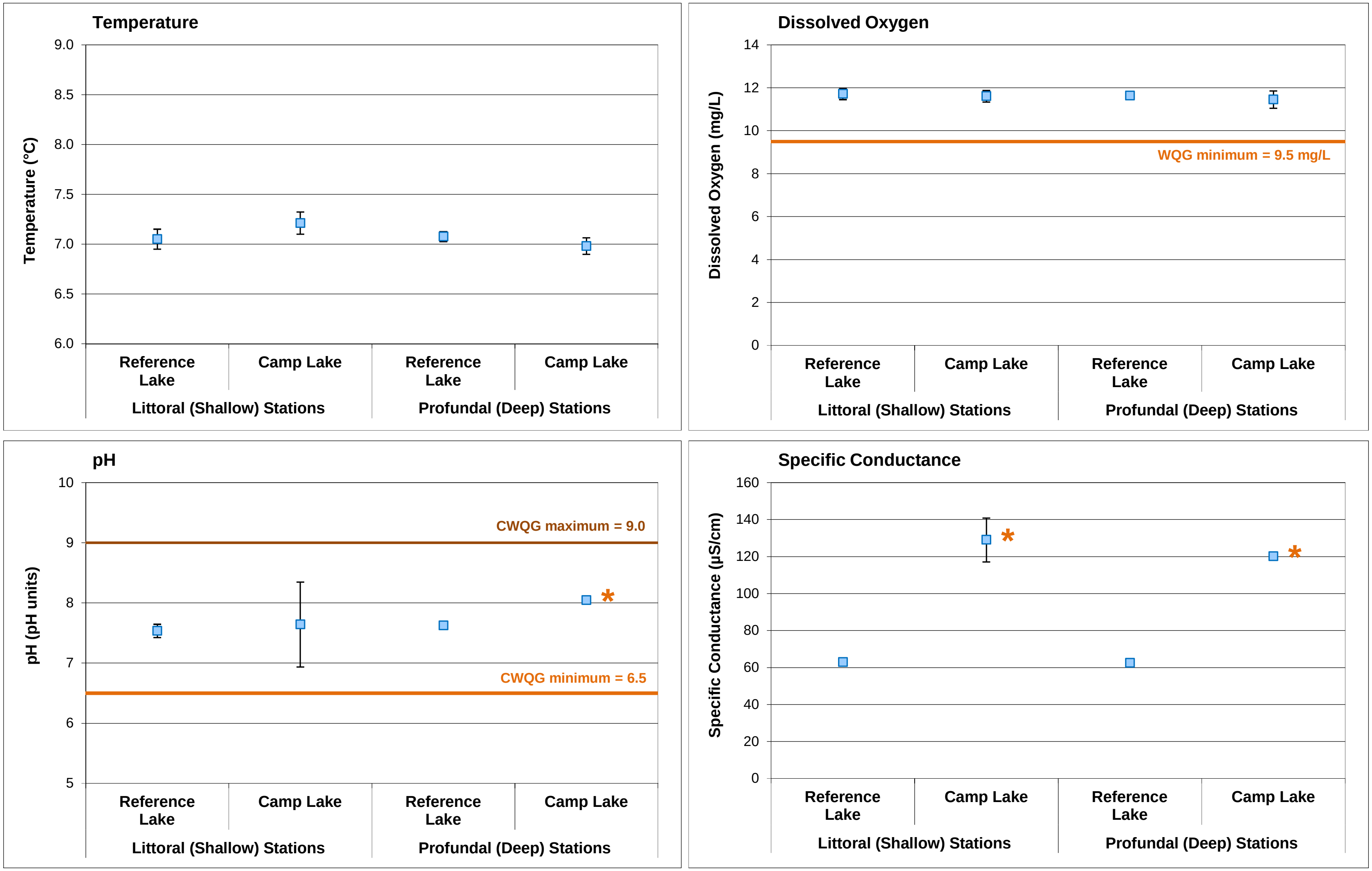

Figure 3.9: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Camp Lake (JLO) and Reference Lake 3 (REF3) Littoral and Profundal Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Note: An asterisk (*) next to data point indicates mean value differs significantly from the Reference Lake 3 mean for the respective littoral or profundal station type.

Dissolved oxygen profiles conducted at Camp Lake in 2018 showed declining saturation levels with increased depth beginning at approximately 5 m below surface in the winter, but otherwise showed no appreciable changes from surface to bottom, and generally reflected the DO profiles observed at Reference Lake 3 for comparable depths, during summer and fall 2018 (Figure 3.8). The Camp Lake DO profiles from 2018 were comparable to those observed in winter, summer, and fall from 2015 to 2017 at Camp Lake. Dissolved oxygen levels near the bottom of the water column at littoral and profundal sampling depths of Camp Lake were generally fully saturated, and did not differ significantly from those at Reference Lake 3, during August 2018 biological sampling (Figure 3.9; Appendix Table C.25). In addition, dissolved oxygen concentrations/saturation levels at Camp Lake were well above the WQG minimum for the protection of sensitive stages of cold water biota (i.e., 9.5 mg/L or 54%, respectively) during all seasonal sampling events in 2018 except at water depths greater than approximately 25 m in winter (Figures 3.8 and 3.9). This suggested that dissolved oxygen concentrations were not likely limiting to biota at Camp Lake for the majority of the year.

In situ profiles of pH and specific conductance showed no marked step changes from the surface to bottom of the Camp Lake water column, indicating the absence of any chemical stratification (Figure 3.8). Although the bottom pH at profundal stations of Camp Lake was significantly higher than at Reference Lake 3 during the August 2018 biological study (Appendix Table C.25), the mean incremental difference between lakes was small (i.e., 0.5 pH units) and all pH values were consistently within WQG limits (Figure 3.9), suggesting that the pH difference between lakes was not ecologically meaningful. Specific conductance was consistently higher at Camp Lake than at Reference Lake 3 in summer and fall 2018, the difference of which was shown to be significant during the August 2018 biological study (Figures 3.8 and 3.9), and suggested a mine-related influence on water quality. Secchi depth readings, which served as a proxy for water clarity, were significantly lower (i.e., shallower) at Camp Lake compared to Reference Lake 3 during the 2018 August biological study (Appendix Table C.25; Appendix Figure C.7). No spatial gradient in Secchi depth readings was apparent with progression from the CLT inlet to the lake outlet stations in fall 2018 at Camp Lake (Appendix Table C.23).

Water chemistry data collected at Camp Lake in 2018 showed no distinct spatial differences with progression from the CLT inlets to the lake outlet during any of the winter, summer or fall sampling events (Table 3.4; Appendix Table C.26), suggesting that the lake waters were well mixed laterally. A slight elevation (i.e., 3- to 5-fold higher) in turbidity and concentrations of chloride, total aluminum, total manganese, and total uranium was evident at Camp Lake compared to Reference Lake 3 during the summer and/or fall 2018 sampling events (Table 3.4; Appendix Table C.27). Of the three metals indicated above, concentrations of dissolved manganese and

Table 3.4: Water Chemistry at Camp Lake (JLO) and Reference Lake 3 (REF3) Monitoring Stations[a], Mary River Project CREMP, August 2018

Parameters		Units	Water Quality Guideline (WQG)[b]	AEMP Benchmark[c]	Reference Lake 3 Average (n = 3)	Camp Lake Stations					
						JL0-02	JL0-10	JL0-01	JL0-07	JL0-09	J0-01 Camp Lake Outlet
					Fall 2018	21-Aug-18	21-Aug-18	20-Aug-18	20-Aug-18	20-Aug-18	27-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	75	137	137	137	136	137	141
	pH (lab)	pH	6.5 - 9.0	-	7.65	8.05	8.04	8.05	8.06	8.04	8.10
	Hardness (as CaCO$_3$)	mg/L	-	-	35	70	70	68	70	69	70
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	46	60	52	78	74	83	90
	Turbidity	NTU	-	-	0.51	0.60	0.52	0.77	0.73	0.90	0.51
	Alkalinity (as CaCO$_3$)	mg/L	-	-	33	62	60	58	58	57	63
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.044	<0.020	<0.020	0.028	0.026	<0.020	0.044
	Nitrate	mg/L	13	13	<0.020	0.025	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.16	0.15	0.25	<0.15	<0.15	0.16	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.9	2.6	2.4	2.5	2.5	2.5	2.2
	Total Organic Carbon	mg/L	-	-	3.8	2.7	2.6	2.5	2.5	2.6	2.8
	Total Phosphorus	mg/L	0.020^{α}	-	0.0049	0.0041	0.0041	0.0053	0.0036	0.0041	0.0030
	Phenols	mg/L	0.004^{α}	-	0.0011	0.0019	<0.0010	0.0015	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.3	3.8	3.7	3.7	3.7	3.7	3.8
	Sulphate (SO$_4$)	mg/L	218^{β}	218	3.7	3.9	3.8	3.8	3.8	3.8	3.9
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0043	0.0129	0.0068	0.0131	0.0096	0.0098	0.0077
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0064	0.0068	0.0070	0.0067	0.0068	0.0068	0.0071
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	7.2	14.0	13.6	13.5	13.2	13.6	14.0
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.00076	0.00093	0.00076	0.00087	0.00087	0.00094	0.00083
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Magnesium (Mg)	mg/L	-	-	4.3	8.3	8.8	8.4	8.3	8.3	8.3
	Manganese (Mn)	mg/L	0.935^{β}	-	0.00064	0.00181	0.00120	0.00175	0.00170	0.00187	0.00208
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00014	0.00032	0.00032	0.00031	0.00030	0.00031	0.00038
	Nickel (Ni)	mg/L	0.025	0.025	0.00050	0.00061	0.00056	0.00062	0.00058	0.00060	0.00067
	Potassium (K)	mg/L	-	-	0.9	1.2	1.3	1.2	1.2	1.2	1.1
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.42	0.34	0.32	0.32	0.33	0.32	0.33
	Sodium (Na)	mg/L	-	-	0.9	1.7	1.8	1.6	1.6	1.6	1.5
	Strontium (Sr)	mg/L	-	-	0.0081	0.0106	0.0102	0.0104	0.0102	0.0105	0.0117
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)	mg/L	0.015	-	0.00026	0.00093	0.00076	0.00085	0.00085	0.00084	0.00087
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Values presented are averages from samples taken from the surface and the bottom of the water column at each station.

[b] Canadian Water Quality Guideline (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[c] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data (2006 - 2013) specific to Camp Lake.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the applicable AEMP benchmark.

dissolved uranium also showed slight elevation at Camp Lake compared to Reference Lake 3 in 2018 suggesting that the elevation in manganese and uranium concentrations at Camp Lake was mine-related. In contrast, because dissolved aluminum concentrations were not elevated at Camp Lake compared to Reference Lake 3, the elevation in total aluminum concentrations at Camp Lake was likely associated with suspended particulate matter as reflected in higher turbidity (Appendix Tables C.26 and C.27). Total aluminum showed a moderately strong significant positive correlation with turbidity from the Camp Lake 2018 water chemistry data whereas dissolved aluminum did not (r = 0.67 and -0.10, respectively; Appendix Table C.28), supporting the notion that aluminum was associated with suspended particulate material in Camp Lake and thus was unlikely to be bioavailable. Concentrations of all parameters were below applicable WQG and AEMP benchmarks at Camp Lake during all sampling events in 2018 with the exception of phenol and total phosphorus concentrations, each of which were above respective WQG near the bottom at one or both of Stations JLO-09 and JLO-10 in winter (Appendix Table C.26). These stations are relatively shallow (i.e., <15 m deep) and showed no substantial change in profile characteristics between surface and bottom during the winter sampling event (Appendix Figures C.3 to C.6), and therefore the reason for higher concentrations of phenol and total phosphorus at the bottom of the water column of these stations in winter was unclear (e.g., no occurrence of low DO concentrations, low pH, or high specific conductance that might facilitate parameter migration from sediments to overlying waters).

Temporal comparisons of Camp Lake water chemistry data indicated that, of the parameters shown to be elevated at CLT1 in fall 2018, most showed near consistent increases over the mine baseline (2005 to 2013) and/or mine operational period (2015 to 2018), including conductivity, hardness, and total concentrations of chloride, manganese, molybdenum, sodium, strontium, sulphate, and uranium (Figure 3.10; Appendix Figure C.8). Other parameters, including iron, nitrate, TDS, and TKN, showed no consistent direction of change between the mine baseline and operational periods. Total aluminum concentrations showed a marked step increase at four of the five Camp Lake stations in fall 2018 compared to concentrations reported during mine baseline and previous years of mine operation (Figure 3.10), the reason for which was unclear. Notably, concentrations of all of the parameters indicated above have consistently been well below WQG and AEMP benchmarks through all years of mine construction and operation at Camp Lake (Figure 3.10; Appendix Figure C.8).

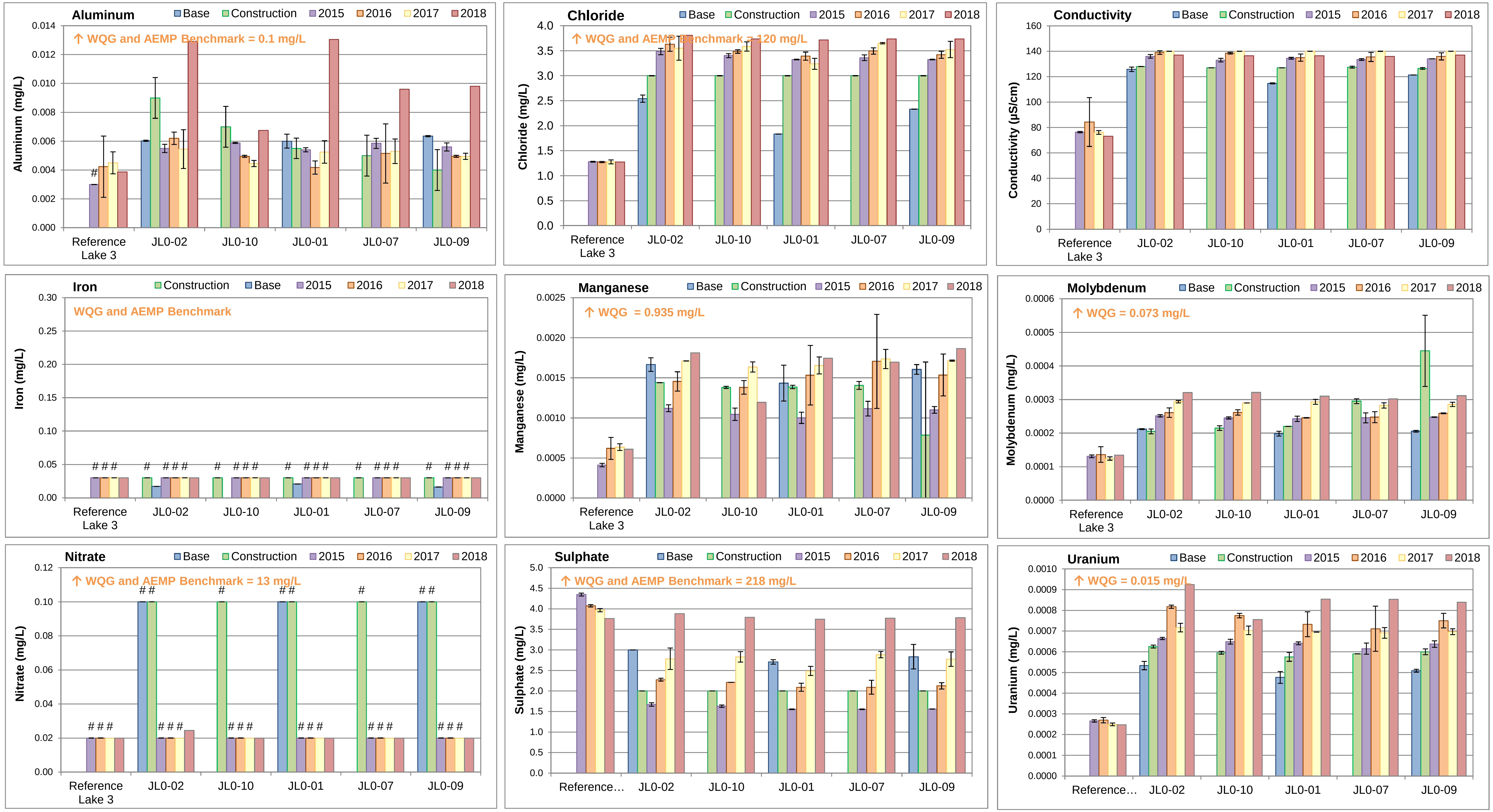

Figure 3.10: Temporal Comparison of Water Chemistry at Camp Lake (JLO) for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2018) Periods during Fall

Notes: Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Camp Lake.

3.3.3 Sediment Quality

Surficial sediment (i.e., top 2 cm) collected at the Camp Lake coring stations in 2018 was characterized primarily by silt loam with low total organic carbon (TOC) content, except at Stations JLO-12 and JLO-16 where sand constituted the predominant substrate material (Figure 3.11; Appendix Table D.6). Surficial sediment at littoral stations of Camp Lake contained significantly less clay content, but otherwise showed similar particle size, than at Reference Lake 3 (Appendix Table D.7). However, TOC content in sediment at littoral and profundal stations of Camp Lake was significantly lower than at Reference Lake 3 (Figure 3.11; Appendix Table D.7). A surficial and/or sub-surface layer of oxidized material (likely iron hydroxide or oxy-hydroxides), visible as reddish-orange to orange-brown substrate, was commonly observed in sediments of Camp Lake (Appendix Tables D.5 and D.6). Similar observations of oxidized material were made at Reference Lake 3 (Appendix Tables D.1 and D.2), suggesting the natural occurrence of iron (oxy)hydroxides in the sediment of lakes within the mine local study area. Substrates of Camp Lake exhibited minor, sporadic blackening at sediment depths greater than 2 cm at some stations, suggesting occasional incidence of reducing conditions within substrates of the lake. However, no strongly defined redox boundaries were identified visually, and no noticeable sulphidic odours potentially associated with reducing sediment conditions were detected at Camp Lake littoral and profundal stations in 2018 (Appendix Tables D.5 and D.6). Qualitative observations suggestive of reducing sediment conditions were similar between Camp Lake and Reference Lake 3 in 2018 (Appendix Tables D.1, D.2, D.5 and D.6), which indicated that factors leading to reduced sediment conditions were comparable between lakes.

No spatial gradients in sediment metal concentrations were evident with progression from stations located nearest to the CLT1 inlet to those located near the outlet of Camp Lake in 2018, although concentrations of a number of metals were higher at stations located in the half of the lake located closest to the CLT1 inlet (Appendix Table D.7). Arsenic and manganese concentrations were slightly elevated (i.e., 3- to 5-fold higher) in sediment at the single Camp Lake littoral station (i.e., Station JLO-02) compared to respective average concentrations in sediment at Reference Lake 3 littoral stations (Table 3.5; Appendix Table D.8). Iron, manganese, and nickel concentrations were above respective SQG, and arsenic, iron, nickel, and phosphorus concentrations were above respective AEMP benchmarks, in sediment at the Camp Lake littoral station (Table 3.5). Of these metals, the average concentration of iron was also above SQG, and the average concentration of copper was above the Camp Lake AEMP benchmark, in littoral sediment at Reference Lake 3 (Table 3.5). Because Camp Lake littoral station JLO-02 is located near the inlet from CLT1, this suggested that mine-influenced flow from this tributary potentially contributed to elevation of the metals indicated above in sediment at this location. Metal concentrations in profundal sediment of Camp Lake were comparable to those of Reference Lake 3 in 2018

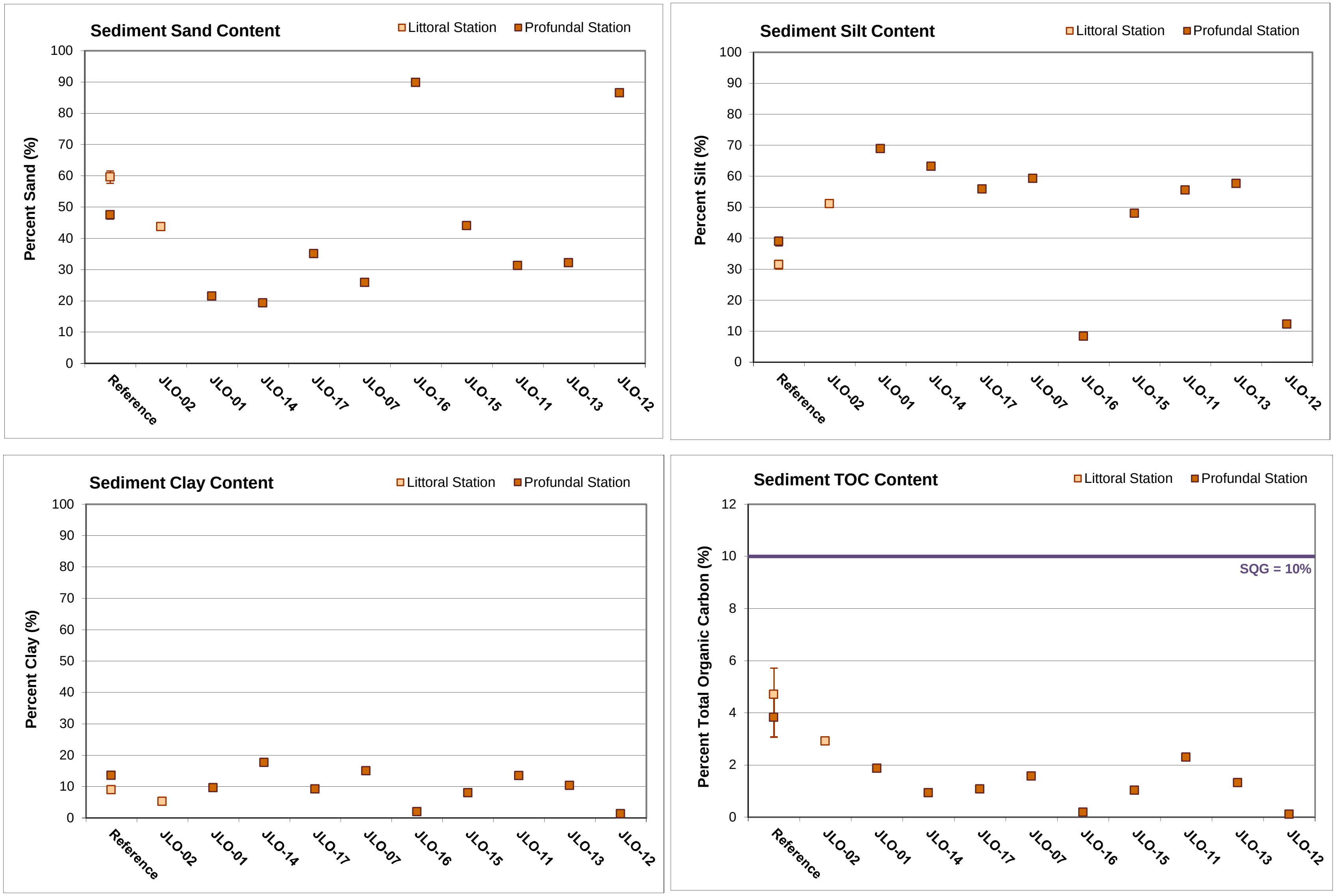

Figure 3.11: **Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Camp Lake (JLO) Sediment Monitoring Stations and to Reference Lake 3 Averages (mean ± SE), Mary River Project CREMP, August 2018**

Table 3.5: Sediment Total Organic Carbon and Metal Concentrations at Camp Lake (JLO) and Reference Lake 3 (REF3) Sediment Monitoring Stations, Mary River Project CREMP, August 2018

Analyte		Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Littoral Stations		Profundal Stations	
					Reference Lake (n = 5)	Camp Lake (n = 1)	Reference Lake (n = 5)	Camp Lake (n = 9)
					Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error
Total Organic Carbon		%	10^{α}	-	4.70 ± 1.01	2.91 ± 0.52	3.82 ± 0.75	1.15 ± 0.24
Metals	Aluminum (Al)	mg/kg	-	-	17,880 ± 1,993	18,600 ± 0	24,420 ± 3,494	16,447 ± 1,992
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	0.10 ± 0.00	<0.10 ± 0.00	<0.10 ± 4.90654E-18
	Arsenic (As)	mg/kg	17	5.9	5.25 ± 0.95	***9.62*** ± 0.00	***6.07*** ± 0.78	4.45 ± 0.69
	Barium (Ba)	mg/kg	-	-	133 ± 25	164 ± 0	152 ± 23	70 ± 10
	Beryllium (Be)	mg/kg	-	-	0.68 ± 0.08	0.89 ± 0.00	0.87 ± 0.12	0.85 ± 0.12
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0	0.30 ± 0.00	<0.20 ± 0.00	0.27 ± 0.02
	Boron (B)	mg/kg	-	-	13.9 ± 1.6	19.7 ± 0.0	15.6 ± 2.2	21.4 ± 2.7
	Cadmium (Cd)	mg/kg	3.5	1.5	0.195 ± 0.044	0.237 ± 0.000	0.197 ± 0.005	0.163 ± 0.027
	Calcium (Ca)	mg/kg	-	-	5,480 ± 804	5,310 ± 0	5,584 ± 664	5,553 ± 1,371
	Chromium (Cr)	mg/kg	90	98	58.9 ± 7.7	76.5 ± 0.0	77.3 ± 11.0	67.5 ± 6.9
	Cobalt (Co)	mg/kg	-	-	11.70 ± 1.40	25.60 ± 0.00	17.42 ± 2.37	16.51 ± 2.11
	Copper (Cu)	mg/kg	110^{α}	50	***73.9*** ± 11.0	49.6 ± 0.0	***96*** ± 14.7	39.9 ± 5.5
	Iron (Fe)	mg/kg	$40{,}000^{\alpha}$	52,400	46,700 ± 9,489	***65,100*** ± 0	50,900 ± 7,115	31,011 ± 3,413
	Lead (Pb)	mg/kg	91	35	16.4 ± 2.1	19.8 ± 0.0	19.5 ± 2.8	18.3 ± 2.5
	Lithium (Li)	mg/kg	-	-	26.0 ± 2.7	30.4 ± 0.0	36.1 ± 5.0	29.2 ± 3.9
	Magnesium (Mg)	mg/kg	-	-	11,104 ± 1,352	15,800 ± 0	15,394 ± 2,199	13,034 ± 872
	Manganese (Mn)	mg/kg	$1{,}100^{\alpha,\beta}$	4,370	640 ± 60	2,390 ± 0	1,279 ± 115	1,132 ± 222
	Mercury (Hg)	mg/kg	0.486	0.17	0.0433 ± 0.0111	0.0418 ± 0.0000	0.0650 ± 0.0121	0.0264 ± 0.0050
	Molybdenum (Mo)	mg/kg	-	-	3.84 ± 0.86	2.35 ± 0.00	2.57 ± 0.27	0.81 ± 0.11
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	72	42.9 ± 5.9	***83.4*** ± 0.0	53.8 ± 6.6	61.7 ± 6.2
	Phosphorus (P)	mg/kg	$2{,}000^{\alpha}$	1,580	1,305 ± 272	***1,650*** ± 0	1,188 ± 118	941 ± 91
	Potassium (K)	mg/kg	-	-	4,134 ± 469	4,100 ± 0	5,660 ± 796	4,010 ± 504
	Selenium (Se)	mg/kg	-	-	0.66 ± 0.14	0.48 ± 0.00	0.81 ± 0.15	0.31 ± 0.03
	Silver (Ag)	mg/kg	-	-	0.15 ± 0.02	0.11 ± 0.00	0.26 ± 0.04	0.12 ± 0.01
	Sodium (Na)	mg/kg	-	-	319.8 ± 43	185 ± 0	433 ± 62	196 ± 29
	Strontium (Sr)	mg/kg	-	-	12.2 ± 1.5	10.1 ± 0.0	13.8 ± 1.6	12.9 ± 1.7
	Thallium (Tl)	mg/kg	-	-	0.450 ± 0.063	0.564 ± 0.000	0.754 ± 0.091	0.429 ± 0.062
	Tin (Sn)	mg/kg	-	-	<2.0 ± 0.0	<2.0 ± 0.0	2.1 ± 0.0	<2.0 ± 0.0
	Titanium (Ti)	mg/kg	-	-	1,155 ± 132	1,180 ± 0	1,388 ± 163	925 ± 99
	Uranium (U)	mg/kg	-	-	13.4 ± 2.3	6.41 ± 0.0	24.5 ± 3.9	4.89 ± 0.7
	Vanadium (V)	mg/kg	-	-	58.3 ± 6.9	67.0 ± 0.0	72.7 ± 9.4	56.7 ± 6.7
	Zinc (Zn)	mg/kg	315	135	81.36 ± 10.2	66.4 ± 0.0	99 ± 14.2	51.5 ± 6.3
	Zirconium (Zr)	mg/kg	-	-	4.1 ± 0.8	6.4 ± 0.0	3.9 ± 0.5	5.2 ± 0.8

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2017)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013). The indicated values are specific to Camp Lake.

▨ Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

(Table 3.5; Appendix Table D.8). Although mean concentrations of iron and manganese were above respective SQG in profundal sediment at Camp Lake, mean concentrations of these metals were also above SQG in profundal sediment at Reference Lake 3 (Table 3.5) indicating naturally high concentrations of iron and manganese in sediment of lakes in the mine local study area. Concentrations of arsenic, copper, and nickel were above respective Camp Lake AEMP benchmarks in sediment at profundal stations located in the half of the lake located closest to the CLT1 outlet, but on average, were below the applicable benchmarks (Table 3.5; Appendix Table D.7). Of these latter metals, average concentrations of arsenic and copper were also above Camp Lake AEMP benchmarks in profundal sediment at Reference Lake 3 (Table 3.5), indicating naturally high concentrations of these metals in sediment of local study area lakes.

Temporal comparisons indicated that average metal concentrations in sediment at Camp Lake littoral and profundal stations were comparable between 2018 and the baseline period for each respective station type, the only exceptions of which were slightly higher (i.e., 3- to 5-fold greater) arsenic and manganese concentrations in sediment at the single Camp Lake littoral station in 2018 (Figure 3.12; Appendix Table D.8).[8] Average metal concentrations in sediment at Camp Lake littoral and profundal stations in 2018 were typically within the range of those observed from 2015 to 2017 (Figure 3.12). In addition, no pattern of consistently higher metal concentrations has occurred in Camp Lake sediment over the 2015 to 2018 period of mine operation (Figure 3.12). Overall, with the exception of a step-increase in arsenic and manganese concentrations shown at the littoral station closest to the CLT1 inlet to Camp Lake in 2015, and taking reference lake data into consideration, no substantial changes to sediment metal concentrations have been observed at Camp Lake littoral and profundal stations following the commencement of commercial mine operations in 2015.

3.3.4 Phytoplankton

Camp Lake chlorophyll-a concentrations showed no clear spatial gradients with distance from the CLT1 inlet to the lake outlet stations during any of the winter, summer, or fall sampling events in 2018 (Figure 3.13). Chlorophyll-a concentrations differed significantly among seasons at Camp Lake, with highest and lowest concentrations occurring during the fall and winter sampling events, respectively (Figure 3.13). On average, chlorophyll-a concentrations at Camp Lake were significantly higher than at Reference Lake 3 during the summer and fall sampling events (Appendix Tables E.7 and E.8), suggesting greater phytoplankton abundance at Camp Lake.

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[8] Reported sediment boron concentrations from 2015 to 2018 were considerably higher (i.e., 10- to 70-fold) than those reported during both the baseline and 2014 studies at all mine-exposed lakes. The lack of any distinct gradient in the magnitude of the elevation in boron concentrations among stations within each lake and among study lakes suggested that the stark contrast in boron concentrations between recent data and data collected prior to 2015 was likely due to laboratory-based analytical differences.

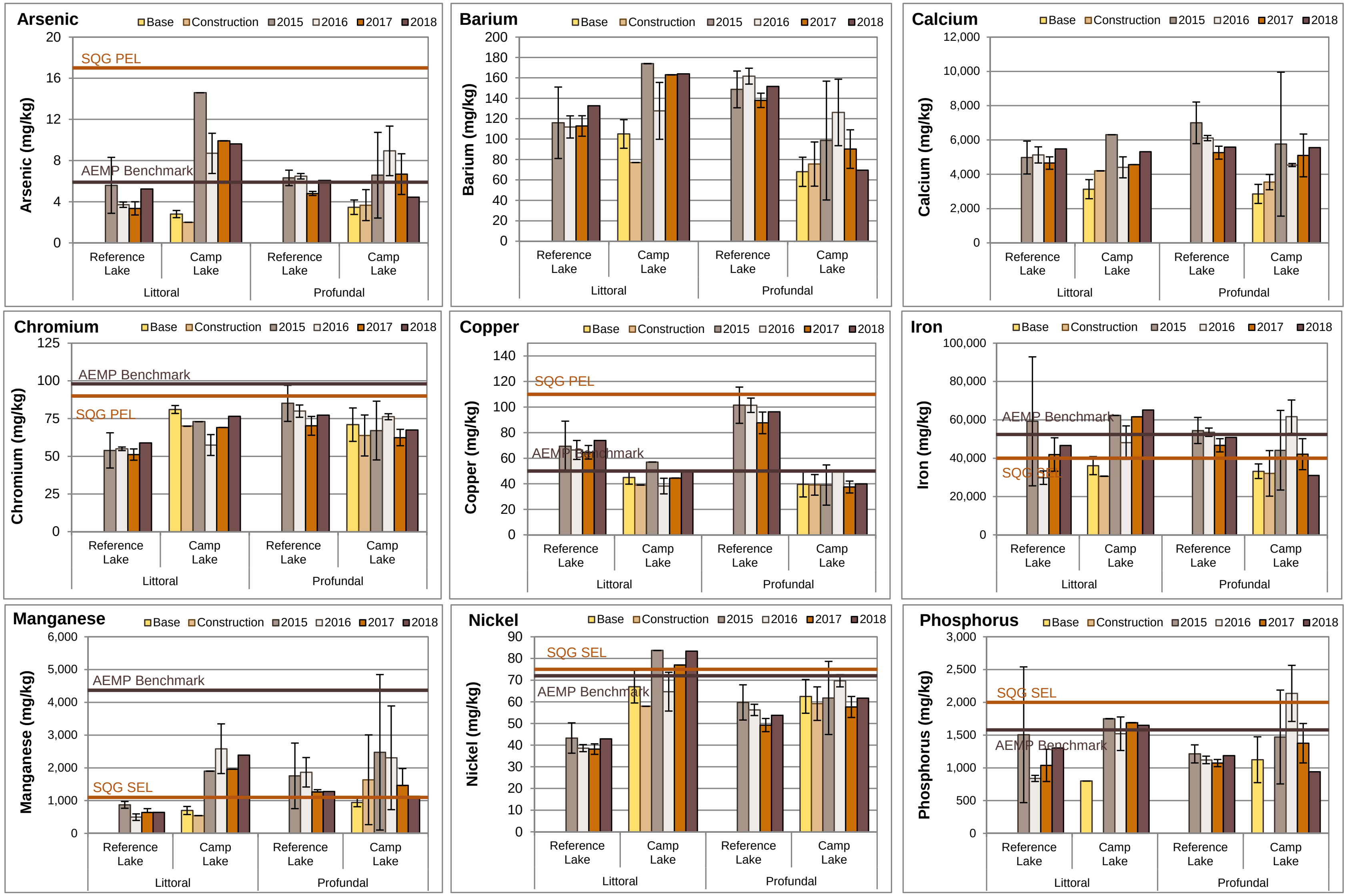

Figure 3.12: **Temporal Comparison of Sediment Metal Concentrations (mean ± SD) at Littoral and Profundal Stations of Camp Lake and Reference Lake 3 for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2018) Periods, Mary River Project CREMP, 2018**

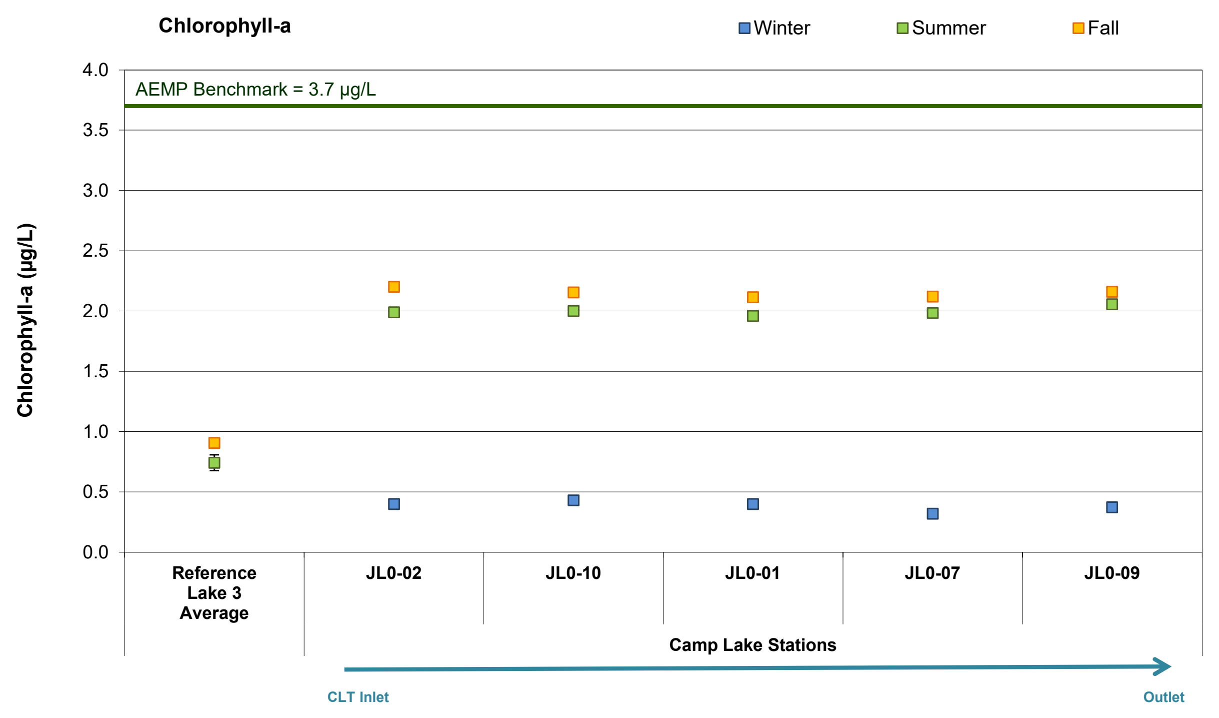

Figure 3.13: Chlorophyll-a Concentrations at Camp Lake (JLO) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2018

Notes: Values are averages of samples taken from the surface and the bottom of the water column at each station. Reference values represent mean ± standard deviation (n = 3). Reference Lake 3 was not sampled in winter 2018.

However, the Camp Lake chlorophyll-a concentrations were consistently well below the AEMP benchmark of 3.7 µg/L during all winter, summer, and fall sampling events in 2018 (Figure 3.13). Average chlorophyll-a concentrations at Camp Lake suggested relatively low phytoplankton abundance and an oligotrophic status based on comparison to Wetzel (2001) lake trophic classifications using chlorophyll-a concentrations. This trophic status classification was also consistent with an ultra-oligotrophic to oligotrophic CWQG categorization for Camp Lake based on mean aqueous total phosphorus concentrations below 10 µg/L during all 2018 sampling events (Table 3.4; Appendix Table C.26).

Temporal comparisons of the Camp Lake chlorophyll-a data did not indicate any consistent significant differences between years of mine construction (2014) and mine operation (2015 to 2018) for seasonal data collected in winter, summer, or fall (Figure 3.14). However, average chlorophyll-a concentrations were significantly higher during summer and fall sampling events in 2018 compared to the previous three years of commercial mine operation (Figure 3.14; Appendix Table E.9). No changes in nitrate concentrations were evident at Camp Lake among the four years of commercial mine operation (Figure 3.10), and therefore the occurrence of higher chlorophyll-a concentrations at Camp Lake in 2018 did not appear to be related to mine-related

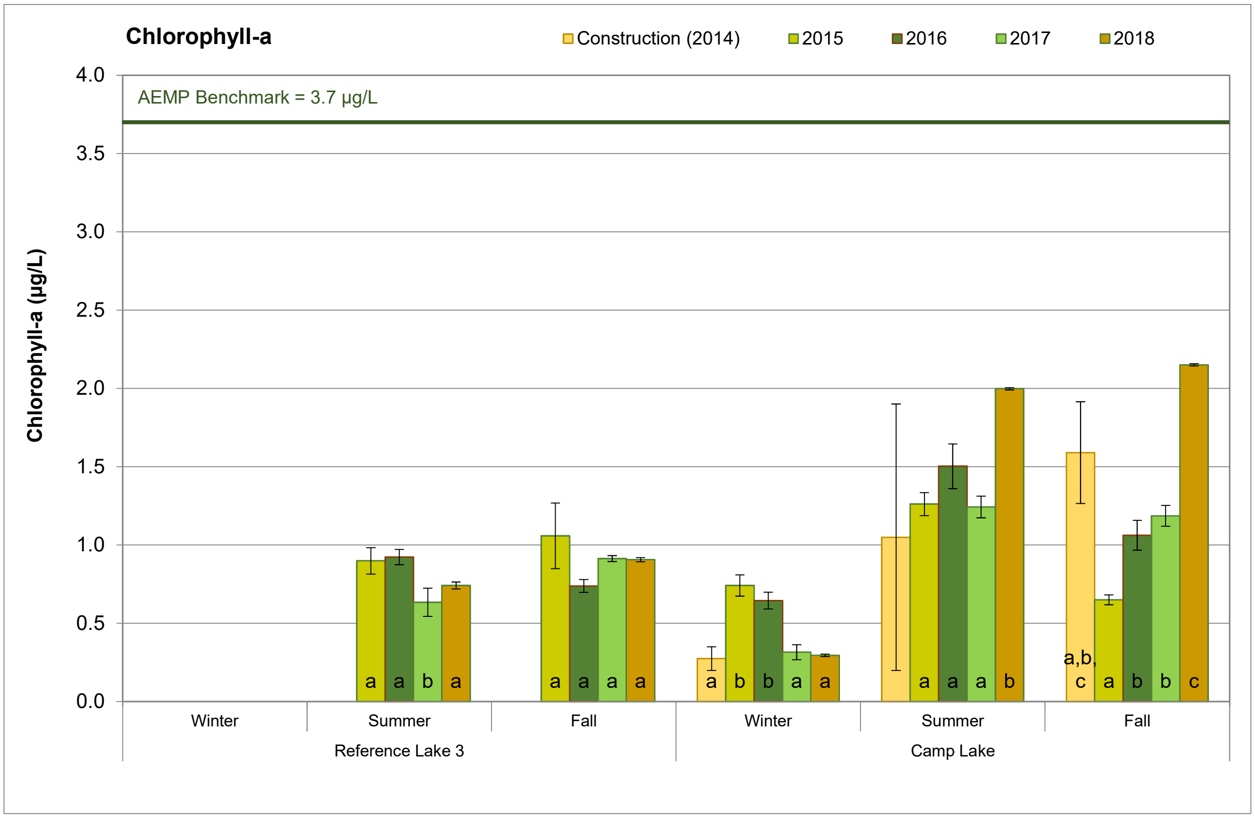

Figure 3.14: Temporal Comparison of Chlorophyll-a Concentrations Among Seasons between Camp Lake and Reference Lake 3 for Mine Construction (2014) and Operational (2015 to 2018) Periods (mean ± SE)

Note: Bars with the same letter at the base do not differ significantly between years for the applicable season.

nutrient inputs. No chlorophyll-a baseline (2005 to 2013) data are available for Camp Lake, precluding comparisons to conditions prior to the mine construction period.

3.3.5 Benthic Invertebrate Community

Benthic invertebrate density was significantly higher at littoral and profundal habitat of Camp Lake compared to like-habitat stations at Reference Lake 3 (Tables 3.6 and 3.7). For both habitat types, the magnitude of difference in density was ecologically meaningful based on a CES_{BIC} outside of ±2 SD_{REF}. Although no significant difference in richness was indicated between lakes at littoral stations, richness was significantly higher at Camp Lake profundal habitat compared to like-habitat at Reference Lake 3 by a magnitude outside of the CES_{BIC} of ±2 SD_{REF} (Tables 3.6 and 3.7). In addition to these differences, benthic invertebrate community structure differences were indicated between Camp Lake and Reference Lake 3 by significantly differing Bray-Curtis Index for both littoral and profundal habitat types (Tables 3.6 and 3.7). However, no ecologically meaningful differences in the relative abundance of any benthic invertebrate dominant groups

Table 3.6: Benthic Invertebrate Community Statistical Comparison Results between Camp Lake (JLO) and Reference Lake 3 for Littoral Habitat Stations, Mary River Project CREMP, August 2018

Metric	Statistical Test Results					Summary Statistics						
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis	Magnitude of Difference [a] (No. of SD)	Study Lake Littoral Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (Individuals/m^2)	none	YES	0.009	ANOVA	6.1	Reference Lake 3	1,045	258	116	696	1,000	1,391
						Camp Lake Littoral	2,623	1,006	450	1,200	3,043	3,539
Richness (Number of Taxa)	none	NO	0.102	ANOVA	1.5	Reference Lake 3	10.8	2.3	1.0	7.0	11.0	13.0
						Camp Lake Littoral	14.2	3.4	1.5	9.0	15.0	18.0
Simpson's Evenness (E)	log10	NO	0.337	ANOVA	0.3	Reference Lake 3	0.825	0.103	0.046	0.720	0.816	0.939
						Camp Lake Littoral	0.851	0.057	0.025	0.784	0.858	0.930
Bray-Curtis Index	square-root	YES	< 0.001	ANOVA	4.9	Reference Lake 3	0.313	0.092	0.041	0.178	0.358	0.394
						Camp Lake Littoral	0.768	0.046	0.020	0.704	0.758	0.821
Nemata (%)	square-root	NO	0.450	ANOVA	-0.5	Reference Lake 3	7.1	8.8	3.9	0.0	3.4	21.3
						Camp Lake Littoral	2.8	3.2	1.5	0.0	1.4	7.7
Ostracoda (%)	fourth-root	YES	< 0.001	ANOVA	-1.3	Reference Lake 3	23.9	18.3	8.2	3.4	20.6	53.3
						Camp Lake Littoral	0.4	0.6	0.3	0.0	0.0	1.5
Chironomidae (%)	none	YES	0.023	ANOVA	1.3	Reference Lake 3	66.9	22.2	10.0	35.5	73.8	91.4
						Camp Lake Littoral	95.4	4.0	1.8	89.1	95.6	99.0
Metal-Sensitive Chironomidae (%)	log10	YES	0.085	ANOVA	-1.0	Reference Lake 3	36.5	19.6	8.8	17.8	27.5	60.1
						Camp Lake Littoral	17.4	18.5	8.3	2.9	14.0	49.1
Collector-Gatherers (%)	none	NO	0.353	ANOVA	0.6	Reference Lake 3	55.6	19.0	8.5	33.0	57.5	79.2
						Camp Lake Littoral	67.3	18.6	8.3	39.4	66.7	89.9
Filterers (%)	log10	YES	0.094	ANOVA	-0.9	Reference Lake 3	33.9	18.7	8.4	15.5	24.9	56.6
						Camp Lake Littoral	16.7	17.8	7.9	2.9	13.6	47.1
Shredders (%)	none	YES	0.010	ANOVA	-1.6	Reference Lake 3	7.0	2.6	1.1	2.9	7.5	9.4
						Camp Lake Littoral	2.9	1.0	0.4	1.4	3.2	3.7
Clingers (%)	square-root	YES	0.018	ANOVA	-1.4	Reference Lake 3	36.1	18.4	8.2	17.1	26.9	58.3
						Camp Lake Littoral	9.5	11.2	5.0	0.0	4.5	28.1
Sprawlers (%)	none	NO	0.938	ANOVA	0.0	Reference Lake 3	51.9	17.7	7.9	29.5	52.5	71.8
						Camp Lake Littoral	52.7	12.0	5.4	34.8	52.4	67.2
Burrowers (%)	square-root	YES	0.006	ANOVA	4.1	Reference Lake 3	12.0	6.4	2.8	6.9	11.1	22.6
						Camp Lake Littoral	37.8	17.2	7.7	19.5	37.8	65.2

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

▨ Grey shading indicates statistically significant difference between study areas based on p-value≤ 0.10.

🟦 Blue shaded values indicate significant difference (ANOVA p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

Table 3.7: Benthic Invertebrate Community Statistical Comparison Results between Camp Lake (JLO) and Reference Lake 3 for Profundal Habitat Stations, Mary River Project CREMP, August 2018

Metric	Statistical Test Results					Summary Statistics						
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis	Magnitude of Difference [a] (No. of SD)	Study Lake Profundal Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (Individuals/m^2)	fourth-root	YES	0.004	ANOVA	5.8	Reference Lake 3	377	155	69	104	452	470
						Camp Lake Profundal	1,270	616	275	887	1,043	2,365
Richness (Number of Taxa)	log10	YES	0.008	ANOVA	2.1	Reference Lake 3	5.4	1.3	0.6	4.0	6.0	7.0
						Camp Lake Profundal	8.2	0.8	0.4	7.0	8.0	9.0
Simpson's Evenness (E)	log10	NO	0.841	ANOVA	-0.3	Reference Lake 3	0.455	0.296	0.132	0.218	0.296	0.933
						Camp Lake Profundal	0.373	0.120	0.054	0.218	0.380	0.499
Bray-Curtis Index	none	YES	0.018	ANOVA	1.8	Reference Lake 3	0.224	0.304	0.136	0.0505	0.109	0.763
						Camp Lake Profundal	0.765	0.273	0.122	0.448	0.951	0.981
Nemata (%)	rank	NO	1.000	Mann-Whitney U	0.1	Reference Lake 3	2.5	3.8	1.7	0.0	0.0	8.7
						Camp Lake Profundal	2.9	5.6	2.5	0.0	0.0	12.9
Hydracarina (%)	none	NO	0.225	t-test (unequal)	-0.6	Reference Lake 3	3.7	3.8	1.7	0.0	3.9	8.7
						Camp Lake Profundal	1.2	1.0	0.4	0.0	1.0	2.6
Ostracoda (%)	fourth-root	YES	0.071	ANOVA	-0.9	Reference Lake 3	3.1	2.9	1.3	0.0	2.0	7.5
						Camp Lake Profundal	0.7	1.5	0.7	0.0	0.0	3.4
Chironomidae (%)	rank	NO	0.151	Mann-Whitney U	0.9	Reference Lake 3	90.8	4.9	2.2	82.7	92.2	95.7
						Camp Lake Profundal	95.2	7.9	3.5	81.1	98.5	99.1
Metal-Sensitive Chironomidae (%)	log10	NO	0.985	ANOVA	-0.3	Reference Lake 3	11.4	16.8	7.5	2.3	3.9	41.4
						Camp Lake Profundal	6.6	3.0	1.3	3.1	5.9	11.0
Collector-Gatherers (%)	rank	NO	0.548	Mann-Whitney U	0.4	Reference Lake 3	89.8	13.6	6.1	66.3	96.2	100.0
						Camp Lake Profundal	95.6	2.9	1.3	91.2	96.9	98.3
Filterers (%)	square-root	NO	0.671	ANOVA	-0.3	Reference Lake 3	6.5	10.5	4.7	0.0	3.7	25.0
						Camp Lake Profundal	3.0	3.7	1.7	0.0	2.1	8.8
Clingers (%)	square-root	NO	0.556	ANOVA	-0.4	Reference Lake 3	10.2	13.6	6.1	0.0	3.9	33.6
						Camp Lake Profundal	4.5	4.7	2.1	0.9	2.6	12.5
Sprawlers (%)	fourth-root	YES	0.083	ANOVA	-1.5	Reference Lake 3	79.3	26.8	12.0	32.7	90.4	100.0
						Camp Lake Profundal	38.4	44.4	19.8	2.2	9.6	93.2
Burrowers (%)	none	YES	0.046	t-test (unequal)	3.3	Reference Lake 3	10.6	14.1	6.3	0.0	5.6	33.6
						Camp Lake Profundal	57.1	41.8	18.7	5.9	85.3	90.9

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

▨ Grey shaded values indicate statistically significant difference between study areas based on p-value ≤ 0.10.

🟦 Blue shaded values indicate significant difference (ANOVA p-value ≤ 0.10) that was also outside of a CES of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

were indicated between Camp Lake and Reference Lake 3 for either habitat type. Therefore, the differences in Bray-Curtis Index indicated between Camp Lake and Reference Lake 3 likely reflected the combination of higher benthic invertebrate density and richness at Camp Lake as well as differences in the densities of individual taxa of the various dominant benthic invertebrate groups between lakes. Because higher benthic invertebrate density and richness are not consistent with adverse influences typically associated with mine operations, factors other than metal concentrations likely accounted for the differences in benthic invertebrate community structure between Camp Lake and Reference Lake 3. This was supported by no ecologically meaningful difference in the relative abundance of metal-sensitive Chironomidae shown between Camp Lake and Reference Lake 3 for both habitat types (Tables 3.6 and 3.7), which suggested that the difference in benthic invertebrate community structure between lakes was unlikely to be associated with differences in metal concentrations. Notably, aqueous metal concentrations were below WQG and AEMP benchmarks at Camp Lake (Appendix Table C.26), and metal concentrations in sediment were generally below SQG at Camp Lake with the exception of iron and manganese, which were also above SQG at Reference Lake 3 (Table 3.5).

The subtle differences in benthic invertebrate community structure between Camp Lake and Reference Lake 3 also did not appear to be related to differences in food resources between lakes as demonstrated by no ecologically meaningful differences in FFG between lakes for either habitat type (Tables 3.6 and 3.7). Rather, an ecologically significant higher relative abundance of burrowing invertebrates at littoral and profundal habitat of Camp Lake compared to Reference Lake 3 suggested that the differences in community structure between lakes may have been related to natural differences in substrate properties between lakes. The key differences in substrate properties of benthic stations between lakes that was common to both littoral and profundal habitats was significantly lower content of moisture and total organic carbon (TOC) in sediment at Camp Lake (Appendix Table F.20). These properties suggested that substrate at Camp Lake was more compact than that at Reference Lake 3. Because substrate compactness is an important factor influencing inhabitation by burrowing invertebrates (Ward 1992), greater substrate compactness at Camp Lake may have accounted for the subtle benthic invertebrate community assemblage differences compared to Reference Lake 3.

Temporal comparisons did not indicate any consistent ecologically significant differences in general community effect indicators of density, richness, and Simpson's Evenness at littoral and profundal habitats of Camp Lake between the mine baseline (2007, 2013) and individual years of commercial mine operation since 2015 (Figure 3.15; Appendix Tables F.22 and F.23). Similarly, no significant differences in benthic invertebrate dominant taxonomic groups or FFG were consistently indicated between baseline and mine operational years for littoral habitat at Camp Lake (Figure 3.15; Appendix Table F.22). Despite a significantly lower relative abundance of

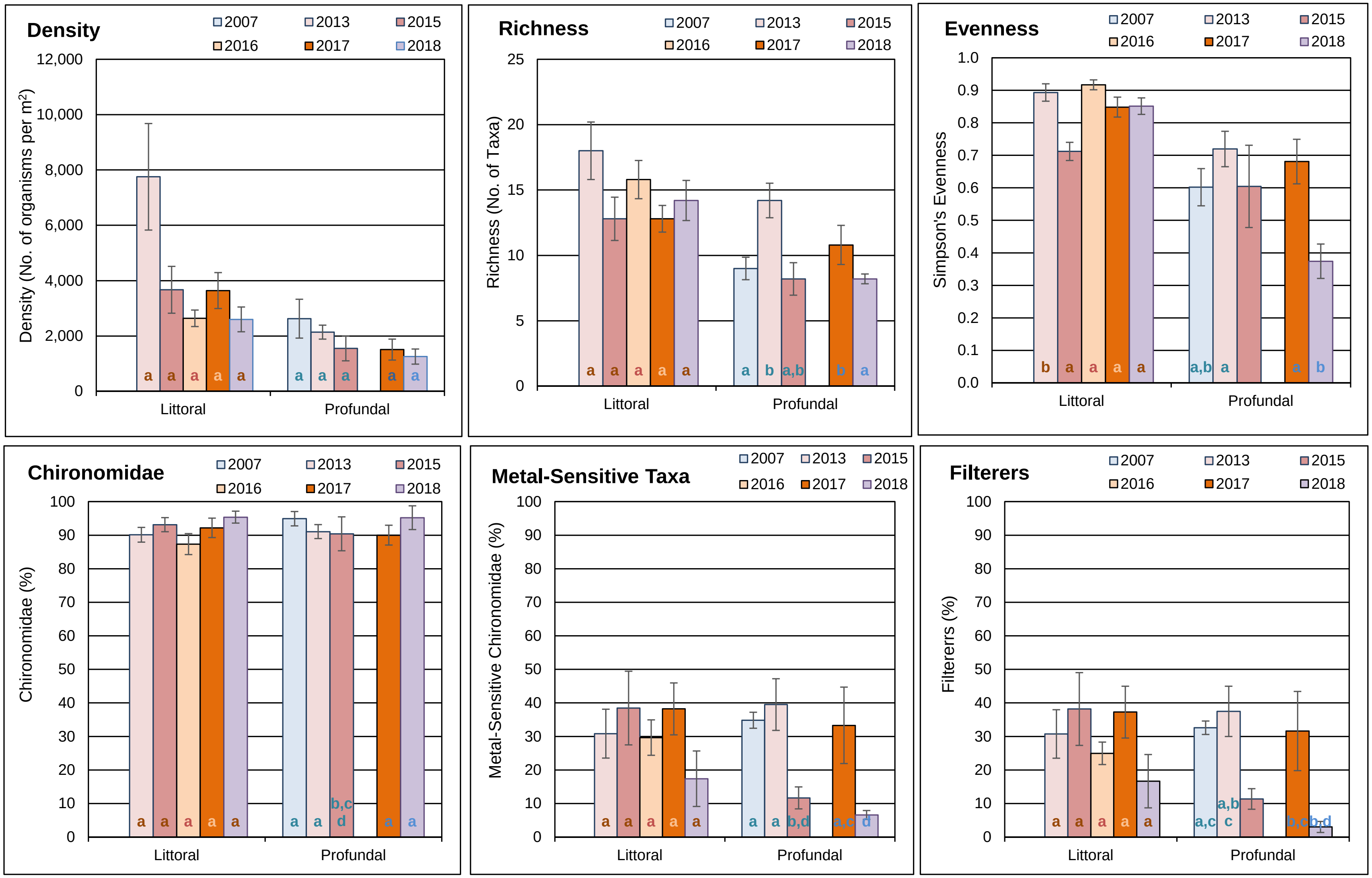

Figure 3.15: **Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Camp Lake Littoral and Profundal Study Areas among Mine Baseline (2007, 2013) and Operational (2015 to 2018) Periods**

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

metal-sensitive chironomids and FFG in mine operational years of 2015 and 2018 compared to the 2007 and 2013 baseline data for profundal habitat at Camp Lake, similar differences were not indicated between 2017 and either of the 2007 or 2013 baseline data (Appendix Table F.23). This indicated that the study-to-study differences in community features at profundal stations of Camp Lake were likely the result of sampling artifacts (e.g., differences in sampling station locations and/or replication among studies) or natural temporal variability among studies unrelated to potential influences from commercial mine operation. Overall, consistent with only minor changes in water and sediment quality since the mine baseline period, no significant changes in benthic invertebrate community features were indicated at littoral and profundal habitat of Camp Lake following the commencement of commercial mine operation in 2015.

3.3.6 Fish Population

3.3.6.1 Camp Lake Fish Community

The Camp Lake fish community was represented by arctic charr (*Salvelinus alpinus*) and ninespine stickleback (*Pungitius pungitius*), reflecting the same fish species composition as that observed at Reference Lake 3 (Table 3.8). A higher density of arctic charr was suggested at Camp Lake compared to Reference Lake 3 based on both greater electrofishing total catch-per-unit-effort (CPUE) from shallow rocky nearshore habitat, and greater gill netting CPUE from deeper littoral/profundal habitat at Camp Lake (Table 3.8). In turn, this suggested higher fish productivity at Camp Lake compared to Reference Lake 3, and was consistent with the chlorophyll-a and benthic invertebrate community results which indicated higher phytoplankton abundance and greater benthic invertebrate density at Camp Lake. Ninespine stickleback, which were first recorded in Camp Lake in 2016 (Minnow 2017), appeared to exhibit similar abundance at rocky nearshore habitat of Camp Lake and Reference Lake 3 based on comparable electrofishing CPUE for this species (Table 3.8). The electrofishing and gill netting CPUE for arctic charr at Camp Lake in 2018 were within or greater than, respectively, the range of those observed during baseline (2005 to 2013) studies (Figure 3.16). In addition, the CPUE of arctic charr was greater than those observed during each of the previous three years of mine operation for each respective collection method (Figure 3.16). In turn, this suggested no decline in the relative abundance of arctic charr at nearshore or littoral/profundal habitats of Camp Lake compared to the mine baseline period or since the commencement of commercial mine operations in 2015.

Table 3.8: Fish Catch and Community Summary from Backpack Electrofishing and Gill Netting Conducted at Camp Lake (JLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2018

Lake	Method [a]		Arctic Charr	Ninespine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	101	2	103	2
		CPUE	1.59	0.02	1.61	
	Gill netting	No. Caught	34	0	34	
		CPUE	0.38	0	0.38	
Camp Lake	Electrofishing	No. Caught	109	1	110	2
		CPUE	7.81	0.07	7.89	
	Gill netting	No. Caught	94	0	94	
		CPUE	4.29	0	4.29	

[a] Catch-per-unit-effort (CPUE) for electrofishing represents the number of fish captured per electrofishing minute, and for gill netting represents the number of fish captured per 100 m hours of net deployed.

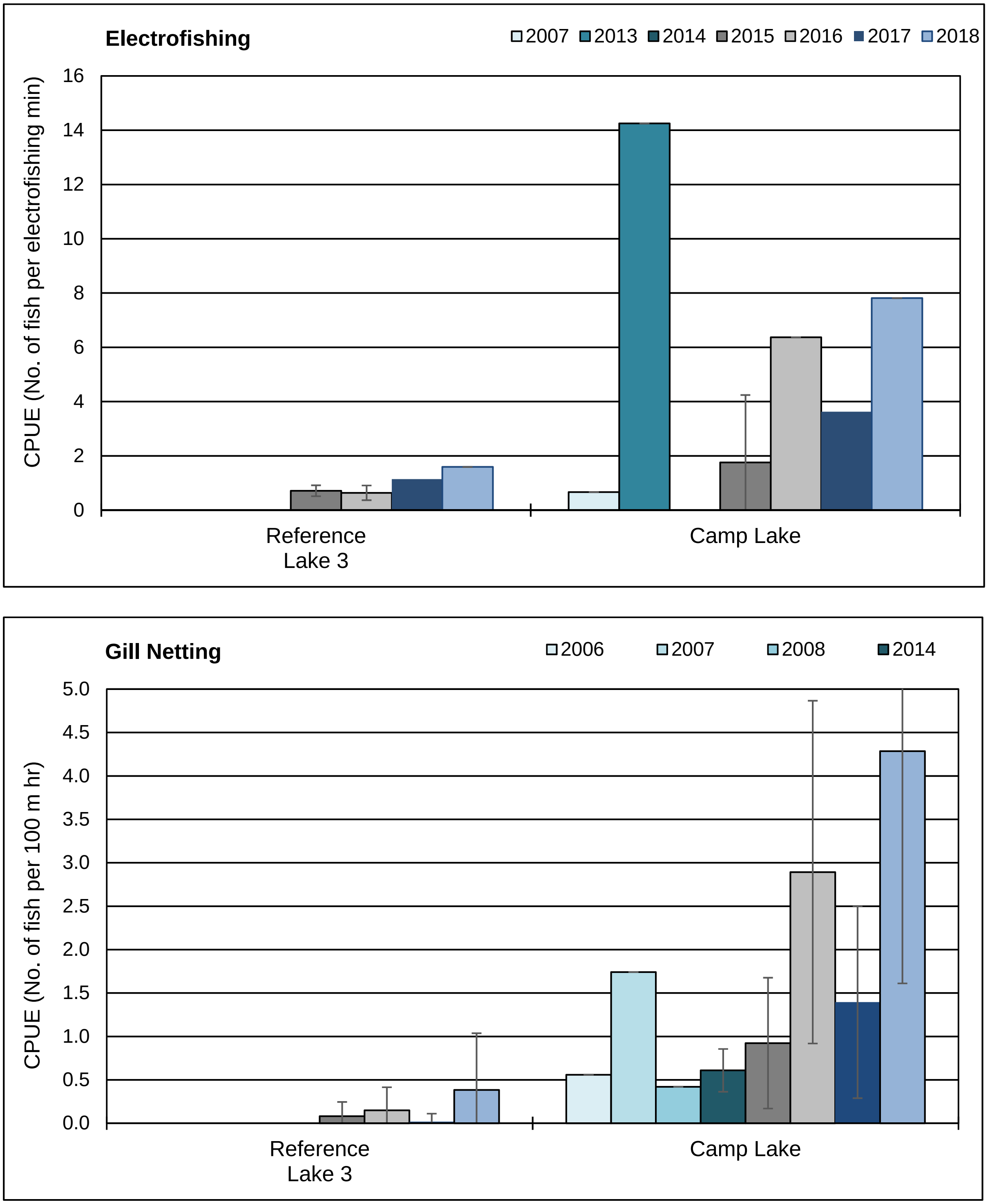

Figure 3.16: Catch-per-unit-effort (CPUE; mean ± SD) of Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Camp Lake (JLO) and Reference Lake 3 (REF3), Mary River Project CREMP, 2006 to 2018

Note: Data presented for fish sampling conducted in fall during baseline (2006, 2007, 2008, 2013), construction (2014) and operational (2015 to 2018) mine phases.

3.3.6.2 Camp Lake Fish Population Assessment

Nearshore Arctic Charr

Mine-related influences on the Camp Lake nearshore arctic charr population (i.e., fish captured by electrofishing) were assessed based on a control-impact analysis using 2018 data from Camp Lake and Reference Lake 3, as well as a before-after analysis using Camp Lake 2018 and baseline (2013) data. A total of 109 and 100 arctic charr were sampled at nearshore habitat of Camp Lake and Reference Lake 3, respectively, in August 2018, for the control-impact analysis. Young-of-the-year (YOY) were distinguished from older (non-YOY) age classes at a fork length cut-off of 4.5 cm for the Camp Lake and Reference Lake 3 data sets based on the evaluation of length-frequency distributions coupled with supporting age determinations (Figure 3.17). Due to the low number of arctic charr YOY captured at Camp Lake (i.e., two), fish population comparisons focused on non-YOY individuals, where applicable, to limit confounding influences of naturally differing weight-at-length relationships between YOY and non-YOY individuals on data interpretation.

The length-frequency distribution for the nearshore arctic charr differed significantly between Camp Lake and Reference Lake 3 (Table 3.9), reflecting the occurrence of very few YOY and greater numbers of larger individuals captured at Camp Lake (Figure 3.17). Non-YOY arctic charr captured at the Camp Lake nearshore were significantly longer (40%) and heavier (135%) than those captured at Reference Lake 3 nearshore (Table 3.9; Appendix Table G.6). However, condition (i.e., weight-at-length relationship) of non-YOY arctic charr was significantly lower at Camp Lake than Reference Lake 3 at a magnitude outside of the ecologically meaningful Critical Effect Size for condition of ±10% (referred to herein as CES$_C$; Table 3.9; Appendix Table G.6). The occurrence of lower arctic charr condition at Camp Lake may have reflected influences associated with greater densities (e.g., intraspecific competition) and/or greater number of larger sized individuals (e.g., natural size-dependent differences) compared to Reference Lake 3.

Temporal comparisons of the Camp Lake nearshore non-YOY arctic charr data indicated significantly different length-frequency distribution between the 2018 study and the 2013 baseline study (Table 3.9). In addition, non-YOY arctic charr captured at the nearshore of Camp Lake in 2018 were significantly shorter (-28%), lighter (-56%) and of lower condition (-9%) than those captured during the 2013 baseline study (Table 3.9; Appendix Table G.7). Similar differences in nearshore non-YOY arctic charr size and condition were indicated at Camp Lake from 2015 to 2017 compared to the 2013 baseline data (Table 3.9). In all studies from 2015 to 2018, the magnitude of difference in non-YOY arctic charr condition compared to the 2013 baseline data was just within the CES$_C$ of ±10% (Table 3.9). This suggested that the differences in non-YOY arctic charr energy use in each year of mine operation compared to the baseline period was within

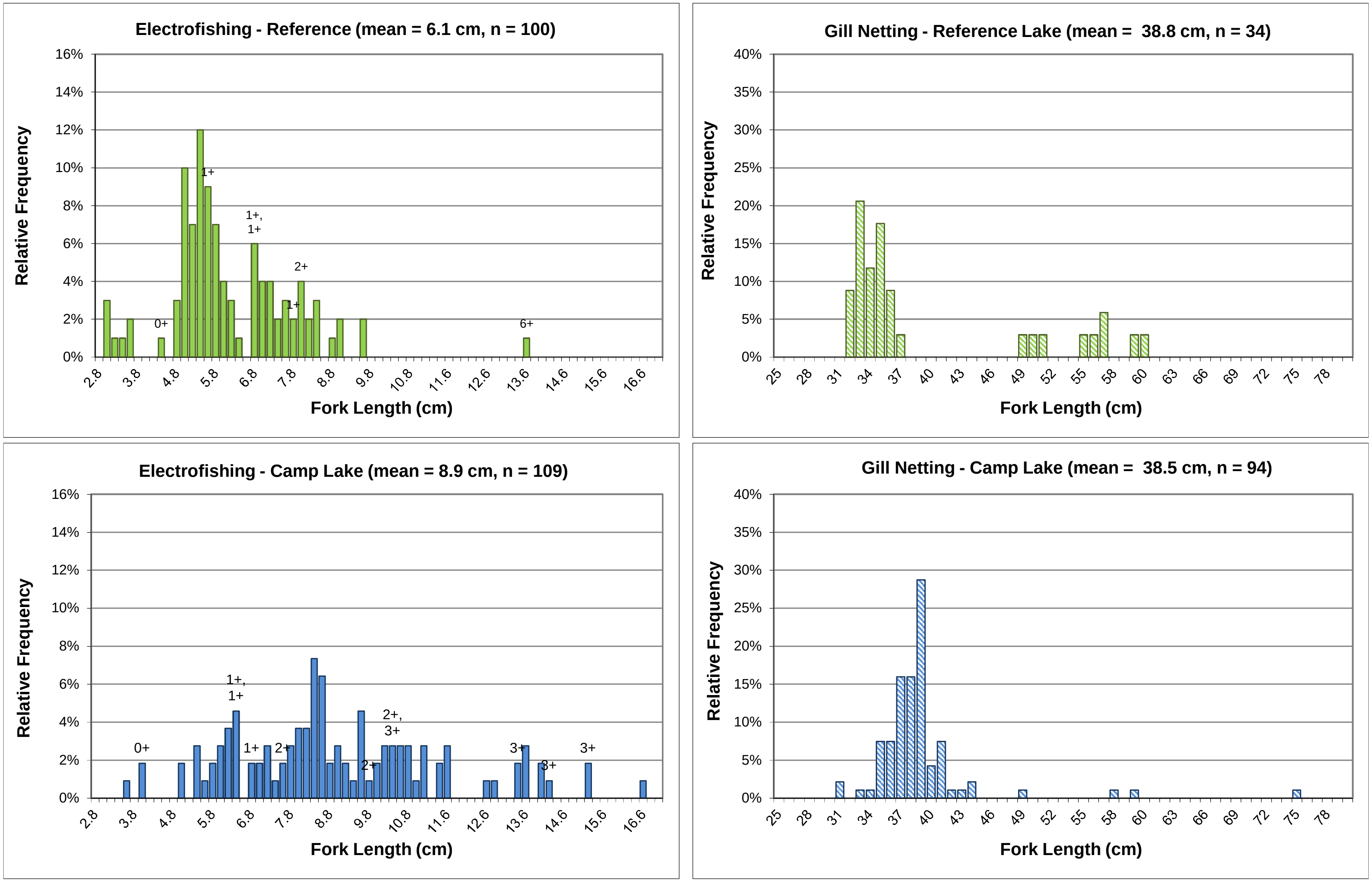

Figure 3.17: Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Camp Lake (JLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2018

Note: Fish ages are shown above the bars, where available.

Table 3.9: Summary of Statistical Results for Arctic Charr Population Comparisons between Camp Lake and Reference Lake 3 from 2015 to 2018, and between Camp Lake Mine Operational and Baseline Period Data, for Fish Captured by Electrofishing and Gill Netting Methods, Mary River Project CREMP

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed?[a]							
			versus Reference Lake 3				versus Camp Lake baseline period data[b]			
			2015	2016	2017	2018	2015	2016	2017	2018
Nearshore Electrofishing	Survival	Length-Frequency Distribution	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
		Age	No	No	No	-	-	-	-	-
	Energy Use (non-YOY)	Size (mean fork length)	**Yes** **(+41%)**	No	**Yes** **(+17%)**	**Yes** **(+40%)**	**Yes** **(-15%)**	**Yes** **(-32%)**	**Yes** **(- 35%)**	**Yes** **(-28%)**
		Size (mean weight)	**Yes** **(+176%)**	No	**Yes** **(+51%)**	**Yes** **(+135%)**	**Yes** **(-42%)**	**Yes** **(-71%)**	**Yes** **(-74%)**	**Yes** **(-56%)**
	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	No	**Yes** **(-6%)**	No	**Yes** **(-14%)**	**Yes** **(-6%)**	**Yes** **(-10%)**	**Yes** **(-10%)**	**Yes** **(- 9%)**
Littoral/Profundal Gill Netting[c]	Survival	Length Frequency Distribution	-	-	-	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
		Age	-	-	-	-	**Yes** **(+48%)**	**Yes** **(+58%)**	**Yes** **(+ 46%)**	**-**
	Energy Use	Size (mean fork length)	-	-	-	**Yes** **(+10%)**	**Yes** **(+6%)**	No	**Yes** **(+12%)**	**Yes** **(+15%)**
		Size (mean weight)	-	-	-	**Yes** **(+46%)**	No	No	**Yes** **(+37%)**	**Yes** **(+46%)**
		Growth (fork length-at-age)	-	-	-	-	No	**Yes** **(nc)**	No	-
		Growth (weight-at-age)	-	-	-	-	No	**Yes** **(nc)**	No	-
	Energy Storage	Condition (body weight-at-fork length)	-	-	-	**Yes** **(+12%)**	No	**Yes** **(-3%)**	No	No

[a] Values in parentheses indicate direction and magnitude of any significant differences.

[b] Baseline period data included 2013 nearshore electrofishing data and 2006, 2008, and 2013 littoral/profundal gill netting data. nc = non-calculable magnitude.

[c] Due to low catches of arctic charr in gill nets at Reference Lake 3 in 2015, 2016, and 2017, no comparison of fish health was conducted for gill netted fish.

the range of variability expected to occur naturally between years at waterbodies uninfluenced by human activity. No consistent differences in nearshore arctic charr size or condition were indicated between Camp Lake and Reference Lake 3 from 2015 to 2018, but in instances in which differences occurred, arctic charr from Camp Lake tended to be significantly larger and of lower condition (Table 3.9). Notably, nearshore arctic charr sampled at Reference Lake 3 were significantly larger and of greater condition in 2018 compared to all previous years from 2015 to 2017, the magnitude of difference in condition of which was near or outside of the CES_C of ±10% (Appendix Table B.12). This suggested that year-to-year variability in condition of nearshore arctic charr can be naturally high at local study area lakes.

Littoral/Profundal Arctic Charr

Mine-related influences on the Camp Lake littoral/profundal arctic charr population (i.e., fish captured by gill netting) was assessed based on a control-impact analysis using 2018 data from Camp Lake and Reference Lake 3, as well as a before-after analysis of Camp Lake 2018 versus baseline (combined 2006, 2007, 2008, and 2013) data. A total of 94 and 34 arctic charr were sampled from littoral/profundal habitat of Camp Lake and Reference Lake 3, respectively, in August 2018, for the control-impact analysis. The length-frequency distribution for littoral/profundal arctic charr differed significantly between Camp Lake and Reference Lake 3, reflecting the occurrence of relatively larger fish at Camp Lake (Table 3.9; Figure 3.17). Littoral/profundal arctic charr captured at Camp Lake were significantly longer (10%) and heavier (46%) than those captured at Reference Lake 3 (Table 3.9; Appendix Table G.12). In addition, the condition of arctic charr captured at littoral/profundal areas of Camp Lake was significantly higher, and at an ecologically meaningful absolute magnitude greater than 10%, than those sampled at Reference Lake 3 (Table 3.9; Appendix Table G.12).

Temporal comparisons of arctic charr data collected from Camp Lake littoral/profundal areas indicated significantly different length-frequency distribution of arctic charr in 2018 compared to the combined baseline data set (i.e., 2006, 2007, 2008, and 2013 studies; Table 3.9). Although fork length and fresh body weight were significantly greater for arctic charr captured at Camp Lake in 2018 compared to the baseline period, no significant difference in condition was indicated between 2018 and the baseline period at Camp Lake (Table 3.9). The 2018 comparisons to baseline conditions were generally consistent with those of the three previous CREMP studies, and collectively indicated no ecologically meaningful differences in condition of spawning-sized arctic charr at Camp Lake between the mine operational years and the baseline period.

3.3.7 Integrated Summary

Potential mine-related influences on water quality of Camp Lake in 2018 included slightly elevated chloride, manganese, and uranium concentrations compared to Reference Lake 3, as well as slightly higher conductivity, hardness, and concentrations of chloride, manganese, molybdenum, sodium, strontium, sulphate, and uranium, compared to Camp Lake baseline data. However, parameter concentrations at Camp Lake were consistently well below WQG and AEMP benchmarks from 2015 to 2018.[9] In sediment of Camp Lake, arsenic and manganese concentrations were elevated at the single littoral station compared to Reference Lake 3 in 2018 and to concentrations observed during the baseline period. However, no metals were elevated in sediment at Camp Lake profundal stations compared to Reference Lake 3 in 2018, nor to concentrations shown in mine baseline studies. Iron and manganese were observed at concentrations above SQG at the Camp Lake littoral station and on average at profundal stations, but average concentrations of these metals were also above SQG at Reference Lake 3 indicating natural elevation of these metals in sediments of regional lakes. Within Camp Lake, arsenic, copper, iron, nickel, and phosphorus concentrations were above AEMP benchmarks at the lone littoral station, as were arsenic, copper, and nickel concentrations in sediment at profundal stations located closest to the CLT1 outlet in 2018. Average concentrations of arsenic and copper were also above the Camp Lake AEMP benchmarks in profundal sediment at Reference Lake 3, indicating naturally high concentrations of these metals in sediment of local study area lakes. Overall, recent mine operations appeared to contribute to higher chloride, manganese, molybdenum, sodium, sulphate, and uranium concentrations in water, as well as to slightly higher arsenic, nickel, and phosphorus concentrations in sediment of Camp Lake. However, concentrations of these parameters generally remained below applicable water or sediment quality guidelines from 2015 to 2018 with the exception of nickel, which was slightly above the SQG at the littoral station.

Camp Lake chlorophyll-a concentrations were significantly higher than at Reference Lake 3 in 2018 suggesting greater primary production at Camp Lake. However, Camp Lake chlorophyll-a concentrations remained well below the AEMP benchmark during all seasonal sampling events, and suggested oligotrophic conditions typical of Arctic waterbodies. Temporal evaluation of the chlorophyll-a data suggested higher chlorophyll-a concentrations in 2018 compared to previous studies, but no changes to the trophic status of Camp Lake since mine operations commenced at the Mary River Project. Benthic invertebrate density and richness were significantly higher in littoral and/or profundal habitat of Camp Lake compared to Reference Lake 3 in 2018, but similar relative abundance of dominant taxonomic groups, including metal-sensitive chironomids, was indicated between lakes. No ecologically significant differences in density, richness, Simpson's Evenness, dominant taxonomic groups, or FFG were consistently indicated between the mine

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[9] Total phenol and phosphorus concentrations were above WQG near the bottom of two stations at Camp Lake in 2018, but appeared to be anomalies (see Section 3.3.2).

baseline (2007, 2013) period and all individual years of mine operation from 2015 to 2018. Analysis of Camp Lake arctic charr populations suggested greater fish abundance compared to Reference Lake 3 in 2018, and no decline in the numbers of arctic charr in 2018 compared to the Camp Lake baseline studies. Although arctic charr captured at the nearshore of Camp Lake exhibited significantly lower condition compared to those captured at Reference Lake 3 in 2018, as well as to those captured at Camp Lake during the mine baseline studies, the magnitude of these differences were generally within the range of variability expected to occur naturally (i.e., ±10% of reference condition). Spawning-sized arctic charr captured at Camp Lake showed significantly greater condition than those captured at Reference Lake 3, but were similar in condition to those captured at Camp Lake during baseline studies. Overall, the chlorophyll-a, benthic invertebrate community, and arctic charr fish population data all suggested no adverse mine-related influences to the biota of Camp Lake since the commencement of commercial mine operation at the Mary River Project in 2015.

4 SHEARDOWN LAKE SYSTEM

4.1 Sheardown Lake Tributaries (SDLT1, SDLT12 and SDLT9)

4.1.1 Water Quality

Sheardown Lake Tributary 1 (SDLT1) dissolved oxygen (DO) concentrations were consistently near or slightly above saturation in spring, summer, and fall monitoring events in 2018 (Appendix Tables C.1 to C.3; Figure 4.1). Dissolved oxygen concentrations at SDLT1 and Sheardown Lake Tributary 12 (SDLT12) did not differ significantly from those at Unnamed Reference Creek during the August 2018 biological study (Figure 4.1). Although DO concentrations were significantly lower at Sheardown Lake Tributary 9 (SDLT9) than at Unnamed Reference Creek and the other Sheardown Lake tributaries, the DO concentrations were well above the WQG minimum for supporting sensitive life stages of cold-water biota (i.e., 9.5 mg/L) at all Sheardown Lake tributaries (Figure 4.1; Appendix Table C.31). *In situ* pH was significantly lower at SDLT1 and SDLT12 compared to Unnamed Reference Creek, whereas pH at SDLT9 did not differ significantly from reference conditions during the August 2018 biological study (Figure 4.1). Despite minor differences in pH among the Sheardown Lake tributaries, pH was consistently within WQG limits at each mine-exposed tributary and thus slight dissimilarity in pH among areas was unlikely to be ecologically meaningful. Specific conductance at each of the Sheardown Lake tributaries was significantly higher than at Unnamed Reference Creek during August 2018 biological sampling (Figure 4.1; Appendix Table C.33). Because specific conductance often serves as an indication of mine-associated influences on water quality (e.g., Environment Canada 2012), these observations suggested a mine-related influence on water quality of the SDLT1, SDLT9, and SDLT12 watercourses.

Sheardown Lake Tributary 1 is the only tributary of the Sheardown Lake system at which routine water quality monitoring is conducted, with one monitoring station established in each of the upper and lower reaches of the tributary (i.e., Stations D1-05 and D1-00, respectively; Figure 2.2). Several parameters, including hardness, TDS, alkalinity, and concentrations of barium, chloride, nitrate, sulphate, total copper, total molybdenum, potassium, sodium, total strontium, and total uranium were elevated (i.e., ≥3-fold) at the SDLT1 stations compared to respective mean concentrations from the reference creek stations. Highest elevation of these parameters typically occurred during the spring sampling event, followed by the summer and fall sampling events (Appendix Tables C.34 and C.35). In addition to the parameters listed above, total manganese and total nickel concentrations were also elevated at the lower SDLT1 station compared to respective mean concentrations from the reference creek stations, but unlike the parameters listed above, the magnitude of elevation for total manganese and nickel concentrations (and

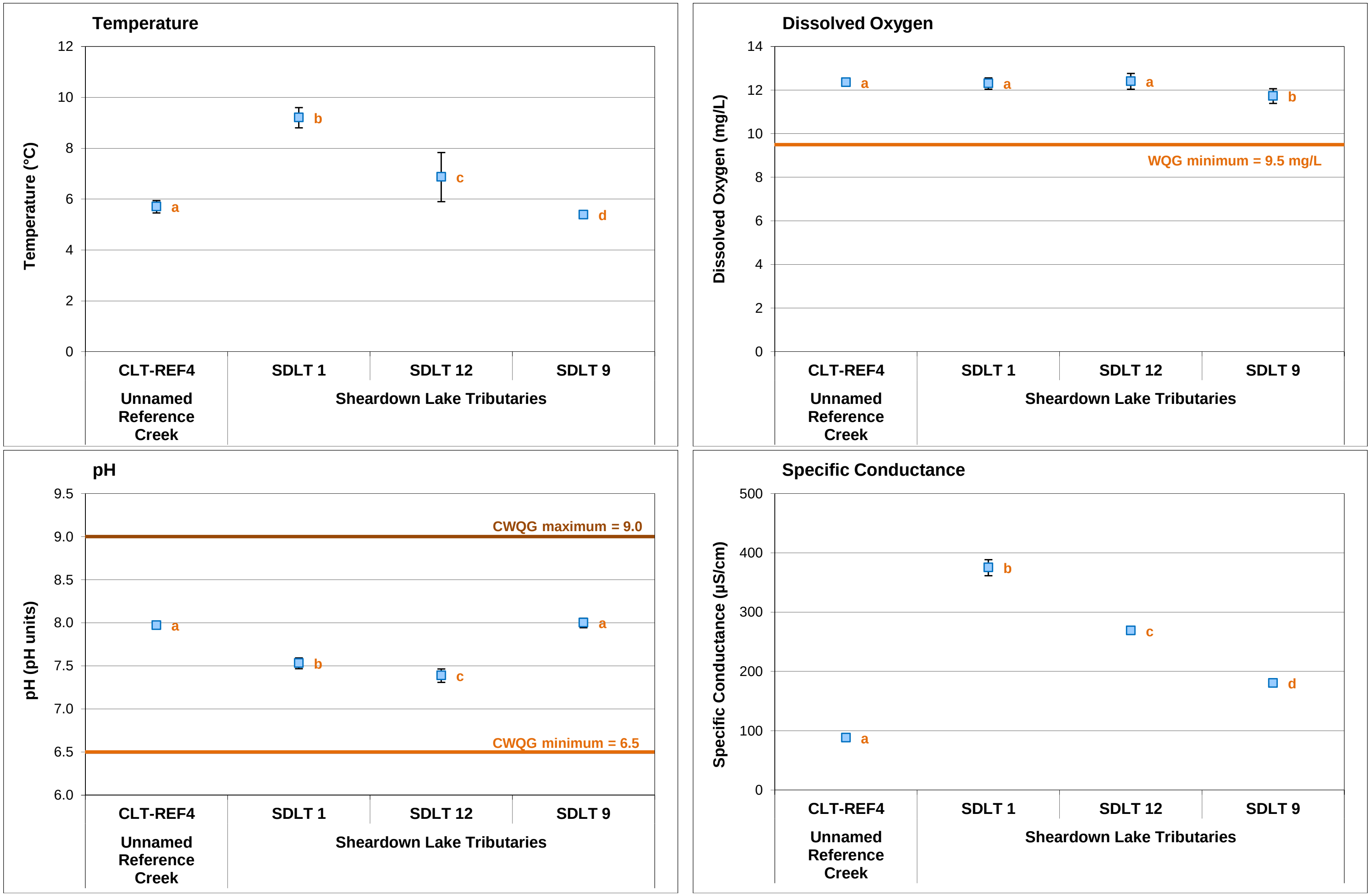

Figure 4.1: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Sheardown Lake Tributaries (SDLT) and Unnamed Reference Creek Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Note: The same letter(s) next to data points indicate study area values do not differ significantly.

nitrate) was smallest in spring and largest in fall (Appendix Tables C.34 and C.35). In most cases, higher parameter concentrations were observed at lower SDLT1 compared to upper SDLT1, suggesting that additional inputs of metals to SDLT1 occurred with distance downstream of the headwaters at the main mine camp (Table 4.1). On average, dissolved concentrations of copper, manganese, molybdenum, potassium, and uranium concentrations were elevated at SDLT1 compared to respective average concentrations from the reference creek stations during all seasonal sampling events in 2018, strongly suggesting a mine-related source for these parameters. Despite elevation of the aforementioned parameters at the SDLT1 stations compared to reference conditions, copper was the only parameter present at concentrations greater than respective WQG or AEMP benchmarks at either of the SDLT1 monitoring stations in 2018 (Table 4.1; Appendix Table C.34).

Temporal comparisons of SDLT1 water chemistry data generally indicated the same parameters observed at elevated concentrations compared to the reference creek stations were also elevated compared to concentrations at the time of mine baseline at the lower SDLT1 monitoring station. In particular, conductivity, hardness, and concentrations of manganese, nickel, nitrate, sodium, strontium, sulphate, TDS, and uranium were elevated at lower SDLT1 in 2018 compared to respective concentrations during the mine baseline in at least one sampling season (Appendix Table C.35; Appendix Figure C.9; Figure 4.2). At upper SDLT1, concentrations of molybdenum, sodium, strontium, sulphate, and uranium were elevated in 2018 compared to baseline conditions only during the spring sampling event (Appendix Table C.35). Notably, total copper concentrations at SDLT1 in 2018 were generally comparable to those during the baseline period (Appendix Table C.35; Appendix Figure C.10), suggesting that concentrations of this metal were naturally high within this tributary prior to commencement of mine operations in 2015.

4.1.2 Phytoplankton

Among the Sheardown Lake tributaries, phytoplankton (chlorophyll-a) monitoring is conducted only at SDLT1 as part of the Mary River Project CREMP (Table 2.1). Chlorophyll-a concentrations were higher at upper SDLT1 (Station D1-05) compared to near the creek mouth (Station D1-00) during each of the spring, summer, and fall sampling events in 2018 (Figure 4.3). Nitrate concentrations were higher near the mouth of SDLT1 (Appendix Table C.34), and therefore lower chlorophyll-a concentrations near the mouth were contrary to typical responses of phytoplankton to higher nutrient concentrations.[10] Therefore, a factor (or factors) other than differing nutrient

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[10] Concentrations of total ammonia, TKN, and total phosphorus were comparable between the upper and lower stations of SDLT1 during each of the spring, summer, and fall sampling events (Appendix Table C.34). Because total phosphorus concentrations were similar between the SDLT1 upper and lower stations, the differences in chlorophyll a between stations did not appear to be related to phosphorus limitation at the lower station.

Table 4.1: Water Chemistry at Sheardown Lake Tributary 1 (SDLT1) Monitoring Stations, Mary River Project CREMP, Fall 2018

Parameters		Units	Water Quality Guideline (WQG)^a	AEMP Bench-mark^b	Reference Creek Average (n = 4) Fall 2018	Sheardown Lake Tributary 1	
						D1-05 (Upper) 26-Aug-2018	D1-00 (Lower) 26-Aug-2018
Conventionals^b	Conductivity (lab)	umho/cm	-	-	97	190	441
	pH (lab)	pH	6.5 - 9.0	-	7.88	7.72	8.05
	Hardness (as $CaCO_3$)	mg/L	-	-	47	99	205
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	53	95	240
	Turbidity	NTU	-	-	2.44	0.28	1.01
	Alkalinity (as $CaCO_3$)	mg/L	-	-	43	84	92
Nutrients and Organics	Total Ammonia	mg/L	variable^c	0.855	0.021	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	1.280
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.20
	Dissolved Organic Carbon	mg/L	-	-	1.5	3.4	4.1
	Total Organic Carbon	mg/L	-	-	2.0	3.8	4.3
	Total Phosphorus	mg/L	0.030$^\alpha$	-	0.0035	<0.0030	<0.0030
	Phenols	mg/L	0.004$^\alpha$	-	<0.0010	0.0011	0.0011
Anions	Bromide (Br)	mg/L	-	-	0.1	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.6	0.6	8.8
	Sulphate (SO_4)	mg/L	218$^\beta$	218	2.7	7.8	110.0
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.054	0.012	0.026
	Antimony (Sb)	mg/L	0.020$^\alpha$	-	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0059	0.0093	0.0174
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	0.000023
	Calcium (Ca)	mg/L	-	-	9.8	19.8	37.6
	Chromium (Cr)	mg/L	0.0089	0.00856	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009$^\alpha$	0.004	<0.00010	0.00057	0.00064
	Copper (Cu)	mg/L	0.002	0.0022	0.0009	***0.0036***	0.0021
	Iron (Fe)	mg/L	0.30	0.326	0.046	<0.030	0.072
	Lead (Pb)	mg/L	0.001	0.001	0.00008	0.00006	0.00005
	Magnesium (Mg)	mg/L	-	-	5.31	12.7	29.2
	Manganese (Mn)	mg/L	0.935$^\beta$	-	0.00065	0.00019	0.10000
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00029	0.00091	0.00322
	Nickel (Ni)	mg/L	0.025	0.025	0.0005	0.0019	0.0044
	Potassium (K)	mg/L	-	-	0.65	1.49	2.81
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.83	1.43	1.38
	Sodium (Na)	mg/L	-	-	1.24	0.39	4.08
	Strontium (Sr)	mg/L	-	-	0.0094	0.0089	0.0240
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010
	Uranium (U)	mg/L	0.015	-	0.00186	0.00337	0.00488
	Vanadium (V)	mg/L	0.006$^\alpha$	0.006	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	0.0075

[a] Canadian Water Quality Guideline (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.3 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data adopted from the Camp Lake Tributaries.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Figure 4.2: Temporal Comparison of Water Chemistry at Sheardown Lake Tributaries (SDLT) for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2018) Periods during Fall

Notes: Values represent mean ± SD. Creek reference includes the CLT-REF and MRY-REF series stations (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Sheardown Lake Tributaries.

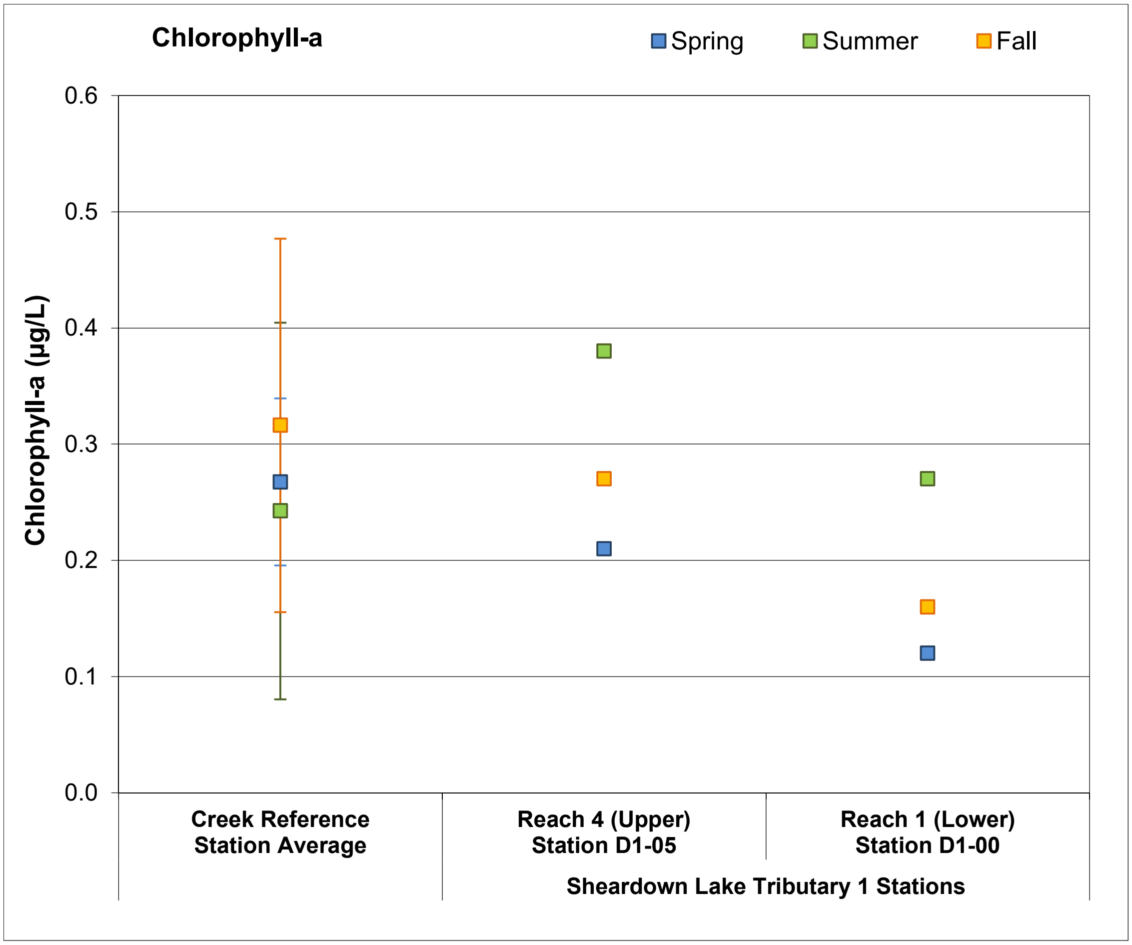

Figure 4.3: Chlorophyll-a Concentrations at Sheardown Lake Tributary 1 Phytoplankton Monitoring Stations, Mary River Project CREMP, 2018

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

concentrations appeared to account for the occurrence of lower chlorophyll-a concentrations at the lower versus upper monitoring station at SDLT1. Chlorophyll-a concentrations at SDLT1 were within the range of variability observed among reference creeks during spring, summer, and fall sampling events at the upper station (D1-05), and during the summer sampling event at the lower station (D1-00), but not during the spring and fall sampling events at the lower station (Figure 4.3). The latter suggested that a mine-related influence on phytoplankton abundance may have occurred seasonally at lower SDLT1. For all sampling events in 2018, chlorophyll-a concentrations were well below the AEMP benchmark of 3.7 µg/L at both of the SDLT1 monitoring stations (Figure 4.3). Similar to the reference creeks and Camp Lake tributaries, chlorophyll-a concentrations at SDLT1 were suggestive of oligotrophic, low productivity conditions based on Dodds et al (1998) trophic status classification for stream environments (i.e., chlorophyll-a concentration <10 µg/L). Relatively low chlorophyll-a concentrations at SDLT1 stations in 2018 were also consistent with an oligotrophic categorization using CWQG classifications based on aqueous phosphorus concentrations (i.e., concentrations below 10 µg/L; Table 4.1; Appendix Table C.34).

Temporal comparisons indicated that chlorophyll-a concentrations at SDLT1 stations in fall 2018 were similar to those during the baseline period (Figure 4.4). In addition, no consistent directional changes in chlorophyll-a concentrations were shown at the SDLT1 stations during fall sampling events over the mine baseline (2005 to 2013), construction (2014), and operational (2015 to 2018) periods (Figure 4.4). These data suggested no adverse mine-related influences to phytoplankton productivity at SDLT1 over the initial four years of mine operation.

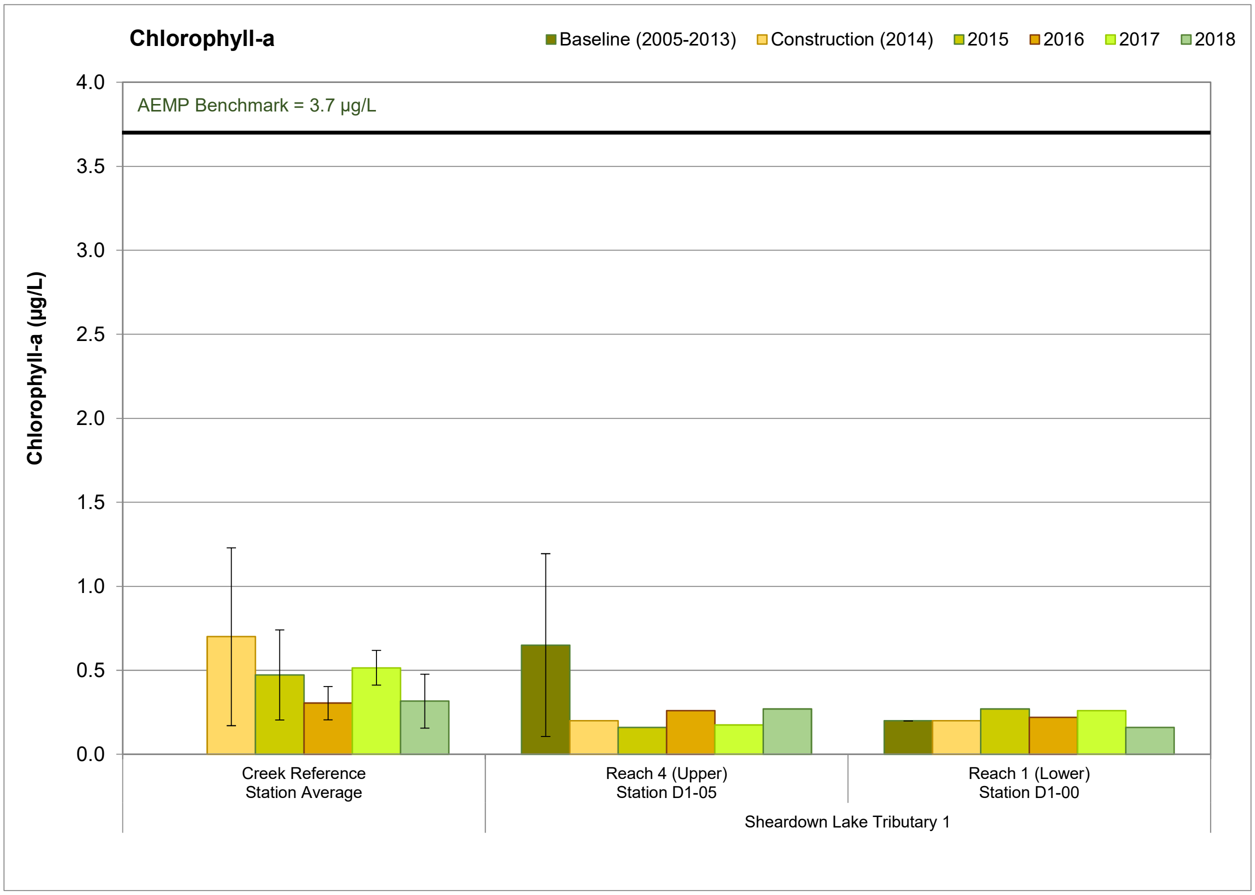

Figure 4.4: Temporal Comparison of Chlorophyll-a Concentrations at Sheardown Lake Tributary 1 for Mine Baseline (2005 - 2013), Construction (2014), and Operational (2015 to 2018) Periods in the Fall, Mary River Project CREMP

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

4.1.3 Benthic Invertebrate Community

4.1.3.1 Sheardown Lake Tributary 1 (SDLT1)

The benthic invertebrate community at the lower reach of SDLT1, near the outlet to Sheardown Lake NW, exhibited significantly lower richness and Simpson's Evenness, and significant differences in assemblage composition (as indicated by Bray-Curtis Index) compared to Unnnamed Reference Creek in 2018 (Figure 4.5; Appendix Table F.30). The key differences in relative abundance of dominant taxonomic groups included ecologically significant greater proportions of Oligochaeta (aquatic worms) and Chironomidae (non-biting midges), and conversely, significantly lower proportion of Nemata (roundworms), Ephemeroptera (mayflies), and Simuliidae (blackflies), at SDLT1 compared to Unnamed Reference Creek (Figure 4.5; Appendix Table F.30). A higher relative abundance of metal-sensitive chironomids at SDLT1 suggested that metal concentrations were not biologically available and/or were not a large contributor to differences in community composition compared to Unnamed Reference Creek, which was consistent with concentrations of all metals but copper below WQG at SDLT1 in 2018 (see Appendix Table C.34).

A significantly higher relative abundance of FFG shredders (Appendix Table F.30), which rely upon plants as an important food source, was consistent with greater density of attached bryophytes (mosses) at SDLT1 compared to the reference creek (Appendix Table F.24). In turn, this suggested that differences in in-stream vegetation likely contributed to differing benthic invertebrate community composition between SDLT1 and Unnamed Reference Creek. A significantly lower relative abundance of FFG filterers was also indicated at SDLT1 compared to the reference creek in 2018. This suggested that benthic invertebrate food sources differed between these watercourses and/or factors contributing to lower filter feeding efficiency were potentially associated with the mine operation. Notably, no significant differences in relative abundance of predominant HPG (i.e., clingers and sprawlers) were indicated between SDLT1 and the reference creek (Figure 4.5; Appendix Table F.30), suggesting that physical habitat alteration from factors such as sedimentation had not substantially affected benthic invertebrate community composition at SDLT1 relative to reference conditions. Overall, the differences in the benthic invertebrate community between SDLT1 and the reference creek in 2018 may have reflected natural differences in the types/amount of in-stream vegetation between watercourses, and mine-related influences on invertebrate filter-feeding efficiency at SDLT1, but did not appear to be related to metal concentrations.

Temporal comparison of the lower SDLT1 benthic invertebrate community data did not indicate any consistent ecologically significant differences in density, richness, or Simpson's Evenness for individual years of mine operation (2015 to 2018) compared to baseline studies conducted in 2008

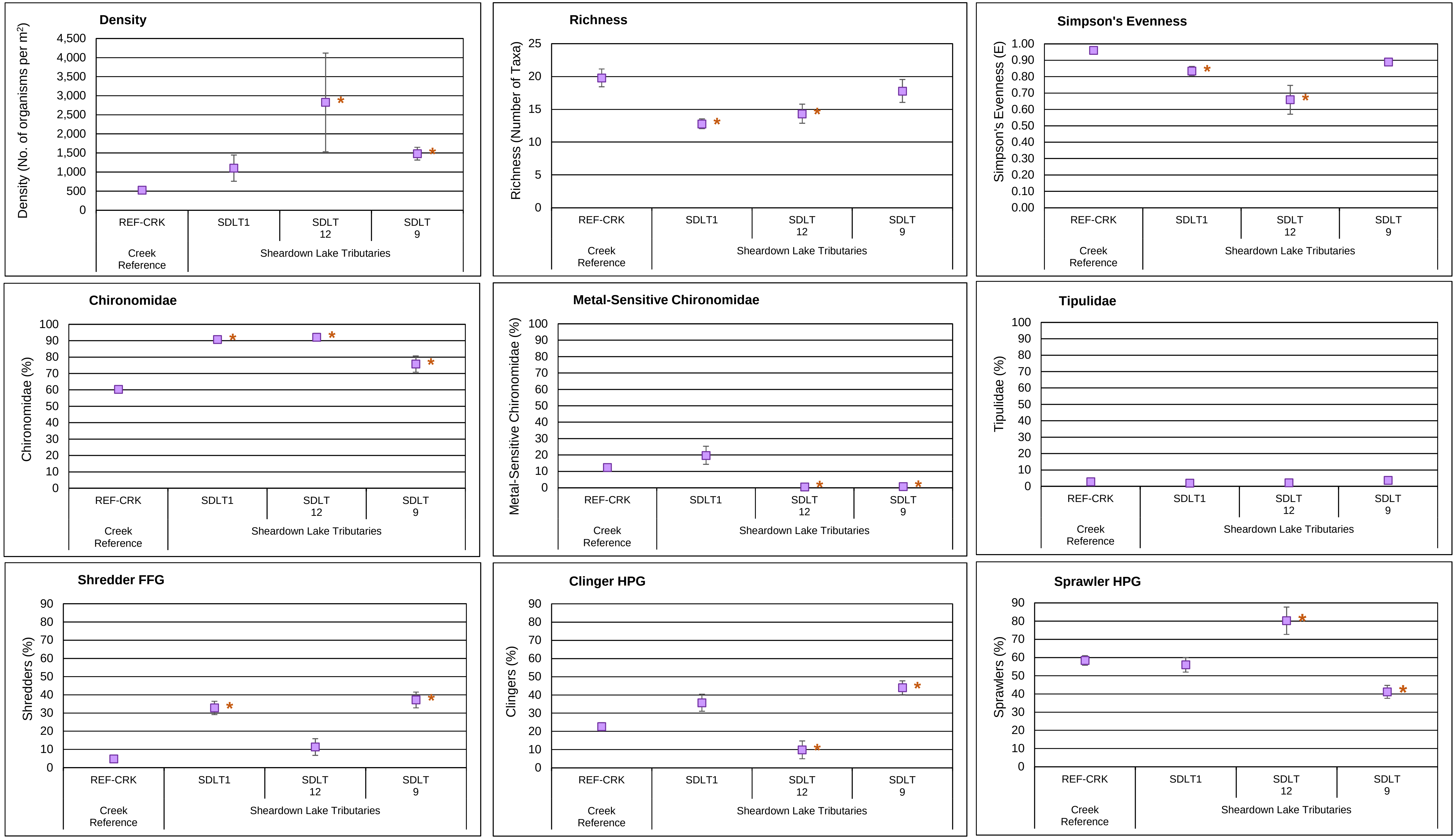

Figure 4.5: **Comparison of Benthic Invertebrate Community Metrics between Sheardown Lake Tributary and Unnamed Reference Creek Study Areas (mean ± SE), Mary River Project CREMP, August 2018**

Note: An asterisk (*) next to SDLT data point indicates that the metric value differs significantly from that at Unnamed Reference Creek.

and 2013 (Figure 4.6; Appendix Table F.31). Similarly, no ecologically significant differences in the relative abundance of any dominant taxonomic groups or FFG were consistently indicated among years of mine operation and baseline studies at SDLT1 (Appendix Tables F.31 and F.32). The absence of any consistent, ecologically significant differences in benthic invertebrate community density, richness, Simpson's Evenness, and composition at SDLT1 between the mine operational and baseline periods indicated no ecologically meaningful influences on benthic biota since the commencement of commercial mine operations in 2015.

4.1.3.2 Sheardown Lake Tributary 12 (SDLT12)

The benthic invertebrate community at SDLT12 exhibited significantly greater density and significantly lower richness and Simpson's Evenness compared to Unnnamed Reference Creek in 2018 (Figure 4.5; Appendix Table F.30). These differences reflected the occurrence of high densities of *Diplocladius* midges at SDLT12, which are characteristic of small, cool, slow-flowing or still streams (compare Appendix Tables F.4 and F.27; Armitage et al. 1995; Namayandeh et al. 2016). The existence of significantly slower water velocity at SDLT12 compared to Unnamed Reference Creek (Appendix Table F.28) thus likely accounted for the differences in benthic invertebrate density and Simpson's Evenness indicated above. Marked differences in community composition indicated between SDLT12 and the reference creek based on significant differences in Bray-Curtis Index, reflected significantly lower relative abundance of roundworms, mayflies, and blackflies, and significantly higher relative abundance of Chironomidae (Figure 4.5; Appendix Table F.30) at SDLT12. In addition, ecologically significant lower relative abundance of FFG filterers and HPG clingers, as well as ecologically significant higher relative abundance of HPG sprawlers, occurred at SDLT12 compared to Unnamed Reference Creek in 2018 (Figure 4.5; Appendix Table F.30). Because mayflies, blackflies, filterers, and clingers generally occur in moderate to swiftly flowing watercourses, the differences in benthic invertebrate community assemblage between SDLT12 and the reference creek were consistent with markedly slower water velocity at SDLT12. Therefore, differing habitat features between SDLT12 and Unnamed Reference Creek appeared to account for the differences in benthic invertebrate community composition between watercourses.

Temporal comparison of the SDLT12 benthic invertebrate community data indicated no on-going unidirectional significant differences in density and Simpson's Evenness, but significantly lower richness on a routine basis, between years of mine operation and baseline (Figure 4.6; Appendix Table F.33). A consistent occurrence of significantly higher relative abundance of burrowing invertebrates, including Oligochaeta and crane fly taxonomic groups, and the collector-gatherer FFG from 2015 to 2018 compared to the 2007 baseline data suggested changes in habitat conditions with the commencement of mine operations. Although such temporal changes

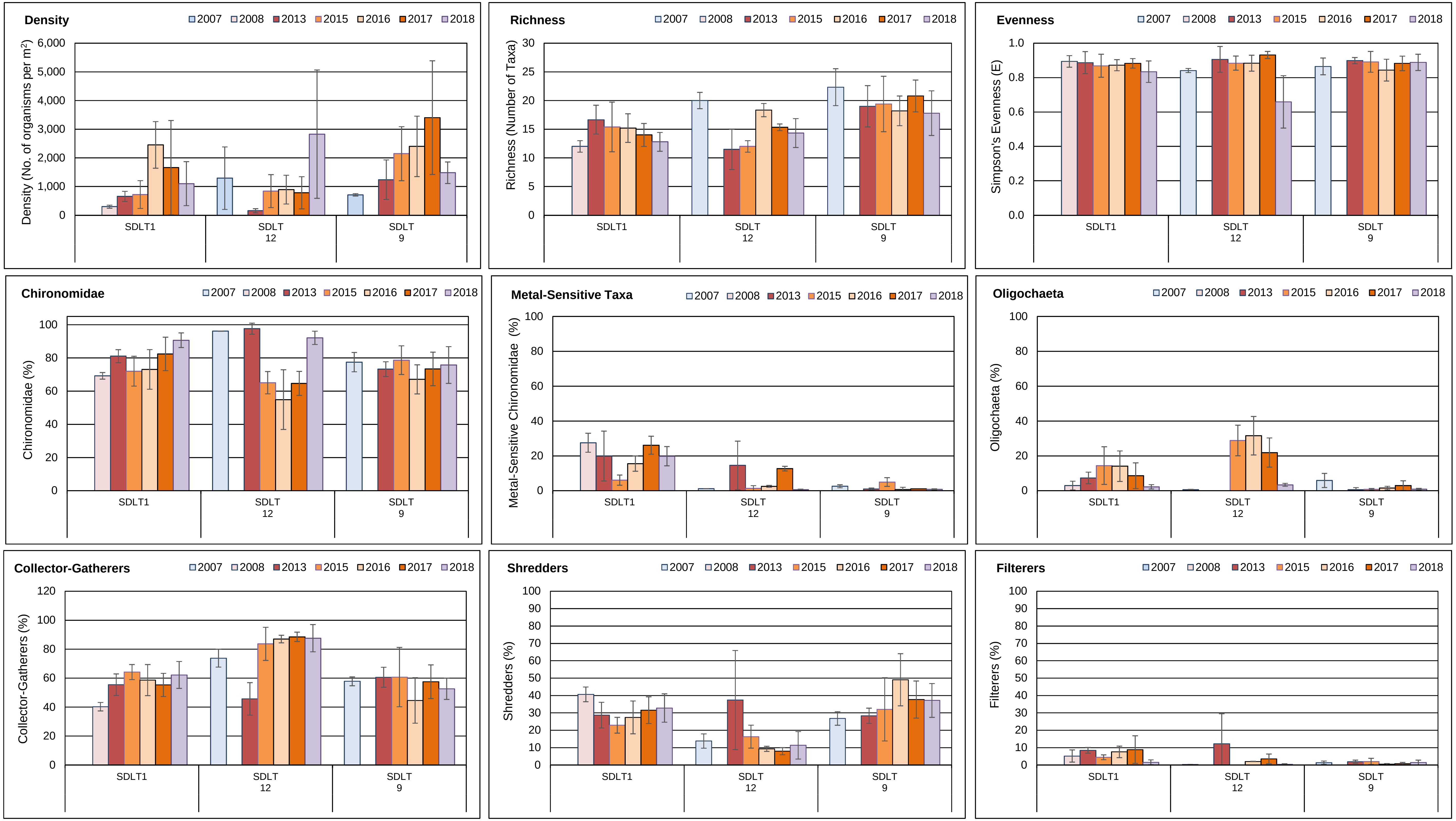

Figure 4.6: **Comparison of Benthic Invertebrate Community Metrics (mean ± SD) at Sheardown Lake Tributaries 1, 12, and 9 among Mine Operational (2015 to 2018) and Baseline (2007, 2008, 2011, 2013) Studies for the Mary River Project CREMP**

potentially reflected slight differences in sampling location between the mine operational and baseline periods, field observations from the 2016 and 2017 studies documented the occurrence of silt deposits on in-stream substrate of SDLT12 suggesting sedimentation within this watercourse. Therefore, a mine-related reduction in flow and/or increased particle loadings (e.g., through dust and/or erosional deposition) may have accounted for temporal changes in the benthic invertebrate community between the mine operational and baseline periods at SDLT12 that included a shift to higher abundance of deposit feeding, burrowing benthic invertebrates. Notably, the relative abundance of metal-sensitive chironomids did not differ significantly among years of mine operation and baseline at SDLT12, suggesting that metals were largely biologically unavailable and/or did not account for the differences in benthic invertebrate community endpoints shown between the mine operational and baseline studies.

4.1.3.3 Sheardown Lake Tributary 9 (SDLT9)

The benthic invertebrate community of Sheardown Lake Tributary 9 (SDLT9) exhibited significantly greater density but no significant differences in richness or Simpson's Evenness compared to Unnnamed Reference Creek in 2018 (Figure 4.5; Appendix Table F.30). Benthic invertebrate community composition differences were indicated between SDLT9 and Unnamed Reference Creek based on significant differences in Bray-Curtis Index. The key differences in dominant taxonomic groups included significantly lower relative abundance of mayflies and blackflies, and significantly higher relative abundance of Hydracarina (aquatic mites) and Chironomidae, at SDLT9 compared to the reference creek (Figure 4.5; Appendix Table F.30). Notably, the relative abundance of metal-sensitive chironomids was significantly lower at SDLT9 than at the reference creek, the magnitude of difference of which was ecologically meaningful (i.e., outside the CES_{BIC} of ±2 SD_{REF}; Figure 4.5; Appendix Table F.30). This suggested that differences in community composition between watercourses were possibly related to differing metal concentrations. However, differing food resources could also have accounted for the differing benthic invertebrate community composition between watercourses as indicated by significant differences in FFG composition between SDLT9 and the reference creek. For instance, the relative abundance of FFG shredders was significantly higher at SDLT9 compared to the reference creek, and was consistent with field observations of greater amounts of rooted in-stream vegetation at SDLT9 compared to the reference creek (Appendix Tables F.24 and F.30) given that vegetation is an important for source for shredders. In addition, because invertebrates within the clinger HPG are often associated with in-stream vegetation, significantly greater relative abundance of clinging aquatic mites at SDLT9 compared to Unnamed Reference Creek likely reflected greater amounts of in-stream vegetation at SDLT9 (Appendix Table F.30). In turn, this suggested that differing amounts and/or types of in-stream vegetation accounted for the differences in benthic invertebrate community composition between SDLT9 and the reference creek.

Temporal comparisons indicated no consistent ecologically significant differences in benthic invertebrate density, richness, Simpson's Evenness, or any dominant taxonomic groups and FFG at SDLT9 between data collected from the 2015 to 2018 mine operational years and baseline period data collected in 2007 and 2013 (Figure 4.6; Appendix Tables F.34 and F.35). Overall, this suggested that the differences in benthic invertebrate community composition between SDLT9 and Unnamed Reference Creek in 2018 likely reflected a natural difference in the amount of in-stream vegetation between watercourses and the associated influences of this vegetation on benthic invertebrate community composition.

4.1.4 Integrated Summary

At Sheardown Lake Tributary 1 (SDLT1), aqueous concentrations of several parameters were elevated compared to average concentrations observed at the reference creek stations in 2018. Of those parameters that were elevated compared to reference conditions, concentrations of manganese, nickel, nitrate, sodium, strontium, sulphate, TDS, and uranium were also elevated at SDLT1 in 2018 compared to the baseline period, suggesting a mine-related influence on water quality of SDLT1. However, with the exception of copper, no parameters were present at concentrations above WQG or AEMP benchmarks in 2018. Chlorophyll-a concentrations outside of the range of variability observed among the reference creeks during spring and fall sampling events only at the lower SDLT1 station, suggesting that a mine-related influence on phytoplankton abundance may occur seasonally at SDLT1. However, chlorophyll-a concentrations were similar between 2018 and the baseline period indicating no clear change to the trophic status of SDLT1 since commercial mine operation commenced. Significantly lower benthic invertebrate richness and Simpson's Evenness, as well as significant differences in community structure, were indicated at SDLT1 in 2018 compared to Unnamed Reference Creek. However, the occurrence of significantly greater relative abundance of shredders, as well as no significant difference in the relative abundance of metal-sensitive chironomids, at SDLT1 compared to the reference creek suggested that differing benthic invertebrate communities likely reflected differences in the types and/or amounts of in-stream vegetation between watercourses rather than influences associated with differing metal concentrations. In addition, studies conducted during years of mine operation from 2015 to 2018 showed no consistent ecologically significant differences in any primary benthic invertebrate community metrics, dominant taxonomic groups, or FFG compared to studies conducted during the mine baseline. In turn, this suggested that metals were not highly bioavailable in water of SDLT1, and that differences in benthic invertebrate community composition between SDLT1 and the reference creek likely reflected natural differences in the amount and/or types of in-stream vegetation between watercourses. Overall, similar to the findings of the three previous CREMP studies, no adverse mine-related effects to biota of SDLT1 were indicated in 2018 based on the chlorophyll-a and benthic invertebrate community data analyses.

At Sheardown Lake Tributary 12 (SDLT12), significantly higher benthic invertebrate density but significantly lower relative abundance of mayflies, blackflies, filterers, and clingers compared to the reference creek were consistent with a difference in habitat between watercourses that most notably included slower water velocities at SDLT12. However, temporal changes in the benthic invertebrate community of SDLT12 that included significantly lower richness and significantly higher relative abundance of collector-gatherers and burrowers following commencement of mine operations potentially indicated a mine-related reduction in flow and/or increased particle loadings (e.g., through dust and/or erosional deposition) over time at SDLT12. Therefore, some mine-related effects to biota of SDLT12 may have occurred since commercial mine operations commenced in 2015.

At Sheardown Lake Tributary 9 (SLDT9), significantly higher benthic invertebrate density and significant differences in community structure were indicated in 2018 compared to the reference creek. However, a significantly greater relative abundance of shredders and clingers at SDLT9 compared to the reference creek suggested that naturally differing amounts and/or types of in-stream vegetation accounted for the differing benthic invertebrate community structure between watercourses. Sampling conducted at SDLT9 during years of mine operation from 2015 to 2018 showed no consistent ecologically significant differences in benthic invertebrate density, richness, Simpson’s Evenness, or relative abundance of dominant taxonomic groups and FFG compared to data collected from the mine baseline period. Overall, no adverse mine-related effects to biota were indicated at SDLT9 following commencement of commercial mine operation in 2015.

4.2 Sheardown Lake Northwest (DLO-1)

4.2.1 Hydraulic Retention Time

A hydraulic retention time of 511 ± 213 days was estimated for Sheardown Lake NW by Minnow (2018) using mean annual watershed runoff extrapolated from Baffinland flow monitoring stations installed in small watershed watercourses (i.e., ≤15 km^2) located on the mine property and a lake volume of 8.18 million cubic metres.

4.2.2 Water Quality

Water quality profiles of *in situ* water temperature, dissolved oxygen, pH, and specific conductance conducted at Sheardown Lake NW in 2018 showed no substantial station-to-station differences during any of the winter, summer, or fall sampling events (Appendix Figures C.11 to C.14). No thermal stratification was indicated at Sheardown Lake NW during the winter, summer, or fall sampling events in 2018 (Figure 4.7). The average water temperature at the bottom of the water column at Sheardown Lake NW littoral and profundal stations was significantly warmer than at Reference Lake 3 during the August 2018 biological sampling (Figure 4.8). However, the incremental difference in average bottom water temperature between lakes at each respective depth was small (i.e., ≤0.6˚C) and thus was unlikely to be ecologically meaningful. Dissolved oxygen profiles at Sheardown Lake NW showed a slight oxycline at depths greater than approximately 14 m during the winter, but no appreciable change in dissolved oxygen saturation from surface to bottom in the summer and fall of 2018 (Figure 4.7; Appendix Figure C.12). Similar dissolved oxygen profiles were observed between Sheardown Lake NW and Reference Lake 3 at like depths during the summer and fall sampling events (Figure 4.7). On average, dissolved oxygen concentrations near the bottom of the water column were slightly greater at Sheardown Lake NW littoral and profundal stations than at like stations in Reference Lake 3 during the August 2018 biological sampling, the difference of which was significant only for the littoral stations (Figure 4.8). Notably, dissolved oxygen concentrations were well above the WQG of 9.5 mg/L at Sheardown Lake NW during the fall sampling events in 2018 (Figure 4.8; Appendix Table C.40).

In situ profiles of pH and specific conductance showed no substantial step changes from the surface to bottom of the Sheardown Lake NW water column during any of the three sampling seasons in 2018, indicating no chemical stratification (Figure 4.7). Mean pH at the bottom of the water column at littoral and profundal stations of Sheardown Lake NW was significantly higher than at Reference Lake 3 during fall sampling in 2018 (Figure 4.8; Appendix Table C.37). However, pH values were consistently within WQG limits of 6.5 to 9.0 through the entire water column during all 2018 sampling events conducted at Sheardown Lake NW (Figures 4.7 and 4.8; Appendix Tables C.33 to C.36). Specific conductance was significantly higher at Sheardown Lake NW compared to Reference Lake 3 during fall sampling (Figure 4.8; Appendix Table C.42). However, specific conductance at Sheardown Lake NW was only slightly higher than that of reference creek and river stations in fall 2018 (i.e., range from 67 to 107 µS/cm), and therefore it was unclear whether higher specific conductance at Sheardown Lake NW than at Reference Lake 3 was related to natural regional variability in surface waters or a mine-related influence. Water clarity, as determined through evaluation of Secchi depth, was significantly lower at Sheardown Lake NW than at Reference Lake 3 during the August 2018 biological sampling (Appendix Table C.42; Appendix Figure C.7). Secchi depth readings showed relatively low variability among stations at Sheardown Lake NW, suggesting no spatial differences in water clarity across the lake (Appendix Table C.40).

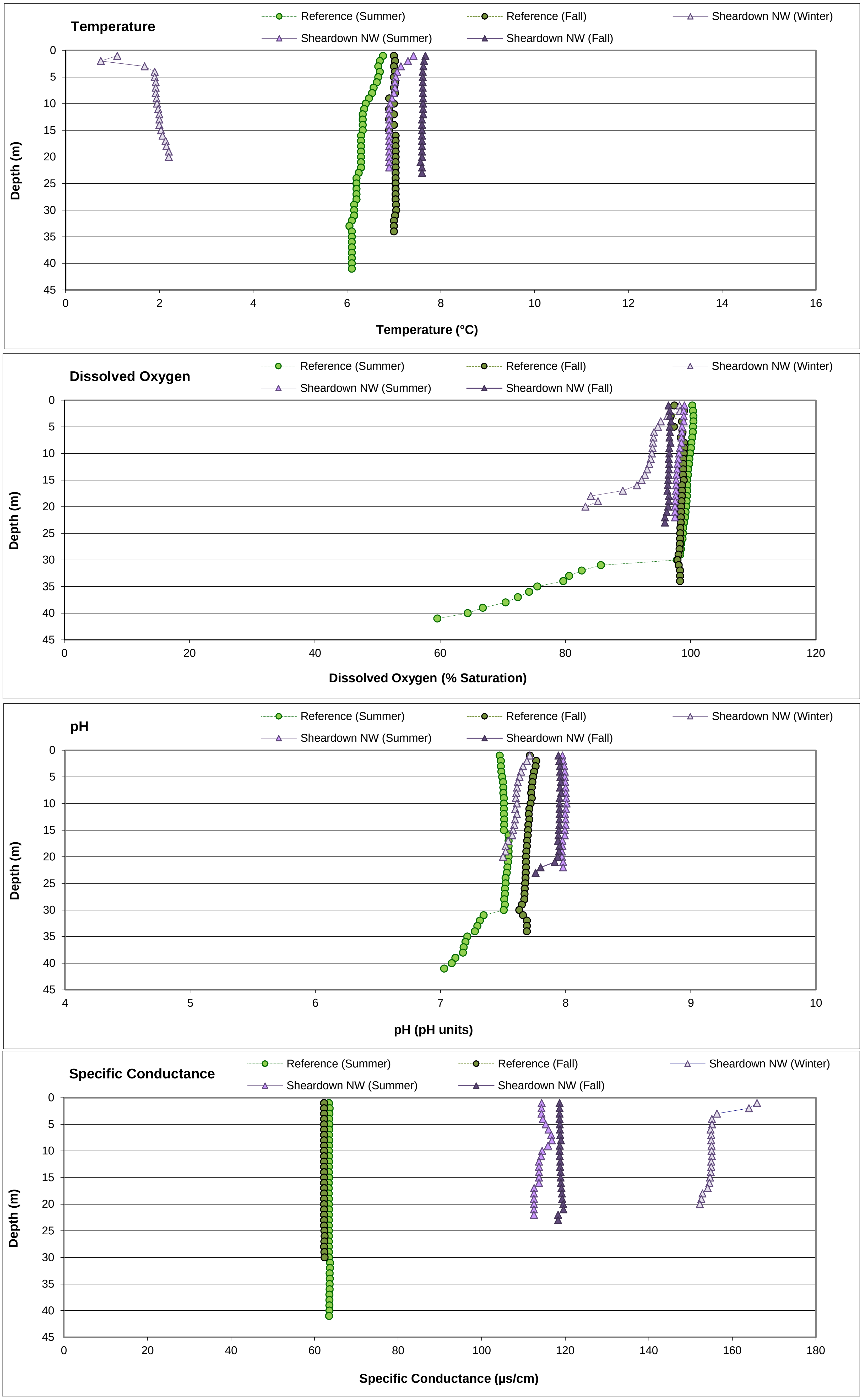

Figure 4.7: **Average *In Situ* Water Quality with Depth from Surface at Sheardown Lake NW (DLO-01) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2018**

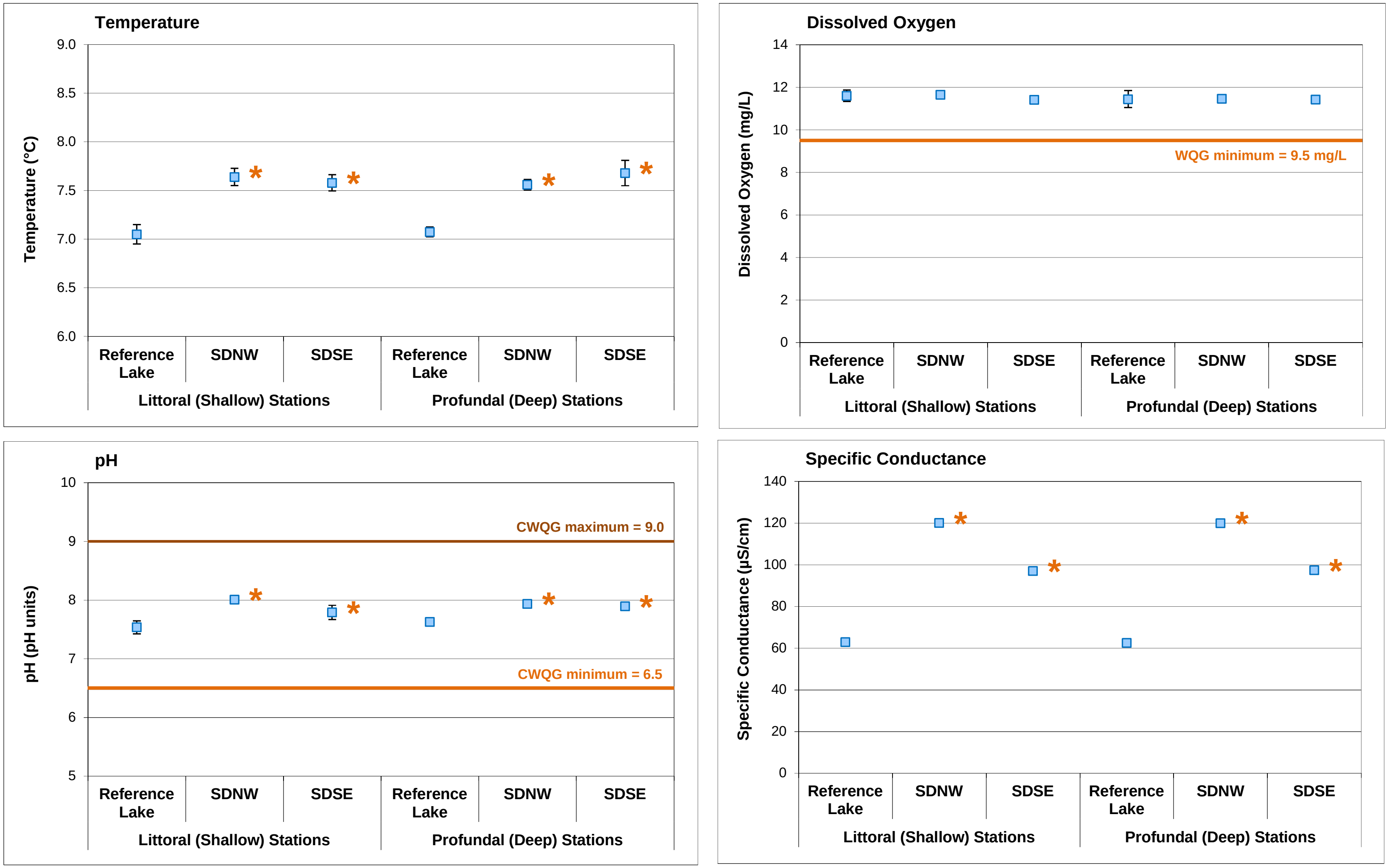

Figure 4.8: **Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Sheardown Lake Basins (SDNW and SDSE) and Reference Lake 3 (REF3) Littoral and Profundal Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018**

Note: An asterisk (*) next to data point indicates mean value differs significantly from the Reference Lake 3 mean for the respective littoral or profundal station type.

Water chemistry within Sheardown Lake NW showed no distinct spatial differences in parameter concentrations among the six sampling stations during any of the winter, summer, or fall sampling events in 2018 (Table 4.2; Appendix Table C.43), suggesting that the lake waters were continually well mixed both laterally and vertically. Turbidity, chloride concentrations, and total concentrations of aluminum, manganese, molybdenum, and uranium were elevated (i.e., ≥3-fold higher) at Sheardown Lake NW compared to Reference Lake 3 during the summer and/or fall sampling events (Table 4.2; Appendix Tables C.43 and C.44). Similar to previous studies, total aluminum and manganese concentrations showed a moderately strong positive correlation with turbidity at Sheardown Lake NW in 2018 (r_s = 0.56 and 0.57, respectively; Appendix Table C.47). This suggested that elevated total aluminum and manganese concentrations at Sheardown Lake NW may have reflected influences associated with surface runoff and/or backflow received from Mary River that contained naturally high concentrations of aluminum and manganese bearing particulate minerals. This was supported by an evaluation of dissolved metal concentrations, which indicated similar dissolved aluminum concentrations between Sheardown Lake NW and Reference Lake 3 (Appendix Table C.46), and the lack of a strong correlation between dissolved concentrations of these metals and turbidity (Appendix Table C.47). In addition, the ratio of dissolved to total concentrations of aluminum and manganese indicated that the majority (i.e., approximately 80%) of each of these metals was in the particulate fraction at Sheardown Lake NW. Total and dissolved concentrations of molybdenum and uranium were not positively correlated with turbidity (Appendix Table C.47), suggesting that these metals were not associated with suspended particulate matter. Despite elevation of total aluminum, manganese, molybdenum, and uranium concentrations at Sheardown Lake NW compared to Reference Lake 3, concentrations of each of these metals were well below applicable WQG and AEMP benchmarks at Sheardown Lake NW during all sampling events in 2018 (Table 4.2; Appendix Table C.43).

Temporal comparisons of the Sheardown Lake NW water chemistry data suggested that 2018 seasonal average total and dissolved concentrations of most parameters were within their respective range of baseline concentrations (Figure 4.9; Appendix Figure C.19). Key exceptions included concentrations of chloride, sulphate, total and dissolved manganese, and dissolved molybdenum, which showed slight elevation (i.e., 3- to 5-fold higher) in 2018 compared to the baseline data in at least one seasonal period (Appendix Tables C.44 and C.46). Conductivity, hardness, and concentrations of chloride, molybdenum, sodium, strontium, and sulphate showed successively higher concentrations over years of mine-construction (2014) through mine operation (2015 to 2018) during fall sampling events at Sheardown Lake NW (Figure 4.9; Appendix Figure C.19). The magnitude of these year-to-year changes were relatively minor and unlikely to be ecologically meaningful given parameter concentrations remained well below WQG.

Table 4.2: Water Chemistry at Sheardown Lake NW (DLO-01) and Reference Lake 3 (REF3) Monitoring Stations[a], Mary River Project CREMP, August 2018

Parameters		Units	Water Quality Guideline (WQG)^b	AEMP Benchmark^c	Reference Lake 3 Average (n = 3)	Sheardown Lake NW Station					
						DD-HAB9 STN1	DL0-01-5	DL0-01-1	DL0-01-4	DL0-01-2	DL0-01-7
					Fall 2018	21-Aug-2018	22-Aug-2018	21-Aug-2018	22-Aug-2018	22-Aug-2018	22-Aug-2018
Conventionals^b	Conductivity (lab)	umho/cm	-	-	75	139	137	133	140	140	141
	pH (lab)	pH	6.5 - 9.0	-	7.65	7.98	7.99	7.96	7.99	8.00	8.02
	Hardness (as $CaCO_3$)	mg/L	-	-	35	69	68	70	67	69	68
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	2.2	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	46	63	83	57	73	73	80
	Turbidity	NTU	-	-	0.51	0.96	0.92	0.96	0.92	0.96	0.95
	Alkalinity (as $CaCO_3$)	mg/L	-	-	33	52	51	52	52	49	52
Nutrients and Organics	Total Ammonia	mg/L	variable^c	0.855	0.044	0.039	0.023	0.033	0.02	0.021	0.02
	Nitrate	mg/L	13	13	<0.020	0.096	0.077	0.086	0.081	0.079	0.078
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.16	<0.15	<0.15	0.155	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.9	2.3	2.5	2.2	2.6	2.5	2.5
	Total Organic Carbon	mg/L	-	-	3.8	2.3	2.6	2.6	2.7	2.7	2.6
	Total Phosphorus	mg/L	0.020^{α}	-	0.005	0.005	0.004	0.011	0.005	0.004	0.004
	Phenols	mg/L	0.004^{α}	-	0.001	0.0012	<0.0010	0.0022	0.0011	0.0011	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.3	3.5	3.5	3.5	3.5	3.5	3.5
	Sulphate (SO_4)	mg/L	218^{β}	218	3.7	9.5	9.3	9.3	9.3	9.5	9.4
Total Metals	Aluminum (Al)	mg/L	0.100	$0.179, 0.173^d$	0.004	0.022	0.018	0.040	0.018	0.014	0.021
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00644	0.00689	0.00694	0.00700	0.00709	0.00592	0.00692
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	7.2	12.0	11.7	12.3	12.1	11.7	12.1
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	<0.00010	0.000115	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0008	0.0009	0.0012	0.0010	0.0009	0.0007	0.0009
	Iron (Fe)	mg/L	0.30	0.300	<0.030	0.0325	<0.030	0.0645	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	0.000107	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.001	0.00105	0.0011	0.0011	0.0011	0.0011	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.3	8.6	8.5	8.6	8.5	7.3	8.5
	Manganese (Mn)	mg/L	0.935^{β}	-	0.00064	0.01115	0.01004	0.01345	0.00974	0.00905	0.01035
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00014	0.00081	0.00079	0.00074	0.00082	0.00079	0.00081
	Nickel (Ni)	mg/L	0.025	0.025	0.0005	0.00077	0.00075	0.00082	0.00076	0.00064	0.00102
	Potassium (K)	mg/L	-	-	0.86	1.31	1.28	1.30	1.29	1.12	1.29
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.42	0.44	0.43	0.45	0.44	0.41	0.44
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.86	1.68	1.65	1.66	1.62	1.57	1.64
	Strontium (Sr)	mg/L	-	-	0.0081	0.0089	0.0091	0.0088	0.0088	0.0086	0.0088
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)	mg/L	0.015	-	0.00026	0.00095	0.00099	0.00101	0.00096	0.00095	0.00095
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Values presented are averages from samples taken from the surface and the bottom of the water column at each station.

[b] Canadian Water Quality Guideline (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[c] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake NW.

[d] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively (Intrinsik 2013).

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Figure 4.9: **Temporal Comparison of Water Chemistry at Sheardown Lake Northwest (DLO-01) and Sheardown Lake Southeast (DLO-02) for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2018) Periods during Fall**

Notes: Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Sheardown Lake (northwest and southeast).

4.2.3 Sediment Quality

Surficial sediment at Sheardown Lake NW varied from silt and sandy loam to loam at littoral areas, to primarily silt loam at profundal areas (Figure 4.10; Appendix Table D.11). Surficial sediment at littoral and profundal areas of Sheardown Lake NW had significantly less sand and significantly more silt than at Reference Lake 3 (Appendix Table D.12). In addition, the TOC content of profundal sediment at Sheardown Lake NW was significantly lower than at Reference Lake 3 (Figure 4.10; Appendix Table D.12). Similar to observations at Reference Lake 3 and Camp Lake, reddish- to orange-brown oxidized material was commonly observed on the surface of Sheardown Lake NW littoral and profundal sediments (Appendix Tables D.10 and D.11). In Sheardown Lake NW, this material occasionally occurred as a thin, distinct layer that was likely composed principally of iron (oxy)hydroxide precipitate. Substrate of Sheardown Lake NW exhibited some blackening (or unusually dark colouration), but no noticeable sulphidic odour, at the time of the August 2018 sampling event (Appendix Tables D.10 and D.11), suggesting the occurrence of reducing conditions in the sediment similar to that observed at Reference Lake 3 (Appendix Tables D.1 and D.2).

Sediment metal concentrations at Sheardown Lake NW showed no consistent spatial differences from stations located nearest to key tributary inlets (e.g., SDLT1 and SDLT12) to those located near the lake outlet in 2018 (Appendix Table D.13). However, iron and phosphorus concentrations in sediment appeared to be highest at Sheardown Lake NW stations situated closest to the outlet of SDLT1 (Stations DD-HAB 9-STN2; Appendix Table D.13). This was consistent with the previous CREMP study, which indicated that SDLT1 was a source of iron loadings to the lake (Minnow 2018). Metal concentrations in littoral and profundal sediment of Sheardown Lake NW were very similar to averages observed for like sampling depths at Reference Lake 3 in 2018 (Table 4.3; Appendix Table D.14), suggesting no marked mine-related influences on sediment metal concentrations at Sheardown Lake NW. Although mean concentrations of iron and manganese were above SQG in sediment at littoral and/or profundal stations of Sheardown Lake NW, the mean concentration of these metals was also above SQG in sediment at Reference Lake 3 (Table 4.3). On average, nickel concentrations were above SQG in sediment at profundal stations, as were concentrations of phosphorus and chromium in sediment at individual littoral and profundal stations, respectively, at Sheardown Lake NW in 2018 (Table 4.3; Appendix Table D.13). However, phosphorus and chromium concentrations were also elevated above SQG in sediment at individual littoral and profundal stations, respectively, at

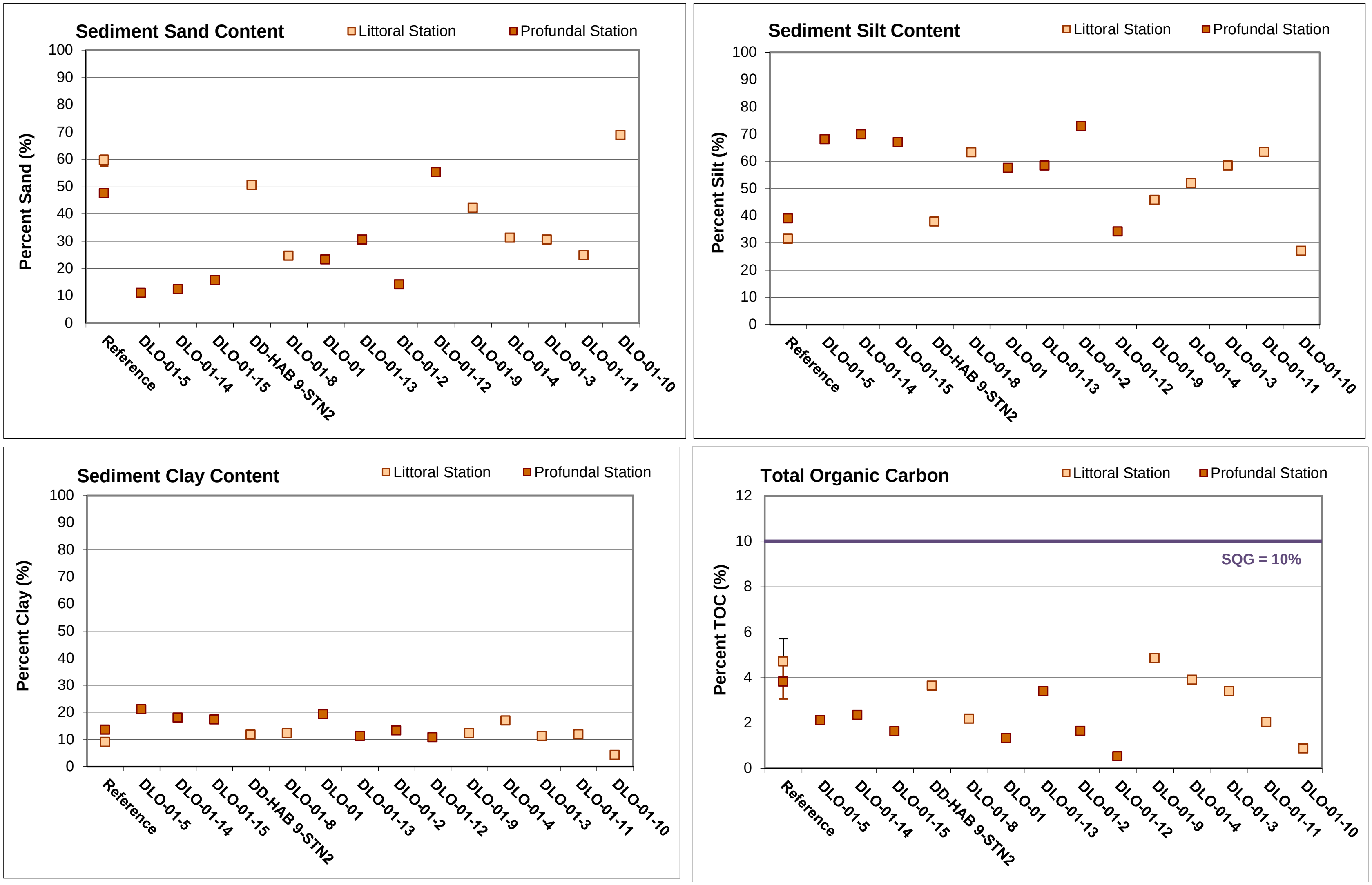

Figure 4.10: Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Sheardown Lake NW (DLO-01) Sediment Monitoring Stations and Reference Lake 3 (mean ± SE), Mary River Project CREMP, August 2018

Table 4.3: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Sheardown Lake NW (DLO-01), Sheardown Lake SE (DLO-02), and Reference Lake 3 (REF3) Sediment Monitoring Stations, Mary River Project CREMP, August 2018

Parameter		Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b] (NW, SE)	Littoral			Profundal		
					Reference Lake (n = 5)	Sheardown Lake NW (n=4)	Sheardown Lake SE (n=3)	Reference Lake (n = 5)	Sheardown Lake NW (n=3)	Sheardown Lake SE (n=2)
					Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error
Total Organic Carbon		%	10[α]	-	4.7 ± 1.0	3.0 ± 0.7	1.3 ± 0.2	3.8 ± 0.8	2.1 ± 0.52	1.2 ± 0.02
Metals	Aluminum (Al)	mg/kg	-	-	17,880 ± 1,993	6,640 ± 3,767	16,800 ± 866	24,420 ± 3,494	24,067 ± 1,934	16,650 ± 50
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	0.11 ± 0.01	<0.10 ± 9.813E-18	<0.10 ± 0	<0.10 ± 0.00	<0.10 ± 0
	Arsenic (As)	mg/kg	17	6.2, 5.9	5.25 ± 0.95	4.56 ± 3.76	4.57 ± 0.76	***6.07*** ± 0.78	***6.28*** ± 0.74	3.32 ± 0.30
	Barium (Ba)	mg/kg	-	-	133 ± 25	134 ± 118	95 ± 9	152 ± 22.8	128 ± 12	82 ± 6.8
	Beryllium (Be)	mg/kg	-	-	0.68 ± 0.08	0.33 ± 0.16	0.76 ± 0.044	0.87 ± 0.1218	1.19 ± 0.063	0.78 ± 0.015
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0	0.22 ± 0.018	0.23 ± 0.028	<0.2 ± 0.0	0.31 ± 0.018	0.20 ± 0.0000
	Boron (B)	mg/kg	-	-	13.9 ± 1.59	9.9 ± 3.69	17.6 ± 0.62	15.6 ± 2.208	29.3 ± 2.70	17.5 ± 1.55
	Cadmium (Cd)	mg/kg	3.5	1.5, 1.5	0.195 ± 0.044	0.143 ± 0.104	0.108 ± 0.00551	0.197 ± 0.005	0.318 ± 0.023	0.088 ± 0.0015
	Calcium (Ca)	mg/kg	-	-	5,480 ± 804	1,891 ± 1,045	6,507 ± 1,402	5,584 ± 664	5,070 ± 345	5,805 ± 495
	Chromium (Cr)	mg/kg	90	97, 79	58.9 ± 7.7	26 ± 14	76 ± 7.4	77.3 ± 11.0	89 ± 6.6	66 ± 1.75
	Cobalt (Co)	mg/kg	-	-	11.7 ± 1.401	5.9 ± 3.50	13.5 ± 0.7	17.4 ± 2.4	19.1 ± 1.1	13.1 ± 0.400
	Copper (Cu)	mg/kg	110	58, 56	***73.9*** ± 11.02	18 ± 11	28 ± 2.0	***96.3*** ± 14.7	55 ± 4.7	27 ± 0.35
	Iron (Fe)	mg/kg	40,000[α]	52,200, 34,400	***46,700*** ± 9,489	26,440 ± 18,271	***40,533*** ± 2,664	***50,900*** ± 7,115	***53,567*** ± 4,807	***36,350*** ± 1,950
	Lead (Pb)	mg/kg	91.3	35	16.4 ± 2.1	7.8 ± 4.57	16.9 ± 1.20	19.5 ± 2.8	25.8 ± 1.6	15.8 ± 0.200
	Lithium (Li)	mg/kg	-	-	26.0 ± 2.7	11.1 ± 6.18	30.0 ± 0.96	36.1 ± 5.0	39.7 ± 1.7	35.0 ± 2.20
	Magnesium (Mg)	mg/kg	-	-	11,104 ± 1,352	4,625 ± 2,530	13,900 ± 1,375	15,394 ± 2,199	15,667 ± 1,065	12,950 ± 50.0
	Manganese (Mn)	mg/kg	1,100[α,β]	4,530, 657	640 ± 60	1,309 ± 1,188	***959*** ± 117	***1,279*** ± 115	3,258 ± 2,269	***713*** ± 270.5
	Mercury (Hg)	mg/kg	0.486	0.17	0.0433 ± 0.0111	0.0371 ± 0.0084	0.0218 ± 0.00139	0.0650 ± 0.0121	0.0415 ± 0.00942	0.0263 ± 0.0001
	Molybdenum (Mo)	mg/kg	-	-	3.84 ± 0.86	3.66 ± 2.92	1.43 ± 0.040	2.57 ± 0.27	4.33 ± 1.74	1.17 ± 0.300
	Nickel (Ni)	mg/kg	75[α,β]	77, 66	42.9 ± 5.9	29.7 ± 18.2	61.1 ± 6.17	53.8 ± 6.6	***78.4*** ± 5.0	51.2 ± 1.400
	Phosphorus (P)	mg/kg	2,000[α]	1,958, 1,278	***1,305*** ± 272	720 ± 506	1,135 ± 124	1,188 ± 118	1,213 ± 117	955 ± 38.0
	Potassium (K)	mg/kg	-	-	4,134 ± 469	1,638 ± 906	3,970 ± 197	5,660 ± 796	6,023 ± 540	4,055 ± 135
	Selenium (Se)	mg/kg	-	-	0.66 ± 0.14	0.29 ± 0.09	0.20 ± 0.00	0.81 ± 0.153	0.44 ± 0.061	0.20 ± 0.0000
	Silver (Ag)	mg/kg	-	-	0.15 ± 0.02	0.11 ± 0.013	0.11 ± 0.006	0.26 ± 0.042	0.20 ± 0.018	0.11 ± 0.0000
	Sodium (Na)	mg/kg	-	-	320 ± 43	108 ± 42	245 ± 12	433 ± 62	331 ± 20	249 ± 2.5
	Strontium (Sr)	mg/kg	-	-	12.2 ± 1.476	4.2 ± 2.19	10.5 ± 0.874	13.8 ± 1.62	12.9 ± 0.76	9.5 ± 0.090
	Sulphur (S)	mg/kg	-	-	1,780 ± 349.85711	1,025 ± 25	<1,000 ± 0	1,400 ± 130.4	<1,000 ± 0	<1,000 ± 0
	Thallium (Tl)	mg/kg	-	-	0.45 ± 0.063	0.21 ± 0.12	0.39 ± 0.031	0.754 ± 0.091	0.64 ± 0.07	0.37 ± 0.0005
	Tin (Sn)	mg/kg	-	-	2.00 ± 0	<2.0 ± 0	<2.0 ± 0	<2.1 ± 0.0	<2.0 ± 0.0	<2.0 ± 0
	Titanium (Ti)	mg/kg	-	-	1,155 ± 132	431 ± 231	1,247 ± 47	1,388 ± 163	1,483 ± 123.5	1,225 ± 15.0
	Uranium (U)	mg/kg	-	-	13.4 ± 2.32	3.47 ± 2.18	4.86 ± 0.026	24.5 ± 3.90	9.56 ± 0.85	5.34 ± 0.095
	Vanadium (V)	mg/kg	-	-	58.3 ± 6.90	20.1 ± 11.3	50.3 ± 2.75	72.7 ± 9.36	70.5 ± 6.18	48.2 ± 0.400
	Zinc (Zn)	mg/kg	315	135	81.4 ± 10.17	24.5 ± 14.3	55.2 ± 2.20	99.2 ± 14.16	83.0 ± 5.65	55.5 ± 0.050
	Zirconium (Zr)	mg/kg	-	-	4.1 ± 0.8	3.5 ± 1.50	14.1 ± 0.85	3.88 ± 0.483	9.13 ± 1.42	16.7 ± 0.00

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2017)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to the Sheardown Lake basins

▨	Indicates parameter concentration above Sediment Quality Guideline (SQG).
BOLD	Indicates parameter concentration above the AEMP Benchmark.

Reference Lake 3 (Table 4.3; Appendix Table D.13), indicating naturally elevated concentrations of these metals, in addition to iron and manganese, in sediment of local study area lakes. Average concentrations of iron and nickel were above Sheardown Lake NW AEMP benchmarks in profundal sediment, however concentrations of these metals were not unlike those observed in profundal sediment at Reference Lake 3 (Table 4.3; Appendix Tables D.13 and D.14).

Temporal comparisons indicated that metal concentrations in sediment at littoral and profundal stations of Sheardown Lake NW in 2018 were comparable to those observed during the mine baseline (2005 to 2013) period (Figure 4.11; Appendix Table D.14). On average, the 2018 metal concentrations in sediment at Sheardown Lake NW littoral stations were in the lower range, and at profundal stations were in the upper range, of those observed at respective station types from 2015 to 2017 (Figure 4.11). No consistent increase in average metal concentrations appeared to occur from 2015 to 2018 at the Sheardown Lake NW littoral stations, but at profundal stations, visual evaluation of plotted data suggested very slightly increasing concentrations of a number of metals occurring from the onset of commercial mine operations in 2015 (Figure 4.11). Nevertheless, based on evaluation of data current to 2018, only minor changes in sediment metal concentrations were indicated at Sheardown Lake NW littoral and profundal stations following the commencement of commercial mine operations in 2015.

4.2.4 Phytoplankton

Chlorophyll-a concentrations at Sheardown Lake NW showed no consistent spatial gradients with progression towards the lake outlet among the winter, summer, and fall sampling events in 2018 (Figure 4.12). Chlorophyll-a concentrations differed significantly among seasons at Sheardown Lake NW in 2018, with highest and lowest concentrations observed in summer and winter, respectively (Appendix Table E.6). The direction of seasonal differences in chlorophyll-a concentrations at Sheardown Lake NW contrasted with those at Reference Lake 3, where highest chlorophyll-a concentrations occurred during the fall sampling event (Appendix Table B.8). Although chlorophyll-a concentrations were significantly higher at Sheardown Lake NW compared to Reference Lake 3 for both the summer and fall sampling events in 2018 (Appendix Tables E.7 and E.8), chlorophyll-a concentrations during each of the winter, summer, and fall sampling events were well below the AEMP benchmark of 3.7 μg/L (Figure 4.12). Chlorophyll-a concentrations at Sheardown Lake NW were suggestive of an oligotrophic status using Wetzel (2001) lake trophic status classifications. This trophic status classification was consistent with an oligotrophic categorization for Sheardown Lake NW using CWQG classifications based on aqueous total phosphorus concentrations (i.e., concentrations below 10 μg/L; Table 4.2; Appendix Table C.43).

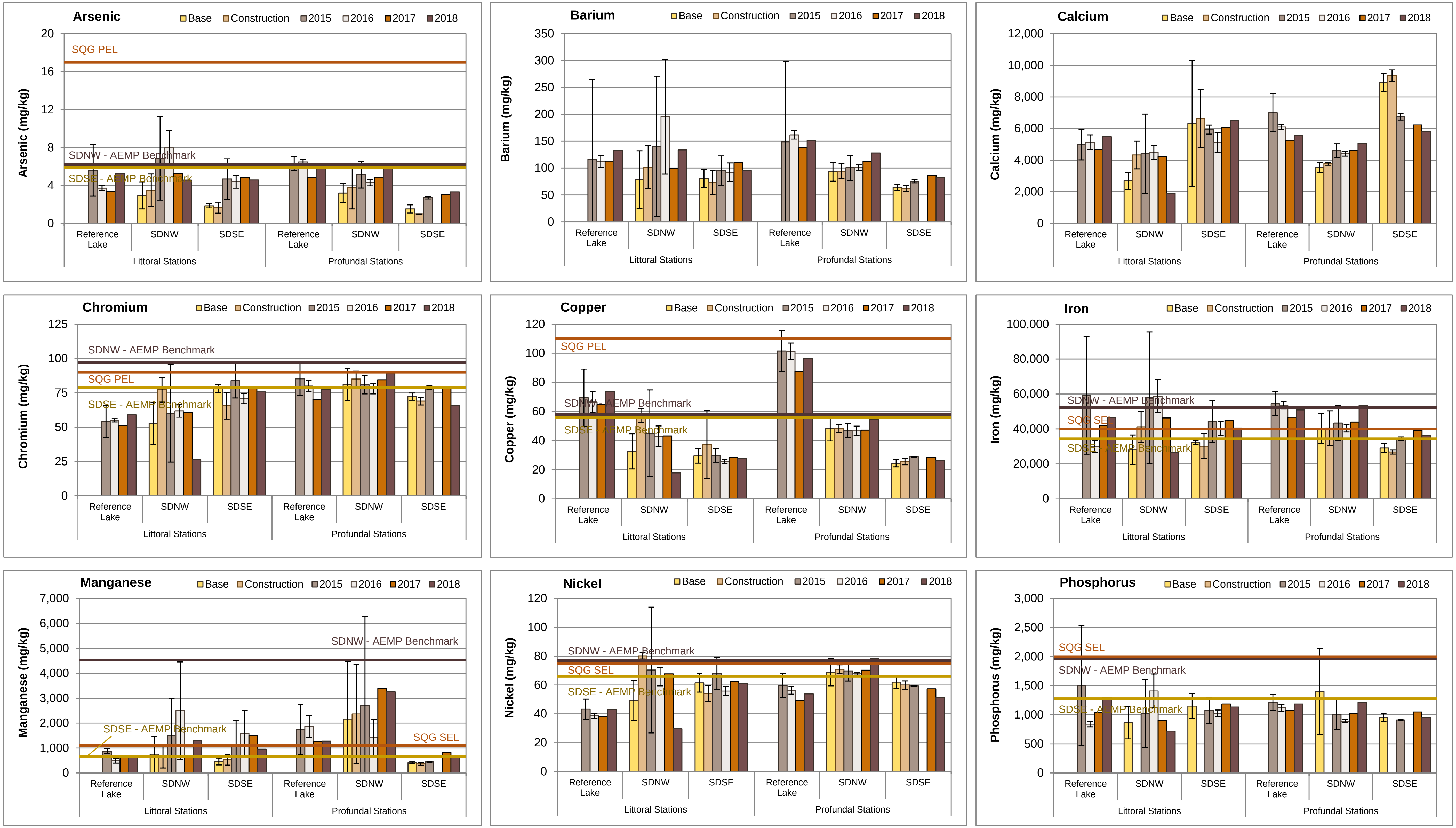

Figure 4.11: Temporal Comparison of Sediment Metal Concentrations (mean ± SD) at Littoral and Profundal Stations of Sheardown Lake NW (SDNW), Sheardown Lake SE (SDSE), and Reference Lake 3 for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2018) Periods

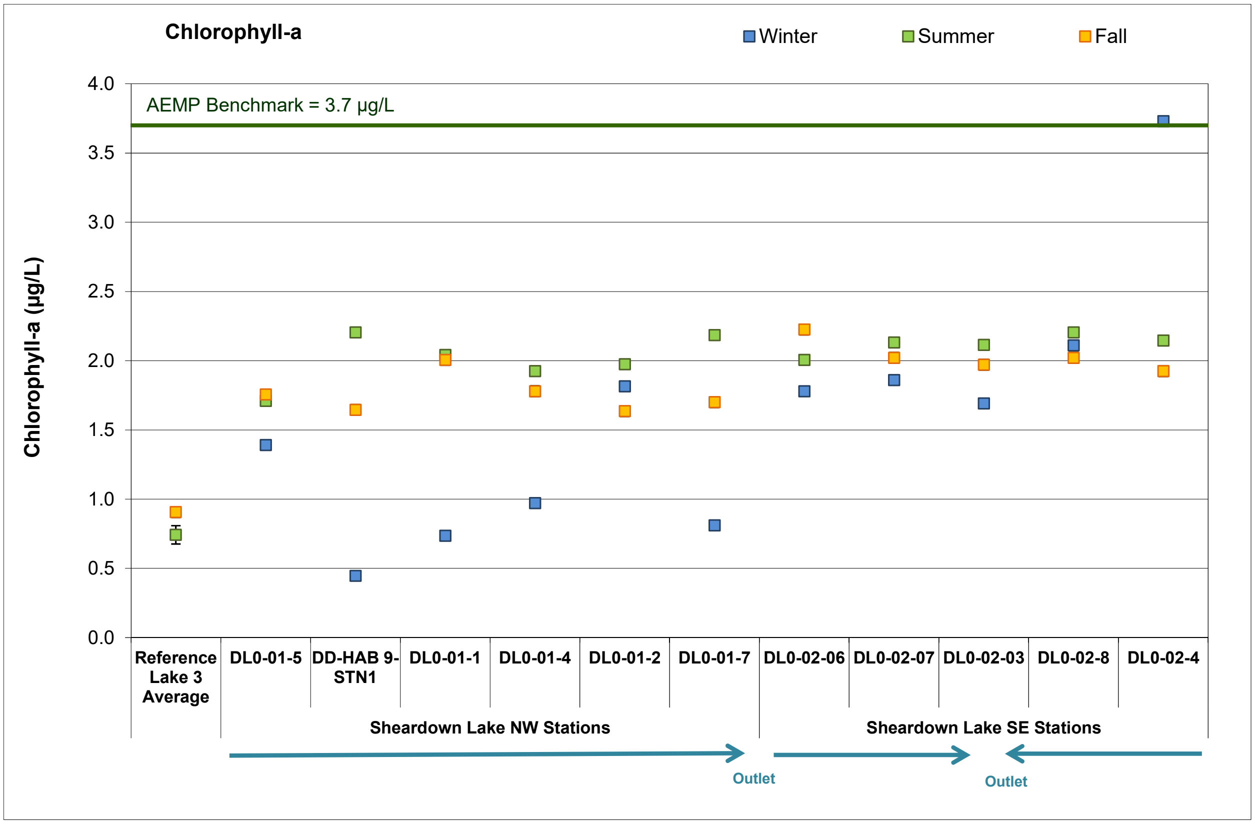

Figure 4.12: Chlorophyll-a Concentrations at Sheardown Lake NW (DLO-1) and Sheardown Lake SE (DLO-2) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2018

Notes: Values are averages of samples taken from the surface and the bottom of the water column at each station. Reference values are expressed as mean ± standard deviation (n = 3). Reference Lake 3 was not sampled in winter 2018.

Temporally, Sheardown Lake NW chlorophyll-a concentrations did not differ significantly between 2018 and years of mine construction (2014) or previous mine operation (2015 to 2016) in any consistent direction for the winter, summer, or fall seasons (Figure 4.13; Appendix Table E.11). This suggested no ecologically meaningful changes in the trophic status of Sheardown Lake NW since the onset of mine operations at the Mary River Project. No chlorophyll-a data are available for Sheardown Lake NW over the mine baseline period (2005 to 2013), precluding comparisons of Sheardown Lake NW chlorophyll-a data to the period prior to mine construction.

4.2.5 Benthic Invertebrate Community

Benthic invertebrate density and richness were significantly higher at littoral and profundal habitats of Sheardown Lake NW compared to like-habitat stations at Reference Lake 3. With the exception of richness at littoral habitat, these differences were at magnitudes outside of the $\mathrm{CES_{BIC}}$ of ±2 $\mathrm{SD_{REF}}$ indicating they were ecologically meaningful (Tables 4.4 and 4.5). In addition

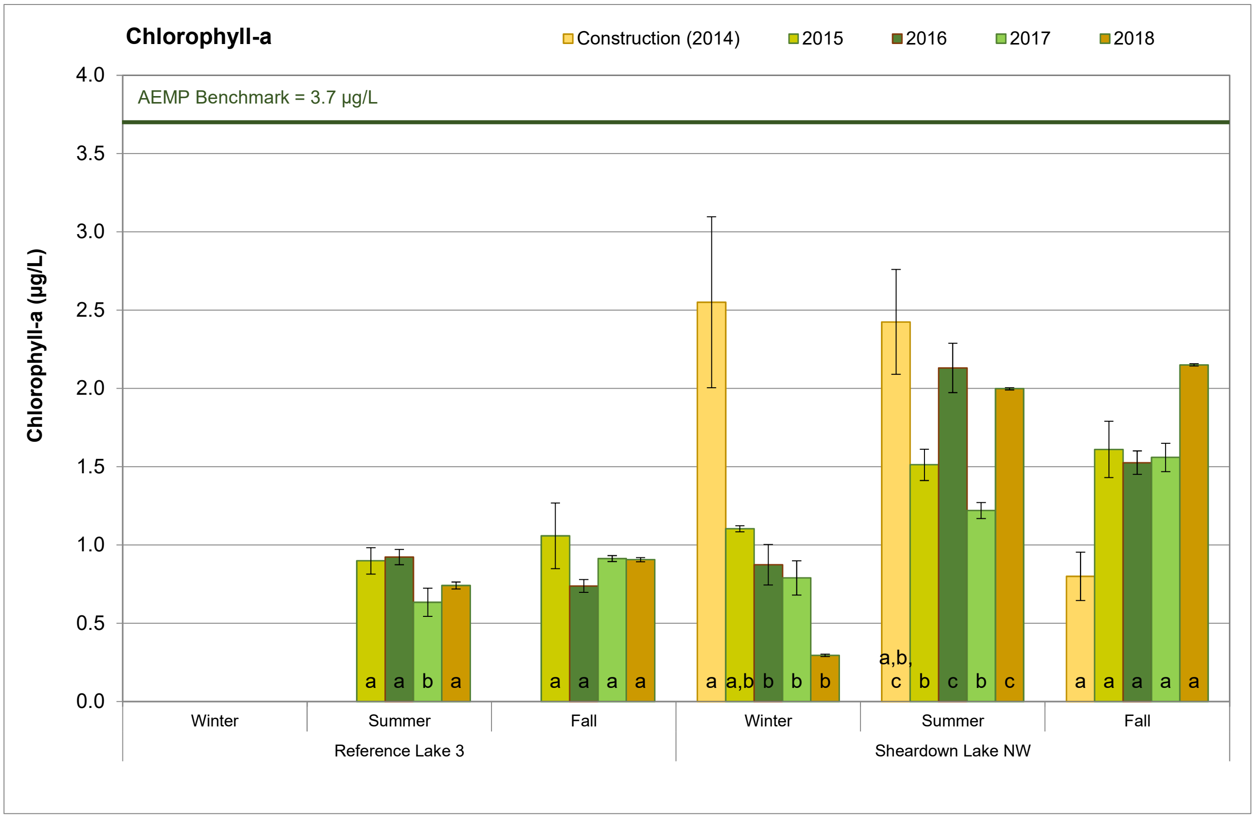

Figure 4.13: Temporal Comparison of Chlorophyll-a Concentrations Among Seasons between Sheardown Lake NW and Reference Lake 3 for Mine Construction (2014) and Operational (2015 to 2018) Periods (mean ± SE)

Note: Bars with the same letter at the base do not differ significantly between years for the applicable season.

Table 4.4: Benthic Invertebrate Community Statistical Comparison Results between Sheardown Lake NW (DLO-01) and Reference Lake 3 for Littoral Habitat Stations, Mary River Project CREMP, August 2018

Metric	Statistical Test Results					Summary Statistics						
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis	Magnitude of Difference [a] (No. of SD)	Study Lake Littoral Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (Individuals/m^2)	log	YES	< 0.001	ANOVA	20.7	Reference Lake 3	1,045	258	116	696	1,000	1,391
						Sheardown NW Littoral	6,390	3,751	1,677	3,087	5,530	11,861
Richness (Number of Taxa)	none	YES	0.007	ANOVA	1.8	Reference Lake 3	10.8	2.3	1.0	7.0	11.0	13.0
						Sheardown NW Littoral	15.0	1.2	0.5	14.0	15.0	17.0
Simpson's Evenness (E)	square root	NO	0.949	ANOVA	-0.5	Reference Lake 3	0.825	0.103	0.046	0.720	0.816	0.939
						Sheardown NW Littoral	0.769	0.163	0.073	0.558	0.827	0.914
Bray-Curtis Index	square root	YES	< 0.001	ANOVA	5.5	Reference Lake 3	0.313	0.092	0.041	0.178	0.358	0.394
						Sheardown NW Littoral	0.823	0.059	0.027	0.754	0.827	0.900
Nemata (%)	square root	NO	0.254	ANOVA	-0.7	Reference Lake 3	7.1	8.8	3.9	0.0	3.4	21.3
						Sheardown NW Littoral	1.3	1.0	0.5	0.3	1.2	2.8
Ostracoda (%)	fourth root	NO	0.381	ANOVA	-0.6	Reference Lake 3	23.9	18.3	8.2	3.4	20.6	53.3
						Sheardown NW Littoral	13.0	4.1	1.8	9.2	11.6	19.1
Chironomidae (%)	none	NO	0.133	ANOVA	0.8	Reference Lake 3	66.9	22.2	10.0	35.5	73.8	91.4
						Sheardown NW Littoral	83.7	2.9	1.3	78.8	84.8	85.7
Metal-Sensitive Chironomidae (%)	log	NO	0.135	ANOVA	-0.9	Reference Lake 3	36.5	19.6	8.8	17.8	27.5	60.1
						Sheardown NW Littoral	18.3	15.0	6.7	1.4	20.9	35.5
Collector-Gatherers (%)	log	YES	0.084	ANOVA	1.1	Reference Lake 3	55.6	19.0	8.5	33.0	57.5	79.2
						Sheardown NW Littoral	76.2	13.1	5.9	60.7	77.8	90.7
Filterers (%)	fourth root	NO	0.148	ANOVA	-0.9	Reference Lake 3	33.9	18.7	8.4	15.5	24.9	56.6
						Sheardown NW Littoral	17.5	15.7	7.0	0.3	20.6	35.2
Shredders (%)	square root	YES	< 0.001	ANOVA	-2.6	Reference Lake 3	7.0	2.6	1.1	2.9	7.5	9.4
						Sheardown NW Littoral	0.4	0.4	0.2	0.0	0.3	1.1
Clingers (%)	none	YES	0.014	ANOVA	-1.4	Reference Lake 3	36.1	18.4	8.2	17.1	26.9	58.3
						Sheardown NW Littoral	9.6	4.7	2.1	4.5	7.9	15.5
Sprawlers (%)	log	NO	0.409	ANOVA	-0.5	Reference Lake 3	51.9	17.7	7.9	29.5	52.5	71.8
						Sheardown NW Littoral	42.5	17.0	7.6	25.9	36.3	65.0
Burrowers (%)	log	YES	< 0.002	ANOVA	5.6	Reference Lake 3	12.0	6.4	2.8	6.9	11.1	22.6
						Sheardown NW Littoral	47.8	19.6	8.8	21.5	48.1	69.6

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

▨ Grey shading indicates statistically significant difference between study areas based on p-value less than 0.10.

🟦 Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a CES of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

Table 4.5: Benthic Invertebrate Community Statistical Comparison Results between Sheardown Lake NW (DLO-01) and Reference Lake 3 for Profundal Habitat Stations, Mary River Project CREMP, August 2018

Metric	Statistical Test Results					Summary Statistics						
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis	Magnitude of Difference [a] (No. of SD)	Study Lake Profundal Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (Individuals/m^2)	none	YES	< 0.001	ANOVA	5.1	Reference Lake 3	377	155	69	104	452	470
						Sheardown NW Profundal	1,163	242	108	930	1,052	1,513
Richness (Number of Taxa)	none	YES	0.044	ANOVA	3.0	Reference Lake 3	5.4	1.3	0.6	4.0	6.0	7.0
						Sheardown NW Profundal	9.4	3.5	1.6	5.0	10.0	14.0
Simpson's Evenness (E)	log	NO	0.294	ANOVA	0.1	Reference Lake 3	0.455	0.296	0.132	0.218	0.296	0.933
						Sheardown NW Profundal	0.491	0.132	0.059	0.331	0.545	0.632
Bray-Curtis Index	log	YES	0.014	ANOVA	1.5	Reference Lake 3	0.224	0.304	0.136	0.0505	0.109	0.763
						Sheardown NW Profundal	0.686	0.268	0.120	0.429	0.584	0.976
Hydracarina (%)	square root	NO	0.486	ANOVA	0.6	Reference Lake 3	3.7	3.8	1.7	0.0	3.9	8.7
						Sheardown NW Profundal	5.9	1.7	0.8	3.4	5.8	7.9
Ostracoda (%)	none	NO	0.873	ANOVA	-0.1	Reference Lake 3	3.1	2.9	1.3	0.0	2.0	7.5
						Sheardown NW Profundal	2.9	2.4	1.1	0.0	2.8	6.6
Chironomidae (%)	none	NO	0.892	ANOVA	-0.1	Reference Lake 3	90.8	4.9	2.2	82.7	92.2	95.7
						Sheardown NW Profundal	90.4	3.8	1.7	87.5	88.1	96.6
Metal-Sensitive Chironomidae (%)	log	NO	0.222	ANOVA	-0.5	Reference Lake 3	11.4	16.8	7.5	2.3	3.9	41.4
						Sheardown NW Profundal	3.3	2.0	0.9	0.9	3.5	6.0
Collector-Gatherers (%)	rank	NO	0.222	ANOVA	-0.3	Reference Lake 3	89.8	13.6	6.1	66.3	96.2	100.0
						Sheardown NW Profundal	85.2	7.7	3.5	71.9	88.3	91.4
Filterers (%)	fourth root	NO	0.503	ANOVA	-0.5	Reference Lake 3	6.5	10.5	4.7	0.0	3.7	25.0
						Sheardown NW Profundal	1.0	1.4	0.6	0.0	0.6	3.5
Clingers (%)	square root	NO	0.958	ANOVA	-0.2	Reference Lake 3	10.2	13.6	6.1	0.0	3.9	33.6
						Sheardown NW Profundal	7.1	2.9	1.3	3.4	7.5	11.4
Sprawlers (%)	log	NO	0.286	ANOVA	-0.8	Reference Lake 3	79.3	26.8	12.0	32.7	90.4	100.0
						Sheardown NW Profundal	58.8	43.5	19.4	8.3	88.5	92.5
Burrowers (%)	none	NO	0.262	ANOVA	1.7	Reference Lake 3	10.6	14.1	6.3	0.0	5.6	33.6
						Sheardown NW Profundal	34.1	41.3	18.5	1.8	6.0	80.3

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

▨ Grey shading indicates a statistically significant difference between study areas based on p-value less than 0.10.

🟦 Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a CES of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

to these differences, benthic invertebrate community structure differed significantly between Sheardown Lake NW and Reference Lake 3 at both littoral and profundal habitat types based on Bray-Curtis Index (Tables 4.4 and 4.5). However, because no ecologically significant differences (i.e., CES_{BIC} outside of ±2 SD_{REF}) in the relative abundance of any dominant taxonomic groups were indicated between Sheardown Lake NW and Reference Lake 3 for either habitat type, the difference in Bray-Curtis Index between lakes mostly reflected substantially higher benthic invertebrate density and richness at Sheardown Lake NW. The occurrence of higher benthic invertebrate density without an accompanying difference in Simpson's Evenness or compositional change in dominant taxonomic groups suggested that Sheardown Lake NW was simply more productive than Reference Lake 3, and was not adversely influenced by mine operations in 2018. This was supported by no significant differences in the relative abundance of metal-sensitive chironomids between lakes, as well as by the occurrence of a higher proportion of burrowing taxa (significantly so, for littoral stations) at Sheardown Lake NW compared to Reference Lake 3 (Tables 4.4 and 4.5), which indicated no sediment metal-related influences on the benthic invertebrate community of Sheardown Lake NW. The only ecologically meaningful difference in benthic invertebrate FFG composition between lakes was significantly greater relative abundance of shredders at littoral stations of Sheardown Lake NW compared to Reference Lake 3 (Tables 4.4 and 4.5). However, vegetation and coarse particulate organic matter, which are key food sources for the shredder FFG (Merritt et al. 2008), were observed between the Sheardown Lake NW and reference lake littoral stations suggesting similar food resources for shredders between lakes (Appendix Tables D.1 and D.10). Therefore, the reason for the difference in relative abundance of shredders between Sheardown Lake NW and Reference Lake 3 in 2018 were uncertain. Overall, no adverse mine-related influences to the benthic invertebrate community of Sheardown Lake NW were indicated in 2018 based on comparisons to reference lake conditions.

Temporal comparisons did not indicate any consistent ecologically significant differences in density, richness, and Simpson's Evenness at littoral and profundal habitats of Sheardown Lake NW between the mine baseline (2007, 2008, 2013) period and individual years since the commencement of commercial mine operation (2015 to 2018; Figure 4.14; Appendix Tables F.38 and F.39). In addition, no significant differences in benthic invertebrate dominant taxonomic groups or FFG were uniformly indicated between baseline and mine operational years for littoral or profundal habitats at Sheardown Lake NW (Figure 4.14; Appendix Tables F.38 and F.39). Overall, consistent with no substantial changes in water and sediment quality since the mine baseline period, no significant changes in benthic invertebrate community features were indicated at littoral and profundal habitat of Sheardown Lake NW following the commencement of commercial mine operation in 2015.

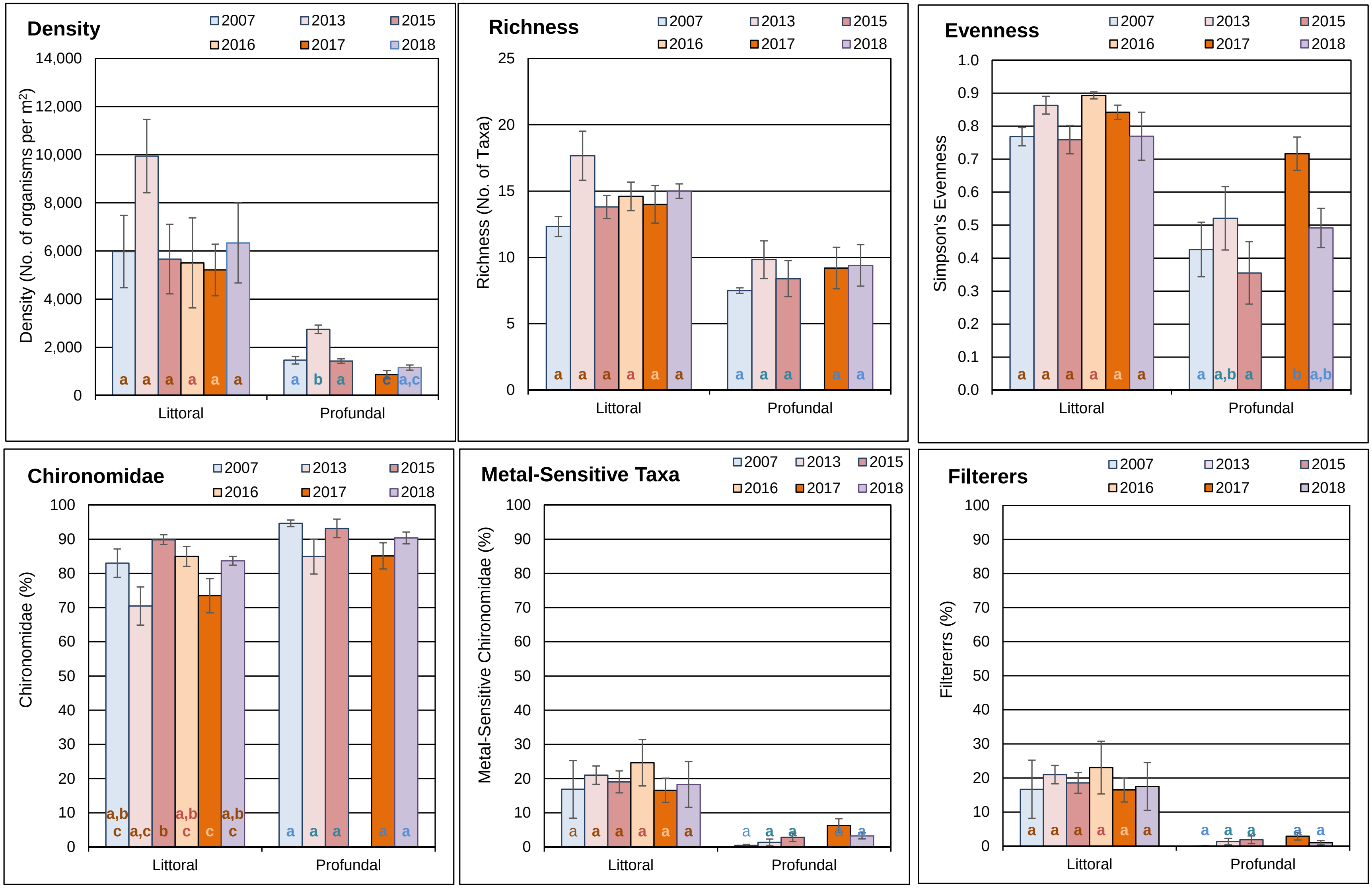

Figure 4.14: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Sheardown Lake NW Littoral and Profundal Study Areas among Mine Baseline (2007, 2013) and Operational (2015 to 2018) Periods

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

4.2.6 Fish Population

4.2.6.1 Sheardown Lake NW Fish Community

Arctic charr was the only fish species captured at the northwest basin of Sheardown Lake in 2018, which differed slightly from that of Reference Lake 3 where low numbers of ninespine stickleback were captured at nearshore rocky habitat in addition to arctic charr (Table 4.6). Total fish CPUE was higher at Sheardown Lake NW than at Reference Lake 3 for nearshore electrofishing and for littoral/profundal gill net sampling (Table 4.6), suggesting higher densities, and/or productivity of arctic charr at the Sheardown Lake northwest basin. A greater relative abundance of fish, together with higher chlorophyll-a concentrations and greater benthic invertebrate density, suggested that overall biological productivity was higher at Sheardown Lake NW than at Reference Lake 3.

Table 4.6: Fish Catch and Community Summary from Backpack Electrofishing and Gill Netting Conducted at Sheardown Lake NW (DLO-01), Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2018

Lake	Method [a]		Arctic Charr	Ninespine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	101	2	103	2
		CPUE	1.59	0.02	1.61	
	Gill netting	No. Caught	34	0	34	
		CPUE	0.38	0	0.38	
Sheardown Lake Northwest	Electrofishing	No. Caught	98	0	98	1
		CPUE	4.33	0	4.33	
	Gill netting	No. Caught	71	0	71	
		CPUE	0.63	0	0.63	
Sheardown Lake Southeast	Electrofishing	No. Caught	99	1	100	2
		CPUE	5.39	0.05	5.44	
	Gill netting	No. Caught	85	0	85	
		CPUE	3.98	0	3.98	

[a] Catch-per-unit-effort (CPUE) for electrofishing represents the number of fish captured per electrofishing minute, and for gill netting represents the number of fish captured per 100 m hours of net.

Temporal comparison of the Sheardown Lake NW electrofishing catch data indicated that arctic charr CPUE in 2018 was within the range shown over the mine baseline period (2006 to 2013), and was also comparable to CPUE during mine construction (2014) and previous studies conducted during mine operation (2015 to 2017), at nearshore rocky habitat of the lake (Figure 4.15). Gill netting CPUE for arctic charr in 2018 was also within the range shown during the baseline period, but was somewhat lower than in each of the three previous years of mine operation (Figure 4.15). These results suggested that the relative abundance of arctic charr at the nearshore and littoral/profundal habitats of Sheardown Lake NW in 2018 was similar to baseline studies, in turn suggesting no mine-related influences to arctic charr numbers in the lake.

4.2.6.2 Sheardown Lake NW Fish Population Assessment

Nearshore Arctic Charr

Mine-related influences on the Sheardown Lake NW nearshore arctic charr population were assessed based on a control-impact analysis using data collected from Sheardown Lake NW and Reference Lake 3 in 2018, as well as a before-after analysis using data collected from Sheardown Lake NW in 2018 and during 2013 baseline characterization. A total of 98 and 100 arctic charr were captured at nearshore habitat of Sheardown Lake NW and Reference Lake 3, respectively, in August 2018 for the control-impact analysis. Distinguishing arctic charr YOY from the older, non-YOY age class was possible using a fork length cut-off of 4.5 cm based on evaluation of length-frequency distributions coupled with supporting age determinations for the Sheardown Lake NW and Reference Lake 3 data sets (Figure 4.16). The nearshore arctic charr health comparisons involved separate assessment of the YOY and non-YOY data sets to account for naturally differing weight-at-length relationships that can occur between these life stages. However, because the YOY data set was small (i.e., 10 and 8 YOY for Sheardown Lake NW and Reference Lake 3, respectively), a greater degree of caution is warranted around conclusions drawn from the analysis of YOY endpoints.

Length-frequency distributions for the nearshore arctic charr differed significantly between Sheardown Lake NW and Reference Lake 3 (Table 4.7), potentially reflecting a larger mean size of both YOY and non-YOY individuals captured at Sheardown Lake NW. Arctic charr YOY and non-YOY were significantly longer and heavier at the Sheardown Lake NW nearshore than at the Reference Lake 3 nearshore (Table 4.7; Appendix Table G.14). No significant difference in the condition of arctic charr YOY was indicated between Sheardown Lake NW and Reference Lake 3 nearshore habitats, and although condition of non-YOY was significantly lower at Sheardown Lake NW, the magnitude of this difference was within the CES_C of ±10% suggesting that this difference was not ecologically meaningful (Table 4.7; Appendix Table G.14). Overall, these

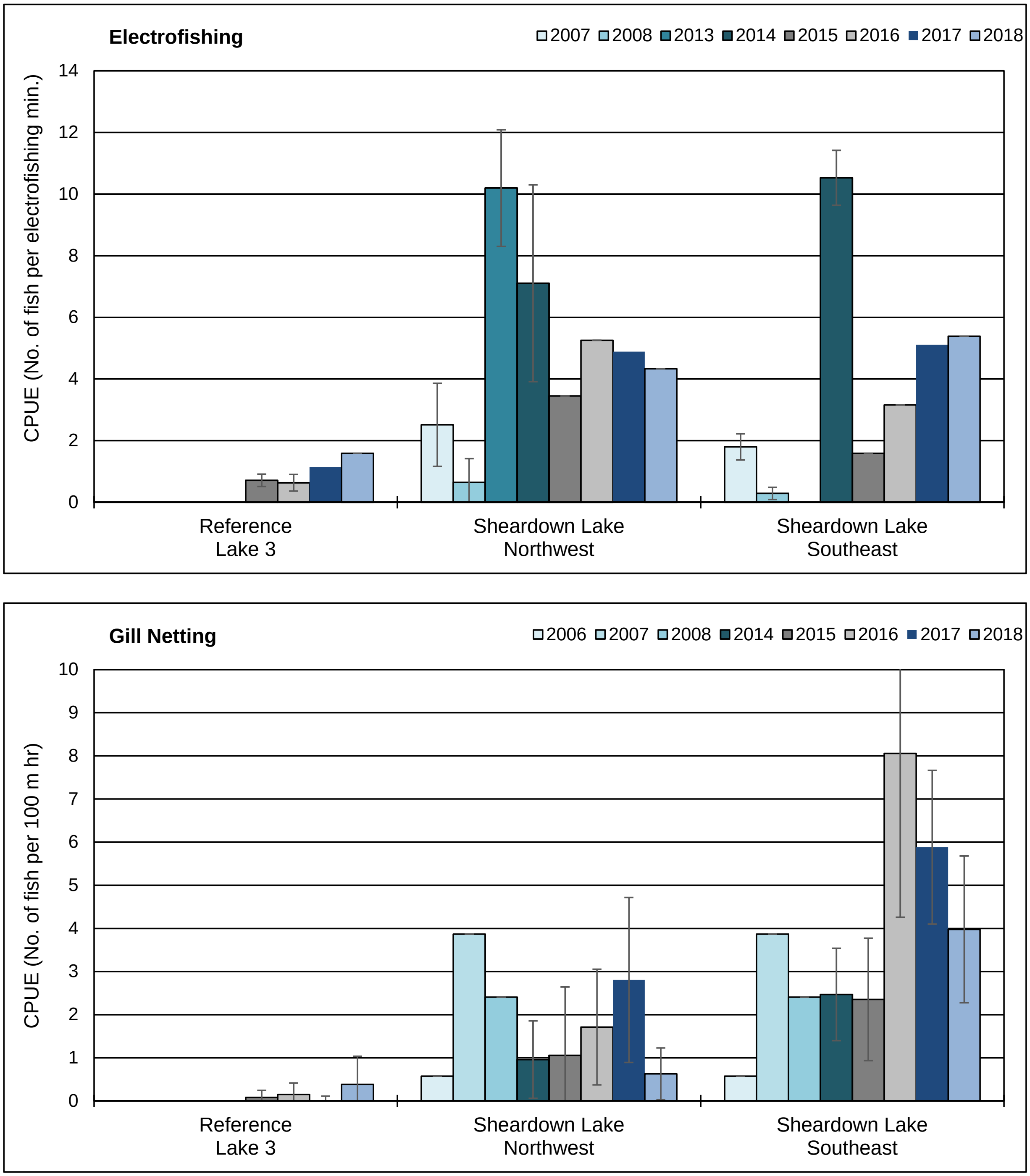

Figure 4.15: Catch-per-unit-effort (CPUE; mean ± SD) of Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Sheardown Lake NW (DLO-01) and Sheardown Lake SE

Notes: Data presented for fish sampling conducted in fall during baseline (2006, 2007, 2008, 2013), construction (2014) and operational (2015 to 2018) mine phases. Lake basins (i.e., NW or SE) were not differentiated historically for baseline gill netting catches.

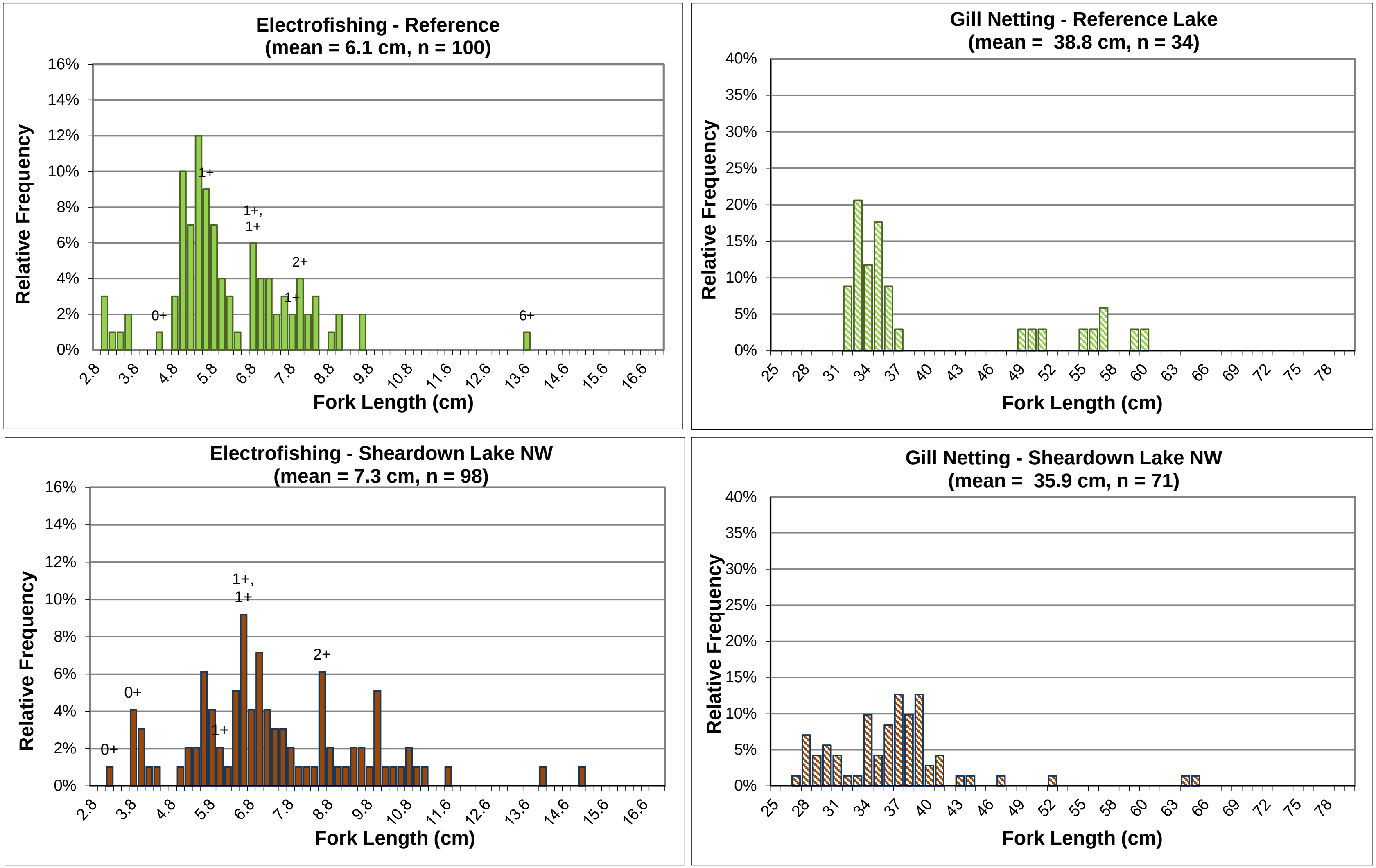

Figure 4.16: **Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Sheardown Lake NW (DLO-01) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2018**

Note: Fish ages are shown above the bars, where available.

Table 4.7: Summary of Statistical Results for Arctic Charr Population Comparisons between Sheardown Lake NW and Reference Lake 3 from 2015 to 2018, and between Sheardown Lake NW Mine Operational and Baseline Period Data, for Fish Captured by Electrofishing and Gill Netting Methods, Mary River Project CREMP

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed? [a]							
			versus Reference Lake 3				versus Sheardown Lake NW baseline period data [b]			
			2015	2016	2017	2018	2015	2016	2017	2018
Nearshore Electrofishing	Survival	Length-Frequency Distribution	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
		Age	No	No	No	-	No	-	-	-
	Energy Use (non-YOY)	Size (mean fork length)	**Yes** **(+29%)**	**Yes** **(+17%)**	**Yes** **(+20%)**	**Yes** **(+24%)**	No	No	No	**Yes** **(-12%)**
		Size (mean weight)	**Yes** **(+121%)**	**Yes** **(+60%)**	No	**Yes** **(+83%)**	No	**Yes** **(-29%)**	No	**Yes** **(-50%)**
	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	**Yes** **(+3%)**	No	**Yes** **(+7%)**	**Yes** **(-5%)**	**Yes** **(-13%)**	**Yes** **(-12%)**	**Yes** **(-9%)**	**Yes** **(-10%)**
Littoral/Profundal Gill Netting [c]	Survival	Length Frequency Distribution	-	-	-	No	**Yes**	**Yes**	**Yes**	No
		Age	-	-	-	-	**Yes** **(-35%)**	**Yes** **(-28%)**	**Yes** **(-26%)**	**-**
	Energy Use	Size (mean fork length)	-	-	-	No	**Yes** **(-21%)**	**Yes** **(-14%)**	**Yes** **(-6%)**	No
		Size (mean weight)	-	-	-	No	**Yes** **(-47%)**	**Yes** **(-31%)**	**Yes** **(-9%)**	No
		Growth (fork length-at-age)	-	-	-	-	No	No	No	-
		Growth (weight-at-age)	-	-	-	-	No	No	**Yes** **(+24%)**	-
	Energy Storage	Condition (body weight-at-fork length)	-	-	-	**Yes** **(+4%)**	**Yes** **(+8%)**	**Yes** **(+11%)**	**Yes** **(+6%)**	No

[a] Values in parentheses indicate direction and magnitude of any significant differences.

[b] Baseline period data included 2002, 2005, 2006, 2008, and 2013 nearshore electrofishing data and 2006, 2008 and 2013 littoral/profundal gill netting data.

[c] Due to low catches of arctic charr in gill nets at Reference Lake 3 in 2015, 2016, and 2017, no comparison of fish health was conducted for gill netted fish.

results indicated no substantial differences in the health of nearshore arctic charr between Sheardown Lake NW and reference lake conditions in 2018.

Temporal comparisons of the Sheardown Lake NW nearshore arctic charr data indicated a significantly different length-frequency distribution between 2018 and the combined 2007 and 2013 baseline data (Table 4.7; Appendix Table G.7). Lengths and weights of arctic charr non-YOY captured at the nearshore of Sheardown Lake NW in 2018 were significantly lower than non-YOY captured during the mine baseline (Table 4.7). In addition, the condition of arctic charr non-YOY was significantly lower in 2018 than during baseline studies conducted at Sheardown Lake NW (Table 4.7). Although the length and weight of non-YOY arctic charr in years of mine operation (i.e., 2015 to 2018) has not shown consistent differences from the baseline period, the condition of non-YOY arctic charr has consistently been significantly lower, at magnitude near the CES_C of ±10%, during all years of mine operation compared to the baseline period (Table 4.7). This suggested on-going, lower condition of arctic charr non-YOY at Sheardown Lake NW nearshore habitat following the commencement of commercial mine operations compared to the baseline period. Temporal comparisons of nearshore arctic charr populations between Sheardown Lake NW and Reference Lake 3 since 2015 generally indicated the continual presence of significantly larger non-YOY at Sheardown Lake NW, but no consistent differences in nearshore arctic charr condition (Table 4.7).

Littoral/Profundal Arctic Charr

Mine-related influences on the Sheardown Lake NW littoral/profundal Arctic charr population were assessed based on a control-impact analysis using 2018 data from Sheardown Lake NW and Reference Lake 3, as well as using a before-after analysis between data collected in 2018 and the baseline characterization studies (combined 2006, 2007, 2008, and 2013). A total of 71 and 34 arctic charr were sampled from littoral/profundal habitat of Sheardown Lake NW and Reference Lake 3, respectively, in August 2018, for the control-impact analysis. The length-frequency distribution for littoral/profundal arctic charr did not differ significantly between lakes (Table 4.7; Figure 4.16). In addition, no significant differences in mean length or weight of littoral/profundal arctic charr were indicated between Sheardown Lake NW and Reference Lake 3 (Table 4.7; Appendix Table G.18). Although condition of arctic charr captured at littoral/profundal areas of Sheardown Lake NW was significantly higher than at Reference Lake 3, the absolute magnitude of this difference was less than the CES_C of 10% suggesting that the difference in arctic charr condition between lakes was not ecologically meaningful (Table 4.7; Appendix Table G.18).

The length-frequency distribution for arctic charr captured at littoral/profundal habitat of Sheardown Lake NW did not differ significantly between 2018 and the baseline period studies

(Table 4.7). In addition, no significant differences in length, weight, or condition of arctic charr captured at littoral/profundal habitat were indicated between 2018 and the baseline period (Table 4.7; Appendix Table G.18). In all previous years of mine operation (i.e., 2015 to 2017), arctic charr sampled from littoral/profundal habitat of Sheardown Lake NW were significantly shorter, lighter, and of greater condition than during the baseline period (Table 4.7). The absence of size and condition differences in 2018 compared to the baseline period appeared to reflect closer comparability in fish size between these study periods than those sampled over the period from 2015 to 2017 when evaluating the data relative to the baseline period.[11] This suggested that arctic charr condition is strongly size dependent and as such, will vary among different age classes of fish. Overall, the general absence of significant, ecologically meaningful differences in condition of arctic charr captured at littoral/ profundal areas of Sheardown Lake NW from 2015 to 2018 compared to the baseline period suggested no adverse mine-related influences on the adult arctic charr population of the lake as a result of on-going mine operation.

4.2.7 Integrated Summary

At Sheardown Lake NW, aqueous concentrations of chloride, molybdenum, and uranium were elevated compared to Reference Lake 3 in 2018, and chloride, manganese, molybdenum, and sulphate concentrations were elevated compared to the baseline period, suggesting a mine-related source of these parameters to the lake. As during the previous CREMP studies, total aluminum and manganese concentrations showed strong positive correlations with turbidity that, in turn, suggested that these metals were largely bound to/contained in suspended particulate matter and were not likely biologically available. The occurrence of relative high turbidity in Sheardown Lake is hypothesized to reflect natural sources of suspended particulates originating from Mary River, upstream of the mine. Notably, no parameters were elevated above WQG or AEMP benchmarks at Sheardown Lake NW in 2018. Metal concentrations in sediment at littoral and profundal habitats of Sheardown Lake NW were very similar to concentrations observed for the same respective habitat types at Reference Lake 3 in 2018, suggesting no marked mine-related influences on sediment metal concentrations in Sheardown Lake NW. Concentrations of chromium, iron, manganese, nickel, and phosphorus were above SQG in sediment at littoral and/or profundal habitats, and concentrations of manganese and nickel were above site-specific AEMP benchmarks in sediment at profundal habitat of Sheardown Lake NW in 2018. However, with the exception of nickel, concentrations of these metals were also above respective SQG and Sheardown Lake NW AEMP benchmarks at Reference Lake 3, suggesting natural elevation of some metals in sediment of local study area lakes. Overall, some mine-related effects on water

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[11] Average fork length of arctic charr sampled for CREMP studies was 37.2 cm during baseline, 29.9 cm in 2015, 32.3 cm in 2016, 32.9 cm in 2017, and 35.9 cm in 2018.

quality and sediment quality were evident at Sheardown Lake NW in 2018, but the effects were minor and did not result in parameter concentrations substantially exceeding applicable guidelines.

Chlorophyll-a concentrations at Sheardown Lake NW were significantly higher than at Reference Lake 3 in 2018 suggesting greater primary production at Sheardown Lake. However, chlorophyll-a concentrations remained well below the AEMP benchmark during all seasonal sampling events in 2018 at Sheardown Lake NW, and suggested oligotrophic conditions typical of Arctic waterbodies. Temporal evaluation of the chlorophyll-a data indicated no changes to the trophic status of Sheardown Lake NW since commencement of commercial mine operations. The benthic invertebrate community of Sheardown Lake NW showed significantly higher density and richness, but no ecologically significant differences in Simpson’s Evenness and relative abundance of dominant groups including metal-sensitive chironomids, compared to Reference Lake 3 in 2018. The occurrence of higher benthic invertebrate density without an accompanying difference in Simpson’s Evenness or compositional change in dominant taxonomic groups suggested that Sheardown Lake NW was simply more productive than Reference Lake 3, and was not adversely influenced by mine operations. No ecologically significant differences in benthic invertebrate density, richness, Simpson’s Evenness, and relative abundance of dominant taxonomic groups or FFG were consistently shown from 2015 to 2018 compared to years in which mine baseline data were collected. Analysis of arctic charr populations suggested greater fish abundance at Sheardown Lake NW compared to Reference Lake 3 in 2018, and similar abundance of arctic charr at Sheardown Lake NW in 2018 compared to the mine baseline studies. Arctic charr captured at nearshore habitat of Sheardown Lake NW showed no ecologically significant differences in size and condition compared to those captured at Reference Lake 3 in 2018. Although non-YOY arctic charr captured at nearshore habitat were of significantly lower condition in 2018 compared to those captured during mine baseline studies, condition has not differed consistently in all years at Sheardown Lake NW since commercial mine operation commenced in 2015. Arctic charr captured at littoral/profundal habitat of Sheardown Lake NW showed no ecologically significant differences in condition compared to Reference Lake 3 in 2018, nor any ecologically meaningful difference in condition compared to those captured during baseline studies. Collectively, the chlorophyll-a, benthic invertebrate community, and arctic charr fish population data all suggested no adverse mine-related influences to the biota of Sheardown Lake NW in the fourth year of mine operation at the Mary River Project.

4.3 Sheardown Lake Southeast (DLO-2)

4.3.1 Hydraulic Retention Time

A hydraulic retention time of 83 ± 35 days was estimated for Sheardown Lake SE by Minnow (2018) using mean annual watershed runoff extrapolated from Baffinland flow monitoring stations installed in small watershed watercourses (i.e., ≤15 km^2) located on the mine property and a lake volume of 1.80 million cubic metres.

4.3.2 Water Quality

Vertical water quality profiles of *in situ* water temperature, dissolved oxygen, pH and specific conductance conducted at Sheardown Lake SE showed no substantial station-to-station differences during any of the winter, summer, or fall sampling events in 2018 (Appendix Figures C.15 to C.18). No thermal stratification was evident at the Sheardown Lake SE basin during any of the winter, summer, or fall sampling events (Figure 4.17). The average water temperature at the bottom of the water column at Sheardown Lake SE littoral and profundal stations was significantly warmer than at Reference Lake 3 during the August 2018 biological sampling (Figure 4.8; Appendix Table C.53). However, the incremental difference in average bottom water temperature between lakes at each respective depth was small (i.e., ≤0.6˚C) and thus was unlikely to be ecologically meaningful. Notably, Sheardown Lake SE is a much smaller and shallower waterbody than Reference Lake 3 (see Figure 2.1; Appendix Table B.1), and therefore heat distribution patterns (i.e., thermal profiles) may be expected to differ naturally between these lakes. Dissolved oxygen profiles conducted at Sheardown Lake SE in 2018 showed no substantial change in dissolved oxygen saturation with depth during summer and fall, but oxycline development characterized by decreasing saturation levels with increasing depth occurring at depths greater than 9 m during the winter sampling event (Figure 4.17). Dissolved oxygen saturation levels at the bottom of the water column at littoral and profundal stations of Sheardown Lake SE did not differ significantly than those at Reference Lake 3 during the August 2018 biological sampling (Figure 4.8; Appendix Table C.53). Dissolved oxygen saturation levels were well above WQG (54% saturation, or 9.5 mg/L) at Sheardown Lake SE at all depths during the winter, summer, fall sampling events in 2018 (Figures 4.8 and 4.17), indicating that dissolved oxygen was not likely to be limiting to pelagic or bottom-dwelling biota within the lake.

In situ profiles of pH and specific conductance showed no substantial change from the surface to the bottom of the Sheardown Lake SE water column, indicating no chemical stratification (Figure 4.17). Similar to the northwest basin, despite pH being significantly higher (i.e., more

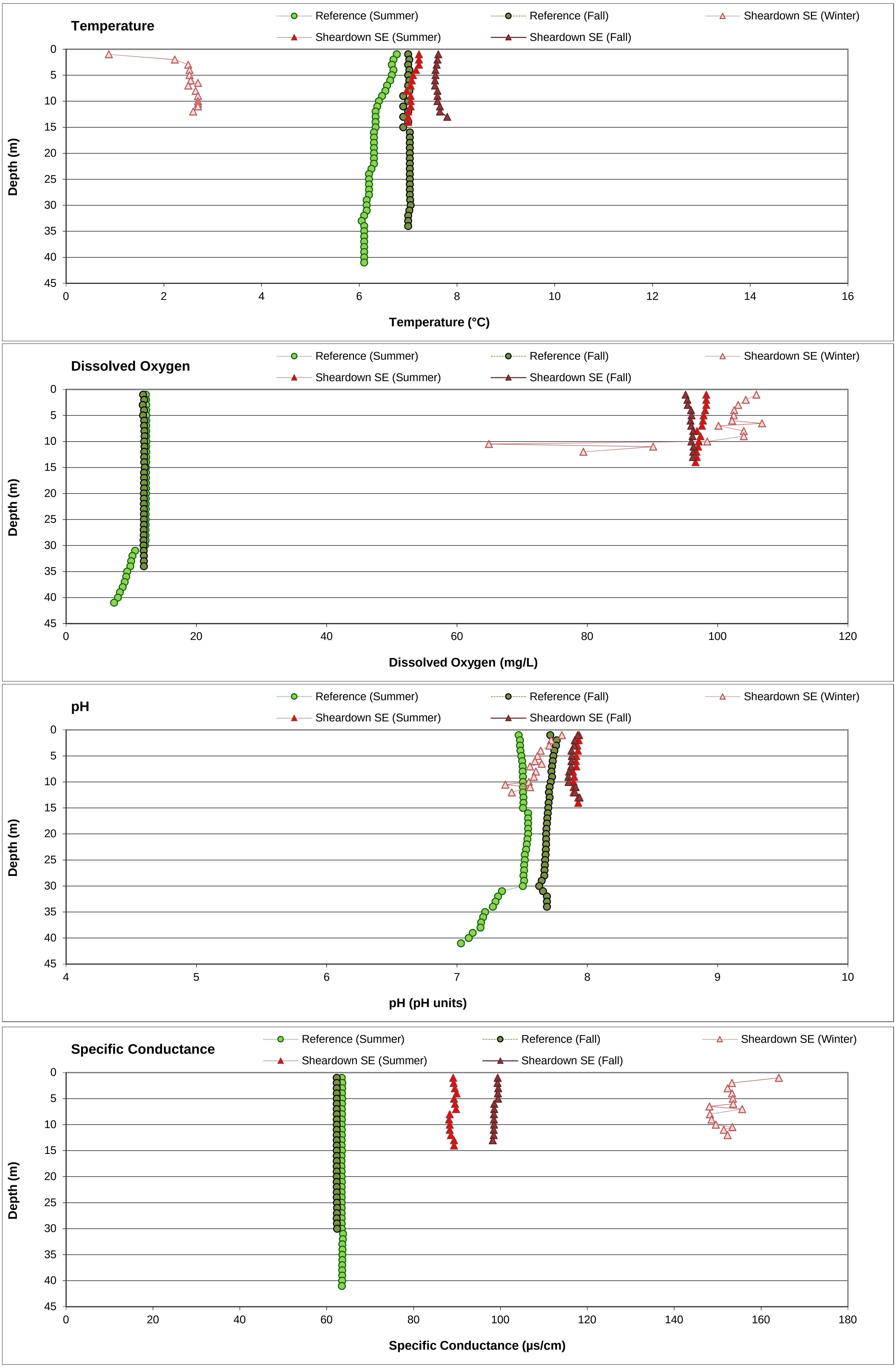

Figure 4.17: **Average *In Situ* Water Quality with Depth from Surface at Sheardown Lake SE (DLO-02) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2018**

alkaline) at Sheardown Lake SE compared to Reference Lake 3 during August 2018 sampling, pH was consistently within WQG limits at Sheardown Lake SE in 2018 (Figure 4.8; Appendix Table C.53; Figure 4.17). Specific conductance was also significantly higher at Sheardown Lake SE compared to Reference Lake 3 during the August 2018 biological study (Figure 4.8). However, mean specific conductance at Sheardown Lake SE (i.e., 97 µS/cm) was within the range observed among the reference creek and river stations in fall 2018 (i.e., 67 to 107 µS/cm). Therefore, similar to previous CREMP studies, the extent to which higher specific conductance at Sheardown Lake SE was related to natural regional variability or a mine-related influence was unclear. Water clarity at Sheardown Lake SE was the lowest among the mine-exposed lakes (Appendix Figure C.7). Secchi depth readings from Sheardown Lake SE were significantly lower (shallower) than at Reference Lake 3 during the August 2018 biological study, but were relatively consistent among stations, suggesting no spatial differences in water clarity of the lake (Appendix Tables C.51 and C.53).

Water chemistry at Sheardown Lake SE showed no consistent spatial changes in parameter concentrations among the five lake sampling stations during any of the winter, summer or fall sampling events in 2018 (Table 4.8; Appendix Table C.54), suggesting that the lake waters were well mixed both laterally and vertically. Total aluminum and manganese concentrations were highly elevated (i.e., ≥10-fold), turbidity was moderately elevated (i.e., 5- to 10-fold), and concentrations of total copper and molybdenum were slightly elevated (i.e., 3- to 5-fold), at Sheardown Lake SE compared to Reference Lake 3 during the 2018 summer and/or fall sampling events (Table 4.8; Appendix Tables C.44 and C.54). Dissolved aluminum and molybdenum concentrations were also slightly elevated at Sheardown Lake SE compared to Reference Lake 3 in one or both of the summer and fall sampling events (Appendix Table C.56). Similar to the northwest basin, total aluminum and manganese concentrations showed highly to moderately strong positive correlations with turbidity for the Sheardown Lake SE combined data set (i.e., winter, summer and fall data; r_s = 0.77 and 0.48, respectively), suggesting that much of the total aluminum and manganese was associated with suspended particles (Appendix Table C.57). This was corroborated by comparison of total and dissolved fractions, which indicated that on average, most aluminum and manganese (i.e., 90% and 83%, respectively) was in particulate form at Sheardown Lake SE (compare Appendix Tables C.54 and C.55). Higher turbidity at Sheardown Lake SE, and lower water clarity (Secchi depth) associated with this turbidity, likely reflected backflow received from the Mary River, which directly affects water levels and chemistry of the southeast basin during moderate to high flow periods. In contrast with aluminum and manganese, total copper and molybdenum concentrations at Sheardown Lake SE were not positively correlated with turbidity, suggesting that slight elevation in these parameters compared to Reference Lake 3 was related to mine operation and/or natural geochemical differences between lakes. Despite elevation of some metals at Sheardown Lake SE, on average, parameter concentrations were all well below established WQG and AEMP benchmarks during the winter, summer and fall sampling events in 2018 (Table 4.8; Appendix Table C.54).

Temporal comparisons of the Sheardown Lake SE water chemistry data indicated no appreciable changes in average parameter concentrations between the 2018 study and mine baseline period (2005 to 2013), the only exception of which was a slightly elevated average dissolved aluminum concentration in fall 2018 (Figure 4.9; Appendix Tables C.44 and C.56; Appendix Figure C.19). As indicated above, because aluminum concentrations were strongly correlated with turbidity, higher dissolved aluminum concentrations in fall 2018 compared to baseline at Sheardown Lake SE likely reflected natural phenomena. No parameters showed consistently higher concentrations annually over the mine construction (2014) and 2015 to 2018 mine operational periods with the exceptions of sodium and sulphate (Figure 4.9; Appendix Figure C.19), suggesting a potential mine-related source of these constituents. However, an average sulphate concentration of approximately 5.5 mg/L at Sheardown Lake SE in 2018 was well below the WQG of 218 mg/L, indicating adverse effects associated with sulphate concentrations were highly unlikely.

4.3.3 Sediment Quality

Surficial sediment at Sheardown Lake SE was composed of silt loam material containing low TOC content throughout the lake (Figure 4.18; Appendix Tables D.15 and D.16). Substrate at littoral stations of Sheardown Lake SE contained significantly lower sand and TOC content, and significantly greater silt and clay content, than at Reference Lake 3 (Appendix Table D.17). Similarly, sediment at profundal stations of Sheardown Lake SE showed significantly lower sand content and significantly higher silt content than at Reference Lake 3 (Appendix Table D.17). The relatively high proportion of fines in substrate of Sheardown Lake SE potentially reflects the receipt of Mary River backflow during high flow periods, which can be expected to result in the deposition of high quantities of naturally suspended, fine-grained material. Similar to observations at the other mine-exposed lakes and Reference Lake 3, iron (oxy)hydroxide material was visible in surficial and/or sub-surface substrate of Sheardown Lake SE, in some cases occurring as a thin, distinct layer or floc (Appendix Tables D.15 and D.16). Below the surficial layer, substrates at Sheardown Lake SE exhibited some sporadic blackening suggesting development of reducing conditions. However, no distinct redox boundary was generally observed in sediment at the Sheardown Lake SE stations (Appendix Tables D.15 and D.16). Observations regarding reducing sediment conditions at Sheardown Lake SE were similar to those made at Reference Lake 3 (Appendix Tables D.1, D.2, D.15 and D.16), suggesting that factors leading to reduced sediment conditions were comparable between lakes.

Table 4.8: Water Chemistry at Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3) Monitoring Stations[a], Mary River Project CREMP, August 2018

	Parameters	Units	Water Quality Guideline (WQG)[b]	AEMP Benchmark[c]	Reference Lake 3 Average (n = 3)	Sheardown Lake Southeast (SDSE) Station				
						DL0-02-6	DL0-02-7	DL0-02-4	DL0-02-8	DL0-02-3
					Fall 2018	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	75	121	120	119.5	118	117
	pH (lab)	pH	6.5 - 9.0	-	7.65	8.02	7.92	8.00	7.97	7.95
	Hardness (as $CaCO_3$)	mg/L	-	-	35	60	57	57	58	58
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	2.1	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	46	43	58	37	39	53
	Turbidity	NTU	-	-	0.5	2.1	2.3	2.3	2.2	2.3
	Alkalinity (as $CaCO_3$)	mg/L	-	-	33	48	46	45	47	43
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.044	<0.020	0.067	0.035	0.027	0.021
	Nitrate	mg/L	13	13	<0.020	0.0435	0.04225	0.0435	0.041	0.0415
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.16	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.94	1.65	1.68	1.65	1.88	1.61
	Total Organic Carbon	mg/L	-	-	3.84	2.60	2.60	2.57	2.79	2.51
	Total Phosphorus	mg/L	0.020^{α}	-	0.0049	0.0077	0.0040	0.0036	0.0052	0.0050
	Phenols	mg/L	0.004^{α}	-	0.0011	0.0012	0.0014	<0.0010	<0.0010	0.0011
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.27	2.87	2.79	2.73	2.76	2.75
	Sulphate (SO_4)	mg/L	218^{β}	218	3.74	6.00	5.69	5.56	5.58	5.58
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[d]	0.004	0.099	0.062	0.065	0.048	0.061
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	0.000105	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0064	0.0070	0.0064	0.0059	0.0067	0.0061
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	7.16	11.75	11.325	11.15	10.85	11.10
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0008	0.0010	0.0009	0.0007	0.0007	0.0008
	Iron (Fe)	mg/L	0.30	0.300	<0.030	0.258	0.061	0.064	0.046	0.062
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.0001625	0.00007425	0.0000735	0.0000625	0.000074
	Magnesium (Mg)	mg/L	-	-	4.26	7.41	7.03	6.58	7.54	6.78
	Manganese (Mn)	mg/L	0.935^{β}	-	0.00064	0.02290	0.00555	0.00499	0.00319	0.00500
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000138	0.000457	0.0004715	0.00045	0.000514	0.00046
	Nickel (Ni)	mg/L	0.025	0.025	0.0005	0.00081	0.000625	0.000595	0.00058	0.000585
	Potassium (K)	mg/L	-	-	0.86	1.08	1.05	0.98	1.12	1.00
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.417	0.605	0.568	0.575	0.565	0.550
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.86	1.30	1.28	1.18	1.34	1.21
	Strontium (Sr)	mg/L	-	-	0.0081	0.0084	0.0081	0.0081	0.0079	0.0081
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)	mg/L	0.015	-	0.00026	0.00079	0.00071	0.00067	0.00058	0.00068
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Values presented are averages from samples taken from the surface and the bottom of the water column at each station.

[b] Canadian Water Quality Guideline (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[c] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake SE.

[d] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively (Intrinsik 2013).

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

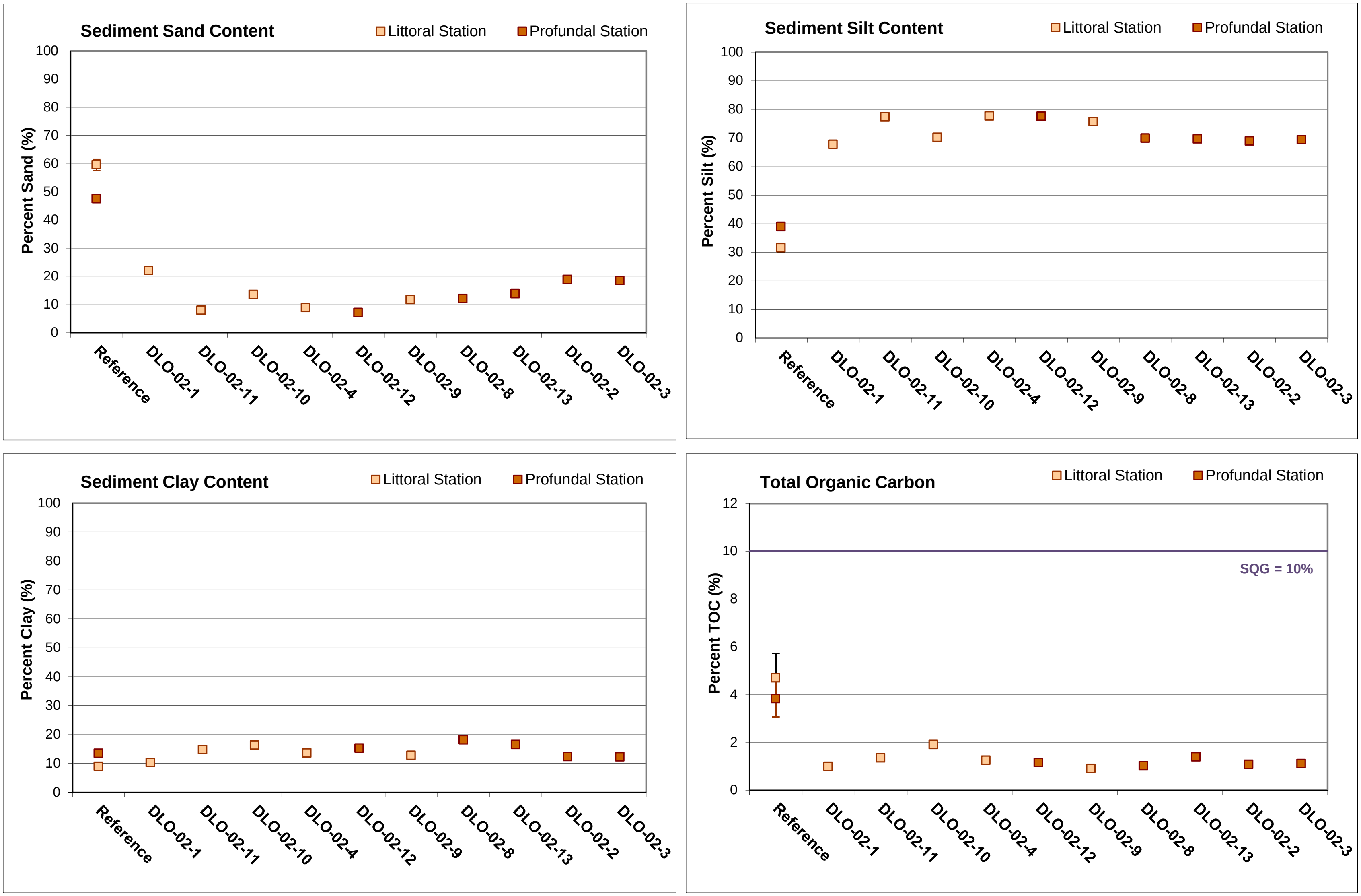

Figure 4.18: Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Sheardown Lake SE (DLO-02) Sediment Monitoring Stations and Reference Lake 3 Averages (mean ± SE), Mary River Project CREMP, August 2018

Sediment metal concentrations at Sheardown Lake SE showed no clear spatial gradients with progression towards the lake outlet in 2018, suggesting no clear point sources of metals to the lake (Appendix Table D.18). Sediment metal concentrations at littoral and profundal stations of Sheardown Lake SE were, on average, similar to those observed for the same respective station types at Reference Lake 3 (Table 4.3; Appendix Table D.19) suggesting no marked mine-related influences on sediment metal concentrations at the southeast lake basin. The average concentration of iron in littoral sediment was above SQG, and average iron and manganese concentrations in littoral and profundal sediment were above AEMP benchmarks, at Sheardown Lake SE (Table 4.3; Appendix Table D.18). However, as indicated previously, average concentrations of iron and manganese were also above respective SQG and AEMP benchmarks at littoral and/or profundal stations of Reference Lake 3 (Table 4.3). This suggested that the elevation of iron and manganese concentrations in sediment of Sheardown Lake SE relative to SQG and AEMP benchmarks may be a natural phenomenon in lakes within the local study area of the mine. Arsenic, chromium, nickel, and phosphorus concentrations were also above lake-specific AEMP benchmarks at littoral station DLO-02-4, but on average, concentrations of these metals were below their respective AEMP benchmarks at Sheardown Lake SE, and were not unlike concentrations observed at individual stations at Reference Lake 3 (Table 4.3; Appendix Tables D.4 and D.18).

Temporal comparisons indicated that metal concentrations in sediment at littoral and profundal stations of Sheardown Lake SE in 2018 were comparable to those observed during the mine baseline (2005 to 2013) period (Figure 4.11; Appendix Table D.19). On average, metal concentrations in sediment at littoral and profundal stations in 2018 were also within the range of those observed from 2015 to 2017, with no occurrence of consistently higher metal concentrations that would suggest an increasing trend over time (Figure 4.11). Overall, no substantial changes in metal concentrations were indicated in sediment at Sheardown Lake SE since the commencement of commercial mine operations in 2015.

4.3.4 Phytoplankton

Chlorophyll-a concentrations at Sheardown Lake SE showed no spatial gradients with closer proximity to the lake outlet during any of the winter, summer, or fall sampling events in 2018 (Figure 4.12). Chlorophyll-a concentrations did not differ significantly among the winter, summer, and fall sampling events in 2018, indicating relatively uniform phytoplankton abundance among seasons (Appendix Table E.6). Similar to Camp Lake and Sheardown Lake NW, chlorophyll-a concentrations at Sheardown Lake SE were significantly greater than at Reference Lake 3 for both the summer and fall sampling events in 2018 (Appendix Table E.7 and E.8), but concentrations were generally well below the AEMP benchmark of 3.7 µg/L at all stations and for all sampling events (Figure 4.12). On average, chlorophyll-a concentrations at Sheardown Lake SE indicated an oligotrophic status as defined by Wetzel (2001). This trophic status classification was consistent with an oligotrophic categorization for Sheardown Lake SE based on CWQG trophic classifications as defined by total phosphorus concentrations (i.e., average concentrations below 10 µg/L; Table 4.8; Appendix Table C.54).

Temporal comparison of Sheardown Lake SE chlorophyll-a concentrations did not indicate any consistent direction of significant differences between the 2018 data and data from the mine construction (2014) period or previous years of mine operation (2015 to 2017) among the winter, summer, or fall seasons (Figure 4.19; Appendix Table E.13). The variability in chlorophyll-a concentrations among years at Sheardown Lake SE may reflect the combination of mine-related influences and variable influence of Mary River on Sheardown Lake SE water levels, hydraulic retention time, and/or chemistry among years/seasons. For instance, Mary River discharges into or drains Sheardown Lake SE during high and low flow periods, respectively, the nature of which may affect phytoplankton abundance and/or community structure. No chlorophyll-a baseline (2005 to 2013) data are available for Sheardown Lake SE, precluding comparisons to conditions prior to the mine construction period.

4.3.5 Benthic Invertebrate Community

Benthic invertebrate density was significantly higher at littoral and profundal habitats of Sheardown Lake SE compared to like-habitat stations at Reference Lake 3, the differences of which were at magnitudes well outside of the CES_{BIC} of ±2 SD_{REF} (Tables 4.9 and 4.10). An ecologically meaningful difference in richness was also indicated between Sheardown Lake SE and Reference Lake 3, but only for profundal habitat. In addition to these differences, benthic invertebrate community structure differences were indicated between Sheardown Lake SE and Reference Lake 3 based on significantly differing Bray-Curtis Index for both littoral and profundal habitat types (Tables 4.9 and 4.10). However, similar to Sheardown Lake NW, no ecologically significant differences in the relative abundance of any dominant taxonomic groups were shown between Sheardown Lake SE and Reference Lake 3 for each habitat type, and therefore the difference in Bray-Curtis Index between lakes most likely reflected substantially higher benthic invertebrate density at Sheardown Lake SE. As at Sheardown Lake NW, the occurrence of higher benthic invertebrate density without an accompanying difference in Simpson's Evenness or change in dominant taxonomic group composition suggested that Sheardown Lake SE was simply more productive than Reference Lake 3, and was not adversely influenced by mine operations in 2018. This was supported by the occurrence of no ecologically significant differences in the relative abundance of metal-sensitive chironomids between lakes (Tables 4.9 and 4.10).

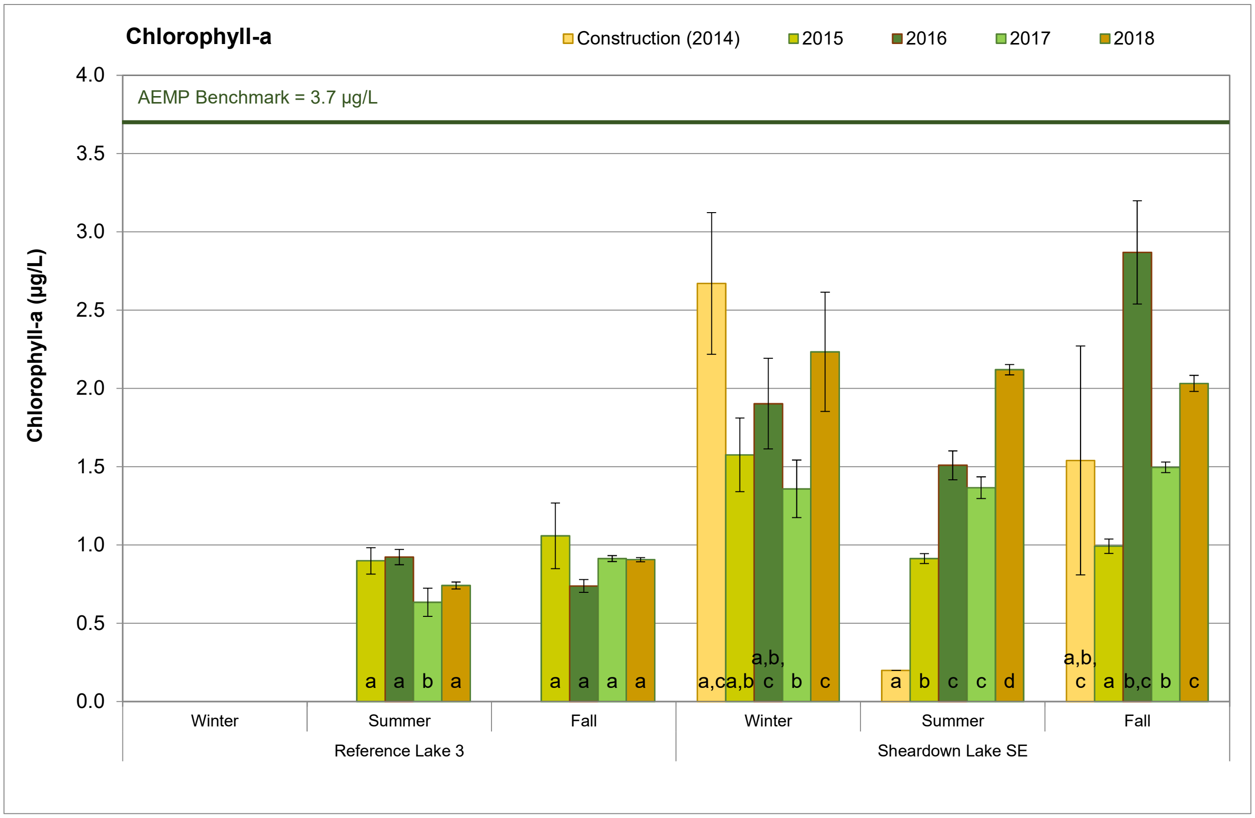

Figure 4.19: **Temporal Comparison of Chlorophyll-a Concentrations Among Seasons between Sheardown Lake SE and Reference Lake 3 for Mine Construction (2014) and Operational (2015 to 2018) Periods (mean ± SE)**

Note: Bars with the same letter at the base do not differ significantly between years for the applicable season

Table 4.9: Benthic Invertebrate Community Statistical Comparison Results between Sheardown Lake SE (DLO-02) and Reference Lake 3 for Littoral Habitat Stations, Mary River Project CREMP, August 2018

Metric	Statistical Test Results					Summary Statistics						
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis	Magnitude of Difference [a] (No. of SD)	Study Lake Littoral Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (Individuals/m^2)	square root	YES	0.002	t-test (unequal)	12.5	Reference Lake 3	1,045	258	116	696	1,000	1,391
						Sheardown SE Littoral	4,277	1,533	686	2,687	4,287	6,000
Richness (Number of Taxa)	none	NO	0.707	ANOVA	-0.3	Reference Lake 3	10.8	2.3	1.0	7.0	11.0	13.0
						Sheardown SE Littoral	10.2	2.6	1.2	7.0	10.0	14.0
Simpson's Evenness (E)	log	NO	0.125	ANOVA	-1.2	Reference Lake 3	0.825	0.103	0.046	0.720	0.816	0.939
						Sheardown SE Littoral	0.704	0.131	0.059	0.582	0.695	0.922
Bray-Curtis Index	none	YES	< 0.001	ANOVA	6.1	Reference Lake 3	0.313	0.092	0.041	0.178	0.358	0.394
						Sheardown SE Littoral	0.871	0.034	0.015	0.833	0.862	0.908
Nemata (%)	square root	NO	0.116	ANOVA	-0.7	Reference Lake 3	7.1	8.8	3.9	0.0	3.4	21.3
						Sheardown SE Littoral	0.6	0.5	0.2	0.0	0.6	1.3
Ostracoda (%)	fourth-root	YES	0.042	ANOVA	-1.0	Reference Lake 3	23.9	18.3	8.2	3.4	20.6	53.3
						Sheardown SE Littoral	6.1	9.9	4.4	0.3	2.0	23.6
Chironomidae (%)	square root	YES	0.058	ANOVA	1.1	Reference Lake 3	66.9	22.2	10.0	35.5	73.8	91.4
						Sheardown SE Littoral	92.4	10.0	4.5	74.5	96.5	97.8
Metal-Sensitive Chironomidae (%)	log	YES	0.017	ANOVA	-1.2	Reference Lake 3	36.5	19.6	8.8	17.8	27.5	60.1
						Sheardown SE Littoral	12.1	8.9	4.0	5.0	10.7	26.7
Collector-Gatherers (%)	none	NO	0.760	ANOVA	-0.2	Reference Lake 3	55.6	19.0	8.5	33.0	57.5	79.2
						Sheardown SE Littoral	52.5	11.1	5.0	37.3	50.1	65.3
Filterers (%)	log	YES	0.025	ANOVA	-1.2	Reference Lake 3	33.9	18.7	8.4	15.5	24.9	56.6
						Sheardown SE Littoral	12.1	8.9	4.0	5.0	10.7	26.7
Shredders (%)	square root	YES	< 0.001	ANOVA	-2.7	Reference Lake 3	7.0	2.6	1.1	2.9	7.5	9.4
						Sheardown SE Littoral	0.1	0.2	0.1	0.0	0.0	0.3
Clingers (%)	none	YES	0.017	ANOVA	-1.4	Reference Lake 3	36.1	18.4	8.2	17.1	26.9	58.3
						Sheardown SE Littoral	10.6	4.8	2.1	5.8	11.4	16.8
Sprawlers (%)	log	NO	0.476	ANOVA	-0.5	Reference Lake 3	51.9	17.7	7.9	29.5	52.5	71.8
						Sheardown SE Littoral	43.9	16.9	7.6	30.3	39.8	72.7
Burrowers (%)	log	YES	0.012	ANOVA	5.3	Reference Lake 3	12.0	6.4	2.8	6.9	11.1	22.6
						Sheardown SE Littoral	45.5	21.2	9.5	10.6	47.0	63.8

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

▨ Grey shading indicates statistically significant difference between study areas based on p-value less than 0.10.

🟦 Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a CES of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

Table 4.10: Benthic Invertebrate Community Statistical Comparison Results between Sheardown Lake SE (DLO-02) and Reference Lake 3 for Profundal Habitat Stations, Mary River Project CREMP, August 2018

Metric	Statistical Test Results					Summary Statistics						
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis	Magnitude of Difference [a] (No. of SD)	Study Lake Profundal Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (Individuals/m^2)	log	YES	0.002	ANOVA	18.5	Reference Lake 3	377	155	69	104	452	470
						Sheardown SE Profundal	3,237	2,771	1,239	1,296	1,757	7,896
Richness (Number of Taxa)	rank	YES	0.080	Mann-Whitney U	2.2	Reference Lake 3	5.4	1.3	0.6	4.0	6.0	7.0
						Sheardown SE Profundal	8.4	2.2	1.0	6.0	10.0	10.0
Simpson's Evenness (E)	log	NO	0.206	ANOVA	0.4	Reference Lake 3	0.455	0.296	0.132	0.218	0.296	0.933
						Sheardown SE Profundal	0.568	0.050	0.022	0.516	0.556	0.643
Bray-Curtis Index	rank	YES	0.008	Mann-Whitney U	2.5	Reference Lake 3	0.224	0.304	0.136	0.051	0.109	0.763
						Sheardown SE Profundal	0.981	0.009	0.004	0.968	0.980	0.991
Ostracoda (%)	square root	NO	0.145	ANOVA	-0.8	Reference Lake 3	3.1	2.9	1.3	0.0	2.0	7.5
						Sheardown SE Profundal	0.8	1.3	0.6	0.0	0.4	3.1
Chironomidae (%)	none	YES	0.021	ANOVA	1.4	Reference Lake 3	90.8	4.9	2.2	82.7	92.2	95.7
						Sheardown SE Profundal	97.6	2.1	0.9	95.5	97.0	100.0
Metal-Sensitive Chironomidae (%)	rank	NO	1.000	Mann-Whitney U	-0.3	Reference Lake 3	11.4	16.8	7.5	2.3	3.9	41.4
						Sheardown SE Profundal	5.9	3.5	1.6	3.4	5.1	11.9
Collector-Gatherers (%)	rank	YES	0.056	Mann-Whitney U	-1.9	Reference Lake 3	89.8	13.6	6.1	66.3	96.2	100.0
						Sheardown SE Profundal	63.8	22.4	10.0	26.2	70.5	83.9
Filterers (%)	fourth root	NO	0.278	ANOVA	-0.1	Reference Lake 3	6.5	10.5	4.7	0.0	3.7	25.0
						Sheardown SE Profundal	5.9	3.5	1.6	3.4	5.1	11.9
Clingers (%)	square root	NO	0.974	ANOVA	-0.3	Reference Lake 3	10.2	13.6	6.1	0.0	3.9	33.6
						Sheardown SE Profundal	6.7	3.2	1.4	3.4	5.7	11.9
Sprawlers (%)	none	YES	0.016	ANOVA	-1.8	Reference Lake 3	79.3	26.8	12.0	32.7	90.4	100.0
						Sheardown SE Profundal	31.2	23.2	10.4	14.1	19.4	70.8
Burrowers (%)	none	YES	0.003	ANOVA	3.7	Reference Lake 3	10.6	14.1	6.3	0.0	5.6	33.6
						Sheardown SE Profundal	62.2	23.6	10.6	22.4	68.8	82.5

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

▨ Grey shading indicates statistically significant difference between study areas based on p-value less than 0.10.

🟦 Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a CES of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

The subtle differences in benthic invertebrate community structure between Sheardown Lake SE and Reference Lake 3 likely reflected marked differences in physical sediment properties between lakes. The key differences in sediment properties between lakes included significantly lower TOC content, significantly greater proportion of silt, and significantly greater sediment compactness (as indicated by lower proportion of moisture) at Sheardown Lake SE compared to Reference Lake 3 (Appendix Table F.40). The occurrence of more stable, compact sediment likely accounted for significantly higher relative abundance of HPG burrowers at Sheardown Lake SE compared to Reference Lake 3 (Tables 4.9 and 4.10). In addition to differences in sediment properties between lakes, significantly shallower 'profundal' sampling depths at Sheardown Lake SE also likely contributed to the differences in benthic invertebrate community features compared to Reference Lake 3 (Appendix Table F.40). Natural depth-related influences on benthic invertebrate community structure that include lower density and richness at greater depth in lake environments are well documented (Ward 1992; Armitage et al. 1995), and were consistently evident at Reference Lake 3 from 2015 to 2018 (Appendix B) suggesting similar patterns in pristine lakes of the Mary River Project region. Notably, the maximum depth of Sheardown Lake SE is approximately 14 m (Minnow 2018). Because profundal habitat for the Mary River Project CREMP is defined as water depths ≥12 m, benthic invertebrate community data collected from profundal depths of Sheardown Lake SE (average station depth of 12.4 m; Appendix Table F.40) are not directly comparable to those collected at the other mine-exposed lakes nor to Reference Lake 3, at which the average profundal sampling depth is ≥ 20 m. Overall, the differences in benthic invertebrate community endpoints between Sheardown Lake SE and Reference Lake 3 likely reflected a combination of naturally greater productivity, naturally more compact sediment with low TOC content, and naturally shallower 'profundal' sampling depths at Sheardown Lake SE. Moreover, no evidence of metal-related influences on the benthic invertebrate community of Sheardown Lake SE were indicated in 2018.

Temporal comparisons indicated no consistent, ecologically significant, differences in general community effect indicators of richness and Simpson's Evenness at littoral or profundal habitats of Sheardown Lake SE between the mine baseline (2007, 2013) and individual years since the commencement of commercial mine operation (2015 to 2018; Figure 4.20; Appendix Tables F.42 and F.43). In addition, no significant differences in benthic invertebrate dominant taxonomic groups or FFG were indicated between mine baseline and mine operational years at littoral or profundal habitats of Sheardown Lake SE (Figure 4.20; Appendix Tables F.42 and F.43). In contrast, significantly lower density has generally occurred at both littoral and profundal habitats of Sheardown Lake SE during individual years of commercial mine operation from 2015 to 2018 compared to mine baseline data collected in 2007 and/or 2013 (Figure 4.20; Appendix Tables F.42 and F.43). Because density was the only benthic invertebrate community metric that differed

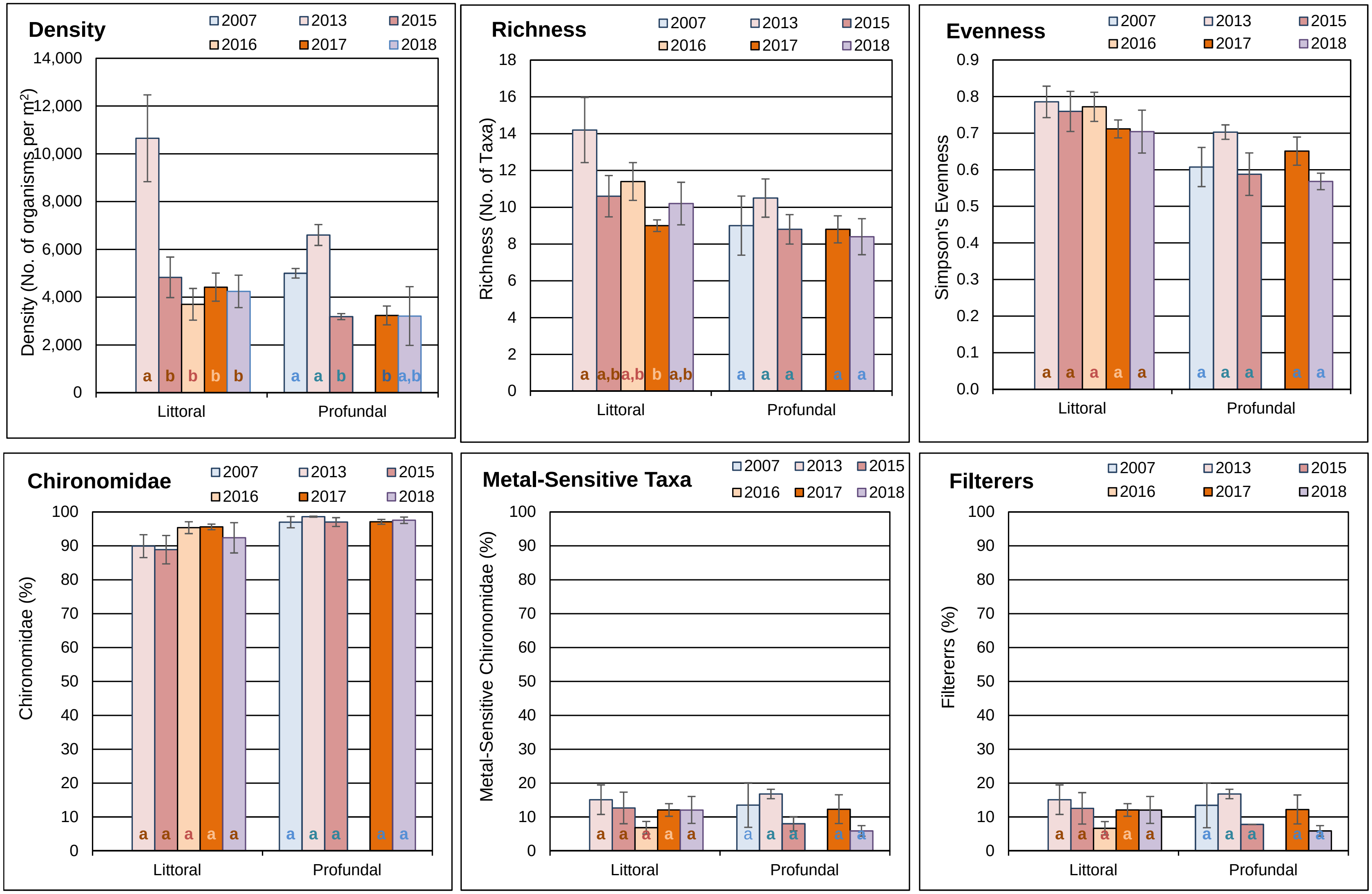

Figure 4.20: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Sheardown Lake SE Littoral and Profundal Study Areas among Mine Baseline (2007, 2013) and Operational (2015 to 2018) Periods

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

significantly between mine-operational and baseline studies at Sheardown Lake SE, natural temporal variability among studies (and in particular, high density during the 2007 baseline study) most likely accounted for the temporal differences in benthic invertebrate density. Overall, consistent with no substantial changes in water and sediment quality since the mine baseline period, no ecologically meaningful changes in benthic invertebrate community features were indicated at littoral and profundal habitat of Sheardown Lake SE following the commencement of commercial mine operation in 2015.

4.3.6 Fish Population

4.3.6.1 Sheardown Lake SE Fish Community

The Sheardown Lake SE fish community was composed of arctic charr and ninespine stickleback, reflecting the same fish species composition as Reference Lake 3, in 2018 (Table 4.6). However, total fish CPUE was much higher at Sheardown Lake SE than at Reference Lake 3 for electrofishing and gill netting collection methods, suggesting higher densities and/or productivity of both arctic charr and ninespine stickleback at Sheardown Lake SE (Table 4.6). Consistent with the other mine lakes, greater numbers of arctic charr, together with greater density of benthic invertebrates, suggested that productivity was higher at Sheardown Lake SE than at Reference Lake 3.

Temporal comparison of the Sheardown Lake SE electrofishing catch data indicated higher fish CPUE in 2018 and the three previous mine operational years (i.e., 2015 to 2017) than during the mine baseline studies (2007 and 2008; Figure 4.15). Gill netting CPUE for arctic charr was also higher from 2016 to 2018 compared to the baseline (2006 to 2008), mine construction (2014) and mine operational (2015) studies (Figure 4.15). In part, higher fish CPUE at Sheardown Lake SE in studies conducted from 2016 to 2018 potentially reflected improvements in sampling efficiency gained through experience from previous studies (see Minnow 2016b, 2017, 2018). Nevertheless, the CPUE data suggested that arctic charr abundance at nearshore and littoral/profundal habitats was likely comparable to, or greater than, the abundance of this species during the baseline period at Sheardown Lake SE, indicating no mine-related influences to arctic charr numbers in the lake following the commencement of commercial mine operation in 2015.

4.3.6.2 Sheardown Lake SE Fish Population Assessment

Nearshore Arctic Charr

Mine-related influences on the Sheardown Lake SE nearshore Arctic charr population were assessed based on a control-impact analysis using data collected from Sheardown Lake SE and Reference Lake 3 in 2018. Although before-after analysis of data collected from Sheardown Lake SE in 2018 (mine operation) and 2007 (baseline) was conducted (Appendix Table G.7), poor accuracy in fresh body weight measures during baseline sampling precluded meaningful data interpretation, and therefore these results were not discussed further herein. A total of 99 and 100 arctic charr were captured at nearshore habitat of Sheardown Lake SE and Reference Lake 3, respectively, in August 2018 for the control-impact analysis. Distinguishing arctic charr YOY from the older, non-YOY age category was possible using a fork length cut-off of 4.7 cm and 4.5 cm for Sheardown Lake SE and Reference Lake 3 data sets, respectively, based on evaluation of length-frequency distributions coupled with supporting age determinations (Figure 4.21). Nearshore arctic charr health comparisons were conducted separately for the YOY and non-YOY data sets to account for naturally differing weight-at-length relationships that occur between these age categories. However, because the YOY data set for Reference Lake 3 was small (i.e., 8 YOY individuals), a greater degree of caution is warranted around conclusions drawn from the analysis of YOY endpoints.

Length-frequency distributions for the nearshore arctic charr differed significantly between Sheardown Lake SE and Reference Lake 3 (Table 4.11), potentially reflecting the combination of greater prevalence of YOY and larger size of individuals within YOY and non-YOY age classes at Sheardown Lake SE (Figure 4.21). Arctic charr in YOY and non-YOY age classes were significantly longer and heavier at the Sheardown Lake SE nearshore than at the Reference Lake 3 nearshore (Table 4.11; Appendix Table G.20). The occurrence of significantly larger YOY suggested faster arctic charr growth at Sheardown Lake SE than at Reference Lake 3 in 2018. Although condition of nearshore arctic charr YOY was significantly greater at Sheardown Lake SE compared to Reference Lake 3, the condition of arctic charr non-YOY was significantly lower at Sheardown Lake SE (Table 4.11; Appendix Table G.20). For each age class, the magnitude of difference in condition was just outside of the CES_C of ±10% suggesting that these differences were ecologically meaningful (Table 4.11; Appendix Table G.20). Temporal comparisons indicated no consistent differences in nearshore non-YOY arctic charr size or condition between Sheardown Lake SE and Reference Lake 3 from 2015 to 2018 (Table 4.11). In turn, this suggested that the differences in nearshore non-YOY arctic charr size and condition between Sheardown Lake SE and Reference Lake 3 reflected natural variability between study lakes over time. Overall, no adverse effects on the health of arctic charr fish collected at the Sheardown Lake SE nearshore were indicated since commercial mine operations commenced in 2015.

Littoral/Profundal Arctic Charr

Mine-related influences on the Sheardown Lake SE littoral/profundal arctic charr population were assessed based on a control-impact analysis using 2018 data collected at Sheardown Lake SE and Reference Lake 3, and based on a before-after analysis using data collected at Sheardown Lake SE in 2018 and during baseline characterization studies (2006 and 2008 combined data).

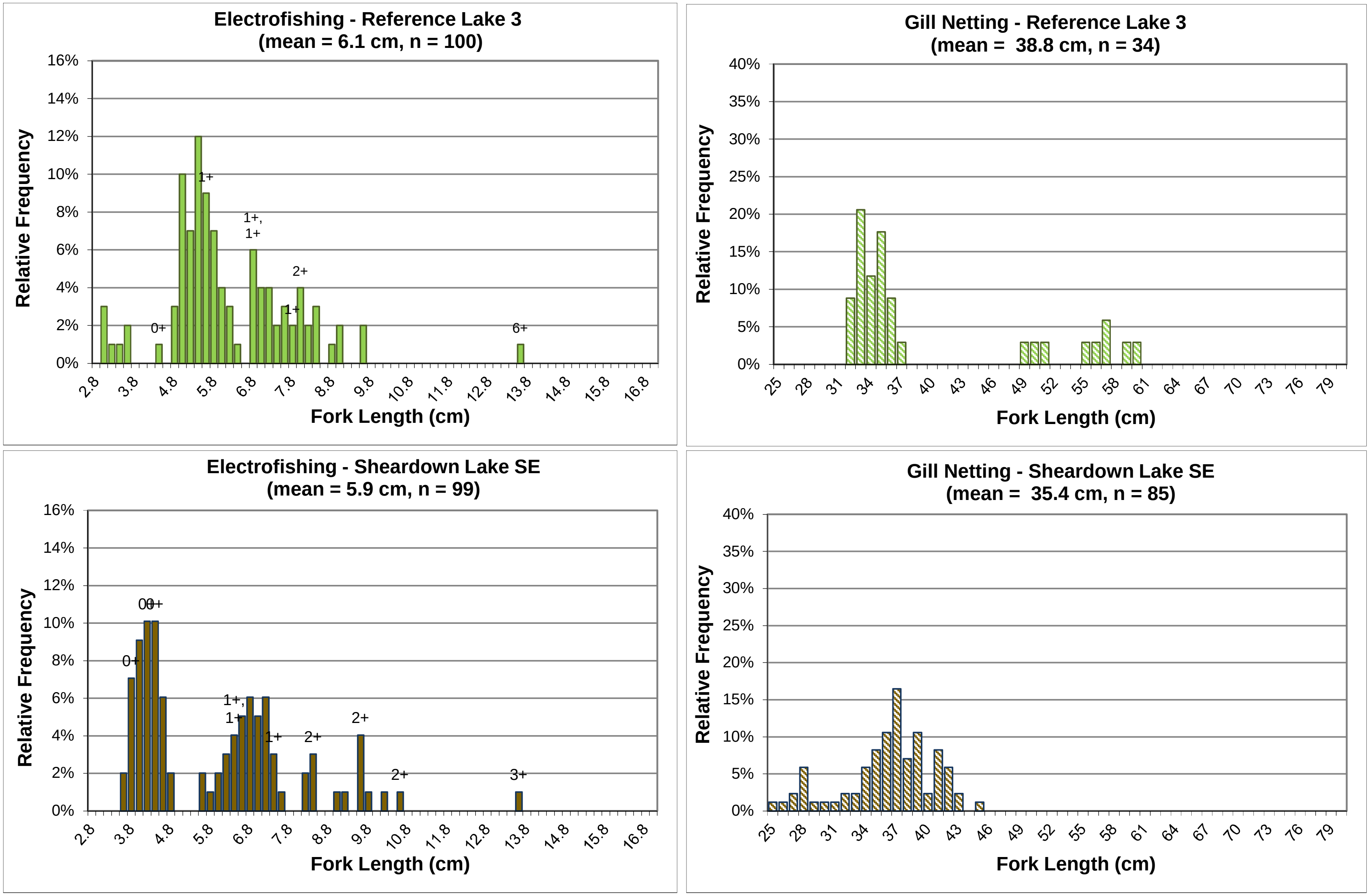

Figure 4.21: Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2018

Note: Fish ages are shown above the bars, where available.

Table 4.11: Summary of Statistical Results for Arctic Charr Population Comparisons between Sheardown Lake SE and Reference Lake 3 from 2015 to 2018, and between Sheardown Lake SE Mine Operational and Baseline Period Data, for Fish Captured by Electrofishing and Gill Netting Methods, Mary River Project CREMP

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed? [a]							
			versus Reference Lake 3				versus Sheardown Lake SE baseline period data [b]			
			2015	2016	2017	2018	2015	2016	2017	2018
Nearshore Electrofishing	Survival	Length-Frequency Distribution	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
		Age	No	No	No	-	**Yes** **(+273%)**	-	-	-
	Energy Use (non-YOY)	Size (mean fork length)	No	No	**Yes** **(+12%)**	**Yes** **(+21%)**	**Yes** **(+7%)**	**Yes** **(-15%)**	**Yes** **(+19%)**	**Yes** **(-47%)**
		Size (mean weight)	No	No	**Yes** **(+55%)**	**Yes** **(+59%)**	No	**Yes** **(-43%)**	**Yes** **(+54%)**	No
	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	**Yes** **(+4%)**	No	**Yes** **(+9%)**	**Yes** **(-13%)**	**Yes** **(-14%)**	**Yes** **(-16%)**	No	**Yes** **(-15%)**
Littoral/Profundal Gill Netting [c]	Survival	Length Frequency Distribution	-	-	-	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
		Age	-	-	-	-	**Yes** **(-13%)**	No	No	-
	Energy Use	Size (mean fork length)	-	-	-	No	**Yes** **(-9%)**	**Yes** **(-7%)**	**Yes** **(-5%)**	**Yes** **(-4%)**
		Size (mean weight)	-	-	-	No	**Yes** **(-26%)**	**Yes** **(-20%)**	**Yes** **(-16%)**	**Yes** **(-16%)**
		Growth (fork length-at-age)	-	-	-	-	No	No	No	-
		Growth (weight-at-age)	-	-	-	-	**Yes** **(+18%)**	**Yes** **(+24%)**	No	-
	Energy Storage	Condition (body weight-at-fork length)	-	-	-	**Yes** **(+7%)**	No	No	**Yes** **(-6%)**	**Yes** **(-7%)**

[a] Values in parentheses indicate direction and magnitude of any significant differences.

[b] Baseline period data included 2007 nearshore electrofishing data and 2007 and 2008 littoral/profundal gill netting data.

[c] Due to low catches of arctic charr in gill nets at Reference Lake 3 in 2015, 2016, and 2017, no comparison of fish health was conducted for gill netted fish.

A total of 85 and 34 arctic charr were sampled from littoral/profundal habitat of Sheardown Lake SE and Reference Lake 3, respectively, in August 2018, for the control-impact analysis. The length-frequency distribution for littoral/profundal arctic charr differed significantly between lakes (Table 4.11; Figure 4.20). However, no significant differences in mean length or weight of littoral/profundal arctic charr were indicated between Sheardown Lake SE and Reference Lake 3 in 2018 (Table 4.11; Appendix Table G.24). In addition, although condition of arctic charr captured at littoral/profundal areas of Sheardown Lake SE was significantly greater than at Reference Lake 3, the absolute magnitude of this difference was less than the CES_C of 10% suggesting that the difference in arctic charr condition between lakes was not ecologically meaningful (Table 4.11; Appendix Table G.24).

The length-frequency distribution of arctic charr captured at littoral/profundal habitat of Sheardown Lake SE differed significantly between 2018 and the baseline period (Table 4.11). In part, the difference in length-frequency distributions may have reflected significantly smaller size (i.e., weight and length) of individuals captured in 2018 compared to the baseline period (Table 4.11; Appendix Table G.24). Although the condition of arctic charr sampled from littoral/profundal habitat of Sheardown Lake SE was significantly lower in 2018 compared to the baseline period, the magnitude of this difference was within the ecologically meaningful CES_C of ±10% (Table 4.11). Temporal comparisons indicated that arctic charr sampled at littoral/profundal habitat of Sheardown Lake SE have consistently been significantly shorter and lighter during years of mine operation from 2015 to 2018 compared to the mine baseline period, but significant differences in condition only occurred in 2017 and 2018 compared to the mine baseline studies (Table 4.11). Notably, the difference in arctic charr condition in both 2017 and 2018 compared to the baseline period was not ecologically meaningful based on the magnitude of difference within the CES_C of ±10% (Table 4.11). In turn, this suggested no adverse influences on adult arctic charr at Sheardown Lake SE through the initial four years of mine operation.

4.3.7 Integrated Summary

At Sheardown Lake SE, aqueous concentrations of copper and molybdenum were elevated compared to Reference Lake 3 in 2018, and molybdenum was elevated compared to the baseline period. However, all water quality parameters were observed at concentrations below applicable WQG and AEMP benchmarks in 2018. Similar to the northwest basin, total aluminum and manganese concentrations showed strong positive correlations with turbidity at Sheardown Lake SE in 2018 that, in turn, suggested that these metals were largely bound to/contained in suspended particulate matter and were not likely biologically available. High turbidity in Sheardown Lake is hypothesized to reflect natural sources of suspended particulates originating from Mary River, upstream of the mine. Sediment metal concentrations at littoral and profundal habitats of Sheardown Lake SE were very similar to average concentrations observed for respective station habitats at Reference Lake 3 in 2018. Mean concentrations of iron and manganese were above SQG and AEMP benchmarks in sediment of Sheardown Lake SE, but concentrations of these metals were also above SQG and/or AEMP benchmarks at Reference Lake 3. Although arsenic, chromium, nickel, and phosphorus concentrations were above AEMP benchmarks at individual littoral and profundal stations, concentrations of these metals were also above AEMP benchmarks at Reference Lake 3. Temporal comparisons indicated that metal concentrations in sediment of Sheardown Lake SE in 2018 were within ranges shown during baseline studies, indicating no substantial mine-related influences on sediment quality over time at Sheardown Lake SE.

Chlorophyll-a concentrations at Sheardown Lake SE were significantly higher than at Reference Lake 3 in 2018 suggesting greater primary production at Sheardown Lake. However, chlorophyll-a concentrations remained well below the AEMP benchmark during all seasonal sampling events in 2018 at Sheardown Lake SE, and suggested oligotrophic conditions typical of Arctic waterbodies. Temporal evaluation of the chlorophyll-a data indicated no changes to the trophic status of Sheardown Lake SE since commencement of commercial mine operations. The benthic invertebrate community of Sheardown Lake SE showed significantly higher density and richness, but no ecologically significant differences in Simpson's Evenness and relative abundance of dominant groups including metal-sensitive chironomids, compared to Reference Lake 3 in 2018. In addition, no ecologically significant differences in benthic invertebrate density, richness, Simpson's Evenness, and relative abundance of dominant taxonomic groups or FFG were consistently shown from 2015 to 2018 compared to years in which mine baseline data were collected at Sheardown Lake SE. The size of the arctic charr population was greater at Sheardown Lake SE compared to Reference Lake 3 in 2018, but similar numbers of arctic charr were present at Sheardown Lake SE in 2018 compared to the baseline period. Arctic charr YOY and non-YOY captured at nearshore habitat of Sheardown Lake SE showed significantly higher and lower condition, respectively, than those captured at Reference Lake 3 in 2018. However, no consistent differences in nearshore non-YOY arctic charr condition was indicated between Sheardown Lake SE and Reference Lake 3 from 2015 to 2018, suggesting that the differences in nearshore non-YOY arctic charr condition reflected natural variability between study lakes over time. No ecologically significant differences in the condition of arctic charr captured at littoral/ profundal habitat were indicated between Sheardown Lake SE and Reference Lake 3 in 2018, nor at Sheardown Lake SE between 2018 and the mine baseline period, indicating no adverse effects on the health of arctic charr at Sheardown Lake SE. Collectively, the chlorophyll-a, benthic invertebrate community, and arctic charr fish population data all suggested no adverse mine-related influences to the biota of Sheardown Lake SE in the fourth year of mine operation at the Mary River Project.

5 MARY RIVER AND MARY LAKE SYSTEM

5.1 Mary River

5.1.1 Water Quality

Dissolved oxygen (DO) concentrations at Mary River stations were consistently at or above saturation during all spring, summer, and fall monitoring events, and were comparable to DO saturation levels observed among the GO-09 series reference river stations for each respective seasonal sampling event (Figure 5.1; Appendix Tables C.1 to C.3). Although DO concentrations differed significantly among the Mary River benthic study areas, higher DO concentrations were shown downstream compared to upstream of the mine at the time of biological sampling in August 2018, and concentrations were consistently well above WQG acceptable levels for sensitive life stages of cold-water biota (i.e., 9.5 mg/L) at all times (Figure 5.1; Appendix Figure C.21; Appendix Table C.61). This suggested that slight differences in DO concentrations among the Mary River study areas were not ecologically meaningful and were unrelated to potential mine influences.

In situ pH at all Mary River stations was similar to pH at the GO-09 series river reference stations during the summer and fall sampling events, but were higher (more alkaline) at and downstream of the mine compared to the GO-09 series river reference stations during the spring sampling event in 2018 (Figure 5.1; Appendix Tables C.1 to C.3). Highest pH was generally observed at Mary River Tributary-F (i.e., Station FO-01) in each season (Figure 5.1). Because Mary River Tributary-F runs adjacent to the pit mine haul road, the occurrence of highest pH suggested a mine-related influence on this tributary. Nevertheless, pH at all Mary River stations was consistently within WQG limits during all spring, summer, and fall sampling events (Figure 5.1; Appendix Table C.61). Specific conductance was consistently lowest in spring and highest in fall at all stations, which likely was a reflection of natural seasonal differences related to the relative proportion of flow from surface runoff (e.g., spring snowmelt). Spatially, specific conductance was slightly higher at Mary River water quality stations located downstream than upstream of the Mary River Tributary-F confluence during summer and fall sampling events, but not during the spring sampling event in 2018 (Figure 5.1). Similar to patterns in pH, highest specific conductance was consistently observed at the Mary River Tributary-F water monitoring station, suggesting that this tributary may be the primary receiver for mine-related inputs within the Mary River system. However, natural differences in base material geology of the Mary River Tributary-F watershed compared to that of Mary River may also contribute to the differences in specific conductance observed between these watercourses.

Water chemistry within Mary River showed no distinct and/or consistent spatial gradients with progression downstream from the GO-09 series river reference stations during any of the spring,

Figure 5.1: Comparison of *In Situ* Water Quality Variables Measured at Mary River Water Quality Monitoring Stations in Spring, Summer, and Fall 2018, Mary River Project CREMP

summer, or fall sampling events in 2018 with the exception of concentrations of manganese and sulphate (Table 5.1; Appendix Table C.62). In general, parameter concentrations at Mary River stations located adjacent to or downstream of the mine (EO and CO series stations) were similar to concentrations observed at the upstream river reference stations (GO-09 series stations) during each respective sampling event (Table 5.1; Appendix Tables C.62 to C.65). However, total and dissolved concentrations of manganese were distinctly elevated at Station EO-03 compared to stations located upstream in the Mary River during the summer and fall sampling events (Table 5.1; Appendix Tables C.62 to C.65). In addition, a generally decreasing gradient in manganese concentrations in Mary River was observed with distance downstream from Station EO-03, indicating a clear source of manganese to Mary River between Stations EO-10 and EO-03 (Table 5.1; Appendix Tables C.62 to C.65). Sulphate concentrations were also distinctly elevated at Mary River stations located downstream of the Mary River Tributary-F confluence during the summer and fall sampling events in 2018 (Table 5.1; Appendix Tables C.62 and C.63). Because highest sulphate concentrations were consistently observed at Mary River Tributary-F in 2018 (Appendix Tables C.62 and C.63), this tributary was clearly an important source of sulphate to Mary River.

Total aluminum concentrations were above WQG at a number of Mary River mine-exposed stations, but were typically below the applicable AEMP benchmark, during the spring, summer and fall monitoring events in 2018 (Table 5.1; Appendix Table C.62). However, total concentrations of aluminum were also elevated above applicable WQG at one or more of the Mary River GO series reference stations during the spring, summer, and fall monitoring events in 2018 (Appendix Table C.62), suggesting naturally high concentrations of aluminum in the Mary River system.[12] Phenol concentrations were above WQG at Mary River mine-exposed stations EO-03 and CO-01 during the spring sampling event, but because phenol concentrations were also above WQG at the upstream-most reference station GO-09A in spring, phenol concentrations above WQG at Mary River were not likely attributable to mine operations (Appendix Table C.62).

Temporal evaluation of Mary River water chemistry data indicated that parameter concentrations during the fall sampling event in 2018 were generally within respective parameter concentration ranges measured at each station during the mine baseline period (2005 to 2013; Figure 5.2; Appendix Figure C.22). Only manganese and sulphate showed higher concentrations in 2018 than during the mine baseline period, as well as a generally increasing trend from mine

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[12] Previous CREMP studies also showed total aluminum concentrations above respective WQG and/or AEMP benchmarks at Mary River GO series reference stations, indicating naturally high concentrations of this metal in Mary River.

Table 5.1: Water Chemistry at Mary River Monitoring Stations, Mary River Project CREMP, August 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Reference Creek Average (n = 4)	Mary River Reference Station			Mary River Upstream		MRTF	Mary River Downstream of Mine						
						G0-09-A	G0-09	G0-09-B	G0-03	GO-01	F0-01	E0-10	EO-03	EO-21	EO-20	C0-10	C0-05	CO-01
					Fall 2018	27-Aug-2018	25-Aug-2018	25-Aug-2018	25-Aug-2018	27-Aug-2018	25-Aug-2018	27-Aug-2018	26-Aug-2018	27-Aug-2018	27-Aug-2018	27-Aug-2018	27-Aug-2018	27-Aug-2018
Conventionals	Conductivity (lab)	umho/cm	-	-	97	134	113	112	121	134	283	177	153	164	163	165	160	149
	pH (lab)	pH	6.5 - 9.0	-	7.88	7.99	8.07	8.14	8.02	8.00	8.29	8.03	8.03	8.05	8.04	8.07	8.01	8.11
	Hardness (as $CaCO_3$)	mg/L	-	-	47	66	55	55	57	65	143	84	72	80	79	81	78	70
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	3.2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	53	55	70	70	60	80	160	81	115	75	80	90	95	75
	Turbidity	NTU	-	-	2.4	2.7	4.9	3.8	3.2	2.7	1.7	2.7	3.0	2.6	2.3	2.1	2.6	2.2
	Alkalinity (as $CaCO_3$)	mg/L	-	-	43	65	50	52	50	59	95	61	58	59	62	65	64	60
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	0.021	0.037	0.069	<0.020	<0.020	<0.020	<0.020	0.022	<0.020	<0.020	<0.020	<0.020	0.032	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.130	0.049	0.021	0.034	0.047	0.044	0.041	0.026
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.5	1.3	2.0	1.9	1.4	1.4	2.2	1.3	2.0	1.4	1.5	1.5	1.7	1.7
	Total Organic Carbon	mg/L	-	-	2.0	2.1	2.1	2.0	1.9	1.9	2.3	1.8	2.1	1.9	2.0	2.3	2.4	2.6
	Total Phosphorus	mg/L	0.020^{α}	-	0.0035	0.0034	0.0073	0.0034	<0.0030	<0.0030	0.0036	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0030	<0.0030
	Phenols	mg/L	0.004^{α}	-	<0.0010	<0.0010	0.0027	<0.0010	0.0011	<0.0010	0.0011	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010
Anions	Bromide (Br)	mg/L	-	-	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.6	2.8	2.9	2.8	5.4	5.5	2.5	5.3	5.5	5.4	5.0	5.0	4.9	4.7
	Sulphate (SO_4)	mg/L	218^{β}	218	2.7	1.6	1.8	1.7	1.6	1.7	49.1	17.9	8.2	12.7	11.8	11.9	10.6	7.3
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.054	0.126	0.155	0.105	0.128	0.139	0.034	0.135	0.123	0.125	0.123	0.093	0.102	0.097
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0059	0.0085	0.0082	0.0080	0.0086	0.0089	0.0132	0.0107	0.0096	0.0101	0.0105	0.0103	0.0099	0.0093
	Beryllium (Be)	mg/L	0.011^{α}	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<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 (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	9.8	13.9	11.8	11.7	12.1	14.0	25.8	16.5	15.1	16.2	16.2	15.9	15.0	16.0
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	<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 (Cu)	mg/L	0.002	0.0024	0.0009	0.0008	0.0009	0.0009	0.0008	0.0008	0.0007	0.0008	0.0008	0.0009	0.0009	0.0010	0.0009	0.0008
	Iron (Fe)	mg/L	0.30	0.874	0.046	0.071	0.102	0.082	0.079	0.074	0.042	0.075	0.075	0.075	0.092	0.059	0.085	0.072
	Lead (Pb)	mg/L	0.001	0.001	0.00008	0.00008	0.00011	0.00009	0.00009	0.00007	<0.000050	0.00007	0.00008	0.00008	0.00009	0.00006	0.00007	0.00006
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	5.3	7.4	6.1	6.5	6.3	7.2	20.4	10.4	8.3	9.2	9.5	9.7	9.3	8.4
	Manganese (Mn)	mg/L	0.935^{β}	-	0.0007	0.0009	0.0012	0.0011	0.0010	0.0008	0.0011	0.0009	0.0094	0.0072	0.0074	0.0057	0.0064	0.0040
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00029	0.00025	0.00029	0.00026	0.00024	0.00030	0.00032	0.00029	0.00045	0.00046	0.00039	0.00044	0.00042	0.00045
	Nickel (Ni)	mg/L	0.025	0.025	0.00053	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00051	0.00054	0.00068	0.00092	0.00078	0.00072
	Potassium (K)	mg/L	-	-	0.65	0.91	0.95	0.97	0.87	0.92	1.26	0.99	0.98	0.99	1.00	0.97	0.99	0.96
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.83	0.96	0.94	0.85	0.96	0.97	0.70	1.01	0.97	0.94	1.00	0.93	0.94	0.93
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.2	2.0	2.0	2.0	1.7	1.9	1.5	1.8	1.7	1.9	1.9	1.7	1.8	1.7
	Strontium (Sr)	mg/L	-	-	0.0094	0.0128	0.0127	0.0129	0.0108	0.0127	0.0199	0.0148	0.0158	0.0159	0.0154	0.0152	0.0147	0.0141
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0019	0.0026	0.0025	0.0027	0.0020	0.0021	0.0023	0.0023	0.0020	0.0022	0.0019	0.0019	0.0017	0.0017
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Mary River

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

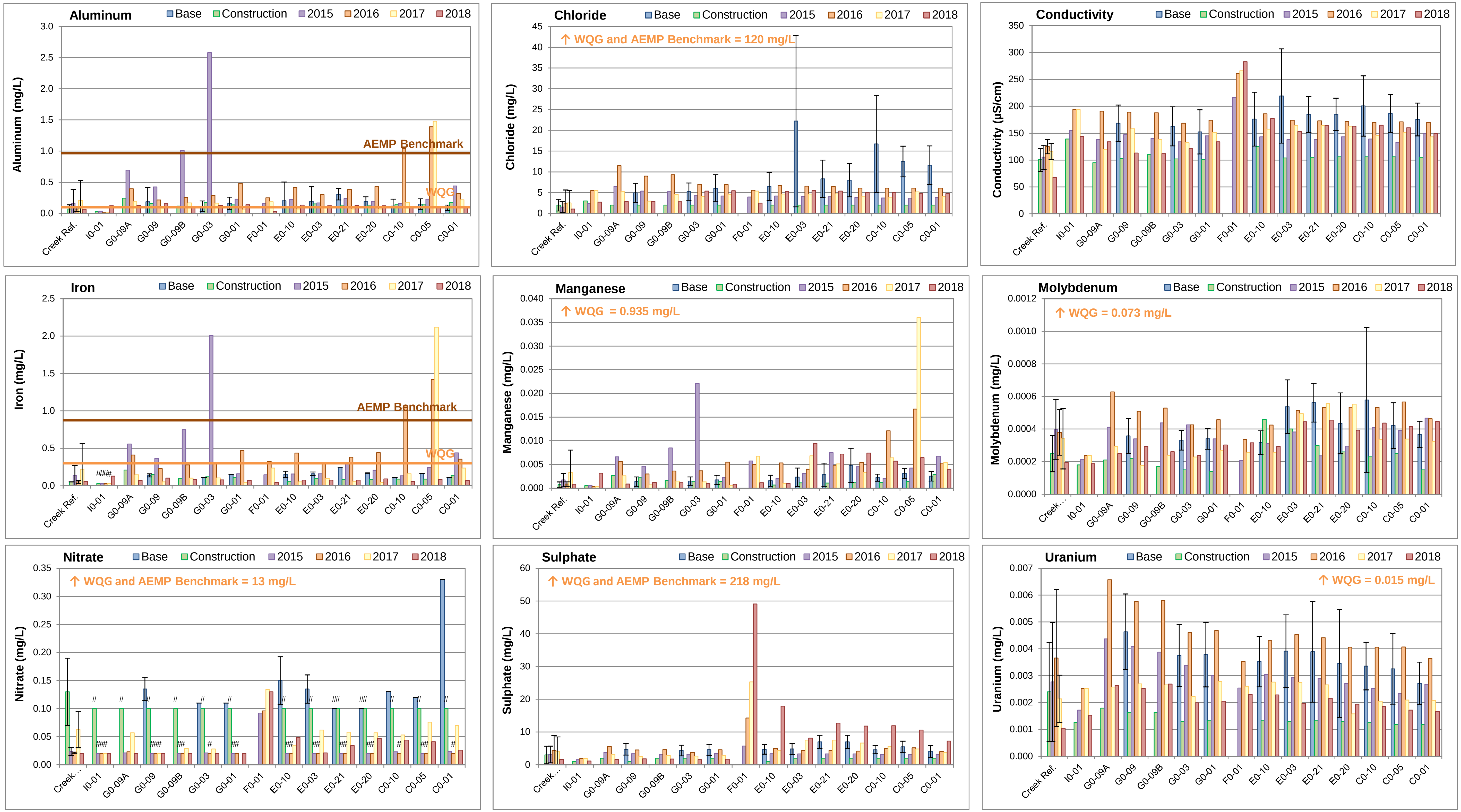

Figure 5.2: **Temporal Comparison of Water Chemistry at Mary River Stations for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2018) Periods in the Fal**

Notes: Values represent mean ± SD. Creek reference includes the CLT-REF and MRY-REF series stations (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guidelines (WQG) AEMP Benchmarks are specific to Mary River.

construction (2014) through operational phases (i.e., 2015 to 2018), suggesting that mine operations have contributed to elevated concentrations of these parameters in Mary River waters (Figure 5.2; Appendix Figure C.22). Despite higher concentrations of manganese and sulphate over time at Mary River water quality stations located downstream of the mine, concentrations of both parameters remained well below applicable WQG and AEMP benchmarks in and prior to 2018 (Figure 5.2).

5.1.2 Phytoplankton

Chlorophyll-a concentrations at Mary River stations located downstream of the mine were generally within the range of, or slightly higher, than the GO series river reference stations and/or creek reference stations during the 2018 spring, summer, and/or fall sampling events (Figure 5.3). Chlorophyll-a concentrations at Mary River Tributary-F (MRTF; Station FO-01), which receives treated effluent discharge from the mine, were also comparable to seasonal average concentrations observed at the reference stations (Figure 5.3). Chlorophyll-a concentrations were consistently well below the AEMP benchmark of 3.7 µg/L during all winter, summer, and fall sampling events at all Mary River and MRTF sampling stations in 2018, and were suggestive of low (i.e., oligotrophic) phytoplankton productivity based on Dodds et al (1998) trophic status classification for stream environments. These results suggested no adverse mine-related influences on phytoplankton abundance at Mary River or MRTF in 2018. Low to moderate phytoplankton productivity was expected for Mary River reference and mine-exposed stations in 2018 given oligotrophic to mesotrophic productivity categorizations based on CWQG classifications that use total phosphorus concentrations to define trophic status (Table 5.1; Appendix Table C.62).

Temporal comparisons of the Mary River chlorophyll-a data suggested that concentrations were generally lower at stations located downstream of the mine sewage treatment plant outfall (i.e., EO-21, EO-20, and CO series stations) in 2018 and during each of the three previous years of mine operation (2015 to 2017) than those observed during the baseline period (Figure 5.4). Notably, baseline period chlorophyll-a concentrations at these same stations were considerably higher than at the reference and mine-exposed stations located upstream for this same period (Figure 5.4). Some of the variability in chlorophyll-a concentrations at Mary River EO-21, EO-20 and CO series stations among baseline and commercial mine operation years may have reflected natural differences in turbidity affecting the amount of light energy available to phytoplankton as opposed to responses related to exposure to metals, nutrient enrichment, or other potential mine-related influences on phytoplankton productivity (Minnow 2017). Changes in chlorophyll-a concentrations at Mary River stations located downstream of the mine among individual years of commercial mine operation (2015 to 2018) and the baseline period were consistent with natural

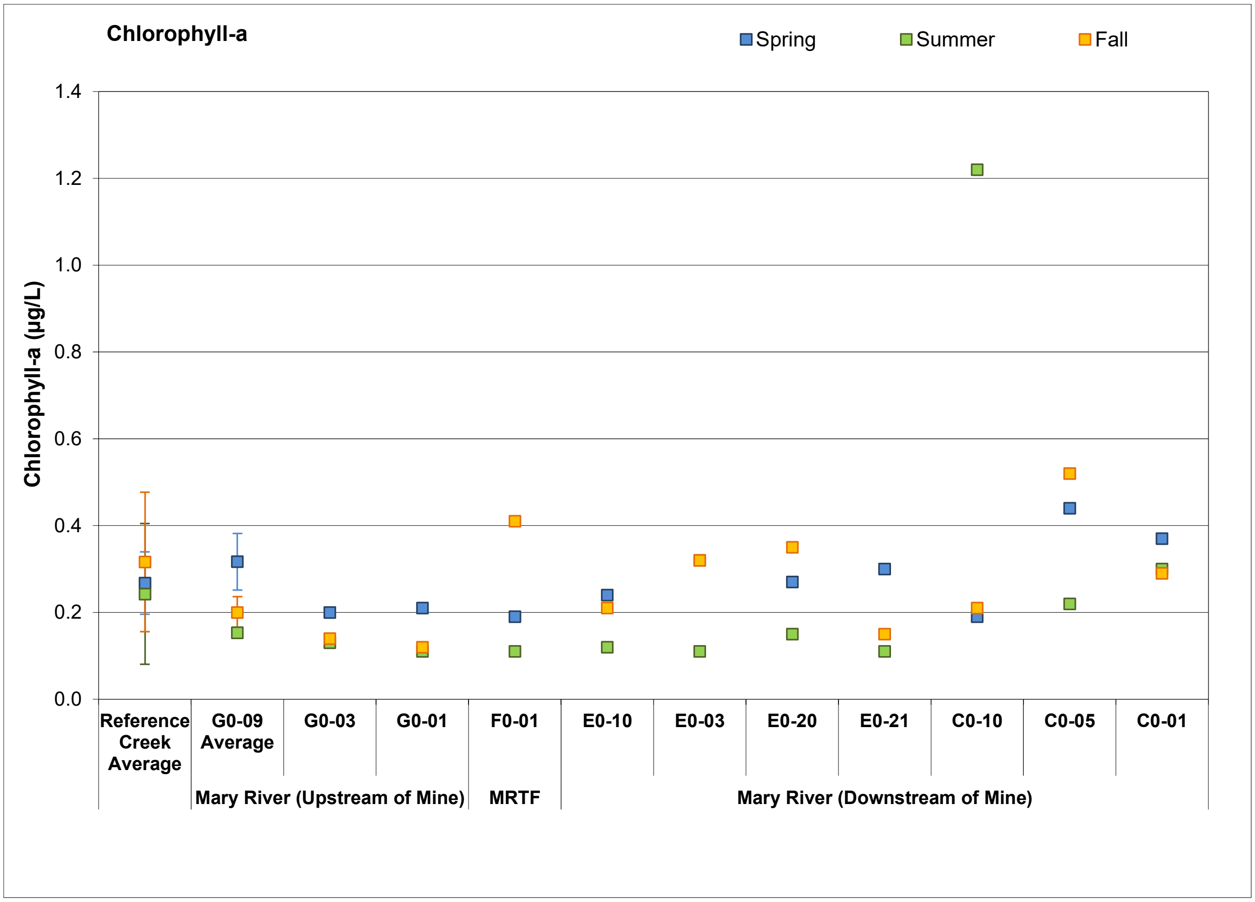

Figure 5.3: **Chlorophyll-a Concentrations at Mary River Phytoplankton Monitoring Stations Located Upstream and Downstream of the Mine, Mary River Project CREMP, 2018**

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

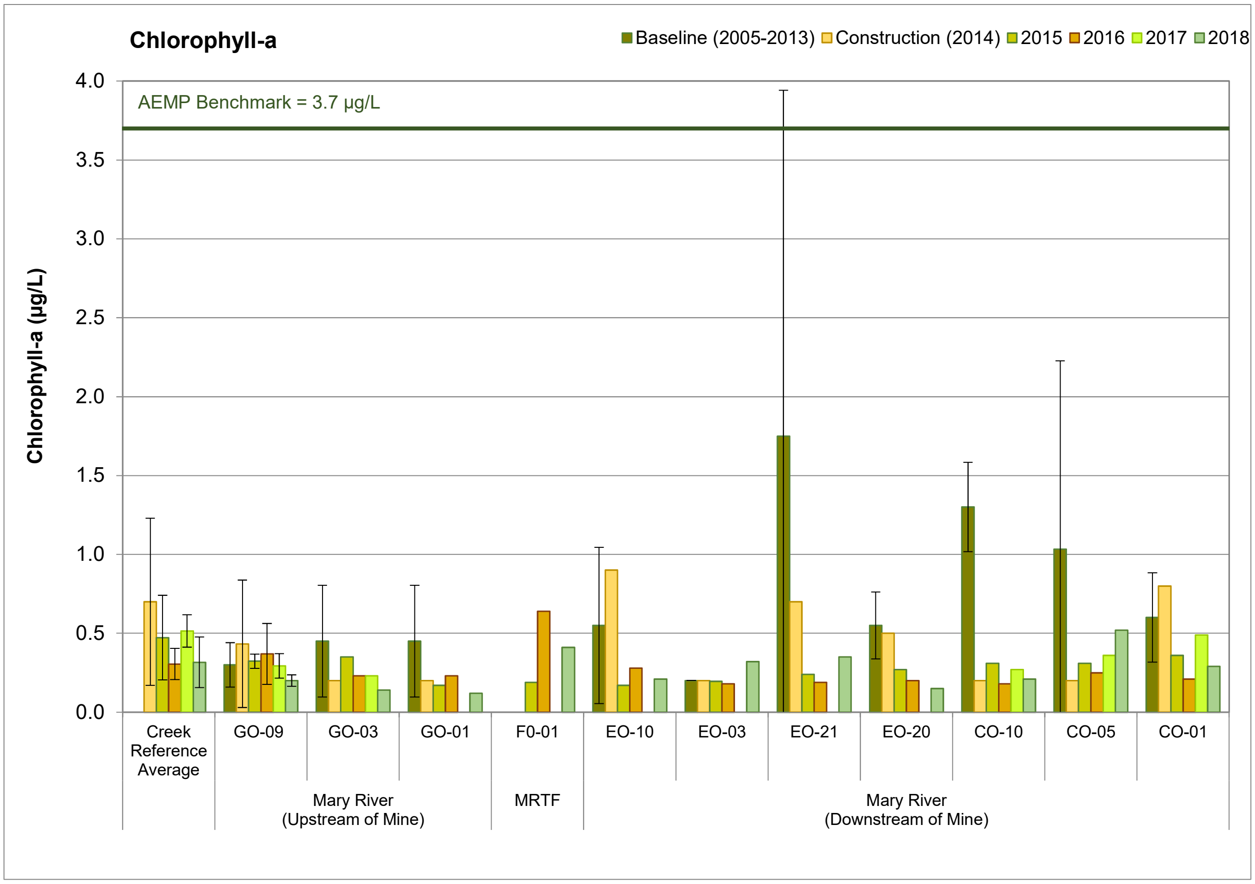

Figure 5.4: **Temporal Comparison of Chlorophyll-a Concentrations at Mary River Stations for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2018) Periods during the Fall**

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

differences in turbidity (i.e., originating from sources upstream of the mine), but may also have reflected influences from sources currently unidentified.

5.1.3 Benthic Invertebrate Community

The Mary River benthic invertebrate community assessment included a spatial statistical analysis of endpoints among two upstream reference areas (GO-09, GO-03), two near-field mine-exposed areas located in close proximity to the mine (EO-01, EO-20), and a far-field cumulative effects mine-exposed area located well downstream of the mine (CO-05; see Table 2.5, Figure 2.4). Benthic invertebrate density, richness, and Simpson's Evenness at the Mary River upper mine-exposed study area EO-01 did not differ significantly from the GO-09 reference area in 2018 (Figure 5.5). Of these endpoints, only richness was significantly lower at the Mary River middle mine-exposed study area EO-20 compared to the GO-09 reference area (Figure 5.5). In contrast, significantly higher density and richness, and significantly lower Simpson's Evenness was

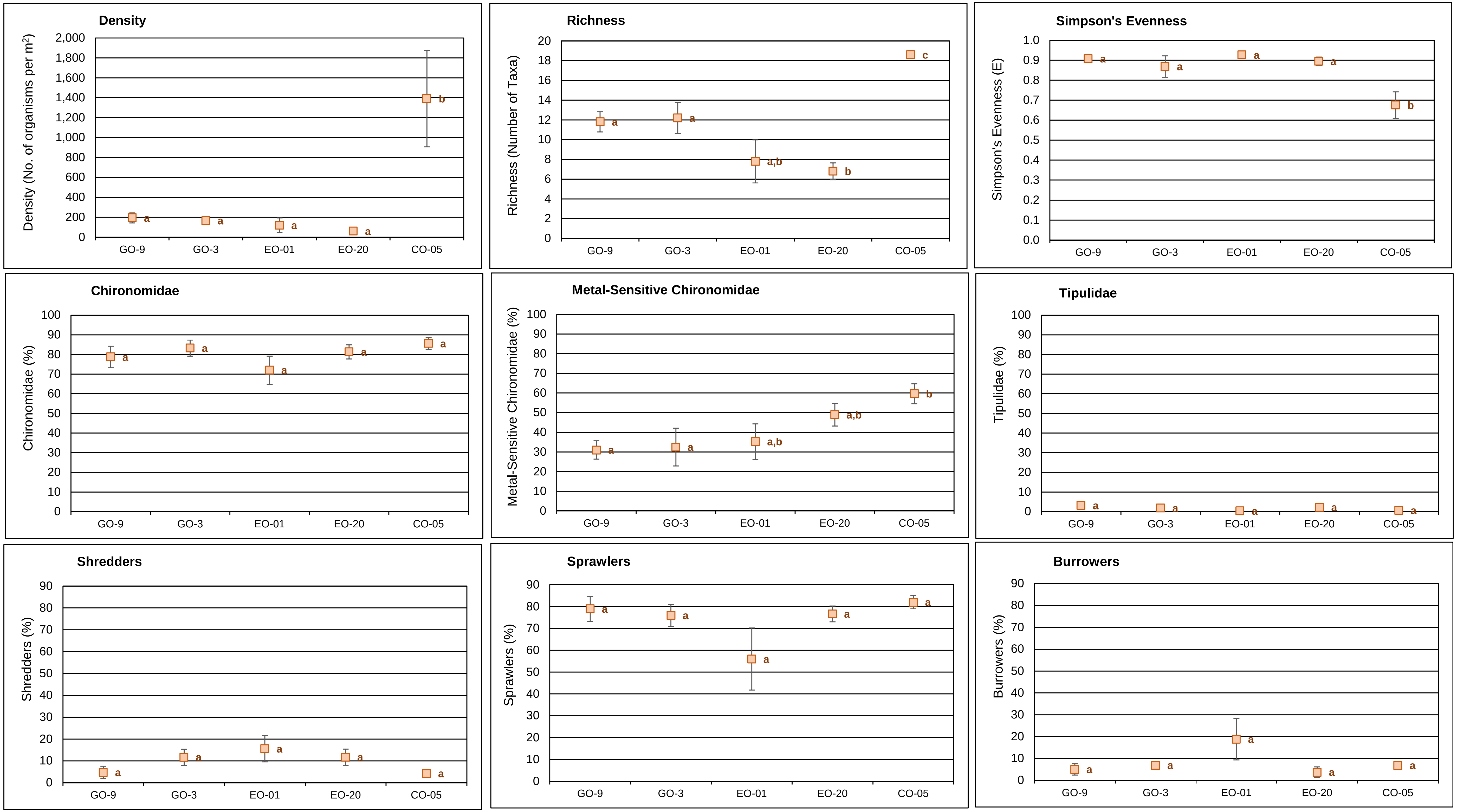

Figure 5.5: Comparison of Benthic Invertebrate Community Metrics among Mary River Study Areas (mean ± SE), Mary River Project CREMP, August 2018

Notes: The same letter(s) next to data points indicates no significant difference between/among study areas.

indicated at the Mary River far-field mine-exposed study area CO-05 compared to the reference area (Figure 5.5). High numbers of the midge genus *Pseudokiefferiella*, which characteristically inhabits clean, cool, arctic-alpine lotic environments (Doughman 1983), were present at CO-05 (Appendix Table F.51). The disproportionately high numbers of this midge resulted in higher density and lower Simpson’s Evenness of benthic invertebrates at this study area compared to the upstream reference area and other Mary River mine-exposed study areas (Appendix Table F.53). Notably, the occurrence of higher benthic invertebrate density and greater richness at CO-05 potentially reflected a slight nutrient enrichment-related effect associated with the mine, which discharges treated sewage effluent to the Mary River near the confluence with the Sheardown Lake SE outlet.

In addition to the differences indicated above, Bray-Curtis Index at the near- and far-field mine-exposed areas of Mary River differed significantly from the upstream GO-09 reference area (Appendix Table F.53). However, no significant differences in dominant taxonomic groups, FFG, or HPG were indicated between the Mary River mine-exposed and reference study areas (Figure 5.5; Appendix Table F.53). The lack of differences in FFG among Mary River study areas suggested no mine-related influences to aquatic food resources available to benthic invertebrates. Similarly, the absence of differences in HPG among Mary River study areas suggested no adverse mine-related influences to physical habitat features (e.g., sedimentation) adjacent to or downstream of the mine. In addition, no adverse significant differences in the relative abundance of metal-sensitive taxa were indicated between Mary River mine-exposed and reference areas (Figure 5.5), suggesting no adverse mine-related influences to benthic invertebrates associated with metal concentrations. Therefore, differences in benthic invertebrate community structure that included differing density, richness, Simpson’s Evenness, and Bray-Curtis Index between Mary River mine-exposed and reference areas in 2018 did not appear to be mine-related but rather, likely reflected natural variability among study areas.

Temporal comparison of the Mary River benthic invertebrate community data indicated no consistent ecologically significant differences in density and richness between mine operational (2015 to 2018) and baseline (2006 to 2011 data) periods at any of the mine-exposed study areas (i.e., EO-01, EO-20, or CO-05; Figure 5.6; Appendix Tables F.56 to F.58). Simpson’s Evenness at the Mary River upper mine-exposed study area EO-01 was continually significantly higher during years of mine operation than during the 2007 mine baseline study, but all other indices did not differ significantly among the years of mine operation and mine baseline at this study area (Appendix Table F.56). At middle mine-exposed study area EO-20, significantly lower and higher relative abundance of chironomids and the collector-gatherer FFG, respectively, generally occurred during years of mine operation compared to mine baseline data collected in 2011 (Appendix Table F.57). At far-field mine-exposed area CO-05, despite several endpoints differing

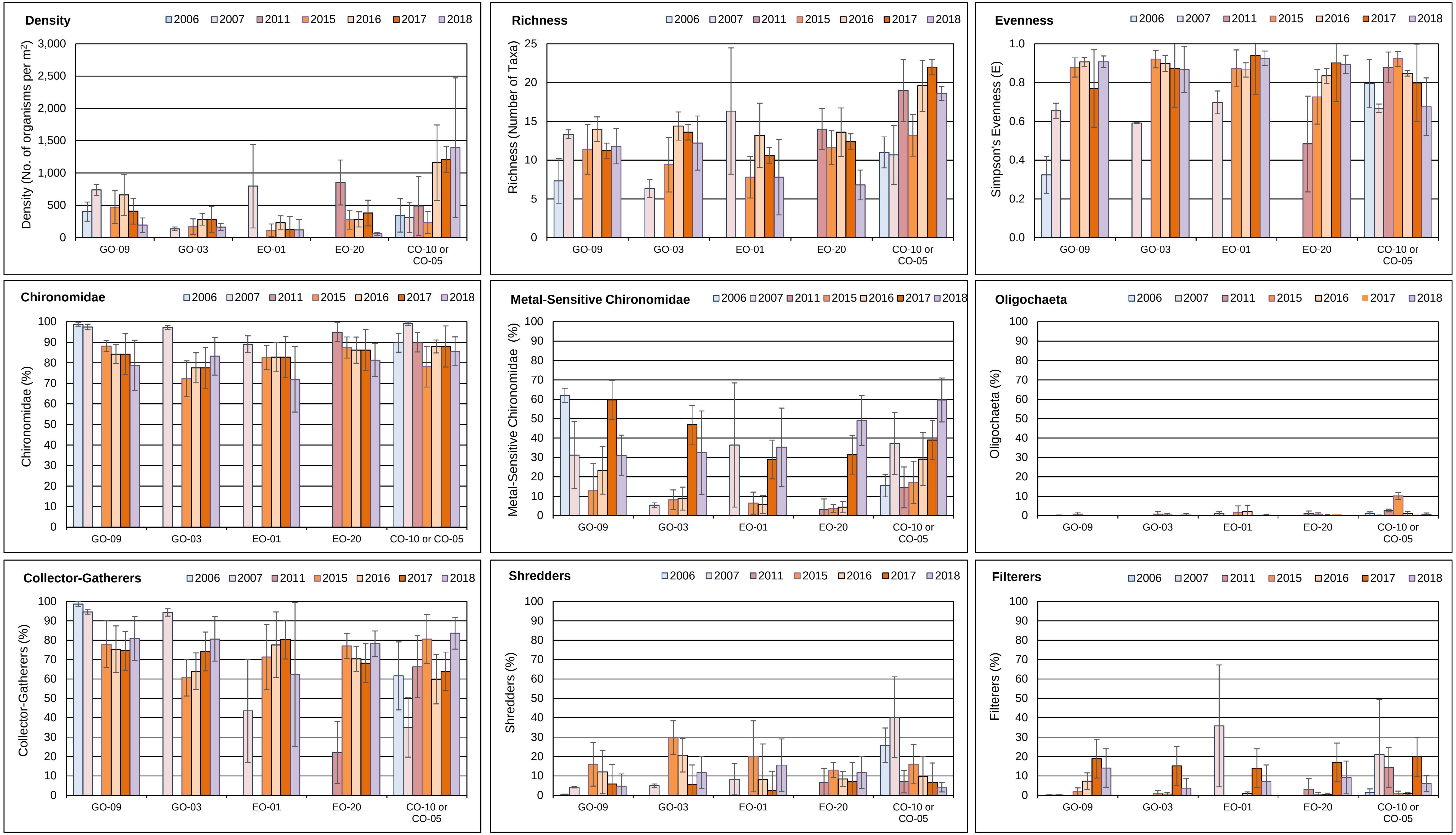

Figure 5.6: **Comparison of Benthic Invertebrate Community Metrics (mean ± SD) at Mary River Study Areas among Mine Baseline (2006, 2007, 2011) and Operational (2015 to 2018) Years for the Mary River Project CREMP**

significantly among the four mine-operational years and two mine baseline years, none of the endpoints showed consistent significant differences between the mine-operational and baseline periods (Appendix Table F.58). Notably, for those benthic invertebrate community metrics that differed significantly between years of mine-operation and baseline at the Mary River mine-exposed study areas, similar types, direction, and magnitude of these differences were generally observed at the Mary River upstream GO-09 and GO-03 reference areas between years of mine operation and baseline (Appendix Tables F.54 and F.55). In turn, this suggested that the differences in these metrics at Mary River areas over time reflected natural temporal variability and/or sampling artifacts of the CREMP (e.g., changes in sampling location, personnel collecting samples, etc.). In addition, temporal comparison of the data at each individual mine-exposed area indicated no cumulative temporal influences on benthic invertebrates of the Mary River since the commencement of commercial mine operations in 2015.

5.1.4 Integrated Summary

Mine-related influences on water quality of Mary River in 2018 included slight elevation of manganese and sulphate concentrations at mine-exposed areas compared to the upstream reference area, as well as to baseline data. Although total aluminum concentrations were above WQG at one or more Mary River mine-exposed stations in 2018, the elevation in aluminum appeared to be associated with naturally high turbidity within Mary River. Aqueous concentrations of all other parameters were well below WQG and AEMP benchmarks at the Mary River mine-exposed stations in 2018, with no indication of increasing concentrations over time. Chlorophyll-a concentrations were similar among the ten Mary River phytoplankton monitoring stations, with no significant differences in annual chlorophyll-a concentrations indicated between the Mary River mine-exposed and reference stations. Although lower chlorophyll-a concentrations were indicated at individual Mary River stations in 2018 compared to the baseline period, these differences likely reflected natural differences in turbidity among years, which would be expected to affect phytoplankton productivity by affecting the amount of light available for photosynthesis. The most notable differences in benthic invertebrate community endpoints among Mary River mine-exposed and reference areas included significantly higher density and richness, and significantly lower Simpson's Evenness, at the far-field (CO-05) study area. No significant differences in the relative abundance of dominant taxonomic groups, FFG, HPG, or metal-sensitive chironomids were indicated at any of the three Mary River mine-exposed study areas compared to the upstream reference area. In addition, no benthic invertebrate community endpoints differed significantly on a continual basis at ecologically meaningful magnitudes over the four years of mine operation compared to baseline data sets at any of the Mary River mine-exposed areas. Moreover, for those metrics that differed significantly between years of mine operation and baseline at mine-exposed areas, similar differences were observed among these years at the Mary River upstream reference area. Therefore, although the occurrence of greater benthic invertebrate density and richness and lower Simpson's Evenness at Mary River mine-exposed study area CO-05 potentially reflected a slight nutrient enrichment-related effect associated with the mine, it is more likely that natural habitat variability and/or sampling artifacts of the CREMP accounted for these differences in 2018. Overall, the chlorophyll-a and benthic invertebrate community data suggested no adverse mine-related influences to Mary River biota since commercial mine operations commenced in 2015.

5.2 Mary Lake

5.2.1 Hydraulic Retention Time

A hydraulic retention time of 75 ± 29 days was estimated for Mary Lake by Minnow (2018) using mean annual watershed runoff extrapolated from Baffinland flow monitoring stations installed in the primary tributaries of Mary Lake (Tom and Mary rivers) and at small watershed watercourses (i.e., ≤15 km^2) located on the mine property, and a lake volume of 156.35 million cubic metres.

5.2.2 Water Quality

Water quality profiles conducted at Mary Lake in 2018 showed similar values and patterns with depth for *in situ* water temperature, DO concentration, and pH measures at the Mary Lake north and south basins, but higher specific conductance was observed at the north basin throughout the year (Figures 5.7 and 5.8). Water temperatures increased from surface to bottom during the winter, and decreased from surface to bottom during the summer, at each of the north and south basins of Mary Lake in 2018, but in all cases, the water temperature difference between the surface and bottom was insufficient to result in thermal stratification of the water column (Figures 5.7 and 5.8). Mary Lake temperature profiles conducted during the summer monitoring event differed slightly from that at Reference Lake 3, where the trend of decreasing water temperature with increased depth was not as pronounced (Figures 5.7 and 5.8). Although similar water temperature profiles were observed between Mary Lake and Reference Lake 3 during the fall monitoring event (Figures 5.7 and 5.8), the average water temperature at the bottom of the water column at Mary Lake littoral stations was significantly cooler than at Reference Lake 3 (Figure 5.9; Appendix Table C.72). Nevertheless, the incremental difference in average bottom water temperature between lakes at littoral sampling depths was small (i.e., ≤0.5˚C), and thus was unlikely to be ecologically meaningful.

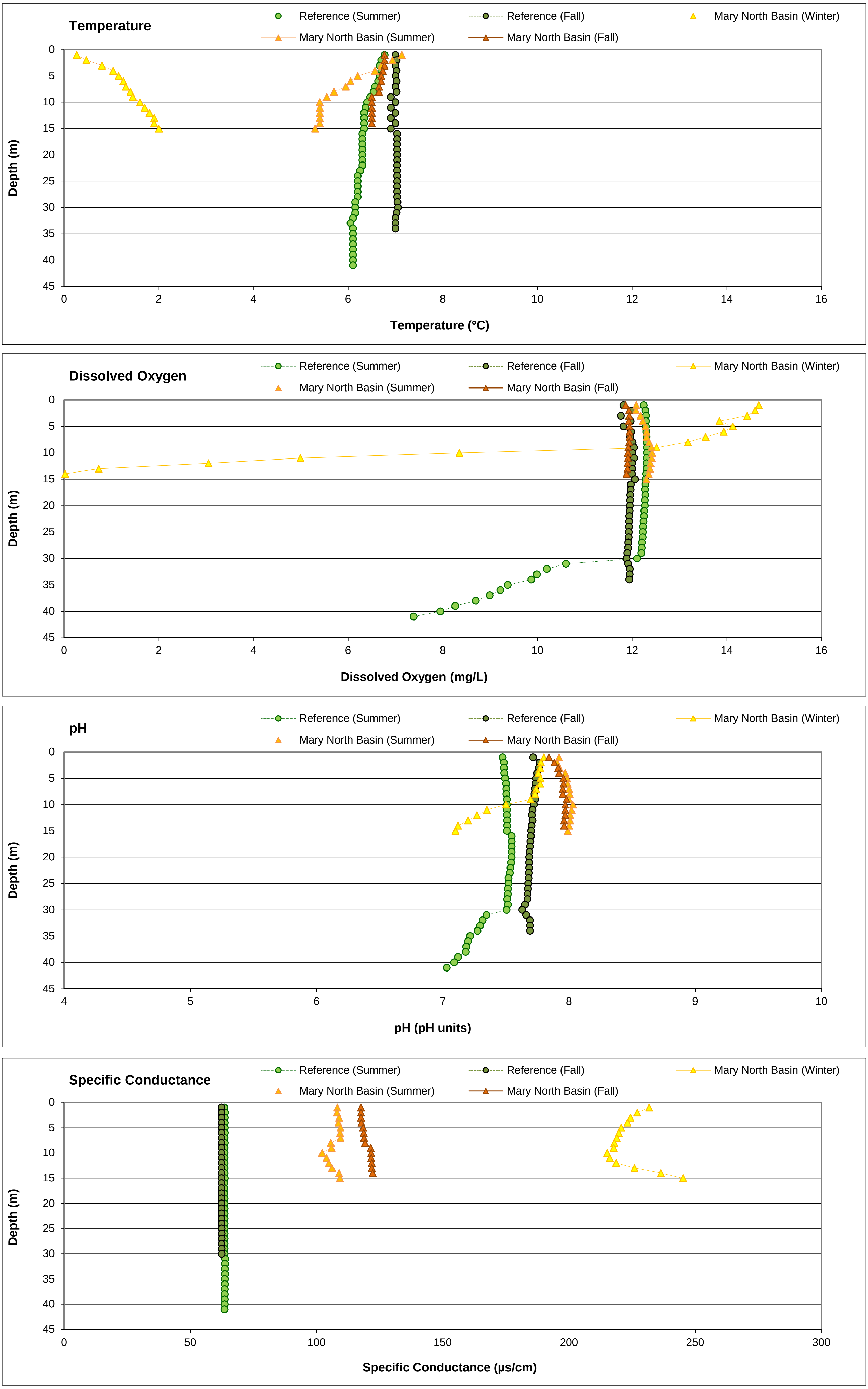

Figure 5.7: **Average *In Situ* Water Quality with Depth from Surface at the Mary Lake North Basin (BLO) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2018**

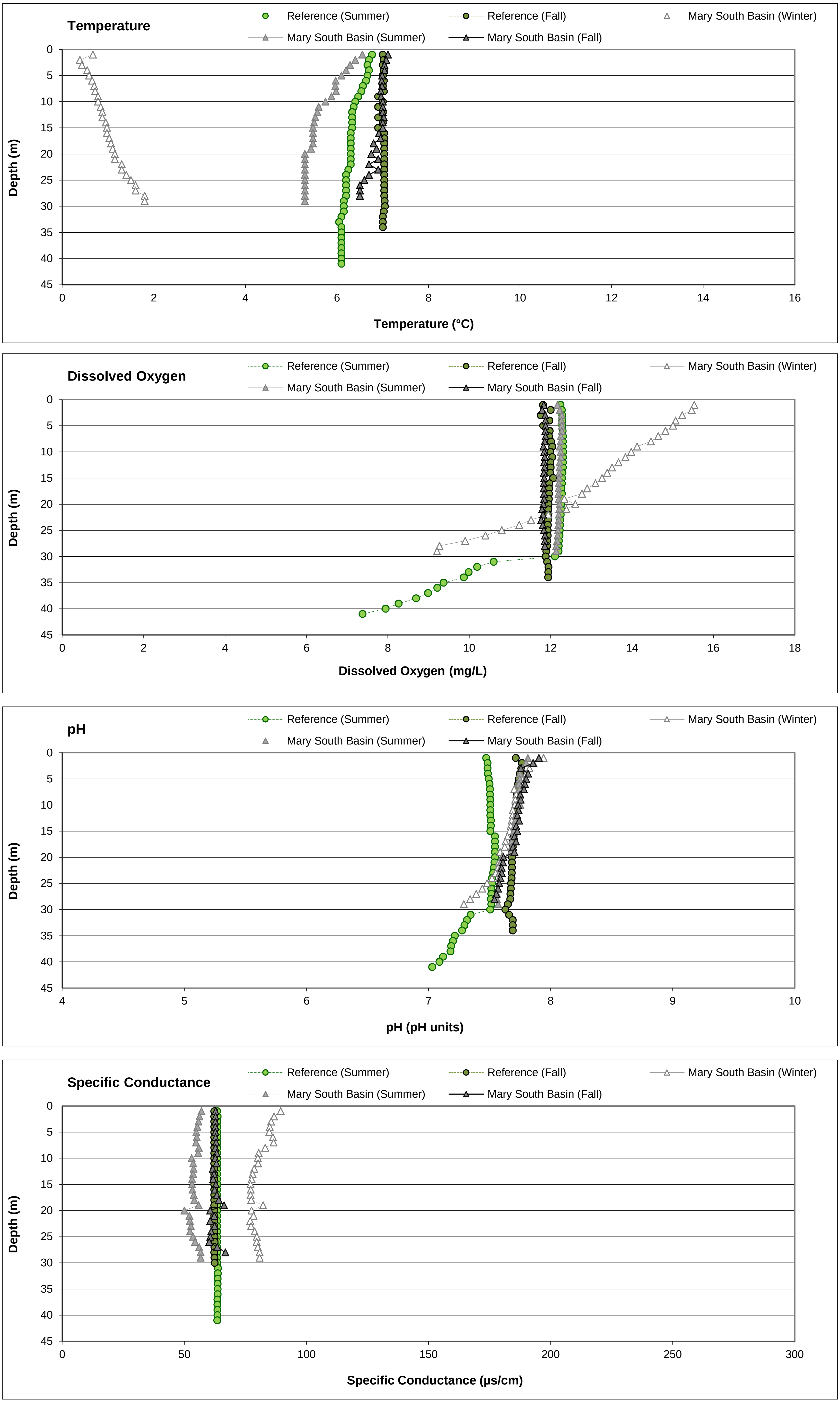

Figure 5.8: Average *In Situ* Water Quality with Depth from Surface at the Mary Lake South Basin (BLO) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2018

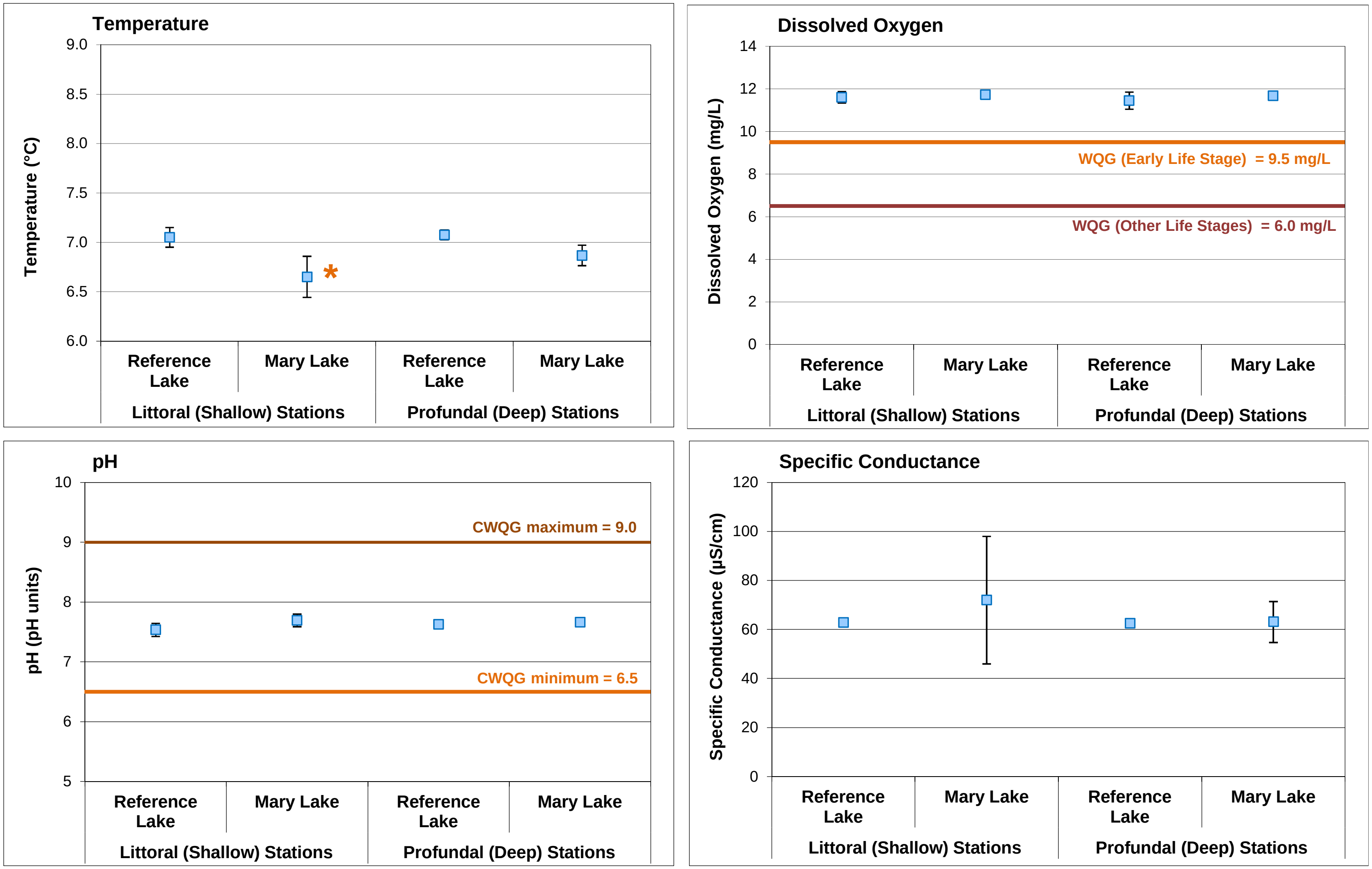

Figure 5.9: **Comparison of *In Situ* Water Quality Variables (mean ± SD) Measured at Mary Lake (BLO) and Reference Lake 3 (REF3) Littoral and Profundal Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018**

Note: An asterisk (*) next to data point indicates mean value differs significantly from the Reference Lake 3 mean for the respective littoral or profundal station type.

Dissolved oxygen profiles conducted at Mary Lake in 2018 indicated the development of a strong oxycline extending through the entire water column at both the north and south basins in winter (Figures 5.7 and 5.8). However, similar to Reference Lake 3, no oxycline development was apparent in the summer or fall of 2018 at either Mary Lake basin. Dissolved oxygen concentrations at Mary Lake were above WQG acceptable levels for early life stages of cold water biota (i.e., 9.5 mg/L) through the entire water column at the south basin in all seasons, and at the north basin in summer and fall seasons (Figures 5.7 and 5.8). However, DO concentrations below this WQG occurred at depths between approximately 10 m and bottom (i.e., 15 m) at the Mary Lake north basin in the winter (Figure 5.7). Dissolved oxygen concentrations near the bottom of the water column at littoral and profundal stations of Mary Lake were well above the WQG, and did not differ significantly from those at respective station types in Reference Lake 3 during August 2018 biological sampling (Figure 5.9; Appendix Table C.72).

In situ profiles of pH showed no substantial change from the surface to bottom of the water column at either the north or south basins of Mary Lake during summer and fall sampling events in 2018, and were also comparable to pH profiles at Reference Lake 3 (Figures 5.7 and 5.8). During the winter sampling event, the pH at the north and south basins of Mary Lake generally decreased (i.e., became more neutral) with increased depth, and appeared to mirror the pattern for DO concentration profiles at each basin in winter (Figures 5.7 and 5.8). Therefore, the winter pH profiles at Mary Lake were likely the result of slight changes in redox conditions with depth. No significant differences in pH near the bottom of the water column were indicated between Mary Lake and Reference Lake 3 at littoral or profundal stations during August 2018 biological sampling (Figure 5.9; Appendix Table F.72). In addition, pH values at Mary Lake water quality and benthic stations were consistently within WQG limits (Figures 5.7 to 5.9).

Specific conductance was substantially higher at the north basin compared to the south basin of Mary Lake (Figures 5.7 and 5.8; Appendix Figure C.27). The differences in specific conductance between lake basins likely reflected natural differences in dominant inflow sources to Mary Lake (i.e., Tom River inflow to the north basin and the Mary River inflow to the south basin) and natural differences in geochemistry associated with these inflows. Specific conductance profiles showed no substantial change from the surface to bottom of the water column at either the north or south basins of Mary Lake during winter, summer, or fall sampling in 2018, and also were similar in profile structure to those at Reference Lake 3 during the summer and fall sampling events (Figures 5.7 and 5.8). Specific conductance at the bottom of the water column of littoral and profundal stations of Mary Lake did not differ significantly from those at like-stations of Reference Lake 3 during the August 2018 biological sampling (Figure 5.9). Water clarity, as determined using Secchi depth readings, was significantly lower at Mary Lake compared to Reference Lake 3 in fall 2018 (Appendix Table C.72; Appendix Figure C.7). In general, Secchi depth readings were similar among the Mary Lake stations, suggesting no spatial differences in water clarity throughout the lake (Appendix Table C.70).

Water chemistry of the Mary Lake north basin showed slightly (i.e., 3- to 5-fold higher) to moderately elevated (i.e., 5- to 10-fold higher) turbidity and concentrations of nitrate, total aluminum, total and dissolved manganese, and total and dissolved uranium compared to Reference Lake 3 at the time of summer and/or fall sampling in 2018 (Table 5.2; Appendix Tables C.74 and C.76). However, on average, concentrations of all parameters were below applicable WQG and AEMP benchmarks at the Mary Lake north basin during the winter, summer, and fall monitoring events in 2018 (Table 5.2; Appendix Table C.73). As in previous studies and other mine-exposed areas, aluminum concentrations showed a strong positive correlation with turbidity at the Mary Lake north basin stations using data collected in 2018, suggesting that much of the aqueous aluminum was associated with suspended particles (e.g., aluminosilicates; Appendix Table C.77). Temporal evaluation of the data indicated that parameter concentrations in 2018 were comparable to respective parameter concentration ranges shown during the mine baseline period (2005 to 2013; Figure 5.10; Appendix Table C.74; Appendix Figure C.28).

Water chemistry at the Mary Lake south basin showed no consistent spatial differences in parameter concentrations with progression from the Mary River inlet to the lake outlet during any of the winter, summer or fall sampling events in 2018 (Table 5.2; Appendix Table C.78), suggesting that the south basin waters were well mixed. On average, turbidity, total aluminum, and dissolved manganese concentrations were moderately to highly elevated, and dissolved aluminum and total manganese slightly elevated (i.e., 3- to 5-fold higher) at the Mary Lake south basin compared to Reference Lake 3 during the 2018 summer and/or fall sampling events (Table 5.2; Appendix Tables C.74 and C.76). The total and dissolved concentrations of aluminum and manganese showed strong to very strong positive correlation with turbidity for the Mary Lake south basin 2018 data (i.e., r_s range from 0.67 to 0.91; Appendix Table C.80), suggesting that these metals were associated with suspended particles (e.g., aluminosilicates). In addition, ratios of dissolved to total concentrations of aluminum and manganese indicated that on average, approximately 69% of these metals were associated with the particulate fraction during summer and fall sampling events. As indicated in previous CREMP, high turbidity in the Mary River originates from natural sources upstream of the mine which, in turn, contributes to high turbidity and elevated concentrations of metals such as aluminum, iron, and manganese at Mary Lake. Concentrations of all parameters were below applicable WQG and AEMP benchmarks at the Mary Lake south basin during the winter, summer, and fall monitoring events in 2018, the lone exception being phenol concentrations above the applicable WQG during the summer monitoring event (Appendix Table C.78). Temporal comparisons of the Mary Lake south basin water chemistry

Table 5.2: Water Chemistry at Mary Lake North Basin (BLO-01) and South Basin (BLO) Monitoring Stations[a], Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[b]	AEMP Benchmark[c]	Reference Lake 3 Average (n = 3) Fall 2018	North Basin (Mine-exposed)			South Basin (Mine-exposed)						
						BL0-01-A	BL0-01	BL0-01-B	BL0-05-A	BL0-05	BL0-05-B	BL0-03	BL0-04	BL0-09	BL0-06
						26-Aug-2018	26-Aug-2018	26-Aug-2018	25-Aug-2018	24-Aug-2018	24-Aug-2018	25-Aug-2018	25-Aug-2018	25-Aug-2018	25-Aug-2018
Conventionals	Conductivity (lab)	umho/cm	-	-	75	146	137	139	82	76	74	74	75	75	76
	pH (lab)	pH	6.5 - 9.0	-	7.65	8.08	8.15	8.08	7.73	7.86	7.88	7.76	7.72	7.71	7.66
	Hardness (as $CaCO_3$)	mg/L	-	-	35	73	70	71	38	38	36	36	35	34	35
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	46	70	68	58	48	114	41	55	40	108	45
	Turbidity	NTU	-	-	0.5	0.7	0.9	0.8	1.4	1.4	1.5	0.8	1.3	1.4	1.5
	Alkalinity (as $CaCO_3$)	mg/L	-	-	33	68	65	67	37	35	34	32	76	33	34
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	0.044	<0.020	<0.020	0.021	<0.020	<0.020	0.021	0.0415	0.0325	0.0265	0.034
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.0205	<0.020	0.070	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.16	0.15	0.15	0.15	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.9	2.6	2.6	2.7	1.8	1.5	1.4	1.9	1.7	1.8	1.7
	Total Organic Carbon	mg/L	-	-	3.8	2.8	2.8	2.8	2.1	1.6	1.5	2.4	2.3	2.3	2.5
	Total Phosphorus	mg/L	0.020^{α}	-	0.005	0.003	0.006	0.003	0.005	0.007	0.005	0.005	0.005	0.004	0.005
	Phenols	mg/L	0.004^{α}	-	0.001	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	0.0011	0.0017	0.0012	<0.0010	0.0012
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.27	2.43	2.24	2.29	1.91	1.64	1.66	1.38	1.62	1.61	1.70
	Sulphate (SO_4)	mg/L	218^{β}	218	3.74	1.39	1.33	1.34	3.10	2.54	2.61	1.34	2.50	2.53	2.84
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.004	0.022	0.028	0.026	0.041	0.046	0.039	0.022	0.038	0.039	0.048
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0064	0.0074	0.0071	0.0074	0.0046	0.0048	0.0044	0.0043	0.0043	0.0043	0.0045
	Beryllium (Be)	mg/L	0.011^{α}	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	7.2	15.0	14.7	14.8	7.8	7.6	7.2	7.3	7.2	7.1	7.1
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00076	0.00086	0.00087	0.00090	0.00060	0.00063	0.00056	0.00058	0.00062	0.00057	0.00059
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.030	<0.030	0.041	0.042	0.038	<0.030	0.035	0.034	0.044
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000054	0.000062	<0.000050	<0.000050	<0.000050	0.000053
	Lithium (Li)	mg/L	-	-	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.3	8.6	8.1	8.3	4.6	4.6	4.3	4.2	4.3	4.2	4.4
	Manganese (Mn)	mg/L	0.935^{β}	-	0.00064	0.00240	0.00226	0.00225	0.00347	0.00304	0.00275	0.00156	0.00255	0.00249	0.00299
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00014	0.00019	0.00019	0.00021	0.00015	0.00014	0.00012	0.00011	0.00012	0.00012	0.00013
	Nickel (Ni)	mg/L	0.025	0.025	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.86	0.82	0.81	0.82	0.57	0.58	0.54	0.50	0.54	0.53	0.55
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.42	0.69	0.68	0.73	0.52	0.53	0.50	0.45	0.49	0.50	0.52
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.86	1.73	1.59	1.59	0.93	0.93	0.87	0.85	0.88	0.87	0.86
	Strontium (Sr)	mg/L	-	-	0.0081	0.0094	0.0097	0.0103	0.0066	0.0065	0.0059	0.0055	0.0058	0.0059	0.0058
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.00026	0.00135	0.00123	0.00124	0.00053	0.00056	0.00045	0.00041	0.00044	0.00043	0.00046
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Values presented are averages from samples taken from the surface and the bottom of the water column at each station

[b] Canadian Water Quality Guideline (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[c] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data (2006 - 2013) specific to Mary Lake

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

data did not indicate any substantial changes in average concentrations of mine-related parameters in 2018 compared to the baseline period (2005 to 2013; Figure 5.10; Appendix Figure C.28). In addition, parameter concentrations at the Mary River south basin in fall 2018 did not show any consistent increase compared to the year of mine construction (2014) and the three previous years of mine operation (2015 to 2017; Figure 5.10; Appendix Figure C.28). The absence of temporal changes in water quality suggested no adverse mine-related influences on water chemistry of the Mary Lake south basin since the onset of commercial mine operations.

5.2.3 Sediment Quality

Surficial sediment of the Mary Lake north basin (BLO-01) was composed of silt loam material with low TOC content (Figure 5.11). At the Mary Lake south basin littoral stations, surficial sediment varied from silt loam to silty clay loam (Figure 5.11; Appendix Table D.21), whereas at the south basin profundal stations, surficial sediment was predominantly variations of silt loam, clay loam, and silty clay loam except at Station BLO-03 where sand was more prevalent (Figure 5.11; Appendix Table D.21). Substrate at littoral and profundal stations of Mary Lake contained significantly lower sand and TOC, and significantly greater silt, than at Reference Lake 3 (Appendix Table D.22). Reddish-brown coloured iron (oxy)hydroxide material was not observed in substrate at the Mary Lake north basin, but was present at some south basin stations, (Appendix Tables D.20 and D.21), mirroring similar observations at Reference Lake 3 and the other mine-exposed lakes where such material was commonly visible as a thin, distinct layer or floc on or within surficial sediment. Substrate of Mary Lake commonly contained sub-surface blackening/dark colouration indicating the presence of reduced sediment conditions, but no distinct redox boundaries were observed (Appendix Table D.21). Similar sub-surface reducing conditions were observed in sediment of Reference Lake 3, including the absence of distinct redox boundaries (Appendix Tables D.1 and D.2), suggesting that factors leading to reduced sediment conditions were comparable between lakes.

Sediment metal concentrations at littoral stations of the Mary Lake north and south basins were comparable to those observed at littoral stations of Reference Lake 3, the only notable exception being manganese, the concentration of which was slightly elevated (i.e., 3- to 5-fold higher) at the north basin (Table 5.3; Appendix Table D.24). Concentrations of iron and manganese were above applicable SQG, and the concentration of arsenic was above the Mary Lake AEMP benchmark, in sediment at the lone Mary Lake north basin station (i.e., BLO-01; Table 5.3). Sediment metal concentrations at the Mary Lake south basin showed no spatial gradients with progression from the Mary River inlet to the lake outlet among the profundal stations (Appendix Table D.23),[13]

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[13] Spatially, sediment stations closest to farthest from the Mary River inlet towards the lake outlet were as follows: BLO-12, BLO-10, BLO-09, BLO-08, and BLO-06 (Figure 2.4). All of these stations, except BLO-06, were profundal.

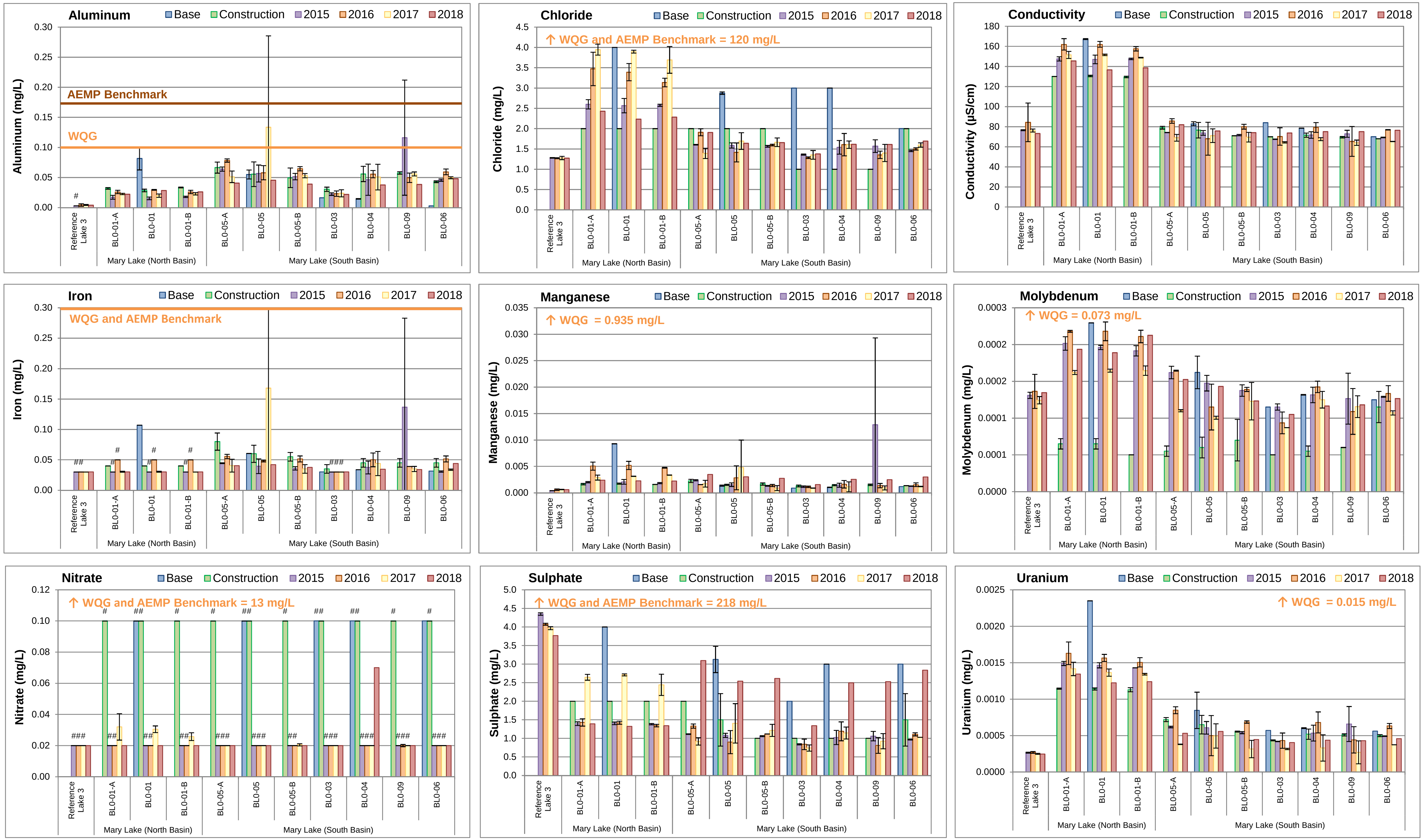


Figure 5.10: **Temporal Comparison of Water Chemistry at Mary Lake (BLO) for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2018) Periods during Fall**

Notes: Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Mary Lake.

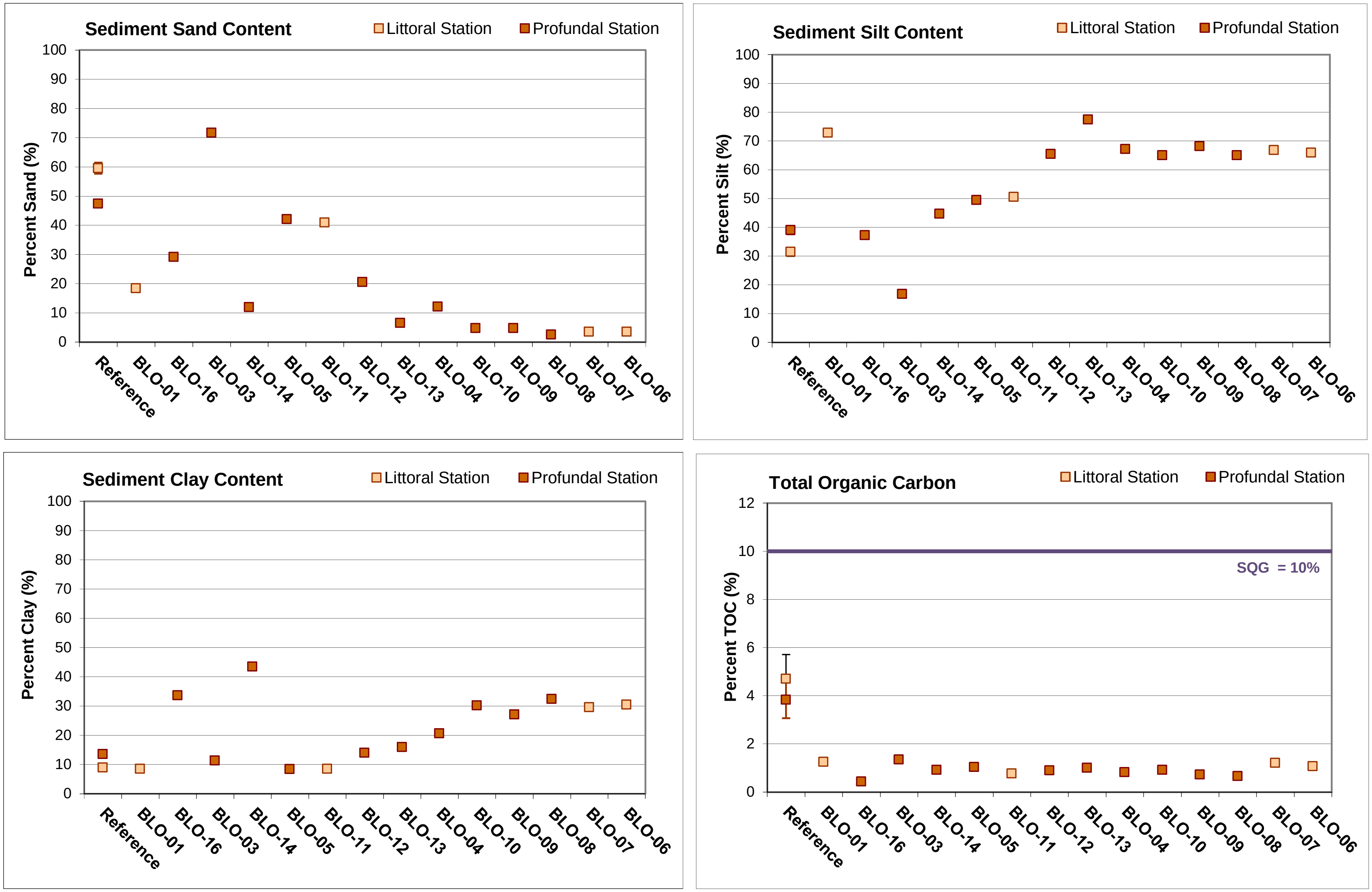


Figure 5.11: Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Mary Lake (BLO) North and South Basin Sediment Monitoring Stations and to Reference Lake 3 (mean ± SE), Mary River Project CREMP, August 2018

Table 5.3: Sediment Total Organic Carbon and Metal Concentrations at Mary Lake North Basin (BLO-01) and South Basin (BLO), and Reference Lake 3 (REF3) Sediment Monitoring Stations, Mary River Project CREMP, August 2018

Parameter		Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Littoral			Profundal	
					Reference Lake (n = 5)	Mary Lake (North Basin) (n = 1)	Mary Lake (South Basin) (n = 1)	Reference Lake (n = 5)	Mary Lake (South Basin) (n = 8)
					Average ± Std. Error			Average ± Std. Error	Average ± Std. Error
Total Organic Carbon		%	10^{α}	-	4.70 ± 1.01	1.25	1.07	3.82 ± 0.75	0.87 ± 0.09
Metals	Aluminum (Al)	mg/kg	-	-	17,880 ± 1,993	17,600	31,200	24,420 ± 3,494	26,813 ± 2,324
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	<0.10	<0.10	<0.10 ± 0.00	<0.10 ± 0.00
	Arsenic (As)	mg/kg	17	5.9	5.25 ± 0.95	***7.95***	4.85	***6.07*** ± 0.78	5.04 ± 0.51
	Barium (Ba)	mg/kg	-	-	133 ± 25	103	136	152 ± 23	111 ± 10
	Boron (B)	mg/kg	-	-	13.9 ± 1.6	23.4	41.0	15.6 ± 2.2	34.4 ± 3.0
	Cadmium (Cd)	mg/kg	3.5	1.5	0.195 ± 0.044	0.106	0.166	0.197 ± 0.005	0.157 ± 0.011
	Calcium (Ca)	mg/kg	-	-	5,480 ± 804	10,200	5,490	5,584 ± 664	4,899 ± 359
	Chromium (Cr)	mg/kg	90	98	58.9 ± 7.7	72.3	***108.0***	77.3 ± 11.0	97.3 ± 7.4
	Cobalt (Co)	mg/kg	-	-	11.70 ± 1.40	16.90	21.00	17.42 ± 2.37	19.23 ± 1.25
	Copper (Cu)	mg/kg	110	50	***73.9*** ± 11.0	31.8	41.3	***96.3*** ± 14.7	37.7 ± 2.9
	Iron (Fe)	mg/kg	$40,000^{\alpha}$	52,400	46,700 ± 9,489	45,200	51,200	50,900 ± 7,115	48,225 ± 3,097
	Lead (Pb)	mg/kg	91.3	35	16.4 ± 2.1	17.0	30.1	19.5 ± 2.8	25.9 ± 2.2
	Magnesium (Mg)	mg/kg	-	-	11,104 ± 1,352	16,200	20,100	15,394 ± 2,199	17,638 ± 1,362
	Manganese (Mn)	mg/kg	$1,100^{\alpha,\beta}$	4,370	640 ± 60	2,180	878	1,279 ± 115	1,976 ± 444
	Mercury (Hg)	mg/kg	0.486	0.17	0.0433 ± 0.0111	0.0262	0.0560	0.0650 ± 0.0121	0.0513 ± 0.0044
	Molybdenum (Mo)	mg/kg	-	-	3.84 ± 0.86	0.78	0.95	2.57 ± 0.27	1.03 ± 0.07
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	72	42.9 ± 5.9	60.7	***73.0***	53.8 ± 6.6	70.4 ± 5.0
	Phosphorus (P)	mg/kg	$2,000^{\alpha}$	1,580	1,305 ± 272	1,460	987	1,188 ± 118	1,138 ± 81
	Potassium (K)	mg/kg	-	-	4,134 ± 469	3,900	7,870	5,660 ± 796	6,589 ± 585
	Selenium (Se)	mg/kg	-	-	0.66 ± 0.14	0.24	0.31	0.81 ± 0.15	0.26 ± 0.02
	Silver (Ag)	mg/kg	-	-	0.15 ± 0.02	0.10	0.17	0.26 ± 0.04	0.16 ± 0.01
	Sodium (Na)	mg/kg	-	-	320 ± 43	262	483	433 ± 62	430 ± 37
	Strontium (Sr)	mg/kg	-	-	12.2 ± 1.5	14.3	17.2	13.8 ± 1.6	16.6 ± 1.5
	Thallium (Tl)	mg/kg	-	-	0.450 ± 0.063	0.366	0.729	0.754 ± 0.091	0.598 ± 0.050
	Uranium (U)	mg/kg	-	-	13.4 ± 2.32	4.2	10.8	24.5 ± 3.90	9.39 ± 0.82
	Vanadium (V)	mg/kg	-	-	58.3 ± 6.9	56.9	87.8	72.7 ± 9.4	75.9 ± 6.0
	Zinc (Zn)	mg/kg	315	135	81.4 ± 10.2	57.8	103.0	99.2 ± 14.2	80.1 ± 7.5

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effect level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effect level (PEL; BCMOE 2017)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013). The indicated values are specific to Mary Lake.

▨ Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

suggesting that the Mary River was not a disproportionate source of metals. Sediment metal concentrations at the Mary Lake south basin profundal stations were similar to average metal concentrations at like-depth stations of Reference Lake 3 (Table 5.3; Appendix Table D.24). On average, concentrations of chromium and iron were above SQG at the Mary Lake south basin littoral station and profundal stations, as was the concentration of manganese at the south basin (Table 5.3). In addition, concentrations of nickel were above SQG, and concentrations of arsenic, chromium, iron, and nickel were above applicable AEMP benchmarks, at individual stations in the Mary Lake south basin (Appendix Table D.23). However, as indicated previously, average concentrations of iron and manganese were elevated above SQG in sediment at Reference Lake 3, as were average concentrations of chromium at individual stations at Reference Lake 3 (Appendix Table D.4). Arsenic, iron, and phosphorus concentrations were also above the Mary Lake AEMP benchmarks at individual stations of Reference Lake 3. In turn, this suggested that concentrations of chromium, iron, and manganese above SQG, and concentrations of arsenic and iron above AEMP benchmarks, at Mary Lake likely reflect natural conditions un-related to mine activity.

Temporal comparisons indicated that metal concentrations in sediment at littoral and profundal stations of Mary Lake in 2018 did not change substantially from those observed during the mine baseline (2005 to 2013) period (Figure 5.12; Appendix Table D.24). On average, metal concentrations in sediment at Mary Lake littoral and profundal stations in 2018 were slightly higher, or were in the upper range, of those observed from 2015 to 2017 (Figure 5.12). However, no occurrence of continual, year-to-year increases in metal concentrations were indicated that would suggest an increasing trend over time (Figure 5.12). Overall, no substantial changes in sediment metal concentrations have been observed at Mary Lake littoral and profundal habitats following the commencement of commercial mine operations in 2015.

5.2.4 Phytoplankton

Chlorophyll-a concentrations at Mary Lake showed no spatial gradients with distance from either the Tom River inlet or the Mary River inlet towards the lake outlet during any of the winter, summer, or fall sampling events in 2018 (Figure 5.13). Chlorophyll-a concentrations were typically lowest in winter and highest in fall at both the north and south basins of Mary Lake (Figure 5.13), and mirrored similar relative differences in chlorophyll-a concentrations between summer and fall sampling events at Reference Lake 3 (Appendix Table B.8). Chlorophyll-a concentrations were significantly lower at the Mary Lake north basin than at Reference Lake 3 in summer, but no significant differences in chlorophyll-a concentrations were indicated between Mary Lake north basin and Reference Lake 3 during the fall sampling event (Appendix Tables E.7 and E.8). At the Mary Lake south basin, chlorophyll-a concentrations did not differ significantly

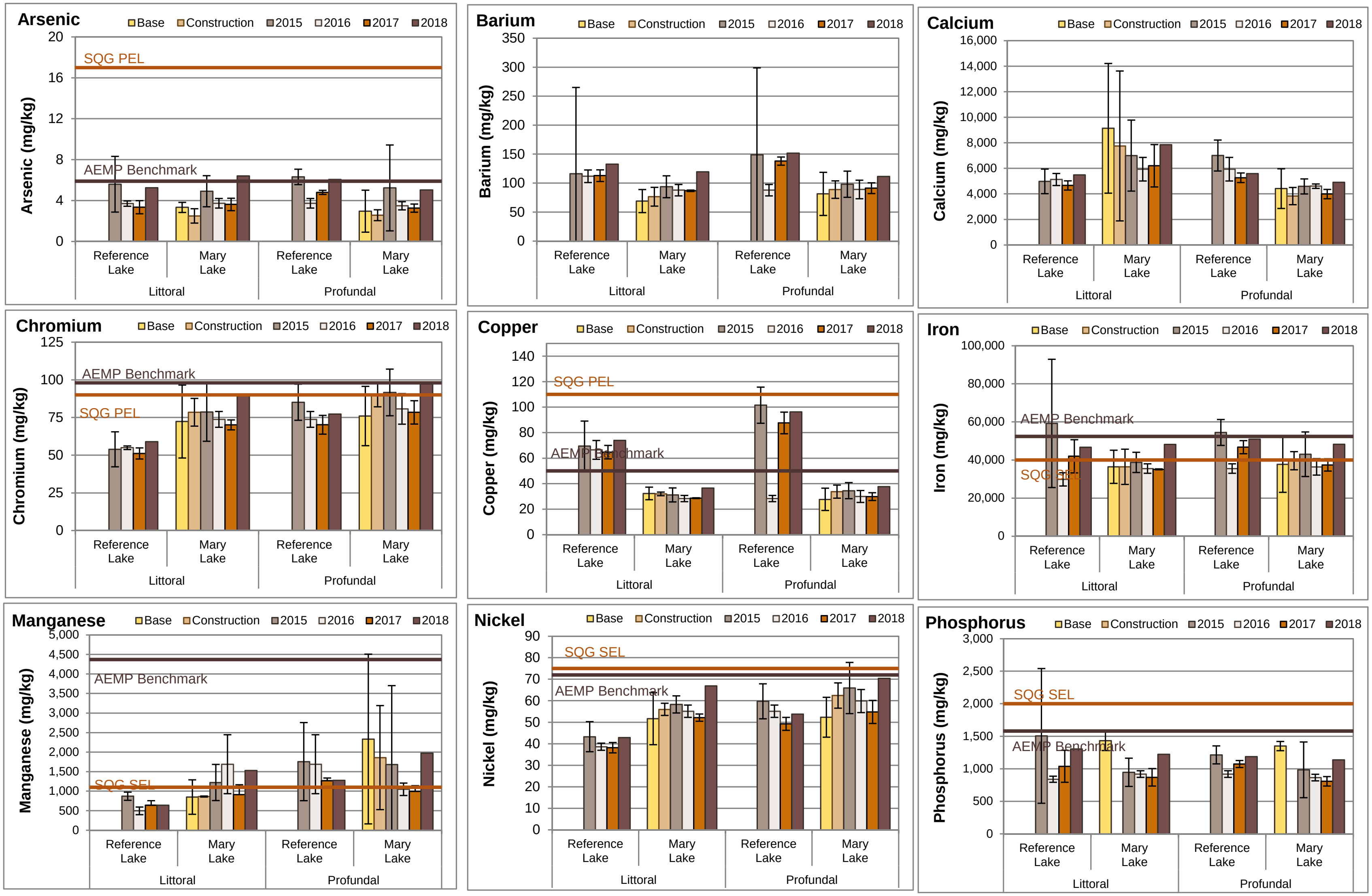


Figure 5.12: **Temporal Comparison of Sediment Metal Concentrations (mean ± SD) at Littoral and Profundal Stations of Mary Lake and Reference Lake 3 for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2018) Periods, Mary River Project CREMP, 2018**

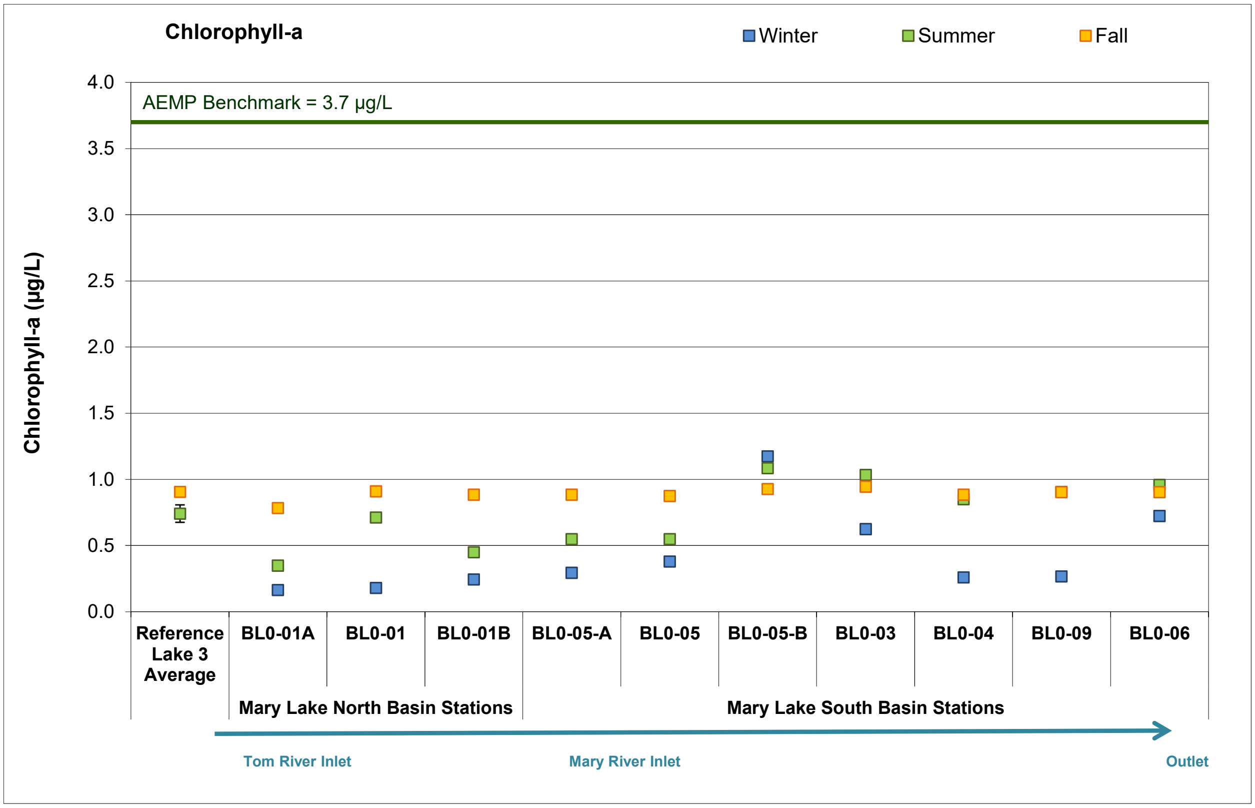


Figure 5.13: Chlorophyll-a Concentrations at Mary Lake (BLO) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2018

Notes: Values presented are averages of samples taken from the surface and the bottom of the water column at each station. Reference lake values represent mean ± standard deviation (n = 3). Reference Lake 3 was not sampled in winter 2018.

from those at Reference Lake 3 during either of the summer or fall sampling events (Appendix Tables E.7 and E.8). Chlorophyll-a concentrations at the Mary Lake north and south basins were well below the AEMP benchmark of 3.7 µg/L during all winter, summer, and fall sampling events in 2018 (Figure 5.13) and reflected an oligotrophic primary productivity categorization based on Wetzel (2001) classification. This oligotrophic categorization was in agreement with CWQG trophic status classification that is based on average aqueous total phosphorus concentrations below 10 µg/L (Table 5.2; Appendix Tables C.73 and C.78).

Temporal comparison of Mary Lake chlorophyll-a concentrations, conducted separately for the north and south basins, did not indicate any consistent direction of significant differences between the 2018 data and data from the mine construction (2014) period or previous years of mine operation (2015 to 2017) during any of the winter, summer, or fall seasons (Figure 5.14; Appendix Figure E.1). In addition, annual average chlorophyll-a concentrations have not shown any consistent direction of change (i.e., increase or decrease) over time since the mine was constructed in 2014 (Figure 5.14; Appendix Figure E.1) suggesting no substantial changes in the

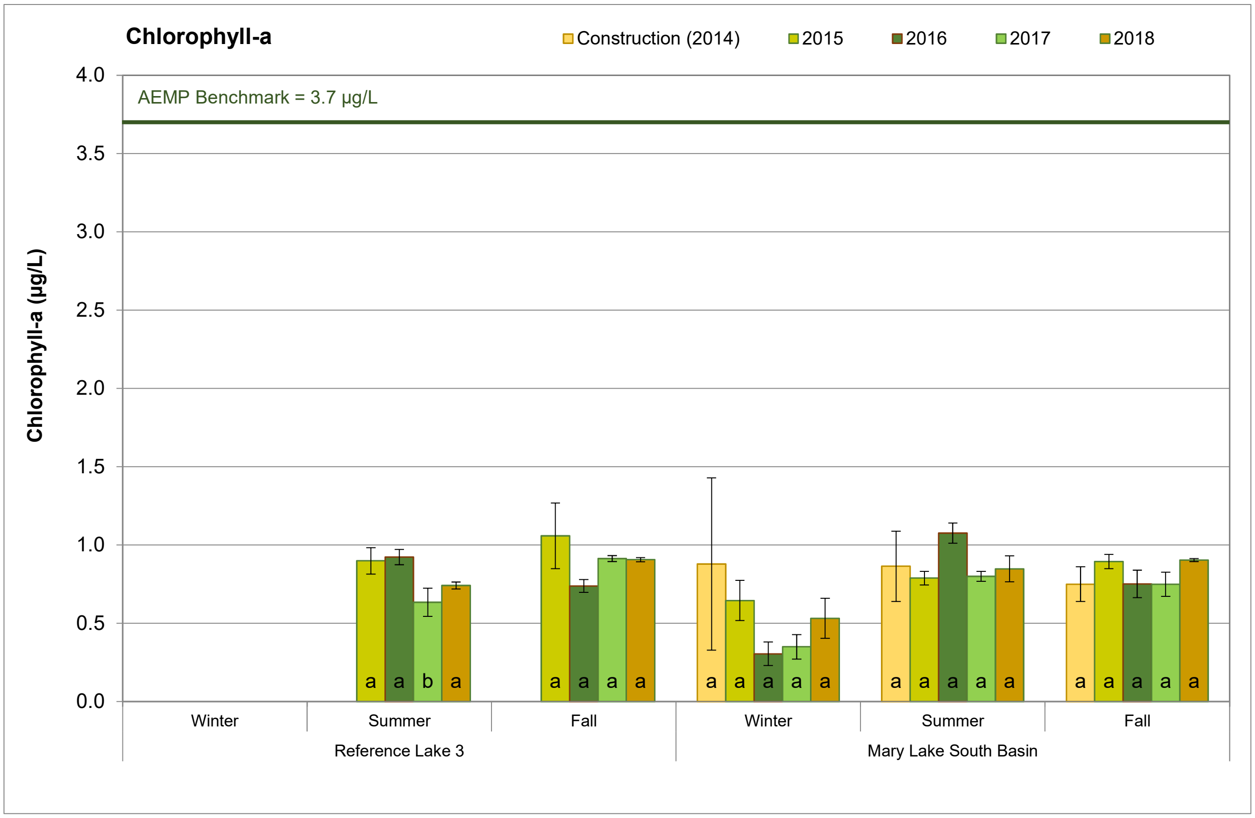


Figure 5.14: Temporal Comparison of Chlorophyll-a Concentrations Among Seasons between the Mary Lake South Basin and Reference Lake 3 for Mine Construction (2014) and Operational (2015 to 2018) Periods (mean ± SE)

Note: Bars with the same letter at the base do not differ significantly between years for the applicable season.

trophic status of the lake since mine operations commenced at the Mary River Project. No chlorophyll-a baseline (2005 to 2013) data are available for Mary Lake, precluding comparisons to conditions prior to mine construction.

5.2.5 Benthic Invertebrate Community

Benthic invertebrate density at littoral habitat did not differ significantly between Mary Lake and Reference Lake 3, but for profundal habitat, significantly higher density was observed at Mary Lake in 2018 (Tables 5.4 and 5.5). *Heterotrissocladius* midges, which are characteristic of ultra-oligotrophic to oligotrophic habitats, were the dominant benthic invertebrates observed at both Mary Lake and Reference Lake 3 (Appendix Tables F.17 and F.60), suggesting similar trophic status between these lakes. No significant differences in richness or Simpson's Evenness were indicated between Mary Lake and Reference Lake 3 for either habitat type (Tables 5.4 and 5.5). Although Bray-Curtis Index at the littoral habitat benthic invertebrate community differed significantly between Mary Lake and Reference Lake 3, no ecologically significant differences in

Table 5.4: Benthic Invertebrate Community Statistical Comparison Results between Mary Lake (BLO) and Reference Lake 3 for Littoral Habitat Stations, Mary River Project CREMP, August 2018

Metric	Statistical Test Results					Summary Statistics						
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis	Magnitude of Difference [a] (No. of SD)	Study Lake Littoral Habitat	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (Individuals/m^2)	square root	NO	0.577	t-test (unequal)	2.7	Reference Lake 3	1,045	258	116	696	1,000	1,391
						Mary Lake Littoral	1,733	1,431	715	287	1,765	3,113
Richness (Number of Taxa)	none	NO	0.339	ANOVA	-0.7	Reference Lake 3	10.8	2.3	1.0	7.0	11.0	13.0
						Mary Lake Littoral	9.3	2.2	1.1	7.0	9.0	12.0
Simpson's Evenness (E)	none	NO	0.114	ANOVA	-2.4	Reference Lake 3	0.825	0.103	0.046	0.720	0.816	0.939
						Mary Lake Littoral	0.575	0.293	0.146	0.141	0.695	0.767
Bray-Curtis Index	none	YES	0.001	ANOVA	4.9	Reference Lake 3	0.313	0.092	0.041	0.178	0.358	0.394
						Mary Lake Littoral	0.768	0.163	0.082	0.593	0.774	0.932
Nemata (%)	fourth root	NO	0.515	ANOVA	-0.4	Reference Lake 3	7.1	8.8	3.9	0.0	3.4	21.3
						Mary Lake Littoral	3.5	6.4	3.2	0.0	0.5	13.1
Ostracoda (%)	log	NO	0.137	ANOVA	-0.8	Reference Lake 3	23.9	18.3	8.2	3.4	20.6	53.3
						Mary Lake Littoral	8.9	10.9	5.5	1.4	4.5	25.0
Chironomidae (%)	log	NO	0.239	ANOVA	0.9	Reference Lake 3	66.9	22.2	10.0	35.5	73.8	91.4
						Mary Lake Littoral	86.2	18.7	9.3	58.3	94.5	97.2
Metal-Sensitive Chironomidae (%)	log	YES	0.035	ANOVA	-1.3	Reference Lake 3	36.5	19.6	8.8	17.8	27.5	60.1
						Mary Lake Littoral	11.6	9.8	4.9	2.5	9.9	23.9
Collector-Gatherers (%)	none	NO	0.308	ANOVA	1.1	Reference Lake 3	55.6	19.0	8.5	33.0	57.5	79.2
						Mary Lake Littoral	76.1	36.4	18.2	21.8	91.8	98.9
Filterers (%)	fourth root	YES	0.009	ANOVA	-1.6	Reference Lake 3	33.9	18.7	8.4	15.5	24.9	56.6
						Mary Lake Littoral	4.1	7.3	3.7	0.0	0.6	15.0
Shredders (%)	fourth root	YES	0.045	t-test (unequal)	-2.4	Reference Lake 3	7.0	2.6	1.1	2.9	7.5	9.4
						Mary Lake Littoral	0.8	1.1	0.6	0.0	0.5	2.3
Clingers (%)	fourth root	YES	0.017	ANOVA	-1.7	Reference Lake 3	36.1	18.4	8.2	17.1	26.9	58.3
						Mary Lake Littoral	5.5	7.4	3.7	0.0	3.0	16.2
Sprawlers (%)	fourth root	YES	0.028	ANOVA	1.8	Reference Lake 3	51.9	17.7	7.9	29.5	52.5	71.8
						Mary Lake Littoral	83.0	10.3	5.1	72.3	81.7	96.3
Burrowers (%)	square root	NO	0.837	ANOVA	-0.1	Reference Lake 3	12.0	6.4	2.8	6.9	11.1	22.6
						Mary Lake Littoral	11.5	6.3	3.2	2.5	13.3	16.7

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

▨ Grey shading indicates statistically significant difference between study areas based on p-value ≤ 0.10.

🟦 Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a CES of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

Table 5.5: Benthic Invertebrate Community Statistical Comparison Results between Mary Lake (BLO) and Reference Lake 3 for Profundal Habitat Stations, Mary River Project CREMP, August 2018

Metric	Statistical Test Results					Summary Statistics						
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis	Magnitude of Difference [a] (No. of SD)	Study Lake Profundal Habitat	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (Individuals/m^2)	none	YES	0.005	t-test (unequal)	7.5	Reference Lake 3	377	155	69	104	452	470
						Mary Lake Profundal	1,533	606	247	991	1,439	2,487
Richness (Number of Taxa)	log	NO	0.265	ANOVA	2.1	Reference Lake 3	5.4	1.3	0.6	4.0	6.0	7.0
						Mary Lake Profundal	8.2	4.4	1.8	4.0	7.0	14.0
Simpson's Evenness (E)	log	NO	0.418	ANOVA	-0.2	Reference Lake 3	0.455	0.296	0.132	0.218	0.296	0.933
						Mary Lake Profundal	0.386	0.360	0.147	0.062	0.248	0.867
Bray-Curtis Index	rank	NO	0.126	Mann-Whitney	1.3	Reference Lake 3	0.224	0.304	0.136	0.051	0.109	0.763
						Mary Lake Profundal	0.611	0.128	0.052	0.441	0.656	0.727
Nemata (%)	fourth root	NO	0.692	ANOVA	-0.2	Reference Lake 3	2.5	3.8	1.7	0.0	0.0	8.7
						Mary Lake Profundal	1.7	1.9	0.8	0.0	1.2	5.2
Hydracarina (%)	none	NO	0.183	t-test (unequal)	-0.7	Reference Lake 3	3.7	3.8	1.7	0.0	3.9	8.7
						Mary Lake Profundal	1.0	0.9	0.4	0.0	0.9	2.1
Ostracoda (%)	square-root	NO	0.882	ANOVA	0.1	Reference Lake 3	3.1	2.9	1.3	0.0	2.0	7.5
						Mary Lake Profundal	3.5	3.2	1.3	0.0	2.9	8.8
Chironomidae (%)	none	NO	0.294	ANOVA	0.6	Reference Lake 3	90.8	4.9	2.2	82.7	92.2	95.7
						Mary Lake Profundal	93.8	4.1	1.7	89.7	92.8	100.0
Metal-Sensitive Chironomidae (%)	log	NO	0.545	ANOVA	-0.2	Reference Lake 3	11.4	16.8	7.5	2.3	3.9	41.4
						Mary Lake Profundal	8.6	11.2	4.6	0.5	2.2	26.9
Collector-Gatherers (%)	rank	NO	0.855	Mann-Whitney	0.0	Reference Lake 3	89.8	13.6	6.1	66.3	96.2	100.0
						Mary Lake Profundal	90.0	13.2	5.4	68.6	97.0	100.0
Filterers (%)	fourth root	NO	0.912	ANOVA	0.1	Reference Lake 3	6.5	10.5	4.7	0.0	3.7	25.0
						Mary Lake Profundal	7.8	11.4	4.7	0.0	1.3	26.0
Clingers (%)	fourth root	NO	0.908	ANOVA	0.0	Reference Lake 3	10.2	13.6	6.1	0.0	3.9	33.6
						Mary Lake Profundal	9.8	13.3	5.4	0.5	1.7	28.7
Sprawlers (%)	rank	NO	0.792	Mann-Whitney	-0.2	Reference Lake 3	79.3	26.8	12.0	32.7	90.4	100.0
						Mary Lake Profundal	75.0	35.3	14.4	24.4	96.5	99.0
Burrowers (%)	fourth root	NO	0.750	ANOVA	0.3	Reference Lake 3	10.6	14.1	6.3	0.0	5.6	33.6
						Mary Lake Profundal	15.2	21.9	9.0	0.0	2.1	46.9

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

▨ Grey shading indicates statistically significant difference between study areas based on p-value ≤ 0.10.

🟦 Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a CES of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

any of the dominant taxonomic groups was indicated between lakes (Table 5.4). Similarly, although the relative abundance of certain FFG and HPG differed significantly between Mary Lake and Reference Lake 3 for littoral habitat, the magnitudes of these differences were generally below ecologically meaningful thresholds (i.e., within the CES_{BIC} of ±2 SD_{REF}; Table 5.4). At profundal habitat, no significant differences in the relative abundance of dominant taxonomic groups, FFG, or HPG were indicated at Mary Lake compared to Reference Lake 3 (Table 5.5). In addition, no ecologically significant difference in the relative abundance of metal-sensitive chironomids was indicated between Mary Lake and Reference Lake 3 for either littoral or profundal habitat types (Tables 5.4 and 5.5), suggesting no metal-related influences on the benthic invertebrate community of Mary Lake. Overall, no adverse mine-related influences to the littoral or profundal benthic invertebrate community were indicated at Mary Lake relative to reference lake conditions in 2018.

Temporal comparisons indicated no ecologically significant differences in benthic invertebrate community density, richness, or Simpson's Evenness at littoral or profundal habitats of Mary Lake between years of mine operation and mine baseline studies (Figure 5.15; Appendix Tables F.61 and F.62). In addition, no significant differences in the relative abundance of dominant taxonomic groups and FFG were indicated between baseline and mine operational years at Mary Lake (Appendix Tables F.61 and F.62). Therefore, consistent with no substantial changes in water and sediment quality since the mine baseline period, no significant changes in benthic invertebrate community features were indicated at littoral and profundal habitat of Mary Lake following the commencement of commercial mine operations in 2015.

5.2.6 Fish Population

5.2.6.1 Mary Lake (South) Fish Community

Arctic charr and ninespine stickleback composed the fish community of Mary Lake in 2018, reflecting the same fish species composition as Reference Lake 3 (Table 5.6). Similar to the other mine-exposed lakes, arctic charr CPUE was higher at Mary Lake than at Reference Lake 3 for electrofishing and gill netting collection methods in 2018, suggesting higher densities and/or productivity of arctic charr at Mary Lake. Also consistent with the other mine-exposed lakes, greater numbers of arctic charr together with greater density of benthic invertebrates suggested that overall biological productivity was higher at Mary Lake than at Reference Lake 3.

Temporal comparison of the Mary Lake electrofishing catch data indicated substantially higher arctic charr CPUE in 2018, as well as in other mine construction/operation years, than during baseline monitoring conducted in 2008 (Figure 5.16). Gill netting CPUE for arctic charr was higher in 2018 compared to all previous baseline (2006 and 2007), mine construction (2014), and mine

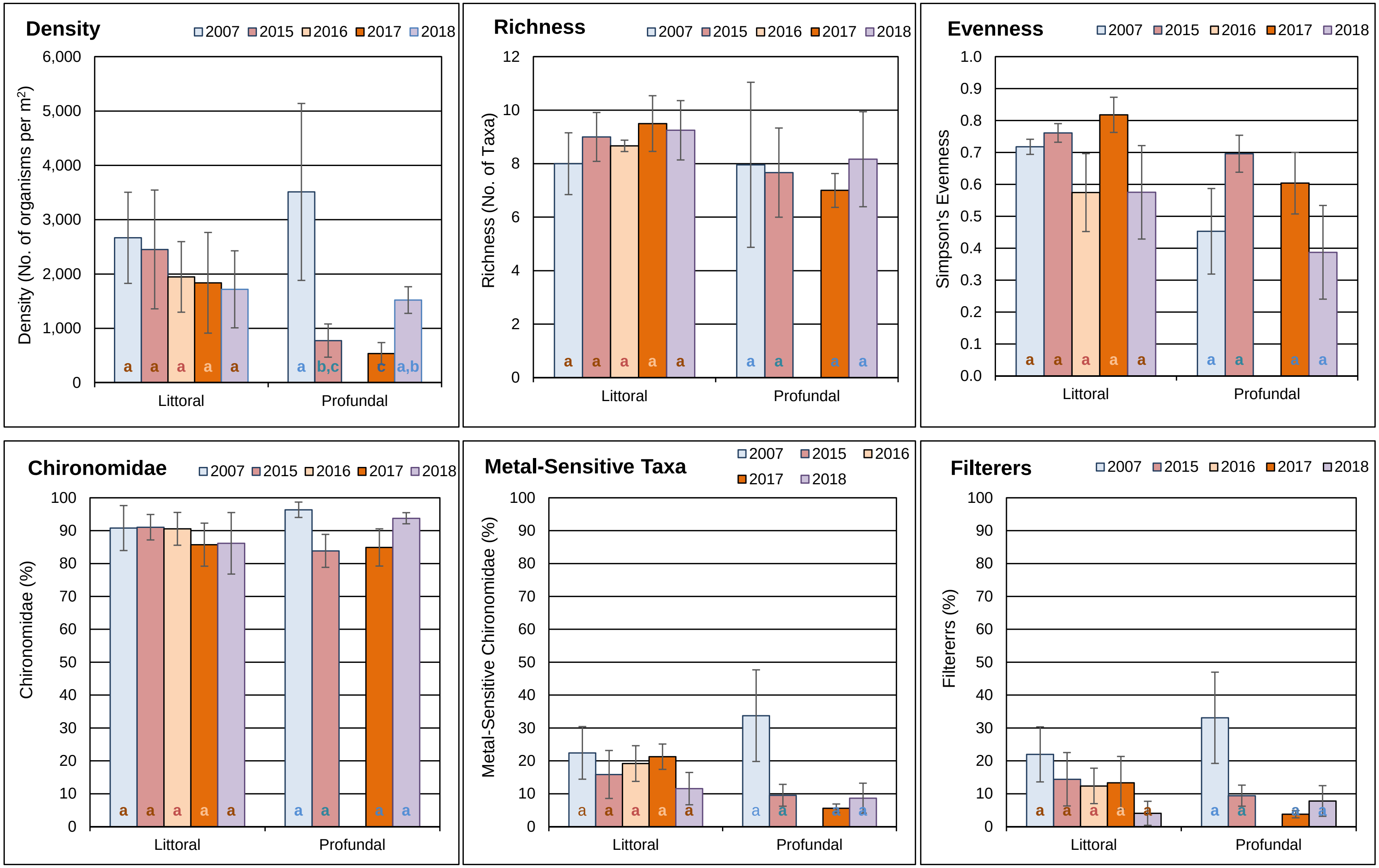


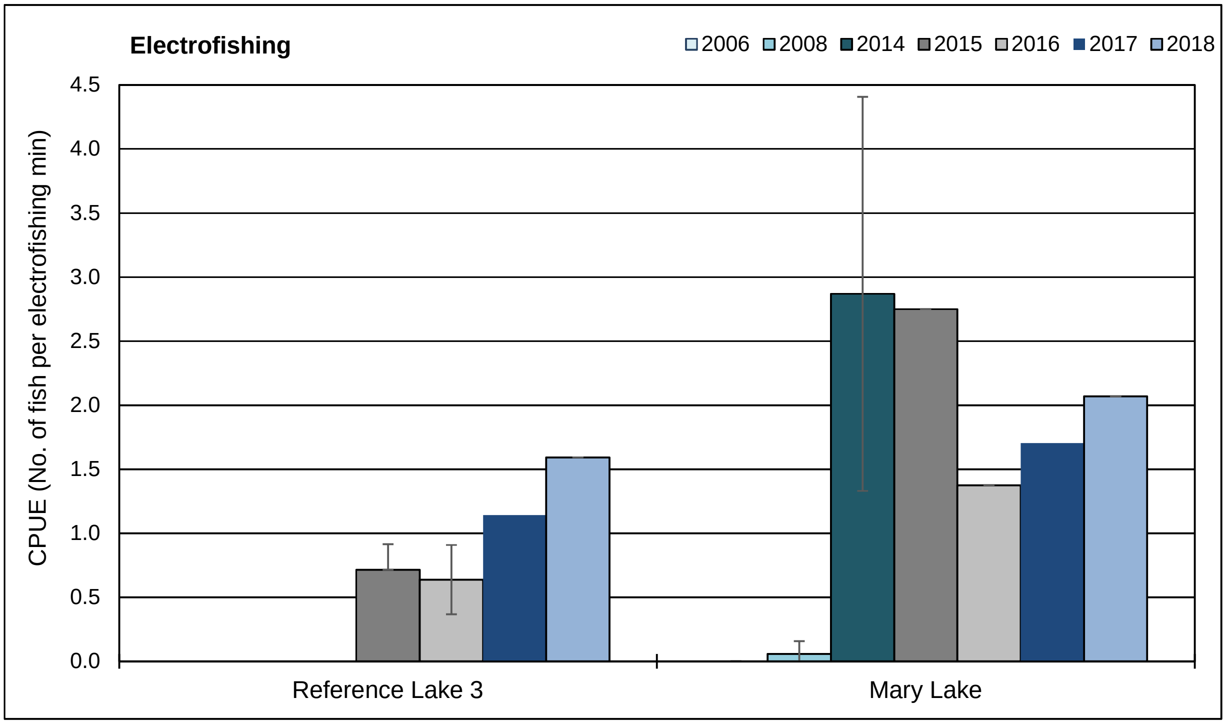
Figure 5.15: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Mary Lake Littoral and Profundal Study Areas among Mine Baseline (2007) and Operational (2015 to 2018) Periods

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

Table 5.6: Fish Catch and Community Summary from Backpack Electrofishing and Gill Netting Conducted at Mary Lake (BLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2018

Lake	Method [a]		Arctic Charr	Ninespine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	101	2	103	2
		CPUE	1.59	0.02	1.61	
	Gill netting	No. Caught	34	0	34	
		CPUE	0.38	0	0.38	
Mary Lake	Electrofishing	No. Caught	103	4	107	2
		CPUE	2.07	0.08	2.15	
	Gill netting	No. Caught	129	0	129	
		CPUE	7.30	0	7.30	

[a] Catch-per-unit-effort (CPUE) for electrofishing represents the number of fish captured per electrofishing minute, and for gill netting represents the number of fish captured per 100 m hours of net.



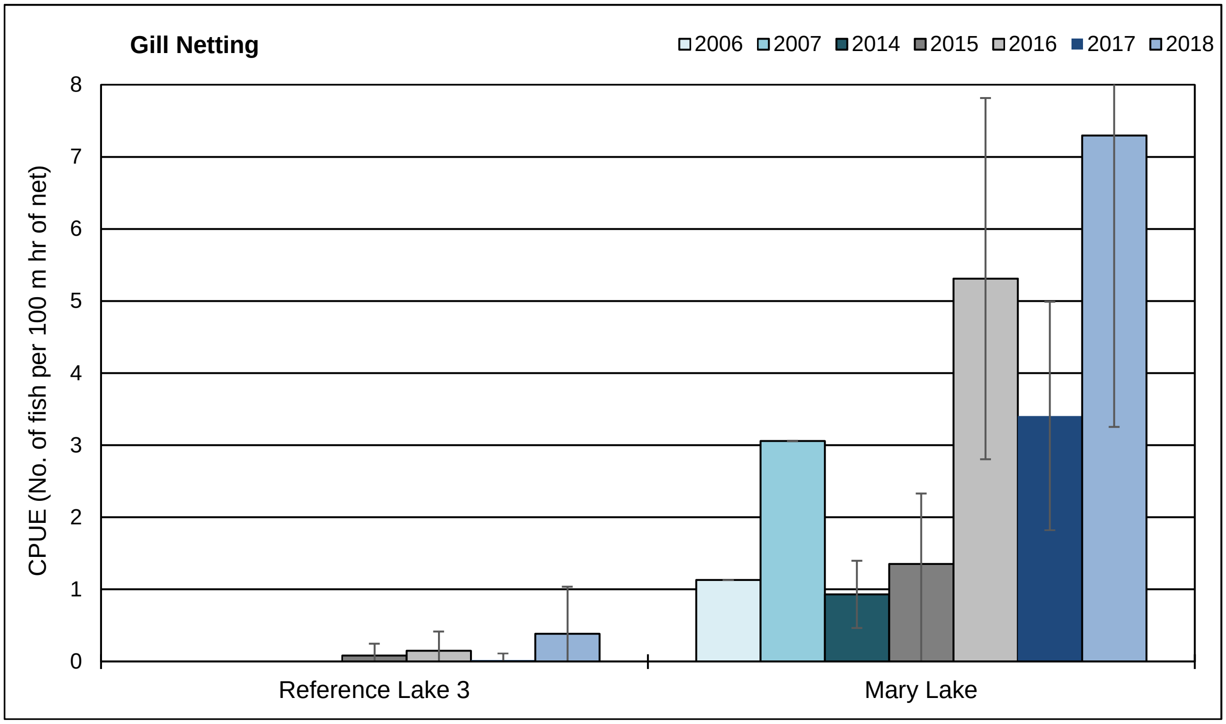


Figure 5.16: **Catch-per-unit-effort (CPUE; mean ± SD) of Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Mary Lake (BLO), Mary River Project CREMP, 2006 to 2018**

Note: Data presented for fish sampling conducted in fall during baseline (2006, 2007), construction (2014), and operational (2015 to 2018) mine phases.

operational (2015 to 2017) studies (Figure 5.16), most likely reflecting improved sampling efficiencies in 2018 relative to the previous studies. Nevertheless, the CPUE data suggested that arctic charr abundance at nearshore and littoral/profundal habitats was likely comparable to, or greater than, the abundance of this species during the baseline period at Mary Lake, indicating no mine-related influences to arctic charr numbers in the lake following commercial mine operation start-up in 2015.

5.2.6.2 Mary Lake (South) Fish Population Assessment

Nearshore Arctic Charr

Mine-related influences on the Mary Lake nearshore arctic charr population were assessed based on a control-impact analysis using data collected from Mary Lake and Reference Lake 3 in 2018. No nearshore arctic charr baseline data were collected at Mary Lake, precluding data analysis using a before-after design. A total of 103 and 100 arctic charr were captured at nearshore habitat of Mary Lake and Reference Lake 3, respectively, in August 2018, for the control-impact analysis. Arctic charr YOY were distinguished from the older, non-YOY age class using a fork length cut-off of 4.5 cm based on the evaluation of length-frequency distributions coupled with supporting age determinations for the Mary Lake and Reference Lake 3 data sets (Figure 5.17). Nearshore arctic charr health comparisons were conducted separately for the YOY and non-YOY data sets to account for naturally differing weight-at-length relationships that occur between these age categories. However, because the YOY data set was small (i.e., 14 and 8 YOY for Mary Lake and Reference Lake 3, respectively), caution is warranted around conclusions drawn from the analysis of YOY endpoints.

Nearshore arctic charr length-frequency distributions differed significantly between Mary Lake and Reference Lake 3, potentially reflecting the occurrence of more YOY and greater numbers of larger non-YOY individuals at Mary Lake (Table 5.7; Figure 5.17; Appendix Table G.26). Arctic charr in YOY and non-YOY age classes were significantly heavier and longer, respectively, at Mary Lake compared to Reference Lake 3 (Table 5.7; Appendix Table G.26). However, YOY condition did not differ significantly between Mary Lake and Reference Lake 3, and although the condition of non-YOY was significantly lower at Mary Lake, the magnitude of this difference was within the CES_C of ±10%, indicating that this difference was not ecologically meaningful (Table 5.7; Appendix Table G.26). Temporal comparisons indicated no consistent differences in size or condition of arctic charr non-YOY at Mary Lake compared to Reference Lake 3 from 2015 to 2018 (Table 5.7). Collectively, the data indicated no adverse response to arctic charr at Mary Lake nearshore areas since the commencement of commercial mine operations in 2015.

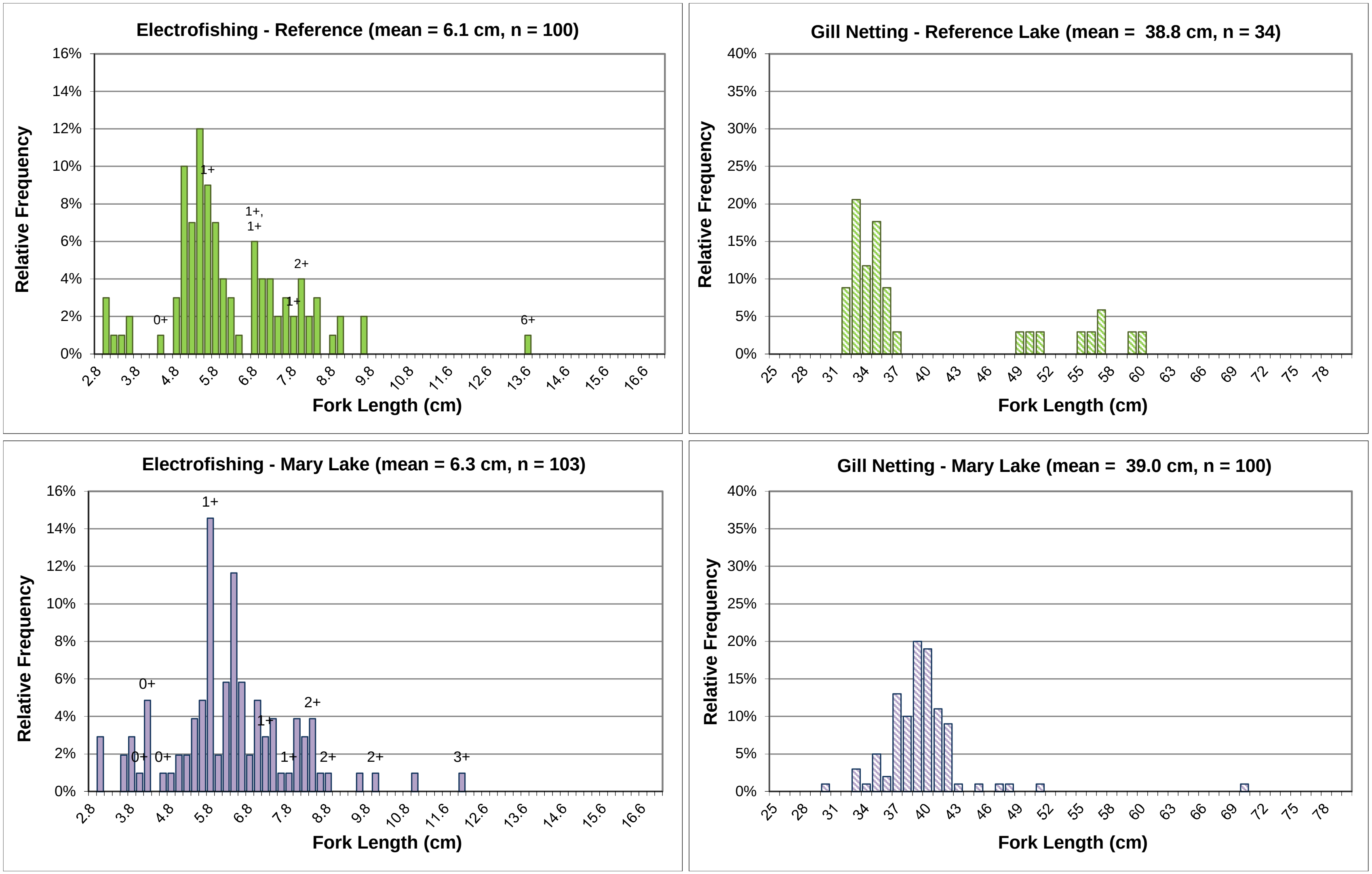


Figure 5.17: Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Mary Lake (BLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2018

Note: Fish ages are shown above the bars, where available.

Table 5.7: Summary of Statistical Results for Arctic Charr Population Comparisons between Mary Lake and Reference Lake 3 from 2015 to 2018, and between Mary Lake Mine Operational and Baseline Period Data, for Fish Captured by Electrofishing and Gill Netting Methods, Mary River Project CREMP

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed? [a]							
			versus Reference Lake 3				versus Mary Lake baseline period data [b]			
			2015	**2016**	**2017**	**2018**	**2015**	**2016**	**2017**	**2018**
Electrofishing Samples	Survival	Length-Frequency Distribution	No	**Yes**	**Yes**	**Yes**	-	-	-	-
		Age	**Yes (-43%)**	No	No	-	-	-	-	-
	Energy Use (non-YOY)	Size (mean fork length)	No	No	**Yes (+17%)**	**Yes (+10%)**	-	-	-	-
		Size (mean weight)	No	No	**Yes (+51%)**	No	-	-	-	-
	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	**Yes (+3%)**	No	No	**Yes (-8 %)**	-	-	-	-
Gill Netting Samples [c]	Survival	Length Frequency Distribution	-	-	-	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
		Age	-	-	-	-	No	**Yes (-14%)**	No	-
	Energy Use	Size (mean fork length)	-	-	-	**Yes (+12%)**	**Yes (+6%)**	No	**Yes (-5%)**	No
		Size (mean weight)	-	-	-	**Yes (+51%)**	**Yes (+19%)**	No	**Yes (-9%)**	No
		Growth (fork length-at-age)	-	-	-	-	No	**Yes (nc)**	No	-
		Growth (weight-at-age)	-	-	-	-	No	**Yes (nc)**	No	-
	Energy Storage	Condition (body weight-at-fork length)	-	-	-	**Yes (+3%)**	No	**Yes (+3%)**	**Yes (+5%)**	**Yes (-3%)**

[a] Values in parentheses indicate direction and magnitude of any signficant differences.

[b] No baseline period data collected for nearshore electrofishing; baseline period littoral/profundal gill netting data included combined 2006 and 2007 information.

[c] Due to low catches of arctic charr in gill nets at Reference Lake 3 in 2015, 2016, and 2017, no comparison of fish health was conducted for gill netted fish.

Littoral/Profundal Arctic Charr

Mine-related influences on the littoral/profundal arctic charr population were evaluated based on a control-impact analysis using 2018 data collected at Mary Lake and Reference Lake 3, and based on a before-after analysis using data collected from Mary Lake in 2018 and during 2006 to 2007 baseline studies. A total of 100 and 34 arctic charr were sampled from littoral/profundal habitat of Mary Lake and Reference Lake 3, respectively, in August 2018, for the control-impact analysis. The length-frequency distribution for littoral/profundal arctic charr differed significantly between lakes (Table 5.7; Figure 5.17). In addition, arctic charr sampled from littoral/profundal habitat of Mary Lake were significantly longer, heavier, and of greater condition than at Reference Lake 3 (Table 5.7). However, the magnitude of difference in condition was within the CES_C of ±10%, indicating that this difference was not ecologically meaningful (Table 5.7; Appendix Table G.30).

The length-frequency distribution of arctic charr captured at littoral/profundal habitat of Mary Lake differed significantly between 2018 and the baseline period (Table 5.7; Appendix Table G.30). However, no significant difference in arctic charr length or weight were indicated between 2018 and the baseline period in fish sampled from littoral/profundal habitat (Table 5.7). In addition, although condition of arctic charr sampled from Mary Lake littoral/profundal habitat was significantly lower in 2018 than during the baseline studies, the magnitude of this difference was within the CES_C of ±10% (Table 5.7) suggesting that this difference was not ecologically meaningful. No consistent differences in adult arctic charr health endpoints of size and condition were indicated at Mary Lake for individual years of mine operation from 2015 to 2018 compared to baseline data (Table 5.7). In turn, this suggested that natural and/or sampling variability accounted for slight differences in the arctic charr health endpoints shown during years of mine operation relative to baseline conditions at Mary Lake.

5.2.7 Integrated Summary

Turbidity and aqueous concentrations of total aluminum, manganese, nitrate, and uranium were elevated compared to Reference Lake 3 in 2018, but none of these metals, or any other parameters, were consistently elevated compared to concentrations observed during the baseline period, and none were consistently above WQG or AEMP benchmarks. Similar to Sheardown Lake, turbidity at Mary Lake was naturally higher than at Reference Lake 3 as a result of receiving flow from relatively large river systems (i.e., Tom River and Mary River inflows to the Mary Lake north and south basins, respectively). Aluminum and manganese were generally shown to be associated with turbidity at all mine lakes, including Mary Lake, which suggested that these metals were largely bound to/comprised the suspended particulate matter and were thus unlikely to be biologically available. Sediment metal concentrations at Mary Lake littoral and profundal stations were similar to those at Reference Lake 3 in 2018 and, with the exception of slightly elevated sediment manganese concentrations at littoral stations, were similar to concentrations observed during the baseline period. Although chromium, iron, manganese, and nickel concentrations were above SQG at Mary Lake in 2018, with the exception of nickel, these metals were also above SQG at Reference Lake 3 suggesting low potential for any adverse effects to biota associated with these metals. Similarly, although arsenic, chromium, iron, and nickel concentrations in sediment of Mary Lake were above AEMP benchmarks at Mary Lake, arsenic, iron, and phosphorus concentrations were above respective AEMP benchmarks at Reference Lake 3 as well, suggesting naturally high concentrations of metals in local study area lakes.

Mary Lake chlorophyll-a concentrations did not consistently differ significantly from those at Reference Lake 3 over all three seasons in 2018, suggesting similar primary production between lakes. Mary Lake chlorophyll-a concentrations were continuously well below the AEMP benchmark during all seasonal sampling events in 2018, and were indicative of oligotrophic conditions normally encountered in Arctic waterbodies. Temporal evaluation of the chlorophyll-a data indicated no changes to the trophic status of Mary Lake since commencement of commercial mine operations. No significant differences in benthic invertebrate density, richness, Simpson’s Evenness, and relative abundance of dominant taxonomic groups, FFG, or metal-sensitive chironomids were indicated at littoral and profundal habitat of Mary Lake compared to Reference Lake 3 in 2018, the lone exception being significantly higher density at profundal habitat of Mary Lake. In addition, no ecologically significant differences in any of the above benthic invertebrate community endpoints occurred continually between years of mine operation and the mine baseline at Mary Lake. Analysis of Mary Lake arctic charr populations suggested greater fish abundance compared to Reference Lake 3 in 2018, and suggested no substantial changes in numbers of arctic charr at Mary Lake in 2018 relative to baseline data. No ecologically significant differences in condition of YOY and non-YOY arctic charr captured at nearshore habitat occurred between Mary Lake and Reference Lake 3 in 2018. In addition, no ecologically significant difference in condition of arctic charr captured at littoral/profundal habitat occurred between Mary Lake and Reference Lake 3 in 2018, nor between 2018 and baseline studies conducted at Mary Lake. Collectively, the chlorophyll-a, benthic invertebrate community, and arctic charr fish population data all suggested no adverse mine-related influences to the biota of Mary Lake since commercial mine operations commenced in 2015.

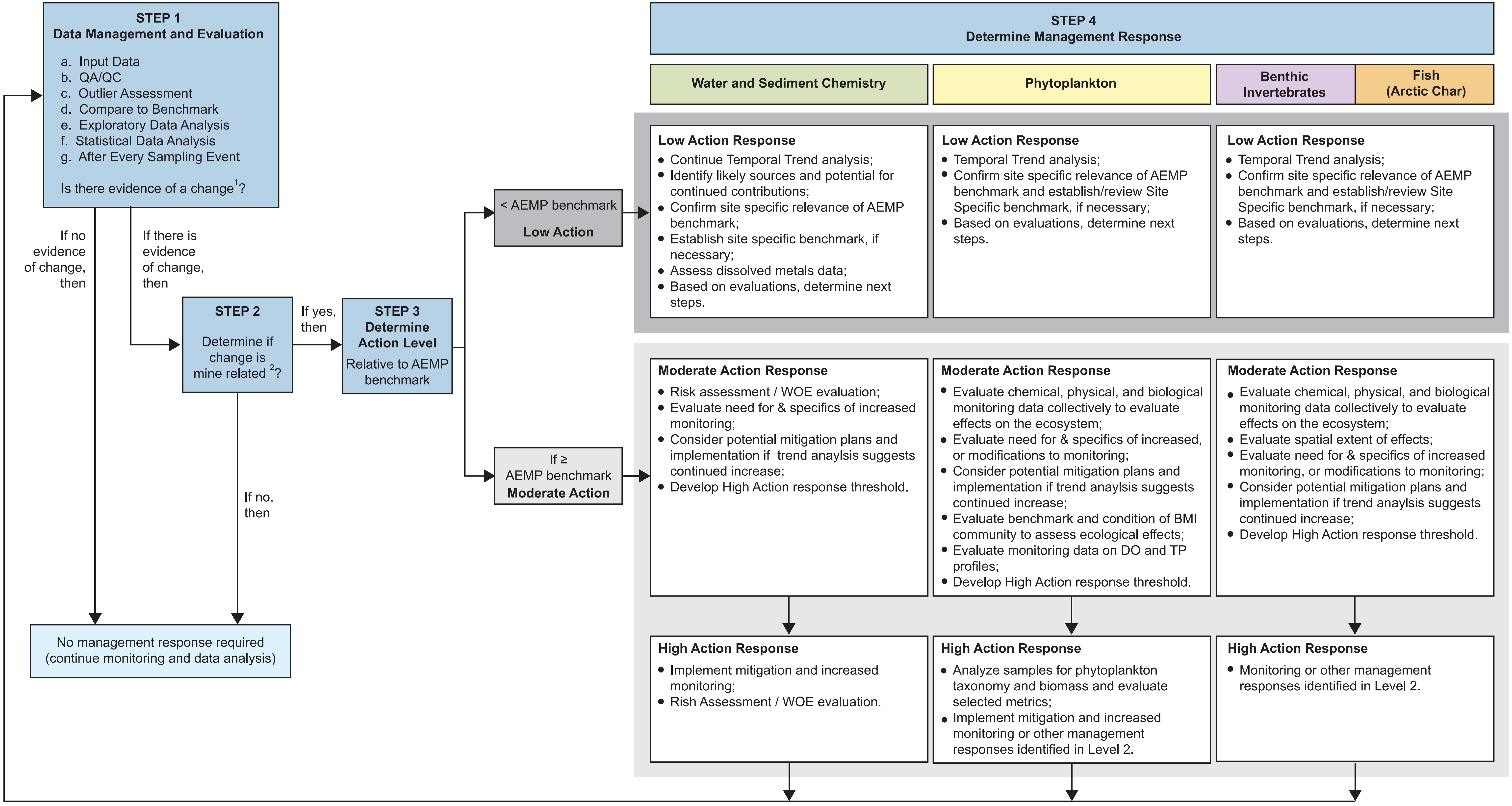
6 EFFECTS DETERMINATION AND RECOMMENDATIONS

6.1 Effects Determination Context

The objective of the 2018 Mary River Project CREMP was to evaluate potential mine-related influences on chemical and biological conditions at aquatic environments located near the mine following the fourth full year of mine operation. The 2018 CREMP utilized an effects-based approach that included standard environmental effects monitoring techniques to provide rigorous evaluation of potential mine-related effects at key waterbodies that receive mine-related deposits from various mine effluents, surface runoff, and among other routes, aerial deposition of dust originating from mine operations. Under this approach, water quality and sediment quality data were used to support the interpretation of phytoplankton, benthic invertebrate community, and fish population survey data collected at mine-exposed areas of the Camp Lake, Sheardown Lake, Mary River, and Mary Lake systems. The evaluation of potential mine-related effects within these systems was based upon comparisons of the 2018 data to applicable reference data, to available baseline data, and to guidelines that included site-specific AEMP benchmarks. The latter were developed to guide management response decisions within a four-step Assessment Approach and Management Response Framework as outlined in the Mary River Project AEMP (Figure 6.1; Baffinland 2015). This effects determination summarizes instances in which the Mary River Project AEMP benchmarks for water and sediment quality were exceeded at waterbodies examined under the CREMP and, based on weight-of-evidence, determines if there have been biological effects at these waterbodies to assist Baffinland with decisions regarding appropriate management actions.

6.2 Camp Lake System

Within the Camp Lake system, AEMP benchmarks for water quality were exceeded only at the main stem channel of Camp Lake Tributary 1 (CLT1), and AEMP benchmarks for sediment quality were exceeded at Camp Lake (Table 6.1). At the CLT1 main stem, aqueous concentrations of aluminum and iron were elevated above their respective AEMP benchmarks during the spring sampling event in 2018, but only at the upstream-most station (i.e., Station L2-03; Table 6.1). Total aluminum concentrations were also above the Camp Lake Tributary AEMP benchmarks at the MRY-REF3 lotic reference station during the summer sampling events in 2018. Notably, higher turbidity was evident at the CLT1 main stem and MRY-REF 3 lotic reference stations than at the other mine-exposed and reference creek stations, which suggested that elevation in total aluminum and iron concentrations compared to AEMP benchmarks reflected association of these metals with suspended particulate matter. This was corroborated by evaluation of the dissolved concentrations of aluminum and iron, which showed similar average concentrations between



STEP 1
Data Management and Evaluation

a. Input Data
b. QA/QC
c. Outlier Assessment
d. Compare to Benchmark
e. Exploratory Data Analysis
f. Statistical Data Analysis
g. After Every Sampling Event

Is there evidence of a change[1]?

If no evidence of change, then

No management response required (continue monitoring and data analysis)

If there is evidence of change, then

STEP 2

Determine if change is mine related [2]?

If no, then

If yes, then

STEP 3
Determine Action Level

Relative to AEMP benchmark

< AEMP benchmark
Low Action

If ≥ AEMP benchmark
Moderate Action

STEP 4
Determine Management Response

Water and Sediment Chemistry	**Phytoplankton**	**Benthic Invertebrates** / **Fish (Arctic Char)**
Low Action Response • Continue Temporal Trend analysis; • Identify likely sources and potential for continued contributions; • Confirm site specific relevance of AEMP benchmark; • Establish site specific benchmark, if necessary; • Assess dissolved metals data; • Based on evaluations, determine next steps.	**Low Action Response** • Temporal Trend analysis; • Confirm site specific relevance of AEMP benchmark and establish/review Site Specific benchmark, if necessary; • Based on evaluations, determine next steps.	**Low Action Response** • Temporal Trend analysis; • Confirm site specific relevance of AEMP benchmark and establish/review Site Specific benchmark, if necessary; • Based on evaluations, determine next steps.
Moderate Action Response • Risk assessment / WOE evaluation; • Evaluate need for & specifics of increased monitoring; • Consider potential mitigation plans and implementation if trend anaylsis suggests continued increase; • Develop High Action response threshold.	**Moderate Action Response** • Evaluate chemical, physical, and biological monitoring data collectively to evaluate effects on the ecosystem; • Evaluate need for & specifics of increased, or modifications to monitoring; • Consider potential mitigation plans and implementation if trend anaylsis suggests continued increase; • Evaluate benchmark and condition of BMI community to assess ecological effects; • Evaluate monitoring data on DO and TP profiles; • Develop High Action response threshold.	**Moderate Action Response** • Evaluate chemical, physical, and biological monitoring data collectively to evaluate effects on the ecosystem; • Evaluate spatial extent of effects; • Evaluate need for & specifics of increased monitoring, or modifications to monitoring; • Consider potential mitigation plans and implementation if trend anaylsis suggests continued increase; • Develop High Action response threshold.
High Action Response • Implement mitigation and increased monitoring; • Rish Assessment / WOE evaluation.	**High Action Response** • Analyze samples for phytoplankton taxonomy and biomass and evaluate selected metrics; • Implement mitigation and increased monitoring or other management responses identified in Level 2.	**High Action Response** • Monitoring or other management responses identified in Level 2.

Notes:
1. Statistical or qualitative change when compared to:
   a) benchmark,
   b) baseline values,
   c) temporal or spatial trents
2. Mine related changes are a result of the mine and associated facilities including but not limited to effects from effluent discharges and dust deposition that are distinguished from natural causes or variation.

Baffinland Mary River Project AEMP Data Assessment Approach and Response Framework

Date: March 2018
Project 177202.0033

minnow environmental inc.

Figure 6.1

Table 6.1: Summary of AEMP Benchmark Exceedances for the Mary River Project 2018 CREMP and Supporting Reference Area and Biological Effects Summary Information

Waterbody	AEMP Benchmark Exceedance	Reference Area Information	Evidence of Biological Effects at Mine-Exposed Area
Camp Lake Tributary 1 (Main Stem)	Aqueous total aluminum concentration greater than 0.179 mg/L benchmark in spring at upper main stem (0.280 mg/L). Aqueous total iron concentration greater than 0.326 mg/L benchmark in spring at upper main stem (0.439 mg/L).	Mean aluminum concentration (spring) = 0.104 mg/L (max = 0.122 mg/L) Mean iron concentration (spring) = 0.077 mg/L (max = 0.106 mg/L)	No ecologically significant and/or adverse effects on phytoplankton or benthic invertebrate community endpoints based on comparisons to reference data and to baseline data.
Camp Lake	No AEMP water quality benchmarks were exceeded at Camp Lake during spring, summer, or fall sampling events in 2018. Sediment arsenic concentration > 5.9 mg/kg benchmark at single littoral monitoring station (9.6 mg/kg). Sediment iron concentration > 52,400 mg/kg benchmark at single littoral monitoring station (65,100 mg/kg). Sediment nickel concentration > 72 mg/kg benchmark at single littoral monitoring station (83 mg/kg). Sediment phosphorus concentration > 1,580 mg/kg benchmark at single littoral monitoring station (1,650 mg/kg). Sediment arsenic, copper, and nickel concentrations above respective benchmarks at individual stations, but below benchmarks on average, at profundal stations.	Aqueous concentrations of all parameters were below applicable Water Quality Guidelines (WQG). Reference lake littoral sediment mean arsenic concentration = 5.25 mg/kg (max = 7.7 mg/kg) Reference lake littoral sediment mean iron concentration = 46,700 mg/kg (max = 74,300 mg/kg). Reference lake littoral sediment mean nickel concentration = 43 mg/kg (max = 55 mg/kg). Reference lake littoral sediment mean phosphorus concentration = 1,305 mg/kg (max = 2,290 mg/kg).	No ecologically significant and/or adverse effects on phytoplankton, benthic invertebrate community, or fish population endpoints compared to reference data and to baseline conditions.
Sheardown Lake Tributary 1	Aqueous copper concentration greater than 0.0022 mg/L benchmark in spring, summer and fall (annual mean = 0.0028 mg/L; max = 0.0036 mg/L)	Mean copper concentration (annual) = 0.0008 mg/L (max = 0.0014 mg/L)	No ecologically significant and/or adverse effects on phytoplankton or benthic invertebrate community endpoints based on comparisons to reference data and to baseline data.
Sheardown Lake NW	No AEMP water quality benchmarks were exceeded at Sheardown Lake NW during spring, summer, or fall sampling events in 2018. Profundal sediment arsenic concentration > 6.2 mg/kg benchmark (mean = 6.3 mg/kg; max = 7.6 mg/kg). Profundal sediment iron concentration > 34,400 mg/kg benchmark (mean = 53,567 mg/kg; max = 62,900 mg/kg). Profundal sediment nickel concentration > 77 mg/kg benchmark (mean = 78 mg/kg; max = 87 mg/kg).	Reference lake profundal sediment mean arsenic concentration = 6.1 mg/kg (max = 7.1 mg/kg) Reference lake profundal sediment mean iron concentration = 50,900 mg/kg (max = 63,600 mg/kg). Reference lake profundal sediment mean nickel concentration = 54 mg/kg (max = 65 mg/kg).	No ecologically significant and/or adverse effects on phytoplankton, benthic invertebrate community, or fish population endpoints compared to reference data and to baseline conditions.
Sheardown Lake SE	No AEMP water quality benchmarks were exceeded at Sheardown Lake SE during spring, summer, or fall sampling events in 2018. Mean sediment iron concentration for lake > 34,400 mg/kg benchmark (mean = 38,860 mg/kg; max = 45,800 mg/kg). Mean sediment manganese concentration for lake > 657 mg/kg benchmark (mean = 860 mg/kg; max = 1,100 mg/kg).	Reference lake mean sediment iron concentration = 48,800 mg/kg (max = 74,300 mg/kg). Reference lake mean sediment manganese concentration = 960 mg/kg (max = 1,590 mg/kg).	No ecologically significant and/or adverse effects on phytoplankton, benthic invertebrate community, or fish population endpoints compared to reference data and to baseline conditions.
Mary Lake	No AEMP water quality benchmarks were exceeded at Mary Lake during spring, summer, or fall sampling events in 2018. Sediment chromium concentration > 98 mg/kg benchmark at single littoral monitoring station (108 mg/kg) of south basin. Sediment nickel concentration > 72 mg/kg benchmark at single littoral monitoring station (73 mg/kg) of south basin. Sediment chromium, iron, and nickel concentrations above respective benchmarks at individual stations, but below benchmarks on average, at profundal stations.	Aqueous concentrations of all parameters were below applicable Water Quality Guidelines (WQG). Reference lake littoral sediment mean chromium concentration = 59 mg/kg (max = 74 mg/kg) Reference lake littoral sediment mean nickel concentration = 43 mg/kg (max = 55 mg/kg).	No ecologically significant and/or adverse effects on phytoplankton, benthic invertebrate community, or fish population endpoints compared to reference data and to baseline conditions.

CLT1 stations and the reference creek stations and suggested that aluminum and iron were not likely to be bioavailable. This was supported by the absence of any ecologically significant, adverse, effects on phytoplankton and benthic invertebrates within the CLT1 main stem in 2018 compared to both reference and baseline conditions. Based on these empirical results, a low action response to isolate the likely source(s) of aluminum and iron to the CLT1 main stem is recommended under the AEMP Management Response Framework.

At Camp Lake, AEMP benchmarks for water quality were consistently met, but benchmarks for sediment quality were exceeded for five parameters, in 2018 (Table 6.1). Arsenic, iron, nickel, and phosphorus concentrations were elevated above AEMP benchmarks in sediment at the single Camp Lake littoral sediment chemistry monitoring station. Arsenic, copper, and nickel concentrations were above AEMP benchmarks in sediment at individual profundal stations, but on average, were below benchmarks within the profundal sediments. Notably, arsenic, iron, and phosphorus concentrations in sediment of Reference Lake 3 were also above the Camp Lake AEMP benchmarks at individual littoral and profundal stations, indicating natural elevation of these parameters in lake sediments of the region (Appendix Table D.4). Sediment arsenic concentrations at the Camp Lake littoral sediment chemistry station in 2018 were slightly elevated compared to concentrations at Reference Lake 3, and concentrations at littoral habitat during baseline at Camp Lake. However, iron, nickel, and phosphorus concentrations in sediment at Camp Lake did not show similar elevation compared to reference lake conditions or Camp Lake baseline conditions for littoral or profundal stations. In addition, no adverse effects to biota in direct contact with sediment (i.e., benthic invertebrates) were indicated at Camp Lake relative to reference conditions and Camp Lake baseline conditions for both littoral and profundal habitats. Because no adverse effects to biota were associated with concentrations of metals above the AEMP benchmarks for sediment quality at Camp Lake, a moderate action response is recommended under the AEMP Management Response Framework. Notably, sediment metal concentrations were elevated above AEMP benchmarks at Reference Lake 3, sediment quality monitoring is conducted only at a single littoral station within Camp Lake, and sediment chemistry data is not always collected at the same locations as benthic invertebrate community samples, under the CREMP. Therefore, as per recommendations 14 to 17 provided by Minnow (2016b; Appendix H) following the 2015 CREMP, the following changes to the existing CREMP lake sediment quality and benthic invertebrate community survey study component designs (including Camp Lake) are recommended:

- Consider updating the AEMP sediment quality benchmarks to reflect not only baseline data, but also reference lake data; and,

- Harmonize the lake sediment quality and benthic invertebrate monitoring stations, focusing only on littoral habitat, to improve the ability of the program to evaluate mine-related effects to biota and potentially allow linkages to be assessed between sediment metal concentrations and benthic endpoints.

6.3 Sheardown Lake System

Within the Sheardown Lake system, AEMP benchmarks for water quality were exceeded only at Sheardown Lake Tributary 1 (SDLT1), and AEMP benchmarks for sediment quality were exceeded at both Sheardown Lake NW and Sheardown Lake SE, in 2018 (Table 6.1). At SDLT1, aqueous copper concentrations were elevated compared to the average concentration from reference creek stations in 2018, but not to concentrations observed at SDLT1 during baseline studies (2005 to 2013 data; Appendix Table C.35). Given close proximity to mine operations and evidence of sedimentation, a mine-related source of copper to SDLT1 seems likely, but because no elevation in copper concentrations was indicated at SDLT1 in 2018 compared to baseline conditions, copper concentrations at SDLT1 may naturally be similar to the AEMP benchmark. Biological monitoring conducted at SDLT1 in 2018 indicated no adverse effects to phytoplankton or benthic invertebrates, potentially reflecting copper concentrations at, or just marginally above, the WQG. Because no adverse effects to biota were associated with copper concentrations above the AEMP benchmark at SDLT1, a low action response to identify the likely source(s) of copper to the system is recommended under the AEMP Management Response Framework.

At Sheardown Lake NW, AEMP benchmarks for water quality were consistently met, but AEMP benchmarks for sediment quality were exceeded for arsenic, iron, and nickel at profundal habitat stations in 2018 (Table 6.1). Concentrations of these metals in profundal sediment of Sheardown Lake NW were similar to concentrations in sediment of like-habitat at Reference Lake 3, as well as to concentrations documented at Sheardown Lake NW in baseline studies (Appendix Table D.14). No adverse effects to benthic invertebrates and other biota were indicated at Sheardown Lake NW in 2018 based on comparisons to reference conditions and to Sheardown Lake NW baseline conditions. Because no adverse effects to biota were associated with concentrations of these metals above AEMP benchmarks, a low action response is recommended under the AEMP Management Response Framework for Sheardown Lake NW. Specifically, it is recommended that, because concentrations of metals in Sheardown Lake NW sediment are similar to Reference Lake 3, consideration should be given to updating the AEMP sediment quality benchmarks for Sheardown Lake NW to reflect not only baseline data, but also reference lake data.

At Sheardown Lake SE, AEMP benchmarks for water quality were consistently met, but AEMP benchmarks for sediment quality were exceeded for iron and manganese at both littoral and profundal habitat stations in 2018 (Table 6.1). Iron and manganese concentrations in sediment of Sheardown Lake SE in 2018 were similar to respective concentrations observed at Reference Lake 3, as well as to concentrations documented at Sheardown Lake SE in baseline studies. Although mean concentrations of iron and manganese were above AEMP benchmarks in sediment of Sheardown Lake SE, concentrations of these metals were also well above these AEMP benchmarks at Reference Lake 3. Notably, AEMP benchmarks established for sediment quality at Sheardown Lake SE tend to be lower than SQG, and are generally lower than AEMP benchmarks established for the other mine-exposed lakes (Baffinland 2015). No adverse effects to benthic invertebrates and other biota were indicated at Sheardown Lake SE in 2018 based on comparisons to reference conditions and to Sheardown Lake SE baseline conditions. Because no adverse effects to biota were associated with sediment iron and manganese concentrations above AEMP benchmarks at Sheardown Lake SE, a low action response is recommended under the AEMP Management Response Framework. Specifically, it is recommended that the relevance of site-specific sediment quality AEMP benchmarks for Sheardown Lake SE be assessed and, if necessary, determined anew taking into consideration data from Reference Lake 3 and applicable SQG.

6.4 Mary River and Mary Lake Systems

Within the Mary River and Mary Lake systems, AEMP benchmarks for water quality were consistently met at all Mary River stations (i.e., 13 in total) and at Mary Lake north and south basins, but benchmarks for sediment quality were exceeded for three metals at the Mary Lake south basin, in 2018 (Table 6.1). At the Mary Lake south basin, AEMP benchmarks for sediment quality were exceeded for chromium and nickel at the single littoral habitat station (Table 6.1). Chromium, iron, and nickel concentrations were also above AEMP benchmarks in sediment at individual profundal stations, but on average, were below benchmarks within sediment at profundal habitat. However, for each of these metals, similar concentrations were observed in like-habitat between Mary Lake and Reference Lake 3 in 2018, and concentrations were similar to those documented at Mary Lake in baseline studies (Appendix Table D.14). In addition, no adverse effects to benthic invertebrates and other biota were indicated at Mary Lake in 2018 based on comparisons to reference conditions and to Mary Lake baseline data. Because no adverse effects to biota were associated with concentrations of these metals above AEMP benchmarks, a low action response is recommended under the AEMP Management Response Framework for Mary Lake. Recommended changes to the existing CREMP lake sediment quality and benthic invertebrate community survey study component designs are the same as those provided previously for Camp Lake, which include:

- Consider updating the AEMP sediment quality benchmarks to reflect not only baseline data, but also reference lake data; and,
- Harmonize the lake sediment quality and benthic invertebrate monitoring stations, focusing only on littoral habitat, to improve the ability of the program to evaluate mine-related effects to biota and potentially allow linkages to be assessed between sediment metal concentrations and benthic endpoints.

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APPENDIX A

DATA QUALITY REVIEW

APPENDIX A DATA QUALITY REVIEW

LIST OF TABLES

A1 INTRODUCTION

Data Quality Review (DQR) was conducted on data collected as part of the Mary River Project 2018 CREMP to define the overall quality of the data collected for the program, and by extension, the confidence with which the data can be used to derive conclusions. A variety of factors can influence the physical, chemical and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Depending on the magnitude of these influences, inaccuracy or imprecision have the potential to affect the reliability of conclusions drawn from the available data. Therefore, it is important to ensure that programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize the variability that does not reflect natural spatial and temporal variability in the environment) and thus assure the quality of the data.

The Mary River Project 2018 CREMP DQR involved comparison of field performance to generic environmental study data quality objectives (DQO) for the evaluation of sample blanks, data precision and data accuracy. DQO were established *a priori* to reflect reasonable and achievable performance expectations. Overall, the intent of comparing data to DQO was not to reject any measurement that did not meet the DQO, but rather to evaluate whether, based on the available data and using a weight-of-evidence approach, whether the field and/or analytical sample data adequately reflected actual conditions and thus could be used with confidence to derive study conclusions. Using this approach, questionable data received more scrutiny to determine what effect, if any, this had on interpretation of results within the context of this project. Quality Control (QC) samples assessed for the Mary River Project CREMP included water sample trip blanks, field blanks, equipment blanks, and field duplicates, sediment sample field duplicates, and the verification of the accuracy of sub-sampling and organism recovery for the benthic invertebrate component, defined as follows:

- Blanks (water quality samples) are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed the same way as regular samples. These samples reflect contamination that occurred from the equipment (in the case of equipment blanks), in the field (in the case of trip or field blanks), or in the laboratory (in the case of laboratory or method blanks). Analyte concentrations should be non-detectable, although a data quality objective of five times the laboratory reportable detection limit (RDL) allows for slight “noise” around the detection limit.
- Trip Blanks are meant to detect any widespread contamination resulting from the container (including caps) and preservative during transport and storage. A trip blank is a bottle set full of de-ionized water that is prepared prior to the field sample

collections, is transported with the regular sample bottles in the field, and remains unopened throughout the trip.

- Field Blanks mimic the sampling and preservative process but do not come in contact with ambient water. Field blanks are exposed to the sampling environment at the sample site. Consequently, they provide information on contamination resulting from the handling technique and through exposure to the atmosphere. They are processed in the same manner as the associated field samples (i.e., they are exposed to all the same potential sources of contamination as the field sample), including handling and, in some cases, filtration, and/or preservation.
- Equipment Blanks are samples of de-ionized water collected from the sampling equipment following decontamination (i.e., rinsing of the sampling device using de-ionized water) in the field between sampling stations and/or events. These blanks are useful in identifying cross contamination of samples in the field as a result of the sampling device.
- Field Duplicates (water quality and sediment quality samples) are sub-sample pairs collected from randomly selected field stations using identical collection and handling methods that are then analyzed separately in the laboratory. The duplicate samples are handled and analyzed in an identical manner in the laboratory. The data from field duplicate samples reflect natural variability, as well as the variability associated with sample collection methods, and therefore provide a measure of field precision.
- Sub-Sampling Checks (benthic invertebrate community samples) are used when excessive sample volume and/or organism density results in only a fraction of the original sample being analyzed. By comparing the numbers of benthic invertebrates recovered between at least two sub-samples, this measure provides an evaluation of how effective the sub-sampling method was in evenly dividing the original sample. Therefore, sub-sampling error provides a measure of analytical precision. The processing of entire samples in representative sample fractions also allows an evaluation of sub-sampling accuracy.
- Organism Recovery Checks (benthic invertebrate community samples) involve the re-processing of previously sorted material from a randomly selected sample to determine the number of invertebrates that were not recovered during the original sample processing. The reprocessing is conducted by an analyst not involved during the original processing to reduce any bias. This check allows the determination of accuracy through assessment of recovery efficiency.

A2 RESULTS

A2.1 Water Quality

A2.1.1 Sample Blanks

Trip blank samples were taken on field sampling campaigns a total of six times during the 2018 CREMP, including two during the winter lake monitoring event (April to May), two during the summer lake/stream monitoring event (July), and two during the fall lake/stream monitoring event (August). Of the 519 total number of analyses conducted on the trip blank samples, only three (0.6%) resulted in analyte detection above the trip blank DQO of less than five-times the RDL (Appendix Table A.1). Barium was the only parameter that was observed at concentrations that were above the DQO in trip blanks, but only in the dissolved fraction. Contamination from the bottle or filtering process were the most likely sources of dissolved barium to the trip blank samples.

Field blank samples were assessed a total of seven times during the 2018 CREMP, including two during the winter lake monitoring event, one during the spring stream monitoring event, two during the summer lake monitoring event, and two during the fall lake/stream monitoring event. Of the 604 determinations made, three (0.5%) resulted in analyte detections above the DQO of less than five-times the laboratory RDL (Appendix Table A.2). Similar to the trip blanks, barium was observed most frequently at concentrations above DQO in the 2018 field blank samples, with turbidity also not achieving the DQO in one instance. A similar frequency of detected concentrations over respective RDL occurred between the trip and field blanks, which suggested that a similar source of contamination was common to both QC sample types.

Equipment blank samples were collected a total of seven times during the 2018 CREMP, including two during the winter lake monitoring event, three during the summer lake monitoring event, and two during the fall lake monitoring event. Of the 609 determinations conducted, five (0.8%) resulted in analyte detection above the DQO of less than five-times the laboratory RDL (Appendix Table A.3). Once again, barium was most frequently detected at concentrations above RDL in the equipment blank samples, suggesting that the sampling device may have been a source of this metal. In addition to barium, turbidity was detected at a concentration above the RDL at a magnitude greater than the DQO in a single equipment blank sample. Notably, a similar frequency of analyte detection above the DQO was observed in the equipment blank samples compared to the trip and field blank samples.

Table A.1: Water Sample Trip Blank Results with Reference to Data Quality Objectives, Mary River CREMP, 2018

	Client Sample ID	Lowest RDL[a]	BL0-05-A	DL0-01-1-S	L1-09	BL0-01-B-S	BL0-04-B	C0-10
	Date Sampled		15-Apr-2018	22-Apr-2018	1-Jul-2018	3-Aug-2018	25-Aug-2018	27-Aug-2018
	ALS Sample ID		L2081994-4	L2085166-3	L2122777-31	L2141395-2	L2153578-11	L2153983-5
	Units							
Physical Tests								
Conductivity	umhos/cm	3.00	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Hardness (as $CaCO_3$)	mg/L	10.0	<10.0	<10.1	<10.2	<10.3	<10.4	<10.5
Total Suspended Solids	mg/L	2.00	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Dissolved Solids	mg/L	20.0	<10	<10	<10	<20	<20	<20
Turbidity	NTU	0.100	0.230	0.250	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients (Water)								
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	<10.0	<10.1	<10.2	<10.3	<10.4	<10.5
Ammonia, Total (as N)	mg/L	0.0200	<0.020	<0.020	<0.020	<0.020	<0.020	0.0620
Bromide (Br)	mg/L	0.100	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride (Cl)	mg/L	0.500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Nitrate and Nitrite as N	mg/L	0.0210	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
Nitrate (as N)	mg/L	0.0200	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Kjeldahl Nitrogen	mg/L	0.150	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Phosphorus, Total	mg/L	0.0030	<0.0030	<0.0030	<0.0030	0.0037	<0.0030	0.0042
Sulfate (SO4)	mg/L	0.300	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Organic / Inorganic Carbon (Water)								
Dissolved Organic Carbon	mg/L	0.500	<1.0	<1.0	<0.50	<0.50	0.600	<0.50
Total Organic Carbon	mg/L	0.500	<1.0	<1.0	<0.50	<0.50	0.800	<0.50
Total Metals (Water)								
Aluminum (Al)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	0.0000500	<0.000050	<0.000050	0.000195	<0.000050	0.000244	<0.000050
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	0.0500	<0.050	<0.050	0.0970	<0.050	0.0800	<0.050
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Manganese (Mn)	mg/L	0.0000700	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Potassium (K)	mg/L	0.200	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)	mg/L	0.100	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Strontium (Sr)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)	mg/L	0.000100	0.000250	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals (Water)								
Aluminum (Al)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	0.0000500	<0.000050	<0.000050	0.000315	0.000411	0.000294	<0.000050
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	0.0500	<0.050	<0.050	0.0890	0.192	0.134	<0.050
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium (Li)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Manganese (Mn)	mg/L	0.0000700	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Potassium (K)	mg/L	0.200	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)	mg/L	0.100	<0.10	<0.10	<0.10	0.270	<0.10	<0.10
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Zinc (Zn)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Aggregate Organics (Water)								
Phenols (4AAP)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	0.0046
Plant Pigments (Water)								
Chlorophyll a	µg/L	0.100	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Phaeophytin a	µg/L	0.200	0.120	0.140	0.170	<0.20	0.110	<0.20

Notes: RDL = Reportable Detection Limit.

▨ Parameter did not meet the data quality objective of ≤ 5x the RDL

[a] For some analytes, a range of RDLs were achieved in different laboratory reports. Each blank was compared to the RDL applicable to that sample.

Table A.2: Water Sample Field Blank Results with Reference to Data Quality Objectives, Mary River CREMP, 2018

Parameter		Lowest RDL[a]	BL0-01-A	DL0-02-06-S	MRY-REF-2	D1-05	BL0-05A-B	BL0-04-B	L1-09
			4/14/2018	4/17/2018	30-Jun-2018	1-Aug-2018	8/2/2018	8/25/2018	25-Aug-2018
			L2081999-1	L2082600-6	L2122777-11	L2140029-11	L2140864-10	L2153578-12	L2153585-3
Physical Tests									
Conductivity	umhos/cm	3.00	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Hardness (as CaCO3)	mg/L	10.0	<10	<10	<10	<10	<10	<10	<10
Total Suspended Solids	mg/L	2.00	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Dissolved Solids	mg/L	20.0	<10	<10	<10	20.0	<20	<20	<20
Turbidity	NTU	0.100	0.410	▨ 0.600	0.150	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients (Water)									
Alkalinity, Total (as CaCO3)	mg/L	10.0	<10	<10	<10	<10	<10	<10	<10
Ammonia, Total (as N)	mg/L	0.0200	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Bromide (Br)	mg/L	0.100	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride (Cl)	mg/L	0.500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Nitrate and Nitrite as N	mg/L	0.0210	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
Nitrate (as N)	mg/L	0.0200	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	0.00500	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Kjeldahl Nitrogen	mg/L	0.150	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Phosphorus, Total	mg/L	0.00300	0.00910	<0.0030	<0.0030	<0.0030	0.00380	<0.0030	<0.0030
Sulfate (SO4)	mg/L	0.300	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Organic / Inorganic Carbon (Water)									
Dissolved Organic Carbon	mg/L	0.500	<1.0	<1.0	<0.50	<0.50	<0.50	0.580	0.650
Total Organic Carbon	mg/L	0.500	<1.0	<1.0	<0.50	0.770	<0.50	1.10	0.950
Total Metals (Water)									
Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	0.0000500	<0.000050	▨ 0.000291	0.000202	<0.000050	<0.000050	0.000210	<0.000050
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	0.0500	<0.050	0.109	0.103	<0.050	<0.050	0.0940	<0.050
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Manganese (Mn)	mg/L	0.0000700	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Potassium (K)	mg/L	0.200	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)	mg/L	0.100	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Strontium (Sr)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.00420	<0.0030
Dissolved Metals (Water)									
Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	0.0000500	0.0000600	<0.000050	0.000181	<0.000050	0.0000950	▨ 0.000269	<0.000050
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	0.0500	0.116	<0.050	0.103	<0.050	0.0870	0.132	<0.050
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.000830	<0.00050
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Manganese (Mn)	mg/L	0.0000700	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Potassium (K)	mg/L	0.200	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)	mg/L	0.100	<0.10	<0.10	<0.10	<0.10	0.270	<0.10	<0.10
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	0.0870	<0.050	<0.050
Strontium (Sr)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	0.000120	<0.00010	<0.00010
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Aggregate Organics (Water)									
Phenols (4AAP)	mg/L	0.00100	0.00150	<0.0010	<0.0010	<0.0010	0.00230	<0.0010	<0.0010
Plant Pigments (Water)									
Chlorophyll a	ug/L	0.100	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Phaeophytin a	ug/L	0.200	0.160	0.150	0.150	<0.20	<0.20	0.110	<0.20

Notes: RDL = Reportable Detection Limit.

▨ Parameter did not meet the data quality objective of ≤ 5x the RDL

[a] For some analytes, a range of RDLs were achieved in different laboratory reports. Each blank was compared to the RDL applicable to that sample.

Table A.3: Water Sample Equipment Blank Results with Reference to Data Quality Objectives, Mary River CREMP, 2018

Client Sample ID		Lowest RDL^a	DD-HAB9-STN-1-B	JLO-02	REF3-02	KEMMERER-2	KEMMERER-1	KEMMERER-2	KEMMERER-2
Date Sampled			4/23/2018	4/13/2018	8/12/2018	7/29/2018	7/30/2018	8/20/2018	8/28/2018
ALS Sample ID			L2085170-3	L2082011-1	L2145787-9	L2137924-25	L2137924-26	L2150018-7	L2154042-1
	Units								
Physical Tests									
Conductivity	umhos/cm	3.00	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Hardness (as $CaCO_3$)	mg/L	10.0	<10	<10	<10	<10	<10	<10	<10
Total Suspended Solids	mg/L	2.00	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Dissolved Solids	mg/L	20.0	<10	<10	<20	<20	<20	<20	<20
Turbidity	NTU	0.100	0.45	0.79	0.12	<0.10	0.40	<0.10	<0.10
Anions and Nutrients (Water)									
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	<10	<10	<10	<10	<10	<10	<10
Ammonia, Total (as N)	mg/L	0.0200	<0.020	<0.020	<0.020	<0.020	0.074	<0.020	0.022
Bromide (Br)	mg/L	0.100	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride (Cl)	mg/L	0.500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Nitrate and Nitrite as N	mg/L	0.0210	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
Nitrate (as N)	mg/L	0.0200	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Kjeldahl Nitrogen	mg/L	0.150	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Phosphorus, Total	mg/L	0.0030	<0.0030	<0.0030	<0.0030	0.0061	0.0054	0.0093	<0.0030
Sulfate (SO4)	mg/L	0.300	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Organic / Inorganic Carbon (Water)									
Dissolved Organic Carbon	mg/L	0.500	<1.0	<1.0	0.54	<0.50	<0.50	0.63	0.51
Total Organic Carbon	mg/L	0.500	<1.0	<1.0	0.67	<0.50	<0.50	0.71	0.92
Total Metals (Water)									
Aluminum (Al)	mg/L	0.0030	<0.0030	<0.0030	0.0039	<0.0030	0.0034	<0.0030	<0.0030
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	0.0000500	0.000082	0.000384	0.000145	0.000418	0.000296	0.000062	<0.000050
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	0.0500	<0.050	0.134	0.056	0.127	0.112	<0.050	<0.050
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Manganese (Mn)	mg/L	0.0000700	<0.000070	<0.000070	0.000274	<0.000070	0.000092	0.000096	<0.000070
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Potassium (K)	mg/L	0.200	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)	mg/L	0.100	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Strontium (Sr)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals (Water)									
Aluminum (Al)	mg/L	0.0030	<0.0030	<0.0030	0.007	<0.0030	0.004	<0.0030	<0.0030
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	0.0000500	<0.000050	0.000282	0.000257	0.00037	0.000351	0.000057	<0.000050
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	0.0500	<0.050	0.123	0.125	0.096	0.123	<0.050	<0.050
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lithium (Li)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Manganese (Mn)	mg/L	0.0000700	<0.000070	<0.000070	0.000291	<0.000070	0.000111	<0.000070	<0.000070
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)	mg/L	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silicon (Si)	mg/L	0.100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silver (Ag)	mg/L	0.0000100	<0.10	<0.10	0.3	<0.10	<0.10	<0.10	<0.10
Strontium (Sr)	mg/L	0.000100	<0.050	<0.050	0.12000	<0.050	<0.050	<0.050	<0.050
Titanium (Ti)	mg/L	0.0100	<0.00010	<0.00010	0.00093	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium (V)	mg/L	0.0010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Zinc (Zn)	mg/L	0.0030	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zirconium (Zr)	mg/L	-	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Aggregate Organics (Water)									
Phenols (4AAP)	mg/L	0.0010	<0.0010	0.0019	0.0012	<0.0010	<0.0010	<0.0010	0.0014
Plant Pigments (Water)									
Chlorophyll a	µg/L	0.100	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Phaeophytin a	µg/L	0.200	0.16	0.14	0.12	<0.20	<0.20	0.16	<0.20

Notes: RDL = Reportable Detection Limit.

▨ Parameter did not meet the data quality objective of≤ 5x the RDL

[a] For some analytes, a range of RDLs were achieved in different laboratory reports. Each blank was compared to the RDL applicable to that sample

A2.1.2 Precision – Field Duplicates

In total, 18 field duplicates were collected over the course of the 2018 Mary River Project CREMP water sampling, including four during the winter lake monitoring event, one during the spring stream monitoring event, nine during the summer stream/lake monitoring event, and four during the fall stream/lake monitoring event. In general, close agreement in parameter concentrations was observed between duplicate samples, with 96% of field duplicate analyte pairs meeting the water quality field duplicate DQO of ≤25% Relative Percent Difference (RPD) in parameter concentrations of the 1,521 duplicate analyses conducted (Appendix Table A.4). Total aluminum, total phosphorus, phenols, and turbidity were the key parameters that most frequently did not meet DQO between the duplicate samples (Appendix Table A.4). In some cases in which DQO were not met, measured concentrations in one or both duplicate samples were close to the RDL (i.e., two- to three-times the RDL) such that small differences in concentrations between duplicate samples resulted in relatively high RPD. In other cases, the relatively high RPD between duplicate samples likely reflected variability in actual concentrations in the field or field sampling related influences. Because metals can be associated with materials reflected by turbidity (e.g., suspended inorganic minerals), the relatively high frequency in which turbidity differed between replicate samples may often have accounted for various metals (e.g., aluminum) not meeting the field duplicate DQO between replicated samples. Nevertheless, in the majority of cases, and for key parameters of concern, the RPD in analyte concentrations was sufficiently low as to not affect interpretation of the data.

A2.2 Sediment Quality

Field duplicate sediment samples were collected at each of Reference Lake 3 (REF03-10), Camp Lake (Station JLO-01), Sheardown Lake NW (Station DLO-01-2), Sheardown Lake SE (Station DLO-02-4), and Mary Lake (BLO-04), which represented 12% of the total number of sediment quality monitoring stations sampled for the 2018 CREMP. Excellent agreement in parameter concentrations were observed between duplicate samples, with none of the duplicate samples exhibiting greater than 40% RPD in parameter concentrations between split samples collected in the field (Appendix Table A.5). Therefore, data precision was very high and considered acceptable for providing reliable interpretation of the sediment quality data.

A2.3 Benthic Invertebrate Community Samples

A2.3.1 Subsampling Accuracy

Sub-sampling of benthic invertebrate community samples was conducted on 15 of 63 stream samples (24%) and 9 of 50 lake samples (18%; total of 21% for 2018 project) with the sorted

Figure A.4: Water Sample Field Duplicate Results with Reference to the Data Quality Objective, Mary River CREMP, 2018

Sample ID	Units	LDL	CLT-REF3	CLT-REF3	RPD	E0-03	EO-03	RPD	I0-01	I0-01	RPD
Date Sampled			25-Aug-18	25-Aug-18		30-Jun-18	29-Jun-18		1-Aug-18	1-Aug-18	
ALS Sample ID			L2153585-5	L2153585-6		L2122777-27	L2122777-12		L2140029-1	L2140029-2	
Conductivity	umhos/cm	3.00	94.4	93.5	1.0	29.8	30.0	0.7	95.0	96.1	1.2
Hardness (as $CaCO_3$)	mg/L	10.0	48.0	47.0	2.1	14.0	14.0	0	50.0	51.0	2.0
pH	pH units	0.100	7.87	7.88	0.1	7.44	7.45	0.1	7.84	7.90	0.8
Total Suspended Solids	mg/L	2.00	<2.0	<2.0	0	4.50	5.60	22	<2.0	<2.0	0
Total Dissolved Solids	mg/L	20.0	38.0	38.0	0	21.0	<10	71	30.0	40.0	29
Turbidity	NTU	0.100	0.520	0.540	3.8	3.31	3.35	1.2	1.69	1.73	2.3
Anions and Nutrients (Water)											
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	44.0	43.0	2.3	14.0	12.0	15	48.0	11.0	125
Ammonia, Total (as N)	mg/L	0.0200	<0.020	<0.020	0	<0.020	0.0370	60	<0.020	<0.020	0
Bromide (Br)	mg/L	0.100	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
Chloride (Cl)	mg/L	0.500	<0.50	<0.50	0	0.590	0.590	0	1.02	1.03	1.0
Nitrate and Nitrite as N	mg/L	0.0210	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0
Nitrate (as N)	mg/L	0.0200	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0
Nitrite (as N)	mg/L	0.00500	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
Total Kjeldahl Nitrogen	mg/L	0.150	<0.15	<0.15	0	<0.15	<0.15	0	<0.15	<0.15	0
Phosphorus, Total	mg/L	0.00300	0.00330	<0.0030	9.5	0.00820	0.0214	89	0.00800	<0.0030	91
Sulfate (SO4)	mg/L	0.300	1.14	1.16	1.7	0.350	0.350	0	0.600	0.600	0
Organic / Inorganic Carbon (Water)											
Dissolved Organic Carbon	mg/L	0.500	1.91	1.98	3.6	0.970	0.880	9.7	1.51	1.36	10
Total Organic Carbon	mg/L	0.500	4.22	2.45	53	1.26	1.48	16	2.03	2.06	1.5
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.0281	0.0282	0.4	0.102	0.0805	24	0.0818	0.144	55
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.00531	0.00524	1.3	0.00296	0.00573	64	0.00551	0.00477	14
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00010	133
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.000050	164
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.0000050	67
Calcium (Ca)	mg/L	0.0500	9.71	9.91	2.0	3.02	3.10	2.6	11.0	9.79	12
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.00113	0.00114	0.9	<0.00050	<0.00050	0	0.0007800	<0.0010	25
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	0	0.0820	0.0670	20	0.0950	0.160	51
Lead (Pb)	mg/L	0.000050	0.000066	0.000073	10	0.000094	0.000097	3.1	0.0001050	0.000097	7.9
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	5.58	5.47	2.0	1.67	1.68	0.6	5.97	6.10	2.2
Manganese (Mn)	mg/L	0.000070	0.0005010	0.0005210	3.9	0.00213	0.00196	8.3	0.00292	0.00230	24
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0004650	0.0004730	1.7	<0.000050	<0.000050	0	0.000074	0.0001140	43
Nickel (Ni)	mg/L	0.0005000	0.0006200	0.0006200	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	0.600	0.590	1.7	0.350	0.340	2.9	0.570	0.526	8.0
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.000050	181
Silicon (Si)	mg/L	0.100	0.850	0.830	2.4	0.490	0.410	18	0.800	0.770	3.8
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000050	133
Sodium (Na)	mg/L	0.0500	0.643	0.654	1.7	0.334	0.336	0.6	0.877	0.841	4.2
Strontium (Sr)	mg/L	0.0001000	0.00613	0.00621	1.3	0.00247	0.00253	2.4	0.00696	0.00640	8.4
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.000010	164
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	0.00771	26
Uranium (U)	mg/L	0.000010	0.00188	0.00186	1.1	0.0001260	0.0001300	3.1	0.0007000	0.0006720	4.1
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.00050	67
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Dissolved Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.0118	0.0120	1.7	0.0339	0.0310	8.9	0.0192	0.0158	19
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.00513	0.00538	4.8	0.00240	0.00228	5.1	0.00484	0.00501	3.5
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	9.63	9.63	0	2.92	2.88	1.4	9.99	10.0	0.1
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.00108	0.00111	2.7	<0.00050	<0.00050	0	0.0006100	0.0006100	0
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	5.76	5.59	3.0	1.61	1.60	0.6	6.11	6.20	1.5
Manganese (Mn)	mg/L	0.000070	0.0003990	0.0004150	3.9	0.0005870	0.0005810	1.0	0.0002070	0.0002140	3.3
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0003840	0.0004420	14	<0.000050	<0.000050	0	0.000093	0.000087	6.7
Nickel (Ni)	mg/L	0.0005000	0.0005600	0.0005700	1.8	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	0.580	0.580	0	0.330	0.330	0	0.550	0.560	1.8
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.790	0.780	1.3	0.340	0.350	2.9	0.700	0.710	1.4
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	0.644	0.642	0.3	0.338	0.341	0.9	0.900	0.928	3.1
Strontium (Sr)	mg/L	0.0001000	0.00633	0.00616	2.7	0.00234	0.00231	1.3	0.00617	0.00620	0.5
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Uranium (U)	mg/L	0.000010	0.00187	0.00181	3.3	0.000093	0.000099	6.3	0.0005980	0.0006030	0.8
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	<0.0010	<0.0010	0	0.00110	0.0229	182	0.00110	<0.0010	9.5
Plant Pigments (Water)											
Chlorophyll a	µg/L	0.100	0.170	0.180	5.7	0.330	0.310	6.3	0.470	0.550	16
Phaeophytin a	µg/L	0.100	0.260	0.240	8.00	0.300	0.300	0	0.410	0.4200	2.4

Notes: LDL = Laboratory Detection Limit
RPD = Relative Percent Difference
DQO= = Data Quality Objective
▭ Values exceeding the DQO of ≤ 25% RPD.

Figure A.4: Water Sample Field Duplicate Results with Reference to the Data Quality Objective, Mary River CREMP, 2018

Sample ID	Units	LDL	L0-01	L0-01	RPD	BL0-01-S	BL0-01-S	RPD	BL0-03-B	BL0-03-B	RPD
Date Sampled			1-Aug-18	1-Aug-18		8/3/2018	8/3/2018		4/15/2018	4/15/2018	
ALS Sample ID			L2140029-4	L2140029-5		L2141395-5	L2141395-8		L2081994-2	L2081994-3	
Conductivity	umhos/cm	3.00	178	176	1.1	107	110	2.76	78.8	85.4	8.04
Hardness (as $CaCO_3$)	mg/L	10.0	88.0	88.0	0	55.0	55.0	0	37.0	42.0	13
pH	pH units	0.100	8.10	8.12	0.2	8.04	8.02	0.25	7.72	7.75	0.388
Total Suspended Solids	mg/L	2.00	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
Total Dissolved Solids	mg/L	20.0	100	95.0	5.1	48.0	45.0	6.45	39.0	43.0	9.76
Turbidity	NTU	0.100	0.810	0.670	19	0.980	0.980	0	0.300	0.340	13
Anions and Nutrients (Water)											
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	77.0	78.0	1.3	57.0	52.0	9.17	37.0	36.0	2.74
Ammonia, Total (as N)	mg/L	0.0200	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0
Bromide (Br)	mg/L	0.100	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
Chloride (Cl)	mg/L	0.500	4.56	4.53	0.7	1.57	1.67	6.17	1.90	2.06	8.08
Nitrate and Nitrite as N	mg/L	0.0210	0.413	0.411	0.5	<0.021	0.581	186	0.0370	0.0340	8.45
Nitrate (as N)	mg/L	0.0200	0.413	0.411	0.5	<0.020	0.581	187	0.0370	0.0340	8.45
Nitrite (as N)	mg/L	0.00500	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
Total Kjeldahl Nitrogen	mg/L	0.150	<0.15	<0.15	0	<0.15	<0.15	0	<0.15	<0.15	0
Phosphorus, Total	mg/L	0.00300	0.00400	0.00330	19	0.00700	0.00600	15	0.00640	0.00310	69
Sulfate (SO4)	mg/L	0.300	5.36	5.34	0.4	1.01	2.71	91	1.30	1.38	5.97
Organic / Inorganic Carbon (Water)											
Dissolved Organic Carbon	mg/L	0.500	2.75	2.73	0.7	1.99	1.98	0.50	1.30	1.50	14
Total Organic Carbon	mg/L	0.500	3.24	3.26	0.6	2.38	1.97	19	1.60	1.70	6.06
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.0233	0.0238	2.1	0.0314	0.0259	19	0.00460	0.00480	4.26
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.0102	0.0102	0	0.00571	0.00597	4.45	0.00428	0.00468	8.93
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	17.8	17.0	4.6	11.6	11.9	2.55	7.91	8.17	3.23
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.00166	0.00165	0.6	0.0007500	0.0007200	4.08	0.0005700	0.0006200	8.40
Iron (Fe)	mg/L	0.0300	0.0420	0.0430	2.4	<0.030	<0.030	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	0.00160	0.00150	6.5	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	10.9	10.8	0.9	6.12	6.13	0.16	4.58	5.01	8.97
Manganese (Mn)	mg/L	0.000070	0.00360	0.00309	15	0.00122	0.00116	5.04	0.0004830	0.0004980	3.06
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0007380	0.0007020	5.0	0.0001480	0.0001390	6.27	0.0001380	0.0001490	7.67
Nickel (Ni)	mg/L	0.0005000	0.0007100	0.0007200	1.4	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	1.75	1.74	0.6	0.640	0.630	1.57	0.560	0.600	6.90
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.900	0.870	3.4	0.680	0.660	2.99	0.410	0.440	7.06
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	2.66	2.53	5.0	1.09	1.03	5.66	1.11	1.17	5.26
Strontium (Sr)	mg/L	0.0001000	0.0132	0.0128	3.1	0.00789	0.00809	2.50	0.00577	0.00614	6.21
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Uranium (U)	mg/L	0.000010	0.00271	0.00272	0.4	0.0007980	0.0007710	3.44	0.0004670	0.0005040	7.62
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	0.00350	0.00440	23	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Dissolved Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.00650	0.00650	0	0.0102	0.00850	18	<0.0030	0.00310	3.28
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.0100	0.00993	0.7	0.00580	0.00543	6.59	0.00413	0.00468	12
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	17.4	17.2	1.2	11.7	11.8	0.85	7.40	8.33	12
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.00168	0.00165	1.8	0.0006700	0.0006900	2.94	0.0005700	0.0006300	10
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	0.00140	0.00140	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	10.7	11.0	2.8	6.25	6.11	2.27	4.53	5.23	14
Manganese (Mn)	mg/L	0.000070	0.00240	0.00240	0	0.0006680	0.0007240	8.05	0.0002450	0.0003370	32
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0007260	0.0007240	0.3	0.0001320	0.0001480	11	0.0001320	0.0001670	23
Nickel (Ni)	mg/L	0.0005000	0.0007400	0.0007100	4.1	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	1.77	1.76	0.6	0.640	0.640	0	0.550	0.620	12
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.860	0.850	1.2	0.630	0.640	1.57	0.390	0.440	12
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	2.62	2.61	0.4	1.07	1.04	2.84	1.13	1.24	9.28
Strontium (Sr)	mg/L	0.0001000	0.0129	0.0129	0	0.00786	0.00794	1.01	0.00549	0.00627	13
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Uranium (U)	mg/L	0.000010	0.00269	0.00268	0.4	0.0007520	0.0007760	3.14	0.0004210	0.0004970	17
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	0.00130	0.00110	17	0.00160	<0.0010	46	0.00240	<0.0010	82
Plant Pigments (Water)											
Chlorophyll a	µg/L	0.100	0.330	0.340	3.0	0.420	0.470	11	<0.10	0.620	144
Phaeophytin a	µg/L	0.100	0.280	0.310	10	0.270	0.300	11	0.190	0.290	42

Notes: LDL = Laboratory Detection Limit

RPD = Relative Percent Difference

DQO= = Data Quality Objective

▨ Values exceeding the DQO of ≤ 25% RPD.

Figure A.4: Water Sample Field Duplicate Results with Reference to the Data Quality Objective, Mary River CREMP, 2018

Sample ID	Units	LDL	BLO-05-B-S	BLO-05-B-S	RPD	BL0-09-B	BL0-09-B	RPD	BL0-09-S	BLO-09-S	RPD
Date Sampled			8/24/2018	8/24/2018		8/2/2018	8/2/2018		4/16/2018	4/16/2018	
ALS Sample ID			L2153235-4	L2153235-5		L2140864-4	L2140864-5		L2081979-4	L2081979-3	
Conductivity	umhos/cm	3.00	75.6	68.9	9.27	69.7	66.0	5.5	87.7	87.8	0.1
Hardness (as $CaCO_3$)	mg/L	10.0	35.0	36.0	2.82	32.0	32.0	0	43.0	45.0	4.5
pH	pH units	0.100	7.88	7.85	0.381	7.74	7.69	0.6	7.74	7.76	0.3
Total Suspended Solids	mg/L	2.00	<2.0	<2.0	0	2.00	<2.0	0	<2.0	<2.0	0
Total Dissolved Solids	mg/L	20.0	40.0	43.0	7.23	35.0	40.0	13	44.0	51.0	15
Turbidity	NTU	0.100	1.37	1.54	12	3.13	2.94	6.3	0.420	0.590	34
Anions and Nutrients (Water)											
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	32.0	34.0	6.06	27.0	28.0	3.6	37.0	35.0	5.6
Ammonia, Total (as N)	mg/L	0.0200	0.0220	<0.020	9.52	<0.020	<0.020	0	<0.020	<0.020	0
Bromide (Br)	mg/L	0.100	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
Chloride (Cl)	mg/L	0.500	1.65	1.65	0	1.51	1.52	0.7	2.12	2.13	0.5
Nitrate and Nitrite as N	mg/L	0.0210	<0.021	<0.021	0	<0.021	<0.021	0	0.0350	0.0350	0
Nitrate (as N)	mg/L	0.0200	<0.020	<0.020	0	<0.020	<0.020	0	0.0350	0.0350	0
Nitrite (as N)	mg/L	0.00500	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
Total Kjeldahl Nitrogen	mg/L	0.150	<0.15	<0.15	0	<0.15	<0.15	0	0.160	<0.15	6.5
Phosphorus, Total	mg/L	0.00300	0.00610	0.00400	42	0.00630	0.00750	17	0.00360	0.0102	96
Sulfate (SO4)	mg/L	0.300	2.61	2.62	0.382	1.88	1.85	1.6	1.48	1.49	0.7
Organic / Inorganic Carbon (Water)											
Dissolved Organic Carbon	mg/L	0.500	1.43	1.43	0	1.29	1.31	1.5	1.50	1.40	6.9
Total Organic Carbon	mg/L	0.500	1.72	0.530	106	1.54	1.43	7.4	1.60	1.70	6.1
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.0394	0.0370	6.28	0.0388	0.0383	1.3	0.00580	0.00420	32
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.00438	0.00435	0.687	0.00448	0.00430	4.1	0.00473	0.00467	1.3
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	7.12	7.21	1.26	6.93	6.82	1.6	8.56	7.80	9.3
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.0005600	0.0005900	5.22	0.0005500	<0.00050	9.5	0.0007300	0.0007100	2.8
Iron (Fe)	mg/L	0.0300	0.0370	0.0350	5.56	<0.030	<0.030	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.000050	<0.000050	0.000099	66	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	4.36	4.29	1.62	4.04	3.80	6.1	5.45	5.08	7.0
Manganese (Mn)	mg/L	0.000070	0.00271	0.00267	1.49	0.00118	0.00109	7.9	0.0004580	0.0004690	2.4
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0001210	0.0001240	2.45	0.0001170	0.0001140	2.6	0.0001570	0.0001330	17
Nickel (Ni)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	0.550	0.530	3.70	0.570	0.550	3.6	0.650	0.630	3.1
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.490	0.490	0	0.510	0.500	2.0	0.430	0.440	2.3
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	0.847	0.855	0.940	0.860	0.833	3.2	1.27	1.22	4.0
Strontium (Sr)	mg/L	0.0001000	0.00578	0.00601	3.90	0.00601	0.00578	3.9	0.00631	0.00589	6.9
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Uranium (U)	mg/L	0.000010	0.0004480	0.0004440	0.897	0.0002520	0.0001170	73	0.0005170	0.0005230	1.2
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Dissolved Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.0150	0.0144	4.08	0.0187	0.0162	14	0.00330	0.00510	43
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.00415	0.00439	5.62	0.00440	0.00442	0.5	0.00482	0.00478	0.8
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	7.21	7.30	1.24	6.78	6.68	1.5	8.33	8.87	6.3
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.0005300	0.0005400	1.87	0.0005400	0.0005400	0	0.0006200	0.00152	84
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	4.25	4.26	0.235	3.56	3.71	4.1	5.31	5.45	2.6
Manganese (Mn)	mg/L	0.000070	0.0008440	0.0008000	5.35	0.00150	0.00143	4.8	0.0003300	0.000966	98
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0001650	0.0001330	21	0.0001220	0.000098	22	0.0001590	0.0001620	1.9
Nickel (Ni)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	0.520	0.510	1.94	0.510	0.500	2.0	0.640	0.650	1.6
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.440	0.440	0	0.460	0.450	2.2	0.440	0.450	2.2
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	0.849	0.862	1.52	0.786	0.787	0.1	1.25	1.32	5.4
Strontium (Sr)	mg/L	0.0001000	0.00588	0.00601	2.19	0.00581	0.00561	3.5	0.00648	0.00658	1.5
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	0.0005800	141
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Uranium (U)	mg/L	0.000010	0.0004550	0.0004460	2.00	0.0003930	0.0003930	0	0.0005270	0.0005480	3.9
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	0.00110	<0.0010	9.52	0.00120	<0.0010	18	<0.0010	<0.0010	0
Plant Pigments (Water)											
Chlorophyll a	µg/L	0.100	0.930	0.980	5.24	0.790	0.800	1.26	0.440	0.430	2.3
Phaeophytin a	µg/L	0.100	1.010	1.000	0.995	0.630	0.660	4.651	<0.10	0.120	18

Notes: LDL = Laboratory Detection Limit

RPD = Relative Percent Difference

DQO= = Data Quality Objective

▨ Values exceeding the DQO of ≤ 25% RPD.

Figure A.4: Water Sample Field Duplicate Results with Reference to the Data Quality Objective, Mary River CREMP, 2018

Sample ID	Units	LDL	DD-HAB9-STN-1-S	DD-HAB9-STN-1-S	RPD	DL0-02-3-B	DL0-02-3-B	RPD	DLO-02-7-B	DLO-02-7-B	RPD
Date Sampled			7/30/2018	7/30/2018		7/31/2018	7/31/2018		8/23/2018	8/23/2018	
ALS Sample ID			L2139231-10	L2139231-11		L2139231-22	L2139231-23		L2152558-2	L2152558-3	
Conductivity	umhos/cm	3.00	129	129	0	99.1	99.2	0.1	120	120	0
Hardness (as $CaCO_3$)	mg/L	10.0	62.0	62.0	0	48.0	50.0	4.1	57.0	58.0	1.7
pH	pH units	0.100	8.10	8.08	0.2	7.89	7.86	0.4	7.94	7.95	0.1
Total Suspended Solids	mg/L	2.00	<2.0	<2.0	0	2.80	<2.0	33	<2.0	<2.0	0
Total Dissolved Solids	mg/L	20.0	60.0	55.0	8.7	62.0	50.0	21	60.0	50.0	18
Turbidity	NTU	0.100	1.22	0.920	28	3.20	2.58	21	2.29	2.18	4.9
Anions and Nutrients (Water)											
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	46.0	53.0	14	40.0	43.0	7.2	45.0	46.0	2.2
Ammonia, Total (as N)	mg/L	0.0200	0.0390	0.0320	20	<0.020	<0.020	0	0.0240	0.0690	97
Bromide (Br)	mg/L	0.100	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
Chloride (Cl)	mg/L	0.500	3.45	3.44	0.3	2.48	2.57	3.6	2.79	2.81	0.7
Nitrate and Nitrite as N	mg/L	0.0210	0.0460	0.0460	0	<0.021	<0.021	0	0.0430	0.0420	2.4
Nitrate (as N)	mg/L	0.0200	0.0460	0.0460	0	<0.020	<0.020	0	0.0430	0.0420	2.4
Nitrite (as N)	mg/L	0.00500	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
Total Kjeldahl Nitrogen	mg/L	0.150	<0.15	<0.15	0	<0.15	<0.15	0	<0.15	<0.15	0
Phosphorus, Total	mg/L	0.00300	0.00400	0.00320	22	0.00740	0.00640	14	0.00370	0.00330	11
Sulfate (SO4)	mg/L	0.300	6.55	6.58	0.5	4.05	4.05	0	5.68	5.71	0.5
Organic / Inorganic Carbon (Water)											
Dissolved Organic Carbon	mg/L	0.500	1.82	1.71	6.2	1.55	1.58	1.9	1.65	1.68	1.8
Total Organic Carbon	mg/L	0.500	2.02	1.90	6.1	1.83	1.88	2.7	2.56	2.46	4.0
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.0126	0.00370	109	0.0589	0.0600	1.9	0.0503	0.0654	26
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.00667	0.00686	2.8	0.00571	0.00583	2.1	0.00640	0.00647	1.1
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	12.8	12.5	2.4	9.91	9.69	2.2	11.3	11.4	0.9
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.0007800	0.0006200	23	0.0006600	0.0007100	7.3	0.0008400	0.0008200	2.4
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	0	0.0770	0.0770	0	0.0520	0.0640	21
Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	0	0.000076	0.000092	19	0.000067	0.000076	13
Lithium (Li)	mg/L	0.00100	0.00110	0.00110	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	7.45	7.89	5.7	5.55	5.75	3.5	6.97	7.12	2.1
Manganese (Mn)	mg/L	0.000070	0.00281	0.0007100	119	0.00426	0.00449	5.3	0.00550	0.00545	0.9
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0008630	0.0008590	0.5	0.0003720	0.0004130	10	0.0004650	0.0005070	8.6
Nickel (Ni)	mg/L	0.0005000	0.0005700	0.0005600	1.8	0.0005000	0.0005400	7.7	0.0006200	0.0006200	0
Potassium (K)	mg/L	0.200	1.14	1.29	12	0.840	0.880	4.7	1.04	1.04	0
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.420	0.430	2.4	0.450	0.460	2.2	0.550	0.580	5.3
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	1.43	1.53	6.8	0.992	1.03	3.8	1.27	1.26	0.8
Strontium (Sr)	mg/L	0.0001000	0.00876	0.00869	0.8	0.00749	0.00735	1.9	0.00811	0.00817	0.7
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Uranium (U)	mg/L	0.000010	0.0009370	0.0006900	30	0.0006030	0.0006500	7.5	0.0006960	0.0006880	1.2
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Dissolved Metals (Water)											
Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	0	0.0107	0.0104	2.8	0.00500	0.0141	95
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.00663	0.00649	2.1	0.00547	0.00530	3.2	0.00605	0.00620	2.4
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	11.5	12.0	4.3	9.22	9.54	3.4	11.4	11.4	0
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.0007900	0.0007500	5.2	0.0006000	0.0006200	3.3	0.0007100	0.0007400	4.1
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	8.08	7.81	3.4	5.96	6.24	4.6	7.01	7.08	1.0
Manganese (Mn)	mg/L	0.000070	0.0004110	0.0003480	17	0.0005610	0.0005560	0.9	0.0006330	0.0006870	8.2
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0007180	0.0007150	0.4	0.0003880	0.0004120	6.0	0.0004790	0.0004580	4.5
Nickel (Ni)	mg/L	0.0005000	0.0005700	0.0005700	0	<0.00050	<0.00050	0	0.0005200	0.0005400	3.8
Potassium (K)	mg/L	0.200	1.21	1.21	0	0.890	0.880	1.1	1.02	1.03	1.0
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.410	0.410	0	0.390	0.390	0	0.480	0.500	4.1
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	1.49	1.48	0.7	1.07	1.06	0.9	1.26	1.27	0.8
Strontium (Sr)	mg/L	0.0001000	0.00762	0.00801	5.0	0.00654	0.00676	3.3	0.00824	0.00813	1.3
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Uranium (U)	mg/L	0.000010	0.0008530	0.0008890	4.1	0.0005560	0.0005600	0.7	0.0007330	0.0007330	0
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	0.00840	0.00200	123	0.00480	0.00280	53	<0.0010	0.00180	57
Plant Pigments (Water)											
Chlorophyll a	µg/L	0.100	1.60	1.62	1.2	2.16	2.20	1.8	2.01	2.03	1.0
Phaeophytin a	µg/L	0.100	0.870	0.810	7.1	0.900	0.820	9.3	0.800	0.790	1.3

Notes: LDL = Laboratory Detection Limit
RPD = Relative Percent Difference
DQO= = Data Quality Objective
▨ Values exceeding the DQO of ≤ 25% RPD.

Figure A.4: Water Sample Field Duplicate Results with Reference to the Data Quality Objective, Mary River CREMP, 2018

Sample ID	Units	LDL	DL0-02-07	DL0-02-07	RPD	JL0-02-B	JL0-02-B	RPD	JLO-09-B	JLO-09-B	RPD
Date Sampled			4/17/2018	4/17/2018		8/21/2018	8/21/2018		4/14/2018	4/14/2018	
ALS Sample ID			L2082600-5	L2082600-4		L2151700-2	L2151700-3		L2081999-9	L2081999-10	
Conductivity	umhos/cm	3.00	157	159	1.3	137	137	0	158	156	1.27
Hardness (as $CaCO_3$)	mg/L	10.0	74.0	75.0	1.3	71.0	72.0	1.4	85.0	85.0	0
pH	pH units	0.100	7.87	7.88	0.1	8.03	8.08	0.6	8.00	8.01	0.125
Total Suspended Solids	mg/L	2.00	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
Total Dissolved Solids	mg/L	20.0	90.0	85.0	5.7	55.0	60.0	8.7	79.0	76.0	3.87
Turbidity	NTU	0.100	0.650	0.530	20	0.650	0.500	26	0.590	0.360	48
Anions and Nutrients (Water)											
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	69.0	71.0	2.9	61.0	61.0	0	69.0	68.0	1.46
Ammonia, Total (as N)	mg/L	0.0200	<0.020	0.0250	22	<0.020	<0.020	0	<0.020	<0.020	0
Bromide (Br)	mg/L	0.100	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
Chloride (Cl)	mg/L	0.500	3.48	3.51	0.9	3.85	3.82	0.8	4.38	4.37	0.229
Nitrate and Nitrite as N	mg/L	0.0210	0.0600	0.0590	1.7	0.0300	0.0260	14	<0.021	<0.021	0
Nitrate (as N)	mg/L	0.0200	0.0600	0.0590	1.7	0.0300	0.0260	14	<0.020	<0.020	0
Nitrite (as N)	mg/L	0.00500	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
Total Kjeldahl Nitrogen	mg/L	0.150	<0.15	<0.15	0	<0.15	<0.15	0	0.150	0.210	33
Phosphorus, Total	mg/L	0.00300	0.00710	0.00670	5.8	0.00330	0.00380	14	<0.0030	0.0251	157
Sulfate (SO4)	mg/L	0.300	4.63	4.67	0.9	3.90	3.89	0.3	3.65	3.64	0.274
Organic / Inorganic Carbon (Water)											
Dissolved Organic Carbon	mg/L	0.500	2.50	1.80	33	2.49	2.39	4.1	1.90	1.80	5.41
Total Organic Carbon	mg/L	0.500	2.00	2.00	0	2.77	2.82	1.8	2.10	2.30	9.09
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.00390	0.00370	5.3	0.0140	0.0127	9.7	<0.0030	<0.0030	0
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.00891	0.00871	2.3	0.00667	0.00654	2.0	0.00778	0.00771	0.904
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	15.0	14.9	0.7	13.9	13.9	0	15.0	15.1	0.664
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.0008600	0.0008700	1.2	0.0009500	0.0008900	6.5	0.00105	0.00118	12
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	0	0.00110	<0.0010	9.5	<0.0010	0.00110	9.52
Magnesium (Mg)	mg/L	0.0500	8.79	9.21	4.7	8.38	8.04	4.1	8.90	8.86	0.450
Manganese (Mn)	mg/L	0.000070	0.00168	0.00175	4.1	0.00187	0.00179	4.4	0.0004810	0.0004190	14
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.0000050	67	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0006450	0.0006410	0.6	0.0002800	0.0002990	6.6	0.0003430	0.0003320	3.26
Nickel (Ni)	mg/L	0.0005000	0.0006800	0.0006600	3.0	0.0006200	0.0005900	5.0	0.0006300	0.0006500	3.12
Potassium (K)	mg/L	0.200	1.36	1.37	0.7	1.24	1.21	2.4	1.28	1.28	0
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.610	0.600	1.7	0.330	0.320	3.1	0.330	0.330	0
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	1.56	1.53	1.9	1.70	1.62	4.8	1.64	1.61	1.85
Strontium (Sr)	mg/L	0.0001000	0.0104	0.0101	2.9	0.0105	0.0105	0	0.0112	0.0115	2.64
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Uranium (U)	mg/L	0.000010	0.0008460	0.0008410	0.6	0.0009400	0.0009020	4.1	0.0008790	0.0008750	0.456
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Dissolved Metals (Water)											
Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	0.00320	6.5	<0.0030	<0.0030	0
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.00791	0.00824	4.1	0.00692	0.00708	2.3	0.00715	0.00704	1.55
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	15.1	15.1	0	14.3	14.4	0.7	17.1	17.0	0.587
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.0008200	0.0008300	1.2	0.0008900	0.000950	6.5	0.0009000	0.0008800	2.25
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	0	0.00110	0.00100	9.5	0.00140	0.00150	6.90
Magnesium (Mg)	mg/L	0.0500	8.77	9.07	3.4	8.56	8.80	2.8	10.2	10.3	0.976
Manganese (Mn)	mg/L	0.000070	0.0009110	0.0008910	2.2	0.0002430	0.0002710	11	0.0001320	0.0001270	3.86
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0006460	0.0006560	1.5	0.0003370	0.0003610	6.9	0.0003700	0.0003780	2.14
Nickel (Ni)	mg/L	0.0005000	0.0006600	0.0006600	0	0.0006000	0.0006500	8.0	0.0007600	0.0006300	19
Potassium (K)	mg/L	0.200	1.37	1.37	0	1.27	1.29	1.6	1.26	1.27	0.791
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.610	0.610	0	0.330	0.340	3.0	0.350	0.340	2.90
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	1.59	1.54	3.2	1.74	1.75	0.6	1.86	1.82	2.17
Strontium (Sr)	mg/L	0.0001000	0.0102	0.0103	1.0	0.0109	0.0108	0.9	0.0115	0.0115	0
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Uranium (U)	mg/L	0.000010	0.0008970	0.0008680	3.3	0.00102	0.00103	1.0	0.0008480	0.0008270	2.51
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	0.00120	0.00420	111
Plant Pigments (Water)											
Chlorophyll a	µg/L	0.100	1.65	2.07	23	2.02	2.41	18	0.160	0.170	6.06
Phaeophytin a	µg/L	0.100	0.890	0.760	16	0.940	0.990	5.2	0.200	0.190	5.128

Notes: LDL = Laboratory Detection Limit

RPD = Relative Percent Difference

DQO= = Data Quality Objective

▨ Values exceeding the DQO of ≤ 25% RPD.

Figure A.4: Water Sample Field Duplicate Results with Reference to the Data Quality Objective, Mary River CREMP, 2018

Sample ID	Units	LDL	JL0-10-S	JL0-10-S	RPD	REF3-01-B	REF3-01-B	RPD	REF3-03-S	REF3-03-S	RPD
Date Sampled			7/29/2018	7/29/2018		8/12/2018	8/12/2018		8/12/2018	8/12/2018	
ALS Sample ID			L2137924-5	L2137924-6		L2145787-6	L2145787-8		L2145787-5	L2145787-4	
Conductivity	umhos/cm	3.00	136	136	0	70.2	70.3	0.142	70.9	70.6	0.424
Hardness (as $CaCO_3$)	mg/L	10.0	66.0	67.0	1.50	36.0	36.0	0	37.0	37.0	0
pH	pH units	0.100	8.09	8.11	0.247	7.82	7.85	0.383	7.93	7.92	0.126
Total Suspended Solids	mg/L	2.00	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
Total Dissolved Solids	mg/L	20.0	60.0	75.0	22	30.0	33.0	9.52	40.0	45.0	12
Turbidity	NTU	0.100	1.00	0.880	13	0.240	0.320	29	0.230	0.270	16
Anions and Nutrients (Water)											
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	56.0	57.0	1.77	32.0	25.0	25	36.0	35.0	2.82
Ammonia, Total (as N)	mg/L	0.0200	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	0.0240	18
Bromide (Br)	mg/L	0.100	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
Chloride (Cl)	mg/L	0.500	3.90	3.77	3.39	1.28	1.29	0.778	1.28	1.29	0.778
Nitrate and Nitrite as N	mg/L	0.0210	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0
Nitrate (as N)	mg/L	0.0200	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0
Nitrite (as N)	mg/L	0.00500	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
Total Kjeldahl Nitrogen	mg/L	0.150	<0.15	<0.15	0	0.150	<0.15	0	<0.15	<0.15	0
Phosphorus, Total	mg/L	0.00300	0.00470	0.00450	4.35	0.00420	0.00570	30	0.00710	0.00660	7.30
Sulfate (SO4)	mg/L	0.300	3.90	3.86	1.03	3.79	3.79	0	3.79	3.85	1.57
Organic / Inorganic Carbon (Water)											
Dissolved Organic Carbon	mg/L	0.500	1.76	1.77	0.567	3.21	3.19	0.625	3.23	3.27	1.23
Total Organic Carbon	mg/L	0.500	2.53	2.39	5.69	3.40	3.35	1.48	3.52	3.98	12
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.0123	0.0171	33	<0.0030	<0.0030	0	0.00440	0.00350	23
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.00674	0.00698	3.50	0.00696	0.00667	4.26	0.00657	0.00640	2.62
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	13.4	13.5	0.743	7.09	7.10	0.141	7.21	7.17	0.556
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.00113	0.00131	15	0.0007000	0.0006500	7.41	0.0008700	0.0008900	2.27
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	0.00120	0.00130	8.00	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	8.62	8.49	1.52	4.66	4.58	1.73	4.48	4.45	0.672
Manganese (Mn)	mg/L	0.000070	0.00241	0.00268	11	0.0001320	0.0007590	141	0.0006120	0.0006350	3.69
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0002920	0.0003030	3.70	0.0001420	0.0001270	11	0.0001390	0.0001250	11
Nickel (Ni)	mg/L	0.0005000	0.0006000	0.0006000	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	1.20	1.21	0.830	1.01	0.980	3.02	0.920	0.940	2.15
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.340	0.330	2.99	0.440	0.430	2.30	0.440	0.440	0
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	1.54	1.62	5.06	0.933	0.918	1.62	0.871	0.880	1.03
Strontium (Sr)	mg/L	0.0001000	0.0100	0.0101	0.995	0.00810	0.00801	1.12	0.00820	0.00812	0.980
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Uranium (U)	mg/L	0.000010	0.0007790	0.0007930	1.78	0.0002170	0.0001860	15	0.0002490	0.0002420	2.85
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Dissolved Metals (Water)											
Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	0.00310	3.28	<0.0030	<0.0030	0
Antimony (Sb)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.000050	0.00657	0.00667	1.51	0.00669	0.00696	3.96	0.00674	0.00704	4.35
Beryllium (Be)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	13.2	13.3	0.755	6.98	7.00	0.286	7.02	7.18	2.25
Chromium (Cr)	mg/L	0.0005000	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.0005000	0.0008300	0.000970	16	0.0007800	0.0007800	0	0.0007800	0.0008100	3.77
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	0.00110	0.00110	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	8.02	8.32	3.67	4.55	4.52	0.662	4.65	4.60	1.08
Manganese (Mn)	mg/L	0.000070	0.0005420	0.0005730	5.56	0.0001080	0.0001760	48	0.0001780	0.0002680	40
Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.000050	0.0003150	0.0002890	8.61	0.0001250	0.0001130	10	0.0001260	0.0001230	2.41
Nickel (Ni)	mg/L	0.0005000	0.0005700	0.0005600	1.77	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	1.16	1.19	2.55	0.930	0.940	1.07	0.940	0.950	1.06
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.300	0.300	0	0.420	0.430	2.35	0.420	0.420	0
Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	1.55	1.59	2.55	0.880	0.895	1.69	0.895	0.892	0.336
Strontium (Sr)	mg/L	0.0001000	0.00991	0.0100	0.904	0.00759	0.00765	0.787	0.00777	0.00795	2.29
Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.0001000	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
Uranium (U)	mg/L	0.000010	0.0008090	0.0007840	3.14	0.0002360	0.0002250	4.77	0.0002440	0.0002450	0.409
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	0.00190	0.00180	5.41	<0.0010	<0.0010	0	0.00110	0.00390	112
Plant Pigments (Water)											
Chlorophyll a	µg/L	0.100	2.05	1.99	2.97	0.740	0.800	7.79	0.620	0.640	3.17
Phaeophytin a	µg/L	0.100	0.950	0.890	6.522	0.500	0.520	3.922	0.530	0.520	1.905

Notes: LDL = Laboratory Detection Limit
RPD = Relative Percent Difference
DQO= = Data Quality Objective
▨ Values exceeding the DQO of ≤ 25% RPD.

Table A.5: **Sediment Sample Field Duplicate Comparisons Indicating, in Highlight, Values Mot Meeting the DQO of ≤ 40% Relative Percent Difference (RPD)**

Parameter	Lowest Detection Limit	Units	REF-03-10	REF-03-DUP	% RPD	JLO-01	JLO-DUP	% RPD	DLO-01-02	DLO-01-DUP	% RPD	BLO-04	BLO-DUP	% RPD
			24-Aug-2018	24-Aug-2018		19-Aug-2018	19-Aug-2018		17-Aug-2018	17-Aug-2018		20-Aug-2018	20-Aug-2018	
Total Organic Carbon	0.10	%	4.20	4.39	4	1.28	1.41	10	1.23	1.29	4	0.67	0.64	5
Aluminum (Al)	50	µg/g	21,900	22,450	2	16,400	17,100	4	19,000	19,600	3	18,400	18,800	2
Antimony (Sb)	0.10	µg/g	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
Arsenic (As)	0.10	µg/g	4.56	4.69	3	4.6	4.8	5	3.95	4.25	7	2.47	2.50	1
Barium (Ba)	0.50	µg/g	137	140	2	72.0	75	5	127.0	139.0	9	78.3	79.5	1
Beryllium (Be)	0.10	µg/g	0.86	0.87	1	0.89	0.93	4	0.91	0.94	3	0.85	0.87	2
Bismuth (Bi)	0.20	µg/g	<0.20	<0.20	0	0.24	0.26	6	0.21	0.22	2	<0.20	<0.20	0
Boron (B)	5.0	µg/g	17.1	17.8	4	21.7	22.1	2	24.6	26.2	6	23.8	25.2	6
Cadmium (Cd)	0.020	µg/g	0.165	0.161	3	0.141	0.155	9	0.247	0.261	6	0.108	0.114	5
Calcium (Ca)	50	µg/g	5,470	5,555	2	3,820	4,005	5	4,880	4,950	1	4,130	4,165	1
Chromium (Cr)	0.50	µg/g	70.6	72.2	2	69.4	73.0	5	77.4	78.9	2	70.0	71.2	2
Cobalt (Co)	0.10	µg/g	16.0	16.2	1	17.7	18.3	3	15.9	16.6	4	13.0	13.2	1
Copper (Cu)	0.50	µg/g	88.7	89.5	1	44.1	45.5	3	41.0	42.4	3	25.3	25.7	2
Iron (Fe)	50	µg/g	46,600	47,100	1	31,900	33,200	4	39,300	41,950	7	32,300	33,000	2
Lead (Pb)	0.50	µg/g	16.9	17.3	2	19.4	20.1	3	19.2	19.6	2	16.7	16.9	1
Lithium (Li)	2.0	µg/g	34.5	35.4	2	29.8	30.9	4	32.4	33.3	3	32.9	33.8	3
Magnesium (Mg)	20	µg/g	14,700	14,900	1	12,700	13,350	5	13,300	13,550	2	12,900	13,200	2
Manganese (Mn)	1.0	µg/g	1,130	1,130	0	928	984	6	10,200	9,805	4	603	559	8
Mercury (Hg)	0.0050	µg/g	0.0562	0.0599	6	0.0302	0.0326	7	0.0319	0.0342	7	0.0362	0.0347	4
Molybdenum (Mo)	0.10	µg/g	2.37	2.41	1	0.73	0.78	6	7.53	8.67	14	0.63	0.62	2
Nickel (Ni)	0.50	µg/g	48.5	49.3	2	62.2	66	6	67.3	69.3	3	47.2	47.7	1
Phosphorus (P)	50	µg/g	1,020	1,060	4	944	972	3	873	934	7	746	759	2
Potassium (K)	100	µg/g	5,640	5,750	2	4,490	4,630	3	4,890	5,105	4	4,890	4,995	2
Selenium (Se)	0.20	µg/g	0.66	0.71	7	0.23	0.27	14	0.28	0.34	19	<0.20	<0.20	0
Silver (Ag)	0.10	µg/g	0.21	0.22	5	0.11	0.12	4	0.14	0.14	0	0.12	0.12	0
Sodium (Na)	50	µg/g	415	431	4	188	198	5	276	287	4	319	332	4
Strontium (Sr)	0.50	µg/g	12.6	13.1	4	11.1	11.2	1	10.8	11.1	3	11.4	11.7	2
Sulfur (S)	5000	µg/g	1,000	1,050	0	<1,000	<1,000	0	<1,000	<1,000	0	<1,000	<1,000	0
Thallium (Tl)	0.050	µg/g	0.665	0.676	2	0.462	0.490	6	0.553	0.581	5	0.406	0.412	1
Tin (Sn)	2.0	µg/g	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
Titanium (Ti)	1.0	µg/g	1,220	1,265	4	829	868	5	1,170	1,220	4	1,390	1,405	1
Uranium (U)	0.050	µg/g	24.3	24.1	1	4.51	4.77	5	6.30	6.50	3	6.49	6.50	0
Vanadium (V)	0.20	µg/g	65.9	67.2	2	59.5	61.8	4	56.9	59.0	4	54.4	55.0	1
Zinc (Zn)	2.0	µg/g	90.6	92.1	2	54.3	56.4	4	65.9	67.6	3	60.7	61.4	1
Zirconium (Zr)	1.0	µg/g	3.2	3.2	2	4.9	5.0	2	7.0	6.8	4	19.8	20.1	1

fraction for these samples ranging between 12.5% (1/8) an 50% (1/2) of the sample material (average of 42%; Appendix Table A.8). Sub-sampling error estimates indicated that, on average, precision and accuracy of the sub-sampled benthic invertebrate community samples met the DQO of ≤ 20% (Appendix Table A.6). Only two of the six sub-sample comparisons resulted in precision or accuracy outside of the DQO for the halved or quartered sample (Appendix Table A.6), but on average for this sample, and all others, precision and accuracy achieved the DQO of ≤ 20%. Overall, this indicated that precision and accuracy for sub-sampling of the benthic invertebrate community samples was acceptable.

A2.3.2 Organism Recovery

Sorting efficiency (i.e., percent recovery) of benthic invertebrate samples was high, averaging 95% for eight lotic samples evaluated and 97% for the five lentic samples evaluated (Appendix Table A.7a,b). Sorting efficiency for these samples achieved the DQO of ≥ 90% recovery, and therefore the benthic invertebrate community sample recovery was considered acceptable.

Table A.6: Subsampling Error for Benthic Invertebrate Community Samples, 2018 CREMP

a) Lotic (creek and river) samples

Station	Whole Organisms	No. of Organisms in Fraction 1	No. of Organisms in Fraction 2	No. of Organisms in Fraction 3	No. of Organisms in Fraction 4	Actual Density*	Precision		Accuracy	
							% range		min	max
CLT1-US-B2	-	97	115	-	-	212	15.7	-	8.5	-
CLT1-DS-B4	-	155	182	-	-	337	14.8	-	8.0	-
SDLT9-B1	-	67	77	89	90	323	1.1	25.6	4.6	17.0
CO-05-B2	-	91	120	-	-	211	24.2	-	13.7	-

b) Lentic (lake) samples

Station	Whole Organisms	Number of Organisms in Fraction 1	Number of Organisms in Fraction 2	Number of Organisms in Fraction 3	Number of Organisms in Fraction 4	Actual Density*	Precision		Accuracy	
							% range		min	max
DLO-02-13	-	89	89	-	-	178	0.0	-	0.0	-
DL0-01-04	-	235	246	-	-	481	4.5	-	2.3	-

* whole large organisms excluded in calculations.
min = minimum absolute % error.   max = maximum absolute % error.

Table A.7: Percent Recovery from Benthic Invertebrate Samples, Mary River Project CREMP, 2018

(a) Lotic (creek and river) samples

Station	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
CLT2-DS-B1	126	132	95.5%
CLT2-US-B2	32	33	97.0%
REF-CRK-B2	143	151	94.7%
SDLT1-B3	153	157	97.5%
SDLT9-B2	147	162	90.7%
CO-05-B3	136	147	92.5%
EO-01-B5	113	115	98.3%
GO-09-B4	96	100	96.0%
		Average % Recovery	**95.3%**

b) Lentic (lake) samples

Station	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
REF-03-09	52	53	98.1%
BLO-05	137	143	95.8%
DLO-01-14	120	121	99.2%
DLO-02-04	292	309	94.5%
JLO-02	187	194	96.4%
		Average % Recovery	**96.8%**

Table A.8: Proportion of Benthic Invertebrates Samples Sorted for the 2018 CREMP

(a) Lotic (creek and river) samples

b) Lentic (lake) samples

Station	Fraction Sorted (500 um)	Station	Fraction Sorted (500 um)	Station	Fraction Sorted (500 um)	Station	Fraction Sorted (500 um)	Station	Fraction Sorted (500 um)
CLT1-US-B2	1/2	SDLT1-B2	1/8	SDLT9-B5	1/4	BLO-05	1/ 2	JLO-02	1/ 2
CLT1-US-B3	1/2	SDLT1-B3	1/2	SDLT12-B1	1/8	DLO-01-03	1/ 4	JLO-16	1/ 2
CLT1-US-B4	1/2	SDLT1-B4	1/2	SDLT12-B3	1/2	DLO-01-04	1/ 2	JLO-18	1/ 2
CLT1-DS-B5	1/2	SDLT9-B1	1/2	-	-	DLO-01-09	1/ 2	-	-
CO-05-B1	1/2	SDLT9-B2	1/2	-	-	DLO-02-03	1/ 4	-	-
CO-05-B4	1/2	SDLT9-B4	1/4	-	-	DLO-02-10	1/ 4	-	-

Notes: Any samples not listed were sorted in their entirety (total of 68 lotic samples and 50 lenthc samples for the program)

QA/QC Notes: Pupae were not counted toward total number of taxa unless they were the sole representative of their taxa group. Immatures were not counted toward total number of taxa unless they were the sole representative of their taxa group.

A3 DATA QUALITY STATEMENT

The DQR results generally indicated that water, sediment, and benthic invertebrate community data were of acceptable quality. Few water quality and sediment quality parameters did not meet acceptable DQO. In general, most parameters that did not meet respective DQO typically showed very low margins of error relative to respective criteria and/or were observed at low concentrations often near RDL which led to relatively small incremental differences in concentrations between replicates resulting in failure to meet DQO. However, key exceptions to this occurred for total and/or dissolved barium concentrations and turbidity in water, which routinely did not meet DQO in trip, field, and equipment blank analyses suggesting that the results for these parameters should be interpreted with caution. Although it was unclear as to the source of these parameters in the various blank samples, because the parameters that did not meet DQO in trip, field, and equipment blanks were consistent, the water bottles/water bottle caps themselves were most likely sources of contamination in the blank samples. Notably, the deionized water used to create blanks was suggested as the most likely source of blank contamination in previous CREMP (KP 2015). The field duplicate samples for sediment indicated very high precision that consistently met DQO. The benthic invertebrate community data quality was also acceptable, meeting most precision, accuracy, and percent recovery benchmarks. Overall, the data associated with the 2018 CREMP were considered defensible and acceptable for interpretation and derivation of conclusions with a good level of confidence.

APPENDIX B

REFERENCE AREA DESCRIPTIVE OVERVIEW

APPENDIX B OVERVIEW OF REFERENCE CONDITIONS

LIST OF FIGURES

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B1 INTRODUCTION

The initial review of background (reference) data collected from lotic (i.e., creeks and rivers) and lentic (i.e., lakes) study areas as part of the 2015 Mary River Project CREMP revealed naturally elevated metal concentrations above guidelines and significant differences in benthic community endpoints between reference lake littoral and profundal stations (Minnow 2016a). Therefore, this overview of reference conditions is included to provide context and perspective regarding water quality, sediment quality, phytoplankton (chlorophyll-a), benthic invertebrate community, and fish population characteristics at the CREMP reference study areas. Key implications of reference area features towards the evaluation of potential mine-related effects at mine-exposed waterbodies as part of the CREMP were also identified as part of this reference area overview.

B2 HABITAT

B2.1 Creek/Tributary Environments

Four reference creek/tributary (reference creek) stations were established among two unnamed tributaries to Angajurjualuk Lake (Stations CLT-REF4, MRY-REF2 and MRY-REF3) and one unnamed tributary to the Mary River (Station CLT-REF3) during the Mary River Project CREMP in 2014 (see Figure 2.2). These stations were intended to provide reference information for the creek water quality and phytoplankton monitoring components of the CREMP, and have been used as such in the four studies conducted since commercial mine operations commenced at the Mary River Project (i.e., 2015 to 2018; see Table 2.1). From 2016 to 2018, habitat conditions at the western tributary to Angajurjualuk Lake that is used for Baffinland CREMP water quality monitoring (Stations CLT-REF4 and MRY-REF) were deemed comparable to habitat conditions at the Camp Lake and Sheardown Lake tributaries. Therefore, this tributary served as a benthic reference creek (REF-CRK) for comparisons involving the various mine-exposed tributaries as part of the 2016 to 2018 annual CREMP studies (see Figure 2.4), and herein has been referred to as Unnamed Reference Creek.

The reference creeks/tributaries are moderate gradient lotic systems characterized predominantly by riffle-run and riffle-rapid stream morphology, with pools occurring rarely based on localized topography and associated gradient. The wetted width and depth of the benthic reference tributary averaged 11.1 m and 0.09 m, respectively, during sampling conducted in August 2017 (Minnow 2018a). The corresponding water velocities across a representative riffle area of the benthic reference tributary ranged from 0.02 to 0.52 m/s in August 2017 (average of 0.28 m/s). As for most small lotic systems in the region, surface flow at all of the CREMP reference tributaries is limited to months in which average ambient air temperatures are near or above freezing (i.e., June to September). The substrate at the reference tributaries is composed mainly of cobble and large pebble (i.e., 50 to 256 mm diameter), with surficial areas of sand generally limited to less than 10% of stream area (Minnow 2018a). In-stream vegetation at the reference tributaries is sparse, and generally includes a relatively thin layer of surficial algae/periphyton attached to relatively stable substrate.

B2.2 River Environments

The area of Mary River located upstream of the mine lease property is only minimally influenced by Mary River Project mining activity (i.e., low amounts of dust deposition; see Baffinland 2015). Therefore, this area has been considered representative of background (reference) conditions for the mine-exposed stations/study areas situated farther downstream on the Mary River under the CREMP (Baffinland 2015; KP 2014a,b, 2015; NSC 2014). Water quality, phytoplankton productivity, and benthic invertebrate community (benthic) data collected at the Mary River reference area, referred to as GO-09 (including water quality stations GO-09A, GO-09 and GO-09B), has been used to compare against areas of the Mary River that are potentially influenced by mine activity. Although area GO-03 can also currently serve as a reference area, potential advancement of the Mary River Project to include the Deposit 2 ore body would result in this area becoming a near-field mine-exposed area in the future.

The Mary River reference area is a moderate gradient erosional environment characterized mainly by riffle and run stream morphology. Depending on flow conditions, average wetted width and average depth of the Mary River reference area has ranged from 30 to 55 m and 0.20 to 0.36 m, respectively, in studies conducted by Minnow (2017, 2018a) during the month of August. On average, the corresponding water velocities across representative riffle areas of the GO-09 benthic study area have ranged from 0.20 to 0.47 m/s during these studies. The substrate at the GO-09 reference area is composed mainly of boulder and cobble, with roughly equal proportion of pebble, gravel, and sand composing the surficial substrate at much of the remaining area (Minnow 2018a). In-stream vegetation at the Mary River GO-09 reference area is sparse, and generally includes a relatively thin layer of periphyton and/or scarce bryophytes (moss) growth on the upper surface of physically stable substrate.

B2.3 Lake Environments

A geographically expansive reconnaissance survey of local study area (LSA) lakes was conducted in 2014 to identify a waterbody that could potentially serve as a suitable reference area for the mine-exposed lakes (i.e., Camp, Sheardown NW, Sheardown SE, and Mary lakes; NSC 2015b). The key criteria for the selection of the suitable reference lake included a waterbody with similar surface area, maximum water depth, substrate features, and fish species composition as the mine-exposed lakes, in addition to also being uninfluenced by current or past mining activity. Based on the results of this survey, Reference Lake 3 was selected to represent reference conditions for the mine-exposed lakes beginning in 2015 as part of the Mary River Project CREMP studies (Appendix Table B.1).

Reference Lake 3 is an unnamed lake located approximately 62 km south of the Mary Lake Project (see Figures 2.1 and 2.3), well outside the area of mine influence. Reference Lake 3 is a headwater lake that is characterized by a relatively complex morphology that includes three basins and connection to a separate lake by a short, shallow channel (see Figure 2.3). The three basins reach approximately 15 m, 30 m and 36 m in depth with progression from east to west, and the average depth of Reference Lake 3 is approximately 11.8 m (Appendix

Table B.1). The outlet of Reference Lake 3, located off the south-central portion of the lake, drains into a large boulder field through which flow can occur largely as sub-surface drainage. Substrate along the shoreline and shallow littoral areas of Reference Lake 3 is composed mainly of large boulder and cobble that is commonly interrupted by areas of bedrock. Substrate of the deeper littoral and profundal areas of Reference Lake 3 is almost exclusively represented by silt loam containing approximately 15 to 35% fine sand (by dry weight) and a moderate organic carbon content of approximately 5%. No substantial aquatic plant beds have been observed at Reference Lake 3, with fish cover provided predominantly by the rocky substrates along the shoreline and shallow littoral zone of the lake.

Table B.1: Physical Characteristics for Mine-Exposed Lakes and Reference Lake 3

Lake Feature	**Mine-Exposed Lakes**				**Reference Lake**
	Camp	Sheardown NW	Sheardown SE	Mary	Reference Lake 3
Drainage Basin Area (km^2)	26.5	6.6	8.9	663.4	23.2
Lake Area (km^2)	2.21	0.68	0.25	13.6	2.05
Drainage Basin: Lake Area Ratio	11.98	9.66	35.6	48.8	11.32
Mean Depth (m)	13.0	12.1	7.4	-	11.8
Maximum Depth (m)	35.1	30.1	14.8	40.0	38.3
Volume (1,000,000 m^3)	27.5	8.18	1.8	156.4	22.6
Hydraulic Retention Time (days)	416 ± 184	511 ± 213	83 ± 35	75 ± 29	-

B3 WATER QUALITY

B3.1 Creek/Tributary Environments

Water chemistry at the reference creek stations met all applicable WQG and AEMP benchmarks for lotic environments in 2018 with the exception of total aluminum concentrations (Appendix Table B.2). Concentrations of aluminum were elevated at reference creek station MRY-REF-3 in the spring and summer of 2018, appearing to be associated with relatively high turbidity at the time of sampling (Appendix Table B.2). Water chemistry at the reference creek stations showed distinct seasonal changes for some parameters (Appendix Figure B.1; Appendix Table B.2). In general, conductivity and concentrations of chloride, sulphate, and total metals were lowest in spring, intermediate in the summer, and highest during the fall in 2018 (Appendix Table B.2; Appendix Figure B.1). This pattern almost certainly reflected dilution from snow melt and precipitation-related sources, with the lowest parameter concentrations typically associated with the spring freshet conditions, and highest parameter concentrations generally associated with low precipitation/streamflow conditions later in the open water season. Previous baseline and 2015 to 2017 water quality monitoring conducted at reference creek stations showed similar seasonal patterns (KP 2014b; Minnow 2016a, 2017, 2018a). Temporal comparison of mean water chemistry for the reference creek stations showed no substantial changes in water quality from 2014 to 2018, suggesting that water chemistry at the reference creek stations was relatively consistent year-to-year taking seasonal sampling timing into account (Figure 3.2; Appendix Figure C.2). Therefore, the reference creek stations were deemed to provide a meaningful benchmark for the evaluation of potential mine-related influences on water chemistry at mine-exposed creek/tributary receiving environments taking seasonality into consideration.

B3.2 River Environments

Water chemistry at the Mary River reference stations (GO-09 series) often showed elevated concentrations of total aluminum, and on a single occasion, total phosphorus and phenol concentrations, compared to WQG and/or AEMP benchmarks in 2018 (Appendix Table B.3). As in previous CREMP studies, Mary River GO-09 reference station total aluminum appeared to be associated with naturally high turbidity and specifically, suspended particulate matter. Comparison of the ratio between dissolved and total concentrations of aluminum indicated that a high proportion of aluminum was in the total (particulate) fraction (i.e., 87%, on average; compare Appendix Tables B.3 and C.64), which can be expected for metals contained in particulate matter.

Table B.2: Water Chemistry at Reference Creek Stations, Mary River Project CREMP, 201

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark	Spring Sampling Event				Summer Sampling Event				Fall Sampling Event			
					CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2	CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2	CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2
					30-Jun-2018	30-Jun-2018	30-Jun-2018	30-Jun-2018	12-Aug-2018	12-Aug-2018	12-Aug-2018	12-Aug-2018	24-Aug-2018	25-Aug-2018	24-Aug-2018	24-Aug-2018
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	32.3	38.4	19.5	38.3	84.2	75.2	49.7	90.2	107	94	78	110
	pH (lab)	pH	6.5 - 9.0	-	7.56	7.54	7.04	7.59	7.99	7.89	7.60	8.03	8.04	7.88	7.70	7.91
	Hardness (as CaCO$_3$)	mg/L	-	-	16	19	<10	19	48	41	21	48	54	47.5	30	55
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	4.7	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	15	16	12	17	50	45	45	48	57	38	55	62
	Turbidity	NTU	-	-	0.7	0.6	5.9	0.9	1.4	0.9	9.4	1.2	1.1	0.5	6.9	1.2
	Alkalinity (as CaCO$_3$)	mg/L	-	-	<10	18	<10	17	45	40	17	47	50	44	25	53
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.024
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Dissolved Organic Carbon	mg/L	-	-	0.72	1.1	0.93	1.1	1.4	2.14	1.45	2.32	1.1	1.9	1.1	1.8
	Total Organic Carbon	mg/L	-	-	1.22	1.3	1.2	1.2	1.6	2.4	1.7	2.6	1.3	3.3	1.3	2.1
	Total Phosphorus	mg/L	0.020[α]	-	0.0034	0.0034	0.0084	0.0041	0.0056	0.0032	0.0109	0.0035	<0.0030	0.0033	0.0047	<0.0030
	Phenols	mg/L	0.004[α]	-	0.0020	0.0038	<0.0010	0.0017	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	<0.50	<0.50	0.92	<0.50	<0.50	<0.50	2.19	0.80	<0.50	<0.50	4.23	1.30
	Sulphate (SO$_4$)	mg/L	218[β]	218	<0.30	0.34	1.31	<0.30	0.46	0.87	4.04	0.73	0.82	1.15	7.5	1.33
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0213	0.0147	0.1220	0.0155	0.0703	0.0457	***0.237***	0.0636	0.0516	0.0282	0.0816	0.056
	Antimony (Sb)	mg/L	0.020[α]	-	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00183	0.00271	0.00310	0.00248	0.00435	0.00516	0.00661	0.00509	0.00465	0.00528	0.0074	0.00631
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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
	Boron (B)	mg/L	1.5	-	<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 (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	3.39	3.88	1.64	3.84	9.49	8.06	4.66	9.50	10.8	9.8	6.86	11.8
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<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 (Cu)	mg/L	0.002	0.0022	<0.00050	0.00070	0.00065	<0.00050	0.00056	0.00135	0.00143	0.00071	<0.00050	0.00114	0.00114	0.00063
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	0.106	<0.030	<0.030	0.037	0.199	0.042	<0.030	<0.030	0.087	0.037
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.000050	0.000148	<0.000050	<0.000050	0.000117	0.000266	<0.000050	<0.000050	0.000070	0.000164	<0.000050
	Lithium (Li)	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
	Magnesium (Mg)	mg/L	-	-	1.80	2.20	0.831	2.12	5.52	4.92	2.29	5.60	6.04	5.53	3.36	6.30
	Manganese (Mn)	mg/L	0.935[β]	-	0.000231	0.000283	0.00202	0.000401	0.000332	0.00067	0.00273	0.000620	0.000205	0.00051	0.001290	0.00060
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	<0.000050	0.000130	0.000070	<0.000050	0.000144	0.000375	0.000223	0.000141	0.000169	0.000469	0.000319	0.000191
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00066	<0.00050	<0.00050	<0.00050	0.00062	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.27	0.34	0.33	0.32	0.52	0.57	0.73	0.61	0.55	0.60	0.77	0.680
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.34	0.47	0.49	0.31	0.81	0.87	1.24	0.80	0.72	0.84	0.94	0.810
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.233	0.282	0.621	0.363	0.549	0.558	1.79	0.83	0.66	0.649	2.59	1.06
	Strontium (Sr)	mg/L	-	-	0.00230	0.00239	0.00327	0.00272	0.00675	0.00502	0.0096	0.00732	0.0080	0.00617	0.0141	0.0095
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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 (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.013	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.000123	0.000203	0.000267	0.000162	0.00190	0.001060	0.000592	0.000726	0.00339	0.00187	0.00093	0.00127
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	-	-												

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

▨ Indicates parameter concentration above applicable Water Qquality Guideline.

BOLD Indicates parameter concentration above AEMP benchmark applicable to the mine lotic receiving environments.

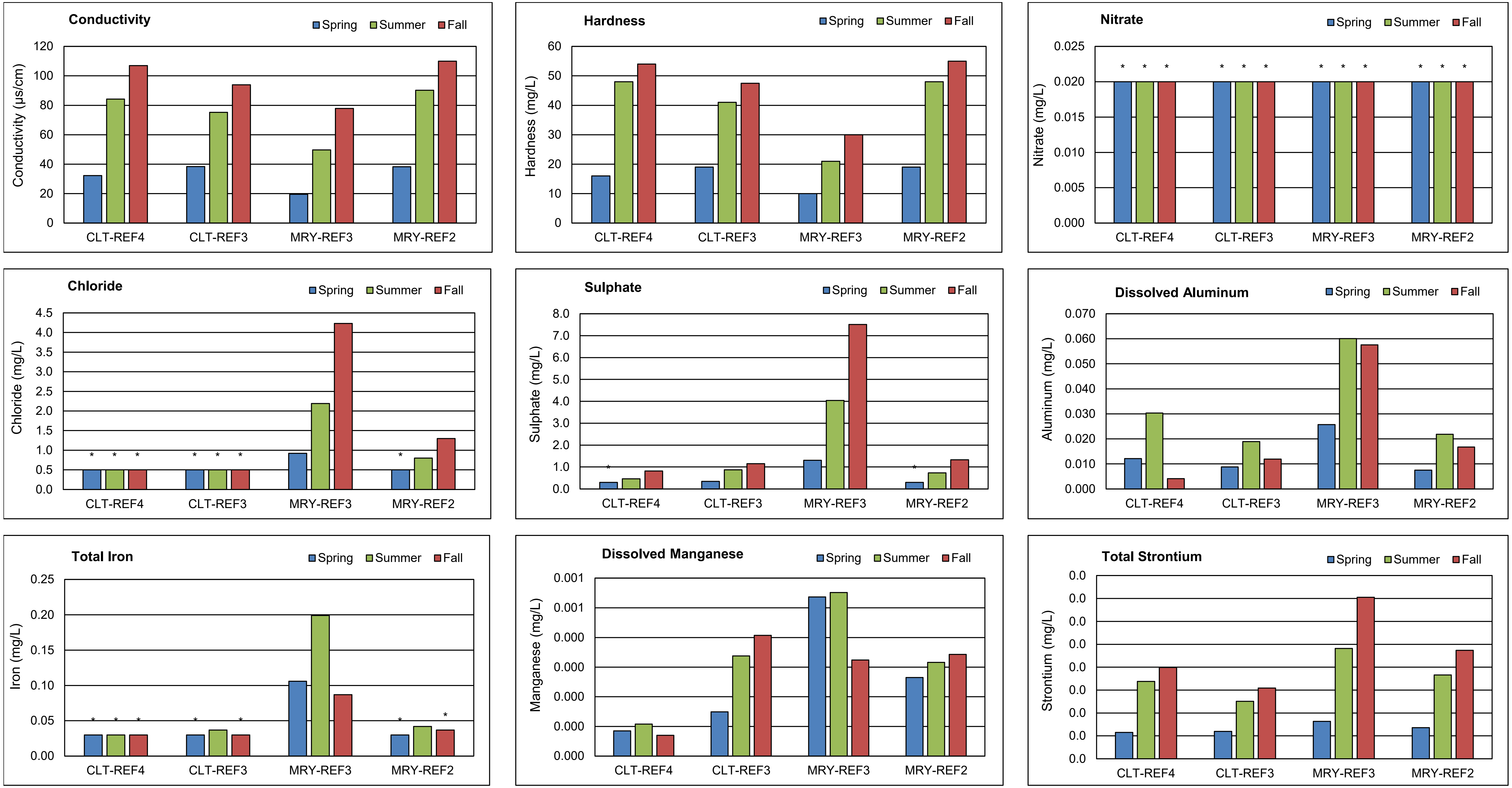

Figure B.1: **Seasonal Variation in Water Chemistry at Stream/Tributary Reference Stations, Mary River Project CREMP, 2018**

Note: Asterisk (*) indicates that the parameter concentration was below the laboratory reportable detection limit.

Table B.3: Water Chemistry at Mary River GO-09 Series Reference Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark	Spring Sampling Event			Summer Sampling Event			Fall Sampling Event		
					G0-09-A 1-Jul-2018	G0-09 1-Jul-2018	G0-09-B 1-Jul-2018	G0-09-A 12-Aug-2018	G0-09 12-Aug-2018	G0-09-B 12-Aug-2018	G0-09-A 27-Aug-2018	G0-09 25-Aug-2018	G0-09-B 25-Aug-2018
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	24.3	25.9	30.2	80.8	84.4	84.6	134	113	112
	pH (lab)	pH	6.5 - 9.0	-	7.3	7.4	7.4	8.16	8.03	8.13	7.99	8.07	8.14
	Hardness (as $CaCO_3$)	mg/L	-	-	11	12	14	40	42	43	66	55	55
	Total Suspended Solids (TSS)	mg/L	-	-	16.9	6.2	3.7	<2.0	<2.0	<2.0	3.2	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	<10	13	11	40	50	50	55	70	70
	Turbidity	NTU	-	-	8.8	7.06	4.72	9.65	8.88	7.73	2.71	4.94	3.81
	Alkalinity (as $CaCO_3$)	mg/L	-	-	11	15	17	46	39	40	65	50	52
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	0.032	<0.020	<0.020	0.037	0.069	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	0.88	0.92	1	1.2	1.29	1.48	1.33	1.96	1.91
	Total Organic Carbon	mg/L	-	-	1.31	1.2	1.25	1.6	1.57	1.67	2.1	2.05	1.95
	Total Phosphorus	mg/L	0.020[α]	-	0.0277	0.0158	0.0074	0.0138	0.0075	0.009	0.0034	0.0073	0.0034
	Phenols	mg/L	0.004[α]	-	0.0061	<0.0010	0.0015	0.0034	<0.0010	<0.0010	<0.0010	0.0027	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	0.53	0.53	0.58	1.89	1.81	1.59	2.83	2.87	2.8
	Sulphate (SO_4)	mg/L	218[β]	218	<0.30	<0.30	<0.30	1.2	1.1	0.9	1.61	1.79	1.74
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	***0.225***	0.135	0.0864	0.1760	***0.426***	0.147	0.126	0.155	0.105
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00395	0.00323	0.00309	0.0069	0.0073	0.0059	0.00845	0.00821	0.008
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	2.45	2.56	3.02	9	9	9	13.9	11.8	11.7
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	0.00072	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.00067	0.0006	0.00055	0.0010	0.0010	0.0008	0.00078	0.00087	0.00088
	Iron (Fe)	mg/L	0.30	0.326	0.181	0.125	0.096	0.138	0.140	0.112	0.071	0.102	0.082
	Lead (Pb)	mg/L	0.001	0.001	0.000219	0.000155	0.000103	0.00018	0.00016	0.00015	0.000076	0.000114	0.000092
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	1.37	1.46	1.63	4.85	5.04	4.44	7.44	6.06	6.48
	Manganese (Mn)	mg/L	0.935[β]	-	0.00418	0.00317	0.00241	0.00176	0.00170	0.00139	0.0009	0.0012	0.0011
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	<0.000050	<0.000050	<0.000050	0.00021	0.00018	0.00015	0.00025	0.00029	0.00026
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.39	0.36	0.36	0.93	0.91	0.76	0.91	0.95	0.97
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.73	0.51	0.54	1.04	1.13	0.94	0.96	0.94	0.85
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.385	0.377	0.412	1.620	1.560	1.310	2.01	1.99	1.98
	Strontium (Sr)	mg/L	-	-	0.00267	0.00267	0.00279	0.010	0.009	0.009	0.0128	0.0127	0.0129
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.000204	0.000165	0.000152	0.0014	0.0014	0.0012	0.00263	0.00253	0.00269
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above AEMP benchmark applicable to the mine lotic receiving environments.

Water chemistry at the Mary River reference stations showed distinct seasonal changes for conservative parameters including conductivity, hardness, chloride, sodium, and sulphate (Appendix Figure B.2; Appendix Table B.3). These seasonal changes in parameter concentrations were consistent with those observed at the reference creek stations in 2018, and in previous baseline (2005 to 2013), and 2015 to 2017 water quality monitoring data collected at the Mary River GO-09 series reference stations (KP 2014b; Minnow 2016a, 2017, 2018a). The seasonal changes in the Mary River reference station parameter concentrations likely reflected greater dilution during the spring snowmelt period, and consecutively lower surface runoff inputs during the summer and fall periods. Temporal comparison of the Mary River GO-09 series reference station water chemistry indicated that on average, parameter concentrations in 2018 were within respective ranges observed between the baseline period and previous operating mine conditions based on fall monitoring data (Figure 5.3; Appendix Figure C.22). Therefore, the Mary River reference stations were deemed to provide a meaningful benchmark for the evaluation of potential mine-related influences on water chemistry at the Mary River mine-exposed study areas.

B3.3 Lake Environments (Reference Lake 3)

In situ water temperature profiles conducted at Reference Lake 3 did not indicate thermal stratification of the water column in either summer or fall of 2018 (Appendix Figure B.3). No marked changes in dissolved oxygen concentration occurred with increased depth at any of the Reference Lake 3 basins, and dissolved oxygen saturation remained high (i.e., ≥ 95%) throughout the entire water column in both the summer and fall profiles (Appendix Figure B.3). The 2018 water quality profiles also showed only minor changes in pH and specific conductance among stations and with depth during each of the summer and fall sampling events (Appendix Figure B.3). Overall, the i*n situ* water quality profiles suggested relatively thorough lateral mixing within Reference Lake 3 and no substantial changes in water temperature, dissolved oxygen, pH, or conductivity with changes in water depth.

The evaluation of water chemistry at Reference Lake 3 indicated that all monitored parameters were below WQG in summer and fall 2018 (Appendix Table B.4). In addition, no parameters were observed at concentrations above lentic AEMP benchmarks at Reference Lake 3 (Appendix Table B.4), suggesting that these water quality benchmarks were relevant for comparisons of water quality for the mine-exposed lakes. No substantial differences in water chemistry were observed between the summer and fall at Reference Lake 3 in 2018, which was similar to observations among winter, summer, and fall at local study area lakes during the mine baseline period and in summer and fall at Reference Lake 3 from 2015 to 2017 (KP 2014a,c; Minnow 2016a, 2017, 2018a). Temporal comparisons also showed no

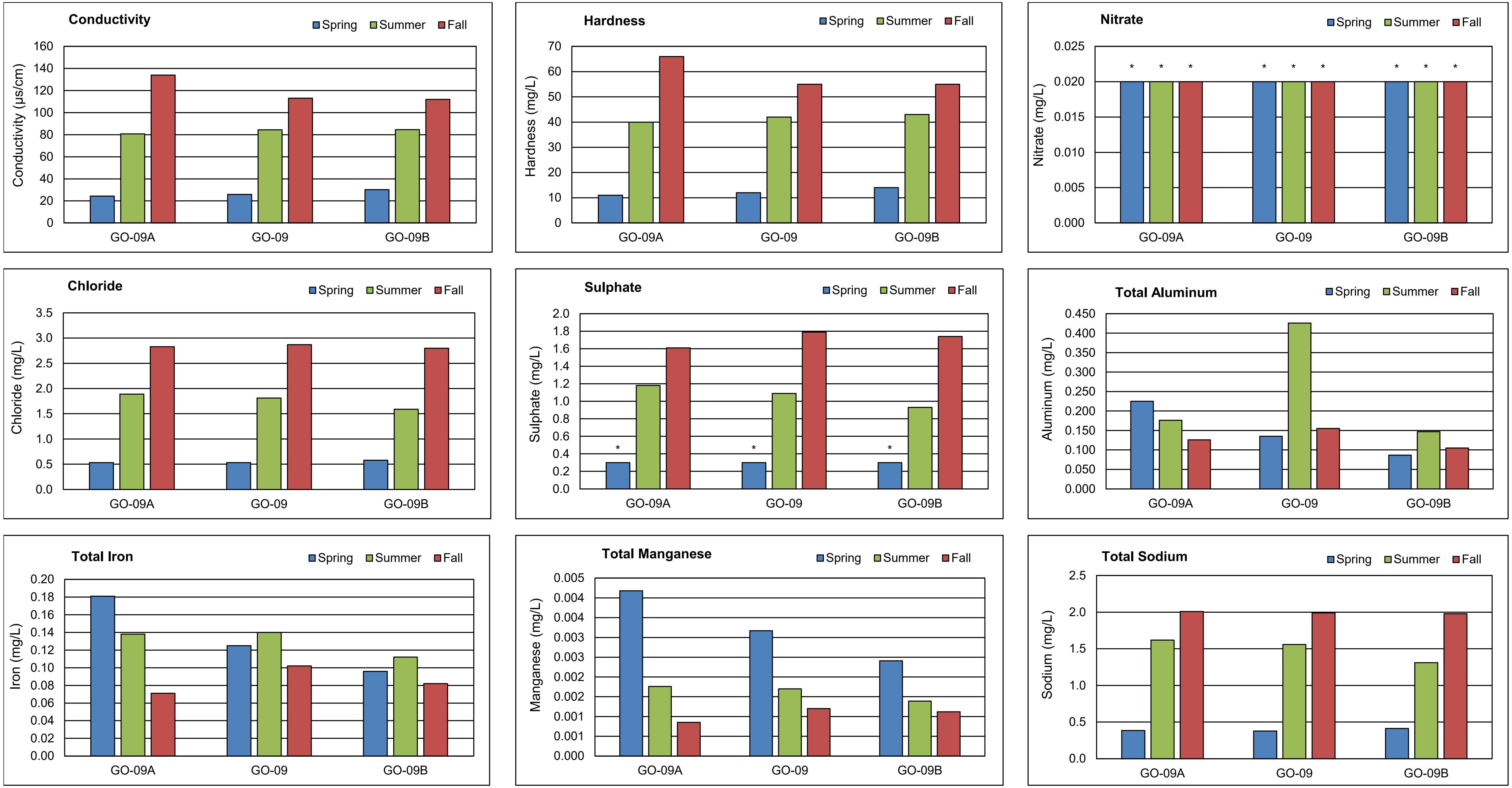

Figure B.2: Seasonal Variation in Water Chemistry at Mary River GO-09 Reference Stations, Mary River Project CREMP, 2018

Note: Asterisk (*) indicates that the parameter concentration was below the laboratory reportable detection limit.

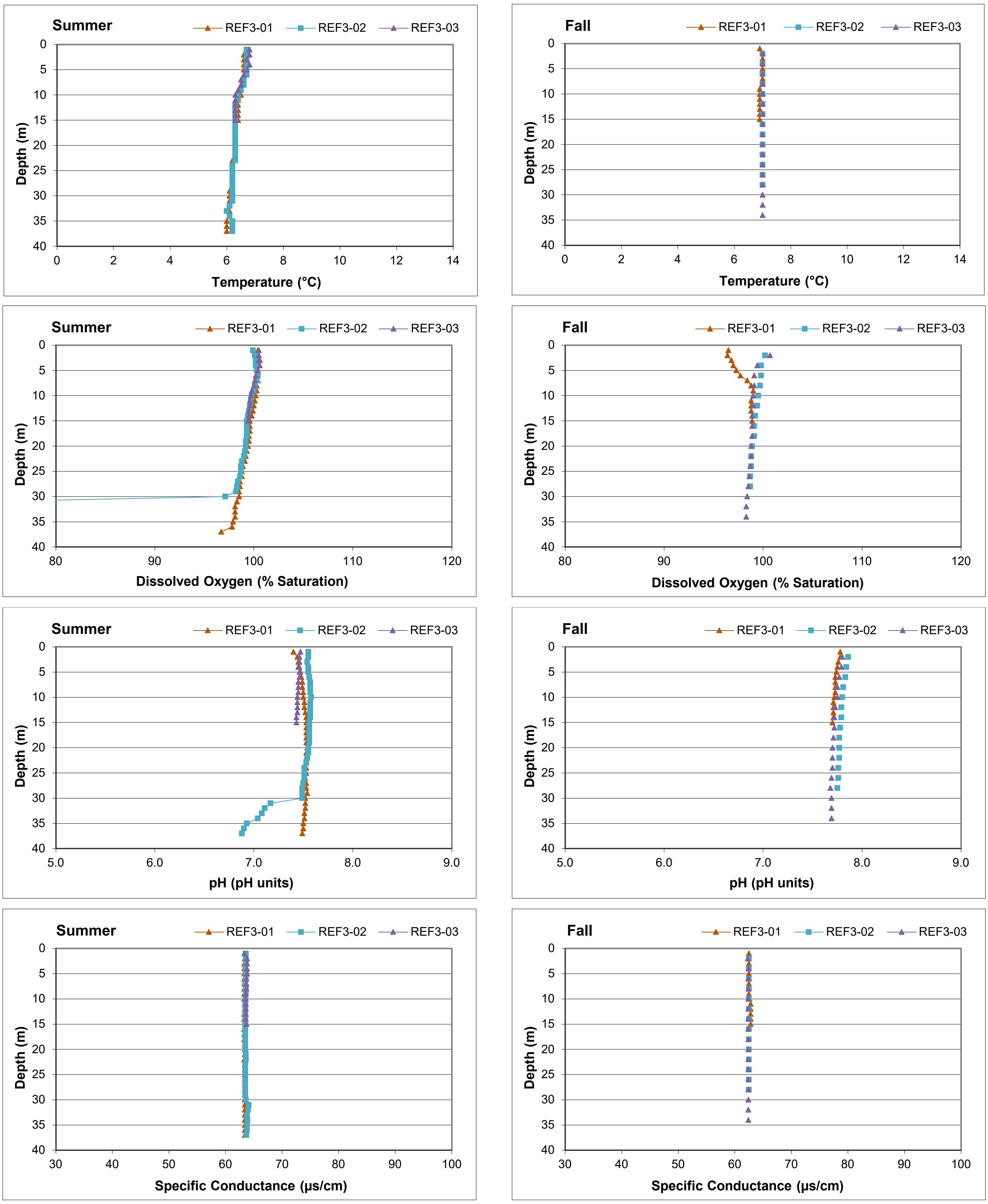

Figure B.3: ***In Situ*** **Water Quality with Depth from Surface at Reference Lake 3 during Summer and Fall Sampling Events, Mary River Project CREMP, 2018**

Table B.4: Water Chemistry at Reference Lake 3, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event						Fall Sampling Event					
					REF3-01 bottom 12-Aug-2018	REF3-01 surface 12-Aug-2018	REF3-02 bottom 12-Aug-2018	REF3-02 surface 12-Aug-2018	REF3-03 bottom 12-Aug-2018	REF3-03 surface 12-Aug-2018	REF3-01 bottom 27-Aug-2018	REF3-01 surface 27-Aug-2018	REF3-02 bottom 27-Aug-2018	REF3-02 surface 27-Aug-2018	REF3-03 bottom 27-Aug-2018	REF3-03 surface 27-Aug-2018
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	70.3	70.4	70.5	72.0	71.2	70.8	75.3	75.6	75.6	75.5	75.3	75.6
	pH (lab)	pH	6.5 - 9.0	-	7.84	7.86	7.91	7.98	7.90	7.93	7.61	7.67	7.64	7.64	7.66	7.68
	Hardness (as $CaCO_3$)	mg/L	-	-	36	35	35	37	36	37	34	34	35	35	35	35
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	32	38	27	29	43	43	47	43	45	44	52	47
	Turbidity	NTU	-	-	0.28	0.23	0.22	0.22	0.25	0.25	0.52	0.48	0.45	0.48	0.41	0.70
	Alkalinity (as $CaCO_3$)	mg/L	-	-	29	31	32	33	35	36	30	32	35	32	33	35
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	0.032	<0.020	<0.020	0.024	<0.020	<0.020	0.090	0.039	0.076	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.17	0.18	<0.15	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Dissolved Organic Carbon	mg/L	-	-	3.2	3.2	3.3	3.2	3.2	3.3	2.9	2.9	2.9	2.9	3.0	2.9
	Total Organic Carbon	mg/L	-	-	3.4	3.5	11.4	3.6	3.5	3.8	4.0	3.7	4.1	3.7	3.8	3.7
	Total Phosphorus	mg/L	0.030[α]	-	0.0050	0.0046	0.0042	0.0038	0.0033	0.0069	<0.0030	<0.0030	0.0055	0.0114	0.0036	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	0.0013	<0.0010	0.0025	<0.0010	0.0013	0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.29	1.27	1.27	1.31	1.27	1.29	1.27	1.27	1.26	1.27	1.26	1.27
	Sulphate (SO_4)	mg/L	218[β]	218	3.79	3.78	3.79	3.79	3.77	3.82	3.75	3.75	3.74	3.74	3.74	3.74
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	<0.0030	0.0041	<0.0030	0.0033	<0.0030	0.0040	0.0069	<0.0030	0.0062	0.0036	0.0033	<0.0030
	Antimony (Sb)	mg/L	0.020[α]	-	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00682	0.00689	0.00660	0.00677	0.00667	1.00640	0.00657	0.00635	0.00662	0.00616	0.00649	0.00645
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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
	Boron (B)	mg/L	1.5	-	<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 (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	7.10	7.15	7.05	6.94	6.96	7.19	6.98	7.22	7.10	7.14	7.36	7.18
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<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 (Cu)	mg/L	0.002	0.0022	0.00068	0.00082	0.00088	0.00078	0.00085	0.00088	0.00077	0.00075	0.00079	0.00076	0.00075	0.00076
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	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
	Magnesium (Mg)	mg/L	-	-	4.62	4.46	4.56	4.27	4.47	4.47	4.34	4.14	4.19	4.21	4.29	4.36
	Manganese (Mn)	mg/L	0.935[β]	-	0.000446	0.000648	0.000611	0.000576	0.000584	0.000624	0.000934	0.000583	0.000634	0.000573	0.000542	0.000558
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000135	0.000135	0.000129	0.000134	0.000121	0.000132	0.000134	0.000141	0.000133	0.000145	0.000138	0.000138
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	1.00	0.93	0.93	0.92	0.93	0.93	0.88	0.85	0.85	0.86	0.85	0.88
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.44	0.47	0.45	0.43	0.44	0.44	0.42	0.41	0.42	0.42	0.41	0.42
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.926	0.903	0.879	0.872	0.879	0.876	0.884	0.821	0.874	0.863	0.842	0.886
	Strontium (Sr)	mg/L	-	-	0.00806	0.00796	0.00800	0.00784	0.00802	0.00816	0.00788	0.00822	0.00794	0.00804	0.00823	0.00814
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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 (Ti)	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
	Uranium (U)	mg/L	0.015	-	0.000202	0.000246	0.000241	0.000236	0.000251	0.000246	0.000266	0.000273	0.000248	0.000258	0.000264	0.000246
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using background water quality data. The values are specific to the Camp Lake system.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

substantial changes in water quality from 2015 to 2018 at Reference Lake 3 (Figure 3.10; Appendix Figure C.8).

Water chemistry data collected at Reference Lake 3 showed no consistent differences in parameter concentrations between the surface and the bottom of the water column at each individual station in 2018 (Appendix Figure B.4; Appendix Table B.4). The absence of any appreciable depth-related differences in parameter concentrations at each station was consistent with only minor differences in dissolved oxygen saturation, pH, and/or specific conductance with increased depth from the surface. Because anoxic conditions do not appear to develop in the summer or fall at Reference Lake 3, reducing conditions conducive to metal mobilization from sediment to the overlying water are less likely to occur near the lake bottom, resulting in relatively uniform water chemistry between surface and bottom waters of Reference Lake 3. Accordingly, metal concentrations can naturally be expected to be similar between surface and bottom of local study area lakes provided no substantial gradients in dissolved oxygen saturation, pH, and/or specific conductance occur within the water column.

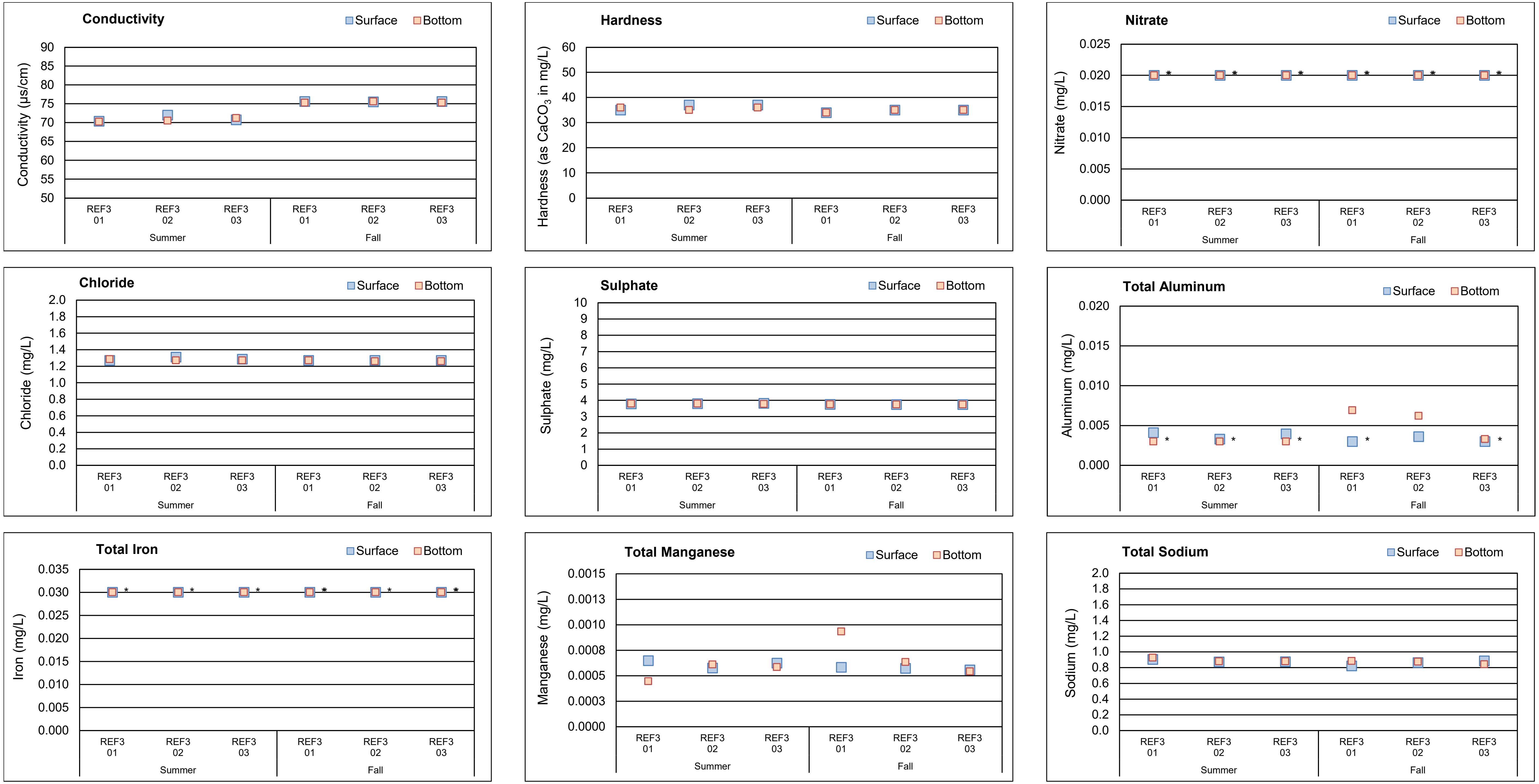

Figure B.4: Water Chemistry Comparison Between the Surface and the Bottom of the Water Column at Reference Lake 3 Routine Monitoring Stations during Summer and Fall, Mary River Project CREMP, 2018

Note: An asterisk (*) indicates that the parameter concentration was below the laboratory reportable detection limit.

B4 SEDIMENT QUALITY

B4.1 Creek/Tributary Environments

Deposited sediment at Unnamed Reference Creek (CLT-REF) was visually characterized as predominantly medium-sized sand by Minnow (2018a). In-stream substrate of the reference creek was described as mainly cobble and pebble material (i.e., substrate diameter 6 to 25 cm, and 2 to 6 cm, respectively), with sand constituting only a small amount (i.e., ~7%) of the material observed at the sediment surface (Minnow 2018a). Deposited sediment suitable for chemical characterization (i.e., sand and finer substrate sizes) was present primarily at shoreline/streambank areas, and not in the main channel. Sediment total organic carbon (TOC) content was very low (i.e., <0.1%) at the reference creek suggesting very limited deposition of fine organic materials (Minnow 2018a). Metal concentrations in deposited sediment at the reference creek were well below SQG during sampling conducted in 2017 (Minnow 2018a), and therefore the Unnamed Reference Creek data were deemed to provide a meaningful benchmark for the evaluation of potential mine-related influences on chemistry of deposited sediment at the mine-exposed creeks.

B4.2 River Environments

Deposited sediment at the Mary River (GO-09) upstream reference area was visually characterized as predominantly coarse sand in 2017 (Minnow 2018a). In-stream substrate of the reference creek was composed mainly of boulder and cobble material (i.e., substrate diameter >25 cm, and 6 to 25 cm, respectively), with sand constituting only a minor amount (i.e., ~10%) of the material observed at the sediment surface. Deposited sediment suitable for chemical characterization (i.e., sand and finer substrate sizes) was collected in-stream from quiescent zones immediately downstream of large boulders in 2017 (Minnow 2018a). Sediment total organic carbon (TOC) content was very low (i.e., <0.1%) at the GO-09 reference area, suggesting very limited deposition of fine organic materials. Metal concentrations in deposited sediment at the reference creek were shown to be well below SQG in 2017 (Minnow 2018a), and therefore the GO-09 data were deemed to provide a meaningful benchmark for the evaluation of potential mine-related influences on chemistry of deposited sediment at the Mary River mine-exposed study areas.

B4.3 Lake Environments (Reference Lake 3)

Sediment sampling was conducted at littoral and profundal (i.e., <12 m and >12 m depths, respectively) areas of Reference Lake 3 from 2015 to 2018 for the analysis of particle size, total organic carbon (TOC) content, and total metal concentrations (see Figure 2.3). Surficial sediment at Reference Lake 3 littoral and profundal areas was composed of silty to sandy loam material with moderate TOC content. Substrate particle size differed significantly between the Reference Lake 3 littoral and profundal habitats in 2018, with significantly higher proportion of sand-sized material and significantly lower proportion of silt- and clay-sized material present at littoral stations compared to profundal stations (Appendix Table F.16). No significant differences in sediment TOC content occurred between the littoral and profundal habitats of the reference lake in 2018 (Appendix Table F.16). A surficial and/or sub-surface layer of oxidized material (likely iron hydroxide or oxy-hydroxides), visible as an orange-brown floc or distinct layer, was commonly observed in the surficial sediment of Reference Lake 3 (Appendix Tables D.1 and D.2). In addition, sub-surface sediment of Reference Lake 3 occasionally contained blackened/dark colouration, which suggested the occurrence of reducing (i.e., anoxic) sediment conditions (Appendix Tables D.1 and D.2). The physical properties of sediment observed at Reference Lake 3 in 2018 were consistent with those of the 2015 and 2016 studies (see Minnow 2016a, 2017).

Metal concentrations in sediment at Reference Lake 3 were generally lower at the littoral stations than at the profundal stations, although less than a two-fold difference in concentrations was typically shown for most parameters between the littoral and profundal station depths (Appendix Table B.5; Appendix Figure B.5). The differences in sediment metal concentrations between the littoral and profundal station depths likely reflected a naturally higher proportion of fine silt- and clay-sized particles at the latter, which is consistent with expected depositional patterns in lakes. Among metals with established SQG, mean concentrations of iron were elevated above SQG at littoral and profundal stations, and mean concentrations of manganese were elevated above SQG at profundal stations of Reference Lake 3 in 2018 (Appendix Table B.5). Phosphorus concentrations were also elevated above SQG in sediment at a single littoral station, and chromium concentrations were elevated above SQG in sediment a two profundal stations, at Reference Lake 3 in 2018 (Appendix Table B.5). Therefore, compared to SQG, high concentrations of iron and manganese, and chromium and phosphorus to a lesser extent, appear to occur naturally in sediments of Mary River Project local study area lakes. Mean copper and iron concentrations at littoral stations, and mean arsenic, copper, iron, and manganese concentrations at profundal stations, were above the most stringent (i.e., lowest) AEMP sediment quality benchmarks at Reference Lake 3 (Appendix Table B.5). This suggested that the AEMP sediment benchmarks for these metals were conservative. No substantial changes in concentrations of metals were indicated from 2015 to 2018 at littoral or profundal stations of Reference Lake 3 (Appendix Figure B.5; Figure 3.12).

Table B.5: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Reference Lake 3 (REF-03) Sediment Stations, Mary River Project CREMP, August 2018

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Littoral Stations							Profundal Stations						
					REF-03-1	REF-03-2	REF-03-3	REF-03-4	REF-03-5	Mean	Standard Error	REF-03-6	REF-03-7	REF-03-8	REF-03-9	REF-03-10	Mean	Standard Error
Non-metals	Sand	%	-	-	59.4	56.6	60.7	66.4	54.9	59.6	2.0	49.9	50.9	44.5	47.0	45.1	47.5	0.90
	Silt	%	-	-	29.8	32.6	33.5	26.6	34.7	31.4	1.45	40.4	33.8	41.5	38.7	40.4	39.0	0.97
	Clay	%	-	-	10.80	10.8	5.80	7.00	10.40	9.0	1.06	9.7	15.3	14.0	14.3	14.5	13.6	0.70
	Moisture	%	-	-	90.7	94.0	84.7	72.6	90.3	86.5	3.77	76.7	87.2	87.0	86.8	87.6	85.1	1.48
	Total Organic Carbon	%	10^{α}	-	5.13	7.37	3.09	1.78	6.14	4.70	1.01	0.84	4.64	4.89	4.47	4.27	3.82	0.532
Metals	Aluminum (Al)	mg/kg	-	-	21,400	20,800	17,400	10,400	19,400	17,880	1,993	10,900	29,000	28,100	24,500	29,600	24,420	2,471
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0
	Arsenic (As)	mg/kg	17	$5.9 - 6.2^{c}$	**7.03**	4.92	4.09	2.53	**7.68**	5.25	0.95	3.03	**7.14**	**6.85**	**6.18**	**7.14**	**6.07**	0.551
	Barium (Ba)	mg/kg	-	-	131	158	101.0	61.7	212.0	133	25	72	164	191	134	197	152	16.12
	Beryllium (Be)	mg/kg	-	-	0.83	0.82	0.66	0.39	0.70	0.68	0.08	0.41	1.04	0.99	0.83	1.07	0.87	0.086
	Bismuth (Bi)	mg/kg	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.00	<0.20	<0.20	0.21	<0.20	0.21	0.20	0.0017
	Boron (B)	mg/kg	-	-	13.9	17.3	14.1	8.1	16.2	13.9	1.6	7.8	16.8	18.9	14.1	20.3	15.6	1.56
	Cadmium (Cd)	mg/kg	3.5	1.5	0.238	0.217	0.099	0.095	0.324	0.195	0.044	0.184	0.201	0.204	0.186	0.210	0.197	0.004
	Calcium (Ca)	mg/kg	-	-	5,620	6,970	4,700	2,850	7,260	5,480	804	3,100	5,920	6,450	5,530	6,920	5,584	469.6
	Chromium (Cr)	mg/kg	90	$79 - 98^{c}$	74.0	65.5	54.5	30.9	69.8	58.9	7.7	***34.6***	89.9	90.5	***77.4***	93.9	77.3	7.80
	Cobalt (Co)	mg/kg	-	-	15.30	10.30	11.2	7.5	14.2	11.7	1.4	8.4	20.4	19.8	17.1	21.4	17.4	1.67
	Copper (Cu)	mg/kg	197	$50 - 58^{c}$	***94***	***96***	***61***	***38***	***80***	***74***	11	**39**	**118**	**111**	**97**	**116**	**96**	10.43
	Iron (Fe)	mg/kg	$40,000^{\alpha}$	$34,400 - 52,400^{c}$	63,600	***36,300***	***35,300***	24,000	***74,300***	***46,700***	9,489	***23,900***	***59,200***	***58,100***	***49,700***	***63,600***	***50,900***	5,031
	Lead (Pb)	mg/kg	91.3	35	19.7	18.7	14.4	9.1	20.2	16.4	2.1	8.7	22.3	22.5	20.3	23.8	19.5	1.96
	Lithium (Li)	mg/kg	-	-	30.0	30.7	26.3	15.7	27.4	26.0	2.7	16.8	42.8	39.1	36.6	45.0	36.1	3.56
	Magnesium (Mg)	mg/kg	-	-	13,100	12,500	10,400	6,120	13,400	11,104	1,352	6,870	18,100	17,500	15,600	18,900	15,394	1,555
	Manganese (Mn)	mg/kg	$1,100^{\alpha,\beta}$	657 - 4,370	803	***454***	***703***	563	678	640	60	***914***	***1,410***	***1,320***	***1,160***	***1,590***	***1,279***	81.1
	Mercury (Hg)	mg/kg	0.486	0.17	0.0512	0.0616	0.0228	0.0120	0.0688	0.0433	0.0111	0.0182	0.0819	0.0762	0.0831	0.0658	0.0650	0.00856
	Molybdenum (Mo)	mg/kg	-	-	6.75	3.48	2.57	1.83	4.56	3.84	0.86	1.59	2.97	2.77	2.39	3.13	2.57	0.194
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	$66 - 77^{c}$	54.9	47.9	36.0	23.2	52.6	42.9	5.9	29.0	61.3	61.6	52.0	65.2	53.8	4.65
	Phosphorus (P)	mg/kg	$2,000^{\alpha}$	$1,278 - 1,958^{c}$	1,420	1,130	986	698	***2,290***	1,305	272	769	1,240	1,350	1,130	1,450	1,188	83.1
	Potassium (K)	mg/kg	-	-	4,730	4,880	4,240	2,310	4,510	4,134	469	2,610	6,460	6,640	5,600	6,990	5,660	562.9
	Selenium (Se)	mg/kg	-	-	0.79	0.83	0.48	0.22	0.98	0.66	0.14	0.20	0.89	0.99	0.97	0.98	0.81	0.108
	Silver (Ag)	mg/kg	-	-	0.18	0.20	<0.10	<0.10	0.16	0.15	0.02	<0.10	0.34	0.30	0.27	0.30	0.26	0.030
	Sodium (Na)	mg/kg	-	-	332	401	301	165	400	320	43	199	471	530	421	542	433	44.1
	Strontium (Sr)	mg/kg	-	-	13.3	14.4	11.2	6.9	15.1	12.2	1.5	7.6	15.6	15.5	13.7	16.7	13.8	1.15
	Sulphur (S)	mg/kg	-	-	1800	2700	<1000	<1000	2400	1,780	350	<1000	1800	1400	1500	1300	1,400	92
	Thallium (Tl)	mg/kg	-	-	0.586	0.460	0.396	0.238	0.569	0.450	0.063	0.409	0.798	0.890	0.751	0.921	0.754	0.0647
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	0.0	<2.0	2.1	2.0	<2.0	2.2	2.1	0.028
	Titanium (Ti)	mg/kg	-	-	1,160	1,190	1,140	726	1,560	1,155	132	801	1,490	1,620	1,300	1,730	1,388	115.5
	Uranium (U)	mg/kg	-	-	19.70	12.1	9.9	7.47	17.7	13.4	2.3	9.7	29.8	28.2	23.6	31.1	24.5	2.76
	Vanadium (V)	mg/kg	-	-	73.8	66.4	52.5	34.3	64.3	58.3	6.9	37.2	84.2	83.4	70.7	88.2	72.7	6.62
	Zinc (Zn)	mg/kg	315	$123 - 135^{c}$	103.0	91.9	70.3	46.9	94.7	81.4	2.0	45	117.0	115.0	98.5	121.0	99.2	10.0
	Zirconium (Zr)	mg/kg	-	-	3.6	4.6	3.4	1.9	6.9	3.9	0.2	2.1	4.6	4.5	3.6	4.6	3.9	0.3

[a] Canadian Sediment Quality Guideline, probable effects level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2017)).

[b] Baffinland Mary River Project Aquatic Effects Monitoring Program (AEMP) sediment quality benckmarks (Baffinland 2014, 2016; Intrinsik 2014, 2015).

[c] The AEMP benchmarks were derived for individual mine-exposed lakes, and therefore a range of values is presented to reflect the AEMP benchmark variation among the mine-exposed lakes. Reference Lake 3 sediment chemistry was screened against the lowest AEMP benchmark for applicable parameters.

▨ Indicates paramter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

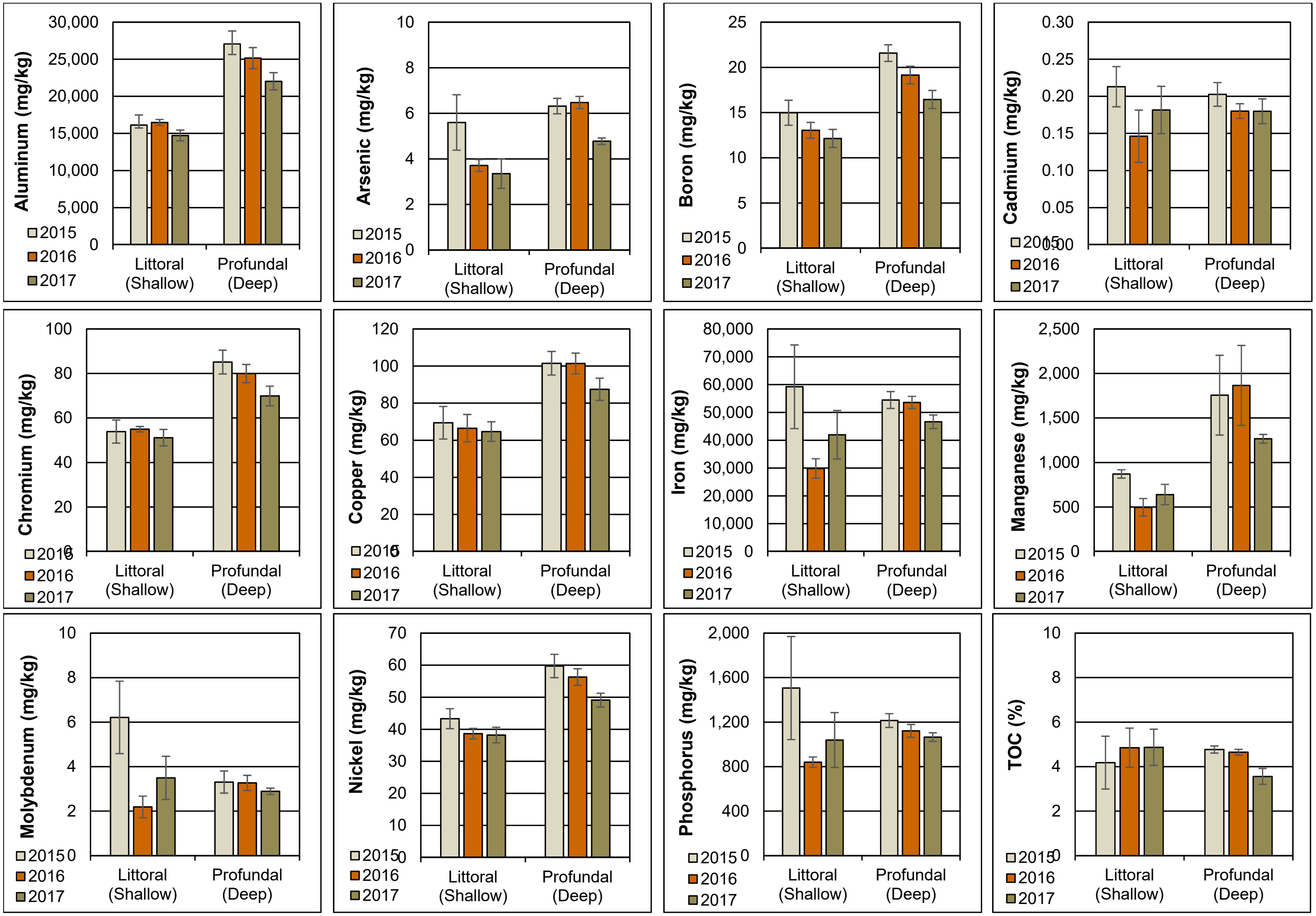

Figure B.5: **Sediment Metal Concentrations (mean ± SE) at Littoral (<12m depth) and Profundal (>12m depth) Monitoring Stations of Reference Lake 3 (REF03), Mary River Project CREMP, 2015 to 2018**

B5 PHYTOPLANKTON (CHLOROPHYLL-A)

B5.1 Lotic Environments

Chlorophyll-a concentrations, which were used as a surrogate for phytoplankton abundance, ranged from 0.13 to 0.48 µg/L at the reference creek and river stations among spring, summer, and fall sampling events in 2018 (Appendix Table B.6). Therefore, lotic reference station chlorophyll-a concentrations were consistently well below the AEMP benchmark of 3.7 µg/L, and reflected low (i.e., oligotrophic) phytoplankton productivity according to Dodds et al (1998) trophic status classification for stream environments. This trophic status classification was consistent with an oligotrophic CWQG categorization for the stream and river reference stations based on mean aqueous total phosphorus concentrations generally ranging between 4 to 10 µg/L during each respective spring, summer, and fall sampling event in 2018 (Appendix Tables B.2 and B.3). Seasonally, chlorophyll-a concentrations did not differ significantly among spring, summer, and fall at the reference creeks, but were significantly lower in the spring than during the summer and fall at the at the Mary River GO-09 series reference stations in 2018 (Appendix Tables B.6 and B.7).

Like-season chlorophyll-a concentrations from 2015 to 2018 showed no consistent significant differences among years over the spring, summer, and fall sampling events at either the reference creek or the Mary River reference area stations (Appendix Figure B.6). The variability in response shown among seasons and years at the lotic reference areas indicated that significant differences in chlorophyll-a concentrations occurs naturally among years and seasons in watercourses within the Mary River Project mine local study area.

B5.2 Lentic Environments (Reference Lake 3)

Chlorophyll-a concentrations at Reference Lake 3 showed no consistent differences between the surface and the bottom of the water column at each individual station during both the summer and fall sampling events in 2018 (Appendix Figure B.7). Chlorophyll-a concentrations were significantly lower near the surface of the water column than bottom in summer, but did not differ significantly between the surface and the bottom of the water column in fall, at Reference Lake 3. This suggested that phytoplankton abundance within the water column can vary from season to season.

Reference Lake 3 chlorophyll-a concentrations averaged 0.74 µg/L in summer and 0.91 µg/L in fall 2018, and were consistently well below the AEMP benchmark of 3.7 µg/L (Appendix Table E.3; Appendix Figure B.7). Similar to the lotic reference stations, mean chlorophyll-a concentrations observed at Reference Lake 3 in 2018 indicated low (i.e., oligotrophic)

Table B.6: **Phytoplankton Monitoring Data Collected at Lotic Reference Stations, Mary River Project CREMP 2018**

	Station	Reference Creek Stations				Mary River Reference Stations		
		CLT-REF3	CLT-REF4	MRY-REF2	MRY-REF3	G0-09-A	G0-09	G0-09-B
Sample Collection Date	Spring	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18	1-Jul-18	1-Jul-18	1-Jul-18
	Summer	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18
	Fall	25-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	27-Aug-18	25-Aug-18	25-Aug-18
Chlorophyll-a (µg/L)	Spring	0.24	0.28	0.36	0.19	0.38	0.32	0.25
	Summer	0.15	0.48	0.21	0.13	0.16	0.16	0.14
	Fall	0.18	0.47	0.44	0.18	0.17	0.24	0.19
	Average	0.19	0.41	0.34	0.17	0.24	0.24	0.19
	Standard Deviation	0.05	0.11	0.12	0.03	0.12	0.08	0.06
	Standard Error	0.03	0.07	0.07	0.02	0.07	0.05	0.03
Phaeophytin-a (µg/L)	Spring	0.26	0.30	0.35	0.26	0.34	0.28	0.27
	Summer	0.22	0.40	0.24	<0.3	0.31	0.28	0.27
	Fall	0.25	0.41	0.35	0.35	0.26	0.30	0.28
	Average	0.24	0.37	0.31	0.31	0.30	0.29	0.27
	Standard Deviation	0.02	0.06	0.06	0.05	0.04	0.01	0.01
	Standard Error	0.01	0.04	0.04	0.03	0.02	0.01	0.00

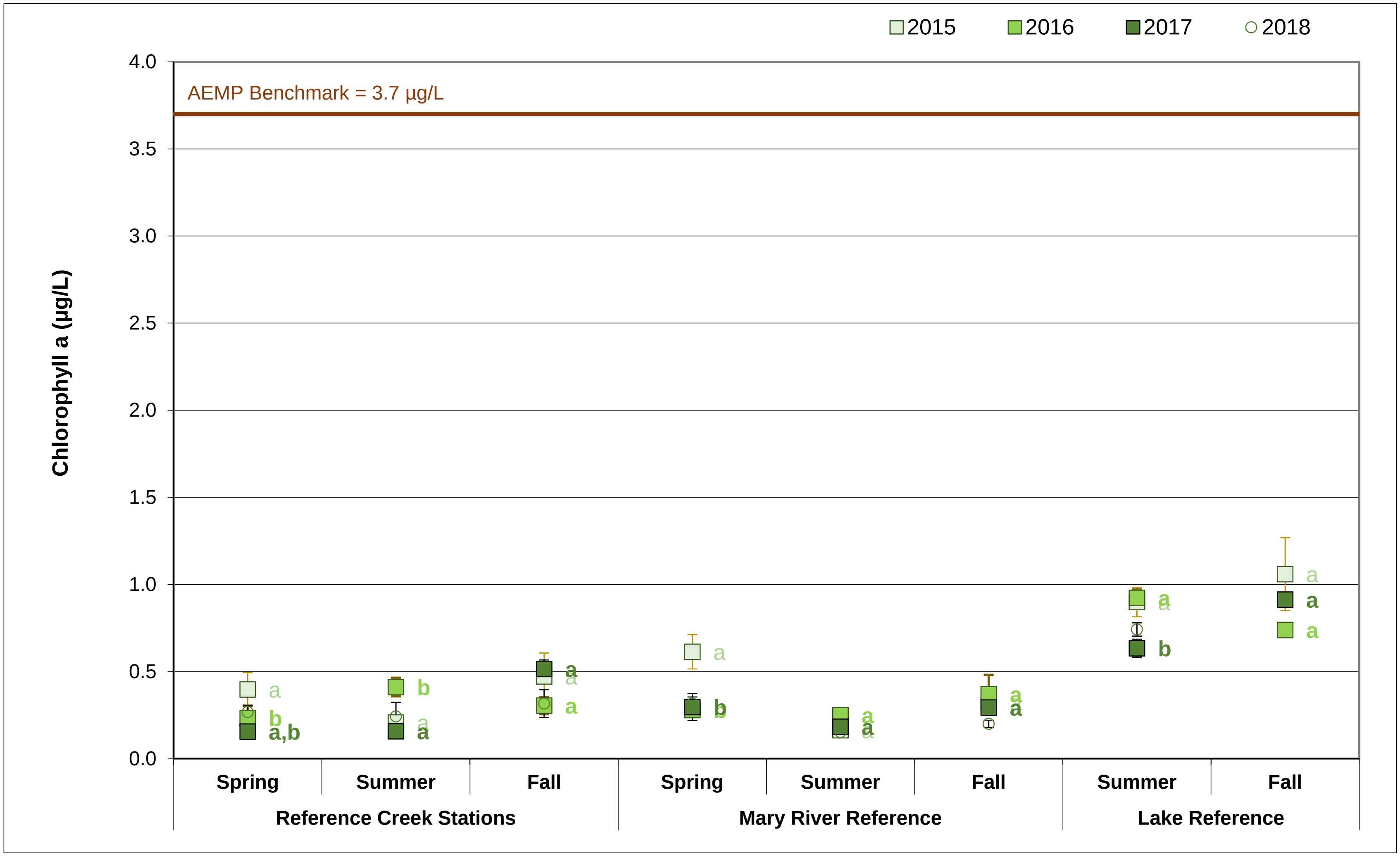

Figure B.6: **Chlorophyll-a Concentration Seasonal Comparison from 2015 to 2018 at Creek, River, and Lake Reference Phytoplankton Monitoring Stations, Mary River Project CREMP**

The same letters next to data points associated with each individual season/reference area indicates no significant difference between points .

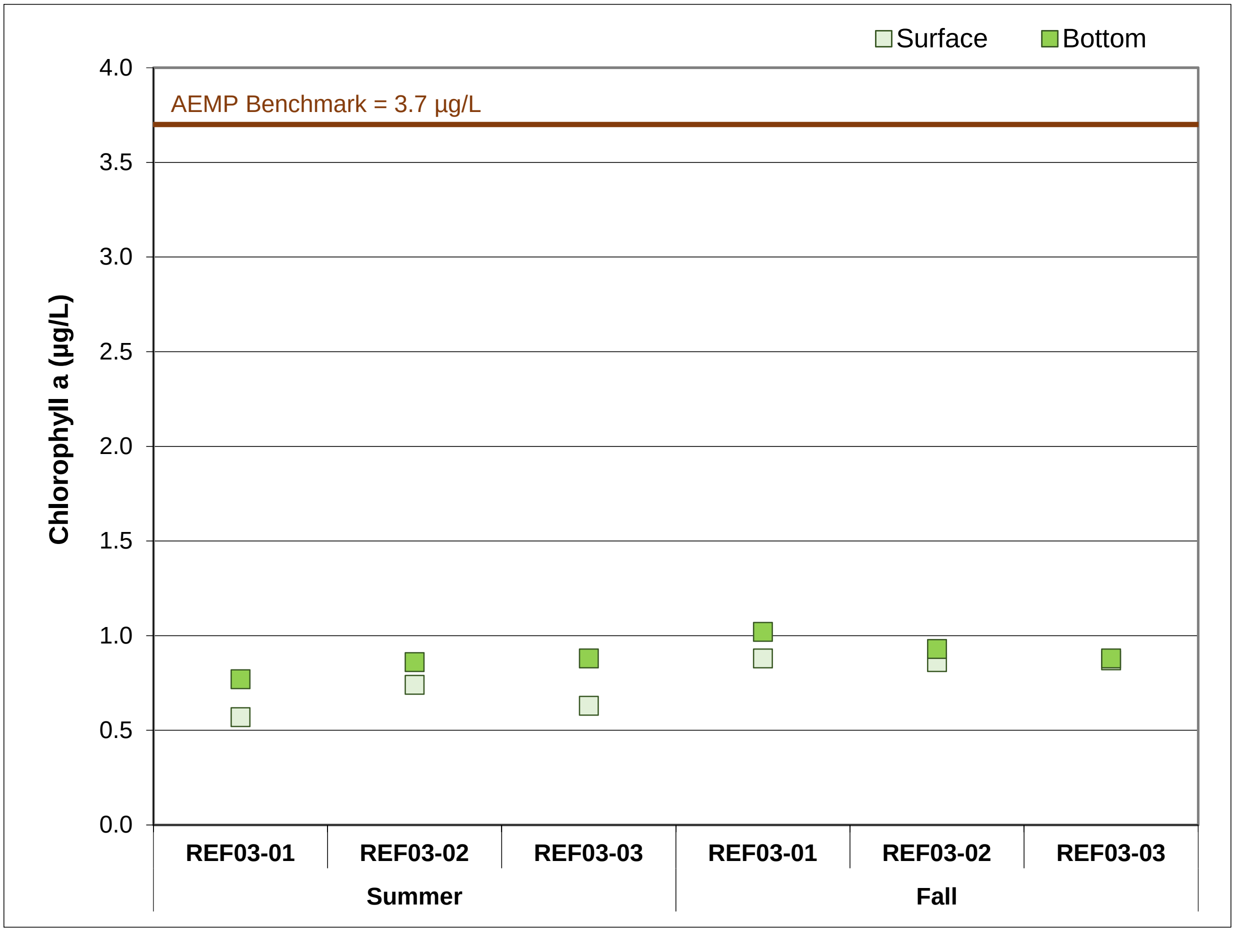

Figure B.7: **Chlorophyll-a Concentrations at the Surface and Bottom of the Water Column at Reference Lake 3 Phytoplankton Monitoring Stations during Summer and Fall Sampling Events, Mary River Project CREMP, 2018**

phytoplankton productivity based on the lake trophic status classification presented in Wetzel (2001). This trophic status classification was also consistent with an oligotrophic CWQG categorization for Reference Lake 3 based on mean aqueous total phosphorus concentrations typically ranging between 4 and 10 µg/L during the summer and fall sampling events in 2018 (Appendix Table B.4). Chlorophyll-a concentrations were significantly lower in the summer than in the fall at Reference Lake 3 in 2018 (Appendix Table B.7), which was similar to the seasonal differences shown in 2017, but differed from results of the 2015 study when chlorophyll-a concentrations did not differ between seasons, and from the results of the 2016 study when chlorophyll-a concentrations were significantly higher in the summer. Although chlorophyll-a concentrations were generally comparable from 2015 to 2018 for like-seasons at Reference Lake 3, the relative seasonal changes in chlorophyll-a concentrations among years suggested naturally variable temporal patterns in phytoplankton abundance can be expected at Mary River Project mine local study area lakes.

Table B.7: Statistical Comparisons of Chlorophyll-a Concentrations among Winter, Spring, Summer, and/or Fall Sampling Events at Reference Lotic and Lentic Study Areas, Mary River Project CREMP, 2018

Study Lake	Overall 3-group Comparison			Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Areas?	p-value	Statistical Test[b]	(I) Area	(J) Area	Significant Difference Between 2 Areas?	p-value	Statistical Test
Stream Reference Stations	NO	0.75140	ANOVA[c]	Spring	Summer	NO	0.9646	Tamhane's
				Spring	Fall	NO	0.8735	
				Summer	Fall	NO	0.7381	
Mary River GO-09 Reference Stations	YES	0.00935	ANOVA[c]	Spring	Summer	YES	0.0088	Tukey's
				Spring	Fall	YES	0.0383	
				Summer	Fall	NO	0.4381	
Reference Lake 3	-	-	-	Winter	Summer	not applicable	-	ANOVA[c]
				Winter	Fall	not applicable	-	
				Summer	Fall	YES	0.0203	

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Statistical tests include Analysis of Variance (ANOVA) and Kruskal Wallis H-test (KW H-test).

[c] Untransformed data normally distributed.

[d] Logged data non-normally distributed.

[e] Kruskal-Wallis H-test used to validate results of ANOVA three-group comparison.

[f] Mann-Whitney U-test used to validate results of post-hoc tests for all pair-wise comparisons.

B6 BENTHIC INVERTEBRATE COMMUNITY

B6.1 Creek/Tributary Environments

The original Mary River Project CREMP design had not included/identified a reference creek from which to evaluate potential mine-related effects on benthic invertebrate communities of creek/tributary environments, instead relying solely on a before-after approach to identify potential mine influences on benthic invertebrates over time (see NSC 2014). Stemming from recommendations from the 2015 CREMP (Minnow 2016b), a reference creek was incorporated into the 2016 to 2018 CREMP benthic invertebrate community studies to provide a stronger basis for evaluating potential within-year mine-related effects to biota residing in mine-exposed tributaries of Camp and Sheardown lakes. The benthic invertebrate community (benthic) study area selected for the CREMP was located within at the same unnamed tributary to Angajurjualuk Lake that is used for reference water quality sampling (Stations CLT-REF4 and MRY-REF2; Table 2.5; Figure 2.4). Criteria used for the selection of this creek as a reference area for the CREMP, which is herein referred to as Unnamed Reference Creek, included a watercourse exhibiting similar habitat characteristics (e.g., width, water velocity, substrate size) as the mine-exposed tributaries that is not/has not been influenced by mining or adverse anthropogenic disturbances. The acceptance of Unnamed Reference Creek as a reference area for the evaluation of mine-related influences on tributary water chemistry under the original CREMP (KP 2014a) was also considered an important criterion in the selection of this watercourse as a suitable reference area for the benthic invertebrate community survey.

Benthic invertebrate density at Unnamed Reference Creek ranged from 262 to 636 individuals/m^2 in 2018 (mean of 526 individuals/m^2) , which is considered moderate for Arctic streams (Craig and McCart 1975). Unnamed Reference Creek showed relatively high richness and Simpson's Evenness in 2018, which was unlike the low production that can naturally be expected in Arctic streams as the result of constraints associated with low nutrients and seasonal temperatures, as well as food limitation (Huryn and Wallace 2000). Chironomidae (non-biting midges) and Simuliidae (blackflies) were the dominant taxomonic groups observed at Unnamed Reference Creek benthic stations, collectively accounting for approximately 76% of the community (Appendix Table B.8). Collector-gatherers were the dominant benthic invertebrate functional feeding group (FFG) present at Unnamed Reference Creek (Appendix Table B.8), suggesting greatest reliance upon deposited fine particulate organic matter as a food source for benthic invertebrates. Shredders constituted a low proportion of the Unnamed Reference Creek benthic invertebrate community (Appendix Table B.9), suggesting that live and/or decomposing leaf material was a less important food source. In terms of benthic invertebrate habitat preference groups (HPG), sprawlers were the dominant group at Unnamed

Table B.8: Benthic Invertebrate Community Summary Statistics for Unnamed Reference Creek and Mary River (GO-09) Reference Areas, Mary River Project CREMP, August 2018

Metric	Area	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unnamed Reference Creek	5	526	152	68	337	714	262	636
	Mary River GO-09 Reference	5	194	112	50	55	332	77	361
Richness (Number of Taxa)	Unnamed Reference Creek	5	19.8	3.0	1.4	16.0	23.6	16.0	24.0
	Mary River GO-09 Reference	5	11.8	2.3	1.0	9.0	14.6	9.0	14.0
Simpson's Evenness	Unnamed Reference Creek	5	0.960	0.011	0.005	0.946	0.974	0.942	0.972
	Mary River GO-09 Reference	5	0.907	0.030	0.013	0.870	0.945	0.876	0.942
Bray-Curtis Index	Unnamed Reference Creek	5	0.208	0.093	0.042	0.092	0.324	0.114	0.342
	Mary River GO-09 Reference	5	0.345	0.137	0.061	0.175	0.515	0.120	0.471
Simuliidae (% of community)	Unnamed Reference Creek	5	15.9%	4.6%	2.0%	10.2%	21.6%	11.2%	22.2%
	Mary River GO-09 Reference	5	14.1%	9.9%	4.4%	1.8%	26.4%	2.9%	28.6%
Hydracarina (% of community)	Unnamed Reference Creek	5	3.3%	1.3%	0.6%	1.6%	4.9%	2.0%	5.3%
	Mary River GO-09 Reference	5	0.3%	0.7%	0.3%	-0.6%	1.2%	0.0%	1.6%
Chironomidae (% of community)	Unnamed Reference Creek	5	60.3%	4.5%	2.0%	54.8%	65.9%	55.0%	66.8%
	Mary River GO-09 Reference	5	78.7%	12.3%	5.5%	63.5%	94.0%	65.9%	91.3%
Metal Sensitive Chironomidae (% of community)	Unnamed Reference Creek	5	12.4%	4.2%	1.9%	7.1%	17.7%	6.9%	18.7%
	Mary River GO-09 Reference	5	31.0%	10.5%	4.7%	18.0%	44.0%	14.3%	41.4%
Tipulidae (% of community)	Unnamed Reference Creek	5	2.8%	1.5%	0.7%	1.0%	4.6%	1.5%	4.7%
	Mary River GO-09 Reference	5	3.1%	4.1%	1.8%	-1.9%	8.2%	0.0%	10.0%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	5	71.5%	4.0%	1.8%	66.5%	76.5%	67.2%	76.0%
	Mary River GO-09 Reference	5	80.9%	11.4%	5.1%	66.7%	95.0%	66.8%	94.2%
Filterer FFG (% of community)	Unnamed Reference Creek	5	16.0%	4.5%	2.0%	10.4%	21.6%	11.2%	22.2%
	Mary River GO-09 Reference	5	14.1%	9.9%	4.4%	1.8%	26.4%	2.9%	28.6%
Shredder FFG (% of community)	Unnamed Reference Creek	5	4.8%	2.8%	1.2%	1.4%	8.2%	1.5%	8.3%
	Mary River GO-09 Reference	5	4.7%	6.3%	2.8%	-3.1%	12.6%	0.0%	15.2%
Clinger HPG (% of community)	Unnamed Reference Creek	5	22.6%	4.9%	2.2%	16.4%	28.7%	17.9%	29.2%
	Mary River GO-09 Reference	5	16.0%	10.2%	4.6%	3.4%	28.7%	2.9%	28.6%
Sprawler HPG (% of community)	Unnamed Reference Creek	5	66.2%	5.0%	2.2%	60.0%	72.5%	61.8%	72.0%
	Mary River GO-09 Reference	5	79.0%	12.7%	5.7%	63.1%	94.8%	61.8%	94.2%
Burrower HPG (% of community)	Unnamed Reference Creek	5	11.2%	1.9%	0.9%	8.8%	13.6%	9.0%	14.0%
	Mary River GO-09 Reference	5	5.0%	5.8%	2.6%	-2.2%	12.2%	0.0%	15.0%

Table B.9: Benthic Invertebrate Community Statistical Comparison Results between Littoral and Profundal Stations at Reference Lake 3, Mary River Project CREMP, August 2018

Metric	Statistical Test Results					Summary Statistics						
	Data Transform-ation	Significant Difference Between Habitats?	p-value	Statistical Analysis[a]	Magnitude of Difference [a] (No. of SD)	Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (Individuals/m^2)	none	YES	0.001	t-equal	-2.6	Lake Littoral	1,045	258	116	696	1,000	1,391
						Lake Profundal	377	155	69	104	452	470
Richness (Number of Taxa)	none	YES	0.002	t-equal	-2.4	Lake Littoral	10.8	2.3	1.0	7.0	11.0	13.0
						Lake Profundal	5.4	1.3	0.6	4.0	6.0	7.0
Simpson's Evenness (E)	log	YES	0.007	t-equal	-3.6	Lake Littoral	0.825	0.103	0.046	0.720	0.816	0.939
						Lake Profundal	0.455	0.296	0.132	0.218	0.296	0.933
Bray-Curtis Index	square root	YES	< 0.001	t-equal	-1.0	Lake Littoral	0.313	0.092	0.041	0.178	0.358	0.394
						Lake Profundal	0.224	0.304	0.136	0.051	0.109	0.763
Nemata (%)	fourth root	NO	0.268	t-equal	-0.5	Lake Littoral	7.1	8.8	3.9	0.0	3.4	21.3
						Lake Profundal	2.5	3.8	1.7	0.0	0.0	8.7
Hydracarina (%)	none	NO	0.447	t-equal	0.7	Lake Littoral	2.1	2.1	0.9	0.0	1.7	5.6
						Lake Profundal	3.7	3.8	1.7	0.0	3.9	8.7
Ostracoda (%)	square root	YES	0.015	t-equal	-1.1	Lake Littoral	23.9	18.3	8.2	3.4	20.6	53.3
						Lake Profundal	3.1	2.9	1.3	0.0	2.0	7.5
Chironomidae (%)	none	YES	0.048	t-equal	1.1	Lake Littoral	66.9	22.2	10.0	35.5	73.8	91.4
						Lake Profundal	90.8	4.9	2.2	82.7	92.2	95.7
Metal-Sensitive Chironomidae (%)	log	YES	0.017	t-equal	-1.3	Lake Littoral	36.5	19.6	8.8	17.8	27.5	60.1
						Lake Profundal	11.4	16.8	7.5	2.3	3.9	41.4
Collector-Gatherers (%)	log	YES	0.019	t-equal	1.8	Lake Littoral	55.6	19.0	8.5	33.0	57.5	79.2
						Lake Profundal	89.8	13.6	6.1	66.3	96.2	100.0
Filterers (%)	fourth root	YES	0.019	t-equal	-1.5	Lake Littoral	33.9	18.7	8.4	15.5	24.9	56.6
						Lake Profundal	6.5	10.5	4.7	0.0	3.7	25.0
Clingers (%)	square root	YES	0.023	t-equal	-1.4	Lake Littoral	36.1	18.4	8.2	17.1	26.9	58.3
						Lake Profundal	10.2	13.6	6.1	0.0	3.9	33.6
Sprawlers (%)	none	YES	0.093	t-equal	1.5	Lake Littoral	51.9	17.7	7.9	29.5	52.5	71.8
						Lake Profundal	79.3	26.8	12.0	32.7	90.4	100.0
Burrowers (%)	square root	NO	0.416	t-equal	-0.2	Lake Littoral	12.0	6.4	2.8	6.9	11.1	22.6
						Lake Profundal	10.6	14.1	6.3	0.0	5.6	33.6

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the standard deviation.

▨	Grey shading indicates statistically significant difference between habitat types based on p-value≤ 0.10.
🟦	Blue shaded values indicate significant difference (p-value≤ 0.10) that was also outside of a CES of ±2 SD, indicating that the difference was ecologically meaningful.

Reference Creek (Appendix Table B.8) suggesting that most invertebrates were associated with substrate surfaces and were not deeply embedded in the substrate (i.e., non-burrowers).

B6.2 River Environments

The area of Mary River located upstream of the mine lease property has been considered representative of reference conditions for the mine-exposed stations/study areas situated farther downstream on the Mary River under the CREMP (Baffinland 2015; KP 2014a,b, 2015; NSC 2014). As in previous CREMP studies, the GO-09 area of Mary River (including water quality stations GO-09A, GO-09 and GO-09B) was used as the benthic reference area for mine-exposed areas of Mary River as part of the 2018 CREMP (see Table 2.5; Figure 2.4).

Benthic invertebrate density at the Mary River reference area in 2018 ranged from 77 to 361 individuals/m^2, which is considered low to moderate for Arctic lotic systems (Craig and McCart 1975). Moderate richness and Simpson's Evenness also characterized the benthic invertebrate community of the Mary River reference area, and reflected naturally low Arctic stream environment productivity as a result of low ambient temperatures and nutrient levels (Huryn and Wallace 2000). Midges of the family Chironomidae were the dominant taxonomic group observed at the Mary River reference area, with the relative abundance of this group ranging from 66 to 91% of individuals (mean of 79%) and chironomid taxa considered metal-sensitive constituting 14 to 41% of the community (Appendix Table B.8). Similar to the reference creek, collector-gatherers were the dominant FFG present at the Mary River reference area (Appendix Table B.8), suggesting that fine particulate organic matter was the predominant food source for benthic invertebrates at this area. Sprawlers composed the dominant HPG at the Mary River reference area (Appendix Table B.8), which suggested that most benthic invertebrates were associated with the surface of rocky substrates.

Comparison of the Mary River reference area benthic invertebrate communities among baseline (2006, 2007) and mine-operational (2015 to 2018) studies for key metrics indicated no consistent significant differences in density, richness, and relative abundance of metal-sensitive chironomids between the baseline and mine-operational periods (Figure 5.6; Appendix Table F.54). Although Simpson's Evenness was significantly higher, and relative abundance of chironomids and FFG collector-gatherers significantly lower, for the mine-operational studies compared to the baseline studies, the direction of these differences was not consistent with an adverse change but rather suggested greater diversity and/or more even distribution of invertebrate groups and FFG for the mine-operational period (Figure 5.6; Appendix Table F.54). These changes in benthic invertebrate community metrics between the mine baseline and operational studies at the Mary River reference area were thus attributable to natural variability in community traits among years and/or to artifacts associated with CREMP sampling among studies.

B6.3 Lentic Environments (Reference Lake 3)

The benthic invertebrate community of Reference Lake 3 differed dramatically between littoral (<12 m depth) and profundal (>12 m depth) stations in 2018. As in previous monitoring conducted from 2015 to 2017, significantly higher benthic invertebrate density, richness, and Simpson's Evenness was observed at littoral stations compared to profundal stations in 2018, most at Critical Effect Sizes outside of ± 2 SD (Appendix Table B.9). In addition, differences in benthic invertebrate community structure occurred between sampling depths as indicated by significantly differing Bray Curtis Index and supported by higher and lower relative abundance of Ostracoda (seed shrimp) and Chironomidae (non-biting midges), respectively, at littoral stations compared to profundal stations (Appendix Table B.9). Significant differences in the relative abundance of FFG or HPG were also indicated between littoral and profundal habitats of Reference Lake 3, although these differences were not at effect sizes considered ecologically meaningful (Appendix Table B.9). The difference in benthic invertebrate community metrics and assemblage features between the littoral and profundal stations observed at Reference Lake 3 from 2015 to 2018 validated proposed changes to the CREMP benthic invertebrate community survey by Minnow (2016b). Specifically, benthic invertebrate community surveys can focus only on littoral habitat to reflect the fact that natural habitat factors that affect community assemblage at profundal areas limit the ability to interpret potential mine-related biological effects at profundal depths of the local study area lakes.

Comparison of littoral habitat benthic invertebrate communities at Reference Lake 3 among the 2015 to 2018 studies for key metrics indicated no consistent significant differences in density, richness, Simpson's Evenness, Bray Curtis Index, relative abundance of dominant FFG, and the relative abundance of all dominant taxonomic groups except Ostracoda (Appendix Table F.18). At profundal habitat, benthic invertebrate density, Simpson's Evenness, and relative abundance of the collector-gatherer FFG routinely differed significantly among years, but no consistent direction of differences has occurred over time (Appendix Table F.19). Overall, this suggested that the benthic invertebrate community at littoral habitat of Reference Lake 3 showed relatively minor changes from 2015 to 2018, whereas the benthic invertebrate community at profundal habitat can vary significantly from year-to-year for certain metrics (e.g., density, Simpson's Evenness).

B7 FISH POPULATION

B7.1 Lotic Environments

Fish population sampling of lotic habitats is not required as part of the Mary River Project CREMP (see NSC 2014). In part, this reflects the fact that fish can only inhabit local study area creeks/rivers for a short period each year (i.e., July to September) as a result of complete freezing/desiccation of these lotic habitats over much of the year. In addition, sampling of juvenile arctic charr within a representative lotic habitat is conducted for the federal Environmental Effects Monitoring (EEM) program to meet Metal and Diamond Mining Effluent Regulation requirements (Baffinland 2015; Minnow 2018b).

B7.2 Lentic Environments (Reference Lake 3)

The Reference Lake 3 fish community was composed of arctic charr and ninespine stickleback. The relative abundance of both species has been low at Reference Lake 3 based on low electrofishing and gill netting catches and catch-per-unit-effort (CPUE) for each species in 2018 (Appendix Tables G.1 and G.2) as well as in all previous studies from 2015 to 2017 (Minnow 2018a). Suitable numbers of arctic charr were captured at nearshore habitat of Reference Lake 3 (i.e., 100 individuals) to allow evaluation of mine-related effects on survival, growth, and condition of fish collected at the mine-exposed lake shorelines. For these fish, young-of-the-year (YOY) individuals were generally distinguishable from the 1+ to 6+ age classes at a fork length of 5.0 cm based on the evaluation of length-frequency distributions coupled with supporting age determinations (Appendix Figure B.8). In 2015, YOY arctic charr captured at nearshore habitat were not able to be distinguished from older age classes at Reference Lake 3 (Appendix Figure B.8). However, population comparisons of nearshore arctic charr captured between the mine-exposed and reference lakes from 2016 to 2018 were completed separately for YOY and non-YOY data sets. Temporal comparisons of the 2015 to 2018 nearshore arctic charr data indicated significantly larger sized fish were sampled in 2016 compared to 2015, 2017, and 2018 at the reference lake, the differences of which in fresh body weight were outside of the critical effect size for growth endpoints of ±25% (Appendix Table B.10). Similarly, condition of nearshore arctic charr differed significantly among the 2015 to 2018 studies at Reference Lake 3, the magnitude of which was outside of the critical effect size for condition of ±10% between the 2015 and 2018 studies, and between the 2017 and 2018 studies (Appendix Figure B.9). This indicated that some year-to-year differences in fish population endpoints can be expected naturally at local study area lakes, and these difference should be considered for the nearshore fish population surveys conducted as part of the Mary River Project CREMP.

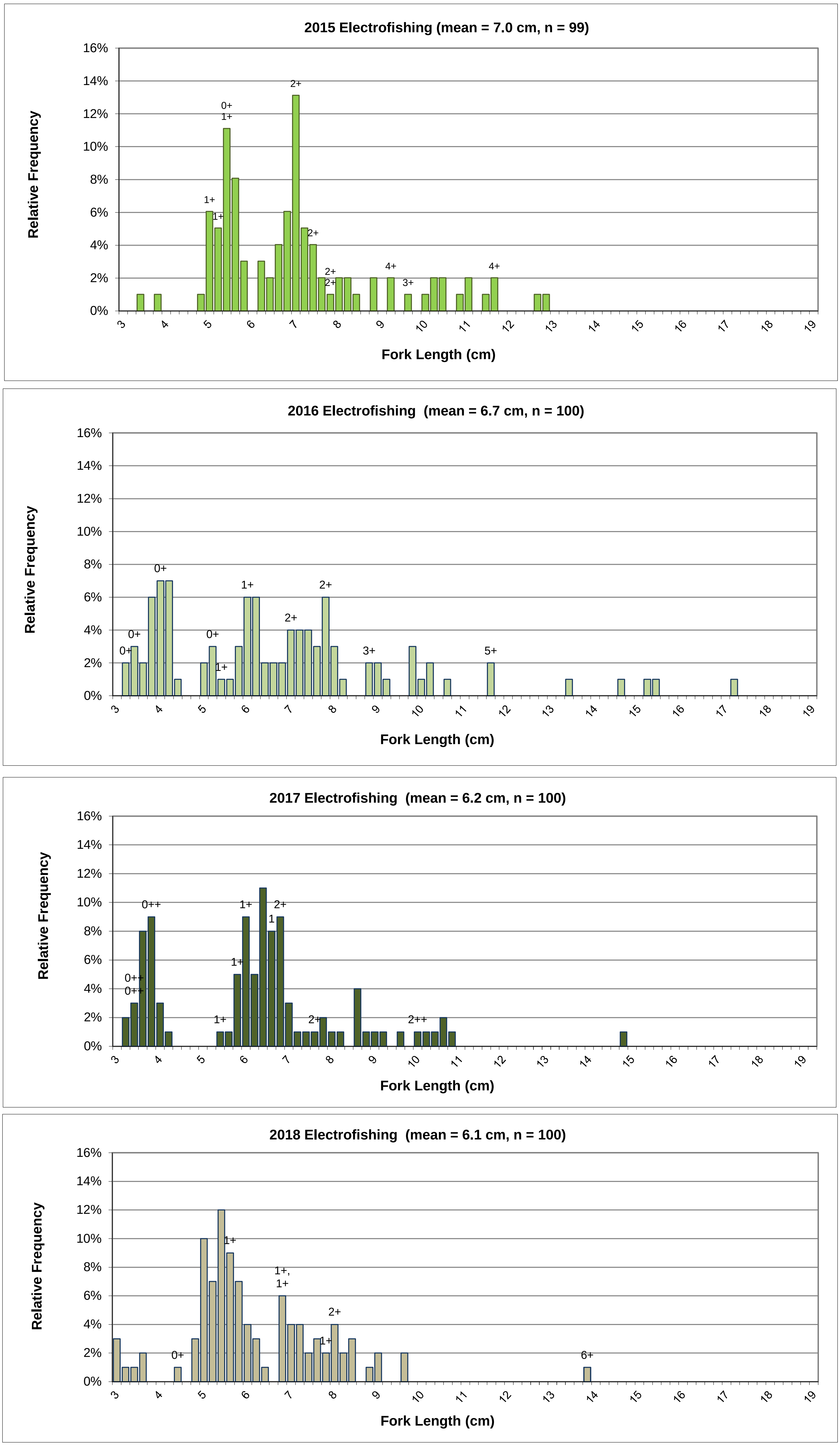

Figure B.8: **Length-frequency Distributions for Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Reference Lake 3 (REF3) in August 2015 to 2018, Mary River Project CREMP**

Note: Fish ages are shown above the bars, where available.

Table B.10: Statistical Comparisons For Length, Weight, and Condition Endpoints For Arctic Charr, Mary River Project CREMP

Endpoint	Variables		Sample Size				Test	Model Statistics			Summary Statistics[b]					Test P-value (Year)	Post-hoc Contrasts P-value and Magnitude of Difference (%)[c]											
	Response	Covariate	2015	2016	2017	2018		Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]	Statistic	2015	2016	2017	2018		2015 vs. 2016		2015 vs. 2017		2015 vs. 2018		2016 vs. 2017		2016 vs. 2018		2017 vs. 2018	
								Interaction P-value	Covariate P-value								P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
Length Frequency Distribution	Fork Length (cm)	-	97	99	100	100	K-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0680	-	0.0220	-	0.0158	-
Body Size	Fork Length (cm)	-	97	68	74	92	K-W	-	-	-	Median	6.8	7.3	6.6	5.8	<0.001	0.005	7	0.387	-3	0.005	-15	0.064	-10	<0.001	-21	<0.001	-12.1
	Weight (g)	-	97	68	74	92	K-W	-	-	-	Median	2.68	3.34	2.49	1.83	<0.001	0.005	25	0.345	-7	0.104	-32	0.075	-25	<0.001	-45	0.014	-26.5
Condition	log[Weight (g)]	log[Fork Length (cm)]	97	68	74	92	ANCOVA	0.051	<0.001	6.84	Adjusted Mean	3	3.05	3	3.35	<0.001	0.662	2	1	0	<0.001	12	0.721	-2	<0.001	10	<0.001	12

▨ Area P-value < 0.1 or Interaction P-value < 0.05

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median and adjusted mean are reported for Kruskal-Wallis and ANCOVA, respectively, and the predicted means of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., different slopes) occurs.

[c] The magnitude of difference calculated as: [(year mean - earlier year mean) /earlier year mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(year predicted mean - earlier year predicted mean) / earlier year predicted mean] x 100.

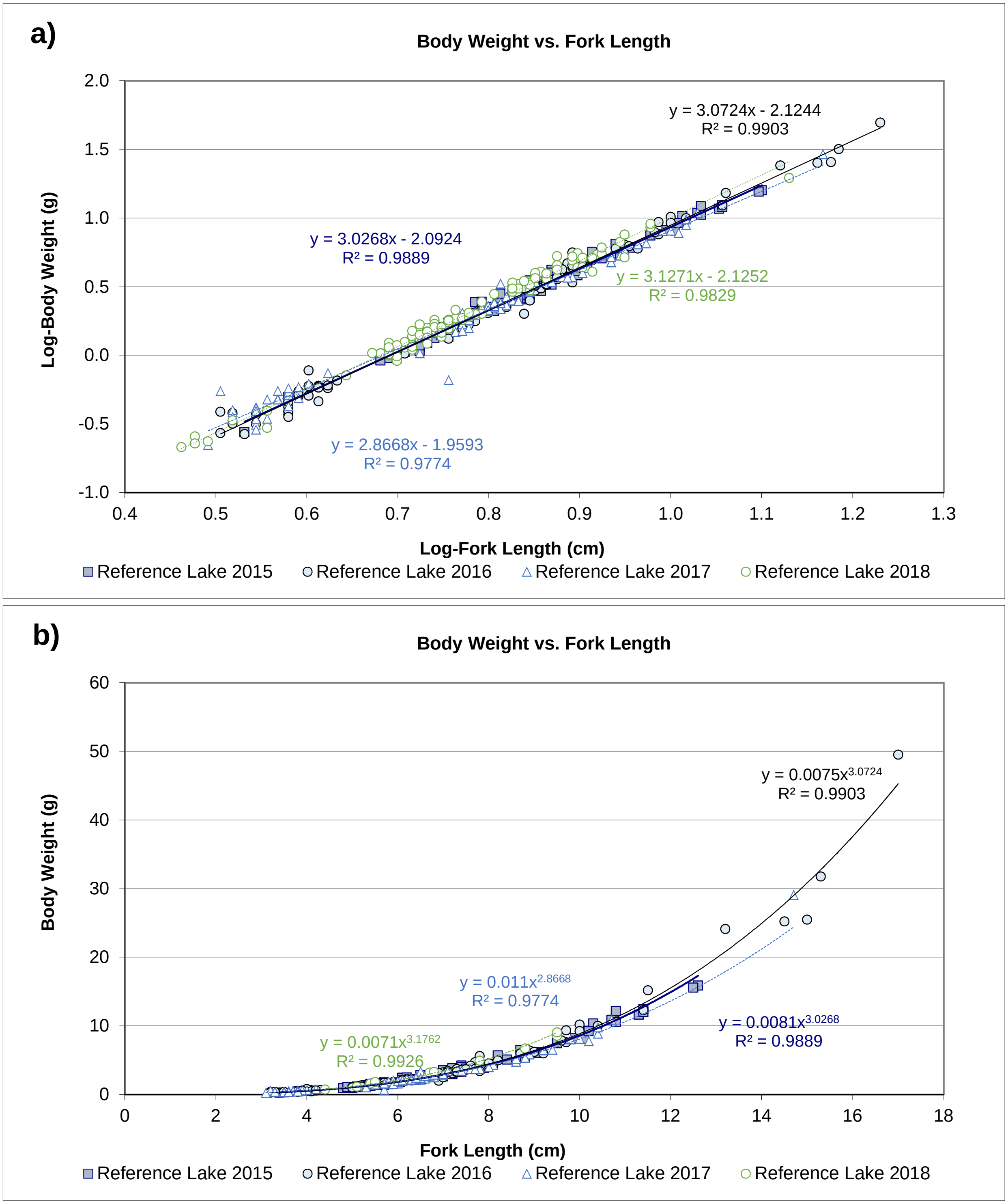

Figure B.9: **Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at the Nearshore Area of Reference Lake 3 in August 2015 to 2018 using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP**

Low numbers of arctic charr were captured at littoral/profundal areas of Reference Lake 3 in 2018 (i.e., 38 individuals) despite application of similar fishing effort to that used at the mine-exposed study lakes (Appendix Table G.2). However, unlike previous studies conducted from 2015 to 2017 that resulted in catches ranging from 1 to 14, the sample size in 2018 was sufficient as a basis for conducting meaningful statistical comparison with the mine-exposed lakes to evaluate mine-related effects on the population of reproductive-aged arctic charr. Notably, because arctic charr can show differential growth rates between the sexes (females grow faster; Jonsson et al. 1999; Skulason et al. 1996; Gulseth and Nilssen 2001), natural differences in sex ratios between study areas could potentially result in falsely attributing differences in growth and/or condition between mine-exposed and reference areas to mine-related influences. Thus, the inability to definitively determine arctic charr sex using external characteristics when applying a non-lethal sampling approach could confound data interpretation. To determine whether differences in sex ratios could potentially confound the interpretation of the CREMP arctic charr health assessment, growth and condition were compared between male and female Arctic charr collected at Camp, Sheardown and Mary lakes during the baseline period as part of the 2015 CREMP (Minnow 2016a). No significant differences in growth and condition were indicated between males and females based on this analysis, suggesting that a non-lethal study approach is unlikely to bias the evaluation of mine-related effects on fish health as part of the CREMP. Contrary to the published literature, the absence of differences in arctic charr growth and condition between males and females at Mary River Project local study area lakes may be explained by naturally slow growth rates and low spawning frequency (i.e., once every 2 to 4 years) at high Arctic areas, and also by low gonadosomatic index (GSI) at the time that sampling is normally conducted for the Mary River Project CREMP (i.e., August).

B8 CREMP IMPLICATIONS

This overview of reference conditions was included in the CREMP to provide context and perspective regarding key chemical, physical, and biological features of the CREMP reference study areas. Key implications of reference area features that could affect the ability of the CREMP to evaluate mine-related effects at mine-exposed waterbodies that were identified through the 2016 to 2018 reference area overviews include the following:

- **Federal Water Quality Guidelines (WQG) are not applicable for aqueous phenol concentrations**. Aqueous concentrations of phenols were routinely elevated above WQG at the CREMP creek, river and lake reference stations in 2015 and 2016. Correlation analysis indicated a significant, positive relationship between phenol and both nitrate and DOC concentrations in the 2015 and 2016 CREMP, suggesting that high phenol concentrations in waterbodies near the Mary River Project mine were associated with influences from natural organic composition. Therefore, phenol concentration comparisons against applicable WQG did not serve as a focus for discussion as part of the 2016 to 2018 CREMP.

- **Greater reliance on the use of dissolved metals concentrations for assessing mine-related influences on aqueous metal concentrations at waterbodies used for the CREMP**. Total aluminum concentrations were routinely elevated, and other metals including (total) iron and manganese periodically elevated, above WQG at creek, river and/or lake reference areas used for the CREMP from 2015 to 2018, and historically in baseline studies. Significant positive correlations between total concentrations of these metals and turbidity were identified using the 2015 to 2018 data sets which suggested that these metals were likely bound to and/or composed suspended particulate materials in water samples. This was supported by a low ratio of dissolved to total metal concentrations in reference water samples from 2015 to 2017. Accordingly, greater emphasis should be placed on comparison of dissolved metal concentrations for assessing potential mine-related influences on water quality as part of the CREMP studies.

- **Use of fall sampling event water quality data to allow the most conservative evaluation of potential mine-related influences on water chemistry**. Water chemistry at lotic reference stations showed distinct seasonal changes in parameter concentrations during the baseline, and 2015 to 2017 studies. In general, conventional parameters, anions, and total metals were observed at lowest concentrations in spring, with intermediate concentrations in the summer, and highest concentrations observed during the fall in each year. Therefore, although water chemistry data from winter, spring, and summer sampling events were examined, the fall water chemistry data generally served as the focus for the evaluation of potential mine-related influences on water quality at the mine-exposed lakes in CREMP studies conducted from 2016 to 2018.

- **Use of average water chemistry and chlorophyll-a data for lake water quality/phytoplankton monitoring stations**. No consistent differences in water chemistry or chlorophyll-a concentrations were observed between the surface and bottom of the water column at Reference Lake 3 stations from 2015 to 2018. Therefore, the evaluation of water chemistry and phytoplankton productivity among stations and study areas for the 2016 to 2018 Mary River Project CREMP studies was based on average water chemistry and chlorophyll-a values from the water column surface and bottom for each lake station.

- **Consider updating of the AEMP sediment quality benchmarks**. Arsenic, chromium, copper, iron, manganese, and phosphorus have been observed at concentrations above the AEMP sediment quality benchmarks in sediment at Reference Lake 3 in CREMP studies conducted from 2015 to 2018. This suggested that the AEMP benchmarks for these metals may be overly conservative and therefore, to improve the applicability of the AEMP benchmarks for these metals, consideration should be given to incorporating reference lake data into derivation of updated sediment quality AEMP benchmarks.

- **Focus lake benthic invertebrate community survey on littoral zone**. Benthic invertebrate community data collected at Reference Lake 3 from 2015 to 2018 consistently indicated that, similar to most lakes, benthic invertebrate community features can be expected to naturally change with depth. In general, as depth increases, lower benthic invertebrate density and richness typically occurs. The occurrence of naturally low density and/or richness can, in turn, limit the ability to distinguish adverse effects associated with a project. Therefore, in order to maximize the confidence in the benthic invertebrate community analysis results, the littoral zone should serve as the focus for the lake benthic invertebrate community survey analysis for the CREMP.

- **Adopting of standard CES for benthic invertebrate community and fish population endpoints into the CREMP**. Year-to-year evaluation of reference creek and lake habitat used for the CREMP has indicated that benthic invertebrate and fish populations differences between years can be expected to vary within the CES set out for use under the federal EEM program (Munkittrick et al. 2009). Therefore, the use of established CES for defining effects appears to be applicable to the Mary River Project CREMP.

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APPENDIX C

WATER QUALITY DATA

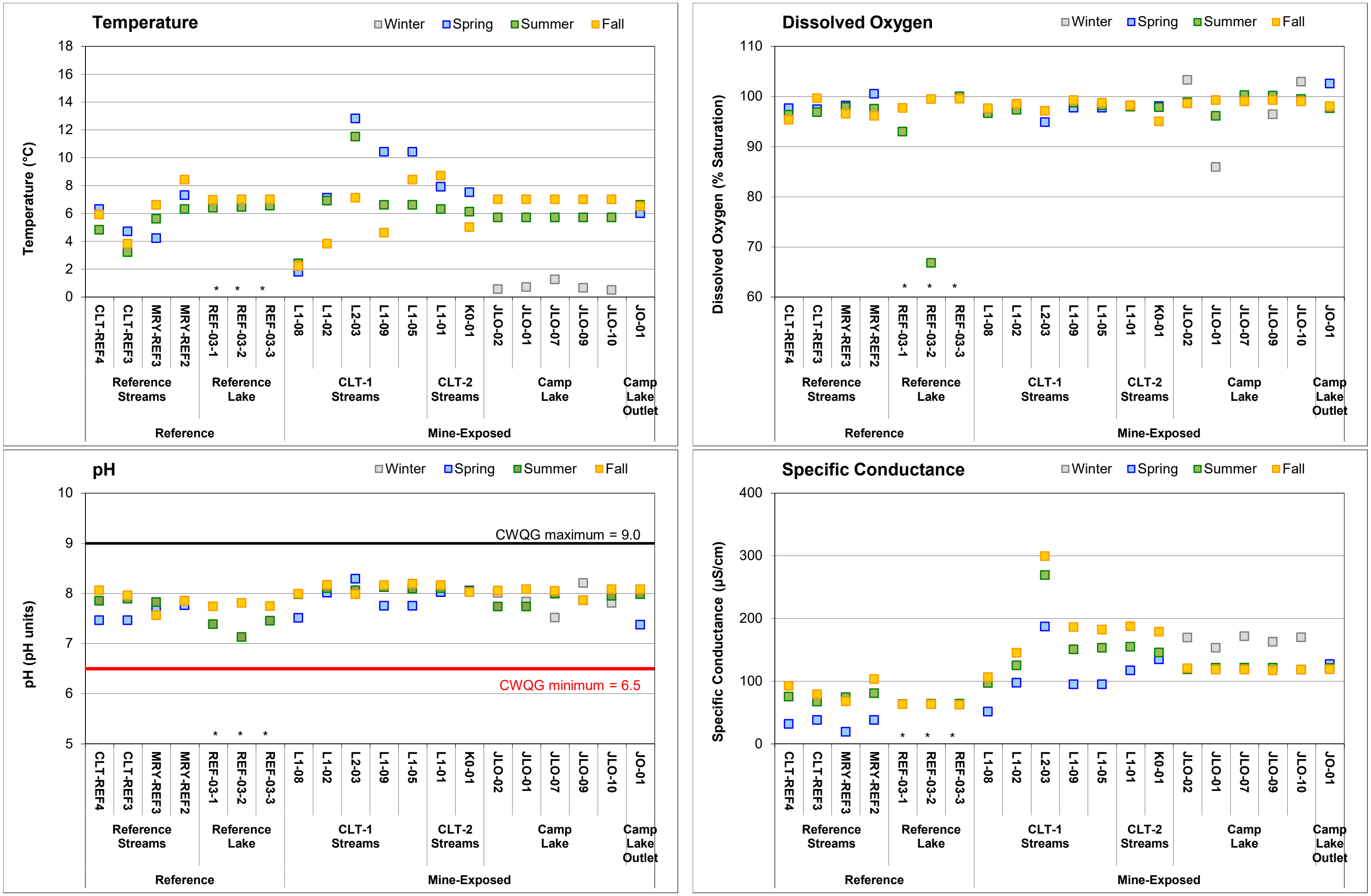


Figure C.1: Comparison of *In Situ* Water Quality Variables Measured at Camp Lake System Water Quality Monitoring Stations in Winter, Spring, Summer, and Fall 2018, Mary River Project CREMP

Notes: Lake values represent mean of surface and bottom *in situ* water quality measurements. Streams were not sampled in winter. Lakes were not sampled in spring.
* Reference Lake 3 (REF-03) was not sampled in winter.

Figure C.2: Temporal Comparison of Water Chemistry at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2018) Periods During Fall

Notes: Values represent mean ± SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Camp Lake Tributaries.

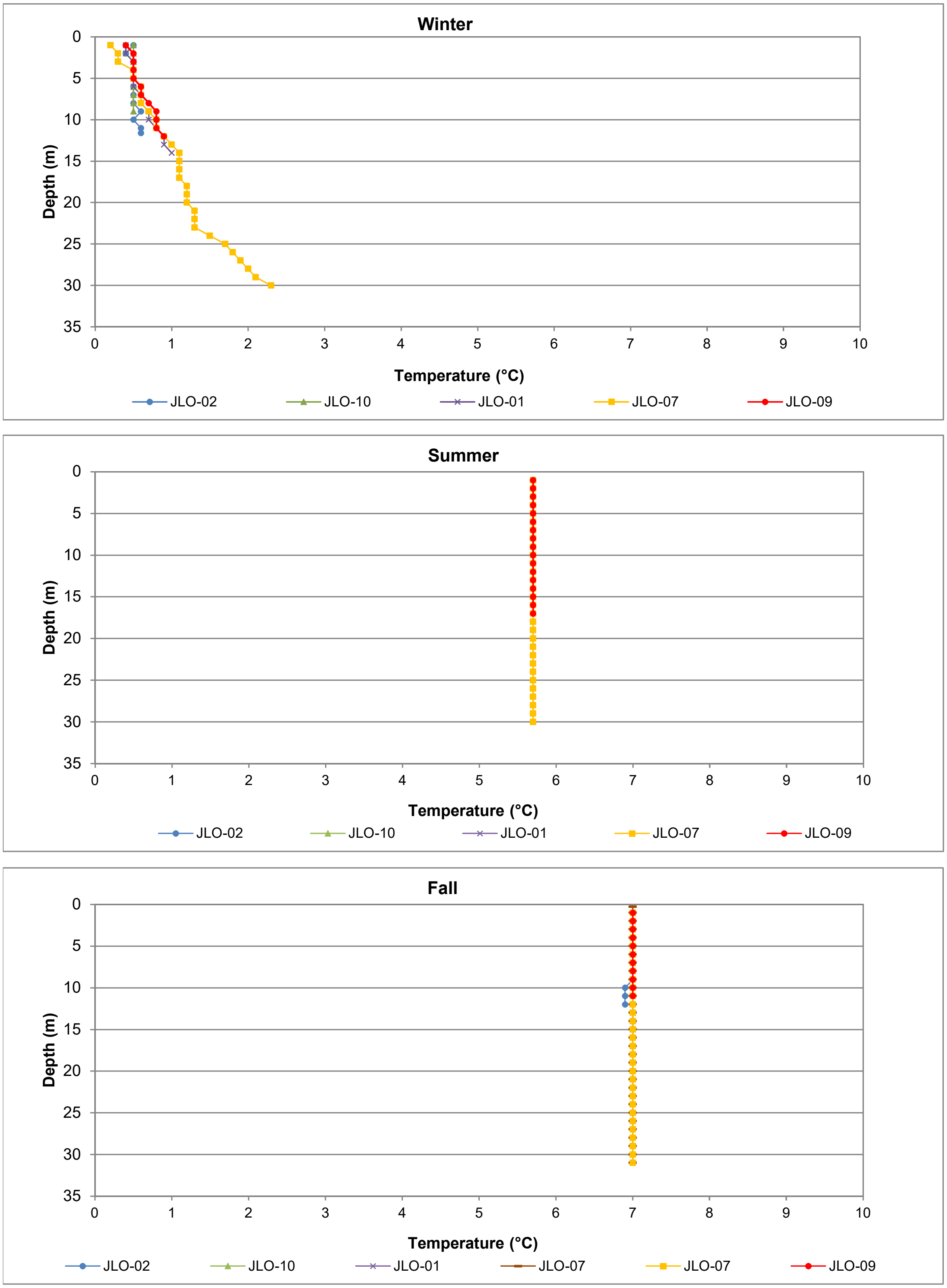


Figure C.3: Vertical Profiles of Temperature Measured at Camp Lake in Winter, Summer, and Fall, 2018

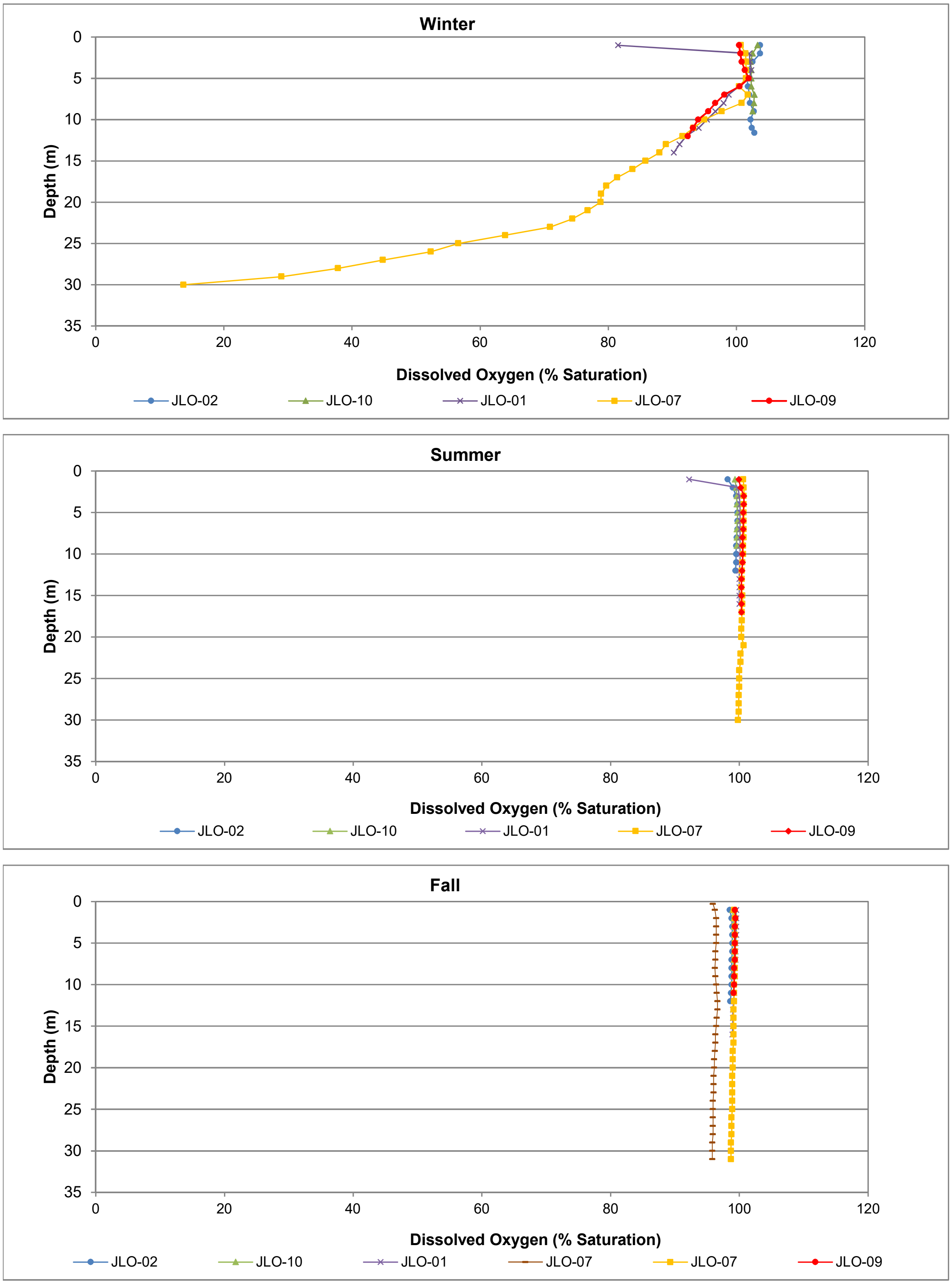


Figure C.4: Vertical Profiles of Dissolved Oxygen Measured at Camp Lake in Winter, Summer, and Fall, 2018

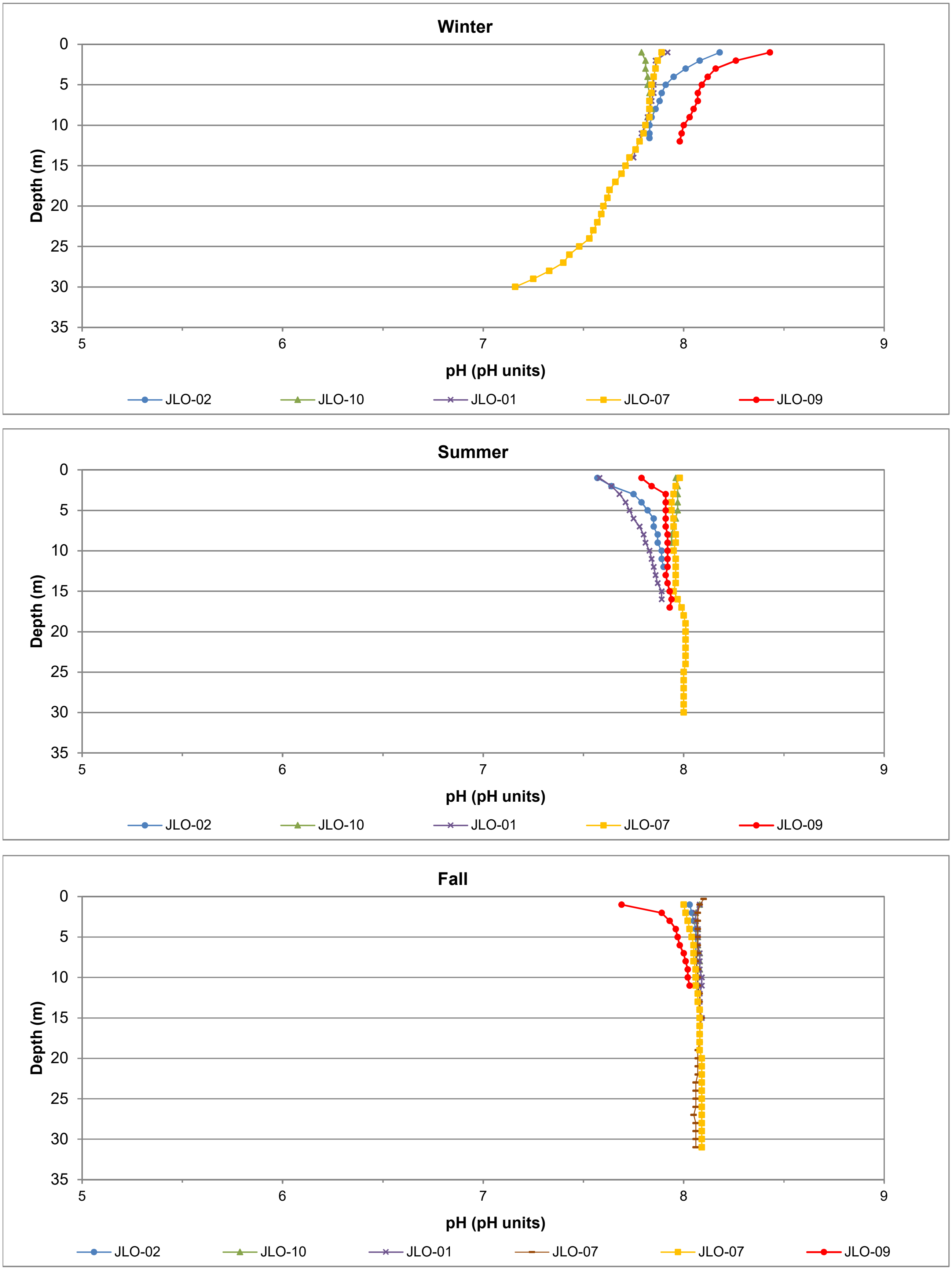


Figure C.5: Vertical Profiles of pH Measured at Camp Lake in Winter, Summer, and Fall, 2018

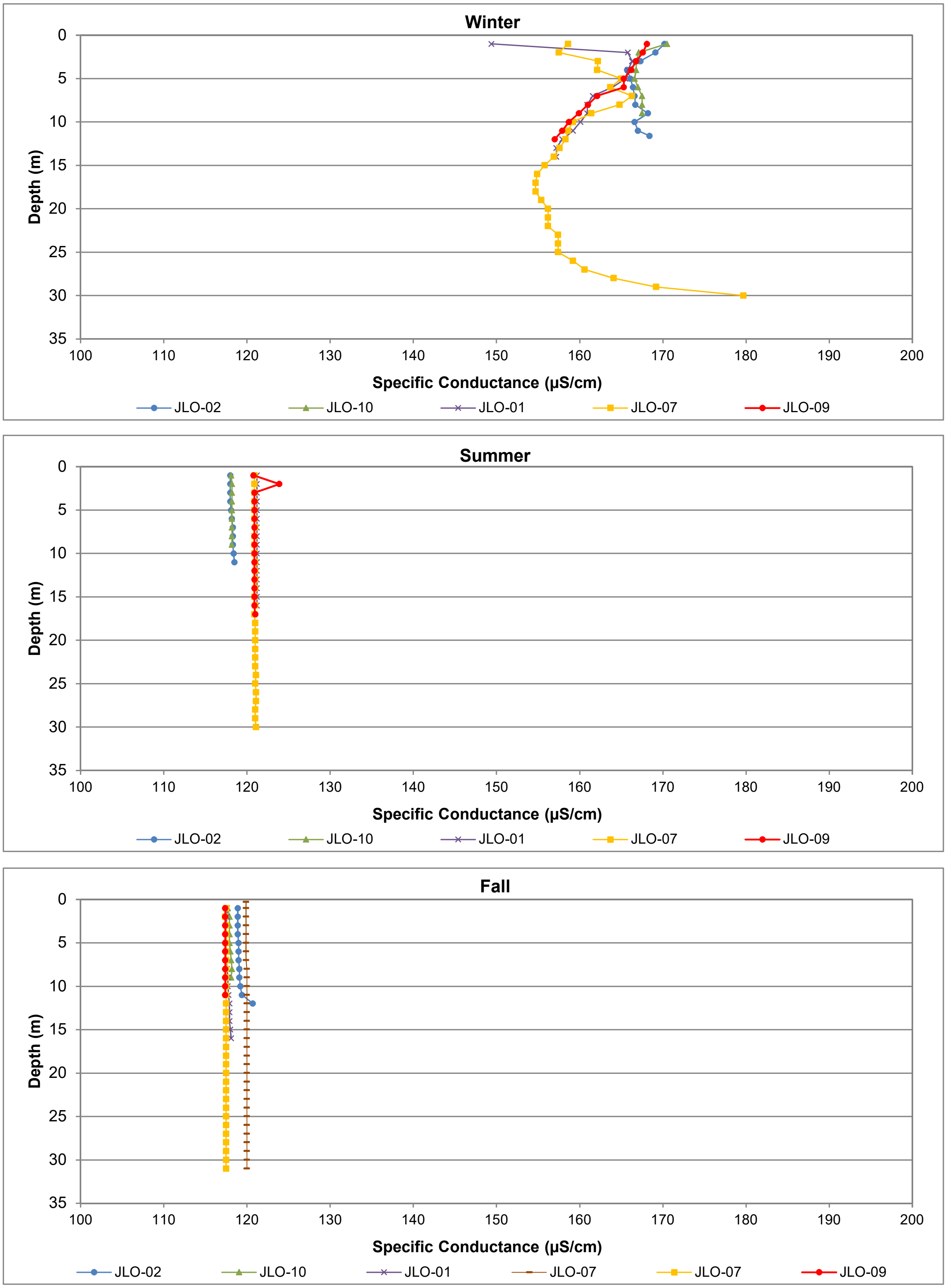


Figure C.6: Vertical Profiles of Specific Conductance Measured at Camp Lake in Winter, Summer, and Fall, 2018

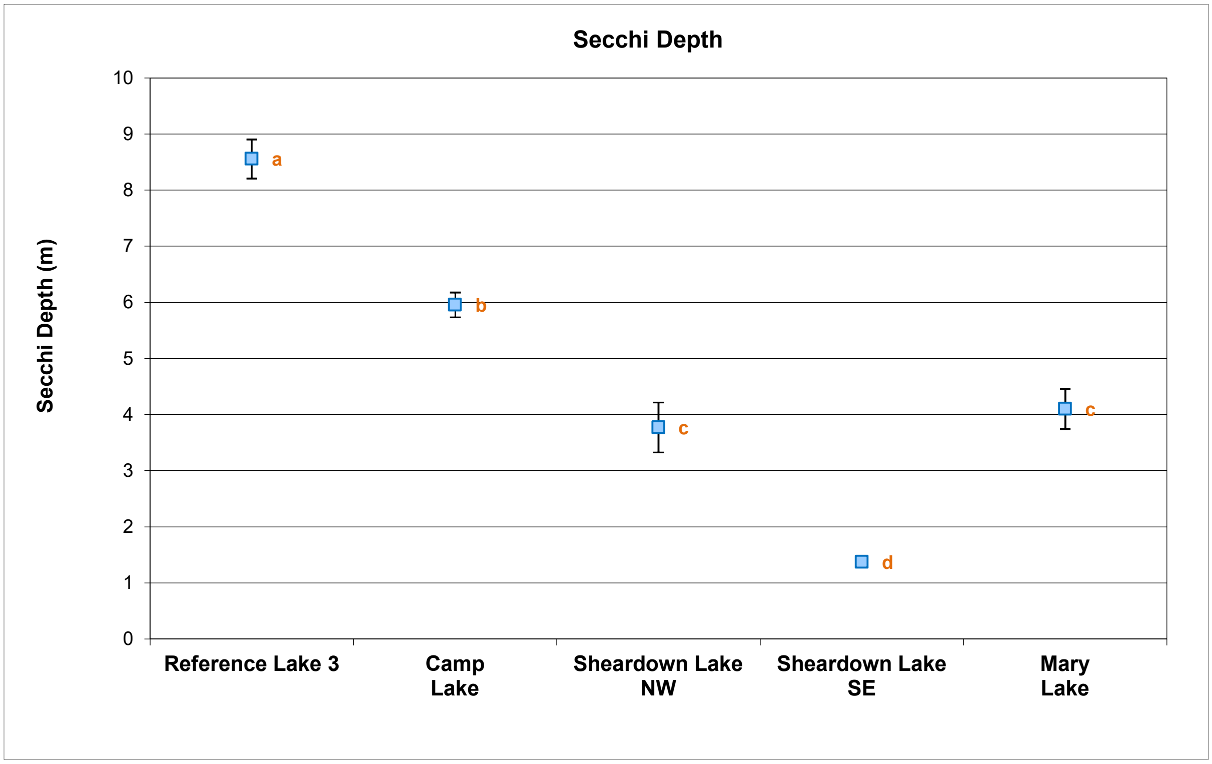


Figure C.7: Comparison of Secchi Depth (mean ± SD) Measured at the Mary River Project Lake Benthic Invertebrate Community Stations, August 2018

Notes: The same letter(s) next to study area data points indicate no significant difference between study areas. Sample size (n) was 10 for all lakes except Reference Lake 3, where n was 8.

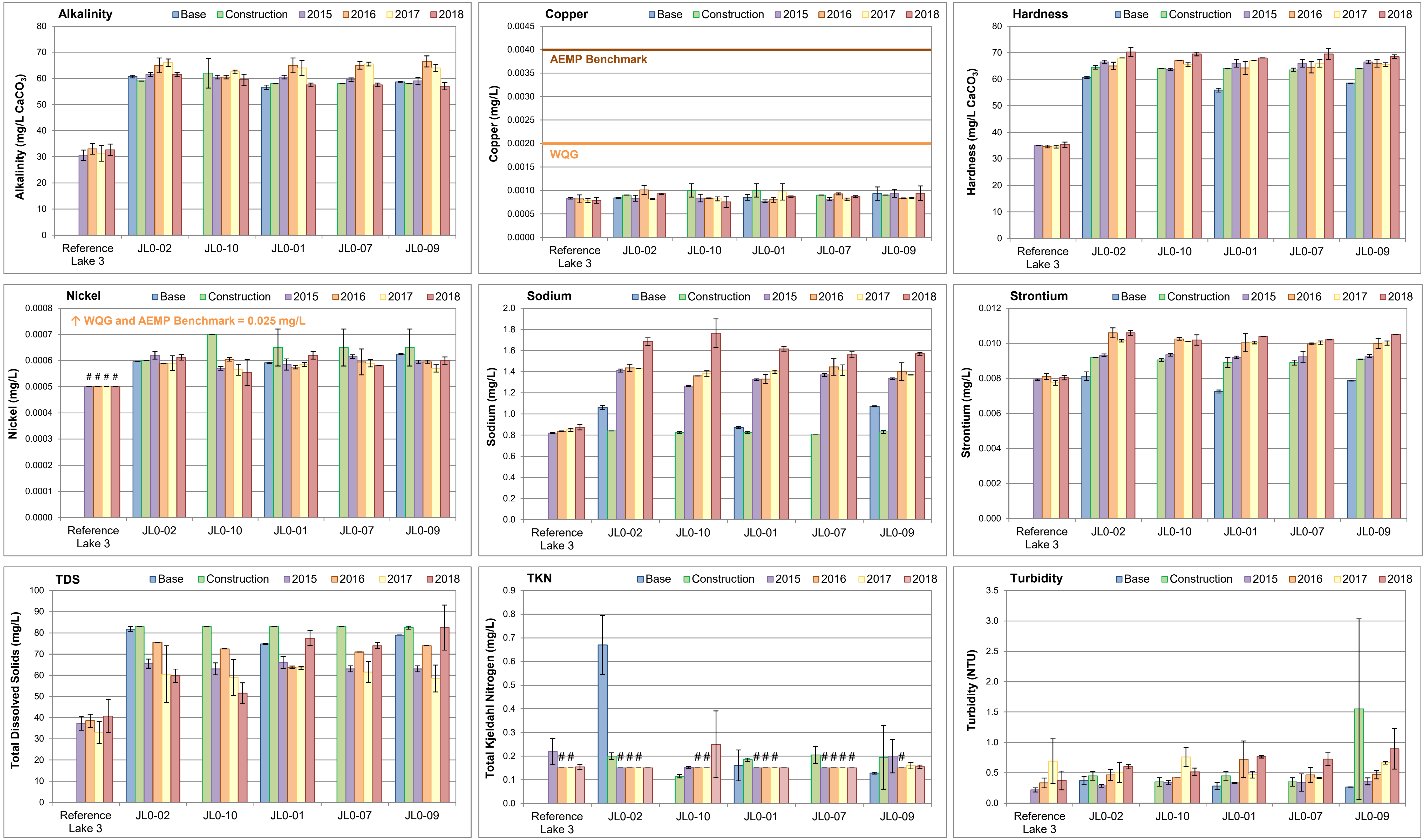

Alkalinity
Copper
Hardness
Nickel
Sodium
Strontium
TDS
TKN
Turbidity

Figure C.8: Temporal Comparison of Water Chemistry at Camp Lake (JLO) for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2018) Periods during Fall

Notes: Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Camp Lake.

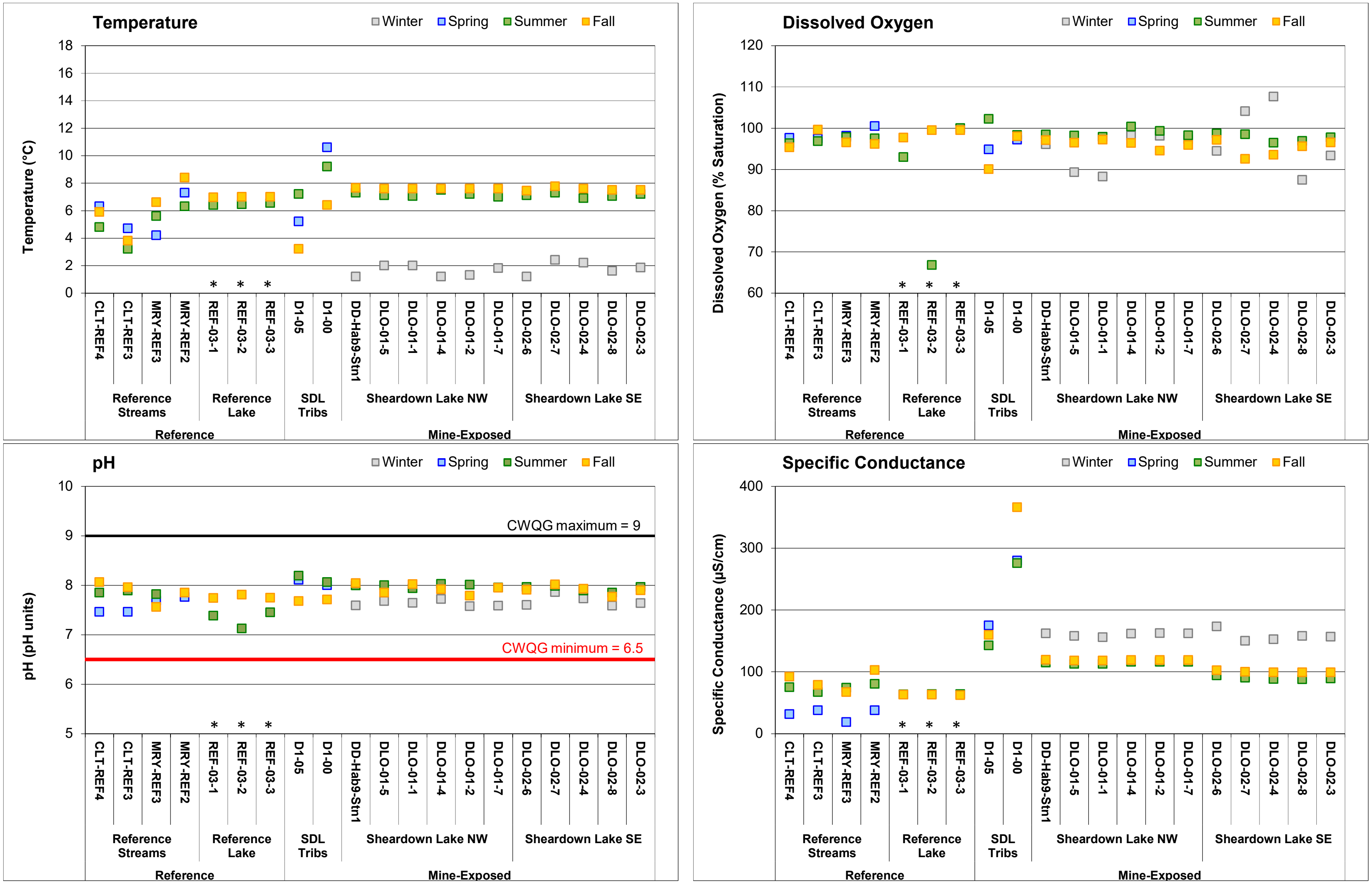


Figure C.9: Comparison of *In Situ* Water Quality Variables Measured at Sheardown Lake System Water Quality Monitoring Stations in Winter, Spring, Summer, and Fall 2018, Mary River Project CREMP

Notes: Lake values represent mean of surface and bottom *in situ* water quality measurements. Streams were not sampled in winter. Lakes were not sampled in spring.

* Reference Lake 3 (REF-03) was not sampled in winter.

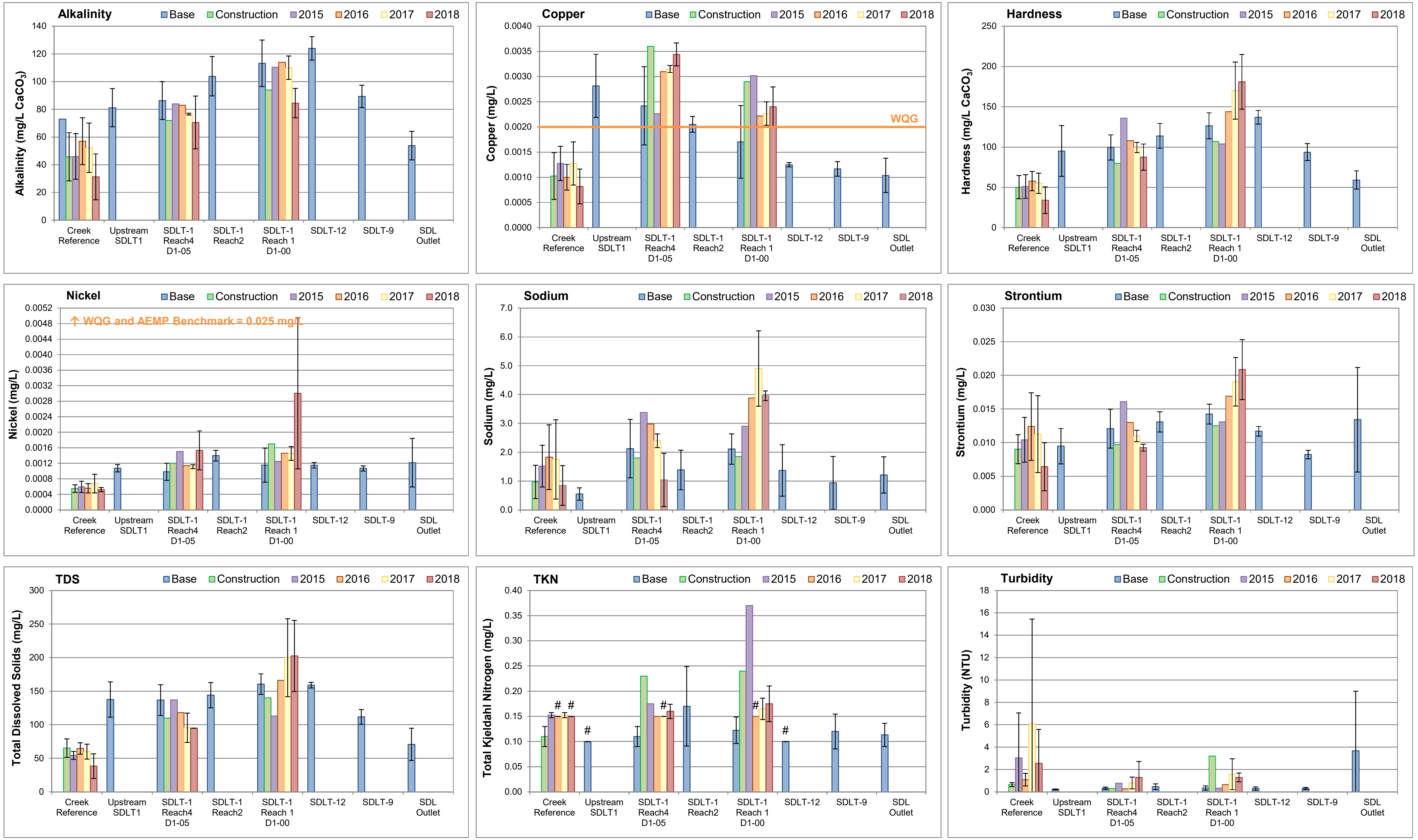
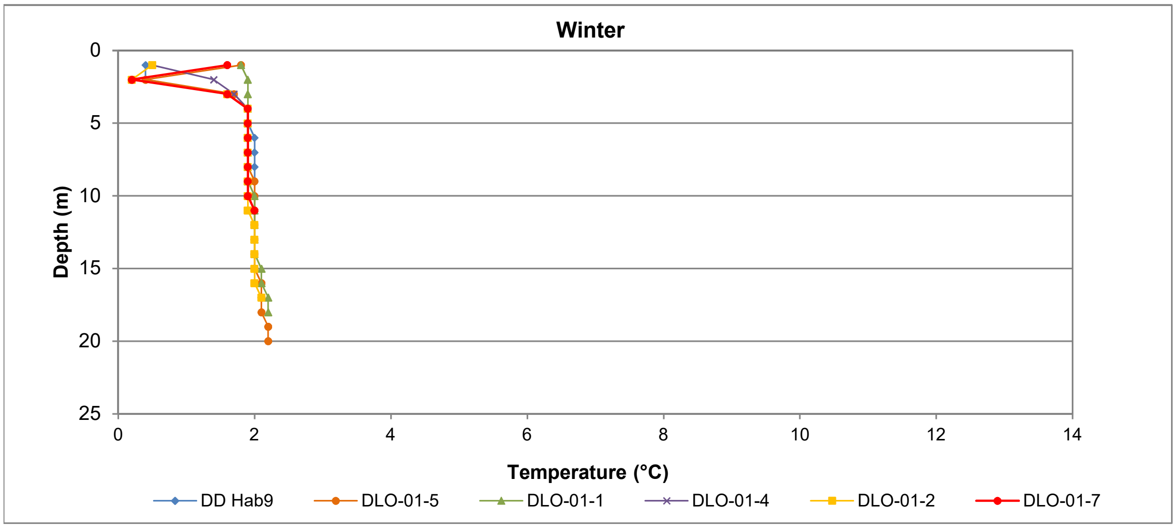
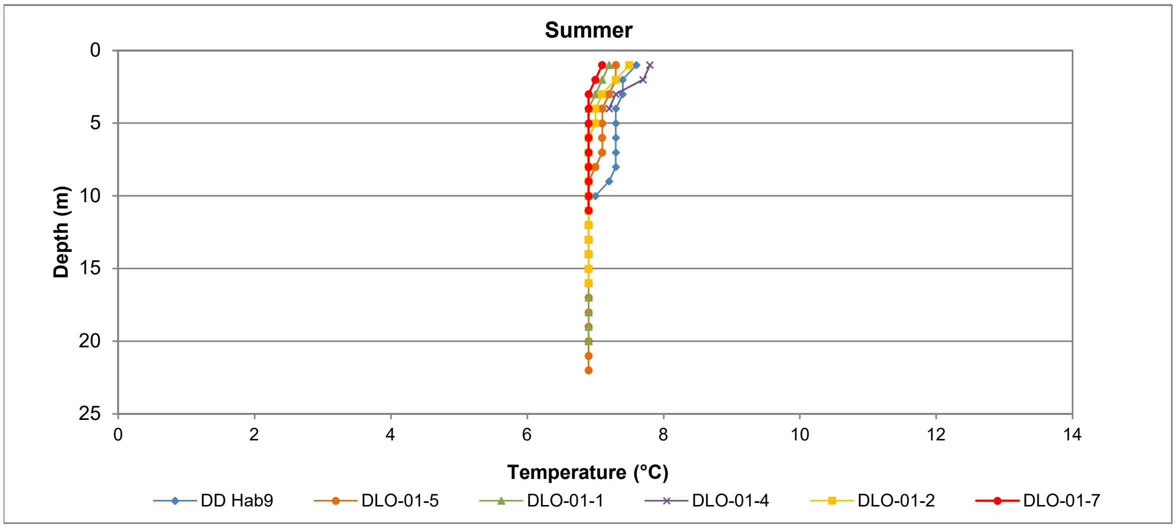


Figure C.10: Temporal Comparison of Water Chemistry at Sheardown Lake Tributaries (SDLT) for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2018) Periods during Fall

Notes: Values represent mean ± SD. Creek reference includes the CLT-REF and MRY-REF series stations (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Sheardown Lake Tributaries.





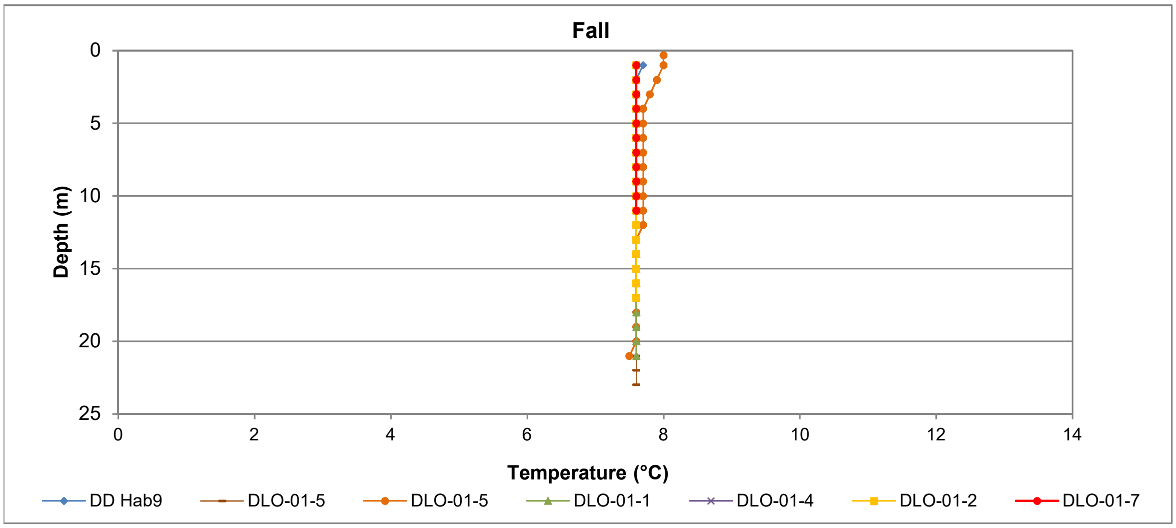


Figure C.11: Vertical Profiles of Temperature Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2018

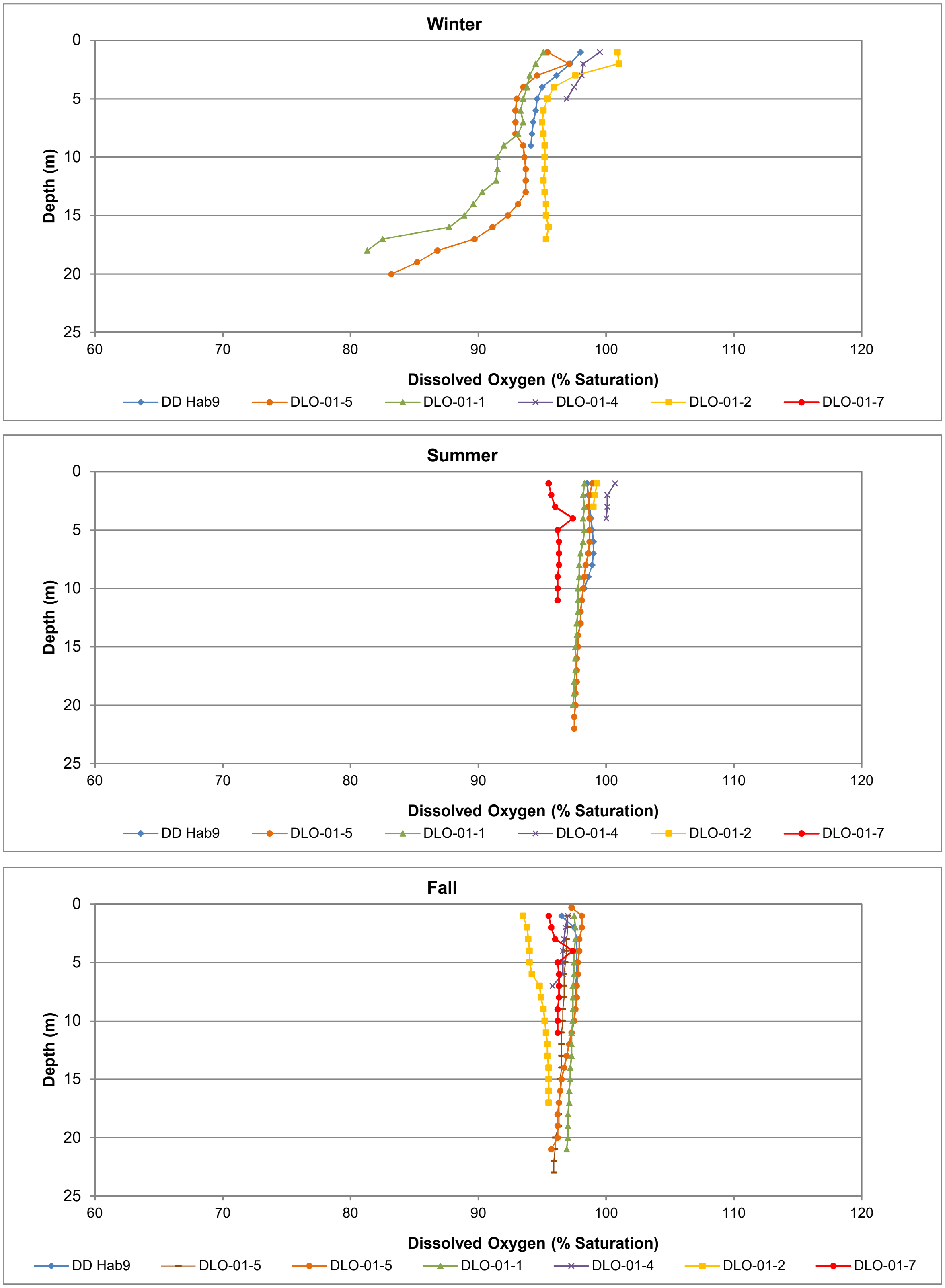


Figure C.12: **Vertical Profiles of Dissolved Oxygen Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2018**

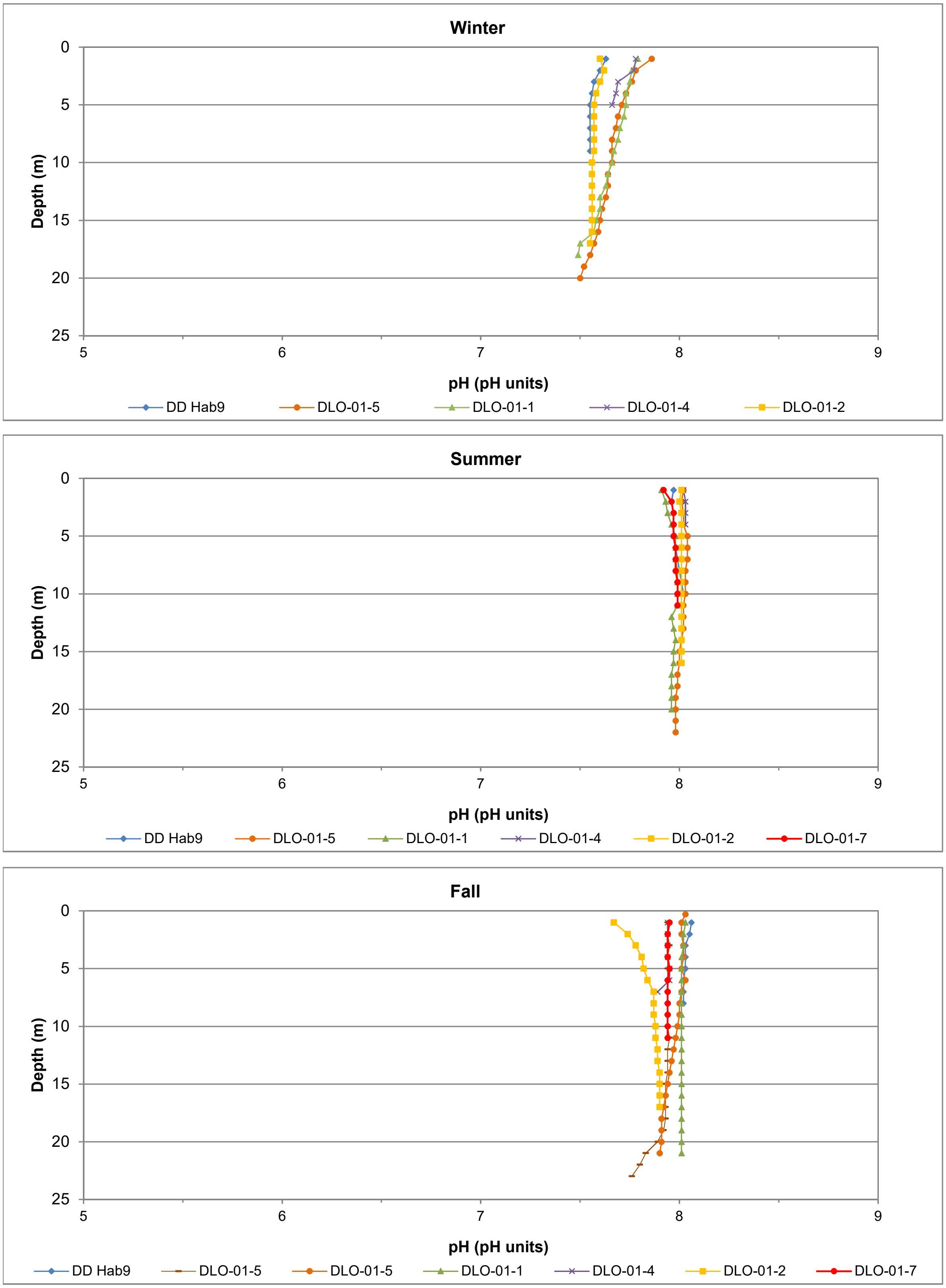


Figure C.13: Vertical Profiles of pH Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2018

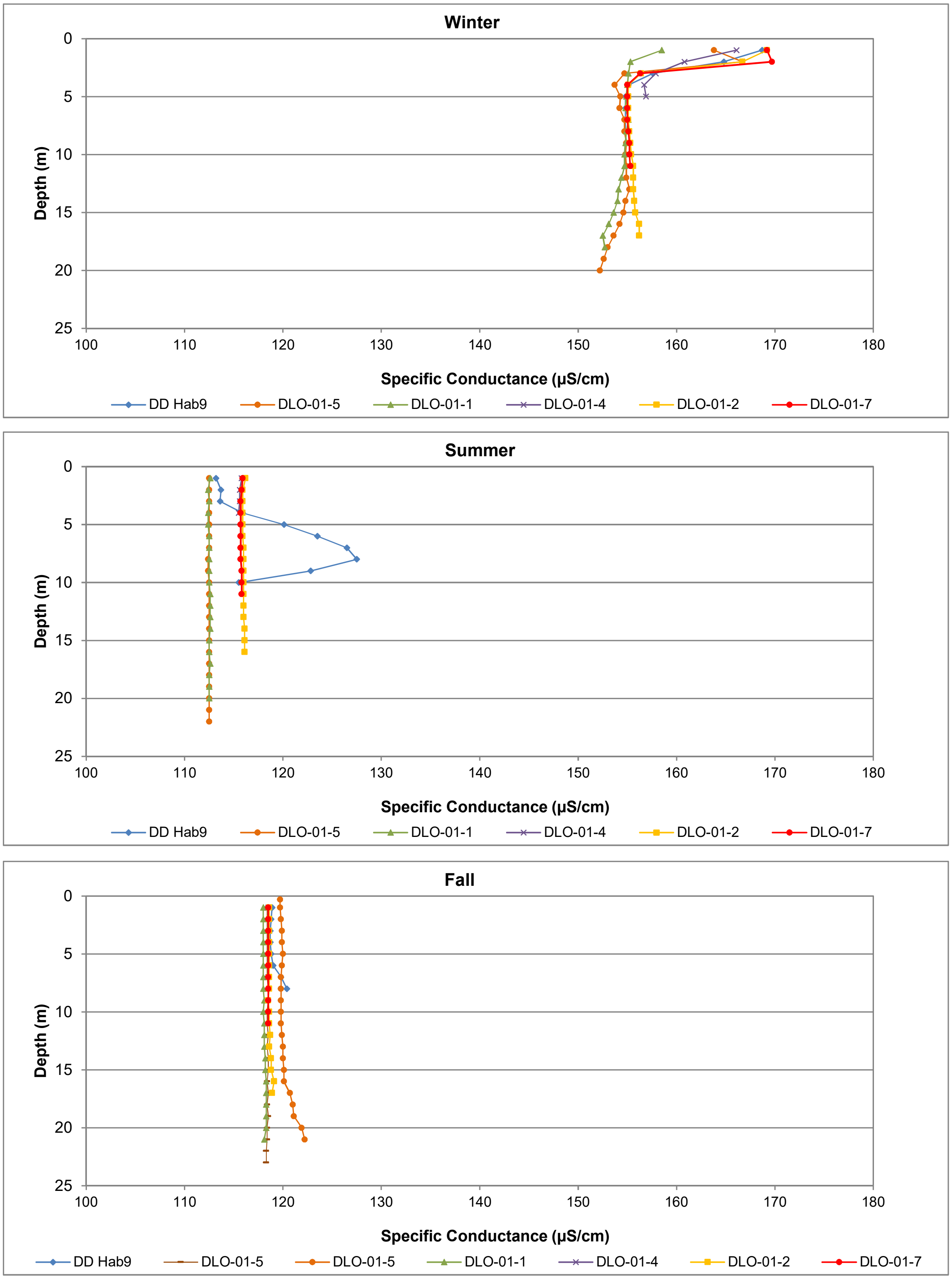


Figure C.14: Vertical Profiles of Specific Conductance Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2018

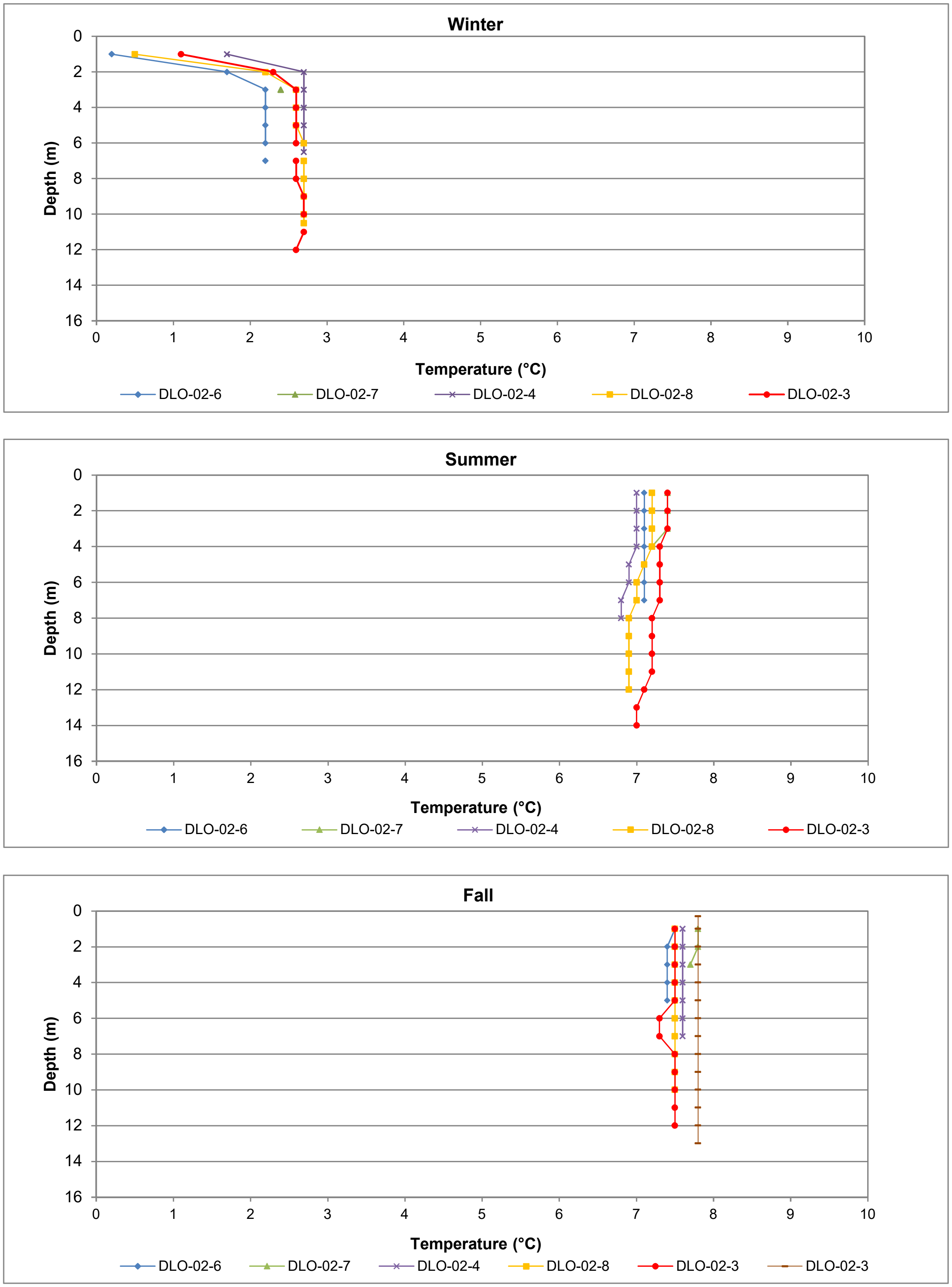


Figure C.15: Vertical Profiles of Temperature Measured at Sheardown Lake SE in Winter, Summer, and Fall, 2018

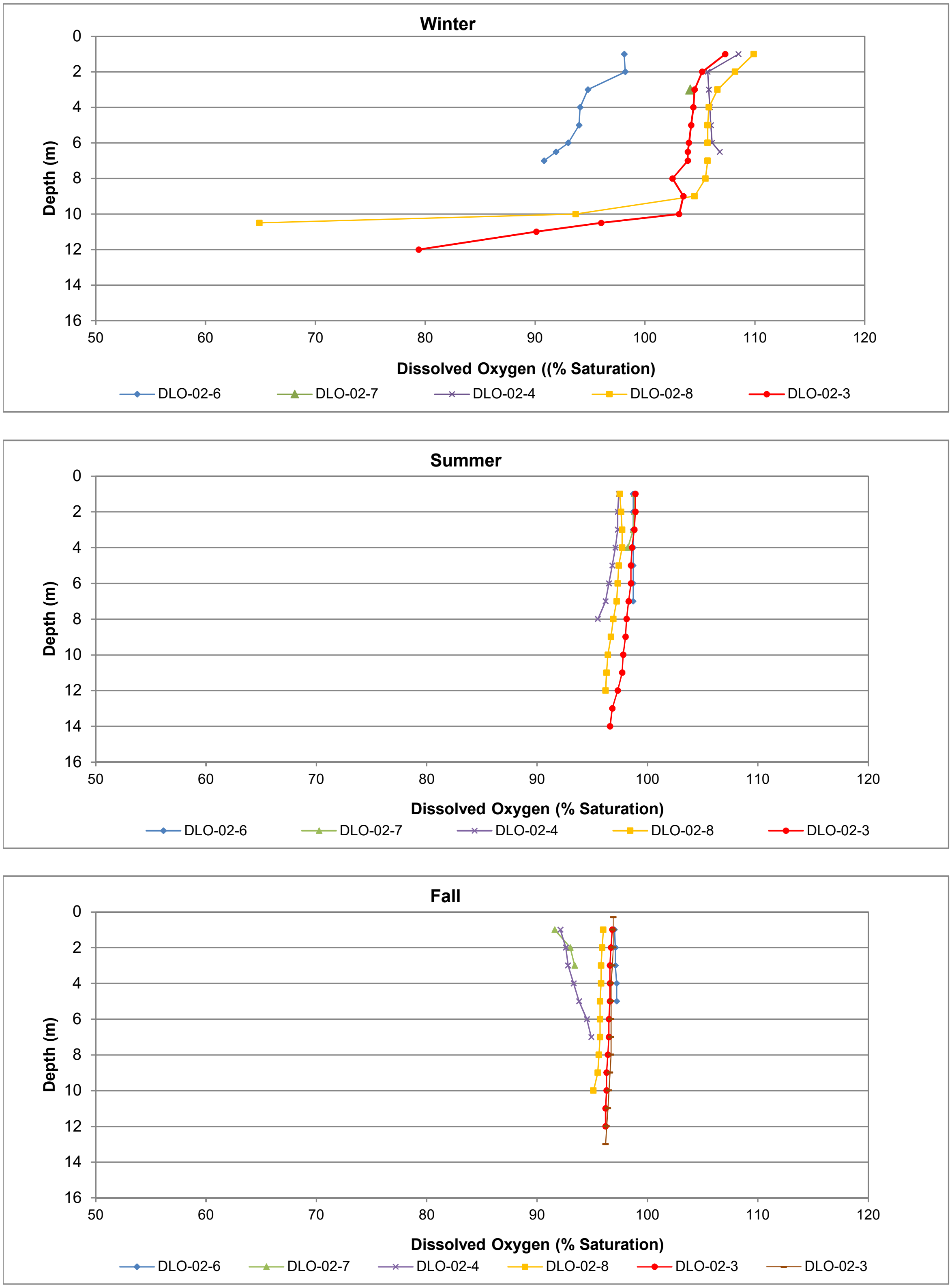


Figure C.16: **Vertical Profiles of Dissolved Oxygen Measured at Sheardown Lake SE in Winter, Summer, and Fall, 2018**

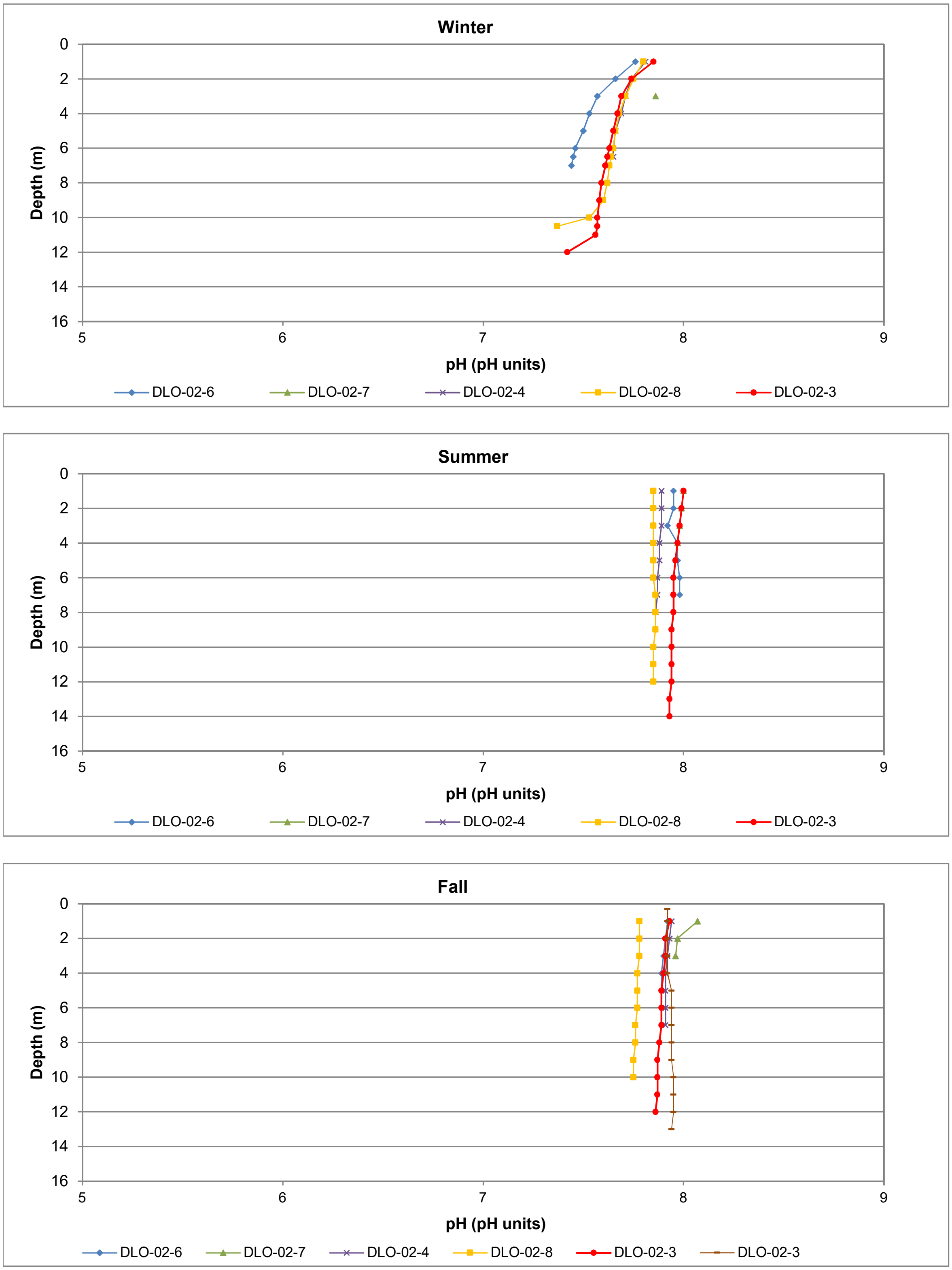


Figure C.17: Vertical Profiles of pH Measured at Sheardown Lake SE in Winter, Summer, and Fall 2018

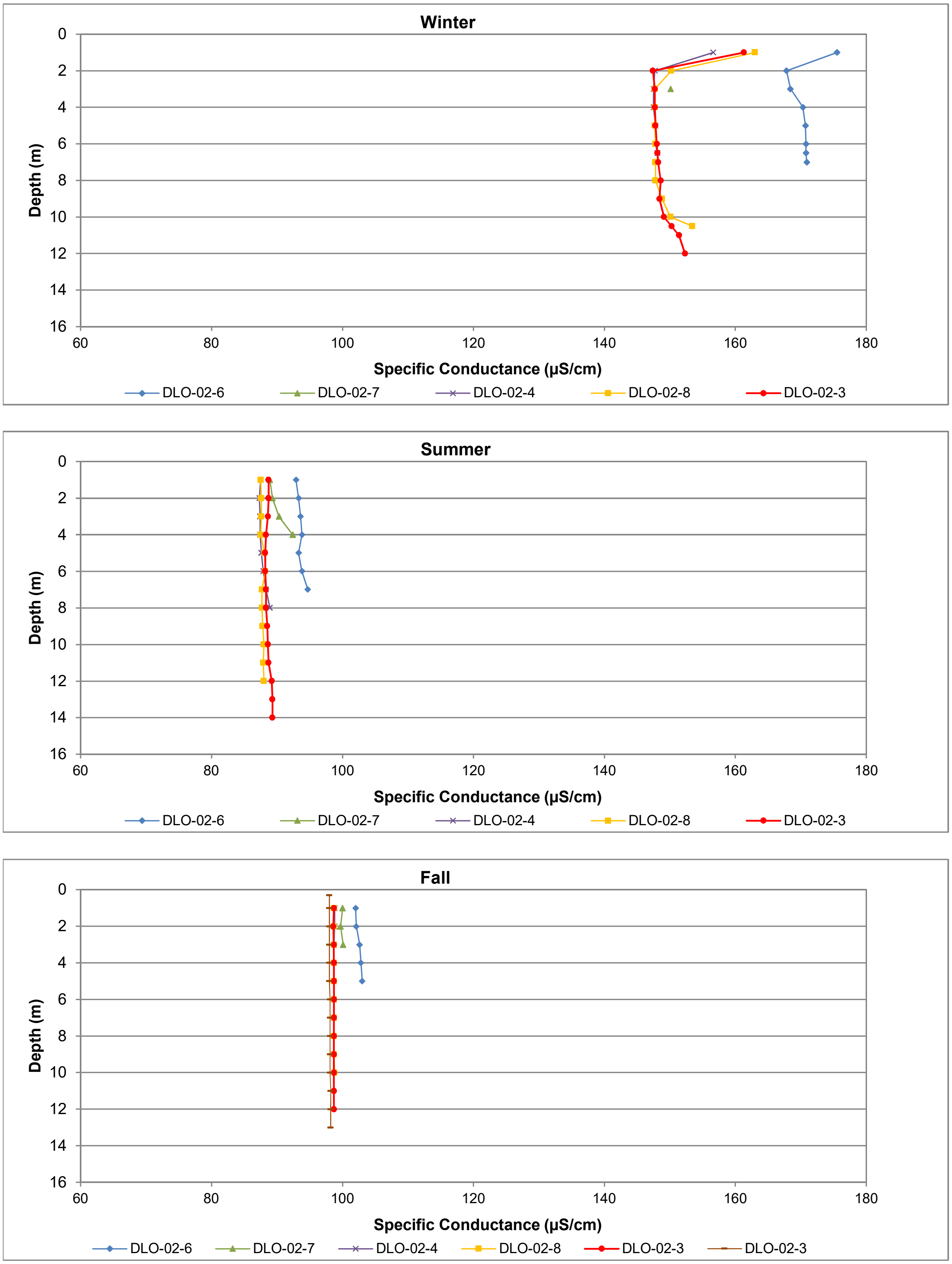


Figure C.18: **Vertical Profiles of Conductivity Measured at Sheardown Lake SE in Winter, Summer, and Fall 2018**

Figure C.19: **Temporal Comparison of Water Chemistry at Sheardown Lake Northwest (DLO-01) and Sheardown Lake Southeast (DLO-02) for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2018) Periods during Fall**

Notes: Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Sheardown Lake (northwest and southeast).

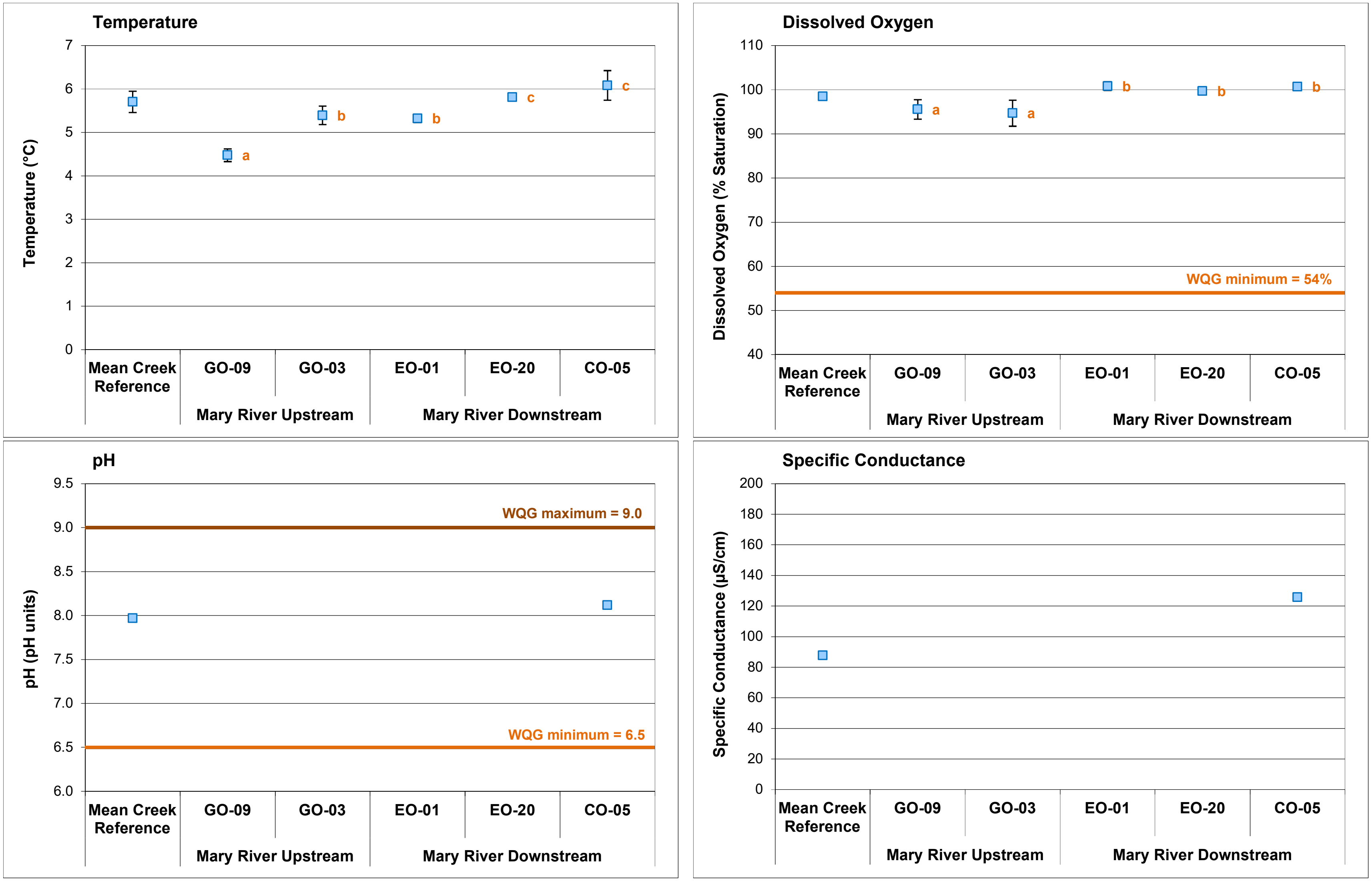


Figure C.20: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Mary River Mine-Exposed and Reference (GO-09) Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Note: The same letters next to Mary River study area data points indicates no significant difference between areas.

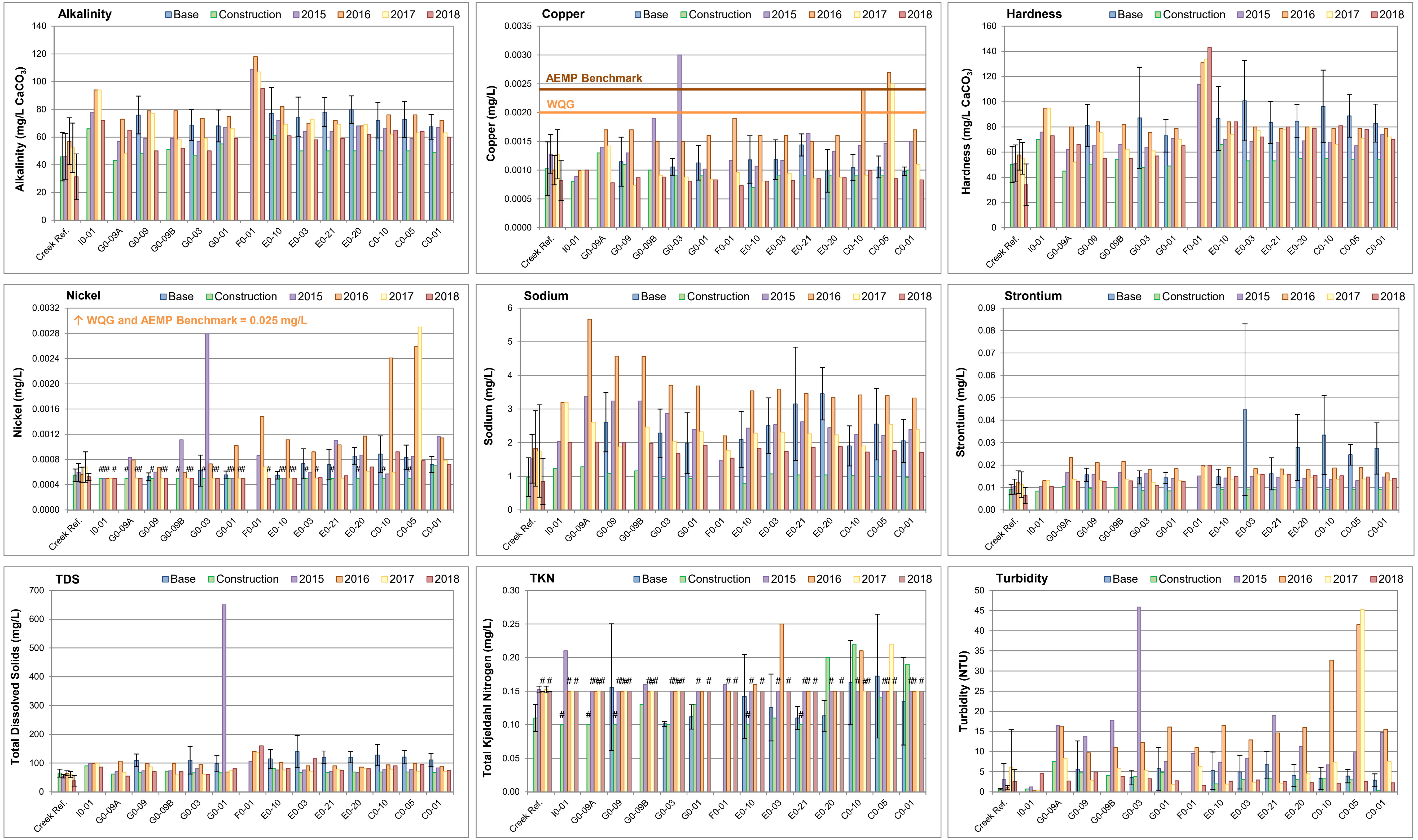


Figure C.22: Temporal Comparison of Water Chemistry at Mary River Stations for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2018) Periods in the Fall

Notes: Values represent mean ± SD. Creek reference includes the CLT-REF and MRY-REF series stations (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guidelines (WQG) AEMP Benchmarks are specific to Mary River.

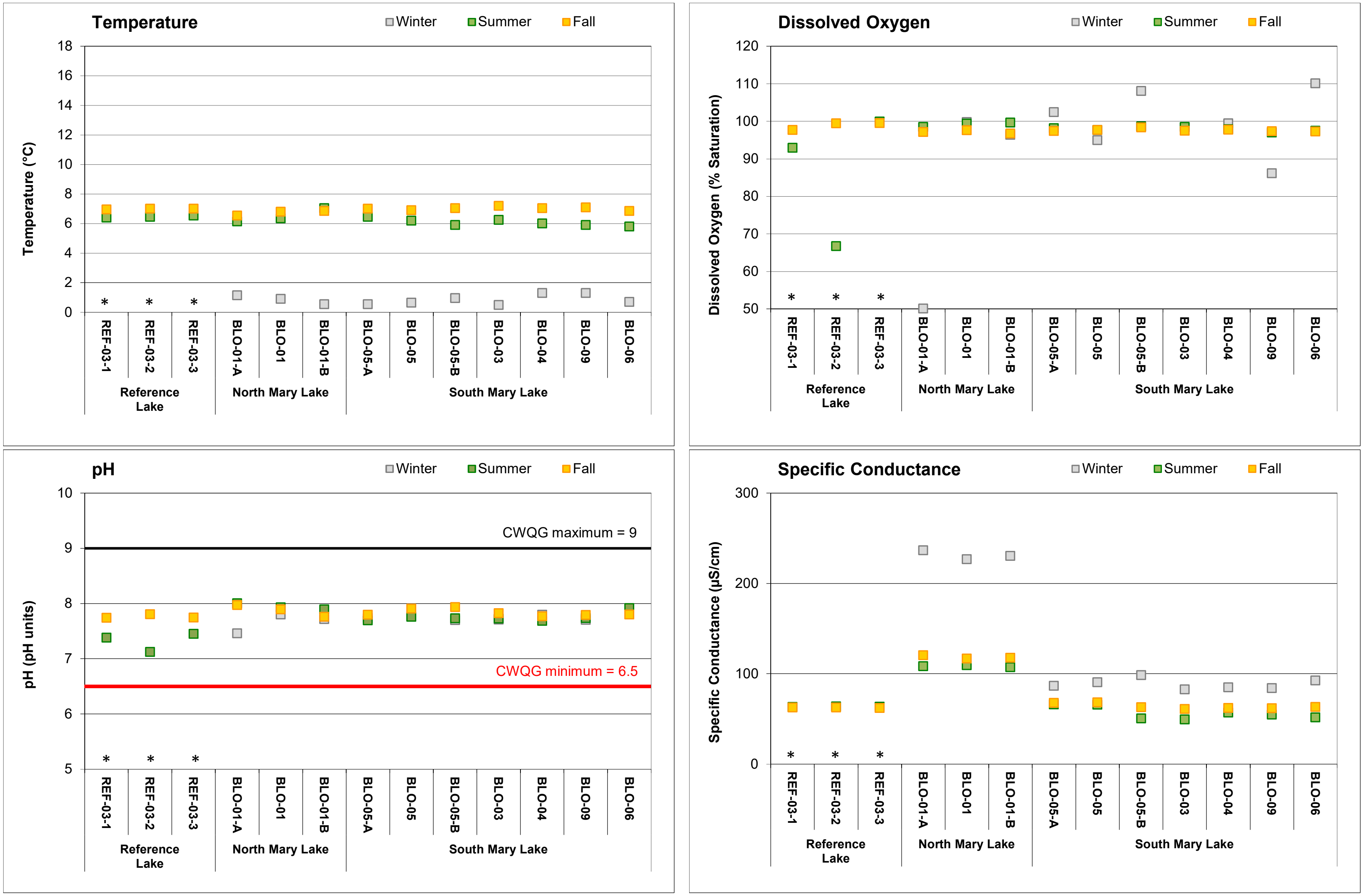


Figure C.23: Comparison of *In Situ* Water Quality Variables Measured at Mary Lake Water Quality Monitoring Stations in Winter, Summer, and Fall 2018, Mary River Project CREMP

Notes: Lake values represent mean of surface and bottom *in situ* water quality measurements. * Reference Lake 3 (REF-03) was not sampled in winter.

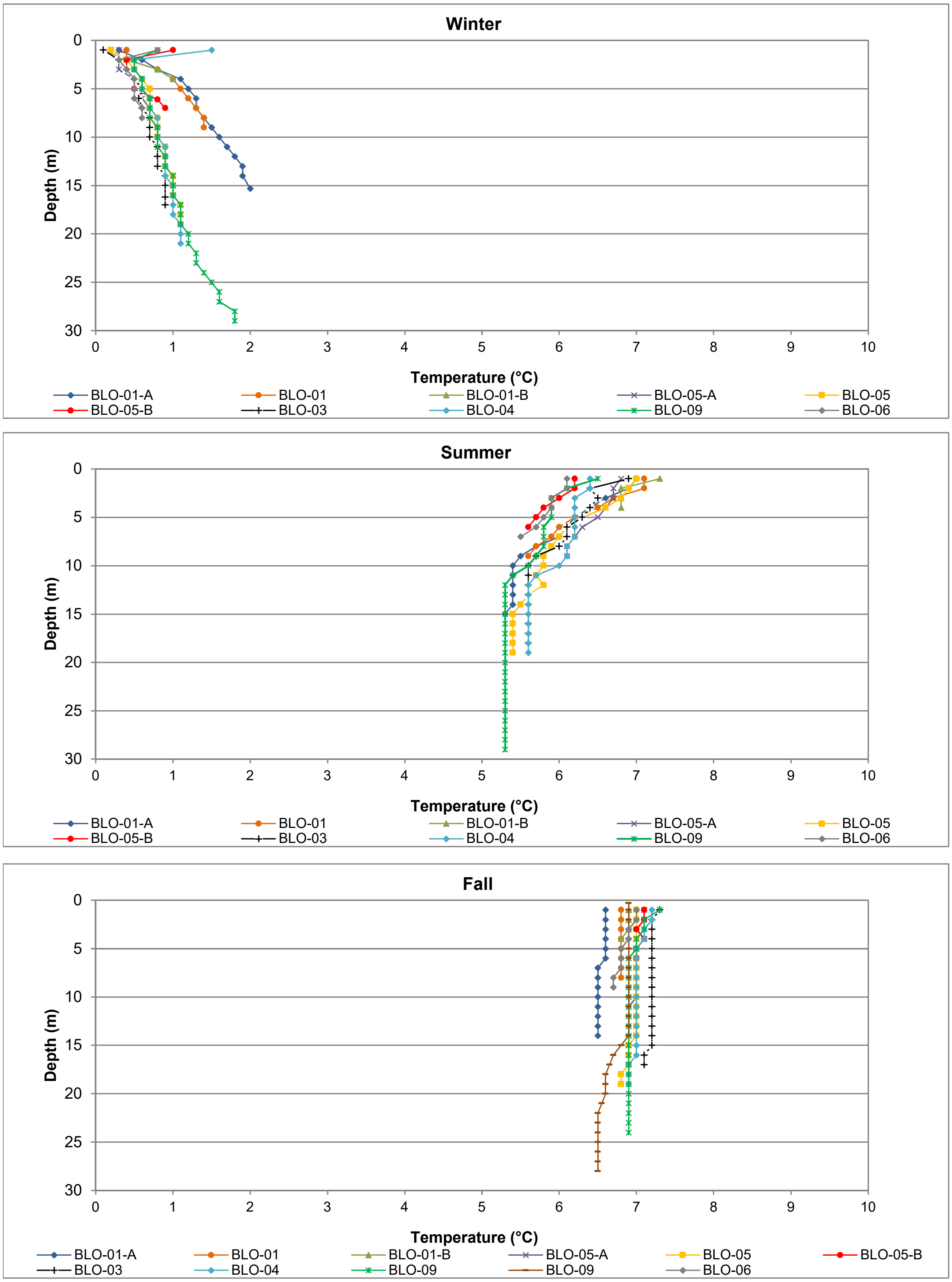


Figure C.24: **Vertical Profiles of Temperature Measured at Mary Lake in Winter, Summer, and Fall, 2018**

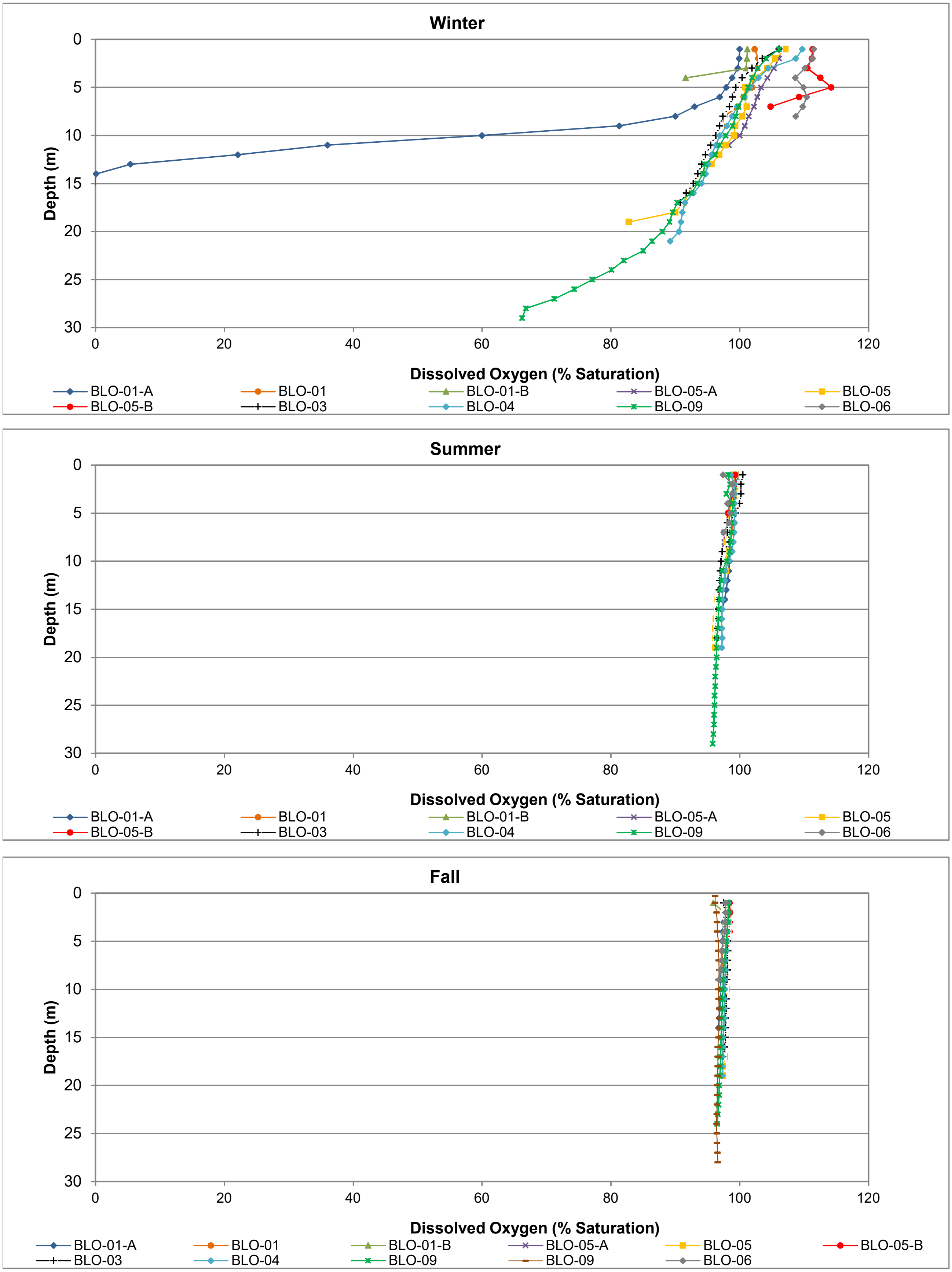


Figure C.25: Vertical Profiles of Dissolved Oxygen Measured at Mary Lake in Winter, Summer, and Fall, 2018

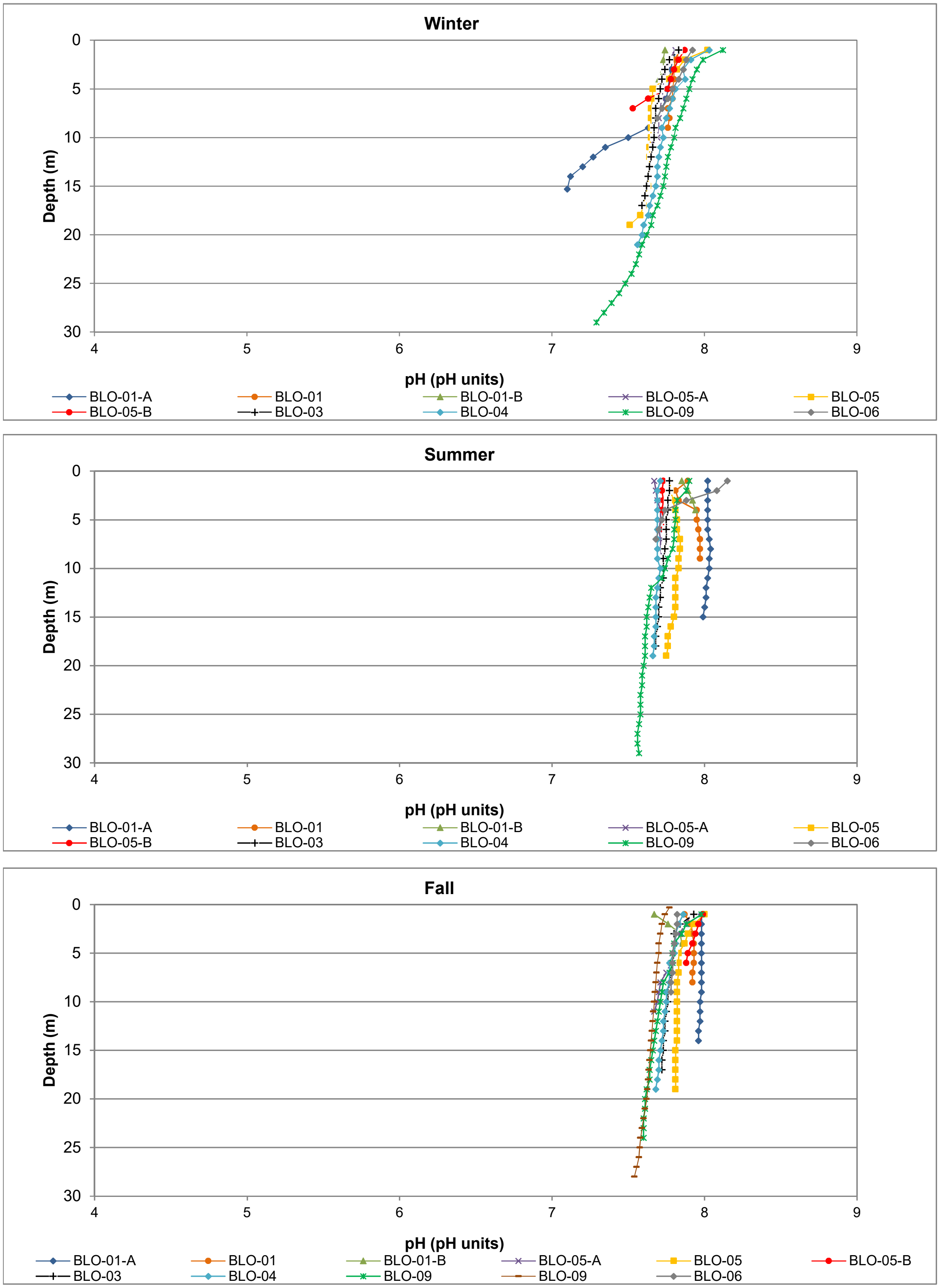


Figure C.26: **Vertical Profiles of pH Measured at Mary Lake in Winter, Summer, and Fall, 2018**

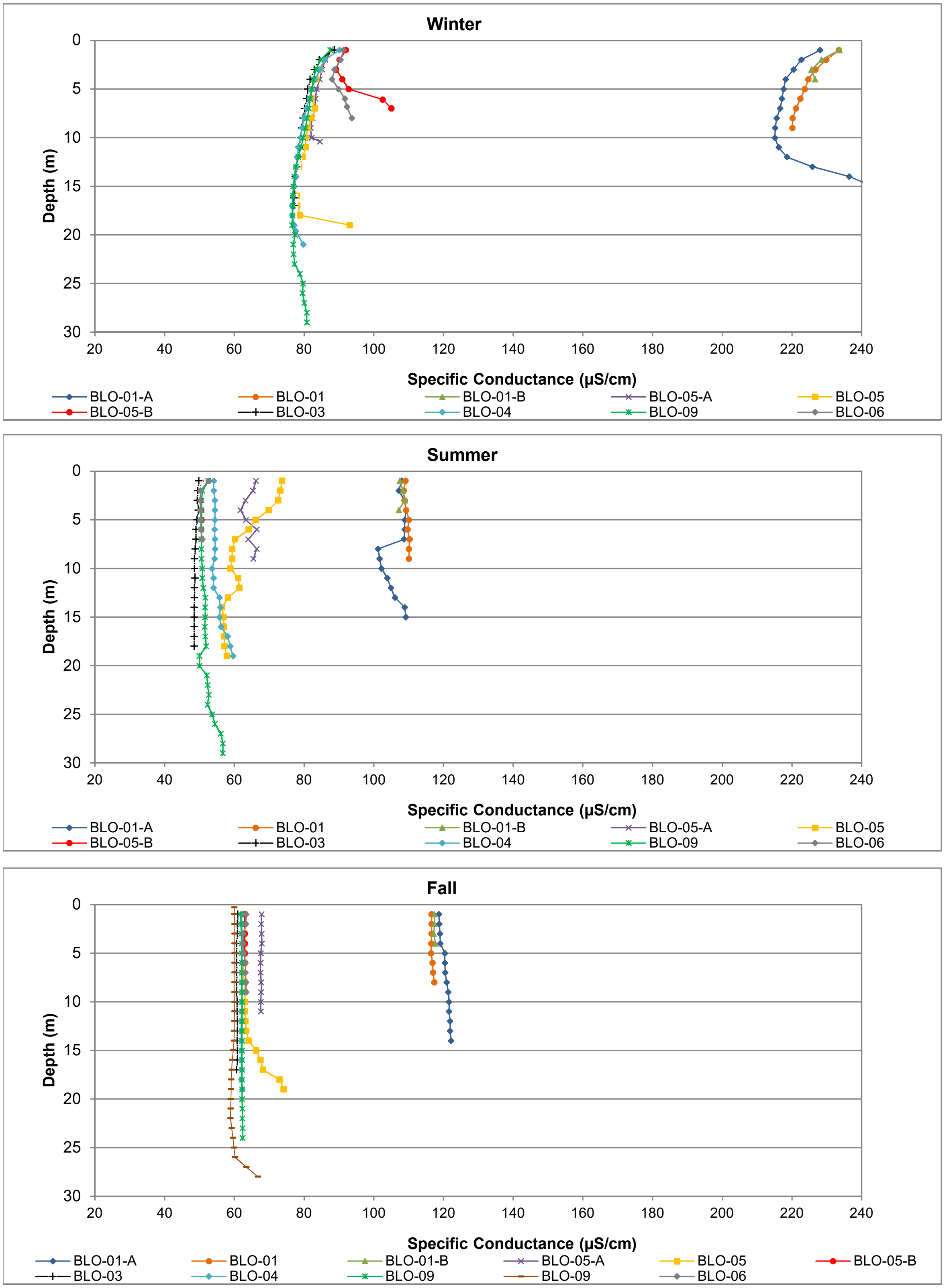


Figure C.27: Vertical Profiles of Specific Conductance Measured at Mary Lake in Winter, Summer, and Fall, 2018

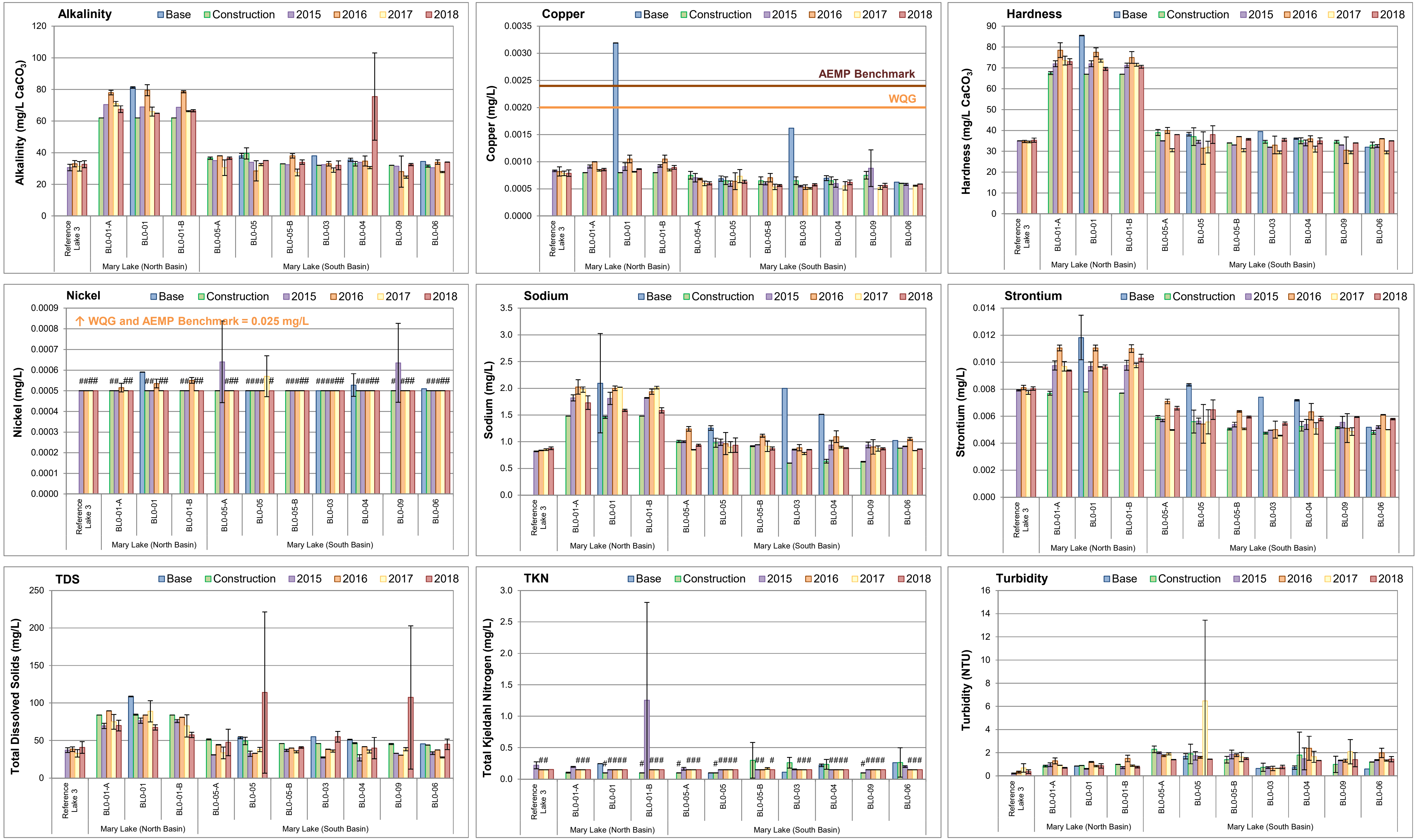


Figure C.28: Temporal Comparison of Water Chemistry at Mary Lake (BLO) for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2018) Periods during Fall

Notes: Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Mary Lake.

Table C.1: *In Situ* **Water Quality Data Collected from Lotic Environments for the Mary River Project CREMP, Spring 2018**

Study Area		Station	Sampling Date	*In Situ* Water Quality Parameter				
				Temperature (°C)	Dissolved Oxygen (% saturation)	pH	Specific Conductance (µS/cm)	Turbidity (NTU)
Camp Lake System	Reference Creek Stations	CLT-REF4	30-Jun-18	6.3	97.6	7.46	31.3	0.79
		CLT-REF3	30-Jun-18	4.7	97.4	7.46	37.5	0.42
		MRY-REF3	30-Jun-18	4.2	98.1	7.69	18.7	5.38
		MRY-REF2	30-Jun-18	7.3	100.5	7.76	37.7	0.61
	CLT-1	L1-08	30-Jun-18	1.8	97.0	7.51	51.0	2.88
		L1-02	1-Jul-18	7.1	98.2	8.01	97.2	0.46
		L2-03	1-Jul-18	12.8	94.8	8.29	187.0	7.69
		L1-09	3-Jul-18	10.4	97.7	7.75	94.5	2.66
		L1-05	3-Jul-18	10.4	97.7	7.75	94.5	2.66
		L0-01	3-Jul-18	7.9	98.2	8.02	116.9	1.02
	CLT-2	K0-01	3-Jul-18	7.5	98.0	8.05	134.4	0.41
	Camp Lake	J0-01	30-Jun-18	6.0	102.5	7.37	126.9	1.42
Sheardown Lake System	SDL Tribs	D1-05	3-Jul-18	5.2	94.8	8.11	174.8	0.63
		D1-00	3-Jul-18	10.6	97.2	8.00	279.6	1.02
Mary River/Lake System	Tom River	I0-01	3-Jul-18	5.3	100.7	8.25	44.7	0.80
	Mary River	G0-09-A	1-Jul-18	4.4	93.7	7.07	21.3	15.45
		G0-09	1-Jul-18	5.4	94.8	7.23	23.4	7.37
		G0-09-B	1-Jul-18	5.9	16.2	7.17	27.7	4.63
		G0-03	1-Jul-18	6.8	97.0	7.19	30.3	4.67
		G0-01	30-Jun-18	3.4	98.7	7.90	25.1	3.26
		F0-01	30-Jun-18	4.8	97.0	7.56	62.2	1.55
		E0-10	1-Jul-18	6.0	98.5	7.50	29.7	8.24
		E0-03	30-Jun-18	8.0	99.2	7.34	29.0	4.05
		E0-20	30-Jun-18	8.2	98.7	7.42	30.2	3.63
		E0-21	30-Jun-18	8.2	98.5	7.46	29.0	3.81
		C0-10	30-Jun-18	8.3	101.3	7.38	29.2	2.89
		C0-05	30-Jun-18	5.7	101.1	7.40	39.0	3.07
		C0-01	30-Jun-18	6.0	102.0	7.42	35.6	3.56

Table C.2: *In Situ* Water Quality Data Collected from Lotic Environments for the Mary River Project CREMP, Summer 2018

Study Area		Station	Sampling Date	*In Situ* Water Quality Parameter				
				Temperature (^{o}C)	Dissolved Oxygen (% saturation)	pH	Specific Conductance (µS/cm)	Turbidity (NTU)
Camp Lake System	Reference Creek Stations	CLT-REF4	11-Aug-18	4.8	96.3	7.85	75.0	1.20
		CLT-REF3	11-Aug-18	3.2	96.8	7.89	67.1	0.80
		MRY-REF3	11-Aug-18	5.6	97.8	7.82	74.3	8.84
		MRY-REF2	11-Aug-18	6.3	97.5	7.80	80.4	0.98
	CLT-1	L1-08	10-Aug-18	2.4	96.6	7.98	96.9	0.80
		L1-02	1-Aug-18	6.9	97.3	8.10	125.0	0.02
		L2-03	1-Aug-18	11.5	not recorded	8.06	268.7	3.20
		L1-09	1-Aug-18	6.6	98.7	8.12	150.5	0.37
		L1-05	1-Aug-18	6.6	98.2	8.09	152.7	0.37
		L0-01	1-Aug-18	6.3	97.9	8.10	154.5	0.28
	CLT-2	K0-01	1-Aug-18	6.1	97.8	8.04	145.2	0.01
	Camp Lake	J0-01	10-Aug-18	6.6	97.6	7.98	120.7	1.07
Sheardown Lake System	SDL Tribs	D1-05	1-Aug-18	7.2	102.2	8.19	142.4	2.57
		D1-00	1-Aug-18	9.2	98.3	8.06	275.6	0.82
Mary River/Lake System	Tom River	I0-01	1-Aug-18	4.8	99.2	7.69	85.0	1.71
	Mary River	G0-09-A	12-Aug-18	8.5	95.6	7.80	72.2	8.91
		G0-09	12-Aug-18	8.4	96.1	7.71	75.3	8.11
		G0-09-B	11-Aug-18	8.0	95.4	7.98	76.7	7.10
		G0-03	11-Aug-18	8.2	96.1	7.85	78.9	5.53
		G0-01	11-Aug-18	7.8	97.7	8.06	78.8	5.53
		F0-01	11-Aug-18	6.1	96.8	8.09	247.2	2.37
		E0-10	11-Aug-18	7.5	97.6	7.84	85.4	5.71
		E0-03	11-Aug-18	6.9	97.8	7.88	93.9	6.68
		E0-20	11-Aug-18	6.9	98.2	7.88	96.2	5.73
		E0-21	11-Aug-18	6.7	98.3	7.88	93.3	6.31
		C0-10	11-Aug-18	8.2	99.5	7.76	95.6	5.16
		C0-05	11-Aug-18	7.9	100.8	7.83	95.8	5.26
		C0-01	10-Aug-18	7.1	98.4	7.97	87.1	6.38

Table C.3: *In Situ* Water Quality Data Collected From Lotic Environments for the Mary River Project CREMP, Fall 2018

Study Area		Station	Sampling Date	*In Situ* Water Quality Parameter				
				Temperature (^{o}C)	Dissolved Oxygen (% saturation)	pH	Specific Conductance (µS/cm)	Turbidity (NTU)
Camp Lake System	Reference Creek Stations	CLT-REF4	24-Aug-18	5.9	95.3	8.06	92.0	0.4
		CLT-REF3	25-Aug-18	3.8	99.6	7.96	78.6	0.3
		MRY-REF3	24-Aug-18	6.6	96.5	7.56	67.2	5.8
		MRY-REF2	24-Aug-18	8.4	96.1	7.85	102.9	0.2
	CLT-1	L1-08	25-Aug-18	2.2	97.6	7.99	106.0	0.3
		L1-02	25-Aug-18	3.8	98.5	8.17	144.9	0.0
		L2-03	26-Aug-18	7.1	97.1	7.98	299.2	0.2
		L1-09	25-Aug-18	4.6	99.2	8.16	185.8	1.1
		L1-05	23-Aug-18	8.4	98.7	8.19	181.9	1.6
		L0-01	23-Aug-18	8.7	98.2	8.16	187.3	1.5
	CLT-2	K0-01	19-Aug-18	5.0	95.0	8.02	178.5	0.9
	Camp Lake	J0-01	27-Aug-18	6.5	98.0	8.08	118.6	0.4
Sheardown Lake System	SDL Tribs	D1-05	26-Aug-18	3.2	90.0	7.68	159.6	-4.4
		D1-00	26-Aug-18	6.4	98.0	7.71	365.8	-3.6
Mary River/Lake System	Tom River	I0-01	19-Aug-18	5.1	95.7	8.01	124.4	2.9
	Mary River	G0-09-A	27-Aug-18	4.8	96.2	8.20	106.6	3.2
		G0-09	25-Aug-18	7.8	96.0	8.13	95.4	4.2
		G0-09-B	25-Aug-18	8.4	96.9	8.17	99.4	4.0
		G0-03	25-Aug-18	8.0	96.9	8.08	101.6	3.2
		G0-01	27-Aug-18	3.2	98.9	8.14	113.2	2.7
		F0-01	25-Aug-18	6.4	97.7	8.39	243.7	3.1
		E0-10	27-Aug-18	3.6	99.8	8.16	155.7	2.5
		E0-03	26-Aug-18	5.3	96.1	8.01	127.4	-1.4
		E0-20	27-Aug-18	3.8	99.8	8.15	137.5	2.2
		E0-21	27-Aug-18	3.4	99.9	8.15	137.7	2.5
		C0-10	27-Aug-18	4.5	99.8	8.16	138.0	2.1
		C0-05	27-Aug-18	4.0	99.7	8.09	133.9	2.7
		C0-01	27-Aug-18	3.8	94.4	8.12	126.1	2.2

Table C.4: **Dissolved Metal Concentrations at Reference Creek Monitoring Stations, Mary River Project CREMP, 2018**

Parameters		Units	Spring Sampling Event				Summer Sampling Event				Fall Sampling Event			
			CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2	CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2	CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2
			30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	24-Aug-18	25-Aug-18	24-Aug-18	24-Aug-18
Dissolved Metals	Aluminum (Al)	mg/L	0.0121	0.0088	0.0257	0.0075	0.0303	0.0189	0.0601	0.0218	0.0041	0.0119	0.0576	0.0167
	Antimony (Sb)	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 (As)	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
	Barium (Ba)	mg/L	0.00171	0.00256	0.00231	0.00224	0.00441	0.00454	0.00529	0.00501	0.00405	0.00526	0.00667	0.00582
	Beryllium (Be)	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
	Bismuth (Bi)	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
	Boron (B)	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 (Cd)	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
	Calcium (Ca)	mg/L	3.31	3.91	1.68	3.88	9.52	8.03	4.70	9.65	11.3	9.6	7.00	11.6
	Chromium (Cr)	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
	Cobalt (Co)	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 (Cu)	mg/L	<0.00050	0.00068	<0.00050	<0.00050	0.00061	0.00127	0.00112	0.0007	<0.00050	0.00110	0.00097	0.00063
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.04	<0.030	<0.030	<0.030	0.03	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000056	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	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
	Magnesium (Mg)	mg/L	1.79	2.16	0.791	2.15	5.95	5.00	2.25	5.72	6.16	5.68	3.16	6.21
	Manganese (Mn)	mg/L	0.000085	0.000149	0.00054	0.0003	0.0001	0.000338	0.000552	0.000316	<0.000070	0.00041	0.000324	0.000343
	Mercury (Hg)	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
	Molybdenum (Mo)	mg/L	<0.000050	0.000131	0.000081	<0.000050	0.000155	0.000372	0.000320	0.000115	0.000195	0.000413	0.000405	0.000172
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00059	<0.00050	<0.00050	<0.00050	0.00057	<0.00050	<0.00050
	Potassium (K)	mg/L	0.270	0.330	0.290	0.320	0.550	0.58	0.66	0.62	0.52	0.58	0.74	0.65
	Selenium (Se)	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
	Silicon (Si)	mg/L	0.330	0.460	0.330	0.300	0.72	0.77	0.95	0.77	0.60	0.79	0.92	0.68
	Silver (Ag)	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
	Sodium (Na)	mg/L	0.23	0.28	0.61	0.367	0.615	0.564	1.82	0.89	0.65	0.643	2.39	1.09
	Strontium (Sr)	mg/L	0.0022	0.0024	0.0032	0.0027	0.00672	0.00505	0.0094	0.00723	0.0081	0.00625	0.0151	0.0091
	Thallium (Tl)	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
	Tin (Sn)	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 (Ti)	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
	Uranium (U)	mg/L	0.000111	0.000191	0.000187	0.000148	0.001820	0.000980	0.000426	0.000704	0.00345	0.00184	0.00087	0.00127
	Vanadium (V)	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
	Zinc (Zn)	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

Table C.5: *In Situ* Water Quality Profile Data Collected at Reference Lake 3 Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2018

Depth (m)	Temperature (°C)			Dissolved Oxygen (mg/L)			Dissolved Oxygen (% Saturation)			pH (pH units)			Specific Conductance (µS/cm)		
	REF3-03	REF3-02	REF3-01	REF3-03	REF3-02	REF3-01	REF3-03	REF3-02	REF3-01	REF3-03	REF3-02	REF3-01	REF3-03	REF3-02	REF3-01
Date Collected	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18
1.0	6.8	6.7	6.8	12.3	12.2	12.3	100.4	99.9	100.5	7.40	7.55	7.47	63	64	63
2.0	6.6	6.7	6.8	12.3	12.2	12.3	100.5	100.1	100.5	7.44	7.55	7.46	63	64	64
3.0	6.6	6.7	6.7	12.3	12.3	12.3	100.6	100.2	100.5	7.45	7.54	7.46	63	64	64
4.0	6.6	6.7	6.8	12.3	12.3	12.3	100.5	100.2	100.6	7.45	7.55	7.46	63	64	64
5.0	6.6	6.7	6.7	12.3	12.3	12.3	100.4	100.3	100.4	7.47	7.55	7.46	63	64	64
6.0	6.6	6.7	6.6	12.3	12.3	12.3	100.4	100.4	100.2	7.48	7.56	7.46	63	64	64
7.0	6.6	6.6	6.5	12.3	12.3	12.3	100.4	100.3	100.1	7.49	7.57	7.45	63	64	64
8.0	6.5	6.6	6.5	12.3	12.3	12.3	100.3	100.1	100.0	7.49	7.57	7.45	63	64	64
9.0	6.5	6.5	6.4	12.3	12.3	12.3	100.3	100.0	99.8	7.50	7.57	7.45	63	64	64
10.0	6.5	6.4	6.3	12.3	12.3	12.3	100.2	99.8	99.7	7.50	7.58	7.44	63	64	64
11.0	6.4	6.4	6.3	12.3	12.3	12.3	100.1	99.7	99.6	7.51	7.57	7.44	63	64	64
12.0	6.4	6.3	6.3	12.3	12.3	12.3	100.0	99.6	99.6	7.51	7.57	7.44	63	64	64
13.0	6.4	6.3	6.3	12.3	12.3	12.3	99.9	9.5	99.5	7.52	7.57	7.44	63	64	64
14.0	6.4	6.3	6.3	12.3	12.3	12.3	99.8	99.4	99.5	7.53	7.57	7.43	63	64	64
15.0	6.4	6.3	6.3	12.3	12.3	12.3	99.6	99.3	99.4	7.53	7.56	7.43	63	64	64
16.0	6.3	6.3		12.3	12.3		99.6	99.3		7.53	7.56		63	64	
17.0	6.3	6.3		12.3	12.3		99.6	99.3		7.53	7.56		63	64	
18.0	6.3	6.3		12.3	12.3		99.5	99.3		7.53	7.56		63	64	
19.0	6.3	6.3		12.3	12.3		99.5	99.2		7.53	7.56		63	64	
20.0	6.3	6.3		12.3	12.3		99.4	99.2		7.54	7.55		63	64	
21.0	6.3	6.3		12.3	12.2		99.3	99.1		7.53	7.55		63	64	
22.0	6.3	6.3		12.3	12.2		99.2	99.0		7.53	7.54		63	64	
23.0	6.2	6.3		12.3	12.2		99.1	98.8		7.53	7.53		63	64	
24.0	6.2	6.2		12.3	12.2		98.9	98.7		7.53	7.51		63	64	
25.0	6.2	6.2		12.2	12.2		98.8	98.7		7.53	7.51		63	64	
26.0	6.2*	6.2		12.2*	12.2		98.8*	98.6		7.52*	7.51		63	64	
27.0	6.2	6.2		12.23	12.2		98.6	98.4		7.53	7.50		63	64	
28.0	6.2	6.2		12.22	12.2		98.6	98.3		7.53	7.49		63	64	
29.0	6.1	6.2		12.22	12.2		98.5	98.2		7.54	7.49		63	64	
30.0	6.1	6.2		12.21	12.0		98.5	97.1		7.52	7.49		63	64	
31.0	6.1	6.2		12.20	9.0		98.3	73.0		7.52	7.17		63	64	
32.0	6.1	6.1		12.19	8.2		98.1	67.1		7.52	7.11		63	64	
33.0	6.1	6.0		12.19	7.8		98.1	63.1		7.51	7.08		63	64	
34.0	6.1	6.1		12.18	7.6		98.1	61.2		7.51	7.04		63	64	
35.0	6.0	6.2		12.17	6.6		97.9	53.1		7.50	6.93		63	64	
36.0	6.0	6.2		12.18	6.3		97.8	50.6		7.50	6.90		63	64	
37.0	6.0	6.2		12.05	5.9		96.7	48.1		7.49	6.88		63	64	
38.0	6.0	6.2		11.64	5.8		94.3	46.6		7.50	6.86		63	64	
39.0	6.0	6.2		11.05	5.5		88.9	44.7		7.41	6.83		63	64	
40.0	6.0	6.2		10.81	5.1		87.2	41.6		7.38	6.80		63	64	
41.0	6.0	6.2		10.58	4.18		85.5	33.6		7.36	6.70*		63	64	

Note: Total depth at stations REF3-03, REF3-02, and REF3-01 was >41, >41, and 15.7 m, respectively, at the time of summer sampling.

Table C.6: ***In Situ*** **Water Quality Profile Data Collected at Reference Lake 3 Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2018**

Depth (m)	Temperature (°C)				Dissolved Oxygen (mg/L)				Dissolved Oxygen (% Saturation)				pH (pH units)				Specific Conductance (µS/cm)			
	REF3-01	REF3-02	REF3-03	REF3-03	REF3-01	REF3-02	REF3-03	REF3-03	REF3-01	REF3-02	REF3-03	REF3-03	REF3-01	REF3-02	REF3-03	REF3-03	REF3-01	REF3-02	REF3-03	REF3-03
Date Collected	27-Aug-18	27-Aug-18	27-Aug-18	24-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	24-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	24-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	24-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	24-Aug-18
surface				7.1				11.89				98.20				7.70				62
1.0	6.9			7.1	11.72			11.91	96.5			98.30	7.78			7.65	62.5			62
2.0	7.0	7.0	7.0	7.1	11.72	12.16	12.20	11.92	96.4	100.2	100.7	98.40	7.78	7.86	7.80	7.62	62.5	63	62	62
3.0	7.0				11.76				96.8				7.76				62.5			
4.0	7.0	7.0	7.0	7.1	11.79	12.12	12.06	11.90	97.0	99.8	99.4	98.30	7.75	7.84	7.79	7.61	62.5	63	62	62
5.0	7.0				11.82				97.3				7.74				62.5			
6.0	7.0	7.0	7.0	7.1	11.87	12.11	12.03	11.90	97.7	99.8	99.1	98.20	7.73	7.83	7.77	7.61	62.5	63	62	62
7.0	7.0				11.96				98.4				7.73				62.5			
8.0	7.0	7.0	7.0	7.1	12.01	12.11	12.02	11.89	98.8	99.7	99.1	98.20	7.73	7.81	7.75	7.61	62.5	63	62	62
9.0	6.9				12.04				99.0				7.73				62.5			
10.0	6.9	7.0	7.0	7.1	12.04	12.09	12.02	11.84	99.0	99.5	99.0	98.10	7.72	7.80	7.75	7.61	63	63	62	62
11.0	6.9				12.04				98.8				7.71				63			
12.0	6.9	7.0	7.0	7.1	12.04	12.07	12.01	11.87	98.8	99.4	99.0	98.00	7.71	7.79	7.73	7.59	63	63	62	62
13.0	6.9								98.8				7.71				63			
14.0	6.9	7.0	7.0	7.1	12.05	12.06	12.01	11.86	98.9	99.2	98.9	98.00	7.71	7.79	7.72	7.59	63	63	62	62
15.0	6.9				12.06				98.9				7.70				63			
16.0		7.0	7.0	7.1		12.05	12.00	11.86		99.1	98.9	97.90		7.78	7.72	7.59		63	62	62
17.0																				
18.0		7.0	7.0	7.1		12.03	12.00	11.85		99.1	98.9	97.80		7.77	7.71	7.59		63	62	62
19.0																				
20.0		7.0	7.0	7.1		12.02	11.99	11.84		98.9	98.8	97.80		7.77	7.70	7.58		63	62	62
21.0																				
22.0		7.0	7.0	7.1		12.00	11.99	11.83		98.8	98.8	97.70		7.77	7.70	7.58		63	62	62
23.0																				
24.0		7.0	7.0	7.1		12.00	11.98	11.82		98.8	98.7	97.60		7.76	7.70	7.58		63	62	62
25.0																				
26.0		7.0	7.0	7.1		11.99	11.97	11.82		98.7	98.6	97.60		7.76	7.69	7.57		63	62	62
27.0																				
28.0		7.0	7.0	7.1		11.98	11.96	11.80		98.7	98.5	97.50		7.75	7.68	7.58		63	62	62
29.0																				
30.0			7.0	7.1			11.96	11.80			98.4	97.40			7.69	7.57			62	62
31.0																				
32.0			7.0				11.95				98.3				7.69				62	
33.0																				
34.0			7.0				11.94				98.3				7.69				62	

Notes: 27-Aug-18 sampling was conducted by Baffinland. 24-Aug-18 sampling was conducted by Minnow. Total depths at stations REF3-01, REF3-02, and REF3-03 were 16.1, 30, and 35 m, respectively, at the time of fall sampling.

Table C.7: Sampling Depth, Water Clarity Measures, and Surface and Bottom *In Situ* Water Quality Measures Collected at Reference Lake 3 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Replicate ID	Date Sampled	Station Depth (m)	Secchi Depth (m)	Colour/ Clarity	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (pH units)	Specific Conductance (µS/cm)
							(mg/L)	(% sat.)		
REF 03-1	24-Aug-18	10.5	9.1	clear/colorless	surface	7.00	11.26	92.7	7.57	62.4
					bottom	6.90	11.21	92.4	7.48	64.3
REF 03-2	24-Aug-18	9.1	8.1	clear/colorless	surface	7.10	11.74	96.8	7.77	62.4
					bottom	7.10	11.78	97.1	7.65	62.4
REF 03-3	23-Aug-18	9.8	-	clear/colorless	surface	-	-	-	-	-
					bottom	-	-	-	-	-
REF 03-4	24-Aug-18	8.4	8.5	clear/colorless	surface	7.10	11.52	95.1	7.64	62.3
					bottom	7.10	11.75	96.9	7.60	62.3
REF 03-5	24-Aug-18	11.2	8.3	clear/colorless	surface	7.10	12.12	100.3	7.70	62.3
					bottom	7.10	11.68	96.4	7.41	62.3
REF 03-6	24-Aug-18	22.5	8.8	clear/colorless	surface	7.00	11.60	95.5	7.74	62.4
					bottom	7.00	11.68	96.1	7.58	62.4
REF 03-7	23-Aug-18	25.0	-	clear/colorless	surface	-	-	-	-	-
					bottom	-	-	-	-	-
REF 03-8	24-Aug-18	18.5	8.3	clear/colorless	surface	7.10	11.39	93.9	7.72	62.7
					bottom	7.10	10.85	90.4	7.63	62.8
REF 03-9	24-Aug-18	21.1	8.6	clear/colorless	surface	7.10	11.45	94.5	7.71	62.3
					bottom	7.10	11.63	96.1	7.62	62.3
REF 03-10	24-Aug-18	19.2	8.9	clear/colorless	surface	7.10	11.54	95.2	7.66	62.3
					bottom	7.10	11.64	95.9	7.67	62.3

Table C.8: Statistical Comparison of Bottom *In Situ* Water Quality Between Littoral and Profundal Stations of Reference Lake 3, Mary River Project CREMP, August 2018

Lake	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Station Type	n	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Reference Lake 3	Secchi Depth (m)	NO	0.616	α	Littoral	4	8.5	0.5	0.2	8.1	9.1
					Profundal	4	8.6	0.3	0.1	8.3	8.9
	Temperature (˚C)	NO	0.886	γ	Littoral	4	7.1	0.1	0.0	6.9	7.1
					Profundal	4	7.1	0.0	0.0	7.0	7.1
	Dissolved Oxygen (mg/L)	NO	0.200	γ	Littoral	4	11.6	0.3	0.1	11.2	11.8
					Profundal	4	11.5	0.4	0.2	10.9	11.7
	Dissolved Oxygen (% saturation)	NO	0.200	γ	Littoral	4	95.7	2.2	1.1	92.4	97.1
					Profundal	4	94.6	2.8	1.4	90.4	96.1
	pH (units)	NO	0.201	η	Littoral	4	7.54	0.11	0.05	7.41	7.65
					Profundal	4	7.63	0.04	0.02	7.58	7.67
	Specific Conductance (umho/cm)	NO	0.886	γ	Littoral	4	62.8	1.0	0.5	62.3	64.3
					Profundal	4	62.5	0.2	0.1	62.3	62.8

▒ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data log-transformed, t-test assuming unequal variance conducted.

Table C.9: **Dissolved Metal Concentrations at Reference Lake 3 Monitoring Stations, Mary River Project CREMP, 2018**

Parameters		Units	Summer Sampling Event						Fall Sampling Event					
			REF3-01 bottom 12-Aug-18	REF3-01 surface 12-Aug-18	REF3-02 bottom 12-Aug-18	REF3-02 surface 12-Aug-18	REF3-03 bottom 12-Aug-18	REF3-03 surface 12-Aug-18	REF3-01 bottom 27-Aug-18	REF3-01 surface 27-Aug-18	REF3-02 bottom 27-Aug-18	REF3-02 surface 27-Aug-18	REF3-03 bottom 27-Aug-18	REF3-03 surface 27-Aug-18
Dissolved Metals	Aluminum (Al)	mg/L	0.00305	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0121	<0.0030	0.0035	0.0056
	Antimony (Sb)	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 (As)	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
	Barium (Ba)	mg/L	0.00683	0.00685	0.00654	0.00685	0.00644	0.00689	0.00649	0.00635	0.00661	0.00641	0.0066	0.0068
	Beryllium (Be)	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
	Bismuth (Bi)	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
	Boron (B)	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 (Cd)	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
	Calcium (Ca)	mg/L	6.99	6.97	6.91	7.27	6.80	7.10	6.99	6.9	7.04	7.24	7.16	7.16
	Chromium (Cr)	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
	Cobalt (Co)	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 (Cu)	mg/L	0.00078	0.00075	0.00077	0.00078	0.00081	0.00080	0.00072	0.00073	0.00081	0.00071	0.00072	0.00074
	Iron (Fe)	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
	Lead (Pb)	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
	Lithium (Li)	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
	Magnesium (Mg)	mg/L	4.54	4.37	4.34	4.46	4.51	4.63	4.08	4.12	4.12	4.15	4.08	4.17
	Manganese (Mn)	mg/L	0.000142	0.000164	0.000126	0.000163	0.000103	0.000223	0.000125	0.000142	0.0004	0.000135	0.00016	0.000297
	Mercury (Hg)	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
	Molybdenum (Mo)	mg/L	0.000119	0.000129	0.000129	0.000123	0.000120	0.000125	0.000139	0.000133	0.000138	0.000133	0.000151	0.00013
	Nickel (Ni)	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
	Potassium (K)	mg/L	0.94	0.94	0.94	0.94	0.94	0.95	0.84	0.84	0.85	0.84	0.84	0.86
	Selenium (Se)	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
	Silicon (Si)	mg/L	0.43	0.43	0.44	0.42	0.43	0.42	0.4	0.4	0.43	0.4	0.41	0.41
	Silver (Ag)	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
	Sodium (Na)	mg/L	0.888	0.867	0.874	0.887	0.877	0.894	0.873	0.862	0.891	0.872	0.84	0.906
	Strontium (Sr)	mg/L	0.00762	0.00767	0.00768	0.00802	0.00746	0.00786	0.00787	0.00783	0.00783	0.00815	0.00824	0.00816
	Thallium (Tl)	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
	Tin (Sn)	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 (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000231	0.000238	0.000232	0.000247	0.000232	0.000245	0.00025	0.000264	0.00027	0.000249	0.000251	0.000262
	Vanadium (V)	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
	Zinc (Zn)	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

Table C.10: **Average Relative Percent Difference (RPD) Values between Water Chemistry Samples Taken at the Top and Bottom of the Water Column at Lake Monitoring Stations, Mary River Project CREMP, 2018**

Parameters		Reference Lake		Camp Lake			Sheardown Lake Northwest			Sheardown Lake Southeast			Mary Lake North Basin			Mary Lake South Basin		
		Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall
Conventionals[b]	Conductivity (lab)	1.0	0.3	4.5	0.3	0.6	6	2	1	2.9	1.3	0.8	1.8	0.5	4.1	6.6	7.7	1.1
	pH (lab)	0.5	0.3	0.7	1.2	0.2	1.5	1.0	0.4	0.3	0.3	0.3	1.2	1.4	0.3	0.6	0.7	0.4
	Hardness (as $CaCO_3$)	3.7	0	7.1	0.8	2.2	5.7	3.0	1.2	5.2	2.4	0.9	3.1	0.6	1.9	7.8	7.8	3.7
	Total Suspended Solids (TSS)	0	0	0	0	0	0	0	3.0	0	3.6	0	0	0	0	0	2.6	0
	Total Dissolved Solids (TDS)	9.0	7.1	19	11	9.7	7.3	16	9.7	9.2	14	27	5.0	23	10	10	17	58
	Turbidity	6.5	22	26	40	21	20	16	4.6	16	18	7.7	41	4.1	17	36	23	17
	Alkalinity (as $CaCO_3$)	4.3	7.1	8.7	15	2.7	6.1	4.2	1.6	5.9	20	4.7	2.7	2.8	2.0	7.9	6.8	11
Nutrients and Organics	Total Ammonia	21	65	56	20	11	27	9.3	35	55	9.2	31	0	0	3.2	5.7	0	42
	Nitrate	0	0	21	0	5.7	9.1	34	1.4	5.8	0	1.6	29	58	0	16	2.0	20
	Nitrite	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0
	Total Kjeldahl Nitrogen (TKN)	0	10	26	0	17	32	0	1.1	5.6	0	0	0	0	0	0.9	8.2	0
	Dissolved Organic Carbon	1.2	0.6	4.6	3.4	7.1	10	4.1	3.4	8.1	3.1	2.5	1.5	9.0	1.6	4.7	2.4	1.6
	Total Organic Carbon	38	6.3	9.2	4.9	2.4	11	9.3	3.7	10	7.2	9.4	11	9.7	2.7	7.0	5.5	12
	Total Phosphorus	29	29	65	42	11	19	16	31	43	19	32	95	38	33	35	12	31
	Phenols	37	8.7	49	44	12	1.6	65	20	0	45	15	46	41	3.2	11	36	16
Anions	Bromide (Br)	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0
	Chloride (Cl)	1.8	0.5	4.0	1.1	0.6	5.7	32	0.5	4.1	4.4	0.4	3.5	8.1	1.9	7.0	5.0	1.0
	Sulphate (SO_4)	0.5	0	4.3	2.3	0.8	5.5	17	0.6	6.0	2.5	0.5	12	23	1.2	7.7	17	2.5
Total Metals	Aluminum (Al)	23	47	0.7	28	34	0	19	30	58	8.0	40	0	15	13	32	21	20
	Antimony (Sb)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Arsenic (As)	0	0	0	0	0	0	0	0	0	0	1.9	13	0	0	0	0	0
	Barium (Ba)	67	3.7	5.4	2.2	5.1	7.0	5.9	8.1	4.1	2.9	12	6.9	1.6	2.3	7.7	10	4.9
	Cadmium (Cd)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Calcium (Ca)	1.9	2.1	6.0	1.0	2.5	4.3	4.0	2.1	7.0	1.3	2.8	2.3	0.7	2.5	7.6	9.6	4.1
	Chromium (Cr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt (Co)	0	0	0	0	0	0	0	4.3	0	0	13	0	0	0	0	0	0
	Copper (Cu)	12	2.6	10	18	11	10	11	20	6.8	7.6	16	9.6	6.5	3.4	9.3	24	5.9
	Iron (Fe)	0	0	0	0	0	0	0	20	1.6	9.2	49	35	0	0	0	24	14
	Lead (Pb)	0	0	0	0	0	0	0	18	0	8.9	35	0	0	0	4.8	19	9.1
	Magnesium (Mg)	3.4	2.3	8.4	1.4	3.0	6.9	3.5	4.8	4.9	1.3	6.7	3.1	4.5	2.8	8.2	7.6	4.9
	Manganese (Mn)	16	20	37	5.3	29	44	16	15	52	15	61	73	30	6.8	55	20	14
	Mercury (Hg)	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0
	Molybdenum (Mo)	4.3	4.6	8.0	2.0	12	5.2	9.4	6.6	8.6	6.0	7.4	11	3.4	7.5	8.8	16	12
	Nickel (Ni)	0	0	6.5	4.0	4.3	7.6	6.5	14	6.7	4.2	17	6.0	0	0	0	0	0
	Potassium (K)	2.6	2.7	7.6	0.6	3.6	7.8	3.0	5.0	5.4	0.9	8.2	4.1	0.8	1.2	9.0	6.5	3.0
	Selenium (Se)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Silicon (Si)	4.1	1.6	19	3.3	3.3	9.6	5.8	3.8	7.2	3.6	6.6	20	1.0	5.9	9.9	12	5.8
	Silver (Ag)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sodium (Na)	1.2	4.6	9.3	1.1	3.9	8.3	5.3	2.4	5.9	0.9	6.5	3.9	4.0	5.6	7.5	6.6	4.9
	Strontium (Sr)	1.6	2.2	4.6	1.4	1.2	5.3	3.9	1.5	6.2	2.5	2.4	3.0	0.8	2.2	6.8	11	4.1
	Thallium (Tl)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Titanium (Ti)	0	0	0	0	0	0	0	0	0	0	1.9	0	0	0	0	0	0
	Uranium (U)	8.1	4.5	11	1.8	9.2	5.8	11	2.7	4.1	2.2	12	12	3.4	4.6	9.3	19	6.4
	Vanadium (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zinc (Zn)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Shaded values indicate RDP >30%

Table C.11: *In Situ* Water Quality Measurements Collected at Camp Lake Tributary 1 and Tributary 2 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Study Area	Station	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Unnamed Reference Creek	REF-CRK-B1	6.0	12.27	98.5	7.98	88
	REF-CRK-B2	5.8	12.32	98.6	7.89	85
	REF-CRK-B3	5.8	12.34	98.6	7.98	89
	REF-CRK-B4	5.5	12.39	98.3	7.99	89
	REF-CRK-B5	5.4	12.42	98.3	7.92	88
Camp Lake Tributary 1 Upstream	CLT-1-US-B1	5.0	13.11	101.8	6.92	182
	CLT-1-US B2	5.1	13.20	102.0	6.94	179
	CLT-1-US-B3	5.2	13.08	101.4	6.88	178
	CLT-1-US-B4	5.0	13.56	106.8	6.99	177
	CLT-1-US-B5	5.1	13.49	105.4	6.91	176
Camp Lake Tributary 1 Downstream	CLT-1-DS-B1	5.1	13.36	104.9	7.02	249
	CLT-1-DS-B2	10.4	12.07	108.6	6.80	243
	CLT-1-DS-B3	10.6	11.91	107.0	6.98	241
	CLT-1-DS-B4	10.6	11.91	107.1	7.25	231
	CLT-1-DS-B5	10.5	11.64	104.5	6.99	244
Camp Lake Tributary 2 Upstream	CLT-2-US-B1	5.0	14.14	111.0	6.34	132
	CLT-2-US-B2	5.1	13.97	109.7	6.30	137
	CLT-2-US-B3	4.7	-	-	-	136
	CLT-2-US-B4	5.9	10.68	107.0	6.64	194
	CLT-2-US-B5	5.9	12.52	100.6	6.70	193
Camp Lake Tributary 2 Downstream	CLT-2-DS-B1	5.8	14.01	112.0	6.23	187
	CLT-2-DS-B2	5.9	13.96	112.2	6.44	208
	CLT-2-DS-B3	5.8	13.96	111.9	6.39	210
	CLT-2-DS-B4	6.0	13.63	109.6	6.40	197
	CLT-2-DS-B5	6.3	13.87	112.4	6.49	220

Table C.12: *In Situ* Water Quality Summary Statistics for the Camp Lake Tributary Benthic Stations, Mary River Project CREMP, August 2018

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Temperature (°C)	Unnamed Reference Creek	5.7	0.2	0.1	5.4	6.0	5.4	6.0
	CLT1-US North Branch	5.1	0.1	0.0	5.0	5.2	5.0	5.2
	CLT1-DS Lower Main Stem	9.4	2.4	1.1	6.4	12.5	5.1	10.6
	CLT2-US Upstream	5.3	0.5	0.2	4.6	6.0	4.7	5.9
	CLT2-DS Downstream	6.0	0.2	0.1	5.7	6.2	5.8	6.3
Dissolved Oxygen (mg/L)	Unnamed Reference Creek	12.35	0.06	0.03	12.27	12.42	12.27	12.42
	CLT1-US North Branch	13.29	0.22	0.10	13.01	13.56	13.08	13.56
	CLT1-DS Lower Main Stem	12.18	0.68	0.30	11.34	13.02	11.64	13.36
	CLT2-US Upstream	12.83	1.61	0.80	10.27	15.38	10.68	14.14
	CLT2-DS Downstream	13.89	0.15	0.07	13.70	14.07	13.63	14.01
Dissolved Oxygen (% Saturation)	Unnamed Reference Creek	98.5	0.2	0.1	98.3	98.6	98.3	98.6
	CLT1-US North Branch	103.5	2.5	1.1	100.4	106.5	101.4	106.8
	CLT1-DS Lower Main Stem	106.4	1.7	0.8	104.3	108.5	104.5	108.6
	CLT2-US Upstream	107.1	4.6	2.3	99.7	114.4	100.6	111.0
	CLT2-DS Downstream	111.6	1.1	0.5	110.2	113.0	109.6	112.4
pH (units)	Unnamed Reference Creek	7.95	0.04	0.02	7.90	8.01	7.89	7.99
	CLT1-US North Branch	6.93	0.04	0.02	6.88	6.98	6.88	6.99
	CLT1-DS Lower Main Stem	7.01	0.16	0.07	6.81	7.21	6.80	7.25
	CLT2-US Upstream	6.50	0.20	0.10	6.17	6.82	6.30	6.70
	CLT2-DS Downstream	6.39	0.10	0.04	6.27	6.51	6.23	6.49
Specific Conductance (µS/cm)	Unnamed Reference Creek	88	1.6	0.7	86	90	85	89
	CLT1-US North Branch	178	2.3	1.0	176	181	176	182
	CLT1-DS Lower Main Stem	242	6.6	3.0	233	250	231	249
	CLT2-US Upstream	158	32.1	14.4	119	198	132	194
	CLT2-DS Downstream	204	12.7	5.7	189	220	187	220

Note: Five stations were sampled at each study area.

Table C.13: *In Situ* Water Quality Statistical Comparisons among Camp Lake Tributary 1 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2018

Metric	Overall 3-group Comparison[a]			Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test [b]	(I) Area	(J) Area	Significant Difference Between 2 Areas?	P-value	Statistical Test
Water Temperature (°C)	YES	0.0117	γ	Unnamed Reference Creek	CLT1 North Branch	YES	0.0079	Mann-Whitney U-test
				Unnamed Reference Creek	CLT1 Lower Main Stem	NO	0.1508	
				CLT1 North Branch	CLT1 Lower Main Stem	YES	0.0317	
Dissolved Oxygen (mg/L)	YES	0.0184	γ	Unnamed Reference Creek	CLT1 North Branch	YES	0.0079	Mann-Whitney U-test
				Unnamed Reference Creek	CLT1 Lower Main Stem	NO	0.1508	
				CLT1 North Branch	CLT1 Lower Main Stem	YES	0.0556	
Dissolved Oxygen (% saturation)	YES	< 0.0001	α	Unnamed Reference Creek	CLT1 North Branch	YES	0.0299	Tamhane's
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0013	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.1766	
pH (units)	YES	< 0.0001	α	Unnamed Reference Creek	CLT1 North Branch	YES	0.0000	Tukey's HSD
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0000	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.4336	
Specific Conductance (µS/cm)	YES	< 0.0001	α	Unnamed Reference Creek	CLT1 North Branch	YES	0.0000	Tukey's HSD
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0000	
				CLT1 North Branch	CLT1 Lower Main Stem	YES	0.0000	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, Kruskal Wallis H-test or Mann-Whitney U-test, as appropriate.

Table C.14: Water Chemistry at Lotic Camp Lake Tributary (CLT) Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)^a	AEMP Benchmark^b	Spring Sampling Event						
					L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01
					30-Jun-18	03-Jul-18	01-Jul-18	01-Jul-18	03-Jul-18	03-Jul-18	03-Jul-18
Conventionals	Conductivity (lab)	umho/cm	-	-	52	105	198	102	116	121	138
	pH (lab)	pH	6.5 - 9.0	-	7.65	7.95	8.06	8	7.97	8	8.01
	Hardness (as CaCO$_3$)	mg/L	-	-	24	51	85	49	55	59	69
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	22.8	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	28	49	98	42	60	58	71
	Turbidity	NTU	-	-	2.8	0.7	8.5	2.3	2.2	2.4	0.9
	Alkalinity (as CaCO$_3$)	mg/L	-	-	20	48	69	47	53	54	53
Nutrients and Organics	Total Ammonia	mg/L	variable^c	0.855	<0.020	<0.020	0.14	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.074	0.022	0.849	0.04	0.099	0.091	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	0.0172	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.31	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.0	1.9	2.7	1.6	2.2	2.1	1.7
	Total Organic Carbon	mg/L	-	-	1.1	2.2	3.5	1.8	2.4	2.4	1.9
	Total Phosphorus	mg/L	0.030$^{\alpha}$	-	0.0048	0.0036	0.0138	0.0043	0.0031	0.0062	0.0031
	Phenols	mg/L	0.004$^{\alpha}$	-	0.0015	0.0016	0.0022	0.0036	<0.0010	0.0022	0.0014
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	0.6	0.9	11.1	2.2	2.3	2.4	1.0
	Sulphate (SO$_4$)	mg/L	218$^{\beta}$	218	1.4	5.5	9.3	2.1	3.2	3.6	13.5
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.023	0.011	***0.280***	0.021	0.043	0.040	0.012
	Antimony (Sb)	mg/L	0.020$^{\alpha}$	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0044	0.0072	0.011	0.0066	0.0072	0.0077	0.0077
	Beryllium (Be)	mg/L	0.011$^{\alpha}$	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	0.016	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	5	11	18	10	11	12	13
	Chromium (Cr)	mg/L	0.0089	0.000856	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009$^{\alpha}$	0.004	<0.00010	<0.00010	0.00027	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.0013	0.0017	0.0017	0.0014	0.0016	0.0016	0.0009
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	***0.439***	0.038	0.057	0.051	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.000544	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0022	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	2.9	6.4	10.2	5.8	6.7	7.2	8.6
	Manganese (Mn)	mg/L	0.935$^{\beta}$	-	0.0008	0.0003	0.0327	0.0013	0.0026	0.0024	0.0005
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00023	0.00027	0.00119	0.00035	0.00037	0.00040	0.00016
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00053	0.00128	<0.00050	0.00062	0.00066	<0.00050
	Potassium (K)	mg/L	-	-	0.98	1.19	2.59	1.28	1.31	1.32	1.00
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.45	0.58	0.88	0.38	0.66	0.65	0.52
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.2	0.6	5.7	1.0	1.2	1.2	0.9
	Strontium (Sr)	mg/L	-	-	0.003	0.005	0.016	0.010	0.008	0.009	0.008
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	0.012	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0002	0.0005	0.0042	0.0006	0.0009	0.0008	0.0005
	Vanadium (V)	mg/L	0.006$^{\alpha}$	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	0.0031	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Camp Lake Tributaries.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.14: Water Chemistry at Lotic Camp Lake Tributary (CLT) Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event						
					L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01
					10-Aug-18	01-Aug-18	01-Aug-18	01-Aug-18	01-Aug-18	01-Aug-18	01-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	109	130	301	171	175	177	161
	pH (lab)	pH	6.5 - 9.0	-	8.05	8.09	8.06	8.07	8.08	8.11	8.08
	Hardness (as $CaCO_3$)	mg/L	-	-	58	75	127	85	85	88	87
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	2.4	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	54	75	170	80	90	97.5	90
	Turbidity	NTU	-	-	0.7	0.3	3.3	0.9	0.8	0.7	<0.10
	Alkalinity (as $CaCO_3$)	mg/L	-	-	49	69	98	71	75	77.5	77
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	0.218	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	0.021	3.500	0.468	0.468	0.412	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	< 0.042	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.74	0.16000	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.2	2.2	3.9	2.7	3.3	2.7	2.9
	Total Organic Carbon	mg/L	-	-	2.5	2.8	4.7	3.3	3.4	3.3	2.8
	Total Phosphorus	mg/L	0.030^{α}	-	0.0057	<0.0030	0.0067	0.0031	0.0031	0.0037	0.0032
	Phenols	mg/L	0.004^{α}	-	0.0025	<0.0010	<0.0010	<0.0010	0.0016	0.0012	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.0	1.1	20.5	4.5	4.7	4.5	1.1
	Sulphate (SO_4)	mg/L	218^{β}	218	3.9	4.3	11.3	5.2	5.3	5.4	11.1
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.023	0.009	0.094	0.022	0.029	0.024	0.011
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	0.000	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0076	0.0097	0.0130	0.0096	0.0105	0.0102	0.0096
	Beryllium (Be)	mg/L	0.011^{α}	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	0.026	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	11	16	26	17	18	17	18
	Chromium (Cr)	mg/L	0.0089	0.000856	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	0.00026	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.0021	0.0018	0.0012	0.0017	0.0018	0.0017	0.0011
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	0.233	0.043	0.058	0.043	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.000118	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0033	0.00150	0.00150	0.00155	0.00120
	Magnesium (Mg)	mg/L	-	-	6.4	8.5	16.3	10.1	10.6	10.9	10.1
	Manganese (Mn)	mg/L	0.935^{β}	-	0.0005	0.0004	0.0278	0.0039	0.0046	0.0033	0.0005
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00036	0.00029	0.00292	0.00077	0.00061	0.00072	0.00020
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.0005	0.00115	0.00066	0.00072	0.00072	<0.00050
	Potassium (K)	mg/L	-	-	1.54	1.47	3.56	1.73	1.77	1.75	1.17
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.74	0.79	1.06	0.84	0.89	0.89	0.73
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.4	0.8	12.8	2.6	2.8	2.6	1.0
	Strontium (Sr)	mg/L	-	-	0.007	0.008	0.025	0.013	0.015	0.013	0.011
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0015	0.0012	0.0154	0.0030	0.0032	0.0027	0.0011
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0040	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Camp Lake Tributaries.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.14: Water Chemistry at Lotic Camp Lake Tributary (CLT) Monitoring Stations, Mary River Project CREMP, 2018

	Parameters	Units	Water Quality Guideline (WQG)^{a}	AEMP Benchmark^{b}	Fall Sampling Event						
					LI-08 25-Aug-18	L1-02 25-Aug-18	L2-03 26-Aug-18	L1-09 25-Aug-18	L0-05 18-Aug-18	L0-01 18-Aug-18	K0-01 19-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	107	171	350	218	204	218	195
	pH (lab)	pH	6.5 - 9.0	-	8.06	8.07	8.03	8.26	8.2	8.19	8.23
	Hardness (as CaCO$_3$)	mg/L	-	-	62	89	146	103	104	108	108
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	3.2	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	60	76	195	110	90	105	124
	Turbidity	NTU	-	-	0.3	0.2	5.6	1.1	1.4	1.3	1.8
	Alkalinity (as CaCO$_3$)	mg/L	-	-	58	83	122	92	92	90	104
Nutrients and Organics	Total Ammonia	mg/L	variable^{c}	0.855	0.045	<0.020	0.508	0.059	0.106	0.147	<0.020
	Nitrate	mg/L	13	13	0.025	0.022	3.53	0.625	0.629	0.571	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	0.0224	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.66	<0.15	0.21	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	3.0	2.6	5.5	3.4	2.9	2.8	3.6
	Total Organic Carbon	mg/L	-	-	2.9	3.3	5.9	4.0	4.4	4.1	2.4
	Total Phosphorus	mg/L	0.030$^{\alpha}$	-	<0.0030	<0.0030	0.0067	<0.0030	<0.0030	<0.0030	<0.0030
	Phenols	mg/L	0.004$^{\alpha}$	-	<0.0010	0.0012	0.0045	<0.0010	<0.0010	<0.0010	0.0011
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.2	1.3	21.7	7.2	7.6	8.1	2.2
	Sulphate (SO$_4$)	mg/L	218$^{\beta}$	218	4.0	3.8	13.8	5.6	6.2	6.2	4.5
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.013	0.007	0.108	0.031	0.033	0.035	0.052
	Antimony (Sb)	mg/L	0.020$^{\alpha}$	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00862	0.0103	0.0144	0.012	0.0118	0.01	0.0113
	Beryllium (Be)	mg/L	0.011$^{\alpha}$	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	0.027	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	0.000035	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	12	19	29	23	21	21	22
	Chromium (Cr)	mg/L	0.0089	0.000856	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009$^{\alpha}$	0.004	<0.00010	<0.00010	0.00031	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.0022	0.0021	0.0014	0.0019	0.0019	0.0016	0.0015
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	0.314	0.077	0.077	0.073	0.054
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.00021	<0.000050	0.000051	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.003	0.0015	0.0018	0.0017	0.0014
	Magnesium (Mg)	mg/L	-	-	7.5	10.8	18	12.3	12.3	11.1	13.2
	Manganese (Mn)	mg/L	0.935$^{\beta}$	-	0.0004	0.0004	0.0250	0.0053	0.0041	0.0032	0.0016
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00078	0.00065	0.00300	0.00109	0.00089	0.00082	0.00032
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00064	0.00139	0.00088	0.00087	0.00079	0.00063
	Potassium (K)	mg/L	-	-	1.81	1.71	3.26	2.04	2.20	1.89	1.54
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.79	0.79	1.23	0.91	0.92	0.9	0.95
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.5	1.2	13.8	4.0	4.1	3.4	1.7
	Strontium (Sr)	mg/L	-	-	0.008	0.009	0.029	0.020	0.019	0.018	0.013
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0023	0.0018	0.0201	0.0052	0.0051	0.0042	0.0014
	Vanadium (V)	mg/L	0.006$^{\alpha}$	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Camp Lake Tributaries.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.15: **Magnitude of Elevation in Seasonal Average Water Chemistry (Total Metal Concentration Data Provided) Between the Camp Lake Tributaries and Average Reference Creek Stations, Mary River Project CREMP, 2018**

Variable	Spring				Summer				Fall			
	CLT1			CLT2	CLT1			CLT2	CLT1			CLT2
	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01
Conductivity (lab)	2.4	6.2	3.5	4.3	1.6	4.0	2.3	2.2	1.4	3.6	2.2	2.0
Hardness (as $CaCO_3$)	2.3	5.3	3.4	4.3	1.7	3.2	2.2	2.2	1.6	3.1	2.3	2.3
Total Suspended Solids (TSS)	0.7	8.5	0.7	0.7	1.0	1.2	1.0	1.0	1.0	1.6	1.0	1.0
Total Dissolved Solids (TDS)	2.6	6.5	3.6	4.7	1.4	3.6	1.9	1.9	1.3	3.7	1.9	2.3
Turbidity	0.9	4.2	1.1	0.4	0.2	1.0	0.2	0.0	0.1	2.3	0.5	0.7
Alkalinity (as $CaCO_3$)	2.5	5.0	3.7	3.9	1.6	2.6	2.0	2.1	1.6	2.8	2.1	2.4
Total Ammonia	1.0	7.0	1.0	1.0	1.0	11	1.0	1.0	1.5	24	5.0	1.0
Nitrate	2.4	42	3.8	1.0	1.0	175	22	1.0	1.2	177	30	1.0
Nitrite	1.0	3.4	1.0	1.0	1.0	8.5	1.0	1.0	1.0	4.5	1.0	1.0
Total Kjeldahl Nitrogen (TKN)	1.0	2.1	1.0	1.0	1.0	4.9	1.0	1.0	1.0	4.4	1.1	1.0
Dissolved Organic Carbon	1.5	2.8	2.0	1.7	1.2	2.1	1.6	1.6	1.9	3.8	2.1	2.5
Total Organic Carbon	1.3	2.9	1.8	1.6	1.3	2.3	1.6	1.4	1.5	3.0	2.1	1.2
Total Phosphorus	0.9	2.9	0.9	0.6	0.8	1.2	0.6	0.6	0.9	1.9	0.9	0.9
Phenols	0.7	1.0	1.1	0.7	1.8	1.0	1.3	1.0	1.1	4.5	1.0	1.1
Bromide (Br)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Chloride (Cl)	1.2	18	3.8	1.7	1.0	21	4.6	1.1	0.8	13	4.7	1.3
Sulphate (SO_4)	6.1	16	5.3	24	2.7	7.4	3.5	7.3	1.4	5.1	2.2	1.7
Aluminum (Al)	0.4	6.5	0.8	0.3	0.2	0.9	0.2	0.1	0.2	2.0	0.6	1.0
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.2	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.2	1.0	1.0
Barium (Ba)	2.3	4.3	2.8	3.0	1.6	2.5	1.9	1.8	1.6	2.4	1.9	1.9
Beryllium (Be)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Bismuth (Bi)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Boron (B)	1.0	1.6	1.0	1.0	1.0	2.6	1.0	1.0	1.0	2.7	1.0	1.0
Cadmium (Cd)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.5	1.0	1.0
Calcium (Ca)	2.4	5.5	3.5	4.2	1.7	3.2	2.2	2.3	1.6	3.0	2.2	2.2
Chromium (Cr)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cobalt (Co)	1.0	2.7	1.0	1.0	1.0	2.6	1.0	1.0	1.0	3.1	1.0	1.0
Copper (Cu)	2.5	2.8	2.6	1.6	2.0	1.2	1.7	1.0	2.5	1.6	2.1	1.7
Iron (Fe)	0.6	9.0	1.0	0.6	0.4	3.0	0.6	0.4	0.7	6.8	1.6	1.2
Lead (Pb)	0.7	7.3	0.7	0.7	0.4	1.0	0.4	0.4	0.6	2.5	0.6	0.6
Lithium (Li)	1.0	2.2	1.0	1.0	1.0	3.3	1.5	1.2	1.0	3.0	1.7	1.4
Magnesium (Mg)	2.7	5.9	3.8	4.9	1.6	3.6	2.3	2.2	1.7	3.4	2.2	2.5
Manganese (Mn)	0.8	45	2.8	0.7	0.4	26	3.6	0.5	0.6	38	6.4	2.4
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	3.4	16	4.9	2.2	1.5	13	3.2	0.9	2.5	10	3.2	1.1
Nickel (Ni)	1.0	2.6	1.2	1.0	0.9	2.1	1.3	0.9	1.1	2.6	1.6	1.2
Potassium (K)	3.4	8.2	4.1	3.2	2.5	5.9	2.9	1.9	2.7	5.0	3.1	2.4
Selenium (Se)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Silicon (Si)	1.3	2.2	1.4	1.3	0.8	1.1	0.9	0.8	1.0	1.5	1.1	1.1
Silver (Ag)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sodium (Na)	1.1	15	3.0	2.3	0.6	14	2.8	1.1	0.7	11	3.1	1.4
Strontium (Sr)	1.5	6.0	3.4	2.8	1.0	3.5	1.9	1.5	0.9	3.1	2.0	1.3
Thallium (Tl)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Titanium (Ti)	1.0	1.2	1.0	1.0	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0
Uranium (U)	1.8	22	4.1	2.7	1.2	14	2.8	1.0	1.1	11	2.6	0.8
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0

🟪 Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference value).
🟨 Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference value).
🟥 Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference value).

Table C.16: Dissolved Metal Concentrations at Camp Lake Tributary Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Spring Sampling Event							Summer Sampling Event							Fall Sampling Event						
			L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01	L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01	LI-08	L1-02	L2-03	L1-09	L0-05	L0-01	K0-01
			30-Jun-18	03-Jul-18	01-Jul-18	01-Jul-18	03-Jul-18	03-Jul-18	03-Jul-18	10-Aug-18	01-Aug-18	01-Aug-18	01-Aug-18	01-Aug-18	01-Aug-18	01-Aug-18	25-Aug-18	25-Aug-18	26-Aug-18	25-Aug-18	18-Aug-18	18-Aug-18	19-Aug-18
Dissolved Metals	Aluminum (Al)	mg/L	0.0059	0.0062	0.0198	0.0065	0.0100	0.0094	0.0043	0.0082	0.0052	0.0067	0.0055	0.0079	0.0065	0.0044	0.0060	0.0046	0.0115	0.0051	0.0074	0.0071	0.0050
	Antimony (Sb)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.0043	0.0072	0.0088	0.0064	0.0072	0.0073	0.0078	0.0082	0.0094	0.0123	0.0096	0.0101	0.0100	0.0089	0.0091	0.0107	0.0137	0.0115	0.0118	0.0115	0.0100
	Beryllium (Be)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	0.016	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.025	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.026	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	4.73	10.20	17.8	9.93	11.10	11.90	13.80	11.20	14.70	25.00	17.00	16.70	17.30	17.50	12.50	18.00	29.00	21.10	21.00	21.60	21.70
	Chromium (Cr)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00021	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00023	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00126	0.00159	0.00100	0.00129	0.00160	0.00154	0.00088	0.00227	0.00179	0.00102	0.00168	0.00170	0.00167	0.00106	0.00219	0.00207	0.00121	0.00186	0.00184	0.00183	0.00126
	Iron (Fe)	mg/L	<0.030	<0.030	0.053	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.077	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.085	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	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	<0.000050	<0.000050	<0.000050	<0.000050	0.000151	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	0.0018	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0033	0.0014	0.0014	0.0014	0.0011	<0.0010	<0.0010	0.0027	0.0011	0.0018	0.0019	0.0015
	Magnesium (Mg)	mg/L	3.06	6.29	9.93	5.79	6.68	7.04	8.41	7.25	9.21	15.70	10.30	10.50	10.85	10.50	7.40	10.80	17.90	12.30	12.50	13.30	13.20
	Manganese (Mn)	mg/L	0.00025	0.00017	0.01720	0.00087	0.00170	0.00136	0.00030	0.00020	0.00022	0.02230	0.00339	0.00314	0.00240	0.00035	0.00030	0.00033	0.02150	0.00442	0.00322	0.00252	0.00071
	Mercury (Hg)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.00023	0.00029	0.00150	0.00034	0.00035	0.00036	0.00018	0.00037	0.00021	0.00315	0.00076	0.00074	0.00073	0.00024	0.00073	0.00066	0.00315	0.00109	0.00075	0.00082	0.00030
	Nickel (Ni)	mg/L	<0.00050	<0.00050	0.00077	<0.00050	0.00059	0.00063	<0.00050	<0.00050	0.00053	0.00095	0.00065	0.00068	0.00073	<0.00050	<0.00050	0.00063	0.0012	0.0008	0.0008	0.0009	0.00059
	Potassium (K)	mg/L	0.990	1.210	2.450	1.300	1.300	1.340	0.990	1.710	1.530	3.490	1.790	1.780	1.765	1.210	1.820	1.690	3.370	2.020	2.230	2.200	1.520
	Selenium (Se)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.43	0.55	0.44	0.36	0.57	0.58	0.49	0.77	0.78	0.88	0.81	0.86	0.86	0.74	0.75	0.78	0.97	0.86	0.89	0.93	0.87
	Silver (Ag)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.24	0.61	5.54	1.00	1.17	1.21	0.86	0.46	0.81	12.60	2.76	2.78	2.62	1.05	0.49	1.09	13.70	4.00	4.24	4.01	1.81
	Strontium (Sr)	mg/L	0.0026	0.0052	0.0156	0.0095	0.0082	0.0088	0.0076	0.0065	0.0074	0.0254	0.0130	0.0131	0.0129	0.0094	0.0083	0.0092	0.0289	0.0194	0.0185	0.0188	0.0125
	Thallium (Tl)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.00019	0.00046	0.00395	0.00055	0.00083	0.00080	0.00051	0.00142	0.00109	0.01520	0.00293	0.00287	0.00269	0.00099	0.00237	0.00175	0.01980	0.00505	0.00496	0.00450	0.00135
	Vanadium (V)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.17: **Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between the Camp Lake Tributaries and Average Reference Creek Stations, Mary River Project CREMP, 2018**

Variable	Spring				Summer				Fall			
	CLT1			CLT2	CLT1			CLT2	CLT1			CLT2
	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01
Aluminum (Al)	0.4	0.6	0.7	0.3	0.2	0.2	0.2	0.1	0.2	0.5	0.3	0.2
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0
Barium (Ba)	2.6	1.8	3.2	3.5	1.8	2.6	2.1	1.8	1.8	2.5	2.1	1.8
Beryllium (Be)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Bismuth (Bi)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Boron (B)	1.0	1.6	1.0	1.0	1.0	2.5	1.0	1.0	1.0	2.6	1.0	1.0
Cadmium (Cd)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Calcium (Ca)	2.3	2.2	3.6	4.3	1.6	3.1	2.2	2.2	1.5	2.9	2.2	2.2
Chromium (Cr)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cobalt (Co)	1.0	1.0	1.0	1.0	1.0	2.1	1.0	1.0	1.0	2.3	1.0	1.0
Copper (Cu)	2.6	1.1	2.8	1.6	2.2	1.1	1.8	1.1	2.7	1.5	2.3	1.6
Iron (Fe)	1.0	1.6	1.0	1.0	0.9	2.4	0.9	0.9	1.0	2.8	1.0	1.0
Lead (Pb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.0	1.0	1.0
Lithium (Li)	1.0	1.8	1.0	1.0	1.0	3.3	1.4	1.1	1.0	2.7	1.8	1.5
Magnesium (Mg)	2.7	2.1	3.9	4.9	1.7	3.3	2.3	2.2	1.7	3.4	2.5	2.5
Manganese (Mn)	0.8	52	5.2	1.2	0.6	68	8.2	1.1	1.1	75	10	2.5
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	3.4	6.2	4.6	2.3	1.2	13	3.1	1.0	2.4	11	2.9	1.0
Nickel (Ni)	1.0	1.5	1.2	1.0	1.0	1.8	1.3	1.0	1.1	2.3	1.7	1.1
Potassium (K)	3.6	4.1	4.4	3.3	2.7	5.8	2.9	2.0	2.8	5.4	3.5	2.4
Selenium (Se)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Silicon (Si)	1.4	0.5	1.5	1.4	1.0	1.1	1.1	0.9	1.0	1.3	1.2	1.2
Silver (Ag)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sodium (Na)	1.1	5.7	3.1	2.3	0.7	13	2.7	1.1	0.7	11	3.4	1.5
Strontium (Sr)	1.5	2.2	3.3	2.9	1.0	3.6	1.8	1.3	0.9	3.0	2.0	1.3
Thallium (Tl)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Uranium (U)	2.0	4.0	4.8	3.2	1.3	15	2.8	1.0	1.1	11	2.5	0.7
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

🟪 Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference value).
🟨 Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference value).
🟥 Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference value).

Table C.18: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations at the Camp Lake Tributaries between 2018 and Mine Baseline (2005 to 2013) Periods

Variable	Spring				Summer				Fall			
	CLT1			CLT2	CLT1			CLT2	CLT1			CLT2
	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01
Aluminum (Al)	0.8	6.3	1.2	0.8	1.4	1.0	1.6	0.9	1.3	4.3	2.5	1.4
Antimony (Sb)	0.5	1.0	1.0	0.6	0.7	1.0	1.0	0.6	0.7	1.0	1.0	0.6
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0
Barium (Ba)	1.8	1.9	1.8	1.4	1.3	1.4	1.1	1.1	1.0	0.8	0.8	0.9
Beryllium (Be)	0.3	5.0	5.0	0.4	0.5	2.1	2.1	0.4	0.5	2.1	2.1	0.4
Bismuth (Bi)	1.1	1.0	1.0	1.1	1.1	1.0	1.0	1.1	1.1	1.0	1.0	1.1
Boron (B)	0.5	1.6	1.0	0.6	0.6	2.5	1.0	1.0	1.0	2.6	1.0	1.0
Cadmium (Cd)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9
Calcium (Ca)	1.7	1.5	1.6	1.9	1.3	1.2	1.2	1.3	0.9	0.7	0.8	1.0
Chromium (Cr)	RDL	RDL	RDL	RDL	RDL	RDL	RDL	0.5	RDL	RDL	RDL	RDL
Cobalt (Co)	0.6	1.0	1.0	0.6	0.8	2.0	1.0	0.6	0.8	2.2	1.0	0.6
Copper (Cu)	1.5	1.6	1.5	1.1	1.2	1.2	1.1	1.1	1.3	1.7	1.1	0.5
Iron (Fe)	1.2	1.5	1.2	1.1	1.6	0.4	1.0	1.4	1.8	0.8	0.7	1.4
Lead (Pb)	0.5	1.0	1.0	0.6	0.7	1.0	1.0	0.6	0.7	3.0	1.0	0.6
Lithium (Li)	0.7	1.8	1.9	0.5	0.4	1.0	0.6	0.4	0.4	0.4	0.4	0.5
Magnesium (Mg)	1.7	1.5	1.6	1.9	1.3	1.3	1.3	1.3	0.9	0.9	0.9	1.0
Manganese (Mn)	0.2	6.1	0.5	0.1	0.7	1.8	1.4	0.5	0.8	1.5	0.8	0.6
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0
Molybdenum (Mo)	1.5	10	2.4	1.2	0.7	15	1.7	0.8	1.0	12	1.4	0.7
Nickel (Ni)	0.8	1.0	0.8	0.2	0.9	0.9	1.2	0.2	0.9	1.0	1.0	0.3
Potassium (K)	1.8	3.1	1.9	1.7	1.3	3.6	1.4	1.2	1.0	2.2	1.2	1.1
Selenium (Se)	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL
Silicon (Si)	1.3	0.7	1.2	1.1	1.4	1.0	1.3	1.2	1.0	0.8	0.9	1.4
Silver (Ag)	0.3	10.0	10.0	0.2	0.5	10.0	10.0	0.2	0.6	10.0	10.0	0.2
Sodium (Na)	1.2	5.4	1.9	2.2	1.0	7.1	2.5	0.9	0.8	4.1	1.8	1.0
Strontium (Sr)	1.8	1.2	1.5	2.2	1.3	0.8	1.0	1.2	1.1	0.3	0.3	1.0
Thallium (Tl)	1.3	10.0	10.0	1.3	1.4	2.5	2.4	1.2	1.6	2.5	2.5	0.2
Titanium (Ti)	1.3	1.0	1.0	1.2	1.1	1.0	1.0	1.2	1.1	1.0	1.0	1.5
Uranium (U)	2.0	18	4.1	3.4	2.1	27	3.8	1.4	0.8	12	1.8	0.8
Vanadium (V)	1.0	1.0	1.0	1.0	0.8	1.0	1.0	0.9	0.9	1.0	1.0	0.6
Zinc (Zn)	2.1	2.1	1.5	1.9	2.2	1.7	1.2	1.2	2.2	1.6	2.1	2.4

🟪 Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference value).
🟨 Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference value).
🟥 Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference value).

Note: RDL = Laboratory Reportable Detection Limit

Table C.19: *In Situ* Water Quality Statistical Comparisons among Camp Lake Tributary 2 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2018

Metric	Overall 3-group Comparison[a]			Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test [b]	(I) Area	(J) Area	Significant Difference Between 2 Areas?	P-value	Statistical Test
Water Temperature (°C)	YES	0.0515	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.5100	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	NO	0.2918	
				CLT2 Upstream	CLT2 Downstream	NO	0.1635	
Dissolved Oxygen (mg/L)	YES	0.0413	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.9323	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0000	
				CLT2 Upstream	CLT2 Downstream	NO	0.6255	
Dissolved Oxygen (% saturation)	YES	0.0048	γ	Unnamed Reference Creek	CLT2 Upstream	YES	0.0159	Mann-Whitney U-test
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0079	
				CLT2 Upstream	CLT2 Downstream	YES	0.0635	
pH (units)	YES	< 0.0001	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0016	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0000	
				CLT2 Upstream	CLT2 Downstream	NO	0.7805	
Specific Conductance (µS/cm)	YES	< 0.0001	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0234	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0001	
				CLT2 Upstream	CLT2 Downstream	YES	0.0851	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, Kruskal Wallis H-test or Mann-Whitney U-test, as appropriate.

Table C.20: ***In Situ*** **Water Quality Profile Data Collected at Camp Lake Water Quality Monitoring Stations in Winter, Mary River Project CREMP, 2018**

Depth (m)	Temperature (°C)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09
Date Collected	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	14-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	14-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	14-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	14-Apr-18
1.0	0.5	0.5	0.4	0.2	0.4	103.7	103.3	81.5	100.7	100.4	8.18	7.79	7.92	7.89	8.43	170	171	149	159	168
2.0	0.4	0.5	0.4	0.3	0.5	103.7	102.5	102.0	101.4	100.6	8.08	7.81	7.86	7.87	8.26	169	167	166	158	168
3.0	0.5	0.5	0.5	0.3	0.5	102.5	102.2	102.1	101.5	100.8	8.01	7.81	7.86	7.86	8.16	167	167	166	162	167
4.0	0.5	0.5	0.5	0.5	0.5	101.7	102.3	102.3	101.5	101.3	7.95	7.82	7.85	7.85	8.12	166	167	166	162	166
5.0	0.5	0.5	0.5	0.5	0.5	101.6	102.3	102.0	101.5	101.9	7.91	7.82	7.85	7.84	8.09	166	167	166	165	165
6.0	0.5	0.5	0.5	0.6	0.6	101.8	102.3	100.4	100.4	100.5	7.89	7.83	7.85	7.84	8.07	166	167	164	164	165
7.0	0.5	0.5	0.6	0.6	0.6	102.0	102.8	98.8	101.8	98.1	7.88	7.83	7.84	7.83	8.07	167	168	162	166	162
8.0	0.5	0.5	0.6	0.6	0.7	102.1	102.7	98.0	100.8	96.7	7.86	7.84	7.83	7.83	8.05	167	168	161	165	161
9.0	0.6	0.5	0.7	0.7	0.8	102.7	102.5	96.7	97.7	95.6	7.84	7.82	7.82	7.83	8.03	168	168	161	161	160
10.0	0.5		0.7	0.8	0.8	102.2		95.4	95.0	94.0	7.83		7.81	7.81	8.00	167		160	159	159
11.0	0.6		0.8	0.8	0.8	102.4		94.1	93.3	93.2	7.83		7.79	7.80	7.99	167		159	159	158
12.0	0.6		0.9	0.9	0.9	102.8		92.2	91.6	92.4	7.83		7.78	7.78	7.98	168		158	158	157
13.0			0.9	1.0				91.1	89.0				7.76	7.76				157	158	
14.0			1.0	1.1				90.2	88.0				7.75	7.73				157	157	
15.0				1.1					85.8					7.71					156	
16.0				1.1					83.8					7.69					155	
17.0				1.1					81.4					7.66					155	
18.0				1.2					79.7					7.63					155	
19.0				1.2					78.9					7.62					155	
20.0				1.2					78.8					7.60					156	
21.0				1.3					76.8					7.59					156	
22.0				1.3					74.4					7.57					156	
23.0				1.3					70.9					7.55					157	
24.0				1.5					63.9					7.53					157	
25.0				1.7					56.6					7.48					157	
26.0				1.8					52.3					7.43					159	
27.0				1.9					44.8					7.40					161	
28.0				2.0					37.8					7.33					164	
29.0				2.1					29.0					7.25					169	
30.0				2.3					13.7					7.16					180	
31.0				2.3					12.0					7.14					184	

Notes: Total depth at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 12.2, 10.0, 15.9, 32.4, and 15.8 m, respectively, at the time of winter sampling. Ice thickness at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 2.02, 2.09, 1.82, 2.07, and 2.01 m, respectively, at the time of winter sampling. Deepest measurement at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 12.0, 9.0, 14.0, 31.0, and 12.0 m, respectively, at the time of winter sampling.

Table C.21: ***In Situ*** **Water Quality Profile Data Collected at Camp Lake Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2018**

Depth (m)	Temperature (°C)					Dissolved Oxygen (mg/L)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09
Date Collected	30-Jul-18	29-Jul-18	30-Jul-18	29-Jul-18	29-Jul-18	30-Jul-18	29-Jul-18	30-Jul-18	29-Jul-18	29-Jul-18	30-Jul-18	29-Jul-18	30-Jul-18	29-Jul-18	29-Jul-18	30-Jul-18	29-Jul-18	30-Jul-18	29-Jul-18	29-Jul-18	30-Jul-18	29-Jul-18	30-Jul-18	29-Jul-18	29-Jul-18
1.0	5.7	5.7	5.7	5.7	5.7	12.31	12.47	12.44	12.61	12.52	98.2	99.3	92.2	100.6	99.9	7.57	7.96	7.58	7.98	7.79	118	118	121	121	121
2.0	5.7	5.7	5.7	5.7	5.7	12.41	12.49	12.53	12.63	12.57	99.0	99.5	99.8	100.7	100.2	7.64	7.97	7.64	7.96	7.84	118	118	121	121	124
3.0	5.7	5.7	5.7	5.7	5.7	12.47	12.50	12.54	12.63	12.62	99.5	99.6	100.0	100.7	100.7	7.75	7.97	7.68	7.95	7.91	118	118	121	121	121
4.0	5.7	5.7	5.7	5.7	5.7	12.49	12.50	12.56	12.63	12.61	99.7	99.6	100.1	100.7	100.7	7.79	7.97	7.71	7.94	7.91	118	118	121	121	121
5.0	5.7	5.7	5.7	5.7	5.7	12.49	12.51	12.56	12.63	12.62	99.7	99.7	100.1	100.7	100.6	7.82	7.97	7.73	7.94	7.91	118	118	121	121	121
6.0	5.7	5.7	5.7	5.7	5.7	12.50	12.50	12.56	12.62	12.62	99.7	99.7	100.1	100.7	100.6	7.85	7.96	7.75	7.95	7.91	118	118	121	121	121
7.0	5.7	5.7	5.7	5.7	5.7	12.50	12.50	12.56	12.63	12.62	99.7	99.6	100.1	100.7	100.6	7.85	7.95	7.78	7.95	7.91	118	118	121	121	121
8.0	5.7	5.7	5.7	5.7	5.7	12.49	12.50	12.56	12.63	12.61	99.6	99.6	100.1	100.7	100.5	7.87	7.94	7.80	7.96	7.92	118	118	121	121	121
9.0	5.7	5.7	5.7	5.7	5.7	12.49	12.50	12.56	12.62	12.61	99.5	99.6	100.1	100.6	100.5	7.87	7.94	7.81	7.96	7.92	118	118	121	121	121
10.0	5.7		5.7	5.7	5.7	12.49		12.56	12.61	12.61	99.5		100.1	100.6	100.5	7.89		7.83	7.95	7.92	118		121	121	121
11.0	5.7		5.7	5.7	5.7	12.48		12.56	12.60	12.60	99.5		100.1	100.5	100.5	7.89		7.84	7.96	7.92	118		121	121	121
12.0	5.7		5.7	5.7	5.7	12.47		12.55	12.60	12.60	99.4		100.0	100.4	100.4	7.90		7.85	7.96	7.92	119		121	121	121
13.0			5.7	5.7	5.7			12.55	12.59	12.58			100.0	100.4	100.3			7.86	7.96	7.91			121	121	121
14.0			5.7	5.7	5.7			12.54	12.58	12.59			100.0	100.3	100.3			7.87	7.96	7.92			121	121	121
15.0			5.7	5.7	5.7			12.54	12.60	12.59			100.0	100.5	100.3			7.89	7.95	7.93			121	121	121
16.0			5.7	5.7	5.7			12.54	12.59	12.58			100.0	100.5	100.3			7.89	7.97	7.94			121	121	121
17.0				5.7	5.7				12.59	12.58				100.4	100.3				7.99	7.93				121	121
18.0				5.7					12.58					100.4					8.00					121	
19.0				5.7					12.58					100.3					8.01					121	
20.0				5.7					12.58					100.3					8.01					121	
21.0				5.7					12.57					100.7					8.01					121	
22.0				5.7					12.57					100.2					8.01					121	
23.0				5.7					12.56					100.2					8.01					121	
24.0				5.7					12.55					100.0					8.01					121	
25.0				5.7					12.54					100.0					8.00					121	
26.0				5.7					12.54					100.0					8.00					121	
27.0				5.7					12.54					99.9					8.00					121	
28.0				5.7					12.53					99.9					8.00					121	
29.0				5.7					12.53					99.9					8.00					121	
30.0				5.7					12.56					99.8					8.00					121	

Note: Total depth at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 13.0, 10.0, 17.4, 32.7, and 17.0 m, respectively, at the time of summer sampling.

Table C.22: *In Situ* Water Quality Profile Data Collected at Camp Lake Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2018

Depth (m)	**Temperature (°C)**						**Dissolved Oxygen (mg/L)**						**Dissolved Oxygen (% Saturation)**					
	JLO-02	**JLO-10**	**JLO-01**	**JLO-07**	**JLO-07**	**JLO-09**	**JLO-02**	**JLO-10**	**JLO-01**	**JLO-07**	**JLO-07**	**JLO-09**	**JLO-02**	**JLO-10**	**JLO-01**	**JLO-07**	**JLO-07**	**JLO-09**
Date Collected	**20-Aug-18**	**20-Aug-18**	**19-Aug-18**	**19-Aug-18**	**18-Aug-18**	**19-Aug-18**	**20-Aug-18**	**20-Aug-18**	**19-Aug-18**	**19-Aug-18**	**18-Aug-18**	**19-Aug-18**	**20-Aug-18**	**20-Aug-18**	**19-Aug-18**	**18-Aug-18**	**19-Aug-18**	**19-Aug-18**
surface				7.0							11.60					95.9		
1.0	7.0	7.0	7.0	7.0	7.0	7.0	11.98	12.00	12.07	12.04	11.68	12.1	98.5	98.9	99.5	96.2	99.2	99.3
2.0	7.0	7.0	7.0	7.0	7.0	7.0	11.99	12.02	12.07	12.05	11.70	12.1	98.8	99.1	99.5	96.4	99.3	99.4
3.0	7.0	7.0	7.0	7.0	7.0	7.0	12.01	12.03	12.06	12.05	11.70	12.1	98.9	99.1	99.5	96.4	99.3	99.3
4.0	7.0	7.0	7.0	7.0	7.0	7.0	12.01	12.04	12.06	12.05	11.70	12.1	98.9	99.2	99.5	96.4	99.3	99.3
5.0	7.0	7.0	7.0	7.0	7.0	7.0	12.01	12.04	12.06	12.05	11.70	12.1	98.9	99.2	99.4	96.4	99.3	99.3
6.0	7.0	7.0	7.0	7.0	7.0	7.0	12.01	12.04	12.06	12.05	11.69	12.0	98.9	99.2	99.4	96.3	99.3	99.3
7.0	7.0	7.0	7.0	7.0	7.0	7.0	12.01	12.03	12.05	12.04	11.69	12.0	98.8	99.1	99.4	96.3	99.3	99.3
8.0	7.0	7.0	7.0	7.0	7.0	7.0	12.01	12.03	12.05	12.05	11.68	12.0	98.8	99.1	99.3	96.2	99.3	99.2
9.0	7.0	7.0	7.0	7.0	7.0	7.0	12.00	12.03	12.04	12.04	11.69	12.0	98.8	99.0	99.3	96.3	99.3	99.2
10.0	6.9		7.0	7.0	7.0	7.0	12.00		12.03	12.04	11.70	12.0	98.8		99.1	96.4	99.2	99.2
11.0	6.9		7.0	7.0	7.0	7.0	12.00		12.03	12.03	11.71	12.0	98.7		99.2	96.5	99.2	99.1
12.0	6.9		7.0	7.0	7.0		12.00		12.03	12.03	11.73		98.6		99.1	96.6	99.2	
13.0			7.0	7.0	7.0				12.02	12.03	11.72				99.0	96.6	99.1	
14.0			7.0	7.0	7.0				12.01	12.03	11.71				99.0	96.5	99.1	
15.0			7.0	7.0	7.0				12.01	12.03	11.70				99.0	96.4	99.1	
16.0			7.0	7.0	7.0				12.01	12.03	11.69				98.9	96.3	99.1	
17.0				7.0	7.0					12.02	11.69					96.3	99.1	
18.0				7.0	7.0					12.02	11.68					96.2	99.0	
19.0				7.0	7.0					12.01	11.67					96.1	99.0	
20.0				7.0	7.0					12.01	11.66					96.1	99.0	
21.0				7.0	7.0					12.01	11.66					96.0	98.9	
22.0				7.0	7.0					12.00	11.65					96.0	98.9	
23.0				7.0	7.0					12.00	11.65					96.0	98.9	
24.0				7.0	7.0					12.00	11.64					95.9	98.9	
25.0				7.0	7.0					12.00	11.64					95.9	98.9	
26.0				7.0	7.0					11.99	11.64					95.9	98.8	
27.0				7.0	7.0					11.99	11.64					95.9	98.8	
28.0				7.0	7.0					11.98	11.64					95.9	98.8	
29.0				7.0	7.0					11.98	11.64					95.8	98.7	
30.0				7.0	7.0					11.98	11.64					95.8	98.7	
31.0				7.0	7.0					11.97	11.63					95.8	98.7	

Notes: 19-Aug-18 and 20-Aug-18 sampling was conducted by Baffinland. 18-Aug-18 sampling was conducted by Minnow. Total depth at Stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 12.1, 9.8, 16.2, 31, and 12 m, respectively, at the time of fall sampling.

Table C.22: ***In Situ*** **Water Quality Profile Data Collected at Camp Lake Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2018**

Depth (m)	pH (pH units)						Specific Conductance (µS/cm)					
	JLO-02	JLO-10	JLO-01	JLO-07	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-07	JLO-09
Date Collected	20-Aug-18	20-Aug-18	19-Aug-18	19-Aug-18	18-Aug-18	19-Aug-18	20-Aug-18	20-Aug-18	19-Aug-18	19-Aug-18	18-Aug-18	19-Aug-18
surface					8.10						120	
1.0	8.03	8.08	8.08	8.00	8.08	7.69	119	118	118	118	120	117
2.0	8.04	8.06	8.06	8.01	8.07	7.89	119	118	118	117	120	117
3.0	8.05	8.06	8.06	8.02	8.07	7.93	119	118	118	118	120	117
4.0	8.06	8.07	8.07	8.03	8.07	7.96	119	118	118	118	120	117
5.0	8.06	8.07	8.07	8.04	8.07	7.97	119	118	118	118	120	117
6.0	8.06	8.07	8.07	8.05	8.07	7.98	119	118	118	118	120	117
7.0	8.06	8.08	8.08	8.05	8.07	8.00	119	118	118	118	120	117
8.0	8.06	8.08	8.08	8.05	8.06	8.01	119	118	118	118	120	117
9.0	8.07	8.08	8.08	8.06	8.07	8.02	119	118	118	118	120	117
10.0	8.07		8.09	8.06	8.07	8.02	119		118	118	120	117
11.0	8.07		8.09	8.06	8.07	8.03	119		118	118	120	117
12.0	8.07		8.08	8.07	8.08		121		118	118	120	
13.0			8.08	8.07	8.08				118	118	120	
14.0			8.08	8.08	8.08				118	118	120	
15.0			8.09	8.08	8.09				118	118	120	
16.0			8.08	8.08	8.08				118	118	120	
17.0				8.08	8.08					118	120	
18.0				8.08	8.08					118	120	
19.0				8.08	8.07					118	120	
20.0				8.09	8.07					118	120	
21.0				8.09	8.07					118	120	
22.0				8.09	8.07					118	120	
23.0				8.09	8.06					118	120	
24.0				8.09	8.06					118	120	
25.0				8.09	8.06					118	120	
26.0				8.09	8.06					118	120	
27.0				8.09	8.05					118	120	
28.0				8.09	8.06					118	120	
29.0				8.09	8.06					118	120	
30.0				8.09	8.06					118	120	
31.0				8.09	8.06					118	120	

Notes: 19-Aug-18 and 20-Aug-18 sampling was conducted by Baffinland. 18-Aug-18 sampling was conducted by Minnow. Total depth at Stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 12.1, 9.8, 16.2, 31, and 12 m, respectively, at the time of fall sampling.

Table C.23: **Sampling Depth, Water Clarity Measures, and Surface and Bottom *In Situ* Water Quality Measures Collected at Camp Lake Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018**

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
							(mg/L)	(% sat.)		
Littoral (Shallow) Stations	JLO-02	18-Aug-18	11.6	6.1	surface	7.30	11.71	97.2	8.02	121
					bottom	7.20	11.37	94.5	7.98	121
	JLO-21	19-Aug-18	10.0	6.2	surface	7.16	12.04	99.7	6.77	139
					bottom	7.39	11.61	96.8	-	146
	JLO-20	19-Aug-18	6.6	5.5	surface	7.10	12.05	99.6	6.89	128
					bottom	7.09	11.96	98.8	6.83	128
	JLO-19	19-Aug-18	7.0	6.1	surface	7.30	12.20	101.3	-	-
					bottom	7.17	11.99	99.3	-	-
	JLO-18	18-Aug-18	12.1	6.1	surface	7.40	11.62	96.7	8.11	121
					bottom	7.20	11.63	96.3	8.11	120
Profundal (Deep) Stations	JLO-01	19-Aug-18	18.0	5.7	surface	7.10	11.59	95.8	8.08	120
					bottom	7.10	11.61	95.9	8.02	120
	JLO-07	19-Aug-18	32.9	6.1	surface	7.00	11.60	95.7	8.10	120
					bottom	7.00	11.63	95.8	8.06	120
	JLO-16	19-Aug-18	16.8	6.0	surface	7.30	11.64	96.7	8.11	121
					bottom	7.00	11.65	96.0	8.07	120
	JLO-11	18-Aug-18	29.6	5.9	surface	7.00	11.58	95.3	8.03	120
					bottom	6.90	11.64	95.7	8.01	120
	JLO-12	18-Aug-18	16.5	5.8	surface	7.00	11.60	95.5	8.09	120
					bottom	6.90	11.60	95.4	8.06	120

Table C.24: Statistical Comparison of Bottom *In Situ* Water Quality Between Camp Lake Littoral and Profundal Stations, Mary River Project CREMP, August 2018

Habitat Variable	Statistical Test Results			Summary Statistics					
	Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Lake Zone	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	NO	0.454	α	Littoral	6.01	0.29	0.13	5.50	6.20
				Profundal	5.90	0.14	0.06	5.71	6.07
Temperature (˚C)	YES	0.006	α	Littoral	7.21	0.11	0.05	7.09	7.39
				Profundal	6.98	0.08	0.04	6.90	7.10
Dissolved Oxygen (mg/L)	NO	0.503	η	Littoral	11.7	0.3	0.1	11.4	12.0
				Profundal	11.6	0.0	0.0	11.6	11.7
Dissolved Oxygen (% saturation)	NO	0.189	η	Littoral	97.1	2.0	0.9	94.5	99.3
				Profundal	95.8	0.2	0.1	95.4	96.0
pH (units)	NO	0.425	η	Littoral	7.64	0.70	0.41	6.83	8.11
				Profundal	8.04	0.03	0.01	8.01	8.07
Specific Conductance (umho/cm)	NO	0.229	η	Littoral	129.0	11.9	5.9	120.4	146.0
				Profundal	120.0	0.2	0.1	119.8	120.3

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.25: Statistical Comparison of Bottom *In Situ* Water Quality Between Camp Lake and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

		Statistical Test Results			Summary Statistics						
Lake Zone	Habitat Variable	Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Station Depth (m)**	NO	0.795	η	Reference	5	9.46	2.55	1.14	6.60	12.10
					Camp	5	9.80	1.11	0.49	8.40	11.20
	Secchi Depth (m)	YES	< 0.001	α	Reference	5	6.01	0.29	0.13	5.50	6.20
					Camp	4	8.49	0.45	0.23	8.05	9.10
	Temperature (˚C)	NO	0.111	γ	Reference	5	7.21	0.11	0.05	7.09	7.39
					Camp	4	7.05	0.10	0.05	6.90	7.10
	Dissolved Oxygen (mg/L)	NO	0.564	α	Reference	5	11.7	0.3	0.1	11.4	12.0
					Camp	4	11.6	0.3	0.1	11.2	11.8
	Dissolved Oxygen (% saturation)	NO	0.730	γ	Reference	5	97.1	2.0	0.9	94.5	99.3
					Camp	4	95.7	2.2	1.1	92.4	97.1
	pH (units)	NO	0.821	η	Reference	3	7.64	0.70	0.41	6.83	8.11
					Camp	4	7.54	0.11	0.05	7.41	7.65
	Specific Conductance (umho/cm)	YES	0.029	γ	Reference	4	129.0	11.9	5.9	120.4	146.0
					Camp	4	62.8	1.0	0.5	62.3	64.3
Profundal (Deep) Stations	**Station Depth (m)**	NO	0.703	η	Reference	5	22.76	7.86	3.51	16.50	32.90
					Camp	5	21.26	2.62	1.17	18.50	25.00
	Secchi Depth (m)	YES	< 0.001	α	Reference	5	5.90	0.14	0.06	5.71	6.07
					Camp	4	8.63	0.26	0.13	8.30	8.90
	Temperature (˚C)	NO	0.111	γ	Reference	5	6.98	0.08	0.04	6.90	7.10
					Camp	4	7.08	0.05	0.02	7.00	7.10
	Dissolved Oxygen (mg/L)	NO	0.905	γ	Reference	5	11.6	0.0	0.0	11.6	11.7
					Camp	4	11.5	0.4	0.2	10.9	11.7
	Dissolved Oxygen (% saturation)	NO	0.413	γ	Reference	5	95.8	0.2	0.1	95.4	96.0
					Camp	4	94.6	2.8	1.4	90.4	96.1
	pH (units)	YES	< 0.001	α	Reference	5	8.04	0.03	0.01	8.01	8.07
					Camp	4	7.63	0.04	0.02	7.58	7.67
	Specific Conductance (umho/cm)	YES	< 0.001	α	Reference	5	120.0	0.2	0.1	119.8	120.3
					Camp	4	62.5	0.2	0.1	62.3	62.8

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.26: Water Chemistry at Camp Lake (JLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event											Summer Sampling Event					
					JL0-02	JL0-02	JL0-10	JL0-10	JL0-01	JL0-01	JL0-07	JL0-07	JL0-09	JL0-09	J0-01	JL0-02	JL0-02	JL0-10	JL0-10	JL0-01	JL0-01
					bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	outlet	bottom	surface	bottom	surface	bottom	surface
					13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	14-Apr-18	14-Apr-18	30-Jun-18	30-Jul-18	30-Jul-18	29-Jul-18	29-Jul-18	30-Jul-18	30-Jul-18
Conventionals	Conductivity (lab)	umho/cm	-	-	167	171	167	172	160	169	161	169	157	168	126	136	135	136	136	135	135
	pH (lab)	pH	6.5 - 9.0	-	8.04	8.03	8.06	8.05	8.02	8.07	7.90	8.07	8.01	8.04	7.88	8.04	8.11	8.11	8.10	8.10	8.40
	Hardness (as $CaCO_3$)	mg/L	-	-	85	92	89	93	83	90	83	92	85	89	61	68	68	67	67	67	67
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	80	89	97	77	75	93	63	85	78	87	61	75	80	70	68	55	50
	Turbidity	NTU	-	-	0.4	0.4	0.5	0.4	0.2	0.3	0.3	0.4	0.5	0.3	1.1	1.0	0.8	0.3	0.9	0.7	0.7
	Alkalinity (as $CaCO_3$)	mg/L	-	-	71	76	70	71	66	83	65	71	69	71	55	62	61	59	57	36	69
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	0.022	<0.020	0.214	0.027	0.029	0.022	0.080	0.170	<0.020	0.024	<0.020	<0.020	0.06	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.065	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.46	0.16	0.16	0.16	0.27	0.23	0.18	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	0.065	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Dissolved Organic Carbon	mg/L	-	-	2.0	1.9	2.0	2.0	1.9	2.0	1.9	2.0	1.9	2.0	1.5	1.8	1.8	1.8	1.8	1.8	1.7
	Total Organic Carbon	mg/L	-	-	2.1	2.0	2.6	2.3	2.3	2.1	1.8	2.2	2.2	2.2	1.8	2.2	2.3	2.6	2.5	2.4	2.7
	Total Phosphorus	mg/L	0.020^{α}	-	<0.0030	0.0043	0.0306	0.0121	0.0048	<0.0030	<0.0030	<0.0030	0.0251	<0.0030	0.0032	0.0043	0.0069	0.0047	0.0046	0.0049	0.0034
	Phenols	mg/L	0.004^{α}	-	0.0010	<0.0010	0.0078	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	0.0027	<0.0010	0.0021	<0.0010	0.0011	0.003	0.0019	0.0014	0.0038
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	4.6	4.7	4.7	4.8	4.4	4.7	4.6	4.5	4.4	4.7	3.5	3.9	3.8	3.8	3.8	3.8	3.8
	Sulphate (SO_4)	mg/L	218^{β}	218	3.9	4.0	4.1	4.0	3.7	3.9	3.6	3.8	3.6	3.9	3.2	3.8	3.8	3.8	3.9	3.7	3.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	<0.0030	<0.0030	<0.0030	0.0031	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.015	0.023	0.011	0.010	0.015	0.010	0.010
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0082	0.0082	0.0081	0.0085	0.0076	0.0087	0.0079	0.0083	0.0077	0.0080	0.0064	0.0070	0.0067	0.0067	0.0069	0.0069	0.0068
	Beryllium (Be)	mg/L	0.011^{α}	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<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 (Cd)	mg/L	0.00012	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	15	16	16	16	15	16	14	16	15	16	13	13	13	14	13	13	13
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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 (Cu)	mg/L	0.002	0.004	0.0010	0.0011	0.0010	0.0010	0.0010	0.0010	0.0014	0.0010	0.0011	0.0011	0.0007	0.0009	0.0008	0.0009	0.0012	0.0009	0.0009
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0010	<0.0010	0.0013	0.0011	0.0012	0.00125	0.0012	0.0012
	Magnesium (Mg)	mg/L	-	-	9.1	9.8	9.1	9.9	8.9	9.8	8.7	9.6	8.9	9.5	7.4	8.6	8.4	8.5	8.6	8.6	8.6
	Manganese (Mn)	mg/L	0.935^{β}	-	0.0004	0.0004	0.0004	0.0004	0.0005	0.0004	0.0026	0.0004	0.0005	0.0004	0.0021	0.0026	0.0023	0.0025	0.0025	0.0023	0.0023
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00036	0.00039	0.00035	0.00036	0.00033	0.00036	0.00030	0.00037	0.00034	0.00034	0.00027	0.00029	0.00028	0.00029	0.00030	0.00029	0.00029
	Nickel (Ni)	mg/L	0.025	0.025	0.00067	0.00071	0.00068	0.00068	0.00063	0.00072	0.00065	0.00070	0.00064	0.00068	0.00057	0.00065	0.00057	0.00060	0.00060	0.00060	0.00059
	Potassium (K)	mg/L	-	-	1.33	1.41	1.36	1.43	1.28	1.41	1.25	1.40	1.28	1.36	1.09	1.22	1.20	1.20	1.21	1.21	1.20
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.32	0.33	0.33	0.34	0.33	0.34	0.87	0.34	0.33	0.33	0.30	0.35	0.33	0.33	0.34	0.34	0.32
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.7	1.8	1.7	1.8	1.6	1.8	2.1	1.8	1.6	1.8	1.4	1.6	1.6	1.6	1.6	1.6	1.6
	Strontium (Sr)	mg/L	-	-	0.012	0.012	0.012	0.013	0.011	0.012	0.011	0.012	0.011	0.012	0.009	0.010	0.010	0.010	0.010	0.010	0.010
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0009	0.0009	0.0009	0.0009	0.0008	0.0010	0.0007	0.0009	0.0009	0.0010	0.0007	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Camp Lake system.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.26: Water Chemistry at Camp Lake (JLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event					Fall Sampling Event										
					JL0-07	JL0-07	JL0-09	JL0-09	J0-01	JL0-02	JL0-02	JL0-10	JL0-10	JL0-01	JL0-01	JL0-07	JL0-07	JL0-09	JL0-09	J0-01
					bottom	surface	bottom	surface	outlet	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	outlet
					29-Jul-18	29-Jul-18	29-Jul-18	29-Jul-18	10-Aug-18	21-Aug-18	21-Aug-18	21-Aug-18	21-Aug-18	20-Aug-18	20-Aug-18	20-Aug-18	20-Aug-18	20-Aug-18	20-Aug-18	27-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	135	134	135	135	136	137	137	138	135	137	136	136	136	137	137	141
	pH (lab)	pH	6.5 - 9.0	-	8.13	8.19	8.11	8.07	7.99	8.06	8.05	8.02	8.05	8.04	8.06	8.06	8.05	8.04	8.03	8.1
	Hardness (as $CaCO_3$)	mg/L	-	-	67	66	66	67	72	72	69	70	69	68	68	68	71	68	69	70
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	60	80	65	71	60	58	62	48	55	80	75	73	75	75	90	90
	Turbidity	NTU	-	-	0.7	1.2	0.6	0.7	7.4	0.6	0.6	0.5	0.6	0.8	0.8	0.8	0.7	1.1	0.7	0.5
	Alkalinity (as $CaCO_3$)	mg/L	-	-	60	58	58	57	61	61	62	58	61	58	57	58	57	56	58	63
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.035	<0.020	<0.020	<0.020	<0.020	0.044
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	0.028	0.021	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.15	0.35	<0.15	<0.15	0.15	<0.15	<0.15	<0.15	0.16	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	<0.021	0.028	0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Dissolved Organic Carbon	mg/L	-	-	1.8	1.8	1.7	1.9	2.4	2.4	2.8	2.4	2.4	2.4	2.5	2.5	2.4	2.4	2.6	2.2
	Total Organic Carbon	mg/L	-	-	2.5	2.4	2.4	2.3	2.7	2.8	2.6	2.6	2.6	2.5	2.6	2.5	2.5	2.5	2.6	2.8
	Total Phosphorus	mg/L	0.020^{α}	-	0.0039	<0.0030	0.0031	0.0095	0.0055	0.0036	0.0046	0.0040	0.0042	0.0056	0.0049	0.0037	0.0035	0.0042	0.0040	<0.0030
	Phenols	mg/L	0.001^{α}	-	0.0011	0.0019	0.0013	0.0011	0.0018	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0019	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.8	3.8	3.8	3.8	3.7	3.8	3.8	3.7	3.7	3.7	3.7	3.7	3.8	3.7	3.7	3.8
	Sulphate (SO_4)	mg/L	218^{β}	218	3.7	3.7	3.7	4.0	3.8	3.9	3.9	3.8	3.8	3.8	3.7	3.8	3.8	3.8	3.8	3.9
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	0.009	0.007	0.007	0.007	0.019	0.013	0.013	0.010	0.004	0.015	0.011	0.008	0.011	0.011	0.009	0.008
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010	<0.00010	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0066	0.0067	0.0068	0.0066	0.0070	0.0066	0.0069	0.0067	0.0073	0.0064	0.0069	0.0067	0.0069	0.0068	0.0068	0.0071
	Beryllium (Be)	mg/L	0.011^{α}	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<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 (Cd)	mg/L	0.00012	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	13	14	13	13	14	14	14	14	13	14	13	13	13	14	13	14
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<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 (Cu)	mg/L	0.002	0.004	0.0012	0.0008	0.0009	0.0009	0.0010	0.0009	0.0009	0.0008	0.0007	0.0009	0.0009	0.0009	0.0009	0.0011	0.0008	0.0008
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	0.034	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.0011	0.0013	0.0013	0.0012	<0.0010	0.0011	0.0010	<0.0010	0.0010	0.0011	0.0011	<0.0010	<0.0010	0.0011	0.0011	0.0015
	Magnesium (Mg)	mg/L	-	-	8.6	8.4	8.2	8.3	8.8	8.2	8.4	8.3	9.3	8.4	8.4	8.2	8.3	8.3	8.3	8.3
	Manganese (Mn)	mg/L	0.935^{β}	-	0.0024	0.0024	0.0023	0.0024	0.0028	0.0018	0.0018	0.0018	0.0006	0.0018	0.0017	0.0016	0.0018	0.0020	0.0017	0.0021
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00029	0.00028	0.00030	0.00030	0.00027	0.00029	0.00035	0.00028	0.00036	0.00033	0.00030	0.00030	0.00030	0.00030	0.00032	0.00038
	Nickel (Ni)	mg/L	0.025	0.025	0.00060	0.00059	0.00058	0.00060	0.00075	0.000605	0.00062	0.00059	0.00052	0.00061	0.00063	0.00058	0.00058	0.00061	0.00059	0.00067
	Potassium (K)	mg/L	-	-	1.18	1.18	1.16	1.16	1.22	1.225	1.24	1.22	1.41	1.21	1.2	1.16	1.17	1.17	1.18	1.13
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.31	0.30	0.30	0.30	0.39	0.325	0.35	0.32	0.32	0.33	0.31	0.33	0.32	0.32	0.32	0.33
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.9	1.6	1.6	1.5	1.6	1.6	1.6	1.5
	Strontium (Sr)	mg/L	-	-	0.010	0.010	0.010	0.010	0.010	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.011	0.011	0.012
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0008	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009	0.0009	0.0006	0.0009	0.0008	0.0009	0.0008	0.0009	0.0008	0.0009
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Camp Lake system.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.27: **Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentration Data Provided) Between Camp Lake and Reference Lake 3 in 2018, and Between Camp Lake 2018 and Baseline (2005 to 2013), Mary River Project CREMP**

Parameter	Camp Lake vs Reference Lake 3 in 2018		Camp Lake 2018 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	1.9	1.8	1.3	1.2	1.1
Hardness (as $CaCO_3$)	1.9	2.0	1.4	1.2	1.2
Total Suspended Solids (TSS)	1.0	1.0	1.0	1.0	1.0
Total Dissolved Solids (TDS)	1.9	1.5	1.0	0.9	0.9
Turbidity	3.2	1.4	1.9	1.5	2.3
Alkalinity (as $CaCO_3$)	1.8	1.8	1.1	1.0	1.0
Total Ammonia	1.1	0.5	1.2	0.3	0.8
Nitrate	1.0	1.0	0.2	0.2	0.2
Nitrite	1.0	1.0	1.9	0.2	1.0
Total Kjeldahl Nitrogen (TKN)	1.0	1.1	1.2	0.7	0.5
Dissolved Organic Carbon	0.6	0.8	1.0	1.0	1.4
Total Organic Carbon	0.5	0.7	1.1	1.2	1.4
Total Phosphorus	1.0	0.9	1.5	1.1	0.8
Phenols	1.4	1.0	1.9	1.3	1.1
Bromide (Br)	1.0	1.0	1.1	0.4	0.4
Chloride (Cl)	3.0	3.0	3.3	1.9	1.7
Sulphate (SO_4)	1.0	1.0	2.8	2.6	1.3
Aluminum (Al)	3.2	2.4	1.9	0.8	1.7
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	0.0	1.1	1.4	1.2	1.2
Beryllium (Be)	1.0	1.0	1.1	1.3	2.8
Cadmium (Cd)	1.0	1.0	0.6	0.8	0.9
Calcium (Ca)	1.9	1.9	1.2	1.1	1.1
Chromium (Cr)	1.0	1.0	RDL	1.0	1.0
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9
Copper (Cu)	1.2	1.1	1.0	0.3	1.0
Iron (Fe)	1.0	1.0	1.1	1.1	1.7
Lead (Pb)	1.0	1.0	0.7	0.6	1.0
Lithium (Li)	1.2	1.1	0.2	0.3	
Magnesium (Mg)	1.9	2.0	1.2	1.2	1.2
Manganese (Mn)	4.1	2.6	0.8	1.2	1.1
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	2.2	2.3	1.7	1.5	1.5
Nickel (Ni)	1.2	1.2	1.0	0.8	1.0
Potassium (K)	1.3	1.4		1.4	1.4
Selenium (Se)	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	0.7	0.8	0.8	0.7	0.8
Silver (Ag)	1.0	1.0	1.1	1.6	2.7
Sodium (Na)	1.8	1.9		1.7	1.6
Strontium (Sr)	1.3	1.3	1.7	1.4	1.3
Thallium (Tl)	1.0	1.0	1.1	1.3	3.2
Tin (Sn)	1.0	1.0	0.1	0.2	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0
Uranium (U)	3.3	3.3	2.0	1.7	1.7
Vanadium (V)	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	2.4	1.3	1.3

🟪 Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).

🟧 Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).

🟥 Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.28: Spearman's Rank Correlation Coefficients for Camp Lake (JLO) Water Quality Data Collected in Winter, Summer, and Fall 2018[a]

Parameters	Conventional Parameters							Total Metals													
	Total Dissolved Solids	Turbidity	Alkalinity	Ammonia (total)	Phosphorus (total)	Cloride	Sulphate	Aluminum	Barium	Calcium	Copper	Lithium	Magnesium	Manganese	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Uranium
Total Dissolved Solids	1	-0.050	0.483	0.352	0.091	0.345	0.209	-0.330	0.324	0.434	0.139	-0.133	0.310	-0.496	0.428	0.434	0.186	-0.008	0.083	0.541	0.486
Turbidity	-0.050	1	-0.677	-0.477	0.030	-0.550	-0.196	0.671	-0.602	-0.637	-0.324	0.636	-0.546	0.485	-0.484	-0.486	-0.670	-0.262	-0.644	-0.596	-0.371
Alkalinity	0.483	-0.677	1	0.599	0.010	0.748	0.288	-0.668	0.716	0.739	0.399	-0.522	0.713	-0.602	0.558	0.688	0.823	0.349	0.714	0.723	0.539
Ammonia (total)	0.352	-0.477	0.599	1	0.107	0.579	0.066	-0.541	0.549	0.491	0.328	-0.490	0.516	-0.309	0.239	0.437	0.472	0.380	0.499	0.472	0.193
Phosphorus (total)	0.091	0.030	0.010	0.107	1	0.107	0.159	0.012	0.003	0.050	0.117	0.203	0.247	-0.109	0.086	0.115	0.103	0.214	-0.048	-0.092	0.052
Chloride	0.345	-0.550	0.748	0.579	0.107	1	0.416	-0.607	0.750	0.754	0.665	-0.233	0.725	-0.367	0.383	0.809	0.690	0.454	0.549	0.623	0.409
Sulphate	0.209	-0.196	0.288	0.066	0.159	0.416	1	-0.030	0.224	0.341	0.172	-0.134	0.230	-0.343	0.304	0.397	0.302	-0.013	0.228	0.275	0.533
Aluminum (total)	-0.330	0.671	-0.668	-0.541	0.012	-0.607	-0.030	1	-0.665	-0.551	-0.291	0.588	-0.654	0.610	-0.616	-0.462	-0.570	-0.057	-0.523	-0.606	-0.227
Barium (total)	0.324	-0.602	0.716	0.549	0.003	0.750	0.224	-0.665	1	0.613	0.595	-0.527	0.859	-0.565	0.673	0.672	0.770	0.474	0.613	0.615	0.376
Calcium (total)	0.434	-0.637	0.739	0.491	0.050	0.754	0.341	-0.551	0.613	1	0.670	-0.400	0.557	-0.525	0.464	0.839	0.695	0.261	0.552	0.902	0.695
Copper (total)	0.139	-0.324	0.399	0.328	0.117	0.665	0.172	-0.291	0.595	0.670	1	-0.139	0.481	-0.124	0.372	0.772	0.419	0.539	0.278	0.570	0.374
Lithium (total)	-0.133	0.636	-0.522	-0.490	0.203	-0.233	-0.134	0.588	-0.527	-0.400	-0.139	1	-0.337	0.711	-0.629	-0.234	-0.511	-0.032	-0.599	-0.598	-0.479
Magnesium (total)	0.310	-0.546	0.713	0.516	0.247	0.725	0.230	-0.654	0.859	0.557	0.481	-0.337	1	-0.468	0.641	0.634	0.825	0.463	0.646	0.457	0.212
Manganese (total)	-0.496	0.485	-0.602	-0.309	-0.109	-0.367	-0.343	0.610	-0.565	-0.525	-0.124	0.711	-0.468	1	-0.798	-0.386	-0.601	0.061	-0.443	-0.704	-0.741
Molybdenum (total)	0.428	-0.484	0.558	0.239	0.086	0.383	0.304	-0.616	0.673	0.464	0.372	-0.629	0.641	-0.798	1	0.509	0.615	0.080	0.486	0.649	0.527
Nickel (total)	0.434	-0.486	0.688	0.437	0.115	0.809	0.397	-0.462	0.672	0.839	0.772	-0.234	0.634	-0.386	0.509	1	0.648	0.496	0.501	0.748	0.616
Potassium (total)	0.186	-0.670	0.823	0.472	0.103	0.690	0.302	-0.570	0.770	0.695	0.419	-0.511	0.825	-0.601	0.615	0.648	1	0.408	0.878	0.627	0.464
Silicon (total)	-0.008	-0.262	0.349	0.380	0.214	0.454	-0.013	-0.057	0.474	0.261	0.539	-0.032	0.463	0.061	0.080	0.496	0.408	1	0.312	0.153	0.134
Sodium (total)	0.083	-0.644	0.714	0.499	-0.048	0.549	0.228	-0.523	0.613	0.552	0.278	-0.599	0.646	-0.443	0.486	0.501	0.878	0.312	1	0.503	0.329
Strontium (total)	0.541	-0.596	0.723	0.472	-0.092	0.623	0.275	-0.606	0.615	0.902	0.570	-0.598	0.457	-0.704	0.649	0.748	0.627	0.153	0.503	1	0.760
Uranium (total)	0.486	-0.371	0.539	0.193	0.052	0.409	0.533	-0.227	0.376	0.695	0.374	-0.479	0.212	-0.741	0.527	0.616	0.464	0.134	0.329	0.760	1

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 33.

🟩 Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

🟦 Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.29: Dissolved Metal Concentrations at Camp Lake Water Quality Monitoring Stations, Mary River Project CREMP, 2018

	Parameters	Units	Winter Sampling Event											Summer Sampling Event					
			JL0-02	JL0-02	JL0-10	JL0-10	JL0-01	JL0-01	JL0-07	JL0-07	JL0-09	JL0-09	J0-01	JL0-02	JL0-02	JL0-10	JL0-10	JL0-01	JL0-01
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	outlet	bottom	surface	bottom	surface	bottom	surface
			13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	13-Apr-18	14-Apr-18	14-Apr-18	30-Jun-18	30-Jul-18	30-Jul-18	29-Jul-18	29-Jul-18	30-Jul-18	30-Jul-18
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.003	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00733	0.00769	0.00740	0.00755	0.00710	0.00746	0.00724	0.00779	0.00710	0.00748	0.00651	0.00672	0.00670	0.00654	0.00662	0.00672	0.00655
	Beryllium (Be)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	16.7	18.7	18.2	18.6	16.8	18.1	16.4	18.6	17.1	18.3	12.3	13.5	13.7	13.2	13.3	13.1	13.3
	Chromium (Cr)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00100	0.00110	0.00093	0.00095	0.00088	0.00096	0.00084	0.00097	0.00089	0.00093	0.00072	0.00082	0.00081	0.00095	0.00090	0.00081	0.00079
	Iron (Fe)	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	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0013	0.0016	0.0016	0.0016	0.0015	0.0016	0.0013	0.0015	0.00145	0.0014	<0.0010	0.0012	0.0013	0.0011	0.0011	0.0011	0.0012
	Magnesium (Mg)	mg/L	10.50	10.90	10.50	11.20	10.00	11.00	10.10	11.00	10.25	10.50	7.40	8.21	8.27	8.19	8.17	8.39	8.15
	Manganese (Mn)	mg/L	0.00022	0.00019	0.000111	0.000152	0.000095	0.000142	0.000946	0.000102	0.000130	0.000175	0.000967	0.000522	0.00046	0.000533	0.000558	0.000467	0.000454
	Mercury (Hg)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000366	0.000393	0.000383	0.000393	0.000363	0.000382	0.000293	0.000378	0.000374	0.000365	0.000271	0.000303	0.000297	0.000313	0.000302	0.000290	0.000276
	Nickel (Ni)	mg/L	0.00067	0.00072	0.00071	0.00073	0.00065	0.00071	0.00066	0.00072	0.00070	0.00066	0.00053	0.00058	0.00057	0.00056	0.00057	0.00055	0.00052
	Potassium (K)	mg/L	1.29	1.34	1.32	1.33	1.23	1.34	1.23	1.38	1.27	1.31	1.09	1.19	1.20	1.18	1.18	1.19	1.17
	Selenium (Se)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.34	0.35	0.34	0.36	0.34	0.36	0.93	0.36	0.35	0.34	0.28	0.31	0.31	0.31	0.30	0.29	0.30
	Silver (Ag)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.90	1.96	1.91	2.08	1.88	2.00	2.37	2.00	1.84	1.98	1.42	1.61	1.61	1.57	1.57	1.54	1.52
	Strontium (Sr)	mg/L	0.0114	0.0124	0.0119	0.0126	0.0116	0.0124	0.0116	0.0127	0.0115	0.0120	0.0092	0.01020	0.01030	0.00997	0.00996	0.00992	0.01000
	Thallium (Tl)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000887	0.000924	0.000873	0.000927	0.000832	0.000906	0.000664	0.000924	0.000838	0.000914	0.000730	0.000788	0.000778	0.000775	0.000797	0.000772	0.000754
	Vanadium (V)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.29: Dissolved Metal Concentrations at Camp Lake Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Summer Sampling Event					Fall Sampling Event										
			JL0-07	JL0-07	JL0-09	JL0-09	J0-01	JL0-02	JL0-02	JL0-10	JL0-10	JL0-01	JL0-01	JL0-07	JL0-07	JL0-09	JL0-09	J0-01
			bottom	surface	bottom	surface	outlet	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	outlet
			29-Jul-18	29-Jul-18	29-Jul-18	29-Jul-18	10-Aug-18	21-Aug-18	21-Aug-18	21-Aug-18	21-Aug-18	20-Aug-18	20-Aug-18	20-Aug-18	20-Aug-18	20-Aug-18	20-Aug-18	27-Aug-18
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	0.0039	0.0032	0.0046	0.0034	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0047
	Antimony (Sb)	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	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00662	0.00667	0.00650	0.00661	0.00707	0.00700	0.00693	0.00706	0.00700	0.00692	0.00646	0.00696	0.00662	0.00620	0.00644	0.00684
	Beryllium (Be)	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	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	13.2	13.1	13.4	13.4	14.2	14.4	14.1	14.3	14.1	13.4	13.2	13.4	13.9	13.4	13.6	14.4
	Chromium (Cr)	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	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	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	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00081	0.00076	0.00086	0.00085	0.00089	0.00092	0.00087	0.00085	0.00090	0.00086	0.00090	0.00090	0.00084	0.00084	0.00080	0.00078
	Iron (Fe)	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	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	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	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0011	0.0011	0.0012	0.0012	0.0010	0.0011	0.0010	0.0011	0.0011	0.0011	0.0010	0.0011	0.0013	0.0012	0.0012	<0.0010
	Magnesium (Mg)	mg/L	8.20	8.13	7.98	8.18	8.84	8.68	8.17	8.31	8.30	8.49	8.43	8.44	8.72	8.36	8.51	8.18
	Manganese (Mn)	mg/L	0.000454	0.000385	0.000418	0.000407	0.00088	0.000257	0.000246	0.000203	0.000159	0.000128	0.000147	0.000138	0.000157	0.000127	0.000141	0.000711
	Mercury (Hg)	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	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000284	0.000287	0.000305	0.000298	0.000276	0.000349	0.000285	0.000261	0.000282	0.000309	0.000313	0.000308	0.000333	0.000324	0.000294	0.000341
	Nickel (Ni)	mg/L	0.00057	0.00053	0.00057	0.00055	0.00071	0.00063	0.00058	0.00058	0.00057	0.00056	0.00059	0.00059	0.00061	0.00055	0.00057	0.00060
	Potassium (K)	mg/L	1.18	1.16	1.18	1.17	1.22	1.28	1.24	1.23	1.24	1.21	1.19	1.21	1.21	1.17	1.17	1.11
	Selenium (Se)	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	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.30	0.29	0.29	0.29	0.36	0.34	0.32	0.32	0.31	0.31	0.31	0.30	0.31	0.30	0.31	0.32
	Silver (Ag)	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	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.55	1.56	1.58	1.57	1.59	1.75	1.62	1.63	1.68	1.62	1.71	1.61	1.64	1.55	1.69	1.47
	Strontium (Sr)	mg/L	0.0100	0.01000	0.01010	0.01010	0.01040	0.01085	0.0106	0.0106	0.0105	0.0103	0.01010	0.0104	0.01070	0.0105	0.0105	0.0109
	Thallium (Tl)	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	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000770	0.000779	0.000745	0.000776	0.000782	0.001025	0.000960	0.000921	0.000922	0.000856	0.000839	0.000838	0.000886	0.000894	0.000839	0.000922
	Vanadium (V)	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	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030	<0.0030	<0.0030

Table C.30: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Camp Lake and Reference Lake 3 in 2018, and Between Camp Lake 2018 and Baseline (2005 to 2013), Mary River Project CREMP

Parameter	Camp Lake vs Reference Lake 3 in 2018		Camp Lake 2018 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	1.0	0.6	0.0	0.6	1.1
Antimony (Sb)	1.0	1.0	0.0	0.0	1.0
Arsenic (As)	1.0	1.0	1.0	0.8	1.0
Barium (Ba)	1.0	1.0	0.0	1.3	1.2
Beryllium (Be)	1.0	1.0	1.2	1.2	2.1
Cadmium (Cd)	1.0	1.0	0.4	0.0	0.8
Calcium (Ca)	1.9	1.9	1.3	1.2	1.2
Chromium (Cr)	1.0	1.0	RDL	RDL	RDL
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9
Copper (Cu)	1.1	1.2	0.8	0.6	1.1
Iron (Fe)	1.0	1.0	1.2	1.2	1.7
Lead (Pb)	1.0	1.0	0.6	1.0	1.0
Lithium (Li)	1.2	1.1	0.3	0.0	0.5
Magnesium (Mg)	1.8	2.0	1.3	1.2	1.2
Manganese (Mn)	3.0	0.8	0.5	0.0	0.3
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	2.4	2.2	1.6	0.0	1.5
Nickel (Ni)	1.1	1.2	1.0	0.6	1.0
Potassium (K)	1.3	1.4	0.8	1.1	1.0
Selenium (Se)	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	0.7	0.8	0.8	0.7	0.8
Silver (Ag)	1.0	1.0	1.2	1.8	2.7
Sodium (Na)	1.8	1.9	1.2	1.2	1.3
Strontium (Sr)	1.3	1.3	1.5	1.4	1.4
Thallium (Tl)	1.0	1.0	1.2	1.3	2.6
Tin (Sn)	1.0	1.0	0.1	0.2	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0
Uranium (U)	3.3	3.5	1.7	1.7	1.8
Vanadium (V)	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.5	1.0	1.9

🟪	Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).
🟧	Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
🟥	Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.31: *In Situ* Water Quality Measurements Collected at Sheardown Lake Tributary 1, Tributary 12, and Tributary 9 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Study Area	Station	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Unnamed Reference Creek	REF-CRK-B1	6.00	12.27	98.5	7.98	87.6
	REF-CRK-B2	5.80	12.32	98.6	7.98	85.9
	REF-CRK-B3	5.80	12.34	98.6	7.98	88.5
	REF-CRK-B4	5.50	12.39	98.3	7.99	88.5
	REF-CRK-B5	5.40	12.42	98.3	1.00	88.3
Sheardown Lake Tributary 1 Reach 1	SDLT-1-R1 B1	9.51	12.22	107.2	7.43	359
	SDLT-1-R1-B2	9.50	12.03	105.5	7.57	371
	SDLT-1-R1-B3	9.44	12.12	106.2	7.59	391
	SDLT-1-R1-B4	8.90	12.46	107.8	7.55	-
	SDLT-1-R1-B5	8.65	12.66	109.0	7.51	379
Sheardown Lake Tributary 12 Downstream	SDLT-12-DS-B1	5.90	12.80	99.8	7.45	268
	SDLT-12-DS-B2	6.86	12.30	101.0	7.41	271
	SDLT-12-DS-B3	7.83	12.10	101.9	7.30	267
Sheardown Lake Tributary 9 Upstream	SDLT-9-DS-B1	5.30	11.26	88.8	7.93	180.9
	SDLT-9-DS-B2	5.30	11.55	91.1	7.96	180.3
	SDLT-9-DS-B3	5.40	11.75	93.3	8.00	180.1
	SDLT-9-DS-B4	5.50	11.95	94.8	8.03	180.3
	SDLT-9-DS-B5	5.40	12.12	96.0	8.07	179.1

Table C.32: *In Situ* Water Quality Summary Statistics for the Sheardown Lake Tributary Benthic Stations, Mary River Project CREMP, August 2018

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Temperature (°C)	Unnamed Reference Creek	5.7	0.2	0.1	5.4	6.0	5.4	6.0
	Sheardown Lake Tributary 1 (SDLT1)	9.2	0.4	0.2	8.7	9.7	8.7	9.5
	Sheardown Lake Tributary 12 (SDLT12)	6.9	1.0	0.6	4.5	9.3	5.9	7.8
	Sheardown Lake Tributary 9 (SDLT9)	5.4	0.1	0.0	5.3	5.5	5.3	5.5
Dissolved Oxygen (mg/L)	Unnamed Reference Creek	12.35	0.06	0.03	12.27	12.42	12.27	12.42
	Sheardown Lake Tributary 1 (SDLT1)	12.30	0.26	0.12	11.98	12.62	12.03	12.66
	Sheardown Lake Tributary 12 (SDLT12)	12.40	0.36	0.21	11.50	13.30	12.10	12.80
	Sheardown Lake Tributary 9 (SDLT9)	11.73	0.34	0.15	11.31	12.14	11.26	12.12
Dissolved Oxygen (% Saturation)	Unnamed Reference Creek	98.5	0.2	0.1	98.3	98.6	98.3	98.6
	Sheardown Lake Tributary 1 (SDLT1)	107.1	1.4	0.6	105.4	108.8	105.5	109.0
	Sheardown Lake Tributary 12 (SDLT12)	100.9	1.1	0.6	98.3	103.5	99.8	101.9
	Sheardown Lake Tributary 9 (SDLT9)	92.8	2.9	1.3	89.2	96.4	88.8	96.0
pH (units)	Unnamed Reference Creek	7.97	0.03	0.01	7.93	8.01	7.92	7.99
	Sheardown Lake Tributary 1 (SDLT1)	7.53	0.06	0.03	7.45	7.61	7.43	7.59
	Sheardown Lake Tributary 12 (SDLT12)	7.39	0.08	0.04	7.19	7.58	7.30	7.45
	Sheardown Lake Tributary 9 (SDLT9)	8.00	0.06	0.02	7.93	8.07	7.93	8.07
Specific Conductance (µS/cm)	Unnamed Reference Creek	88	1.1	0.5	86.4	89.1	85.9	88.5
	Sheardown Lake Tributary 1 (SDLT1)	375	13	7	354	396	359	391
	Sheardown Lake Tributary 12 (SDLT12)	269	2	1	263	274	267	271
	Sheardown Lake Tributary 9 (SDLT9)	180	1	0	179	181	179	181

Note: Five stations were sampled at each study area except Tributary 9, where three stations were sampled.

Table C.33: ***In Situ*** **Water Quality Statistical Comparisons Among the Sheardown Lake Tributaries and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2018**

Metric	Overall 4-group Comparison			Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test [b]	(I) Area	(J) Area	Significant Difference Between Areas?	P-value	Statistical Test
Water Temperature (°C)	YES	0.0019	γ	Unnamed Reference Creek	Sheardown Tributary 1	YES	0.0079	Mann-Whitney U-test
				Unnamed Reference Creek	Sheardown Tributary 12	YES	0.0714	
				Unnamed Reference Creek	Sheardown Tributary 9	YES	0.0317	
				Sheardown Tributary 1	Sheardown Tributary 12	YES	0.0357	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0079	
				Sheardown Tributary 12	Sheardown Tributary 9	YES	0.0357	
Dissolved Oxygen (% saturation)	YES	< 0.0001	α	Unnamed Reference Creek	Sheardown Tributary 1	YES	0.0008	Tamhane's
				Unnamed Reference Creek	Sheardown Tributary 12	NO	0.2889	
				Unnamed Reference Creek	Sheardown Tributary 9	YES	0.0686	
				Sheardown Tributary 1	Sheardown Tributary 12	YES	0.0035	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0005	
				Sheardown Tributary 12	Sheardown Tributary 9	YES	0.0108	
pH (units)	YES	0.0032	γ	Unnamed Reference Creek	Sheardown Tributary 1	YES	0.0079	Mann-Whitney U-test
				Unnamed Reference Creek	Sheardown Tributary 12	YES	0.0357	
				Unnamed Reference Creek	Sheardown Tributary 9	NO	0.4206	
				Sheardown Tributary 1	Sheardown Tributary 12	YES	0.0714	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0079	
				Sheardown Tributary 12	Sheardown Tributary 9	YES	0.0357	
Specific Conductance (µS/cm)	YES	< 0.0001	α	Unnamed Reference Creek	Sheardown Tributary 1	YES	0.0002	Tamhane's
				Unnamed Reference Creek	Sheardown Tributary 12	YES	0.0000	
				Unnamed Reference Creek	Sheardown Tributary 9	YES	0.0000	
				Sheardown Tributary 1	Sheardown Tributary 12	YES	0.0025	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0005	
				Sheardown Tributary 12	Sheardown Tributary 9	YES	0.0005	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, Kruskal Wallis H-test or Mann-Whitney U-test conducted, as appropriate.

Table C.34: Water Chemistry at Sheardown Lake Tributary 1 (SDLT1) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Spring Sampling Event		Summer Sampling Event		Fall Sampling Event	
					D1-05 03-Jul-18	D1-00 03-Jul-18	D1-05 01-Aug-18	D1-00 01-Aug-18	DI-05 26-Aug-18	DI-00 26-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	179	282	132	307	190	441
	pH (lab)	pH	6.5 - 9.0	-	7.90	8.10	7.87	8.05	7.72	8.05
	Hardness (as $CaCO_3$)	mg/L	-	-	84	136	76	157	99	205
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	95	159	95	165	95	240
	Turbidity	NTU	-	-	1.07	1.37	2.30	1.57	0.28	1.01
	Alkalinity (as $CaCO_3$)	mg/L	-	-	56	83	57	77	84	92
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.164	0.357	0.236	0.881	<0.020	1.280
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	0.0058	<0.0050	0.0057
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.17	<0.15	<0.15	0.2
	Dissolved Organic Carbon	mg/L	-	-	2.5	2.0	3.2	3.2	3.4	4.1
	Total Organic Carbon	mg/L	-	-	2.7	3.3	3.7	3.8	3.8	4.3
	Total Phosphorus	mg/L	0.030^{α}	-	0.0053	0.0052	0.0042	0.0036	<0.0030	<0.0030
	Phenols	mg/L	0.004^{α}	-	0.0016	<0.0010	0.0016	0.0012	0.0011	0.0011
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	6.4	10.4	4.5	7.9	0.6	8.8
	Sulphate (SO_4)	mg/L	218^{β}	218	20.7	42.9	12.3	63.5	7.8	110.0
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.024	0.028	0.069	0.041	0.012	0.026
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0099	0.0167	0.0088	0.0161	0.0093	0.0174
	Beryllium (Be)	mg/L	0.011^{α}	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	0.012	<0.010	0.011	<0.010	0.012
	Cadmium (Cd)	mg/L	0.00012	0.00008	0.00003	0.00001	0.00003	0.00002	<0.000010	0.00002
	Calcium (Ca)	mg/L	-	-	16	26	14	27	20	38
	Chromium (Cr)	mg/L	0.0089	0.00856	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	<0.00010	0.00024	0.00057	0.00064
	Copper (Cu)	mg/L	0.002	0.0022	***0.0028***	0.0021	***0.0033***	***0.0027***	***0.0036***	0.0021
	Iron (Fe)	mg/L	0.30	0.326	<0.030	0.084	0.071	0.067	<0.030	0.072
	Lead (Pb)	mg/L	0.001	0.001	0.000107	0.000055	0.000158	0.000085	0.000061	0.000053
	Lithium (Li)	mg/L	-	-	<0.0010	0.0019	0.0013	0.0020	<0.0010	0.0021
	Magnesium (Mg)	mg/L	-	-	11.1	17.3	9.9	21.7	12.7	29.2
	Manganese (Mn)	mg/L	0.935^{β}	-	0.0010	0.0050	0.001220	0.0399	0.0002	0.1000
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00311	0.00261	0.00575	0.00403	0.00091	0.00322
	Nickel (Ni)	mg/L	0.025	0.025	0.00115	0.00132	0.00118	0.00163	0.00189	0.00438
	Potassium (K)	mg/L	-	-	2.25	2.78	2.30	2.70	1.49	2.81
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	1.10	0.99	1.46	1.50	1.43	1.38
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.6	4.1	1.7	3.8	0.4	4.1
	Strontium (Sr)	mg/L	-	-	0.011	0.016	0.010	0.018	0.009	0.024
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0028	0.0038	0.0026	0.0041	0.0034	0.0049
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	0.0117	<0.0030	0.0055	<0.0030	0.0075

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for WQG information.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data and adopted from the Camp Lake Tributaries.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.35: Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentration Data Provided) Between SDLT1 and Reference Creek Stations in 2018, and at SDLT1 Between 2018 and the Baseline Period, Mary River Project CREMP

Parameter	SDLT1 Station D1-05 (Reach 4)						SDLT1 Station D1-00 (Reach 1)					
	2018 vs Reference Creek			2018 vs Baseline			2018 vs Reference Creek			2018 vs Baseline		
	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
Conductivity (lab)	5.6	1.8	2.0	2.6	0.9	0.9	8.8	4.1	4.5	3.4	1.6	1.8
Hardness (as $CaCO_3$)	5.3	1.9	2.1	2.4	1.1	1.0	8.5	4.0	4.4	3.2	1.5	1.6
Total Suspended Solids (TSS)	0.7	1.0	1.0	1.0	1.0	1.0	0.7	1.0	1.0	1.0	1.0	1.0
Total Dissolved Solids (TDS)	6.3	2.0	1.8	2.2	1.0	0.7	11	3.5	4.5	3.0	1.3	1.5
Turbidity	0.5	0.7	0.1	1.5	6.5	0.9	0.7	0.5	0.4	0.3	2.4	2.9
Alkalinity (as $CaCO_3$)	4.1	1.5	2.0	1.9	0.9	1.0	6.0	2.1	2.1	2.2	0.8	0.8
Total Ammonia	1.0	1.0	1.0	0.1	0.2	0.3	1.0	1.0	1.0	0.1	0.4	0.7
Nitrate	8.2	12	1.0	1.9	2.5	0.1	18	44	64	3.6	8.8	12
Nitrite	1.0	1.0	1.0	1.0		0.7	1.0	1.2	1.1	1.0		1.0
Total Kjeldahl Nitrogen (TKN)	1.0	1.1	1.0	1.1	1.5	1.4	1.0	1.0	1.3	0.7	0.8	1.6
Dissolved Organic Carbon	2.6	1.7	2.3	0.7	1.3	1.5	2.0	1.7	2.8	0.5	1.1	1.7
Total Organic Carbon	2.3	1.8	1.9	0.8	1.5	1.6	2.7	1.8	2.1	0.7	1.2	1.7
Total Phosphorus	1.1	0.7	0.9	0.4	0.9	1.0	1.1	0.6	0.9	0.5	0.8	0.4
Phenols	0.8	1.6	1.1				0.5	1.2	1.1			
Bromide (Br)	1.0	1.0	1.0	0.4			1.0	1.0	1.0	0.4		
Chloride (Cl)	11	4.5	0.4	1.5	1.3	0.1	17	7.9	5.4		1.7	1.2
Sulphate (SO_4)	37	8.1	2.9	26	2.7	0.8	76	42	41	86	12	13
Aluminum (Al)	0.5	0.7	0.2	0.7	4.7	1.1	0.6	0.4	0.5	0.2	1.9	2.3
Antimony (Sb)	1.0	1.0	1.0	0.5	0.7	0.7	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	3.9	1.7	1.6	2.4	1.2	0.9	6.6	3.0	3.0	3.1	1.4	1.4
Boron (B)	1.0	1.0	1.0	1.0	0.6	0.6	1.2	1.1	1.2	1.1	0.6	0.9
Cadmium (Cd)	3.3	3.1	1.0	1.1	0.9	0.3	1.3	2.0	2.3	0.9	1.1	1.6
Calcium (Ca)	5.1	1.8	2.0	2.5	1.0	1.1	8.0	3.4	3.8	3.2	1.4	1.5
Chromium (Cr)	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL
Cobalt (Co)	1.0	1.0	5.7	0.6	0.8	4.4	1.0	2.4	6.4	0.8	2.4	6.4
Copper (Cu)	4.8	3.2	4.2	0.9	1.1	1.5	3.5	2.6	2.5	0.7	1.1	1.2
Iron (Fe)	0.6	0.9	0.7	0.5	2.7	1.2	1.7	0.9	1.6	0.5	0.6	1.4
Lead (Pb)	1.4	1.3	0.7	0.4	1.5	0.8	0.7	0.7	0.6	0.2	1.5	1.0
Lithium (Li)	1.0	1.3	1.0	2.0	1.5	1.1	1.9	2.0	2.1	3.8	1.6	1.8
Magnesium (Mg)	6.4	2.2	2.4	2.6	1.1	1.0	10.0	4.7	5.5	3.3	1.7	2.1
Manganese (Mn)	1.3	1.1	0.3	1.1	1.7	0.4	6.8	37	153	1.2	15	67
Mercury (Hg)	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		
Molybdenum (Mo)	41	26	3.2	3.5	2.4	0.3	35	18	11	2.1	2.0	1.7
Nickel (Ni)	2.3	2.2	3.6	0.7	1.1	1.9	2.6	3.0	8.3	0.6	1.2	3.8
Potassium (K)	7.1	3.8	2.3	2.5	1.4	0.8	8.8	4.4	4.3	2.9	1.5	1.6
Silicon (Si)	2.7	1.6	1.7	1.3	1.2	1.1	2.5	1.6	1.7	0.9	1.1	1.1
Silver (Ag)	1.0	1.0	1.0	0.9			1.0	1.0	1.0			
Sodium (Na)	4.2	1.8	0.3	5.3	1.7	0.2	11	4.1	3.3	8.1	3.1	1.9
Strontium (Sr)	4.0	1.3	0.9	3.2	1.2	0.7	6.0	2.5	2.5	3.2	1.5	1.7
Thallium (Tl)	1.0	1.0	0.0	RDL	RDL	RDL	1.0	1.0	0.0	RDL	RDL	RDL
Titanium (Ti)	1.0	0.9	1.0	1.0			1.0	0.9	1.0	1.0		
Uranium (U)	15	2.4	1.8	4.4	1.0	0.5	20	3.9	2.6	6.1	1.7	1.1
Vanadium (V)	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		
Zinc (Zn)	1.0	1.0	1.0	2.2	1.2	1.4	3.9	1.8	2.5	12	1.2	2.7

🟪 Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).
🟨 Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
🟥 Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.36: Dissolved Metal Concentrations at Sheardown Lake Tributary Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Spring Sampling Event		Summer Sampling Event		Fall Sampling Event	
			D1-05 3-Jul-18	D1-00 3-Jul-18	D1-05 1-Aug-18	D1-00 1-Aug-18	D1-05 26-Aug-18	DI-00 26-Aug-18
Dissolved Metals	Aluminum (Al)	mg/L	0.0084	0.0083	0.0141	0.0072	0.0036	0.0076
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.0094	0.0166	0.0086	0.0162	0.0096	0.0180
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	0.012	<0.010	0.011	<0.010	0.012
	Cadmium (Cd)	mg/L	0.000036	0.000011	0.000038	0.000023	<0.000010	0.000021
	Calcium (Ca)	mg/L	15.8	25.8	14.1	27.0	19.3	35.5
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	0.00022	0.00058	0.00061
	Copper (Cu)	mg/L	0.00264	0.00197	0.00324	0.00259	0.00349	0.00207
	Iron (Fe)	mg/L	<0.030	0.041	<0.030	<0.030	<0.030	0.036
	Lead (Pb)	mg/L	<0.000050	<0.000050	0.000053	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	0.0017	0.0012	0.0021	<0.0010	0.0020
	Magnesium (Mg)	mg/L	10.9	17.4	9.8	21.8	12.3	28.4
	Manganese (Mn)	mg/L	0.00036	0.00427	0.00036	0.04100	0.00016	0.09740
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.00294	0.00265	0.00587	0.00409	0.00106	0.00319
	Nickel (Ni)	mg/L	0.00107	0.00131	0.00112	0.00154	0.00187	0.00439
	Potassium (K)	mg/L	2.26	2.80	2.26	2.70	1.45	2.60
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	1.07	0.96	1.32	1.43	1.46	1.34
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.51	4.19	1.69	3.86	0.38	3.94
	Strontium (Sr)	mg/L	0.0105	0.0163	0.0098	0.0189	0.0099	0.0231
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.0027	0.0037	0.0026	0.0041	0.0034	0.0050
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	0.011	<0.0030	0.0053	<0.0030	0.0077

Table C.37: *In Situ* Water Quality Profile Data Collected at Sheardown Lake NW Water Quality Monitoring Stations in Winter, Mary River Project CREMP, 2018

Depth (m)	Temperature (°C)						Dissolved Oxygen (mg/L)						Dissolved Oxygen (% Saturation)						pH (pH units)						Specific Conductance (µS/cm)					
	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7
Date Collected	23-Apr-18	23-Apr-18	22-Apr-18	22-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	22-Apr-18	22-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	22-Apr-18	22-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	22-Apr-18	22-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	22-Apr-18	22-Apr-18	23-Apr-18	23-Apr-18
1.0	0.4	1.8	1.8	0.5	0.5	1.6	14.2	13.2	13.3	14.3	14.5	14.1	98.0	95.4	95.1	99.5	100.9	100.5	7.63	7.86	7.79	7.78	7.60	7.62	169	164	159	166	169	169
2.0	0.4	0.4	1.9	1.4	0.2	0.2	14.1	14.1	13.1	13.8	14.7	17.8	97.2	97.1	94.5	98.2	101.0	101.8	7.60	7.78	7.76	7.77	7.62	7.61	165	167	155	161	167	170
3.0	1.6	1.7	1.9	1.7	1.6	1.6	13.4	13.2	13.0	13.6	13.6	13.6	96.1	94.6	94.0	98.1	97.6	97.3	7.57	7.76	7.75	7.69	7.60	7.59	158	155	155	158	156	156
4.0	1.9	1.9	1.9	1.9	1.9	1.9	13.2	13.0	13.0	13.4	13.3	13.3	95.0	93.5	93.8	97.5	95.9	95.7	7.56	7.73	7.73	7.68	7.58	7.58	155	154	155	157	155	155
5.0	1.9	1.9	1.9	1.9	1.9	1.9	13.1	12.9	13.0	13.4	13.2	13.2	94.6	93.0	93.5	96.9	95.4	95.2	7.55	7.71	7.73	7.66	7.57	7.57	155	154	155	157	155	155
6.0	2.0	1.9	1.9		1.9	1.9	13.1	12.9	12.9		13.2	13.1	94.5	92.9	93.3		95.1	94.9	7.55	7.69	7.72		7.57	7.56	155	154	155		155	155
7.0	2.0	1.9	1.9		1.9	1.9	13.1	12.9	13.0		13.2	13.1	94.3	92.9	93.5		95.0	94.6	7.55	7.68	7.70		7.57	7.56	155	155	155		155	155
8.0	2.0	1.9	1.9		1.9	1.9	13.0	12.9	12.9		13.2	13.1	94.2	92.9	93.1		95.1	94.5	7.55	7.66	7.69		7.57	7.56	155	155	155		155	155
9.0	2.0	2.0	1.9		1.9	1.9	13.0	12.9	12.7		13.2	13.1	94.1	93.5	92.0		95.2	94.7	7.55	7.66	7.67		7.57	7.56	155	155	155		155	155
10.0		2.0	2.0		1.9	1.9		13.0	12.7		13.2	13.1		93.6	91.5		95.2	94.9		7.66	7.66		7.56	7.56		155	155		155	155
11.0		2.0	2.0		1.9	2.0		13.0	12.7		13.2	13.0		93.7	91.5		95.2	94.1		7.64	7.64		7.56	7.55		155	155		156	155
12.0		2.0	2.0		2.0			13.0	12.6		13.2			93.7	91.4		95.1			7.64	7.63		7.56			155	154		156	
13.0		2.0	2.0		2.0			13.0	12.5		13.2			93.7	90.3		95.2			7.63	7.60		7.56			155	154		156	
14.0		2.0	2.0		2.0			12.9	12.4		13.2			93.1	89.6		95.3			7.61	7.60		7.56			155	154		156	
15.0		2.0	2.1		2.0			12.7	12.2		13.2			92.3	88.9		95.3			7.60	7.58		7.56			155	154		156	
16.0		2.1	2.1		2.0			12.6	12.0		13.2			91.1	87.7		95.5			7.59	7.57		7.56			154	153		156	
17.0		2.1	2.2		2.1			12.3	11.4		13.1			89.7	82.5		95.3			7.57	7.50		7.55			154	153		156	
18.0		2.1	2.2					12.0	11.2					86.8	81.3					7.55	7.49					153	153			
19.0		2.2						11.7						85.2						7.52						153				
20.0		2.2						11.4						83.2						7.50						152				
21.0																														
21.7																														

Notes: Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 9, 20, 18, 5, 17 and 11 m, respectively, at the time of winter sampling. Ice thickness at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 2.2, 1.7, 2.7, 2.4, and 1.7 m, respectively, at the time of winter sampling. Deepest measurement at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 7.9, 21.7, 20, 5.0, 15.4, and 10.4 m, respectively, at the time of winter sampling.

Table C.38: *In Situ* Water Quality Profile Data Collected at Sheardown Lake NW Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2018

Depth (m)	Temperature (°C)						Dissolved Oxygen (mg/L)						Dissolved Oxygen (% Saturation)						pH (pH units)						Specific Conductance (µS/cm)					
	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7
Date Collected	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18
1.0	7.6	7.3	7.2	7.8	7.5	7.1	11.80	11.90	11.86	11.98	11.95	11.93	98.5	98.9	98.3	100.7	99.3	98.3	7.97	8.02	7.91	8.02	8.01	7.92	113	113	113	116	116	116
2.0	7.4	7.3	7.1	7.7	7.3	7.0	11.86	11.89	11.89	12.05	11.96	11.99	98.6	98.7	98.2	100.1	99.1	98.7	7.96	8.01	7.93	8.03	8.00	7.96	114	113	112	116	116	116
3.0	7.4	7.2	7.0	7.3	7.1	6.9	11.88	11.92	11.93	12.06	11.99	12.00	98.7	98.6	98.3	100.1	99.0	98.6	7.97	8.02	7.94	8.03	8.01	7.97	114	113	113	116	116	116
4.0	7.3	7.1	6.9	7.2	7.0	6.9	11.89	11.96	11.94	12.08	12.00	12.00	98.8	98.7	98.2	100.0		98.7	7.97	8.02	7.96	8.03	8.01	7.97	116	113	112	116	116	116
5.0	7.3	7.1	6.9		7.0	6.9	11.90	11.96	11.94		12.00	11.99	98.9	98.7	98.3			98.6	7.97	8.04	7.98		8.01	7.97	120	113	112		116	116
6.0	7.3	7.1	6.9		6.9	6.9	11.93	11.96	11.93		12.00	11.99	99.0	98.7	98.2			98.5	7.98	8.04	7.98		8.01	7.98	124	113	113		116	116
7.0	7.3	7.1	6.9		6.9	6.9	11.93	11.95	11.92		11.99	11.98	99.0	98.6	98.0			98.5	7.99	8.04	7.98		8.01	7.98	127	113	113		116	116
8.0	7.3	7.0	6.9		6.9	6.9	11.92	11.95	11.91		11.99	11.97	98.9	98.4	97.9			98.9	8.00	8.03	7.99		8.01	7.98	128	112	113		116	116
9.0	7.2	6.9	6.9		6.9	6.9	11.91	11.94	11.90		11.99	11.97	98.6	98.3	97.9			98.3	8.01	8.03	7.99		8.01	7.99	123	112	113		116	116
10.0	7.0	6.9	6.9		6.9	6.9	11.93	11.94	11.90		11.98	11.96	98.3	98.2	97.8			98.3	8.02	8.03	7.99		8.01	7.99	116	113	113		116	116
11.0		6.9	6.9		6.9	6.9		11.93	11.89		11.97	11.95		98.1	97.8			98.2		8.02	7.99		8.01	7.99		113	113		116	116
12.0		6.9	6.9		6.9			11.92	11.89		11.96			98.0	97.8					8.02	7.96		8.01			113	113		116	
13.0		6.9	6.9		6.9			11.91	11.89		11.95			98.0	97.7					8.02	7.97		8.01			113	113		116	
14.0		6.9	6.9		6.9			11.90	11.88		11.94			97.8	97.7					8.01	7.98		8.01			113	113		116	
15.0		6.9	6.9		6.9			11.89	11.88		11.93			97.8	97.6					8.00	7.97		8.01			113	113		116	
16.0		6.9	6.9		6.9			11.89	11.88		11.93			97.7	97.6					8.00	7.97		8.01			113	113		116	
17.0		6.9	6.9					11.88	11.87					97.7	97.6					7.99	7.96					113	113			
18.0		6.9	6.9					11.88	11.87					97.7	97.5					7.99	7.96					113	113			
19.0		6.9	6.9					11.88	11.86					97.6	97.5					7.98	7.96					113	113			
20.0		6.9	6.9					11.87	11.86					97.6	97.4					7.98	7.96					113	113			
21.0		6.9						11.86						97.5						7.98						113				
22.0		6.9						11.86						97.5						7.98						113				

Note: Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 10.5, 23.4, 22, 5.4, 17.4, and 11.5 m, respectively, at the time of summer sampling.

Table C.39: ***In Situ*** **Water Quality Profile Data Collected at Sheardown Lake NW Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2018**

Depth (m)	Temperature (°C)							Dissolved Oxygen (mg/L)							Dissolved Oxygen (% Saturation)						
	DD Hab9	DLO-01-5	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7
Date Collected	20-Aug-18	21-Aug-18	17-Aug-18	20-Aug-18	21-Aug-18	21-Aug-18	21-Aug-18	20-Aug-18	21-Aug-18	17-Aug-18	20-Aug-18	21-Aug-18	21-Aug-18	21-Aug-18	20-Aug-18	21-Aug-18	17-Aug-18	20-Aug-18	21-Aug-18	21-Aug-18	21-Aug-18
surface			8.0							11.6							97.3				
1.0	7.7	7.6	8.0	7.6	7.6	7.6	7.6	11.5	11.6	11.6	11.7	11.6	11.2	11.4	96.5	97.0	98.1	97.5	97.0	93.5	95.5
2.0	7.6	7.6	7.9	7.6	7.6	7.6	7.6	11.7	11.6	11.7	11.7	11.6	11.2	11.4	97.5	97.0	98.1	97.6	96.8	93.8	95.7
3.0	7.6	7.6	7.8	7.6	7.6	7.6	7.6	11.7	11.6	11.7	11.7	11.6	11.2	11.5	97.7	96.9	97.9	97.6	96.7	93.9	96.0
4.0	7.6	7.6	7.7	7.6	7.6	7.6	7.6	11.7	11.6	11.7	11.7	11.6	11.2	11.5	97.7	96.9	97.9	97.5	96.6	94.0	97.4
5.0	7.6	7.6	7.7	7.6	7.6	7.6	7.6	11.7	11.6	11.7	11.7	11.6	11.2	11.5	97.7	96.8	97.8	97.5	96.6	94.0	96.2
6.0	7.6	7.6	7.7	7.6	7.6	7.6	7.6	11.7	11.6	11.7	11.7	11.6	11.25	11.5	97.7	96.7	97.8	97.5	96.6	94.2	96.3
7.0	7.6	7.6	7.7	7.6	7.6	7.6	7.6	11.7	11.6	11.7	11.6	11.5	11.3	11.5	97.6	96.7	97.7	97.4	95.8	94.8	96.3
8.0	7.6	7.6	7.7	7.6		7.6	7.6	11.7	11.6	11.6	11.6		11.4	11.5	97.6	96.7	97.7	97.4		94.9	96.3
9.0		7.6	7.7	7.6		7.6	7.6		11.6	11.6	11.6		11.4	11.5		96.6	97.6	97.4		95.1	96.2
10.0		7.6	7.7	7.6		7.6	7.6		11.5	11.6	11.6		11.4	11.5		96.6	97.5	97.4		95.2	96.2
11.0		7.6	7.7	7.6		7.6	7.6		11.5	11.6	11.6		11.4	11.5		96.5	97.3	97.3		95.3	96.2
12.0		7.6	7.7	7.6		7.6			11.5	11.6	11.6		11.4			96.5	97.1	97.3		95.4	
13.0		7.6	7.6	7.6		7.6			11.5	11.6	11.6		11.4			96.5	96.9	97.3		95.4	
14.0		7.6	7.6	7.6		7.6			11.5	11.6	11.6		11.4			96.5	96.7	97.2		95.5	
15.0		7.6	7.6	7.6		7.6			11.5	11.5	11.6		11.4			96.4	96.5	97.2		95.5	
16.0		7.6	7.6	7.6		7.6			11.5	11.5	11.6		11.4			96.4	96.4	97.1		95.5	
17.0		7.6	7.6	7.6		7.6			11.5	11.5	11.6		11.4			96.3	96.3	97.1		95.5	
18.0		7.6	7.6	7.6					11.5	11.5	11.6					96.3	96.2	97.0			
19.0		7.6	7.6	7.6					11.5	11.5	11.6					96.3	96.2	97.0			
20.0		7.6	7.6	7.6					11.5	11.5	11.6					96.0	96.2	97.0			
21.0		7.6	7.5	7.6					11.5	11.5	11.6					96.0	95.7	96.9			
22.0		7.6							11.5							95.9					
23.0		7.6							11.5							95.9					

Notes: 17-Aug-18 sampling was conducted by Minnow. Sheardown Lake NW water profile sampling on all other dates was conducted by Baffinland. Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 8.6, 23.5, 20.6, 7.0, 17.4, and 10.7 m, respectively, at the time of fall sampling.

Table C.39: *In Situ* Water Quality Profile Data Collected at Sheardown Lake NW Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2018

Depth (m)	pH (pH units)							Specific Conductance (µS/cm)						
	DD Hab9	DLO-01-5	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7
Date Collected	**20-Aug-18**	**21-Aug-18**	**17-Aug-18**	**20-Aug-18**	**21-Aug-18**	**21-Aug-18**	**21-Aug-18**	**20-Aug-18**	**21-Aug-18**	**17-Aug-18**	**20-Aug-18**	**21-Aug-18**	**21-Aug-18**	**21-Aug-18**
surface			8.03							120				
1.0	8.06	7.94	8.01	8.03	7.94	7.67	7.95	119	118	120	118	119	119	119
2.0	8.05	7.94	8.01	8.02	7.94	7.74	7.94	119	118	120	118	119	119	119
3.0	8.03	7.95	8.02	8.02	7.94	7.78	7.94	119	118	120	118	119	119	119
4.0	8.03	7.94	8.02	8.01	7.94	7.81	7.94	119	118	120	118	119	119	119
5.0	8.03	7.94	8.01	8.01	7.95	7.82	7.95	119	118	120	118	119	119	119
6.0	8.02	7.94	8.03	8.01	7.95	7.84	7.94	119	118	120	118	119	119	119
7.0	8.02	7.94	8.01	8.01	7.89	7.87	7.94	120	118	120	118	119	119	119
8.0	8.02	7.94	8.00	8.01		7.87	7.94	120	119	120	118		119	119
9.0		7.94	8.00	8.01		7.87	7.94		119	120	118		119	119
10.0		7.94	7.99	8.01		7.88	7.94		118	120	118		119	119
11.0		7.95	7.98	8.01		7.88	7.94		118	120	118		119	119
12.0		7.94	7.97	8.01		7.89			119	120	118		119	
13.0		7.94	7.96	8.01		7.89			118	120	118		119	
14.0		7.94	7.95	8.01		7.90			119	120	118		119	
15.0		7.93	7.94	8.01		7.90			119	120	118		119	
16.0		7.93	7.93	8.01		7.90			118	120	118		119	
17.0		7.93	7.92	8.01		7.90			119	121	118		119	
18.0		7.93	7.91	8.01					118	121	118			
19.0		7.92	7.91	8.01					119	121	118			
20.0		7.89	7.91	8.01					118	122	118			
21.0		7.83	7.90	8.01					118	122	118			
22.0		7.80							118					
23.0		7.76							118					

Notes: 17-Aug-18 sampling was conducted by Minnow. Sheardown Lake NW water profile sampling on all other dates was conducted by Baffinland. Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 8.6, 23.5, 20.6, 7.0, 17.4, and 10.7 m, respectively, at the time of fall sampling.

Table C.40: Sampling Depth, Water Clarity Measures, and Surface and Bottom *In Situ* Water Quality Measures Collected at Sheardown Lake NW Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
							(mg/L)	(% sat.)		
Littoral (Shallow) Stations	DLO-01-9	17-Aug-2018	8.2	3.3	surface	7.80	11.65	97.9	7.96	120
					bottom	7.60	11.64	97.1	8.01	121
	DLO-01-4	17-Aug-2018	6.7	3.7	surface	7.80	11.68	98.3	8.01	120
					bottom	7.50	11.67	97.5	8.02	120
	DLO-01-3	17-Aug-2018	7.3	3.6	surface	8.10	11.65	98.6	7.99	120
					bottom	7.70	11.68	98.1	7.98	120
	DLO-01-11	17-Aug-2018	8.2	3.7	surface	7.90	11.63	98.0	8.02	120
					bottom	7.70	11.63	97.7	8.00	120
	DLO-01-10	17-Aug-2018	8.8	3.5	surface	7.90	11.65	98.7	8.00	120
					bottom	7.70	11.65	97.8	8.03	120
Profundal (Deep) Stations	DLO-01-5	17-Aug-2018	23.8	4.6	surface	7.80	11.61	97.6	7.81	120
					bottom	7.50	11.27	93.7	7.83	120
	DLO-01-14	17-Aug-2018	23.8	3.5	surface	7.80	11.65	98.0	8.04	119
					bottom	7.50	11.41	95.2	7.94	120
	DLO-01-15	17-Aug-2018	21.3	4.5	surface	7.80	11.68	98.2	7.99	120
					bottom	7.60	11.50	96.1	7.96	120
	DLO-01-2	17-Aug-2018	17.1	3.9	surface	7.90	11.67	98.3	7.99	120
					bottom	7.60	11.59	97.0	7.98	120
	DLO-01-12	17-Aug-2018	14.0	3.4	surface	8.00	11.66	98.4	7.98	120
					bottom	7.60	11.60	97.1	7.97	120

Table C.41: Statistical Comparison of Bottom *In Situ* Water Quality Between Sheardown Lake NW Littoral and Profundal Stations, Mary River Project CREMP, August 2018

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Lake Zone	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	NO	0.169	α	Littoral	5	3.56	0.17	0.07	3.30	3.70
				Profundal	5	3.98	0.55	0.25	3.40	4.60
Temperature (˚C)	NO	0.151	β , ζ	Littoral	5	7.64	0.09	0.04	7.50	7.70
				Profundal	5	7.56	0.05	0.02	7.50	7.60
Dissolved Oxygen (mg/L)	YES	0.042	β , ζ	Littoral	5	11.7	0.0	0.0	11.6	11.7
				Profundal	5	11.5	0.1	0.1	11.3	11.6
Dissolved Oxygen (% saturation)	YES	0.043	α	Littoral	5	97.6	0.4	0.2	97.1	98.1
				Profundal	5	95.8	1.4	0.6	93.7	97.1
pH (units)	YES	0.008	α	Littoral	5	8.01	0.02	0.01	7.98	8.03
				Profundal	5	7.94	0.06	0.03	7.83	7.98
Specific Conductance (umho/cm)	NO	0.829	α	Littoral	5	120.0	0.4	0.2	119.7	120.7
				Profundal	5	120.0	0.5	0.2	119.5	120.4

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.42: Statistical Comparison of Bottom *In Situ* Water Quality Between Sheardown Lake NW and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Station Depth (m)**	YES	0.013	α	Reference	5	9.80	1.11	0.49	8.40	11.20
					Sheardown NW	5	7.84	0.83	0.37	6.70	8.80
	Secchi Depth (m)	YES	< 0.001	α	Reference	4	8.49	0.45	0.23	8.05	9.10
					Sheardown NW	5	3.56	0.17	0.07	3.30	3.70
	Temperature (˚C)	YES	0.016	γ	Reference	4	7.05	0.10	0.05	6.90	7.10
					Sheardown NW	5	7.64	0.09	0.04	7.50	7.70
	Dissolved Oxygen (mg/L)	NO	0.738	η	Reference	4	11.6	0.3	0.1	11.2	11.8
					Sheardown NW	5	11.7	0.0	0.0	11.6	11.7
	Dissolved Oxygen (% saturation)	YES	0.016	γ	Reference	4	95.7	2.2	1.1	92.4	97.1
					Sheardown NW	5	97.6	0.4	0.2	97.1	98.1
	pH (units)	YES	0.003	η	Reference	4	7.54	0.11	0.05	7.41	7.65
					Sheardown NW	5	8.01	0.02	0.01	7.98	8.03
	Specific Conductance (umho/cm)	YES	< 0.001	α	Reference	4	62.8	1.0	0.5	62.3	64.3
					Sheardown NW	5	120.0	0.4	0.2	119.7	120.7
Profundal (Deep) Stations	**Station Depth (m)**	NO	0.593	α	Reference	5	21.26	2.62	1.17	18.50	25.00
					Sheardown NW	5	20.00	4.33	1.94	14.00	23.80
	Secchi Depth (m)	YES	< 0.001	α	Reference	4	8.63	0.26	0.13	8.30	8.90
					Sheardown NW	5	3.98	0.55	0.25	3.40	4.60
	Temperature (˚C)	YES	0.016	γ	Reference	4	7.08	0.05	0.02	7.00	7.10
					Sheardown NW	5	7.56	0.05	0.02	7.50	7.60
	Dissolved Oxygen (mg/L)	NO	0.286	γ	Reference	4	11.5	0.4	0.2	10.9	11.7
					Sheardown NW	5	11.5	0.1	0.1	11.3	11.6
	Dissolved Oxygen (% saturation)	NO	0.556	γ	Reference	4	94.6	2.8	1.4	90.4	96.1
					Sheardown NW	5	95.8	1.4	0.6	93.7	97.1
	pH (units)	YES	0.016	γ	Reference	4	7.63	0.04	0.02	7.58	7.67
					Sheardown NW	5	7.94	0.06	0.03	7.83	7.98
	Specific Conductance (umho/cm)	YES	< 0.001	α	Reference	4	62.5	0.2	0.1	62.3	62.8
					Sheardown NW	5	120.0	0.5	0.2	119.5	120.4

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.43: Water Chemistry at Sheardown Lake NW (DLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event											
					DD-HAB9-STN1	DD-HAB9-STN1	DL0-01-5	DL0-01-5	DL0-01-1	DL0-01-1	DL0-01-4	DL0-01-4	DL0-01-2	DL0-01-2	DL0-01-7	DL0-01-7
					bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
					23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	22-Apr-18	22-Apr-18	22-Apr-18	22-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18
Conventionals	Conductivity (lab)	umho/cm	-	-	154	160	148	171	152	158	156	161	155	159	156	166
	pH (lab)	pH	6.5 - 9.0	-	7.93	7.95	7.72	8.16	7.93	7.96	7.89	7.91	8.12	7.94	8.03	8.00
	Hardness (as $CaCO_3$)	mg/L	-	-	66	69	68	75	68	70	68	72	69	72	69	74
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	71	76	73	78	68	73	76	85	73	76	74	80
	Turbidity	NTU	-	-	0.3	0.3	0.4	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.4	0.3
	Alkalinity (as $CaCO_3$)	mg/L	-	-	64	70	63	69	60	64	63	67	66	68	69	71
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	0.023	<0.020	0.032	<0.020	<0.020	0.034	0.033	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.083	0.085	0.120	0.097	0.104	0.083	0.082	0.083	0.079	0.081	0.081	0.085
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	0.28	<0.15	0.27	<0.15	<0.15	0.18	0.21	<0.15	<0.15	0.28	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.7	1.8	1.8	1.8	1.7	1.7	<1.0	1.8	1.8	1.8	1.8	1.8
	Total Organic Carbon	mg/L	-	-	1.9	2.0	1.9	2.3	1.9	2.2	2.0	2.1	2.1	2.1	1.8	2.2
	Total Phosphorus	mg/L	0.020[α]	-	0.0031	0.0036	<0.0030	<0.0030	0.0050	0.0048	0.0034	0.0042	0.0039	0.0046	0.0055	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.7	3.9	3.7	4.2	3.7	3.9	3.8	4.0	3.8	3.9	3.7	4.0
	Sulphate (SO_4)	mg/L	218[β]	218	6.7	6.9	6.5	7.4	6.6	6.9	6.8	7.0	6.7	7.0	6.7	7.1
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	mg/L	0.020[α]	-	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0079	0.0079	0.0074	0.0083	0.0079	0.0084	0.0083	0.0081	0.0083	0.0079	0.0073	0.0086
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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
	Boron (B)	mg/L	1.5	-	<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 (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	14	14	14	15	14	14	14	14	13	14	14	15
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<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 (Cu)	mg/L	0.002	0.0024	0.0010	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0011	0.0009	0.0008	0.0008	0.0009
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	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
	Magnesium (Mg)	mg/L	-	-	8.6	8.7	8.1	8.8	8.2	9.1	8.4	8.9	8.4	8.5	7.9	9.1
	Manganese (Mn)	mg/L	0.935[β]	-	0.0006	0.0006	0.0011	0.0005	0.0009	0.0006	0.0002	0.0007	0.0007	0.0006	0.0006	0.0006
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00090	0.00097	0.00084	0.00097	0.00090	0.00092	0.00096	0.00099	0.00092	0.00094	0.00096	0.00097
	Nickel (Ni)	mg/L	0.025	0.025	0.00064	0.00066	0.00062	0.00067	0.00062	0.00069	0.00066	0.00070	0.00065	0.00067	0.00060	0.00070
	Potassium (K)	mg/L	-	-	1.25	1.34	1.23	1.34	1.25	1.34	1.29	1.36	1.28	1.29	1.16	1.39
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.49	0.50	0.69	0.52	0.62	0.49	0.49	0.49	0.48	0.48	0.49	0.51
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.5	1.6	1.5	1.6	1.4	1.6	1.5	1.7	1.5	1.5	1.4	1.7
	Strontium (Sr)	mg/L	-	-	0.010	0.010	0.009	0.010	0.009	0.010	0.010	0.010	0.010	0.010	0.010	0.010
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00018	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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
	Uranium (U)	mg/L	0.015	-	0.0011	0.0011	0.0009	0.0011	0.0010	0.0011	0.0011	0.0011	0.0010	0.0010	0.0010	0.0011
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.43: Water Chemistry at Sheardown Lake NW (DLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event											
					DD-HAB9-STN1 bottom 30-Jul-18	DD-HAB9-STN1 surface 30-Jul-18	DL0-01-5 bottom 30-Jul-18	DL0-01-5 surface 30-Jul-18	DL0-01-1 bottom 30-Jul-18	DL0-01-1 surface 30-Jul-18	DL0-01-4 bottom 30-Jul-18	DL0-01-4 surface 30-Jul-18	DL0-01-2 bottom 30-Jul-18	DL0-01-2 surface 30-Jul-18	DL0-01-7 bottom 30-Jul-18	DL0-01-7 surface 30-Jul-18
Conventionals	Conductivity (lab)	umho/cm	-	-	144	129	129	129	129	129	128	128	129	129	129	128
	pH (lab)	pH	6.5 - 9.0	-	8.07	8.09	8.13	8.10	8.04	7.85	8.11	8.12	8.11	8.25	8.19	8.11
	Hardness (as $CaCO_3$)	mg/L	-	-	72	62	63	63	64	63	63	63	63	63	63	62
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	55	58	50	55	40	50	50	60	50	40	40	50
	Turbidity	NTU	-	-	0.9	1.1	1.0	1.0	1.0	1.0	1.3	0.9	1.0	1.0	1.3	0.9
	Alkalinity (as $CaCO_3$)	mg/L	-	-	55	50	56	53	56	54	55	55	55	53	55	54
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	0.0355	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.950	0.046	0.043	0.043	0.050	0.045	0.045	0.042	0.045	0.044	0.042	0.042
	Nitrite	mg/L	0.06	0.06	***0.0972***	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.9	1.8	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.9	2.1
	Total Organic Carbon	mg/L	-	-	2.1	2.0	2.0	2.5	2.0	1.9	2.1	1.9	1.8	2.0	1.9	2.0
	Total Phosphorus	mg/L	0.020[α]	-	0.0035	0.0036	0.0037	0.0057	0.0041	0.0040	0.0051	0.0037	0.0049	0.0055	0.0050	0.0047
	Phenols	mg/L	0.004[α]	-	0.0027	0.0052	<0.0010	0.0044	0.0018	0.0039	0.0017	0.0015	0.0027	0.0013	0.0016	<0.0010
Anions	Bromide (Br)	mg/L	-	-	0.23	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	65.8	3.4	3.4	3.5	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.5
	Sulphate (SO_4)	mg/L	218[β]	218	19.0	6.6	6.5	6.5	6.5	6.6	6.4	6.5	6.6	6.5	6.5	6.5
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.020	0.008	0.014	0.015	0.013	0.013	0.015	0.017	0.012	0.012	0.014	0.015
	Antimony (Sb)	mg/L	0.020[α]	-	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0078	0.0068	0.0070	0.0072	0.0070	0.0067	0.0070	0.0076	0.0066	0.0068	0.0070	0.0068
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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
	Boron (B)	mg/L	1.5	-	<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 (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	14	13	13	13	13	13	13	12	13	13	13	13
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<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 (Cu)	mg/L	0.002	0.0024	0.00102	0.00070	0.0009	0.00084	0.0009	0.0009	0.0008	0.00084	0.0008	0.0008	0.0008	0.00080
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.0011	0.0011	0.0012	0.0010	0.0012	<0.0010	<0.0010	<0.0010	0.001	<0.0010	0.001	<0.0010
	Magnesium (Mg)	mg/L	-	-	8.7	7.7	7.8	7.8	7.6	7.6	7.6	7.9	7.6	7.4	7.5	7.6
	Manganese (Mn)	mg/L	0.935[β]	-	0.0035	0.0018	0.0034	0.0032	0.0031	0.0032	0.0031	0.0030	0.0032	0.0030	0.0033	0.0032
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00123	0.00086	0.00076	0.00079	0.00081	0.00072	0.00075	0.00076	0.00075	0.00074	0.00080	0.00077
	Nickel (Ni)	mg/L	0.025	0.025	0.00068	0.00057	0.00062	0.00060	0.00062	0.00060	0.00059	0.00059	0.00062	0.00055	0.00058	0.00059
	Potassium (K)	mg/L	-	-	1.34	1.22	1.21	1.23	1.18	1.20	1.18	1.20	1.18	1.16	1.15	1.17
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.55	0.43	0.43	0.43	0.42	0.43	0.43	0.42	0.42	0.43	0.42	0.43
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.7	1.5	1.4	1.6	1.4	1.5	1.5	1.5	1.4	1.4	1.4	1.4
	Strontium (Sr)	mg/L	-	-	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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 (Ti)	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
	Uranium (U)	mg/L	0.015	-	0.0014	0.0008	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0010	0.0009	0.0009	0.0009
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.43: Water Chemistry at Sheardown Lake NW (DLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event											
					DD-HAB9-STN1	DD-HAB9-STN1	DL0-01-5	DL0-01-5	DL0-01-1	DL0-01-1	DL0-01-4	DL0-01-4	DL0-01-2	DL0-01-2	DL0-01-7	DL0-01-7
					bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
					21-Aug-18	21-Aug-18	22-Aug-18	22-Aug-18	21-Aug-18	21-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	141	136	138	135	131	134	140	140	140	140	141	140
	pH (lab)	pH	6.5 - 9.0	-	7.95	8.00	8.00	7.98	7.97	7.95	7.97	8.01	8.00	8.00	7.98	8.06
	Hardness (as $CaCO_3$)	mg/L	-	-	69	69	68	67	69	70	67	66	69	68	68	67
	Total Suspended Solids (TSS)	mg/L	-	-	2	<2.0	<2.0	<2.0	<2.0	<2.0	2	2.4	2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	65	60	80	85	55	59	75	70	75	71	90	70
	Turbidity	NTU	-	-	1.0	1.0	0.9	0.9	0.9	1.0	0.9	1.0	1.0	0.9	0.9	1.0
	Alkalinity (as $CaCO_3$)	mg/L	-	-	51	53	50	52	52	52	52	52	49	49	51	52
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.057	<0.020	0.026	<0.020	0.046	<0.020	<0.020	<0.020	0.022	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.097	0.095	0.078	0.076	0.086	0.086	0.081	0.081	0.079	0.078	0.079	0.077
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	0.15	0.16	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.2	2.3	2.4	2.5	2.2	2.3	2.7	2.5	2.5	2.5	2.5	2.5
	Total Organic Carbon	mg/L	-	-	2.3	2.4	2.6	2.6	2.7	2.5	2.6	2.7	2.7	2.7	2.5	2.6
	Total Phosphorus	mg/L	0.020[α]	-	0.0050	0.0050	0.0037	0.0034	0.0159	0.0052	0.0060	0.0049	<0.0030	0.0051	0.0042	0.0045
	Phenols	mg/L	0.004[α]	-	0.0011	0.0013	<0.0010	0.0010	0.0014	0.0030	<0.0010	0.0012	0.0010	0.0011	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.5	3.5	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.4	3.5	3.4
	Sulphate (SO_4)	mg/L	218[β]	218	9.5	9.5	9.3	9.3	9.2	9.3	9.3	9.3	9.5	9.4	9.4	9.4
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.024	0.019	0.017	0.019	0.060	0.020	0.017	0.020	0.016	0.013	0.020	0.021
	Antimony (Sb)	mg/L	0.020[α]	-	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0071	0.0067	0.0069	0.0070	0.0072	0.0068	0.0070	0.0072	0.0069	0.0050	0.0070	0.0069
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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
	Boron (B)	mg/L	1.5	-	<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 (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	13	13	13	14	13	13	13	13	13	13	13	13
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0009	0.0009	0.00087	0.0016	0.0011	0.0009	0.0009	0.0009	0.0008	0.0007	0.0009	0.0009
	Iron (Fe)	mg/L	0.30	0.300	0.035	<0.030	<0.030	<0.030	0.099	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	0.000164	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	0.0011	0.0010	0.0011	0.0011	0.0010	0.0011	0.0011	0.0011	0.001	0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	8.6	8.6	8.5	8.5	8.5	8.6	8.6	8.5	8.2	6.4	8.5	8.5
	Manganese (Mn)	mg/L	0.935[β]	-	0.0117	0.0106	0.00988	0.0102	0.0166	0.0103	0.0097	0.0097	0.0102	0.0079	0.0102	0.0105
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00083	0.00080	0.00077	0.00081	0.00074	0.00074	0.00079	0.00086	0.00082	0.00076	0.00086	0.00075
	Nickel (Ni)	mg/L	0.025	0.025	0.00077	0.00076	0.00073	0.00077	0.00090	0.00074	0.00076	0.00075	0.00072	0.00056	0.00085	0.00119
	Potassium (K)	mg/L	-	-	1.30	1.31	1.28	1.27	1.29	1.30	1.28	1.29	1.27	0.97	1.29	1.29
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.44	0.43	0.43	0.43	0.47	0.42	0.45	0.43	0.41	0.40	0.43	0.44
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.7	1.7	1.7	1.6	1.6	1.7	1.6	1.6	1.6	1.6	1.6	1.7
	Strontium (Sr)	mg/L	-	-	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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 (Ti)	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
	Uranium (U)	mg/L	0.015	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0009	0.0010	0.0009	0.0010
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.44: **Summary of the Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentration Data Provided) Between the Sheardown Lake Basins and Reference Lake 3 in 2018, and at the Sheardown Lake Basins Between 2018 and the Baseline Period**

Variable	Sheardown Lake NW					Sheardown Lake SE				
	2018 vs Reference Lake 3		2018 vs Baseline			2018 vs Reference Lake 3		2018 vs Baseline		
	Summer	Fall	Winter	Summer	Fall	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	1.8	1.8	1.1	1.1	1.1	1.4	1.6	1.0	1.0	1.1
Hardness (as $CaCO_3$)	1.8	2.0	1.0	1.1	1.1	1.4	1.7	1.0	1.0	1.1
Total Suspended Solids (TSS)	1.0	1.0	1.0	0.5	0.8	1.0	1.0	0.9	0.8	0.8
Total Dissolved Solids (TDS)	1.4	1.5	0.8	0.7	0.9	1.8	1.0	0.9	1.0	0.6
Turbidity	4.3	1.9	1.4	1.3	1.8	9.8	4.4	1.5	1.4	1.3
Alkalinity (as $CaCO_3$)	1.7	1.6	1.0	1.0	0.9	1.2	1.4	0.9	0.8	0.9
Total Ammonia	0.9	0.6	0.1	0.5	0.6	0.9	0.8	0.4	0.8	1.1
Nitrate	6.0	4.1	0.9	1.2	0.8	1.0	2.1	0.6	0.2	0.4
Nitrite	2.5	1.0	1.3	0.4	1.1	1.0	1.0	1.4	0.4	1.1
Total Kjeldahl Nitrogen (TKN)	1.0	1.0	0.8	0.9	1.0	1.0	0.9	0.7	1.0	0.7
Dissolved Organic Carbon	0.6	0.8	1.0	1.0	1.4	0.5	0.6	1.0	1.0	1.1
Total Organic Carbon	0.4	0.7	1.1	1.1	1.4	0.4	0.7	1.1	1.1	1.6
Total Phosphorus	1.0	1.1	1.1	0.7	1.0	1.5	1.0	1.7	0.9	0.9
Phenols	1.8	1.2	1.0	2.4	1.3	1.5	1.1	1.0	2.1	1.1
Bromide (Br)	1.1	1.0	0.6	0.5	0.4	1.0	1.0	0.7	0.4	0.4
Chloride (Cl)	6.7	2.7	1.2	3.5	1.3	1.9	2.2	1.1	1.0	0.9
Sulphate (SO_4)	2.0	2.5	2.1	2.8	3.1	1.1	1.5	1.6	1.8	2.3
Aluminum (Al)	4.1	5.1	1.0	1.0	1.1	18	15	0.8	0.8	1.0
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	0.0	1.1	1.3	1.4	1.3	0.0	1.0	1.2	1.1	1.1
Beryllium (Be)	1.0	1.0	2.0	1.4	1.5	1.0	1.0	1.5	1.2	1.3
Cadmium (Cd)	1.0	1.0	0.8	0.9	0.9	1.0	1.0	0.8	0.8	0.8
Calcium (Ca)	1.8	1.8	1.0	1.1	1.1	1.4	1.6	0.9	1.1	1.0
Chromium (Cr)	1.0	1.0	RDL	RDL	RDL	1.0	1.0	RDL	RDL	RDL
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9	1.0	1.1	1.0	0.9	1.0
Copper (Cu)	1.0	1.4	0.9	0.8	0.7	0.9	1.1	0.8	0.6	0.8
Iron (Fe)	1.0	1.2	1.2	1.1	0.9	2.5	3.3	0.6	0.7	1.3
Lead (Pb)	1.0	1.2	0.9	0.9	0.1	1.6	1.8	0.5	0.7	1.0
Lithium (Li)	1.1	1.1	0.4	0.3	0.0	1.0	1.0	0.3	0.2	0.3
Magnesium (Mg)	1.7	2.0	1.0	1.1	1.2	1.3	1.7	0.9	1.1	1.1
Manganese (Mn)	5.3	17	1.0	1.7	4.8	7.5	13	0.2	0.7	2.6
Mercury (Hg)	1.0	1.0	1.0	0.9	0.3	1.0	1.0	0.6	1.0	1.0
Molybdenum (Mo)	6.2	5.7	1.2	1.3	1.2	3.1	3.4	1.2	1.2	1.1
Nickel (Ni)	1.2	1.6	0.8	0.9	1.1	1.1	1.3	0.8	0.8	1.0
Potassium (K)	1.3	1.5	1.2	1.5	1.5	0.9	1.2	1.3	1.4	1.4
Selenium (Se)	1.0	1.0	RDL	RDL	RDL	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	1.0	1.0	0.7	0.7	0.7	1.1	1.4	0.7	0.7	0.8
Silver (Ag)	1.0	1.0	2.5	1.0	1.3	1.0	1.0	1.6	1.4	1.4
Sodium (Na)	1.7	1.9	1.1	1.3	1.4	1.2	1.5	1.1	1.6	1.4
Strontium (Sr)	1.1	1.1	1.1	1.2	1.1	0.9	1.0	0.8	0.9	0.8
Thallium (Tl)	1.0	1.0	2.3	1.6	0.4	1.0	1.0	1.6	1.2	1.3
Tin (Sn)	1.0	1.0	0.2	0.2	0.2	1.0	1.0	0.1	0.1	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9
Uranium (U)	4.0	3.7	1.1	1.3	1.2	2.6	2.7	1.0	1.1	0.9
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.2	1.5	1.2	1.0	1.0	1.0	1.8	1.9

🟪	Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).
🟨	Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
🟥	Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.45: Dissolved Metal Concentrations at Sheardown Lake NW Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Winter Sampling Event												Summer Sampling Event					
			DD-HAB9-STN1	DD-HAB9-STN1	DL0-01-5	DL0-01-5	DL0-01-1	DL0-01-1	DL0-01-4	DL0-01-4	DL0-01-2	DL0-01-2	DL0-01-7	DL0-01-7	DD-HAB9-STN1	DD-HAB9-STN1	DL0-01-5	DL0-01-5	DL0-01-1	DL0-01-1
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	22-Apr-18	22-Apr-18	22-Apr-18	22-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18
Dissolved Metals	Aluminum (Al)	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	0.0033	<0.0030	<0.0030	<0.0030	0.0031	<0.0030
	Antimony (Sb)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00775	0.00778	0.00738	0.00812	0.00738	0.00798	0.00754	0.00794	0.00756	0.00795	0.00766	0.00849	0.00718	0.00656	0.00662	0.00682	0.00686	0.00645
	Beryllium (Be)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	13.4	13.7	13.1	15.0	13.8	14.1	13.5	13.9	14.1	14.6	13.4	14.8	13.7	11.8	12.2	12.3	12.3	12.3
	Chromium (Cr)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00080	0.00084	0.00080	0.00086	0.00080	0.00080	0.00090	0.00084	0.00082	0.00087	0.00088	0.00092	0.00097	0.00077	0.00078	0.00079	0.00080	0.00083
	Iron (Fe)	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	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	0.0012	0.0011	<0.0010	<0.0010	0.0011	<0.0010	0.0011	<0.0010	<0.0010	0.0013	<0.0010	0.0012	0.0011	0.0011	0.0011
	Magnesium (Mg)	mg/L	7.97	8.53	8.58	9.07	8.14	8.55	8.44	9.06	8.25	8.56	8.64	9.08	9.05	7.95	7.86	7.89	7.96	7.97
	Manganese (Mn)	mg/L	0.000142	0.000272	0.000221	0.000180	0.000117	0.000123	0.000640	0.000301	0.000134	0.000150	0.000155	0.000221	0.000875	0.000380	0.000223	0.000328	0.000233	0.000342
	Mercury (Hg)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000894	0.000913	0.000870	0.001010	0.000898	0.000934	0.000904	0.000968	0.000880	0.000957	0.000927	0.001000	0.001150	0.000717	0.000737	0.000768	0.000775	0.000759
	Nickel (Ni)	mg/L	0.000640	0.00067	0.00065	0.00069	0.00064	0.00065	0.00072	0.00067	0.00063	0.00068	0.00065	0.00070	0.00064	0.00057	0.00057	0.00056	0.00057	0.00056
	Potassium (K)	mg/L	1.22	1.27	1.21	1.36	1.20	1.28	1.25	1.35	1.24	1.28	1.24	1.37	1.36	1.21	1.23	1.22	1.20	1.20
	Selenium (Se)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.48	0.49	0.68	0.50	0.59	0.48	0.49	0.50	0.47	0.49	0.48	0.51	0.53	0.41	0.40	0.41	0.41	0.40
	Silver (Ag)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.51	1.59	1.46	1.64	1.44	1.50	1.46	1.68	1.56	1.58	1.52	1.62	1.73	1.49	1.49	1.45	1.49	1.53
	Strontium (Sr)	mg/L	0.00956	0.00942	0.00922	0.01050	0.00957	0.00986	0.00962	0.01030	0.00931	0.01010	0.00937	0.01030	0.00918	0.00782	0.00812	0.00818	0.00822	0.00828
	Thallium (Tl)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.00107	0.00108	0.00095	0.00109	0.00098	0.00106	0.00102	0.00109	0.00106	0.00106	0.00104	0.00110	0.00127	0.00087	0.00085	0.00090	0.00089	0.00088
	Vanadium (V)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.45: Dissolved Metal Concentrations at Sheardown Lake NW Water Quality Monitoring Stations, Mary River Project CREMP, 2018

	Parameters	Units	Summer Sampling Event						Fall Sampling Event											
			DL0-01-04	DL0-01-04	DL0-01-2	DL0-01-2	DL0-01-7	DL0-01-7	DD-HAB9-STN1	DD-HAB9-STN1	DL0-01-1	DL0-01-1	DL0-01-5	DL0-01-5	DL0-01-4	DL0-01-4	DL0-01-2	DL0-01-2	DL0-01-7	DL0-01-7
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	30-Jul-18	21-Aug-18	21-Aug-18	22-Aug-18	22-Aug-18	21-Aug-18	21-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.004	0.0033	0.0041	<0.0030	0.0045	<0.0030	<0.0030	<0.0030	<0.0030	0.0046	<0.0030	0.0034	<0.0030
	Antimony (Sb)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00680	0.00687	0.00663	0.00702	0.00656	0.00676	0.00697	0.00674	0.00694	0.00670	0.00684	0.00682	0.00690	0.00643	0.00684	0.00646	0.00692	0.00699
	Beryllium (Be)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	12.2	12.6	12.2	12.4	12.2	12.2	13.5	13.5	13.2	13.2	13.4	13.8	13.1	13.2	13.1	13.3	13.2	13.2
	Chromium (Cr)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00075	0.00078	0.00076	0.00074	0.00073	0.00080	0.00105	0.00084	0.00082	0.00089	0.00079	0.00079	0.00076	0.00078	0.00085	0.00078	0.00085	0.00079
	Iron (Fe)	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	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0011	<0.0010	<0.0010	0.0011	0.001	0.0011	0.0011	0.0011	0.001	0.001	0.001	0.0012	<0.0010	0.0011	0.0011	0.0010	0.001	0.0011
	Magnesium (Mg)	mg/L	7.91	7.64	7.94	7.80	8.00	7.74	8.43	8.72	8.54	8.33	8.58	8.58	8.44	7.96	8.69	8.58	8.41	8.36
	Manganese (Mn)	mg/L	0.000350	0.000420	0.000204	0.000303	0.000194	0.000271	0.002970	0.002900	0.002280	0.002420	0.002280	0.002240	0.002030	0.001920	0.002640	0.002210	0.002190	0.002260
	Mercury (Hg)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000784	0.000765	0.000753	0.000754	0.000780	0.000776	0.000845	0.000862	0.000778	0.000775	0.000861	0.000902	0.000766	0.000839	0.000796	0.000774	0.000788	0.000783
	Nickel (Ni)	mg/L	0.00062	0.00056	0.00061	0.00057	0.00057	0.00060	0.00071	0.00071	0.00069	0.00070	0.00074	0.00071	0.00067	0.00066	0.00074	0.00072	0.00071	0.00073
	Potassium (K)	mg/L	1.19	1.16	1.21	1.18	1.21	1.20	1.29	1.30	1.28	1.28	1.30	1.28	1.24	1.23	1.27	1.27	1.29	1.30
	Selenium (Se)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.40	0.41	0.40	0.40	0.41	0.40	0.42	0.42	0.41	0.41	0.42	0.40	0.40	0.39	0.41	0.41	0.40	0.40
	Silver (Ag)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.47	1.44	1.48	1.46	1.50	1.45	1.60	1.66	1.64	1.66	1.63	1.56	1.62	1.54	1.60	1.53	1.61	1.69
	Strontium (Sr)	mg/L	0.00816	0.00868	0.00817	0.00835	0.00826	0.00817	0.00897	0.00900	0.00882	0.00879	0.00888	0.00906	0.00880	0.00880	0.00883	0.00882	0.00880	0.00888
	Thallium (Tl)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.00085	0.00093	0.00087	0.00089	0.00091	0.00087	0.00098	0.00101	0.00098	0.00095	0.00099	0.00101	0.00099	0.00097	0.00098	0.00099	0.00099	0.00099
	Vanadium (V)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.46: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Sheardown Lake Northwest and Reference Lake 3 in 2018, and at Sheardown Lake Northwest Between 2018 and the Baseline Period

Dissolved Metal	Sheardown Lake NW				
	2018 vs Reference Lake 3		2018 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	1.0	0.7	0.0	0.7	1.1
Antimony (Sb)	1.0	1.0	0.0	0.0	1.0
Arsenic (As)	1.0	1.0	1.0	0.8	1.0
Barium (Ba)	1.0	1.0	0.0	1.3	1.2
Beryllium (Be)	1.0	1.0	1.2	1.2	2.1
Cadmium (Cd)	1.0	1.0	0.4	0.0	0.8
Calcium (Ca)	1.8	1.9	1.1	1.1	1.1
Chromium (Cr)	1.0	1.0	RDL	RDL	RDL
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9
Copper (Cu)	1.0	1.1	0.7	0.5	1.0
Iron (Fe)	1.0	1.0	1.2	1.2	1.7
Lead (Pb)	1.0	1.0	0.6	1.0	1.0
Lithium (Li)	1.1	1.1	0.2	0.0	0.5
Magnesium (Mg)	1.8	2.1	1.1	1.2	1.2
Manganese (Mn)	2.2	11	0.4	0.0	3.6
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	6.4	5.9	4.0	0.0	4.0
Nickel (Ni)	1.2	1.4	0.9	0.6	1.2
Potassium (K)	1.3	1.5	0.8	1.1	1.1
Selenium (Se)	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	1.0	1.0	1.1	1.0	1.0
Silver (Ag)	1.0	1.0	1.2	1.8	2.7
Sodium (Na)	1.7	1.8	0.9	1.2	1.2
Strontium (Sr)	1.1	1.1	1.3	1.2	1.2
Thallium (Tl)	1.0	1.0	1.2	1.3	2.6
Tin (Sn)	1.0	1.0	0.1	0.2	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0
Uranium (U)	3.9	3.8	2.1	2.0	2.0
Vanadium (V)	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.5	1.0	1.9

🟪 Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).

🟨 Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).

🟥 Denotes highly elevated concentration (mean concentration≥ 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit that confounds interpretation.

Table C.47: Spearman's Rank Correlation Coefficients for Sheardown Lake NW (DLO-1) Water Quality Data Collected in Winter, Summer, and Fall 2018[a]

Parameters	Conventional Parameters										Total Metals										
	Conduct-ivity	Hardness	Total Dissolved Solids	Turbidity	Alkalinity	Nitrate	Total Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Manganese	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	1	0.709	0.749	-0.745	0.444	0.675	0.016	-0.250	0.788	0.342	-0.482	0.644	0.328	-0.437	0.796	0.305	0.504	0.727	0.164	0.773	0.721
Hardness	0.709	1	0.551	-0.401	0.178	0.736	0.288	0.043	0.616	0.564	-0.079	0.338	0.363	0.023	0.367	0.506	0.662	0.396	0.489	0.619	0.654
Total Dissolved Solids	0.749	0.551	1	-0.602	0.074	0.370	0.305	-0.423	0.480	0.500	-0.187	0.427	0.366	-0.188	0.586	0.442	0.474	0.439	0.394	0.551	0.590
Turbidity	-0.745	-0.401	-0.602	1	-0.555	-0.487	0.169	0.253	-0.766	0.009	0.560	-0.692	-0.283	0.573	-0.613	-0.054	-0.208	-0.775	0.131	-0.647	-0.646
Alkalinity	0.444	0.178	0.074	-0.555	1	0.192	-0.659	-0.135	0.555	-0.546	-0.725	0.695	0.080	-0.795	0.532	-0.266	0.008	0.629	-0.481	0.638	0.399
Nitrate	0.675	0.736	0.370	-0.487	0.192	1	0.107	0.015	1	0.384	-0.097	0.398	0.484	-0.006	0.385	0.481	0.637	0.634	0.374	0.601	0.581
Total Organic Carbon	0.016	0.288	0.305	0.169	-0.659	0.107	1	0.189	-0.097	1	0.603	-0.239	0.304	0.652	-0.270	0.600	0.422	-0.231	0.771	-0.183	0.126
Total Phosphorus	-0.250	0.043	-0.423	0.253	-0.135	0.015	0.189	1	-0.114	0.054	0	-0.256	-0.224	0.330	-0.444	0.006	-0.081	-0.118	0.097	-0.326	-0.097
Chloride	0.788	0.616	0.480	-0.766	0.555	0.662	-0.097	-0.114	1	0.101	-0.501	1	0.311	-0.484	0.697	0.202	0.489	0.808	0.032	0.721	0.673
Sulphate	0.342	0.564	0.500	0.009	-0.546	0.384	0.726	0.054	0.101	1	0.484	-0.255	0	0.593	0.012	0.737	0.586	-0.096	0.752	0.097	0.341
Aluminum (total)	-0.482	-0.079	-0.187	0.560	-0.725	-0.097	0.603	0.334	-0.501	0.484	1	-0.472	0.250	1	-0.644	0.577	0.259	-0.455	0.586	-0.481	-0.248
Barium (total)	0.644	0.338	0.427	-0.692	0.695	0.398	-0.239	-0.256	0.687	-0.255	-0.472	1	0.397	-0.627	1	0.076	0.319	0.754	-0.121	0.682	0.576
Copper (total)	0.328	0.363	0.366	-0.283	0.080	0.484	0.304	-0.224	0.311	0.356	0.250	0.397	1	0.202	0.240	1	0.687	0.339	0.509	0.564	0.537
Manganese (total)	-0.437	0.023	-0.188	0.573	-0.795	-0.006	0.652	0.330	-0.484	0.593	0.916	-0.627	0.202	1	-0.662	0.567	0	-0.492	0.623	-0.455	-0.244
Molybdenum (total)	0.796	0.367	0.586	-0.613	0.532	0.385	-0.270	-0.444	0.697	0.012	-0.644	0.679	0.240	-0.662	1	-0.009	0.273	1	-0.145	0.722	0.442
Nickel (total)	0.305	0.506	0.442	-0.054	-0.266	0.481	0.600	0.006	0.202	0.737	0.577	0.076	0.717	0.567	-0.009	1	0.794	0.221	1	0.327	0.449
Potassium (total)	0.504	0.662	0.474	-0.208	0.008	0.637	0.422	-0.081	0.489	0.586	0.259	0.319	0.687	0.231	0.273	0.794	1	0.387	0.756	0	0.569
Silicon (total)	0.727	0.396	0.439	-0.775	0.629	0.634	-0.231	-0.118	0.808	-0.096	-0.455	0.754	0.339	-0.492	0.601	0.221	0.387	1	-0.045	0.730	0.601
Sodium (total)	0.164	0.489	0.394	0.131	-0.481	0.374	0.771	0.097	0.032	0.752	0.586	-0.121	0.509	0.623	-0.145	0.738	0.756	-0.045	1	0.068	0
Strontium (total)	0.773	0.619	0.551	-0.647	0.638	0.601	-0.183	-0.326	0.721	0.097	-0.481	0.682	0.564	-0.455	0.722	0.327	0.484	0.730	0.068	1	0.752
Uranium (total)	0.721	0.654	0.590	-0.646	0.399	0.581	0.126	-0.097	0.673	0.341	-0.248	0.576	0.537	-0.244	0.442	0.449	0.569	0.601	0.290	0.752	1
Aluminum (dissolved)	-0.178	0.039	0.057	0.214	-0.356	-0.052	0.224	-0.211	-0.114	0.399	0.386	-0.328	0.244	0.446	-0.024	0.310	0.082	-0.307	0.180	-0.073	-0.253
Barium (dissolved)	0.773	0.554	0.550	-0.739	0.635	0.487	-0.261	-0.282	0.714	0.001	-0.483	0.740	0.301	-0.544	0.608	0.210	0.400	0.778	-0.042	0.745	0.589
Copper (dissolved)	0.624	0.625	0.637	-0.469	0.201	0.446	0.070	-0.371	0.600	0.423	-0.144	0.412	0.436	-0.139	0.600	0.418	0.462	0.422	0.225	0.682	0.489
Manganese (dissolved)	-0.222	0.175	0.148	0.422	-0.774	0.093	0.721	0.074	-0.303	0.717	0.796	-0.448	0.256	0.804	-0.424	0.586	0.407	-0.379	0.778	-0.291	-0.046
Molybdenum (dissolved)	0.776	0.771	0.418	-0.565	0.585	0.729	-0.103	-0.071	0.775	0.133	-0.381	0.618	0.357	-0.378	0.597	0.265	0.541	0.686	0.146	0.784	0.702
Nickel (dissolved)	0.407	0.658	0.503	-0.089	-0.383	0.522	0.660	0.007	0.209	0.845	0.377	-0.098	0.351	0.473	-0.031	0.712	0.583	0.097	0.680	0.226	0.483
Potassium (dissolved)	0.449	0.722	0.533	-0.100	-0.249	0.461	0.616	0.075	0.311	0.829	0.361	-0.014	0.511	0.446	0.094	0.775	0.750	0.162	0.798	0.379	0.547
Silicon (dissolved)	0.659	0.521	0.342	-0.661	0.604	0.580	-0.353	-0.292	0.714	-0.132	-0.650	0.671	0.194	-0.567	0.651	-0.091	0.203	0.690	-0.152	0.741	0.527
Sodium (dissolved)	0.317	0.559	0.501	-0.005	-0.294	0.297	0.638	0.017	0.103	0.808	0.426	-0.122	0.513	0.513	0.021	0.789	0.640	0.061	0.756	0.295	0.426
Strontium (dissolved)	0.885	0.807	0.571	-0.721	0.503	0.785	-0.038	-0.160	0.802	0.277	-0.415	0.639	0.381	-0.367	0.602	0.322	0.564	0.713	0.209	0.802	0.820
Uranium (dissolved)	0.835	0.771	0.640	-0.634	0.376	0.623	0.142	-0.045	0.697	0.451	-0.288	0.490	0.396	-0.264	0.532	0.390	0.602	0.551	0.341	0.689	0.833

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

🟩 Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

🟦 Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.47: Spearman's Rank Correlation Coefficients for Sheardown Lake NW (DLO-1) Water Quality Data Collected in Winter, Summer, and Fall 2018[a]

Parameters	Dissolved Metals										
	Aluminum	Barium	Copper	Manganese	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	-0.178	0.773	0.624	-0.222	0.776	0.407	0.449	0.659	0.317	0.885	0.835
Hardness	0.039	0.554	0.625	0.175	0.771	0.658	0.722	0.521	0.559	0.807	0.771
Total Dissolved Solids	0.057	0.550	0.637	0.148	0.418	0.503	0.533	0.342	0.501	0.571	0.640
Turbidity	0.214	-0.739	-0.469	0.422	-0.565	-0.089	-0.100	-0.661	-0.005	-0.721	-0.634
Alkalinity	-0.356	0.635	0.201	-0.774	0.585	-0.383	-0.249	0.604	-0.294	0.503	0.376
Nitrate	-0.052	0.487	0.446	0.093	0.729	0.522	0.461	0.580	0.297	0.785	0.623
Total Organic Carbon	0.224	-0.261	0.070	0.721	-0.103	0.660	0.616	-0.353	0.638	-0.038	0.142
Total Phosphorus	-0.211	-0.282	-0.371	0.074	-0.071	0.007	0.075	-0.292	0.017	-0.160	-0.045
Chloride	-0.114	0.714	0.600	-0.303	0.775	0.209	0.311	0.714	0.103	0.802	0.697
Sulphate	0.399	0.001	0.423	0.717	0.133	0.845	0.829	-0.132	0.808	0.277	0.451
Aluminum (total)	0.386	-0.483	-0.144	0.796	-0.381	0.377	0.361	-0.650	0.426	-0.415	-0.288
Barium (total)	-0.328	0.740	0.412	-0.448	0.618	-0.098	-0.014	0.671	-0.122	0.639	0.490
Copper (total)	0.244	0.301	0.436	0.256	0.357	0.351	0.511	0.194	0.513	0.381	0.396
Manganese (total)	0.446	-0.544	-0.139	0.804	-0.378	0.473	0.446	-0.567	0.513	-0.367	-0.264
Molybdenum (total)	-0.024	0.608	0.600	-0.424	0.597	-0.031	0.094	0.651	0.021	0.602	0.532
Nickel (total)	0.310	0.210	0.418	0.586	0.265	0.712	0.775	-0.091	0.789	0.322	0.390
Potassium (total)	0.082	0.400	0.462	0.407	0.541	0.583	0.750	0.203	0.640	0.564	0.602
Silicon (total)	-0.307	0.778	0.422	-0.379	0.686	0.097	0.162	0.690	0.061	0.713	0.551
Sodium (total)	0	0	0	1	0	1	1	0	1	0	0.341
Strontium (total)	-0.073	0.745	0.682	-0.291	0.784	0.226	0.379	0.741	0.295	0.802	0.689
Uranium (total)	-0.253	0.589	0.489	-0.046	0.702	0.483	0.547	0.527	0.426	0.820	0.833
Aluminum (dissolved)	1	-0.231	0.481	0.455	-0.147	0.245	0.202	-0.174	0.265	-0.213	-0.220
Barium (dissolved)	-0.231	1	0.567	-0.365	0.695	0.136	0.237	0.680	0.139	0.782	0.679
Copper (dissolved)	0.481	0.567	1	0.152	0.575	0.453	0.507	0.530	0.338	0.594	0.485
Manganese (dissolved)	0.455	-0.365	0.152	1	-0.244	0.666	0.585	-0.368	0.574	-0.180	-0.065
Molybdenum (dissolved)	-0.147	0.695	0.575	-0.244	1	0.355	0.388	0.651	0.198	0.893	0.738
Nickel (dissolved)	0.245	0.136	0.453	0.666	0.355	1	0.819	0.059	0.686	0.455	0.491
Potassium (dissolved)	0.202	0.237	0.507	0.585	0.388	0.819	1	0.127	0.881	0.472	0.608
Silicon (dissolved)	-0.174	0.680	0.530	-0.368	0.651	0.059	0.127	1	-0.058	0.752	0.514
Sodium (dissolved)	0.265	0.139	0.338	0.574	0.198	0.686	0.881	-0.058	1	0.272	0.488
Strontium (dissolved)	-0.213	0.782	0.594	-0.180	0.893	0.455	0.472	0.752	0.272	1	0.870
Uranium (dissolved)	-0.220	0.679	0.485	-0.065	0.738	0.491	0.608	0.514	0.488	0.870	1

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

🟩 Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

🟦 Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.48: *In Situ* Water Quality Profile Data Collected at Sheardown Lake SE Water Quality Monitoring Stations in Winter, Mary River Project CREMP, 2018

Depth (m)	Temperature (°C)					Dissolved Oxygen (mg/L)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3
Date Collected	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18
1.0	0.2		1.7	0.5	1.1	14.25		15.10	15.82	15.20	98.1		108.5	109.9	107.3	7.76		7.81	7.80	7.85	176		157	163	161
2.0	1.7		2.7	2.2	2.3	13.66		14.35	14.88	14.38	98.2		105.7	108.2	105.2	7.66		7.74	7.75	7.74	168		148	150	147
3.0	2.2	2.4	2.7	2.6	2.6	13.02	14.23	14.36	14.50	14.22	94.8	104.1	105.8	106.6	104.5	7.57	7.86	7.71	7.71	7.69	168	150	148	148	148
4.0	2.2		2.7	2.6	2.6	12.93		14.37	14.38	14.20	94.1		105.9	105.8	104.4	7.53		7.69	7.68	7.67	170		148	148	148
5.0	2.2		2.7	2.6	2.6	12.91		14.39	14.36	14.17	94.0		106.0	105.7	104.2	7.50		7.66	7.66	7.65	171		148	148	148
6.0	2.2		2.7	2.7	2.6	12.77		14.40	14.36	14.14	93.0		106.1	105.7	104.0	7.46		7.65	7.65	7.63	171		148	148	148
6.5			2.7					14.49					106.8					7.65					148		
7.0	2.2			2.7	2.6	12.40			14.36	14.12	90.8			105.7	103.9	7.44			7.63	7.61	171			148	148
8.0				2.7	2.6				14.33	13.90				105.5	102.5				7.62	7.59				148	149
9.0				2.7	2.7				14.17	14.07				104.5	103.5				7.60	7.58				149	148
10.0				2.7	2.7				12.81	13.93				93.7	103.1				7.53	7.57				150	149
10.5				2.7					8.82					64.9					7.37					153	
11.0					2.7					12.23					90.1					7.56					151
12.0					2.6					10.75					79.4					7.42					152
13.0																									
14.0																									

Notes: Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 7.1, 3.8, 8.5, 12.9, and 13.9 m, respectively, at the time of winter sampling. Ice thickness at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 2.1, 2.1, 2.1, 2.1, and 1.9 m, respectively, at the time of winter sampling. Deepest measurement at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 7, 2.9, 6.5, 10.5, and 12 m, respectively, at the time of winter sampling.

Table C.49: *In Situ* Water Quality Profile Data Collected at Sheardown Lake SE Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2018

Depth (m)	Temperature (°C)					Dissolved Oxygen (mg/L)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3
Date Collected	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18
1.0	7.1	7.4	7.0	7.2	7.4	11.94	11.86	11.81	11.78	11.88	98.7	98.8	97.4	97.5	98.9	7.95	8.00	7.89	7.85	8.00	93	89	88	88	89
2.0	7.1	7.4	7.0	7.2	7.4	11.94	11.87	11.81	11.80	11.88	98.7	98.8	97.3	97.6	98.9	7.95	7.99	7.89	7.85	7.99	93	89	87	88	89
3.0	7.1	7.4	7.0	7.2	7.4	11.95	11.87	11.80	11.81	11.87	98.7	98.7	97.3	97.7	98.8	7.92	7.98	7.89	7.85	7.98	94	90	87	88	89
4.0	7.1	7.2	7.0	7.2	7.3	11.95	11.86	11.80	11.81	11.87	98.7	98.2	97.1	97.7	98.6	7.97	7.97	7.88	7.85	7.97	94	92	87	88	88
5.0	7.1		6.9	7.1	7.3	11.94		11.78	11.80	11.87	98.7		96.8	97.4	98.5	7.97		7.88	7.85	7.96	93		88	88	88
6.0	7.1		6.9	7.0	7.3	11.93		11.75	11.81	11.86	98.7		96.5	97.3	98.5	7.98		7.87	7.85	7.95	94		88	88	88
7.0	7.1		6.8	7.0	7.3	11.94		11.72	11.80	11.85	98.7		96.2	97.2	98.3	7.98		7.87	7.86	7.95	95		88	88	88
8.0			6.8	6.9	7.2			11.65	11.78	11.84			95.5	96.9	98.1			7.86	7.86	7.95			89	88	88
9.0				6.9	7.2				11.76	11.83				96.7	98.0				7.86	7.94				88	89
10.0				6.9	7.2				11.74	11.81				96.4	97.8				7.85	7.94				88	89
11.0				6.9	7.2				11.73	11.80				96.3	97.7				7.85	7.94				88	89
12.0				6.9	7.1				11.72	11.78				96.2	97.3				7.85	7.94				88	89
13.0					7.0					11.76					96.8					7.93					89
14.0					7.0					11.73					96.6					7.93					89

Note: Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 7.8, 4.9, 9.9, 13.8, and 15.5 m, respectively, at the time of summer sampling.

Table C.50: *In Situ* Water Quality Profile Data Collected at Sheardown Lake SE Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2018

Depth (m)	Temperature (°C)						Dissolved Oxygen (mg/L)						Dissolved Oxygen (% Saturation)					
	DLO-02-6	**DLO-02-7**	**DLO-02-4**	**DLO-02-8**	**DLO-02-3**	**DLO-02-3**	**DLO-02-6**	**DLO-02-7**	**DLO-02-4**	**DLO-02-8**	**DLO-02-3**	**DLO-02-3**	**DLO-02-6**	**DLO-02-7**	**DLO-02-4**	**DLO-02-8**	**DLO-02-3**	**DLO-02-3**
Date Collected	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**16-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**16-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**16-Aug-18**
surface						7.8						11.53						96.9
1.0	7.5	7.8	7.6	7.5	7.5	7.8	11.6	10.9	11.0	11.5	11.6	11.52	97.0	91.6	92.1	96.0	96.8	96.9
2.0	7.4	7.8	7.6	7.5	7.5	7.8	11.7	11.1	11.1	11.5	11.6	11.53	97.1	93.0	92.6	95.9	96.7	96.9
3.0	7.4	7.7	7.6	7.5	7.5	7.8	11.7	11.2	11.1	11.5	11.6	11.51	97.1	93.4	92.8	95.8	96.6	96.8
4.0	7.4		7.6	7.5	7.5	7.8	11.7		11.2	11.5	11.6	11.51	97.2		93.3	95.8	96.6	96.7
5.0	7.4		7.6	7.5	7.5	7.8	11.7		11.2	11.5	11.6	11.50	97.2		93.8	95.7	96.6	96.7
6.0			7.6	7.5	7.3	7.8			11.3	11.5	11.6	11.50			94.5	95.7	96.5	96.7
7.0			7.6	7.5	7.3	7.8			11.4	11.5	11.6	11.50			94.9	95.7	96.5	96.7
8.0				7.5	7.5	7.8				11.5	11.5	11.50				95.6	96.4	96.7
9.0				7.5	7.5	7.8				11.4	11.5	11.49				95.5	96.3	96.6
10.0				7.5	7.5	7.8				11.4	11.5	11.48				95.1	96.3	96.5
11.0					7.5	7.8					11.5	11.47					96.2	96.4
12.0					7.5	7.8					11.5	11.46					96.2	96.3
13.0						7.8						11.44						96.2

Notes: 23-Aug-18 sampling was conducted by Baffinland. 16-Aug-18 sampling was conducted by Minnow. Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 6.5, 3.4, 8.4, 12.7, and 13.7 m, respectively, at the time of fall sampling.

Table C.50: *In Situ* Water Quality Profile Data Collected at Sheardown Lake SE Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2018

Depth (m)	pH (pH units)						Specific Conductance (µS/cm)					
	DLO-02-6	**DLO-02-7**	**DLO-02-4**	**DLO-02-8**	**DLO-02-3**	**DLO-02-3**	**DLO-02-6**	**DLO-02-7**	**DLO-02-4**	**DLO-02-8**	**DLO-02-3**	**DLO-02-3**
Date Collected	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**16-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**23-Aug-18**	**16-Aug-18**
surface						7.92						98
1.0	7.92	8.07	7.94	7.78	7.93	7.92	102	100	99	99	99	98
2.0	7.91	7.97	7.93	7.78	7.91	7.92	102	100	99	99	99	98
3.0	7.90	7.96	7.92	7.78	7.91	7.92	103	100	99	99	99	98
4.0	7.89		7.91	7.77	7.90	7.92	103		99	99	99	98
5.0	7.89		7.91	7.77	7.89	7.94	103		99	99	99	98
6.0			7.91	7.77	7.89	7.94			99	99	99	98
7.0			7.91	7.76	7.89	7.94			99	99	99	98
8.0				7.76	7.88	7.94				99	99	98
9.0				7.75	7.87	7.94				99	99	98
10.0				7.75	7.87	7.95				99	99	98
11.0					7.87	7.95					99	98
12.0					7.86	7.95					99	98
13.0						7.94						98

Notes: 23-Aug-18 sampling was conducted by Baffinland. 16-Aug-18 sampling was conducted by Minnow. Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 6.5, 3.4, 8.4, 12.7, and 13.7 m, respectively, at the time of fall sampling.

Table C.51: Sampling Depth, Water Clarity Measures, and Surface and Bottom *In Situ* Water Quality Measures Collected at Sheardown Lake SE Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
							(mg/L)	(% sat.)		
Littoral (Shallow) Stations	DLO-02-1	16-Aug-18	9.8	1.4	surface	7.70	11.56	96.9	7.92	100
					bottom	7.70	11.52	96.6	7.94	100
	DLO-02-11	16-Aug-18	8.2	1.3	surface	7.50	11.46	95.6	7.77	96
					bottom	7.50	11.38	95.0	7.76	96
	DLO-02-10	16-Aug-18	6.7	1.2	surface	7.50	11.43	95.4	7.67	96
					bottom	7.50	11.33	94.6	7.61	96
	DLO-02-4	16-Aug-18	7.6	1.4	surface	7.50	11.47	95.7	7.80	96
					bottom	7.60	11.41	95.2	7.80	96
	DLO-02-9	16-Aug-18	8.8	1.4	surface	7.60	11.51	96.3	7.84	96
					bottom	7.60	11.43	95.7	7.84	97
Profundal (Deep) Stations	DLO-02-12	16-Aug-18	10.7	1.4	surface	7.50	11.52	96.3	7.89	96
					bottom	7.60	11.41	95.3	7.85	96
	DLO-02-8	16-Aug-18	13.4	1.4	surface	7.70	11.52	96.6	7.90	97
					bottom	7.50	11.38	95.0	7.87	97
	DLO-02-13	16-Aug-18	7.0	1.5	surface	7.70	11.52	96.6	7.90	98
					bottom	7.80	11.49	96.5	7.90	98
	DLO-02-2	16-Aug-18	14.0	1.4	surface	7.70	11.52	96.6	7.92	98
					bottom	7.70	11.42	95.8	7.90	98
	DLO-02-3	16-Aug-18	13.4	1.5	surface	7.80	11.53	96.9	7.92	98
					bottom	7.80	11.44	96.2	7.94	98

Table C.52: Statistical Comparison of Bottom *In Situ* Water Quality Between Sheardown Lake SE Littoral and Profundal Stations, Mary River Project CREMP, August 2018

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Lake Zone	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	YES	0.095	γ	Littoral	5	1.33	0.11	0.05	1.15	1.40
				Profundal	5	1.42	0.03	0.01	1.40	1.45
Temperature (˚C)	NO	0.187	α	Littoral	5	7.58	0.08	0.04	7.50	7.70
				Profundal	5	7.68	0.13	0.06	7.50	7.80
Dissolved Oxygen (mg/L)	NO	0.710	α	Littoral	5	11.4	0.1	0.0	11.3	11.5
				Profundal	5	11.4	0.0	0.0	11.4	11.5
Dissolved Oxygen (% saturation)	NO	0.463	α	Littoral	5	95.4	0.8	0.3	94.6	96.6
				Profundal	5	95.8	0.6	0.3	95.0	96.5
pH (units)	NO	0.107	α	Littoral	5	7.79	0.12	0.05	7.61	7.94
				Profundal	5	7.89	0.03	0.02	7.85	7.94
Specific Conductance (umho/cm)	NO	0.310	γ	Littoral	5	97.0	1.9	0.8	96.0	100.3
				Profundal	5	97.4	1.0	0.4	96.2	98.2

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.53: Statistical Comparison of Bottom *In Situ* Water Quality Between Sheardown Lake SE and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Station Depth (m)**	YES	0.060	α	Reference	5	9.80	1.11	0.49	8.40	11.20
					Sheardown SE	5	8.22	1.18	0.53	6.70	9.80
	Secchi Depth (m)	YES	0.016	γ	Reference	4	8.49	0.45	0.23	8.05	9.10
					Sheardown SE	5	1.33	0.11	0.05	1.15	1.40
	Temperature (˚C)	YES	0.016	γ	Reference	4	7.05	0.10	0.05	6.90	7.10
					Sheardown SE	5	7.58	0.08	0.04	7.50	7.70
	Dissolved Oxygen (mg/L)	NO	0.163	α	Reference	4	11.6	0.3	0.1	11.2	11.8
					Sheardown SE	5	11.4	0.1	0.0	11.3	11.5
	Dissolved Oxygen (% saturation)	NO	0.413	γ	Reference	4	95.7	2.2	1.1	92.4	97.1
					Sheardown SE	5	95.4	0.8	0.3	94.6	96.6
	pH (units)	YES	0.014	α	Reference	4	7.54	0.11	0.05	7.41	7.65
					Sheardown SE	5	7.79	0.12	0.05	7.61	7.94
	Specific Conductance (umho/cm)	YES	0.016	γ	Reference	4	62.8	1.0	0.5	62.3	64.3
					Sheardown SE	5	97.0	1.9	0.8	96.0	100.3
Profundal (Deep) Stations	**Station Depth (m)**	YES	< 0.001	α	Reference	5	21.26	2.62	1.17	18.50	25.00
					Sheardown SE	5	11.70	2.92	1.31	7.00	14.00
	Secchi Depth (m)	YES	0.016	γ	Reference	4	8.63	0.26	0.13	8.30	8.90
					Sheardown SE	5	1.42	0.03	0.01	1.40	1.45
	Temperature (˚C)	YES	0.016	γ	Reference	4	7.08	0.05	0.02	7.00	7.10
					Sheardown SE	5	7.68	0.13	0.06	7.50	7.80
	Dissolved Oxygen (mg/L)	NO	0.286	γ	Reference	4	11.5	0.4	0.2	10.9	11.7
					Sheardown SE	5	11.4	0.0	0.0	11.4	11.5
	Dissolved Oxygen (% saturation)	NO	0.905	γ	Reference	4	94.6	2.8	1.4	90.4	96.1
					Sheardown SE	5	95.8	0.6	0.3	95.0	96.5
	pH (units)	YES	< 0.001	α	Reference	4	7.63	0.04	0.02	7.58	7.67
					Sheardown SE	5	7.89	0.03	0.02	7.85	7.94
	Specific Conductance (umho/cm)	YES	< 0.001	η	Reference	4	62.5	0.2	0.1	62.3	62.8
					Sheardown SE	5	97.4	1.0	0.4	96.2	98.2

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.54: Water Chemistry at Sheardown Lake SE (DLO-02) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)^{a}	AEMP Benchmark^{b}	Winter Sampling Event								
					DL0-02-6 bottom 17-Apr-18	DL0-02-6 surface 17-Apr-18	DL0-02-7 surface 17-Apr-18	DL0-02-4 bottom 17-Apr-18	DL0-02-4 surface 17-Apr-18	DL0-02-8 bottom 17-Apr-18	DL0-02-8 surface 17-Apr-18	DL0-02-3 bottom 17-Apr-18	DL0-02-3 surface 17-Apr-18
Conventionals	Conductivity (lab)	umho/cm	-	-	174	174	158	155	154	151	161	153	160
	pH (lab)	pH	6.5 - 9.0	-	7.82	7.81	7.88	7.93	7.91	7.93	7.91	7.85	7.91
	Hardness (as $CaCO_3$)	mg/L	-	-	79	80	75	68	75	69	73	71	74
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	96	92	88	78	86	80	91	85	94
	Turbidity	NTU	-	-	0.6	0.6	0.6	0.7	0.5	0.8	0.6	0.7	0.8
	Alkalinity (as $CaCO_3$)	mg/L	-	-	76	77	70	63	69	64	68	67	72
Nutrients and Organics	Total Ammonia	mg/L	variable^{c}	0.855	0.066	<0.020	0.025	<0.020	<0.020	<0.020	<0.020	0.044	0.163
	Nitrate	mg/L	13	13	0.087	0.089	0.060	0.049	0.051	0.047	0.053	0.061	0.058
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	0.15	0.16	0.2	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.7	2.0	2.2	1.8	1.9	1.8	1.9	1.8	1.9
	Total Organic Carbon	mg/L	-	-	2.3	2.1	2.0	1.9	2.0	2.0	2.2	2.1	2.5
	Total Phosphorus	mg/L	0.020^{α}	-	0.0033	0.0033	0.0069	0.0032	0.0036	0.0065	0.0071	0.0312	0.0044
	Phenols	mg/L	0.004^{α}	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.8	3.9	3.5	3.3	3.4	3.3	3.6	3.4	3.6
	Sulphate (SO_4)	mg/L	218^{β}	218	4.9	5.1	4.7	4.5	4.5	4.4	4.8	4.3	4.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173^{c}	0.0032	0.0030	0.004	0.006	<0.0030	0.009	0.0033	0.007	0.0032
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0094	0.0097	0.0088	0.0081	0.0080	0.0078	0.0086	0.0081	0.0082
	Beryllium (Be)	mg/L	0.011^{α}	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	15	16	15	14	14	13	15	14	15
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0009	0.0010	0.0009	0.0008	0.0009	0.0009	0.0009	0.0008	0.0009
	Iron (Fe)	mg/L	0.30	0.300	0.032	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	9.3	9.7	9.0	8.1	8.3	8.4	8.8	8.5	9.3
	Manganese (Mn)	mg/L	0.935^{β}	-	0.0049	0.0025	0.0017	0.0015	0.0013	0.0020	0.0010	0.0026	0.0013
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.000010	<0.0000075	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00062	0.00068	0.00064	0.00060	0.00066	0.00058	0.00062	0.00059	0.00064
	Nickel (Ni)	mg/L	0.025	0.025	0.00070	0.00075	0.00067	0.00061	0.00060	0.00062	0.00069	0.00065	0.00070
	Potassium (K)	mg/L	-	-	1.46	1.52	1.37	1.27	1.28	1.27	1.34	1.25	1.40
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.72	0.74	0.61	0.55	0.56	0.56	0.58	0.74	0.60
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.7	1.6	1.5	1.4	1.5	1.4	1.5	1.4	1.6
	Strontium (Sr)	mg/L	-	-	0.010	0.011	0.010	0.009	0.010	0.009	0.010	0.010	0.010
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0008	0.0009	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.54: Water Chemistry at Sheardown Lake SE (DLO-02) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event									
					DL0-02-6 bottom 31-Jul-18	DL0-02-6 surface 31-Jul-18	DL0-02-7 bottom 31-Jul-18	DL0-02-7 surface 31-Jul-18	DL0-02-4 bottom 31-Jul-18	DL0-02-4 surface 31-Jul-18	DL0-02-8 bottom 31-Jul-18	DL0-02-8 surface 31-Jul-18	DL0-02-3 bottom 31-Jul-18	DL0-02-3 surface 31-Jul-18
Conventionals	Conductivity (lab)	umho/cm	-	-	104	103	100	99	99	97	98	100	99	98
	pH (lab)	pH	6.5 - 9.0	-	7.94	7.95	7.95	7.94	7.85	7.90	7.91	7.94	7.88	7.88
	Hardness (as $CaCO_3$)	mg/L	-	-	52	50	49	49	50	47	48	48	49	48
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	70	60	75	70	52	55	55	67	56	70
	Turbidity	NTU	-	-	2.0	2.7	2.0	2.0	2.2	2.1	2.3	3.1	2.9	2.3
	Alkalinity (as $CaCO_3$)	mg/L	-	-	42	19	41	42	47	39	42	41	42	41
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	0.032	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.7	1.6	1.6	1.6	1.6	1.5	1.6	1.6	1.6	1.6
	Total Organic Carbon	mg/L	-	-	2.0	1.8	1.6	1.7	1.5	1.8	1.8	1.8	1.9	1.8
	Total Phosphorus	mg/L	0.020$^{\alpha}$	-	0.0062	0.0059	0.0110	0.0066	0.0082	0.0068	0.0056	0.0065	0.0069	0.0065
	Phenols	mg/L	0.001$^{\alpha}$	-	0.0017	0.0030	0.0023	<0.0010	0.0014	0.0016	0.0027	0.0024	0.0038	0.0019
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.5	2.7	2.4	2.4	2.5	2.3	2.4	2.4	2.5	2.4
	Sulphate (SO_4)	mg/L	218$^{\beta}$	218	4.3	4.3	4.0	4.0	4.1	3.9	4.0	3.9	4.1	4.0
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.054	0.053	0.058	0.055	0.073	0.057	0.072	0.068	0.059	0.059
	Antimony (Sb)	mg/L	0.020$^{\alpha}$	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0060	0.0060	0.0058	0.0059	0.0062	0.0058	0.0060	0.0058	0.0058	0.0058
	Beryllium (Be)	mg/L	0.011$^{\alpha}$	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	11	10	10	10	10	10	10	10	10	10
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009$^{\alpha}$	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00079	0.00072	0.00071	0.00074	0.00070	0.00071	0.00071	0.0007	0.0007	0.00084
	Iron (Fe)	mg/L	0.30	0.300	0.065	0.067	0.066	0.067	0.090	0.072	0.086	0.077	0.077	0.071
	Lead (Pb)	mg/L	0.001	0.001	0.000071	0.000068	0.000068	0.000073	0.000092	0.000078	0.000091	0.000078	0.000084	0.000083
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	6.1	6.1	5.9	5.9	5.8	5.7	5.7	5.7	5.7	5.7
	Manganese (Mn)	mg/L	0.935$^{\beta}$	-	0.0038	0.0039	0.0037	0.0038	0.0060	0.0041	0.0049	0.0040	0.0044	0.0039
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00047	0.00041	0.00038	0.00042	0.00038	0.00039	0.00041	0.00041	0.00039	0.00040
	Nickel (Ni)	mg/L	0.025	0.025	0.00055	0.00054	0.00051	<0.00050	0.00055	<0.00050	0.00055	0.00051	0.00052	0.00052
	Potassium (K)	mg/L	-	-	0.91	0.92	0.88	0.87	0.88	0.87	0.89	0.88	0.86	0.86
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.47	0.47	0.45	0.45	0.51	0.45	0.48	0.47	0.46	0.47
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.1	1.1	1.0	1.0	1.1	1.1	1.0	1.0	1.0	1.0
	Strontium (Sr)	mg/L	-	-	0.008	0.008	0.007	0.007	0.008	0.007	0.007	0.007	0.007	0.007
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
	Vanadium (V)	mg/L	0.006$^{\alpha}$	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.54: Water Chemistry at Sheardown Lake SE (DLO-02) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)^{a}	AEMP Benchmark^{b}	Fall Sampling Event									
					DL0-02-6 bottom 23-Aug-18	DL0-02-6 surface 23-Aug-18	DL0-02-7 bottom 23-Aug-18	DL0-02-7 surface 23-Aug-18	DL0-02-4 bottom 23-Aug-18	DL0-02-4 surface 23-Aug-18	DL0-02-8 bottom 23-Aug-18	DL0-02-8 surface 23-Aug-18	DL0-02-3 bottom 23-Aug-18	DL0-02-3 surface 23-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	120	122	120	120	118	121	118	118	117	117
	pH (lab)	pH	6.5 - 9.0	-	8.02	8.02	7.95	7.89	8.00	8.00	7.95	7.99	7.97	7.93
	Hardness (as $CaCO_3$)	mg/L	-	-	60	60	58	57	57	57	58	57	57	58
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	30	55	55	60	35	38	33	45	45	60
	Turbidity	NTU	-	-	2.2	2.0	2.2	2.4	2.4	2.2	2.1	2.3	2.3	2.4
	Alkalinity (as $CaCO_3$)	mg/L	-	-	49	47	46	47	46	44	47	46	41	45
Nutrients and Organics	Total Ammonia	mg/L	variable^{c}	0.855	<0.020	<0.020	0.0465	0.087	<0.020	0.049	0.026	0.027	<0.020	0.021
	Nitrate	mg/L	13	13	0.044	0.043	0.0425	0.042	0.044	0.043	0.041	0.041	0.042	0.041
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.6	1.7	1.7	1.7	1.7	1.7	1.8	2.0	1.6	1.6
	Total Organic Carbon	mg/L	-	-	2.7	2.5	2.5	2.7	2.7	2.4	2.5	3.1	2.5	2.5
	Total Phosphorus	mg/L	0.020$^{\alpha}$	-	0.0104	0.0049	0.0035	0.0045	0.0032	0.0039	0.0058	0.0045	0.0054	0.0046
	Phenols	mg/L	0.001$^{\alpha}$	-	0.0011	0.0012	0.0018	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.9	2.9	2.8	2.8	2.7	2.7	2.8	2.8	2.8	2.7
	Sulphate (SO_4)	mg/L	218$^{\beta}$	218	6.0	6.0	5.7	5.7	5.6	5.6	5.6	5.6	5.6	5.6
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173^{c}	0.155	0.044	0.058	0.066	0.071	0.060	0.057	0.039	0.067	0.056
	Antimony (Sb)	mg/L	0.020$^{\alpha}$	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0077	0.0064	0.0064	0.0064	0.0065	0.0054	0.0064	0.0070	0.0058	0.0065
	Beryllium (Be)	mg/L	0.011$^{\alpha}$	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	12	12	11	11	11	11	11	11	11	11
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009$^{\alpha}$	0.004	0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0011	0.0009	0.0008	0.0009	0.0008	0.0007	0.0008	0.0006	0.0007	0.0008
	Iron (Fe)	mg/L	0.30	0.300	***0.463***	0.053	0.058	0.063	0.066	0.061	0.061	<0.030	0.061	0.062
	Lead (Pb)	mg/L	0.001	0.001	0.000260	0.000065	0.0000715	0.000077	0.000073	0.000074	0.000075	<0.000050	0.000076	0.000072
	Lithium (Li)	mg/L	-	-	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	7.5	7.3	7.0	7.0	6.9	6.2	6.9	8.2	6.7	6.9
	Manganese (Mn)	mg/L	0.935$^{\beta}$	-	0.0401	0.0057	0.0055	0.0056	0.0053	0.0047	0.0054	0.0010	0.0049	0.0051
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00042	0.00049	0.00049	0.00046	0.00046	0.00044	0.00050	0.00053	0.00047	0.00045
	Nickel (Ni)	mg/L	0.025	0.025	0.00101	0.00061	0.00062	0.00063	0.00065	0.00054	0.00062	0.00054	0.00058	0.00059
	Potassium (K)	mg/L	-	-	1.10	1.05	1.04	1.05	1.05	0.91	1.03	1.20	0.97	1.03
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.67	0.54	0.57	0.57	0.59	0.56	0.58	0.55	0.55	0.55
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.3	1.3	1.3	1.3	1.3	1.1	1.3	1.4	1.2	1.2
	Strontium (Sr)	mg/L	-	-	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.01100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0008	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0005	0.0007	0.0007
	Vanadium (V)	mg/L	0.006$^{\alpha}$	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.55: Dissolved Metal Concentrations at Sheardown Lake SE Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Winter Sampling Event									Summer Sampling Event					
			DL0-02-6	DL0-02-6	DL0-02-7	DL0-02-4	DL0-02-4	DL0-02-8	DL0-02-8	DL0-02-3	DL0-02-3	DL0-02-6	DL0-02-6	DL0-02-7	DL0-02-7	DL0-02-4	DL0-02-4
			bottom	surface	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	17-Apr-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0094	0.0086	0.0101	0.0098	0.0141	0.0097
	Antimony (Sb)	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	<0.00010	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00848	0.00880	0.00808	0.00747	0.00782	0.00711	0.00796	0.00760	0.00781	0.00536	0.00543	0.00531	0.00521	0.00542	0.00534
	Beryllium (Be)	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	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	16.0	15.9	15.1	13.7	15.1	13.9	14.9	14.5	14.4	10.4	10.0	9.6	9.5	9.7	9.3
	Chromium (Cr)	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	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	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	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00080	0.00088	0.00083	0.00078	0.00086	0.00080	0.00093	0.00082	0.00083	0.00065	0.00064	0.00068	0.00061	0.00072	0.00062
	Iron (Fe)	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	<0.030	<0.030	<0.030
	Lead (Pb)	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	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	0.00110	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	9.59	9.73	8.92	8.30	8.96	8.38	8.60	8.55	9.12	6.41	6.13	6.07	6.05	6.19	5.9
	Manganese (Mn)	mg/L	0.001110	0.000678	0.000901	0.000186	0.000682	0.000168	0.000720	0.000282	0.000255	0.000509	0.00037	0.000348	0.000386	0.000828	0.000265
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000695	0.000701	0.000651	0.000622	0.000674	0.000617	0.000647	0.000622	0.000647	0.00044	0.000468	0.000425	0.000401	0.000345	0.000385
	Nickel (Ni)	mg/L	0.000670	0.000730	0.000660	0.000600	0.000680	0.000600	0.000640	0.000600	0.000660	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	1.46	1.52	1.37	1.26	1.40	1.29	1.38	1.30	1.39	0.92	0.91	0.88	0.86	0.87	0.85
	Selenium (Se)	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	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.74	0.73	0.61	0.56	0.61	0.57	0.58	0.70	0.62	0.41	0.4	0.39	0.39	0.44	0.39
	Silver (Ag)	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	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.66	1.75	1.57	1.48	1.65	1.50	1.57	1.54	1.63	1.12	1.1	1.08	1.06	1.08	1.05
	Strontium (Sr)	mg/L	0.01100	0.01120	0.01025	0.00963	0.01020	0.00964	0.01020	0.00986	0.01030	0.00729	0.00699	0.00679	0.00687	0.00712	0.00669
	Thallium (Tl)	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	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000914	0.000909	0.000883	0.000821	0.000885	0.000867	0.000868	0.000824	0.000870	0.000601	0.000614	0.00057	0.000547	0.000568	0.000542
	Vanadium (V)	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	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030	<0.0030

Table C.55: Dissolved Metal Concentrations at Sheardown Lake SE Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Summer Sampling Event				Fall Sampling Event									
			DL0-02-8	DL0-02-8	DL0-02-3	DL0-02-3	DL0-02-6	DL0-02-6	DL0-02-7	DL0-02-7	DL0-02-4	DL0-02-4	DL0-02-8	DL0-02-8	DL0-02-3	DL0-02-3
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			31-Jul-18	31-Jul-18	31-Jul-18	31-Jul-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18
Dissolved Metals	Aluminum (Al)	mg/L	0.0109	0.0101	0.01055	0.0078	0.0108	0.0111	0.0096	0.0139	0.0060	0.0052	0.0126	0.0163	0.0052	0.0054
	Antimony (Sb)	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	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00528	0.00506	0.005385	0.00537	0.00631	0.00640	0.00613	0.00613	0.00609	0.00616	0.00627	0.00611	0.00618	0.00622
	Beryllium (Be)	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	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010
	Calcium (Ca)	mg/L	9.3	9.3	9.4	9.4	12.0	12.0	11.4	11.4	11.4	11.3	11.3	11.3	11.5	11.5
	Chromium (Cr)	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	<0.00050	<0.00050
	Cobalt (Co)	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	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00065	0.00083	0.00061	0.00056	0.00076	0.00131	0.00073	0.00075	0.00071	0.00070	0.00073	0.00075	0.00070	0.00072
	Iron (Fe)	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	<0.030	<0.030
	Lead (Pb)	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	<0.000050	<0.000050
	Lithium (Li)	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	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	5.94	5.99	6.1	6.01	7.27	7.27	7.05	7.01	6.87	7.07	7.16	7.06	6.96	7.08
	Manganese (Mn)	mg/L	0.000398	0.000346	0.0005585	0.000387	0.000883	0.000641	0.000660	0.000656	0.000411	0.000365	0.000410	0.000491	0.000305	0.000324
	Mercury (Hg)	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	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000396	0.000408	0.000400	0.000372	0.000513	0.000557	0.000469	0.000516	0.000469	0.000479	0.000493	0.000474	0.000432	0.000515
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00058	0.00055	0.00053	0.00051	0.00053	0.00052	0.00054	0.0005	0.00055	0.00051
	Potassium (K)	mg/L	0.88	0.87	0.885	0.89	1.07	1.05	1.03	1.02	1.03	1.01	1.03	1.02	1.02	1.03
	Selenium (Se)	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	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.4	0.39	0.39	0.38	0.49	0.48	0.49	0.49	0.48	0.48	0.50	0.49	0.48	0.47
	Silver (Ag)	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	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.06	1.06	1.065	1.06	1.32	1.29	1.27	1.26	1.26	1.25	1.26	1.27	1.25	1.27
	Strontium (Sr)	mg/L	0.00670	0.00666	0.00665	0.00670	0.00857	0.00846	0.00819	0.00816	0.00808	0.00816	0.00807	0.00816	0.00824	0.00819
	Thallium (Tl)	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	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010
	Uranium (U)	mg/L	0.000546	0.000547	0.000558	0.000543	0.000759	0.000765	0.000733	0.000727	0.000710	0.000708	0.000700	0.000702	0.000697	0.000720
	Vanadium (V)	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	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030

Table C.56: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Sheardown Lake Southeast and Reference Lake 3 in 2018, and at Sheardown Lake Southeast Between 2018 and the Baseline Period

Dissolved Metal	Sheardown Lake SE				
	2018 vs Reference Lake 3		2018 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	3.4	1.9	0.0	2.2	3.2
Antimony (Sb)	1.0	1.0	0.0	0.0	1.0
Arsenic (As)	1.0	1.0	1.0	0.8	1.0
Barium (Ba)	0.8	0.9	0.0	1.0	1.1
Beryllium (Be)	1.0	1.0	1.2	1.2	2.1
Cadmium (Cd)	1.0	1.0	0.4	0.0	0.8
Calcium (Ca)	1.4	1.6	1.1	0.8	1.0
Chromium (Cr)	1.0	1.0	RDL	RDL	RDL
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9
Copper (Cu)	0.8	1.1	0.7	0.4	1.0
Iron (Fe)	1.0	1.0	1.2	1.2	1.7
Lead (Pb)	1.0	1.0	0.6	1.0	1.0
Lithium (Li)	1.0	1.0	0.2	0.0	0.4
Magnesium (Mg)	1.4	1.7	1.1	0.9	1.0
Manganese (Mn)	2.9	2.5	1.0	0.0	0.8
Mercury (Hg)	1.0	1.0	0.9	1.0	1.0
Molybdenum (Mo)	3.3	3.6	2.8	0.0	2.4
Nickel (Ni)	1.0	1.1	0.9	0.5	0.9
Potassium (K)	0.9	1.2	0.9	0.8	0.9
Selenium (Se)	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	0.9	1.2	1.3	1.0	1.2
Silver (Ag)	1.0	1.0	1.2	1.8	2.7
Sodium (Na)	1.2	1.5	1.0	0.8	1.0
Strontium (Sr)	0.9	1.0	1.3	1.0	1.1
Thallium (Tl)	1.0	1.0	1.2	1.3	2.6
Tin (Sn)	1.0	1.0	0.1	0.2	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0
Uranium (U)	2.4	2.8	1.8	1.2	1.4
Vanadium (V)	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.5	1.0	1.9

🟪 Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).

🟨 Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).

🟥 Denotes highly elevated concentration (mean concentration≥ 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.57: Spearman's Rank Correlation Coefficients for Sheardown Lake SE (DLO-2) Water Quality Data Collected in Winter, Summer, and Fall 2018[a]

Parameters	Conventional Parameters									Total Metals											
	Conduct-ivity	Hardness	Total Dissolved Solids	Turbidity	Alkalinity	Dissolved Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Iron	Manganese	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	1	0.934	0.697	-0.726	0.897	0.810	-0.370	0.964	0.383	-0.750	0.872	0.705	-0.785	-0.440	0.914	0.787	0.943	0.808	0.928	0.945	0.843
Hardness	0.934	1	0.679	-0.774	0.942	0.786	-0.285	0.960	0.382	-0.777	0.923	0.779	-0.758	-0.388	0.933	0.816	0.945	0.827	0.944	0.975	0.893
Total Dissolved Solids	0.697	0.679	1	-0.676	0.669	0.539	-0.211	0.704	-0.213	-0.835	0.710	0.533	-0.633	-0.575	0.713	0.445	0.700	0.388	0.675	0.694	0.573
Turbidity	-0.726	-0.774	-0.676	1	-0.788	-0.604	0.156	-0.719	0.083	0.777	-0.711	-0.534	0.657	0.482	-0.752	-0.488	-0.679	-0.520	-0.718	-0.732	-0.698
Alkalinity	0.897	0.942	0.669	-0.788	1	0.783	-0.202	0.938	0.302	-0.696	0.926	0.755	-0.698	-0.354	0.876	0.842	0.921	0.828	0.931	0.930	0.835
Dissolved Organic Carbon	0.810	0.786	0.539	-0.604	0.783	1	-0.254	0.823	0.359	-0.736	0.773	0.515	-0.893	-0.680	0.913	0.575	0.848	0.652	0.841	0.750	0.618
Total Phosphorus	-0.370	-0.285	-0.211	0.156	-0.202	-0.254	1	-0.271	-0.362	0.357	-0.216	-0.220	0.353	0.127	-0.413	-0.081	-0.350	-0.093	-0.277	-0.298	-0.190
Chloride	0.964	0.960	0.704	-0.719	0.938	0.823	-0.271	1	0.397	-0.762	0.937	0.767	-0.772	-0.414	0.922	0.862	0.970	0.857	0.971	0.968	0.863
Sulphate	0.383	0.382	-0.213	0.083	0.302	0.359	-0.362	0.397	1.000	0.006	0.307	0.416	-0.203	0.229	0.350	0.521	0.393	0.557	0.404	0.395	0.368
Aluminum (total)	-0.750	-0.777	-0.835	0.777	-0.696	-0.736	0.357	-0.762	0.006	1.000	-0.756	-0.468	0.853	0.758	-0.867	-0.391	-0.787	-0.416	-0.796	-0.757	-0.576
Barium (total)	0.872	0.923	0.710	-0.711	0.926	0.773	-0.216	0.937	0.307	-0.756	1	0.719	-0.736	-0.440	0.881	0.826	0.954	0.763	0.942	0.938	0.829
Copper (total)	0.705	0.779	0.533	-0.534	0.755	0.515	-0.220	0.767	0.416	-0.468	0.719	1	-0.357	-0.051	0.681	0.828	0.740	0.709	0.709	0.774	0.889
Iron (total)	-0.785	-0.758	-0.633	0.657	-0.698	-0.893	0.353	-0.772	-0.203	0.853	-0.736	-0.357	1	0.768	-0.900	-0.423	-0.800	-0.512	-0.802	-0.743	-0.529
Manganese (total)	-0.440	-0.388	-0.575	0.482	-0.354	-0.680	0.127	-0.414	0.229	0.758	-0.440	-0.051	0.768	1	-0.595	-0.011	-0.493	-0.036	-0.470	-0.368	-0.192
Molybdenum (total)	0.914	0.933	0.713	-0.752	0.876	0.913	-0.413	0.922	0.350	-0.867	0.881	0.681	-0.900	-0.595	1	0.675	0.938	0.721	0.926	0.908	0.780
Nickel (total)	0.787	0.816	0.445	-0.488	0.842	0.575	-0.081	0.862	0.521	-0.391	0.826	0.828	-0.423	-0.011	0.675	1	0.816	0.925	0.809	0.860	0.851
Potassium (total)	0.943	0.945	0.700	-0.679	0.921	0.848	-0.350	0.970	0.393	-0.787	0.954	0.740	-0.800	-0.493	0.938	0.816	1	0.790	0.979	0.957	0.836
Silicon (total)	0.808	0.827	0.388	-0.520	0.828	0.652	-0.093	0.857	0.557	-0.416	0.763	0.709	-0.512	-0.036	0.721	0.925	0.790	1	0.817	0.838	0.780
Sodium (total)	0.928	0.944	0.675	-0.718	0.931	0.841	-0.277	0.971	0.404	-0.796	0.942	0.709	-0.802	-0.470	0.926	0.809	0.979	0.817	1	0.953	0.806
Strontium (total)	0.945	0.975	0.694	-0.732	0.930	0.750	-0.298	0.968	0.395	-0.757	0.938	0.774	-0.743	-0.368	0.908	0.860	0.957	0.838	0.953	1	0.900
Uranium (total)	0.843	0.893	0.573	-0.698	0.835	0.618	-0.190	0.863	0.368	-0.576	0.829	0.889	-0.529	-0.192	0.780	0.851	0.836	0.780	0.806	0.900	1
Aluminum (dissolved)	-0.777	-0.758	-0.808	0.760	-0.636	-0.528	0.229	-0.725	0.093	0.806	-0.669	-0.501	0.711	0.549	-0.734	-0.459	-0.700	-0.462	-0.680	-0.774	-0.706
Barium (dissolved)	0.942	0.978	0.651	-0.788	0.924	0.762	-0.250	0.946	0.368	-0.761	0.908	0.751	-0.741	-0.375	0.907	0.822	0.933	0.837	0.939	0.977	0.902
Copper (dissolved)	0.789	0.769	0.669	-0.548	0.793	0.771	-0.108	0.790	0.147	-0.610	0.761	0.642	-0.652	-0.511	0.777	0.658	0.800	0.646	0.752	0.742	0.663
Manganese (dissolved)	0.244	0.302	0.021	-0.214	0.354	0.189	0.053	0.294	0.367	-0.012	0.313	0.343	0.090	0.239	0.190	0.399	0.268	0.393	0.301	0.252	0.363
Molybdenum (dissolved)	0.941	0.958	0.737	-0.723	0.892	0.797	-0.353	0.934	0.361	-0.799	0.888	0.793	-0.771	-0.442	0.944	0.767	0.942	0.782	0.923	0.950	0.877
Nickel (dissolved)	0.934	0.970	0.683	-0.822	0.921	0.748	-0.314	0.933	0.314	-0.749	0.864	0.814	-0.723	-0.365	0.913	0.803	0.907	0.810	0.897	0.955	0.917
Potassium (dissolved)	0.931	0.987	0.685	-0.729	0.926	0.778	-0.319	0.959	0.383	-0.774	0.927	0.786	-0.757	-0.406	0.931	0.831	0.961	0.825	0.945	0.975	0.881
Silicon (dissolved)	0.928	0.954	0.651	-0.753	0.949	0.814	-0.287	0.962	0.356	-0.749	0.910	0.696	-0.794	-0.387	0.922	0.823	0.944	0.873	0.959	0.946	0.807
Sodium (dissolved)	0.935	0.983	0.693	-0.725	0.932	0.807	-0.312	0.967	0.394	-0.799	0.943	0.747	-0.786	-0.458	0.935	0.801	0.972	0.799	0.968	0.970	0.852
Strontium (dissolved)	0.945	0.978	0.700	-0.748	0.937	0.769	-0.292	0.967	0.395	-0.770	0.937	0.743	-0.762	-0.401	0.912	0.825	0.955	0.820	0.960	0.988	0.878
Uranium (dissolved)	0.957	0.976	0.710	-0.733	0.925	0.777	-0.329	0.968	0.397	-0.757	0.909	0.792	-0.750	-0.380	0.919	0.810	0.955	0.808	0.950	0.969	0.899

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 28.

🟩 Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

🟦 Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.57: Spearman's Rank Correlation Coefficients for Sheardown Lake SE (DLO-2) Water Quality Data Collected in Winter, Summer, and Fall 2018[a]

Parameters	Dissolved Metals										
	Aluminum	Barium	Copper	Manganese	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	-0.777	0.942	0.789	0.244	0.941	0.934	0.931	0.928	0.935	0.945	0.957
Hardness	-0.758	0.978	0.769	0.302	0.958	0.970	0.987	0.954	0.983	0.978	0.976
Total Dissolved Solids	-0.808	0.651	0.669	0.021	0.737	0.683	0.685	0.651	0.693	0.700	0.710
Turbidity	0.760	-0.788	-0.548	-0.214	-0.723	-0.822	-0.729	-0.753	-0.725	-0.748	-0.733
Alkalinity	-0.636	0.924	0.793	0.354	0.892	0.921	0.926	0.949	0.932	0.937	0.925
Dissolved Organic Carbon	-0.528	0.762	0.771	0.189	0.797	0.748	0.778	0.814	0.807	0.769	0.777
Total Phosphorus	0.229	-0.250	-0.108	0.053	-0.353	-0.314	-0.319	-0.287	-0.312	-0.292	-0.329
Chloride	-0.725	0.946	0.790	0.294	0.934	0.933	0.959	0.962	0.967	0.967	0.968
Sulphate	0.093	0.368	0.147	0.367	0.361	0.314	0.383	0.356	0.394	0.395	0.397
Aluminum (total)	0.806	-0.761	-0.610	-0.012	-0.799	-0.749	-0.774	-0.749	-0.799	-0.770	-0.757
Barium (total)	-0.669	0.908	0.761	0.313	0.888	0.864	0.927	0.910	0.943	0.937	0.909
Copper (total)	-0.501	0.751	0.642	0.343	0.793	0.814	0.786	0.696	0.747	0.743	0.792
Iron (total)	0.711	-0.741	-0.652	0.090	-0.771	-0.723	-0.757	-0.794	-0.786	-0.762	-0.750
Manganese (total)	0.549	-0.375	-0.511	0.239	-0.442	-0.365	-0.406	-0.387	-0.458	-0.401	-0.380
Molybdenum (total)	-0.734	0.907	0.777	0.190	0.944	0.913	0.931	0.922	0.935	0.912	0.919
Nickel (total)	-0.459	0.822	0.658	0.399	0.767	0.803	0.831	0.823	0.801	0.825	0.810
Potassium (total)	-0.700	0.933	0.800	0.268	0.942	0.907	0.961	0.944	0.972	0.955	0.955
Silicon (total)	-0.462	0.837	0.646	0.393	0.782	0.810	0.825	0.873	0.799	0.820	0.808
Sodium (total)	-0.680	0.939	0.752	0.301	0.923	0.897	0.945	0.959	0.968	0.960	0.950
Strontium (total)	-0.774	0.977	0.742	0.252	0.950	0.955	0.975	0.946	0.970	0.988	0.969
Uranium (total)	-0.706	0.902	0.663	0.363	0.877	0.917	0.881	0.807	0.852	0.878	0.899
Aluminum (dissolved)	1	-0.770	-0.588	0.133	-0.771	-0.800	-0.750	-0.691	-0.738	-0.771	-0.770
Barium (dissolved)	-0.770	1	0.737	0.293	0.957	0.963	0.968	0.944	0.955	0.964	0.952
Copper (dissolved)	-0.588	0.737	1	0.211	0.792	0.776	0.799	0.758	0.798	0.738	0.778
Manganese (dissolved)	0.133	0.293	0.211	1	0.223	0.253	0.262	0.252	0.281	0.274	0.313
Molybdenum (dissolved)	-0.771	0.957	0.792	0.223	1	0.944	0.962	0.920	0.952	0.941	0.957
Nickel (dissolved)	-0.800	0.963	0.776	0.253	0.944	1	0.962	0.930	0.936	0.942	0.955
Potassium (dissolved)	-0.750	0.968	0.799	0.262	0.962	0.962	1	0.955	0.986	0.966	0.966
Silicon (dissolved)	-0.691	0.944	0.758	0.252	0.920	0.930	0.955	1	0.949	0.941	0.936
Sodium (dissolved)	-0.738	0.955	0.798	0.281	0.952	0.936	0.986	0.949	1	0.981	0.976
Strontium (dissolved)	-0.771	0.964	0.738	0.274	0.941	0.942	0.966	0.941	0.981	1	0.980
Uranium (dissolved)	-0.770	0.952	0.778	0.313	0.957	0.955	0.966	0.936	0.976	0.980	1

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 28.

🟩 Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

🟦 Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.59: *In Situ* Water Quality Measurements Collected at Mary River Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Study Area	Station	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Mary River Upstream (GO-09)	GO-09 B1	4.7	11.93	92.7	6.75*	93*
	GO-09 B2	4.5	12.26	94.7	5.48*	-
	GO-09 B3	4.5	12.44	96.1	5.40*	-
	GO-09 B4	4.4	12.37	95.3	5.36*	-
	GO-09 B5	4.4	12.82	98.8	5.57*	-
Mary River Upstream (GO-03)	GO-03 B1	5.6	11.63	92.5	2.75*	-
	GO-03 B2	5.6	11.52	91.6	2.87*	-
	GO-03 B3	5.4	11.85	93.8	2.66*	-
	GO-03 B4	5.3	12.48	98.5	2.60*	-
	GO-03 B5	5.1	12.33	96.9	5.68*	-
Mary River Downstream (EO-01)	EO-01 B1	5.3	12.86	101.5	6.48*	158*
	EO-01 B2	5.4	12.72	100.7	5.18*	85*
	EO-01 B3	5.4	12.66	100.2	5.20*	90*
	EO-01 B4	5.2	12.66	99.6	6.64*	156*
	EO-01 B5	5.4	12.89	102.0	5.48*	90*
Mary River Downstream (EO-20)	EO-20 B1	5.7	12.51	100.0	5.43*	91*
	EO-20 B2	5.8	12.50	99.8	5.55*	87*
	EO-20 B3	5.8	12.51	99.7	5.46*	88*
	EO-20 B4	5.9	12.40	99.5	5.86*	88*
	EO-20 B5	5.9	12.35	99.4	5.62*	92*
Mary River Downstream (CO-05)	CO-05 B1	6.4	12.45	101.0	8.13	126
	CO-05 B2	6.4	12.51	101.0	8.12	126
	CO-05 B3	6.1	12.51	100.8	8.14	126
	CO-05 B4	5.9	12.54	100.5	8.12	126
	CO-05 B5	5.6	12.49	100.0	8.08	125

Note: * Meter not functioning properly, and therefore readings of pH and specific conductance were not used for further evaluation.

Table C.60: *In Situ* Water Quality Summary for Mary River Benthic Invertebrate Community Study Areas, Mary River Project CREMP, August 2018

Metric	Station	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Temperature (˚C)	GO-09	5	4.47	0.15	0.07	4.29	4.66	4.35	4.72
	GO-03	5	5.39	0.21	0.10	5.13	5.66	5.11	5.61
	EO-01	5	5.32	0.09	0.04	5.20	5.43	5.18	5.42
	EO-20	5	5.81	0.08	0.03	5.71	5.91	5.74	5.92
	CO-05	5	6.08	0.34	0.15	5.66	6.50	5.60	6.40
Dissolved Oxygen (mg/L)	GO-09	5	12.4	0.3	0.1	12.0	12.8	11.9	12.8
	GO-03	5	12.0	0.4	0.2	11.4	12.5	11.5	12.5
	EO-01	5	12.8	0.1	0.0	12.6	12.9	12.7	12.9
	EO-20	5	12.5	0.1	0.0	12.4	12.5	12.4	12.5
	CO-05	5	12.5	0.0	0.0	12.5	12.5	12.5	12.5
Dissolved Oxygen (% saturation)	GO-09	5	95.5	2.2	1.0	92.8	98.3	92.7	98.8
	GO-03	5	94.7	2.9	1.3	91.0	98.3	91.6	98.5
	EO-01	5	100.8	1.0	0.4	99.6	102.0	99.6	102.0
	EO-20	5	99.7	0.2	0.1	99.4	100.0	99.4	100.0
	CO-05	5	100.7	0.4	0.2	100.1	101.2	100.0	101.0
pH (pH units)	GO-09	5	-	-	-	-	-	-	-
	GO-03	5	-	-	-	-	-	-	-
	EO-01	5	-	-	-	-	-	-	-
	EO-20	5	-	-	-	-	-	-	-
	CO-05	5	8.12	0.02	0.01	8.09	8.15	8.08	8.14
Specific Conductance (µS/cm)	GO-09	5	-	-	-	-	-	-	-
	GO-03	5	-	-	-	-	-	-	-
	EO-01	5	-	-	-	-	-	-	-
	EO-20	5	-	-	-	-	-	-	-
	CO-05	5	125.7	0.5	0.2	125.1	126.3	124.9	126.1

Note: Meter not functioning properly, and therefore readings of pH and specific conductance were not able to be calculated for GO-09, GO-03, EO-01, and EO-20.

Table C.61: Statistical Comparison of *In Situ* Water Quality Variables Among Mary River Benthic Invertebrate Community Study Areas, Mary River Project CREMP, August 2018

***In Situ* Variable**	**Overall 5-group Comparison**			**Pair-wise, *post hoc* comparisons[a]**				
	Significant Difference Among Areas?	**P-value**	**Statistical Test[b]**	**(I) Area**	**(J) Area**	**Significant Difference Between Areas?**	**P-value**	**Statistical Test**
Temperature (˚C)	YES	< 0.001	α	GO-09	GO-03	YES	0.000	Tukey's HSD
				GO-09	EO-01	YES	0.000	
				GO-09	EO-20	YES	0.000	
				GO-09	CO-05	YES	0.000	
				GO-03	EO-01	NO	0.975	
				GO-03	EO-20	YES	0.025	
				GO-03	CO-05	YES	0.000	
				EO-01	EO-20	YES	0.007	
				EO-01	CO-05	YES	0.000	
				EO-20	CO-05	NO	0.242	
Dissolved Oxygen (mg/L)	YES	0.0017	α	GO-09	GO-03	NO	0.112	Tukey's HSD
				GO-09	EO-01	NO	0.123	
				GO-09	EO-20	NO	0.977	
				GO-09	CO-05	NO	0.903	
				GO-03	EO-01	YES	0.000	
				GO-03	EO-20	YES	0.035	
				GO-03	CO-05	YES	0.019	
				EO-01	EO-20	NO	0.323	
				EO-01	CO-05	NO	0.480	
				EO-20	CO-05	NO	0.998	
Dissolved Oxygen (% Saturation)	YES	< 0.001	α	GO-09	GO-03	NO	0.929	Tukey's HSD
				GO-09	EO-01	YES	0.001	
				GO-09	EO-20	YES	0.008	
				GO-09	CO-05	YES	0.001	
				GO-03	EO-01	YES	0.000	
				GO-03	EO-20	YES	0.001	
				GO-03	CO-05	YES	0.000	
				EO-01	EO-20	NO	0.838	
				EO-01	CO-05	NO	1.000	
				EO-20	CO-05	NO	0.893	

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

b Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, Kruskal Wallis H-test or Mann-Whitney U-test, as appropriate.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.62: Water Chemistry at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Spring Sampling Event												
					G0-09-A	G0-09	G0-09-B	G0-03	G0-01	F0-01	E0-10	E0-03	E0-21	E0-20	C0-10	C0-05	C0-01
					01-Jul-18	01-Jul-18	01-Jul-18	01-Jul-18	30-Jun-18	30-Jun-18	01-Jul-18	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18
Conventionals	Conductivity (lab)	umho/cm	-	-	24	26	30	33	26	65	33	30	30	31	30	39	36
	pH (lab)	pH	6.5 - 9.0	-	7.3	7.4	7.4	7.44	7.3	7.72	7.39	7.445	7.39	7.48	7.4	7.43	7.45
	Hardness (as $CaCO_3$)	mg/L	-	-	11	12	14	15	12	31	15	14	14	15	14	18	17
	Total Suspended Solids (TSS)	mg/L	-	-	16.9	6.2	3.7	<2.0	2.1	<2.0	<2.0	5.1	3.7	3.7	<2.0	<2.0	2.8
	Total Dissolved Solids (TDS)	mg/L	-	-	<10	13	11	11	16	37	22	21	21	22	30	26	24
	Turbidity	NTU	-	-	8.8	7.1	4.7	3.5	3.7	1.2	3.3	3.3	3.6	3.2	3.3	3.8	3.3
	Alkalinity (as $CaCO_3$)	mg/L	-	-	11	15	17	16	<10	29	15	13	13	13	<10	16	16
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.0285	0.043	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	0.9	0.9	1.0	1.0	1.0	0.6	0.9	0.9	1.0	1.0	1.0	1.1	1.1
	Total Organic Carbon	mg/L	-	-	1.3	1.2	1.3	1.2	1.4	1.0	1.1	1.4	1.2	1.3	1.3	1.4	1.3
	Total Phosphorus	mg/L	0.030[α]	-	0.0277	0.0158	0.0074	0.0060	0.0069	0.0035	0.0063	0.0148	0.0076	0.0091	0.0059	0.0053	0.006
	Phenols	mg/L	0.004[α]	-	0.0061	<0.0010	0.0015	0.0025	0.0014	0.0038	0.0013	0.012	0.0026	0.0016	0.0016	0.0034	0.0079
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	0.5	0.53	0.6	1.7	0.6	<0.50	0.6	0.6	0.58	0.6	0.6	0.8	0.8
	Sulphate (SO_4)	mg/L	218[β]	218	<0.30	<0.30	<0.30	<0.30	<0.30	2.1	1.1	0.4	0.4	0.4	0.4	0.7	0.6
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.225	0.135	0.086	0.123	0.084	0.036	0.087	0.091	0.094	0.073	0.098	0.048	0.091
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0040	0.0032	0.0031	0.0033	0.0025	0.0034	0.0030	0.0043	0.0030	0.0027	0.0029	0.0031	0.0032
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	2	3	3	3	3	6	3	3	3	3	3	4	4
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	0.00072	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<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 (Cu)	mg/L	0.002	0.0024	0.00067	0.0006	0.0006	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	0.30	0.874	0.181	0.125	0.096	0.083	0.064	0.036	0.061	0.075	0.086	0.043	0.069	0.043	0.071
	Lead (Pb)	mg/L	0.001	0.001	0.000219	0.000155	0.000103	0.000090	0.000077	<0.000050	0.000071	0.000096	0.000093	<0.000050	0.000082	0.000066	0.000092
	Lithium (Li)	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	<0.0010
	Magnesium (Mg)	mg/L	-	-	1.4	1.5	1.6	1.7	1.4	3.8	1.8	1.7	1.7	1.9	1.7	2.2	2.0
	Manganese (Mn)	mg/L	0.935[β]	-	0.0042	0.0032	0.00241	0.0015	0.0014	0.0008	0.0013	0.0020	0.0025	0.0007	0.0015	0.0025	0.0024
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000052	<0.000050	0.00009	0.00007
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.39	0.36	0.36	0.37	0.32	0.43	0.35	0.345	0.36	0.39	0.36	0.42	0.4
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.73	0.51	0.54	0.55	0.44	0.38	0.47	0.45	0.46	0.47	0.49	0.36	0.48
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.414000
	Strontium (Sr)	mg/L	-	-	0.0027	0.0027	0.0028	0.0028	0.0023	0.0034	0.0026	0.0025	0.0025	0.0026	0.0025	0.0030	0.0029
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0002	0.0002	0.0002	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Mary River system.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.62: Water Chemistry at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event												
					G0-09-A	G0-09	G0-09-B	G0-03	G0-01	F0-01	E0-10	E0-03	E0-21	E0-20	C0-10	C0-05	C0-01
					12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	10-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	81	84	85	88	88	270	96	106	104	107	107	110	100
	pH (lab)	pH	6.5 - 9.0	-	8.16	8.03	8.13	8.12	8.08	8.29	8.10	8.09	8.14	8.13	8.03	8.09	8.13
	Hardness (as $CaCO_3$)	mg/L	-	-	40	42	43	44	45	145	48	53	52	53	55	54	50
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	40	50	50	40	50	145	50	55	46	68	52	70	40
	Turbidity	NTU	-	-	9.7	8.9	7.7	6.1	6.3	1.6	6.0	6.6	6.4	5.4	3.5	5.4	1.0
	Alkalinity (as $CaCO_3$)	mg/L	-	-	46	39	40	39	40	83	41	45	41	45	50	49	42
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.032	<0.020	<0.020	0.033	<0.020	<0.020	0.044	0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	0.210	<0.020	0.021	<0.020	0.023	0.033	0.022	0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.2	1.29	1.48	1.53	1.47	1.38	1.5	1.42	1.41	1.63	1.88	1.7	1.7
	Total Organic Carbon	mg/L	-	-	1.6	1.57	1.67	1.69	1.64	1.54	1.68	1.89	1.68	1.87	2.07	2.2	2.1
	Total Phosphorus	mg/L	0.020[α]	-	0.0138	0.0075	0.0090	0.0066	0.0074	0.0048	0.0068	0.0080	0.0082	0.0067	0.0082	0.0089	0.0077
	Phenols	mg/L	0.004[α]	-	0.0034	<0.0010	<0.0010	0.0014	<0.0010	0.0013	<0.0010	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.9	1.8	1.6	4.0	2.7	1.9	2.6	2.7	2.6	2.4	2.6	2.3	2.0
	Sulphate (SO_4)	mg/L	218[β]	218	1.2	1.1	0.9	0.9	0.9	59.9	3.3	7.5	7.2	6.4	5.2	5.9	4.9
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.176	0.426	0.147	0.166	0.163	0.042	0.099	0.146	0.112	0.113	0.107	0.153	0.141
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0069	0.0073	0.0059	0.0068	0.0073	0.0132	0.0069	0.0075	0.0074	0.0073	0.0069	0.0076	0.0070
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	9	9	9	9	9	26	10	10	10	11	10	11	10
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00022	< 0.00021	< 0.00017	<0.00010	< 0.00015	< 0.00013
	Copper (Cu)	mg/L	0.002	0.0024	0.0010	0.0010	0.0008	0.0009	0.0010	0.0007	0.0009	0.0010	0.0010	0.0010	0.0009	0.0010	0.0010
	Iron (Fe)	mg/L	0.30	0.874	0.138	0.140	0.112	0.110	0.109	0.049	0.083	0.122	0.105	0.103	0.115	0.128	0.134
	Lead (Pb)	mg/L	0.001	0.001	0.000177	0.000164	0.000146	0.000128	0.000129	<0.000050	0.000109	0.000139	0.000135	0.000119	0.000146	0.000137	0.000155
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00140	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.9	5.0	4.4	5.2	5.3	20.5	5.9	6.7	6.5	7.1	6.8	6.7	6.1
	Manganese (Mn)	mg/L	0.935[β]	-	0.0018	0.0017	0.0014	0.0013	0.0013	0.0018	0.0012	0.0210	0.0184	0.0145	0.0060	0.0121	0.0081
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00021	0.00018	0.00015	0.00015	0.00018	0.00021	0.00015	0.00024	0.00026	0.00024	0.00038	0.00029	0.00021
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0006	0.0006	0.0007	0.0007	0.0008	0.0007
	Potassium (K)	mg/L	-	-	0.93	0.91	0.76	0.84	0.84	1.35	0.83	0.88	0.86	0.87	1.01	0.92	0.84
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	1.04	1.13	0.94	1.07	1.01	0.87	0.91	1.00	0.92	0.97	0.65	1.08	0.97
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.6	1.6	1.3	1.3	1.3	1.4	1.3	1.3	1.3	1.3	1.2	1.3	1.1
	Strontium (Sr)	mg/L	-	-	0.0098	0.0094	0.0088	0.0087	0.0087	0.018	0.0088	0.0110	0.0107	0.0105	0.0075	0.0104	0.0097
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010
	Titanium (Ti)	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	<0.010
	Uranium (U)	mg/L	0.015	-	0.0014	0.0014	0.0012	0.0010	0.0010	0.0018	0.0010	0.0010	0.0010	0.0009	0.0007	0.0009	0.0008
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Mary River system.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.62: Water Chemistry at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event												
					G0-09-A	G0-09	G0-09-B	G0-03	GO-01	F0-01	E0-10	EO-03	EO-21	EO-20	C0-10	C0-05	CO-01
					27-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	27-Aug-18	25-Aug-18	27-Aug-18	26-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	134	113	112	121	134	283	177	153	164	163	165	160	149
	pH (lab)	pH	6.5 - 9.0	-	7.99	8.07	8.14	8.02	8.00	8.29	8.03	8.03	8.05	8.04	8.07	8.01	8.11
	Hardness (as $CaCO_3$)	mg/L	-	-	66	55	55	57	65	143	84	72	80	79	81	78	70
	Total Suspended Solids (TSS)	mg/L	-	-	3.2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	55	70	70	60	80	160	81	115	75	80	90	95	75
	Turbidity	NTU	-	-	2.7	4.9	3.8	3.2	2.7	1.7	2.7	3.0	2.6	2.3	2.1	2.6	2.2
	Alkalinity (as $CaCO_3$)	mg/L	-	-	65	50	52	50	59	95	61	58	59	62	65	64	60
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.037	0.069	<0.020	<0.020	<0.020	<0.020	0.022	<0.020	<0.020	<0.020	<0.020	0.032	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	0.13	0.049	0.021	0.034	0.047	0.044	0.041	0.026
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.3	2.0	1.9	1.4	1.4	2.23	1.3	2.0	1.4	1.5	1.5	1.7	1.7
	Total Organic Carbon	mg/L	-	-	2.1	2.1	2.0	1.9	1.9	2.3	1.8	2.1	1.9	2.0	2.3	2.4	2.6
	Total Phosphorus	mg/L	0.020[α]	-	0.0034	0.0073	0.0034	<0.0030	<0.0030	0.0036	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0030	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	0.0027	<0.0010	0.0011	<0.0010	0.0011	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.8	2.9	2.8	5.4	5.5	2.5	5.3	5.5	5.4	5.0	5.0	4.9	4.7
	Sulphate (SO_4)	mg/L	218[β]	218	1.6	1.8	1.7	1.6	1.7	49.1	17.9	8.2	12.7	11.8	11.9	10.6	7.3
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.126	0.155	0.105	0.128	0.139	0.034	0.135	0.123	0.125	0.123	0.0927	0.102	0.0974
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0085	0.0082	0.0080	0.0086	0.0089	0.0132	0.0107	0.00963	0.0101	0.0105	0.0103	0.00985	0.00932
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	14	12	12	12	14	26	17	15	16	16	16	15	16
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<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 (Cu)	mg/L	0.002	0.0024	0.0008	0.0009	0.0009	0.0008	0.0008	0.0007	0.0008	0.0008	0.0009	0.0009	0.0010	0.0009	0.0008
	Iron (Fe)	mg/L	0.30	0.874	0.071	0.102	0.082	0.079	0.074	0.042	0.075	0.075	0.075	0.092	0.059	0.085	0.072
	Lead (Pb)	mg/L	0.001	0.001	0.000076	0.000114	0.000092	0.000086	0.000069	<0.000050	0.000068	0.000076	0.000076	0.000092	0.000061	0.000068	0.000060
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	7.4	6.1	6.5	6.3	7.2	20.4	10.4	8.3	9.2	9.5	9.7	9.3	8.4
	Manganese (Mn)	mg/L	0.935[β]	-	0.0009	0.0012	0.0011	0.0010	0.0008	0.0011	0.0009	0.0094	0.0072	0.0074	0.0057	0.0064	0.0040
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00025	0.00029	0.00026	0.00024	0.00030	0.00032	0.00029	0.00045	0.00046	0.00039	0.00044	0.00042	0.00045
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00051	0.00054	0.00068	0.00092	0.00078	0.00072
	Potassium (K)	mg/L	-	-	0.91	0.95	0.97	0.87	0.92	1.26	0.99	0.98	0.99	1	0.97	0.99	0.96
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.96	0.94	0.85	0.96	0.97	0.7	1.01	0.97	0.94	1	0.93	0.94	0.93
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	2.0	2.0	2.0	1.7	1.9	1.5	1.8	1.7	1.9	1.9	1.7	1.8	1.7
	Strontium (Sr)	mg/L	-	-	0.0128	0.0127	0.0129	0.0108	0.0127	0.020	0.0148	0.016	0.016	0.015	0.0152	0.0147	0.0141
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010
	Titanium (Ti)	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	<0.010
	Uranium (U)	mg/L	0.015	-	0.0026	0.0025	0.0027	0.0020	0.0021	0.0023	0.0023	0.0020	0.0022	0.0019	0.0019	0.0017	0.0017
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Mary River system.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.63: Summary of the Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentration Data Provided) Between Mary River Mine-Exposed and Reference (GO-09) Stations in 2018

Variable	Spring										Summer									
	G0-03	G0-01	FO-01	E0-10	E0-03	E0-21	E0-20	C0-10	CO-05	CO-01	G0-03	G0-01	FO-01	E0-10	E0-03	E0-21	E0-20	C0-10	CO-05	CO-01
Conductivity (lab)	1.2	1.0	2.4	1.2	1.1	1.1	1.2	1.1	1.5	1.4	1.1	1.1	3.2	1.2	1.3	1.2	1.3	1.3	1.3	1.2
Hardness (as $CaCO_3$)	1.2	1.0	2.5	1.2	1.1	1.1	1.2	1.1	1.5	1.4	1.1	1.1	3.5	1.2	1.3	1.2	1.3	1.3	1.3	1.2
Total Suspended Solids (TSS)	0.2	0.2	0.2	0.2	0.6	0.4	0.4	0.2	0.2	0.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total Dissolved Solids (TDS)	1.0	1.4	3.3	1.9	1.9	1.9	1.9	2.6	2.3	2.1	0.9	1.1	3.1	1.1	1.2	1.0	1.5	1.1	1.5	0.9
Turbidity	0.5	0.5	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.7	0.2	0.7	0.8	0.7	0.6	0.4	0.6	0.1
Alkalinity (as $CaCO_3$)	1.1	0.7	2.0	1.0	0.9	0.9	0.9	0.7	1.1	1.1	0.9	1.0	2.0	1.0	1.1	1.0	1.1	1.2	1.2	1.0
Total Ammonia	1.0	1.0	1.0	1.0	1.4	2.2	1.0	1.0	1.0	1.0	1.4	0.8	0.8	1.8	0.8	0.8	0.8	0.8	0.8	0.8
Nitrate	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	11	1.0	1.1	1.0	1.2	1.7	1.1	1.0
Nitrite	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total Kjeldahl Nitrogen (TKN)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Dissolved Organic Carbon	1.0	1.1	0.6	1.0	1.0	1.0	1.1	1.0	1.2	1.2	1.2	1.1	1.0	1.1	1.1	1.1	1.2	1.4	1.3	1.3
Total Organic Carbon	0.9	1.1	0.8	0.9	1.1	0.9	1.0	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.2	1.0	1.2	1.3	1.3	1.3
Total Phosphorus	0.4	0.4	0.2	0.4	0.9	0.4	0.5	0.3	0.3	0.4	0.7	0.7	0.5	0.7	0.8	0.8	0.7	0.8	0.9	0.8
Phenols	0.9	0.5	1.3	0.5	4.2	0.9	0.6	0.6	1.2	2.8	0.8	0.6	0.7	0.6	0.7	0.6	0.6	0.6	0.6	0.6
Bromide (Br)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Chloride (Cl)	3.1	1.1	0.9	1.2	1.1	1.1	1.1	1.1	1.5	1.4	2.3	1.5	1.1	1.5	1.5	1.5	1.3	1.5	1.3	1.1
Sulphate (SO_4)	1.0	1.0	6.9	3.7	1.2	1.2	1.3	1.2	2.3	2.0	0.8	0.9	56	3.1	7.0	6.7	6.0	4.9	5.5	4.6
Aluminum (Al)	0.8	0.6	0.2	0.6	0.6	0.6	0.5	0.7	0.3	0.6	0.7	0.7	0.2	0.4	0.6	0.4	0.5	0.4	0.6	0.6
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	1.0	0.7	1.0	0.9	1.3	0.9	0.8	0.9	0.9	0.9	1.0	1.1	2.0	1.0	1.1	1.1	1.1	1.0	1.1	1.0
Beryllium (Be)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cadmium (Cd)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Calcium (Ca)	1.2	0.9	2.4	1.2	1.1	1.1	1.2	1.1	1.4	1.3	1.1	1.1	3.0	1.1	1.2	1.2	1.3	1.2	1.3	1.2
Chromium (Cr)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cobalt (Co)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.2	2.1	1.7	1.0	1.5	1.3
Copper (Cu)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.0	1.0	0.8	0.9	1.0	1.0	1.0	1.0	1.0	1.0
Iron (Fe)	0.6	0.5	0.3	0.5	0.6	0.6	0.3	0.5	0.3	0.5	0.8	0.8	0.4	0.6	0.9	0.8	0.8	0.9	1.0	1.0
Lead (Pb)	0.6	0.5	0.3	0.4	0.6	0.6	0.3	0.5	0.4	0.6	0.8	0.8	0.3	0.7	0.9	0.8	0.7	0.9	0.8	1.0
Lithium (Li)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Magnesium (Mg)	1.2	0.9	2.6	1.2	1.1	1.2	1.2	1.1	1.5	1.3	1.1	1.1	4.3	1.2	1.4	1.4	1.5	1.4	1.4	1.3
Manganese (Mn)	0.5	0.4	0.2	0.4	0.6	0.8	0.2	0.5	0.8	0.7	0.8	0.8	1.1	0.7	13	11	9.0	3.7	7.5	5.0
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.5	0.8	1.0	1.2	0.9	1.3	1.4	1.3	2.1	1.6	1.2
Nickel (Ni)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.1	1.4	1.5	1.5	1.4
Potassium (K)	1.0	0.9	1.2	0.9	0.9	1.0	1.1	1.0	1.1	1.1	1.0	1.0	1.6	1.0	1.0	1.0	1.0	1.2	1.1	1.0
Selenium (Se)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Silicon (Si)	0.9	0.7	0.6	0.8	0.8	0.8	0.8	0.8	0.6	0.8	1.0	1.0	0.8	0.9	1.0	0.9	0.9	0.6	1.0	0.9
Silver (Ag)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sodium (Na)	1.0	0.9	0.7	0.9	0.9	0.9	1.0	0.9	1.2	1.1	0.9	0.9	1.0	0.9	0.9	0.9	0.9	0.8	0.9	0.8
Strontium (Sr)	1.0	0.8	1.3	1.0	0.9	0.9	1.0	0.9	1.1	1.1	0.9	0.9	2.0	0.9	1.2	1.1	1.1	0.8	1.1	1.0
Thallium (Tl)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Tin (Sn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Titanium (Ti)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Uranium (U)	0.7	0.6	1.0	0.8	0.7	0.7	0.3	0.7	1.0	0.9	0.8	0.8	1.4	0.7	0.8	0.7	0.7	0.5	0.7	0.6
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

🟪 Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).
🟨 Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
🟥 Denotes highly elevated concentration (mean concentration ≥ 10 times higher than respective mean reference or baseline period value).

Table C.63: Summary of the Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentration Data Provided) Between Mary River Mine-Exposed and Reference (GO-09) Stations in 2018

Variable	Fall									
	G0-03	G0-01	FO-01	E0-10	E0-03	E0-21	E0-20	C0-10	CO-05	CO-01
Conductivity (lab)	1.0	1.1	2.4	1.5	1.3	1.4	1.4	1.4	1.3	1.2
Hardness (as $CaCO_3$)	1.0	1.1	2.4	1.4	1.2	1.4	1.3	1.4	1.3	1.2
Total Suspended Solids (TSS)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Total Dissolved Solids (TDS)	0.9	1.2	2.5	1.2	1.8	1.2	1.2	1.4	1.5	1.2
Turbidity	0.8	0.7	0.4	0.7	0.8	0.7	0.6	0.6	0.7	0.6
Alkalinity (as $CaCO_3$)	0.9	1.1	1.7	1.1	1.0	1.1	1.1	1.2	1.1	1.1
Total Ammonia	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8	0.5
Nitrate	1.0	1.0	6.5	2.5	1.1	1.7	2.4	2.2	2.1	1.3
Nitrite	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total Kjeldahl Nitrogen (TKN)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Dissolved Organic Carbon	0.8	0.8	1.3	0.8	1.2	0.8	0.9	0.9	1.0	1.0
Total Organic Carbon	0.9	0.9	1.1	0.9	1.0	0.9	1.0	1.1	1.2	1.3
Total Phosphorus	0.6	0.6	0.8	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Phenols	0.7	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.8	0.6
Bromide (Br)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Chloride (Cl)	1.9	1.9	0.9	1.9	1.9	1.9	1.8	1.8	1.7	1.7
Sulphate (SO_4)	0.9	1.0	29	10	4.8	7.4	6.9	6.9	6.2	4.2
Aluminum (Al)	1.0	1.1	0.3	1.0	1.0	1.0	1.0	0.7	0.8	0.8
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	1.0	1.1	1.6	1.3	1.2	1.2	1.3	1.3	1.2	1.1
Beryllium (Be)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cadmium (Cd)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Calcium (Ca)	1.0	1.1	2.1	1.3	1.2	1.3	1.3	1.3	1.2	1.3
Chromium (Cr)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cobalt (Co)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Copper (Cu)	1.0	1.0	0.9	1.0	1.0	1.0	1.0	1.2	1.0	1.0
Iron (Fe)	0.9	0.9	0.5	0.9	0.9	0.9	1.1	0.7	1.0	0.8
Lead (Pb)	0.9	0.7	0.5	0.7	0.8	0.8	1.0	0.6	0.7	0.6
Lithium (Li)	1.0	1.0	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Magnesium (Mg)	0.9	1.1	3.1	1.6	1.2	1.4	1.4	1.5	1.4	1.3
Manganese (Mn)	0.9	0.8	1.1	0.9	8.9	6.8	7.0	5.4	6.1	3.8
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	0.9	1.1	1.2	1.1	1.7	1.7	1.5	1.6	1.5	1.7
Nickel (Ni)	1.0	1.0	1.0	1.0	1.0	1.1	1.4	1.8	1.6	1.4
Potassium (K)	0.9	1.0	1.3	1.0	1.0	1.0	1.1	1.0	1.0	1.0
Selenium (Se)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Silicon (Si)	1.0	1.1	0.8	1.1	1.1	1.0	1.1	1.0	1.0	1.0
Silver (Ag)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sodium (Na)	0.8	1.0	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Strontium (Sr)	0.8	1.0	1.6	1.2	1.2	1.2	1.2	1.2	1.1	1.1
Thallium (Tl)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Tin (Sn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Uranium (U)	0.8	0.8	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.6
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

🟪	Denotes slight ele
🟧	Denotes moderate
🟥	Denotes highly ele

Table C.64: Dissolved Metal Concentrations at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Spring Sampling Event													Summer Sampling Event					
			G0-09-A	G0-09	G0-09-B	G0-03	G0-01	F0-01	E0-10	E0-03	E0-21	E0-20	C0-10	C0-05	C0-01	G0-09-A	G0-09	G0-09-B	G0-03	G0-01	F0-01
			1-Jul-18	1-Jul-18	1-Jul-18	1-Jul-18	30-Jun-18	30-Jun-18	1-Jul-18	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18
Dissolved Metals	Aluminum (Al)	mg/L	0.0594	0.0443	0.0344	0.0375	0.0258	0.0094	0.0366	0.0325	0.0291	0.0319	0.0320	0.0249	0.0268	0.0781	0.0535	0.0674	0.0283	0.0151	0.0056
	Antimony (Sb)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00235	0.00226	0.00241	0.00275	0.00212	0.00312	0.00275	0.00234	0.00243	0.00283	0.00259	0.00282	0.00267	0.00572	0.00607	0.00592	0.00581	0.00621	0.01310
	Beryllium (Be)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	2.27	2.37	2.96	3.18	2.51	6.10	3.25	2.90	2.98	3.13	2.87	3.70	3.46	8.60	8.69	8.60	9.04	9.19	23.90
	Chromium (Cr)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	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	<0.00050	0.00084	0.00083	0.00078	0.00081	0.0008	0.00065
	Iron (Fe)	mg/L	0.034	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.039	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	1.24	1.37	1.62	1.70	1.37	3.78	1.78	1.61	1.62	1.69	1.61	2.19	2.01	4.60	5.00	5.16	5.12	5.26	20.70
	Manganese (Mn)	mg/L	0.00117	0.00082	0.00075	0.00053	0.00046	0.00016	0.00046	0.00058	0.00048	0.00056	0.00060	0.00137	0.00100	0.00044	0.00030	0.00034	0.00020	0.00015	0.00057
	Mercury (Hg)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000053	<0.000050	<0.000050	<0.000050	<0.000050	0.000052	<0.000050	<0.000050	<0.000050	<0.000050	0.000051	0.000087	0.00008	0.000298	0.000252	0.000203	0.000171	0.000204	0.000225
	Nickel (Ni)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.34	0.33	0.36	0.35	0.30	0.41	0.33	0.33	0.33	0.33	0.34	0.41	0.38	0.87	0.86	0.86	0.78	0.80	1.35
	Selenium (Se)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.40	0.38	0.38	0.39	0.32	0.32	0.36	0.35	0.35	0.34	0.34	0.34	0.34	0.85	0.82	0.73	0.78	0.76	0.82
	Silver (Ag)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.37	0.39	0.42	0.38	0.34	0.26	0.35	0.34	0.34	0.34	0.37	0.45	0.42	1.58	1.65	1.51	1.30	1.33	1.37
	Strontium (Sr)	mg/L	0.0024	0.0023	0.0026	0.0026	0.0022	0.0033	0.0026	0.0023	0.0024	0.0025	0.0024	0.0028	0.0027	0.0098	0.0094	0.0087	0.0083	0.0082	0.0177
	Thallium (Tl)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000129	0.000115	0.000125	0.000097	0.000091	0.000161	0.000112	0.000096	0.000099	0.000103	0.000100	0.000161	0.000137	0.001430	0.001320	0.001160	0.000904	0.000856	0.001800
	Vanadium (V)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.64: Dissolved Metal Concentrations at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Summer Sampling Event							Fall Sampling Event												
			E0-10	**E0-03**	**E0-21**	**E0-20**	**C0-10**	**C0-05**	**C0-01**	**G0-09-A**	**G0-09**	**G0-09-B**	**G0-03**	**GO-01**	**FO-01**	**EO-10**	**EO-03**	**EO-21**	**EO-20**	**C0-10**	**C0-05**	**CO-01**
			12-Aug-18	**12-Aug-18**	**12-Aug-18**	**12-Aug-18**	**12-Aug-18**	**12-Aug-18**	**10-Aug-18**	**27-Aug-18**	**25-Aug-18**	**25-Aug-18**	**25-Aug-18**	**27-Aug-18**	**25-Aug-18**	**27-Aug-18**	**26-Aug-18**	**27-Aug-18**	**27-Aug-18**	**27-Aug-18**	**27-Aug-18**	**27-Aug-18**
Dissolved Metals	Aluminum (Al)	mg/L	0.0507	0.0504	0.0325	0.0308	0.0177	0.0519	0.0437	0.0242	0.0376	0.0075	0.0067	0.0281	0.0053	0.0229	0.0223	0.0235	0.0044	0.0203	0.0138	0.0246
	Antimony (Sb)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00639	0.00653	0.00687	0.00666	0.00596	0.00676	0.00604	0.00789	0.00702	0.00737	0.00743	0.00884	0.01350	0.00975	0.00888	0.00963	0.00893	0.00964	0.00925	0.00864
	Beryllium (Be)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	9.52	10.50	10.20	10.40	10.60	10.50	9.51	14.40	12.20	11.90	12.50	14.30	25.40	16.90	14.90	16.90	16.20	16.40	16.50	14.30
	Chromium (Cr)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	0.00017	0.00015	0.00012	<0.00010	0.00011	<0.00010	<0.00010	<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 (Cu)	mg/L	0.00079	0.00076	0.00077	0.00083	0.00077	0.0009	0.00079	0.00068	0.00073	0.00074	0.00070	0.00079	0.00067	0.00073	0.00077	0.00077	0.00072	0.00079	0.00119	0.00083
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.034	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	5.99	6.49	6.35	6.65	6.93	6.85	6.27	7.19	5.83	6.26	6.13	7.06	19.40	10.00	8.47	9.16	9.40	9.75	9.02	8.40
	Manganese (Mn)	mg/L	0.00026	0.01880	0.01680	0.01340	0.00127	0.01030	0.00588	0.00012	0.00020	0.00010	0.00010	0.00015	0.00023	0.00016	0.00847	0.00630	0.00505	0.00477	0.00494	0.00299
	Mercury (Hg)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000184	0.000270	0.000280	0.000267	0.000460	0.000320	0.000234	0.000280	0.000351	0.000297	0.000250	0.000283	0.000294	0.000287	0.000424	0.000435	0.000432	0.000443	0.000456	0.000376
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	0.00061	<0.00050	0.00065	0.00053	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00053	0.00061	0.00068	0.00062
	Potassium (K)	mg/L	0.81	0.82	0.82	0.84	0.99	0.89	0.82	0.86	0.90	0.91	0.82	0.89	1.24	0.92	0.93	0.95	0.94	0.96	0.94	0.98
	Selenium (Se)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.83	0.84	0.77	0.83	0.52	0.88	0.87	0.70	0.70	0.66	0.67	0.78	0.63	0.72	0.74	0.73	0.73	0.77	0.75	0.75
	Silver (Ag)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.29	1.23	1.31	1.30	1.24	1.32	1.18	1.97	2.00	2.06	1.74	1.79	1.44	1.79	1.82	1.83	1.70	1.78	1.70	1.64
	Strontium (Sr)	mg/L	0.0086	0.0110	0.0105	0.0100	0.0078	0.0098	0.0090	0.0131	0.0125	0.0123	0.0108	0.0129	0.0195	0.0146	0.0158	0.0162	0.0150	0.0154	0.0153	0.0145
	Thallium (Tl)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	0.00018	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000939	0.000915	0.000886	0.000844	0.000637	0.000813	0.000698	0.002650	0.002390	0.002380	0.001960	0.002050	0.002280	0.002210	0.002040	0.002140	0.002030	0.001890	0.001700	0.001720
	Vanadium (V)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.65: Summary of the Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Mary River Mine-Exposed and Reference (GO-09) Stations in 2018

Variable	Spring										Summer										Fall									
	G0-03	G0-01	FO-01	E0-10	E0-03	E0-21	E0-20	C0-10	CO-05	CO-01	G0-03	G0-01	FO-01	E0-10	E0-03	E0-21	E0-20	C0-10	CO-05	CO-01	G0-03	G0-01	FO-01	E0-10	E0-03	E0-21	E0-20	C0-10	CO-05	CO-01
Aluminum (Al)	0.8	0.6	0.2	0.8	0.7	0.6	0.7	0.7	0.5	0.6	0.4	0.2	0.1	0.8	0.8	0.5	0.5	0.3	0.8	0.7	0.3	1.2	0.2	1.0	1.0	1.0	0.2	0.9	0.6	1.1
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	1.2	0.9	1.3	1.2	1.0	1.0	1.2	1.1	1.2	1.1	1.0	1.1	2.2	1.1	1.1	1.2	1.1	1.0	1.1	1.0	1.0	1.2	1.8	1.3	1.2	1.3	1.2	1.3	1.2	1.2
Beryllium (Be)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cadmium (Cd)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Calcium (Ca)	1.3	1.0	2.4	1.3	1.1	1.2	1.2	1.1	1.5	1.4	1.0	1.1	2.8	1.1	1.2	1.2	1.2	1.2	1.2	1.1	1.0	1.1	2.0	1.3	1.2	1.3	1.3	1.3	1.3	1.1
Chromium (Cr)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cobalt (Co)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.5	1.2	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Copper (Cu)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	1.0	0.9	0.9	1.0	0.9	1.1	1.0	1.0	1.1	0.9	1.0	1.1	1.1	1.0	1.1	1.7	1.2
Iron (Fe)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lead (Pb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lithium (Li)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Magnesium (Mg)	1.2	1.0	2.7	1.3	1.1	1.1	1.2	1.1	1.6	1.4	1.0	1.1	4.2	1.2	1.3	1.3	1.4	1.4	1.4	1.3	1.0	1.1	3.0	1.6	1.3	1.4	1.5	1.5	1.4	1.3
Manganese (Mn)	0.6	0.5	0.2	0.5	0.6	0.5	0.6	0.7	1.5	1.1	0.5	0.4	1.6	0.7	53	47	38	3.6	29	17	0.7	1.1	1.6	1.1	61	45	36	34	36	22
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.6	0.7	0.8	0.9	0.7	1.1	1.1	1.1	1.8	1.3	0.9	0.8	0.9	1.0	0.9	1.4	1.4	1.4	1.4	1.5	1.2
Nickel (Ni)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.0	1.3	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.2	1.4	1.2
Potassium (K)	1.0	0.9	1.2	1.0	1.0	1.0	1.0	1.0	1.2	1.1	0.9	0.9	1.6	0.9	0.9	0.9	1.0	1.1	1.0	0.9	0.9	1.0	1.4	1.0	1.0	1.1	1.1	1.1	1.1	1.1
Selenium (Se)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Silicon (Si)	1.0	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.0	1.0	0.7	1.1	1.1	1.0	1.1	0.9	1.0	1.1	1.1	1.1	1.1	1.1	1.1
Silver (Ag)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sodium (Na)	1.0	0.9	0.7	0.9	0.9	0.9	0.9	0.9	1.2	1.1	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.9	0.9	0.7	0.9	0.9	0.9	0.8	0.9	0.8	0.8
Strontium (Sr)	1.1	0.9	1.4	1.1	1.0	1.0	1.0	1.0	1.2	1.1	0.9	0.9	1.9	0.9	1.2	1.1	1.1	0.8	1.1	1.0	0.9	1.0	1.5	1.2	1.3	1.3	1.2	1.2	1.2	1.1
Thallium (Tl)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Tin (Sn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.8	1.0	1.0	1.0	1.0	1.0	1.0
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Uranium (U)	0.8	0.7	1.3	0.9	0.8	0.8	0.8	0.8	1.3	1.1	0.7	0.7	1.4	0.7	0.7	0.7	0.6	0.5	0.6	0.5	0.8	0.8	0.9	0.9	0.8	0.9	0.8	0.8	0.7	0.7
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

🟪	Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).
🟧	Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
🟥	Denotes highly elevated concentration (mean concentration ≥ 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.66: **Spearman's Rank Correlation Coefficients for Mary River Water Quality Data Collected in Spring, Summer, and Fall 2018**[a]

Parameters	Conventional Parameters										Total Metals										
	Conduct-ivity	Hardness	Total Suspended Solids	Total Dissolved Solids	Turbidity	Alkalinity	Dissolved Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Iron	Manganese	Molybdenum	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	1	0.992	-0.096	0.969	-0.102	0.986	-0.056	-0.430	0.867	0.928	0.043	0.957	0.523	-0.038	0.132	0.764	0.921	0.854	0.804	0.963	0.882
Hardness	0.992	1	-0.071	0.967	-0.108	0.985	-0.039	-0.429	0.854	0.922	0.021	0.952	0.527	-0.053	0.137	0.773	0.923	0.843	0.795	0.958	0.864
Total Suspended Solids	-0.096	-0.071	1	-0.072	0.174	-0.121	0.188	0.510	-0.093	-0.092	0.258	-0.030	-0.115	0.100	0.327	-0.138	-0.021	-0.135	-0.111	-0.078	-0.213
Total Dissolved Solids	0.969	0.967	-0.072	1	-0.030	0.967	-0.044	-0.424	0.847	0.902	0.086	0.936	0.498	-0.019	0.136	0.724	0.908	0.847	0.785	0.949	0.870
Turbidity	-0.102	-0.108	0.174	-0.030	1	-0.108	-0.171	0.258	0.109	0.049	0.714	0.052	0.357	0.744	0.353	-0.070	0.145	0.164	0.140	-0.011	0.030
Alkalinity	0.986	0.985	-0.121	0.967	-0.108	1	-0.044	-0.429	0.861	0.906	0.058	0.950	0.534	-0.010	0.120	0.777	0.920	0.859	0.802	0.956	0.888
Dissolved Organic Carbon	-0.056	-0.039	0.188	-0.044	-0.171	-0.044	1	0.127	0.009	-0.086	0.106	0.015	0.044	-0.031	0.052	0.170	0.043	0.114	0.072	-0.082	-0.033
Total Phosphorus	-0.430	-0.429	0.510	-0.424	0.258	-0.429	0.127	1	-0.261	-0.389	0.426	-0.326	0.061	0.443	0.451	-0.244	-0.255	-0.259	-0.247	-0.336	-0.352
Chloride	0.867	0.854	-0.093	0.847	0.109	0.861	0.009	-0.261	1	0.816	0.343	0.889	0.704	0.209	0.139	0.728	0.909	0.918	0.952	0.889	0.948
Sulphate	0.928	0.922	-0.092	0.902	0.049	0.906	-0.086	-0.389	0.816	1	0.095	0.941	0.551	0.068	0.307	0.783	0.898	0.792	0.734	0.927	0.773
Aluminum (total)	0.043	0.021	0.258	0.086	0.714	0.058	0.106	0.426	0.343	0.095	1	0.215	0.476	0.857	0.368	0.070	0.319	0.427	0.364	0.139	0.267
Barium (total)	0.957	0.952	-0.030	0.936	0.052	0.950	0.015	-0.326	0.889	0.941	0.215	1	0.644	0.138	0.279	0.810	0.968	0.890	0.853	0.968	0.858
Copper (total)	0.523	0.527	-0.115	0.498	0.357	0.534	0.044	0.061	0.704	0.551	0.476	0.644	1	0.622	0.544	0.769	0.694	0.697	0.725	0.624	0.605
Iron (total)	-0.038	-0.053	0.100	-0.019	0.744	-0.010	-0.031	0.443	0.209	0.068	0.857	0.138	0.622	1	0.540	0.199	0.216	0.297	0.209	0.080	0.136
Manganese (total)	0.132	0.137	0.327	0.136	0.353	0.120	0.052	0.451	0.139	0.307	0.368	0.279	0.544	0.540	1	0.444	0.258	0.161	0.130	0.265	-0.012
Molybdenum (total)	0.764	0.773	-0.138	0.724	-0.070	0.777	0.170	-0.244	0.728	0.783	0.070	0.810	0.769	0.199	0.444	1	0.781	0.735	0.714	0.825	0.672
Potassium (total)	0.921	0.923	-0.021	0.908	0.145	0.920	0.043	-0.255	0.909	0.898	0.319	0.968	0.694	0.216	0.258	0.781	1	0.922	0.877	0.937	0.869
Silicon (total)	0.854	0.843	-0.135	0.847	0.164	0.859	0.114	-0.259	0.918	0.792	0.427	0.890	0.697	0.297	0.161	0.735	0.922	1	0.905	0.874	0.899
Sodium (total)	0.804	0.795	-0.111	0.785	0.140	0.802	0.072	-0.247	0.952	0.734	0.364	0.853	0.725	0.209	0.130	0.714	0.877	0.905	1	0.835	0.920
Strontium (total)	0.963	0.958	-0.078	0.949	-0.011	0.956	-0.082	-0.336	0.889	0.927	0.139	0.968	0.624	0.080	0.265	0.825	0.937	0.874	0.835	1	0.869
Uranium (total)	0.882	0.864	-0.213	0.870	0.030	0.888	-0.033	-0.352	0.948	0.773	0.267	0.858	0.605	0.136	-0.012	0.672	0.869	0.899	0.920	0.869	1
Aluminum (dissolved)	-0.414	-0.413	-0.152	-0.364	0.363	-0.400	0.020	0.027	-0.146	-0.253	0.239	-0.308	0.119	0.279	0.179	-0.111	-0.247	-0.148	-0.087	-0.332	-0.272
Barium (dissolved)	0.978	0.979	-0.110	0.941	-0.115	0.970	-0.013	-0.419	0.869	0.923	0.032	0.954	0.601	-0.006	0.179	0.835	0.925	0.855	0.809	0.956	0.853
Copper (dissolved)	0.786	0.788	-0.207	0.723	0.049	0.774	-0.091	-0.411	0.737	0.803	0.019	0.814	0.569	0.039	0.127	0.694	0.781	0.694	0.737	0.758	0.692
Manganese (dissolved)	0.248	0.268	0.242	0.202	-0.010	0.221	0.002	0.090	0.103	0.415	-0.063	0.318	0.227	0.059	0.690	0.406	0.211	0.105	0.047	0.300	-0.060
Molybdenum (dissolved)	0.845	0.843	-0.107	0.825	0.103	0.821	-0.091	-0.316	0.805	0.923	0.128	0.882	0.656	0.111	0.427	0.818	0.852	0.773	0.783	0.895	0.723
Potassium (dissolved)	0.935	0.940	-0.055	0.909	-0.004	0.930	0.012	-0.346	0.883	0.908	0.176	0.964	0.638	0.082	0.210	0.794	0.959	0.880	0.846	0.939	0.825
Silicon (dissolved)	0.916	0.916	-0.162	0.901	-0.098	0.925	0.105	-0.402	0.857	0.814	0.120	0.895	0.615	0.029	0.098	0.780	0.892	0.910	0.834	0.903	0.847
Sodium (dissolved)	0.771	0.770	-0.111	0.769	0.203	0.770	0.071	-0.237	0.937	0.716	0.375	0.817	0.721	0.231	0.123	0.698	0.844	0.884	0.968	0.811	0.902
Strontium (dissolved)	0.972	0.970	-0.067	0.948	-0.034	0.967	-0.095	-0.363	0.890	0.941	0.128	0.965	0.598	0.054	0.245	0.804	0.939	0.869	0.840	0.978	0.876
Uranium (dissolved)	0.897	0.883	-0.215	0.888	-0.014	0.905	-0.043	-0.389	0.947	0.805	0.227	0.874	0.598	0.093	0.016	0.695	0.882	0.887	0.913	0.890	0.987

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

🟩 Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

🟦 Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

Table C.66: Spearman's Rank Correlation Coefficients for Mary River Water Quality Data Collected in Spring, Summer, and Fall 2018[a]

Parameters	Dissolved Metals									
	Aluminum	Barium	Copper	Manganese	Molybdenum	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	-0.414	0.978	0.786	0.248	0.845	0.935	0.916	0.771	0.972	0.897
Hardness	-0.413	0.979	0.788	0.268	0.843	0.940	0.916	0.770	0.970	0.883
Total Suspended Solids	-0.152	-0.110	-0.207	0.242	-0.107	-0.055	-0.162	-0.111	-0.067	-0.215
Total Dissolved Solids	-0.364	0.941	0.723	0.202	0.825	0.909	0.901	0.769	0.948	0.888
Turbidity	0.363	-0.115	0.049	-0.010	0.103	-0.004	-0.098	0.203	-0.034	-0.014
Alkalinity	-0.400	0.970	0.774	0.221	0.821	0.930	0.925	0.770	0.967	0.905
Dissolved Organic Carbon	0.020	-0.013	-0.091	0.002	-0.091	0.012	0.105	0.071	-0.095	-0.043
Total Phosphorus	0.027	-0.419	-0.411	0.090	-0.316	-0.346	-0.402	-0.237	-0.363	-0.389
Chloride	-0.146	0.869	0.737	0.103	0.805	0.883	0.857	0.937	0.890	0.947
Sulphate	-0.253	0.923	0.803	0.415	0.923	0.908	0.814	0.716	0.941	0.805
Aluminum (total)	0.239	0.032	0.019	-0.063	0.128	0.176	0.120	0.375	0.128	0.227
Barium (total)	-0.308	0.954	0.814	0.318	0.882	0.964	0.895	0.817	0.965	0.874
Copper (total)	0.119	0.601	0.569	0.227	0.656	0.638	0.615	0.721	0.598	0.598
Iron (total)	0.279	-0.006	0.039	0.059	0.111	0.082	0.029	0.231	0.054	0.093
Manganese (total)	0.179	0.179	0.127	0.690	0.427	0.210	0.098	0.123	0.245	0.016
Molybdenum (total)	-0.111	0.835	0.694	0.406	0.818	0.794	0.780	0.698	0.804	0.695
Potassium (total)	-0.247	0.925	0.781	0.211	0.852	0.959	0.892	0.844	0.939	0.882
Silicon (total)	-0.148	0.855	0.694	0.105	0.773	0.880	0.910	0.884	0.869	0.887
Sodium (total)	-0.087	0.809	0.737	0.047	0.783	0.846	0.834	0.968	0.840	0.913
Strontium (total)	-0.332	0.956	0.758	0.300	0.895	0.939	0.903	0.811	0.978	0.890
Uranium (total)	-0.272	0.853	0.692	-0.060	0.723	0.825	0.847	0.902	0.876	0.987
Aluminum (dissolved)	1	-0.330	-0.116	0.072	-0.063	-0.247	-0.329	-0.060	-0.304	-0.252
Barium (dissolved)	-0.330	1	0.808	0.302	0.867	0.955	0.924	0.783	0.969	0.873
Copper (dissolved)	-0.116	0.808	1	0.328	0.799	0.843	0.716	0.729	0.786	0.691
Manganese (dissolved)	0.072	0.302	0.328	1	0.494	0.300	0.160	0.067	0.309	-0.027
Molybdenum (dissolved)	-0.063	0.867	0.799	0.494	1	0.870	0.776	0.777	0.907	0.761
Potassium (dissolved)	-0.247	0.955	0.843	0.300	0.870	1	0.916	0.821	0.947	0.840
Silicon (dissolved)	-0.329	0.924	0.716	0.160	0.776	0.916	1	0.810	0.898	0.852
Sodium (dissolved)	-0.060	0.783	0.729	0.067	0.777	0.821	0.810	1	0.811	0.881
Strontium (dissolved)	-0.304	0.969	0.786	0.309	0.907	0.947	0.898	0.811	1	0.900
Uranium (dissolved)	-0.252	0.873	0.691	-0.027	0.761	0.840	0.852	0.881	0.900	1

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

🟩 Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

🟦 Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

Table C.67: *In Situ* Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Winter, Mary River Project CREMP, 2018

Depth (m)	Temperature (°C)										Dissolved Oxygen (mg/L)										Dissolved Oxygen (% Saturation)				
	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05
Date Collected	14-Apr-18	14-Apr-18	14-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	16-Apr-18	18-Apr-18	15-Apr-18	14-Apr-18	14-Apr-18	14-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	16-Apr-18	18-Apr-18	15-Apr-18	14-Apr-18	14-Apr-18	14-Apr-18	15-Apr-18	15-Apr-18
1.0	0.3	0.4	0.1	0.3	0.2	1.0	0.1	1.5	0.8	0.8	14.5	14.8	14.8	15.5	15.6	15.7	15.5	15.4	15.1	16.0	100.0	102.3	101.2	106.5	107.1
2.0	0.6	0.4	0.4	0.3	0.4	0.4	0.3	0.5	0.5	0.3	14.4	14.9	14.6	15.4	15.2	16.0	15.0	15.5	15.0	16.1	99.9	102.9	101.1	106.1	105.5
3.0	0.8	0.8	0.8	0.3	0.5	0.4	0.4	0.5	0.5	0.4	14.2	14.7	14.4	15.2	15.0	16.0	14.7	15.0	14.8	15.9	99.7	102.6	101.0	105.3	104.3
4.0	1.1	1.0	1.0	0.5	0.6	0.5	0.5	0.6	0.6	0.5	14.0	14.5	13.0	15.0	14.7	16.2	14.5	14.8	14.7	15.7	98.8	102.2	91.6	104.3	102.4
5.0	1.2	1.1		0.6	0.7	0.5	0.6	0.6	0.6	0.5	13.8	14.4		14.9	14.5	16.5	14.3	14.6	14.6	15.8	97.9	101.9		103.3	100.9
6.0	1.3	1.2		0.6	0.7	0.8	0.6	0.7	0.7	0.5	13.7	14.2		14.7	14.4	15.6	14.2	14.4	14.4	15.9	96.9	100.6		102.7	100.7
7.0	1.3	1.3		0.7	0.7	0.9	0.6	0.7	0.7	0.6	13.1	14.0		14.7	14.5	14.8	14.1	14.3	14.4	15.8	93.0	99.7		102.2	101.1
8.0	1.4	1.4		0.7	0.8		0.7	0.8	0.7	0.6	12.6	13.7		14.5	14.4		14.0	14.1	14.2	15.6	90.0	97.6		101.4	100.4
9.0	1.5	1.4		0.8	0.8		0.7	0.8	0.8		11.4	13.7		14.4	14.2		13.9	14.0	14.2		81.3	97.3		100.8	99.3
10.0	1.6			0.8	0.8		0.7	0.8	0.8		8.4			14.3	14.0		13.8	13.8	14.0		60.0			100.0	99.1
11.0	1.7			0.8	0.9		0.8	0.9	0.8		5.0			14.0	13.9		13.7	13.7	13.8		36.0			98.3	97.8
12.0	1.8				0.9		0.8	0.9	0.9		3.1				13.8		13.5	13.6	13.7		22.1				96.8
13.0	1.9				0.9		0.8	0.9	0.9		0.7				13.6		13.4	13.5	13.5		5.4				95.6
14.0	1.9				1.0		0.9	0.9	1.0		0.0				13.3		13.3	13.5	13.4		0.1				93.7
15.0	2.0				1.0		0.9	1.0	1.0		0.0				13.2		13.2	13.4	13.3		-0.1				92.9
16.0					1.0		0.9	1.0	1.0						13.1		13.1	13.2	13.1						92.1
17.0					1.1		0.9	1.0	1.1						12.9		12.9	13.0	12.8						91.3
18.0					1.1			1.0	1.1						12.7			12.9	12.7						90.0
19.0					1.1			1.1	1.1						11.5			12.9	12.6						82.8
20.0								1.1	1.2									12.8	12.4						
21.0								1.1	1.2									12.6	12.2						
22.0									1.3										11.9						
23.0									1.3										11.5						
24.0									1.4										11.2						
25.0									1.5										10.8						
26.0									1.6										10.4						
27.0									1.6										9.9						
28.0									1.8										9.3						
29.0									1.8										9.2						
30.0																									

Notes: Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 15.5, 9.4, 5, 11.6, 20.7, 7.2, 17.5, 20.9, 29.4, and 8.9 m, respectively, at the time of winter sampling. Ice thickness at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 1.9, 1.6, 2.1, 1.8, 1.9, 1.7, 1.9, 1.7, 1.7, and 2 m, respectively, at the time of winter sampling. Deepest measurement at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 15, 9, 4, 11, 19, 7, 17, 21, 29, and 8 m, respectively, at the time of winter sampling.

Table C.67: *In Situ* Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Winter, Mary River Project CREMP, 2018

Depth (m)	Dissolved Oxygen (% Saturation)					pH (pH units)										Specific Conductance (µS/cm)									
	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06
Date Collected	15-Apr-18	15-Apr-18	16-Apr-18	18-Apr-18	15-Apr-18	14-Apr-18	14-Apr-18	14-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	16-Apr-18	18-Apr-18	15-Apr-18	14-Apr-18	14-Apr-18	14-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	16-Apr-18	18-Apr-18	15-Apr-18
1.0	111.3	106.1	109.7	106.1	111.5	7.82	7.84	7.74	7.81	8.02	7.87	7.83	8.03	8.12	7.92	228	234	234	88	88	92	89	90	88	91
2.0	111.2	103.5	108.7	104.1	111.3	7.79	7.81	7.73	7.77	7.87	7.83	7.77	7.91	7.99	7.88	223	230	229	86	85	90	84	86	85	91
3.0	110.5	101.9	104.4	102.8	110.1	7.78	7.80	7.73	7.75	7.82	7.80	7.74	7.86	7.95	7.86	221	227	226	85	85	89	83	85	83	89
4.0	112.5	100.4	102.9	101.9	108.6	7.77	7.80	7.70	7.73	7.74	7.78	7.72	7.87	7.92	7.83	218	225	227	85	84	91	82	83	83	88
5.0	114.2	99.4	101.6	101.3	109.9	7.76	7.79		7.73	7.66	7.76	7.71	7.81	7.90	7.79	218	224		84	82	93	81	82	82	90
6.0	109.2	98.9	100.7	100.6	110.4	7.75	7.79		7.72	7.66	7.63	7.70	7.79	7.88	7.76	217	222		83	82	103	81	82	82	92
7.0	104.8	98.4	99.6	99.8	109.8	7.72	7.76		7.71	7.65	7.53	7.68	7.77	7.86	7.72	217	221		83	83	105	80	81	81	92
8.0		97.4	98.8	99.4	108.7	7.69	7.77		7.70	7.65		7.68	7.75	7.84	7.69	216	220		82	82		80	80	81	94
9.0		96.9	98.0	98.9		7.63	7.76		7.70	7.65		7.67	7.72	7.81		215	220		82	81		79	79	80	
10.0		96.3	96.9	97.8		7.50			7.69	7.65		7.67	7.73	7.80		215			82	80		79	79	80	
11.0		95.5	96.3	96.9		7.35			7.66	7.64		7.66	7.71	7.78		216			85	81		79	78	79	
12.0		94.7	95.6	96.2		7.27				7.64		7.65	7.70	7.76		219				80		78	78	78	
13.0		94.1	95.1	94.6		7.20				7.64		7.64	7.69	7.75		226				79		78	78	78	
14.0		93.5	94.7	94.3		7.12				7.63		7.63	7.69	7.74		236				78		78	78	77	
15.0		92.8	94.1	93.4		7.10				7.63		7.62	7.68	7.73		245				77		77	77	77	
16.0		91.7	92.8	92.5						7.61		7.61	7.66	7.71						78		77	77	77	
17.0		90.8	91.5	90.3						7.60		7.59	7.64	7.69						78		77	77	77	
18.0			91.1	89.6						7.58			7.63	7.66						79			77	77	
19.0			90.9	89.1						7.51			7.60	7.65						93			77	77	
20.0			90.6	88.0									7.59	7.62									78	77	
21.0			89.2	86.4									7.56	7.59									80	77	
22.0				85.0										7.57										77	
23.0				82.0										7.55										77	
24.0				80.1										7.52										79	
25.0				77.1										7.48										80	
26.0				74.3										7.44										80	
27.0				71.2										7.39										80	
28.0				66.8										7.34										81	
29.0				66.2										7.29										81	
30.0																									

Notes: Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 15.5, 9.4, 5, 11.6, 20.7, 7.2, 17.5, 20.9, 29.4, and 8.9 m, respectively, at the time of winter sampling. Ice thickness at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 1.9, 1.6, 2.1, 1.8, 1.9, 1.7, 1.9, 1.7, 1.7, and 2 m, respectively, at the time of winter sampling. Deepest measurement at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 15, 9, 4, 11, 19, 7, 17, 21, 29, and 8 m, respectively, at the time of winter sampling.

Table C.68: *In Situ* Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2018

Depth (m)	Temperature (°C)										Dissolved Oxygen (mg/L)										Dissolved Oxygen (% Saturation)				
	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05
Date Collected	3-Aug-18	3-Aug-18	3-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	3-Aug-18	3-Aug-18	3-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	3-Aug-18	3-Aug-18	3-Aug-18	2-Aug-18	2-Aug-18
1.0	7.0	7.1	7.3	6.8	7.0	6.2	6.9	6.4	6.5	6.1	12.1	12.1	12.0	12.1	12.1	12.3	12.3	12.2	12.2	12.1	99.8	100.0	100.0	99.2	99.2
2.0	6.9	7.1	6.8	6.7	6.9	6.2	6.4	6.4	6.1	6.1	12.1	12.1	12.0	12.1	12.1	12.3	12.3	12.2	12.2	12.3	99.4	99.7	99.5	99.2	99.1
3.0	6.6	6.7	6.8	6.7	6.8	6.0	6.5	6.2	5.9	5.9	12.2	12.2	12.2	12.2	12.1	12.4	12.3	12.3	12.3	12.4	99.2	99.6	99.6	99.4	99.1
4.0	6.4	6.5	6.8	6.6	6.6	5.8	6.4	6.2	5.9	5.9	12.2	12.2	12.2	12.2	12.1	12.3	12.3	12.3	12.3	12.3	98.9	99.5	99.3	99.3	98.6
5.0	6.2	6.2		6.5	6.3	5.7	6.3	6.2	5.9	5.8	12.3	12.3		12.2	12.2	12.3	12.3	12.3	12.4	12.3	99.0	99.3		99.0	98.4
6.0	6.1	6.0		6.3	6.1	5.6	6.1	6.2	5.8	5.7	12.3	12.3		12.2	12.2	12.3	12.3	12.3	12.3	12.3	98.6	99.1		98.5	98.2
7.0	6.0	5.9		6.2	6.0		6.1	6.2	5.8	5.5	12.3	12.3		12.1	12.2		12.3	12.3	12.4	12.3	98.4	98.7		97.6	98.0
8.0	5.7	5.7		6.1	5.9		6.0	6.1	5.8		12.3	12.4		12.1	12.2		12.3	12.3	12.4		98.2	98.7		97.6	97.9
9.0	5.5	5.6		6.1	5.8		5.7	6.1	5.7		12.4	12.4		12.1	12.2		12.2	12.3	12.3		98.5	98.7		97.1	98.0
10.0	5.4				5.8		5.6	6.0	5.6		12.4				12.2		12.2	12.2	12.3		98.4				97.8
11.0	5.4				5.7		5.6	5.7	5.4		12.4				12.3		12.2	12.3	12.3		98.3				97.9
12.0	5.4				5.8		5.6	5.6	5.3		12.4				12.2		12.2	12.3	12.3		98.1				97.3
13.0	5.4				5.6		5.6	5.6	5.3		12.4				12.2		12.2	12.2	12.3		97.9				96.8
14.0	5.4				5.5		5.6	5.6	5.3		12.4				12.2		12.2	12.2	12.3		97.7				96.6
15.0	5.3				5.4		5.6	5.6	5.3		12.3				12.2		12.2	12.2	12.3		97.2				96.5
16.0					5.4		5.6	5.6	5.3						12.2		12.2	12.2	12.3						96.3
17.0					5.4		5.6	5.6	5.3						12.2		12.2	12.2	12.2						96.2
18.0					5.4		5.6	5.6	5.3						12.2		12.1	12.2	12.2						96.2
19.0					5.4			5.6	5.3						12.2			12.2	12.2						96.2
20.0									5.3										12.2						
21.0									5.3										12.2						
22.0									5.3										12.2						
23.0									5.3										12.2						
24.0									5.3										12.2						
25.0									5.3										12.2						
26.0									5.3										12.2						
27.0									5.3										12.2						
28.0									5.3										12.1						
29.0									5.3										12.1						
30.0																									

Notes: Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 15.3, 10.7, 5.3, 11.3, 21.5, 7.8, 19.2, 21.7, 30.4, and 8.0 m, respectively, at the time of summer sampling.

Table C.68: ***In Situ*** **Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2018**

Depth (m)	Dissolved Oxygen (% Saturation)					pH (pH units)										Specific Conductance (µS/cm)									
	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06
Date Collected	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	3-Aug-18	3-Aug-18	3-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	3-Aug-18	3-Aug-18	3-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18
1.0	99.3	100.5	98.6	98.2	97.4	8.02	7.89	7.85	7.67	7.77	7.73	7.77	7.71	7.90	8.15	108	109	108	66	74	50	50	54	53	53
2.0	99.3	100.2	99.2	98.5	98.9	8.02	7.81	7.89	7.68	7.78	7.72	7.77	7.69	7.88	8.08	107	109	108	65	73	50	50	54	51	50
3.0	99.0	100.2	99.2	97.9	98.8	8.02	7.83	7.92	7.69	7.79	7.73	7.76	7.69	7.82	7.88	109	109	109	63	73	50	49	54	51	50
4.0	98.4	100.0	99.2	98.9	98.1	8.02	7.95	7.94	7.71	7.81	7.72	7.76	7.69	7.81	7.74	109	109	107	62	70	51	50	54	51	50
5.0	98.2	99.4	99.2	98.8	98.5	8.02	7.95		7.71	7.82	7.73	7.75	7.69	7.81	7.72	109	110		63	66	51	49	54	51	50
6.0	97.9	98.1	99.2	98.7	98.3	8.02	7.96		7.70	7.82	7.73	7.75	7.69	7.80	7.70	109	110		66	64	51	49	54	51	50
7.0		98.1	99.1	98.7	97.5	8.03	7.97		7.71	7.84		7.75	7.69	7.80	7.68	109	110		64	60		49	54	51	51
8.0		98.5	99.0	98.6		8.04	7.97		7.71	7.84		7.74	7.69	7.79		101	110		66	59		49	55	51	
9.0		97.3	98.8	98.4		8.03	7.97		7.72	7.83		7.73	7.69	7.76		102	110		66	59		49	54	51	
10.0		97.1	98.3	98.0		8.03				7.83		7.73	7.71	7.74		102				59		49	54	51	
11.0		97.0	97.7	97.2		8.02				7.81		7.73	7.70	7.72		104				61		49	54	51	
12.0		96.9	97.7	97.1		8.01				7.81		7.71	7.69	7.65		105				62		49	54	51	
13.0		96.8	97.3	96.9		8.01				7.81		7.71	7.68	7.64		106				58		49	56	52	
14.0		96.8	97.3	96.8		8.00				7.81		7.70	7.68	7.63		109				57		49	56	52	
15.0		96.7	97.3	96.7		7.99				7.80		7.70	7.68	7.62		109				57		49	56	52	
16.0		96.7	97.2	96.7						7.78		7.69	7.68	7.62						57		49	56	52	
17.0		96.6	97.2	96.6						7.76		7.68	7.67	7.61						57		49	58	52	
18.0		96.5	97.3	96.4						7.76		7.68	7.67	7.61						57		49	59	52	
19.0			97.2	96.4						7.75			7.66	7.61						58			60	50	
20.0				96.4										7.60										50	
21.0				96.3										7.59										52	
22.0				96.2										7.59										52	
23.0				96.2										7.58										53	
24.0				96.1										7.58										52	
25.0				96.1										7.58										54	
26.0				96.0										7.57										54	
27.0				96.0										7.56										56	
28.0				95.9										7.56										57	
29.0				95.8										7.57										57	
30.0																									

Notes: Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 15.3, 10.7, 5.3, 11.3, 21.5, 7.8, 19.2, 21.7, 30.4, and 8.0 m, respectively, at the time of summer sampling.

Table C.69: *In Situ* Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2018

Depth (m)	Temperature (°C)											Dissolved Oxygen (mg/L)											Dissolved Oxygen (% Saturation)				
	BLO-01-A	**BLO-01**	**BLO-01-B**	**BLO-05-A**	**BLO-05**	**BLO-05-B**	**BLO-03**	**BLO-04**	**BLO-09**	**BLO-09**	**BLO-06**	**BLO-01-A**	**BLO-01**	**BLO-01-B**	**BLO-05-A**	**BLO-05**	**BLO-05-B**	**BLO-03**	**BLO-04**	**BLO-09**	**BLO-09**	**BLO-06**	**BLO-01-A**	**BLO-01**	**BLO-01-B**	**BLO-05-A**	**BLO-05**
Date Collected	**26-Aug-18**	**26-Aug-18**	**26-Aug-18**	**25-Aug-18**	**24-Aug-18**	**24-Aug-18**	**25-Aug-18**	**25-Aug-18**	**25-Aug-18**	**20-Aug-18**	**25-Aug-18**	**26-Aug-18**	**26-Aug-18**	**26-Aug-18**	**25-Aug-18**	**24-Aug-18**	**24-Aug-18**	**25-Aug-18**	**25-Aug-18**	**25-Aug-18**	**20-Aug-18**	**25-Aug-18**	**26-Aug-18**	**26-Aug-18**	**26-Aug-18**	**25-Aug-18**	**24-Aug-18**
surface										6.90											11.69						
1.0	6.6	6.8	6.9	7.1	7.0	7.1	7.3	7.2	7.3	6.9	7.0	11.95	11.96	11.68	11.83	11.89	11.92	11.75	11.86	11.83	11.70	11.87	97.6	98.0	95.9	97.7	98.0
2.0	6.6	6.8	6.9	7.1	7.0	7.1	7.2	7.2	7.1	6.9	7.0	11.96	11.95	11.89	11.86	11.40	11.94	11.80	11.87	11.90	11.72	11.87	97.6	97.9	97.6	98.0	98.1
3.0	6.6	6.8	6.9	7.1	7.0	7.0	7.2	7.1	7.1	6.9	6.9	11.95	11.95	11.92	11.87	11.91	11.93	11.85	11.88	11.89	11.73	11.88	97.5	97.8	97.7	98.1	98.2
4.0	6.6	6.8	6.8	7.1	7.0	7.1	7.2	7.1	7.0	6.9	6.9	11.94	11.94	11.91	11.88	11.91	11.93	11.85	11.88	11.90	11.74	11.88	97.4	97.8	97.5	98.0	98.1
5.0	6.6	6.8		7.0	7.0	7.0	7.2	7.0	7.0	6.9	6.8	11.94	11.95		11.89	11.91	11.92	11.86	11.88	11.90	11.76	11.87	97.3	97.7		98.0	98.2
6.0	6.6	6.8		7.0	7.0	7.0	7.2	7.0	6.9	6.9	6.8	11.94	11.95		11.88	11.91	11.92	11.86	11.89	11.90	11.76	11.86	97.3	97.3		97.9	98.1
7.0	6.5	6.8		7.0	7.0		7.2	7.0	6.9		6.8	11.93	11.96		11.87	11.90		11.86	11.88	11.88		11.86	97.2	97.3		97.8	98.1
8.0	6.5	6.8		7.0	7.0		7.2	7.0	6.9	6.9	6.7	11.92	11.95		11.86	11.91		11.86	11.87	11.86	11.77	11.85	97.1	97.2		97.6	98.2
9.0	6.5			7.0	7.0		7.2	7.0	6.9		6.7	11.92			11.85	11.90		11.65	11.86	11.86		11.83	97.0			97.5	98.1
10.0	6.5			7.0	7.0		7.2	7.0	6.9	6.9		11.91			11.84	11.90		11.84	11.86	11.85	11.77		97.0			97.5	98.0
11.0	6.5			6.9	7.0		7.2	7.0	6.9			11.91			11.82	11.90		11.84	11.86	11.85			97.0			97.1	98.0
12.0	6.5				7.0		7.2	7.0	6.9	6.9		11.90				11.89		11.84	11.85	11.84	11.78		96.9				97.9
13.0	6.5				7.0		7.2	7.0	6.9			11.90				11.89		11.83	11.85	11.84			96.8				97.9
14.0	6.5				7.0		7.2	7.0	6.9	6.9		11.88				11.88		11.83	11.84	11.83	11.79		96.7				97.8
15.0					6.9		7.2	7.0	6.9							11.89		11.82	11.84	11.83							97.8
16.0					6.9		7.1	7.0	6.9	6.7						11.89		11.81	11.83	11.82	11.81						97.8
17.0					6.9		7.1	6.9	6.9							11.88		11.80	11.83	11.82							97.7
18.0					6.8			6.9	6.9	6.6						11.89			11.82	11.82	11.83						97.4
19.0					6.8			6.9	6.9							11.89			11.82	11.81							97.4
20.0									6.9	6.6										11.80	11.85						
21.0									6.9											11.79							
22.0									6.9	6.5										11.78	11.85						
23.0									6.9											11.77							
24.0									6.9	6.5										11.76	11.86						
25.0																											
26.0										6.5											11.86						
27.0																											
28.0										6.5											11.86						
29.0																											

Notes: 24-Aug-18 to 26-Aug-18 sampling was conducted by Baffinland. 20-Aug-18 sampling was conducted by Minnow.Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 15, 9.4, 4, 11.8, 23, 7.7, 19, 22, 32, and 9.8 m, respectively, at the time of fall sampling.

Table C.69: *In Situ* Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2018

Depth (m)	Dissolved Oxygen (% Saturation)						pH (pH units)											Specific Conductance (µS/cm)										
	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-09	BLO-06
Date Collected	24-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	20-Aug-18	25-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	25-Aug-18	24-Aug-18	24-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	20-Aug-18	25-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	25-Aug-18	24-Aug-18	24-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	20-Aug-18	25-Aug-18
surface					96.2											7.77											60	
1.0	98.4	97.5	98.2	98.2	96.2	97.8	7.98	7.87	7.67	7.92	8.00	7.99	7.93	7.86	7.98	7.74	7.82	119	117	117	68	63	63	61	62	62	60	63
2.0	98.5	97.8	98.2	98.4	96.4	97.8	7.98	7.91	7.76	7.87	7.93	7.96	7.84	7.83	7.88	7.72	7.82	119	117	117	68	63	63	61	62	62	60	63
3.0	98.4	98.1	98.1	98.2	96.5	97.7	7.98	7.92	7.84	7.84	7.89	7.94	7.20	7.81	7.85	7.71	7.81	119	117	117	68	63	63	61	62	62	60	63
4.0	98.4	98.1	98.1	98.0	96.5	97.7	7.98	7.93	7.85	7.81	7.87	7.92	7.81	7.81	7.80	7.70	7.80	119	117	118	68	63	63	61	62	62	60	63
5.0	98.3	98.1	98.0	97.9	96.7	97.4	7.98	7.93		7.79	7.83	7.89	7.80	7.80	7.79	7.70	7.79	120	116		68	63	63	61	62	62	60	63
6.0	98.3	98.1	97.9	97.8	96.7	97.2	7.98	7.93		7.78	7.83	7.88	7.79	7.77	7.79	7.69	7.79	120	117		68	63	63	61	62	62	60	63
7.0		98.1	97.8	97.6		97.2	7.98	7.92		7.75	7.83		7.78	7.77	7.77		7.79	121	117		68	62		61	62	62		63
8.0		98.1	97.8	97.5	96.8	97.0	7.98	7.92		7.71	7.82		7.77	7.77	7.73	7.68	7.78	121	117		68	63		61	62	62	60	63
9.0		9.8	97.7	97.4		96.8	7.98			7.70	7.82		7.76	7.75	7.72		7.78	121			68	63		61	62	62		63
10.0		97.7	97.7	97.4	96.7		7.97			7.69	7.82		7.76	7.75	7.71	7.67		122			68	63		61	62	62	60	
11.0		97.9	97.6	97.3			7.97			7.67	7.82		7.75	7.74	7.70			122			68	63		61	62	62		
12.0		97.9	97.6	97.3	96.8		7.97				7.82		7.74	7.73	7.69	7.66		122				63		61	62	62	60	
13.0		97.8	97.6	97.2			7.96				7.82		7.74	7.73	7.68			122				63		61	62	62		
14.0		97.8	97.5	97.2	96.8		7.96				7.82		7.73	7.72	7.67	7.65		122				64		61	62	62	60	
15.0		97.8	97.4	97.1							7.81		7.73	7.71	7.66							66		61	62	62		
16.0		97.7	97.4	97.1	96.6						7.81		7.72	7.70	7.65	7.64						68		61	62	62	59	
17.0		97.4	97.3	97.0							7.81		7.72	7.70	7.64							68		61	62	62		
18.0			97.3	97.0	96.6						7.81			7.69	7.64	7.63						73			62	62	59	
19.0			97.3	96.9							7.81			7.68	7.62							74			62	62		
20.0				96.8	96.5										7.61	7.62										62	59	
21.0				96.8											7.61											62		
22.0				96.7	96.5										7.60	7.60										62	59	
23.0				96.6											7.60											62		
24.0				96.5	96.4										7.60	7.58										62	60	
25.0																												
26.0					96.5											7.57											60	
27.0																												
28.0					96.6											7.54											67	
29.0																												

Notes: 24-Aug-18 to 26-Aug-18 sampling was conducted by Baffinland. 20-Aug-18 sampling was conducted by Minnow.Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 15, 9.4, 4, 11.8, 23, 7.7, 19, 22, 32, and 9.8 m, respectively, at the time of fall sampling.

Table C.70: Sampling Depth, Water Clarity Measures, and Surface and Bottom *In Situ* Water Quality Measures Collected at Mary Lake Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2018

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
							(mg/L)	(% sat.)		
Littoral (Shallow) Stations	BLO-01	20-Aug-18	9.7	4.4	surface	6.70	11.59	94.7	7.64	111
					bottom	6.40	11.83	95.9	7.85	111
	BLO-11	20-Aug-18	10.7	3.8	surface	7.00	11.74	96.6	7.68	60
					bottom	6.90	11.76	96.5	7.64	60
	BLO-07	20-Aug-18	12.1	4.2	surface	6.60	11.75	95.9	7.71	58
					bottom	6.60	11.76	95.9	7.63	58
	BLO-06	20-Aug-18	8.3	3.5	surface	6.80	11.71	95.9	7.69	59
					bottom	6.70	11.57	94.5	7.65	59
Profundal (Deep) Stations	BLO-03	20-Aug-18	15.1	4.3	surface	7.10	11.70	96.5	7.87	59
					bottom	7.00	11.67	96.1	7.75	59
	BLO-15	20-Aug-18	28.1	4.1	surface	7.00	11.68	96.3	7.75	59
					bottom	6.90	11.62	95.6	7.69	60
	BLO-14	20-Aug-18	17.1	4.6	surface	7.00	11.69	96.3	7.73	59
					bottom	6.90	11.60	95.1	7.63	59
	BLO-05	20-Aug-18	20.5	3.7	surface	7.00	11.74	96.6	7.71	61
					bottom	6.80	11.74	96.3	7.64	80
	BLO-13	20-Aug-18	21.1	4.2	surface	7.00	11.68	96.1	7.68	60
					bottom	6.70	11.72	95.8	7.64	61
	BLO-04	20-Aug-18	21.6	4.4	surface	6.90	11.71	96.3	7.66	60
					bottom	6.90	11.70	96.1	7.62	60

Table C.71: Statistical Comparison of Bottom *In Situ* Water Quality Between Mary Lake Littoral and Profundal Stations, Mary River Project CREMP, August 2018

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Lake Zone	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	NO	0.297	α	Littoral	4	3.95	0.41	0.21	3.45	4.39
				Profundal	6	4.20	0.31	0.13	3.70	4.63
Temperature (˚C)	YES	0.057	α	Littoral	4	6.65	0.21	0.10	6.40	6.90
				Profundal	6	6.87	0.10	0.04	6.70	7.00
Dissolved Oxygen (mg/L)	NO	0.326	α	Littoral	4	11.7	0.1	0.1	11.6	11.8
				Profundal	6	11.7	0.1	0.0	11.6	11.7
Dissolved Oxygen (% saturation)	NO	0.749	α	Littoral	4	95.7	0.8	0.4	94.5	96.5
				Profundal	6	95.8	0.4	0.2	95.1	96.3
pH (units)	NO	0.610	γ	Littoral	4	7.69	0.11	0.05	7.63	7.85
				Profundal	6	7.66	0.05	0.02	7.62	7.75
Specific Conductance (umho/cm)	NO	0.610	γ	Littoral	4	72.0	26.0	13.0	58.3	111.0
				Profundal	6	63.1	8.4	3.4	59.1	80.1

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.72: Statistical Comparison of Bottom *In Situ* Water Quality Between Mary Lake and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Station Depth (m)**	NO	0.670	α	Reference	5	9.80	1.11	0.49	8.40	11.20
					Mary Lake	4	10.20	1.60	0.80	8.30	12.10
	Secchi Depth (m)	YES	< 0.001	α	Reference	4	8.49	0.45	0.23	8.05	9.10
					Mary Lake	4	3.95	0.41	0.21	3.45	4.39
	Temperature (˚C)	YES	0.029	γ	Reference	4	7.05	0.10	0.05	6.90	7.10
					Mary Lake	4	6.65	0.21	0.10	6.40	6.90
	Dissolved Oxygen (mg/L)	NO	0.420	α	Reference	4	11.6	0.3	0.1	11.2	11.8
					Mary Lake	4	11.7	0.1	0.1	11.6	11.8
	Dissolved Oxygen (% saturation)	NO	0.486	γ	Reference	4	95.7	2.2	1.1	92.4	97.1
					Mary Lake	4	95.7	0.8	0.4	94.5	96.5
	pH (units)	NO	0.114	γ	Reference	4	7.54	0.11	0.05	7.41	7.65
					Mary Lake	4	7.69	0.11	0.05	7.63	7.85
	Specific Conductance (umho/cm)	NO	0.343	γ	Reference	4	62.8	1.0	0.5	62.3	64.3
					Mary Lake	4	72.0	26.0	13.0	58.3	111.0
Profundal (Deep) Stations	**Station Depth (m)**	NO	0.773	α	Reference	5	21.26	2.62	1.17	18.50	25.00
					Mary Lake	6	20.58	4.47	1.83	15.10	28.10
	Secchi Depth (m)	YES	< 0.001	α	Reference	4	8.63	0.26	0.13	8.30	8.90
					Mary Lake	6	4.20	0.31	0.13	3.70	4.63
	Temperature (˚C)	NO	0.010	γ	Reference	4	7.08	0.05	0.02	7.00	7.10
					Mary Lake	6	6.87	0.10	0.04	6.70	7.00
	Dissolved Oxygen (mg/L)	NO	0.352	γ	Reference	4	11.5	0.4	0.2	10.9	11.7
					Mary Lake	6	11.7	0.1	0.0	11.6	11.7
	Dissolved Oxygen (% saturation)	YES	0.914	γ	Reference	4	94.6	2.8	1.4	90.4	96.1
					Mary Lake	6	95.8	0.4	0.2	95.1	96.3
	pH (units)	YES	0.245	α	Reference	4	7.63	0.04	0.02	7.58	7.67
					Mary Lake	6	7.66	0.05	0.02	7.62	7.75
	Specific Conductance (umho/cm)	YES	0.114	γ	Reference	4	62.5	0.2	0.1	62.3	62.8
					Mary Lake	6	63.1	8.4	3.4	59.1	80.1

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.73: Water Chemistry at Mary Lake North Basin (BLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event					
					BL0-01-A bottom 14-Apr-18	BL0-01-A surface 14-Apr-18	BL0-01 bottom 14-Apr-18	BL0-01 surface 14-Apr-18	BL0-01-B bottom 14-Apr-18	BL0-01-B surface 14-Apr-18
Conventionals	Conductivity (lab)	umho/cm	-	-	219	222	220	228	225	226
	pH (lab)	pH	6.5 - 9.0	-	7.83	8.07	8.07	8.08	8.05	8.02
	Hardness (as $CaCO_3$)	mg/L	-	-	115	117	115	121	119	122
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	119	121	117	124	114	123
	Turbidity	NTU	-	-	0.4	0.3	0.4	0.6	0.3	0.4
	Alkalinity (as $CaCO_3$)	mg/L	-	-	97	101	96	100	100	100
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.173	0.075	0.070	0.075	0.075	0.076
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.2	2.3	2.4	2.4	2.4	2.4
	Total Organic Carbon	mg/L	-	-	2.2	2.7	2.7	2.6	2.6	2.4
	Total Phosphorus	mg/L	0.020[α]	-	0.0060	0.0287	<0.0030	0.0107	0.0046	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	0.0028	0.0016	0.0014	0.0016	0.0012
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	6.3	6.6	6.5	6.8	6.6	6.6
	Sulphate (SO_4)	mg/L	218[β]	218	2.8	3.8	3.7	3.9	3.8	3.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0100	0.0107	0.0105	0.0113	0.0105	0.0112
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	21	21	21	22	24	24
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0009	0.0011	0.0012	0.0011	0.0012	0.0011
	Iron (Fe)	mg/L	0.30	0.326	0.096	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	0.0013	0.0013
	Magnesium (Mg)	mg/L	-	-	12.2	12.6	12.6	13.3	14.2	14.3
	Manganese (Mn)	mg/L	0.935[β]	-	0.1020	0.0012	0.0020	0.0017	0.0020	0.0021
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00025	0.00030	0.00028	0.00030	0.00030	0.00032
	Nickel (Ni)	mg/L	0.025	0.025	0.00071	0.00064	0.00062	0.00064	0.00064	0.00067
	Potassium (K)	mg/L	-	-	1.15	1.22	1.24	1.27	1.18	1.23
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	1.75	1.03	1.04	1.07	1.09	1.14
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	2.7	2.9	2.9	3.1	3.2	3.2
	Strontium (Sr)	mg/L	-	-	0.014	0.015	0.014	0.015	0.015	0.015
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0017	0.0023	0.0023	0.0023	0.0022	0.0023
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intinsik (2013) using baseline water quality data specific to Mary Lake.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.73: Water Chemistry at Mary Lake North Basin (BLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)^a	AEMP Benchmark^b	Summer Sampling Event					
					BL0-01-A	BL0-01-A	BL0-01	BL0-01	BL0-01-B	BL0-01-B
					bottom	surface	bottom	surface	bottom	surface
					03-Aug-18	03-Aug-18	03-Aug-18	03-Aug-18	03-Aug-18	03-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	106	105	109	109	106	106
	pH (lab)	pH	6.5 - 9.0	-	7.95	8.01	7.84	8.03	7.98	8.06
	Hardness (as CaCO$_3$)	mg/L	-	-	53	54	55	55	54	54
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	60	75	60	47	62	76
	Turbidity	NTU	-	-	1.0	1.0	1.0	1.0	0.9	1.0
	Alkalinity (as CaCO$_3$)	mg/L	-	-	54	53	51	55	56	56
Nutrients and Organics	Total Ammonia	mg/L	variable^c	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	0.3005	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.9	1.73	2.17	1.985	1.72	1.86
	Total Organic Carbon	mg/L	-	-	2.2	1.84	2.4	2.2	1.9	2.0
	Total Phosphorus	mg/L	0.020$^{\alpha}$	-	0.0072	0.0063	0.0176	0.0065	0.0063	0.0069
	Phenols	mg/L	0.004$^{\alpha}$	-	<0.0010	<0.0010	0.0026	0.0013	<0.0010	0.0018
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.6	1.4	1.8	1.6	1.6	1.5
	Sulphate (SO$_4$)	mg/L	218$^{\beta}$	218	1.0	0.9	1.1	1.9	1.0	1.0
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.028	0.036	0.027	0.029	0.034	0.029
	Antimony (Sb)	mg/L	0.020$^{\alpha}$	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0057	0.0057	0.0060	0.0058	0.0059	0.0058
	Beryllium (Be)	mg/L	0.011$^{\alpha}$	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	12	12	12	12	12	12
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009$^{\alpha}$	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00069	0.00079	0.00073	0.00074	0.00077	0.00073
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	6.3	6.1	6.5	6.1	6.3	6.0
	Manganese (Mn)	mg/L	0.935$^{\beta}$	-	0.0018	0.0010	0.0016	0.0012	0.0011	0.0010
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00013	0.00012	0.00014	0.00014	0.00013	0.00013
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.62	0.63	0.63	0.64	0.63	0.63
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.71	0.70	0.67	0.67	0.68	0.69
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.1	1.1	1.2	1.1	1.1	1.1
	Strontium (Sr)	mg/L	-	-	0.008	0.008	0.008	0.008	0.008	0.008
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0008	0.0007	0.0008	0.0008	0.0008	0.0008
	Vanadium (V)	mg/L	0.006$^{\alpha}$	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intinsik (2013) using baseline water quality data specific to Mary Lake.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.73: Water Chemistry at Mary Lake North Basin (BLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event					
					BLO-01-A bottom 26-Aug-18	BLO-01-A surface 26-Aug-18	BLO-01 bottom 26-Aug-18	BLO-01 surface 26-Aug-18	BLO-01-B bottom 26-Aug-18	BLO-01-B surface 26-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	148	143	133	140	136	141
	pH (lab)	pH	6.5 - 9.0	-	8.08	8.08	8.18	8.12	8.09	8.07
	Hardness (as $CaCO_3$)	mg/L	-	-	74	72	69	70	71	70
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	65	75	65	70	55	60
	Turbidity	NTU	-	-	0.7	0.7	1.0	0.7	0.8	0.7
	Alkalinity (as $CaCO_3$)	mg/L	-	-	69	66	65	65	67	66
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	0.022	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.6	2.6	2.6	2.7	2.7	2.7
	Total Organic Carbon	mg/L	-	-	2.8	2.8	2.9	2.8	2.9	2.8
	Total Phosphorus	mg/L	0.020[α]	-	<0.0030	<0.0030	0.0088	<0.0030	<0.0030	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.5	2.4	2.2	2.2	2.3	2.3
	Sulphate (SO_4)	mg/L	218[β]	218	1.4	1.4	1.3	1.3	1.3	1.3
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.024	0.020	0.031	0.026	0.026	0.027
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0075	0.0072	0.0072	0.0070	0.0075	0.0074
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	15	15	14	15	15	15
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0009	0.0008	0.0009	0.0009	0.0009	0.0009
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.030	<0.030	<0.030	0.03
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	8.8	8.4	8.2	8.1	8.2	8.4
	Manganese (Mn)	mg/L	0.935[β]	-	0.0025	0.0023	0.0024	0.0021	0.0022	0.0023
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00019	0.00020	0.00018	0.00020	0.00020	0.00023
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.82	0.81	0.81	0.80	0.81	0.82
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.69	0.68	0.62	0.73	0.73	0.73
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.8	1.6	1.6	1.6	1.6	1.6
	Strontium (Sr)	mg/L	-	-	0.009	0.009	0.010	0.010	0.010	0.011
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0014	0.0013	0.0012	0.0012	0.0012	0.0013
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intinsik (2013) using baseline water quality data specific to Mary Lake.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.74: **Summary of the Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentrations Provided) Between Mary Lake and Reference Lake 3 in 2018, and at Mary Lake Between 2018 and the Baseline Period**

Parameter	Mary Lake North Basin					Mary Lake South Basin				
	2018 vs Reference Lake 3		2018 vs Baseline			2018 vs Reference Lake 3		2018 vs Baseline		
	Summer	Fall	Winter	Summer	Fall	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	1.5	1.9	0.9	1.0	0.8	0.9	1.0	0.9	1.0	1.0
Hardness (as $CaCO_3$)	1.5	2.0	1.0	1.0	0.8	0.9	1.0	0.9	1.0	0.9
Total Suspended Solids (TSS)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	1.0
Total Dissolved Solids (TDS)	1.8	1.4	0.7	0.9	0.6	1.2	1.4	0.7	0.9	0.9
Turbidity	4.0	1.5	1.9	0.4	0.9	11	2.6	0.8	1.4	1.2
Alkalinity (as $CaCO_3$)	1.7	2.0	0.9	1.0	0.8	0.9	1.2	0.8	0.9	0.9
Total Ammonia	0.9	0.5	0.2	0.2	0.1	0.9	0.6	0.2	0.3	0.5
Nitrate	3.3	1.0	0.8	0.7	0.2	1.0	1.4	0.4	0.2	0.2
Nitrite	1.0	1.0	1.2	1.2	0.8	1.0	1.0	1.6	0.3	1.1
Total Kjeldahl Nitrogen (TKN)	1.0	0.9	0.7	0.5	0.6	1.1	0.9	1.1	1.0	0.9
Dissolved Organic Carbon	0.6	0.9	1.1	1.3	1.5	0.4	0.6	1.0	0.9	1.2
Total Organic Carbon	0.4	0.7	1.2	1.3	1.6	0.3	0.5	1.1	1.0	1.7
Total Phosphorus	1.8	0.8	1.3	1.0	0.6	1.8	1.0	1.1	1.4	0.8
Phenols	1.1	1.0	1.6	1.5	1.0	1.3	1.1	1.1	1.6	1.2
Bromide (Br)	1.0	1.0	0.5	0.5	0.7	1.0	1.0	0.9	0.4	0.4
Chloride (Cl)	1.2	1.8	0.7	0.9	0.6	1.1	1.3	0.7	0.6	0.6
Sulphate (SO_4)	0.3	0.4	0.7	0.5	0.3	0.5	0.7	0.8	0.9	1.0
Aluminum (Al)	8.9	5.9	0.5	0.4	0.3	17	9.0	0.5	0.8	1.4
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.1	1.0	0.5	1.0	1.0	1.0	1.0	0.9
Barium (Ba)	0.0	1.1	0.9	0.9	0.8	0.0	0.7	0.9	1.0	0.9
Beryllium (Be)	1.0	1.0	1.5	1.5	1.0	1.0	1.0	1.1	1.5	2.0
Bismuth (Bi)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Boron (B)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cadmium (Cd)	1.0	1.0	0.8	0.9	0.7	1.0	1.0	0.2	0.9	0.8
Calcium (Ca)	1.7	2.1	0.9	1.0	0.9	0.9	1.0	0.9	1.0	0.9
Chromium (Cr)	1.0	1.0	RDL	RDL	RDL	1.0	1.0	RDL	RDL	RDL
Cobalt (Co)	1.0	1.0	1.0	0.8	0.7	1.0	1.0	1.0	0.9	0.9
Copper (Cu)	0.9	1.1	0.9	0.8	0.3	0.9	0.8	0.9	0.9	
Iron (Fe)	1.0	1.0	1.5	0.3	0.3	2.1	1.3	1.0	0.9	1.0
Lead (Pb)	1.0	1.0	0.9	0.7	0.7	1.5	1.1	0.9	0.9	0.9
Lithium (Li)	1.0	1.0	0.4	0.3	0.2	1.0	1.0	0.2	0.3	0.4
Magnesium (Mg)	1.4	2.0	0.9	1.0	0.8	0.8	1.0	0.9	1.0	1.0
Manganese (Mn)	2.2	3.6	3.0	0.3	0.2	4.9	4.2	0.9	1.3	2.5
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	1.0	1.4	0.9	1.0	0.9	0.9	0.9	1.0	1.1	0.9
Nickel (Ni)	1.0	1.0	0.8	0.9	0.8	1.0	1.0	1.0	1.0	1.0
Potassium (K)	0.7	0.9	0.9	1.1	1.0	0.6	0.6	0.9	1.1	1.1
Selenium (Se)	1.0	1.0	RDL	RDL	RDL	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	1.5	1.7	0.9	1.0	0.8	1.2	1.2	0.9	1.0	1.2
Silver (Ag)	1.0	1.0	1.6	1.8	1.8	1.0	1.0	1.2	1.9	2.3
Sodium (Na)	1.2	1.9	0.7	1.3	0.8	0.9	1.0	0.9	1.0	0.8
Strontium (Sr)	1.0	1.2	0.9	1.1	0.8	0.7	0.7	0.7	0.9	0.8
Thallium (Tl)	1.0	1.0	1.6	1.5	1.0	1.0	1.0	1.1	1.5	2.1
Tin (Sn)	1.0	1.0	0.1	0.0	0.0	1.0	1.0	0.2	0.1	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Uranium (U)	3.3	4.9	0.7	0.9	0.5	1.7	1.8	0.7	0.8	0.7
Vanadium (V)	1.0	1.0	1.0	1.0	0.5	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.6	1.6	3.0	1.0	1.0	1.7	1.4	1.4

🟪 Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference ot baseline period value).
🟨 Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
🟥 Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.75: Dissolved Metal Concentrations at Mary Lake North Basin Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Winter Sampling Event						Summer Sampling Event						Fall Sampling Event					
			BL0-01-A	BL0-01-A	BL0-01	BL0-01	BL0-01-B	BL0-01-B	BL0-01-A	BL0-01-A	BL0-01	BL0-01	BL0-01-B	BL0-01-B	BLO-01-A	BLO-01-A	BLO-01	BLO-01	BLO-01-B	BLO-01-B
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			14-Apr-18	14-Apr-18	14-Apr-18	14-Apr-18	14-Apr-18	14-Apr-18	03-Aug-18	03-Aug-18	03-Aug-18	03-Aug-18	03-Aug-18	03-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0038	0.0110	0.0043	0.0094	0.0044	0.0108	0.0087	0.0088	0.0090	0.0089	0.0083	0.0100
	Antimony (Sb)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.0093	0.0098	0.0100	0.0105	0.0101	0.0104	0.0056	0.0055	0.0053	0.0056	0.0058	0.0058	0.0076	0.0072	0.0069	0.0071	0.0072	0.0073
	Beryllium (Be)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	23.9	23.8	23.5	24.4	24.2	25	11.3	11.5	11.8	11.8	11.5	11.9	15.6	15.5	14.3	14.4	14.9	14.4
	Chromium (Cr)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00078	0.00104	0.00104	0.00114	0.00111	0.00111	0.00068	0.00068	0.00067	0.00068	0.00068	0.00068	0.00087	0.00084	0.00079	0.00083	0.00082	0.00084
	Iron (Fe)	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	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0012	0.0013	0.00130	0.0014	0.0013	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	13.6	14.0	13.8	14.6	14.3	14.5	6.1	6.2	6.1	6.2	6.2	6.0	8.5	8.1	8.1	8.4	8.2	8.2
	Manganese (Mn)	mg/L	0.02270	0.00037	0.00074	0.00076	0.00093	0.00123	0.00099	0.00058	0.00079	0.00070	0.00065	0.00058	0.00178	0.00152	0.00154	0.00138	0.00145	0.00146
	Mercury (Hg)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000259	0.000299	0.000280	0.000293	0.000305	0.000295	0.000118	0.000117	0.000128	0.000140	0.000139	0.000145	0.000233	0.000199	0.000197	0.000199	0.000210	0.000208
	Nickel (Ni)	mg/L	0.00066	0.00060	0.00060	0.00061	0.00064	0.00065	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	1.10	1.18	1.15	1.24	1.19	1.24	0.61	0.63	0.63	0.64	0.62	0.63	0.83	0.80	0.78	0.78	0.79	0.79
	Selenium (Se)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	1.66	1.08	1.06	1.11	1.09	1.14	0.66	0.65	0.61	0.64	0.62	0.65	0.66	0.66	0.67	0.70	0.67	0.67
	Silver (Ag)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	2.96	3.18	3.15	3.35	3.15	3.29	1.09	1.05	1.14	1.06	1.05	1.08	1.73	1.64	1.57	1.60	1.58	1.60
	Strontium (Sr)	mg/L	0.0138	0.0145	0.0141	0.0147	0.0142	0.015	0.0076	0.0077	0.0080	0.0079	0.0077	0.0079	0.0106	0.0099	0.0093	0.0093	0.0098	0.0098
	Thallium (Tl)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.00166	0.00215	0.00209	0.00234	0.00222	0.00221	0.00078	0.00077	0.00079	0.00076	0.00076	0.00077	0.00140	0.00128	0.00123	0.00122	0.00122	0.00122
	Vanadium (V)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.76: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Mary Lake and Reference Lake 3 in 2018, and at Mary Lake Between 2018 and the Baseline Period

Dissolved Metal	Mary Lake North Basin					Mary Lake South Basin				
	2018 vs Reference Lake 3		2018 vs Baseline			2018 vs Reference Lake 3		2018 vs Baseline		
	Summer	Fall	Winter	Summer	Fall	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	2.4	1.8	0.3	0.6	1.9	4.4	2.9	0.3	1.1	3.1
Antimony (Sb)	1.0	1.0	0.8	0.8	1.0	1.0	1.0	0.8	0.8	1.0
Arsenic (As)	1.0	1.0	0.8	0.9	1.0	1.0	1.0	0.8	0.9	1.0
Barium (Ba)	0.8	1.1	1.1	0.6	1.6	0.6	0.7	0.5	0.4	1.0
Beryllium (Be)	1.0	1.0	1.0	1.4	2.1	1.0	1.0	1.0	1.4	2.1
Bismuth (Bi)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Boron (B)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cadmium (Cd)	1.0	1.0	0.8	0.5	1.0	1.0	1.0	0.8	0.5	1.0
Calcium (Ca)	1.7	2.1	1.4	0.7	1.0	1.0	1.0	0.5	0.4	0.5
Chromium (Cr)	1.0	1.0	1.3	1.7	2.1	1.0	1.0	1.3	1.7	2.1
Cobalt (Co)	1.0	1.0	0.8	0.8	1.0	1.0	1.0	0.8	0.8	1.0
Copper (Cu)	0.9	1.1	0.7	0.5	1.1	0.7	0.7	0.4	0.4	0.7
Iron (Fe)	1.0	1.0	0.9	1.0	1.8	1.0	1.0	0.9	1.0	1.8
Lead (Pb)	1.0	1.0	1.0	0.8	1.0	1.0	1.1	1.0	0.8	1.1
Lithium (Li)	1.0	1.0	0.3	0.3	0.4	1.0	1.0	0.2	0.3	0.4
Magnesium (Mg)	1.4	2.0	1.4	0.6	0.9	0.8	1.0	0.5	0.4	0.5
Manganese (Mn)	4.7	7.3	3.4	0.5	0.3	7.5	3.5	0.3	0.8	0.2
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	1.1	1.5	1.2	0.5	1.2	1.0	1.0	0.6	0.5	0.8
Nickel (Ni)	1.0	1.0	1.0	0.7	0.9	1.0	1.0	0.8	0.7	0.9
Potassium (K)	0.7	0.9	1.4	0.7	1.0	0.5	0.6	0.7	0.6	0.7
Selenium (Se)	1.0	1.0	RDL	RDL	RDL	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	1.5	1.6	1.3	0.7	0.7	1.0	1.1	0.5	0.5	0.5
Silver (Ag)	1.0	1.0	0.2	1.8	2.5	1.0	1.0	0.2	1.8	2.5
Sodium (Na)	1.2	1.9	1.9	0.5	0.8	0.9	1.0	0.7	0.4	0.4
Strontium (Sr)	1.0	1.2	1.3	0.7	1.0	0.7	0.8	0.6	0.5	0.6
Thallium (Tl)	1.0	1.0	1.0	1.4	2.5	1.0	1.0	1.0	1.4	2.5
Tin (Sn)	1.0	1.0	0.0	0.2	0.4	1.0	1.0	0.0	0.2	0.4
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Uranium (U)	3.3	4.9	1.1	0.4	0.8	1.7	1.8	0.2	0.2	0.3
Vanadium (V)	1.0	1.0	0.8	0.9	1.0	1.0	1.0	0.8	0.9	1.0
Zinc (Zn)	1.0	1.0	1.6	1.3	1.2	1.0	1.0	1.6	1.4	1.2

🟪 Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference ot baseline period value).

🟧 Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).

🟥 Denotes highly elevated concentration (mean concentration ≥ 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.77: Spearman's Rank Correlation Coefficients for Mary Lake North Basin (BLO) Water Quality Data Collected in Winter, Summer, and Fall 2018[a]

Parameters	Conventional Parameters									Total Metals								
	Conduct-ivity	Hardness	Total Dissolved Solids	Turbidity	Alkalinity	Dissolved Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Copper	Manganese	Molybdenum	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	1	0.992	0.936	-0.476	0.935	0.898	-0.562	0.954	0.994	-0.882	0.870	-0.155	0.937	0.969	0.896	0.972	0.988	0.994
Hardness	0.031	0	-0.065	0.567	-0.033	0.105	-0.664	-0.023	0.005	-0.065	0.196	0.343	0.022	0.016	0.072	-0.006	0.017	0.026
Total Dissolved Solids	0.936	0.934	1	-0.494	0.903	0.876	-0.522	0.897	0.926	-0.862	0.842	-0.061	0.928	0.928	0.885	0.926	0.933	0.941
Turbidity	-0.476	-0.469	-0.494	1	-0.409	-0.424	-0.088	-0.455	-0.455	0.419	-0.346	0.546	-0.488	-0.513	-0.367	-0.505	-0.472	-0.466
Alkalinity	0.935	0.958	0.903	-0.409	1	0.897	-0.525	0.942	0.951	-0.906	0.868	-0.118	0.938	0.933	0.888	0.935	0.951	0.950
Dissolved Organic Carbon	0.898	0.896	0.876	-0.424	0.897	1	-0.647	0.896	0.895	-0.923	0.881	-0.210	0.891	0.898	0.943	0.889	0.901	0.895
Total Phosphorus	-0.562	-0.572	-0.522	-0.088	-0.525	-0.647	1	-0.527	-0.548	0.601	-0.734	-0.031	-0.579	-0.590	-0.584	-0.551	-0.564	-0.574
Chloride	0.954	0.951	0.897	-0.455	0.942	0.896	-0.527	1	0.969	-0.924	0.847	-0.175	0.924	0.945	0.846	0.964	0.945	0.945
Sulphate	0.994	0.993	0.926	-0.455	0.951	0.895	-0.548	0.969	1	-0.888	0.872	-0.172	0.942	0.968	0.889	0.975	0.986	0.988
Aluminum (total)	-0.882	-0.894	-0.862	0.419	-0.906	-0.923	0.601	-0.924	-0.888	1	-0.795	0.125	-0.855	-0.875	-0.894	-0.869	-0.889	-0.883
Copper (total)	0.870	0.879	0.842	-0.346	0.868	0.881	-0.734	0.847	0.872	-0.795	1	-0.226	0.881	0.889	0.812	0.875	0.883	0.879
Manganese (total)	-0.155	-0.156	-0.061	0.546	-0.118	-0.210	-0.031	-0.175	-0.172	0.125	-0.226	1	-0.180	-0.155	-0.058	-0.166	-0.156	-0.142
Molybdenum (total)	0.937	0.952	0.928	-0.488	0.938	0.891	-0.579	0.924	0.942	-0.855	0.881	-0.180	1	0.964	0.862	0.970	0.955	0.944
Potassium (total)	0.969	0.975	0.928	-0.513	0.933	0.898	-0.590	0.945	0.968	-0.875	0.889	-0.155	0.964	1	0.887	0.992	0.977	0.975
Silicon (total)	0.896	0.897	0.885	-0.367	0.888	0.943	-0.584	0.846	0.889	-0.894	0.812	-0.058	0.862	0.887	1	0.866	0.904	0.901
Sodium (total)	0.972	0.971	0.926	-0.505	0.935	0.889	-0.551	0.964	0.975	-0.869	0.875	-0.166	0.970	0.992	0.866	1	0.972	0.971
Strontium (total)	0.988	0.994	0.933	-0.472	0.951	0.901	-0.564	0.945	0.986	-0.889	0.883	-0.156	0.955	0.977	0.904	0.972	1	0.992
Uranium (total)	0.994	0.994	0.941	-0.466	0.950	0.895	-0.574	0.945	0.988	-0.883	0.879	-0.142	0.944	0.975	0.901	0.971	0.992	1
Aluminum (dissolved)	-0.733	-0.699	-0.713	0.694	-0.643	-0.657	0.187	-0.790	-0.735	0.703	-0.583	0.353	-0.702	-0.716	-0.618	-0.745	-0.694	-0.699
Copper (dissolved)	0.777	0.787	0.739	-0.210	0.800	0.769	-0.571	0.814	0.805	-0.667	0.871	-0.048	0.816	0.810	0.667	0.829	0.782	0.764
Manganese (dissolved)	0.164	0.147	0.094	0.524	0.133	0.121	-0.518	0.200	0.153	-0.155	0.294	0.459	0.102	0.158	0.047	0.161	0.150	0.173
Molybdenum (dissolved)	0.926	0.937	0.896	-0.447	0.966	0.895	-0.513	0.973	0.944	-0.933	0.864	-0.162	0.926	0.940	0.856	0.953	0.938	0.933
Potassium (dissolved)	0.942	0.951	0.921	-0.487	0.948	0.899	-0.553	0.980	0.951	-0.931	0.861	-0.149	0.947	0.955	0.846	0.961	0.944	0.943
Sodium (dissolved)	0.946	0.956	0.912	-0.436	0.953	0.903	-0.530	0.976	0.959	-0.934	0.839	-0.168	0.941	0.939	0.856	0.952	0.948	0.945
Strontium (dissolved)	0.994	0.997	0.943	-0.470	0.958	0.895	-0.562	0.951	0.994	-0.878	0.888	-0.152	0.949	0.975	0.896	0.974	0.991	0.996
Uranium (dissolved)	0.979	0.982	0.937	-0.468	0.937	0.897	-0.554	0.942	0.983	-0.881	0.858	-0.181	0.950	0.945	0.877	0.956	0.967	0.968

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 18.

🟩 Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

🟦 Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

Table C.77: Spearman's Rank Correlation Coefficients for Mary Lake North Basin (BLO) Water Quality Data Collected in Winter, Summer and Fall 2018[a]

Parameters	Dissolved Metals							
	Aluminum	Copper	Manganese	Molybdenum	Potassium	Sodium	Strontium	Uranium
Conductivity	-0.733	0.777	0.164	0.926	0.942	0.946	0.994	0.979
Hardness	0.245	0.175	0.735	-0.042	0.008	0.025	0.002	0.028
Total Dissolved Solids	-0.713	0.739	0.094	0.896	0.921	0.912	0.943	0.937
Turbidity	0.694	-0.210	0.524	-0.447	-0.487	-0.436	-0.470	-0.468
Alkalinity	-0.643	0.800	0.133	0.966	0.948	0.953	0.958	0.937
Dissolved Organic Carbon	-0.657	0.769	0.121	0.895	0.899	0.903	0.895	0.897
Total Phosphorus	0.187	-0.571	-0.518	-0.513	-0.553	-0.530	-0.562	-0.554
Chloride	-0.790	0.814	0.200	0.973	0.980	0.976	0.951	0.942
Sulphate	-0.735	0.805	0.153	0.944	0.951	0.959	0.994	0.983
Aluminum (total)	0.703	-0.667	-0.155	-0.933	-0.931	-0.934	-0.878	-0.881
Copper (total)	-0.583	0.871	0.294	0.864	0.861	0.839	0.888	0.858
Manganese (total)	0.353	-0.048	0.459	-0.162	-0.149	-0.168	-0.152	-0.181
Molybdenum (total)	-0.702	0.816	0.102	0.926	0.947	0.941	0.949	0.950
Potassium (total)	-0.716	0.810	0.158	0.940	0.955	0.939	0.975	0.945
Silicon (total)	-0.618	0.667	0.047	0.856	0.846	0.856	0.896	0.877
Sodium (total)	-0.745	0.829	0.161	0.953	0.961	0.952	0.974	0.956
Strontium (total)	-0.694	0.782	0.150	0.938	0.944	0.948	0.991	0.967
Uranium (total)	-0.699	0.764	0.173	0.933	0.943	0.945	0.996	0.968
Aluminum (dissolved)	1	-0.502	0.101	-0.719	-0.783	-0.747	-0.703	-0.713
Copper (dissolved)	-0.502	1	0.378	0.809	0.808	0.796	0.797	0.802
Manganese (dissolved)	0.101	0.378	1	0.189	0.209	0.201	0.150	0.109
Molybdenum (dissolved)	-0.719	0.809	0.189	1	0.969	0.969	0.937	0.919
Potassium (dissolved)	-0.783	0.808	0.209	0.969	1	0.986	0.946	0.940
Sodium (dissolved)	-0.747	0.796	0.201	0.969	0.986	1	0.948	0.958
Strontium (dissolved)	-0.703	0.797	0.150	0.937	0.946	0.948	1	0.979
Uranium (dissolved)	-0.713	0.802	0.109	0.919	0.940	0.958	0.979	1

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 18.

🟩 Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

🟦 Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

Table C.78: Water Chemistry at Mary Lake South Basin (BLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event													
					BL0-05-A	BL0-05-A	BL0-05	BL0-05	BL0-05-B	BL0-05-B	BL0-03	BL0-03	BL0-04	BL0-04	BL0-09	BL0-09	BL0-06	BL0-06
					bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
					15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	16-Apr-18	16-Apr-18	16-Apr-18	16-Apr-18	15-Apr-18	15-Apr-18
Conventionals	Conductivity (lab)	umho/cm	-	-	80	86	79	87	89	91	82	86	78	90	80	88	90	90
	pH (lab)	pH	6.5 - 9.0	-	7.66	7.70	7.71	7.76	7.76	7.75	7.74	7.73	7.70	7.75	7.65	7.75	7.68	7.74
	Hardness (as $CaCO_3$)	mg/L	-	-	40	42	39	43	44	44	40	43	38	44	38	44	44	43
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	43	40	39	46	48	52	41	40	39	44	44	48	59	50
	Turbidity	NTU	-	-	0.4	0.5	0.3	0.4	0.5	0.9	0.3	0.4	0.2	0.3	0.3	0.5	0.4	0.4
	Alkalinity (as $CaCO_3$)	mg/L	-	-	36	38	31	36	34	38	37	35	34	38	34	36	36	35
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	0.03	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.032	0.034	0.033	0.034	0.031	0.036	0.036	0.034	0.040	0.035	0.068	0.035	0.037	0.035
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.16	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.5	1.5	1.4	1.5	1.6	1.6	1.4	1.4	1.2	1.4	1.3	1.5	1.6	1.6
	Total Organic Carbon	mg/L	-	-	1.6	1.6	1.6	1.7	1.8	1.7	1.7	1.7	1.4	1.7	1.5	1.7	1.8	1.9
	Total Phosphorus	mg/L	0.020[α]	-	0.0032	0.0041	<0.0030	0.0039	0.0033	0.0050	0.00475	0.0037	0.0035	0.0047	<0.0030	0.0069	0.0037	0.0031
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0024	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.9	2.1	1.9	2.1	2.2	2.2	2.0	2.1	1.8	2.2	2.0	2.1	2.2	2.2
	Sulphate (SO_4)	mg/L	218[β]	218	1.4	1.5	1.3	1.5	1.5	1.5	1.3	1.4	1.3	1.5	1.3	1.5	1.5	1.5
Total Metals	Aluminum (Al)	mg/L	0.100	0.130	0.004	0.005	0.004	0.005	0.0060	0.010	0.005	0.004	0.005	0.004	0.012	0.005	0.006	0.004
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0044	0.0049	0.0044	0.0047	0.00499	0.0057	0.0045	0.0044	0.0042	0.0048	0.0045	0.0047	0.0049	0.0049
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<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 (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	8	8	8	9	8.74	9	8	8	7	8	8	8	9	9
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<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 (Cu)	mg/L	0.002	0.0024	0.0007	0.0007	0.0008	0.0007	0.00071	0.0008	0.0006	0.0006	0.0007	0.0007	0.0008	0.0007	0.0008	0.0007
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.00007	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	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	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.7	5.0	4.7	5.3	5.23	5.5	4.8	5.0	4.5	5.3	4.7	5.3	5.4	5.3
	Manganese (Mn)	mg/L	0.935[β]	-	0.0005	0.0005	0.0006	0.0005	0.000676	0.0047	0.0005	0.0005	0.0007	0.0004	0.0014	0.0005	0.0009	0.0006
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00015	0.00015	0.00014	0.00016	0.000170	0.00015	0.00014	0.00015	0.00012	0.00015	0.00014	0.00015	0.00017	0.00016
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.58	0.63	0.56	0.64	0.65	0.68	0.58	0.61	0.54	0.65	0.57	0.64	0.65	0.64
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.41	0.43	0.40	0.44	0.43	0.47	0.43	0.43	0.43	0.45	0.64	0.44	0.46	0.45
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.1	1.2	1.1	1.3	1.28	1.3	1.1	1.2	1.1	1.3	1.2	1.2	1.2	1.3
	Strontium (Sr)	mg/L	-	-	0.00593	0.00644	0.00584	0.00632	0.00653	0.00677	0.00596	0.00601	0.00506	0.00618	0.00579	0.0061	0.00664	0.00653
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0005	0.0005	0.0005	0.0005	0.000531	0.0006	0.0005	0.0005	0.0004	0.0005	0.0004	0.0005	0.0005	0.0005
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intinsik (2013) using baseline water quality data specific to Mary Lake.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.78: Water Chemistry at Mary Lake South Basin (BLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event													
					BL0-05-A	BL0-05-A	BL0-05	BL0-05	BL0-05-B	BL0-05-B	BL0-03	BL0-03	BL0-04	BL0-04	BL0-09	BL0-09	BL0-06	BL0-06
					bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
					2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	78	79	67	87	60	59	57	60	70	64	68	60	60	60
	pH (lab)	pH	6.5 - 9.0	-	7.77	7.81	7.68	7.78	7.64	7.68	7.61	7.70	7.71	7.72	7.72	7.67	7.65	7.61
	Hardness (as $CaCO_3$)	mg/L	-	-	38	38	32	41	27	28	28	28	34	31	32	28	27	28
	Total Suspended Solids (TSS)	mg/L	-	-	2.4	<2.0	2.0	<2.0	<2.0	2.0	<2.0	<2.0	<2.0	2.0	2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	43	38	52	48	33	43	35	40	50	45	38	29	38	48
	Turbidity	NTU	-	-	4.0	3.9	3.2	4.3	2.0	1.9	1.3	0.9	3.2	2.0	3.0	1.9	2.1	2.1
	Alkalinity (as $CaCO_3$)	mg/L	-	-	32	31	29	37	25	25	25	26	30	27	28	27	28	27
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	0.023	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.27	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.3	1.3	1.3	1.2	1.3	1.3	1.4	1.4	1.3	1.2	1.3	1.3	1.3	1.3
	Total Organic Carbon	mg/L	-	-	1.4	1.6	1.4	1.4	1.5	1.4	1.5	1.5	1.5	1.5	1.5	1.5	1.7	1.5
	Total Phosphorus	mg/L	0.020[α]	-	0.0079	0.0075	0.0099	0.0074	0.0074	0.0080	0.0073	0.0076	0.0078	0.0086	0.0069	0.0064	0.0117	0.0092
	Phenols	mg/L	0.004[α]	-	0.0015	0.0013	<0.0010	0.0022	0.0018	0.0016	0.0011	0.0012	<0.0010	<0.0010	0.0012	0.0012	0.0058	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.5	1.5	1.4	1.7	1.4	1.4	1.3	1.3	1.5	1.4	1.5	1.4	1.4	1.4
	Sulphate (SO_4)	mg/L	218[β]	218	2.8	2.8	1.9	3.0	1.3	1.3	0.9	0.9	2.2	1.6	1.9	1.4	1.4	1.4
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.094	0.079	0.074	0.086	0.046	0.044	0.033	0.022	0.075	0.050	0.039	0.049	0.050	0.046
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0052	0.0054	0.0045	0.0061	0.0038	0.0038	0.0034	0.0038	0.0049	0.0044	0.0044	0.0039	0.0041	0.0039
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<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 (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	8	8	7	9	6	6	6	6	7	6	7	6	6	6
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<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 (Cu)	mg/L	0.002	0.0024	0.00073	0.00070	0.0006	0.0008	0.00057	0.00058	0.00067	0.00181	0.0006	0.00056	0.0005	0.00067	0.00066	0.00055
	Iron (Fe)	mg/L	0.30	0.326	0.102	0.088	0.082	0.092	0.057	0.054	0.045	<0.030	0.088	0.060	<0.030	0.053	0.058	0.057
	Lead (Pb)	mg/L	0.001	0.001	0.000101	0.000096	0.000085	0.000099	0.000060	0.000061	0.000085	<0.000050	0.000092	0.000068	<0.000050	0.000063	0.000065	0.000067
	Lithium (Li)	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	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.4	4.4	3.7	4.7	3.2	3.3	3.3	3.3	3.9	3.5	3.9	3.3	3.3	3.2
	Manganese (Mn)	mg/L	0.935[β]	-	0.0040	0.0040	0.0036	0.0034	0.0027	0.0025	0.0025	0.0018	0.0036	0.0031	0.0011	0.0025	0.0025	0.0025
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00013	0.00015	0.00011	0.00021	0.00010	0.00010	0.00009	0.00010	0.00013	0.00011	0.00012	0.00011	0.00010	0.00010
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.59	0.60	0.54	0.68	0.49	0.49	0.46	0.46	0.55	0.51	0.56	0.50	0.49	0.48
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.77	0.69	0.59	0.81	0.43	0.44	0.39	0.37	0.63	0.49	0.51	0.45	0.44	0.44
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.9	0.9	0.8	1.0	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.7	0.7	0.7
	Strontium (Sr)	mg/L	-	-	0.00701	0.00724	0.00592	0.00847	0.00494	0.00487	0.00471	0.00486	0.00625	0.00544	0.00590	0.00494	0.00496	0.00510
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0006	0.0006	0.0004	0.0006	0.0003	0.0003	0.0003	0.0003	0.0005	0.0004	0.0002	0.0003	0.0003	0.0003
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intinisik (2013) using baseline water quality data specific to Mary Lake.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.78: Water Chemistry at Mary Lake South Basin (BLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event													
					BL0-05-A	BL0-05-A	BL0-05	BL0-05	BL0-05-B	BL0-05-B	BL0-03	BL0-03	BL0-04	BL0-04	BL0-09	BL0-09	BL0-06	BL0-06
					bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
					25-Aug-18	25-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18
Conventionals	Conductivity (lab)	umho/cm	-	-	82	82	75	77	76	72	74	74	75	75	75	75	76	76
	pH (lab)	pH	6.5 - 9.0	-	7.73	7.72	7.85	7.86	7.90	7.87	7.75	7.76	7.72	7.72	7.70	7.72	7.58	7.73
	Hardness (as $CaCO_3$)	mg/L	-	-	38	38	41	35	36	36	36	35	36	34	34	34	35	35
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	60	35	38	190	40	42	50	60	50	30	175	40	40	50
	Turbidity	NTU	-	-	1.4	1.4	1.4	1.5	1.6	1.5	0.7	0.9	1.3	1.3	1.8	1.0	1.6	1.3
	Alkalinity (as $CaCO_3$)	mg/L	-	-	37	36	35	35	35	33	30	34	95	56	32	33	34	34
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	0.022	0.021	0.062	0.045	<0.020	0.03	0.023	0.048	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.12	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.8	1.8	1.5	1.5	1.4	1.4	1.9	1.9	1.7	1.7	1.8	1.8	1.7	1.7
	Total Organic Carbon	mg/L	-	-	2.2	2.0	1.6	1.6	1.8	1.1	2.4	2.3	2.2	2.3	2.3	2.3	2.7	2.3
	Total Phosphorus	mg/L	0.020^{α}	-	0.0048	0.0051	0.0092	0.0056	0.0052	0.0051	0.0060	0.0041	0.0061	<0.0030	0.0039	0.0045	0.0057	0.0038
	Phenols	mg/L	0.004^{α}	-	<0.0010	0.0010	0.0012	0.0011	0.0010	0.0011	0.0014	0.0019	<0.0010	0.0014	<0.0010	<0.0010	<0.0010	0.0014
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.9	1.9	1.6	1.7	1.7	1.7	1.4	1.4	1.6	1.6	1.6	1.6	1.7	1.7
	Sulphate (SO_4)	mg/L	218^{β}	218	3.1	3.1	2.5	2.6	2.6	2.6	1.4	1.3	2.5	2.5	2.6	2.4	2.9	2.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.049	0.032	0.053	0.039	0.040	0.038	0.023	0.021	0.042	0.034	0.041	0.037	0.052	0.044
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<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 (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0045	0.0047	0.0051	0.0044	0.0044	0.0044	0.0044	0.0043	0.0044	0.0042	0.0043	0.0043	0.0047	0.0043
	Beryllium (Be)	mg/L	0.011^{α}	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<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 (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	8	8	8	7	7	7	7	7	7	7	7	7	7	7
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	<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 (Cu)	mg/L	0.002	0.0024	0.0006	0.0006	0.0007	0.0006	0.00055	0.0006	0.00059	0.0006	0.0007	0.0006	0.00059	0.0005	0.0006	0.0006
	Iron (Fe)	mg/L	0.30	0.326	0.046	0.035	0.045	0.039	0.039	0.036	<0.030	<0.030	0.038	0.031	0.035	0.033	0.049	0.039
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.000058	<0.000050	<0.000050	0.000075	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000055	<0.000050
	Lithium (Li)	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	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.7	4.6	5.0	4.2	4.2	4.3	4.1	4.3	4.3	4.3	4.3	4.1	4.4	4.4
	Manganese (Mn)	mg/L	0.935^{β}	-	0.0038	0.0031	0.0035	0.0026	0.0028	0.0027	0.0016	0.0015	0.0028	0.0023	0.0027	0.0023	0.0032	0.0028
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00015	0.00015	0.00018	0.00011	0.00012	0.00012	0.00012	0.00009	0.00011	0.00012	0.00012	0.00012	0.00013	0.00012
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.58	0.55	0.61	0.55	0.53	0.54	0.50	0.50	0.54	0.53	0.53	0.53	0.55	0.54
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.54	0.50	0.58	0.47	0.50	0.49	0.45	0.44	0.49	0.48	0.49	0.50	0.53	0.51
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.9	0.9	1.0	0.8	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	Strontium (Sr)	mg/L	-	-	0.007	0.007	0.007	0.006	0.006	0.006	0.006	0.005	0.006	0.006	0.006	0.006	0.006	0.006
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0005	0.0005	0.0006	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intinsik (2013) using baseline water quality data specific to Mary Lake.

▨ Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.79: Dissolved Metal Concentrations at Mary Lake South Basin Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Winter Sampling Event													
			BL0-05-A	BL0-05-A	BL0-05	BL0-05	BL0-05-B	BL0-05-B	BL0-03	BL0-03	BL0-04	BL0-04	BL0-09	BL0-09	BL0-06	BL0-06
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	15-Apr-18	4/15/2018	15-Apr-18	16-Apr-18	16-Apr-18	16-Apr-18	16-Apr-18	15-Apr-18	15-Apr-18
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	0.0034	<0.0030	0.00300	0.0033	0.0036	0.0031	0.0044	<0.0030	0.0039	0.0041	0.0042	<0.0030	0.0031
	Antimony (Sb)	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	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00434	0.00491	0.00420	0.00466	0.00510	0.00503	0.00441	0.00477	0.00414	0.00503	0.00435	0.00480	0.00476	0.00481
	Beryllium (Be)	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	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010
	Calcium (Ca)	mg/L	7.67	8.44	7.70	8.51	8.63	8.84	7.87	8.58	7.44	8.65	7.40	8.60	8.76	8.60
	Chromium (Cr)	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	<0.00050	<0.00050
	Cobalt (Co)	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	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00064	0.00065	0.00059	0.00065	0.00069	0.00069	0.00060	0.00063	0.00060	0.00067	0.00059	0.00107	0.00065	0.00067
	Iron (Fe)	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	<0.030	<0.030
	Lead (Pb)	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	<0.000050	<0.000050
	Lithium (Li)	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	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	5.01	5.08	4.71	5.34	5.37	5.40	4.88	5.23	4.66	5.39	4.82	5.38	5.29	5.23
	Manganese (Mn)	mg/L	0.000366	0.000322	0.000349	0.000323	0.000391	0.000453	0.000291	0.000390	0.000345	0.000337	0.000514	0.000648	0.000525	0.000348
	Mercury (Hg)	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	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000151	0.000157	0.000146	0.000166	0.000159	0.000169	0.000150	0.000152	0.000137	0.000163	0.000140	0.000161	0.000150	0.000159
	Nickel (Ni)	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	<0.00050	<0.00050
	Potassium (K)	mg/L	0.58	0.63	0.57	0.63	0.65	0.65	0.59	0.63	0.55	0.65	0.56	0.65	0.64	0.65
	Selenium (Se)	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	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.41	0.44	0.40	0.43	0.45	0.45	0.42	0.44	0.42	0.46	0.67	0.45	0.45	0.45
	Silver (Ag)	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	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.19	1.20	1.12	1.22	1.32	1.31	1.19	1.21	1.10	1.31	1.21	1.29	1.29	1.23
	Strontium (Sr)	mg/L	0.00605	0.00624	0.00569	0.00635	0.00638	0.00681	0.00588	0.00634	0.00558	0.00647	0.00565	0.00653	0.00652	0.00672
	Thallium (Tl)	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	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00034	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010
	Uranium (U)	mg/L	0.000463	0.000515	0.000450	0.000539	0.000553	0.000529	0.000459	0.000515	0.000445	0.000534	0.000395	0.000538	0.000521	0.000519
	Vanadium (V)	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	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	0.00330	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.79: Dissolved Metal Concentrations at Mary Lake South Basin Water Quality Monitoring Stations, Mary River Project CREMP, 2018

Parameters		Units	Summer Sampling Event							Summer Sampling Event						
			BL0-05-A	BL0-05-A	BL0-05	BL0-05	BL0-05-B	BL0-05-B	BL0-03	BL0-03	BL0-04	BL0-04	BL0-09	BL0-09	BL0-06	BL0-06
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18	2-Aug-18
Dissolved Metals	Aluminum (Al)	mg/L	0.0253	0.0182	0.0209	0.0405	0.0042	0.0050	0.0044	0.0086	0.0099	0.0067	0.0175	0.0049	0.0136	0.0061
	Antimony (Sb)	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	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00471	0.00490	0.00394	0.00566	0.00338	0.00337	0.00327	0.00347	0.00461	0.00417	0.00441	0.00340	0.00366	0.00382
	Beryllium (Be)	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	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010
	Calcium (Ca)	mg/L	7.88	8.03	6.76	8.96	5.76	5.99	5.94	5.99	7.28	6.73	6.73	5.74	5.91	5.83
	Chromium (Cr)	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	<0.00050	<0.00050
	Cobalt (Co)	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	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00058	0.00062	0.00052	0.00097	<0.00050	<0.00050	<0.00050	<0.00050	0.00053	<0.00050	0.00054	<0.00050	0.0008	<0.00050
	Iron (Fe)	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	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	0.00006	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	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	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	4.37	4.36	3.73	4.54	3.05	3.13	3.17	3.16	3.83	3.49	3.64	3.24	3.04	3.31
	Manganese (Mn)	mg/L	0.002050	0.002340	0.001230	0.001910	0.000625	0.000683	0.000453	0.000638	0.001400	0.001010	0.001465	0.000740	0.000798	0.000744
	Mercury (Hg)	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	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000157	0.000162	0.000130	0.000213	0.000105	0.000106	0.000106	0.000094	0.000122	0.000116	0.000110	0.000098	0.000105	0.000111
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	0.0007	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.57	0.59	0.52	0.64	0.45	0.46	0.44	0.44	0.53	0.49	0.51	0.47	0.46	0.47
	Selenium (Se)	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	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.62	0.60	0.47	0.71	0.35	0.36	0.33	0.35	0.51	0.40	0.46	0.37	0.38	0.36
	Silver (Ag)	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	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.88	0.90	0.79	1.01	0.70	0.72	0.70	0.70	0.81	0.77	0.79	0.73	0.70	0.73
	Strontium (Sr)	mg/L	0.00710	0.00730	0.00594	0.00844	0.00486	0.00494	0.00467	0.00468	0.00625	0.00556	0.00571	0.00478	0.00490	0.00478
	Thallium (Tl)	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	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010
	Uranium (U)	mg/L	0.000541	0.000557	0.000410	0.000657	0.000316	0.000327	0.000293	0.000314	0.000422	0.000372	0.000393	0.000313	0.000315	0.000313
	Vanadium (V)	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	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	0.0045	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.79: Dissolved Metal Concentrations at Mary Lake South Basin Water Quality Monitoring Stations, Mary River Project CREMP, 2018

	Parameters	Units	Fall Sampling Event													
			BL0-05-A	BL0-05-A	BL0-05	BL0-05	BL0-05-B	BL0-05-B	BL0-03	BL0-03	BL0-04	BL0-04	BL0-09	BL0-09	BL0-06	BL0-06
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			25-Aug-18	25-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18
Dissolved Metals	Aluminum (Al)	mg/L	0.0166	0.0137	0.0177	0.0133	0.0160	0.0147	0.0101	0.0084	0.0149	0.0121	0.0113	0.0137	0.0158	0.0278
	Antimony (Sb)	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	<0.00010	<0.00010
	Arsenic (As)	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	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00452	0.00438	0.00496	0.00410	0.00410	0.00427	0.00418	0.00408	0.00422	0.00413	0.00407	0.00412	0.00417	0.00457
	Beryllium (Be)	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	<0.00050	<0.00050
	Bismuth (Bi)	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	<0.00050	<0.00050
	Boron (B)	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	<0.010	<0.010
	Cadmium (Cd)	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	<0.000010	<0.000010
	Calcium (Ca)	mg/L	7.79	7.70	8.40	7.09	7.59	7.26	7.28	7.15	7.07	7.20	6.98	7.15	7.15	7.27
	Chromium (Cr)	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	<0.00050	<0.00050
	Cobalt (Co)	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	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00055	0.00055	0.00057	0.00053	0.00054	0.00054	0.00053	0.00056	0.00056	0.00052	0.00051	0.00052	0.00055	0.00054
	Iron (Fe)	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	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000095	<0.000050	<0.000050
	Lithium (Li)	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	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	4.57	4.68	4.83	4.14	4.15	4.26	4.22	4.19	4.38	3.94	3.92	4.03	4.15	4.21
	Manganese (Mn)	mg/L	0.001350	0.001170	0.001510	0.000736	0.000769	0.000822	0.000242	0.000270	0.000566	0.000571	0.000454	0.000542	0.000603	0.000820
	Mercury (Hg)	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	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000148	0.000148	0.000165	0.000108	0.000129	0.000149	0.000127	0.000121	0.000130	0.000130	0.000125	0.000118	0.000120	0.000128
	Nickel (Ni)	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	<0.00050	<0.00050
	Potassium (K)	mg/L	0.54	0.55	0.58	0.51	0.52	0.52	0.48	0.48	0.52	0.52	0.49	0.50	0.52	0.54
	Selenium (Se)	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	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.47	0.45	0.50	0.43	0.44	0.44	0.42	0.42	0.45	0.43	0.44	0.42	0.45	0.47
	Silver (Ag)	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	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.92	0.91	0.97	0.86	0.86	0.86	0.84	0.84	0.85	0.82	0.77	0.82	0.89	0.85
	Strontium (Sr)	mg/L	0.00663	0.00644	0.00725	0.00581	0.00617	0.00595	0.00542	0.00536	0.00572	0.00597	0.00582	0.00571	0.00600	0.00607
	Thallium (Tl)	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	<0.00010	<0.00010
	Tin (Sn)	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	<0.00010	<0.00010
	Titanium (Ti)	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	<0.010	<0.010
	Uranium (U)	mg/L	0.000538	0.000533	0.000669	0.000448	0.000434	0.000451	0.000404	0.000400	0.000441	0.000431	0.000421	0.000429	0.000452	0.000451
	Vanadium (V)	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	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030

Table C.80: Spearman's Rank Correlation Coefficients for Mary Lake South Basin (BLO) Water Quality Data Collected in Winter, Summer, and Fall 2018[a]

Parameters	Conventional Parameters									Total Metals										
	Conduct-ivity	Hardness	Total Dissolved Solids	Turbidity	Alkalinity	Dissolved Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Iron	Manganese	Molybdenum	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	1	0.935	0.354	-0.450	0.828	0.336	-0.611	0.916	0.341	-0.397	0.756	0.398	-0.394	-0.103	0.856	0.880	0.237	0.936	0.771	0.824
Hardness	0.935	1	0.318	-0.500	0.793	0.242	-0.523	0.846	0.259	-0.408	0.772	0.446	-0.424	-0.122	0.882	0.891	0.213	0.943	0.764	0.849
Total Dissolved Solids	0.354	0.318	1	-0.120	0.287	0.181	-0.166	0.263	0.147	-0.083	0.343	0.082	-0.113	0.053	0.133	0.281	0.130	0.229	0.252	0.278
Turbidity	-0.450	-0.500	-0.120	1	0	-0.391	0.756	-0.518	0.466	0.909	0.057	-0.238	0.874	0.699	-0.233	-0.191	0.500	-0.572	0.052	-0.092
Alkalinity	0.828	0.793	0.287	0	1	0.484	-0.594	0.796	0.391	-0.362	0.566	0.224	-0.390	-0.072	0.696	0.697	0.190	0.814	0.640	0.705
Dissolved Organic Carbon	0.336	0.242	0.181	-0.391	0.484	1	-0.484	0.272	0.228	-0.285	0.109	-0.167	-0.390	-0.124	0.193	0.089	-0.010	0.322	0.199	0.178
Total Phosphorus	-0.611	-0.523	-0.166	0.756	-0.594	-0.484	1	-0.674	0.080	0.751	-0.074	-0.105	0.750	0.554	-0.392	-0.340	0.170	-0.688	-0.184	-0.206
Chloride	0.916	0.846	0.263	-0.518	0.796	0.272	-0.674	1	0.288	-0.486	0.625	0.263	-0.470	-0.185	0.807	0.807	0.168	0.907	0.635	0.690
Sulphate	0.341	0.259	0.147	0.466	0.391	0.228	0.080	0.288	1	0.516	0.574	-0.172	0.416	0.647	0.473	0.421	0.768	0.204	0.677	0.590
Aluminum (total)	-0.397	-0.408	-0.083	0.909	-0.362	-0.285	0.751	-0.486	0.516	1	0.137	-0.128	0.928	0.806	-0.149	-0.146	0.609	-0.495	0.085	0.023
Barium (total)	0.756	0.772	0.343	0.057	0.566	0.109	-0.074	0.625	0.574	0.137	1	0.355	0.079	0.352	0.822	0.903	0.631	0.671	0.898	0.885
Copper (total)	0.398	0.446	0.082	-0.238	0.224	-0.167	-0.105	0.263	-0.172	-0.128	0.355	1	-0.092	-0.013	0.379	0.443	-0.018	0.384	0.249	0.388
Iron (total)	-0.394	-0.424	-0.113	0.874	-0.390	-0.390	0.750	-0.470	0.416	0.928	0.079	-0.092	1	0.746	-0.181	-0.192	0.448	-0.509	0.043	0.033
Manganese (total)	-0.103	-0.122	0.053	0.699	-0.072	-0.124	0.554	-0.185	0.647	0.806	0.352	-0.013	0.746	1	0.051	0.055	0.647	-0.204	0.320	0.292
Molybdenum (total)	0.856	0.882	0.133	-0.233	0.696	0.193	-0.392	0.807	0.473	-0.149	0.822	0.379	-0.181	0.051	1	0.897	0.425	0.851	0.861	0.866
Potassium (total)	0.880	0.891	0.281	-0.191	0.697	0.089	-0.340	0.807	0.421	-0.146	0.903	0.443	-0.192	0.055	0.897	1	0.437	0.840	0.860	0.866
Silicon (total)	0.237	0.213	0.130	0.500	0.190	-0.010	0.170	0.168	0.768	0.609	0.631	-0.018	0.448	0.647	0.425	0.437	1	0.174	0.596	0.440
Sodium (total)	0.936	0.943	0.229	-0.572	0.814	0.322	-0.688	0.907	0.204	-0.495	0.671	0.384	-0.509	-0.204	0.851	0.840	0.174	1	0.689	0.748
Strontium (total)	0.771	0.764	0.252	0.052	0.640	0.199	-0.184	0.635	0.677	0.085	0.898	0.249	0.043	0.320	0.861	0.860	0.596	0.689	1	0.908
Uranium (total)	0.824	0.849	0.278	-0.092	0.705	0.178	-0.206	0.690	0.590	0.023	0.885	0.388	0.033	0.292	0.866	0.866	0.440	0.748	0.908	1
Aluminum (dissolved)	-0.163	-0.234	-0.019	0.666	-0.070	0.086	0.409	-0.296	0.692	0.687	0.184	-0.296	0.536	0.617	-0.073	-0.052	0.673	-0.307	0.235	0.148
Barium (dissolved)	0.837	0.788	0.256	-0.129	0.608	0.186	-0.353	0.727	0.459	-0.162	0.847	0.254	-0.186	0.074	0.795	0.854	0.450	0.744	0.796	0.756
Copper (dissolved)	0.788	0.756	0.221	-0.344	0.577	0.221	-0.405	0.641	0.121	-0.353	0.610	0.447	-0.336	-0.210	0.671	0.727	0.110	0.718	0.592	0.617
Manganese (dissolved)	-0.189	-0.283	-0.097	0.805	-0.246	-0.208	0.614	-0.310	0.528	0.797	0.242	-0.104	0.729	0.685	-0.031	-0.004	0.621	-0.355	0.235	0.127
Molybdenum (dissolved)	0.906	0.859	0.349	-0.286	0.744	0.183	-0.465	0.775	0.364	-0.290	0.753	0.353	-0.226	0.013	0.762	0.804	0.288	0.825	0.757	0.790
Potassium (dissolved)	0.939	0.887	0.357	-0.333	0.722	0.213	-0.479	0.828	0.307	-0.299	0.827	0.416	-0.274	-0.052	0.822	0.904	0.308	0.867	0.779	0.799
Silicon (dissolved)	0.577	0.513	0.245	0.129	0.442	0.161	-0.175	0.445	0.572	0.177	0.768	0.165	0.072	0.303	0.587	0.672	0.795	0.482	0.713	0.603
Sodium (dissolved)	0.957	0.943	0.341	-0.545	0.748	0.244	-0.627	0.901	0.208	-0.482	0.708	0.379	-0.470	-0.199	0.829	0.858	0.192	0.929	0.712	0.762
Strontium (dissolved)	0.821	0.748	0.329	-0.014	0.685	0.286	-0.271	0.659	0.636	0.014	0.871	0.280	0.011	0.262	0.782	0.841	0.527	0.683	0.907	0.882
Uranium (dissolved)	0.876	0.840	0.237	-0.189	0.731	0.314	-0.380	0.711	0.550	-0.131	0.790	0.270	-0.131	0.127	0.829	0.822	0.376	0.783	0.867	0.902

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 42.

🟩 Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

🟦 Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

Table C.80: Spearman's Rank Correlation Coefficients for Mary Lake South Basin (BLO) Water Quality Data Collected in Winter, Summer, and Fall 2018[a]

Parameters	Dissolved Metals									
	Aluminum	Barium	Copper	Manganese	Molybdenum	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	-0.163	0.837	0.788	-0.189	0.906	0.939	0.577	0.957	0.821	0.876
Hardness	-0.234	0.788	0.756	-0.283	0.859	0.887	0.513	0.943	0.748	0.840
Total Dissolved Solids	-0.019	0.256	0.221	-0.097	0.349	0.357	0.245	0.341	0.329	0.237
Turbidity	0.666	-0.129	-0.344	0.805	-0.286	-0.333	0.129	-0.545	-0.014	-0.189
Alkalinity	-0.070	0.608	0.577	-0.246	0.744	0.722	0.442	0.748	0.685	0.731
Dissolved Organic Carbon	0.086	0.186	0.221	-0.208	0.183	0.213	0.161	0.244	0.286	0.314
Total Phosphorus	0.409	-0.353	-0.405	0.614	-0.465	-0.479	-0.175	-0.627	-0.271	-0.380
Chloride	-0.296	0.727	0.641	-0.310	0.775	0.828	0.445	0.901	0.659	0.711
Sulphate	0.692	0.459	0.121	0.528	0.364	0.307	0.572	0.208	0.636	0.550
Aluminum (total)	0.687	-0.162	-0.353	0.797	-0.290	-0.299	0.177	-0.482	0.014	-0.131
Barium (total)	0.184	0.847	0.610	0.242	0.753	0.827	0.768	0.708	0.871	0.790
Copper (total)	-0.296	0.254	0.447	-0.104	0.353	0.416	0.165	0.379	0.280	0.270
Iron (total)	0.536	-0.186	-0.336	0.729	-0.226	-0.274	0.072	-0.470	0.011	-0.131
Manganese (total)	0.617	0.074	-0.210	0.685	0.013	-0.052	0.303	-0.199	0.262	0.127
Molybdenum (total)	-0.073	0.795	0.671	-0.031	0.762	0.822	0.587	0.829	0.782	0.829
Potassium (total)	-0.052	0.854	0.727	-0.004	0.804	0.904	0.672	0.858	0.841	0.822
Silicon (total)	0.673	0.450	0.110	0.621	0.288	0.308	0.795	0.192	0.527	0.376
Sodium (total)	-0.307	0.744	0.718	-0.355	0.825	0.867	0.482	0.929	0.683	0.783
Strontium (total)	0.235	0.796	0.592	0.235	0.757	0.779	0.713	0.712	0.907	0.867
Uranium (total)	0.148	0.756	0.617	0.127	0.790	0.799	0.603	0.762	0.882	0.902
Aluminum (dissolved)	1	0.105	-0.106	0.757	-0.011	-0.089	0.510	-0.227	0.282	0.194
Barium (dissolved)	0.105	1	0.735	0.144	0.855	0.897	0.763	0.803	0.871	0.847
Copper (dissolved)	-0.106	0.735	1	-0.147	0.757	0.803	0.499	0.796	0.647	0.705
Manganese (dissolved)	0.757	0.144	-0.147	1	-0.033	-0.038	0.440	-0.248	0.293	0.139
Molybdenum (dissolved)	-0.011	0.855	0.757	-0.033	1	0.926	0.640	0.875	0.857	0.885
Potassium (dissolved)	-0.089	0.897	0.803	-0.038	0.926	1	0.683	0.932	0.870	0.872
Silicon (dissolved)	0.510	0.763	0.499	0.440	0.640	1	1	0.549	0.787	0.666
Sodium (dissolved)	-0.227	0.803	0.796	-0.248	0.875	0.932	0.549	1	0.747	0.825
Strontium (dissolved)	0.282	0.871	0.647	0.293	0.857	0.870	0.787	0.747	1	0.932
Uranium (dissolved)	0.194	0.847	0.705	0.139	0.885	0.872	0.666	0.825	0.932	1

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 42.

🟩 Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

🟦 Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

APPENDIX D

SEDIMENT QUALITY DATA

Table D.1: Field Observations of Sediment Properties at Reference Lake 3 (REF-03) Benthic Stations [a], Mary River Project CREMP, August 2018

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
REF-03-1	10.5	thin oxidized layer of reddish silt over light grey-brown coloured silt; some organics	none detected	sparse bryophytes, sparse algae (mare's eggs)
REF-03-2	9.1	thin surficial oxidized reddish layer over grey-brown coloured silt	none detected	sparse byrophytes
REF-03-3	9.8	light brown-coloured silt with some sand intermixed	none detected	none observed
REF-03-4	8.4	medium brown-grey coloured silt with some sand intermixed at greater depth	none detected	sparse algae (mare's eggs)
REF-03-5	11.2	oxidized orange layer over medium grey-coloured silt; sediment grey-green at greater depths	none detected	sparse algae (mare's eggs)
REF-03-6	22.5	medium brown-coloured silt	none detected	none observed
REF-03-7	25.0	medium brown-coloured silt	none detected	none observed
REF-03-8	18.0	iron oxide layer at sediment surface (1 cm thick), occurring as ferricrete layer at greater depth, and with reduced sediment layer occurring below; mostly silt, but some fine sand intermixed	blackened sediment present	none observed
REF-03-9	21.1	medium brown-coloured silt	none detected	none observed
REF-03-10	19.2	reddish oxidized layer at sediment surface and at approximately 3 cm below surface occurring as ferricrete layer with reduced substrate below; silt material	blackened sediment present	sparse algae (mare's eggs)

[a] Sediment particle size and benthic invertebrate community samples were collected by Petite Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.2: Observations from Sediment Cores Collected at Reference Lake 3 (REF-03), Mary River Project CREMP, August 2018

Sample Station	Station Depth (m)	Station Type	Core Number	Core Length (cm)	Surficial Substrate Texture Description
REF-03-1	8.0	Littoral	1	16	reddish-brown sandy loam; grey silt beginning at 2 cm depth, with ome evidence of anoxia for deep sediment
			2	21	
			3	11	
			4	33	
REF-03-6	20.0	Profundal	1	13	brown-coloured loam, becoming more compact with depth; grey silt beginning at depth from 11 to 16 cm
			2	16	
			3	14	
			4	16	
REF-03-2	9.4	Littoral	1	32	reddish-brown sandy loam; grey silt beginning at 2 cm depth and deeper
			2	27	
			3	33	
			4	36	
REF-03-7	24.0	Profundal	1	23	brown-coloured loam, becoming more compact with depth; grey silt beginning at depth from 6 to 19 cm
			2	22	
			3	22	
			4	12	
REF-03-3	10.2	Littoral	1	22	brown-coloured sandy loam, becoming more compact with depth; grey silt beginning at depth of 11 to 13 cm
			2	18	
			3	17	
			4	not measured	
REF-03-8	18.5	Profundal	1	22	brown-coloured loam, becoming more compact with depth; grey silt beginning at depth from 11 to 25 cm
			2	17	
			3	32	
			4	28	
REF-03-4	9.3	Littoral	1	16	reddish-brown sandy loam; grey silt beginning at depth from 2 to 7 cm
			2	15	
			3	8	
			4	22	
REF-03-9	20.1	Profundal	1	24	brown-coloured loam; multiple layers, including oxidized reddish material at greater depth
			2	30	
			3	16	
			4	14	
REF-03-5	11.1	Littoral	1	26	oxidized red-brown floc over dark gray-brown sandy loam; grey silt beginning from 9 to 14 cm below surface
			2	27	
			3	29	
			4	32	
REF-03-10	19.5	Profundal	1	28	brown-coloured loam; multiple layers, including oxidized reddish material at greater depth
			2	11	
			3	11	
			4	17	

Table D.3: Statistical Comparison of Substrate Physical Properties between Littoral and Profundal Sediment Stations of Individual Study Lakes, Mary River Project CREMP, August 2018

Lake	Sediment Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Station Type	N	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Camp Lake	Sand (% by weight)	NO	0.240	γ	Littoral	5	59.7	20.3	9.1	34.5	79.2
					Profundal	9	42.8	26.8	8.9	19.3	89.8
	Silt (% by weight)	NO	0.438	γ	Littoral	5	36.9	18.7	8.4	18.6	60.6
					Profundal	9	47.6	21.9	7.3	8.3	68.8
	Clay (% by weight)	YES	0.032	α	Littoral	5	3.4	1.6	0.7	1.6	5.2
					Profundal	9	9.6	5.5	1.8	1.3	17.6
	TOC (%)	NO	0.416	α	Littoral	5	1.5	0.9	0.4	0.7	2.9
					Profundal	9	1.1	0.7	0.2	0.1	2.3
Sheardown Lake NW	Sand (% by weight)	YES	0.056	β	Littoral	7	38.9	16.2	6.1	24.6	68.8
					Profundal	7	23.1	15.7	5.9	11.0	55.2
	Silt (% by weight)	NO	0.137	α	Littoral	7	49.6	13.7	5.2	27.0	63.4
					Profundal	7	61.1	13.2	5.0	34.1	72.8
	Clay (% by weight)	YES	0.060	α	Littoral	7	11.5	3.7	1.4	4.2	16.9
					Profundal	7	15.8	4.1	1.5	10.7	21.0
	TOC (%)	YES	0.091	α	Littoral	7	3.0	1.4	0.5	0.9	4.9
					Profundal	7	1.9	0.9	0.3	0.5	3.4
Sheardown Lake SE	Sand (% by weight)	NO	0.718	α	Littoral	5	12.8	5.6	2.5	7.9	22.0
					Profundal	5	14.0	4.8	2.2	7.1	18.8
	Silt (% by weight)	NO	0.421	γ	Littoral	5	73.7	4.5	2.0	67.7	77.6
					Profundal	5	71.0	3.7	1.6	68.8	77.5
	Clay (% by weight)	NO	0.398	α	Littoral	5	13.6	2.3	1.0	10.3	16.4
					Profundal	5	15.0	2.6	1.2	12.3	18.2
	TOC (%)	NO	0.502	α	Littoral	5	1.3	0.4	0.2	0.9	1.9
					Profundal	5	1.2	0.1	0.1	1.0	1.4
Mary Lake	Sand (% by weight)	NO	0.706	β	Littoral	4	16.7	17.7	8.8	3.6	41.0
					Profundal	10	20.7	21.9	6.9	2.6	71.7
	Silt (% by weight)	NO	0.409	α	Littoral	4	64.0	9.5	4.8	50.5	72.8
					Profundal	10	55.6	18.4	5.8	16.8	77.4
	Clay (% by weight)	NO	0.539	γ	Littoral	4	19.3	12.4	6.2	8.6	30.5
					Profundal	10	23.8	11.4	3.6	8.5	43.5
	TOC (%)	NO	0.186	α	Littoral	4	1.1	0.2	0.1	0.8	1.3
					Profundal	10	0.9	0.2	0.1	0.4	1.3

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data logit transformed, single factor ANOVA test conducted; γ - data non-normal, Mann Whitney U-test conducted; and, δ - data untransformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between habitat types based on ANOVA p-value less than 0.10.

Table D.4: **Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Reference Lake 3 (REF-03) Sediment Stations, Mary River Project CREMP, August 2018**

Parameter		Units	Sediment Quality Guideline (SQG)[a]	Reference Lake 3 Station										Study Area Summary Statistics		
				REF-03-1 (littoral)	REF-03-6 (profundal)	REF-03-2 (littoral)	REF-03-7 (profundal)	REF-03-3 (littoral)	REF-03-8 (profundal)	REF-03-4 (littoral)	REF-03-9 (profundal)	REF-03-5 (littoral)	REF-03-10 (profundal)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	59.4	49.9	56.6	50.9	60.7	44.5	66.4	47.0	54.9	45.1	53.5	7.3	2.30
	Silt	%	-	29.8	40.4	32.6	33.8	33.5	41.5	26.6	38.7	34.7	40.4	35.2	4.96	1.57
	Clay	%	-	10.80	9.7	10.8	15.3	5.80	14.0	7.00	14.3	10.40	14.5	11.3	3.25	1.03
	Moisture	%	-	90.7	76.7	94.0	87.2	84.7	87.0	72.6	86.8	90.3	87.6	86	6.48	2.05
	Total Organic Carbon	%	10[α]	5.13	0.84	7.37	4.64	3.09	4.89	1.78	4.47	6.14	4.27	4.26	1.94	0.613
Metals	Aluminum (Al)	mg/kg	-	21,400	10,900	20,800	29,000	17,400	28,100	10,400	24,500	19,400	29,600	21,150	6,916	2,187
	Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
	Arsenic (As)	mg/kg	17	7.03	3.03	4.92	7.14	4.09	6.85	2.53	6.18	7.68	7.14	5.66	1.88	0.594
	Barium (Ba)	mg/kg	-	131	72	158	164	101.0	191	61.7	134	212.0	197	142	51.9	16.42
	Beryllium (Be)	mg/kg	-	0.83	0.41	0.82	1.04	0.66	0.99	0.39	0.83	0.70	1.07	0.77	0.24	0.075
	Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	0.21	<0.20	<0.20	<0.20	0.21	0.20	0.0042	0.0013
	Boron (B)	mg/kg	-	13.9	7.8	17.3	16.8	14.1	18.9	8.1	14.1	16.2	20.3	14.8	4.15	1.31
	Cadmium (Cd)	mg/kg	3.5	0.238	0.184	0.217	0.201	0.099	0.204	0.095	0.186	0.324	0.210	0.20	0.066	0.021
	Calcium (Ca)	mg/kg	-	5,620	3,100	6,970	5,920	4,700	6,450	2,850	5,530	7,260	6,920	5,532	1,556	492.0
	Chromium (Cr)	mg/kg	90	74.0	34.6	65.5	89.9	54.5	90.5	30.9	77.4	69.8	93.9	68.1	22.3	7.04
	Cobalt (Co)	mg/kg	-	15.30	8.4	10.30	20.4	11.2	19.8	7.5	17.1	14.2	21.4	14.6	5.09	1.61
	Copper (Cu)	mg/kg	197	94.2	39.1	96.3	118	61.0	111	37.7	97.3	80.2	116.0	85.1	29.9	9.45
	Iron (Fe)	mg/kg	40,000[α]	63,600	23,900	36,300	59,200	35,300	58,100	24,000	49,700	74,300	63,600	48,800	17,818	5,635
	Lead (Pb)	mg/kg	91.3	19.7	8.7	18.7	22.3	14.4	22.5	9.1	20.3	20.2	23.8	18.0	5.43	1.72
	Lithium (Li)	mg/kg	-	30.0	16.8	30.7	42.8	26.3	39.1	15.7	36.6	27.4	45.0	31.0	10.02	3.17
	Magnesium (Mg)	mg/kg	-	13,100	6,870	12,500	18,100	10,400	17,500	6,120	15,600	13,400	18,900	13,249	4,463	1,411
	Manganese (Mn)	mg/kg	1,100[α,β]	803	914	454	1,410	703	1,320	563	1,160	678	1,590	960	388.0	122.7
	Mercury (Hg)	mg/kg	0.486	0.051	0.018	0.062	0.082	0.023	0.076	0.012	0.083	0.069	0.066	0.054	0.027	0.009
	Molybdenum (Mo)	mg/kg	-	6.75	1.59	3.48	2.97	2.57	2.77	1.83	2.39	4.56	3.13	3.20	1.50	0.475
	Nickel (Ni)	mg/kg	75[α,β]	54.9	29.0	47.9	61.3	36.0	61.6	23.2	52.0	52.6	65.2	48.4	14.38	4.55
	Phosphorus (P)	mg/kg	2,000[α]	1,420	769	1,130	1,240	986	1,350	698	1,130	2,290	1,450	1,246	446.6	141.2
	Potassium (K)	mg/kg	-	4,730	2,610	4,880	6,460	4,240	6,640	2,310	5,600	4,510	6,990	4,897	1,595	504.3
	Selenium (Se)	mg/kg	-	0.79	0.20	0.83	0.89	0.48	0.99	0.22	0.97	0.98	0.98	0.73	0.31	0.100
	Silver (Ag)	mg/kg	-	0.18	<0.10	0.20	0.34	<0.10	0.30	<0.10	0.27	0.16	0.30	0.21	0.092	0.029
	Sodium (Na)	mg/kg	-	332	199	401	471	301	530	165	421	400	542	376	128	40.4
	Strontium (Sr)	mg/kg	-	13.3	7.6	14.4	15.6	11.2	15.5	6.9	13.7	15.1	16.7	13.0	3.38	1.07
	Sulphur (S)	mg/kg	-	1800	<1000	2700	1800	<1000	1400	<1000	1500	2400	1300	1,590.0	591.5	187.1
	Thallium (Tl)	mg/kg	-	0.586	0.409	0.460	0.798	0.396	0.890	0.238	0.751	0.569	0.921	0.602	0.231	0.0730
	Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	2.1	<2.0	2.0	<2.0	<2.0	<2.0	2.2	2.0	0.07	0.021
	Titanium (Ti)	mg/kg	-	1,160	801	1,190	1,490	1,140	1,620	726	1,300	1,560	1,730	1,272	336	106.4
	Tungsten (W)	mg/kg	-	<0.50	<0.50	0.51	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	0.00	0.00
	Uranium (U)	mg/kg	-	19.70	9.7	12.1	29.8	9.9	28.2	7.47	23.6	17.7	31.1	18.9	8.95	2.83
	Vanadium (V)	mg/kg	-	73.8	37.2	66.4	84.2	52.5	83.4	34.3	70.7	64.3	88.2	65.5	18.9	5.99
	Zinc (Zn)	mg/kg	315	103.0	45	91.9	117	70.3	115	46.9	98.5	94.7	121	90	27.6	8.74
	Zirconium (Zr)	mg/kg	-	3.6	2.1	4.6	4.6	3.4	4.5	1.9	3.6	6.9	4.6	4.0	1.4	0.5

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

▨ Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.5: **Field Observations of Sediment Properties at Camp Lake (JLO) Benthic Stations[a], Mary River Project CREMP, August 2018**

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
JLO-02	11.3	iron oxide precipitate over grey-brown coloured silt with some sand intermixed	none detected	sparse algae (mare's eggs)
JLO-01	17.8	reddish brown-coloured silt	none detected	none observed
JLO-21	10.0	medium brown-coloured silt with some sand intermixed	none detected	algae common (mare's eggs)
JLO-20	6.6	thin layer of oxidized red material overlying brown-coloured silt with some sand intermixed	none detected	sparse algae (mare's eggs)
JLO-19	7.0	sand	none detected	sparse algae (mare's eggs)
JLO-07	31.4	oxidized floc material overlying light brown-coloured silt	none detected	sparse algae
JLO-18	12.2	terrestrial organics (from eroding banks) intermixed with sand	none detected	sparse algae (mare's eggs)
JLO-16	16.0	brown-coloured silty sand	none detected	sparse algae (mare's eggs)
JLO-11	29.0	red to light brown coloured silt, some layering with dark material at depth	none detected	sparse algae (mare's eggs)
JLO-12	15.3	medium brown-coloured sand with gravel occurring at depth; some oxidized material at sediment surface	none detected	sparse algae (mare's eggs)

[a] Sediment particle size and benthic invertebrate community samples were collected by Petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.6: **Observations from Sediment Cores Collected at Camp Lake (JLO), Mary River Project CREMP, August 2018**

Sample Station	Station Depth (m)	Station Type	Core Number	Core Length (cm)	Surficial Substrate Texture Description
JLO-02	11.3	Littoral	1	approx. 14	reddish-brown coloured silt loam with some organics
			2		
			3		
			4		
JLO-01	16.5	Profundal	1	approx. 16	reddish-brown coloured silt loam
			2		
			3		
			4		
JLO-14	26.1	Profundal	1	14	brown coloured silt loam, some blackened substrate at approximately 10 cm depth
			2	15	
			3	11	
			4	13	
JLO-17	14.4	Profundal	1	approx. 9	reddish-brown coloured silt loam
			2		
			3		
			4		
JLO-07	32.8	Profundal	1	17	reddish-brown coloured silt loam; grey silt sand at depth showing some blackening
			2	22	
			3	9	
			4	20	
JLO-16	16.1	Profundal	1	approx. 7	brown-grey coloured sand with thin oxidized layer at sediment surface
			2		
			3		
			4		
JLO-15	17.3	Profundal	1	approx. 13	reddish-brown coloured loam
			2		
			3		
			4		
JLO-11	28.8	Profundal	1	no information taken	silt loam
			2		
			3		
			4		
JLO-13	16.6	Profundal	1	no information taken	silt loam
			2		
			3		
			4		
JLO-12	16.2	Profundal	1	no information taken	sand
			2		
			3		
			4		

Table D.7: Statistical Comparison of Sediment Physical Properties Between Camp Lake and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

Lake Zone	Sediment Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Sand-Sized Material (%)**	NO	0.992	η	Reference	5	59.6	4.4	2.0	54.9	66.4
					Camp	5	59.7	20.3	9.1	34.5	79.2
	Silt-Sized Material (%)	NO	0.554	η	Reference	5	31.4	3.3	1.5	26.6	34.7
					Camp	5	36.9	18.7	8.4	18.6	60.6
	Clay-Sized Material (%)	YES	0.003	α	Reference	5	9.0	2.4	1.1	5.8	10.8
					Camp	5	3.4	1.6	0.7	1.6	5.2
	Moisture (%)	YES	0.005	α	Reference	5	86.5	8.4	3.8	72.6	94.0
					Camp	5	55.6	15.7	7.0	32.7	71.5
	Total Organic Carbon (TOC) Content (%)	YES	0.031	η	Reference	5	4.7	2.3	1.0	1.8	7.4
					Camp	5	1.5	0.9	0.4	0.7	2.9
Profundal (Deep) Stations	**Sand-Sized Material (%)**	NO	0.112	γ	Reference	5	47.5	2.8	1.3	44.5	50.9
					Camp	9	42.8	26.8	8.9	19.3	89.8
	Silt-Sized Material (%)	NO	0.112	γ	Reference	5	39.0	3.1	1.4	33.8	41.5
					Camp	9	47.6	21.9	7.3	8.3	68.8
	Clay-Sized Material (%)	NO	0.147	γ	Reference	5	13.6	2.2	1.0	9.7	15.3
					Camp	9	9.6	5.5	1.8	1.3	17.6
	Moisture (%)	YES	0.001	γ	Reference	5	85.1	4.7	2.1	76.7	87.6
					Camp	9	51.7	15.6	5.2	22.7	74.5
	Total Organic Carbon (TOC) Content (%)	YES	0.042	γ	Reference	5	3.8	1.7	0.8	0.8	4.9
					Camp	9	1.1	0.7	0.2	0.1	2.3

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data logit- or log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data logit- or log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on statistical p-value less than 0.10.

Table D.8: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Camp Lake (JLO) Sediment Stations, Mary River Project CREMP, August 2018

Parameter		Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Camp Lake Stations										Summary Statistics	
					JLO-02 (littoral)	JLO-01 (profundal)	JLO-14 (profundal)	JLO-17 (profundal)	JLO-07 (profundal)	JLO-16 (profundal)	JLO-15 (profundal)	JLO-11 (profundal)	JLO-13 (profundal)	JLO-12 (profundal)	Mean	Standard Deviation
Non-metals	Sand	%	-	-	44	22	19	35	26	90	44	31	32	87	43	25
	Silt	%	-	-	51	69	63	56	59	8	48	56	58	12	48	21
	Clay	%	-	-	5.2	9.6	18	9.2	15	1.9	8.0	13.4	10.3	1.3	9.2	5.3
	Moisture	%	-	-	72	75	57	50	58	23	55	57	58	31	54	16
	Total Organic Carbon	%	10[α]	-	2.91	1.87	0.93	1.07	1.57	0.18	1.02	2.29	1.31	<0.10	1.33	0.88
Metals	Aluminum (Al)	mg/kg	-	-	18,600	20,900	22,200	18,100	21,000	5,470	16,600	18,100	18,300	7,350	16,662	5,676
	Antimony (Sb)	mg/kg	-	-	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.100	0.000
	Arsenic (As)	mg/kg	17	5.9	***9.6***	***6.0***	***6.5***	5.4	***6.7***	1.0	4.4	3.4	5.1	1.7	5.0	2.5
	Barium (Ba)	mg/kg	-	-	164	86	89	89	111	21	63	70	71	28	79	41
	Beryllium (Be)	mg/kg	-	-	0.89	1.09	1.21	0.99	1.11	0.22	0.78	0.97	0.94	0.34	0.85	0.33
	Bismuth (Bi)	mg/kg	-	-	0.30	0.32	0.32	0.25	0.30	<0.20	0.24	0.32	0.27	<0.20	0.27	0.05
	Boron (B)	mg/kg	-	-	19.7	26.2	28.4	24.2	28.3	7.5	19.9	26.4	23.5	7.8	21.2	7.74
	Cadmium (Cd)	mg/kg	3.5	1.5	0.237	0.208	0.185	0.204	0.281	0.036	0.131	0.226	0.146	0.050	0.17	0.080
	Calcium (Ca)	mg/kg	-	-	5,310	4,630	4,710	4,430	4,850	16,200	3,720	5,540	3,910	1,990	5,529	3,880
	Chromium (Cr)	mg/kg	90	98	76.5	83	88	74.6	83.1	32.1	69.1	74.5	70.6	33.5	68.4	19.6
	Cobalt (Co)	mg/kg	-	-	25.6	20.1	22.5	20.8	23.2	5.47	16.3	14.4	18.2	7.64	17.4	6.62
	Copper (Cu)	mg/kg	197	50	49.6	***53***	***54***	43.2	***51.3***	10.3	38.0	***51.5***	44.2	14.5	40.9	15.8
	Iron (Fe)	mg/kg	40,000[α]	52,400	***65,100***	38,200	40,900	33,100	41,800	12,000	30,900	31,500	33,800	16,900	34,420	14,471
	Lead (Pb)	mg/kg	91.3	35	19.8	24.1	26.3	20.9	23.2	5.07	17.6	21.6	19.9	6.27	18.5	7.18
	Lithium (Li)	mg/kg	-	-	30.4	40.4	38.4	33.4	39.1	8.5	26.6	33.9	31.7	11.1	29.4	11.15
	Magnesium (Mg)	mg/kg	-	-	15,800	14,500	15,700	12,700	14,400	13,700	12,800	14,300	12,600	6,610	13,311	2,618
	Manganese (Mn)	mg/kg	1,100[α,β]	4,370	2,390	1,200	1,140	1,470	2,230	146	814	284	1,800	1,100	1,257	744.6
	Mercury (Hg)	mg/kg	0.486	0.17	0.0418	0.0383	0.0305	0.0214	0.0347	<0.0050	0.0221	0.0519	0.0276	0.0064	0.0280	0.0149
	Molybdenum (Mo)	mg/kg	-	-	2.35	0.96	0.77	1.26	1.33	0.34	0.62	0.55	0.89	0.60	0.97	0.58
	Nickel (Ni)	mg/kg	75[α,β]	72	***83.4***	***77.1***	***74.8***	***73***	***80.6***	31.2	60.3	63.9	63	31.7	63.9	18.7
	Phosphorus (P)	mg/kg	2,000[α]	1,580	***1,650***	1,060	1,160	1,080	1,320	476	931	867	1,010	565	1,012	341
	Potassium (K)	mg/kg	-	-	4,100	4,830	5,490	4,570	5,210	1,390	4,000	4,650	4,440	1,510	4,019	1,427
	Selenium (Se)	mg/kg	-	-	0.48	0.43	0.30	0.32	0.41	<0.20	0.23	0.43	0.23	<0.20	0.32	0.11
	Silver (Ag)	mg/kg	-	-	0.11	0.14	0.16	0.10	0.14	<0.10	<0.10	0.17	0.11	<0.10	0.12	0.027
	Sodium (Na)	mg/kg	-	-	185	216	257	183	335	74	174	275	179	69	195	83
	Strontium (Sr)	mg/kg	-	-	10.1	12.2	17.1	15.6	22.3	8.6	10.6	12.8	12.5	4.76	12.7	4.85
	Sulphur (S)	mg/kg	-	-	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1,000	0
	Thallium (Tl)	mg/kg	-	-	0.564	0.622	0.599	0.489	0.573	0.101	0.401	0.452	0.470	0.155	0.443	0.180
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0
	Titanium (Ti)	mg/kg	-	-	1,180	1,110	1,230	1,010	1,180	393	950	1,040	939	473	951	290
	Tungsten (W)	mg/kg	-	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	0.00
	Uranium (U)	mg/kg	-	-	6.4	6.8	7.2	5.0	6.8	1.0	4.6	5.7	5.4	1.6	5.0	2.1
	Vanadium (V)	mg/kg	-	-	67.0	72.3	75.8	62.5	71.2	19.7	58.4	62.7	61.6	26.1	57.7	19.2
	Zinc (Zn)	mg/kg	315	135	66.4	65.4	70.1	55.2	66.4	17.2	51.1	59.5	55.1	23.4	53.0	18.3
	Zirconium (Zr)	mg/kg	-	-	6.4	4.9	6.4	4.6	5.9	5.5	3.9	10.6	3.6	1.6	5.3	2.4

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to Camp Lake.

▨ Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table D.9: Magnitude of Elevation in Sediment Metal Concentrations between Camp Lake and Reference Lake 3 2018 Data, and between Camp Lake 2018 and Baseline Data, Mary River Project CREMP, 2018

Parameter	Camp Lake versus Reference Lake 3, 2018				Camp Lake 2018 versus Baseline Period			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Camp Lake Baseline Concentration (mg/kg)	Magnitude of Elevation	Camp Lake Baseline Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	17,880	1.0	24,420	0.7	18,267	1.0	15,175	1.1
Antimony (Sb)	<0.10	1.0	<0.10	1.0	1.0	0.1	1.0	0.1
Arsenic (As)	5.3	3.0	6.1	0.7	2.8	3.4	3.5	1.3
Barium (Ba)	133	1.2	152	0.5	105	1.6	68	1.0
Beryllium (Be)	0.7	1.3	0.9	1.0	1.0	0.9	1.0	0.9
Bismuth (Bi)	<0.20	1.5	0.20	1.3	-	-	-	-
Boron (B)	13.9	1.4	15.6	1.4	0.7	26.9	1.8	11.6
Cadmium (Cd)	0.2	1.2	0.2	0.8	0.5	0.5	0.5	0.3
Calcium (Ca)	5,480	1.0	5,584	1.0	3,130	1.7	2,857	1.9
Chromium (Cr)	59	1.3	77	0.9	81	0.9	71	1.0
Cobalt (Co)	12	2.2	17	0.9	18	1.4	17	1.0
Copper (Cu)	74	0.7	96	0.4	45	1.1	40	1.0
Iron (Fe)	46,700	1.4	50,900	0.6	36,133	1.8	33,206	0.9
Lead (Pb)	16	1.2	20	0.9	18	1.1	19	1.0
Lithium (Li)	26	1.2	36	0.8	-	-	-	-
Magnesium (Mg)	11,104	1.4	15,394	0.8	13,967	1.1	10,113	1.3
Manganese (Mn)	640	3.7	1,279	0.9	699	3.4	942	1.2
Mercury (Hg)	0.0433	1.0	0.0650	0.4	0.100	0.4	0.100	0.3
Molybdenum (Mo)	3.838	0.6	2.570	0.3	1.0	2.4	1.0	0.8
Nickel (Ni)	43	1.9	54	1.1	67	1.2	63	1.0
Phosphorus (P)	1,305	1.3	1,188	0.8	800	2.1	1,125	0.8
Potassium (K)	4,134	1.0	5,660	0.7	3,450	1.2	3,771	1.1
Selenium (Se)	0.7	0.7	0.8	0.4	1.0	0.5	1.0	0.3
Silver (Ag)	0.1	0.7	0.3	0.5	0.3	0.4	0.3	0.4
Sodium (Na)	320	0.6	433	0.5	279	0.7	254	0.8
Strontium (Sr)	12	0.8	14	0.9	9.3	1.1	12.0	1.1
Sulphur (S)	1,780	0.6	1,400	0.7	-	-	-	-
Thallium (Tl)	0.450	1.3	0.754	0.6	1.0	0.6	1.0	0.4
Tin (Sn)	2	1.0	2	1.0	-	-	-	-
Titanium (Ti)	1,155	1.0	1,388	0.7	-	-	-	-
Tungsten	1		1	0.0	-	-	-	-
Uranium (U)	13	0.5	24	0.2	-	-	-	-
Vanadium (V)	58	1.2	73	0.8	69	1.0	57	1.0
Zinc (Zn)	81	0.8	99	0.5	67	1.0	57	0.9
Zirconium (Zr)	4.1	1.6	3.9	1.3	-	-	-	-

🟪	Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective mean reference lake value or baseline period, as applicable).
🟨	Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective mean reference area value or baseline period value, as applicable).
🟥	Denotes high elevation (mean parameter concentration is≥ 10 times higher than respective mean reference area value or baseline period value, as applicable).

Table D.10: Field Observations of Sediment Properties at Sheardown Lake Northwest (DLO-01) Benthic Stations [a], Mary River Project CREMP, August 2018

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
DLO-01-9	8.2	thin oxidized layer over medium brown-coloured silt	none detected	globular algae (sparse), bryophytes (sparse)
DLO-01-4	6.7	some iron oxide precipitate over medium brown-grey coloured silt	none detected	aquatic moss (sparse)
DLO-01-3	7.3	medium dark brown-grey coloured silt	none detected	*Chara* present (sparse)
DLO-01-11	8.2	thin iron oxide precipitate over brown coloured silt	none detected	none observed
DLO-01-10	8.8	reddish-brown coloured silt over sand-silt	some blackened substrate	none observed
DLO-01-5	23.8	brown-coloured silt, with some decaying organics	none detected	none observed
DLO-01-14	23.8	brown-coloured silt, with some decaying organics	none detected	none observed
DLO-01-15	21.3	reddish-brown coloured silt	none detected	none observed
DLO-01-2	17.0	reddish-brown coloured silt	none detected	none observed
DLO-01-12	14.0	reddish-brown coloured silt	none detected	none observed

[a] Sediment particle size and benthic invertebrate community samples were collected by Petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.11: Observations from Sediment Cores Collected at Sheardown Lake NW (DLO-01), Mary River Project CREMP, August 2018

Sample Station	Station Depth (m)	Station Type	Core Number	Core Length (cm)	Surficial Substrate Texture Description
DLO-01-05	23.2	Profundal	1	10	reddish-brown oxidized layer over dark grey coloured silt loam; some blackened substrate in upper 5 cm
			2	15	
			3	21	
			4	23	
DD-HAB 9-STN2	10.5	Littoral	1	13	reddish-brown coloured loam over grey-brown coloured silt
			2	16	
			3	16	
			4	21	
DLO-01-08	12.1	Littoral	1	13	reddish-brown oxidized layer over grey-brown coloured silt loam
			2	23	
			3	26	
			4	24	
DLO-01	22.0	Profundal	1	14	reddish-brown coloured oxidized floc over light brown-grey coloured silt loam
			2	5	
			3	20	
			4	20	
DLO-01-13	17.8	Profundal	1	16	reddish-brown coloured silt loam; some blackened substrate at 6 - 10 cm below sediment surface
			2	12	
			3	20	
			4	19	
DLO-01-2	16.8	Profundal	1	11	reddish-brown coloured oxidized floc over brown coloured silt loam
			2	16	
			3	17	
			4	12	
DLO-01-9	7.7	Littoral	1	20	reddish-brown coloured oxidized floc over brown coloured loam
			2	20	
			3	23	
			4	23	
DLO-01-10	7.8	Littoral	1	15	reddish-brown coloured oxidized floc over brown coloured sandy loam; some blackened substrate 6 to 7 cm below sediment surface
			2	10	
			3	16	
			4	14	

Table D.12: Statistical Comparison of Sediment Physical Properties Between Sheardown Lake NW and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

Lake Zone	Sediment Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Sand-Sized Material (%)**	YES	0.014	η	Reference	5	59.6	4.4	2.0	54.9	66.4
					Sheardown NW	7	38.9	16.2	6.1	24.6	68.8
	Silt-Sized Material (%)	YES	0.012	η	Reference	5	31.4	3.3	1.5	26.6	34.7
					Sheardown NW	7	49.6	13.7	5.2	27.0	63.4
	Clay-Sized Material (%)	NO	0.220	α	Reference	5	9.0	2.4	1.1	5.8	10.8
					Sheardown NW	7	11.5	3.7	1.4	4.2	16.9
	Moisture (%)	YES	0.013	α	Reference	5	86.5	8.4	3.8	72.6	94.0
					Sheardown NW	7	67.8	11.7	4.4	45.7	79.9
	Total Organic Carbon (TOC) Content (%)	NO	0.129	α	Reference	5	4.7	2.3	1.0	1.8	7.4
					Sheardown NW	7	3.0	1.4	0.5	0.9	4.9
Profundal (Deep) Stations	**Sand-Sized Material (%)**	YES	0.007	δ	Reference	5	47.5	2.8	1.3	44.5	50.9
					Sheardown NW	7	23.1	15.7	5.9	11.0	55.2
	Silt-Sized Material (%)	YES	0.005	α	Reference	5	39.0	3.1	1.4	33.8	41.5
					Sheardown NW	7	61.1	13.2	5.0	34.1	72.8
	Clay-Sized Material (%)	NO	0.432	γ	Reference	5	13.6	2.2	1.0	9.7	15.3
					Sheardown NW	7	15.8	4.1	1.5	10.7	21.0
	Moisture (%)	YES	0.003	γ	Reference	5	85.1	4.7	2.1	76.7	87.6
					Sheardown NW	7	60.8	15.8	6.0	27.7	74.0
	Total Organic Carbon (TOC) Content (%)	YES	0.073	γ	Reference	5	3.8	1.7	0.8	0.8	4.9
					Sheardown NW	7	1.9	0.9	0.3	0.5	3.4

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data logit- or log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data logit- or log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on statistical p-value less than 0.10.

Table D.13: Sediment Particle Size, Total Organic Carbon, Metal Concentrations at Sheardown Lake Northwest (DLO-01) Sediment Stations, Mary River Project CREMP, August 2018

Parameter		Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Sheardown Lake Northwest Stations							Summary Statistics	
					DLO-01-5 (profundal)	DD-HAB 9-STN2 (littoral)	DLO-01-8 (littoral)	DLO-01 (profundal)	DLO-01-2 (profundal)	DLO-01-9 (littoral)	DLO-01-10 (littoral)	Mean	Standard Deviation
Non-metals	Sand	%	-	-	11	51	25	23	14	42	69	33	20
	Silt	%	-	-	68	38	63	58	73	46	27	54	16
	Clay	%	-	-	21	12	12	19	13	12	4.2	13	5.2
	Moisture	%	-	-	67	65	77	56	62	72	46	65	10
	Total Organic Carbon	%	10[α]	-	2.12	3.64	2.18	1.33	1.64	4.86	0.87	2.50	1.35
Metals	Aluminum (Al)	mg/kg	-	-	21,100	17,100	1,090	27,700	23,400	1,180	7,190	14,109	10,904
	Antimony (Sb)	mg/kg	-	-	<0.10	0.14	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	0.0151
	Arsenic (As)	mg/kg	17	6.2	***7.61***	***15.80***	0.51	6.19	5.05	0.26	1.68	5.30	5.45
	Barium (Ba)	mg/kg	-	-	104	487	8	138	142	7	33	131	167
	Beryllium (Be)	mg/kg	-	-	1.15	0.78	<0.10	1.31	1.10	<0.10	0.34	0.697	0.515
	Bismuth (Bi)	mg/kg	-	-	0.34	0.27	<0.20	0.32	0.28	<0.20	<0.20	0.26	0.060
	Boron (B)	mg/kg	-	-	24.2	20.6	<5.0	33.4	30.3	<5.0	9.0	18.2	11.9
	Cadmium (Cd)	mg/kg	3.5	1.5	0.278	0.454	<0.020	0.359	0.316	0.027	0.069	0.218	0.176
	Calcium (Ca)	mg/kg	-	-	4,380	4,690	256	5,400	5,430	326	2,290	3,253	2,279
	Chromium (Cr)	mg/kg	90	97	78.1	64.1	4.1	***101.0***	89.2	4.3	33.3	53.4	39.8
	Cobalt (Co)	mg/kg	-	-	17.5	15.8	1.1	21.2	18.6	0.8	5.76	11.5	8.71
	Copper (Cu)	mg/kg	197	58	49.7	50.9	2.6	***63.9***	50.2	3.6	14.30	33.6	25.78
	Iron (Fe)	mg/kg	40,000[α]	52,200	***62,900***	***80,300***	4,830	50,900	46,900	2,630	18,000	38,066	30,017
	Lead (Pb)	mg/kg	91.3	35	24.5	20.6	1.2	28.9	24.0	1.2	8.05	15.5	11.71
	Lithium (Li)	mg/kg	-	-	39.1	28.2	<2.0	42.9	37.2	<2.0	12.0	23.3	17.7
	Magnesium (Mg)	mg/kg	-	-	14,100	11,400	731	17,700	15,200	778	5,590	9,357	6,983
	Manganese (Mn)	mg/kg	1,100[α,β]	4,530	584	***4,870***	121	1,420	***7,770***	22	223	2,144	3,009
	Mercury (Hg)	mg/kg	0.486	0.17	0.0603	0.0487	0.0347	0.0317	0.0324	0.051	0.0144	0.0390	0.0153
	Molybdenum (Mo)	mg/kg	-	-	3.13	12.40	0.82	2.11	7.76	0.25	1.16	3.95	4.50
	Nickel (Ni)	mg/kg	75[α,β]	77	69.4	***81.6***	4.4	***86.7***	***79.0***	4.3	28.4	50.5	37.0
	Phosphorus (P)	mg/kg	2,000[α]	1,958	1,440	***2,200***	81	1,150	1,050	<50	547	931	772
	Potassium (K)	mg/kg	-	-	5,150	4,110	270	7,010	5,910	290	1,880	3,517	2,726
	Selenium (Se)	mg/kg	-	-	0.56	0.54	<0.20	0.36	0.40	<0.20	<0.20	0.35	0.16
	Silver (Ag)	mg/kg	-	-	0.21	0.15	<0.10	0.23	0.17	<0.10	<0.10	0.15	0.055
	Sodium (Na)	mg/kg	-	-	299	227	<50	367	328	<50	105	204	135
	Strontium (Sr)	mg/kg	-	-	11.5	9.6	0.6	14.1	13.2	0.6	5.9	7.9	5.7
	Sulphur (S)	mg/kg	-	-	<1000	1,100	<1000	<1000	<1000	<1000	<1000	1,014.3	37.8
	Thallium (Tl)	mg/kg	-	-	0.514	0.575	<0.050	0.758	0.658	<0.050	0.183	0.398	0.297
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0
	Titanium (Ti)	mg/kg	-	-	1,250	1,040	69	1,670	1,530	75	541	882	662
	Tungsten (W)	mg/kg	-	-	<0.50	<0.50	<0.50	<0.50	0.54	<0.50	<0.50	0.51	0.02
	Uranium (U)	mg/kg	-	-	9.12	9.76	0.35	11.20	8.36	0.69	3.08	6.08	4.57
	Vanadium (V)	mg/kg	-	-	59.9	51.5	3.4	81.3	70.2	3.6	21.90	41.7	31.9
	Zinc (Zn)	mg/kg	315	123	75.2	64.6	3.9	94.0	79.9	4.2	25.1	49.6	37.7
	Zirconium (Zr)	mg/kg	-	-	11.7	7.1	<1.0	8.9	6.8	<1.0	4.8	5.9	3.96

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to Sheardown Lake Northwest.

▨ Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD5 Indicates parameter concentration above the AEMP Benchmark.

Table D.14: Magnitude of Elevation in Sediment Metal Concentrations between Sheardown Lake NW and Reference Lake 3 2018 Data, and between Sheardown Lake NW 2018 and Baseline Data, Mary River Project CREMP, 2018

Parameter	Sheardown Lake NW versus Reference Lake 3 in 2018				Sheardown Lake NW 2018 versus Baseline Period			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake NW Baseline Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake NW Baseline Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	17,880	0.4	24,420	1.0	11,792	0.6	17,745	1.4
Antimony (Sb)	<0.10	1.1	<0.10	1.0	1.0	0.1	1.0	0.1
Arsenic (As)	5.3	0.9	6.1	1.0	3.0	1.5	3.2	2.0
Barium (Ba)	133	1.0	152	0.8	78	1.7	93	1.4
Beryllium (Be)	0.7	0.5	0.9	1.4	1.0	0.3	1.0	1.2
Bismuth (Bi)	<0.20	1.1	0.20	1.5	-	-	-	-
Boron (B)	13.9	0.7	15.6	1.9	3	3.5	3	9.4
Cadmium (Cd)	0.2	0.7	0.2	1.6	0.5	0.3	0.5	0.6
Calcium (Ca)	5,480	0.3	5,584	0.9	2,697	0.7	3,558	1.4
Chromium (Cr)	59	0.4	77	1.2	53	0.5	81	1.1
Cobalt (Co)	12	0.5	17	1.1	10	0.6	15	1.2
Copper (Cu)	74	0.2	96	0.6	33	0.5	48	1.1
Iron (Fe)	46,700	0.6	50,900	1.1	28,120	0.9	40,382	1.3
Lead (Pb)	16	0.5	20	1.3	13	0.6	20	1.3
Lithium (Li)	26	0.4	36	1.1	-	-	-	-
Magnesium (Mg)	11,104	0.4	15,394	1.0	7,448	0.6	11,498	1.4
Manganese (Mn)	640	2.0	1,279	2.5	756	1.7	2,164	1.5
Mercury (Hg)	0.0433	0.9	0.0650	0.6	0.100	0.4	0.100	0.4
Molybdenum (Mo)	3.838	1.0	2.570	1.7	3.4	1.1	3.5	1.2
Nickel (Ni)	43	0.7	54	1.5	49	0.6	69	1.1
Phosphorus (P)	1,305	0.6	1,188	1.0	863	0.8	1,400	0.9
Potassium (K)	4,134	0.4	5,660	1.1	2,681	0.6	4,612	1.3
Selenium (Se)	0.7	0.4	0.8	0.5	1.0	0.3	1.0	0.4
Silver (Ag)	0.1	0.8	0.3	0.8	0.3	0.4	0.3	0.7
Sodium (Na)	320	0.3	433	0.8	249	0.4	342	1.0
Strontium (Sr)	12	0.3	14	0.9	7.2	0.6	11.4	1.1
Sulphur (S)	1,780	0.6	1,400	0.7	-	-	-	-
Thallium (Tl)	0.450	0.5	0.754	0.9	1.0	0.2	1.0	0.6
Tin (Sn)	2	1.0	2	1.0	-	-	-	-
Titanium (Ti)	1,155	0.4	1,388	1.1	-	-	-	-
Uranium (U)	13	0.3	24	0.4	-	-	-	-
Vanadium (V)	58	0.3	73	1.0	37	0.5	58	1.2
Zinc (Zn)	81	0.3	99	0.8	51	0.5	76	1.1
Zirconium (Zr)	4.1	0.9	3.9	2.4	-	-	-	-

🟪 Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective mean reference lake value or baseline period, as applicable).
🟧 Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective mean reference area value or baseline period value, as applicable).
🟥 Denotes high elevation (mean parameter concentration is≥ 10 times higher than respective mean reference area value or baseline period value, as applicable).

Table D.15: Field Observations of Sediment Properties at Sheardown Lake Southeast (DLO-02) Benthic Stations[a], Mary River Project CREMP, August 2018

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
DLO-02-11	8.2	reddish-brown coloured silt-clay	blackened substrate at greater depth	sparse periphyton and globular algae (mare's eggs), sparse *Chara*
DLO-02-10	6.7	greyish-brown coloured silt-clay	none detected	sparse globular algae (Mare's eggs), *Chara* common
DLO-02-4	7.6	reddish-brown coloured silt-clay	none detected	sparse globular algae (Mare's eggs), *Chara* sparse
DLO-02-9	8.8	reddish-brown coloured silt-clay	none detected	sparse globular algae (Mare's eggs), *Chara* sparse
DLO-02-1	9.8	brownish-grey coloured silt	none detected	none observed
DLO-02-12	10.5	reddish-brown coloured silt-clay	none detected	none observed
DLO-02-8	13.4	brownish-grey coloured silt	none detected	none observed
DLO-02-13	7.0	brownish-red coloured silt-clay	none detected	sparse globular algae (Mare's eggs), *Chara* sparse
DLO-02-2	14.0	brownish-grey coloured silt	none detected	sparse periphyton
DLO-02-3	13.4	brownish-grey clay	blackened substrate just below sediment surface	sparse globular algae (Mare's eggs), macrophyte roots

[a] Sediment particle size and benthic invertebrate community samples were collected by Petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.16: **Observations from Sediment Cores Collected at Sheardown Lake SE (DLO-02), Mary River Project CREMP, August 2018**

Sample Station	Station Depth (m)	Station Type	Core Number	Core Length (cm)	Surficial Substrate Texture Description
DLO-02-1	11.5	Littoral	1	16	thin reddish-brown oxidized layer overlying light brown-grey coloured silt loam
			2	5	
			3	5	
			4	6	
DLO-02-11	7.8	Littoral	1	17	thin reddish-brown oxidized layer overlying light brown coloured silt loam; some blackened substrate at depths between 1 and 11 cm below surface
			2	16	
			3	11	
			4	12	
DLO-02-4	8.5	Littoral	1	15	thin reddish-brown oxidized layer over light brown-grey coloured silt loam; some blackened substrate at depths between 6 and 18 cm below surface
			2	18	
			3	14	
			4	15	
DLO-02-2	13.4	Profundal	1	18	thin reddish-brown oxidized layer overlying brown coloured silt loam; some blackened substrate at depths between 1 and 5 cm below surface
			2	11	
			3	11	
DLO-02-3	13.0	Profundal	1	18	thin reddish-brown oxidized layer overlying brown coloured silt loam; some blackened substrate at depths between 1 and 4 cm below surface
			2	12	
			3	10	

Table D.17: Statistical Comparison of Sediment Physical Properties Between Sheardown Lake SE and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

Lake Zone	Sediment Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Sand-Sized Material (%)**	YES	< 0.001	α	Reference	5	59.6	4.4	2.0	54.9	66.4
					Sheardown SE	5	12.8	5.6	2.5	7.9	22.0
	Silt-Sized Material (%)	YES	< 0.001	α	Reference	5	31.4	3.3	1.5	26.6	34.7
					Sheardown SE	5	73.7	4.5	2.0	67.7	77.6
	Clay-Sized Material (%)	NO	0.014	α	Reference	5	9.0	2.4	1.1	5.8	10.8
					Sheardown SE	5	13.6	2.3	1.0	10.3	16.4
	Moisture (%)	YES	< 0.001	α	Reference	5	86.5	8.4	3.8	72.6	94.0
					Sheardown SE	5	53.4	7.9	3.5	42.5	61.2
	Total Organic Carbon (TOC) Content (%)	NO	0.027	η	Reference	5	4.7	2.3	1.0	1.8	7.4
					Sheardown SE	5	1.3	0.4	0.2	0.9	1.9
Profundal (Deep) Stations	**Sand-Sized Material (%)**	YES	< 0.001	α	Reference	5	47.5	2.8	1.3	44.5	50.9
					Sheardown SE	5	14.0	4.8	2.2	7.1	18.8
	Silt-Sized Material (%)	YES	0.008	γ	Reference	5	39.0	3.1	1.4	33.8	41.5
					Sheardown SE	5	71.0	3.7	1.6	68.8	77.5
	Clay-Sized Material (%)	NO	0.421	γ	Reference	5	13.6	2.2	1.0	9.7	15.3
					Sheardown SE	5	15.0	2.6	1.2	12.3	18.2
	Moisture (%)	YES	0.008	γ	Reference	5	85.1	4.7	2.1	76.7	87.6
					Sheardown SE	5	50.9	2.7	1.2	46.9	54.4
	Total Organic Carbon (TOC) Content (%)	YES	0.151	γ	Reference	5	3.8	1.7	0.8	0.8	4.9
					Sheardown SE	5	1.2	0.1	0.1	1.0	1.4

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data logit- or log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data logit- or log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on statistical p-value less than 0.10.

Table D.18: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Sheardown Lake Southeast (DLO-02) Sediment Stations, Mary River Project CREMP, August 2018

Parameter		Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Sheardown Lake Southeast Basin Station					Summary Statistics		
					DLO-02-1 (littoral)	DLO-02-11 (littoral)	DLO-02-4 (littoral)	DLO-02-2 (profundal)	DLO-02-3 (profundal)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	22	8	9	19	18	15	6.4	2.9
	Silt	%	-	-	68	77	78	69	69	72	4.9	2.2
	Clay	%	-	-	10	15	14	12	12	13	1.7	0.7
	Moisture	%	-	-	48	61	56	51	51	53	5.2	2.3
	Total Organic Carbon	%	10^{α}	-	0.99	1.35	1.25	1.08	1.11	1.16	0.14	0.064
Metals	Aluminum (Al)	mg/kg	-	-	15,300	16,800	18,300	16,600	16,700	16,740	1,064	476
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
	Arsenic (As)	mg/kg	17	5.9	3.41	4.29	***6.01***	3.02	3.62	4.07	1.18	0.527
	Barium (Ba)	mg/kg	-	-	78.1	97.8	110	75.5	89.0	90.1	14.3	6.38
	Beryllium (Be)	mg/kg	-	-	0.68	0.78	0.83	0.76	0.79	0.77	0.06	0.025
	Bismuth (Bi)	mg/kg	-	-	<0.20	0.21	0.29	<0.20	<0.20	0.22	0.0394	0.0176
	Boron (B)	mg/kg	-	-	16.4	17.9	18.5	15.9	19.0	17.5	1.34	0.60
	Cadmium (Cd)	mg/kg	3.5	1.5	0.103	0.102	0.119	0.089	0.086	0.100	0.013	0.006
	Calcium (Ca)	mg/kg	-	-	5,170	5,040	9,310	5,310	6,300	6,226	1,794	802.4
	Chromium (Cr)	mg/kg	90	79	64.7	72.5	***89.7***	63.9	67.4	71.6	10.6	4.76
	Cobalt (Co)	mg/kg	-	-	12.7	13.0	14.9	12.7	13.5	13.4	0.92	0.412
	Copper (Cu)	mg/kg	110	56	24.6	27.7	31.5	27.0	26.3	27.4	2.55	1.14
	Iron (Fe)	mg/kg	$40,000^{\alpha}$	34,400	***37,200***	***38,600***	***45,800***	34,400	***38,300***	***38,860***	4,219	1,887
	Lead (Pb)	mg/kg	91.3	35	14.6	17.3	18.7	15.6	16.0	16.4	1.59	0.71
	Lithium (Li)	mg/kg	-	-	28.1	31.3	30.5	32.8	37.2	32.0	3.38	1.51
	Magnesium (Mg)	mg/kg	-	-	12,100	13,000	16,600	13,000	12,900	13,520	1,763	788
	Manganese (Mn)	mg/kg	$1,100^{\alpha,\beta}$	657	***726***	***1,050***	***1,100***	442	***983***	***860***	275	123
	Mercury (Hg)	mg/kg	0.486	0.17	0.0212	0.0245	0.0198	0.0264	0.0261	0.0236	0.0030	0.0013
	Molybdenum (Mo)	mg/kg	-	-	1.36	1.50	1.43	0.87	1.47	1.33	0.26	0.12
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	66	51.5	59.1	***72.6***	49.8	52.6	57.1	9.3	4.2
	Phosphorus (P)	mg/kg	$2,000^{\alpha}$	1,278	1,040	984	***1,380***	917	993	1,063	183	81.7
	Potassium (K)	mg/kg	-	-	3,590	4,070	4,250	3,920	4,190	4,004	264	117.9
	Selenium (Se)	mg/kg	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.000	0.0000
	Silver (Ag)	mg/kg	-	-	<0.10	0.11	0.12	0.11	0.11	0.11	0.007	0.0032
	Sodium (Na)	mg/kg	-	-	225	245	266	251	246	247	15	7
	Strontium (Sr)	mg/kg	-	-	9.5	9.6	12.2	9.6	9.4	10.1	1.2	0.5
	Sulphur (S)	mg/kg	-	-	<1000	<1000	<1000	<1000	<1000	<1,000	0	0
	Thallium (Tl)	mg/kg	-	-	0.334	0.405	0.440	0.366	0.367	0.382	0.041	0.018
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
	Titanium (Ti)	mg/kg	-	-	1,210	1,190	1,340	1,210	1,240	1,238	60	27
	Tungsten (W)	mg/kg	-	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0	0
	Uranium (U)	mg/kg	-	-	4.81	4.90	4.86	5.24	5.43	5.05	0.27	0.12
	Vanadium (V)	mg/kg	-	-	46.3	49.1	55.6	47.8	48.6	49.5	3.6	1.6
	Zinc (Zn)	mg/kg	315	135	51.8	54.4	59.3	55.4	55.5	55.3	2.7	1.2
	Zirconium (Zr)	mg/kg	-	-	13.2	13.3	15.8	16.7	16.7	15.1	1.8	0.8

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to Sheardown Lake Southeast.

▨ Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table D.19: Magnitude of Elevation in Sediment Metal Concentrations between Sheardown Lake SE and Reference Lake 3 2018 Data, and between Sheardown Lake SE 2018 and Baseline Data, Mary River Project CREMP, 2018

Parameter	**Sheardown Lake SE versus Reference Lake 3 in 2018**				**Sheardown Lake SE 2018 versus Baseline Period**			
	Littoral Stations		**Profundal Stations**		**Littoral Stations**		**Profundal Stations**	
	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake SE Baseline Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake SE Baseline Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	17,880	0.9	24,420	0.7	14,950	1.1	13,133	1.3
Antimony (Sb)	<0.10	1.0	<0.10	1.0	1.0	0.1	1.0	0.1
Arsenic (As)	5.3	0.9	6.1	0.5	1.9	2.5	1.5	2.2
Barium (Ba)	133	0.7	152	0.5	81	1.2	64	1.3
Beryllium (Be)	0.7	1.1	0.9	0.9	1.0	0.8	1.0	0.8
Bismuth (Bi)	<0.20	1.2	0.20	1.0	-	-	-	-
Boron (B)	13.9	1.3	15.6	1.1	2.5	7.0	1.4	12.9
Cadmium (Cd)	0.2	0.6	0.2	0.4	0.5	0.2	0.6	0.1
Calcium (Ca)	5,480	1.2	5,584	1.0	6,310	1.0	8,925	0.7
Chromium (Cr)	59	1.3	77	0.8	78	1.0	72	0.9
Cobalt (Co)	12	1.2	17	0.8	13	1.1	12	1.1
Copper (Cu)	74	0.4	96	0.3	30	0.9	25	1.1
Iron (Fe)	46,700	0.9	50,900	0.7	32,284	1.3	29,117	1.2
Lead (Pb)	16	1.0	20	0.8	17	1.0	14	1.1
Lithium (Li)	26	1.2	36	1.0	-	-	-	-
Magnesium (Mg)	11,104	1.3	15,394	0.8	12,634	1.1	13,742	0.9
Manganese (Mn)	640	1.5	1,279	0.6	462	2.1	410	1.7
Mercury (Hg)	0.0433	0.5	0.0650	0.4	0.100	0.2	0.100	0.3
Molybdenum (Mo)	3.838	0.4	2.570	0.5	1.5	1.0	1.0	1.2
Nickel (Ni)	43	1.4	54	1.0	62	1.0	62	0.8
Phosphorus (P)	1,305	0.9	1,188	0.8	1,150	1.0	950	1.0
Potassium (K)	4,134	1.0	5,660	0.7	3,947	1.0	3,317	1.2
Selenium (Se)	0.7	0.3	0.8	0.2	1.0	0.2	1.0	0.2
Silver (Ag)	0.1	0.7	0.3	0.4	0.4	0.3	0.3	0.4
Sodium (Na)	320	0.8	433	0.6	353	0.7	330	0.8
Strontium (Sr)	12.2	0.9	13.8	0.7	16.0	0.7	11.0	0.9
Sulphur (S)	1,780	0.6	1,400	0.7	-	-	-	-
Thallium (Tl)	0.450	0.9	0.754	0.5	1.0	0.4	1.0	0.4
Tin (Sn)	<2	1.0	<2	1.0	-	-	-	-
Titanium (Ti)	1,155	1.1	1,388	0.9	-	-	-	-
Tungsten (W)	0.50	1.0	0.50	1.0	-	-	-	-
Uranium (U)	13	0.4	24	0.2	-	-	-	-
Vanadium (V)	58	0.9	73	0.7	52	1.0	44	1.1
Zinc (Zn)	81	0.7	99	0.6	51	1.1	51	1.1

🟪	Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective mean reference lake value or baseline period, as applicable).
🟧	Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective mean reference area value or baseline period value, as applicable).
🟥	Denotes high elevation (mean parameter concentration is≥ 10 times higher than respective mean reference area value or baseline period value, as applicable).

Table D.20: Field Observations of Sediment Properties at Mary Lake (BLO) Benthic Stations[a], Mary River Project CREMP, August 2018

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
BLO-01	9.7	medium brown coloured silt with some sand intermixed	none detected	none observed
BLO-11	10.7	reddish-brown coloured silt-sand mixture	none detected	none observed
BLO-7	12.1	medum reddish-brown coloured silt	none detected	sparse algae (mare's eggs)
BLO-6	8.3	reddish-brown coloured silt	none detected	none observed
BLO-3	15.1	medium to coarse sand with some organics	none detected	none observed
BLO-15	28.1	reddish-brown (~2cm) layer of silt overlying brown coloured silt with some sand intermixed	none detected	none observed
BLO-14	17.1	reddish-brown coloured, moderately compact, silt	none detected	none observed
BLO-13	20.1	reddish-brown coloured silt	none detected	none observed
BLO-4	21.6	medium brown coloured, moderately compact, silt	none detected	none observed
BLO-5	20.5	dark brown coloured silt, minor amount of fine sand, organic debris from river mouth	none detected	none observed

[a] Sediment particle size and benthic invertebrate community samples were collected by Petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.21: **Observations from Sediment Cores Collected at Mary Lake (BLO), Mary River Project CREMP, August 2018**

Sample Station	Station Depth (m)	Station Type	Core Number	Core Length (cm)	Surficial Substrate Texture Description
BLO-01	9.8	Littoral	1	14	reddish-brown coloured silt loam
			2	16	
			3	14	
			4	16	
BLO-16	30.5	Profundal	1	30	thin oxidized layer overlying grey-brown coloured clay loam
			2	32	
			3	29	
			4	32	
BLO-03	16.0	Profundal	1	15	reddish-brown coloured sandy loam overlying grey-brown coloured sandy silt
			2	13	
			3	17	
			4	-	
BLO-14	20.0	Profundal	1	17	reddish-brown coloured silty clay overlying grey-brown coloured silt; some blackened substrate 6 to 10 cm below sediment surface
			2	13	
			3	18	
			4	18	
BLO-12	20.0	Profundal	1	14	medium brown coloured silt loam
			2	14	
			3	14	
			4	15	
BLO-04	19.5	Profundal	1	22	reddish-brown coloured silt loam overlying grey-brown coloured silt; some blackened substrate 1 to 3 cm below sediment surface
			2	13	
			3	15	
			4	12	
BLO-10	9.8	Profundal	1	14	brown coloured silty clay loam; some blackened subtrate 3 to 4 cm below sediment surface
			2	17	
			3	14	
			4	15	
BLO-09	30.0	Profundal	1	15	thin layer of reddish brown silt loam/silty clay loam over grey-brown coloured silt; some blackened substrate 2 to 6 cm below sediment surface
			2	17	
			3	15	
			4	15	
BLO-08	25.8	Profundal	1	19	reddish-brown coloured silty clay loam overlying grey-brown coloured silt; some blackened substrate about 2 cm below sediment surface
			2	17	
			3	19	
			4	16	
BLO-06	5.5	Littoral	1	12	medium brown coloured silt loam; some blackened substrate about 2 cm below sediment surface
			2	11	
			3	11	
			4	12	

Table D.22: Statistical Comparison of Sediment Physical Properties Between Mary Lake and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

Lake Zone	Sediment Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Sand-Sized Material (%)**	YES	0.001	α	Reference	5	59.6	4.4	2.0	54.9	66.4
					Mary	4	16.7	17.7	8.8	3.6	41.0
	Silt-Sized Material (%)	YES	< 0.001	α	Reference	5	31.4	3.3	1.5	26.6	34.7
					Mary	4	64.0	9.5	4.8	50.5	72.8
	Clay-Sized Material (%)	NO	0.413	γ	Reference	5	9.0	2.4	1.1	5.8	10.8
					Mary	4	19.3	12.4	6.2	8.6	30.5
	Moisture (%)	YES	0.003	α	Reference	5	86.5	8.4	3.8	72.6	94.0
					Mary	4	54.6	13.5	6.7	40.2	68.0
	Total Organic Carbon (TOC) Content (%)	YES	0.023	η	Reference	5	4.7	2.3	1.0	1.8	7.4
					Mary	4	1.1	0.2	0.1	0.8	1.3
Profundal (Deep) Stations	**Sand-Sized Material (%)**	YES	0.004	δ	Reference	5	47.5	2.8	1.3	44.5	50.9
					Mary	10	20.7	21.9	6.9	2.6	71.7
	Silt-Sized Material (%)	YES	0.019	η	Reference	5	39.0	3.1	1.4	33.8	41.5
					Mary	10	55.6	18.4	5.8	16.8	77.4
	Clay-Sized Material (%)	NO	0.129	γ	Reference	5	13.6	2.2	1.0	9.7	15.3
					Mary	10	23.8	11.4	3.6	8.5	43.5
	Moisture (%)	YES	0.001	γ	Reference	5	85.1	4.7	2.1	76.7	87.6
					Mary	10	48.4	7.6	2.4	35.3	57.9
	Total Organic Carbon (TOC) Content (%)	YES	0.019	γ	Reference	5	3.8	1.7	0.8	0.8	4.9
					Mary	10	0.9	0.2	0.1	0.4	1.3

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data logit- or log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; η - data untransformed, t-test assuming unequal variance conducted; δ - data logit- or log-transformed, t-test assuming unequal variance conducted.

▨ Highlighted values indicate significant difference between study areas based on statistical p-value less than 0.10.

Table D.23: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Mary Lake (BLO) Sediment Stations, Mary River Project CREMP, August 2018

Analyte		Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Mary Lake Stations										Summary Statistics		
					BLO-01 (littoral)	BLO-16 (profundal)	BLO-03 (profundal)	BLO-14 (profundal)	BLO-12 (profundal)	BLO-04 (profundal)	BLO-10 (profundal)	BLO-09 (profundal)	BLO-08 (profundal)	BLO-06 (littoral)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	19	29	72	12	21	12	5	4.8	2.6	3.6	18	21	6.6
	Silt	%	-	-	73	37	16.8	45	65	67	65	68	65	66	57	18	5.7
	Clay	%	-	-	9	34	11.4	44	14	21	30	27	32	31	25	11	3.5
	Moisture	%	-	-	46	54	38	56	45	58	52	49	52	64	51	7.4	2.3
	Total Organic Carbon	%	10[α]	-	1.25	0.43	1.34	0.92	0.89	0.82	0.92	0.72	0.66	1.07	0.90	0.27	0.086
Metals	Aluminum (Al)	mg/kg	-	-	17,600	28,900	16,600	36,000	20,100	22,300	31,300	27,700	31,600	31,200	26,330	6,701	2,119
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
	Arsenic (As)	mg/kg	17	5.9	***7.95***	***8.20***	3.38	5.73	4.29	4.15	4.80	4.66	5.11	4.85	5.31	1.58	0.50
	Barium (Ba)	mg/kg	-	-	103	126	64	125	83	90	138	132	133	136	113	26	8
	Beryllium (Be)	mg/kg	-	-	0.90	1.42	0.81	1.70	0.89	0.96	1.44	1.22	1.45	1.46	1.23	0.312	0.0987
	Bismuth (Bi)	mg/kg	-	-	<0.20	0.28	0.24	0.35	0.23	0.24	0.30	0.31	0.34	0.29	0.28	0.049	0.016
	Boron (B)	mg/kg	-	-	23.4	37.9	23.7	47.7	26.0	26.5	40.3	33.8	39.1	41.0	33.9	8.54	2.70
	Cadmium (Cd)	mg/kg	3.5	1.5	0.106	0.151	0.130	0.200	0.1190	0.124	0.183	0.171	0.180	0.166	0.153	0.0317	0.01004
	Calcium (Ca)	mg/kg	-	-	10,200	4,180	2,950	5,640	4,880	4,420	5,680	5,450	5,990	5,490	5,488	1,891	597.9
	Chromium (Cr)	mg/kg	90	98	72.3	96.6	57.4	***115.0***	81.4	88.3	***110.0***	***111***	***119***	***108.0***	95.9	20.5	6.48
	Cobalt (Co)	mg/kg	-	-	16.9	18.9	13.4	23.8	15.8	17.2	21.3	21.1	22.3	21.0	19.2	3.28	1.036
	Copper (Cu)	mg/kg	110	50	31.8	40	24.8	48.6	29.4	31.2	42.6	39.6	44.8	41.3	37.5	7.67	2.42
	Iron (Fe)	mg/kg	40,000[α]	52,400	45,200	***57,200***	32,500	***58,600***	41,100	43,800	51,700	48,300	***52,600***	51,200	48,220	7,853	2,483
	Lead (Pb)	mg/kg	91.3	35	17.0	28.3	17.0	34.2	19.1	20.8	29.9	26.5	31.2	30.1	25.4	6.37	2.01
	Lithium (Li)	mg/kg	-	-	36.7	55.1	29.0	62.2	35.9	37.3	53.7	44.4	53.2	52.5	46.0	10.8	3.42
	Magnesium (Mg)	mg/kg	-	-	16,200	18,100	10,700	22,200	14,800	15,200	20,700	18,500	20,900	20,100	17,740	3,527	1,115
	Manganese (Mn)	mg/kg	1,100[α,β]	4,370	2,180	567	2,800	1,020	2,030	2,600	898	4,360	1,530	878	1,886	1,163	368
	Mercury (Hg)	mg/kg	0.486	0.17	0.0262	0.0659	0.0420	0.0669	0.0380	0.0395	0.0607	0.0416	0.0559	0.0560	0.0493	0.0136	0.00431
	Molybdenum (Mo)	mg/kg	-	-	0.78	1.04	0.78	0.89	0.89	1.21	0.93	1.34	1.19	0.95	1.00	0.19	0.06
	Nickel (Ni)	mg/kg	75[α,β]	72	60.7	66.8	43.8	***78.2***	60.9	65.1	***77.6***	***83***	***87.4***	***73.0***	69.7	12.9	4.08
	Phosphorus (P)	mg/kg	2,000[α]	1,580	1,460	1,490	727	1,040	1,350	1,230	1,050	1,140	1,080	987	1,155	233	74
	Potassium (K)	mg/kg	-	-	3,900	6,880	4,230	8,840	4,770	5,360	8,090	6,810	7,730	7,870	6,448	1,758	556
	Selenium (Se)	mg/kg	-	-	0.24	0.27	<0.20	0.37	0.22	0.21	0.32	0.24	0.25	0.31	0.26	0.055	0.017
	Silver (Ag)	mg/kg	-	-	<0.10	0.18	<0.10	0.2	0.13	0.12	0.18	0.17	0.19	0.17	0.15	0.038	0.012
	Sodium (Na)	mg/kg	-	-	262	488	249	520	324	361	507	470	521	483	419	108.4	34.3
	Strontium (Sr)	mg/kg	-	-	14.3	22.9	10.5	20.4	13.0	13.0	18.1	16.6	18.5	17.2	16.5	3.78	1.195
	Sulphur (S)	mg/kg	-	-	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1,000	0	0
	Thallium (Tl)	mg/kg	-	-	0.366	0.59	0.399	0.820	0.469	0.483	0.698	0.627	0.703	0.729	0.588	0.153	0.0484
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	2.4	<2.0	<2.0	2.1	<2.0	2.2	2.4	<2.0	0.000	0.000
	Titanium (Ti)	mg/kg	-	-	1,190	1,720	1,130	2,350	1,620	1,620	2,220	2,010	2,240	2,210	1,831	443	140
	Tungsten (W)	mg/kg	-	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0	0
	Uranium (U)	mg/kg	-	-	4.18	10.20	6.66	13.6	7.47	7.31	11.1	8.69	10.1	10.8	9.01	2.70	0.853
	Vanadium (V)	mg/kg	-	-	56.9	80.9	49.2	99.5	60.5	62.7	87.8	77.6	88.8	87.8	75.2	16.7	5.29
	Zinc (Zn)	mg/kg	315	135	58	89	45.5	94.2	60.3	62.2	101.0	87.6	101	103.0	80.2	21.5	6.79
	Zirconium (Zr)	mg/kg	-	-	9.8	27.5	11.8	29.9	16.9	17.8	29.4	24.5	31.2	24.5	22.3	7.75	2.45

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to Mary Lake.

▨ Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table D.24: Magnitude of Elevation in Sediment Metal Concentrations between Mary Lake and Reference Lake 3 2018 Data, and between Mary Lake 2018 and Baseline Data, Mary River Project CREMP, 2018

Parameter	Mary Lake versus Reference Lake 3 in 2018				Mary Lake 2018 versus Baseline Period			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Mary Lake Baseline Concentration (mg/kg)	Magnitude of Elevation	Mary Lake Baseline Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	17,880	1.4	24,420	1.1	18,267	1.3	17,000	1.6
Antimony (Sb)	<0.10	1.0	0.10	1.0	1.0	0.1	1.0	0.1
Arsenic (As)	5.3	1.2	6.1	0.8	2.8	2.3	3.7	1.4
Barium (Ba)	133	0.9	152	0.7	105	1.1	76	1.5
Beryllium (Be)	0.7	1.7	0.9	1.4	1.0	1.2	1.0	1.2
Bismuth (Bi)	<0.20	1.2	0.20	1.4	-	-	-	-
Boron (B)	13.9	2.3	15.6	2.2	1	43.9	2	16.5
Cadmium (Cd)	0.2	0.7	0.2	0.8	0.5	0.3	0.5	0.3
Calcium (Ca)	5,480	1.4	5,584	0.9	3,130	2.5	2,934	1.7
Chromium (Cr)	59	1.5	77	1.3	81	1.1	76	1.3
Cobalt (Co)	12	1.6	17	1.1	18	1.0	18	1.1
Copper (Cu)	74	0.5	96	0.4	45	0.8	44	0.9
Iron (Fe)	46,700	1.0	50,900	0.9	36,133	1.3	35,654	1.4
Lead (Pb)	16	1.4	20	1.3	18	1.3	21	1.2
Lithium (Li)	26	1.7	36	1.3	-	-	-	-
Magnesium (Mg)	11,104	1.6	15,394	1.1	13,967	1.3	10,903	1.6
Manganese (Mn)	640	2.4	1,279	1.5	699	2.2	991	2.0
Mercury (Hg)	0.0433	0.9	0.0650	0.8	0.100	0.4	0.100	0.5
Molybdenum (Mo)	3.838	0.2	2.570	0.4	1.0	0.9	1.0	1.0
Nickel (Ni)	43	1.6	54	1.3	67	1.0	65	1.1
Phosphorus (P)	1,305	0.9	1,188	1.0	800	1.5	1,325	0.9
Potassium (K)	4,134	1.4	5,660	1.2	3,450	1.7	4,287	1.5
Selenium (Se)	0.7	0.4	0.8	0.3	1.0	0.3	1.0	0.3
Silver (Ag)	0.1	0.9	0.3	0.6	0.3	0.5	0.4	0.4
Sodium (Na)	320	1.2	433	1.0	279	1.3	284	1.5
Strontium (Sr)	12.2	1.3	13.8	1.2	9.3	1.7	13.3	1.3
Sulphur (S)	1,780	0.6	1,400	0.7	-	-	-	-
Thallium (Tl)	0.450	1.2	0.754	0.8	1.0	0.5	1.0	0.6
Tin (Sn)	2	1.1	2	1.0	-	-	-	-
Titanium (Ti)	1,155	1.5	1,388	1.3	-	-	-	-
Tungsten (W)	1	1.0	1	1.0	-	-	-	-
Uranium (U)	13	0.6	24	0.4	-	-	-	-
Vanadium (V)	58	1.2	73	1.0	69	1.0	63	1.2
Zinc (Zn)	81	1.0	99	0.8	67	1.2	64	1.3

🟪 Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective mean reference lake value or baseline period).
🟨 Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than mean reference area value or baseline period value).
🟥 Denotes high levitation (mean parameter concentration is≥ 10 times higher than mean reference area value or baseline period value).

APPENDIX E

PHYTOPLANKTON DATA

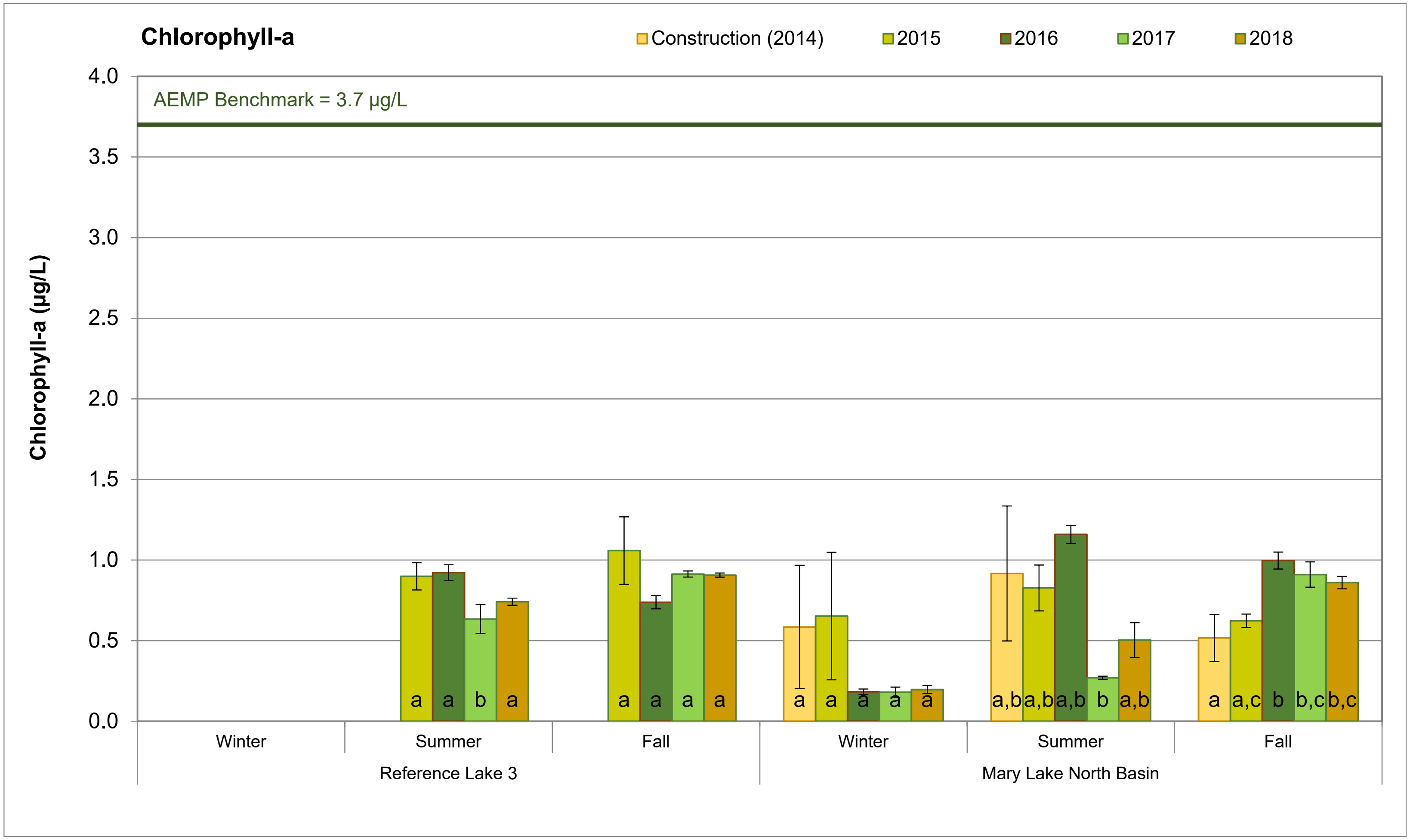


Figure E.1: **Temporal Comparison of Chlorophyll-a Concentrations Among Seasons between the Mary Lake North Basin and Reference Lake 3 for Mine Construction (2014) and Operational (2015 to 2018) Periods (mean ± SE)**

Note: Bars with the same letter at the base do not differ signficantly between years for the applicable season.

Table E.1: Phytoplankton Monitoring Data (i.e., chlorophyll-a and phaeophytin-a concentrations) Collected at Lotic Reference Stations, Camp Lake Tributaries, Sheardown Lake Tributary 1, and Tom River, Mary River Project 2018 CREMP

	Station	Reference Creek Stations				Camp Lake Tributary 1 (CLT1)						Camp Lake Tributary 2	Camp Lake Outlet	Sheardown Lake Tributary 1 (SDLT1)		Tom River
						North Branch		Main Stem								
		CLT-REF3	CLT-REF4	MRY-REF2	MRY-REF3	L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01	J0-01	D1-05	D1-00	I0-01
Sample Collection Date	Spring	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18	3-Jul-18	1-Jul-18	1-Jul-18	3-Jul-18	3-Jul-18	3-Jul-18	30-Jun-18	3-Jul-18	3-Jul-18	3-Jul-18
							10-Jul-18			10-Jul-18	10-Jul-18	10-Jul-18		10-Jul-18	10-Jul-18	10-Jul-18
	Summer	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	10-Aug-18	1-Aug-18	1-Aug-18	1-Aug-18	1-Aug-18	1-Aug-18	1-Aug-18	10-Aug-18	1-Aug-18	1-Aug-18	1-Aug-18
	Fall	25-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	25-Aug-18	25-Aug-18	26-Aug-18	25-Aug-18	18-Aug-18	18-Aug-18	26-Aug-18	27-Aug-18	26-Aug-18	26-Aug-18	19-Aug-18
Chlorophyll-a (µg/L)	Spring	0.24	0.28	0.36	0.19	0.13	0.18	1.47	0.36	0.22	0.18	0.17	0.60	0.21	0.12	0.13
							0.24			0.37	0.32	0.23		0.38	0.27	0.21
	Summer	0.15	0.48	0.21	0.13	0.11	0.25	0.77	0.29	0.34	0.35	0.20	1.81	0.27	0.16	0.51
	Fall	0.18	0.47	0.44	0.18	0.12	0.33	1.68	0.54	0.91	0.85	0.56	2.25	0.38	0.19	0.21
	Average	0.19	0.41	0.34	0.17	0.12	0.25	1.31	0.40	0.46	0.43	0.29	1.55	0.31	0.19	0.27
	Standard Deviation	0.05	0.11	0.12	0.03	0.01	0.06	0.48	0.13	0.31	0.29	0.18	0.85	0.08	0.06	0.17
	Standard Error	0.03	0.07	0.07	0.02	0.01	0.04	0.28	0.07	0.18	0.17	0.10	0.49	0.05	0.04	0.10
Phaeophytin-a (µg/L)	Spring	0.26	0.30	0.35	0.26	0.27	0.18	0.83	0.41	0.23	0.18	0.14	0.52	0.21	0.16	0.12
							0.28			0.35	0.29	0.24		0.33	0.28	0.24
	Summer	0.22	0.40	0.24	0.31	0.19	0.32	0.50	0.30	0.32	0.30	0.23	0.70	0.28	0.22	0.42
	Fall	0.25	0.41	0.35	0.35	0.21	0.36	0.90	0.43	0.55	0.50	0.37	0.80	0.33	0.25	0.31
	Average	0.24	0.37	0.31	0.31	0.22	0.29	0.74	0.38	0.36	0.32	0.25	0.67	0.29	0.23	0.27
	Standard Deviation	0.02	0.06	0.06	0.05	0.04	0.08	0.21	0.07	0.14	0.13	0.09	0.14	0.06	0.05	0.12
	Standard Error	0.01	0.04	0.04	0.03	0.02	0.04	0.12	0.04	0.08	0.08	0.05	0.08	0.03	0.03	0.07

Table E.2: Chlorophyll-a Concentration (µg/L) Data Summary and Statistical Comparison Results between Camp Lake Tributary 1 Main Stem Stations and Lotic Reference Creek Stations for Spring, Summer and Fall Sampling Events in 2018

Season	Two-Area Comparison			Study Area	Sample Size	Mean	Standard Deviation	Standard Error	Minimum	Maximum
	Significant Difference between Areas?	P-value	Statistical Test							
Spring	No	0.4019	β	Reference	4	0.268	0.072	0.036	0.190	0.360
				CLT1 Main Stem	6	0.487	0.488	0.199	0.180	1.470
Summer	No	0.1251	β	Reference	4	0.243	0.162	0.081	0.130	0.480
				CLT1 Main Stem	4	0.438	0.223	0.112	0.290	0.770
Fall	YES	0.0376	α	Reference	4	0.316	0.161	0.080	0.175	0.470
				CLT1 Main Stem	4	0.995	0.485	0.242	0.540	1.680

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; ζ - data untransformed, t-test assuming unequal variance conducted; η - data log-transformed, t-test assuming unequal variance conducted.

Table E.3: Phytoplankton Monitoring Data (i.e., chlorophyll-a and phaeophytin-a concentrations) Collected at Reference Lake 3 (REF-03), Mary River Project 2018 CREMP

	Analyte	Chlorophyll-a (µg/L)						Phaeophytin-a (µg/L)					
	Station	REF3-01	REF3-02	REF3-03	Average	Standard Deviation	Standard Error	REF3-01	REF3-02	REF3-03	Average	Standard Deviation	Standard Error
Sample Collection Date	Summer	12-Aug-18			-	-	-	12-Aug-18			-	-	-
	Fall	27-Aug-17			-	-	-	27-Aug-17			-	-	-
Summer	Surface	0.57	0.74	0.63	0.65	0.09	0.05	0.5	0.61	0.525	0.55	0.06	0.03
	Bottom	0.77	0.86	0.88	0.84	0.06	0.03	0.51	0.53	0.64	0.56	0.07	0.04
	Average	0.67	0.80	0.76	0.74	0.07	0.04	0.51	0.57	0.58	0.55	0.04	0.02
Fall	Surface	0.88	0.86	0.87	0.87	0.01	0.01	0.56	0.56	0.56	0.56	0.00	0.00
	Bottom	1.02	0.93	0.88	0.94	0.07	0.04	0.62	0.51	0.59	0.57	0.06	0.03
	Average	0.95	0.90	0.88	0.91	0.04	0.02	0.59	0.54	0.58	0.57	0.03	0.02

Table E.4: Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Reference Lake 3, Mary River Project CREMP

Season	Overall 4-group Comparison			Summary		Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Years?	P-value	Statistical Treatment[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	P-value	Statistical Test[b]
Summer	YES	0.0247	α	2015	0.899	2015	2016	NO	0.992	Tukey's HSD (α)
				2016	0.923	2015	2017	YES	0.050	
				2017	0.634	2015	2018	NO	0.298	
				2018	0.742	2016	2017	YES	0.034	
						2016	2018	NO	0.206	
						2017	2018	NO	0.587	
Fall	NO	0.2887	α	2015	1.059	2015	2016	NO	0.840	Tamhane's (α)
				2016	0.738	2015	2017	NO	0.993	
				2017	0.913	2015	2018	NO	0.991	
				2018	0.907	2016	2017	NO	0.230	
						2016	2018	NO	0.190	
						2017	2018	NO	1.000	

▨ Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison) conducted, as appropriate.

Table E.5: Phytoplankton Monitoring Data (i.e., chlorophyll-a and phaeophytin-a concentrations) Collected at Camp Lake (JLO), Mary River Project CREMP, 2018

	Analyte	Chlorophyll-a (µg/L)							
	Station	**JL0-02**	**JL0-10**	**JL0-01**	**JL0-07**	**JL0-09**	**Average**	**Standard Deviation**	**Standard Error**
Sample Collection Date	Winter	4/13/2018	4/13/2018	4/13/2018	4/13/2018	4/14/2018	-	-	-
	Summer	7/30/2018	7/29/2018	7/30/2018	7/29/2018	7/29/2018	-	-	-
	Fall	8/21/2018	8/21/2018	8/20/2018	8/20/2018	8/20/2018	-	-	-
Winter	Surface	0.42	0.55	0.63	0.51	0.58	0.54	0.08	0.04
	Bottom	0.38	0.31	0.17	0.13	<0.17	0.23	0.11	0.05
	Average	0.40	0.43	0.40	0.32	0.37	0.38	0.04	0.02
Summer	Surface	1.88	2.02	1.98	2.10	2.10	2.02	0.09	0.04
	Bottom	2.10	1.98	1.94	1.87	2.01	1.98	0.09	0.04
	Average	1.99	2.00	1.96	1.99	2.06	2.00	0.04	0.02
Fall	Surface	2.19	2.16	2.20	2.12	2.20	2.17	0.03	0.02
	Bottom	2.22	2.15	2.03	2.12	2.12	2.13	0.07	0.03
	Average	2.20	2.16	2.12	2.12	2.16	2.15	0.04	0.02

	Analyte	Phaeophytin-a (µg/L)							
	Station	**JL0-02**	**JL0-10**	**JL0-01**	**JL0-07**	**JL0-09**	**Average**	**Standard Deviation**	**Standard Error**
Sample Collection Date	Winter	4/13/2018	4/13/2018	4/13/2018	4/13/2018	4/14/2018	-	-	-
	Summer	7/30/2018	7/29/2018	7/30/2018	7/29/2018	7/29/2018	-	-	-
	Fall	8/21/2018	8/21/2018	8/20/2018	8/20/2018	8/20/2018	-	-	-
Winter	Surface	0.30	0.38	0.31	0.39	0.29	0.33	0.05	0.02
	Bottom	0.29	0.33	0.26	0.21	0.20	0.26	0.06	0.02
	Average	0.30	0.36	0.29	0.30	0.24	0.30	0.04	0.02
Summer	Surface	0.90	0.92	0.89	0.98	0.89	0.92	0.04	0.02
	Bottom	0.80	0.94	0.79	1.13	1.00	0.93	0.14	0.06
	Average	0.85	0.93	0.84	1.06	0.95	0.92	0.09	0.04
Fall	Surface	0.77	0.87	0.88	0.93	0.86	0.86	0.06	0.03
	Bottom	0.97	0.91	1.01	0.87	0.84	0.92	0.07	0.03
	Average	0.87	0.89	0.95	0.90	0.85	0.89	0.04	0.02

Table E.6: Statistical Comparisons of Chlorophyll-a Concentrations Among Winter, Spring, Summer and/or Fall Sampling Events at Mine-Exposed and Reference Creek and Lake Study Areas, Mary River Project CREMP, 2018

Study Area	Overall 3-group Comparison			Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Seasons?	P-value	Statistical Test[b]	(I) Season	(J) Season	Significant Difference Between 2 Seasons?	P-value	Statistical Test
Reference Creek Stations	NO	0.75140	ANOVA[a]	Spring	Summer	NO	0.9646	Tamhane's[a]
				Spring	Fall	NO	0.8735	
				Summer	Fall	NO	0.7381	
Mary River GO-09 Reference Stations	YES	0.00935	ANOVA[a]	Spring	Summer	YES	0.0088	Tukey's[a]
				Spring	Fall	YES	0.0383	
				Summer	Fall	NO	0.4381	
Reference Lake 3	-	-	-	Winter	Summer	not applicable		ANOVA[a]
				Winter	Fall	not applicable		
				Summer	Fall	YES	0.0203	
Camp Lake	YES	< 0.001	ANOVA[a]	Winter	Summer	YES	0.0000	Tukey's[a,c]
				Winter	Fall	YES	0.0000	
				Summer	Fall	YES	0.0001	
Sheardown Lake NW	YES	0.00022	ANOVA[a]	Winter	Summer	YES	0.0102	Tamhane's[a,c]
				Winter	Fall	YES	0.0426	
				Summer	Fall	YES	0.0679	
Sheardown Lake SE	NO	0.28874	KW H-test[e]	Winter	Summer	NO	0.2222	MW U-test[f]
				Winter	Fall	NO	0.5476	
				Summer	Fall	NO	0.3095	
Mary Lake North Basin	YES	0.00136	ANOVA[a]	Winter	Summer	YES	0.0419	Tukey's[a,c]
				Winter	Fall	YES	0.0011	
				Summer	Fall	YES	0.0231	
Mary Lake South Basin	YES	0.01645	ANOVA[b]	Winter	Summer	NO	0.1786	Tukey's[b]
				Winter	Fall	YES	0.0783	
				Summer	Fall	NO	0.8935	

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Statistical tests include Analysis of Variance (ANOVA) and Kruskal Wallis H-test (KW H-test).

[c] Untransformed data, normally distributed, used for the analysis

[d] Log-transformed data, normally distributed, used for the analysis.

[e] Kruskal-Wallis H-test performed using untransformed data.

[f] Mann-Whitney U-test performed using untransformed data.

Table E.7: Summary Data and Statistical Results for Chlorophyll-a Concentration (mg/L) Comparisons between Individual Mine-Exposed Lakes and Reference Lake 3 for Summer Sampling, Mary River Project CREMP, 2018

Study Lake	Two-Group Comparison to Reference				Number of Stations (n)	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	P-value	Statistical Test	Magnitude of Difference					Lower Bound	Upper Bound		
Reference Lake 03	-	-	-	-	3	0.74	0.07	0.04	0.58	0.91	0.67	0.80
Camp Lake	YES	<0.001	α	19.0	5	2.00	0.04	0.02	1.95	2.04	1.96	2.06
Sheardown Lake NW	YES	<0.001	α	19.2	6	2.01	0.18	0.07	1.81	2.20	1.71	2.21
Sheardown Lake SE	YES	<0.001	α	20.9	5	2.12	0.07	0.03	2.03	2.21	2.01	2.21
Mary Lake North	YES	<0.001	α	-3.6	3	0.50	0.19	0.11	0.04	0.97	0.35	0.71
Mary Lake South	No	0.444	α	1.6	7	0.85	0.22	0.08	0.65	1.05	0.55	1.09

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Mann-Whitney U-test; δ - data exhibit unequal variance; test results validated using t-test assuming unequal variance

[b] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

▨ Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table E.8: Summary Data and Statistical Results for Chlorophyll-a Concentration (mg/L) Comparisons between Individual Mine-Exposed Lakes and Reference Lake 3 for Fall Sampling, Mary River Project CREMP, 2018

Study Lake	Two-Group Comparison to Reference				Number of Stations (n)	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	P-value	Statistical Test	Magnitude of Difference					Lower Bound	Upper Bound		
Reference Lake 03	-	-	-	-	3	0.91	0.04	0.02	0.81	1.00	0.88	0.95
Camp Lake	YES	<0.001	α	32.0	5	2.15	0.04	0.02	2.11	2.19	2.12	2.20
Sheardown Lake NW	YES	<0.001	α	21.8	6	1.75	0.14	0.06	1.61	1.90	1.64	2.01
Sheardown Lake SE	YES	<0.001	α	29.0	5	2.03	0.11	0.05	1.89	2.17	1.93	2.23
Mary Lake North	No	0.3514	α	-1.2	3	0.86	0.07	0.04	0.70	1.02	0.79	0.91
Mary Lake South	No	0.8952	α	-0.1	7	0.90	0.03	0.01	0.88	0.93	0.88	0.95

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Mann-Whitney U-test; δ - data exhibit unequal variance; test results validated using t-test assuming unequal variance

[b] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

▨ Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table E.9: Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Camp Lake, Mary River Project CREMP

Season	**Overall 5-group Comparison**			**Summary**		**Pair-wise, *post hoc* comparisons**[a]				
	Significant Difference Among Years?	**P-value**	**Statistical Treatment**[b]	**Year**	**Mean Concentration (μg/L)**	**(I) Year**	**(J) Year**	**Significant Difference Between 2 Years?**	**P-value**	**Statistical Test**[b]
Winter	YES	0.0015	γ	2014	0.275	2014	2015	YES	0.016	Mann-Whitney U-test
						2014	2016	YES	0.032	
				2015	0.742	2014	2017	NO	0.190	
						2014	2018	NO	0.286	
				2016	0.646	2015	2016	NO	0.151	
						2015	2017	YES	0.008	
				2017	0.316	2015	2018	YES	0.008	
						2016	2017	YES	0.016	
				2018	0.385	2016	2018	YES	0.008	
						2017	2018	NO	0.151	
Summer	YES	0.0054	γ	2014	1.050	2014	2015	-	-	Mann-Whitney U-test
						2014	2016	-	-	
				2015	1.262	2014	2017	-	-	
						2014	2018	-	-	
				2016	1.503	2015	2016	NO	0.151	
						2015	2017	NO	0.548	
				2017	1.243	2015	2018	YES	0.008	
						2016	2017	NO	0.151	
				2018	1.998	2016	2018	YES	0.008	
						2017	2018	YES	0.008	

Table E.9: Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Camp Lake, Mary River Project CREMP

Season	Overall 5-group Comparison			Summary		Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Years?	P-value	Statistical Treatment[b]	Year	Mean Concentration (µg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	P-value	Statistical Test[b]
Fall	YES	<0.0001	α	2014	1.590	2014	2015	NO	0.362	Tamhane's (α)
						2014	2016	NO	0.868	
				2015	0.651	2014	2017	NO	0.965	
						2014	2018	NO	0.824	
				2016	1.063	2015	2016	YES	0.096	
						2015	2017	YES	0.004	
				2017	1.187	2015	2018	YES	0.000	
						2016	2017	NO	0.980	
				2018	2.151	2016	2018	YES	0.003	
						2017	2018	YES	0.001	
Annual	NO	0.1704	γ	2014	1.014	2014	2015	NO	0.799	Mann-Whitney U-test
						2014	2016	NO	0.610	
				2015	0.885	2014	2017	NO	0.683	
						2014	2018	NO	0.087	
				2016	1.070	2015	2016	NO	0.217	
						2015	2017	NO	0.744	
				2017	0.915	2015	2018	NO	0.126	
						2016	2017	NO	0.486	
				2018	1.511	2016	2018	NO	0.126	
						2017	2018	NO	0.016	

▨ Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison) conducted, as appropriate.

Table E.10: Phytoplankton Monitoring Data (i.e., chlorophyll-a and phaeophytin-a concentrations) Collected at Sheardown Lake Northwest (DLO-01), Mary River Project CREMP, 2018

	Analyte	Chlorophyll-a (µg/L)								
	Station	DD-HAB 9-STN1	DL0-01-5	DL0-01-1	DL0-01-4	DL0-01-2	DL0-01-7	Average	Standard Deviation	Standard Error
Sample Collection Date	Winter	4/23/2018	4/23/2018	4/22/2018	4/22/2018	4/23/2018	4/23/2018	-	-	-
	Summer	7/30/2018	7/30/2018	7/30/2018	7/30/2018	7/30/2018	7/30/2018	-	-	-
	Fall	8/21/2018	8/22/2018	8/21/2018	8/22/2018	8/22/2018	8/22/2018	-	-	-
Winter	Surface	1.60	0.73	1.19	0.76	2.22	0.34	1.14	0.68	0.28
	Bottom	1.18	0.16	0.28	1.18	1.41	1.28	0.92	0.55	0.22
	Average	1.39	0.45	0.74	0.97	1.82	0.81	1.03	0.50	0.20
Summer	Surface	1.61	2.15	1.94	1.52	1.87	2.09	1.86	0.25	0.10
	Bottom	1.81	2.26	2.14	2.33	2.08	2.28	2.15	0.19	0.08
	Average	1.71	2.21	2.04	1.93	1.98	2.19	2.01	0.18	0.07
Fall	Surface	1.77	1.79	1.70	1.63	1.64	1.74	1.71	0.07	0.03
	Bottom	1.74	1.50	2.31	1.93	1.63	1.66	1.80	0.29	0.12
	Average	1.76	1.65	2.01	1.78	1.64	1.70	1.75	0.14	0.06

	Analyte	Phaeophytin-a (µg/L)								
	Station	DD-HAB 9-STN1	DL0-01-5	DL0-01-1	DL0-01-4	DL0-01-2	DL0-01-7	Average	Standard Deviation	Standard Error
Sample Collection Date	Winter	4/23/2018	4/23/2018	4/22/2018	4/22/2018	4/23/2018	4/23/2018	-	-	-
	Summer	7/30/2018	7/30/2018	7/30/2018	7/30/2018	7/30/2018	7/30/2018	-	-	-
	Fall	8/21/2018	8/22/2018	8/21/2018	8/22/2018	8/22/2018	8/22/2018	-	-	-
Winter	Surface	0.45	0.36	0.54	0.44	0.47	0.31	0.43	0.08	0.03
	Bottom	0.36	0.24	0.28	0.60	0.51	0.66	0.44	0.17	0.07
	Average	0.41	0.30	0.41	0.52	0.49	0.49	0.44	0.08	0.03
Summer	Surface	0.84	0.76	0.96	0.95	1.03	1.13	0.95	0.13	0.05
	Bottom	0.89	1.01	1.01	1.12	1.00	1.11	1.02	0.08	0.03
	Average	0.87	0.89	0.99	1.04	1.02	1.12	0.98	0.10	0.04
Fall	Surface	0.70	0.74	0.86	0.86	0.78	0.80	0.79	0.06	0.03
	Bottom	0.85	0.93	0.93	0.68	0.76	0.88	0.84	0.10	0.04
	Average	0.78	0.84	0.90	0.77	0.77	0.84	0.81	0.05	0.02

Table E.11: Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Sheardown Lake NW, Mary River Project CREMP

Season	Overall 5-group Comparison			Summary		Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Years?	P-value	Statistical Treatment[b]	Year	Mean Concentration (µg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	P-value	Statistical Test[b]
Winter	YES	0.0077	β	2014	2.550	2014	2015	NO	0.162	Tukey's HSD (β)
						2014	2016	YES	0.019	
				2015	1.104	2014	2017	YES	0.007	
						2014	2018	YES	0.046	
				2016	0.874	2015	2016	NO	0.847	
						2015	2017	NO	0.630	
				2017	0.790	2015	2018	NO	0.970	
						2016	2017	NO	0.995	
				2018	1.028	2016	2018	NO	0.995	
						2017	2018	NO	0.933	
Summer	YES	0.0004	α	2014	2.425	2014	2015	NO	0.342	Tamhane's (α)
						2014	2016	NO	0.998	
				2015	1.512	2014	2017	NO	0.142	
						2014	2018	NO	0.959	
				2016	2.131	2015	2016	YES	0.094	
						2015	2017	NO	0.289	
				2017	1.220	2015	2018	YES	0.030	
						2016	2017	YES	0.015	
				2018	2.007	2016	2018	NO	0.999	
						2017	2018	YES	0.000	

Table E.11: Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Sheardown Lake NW, Mary River Project CREMP

Season	Overall 5-group Comparison			Summary		Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Years?	P-value	Statistical Treatment[b]	Year	Mean Concentration (µg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	P-value	Statistical Test[b]
Fall	YES	0.0003	β	2014	0.800	2014	2015	NO	0.250	Tamhane's (β)
						2014	2016	NO	0.290	
				2015	1.611	2014	2017	NO	0.268	
						2014	2018	NO	0.172	
				2016	1.526	2015	2016	NO	1.000	
						2015	2017	NO	1.000	
				2017	1.560	2015	2018	NO	0.982	
						2016	2017	NO	1.000	
				2018	1.753	2016	2018	NO	0.317	
						2017	2018	NO	0.616	
Annual	YES	0.0885	γ	2014	1.925	2014	2015	NO	0.339	Mann-Whitney U-test
						2014	2016	NO	0.389	
				2015	1.409	2014	2017	NO	0.126	
						2014	2018	NO	0.443	
				2016	1.510	2015	2016	NO	0.501	
						2015	2017	NO	0.181	
				2017	1.190	2015	2018	YES	0.068	
						2016	2017	YES	0.064	
				2018	1.596	2016	2018	NO	0.406	
						2017	2018	YES	0.006	

▨ Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison) conducted, as appropriate.

Table E.12: Phytoplankton Monitoring Data (i.e., chlorophyll-a and phaeophytin-a concentrations) Collected at Sheardown Lake SE (DLO-02), Mary River Project CREMP, 2018

	Analyte	**Chlorophyll-a (µg/L)**							
	Station	**DL0-02-06**	**DL0-02-07**	**DL0-02-4**	**DL0-02-8**	**DL0-02-03**	**Average**	**Standard Deviation**	**Standard Error**
Sample Collection Date	Winter	4/17/2018	4/17/2018	4/17/2018	4/17/2018	4/17/2018	-	-	-
	Summer	7/31/2018	7/31/2018	7/31/2018	7/31/2018	7/31/2018	-	-	-
	Fall	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	-	-	-
Winter	Surface	2.27	1.86	0.64	2.34	5.84	2.59	1.94	0.87
	Bottom	1.29		2.74	1.88	1.62	1.88	0.62	0.31
	Average	1.78	1.86	1.69	2.11	3.73	2.23	0.85	0.38
Summer	Surface	2.04	2.12	2.07	2.28	2.11	2.12	0.09	0.04
	Bottom	1.97	2.14	2.16	2.13	2.18	2.12	0.08	0.04
	Average	2.01	2.13	2.12	2.21	2.15	2.12	0.07	0.03
Fall	Surface	1.92	2.02	2.03	2.06	1.83	1.97	0.10	0.04
	Bottom	2.53	2.02	1.91	1.98	2.02	2.09	0.25	0.11
	Average	2.23	2.02	1.97	2.02	1.93	2.03	0.11	0.05

	Analyte	**Phaeophytin-a (µg/L)**							
	Station	**DL0-02-06**	**DL0-02-07**	**DL0-02-4**	**DL0-02-8**	**DL0-02-03**	**Average**	**Standard Deviation**	**Standard Error**
Sample Collection Date	Winter	4/17/2018	4/17/2018	4/17/2018	4/17/2018	4/17/2018	-	-	-
	Summer	7/31/2018	7/31/2018	7/31/2018	7/31/2018	7/31/2018	-	-	-
	Fall	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	-	-	-
Winter	Surface	0.77	0.83	0.42	1.06	1.01	0.82	0.25	0.11
	Bottom	0.60		1.01	0.80	0.81	0.81	0.17	0.08
	Average	0.69	0.83	0.72	0.93	0.91	0.81	0.11	0.05
Summer	Surface	0.89	0.85	0.82	0.88	0.92	0.87	0.04	0.02
	Bottom	0.83	0.86	0.90	0.86	0.86	0.86	0.02	0.01
	Average	0.86	0.86	0.86	0.87	0.89	0.87	0.01	0.01
Fall	Surface	0.85	0.85	0.84	0.84	0.82	0.84	0.01	0.01
	Bottom	1.04	0.80	0.92	0.87	0.83	0.89	0.10	0.04
	Average	0.95	0.82	0.88	0.86	0.83	0.87	0.05	0.02

Table E.13: Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Sheardown Lake SE, Mary River Project CREMP

Season	Overall 5-group Comparison			Summary		Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Years?	P-value	Statistical Treatment[b]	Year	Mean Concentration (µg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	P-value	Statistical Test[b]
Winter	YES	0.0776	γ	2014	2.670	2014	2015	NO	0.151	Mann-Whitney U-test
						2014	2016	NO	0.310	
				2015	1.576	2014	2017	YES	0.056	
						2014	2018	NO	0.421	
				2016	1.903	2015	2016	NO	0.421	
						2015	2017	NO	1.000	
				2017	1.359	2015	2018	YES	0.095	
						2016	2017	NO	0.222	
				2018	2.234	2016	2018	NO	0.548	
						2017	2018	YES	0.016	
Summer	YES	0.0004	α	2014	0.203	2014	2015	YES	0.000	Tamhane's (α)
						2014	2016	YES	0.001	
				2015	0.914	2014	2017	YES	0.001	
						2014	2018	YES	0.000	
				2016	1.509	2015	2016	YES	0.019	
						2015	2017	YES	0.013	
				2017	1.366	2015	2018	YES	0.000	
						2016	2017	NO	0.948	
				2018	2.120	2016	2018	YES	0.016	
						2017	2018	YES	0.001	

Table E.13: Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Sheardown Lake SE, Mary River Project CREMP

	Overall 5-group Comparison			Summary		Pair-wise, *post hoc* comparisons[a]				
Season	**Significant Difference Among Years?**	**P-value**	**Statistical Treatment[b]**	**Year**	**Mean Concentration (µg/L)**	**(I) Year**	**(J) Year**	**Significant Difference Between 2 Years?**	**P-value**	**Statistical Test[b]**
Fall	YES	0.0003	α	2014	1.540	2014	2015	NO	0.999	Tamhane's (α)
						2014	2016	NO	0.809	
				2015	0.992	2014	2017	NO	1.000	
						2014	2018	NO	1.000	
				2016	2.869	2015	2016	YES	0.043	
						2015	2017	YES	0.000	
				2017	1.496	2015	2018	YES	0.000	
						2016	2017	NO	0.129	
				2018	2.032	2016	2018	NO	0.480	
						2017	2018	YES	0.001	
Annual	YES	0.0885	γ	2014	1.471	2014	2015	NO	0.683	Mann-Whitney U-test
						2014	2016	NO	0.126	
				2015	1.160	2014	2017	NO	0.461	
						2014	2018	NO	0.116	
				2016	2.094	2015	2016	YES	0.000	
						2015	2017	YES	0.010	
				2017	1.407	2015	2018	YES	0.000	
						2016	2017	YES	0.009	
				2018	2.129	2016	2018	NO	0.436	
						2017	2018	YES	0.000	

▨ Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison) conducted, as appropriate.

Table E.14: Phytoplankton Monitoring Data (i.e., chlorophyll-a and phaeophytin-a concentrations) Collected at the Mary River, Mary River Project CREMP, 2018

	Station	Upstream Reference			Upstream Mine-Exposed							Downstream Mine-Exposed		
		G0-09-A	**G0-09**	**G0-09-B**	**G0-03**	**G0-01**	**F0-01**	**E0-10**	**E0-03**	**E0-20**	**E0-21**	**C0-10**	**C0-05**	**C0-01**
Sample Collection Date	Spring	1-Jul-18	1-Jul-18	1-Jul-18	1-Jul-18	30-Jun-18	30-Jun-18	1-Jul-18	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18	30-Jun-18
	Summer	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	12-Aug-18	10-Aug-18
	Fall	27-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	27-Aug-18	25-Aug-18	27-Aug-18	26-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18
Chlorophyll-a (µg/L)	Spring	0.38	0.32	0.25	0.20	0.21	<0.19	0.24	0.32	0.27	0.30	0.19	0.44	0.37
	Summer	0.16	0.16	0.14	0.13	0.11	0.11	0.12	0.11	0.15	0.11	1.22	0.22	0.30
	Fall	0.17	0.24	0.19	0.14	0.12	0.41	0.21	0.32	0.35	0.15	0.21	0.52	0.29
	Average	0.24	0.24	0.19	0.16	0.15	0.24	0.19	0.25	0.26	0.19	0.54	0.39	0.32
	Standard Deviation	0.12	0.08	0.06	0.04	0.06	0.16	0.06	0.12	0.10	0.10	0.59	0.16	0.04
	Standard Error	0.07	0.05	0.03	0.02	0.032	0.09	0.04	0.07	0.06	0.06	0.34	0.09	0.03
Phaeophytin-a (µg/L)	Spring	0.34	0.28	0.27	0.26	0.27	0.24	0.25	0.30	0.27	0.30	0.25	0.33	0.33
	Summer	0.31	0.28	0.27	0.24	0.27	0.19	0.31	0.28	<0.32	0.24	0.42	0.28	0.31
	Fall	0.26	0.30	0.28	0.28	0.28	0.30	0.34	0.34	0.35	<0.40	0.29	0.40	0.31
	Average	0.30	0.29	0.27	0.26	0.27	0.24	0.30	0.31	0.31	0.27	0.32	0.34	0.32
	Standard Deviation	0.04	0.01	0.01	0.02	0.01	0.06	0.05	0.03	0.04	0.04	0.09	0.06	0.01
	Standard Error	0.02	0.01	0.00	0.01	0.00	0.03	0.03	0.018	0.02	0.03	0.05	0.03	0.01

Table E.15: **Phytoplankton Monitoring Data (i.e., chlorophyll-a and phaeophytin-a concentrations) Collected at Mary Lake (north and south basins; BLO), Mary River Project CREMP, 2018**

	Analyte	Chlorophyll-a (µg/L)												
	Station	Mary Lake North			Mary Lake South							Average	Standard Deviation	Standard Error
		BL0-01A	BL0-01	BL0-01B	BL0-05-A	BL0-05	BL0-05-B	BL0-03	BL0-04	BL0-09	BL0-06			
Sample Collection Date	Winter	4/14/2018	4/14/2018	4/14/2018	4/15/2018	4/15/2018	4/15/2018	4/15/2018	4/16/2018	4/16/2018	4/15/2018	-	-	-
	Summer	8/3/2018	8/3/2018	8/3/2018	8/2/2018	8/2/2018	8/2/2018	8/2/2018	8/2/2018	8/2/2018	8/2/2018	-	-	-
	Fall	8/26/2018	8/26/2018	8/26/2018	8/25/2018	8/24/2018	8/24/2018	8/25/2018	8/25/2018	8/25/2018	8/25/2018	-	-	-
Winter	Surface	0.23	0.26	0.35	0.49	0.66	1.57	0.63	0.42	0.44	1.35	0.64	0.46	0.14
	Bottom	<0.10	<0.10	0.14	<0.10	<0.10	0.78	0.62	<0.10	<0.10	<0.10	0.22	0.25	0.08
	Average	0.17	0.18	0.25	0.30	0.38	1.18	0.63	0.26	0.27	0.73	0.43	0.32	0.10
Summer	Surface	0.27	0.45	0.37	0.56	0.36	1.03	1.16	0.96	1.02	0.90	0.71	0.34	0.11
	Bottom	0.43	0.98	0.53	0.54	0.74	1.14	0.91	0.74	0.80	1.02	0.78	0.23	0.07
	Average	0.35	0.71	0.45	0.55	0.55	1.09	1.04	0.85	0.91	0.96	0.75	0.26	0.08
Fall	Surface	0.95	1.04	0.84	0.92	0.89	0.96	0.95	0.86	0.86	0.89	0.92	0.06	0.02
	Bottom	0.62	0.78	0.93	0.85	0.86	0.90	0.94	0.91	0.95	0.92	0.87	0.10	0.03
	Average	0.79	0.91	0.89	0.89	0.88	0.93	0.95	0.89	0.91	0.91	0.89	0.04	0.01

	Analyte	Phaeophytin-a (µg/L)												
	Station	Mary Lake North			Mary Lake South							Average	Standard Deviation	Standard Error
		BL0-01-A	BL0-01	BL0-01-B	BL0-05-A	BL0-05	BL0-05-B	BL0-03	BL0-04	BL0-09	BL0-06			
Sample Collection Date	Winter	4/14/2018	4/14/2018	4/14/2018	4/15/2018	4/15/2018	4/15/2018	4/15/2018	4/16/2018	4/16/2018	4/15/2018	-	-	-
	Summer	8/3/2018	8/3/2018	8/3/2018	8/2/2018	8/2/2018	8/2/2018	8/2/2018	8/2/2018	8/2/2018	8/2/2018	-	-	-
	Fall	8/26/2018	8/26/2018	8/26/2018	8/25/2018	8/24/2018	8/24/2018	8/25/2018	8/25/2018	8/25/2018	8/25/2018	-	-	-
Winter	Surface	0.22	0.22	0.23	0.25	0.33	1.63	0.36	<0.10	0.11	0.56	0.40	0.45	0.14
	Bottom	0.17	0.17	0.19	0.17	0.18	0.40	0.24	<0.10	<0.10	0.19	0.19	0.08	0.03
	Average	0.20	0.20	0.21	0.21	0.26	1.02	0.30	0.10	0.11	0.38	0.30	0.27	0.08
Summer	Surface	0.25	0.29	0.30	0.46	0.32	0.74	0.78	0.90	0.85	0.73	0.56	0.26	0.08
	Bottom	0.37	0.41	0.34	0.47	0.57	0.90	0.83	0.59	0.65	0.78	0.59	0.20	0.06
	Average	0.31	0.35	0.32	0.47	0.45	0.82	0.81	0.75	0.75	0.76	0.58	0.22	0.07
Fall	Surface	0.43	0.36	0.47	0.98	0.99	1.01	1.14	1.02	0.89	1.05	0.83	0.29	0.09
	Bottom	0.39	0.40	0.34	0.90	0.88	0.88	1.01	0.98	1.06	1.02	0.79	0.29	0.09
	Average	0.41	0.38	0.41	0.94	0.94	0.94	1.08	1.00	0.98	1.04	0.81	0.29	0.09

Table E.16: Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Mary Lake North, Mary River Project CREMP

Season	Overall 5-group Comparison			Summary		Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Years?	P-value	Statistical Treatment[b]	Year	Mean Concentration (µg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	P-value	Statistical Test[b]
Winter	NO	0.1615	γ	2014	0.585	2014	2015	NO	0.400	Mann-Whitney U-test
						2014	2016	NO	0.200	
				2015	0.653	2014	2017	NO	0.400	
						2014	2018	NO	0.400	
				2016	0.183	2015	2016	NO	0.200	
						2015	2017	NO	0.100	
				2017	0.178	2015	2018	NO	0.200	
						2016	2017	NO	1.000	
				2018	0.197	2016	2018	NO	0.800	
						2017	2018	NO	1.000	
Summer	YES	0.0759	α	2014	0.917	2014	2015	NO	0.998	Tukey's HSD (α)
						2014	2016	NO	0.913	
				2015	0.827	2014	2017	NO	0.240	
						2014	2018	NO	0.629	
				2016	1.159	2015	2016	NO	0.780	
						2015	2017	NO	0.361	
				2017	0.266	2015	2018	NO	0.797	
						2016	2017	YES	0.069	
				2018	0.504	2016	2018	NO	0.235	
						2017	2018	NO	0.918	

Table E.16: Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Mary Lake North, Mary River Project CREMP

Season	Overall 5-group Comparison			Summary		Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Years?	P-value	Statistical Treatment[b]	Year	Mean Concentration (µg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	P-value	Statistical Test[b]
Fall	YES	0.0093	α	2014	0.517	2014	2015	NO	0.881	Tukey's HSD (α)
						2014	2016	YES	0.013	
				2015	0.623	2014	2017	YES	0.044	
						2014	2018	YES	0.081	
				2016	0.997	2015	2016	YES	0.054	
						2015	2017	NO	0.181	
				2017	0.905	2015	2018	NO	0.310	
						2016	2017	NO	0.926	
				2018	0.860	2016	2018	NO	0.759	
						2017	2018	NO	0.994	
Annual	NO	0.3640	γ	2014	0.673	2014	2015	NO	0.605	Mann-Whitney U-test
						2014	2016	NO	0.606	
				2015	0.701	2014	2017	NO	0.605	
						2014	2018	NO	0.666	
				2016	0.854	2015	2016	NO	0.481	
						2015	2017	NO	0.190	
				2017	0.450	2015	2018	NO	0.546	
						2016	2017	NO	0.074	
				2018	0.520	2016	2018	NO	0.059	
						2017	2018	NO	0.730	

▨ Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison) conducted, as appropriate.

Table E.17: **Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Mary Lake South, Mary River Project CREMP**

Season	Overall 5-group Comparison			Summary		Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Years?	P-value	Statistical Treatment[b]	Year	Mean Concentration (µg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	P-value	Statistical Test[b]
Winter	NO	0.2455	γ	2014	0.879	2014	2015	NO	0.456	Mann-Whitney U-test
						2014	2016	NO	0.805	
				2015	0.646	2014	2017	NO	0.710	
						2014	2018	NO	0.165	
				2016	0.306	2015	2016	NO	0.073	
						2015	2017	NO	0.073	
				2017	0.351	2015	2018	NO	0.535	
						2016	2017	NO	0.620	
				2018	0.533	2016	2018	NO	0.097	
						2017	2018	NO	0.456	
Summer	NO	0.3989	α	2014	0.864	2014	2015	NO	1.000	Tamhane's (α)
						2014	2016	NO	0.993	
				2015	0.789	2014	2017	NO	1.000	
						2014	2018	NO	1.000	
				2016	1.076	2015	2016	NO	0.039	
						2015	2017	NO	1.000	
				2017	0.803	2015	2018	NO	1.000	
						2016	2017	NO	0.045	
				2018	0.848	2016	2018	NO	0.413	
						2017	2018	NO	1.000	

Table E.17: Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Mary Lake South, Mary River Project CREMP

Season	Overall 5-group Comparison			Summary		Pair-wise, *post hoc* comparisons[a]				
	Significant Difference Among Years?	P-value	Statistical Treatment[b]	Year	Mean Concentration (µg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	P-value	Statistical Test[b]
Fall	NO	0.1910	γ	2014	0.750	2014	2015	NO	0.620	Mann-Whitney U-test
						2014	2016	NO	0.805	
				2015	0.895	2014	2017	NO	0.710	
						2014	2018	NO	0.209	
				2016	0.752	2015	2016	NO	0.259	
						2015	2017	NO	0.053	
				2017	0.750	2015	2018	NO	0.710	
						2016	2017	NO	1.000	
				2018	0.904	2016	2018	NO	0.209	
						2017	2018	NO	0.007	
Annual	NO	0.4764	γ	2014	0.831	2014	2015	NO	0.772	Mann-Whitney U-test
						2014	2016	NO	0.734	
				2015	0.777	2014	2017	NO	0.650	
						2014	2018	NO	0.443	
				2016	0.711	2015	2016	NO	0.811	
						2015	2017	NO	0.068	
				2017	0.634	2015	2018	NO	0.960	
						2016	2017	NO	0.385	
				2018	0.762	2016	2018	NO	0.763	
						2017	2018	NO	0.043	

▨ Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] *Post hoc* analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison) conducted, as appropriate.

APPENDIX F

BENTHIC INVERTEBRATE COMMUNITY DATA

Table F.1: Replicate Grab Data for Benthic Invertebrate Community Samples Collected at the Unnamed Reference Creek and Camp Lake Tributaries, Mary River Project CREMP, August 2018

Study Area	Station	Water Depth (cm)			Water Velocity (m/s)			Embeddedness			In-Stream Vegetation			Algae Presence		
		Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3
Unnamed Reference Creek	REF-CRK-B1	10	10	10	0.42	0.41	0.42	25%	25%	25%	scarce	scarce	scarce	scarce	scarce	scarce
	REF-CRK-B2	9	9	11	0.52	0.48	0.42	25%	25%	25%	scarce	scarce	scarce	scarce	common	common
	REF-CRK-B3	17	17	10	0.55	0.46	0.55	25%	25%	25%	scarce	scarce	scarce	common	common	common
	REF-CRK-B4	10	12	10	0.45	0.45	0.60	25%	25%	25%	scarce	common	scarce	common	common	common
	REF-CRK-B5	12	14	14	0.41	0.47	0.59	25%	25%	25%	scarce	scarce	scarce	common	common	common
Camp Lake Tributary 1 Upstream	CLT-1-US-B1	10	10	10	0.45	0.48	0.39	13%	25%	38%	scarce	scarce	scarce	common	common	scarce
	CLT-1-US-B2	10	12	14	0.32	0.43	0.51	25%	38%	38%	scarce	scarce	scarce	common	common	scarce
	CLT-1-US-B3	15	10	12	0.43	0.39	0.37	25%	50%	50%	scarce	common	scarce	scarce	scarce	scarce
	CLT-1-US-B4	8	13	9	0.39	0.40	0.31	25%	14%	25%	scarce	common	scarce	scarce	common	scarce
	CLT-1-US-B5	10	9	8	0.62	0.43	0.38	50%	50%	50%	common	scarce	none	scarce	scarce	scarce
Camp Lake Tributary 1 Downstream	CLT-1-DS-B1	15	17	16	0.53	0.51	0.53	25%	13%	25%	scarce	scarce	scarce	scarce	scarce	scarce
	CLT-1-DS-B2	13	14	15	-	-	-	25%	25%	38%	scarce	none	none	common	scarce	scarce
	CLT-1-DS-B3	13	13	15	-	-	-	25%	25%	25%	scarce	none	none	common	scarce	common
	CLT-1-DS-B4	13	15	16	-	-	-	38%	25%	38%	scarce	none	common	common	common	common
	CLT-1-DS-B5	13	15	16	-	-	-	25%	25%	25%	scarce	scarce	scarce	scarce	common	scarce
Camp Lake Tributary 2 Upstream	CLT-2-US-B1	22	20	14	0.42	0.52	0.50	25%	50%	50%	none	none	scarce	none	none	scarce
	CLT-2-US-B2	15	16	18	0.53	0.50	0.46	25%	75%	25%	none	none	none	none	none	scarce
	CLT-2-US-B3	19	11	15	0.42	0.42	0.41	25%	25%	50%	none	scarce	none	scarce	scarce	scarce
	CLT-2-US-B4	16	8	10	0.39	0.45	0.40	13%	13%	38%	scarce	scarce	none	scarce	scarce	scarce
	CLT-2-US-B5	8	10	8	0.42	0.51	0.39	0%	13%	13%	none	none	none	scarce	scarce	scarce
Camp Lake Tributary 2 Downstream	CLT-2-DS-B1	15	19	11	0.46	0.58	0.44	50%	75%	25%	scarce	none	none	common	common	scarce
	CLT-2-DS-B2	12	13	13	0.53	0.51	0.55	25%	25%	50%	scarce	scarce	none	scarce	scarce	scarce
	CLT-2-DS-B3	16	16	14	0.41	0.52	0.42	25%	25%	50%	none	none	none	scarce	scarce	scarce
	CLT-2-DS-B4	18	17	11	0.50	0.45	0.48	50%	50%	25%	none	none	none	scarce	scarce	scarce
	CLT-2-DS-B5	15	13	14	0.42	0.42	0.56	50%	25%	25%	none	none	none	none	none	scarce

Table F.2: **Replicate Station Habitat Feature Summary Statistics for the Camp Lake Tributary Benthic Stations, Mary River Project CREMP, August 2018**

Metric	Study Area	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Water Depth (cm)	Unnamed Reference Creek	5	11.7	2.2	1.0	8.9	14.4	9.7	14.7
	CLT1-US North Branch	5	10.7	1.4	0.6	8.9	12.4	9.0	12.3
	CLT1-DS Lower Main Stem	5	14.6	0.9	0.4	13.5	15.7	13.7	16.0
	CLT2-US Upstream	5	9.1	1.7	0.8	7.0	11.2	7.3	11.0
	CLT2-DS Downstream	5	8.7	0.9	0.4	7.5	9.8	7.3	9.7
Water Velocity (cm/s)	Unnamed Reference Creek	5	48.0	3.9	1.8	43.1	52.9	41.7	52.0
	CLT1-US North Branch	5	42.0	4.2	1.9	36.8	47.2	36.7	47.7
	CLT1-DS Lower Main Stem	1	52.3	-	-	-	-	52.3	52.3
	CLT2-US Upstream	5	49.5	4.1	1.8	44.4	54.6	44.7	55.3
	CLT2-DS Downstream	5	44.9	1.5	0.7	43.0	46.8	42.3	46.3
Substrate Embeddedness (%)	Unnamed Reference Creek	5	25	0	0	25	25	25	25
	CLT1-US North Branch	5	34	12	5	20	49	21	50
	CLT1-DS Lower Main Stem	5	27	5	2	21	33	21	33
	CLT2-US Upstream	5	62	5	2	56	69	58	71
	CLT2-DS Downstream	5	60	6	3	53	67	52	67

Note: Five stations were sampled at each study area.

Table F.3: Benthic Station Habitat Feature Statistical Comparisons among Camp Lake Tributary 1 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2018

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test[b]	(I) Area	(J) Area	Significant Difference Between 2 Areas?	P-value	Statistical Test
Water Depth (cm)	YES	0.0060	α	Unnamed Reference Creek	CLT1 Upstream	No	0.8097	Tamhane's
				Unnamed Reference Creek	CLT1 Downstream	No	0.1099	
				CLT1 Upstream	CLT1 Downstream	YES	0.0043	
Water Velocity (cm/s)	not applicable data available for only two study areas			Unnamed Reference Creek	CLT1 Upstream	YES	0.0475	α
				Unnamed Reference Creek	CLT1 Downstream	-	na	
				CLT1 Upstream	CLT1 Downstream	-	na	
Substrate Embeddedness (%)	NO	0.1499	α	Unnamed Reference Creek	CLT1 Upstream	No	0.3990	Tamhane's
				Unnamed Reference Creek	CLT1 Downstream	No	0.8566	
				CLT1 Upstream	CLT1 Downstream	No	0.5601	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - Kruskal-Wallis H-test (multiple group) or Mann-Whitney U-test (pair-wise) conducted using untransformed data; ζ - data untransformed, t-test assuming unequal variance used; η - data log transformed, t-test assuming unequal variance used.

Table F.4: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Unnamed Reference Creek Study Area, August 2018

Taxa	Study Area	Unnamed Reference Creek				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		25	29	57	14	36
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
F. Sperchonidae						
Sperchon		14	11	22	14	18
SEED SHRIMPS						
Cl. Ostracoda		-	4	7	7	7
INSECTS						
Cl. Insecta						
MAYFLIES						
O. Ephemeroptera						
F. Baetidae						
Acentrella feropagus		25	50	36	11	29
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		7	7	4	-	-
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
Culicoides		32	4	-	14	4
MIDGES						
F. Chironomidae						
chironomid pupae		**25**	**4**	**11**	**4**	**14**
S.F. Chironominae						
Tanytarsus		4	-	-	-	-
S.F. Diamesinae						
Diamesa		97	36	32	18	39
Pseudokiefferiella		11	29	36	-	32
S.F. Orthocladiinae						
Chaetocladius		-	11	-	-	11
Corynoneura		-	-	4	-	-
Cricotopus		-	4	4	-	-
Cricotopus/Orthocladius		-	4	14	-	14
Diplocladius		-	-	-	-	-
Eukiefferiella		29	7	11	-	-
Hydrobaenus		-	4	4	-	4
Hydrosmittia		-	-	7	-	-
Krenosmittia		-	-	-	-	-
Limnophyes		133	57	86	39	29
Orthocladius (Euorthocladius)		36	47	50	29	25

Table F.4: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Unnamed Reference Creek Study Area, August 2018

Taxa Study Area	Unnamed Reference Creek				
Replicate Station	B1	B2	B3	B4	B5
Paraphaenocladius	-	4	-	-	-
Synorthocladius	-	-	-	-	-
Thienemanniella	7	32	22	22	50
Tokunagaia	65	90	86	25	90
Tvetenia	18	11	-	7	18
indeterminate	-	-	-	-	-
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	4
F. Empididae					
Clinocera	11	18	11	4	7
pupae	-	-	-	-	-
F. Simuliidae					
Gymnopais	-	4	-	4	-
Metacnephia	50	32	47	32	61
Prosimulium	36	25	36	14	65
Simulium	-	-	-	-	-
indeterminate	-	-	-	-	-
F. Tipulidae					
Tipula	11	22	29	4	11
Number of Organisms (No. organisms per m^2)	636	546	616	262	568
Richness (total number of taxa)[a]	18	24	21	16	20
Simpson's Evenness (E)	0.942	0.961	0.963	0.972	0.964
Bray-Curtis Index	0.262	0.114	0.144	0.342	0.175
Percent Composition					
% Nemata	3.9%	5.3%	9.3%	5.3%	6.3%
% Oligochaeta	0.0%	0.0%	0.0%	0.0%	0.0%
% Hydracarina	2.2%	2.0%	3.6%	5.3%	3.2%
% Ostracods	0.0%	0.7%	1.1%	2.7%	1.2%
% Ephemeroptera	3.9%	9.2%	5.8%	4.2%	5.1%
% Chironomids	66.8%	62.3%	59.6%	55.0%	58.1%
% Metal Sensitive Chironmids	18.7%	12.1%	11.4%	6.9%	13.0%
% Simuliidae	13.5%	11.2%	13.5%	19.1%	22.2%
% Tipulidae	1.7%	4.0%	4.7%	1.5%	1.9%
Functional Feeding Group Composition					
% Collector - Gatherers	74.1%	76.0%	72.9%	67.2%	67.4%
% Filterers	14.2%	11.2%	13.5%	19.1%	22.2%
% Shredders	2.8%	6.8%	8.3%	1.5%	4.6%
Habitat Preference Group Composition					
% Clingers	18.1%	17.9%	21.8%	26.0%	29.2%
% Sprawlers	71.2%	72.0%	64.3%	61.8%	61.8%
% Burrowers	10.7%	10.1%	14.0%	12.2%	9.0%

[a] Bold entries excluded from taxa count

Table F.5: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 1 Study Areas, August 2018

Taxa	Study Area	North Branch Upstream (CLT1-US)				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		14	43	7	36	11
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		7	43	14	22	7
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
F. Sperchonidae						
Sperchon		47	122	57	108	39
SEED SHRIMPS						
Cl. Ostracoda		-	-	-	-	-
INSECTS						
Cl. Insecta						
MAYFLIES						
O. Ephemeroptera						
F. Baetidae						
Acentrella feropagus		22	-	14	14	14
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		4	-	-	-	-
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
Culicoides		-	-	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		**61**	**100**	**129**	**57**	**47**
S.F. Chironominae						
Tanytarsus		-	-	-	-	-
S.F. Diamesinae						
Diamesa		7	14	-	7	7
Pseudokiefferiella		104	187	251	337	190
S.F. Orthocladiinae						
Chaetocladius		-	-	-	-	4
Corynoneura		-	-	-	-	-
Cricotopus		29	93	158	115	61
Cricotopus/Orthocladius		319	782	337	337	118
Diplocladius		-	-	-	-	-
Eukiefferiella		11	-	-	-	-
Hydrobaenus		-	129	7	36	22
Hydrosmittia		18	151	201	172	100
Krenosmittia		-	-	-	7	7
Limnophyes		7	29	7	7	-
Orthocladius (Euorthocladius)		7	36	244	194	79
Paraphaenocladius		-	-	-	-	-
Synorthocladius		-	-	-	7	-

Table F.5: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 1 Study Areas, August 2018

Taxa	Study Area	North Branch Upstream (CLT1-US)				
	Replicate Station	B1	B2	B3	B4	B5
Thienemanniella		7	-	14	-	-
Tokunagaia		11	151	57	22	47
Tvetenia		39	72	43	122	111
indeterminate		-	-	-	-	-
S.F. Tanypodinae						
Thienemannimyia complex		-	-	-	-	-
F. Empididae						
Clinocera		-	14	-	7	4
pupae		-	-	-	-	-
F. Simuliidae						
Gymnopais		-	-	7	7	-
Metacnephia		-	-	-	-	-
Prosimulium		-	-	-	-	-
Simulium		-	-	7	-	-
indeterminate		-	-	-	**7**	7
F. Tipulidae						
Tipula		47	22	7	57	32
Number of Organisms (No. organisms per m^2)		761	1,988	1,561	1,678	907
Richness (total number of taxa)[a]		17	15	17	19	18
Simpson's Evenness (E)		0.792	0.845	0.899	0.917	0.931
Bray-Curtis Index		0.743	0.769	0.792	0.817	0.717
Percent Composition						
% Nemata		1.8%	2.2%	0.4%	2.1%	1.2%
% Oligochaeta		0.9%	2.2%	0.9%	1.3%	0.8%
% Hydracarina		6.2%	6.1%	3.7%	6.4%	4.3%
% Ostracods		0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera		2.9%	0.0%	0.9%	0.8%	1.5%
% Chironomids		81.5%	87.7%	92.8%	84.6%	87.4%
% Metal Sensitive Chironmids		16.2%	10.7%	17.7%	21.3%	23.0%
% Simuliidae		0.0%	0.0%	0.9%	0.8%	0.8%
% Tipulidae		6.2%	1.1%	0.4%	3.4%	3.5%
Functional Feeding Group Composition						
% Collector - Gatherers		36.4%	45.3%	60.2%	60.8%	70.0%
% Filterers		0.0%	0.0%	0.9%	0.8%	0.8%
% Shredders		57.4%	47.8%	35.2%	31.5%	24.5%
Habitat Preference Group Composition						
% Clingers		56.9%	53.6%	39.3%	35.8%	26.5%
% Sprawlers		34.2%	41.0%	58.9%	57.4%	68.0%
% Burrowers		8.9%	5.4%	1.8%	6.9%	5.5%

[a] Bold entries excluded from taxa count

Table F.5: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 1 Study Areas, August 2018

Taxa	Study Area	Lower Main Stem (CLT1-DS)				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		11	32	7	7	36
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		4	18	-	11	14
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
F. Sperchonidae						
Sperchon		14	11	29	39	50
SEED SHRIMPS						
Cl. Ostracoda		-	-	4	-	-
INSECTS						
Cl. Insecta						
MAYFLIES						
O. Ephemeroptera						
F. Baetidae						
Acentrella feropagus		7	-	4	-	-
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		-	-	-	-	-
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
Culicoides		-	-	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		**86**	**93**	**133**	**165**	**208**
S.F. Chironominae						
Tanytarsus		-	-	-	-	-
S.F. Diamesinae						
Diamesa		-	4	4	7	7
Pseudokiefferiella		47	86	14	39	22
S.F. Orthocladiinae						
Chaetocladius		-	-	-	-	-
Corynoneura		-	-	-	-	-
Cricotopus		36	18	18	90	72
Cricotopus/Orthocladius		65	122	147	251	115
Diplocladius		-	-	-	-	-
Eukiefferiella		-	-	-	-	-
Hydrobaenus		-	4	-	-	-
Hydrosmittia		100	133	97	431	323
Krenosmittia		4	-	-	4	-
Limnophyes		4	-	-	11	14
Orthocladius (Euorthocladius)		7	25	25	65	22
Paraphaenocladius		-	-	-	-	-
Synorthocladius		-	-	-	-	-

Table F.5: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 1 Study Areas, August 2018

Taxa Study Area	Lower Main Stem (CLT1-DS)				
Replicate Station	B1	B2	B3	B4	B5
Thienemanniella	-	-	-	-	-
Tokunagaia	11	-	-	7	-
Tvetenia	32	50	32	50	57
indeterminate	-	-	-	-	-
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
Clinocera	4	11	4	4	7
pupae	-	-	-	-	-
F. Simuliidae					
Gymnopais	-	-	-	4	-
Metacnephia	-	7	4	-	-
Prosimulium	-	-	-	-	-
Simulium	-	-	-	-	-
indeterminate	-	-	-	-	-
F. Tipulidae					
Tipula	43	25	39	25	22
Number of Organisms (No. organisms per m^2)	475	639	561	1,210	969
Richness (total number of taxa)[a]	15	14	14	16	13
Simpson's Evenness (E)	0.912	0.903	0.848	0.800	0.819
Bray-Curtis Index	0.752	0.729	0.764	0.826	0.778
Percent Composition					
% Nemata	2.3%	5.0%	1.2%	0.6%	3.7%
% Oligochaeta	0.8%	2.8%	0.0%	0.9%	1.4%
% Hydracarina	2.9%	1.7%	5.2%	3.2%	5.2%
% Ostracods	0.0%	0.0%	0.7%	0.0%	0.0%
% Ephemeroptera	1.5%	0.0%	0.7%	0.0%	0.0%
% Chironomids	82.5%	83.7%	83.8%	92.6%	86.7%
% Metal Sensitive Chironmids	12.6%	17.1%	4.6%	4.5%	3.9%
% Simuliidae	0.0%	1.1%	0.7%	0.3%	0.0%
% Tipulidae	9.1%	3.9%	7.0%	2.1%	2.3%
Functional Feeding Group Composition					
% Collector - Gatherers	60.0%	65.1%	45.5%	61.0%	66.2%
% Filterers	0.0%	1.1%	0.7%	0.3%	0.0%
% Shredders	36.2%	30.4%	48.0%	35.1%	28.0%
Habitat Preference Group Composition					
% Clingers	30.9%	31.0%	47.6%	36.9%	31.6%
% Sprawlers	56.8%	57.3%	44.2%	59.5%	61.0%
% Burrowers	12.2%	11.7%	8.2%	3.6%	7.4%

[a] Bold entries excluded from taxa count

Table F.6: **Benthic Invertebrate Community Summary Statistics for Camp Lake Tributary 1 Study Areas, Mary River Project CREMP, August 2018**

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unnamed Reference Creek	526	152	68	337	714	262	636
	CLT1 Upstream	1,379	524	234	728	2,030	761	1,988
	CLT1 Downstream	771	309	138	388	1,154	475	1,210
Richness (Number of Taxa)	Unnamed Reference Creek	19.8	3.0	1.4	16.0	23.6	16.0	24.0
	CLT1 Upstream	17.2	1.5	0.7	15.4	19.0	15.0	19.0
	CLT1 Downstream	14.4	1.1	0.5	13.0	15.8	13.0	16.0
Simpson's Evenness	Unnamed Reference Creek	0.960	0.011	0.005	0.946	0.974	0.942	0.972
	CLT1 Upstream	0.877	0.058	0.026	0.805	0.949	0.792	0.931
	CLT1 Downstream	0.857	0.050	0.022	0.795	0.919	0.800	0.912
Bray-Curtis Index	Unnamed Reference Creek	0.208	0.093	0.042	0.092	0.324	0.114	0.342
	CLT1 Upstream	0.767	0.039	0.018	0.719	0.816	0.717	0.817
	CLT1 Downstream	0.770	0.036	0.016	0.725	0.815	0.729	0.826
Nemata (% of community)	Unnamed Reference Creek	6.0%	2.0%	0.9%	3.6%	8.5%	3.9%	9.3%
	CLT1 Upstream	1.6%	0.7%	0.3%	0.7%	2.5%	0.4%	2.2%
	CLT1 Downstream	2.6%	1.8%	0.8%	0.3%	4.8%	0.6%	5.0%
Oligochaeta (% of community)	Unnamed Reference Creek	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT1 Upstream	1.2%	0.6%	0.3%	0.5%	1.9%	0.8%	2.2%
	CLT1 Downstream	1.2%	1.0%	0.5%	-0.1%	2.5%	0.0%	2.8%
Hydracarina (% of community)	Unnamed Reference Creek	3.3%	1.3%	0.6%	1.6%	4.9%	2.0%	5.3%
	CLT1 Upstream	5.3%	1.3%	0.6%	3.8%	6.9%	3.7%	6.4%
	CLT1 Downstream	3.6%	1.5%	0.7%	1.8%	5.5%	1.7%	5.2%
Ostracoda (% of community)	Unnamed Reference Creek	1.2%	1.0%	0.4%	-0.1%	2.4%	0.0%	2.7%
	CLT1 Upstream	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT1 Downstream	0.1%	0.3%	0.1%	-0.3%	0.5%	0.0%	0.7%
Ephemeroptera (% of community)	Unnamed Reference Creek	5.6%	2.1%	0.9%	3.0%	8.3%	3.9%	9.2%
	CLT1 Upstream	1.2%	1.1%	0.5%	-0.1%	2.6%	0.0%	2.9%
	CLT1 Downstream	0.4%	0.7%	0.3%	-0.4%	1.3%	0.0%	1.5%
Chironomidae (% of community)	Unnamed Reference Creek	60.3%	4.5%	2.0%	54.8%	65.9%	55.0%	66.8%
	CLT1 Upstream	86.8%	4.2%	1.9%	81.6%	92.0%	81.5%	92.8%
	CLT1 Downstream	85.9%	4.0%	1.8%	80.8%	90.9%	82.5%	92.6%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	12.4%	4.2%	1.9%	7.1%	17.7%	6.9%	18.7%
	CLT1 Upstream	17.8%	4.8%	2.2%	11.8%	23.8%	10.7%	23.0%
	CLT1 Downstream	8.6%	6.0%	2.7%	1.2%	16.0%	3.9%	17.1%
Simuliidae (% of community)	Unnamed Reference Creek	15.9%	4.6%	2.0%	10.2%	21.6%	11.2%	22.2%
	CLT1 Upstream	0.5%	0.5%	0.2%	-0.1%	1.1%	0.0%	0.9%
	CLT1 Downstream	0.4%	0.5%	0.2%	-0.2%	1.0%	0.0%	1.1%
Tipulidae (% of community)	Unnamed Reference Creek	2.8%	1.5%	0.7%	1.0%	4.6%	1.5%	4.7%
	CLT1 Upstream	2.9%	2.3%	1.0%	0.1%	5.7%	0.4%	6.2%
	CLT1 Downstream	4.9%	3.1%	1.4%	1.1%	8.6%	2.1%	9.1%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	71.5%	4.0%	1.8%	66.5%	76.5%	67.2%	76.0%
	CLT1 Upstream	54.6%	13.5%	6.0%	37.8%	71.3%	36.4%	70.0%
	CLT1 Downstream	59.5%	8.3%	3.7%	49.2%	69.8%	45.5%	66.2%
Filterer FFG (% of community)	Unnamed Reference Creek	16.0%	4.5%	2.0%	10.4%	21.6%	11.2%	22.2%
	CLT1 Upstream	0.5%	0.5%	0.2%	-0.1%	1.1%	0.0%	0.9%
	CLT1 Downstream	0.4%	0.5%	0.2%	-0.2%	1.0%	0.0%	1.1%
Shredder FFG (% of community)	Unnamed Reference Creek	4.8%	2.8%	1.2%	1.4%	8.2%	1.5%	8.3%
	CLT1 Upstream	39.3%	13.2%	5.9%	22.9%	55.7%	24.5%	57.4%
	CLT1 Downstream	35.5%	7.7%	3.5%	25.9%	45.1%	28.0%	48.0%
Clinger HPG (% of community)	Unnamed Reference Creek	22.6%	4.9%	2.2%	16.4%	28.7%	17.9%	29.2%
	CLT1 Upstream	42.4%	12.7%	5.7%	26.7%	58.1%	26.5%	56.9%
	CLT1 Downstream	35.6%	7.2%	3.2%	26.7%	44.5%	30.9%	47.6%
Sprawler HPG (% of community)	Unnamed Reference Creek	66.2%	5.0%	2.2%	60.0%	72.5%	61.8%	72.0%
	CLT1 Upstream	51.9%	13.9%	6.2%	34.6%	69.1%	34.2%	68.0%
	CLT1 Downstream	55.8%	6.7%	3.0%	47.5%	64.1%	44.2%	61.0%
Burrower HPG (% of community)	Unnamed Reference Creek	11.2%	1.9%	0.9%	8.8%	13.6%	9.0%	14.0%
	CLT1 Upstream	5.7%	2.6%	1.2%	2.5%	8.9%	1.8%	8.9%
	CLT1 Downstream	8.6%	3.5%	1.6%	4.2%	13.0%	3.6%	12.2%

Table F.7: Statistical Comparison of Primary and Percent Compositional Benthic Metrics at Camp Lake Tributary 1 North Branch (CLT1 US) Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Effect Size vs. Baseline Year 2011	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.1864	2007	3	505	330	-	-3.2	a	Tukey's HSD
				2011	3	949	139	1.3	-	a	
				2015	5	1,446	836	2.9	3.6	a	
				2016	5	1,610	806	3.4	4.8	a	
				2017	5	1,242	143	2.2	2.1	a	
				2018	5	1,379	524	2.7	3.1	a	
Richness (No. of Taxa)	none	YES	0.0318	2007	3	13.7	2.3	-	-0.3	a	Mann-Whitney U-test
				2011	3	14.3	2.1	0.3	-	a	
				2015	5	15.0	2.7	0.6	0.3	a,c	
				2016	5	14.0	2.6	0.1	-0.2	a	
				2017	5	19.2	2.6	2.4	2.3	b,c	
				2018	5	17.2	1.5	1.5	1.4	c	
Simpson's Evenness	none	YES	0.0009	2007	3	0.749	0.082	-	-3.0	a	Tukey's HSD
				2011	3	0.874	0.042	1.5	-	b	
				2015	5	0.899	0.037	1.8	0.6	b	
				2016	5	0.908	0.032	1.9	0.8	b	
				2017	5	0.925	0.019	2.1	1.2	b	
				2018	5	0.877	0.058	1.6	0.1	b	
Nemata (% of community)	modified probit	YES	0.0013	2007	3	0.1	0.3	-	-0.7	a	Tamhane's
				2011	3	0.7	0.8	2.1	-	a	
				2015	5	1.7	0.7	6.0	1.3	a	
				2016	5	1.3	0.5	4.5	0.8	a	
				2017	5	4.1	2.1	15.4	4.4	a	
				2018	5	1.6	0.7	5.5	1.1	a	
Oligochaeta (% of community)	none	NO	0.6918	2007	3	1.5	2.1	-	1.4	a	Mann-Whitney U-test
				2011	3	0.7	0.5	-0.3	-	a	
				2015	5	1.4	1.3	0.0	1.3	a	
				2016	5	1.5	0.6	0.0	1.5	a	
				2017	5	1.1	1.3	-0.2	0.7	a	
				2018	5	1.2	0.6	-0.1	0.9	a	
Hydracarina (% of community)	none	YES	0.0000	2007	3	0.8	1.0	-	-2.0	a	Tukey's HSD
				2011	3	14.4	6.7	13.3	-	a,b,c	
				2015	5	2.3	1.7	1.5	-1.8	a,c	
				2016	5	9.8	3.2	8.8	-0.7	b,d	
				2017	5	7.6	1.1	6.7	-1.0	b,d	
				2018	5	5.3	1.3	4.4	-1.4	c,d	
Chironomidae (% of community)	none	YES	0.0024	2007	3	88.1	7.1	-	2.3	a,d	Tukey's HSD
				2011	3	76.3	5.1	-1.7	-	a,b,c,d	
				2015	5	75.6	7.5	-1.8	-0.1	a,b,c,d	
				2016	5	68.6	10.6	-2.7	-1.5	b,c	
				2017	5	74.0	1.7	-2.0	-0.5	c	
				2018	5	86.8	4.2	-0.2	2.1	d	
Metal Sensitive Taxa (% of community)	none	NO	0.2747	2007	3	3.7	3.6	-	-1.1	a	Tukey's HSD
				2011	3	10.8	6.6	2.0	-	a	
				2015	5	12.7	14.0	2.5	0.3	a	
				2016	5	9.1	9.0	1.5	-0.3	a	
				2017	5	7.2	5.2	1.0	-0.5	a	
				2018	5	17.8	4.8	3.9	1.1	a	
Tipulidae (% of community)	none	YES	0.0087	2007	3	8.9	4.1	-	0.9	a,b,c	Tukey's HSD
				2011	3	6.9	2.1	-0.5	-	a,b,c	
				2015	5	16.8	4.7	2.0	4.6	a,b	
				2016	5	16.9	11.8	2.0	4.7	b	
				2017	5	8.4	1.5	-0.1	0.7	a,b,c	
				2018	5	2.9	2.3	-1.5	-1.9	c	

▒ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study ye

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.8: Statistical Comparison of Functional Feeding Group (FFG) Benthic Metrics at Camp Lake Tributary 1 North Branch (CLT1 US) Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2007	vs. Baseline Year 2011		
Collector-Gatherer FFG (% of community)	none	YES	0.0040	2007	3	72.6	11.0	-	2.2	a	Tamhane's
				2011	3	41.4	14.1	-2.8	-	b	
				2015	5	50.2	7.3	-2.0	0.6	b	
				2016	5	40.8	11.4	-2.9	0.0	b	
				2017	5	38.8	7.1	-3.1	-0.2	b	
				2018	5	54.6	13.5	-1.6	0.9	a,b	
Filterer FFG (% of community)	modified probit	YES	0.0554	2007	3	0.3	0.3	-	nc	a	Mann-Whitney U-test
				2011	3	0.0	0.0	-1.2	-	a,b	
				2015	5	0.0	0.0	-1.2	nc	b	
				2016	5	0.5	0.6	0.9	nc	a,b	
				2017	5	1.3	1.5	3.9	nc	a,b	
				2018	5	0.5	0.5	0.8	nc	a,b	
Shredder FFG (% of community)	none	YES	0.0490	2007	3	23.1	8.8	-	-1.2	a	Mann-Whitney U-test
				2011	3	40.1	14.3	1.9	-	a,b	
				2015	5	46.1	7.3	2.6	0.4	b	
				2016	5	47.8	14.0	2.8	0.5	b	
				2017	5	49.5	6.4	3.0	0.7	b	
				2018	5	39.3	13.2	1.8	-0.1	a,b	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint values between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.9: Statistical Comparison of Primary and Percent Compositional Benthic Metrics at the Camp Lake Tributary 1 Lower Main Stem (CLT1 DS) Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2007	vs. Baseline Year 2011		
Density (No. per m^2)	none	NO	0.2257	2007	3	754	573	-	-0.8	a	Tukey's HSD
				2011	3	898	183	0.3	-	a	
				2015	5	1,301	479	1.0	2.2	a	
				2016	5	1,143	443	0.7	1.3	a	
				2017	5	1,465	735	1.2	3.1	a	
				2018	5	771	309	0.0	-0.7	a	
Richness (No. of Taxa)	none	YES	0.0777	2007	3	20.3	6.0	-	1.1	a	Tamhane's
				2011	3	15.3	4.5	-0.8	-	a	
				2015	5	14.6	1.1	-1.0	-0.2	a	
				2016	5	17.0	1.6	-0.6	0.4	a	
				2017	5	16.8	1.9	-0.6	0.3	a	
				2018	5	14.4	1.1	-1.0	-0.2	a	
Simpson's Evenness	none	NO	0.9565	2007	3	0.864	0.040	-	0.0	a	Tukey's HSD
				2011	3	0.864	0.026	0.0	-	a	
				2015	5	0.889	0.043	0.6	1.0	a	
				2016	5	0.864	0.095	0.0	0.0	a	
				2017	5	0.874	0.033	0.2	0.4	a	
				2018	5	0.857	0.050	-0.2	-0.3	a	
Nemata (% of community)	none	NO	0.4075	2007	3	1.0	1.3	-	1.7	a	Tukey's HSD
				2011	3	0.4	0.4	-0.5	-	a	
				2015	5	3.2	2.6	1.6	7.7	a	
				2016	5	4.5	4.1	2.6	11.3	a	
				2017	5	4.6	5.0	2.6	11.5	a	
				2018	5	2.6	1.8	1.2	6.0	a	
Oligochaeta (% of community)	none	YES	0.0055	2007	3	7.3	6.2	-	3.9	a,b	Tukey's HSD
				2011	3	1.1	1.6	-1.0	-	b	
				2015	5	5.6	3.1	-0.3	2.9	a,b	
				2016	5	9.7	3.7	0.4	5.5	a	
				2017	5	5.0	2.7	-0.4	2.5	a,b	
				2018	5	1.2	1.0	-1.0	0.1	b	
Hydracarina (% of community)	none	YES	0.0000	2007	3	2.9	1.4	-	-3.4	a	Tamhane's
				2011	3	24.7	6.4	15.4	-	a	
				2015	5	1.7	1.6	-0.8	-3.6	a	
				2016	5	4.6	0.8	1.2	-3.1	a	
				2017	5	4.0	1.4	0.8	-3.2	a	
				2018	5	3.6	1.5	0.5	-3.3	a	
Chironomidae (% of community)	none	YES	0.0720	2007	3	80.8	8.5	-	1.7	a,c,d	Tukey's HSD
				2011	3	65.3	9.0	-1.8	-	b	
				2015	5	85.2	4.0	0.5	2.2	c	
				2016	5	73.9	5.9	-0.8	1.0	d	
				2017	5	80.9	4.5	0.0	1.7	a,c,d	
				2018	5	85.9	4.0	0.6	2.3	a,c,d	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0720	2007	3	15.1	10.2	-	1.0	a	Tukey's HSD
				2011	3	7.6	7.3	-0.7	-	a,b	
				2015	5	4.4	3.5	-1.1	-0.4	a,b	
				2016	5	3.8	3.3	-1.1	-0.5	a,b	
				2017	5	1.5	0.7	-1.3	-0.8	b	
				2018	5	8.6	6.0	-0.6	0.1	a,b	
Tipulidae (% of community)	none	NO	0.1637	2007	3	6.4	2.6	-	-0.6	a	Tukey's HSD
				2011	3	8.4	3.2	0.7	-	a	
				2015	5	3.1	1.0	-1.3	-1.6	a	
				2016	5	6.1	3.4	-0.1	-0.7	a	
				2017	5	3.9	3.1	-1.0	-1.4	a	
				2018	5	4.9	3.1	-0.6	-1.1	a	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study ye

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.10: Statistical Comparison of Functional Feeding Group (FFG) Benthic Metrics at the Camp Lake Tributary 1 Lower Main Stem (CLT1 DS) Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]							
								Effect Size			
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	vs. Baseline Year 2007	vs. Baseline Year 2011	Pairwise Comparison	Statistical Test
Collector-Gatherer FFG (% of community)	none	YES	0.0006	2007	3	51.7	24.3	-	1.5	a,b	Tamhane's
				2011	3	35.6	10.5	-0.7	-	b	
				2015	5	78.4	9.5	1.1	4.1	a	
				2016	5	73.8	9.9	0.9	3.7	a	
				2017	5	67.2	6.4	0.6	3.0	a,b	
				2018	5	59.5	8.3	0.3	2.3	a,b	
Filterer FFG (% of community)	none	NO	0.3782	2007	3	10.2	13.1	-	nc	a	Mann-Whitney U-test
				2011	3	0.3	0.3	-0.8	-	a	
				2015	5	0.2	0.5	-0.8	nc	a	
				2016	5	1.3	1.5	-0.7	nc	a	
				2017	5	0.3	0.5	-0.8	0.2	a	
				2018	5	0.4	0.5	-0.7	nc	a	
Shredder FFG (% of community)	none	YES	0.0118	2007	3	22.1	3.1	-	-3.7	a,b,c	Mann-Whitney U-test
				2011	3	38.9	4.5	5.5	-	b,d	
				2015	5	19.3	9.0	-0.9	-4.3	c	
				2016	5	19.6	9.5	-0.8	-4.2	c	
				2017	5	27.6	4.9	1.8	-2.5	c,d	
				2018	5	35.5	7.7	4.4	-0.7	d	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint values between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.11: Benthic Station Habitat Feature Statistical Comparisons among Camp Lake Tributary 2 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2018

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test [b]	(I) Area	(J) Area	Significant Difference Between 2 Areas?	P-value	Statistical Test
Water Depth (cm)	YES	0.0322	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.2021	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	NO	0.1021	
				CLT2 Upstream	CLT2 Downstream	NO	0.9598	
Water Velocity (cm/s)	NO	0.1350	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.7602	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	NO	0.3584	
				CLT2 Upstream	CLT2 Downstream	NO	0.1229	
Substrate Embeddedness (%)	YES	< 0.0001	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0000	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0000	
				CLT2 Upstream	CLT2 Downstream	NO	0.7776	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - Kruskal-Wallis H-test (multiple group) or Mann-Whitney U-test (pair-wise) conducted using untransformed data; ζ - data untransformed, t-test assuming unequal variance used; η - data log transformed, t-test assuming unequal variance used.

Table F.12: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 2 Study Areas, August 2018

Taxa Study Area	Upstream (CLT2-US)				
Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	-	-	4	7	-
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	7	7	-	-	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
F. Sperchonidae					
Sperchon	-	4	14	4	18
SEED SHRIMPS					
Cl. Ostracoda	-	-	-	-	-
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
Acentrella feropagus	-	-	-	-	-
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature	-	-	-	-	-
TRUE FLIES					
O. Diptera					
BITING-MIDGE					
F. Ceratopogonidae					
Culicoides	-	-	-	4	-
MIDGES					
F. Chironomidae					
chironomid pupae	**4**	**18**	**11**	**39**	**22**
S.F. Chironominae					
Tanytarsus	-	-	-	-	-
S.F. Diamesinae					
Diamesa	-	14	-	7	11
Pseudokiefferiella	7	-	4	22	7
S.F. Orthocladiinae					
Chaetocladius	-	4	-	-	4
Corynoneura	-	-	-	-	-
Cricotopus	-	-	4	7	7
Cricotopus/Orthocladius	7	4	11	22	18
Diplocladius	4	-	-	-	-
Eukiefferiella	4	4	-	7	11
Hydrobaenus	-	-	-	-	-
Hydrosmittia	-	-	-	4	-
Krenosmittia	4	4	4	7	4
Limnophyes	-	-	-	4	-
Orthocladius (Euorthocladius)	22	25	50	29	57
Paraphaenocladius	-	-	-	4	-
Synorthocladius	-	-	-	-	-

Table F.12: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 2 Study Areas, August 2018

Taxa / Study Area	Upstream (CLT2-US)				
Replicate Station	B1	B2	B3	B4	B5
Thienemanniella	7	4	-	14	11
Tokunagaia	7	4	7	11	7
Tvetenia	14	7	14	18	14
indeterminate	**14**	**7**	-	-	**7**
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
Clinocera	4	-	4	4	-
pupae	-	4	-	-	-
F. Simuliidae					
Gymnopais	-	7	4	14	4
Metacnephia	-	-	-	4	4
Prosimulium	-	4	-	18	7
Simulium	-	-	-	-	-
indeterminate	-	-	-	-	-
F. Tipulidae					
Tipula	4	-	4	4	7
Number of Organisms (No. organisms per m^2)	109	121	135	254	220
Richness (total number of taxa)[a]	12	14	12	21	16
Simpson's Evenness (E)	0.943	0.920	0.856	0.972	0.918
Bray-Curtis Index	0.730	0.700	0.710	0.531	0.626
Percent Composition					
% Nemata	0.0%	0.0%	3.0%	2.8%	0.0%
% Oligochaeta	6.4%	5.8%	0.0%	0.0%	0.0%
% Hydracarina	0.0%	3.3%	10.4%	1.6%	8.2%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	86.2%	78.5%	77.8%	76.8%	81.8%
% Metal Sensitive Chironmids	6.4%	14.0%	3.0%	14.6%	9.5%
% Simuliidae	0.0%	9.1%	3.0%	14.2%	6.8%
% Tipulidae	3.7%	0.0%	3.0%	1.6%	3.2%
Functional Feeding Group Composition					
% Collector - Gatherers	84.4%	80.2%	68.1%	65.0%	68.2%
% Filterers	0.0%	9.1%	3.0%	14.2%	6.8%
% Shredders	11.9%	4.1%	15.6%	16.1%	16.8%
Habitat Preference Group Composition					
% Clingers	11.9%	19.8%	28.9%	31.9%	28.6%
% Sprawlers	78.0%	74.4%	65.2%	62.2%	68.2%
% Burrowers	10.1%	5.8%	5.9%	5.9%	3.2%

[a] Bold entries excluded from taxa count

Table F.12: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 2 Study Areas, August 2018

Taxa Study Area	Downstream (CLT2-DS)				
Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	7	4	-	11	-
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	-	-	-	-	4
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
F. Sperchonidae					
Sperchon	-	4	-	14	4
SEED SHRIMPS					
Cl. Ostracoda	-	4	-	-	-
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
Acentrella feropagus	-	-	-	-	-
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature	-	-	-	-	-
TRUE FLIES					
O. Diptera					
BITING-MIDGE					
F. Ceratopogonidae					
Culicoides	4	-	4	-	-
MIDGES					
F. Chironomidae					
chironomid pupae	**7**	**4**	**4**	**14**	**14**
S.F. Chironominae					
Tanytarsus	-	-	-	-	-
S.F. Diamesinae					
Diamesa	11	4	-	7	7
Pseudokiefferiella	18	-	-	4	-
S.F. Orthocladiinae					
Chaetocladius	-	-	4	4	-
Corynoneura	4	-	-	-	-
Cricotopus	14	-	-	-	4
Cricotopus/Orthocladius	14	4	-	-	-
Diplocladius	-	-	-	-	-
Eukiefferiella	-	-	4	-	-
Hydrobaenus	-	-	-	-	-
Hydrosmittia	4	-	-	14	-
Krenosmittia	22	-	18	-	4
Limnophyes	-	4	11	4	4
Orthocladius (Euorthocladius)	36	75	14	14	4
Paraphaenocladius	-	-	-	-	-
Synorthocladius	-	-	-	-	-

Table F.12: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 2 Study Areas, August 2018

Taxa Study Area	Downstream (CLT2-DS)				
Replicate Station	B1	B2	B3	B4	B5
Thienemanniella	-	4	-	-	-
Tokunagaia	11	25	7	29	18
Tvetenia	18	11	4	18	4
indeterminate	-	**4**	-	**4**	-
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
Clinocera	7	-	4	-	4
pupae	-	-	-	-	-
F. Simuliidae					
Gymnopais	-	-	-	-	-
Metacnephia	-	-	-	-	-
Prosimulium	-	-	-	7	-
Simulium	-	-	-	-	-
indeterminate	-	-	-	-	-
F. Tipulidae					
Tipula	7	7	-	7	-
Number of Organisms (No. organisms per m^2)	184	154	74	151	71
Richness (total number of taxa)[a]	14	11	9	12	10
Simpson's Evenness (E)	0.963	0.755	0.941	0.957	0.926
Bray-Curtis Index	0.645	0.656	0.823	0.633	0.798
Percent Composition					
% Nemata	3.8%	2.6%	0.0%	7.3%	0.0%
% Oligochaeta	0.0%	0.0%	0.0%	0.0%	5.6%
% Hydracarina	0.0%	2.6%	0.0%	9.3%	5.6%
% Ostracods	0.0%	2.6%	0.0%	0.0%	0.0%
% Ephemeroptera	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	86.4%	87.7%	89.2%	74.2%	83.1%
% Metal Sensitive Chironmids	16.8%	2.6%	0.0%	7.9%	12.7%
% Simuliidae	0.0%	0.0%	0.0%	4.6%	0.0%
% Tipulidae	3.8%	4.5%	0.0%	4.6%	0.0%
Functional Feeding Group Composition					
% Collector - Gatherers	74.5%	90.3%	89.2%	81.5%	81.7%
% Filterers	0.0%	0.0%	0.0%	4.6%	0.0%
% Shredders	19.6%	7.1%	0.0%	4.6%	7.0%
Habitat Preference Group Composition					
% Clingers	19.6%	5.2%	5.4%	13.9%	18.3%
% Sprawlers	70.7%	87.7%	89.2%	74.2%	76.1%
% Burrowers	9.8%	7.1%	5.4%	11.9%	5.6%

[a] Bold entries excluded from taxa count

Table F.13: **Benthic Invertebrate Community Summary Statistics for Camp Lake Tributary 2 Study Areas, Mary River Project CREMP, August 2018**

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unnamed Reference Creek	526	152	68	337	714	262	636
	CLT2 Upstream	168	65	29	87	248	109	254
	CLT2 Downstream	127	51	23	63	190	71	184
Richness (Number of Taxa)	Unnamed Reference Creek	19.8	3.0	1.4	16.0	23.6	16.0	24.0
	CLT2 Upstream	15.0	3.7	1.7	10.4	19.6	12.0	21.0
	CLT2 Downstream	11.2	1.9	0.9	8.8	13.6	9.0	14.0
Simpson's Evenness	Unnamed Reference Creek	0.960	0.011	0.005	0.946	0.974	0.942	0.972
	CLT2 Upstream	0.922	0.042	0.019	0.869	0.975	0.856	0.972
	CLT2 Downstream	0.908	0.087	0.039	0.800	1.016	0.755	0.963
Bray-Curtis Index	Unnamed Reference Creek	0.208	0.093	0.042	0.092	0.324	0.114	0.342
	CLT2 Upstream	0.659	0.082	0.037	0.558	0.761	0.531	0.730
	CLT2 Downstream	0.711	0.092	0.041	0.597	0.825	0.633	0.823
Nemata (% of community)	Unnamed Reference Creek	6.0%	2.0%	0.9%	3.6%	8.5%	3.9%	9.3%
	CLT2 Upstream	1.1%	1.6%	0.7%	-0.8%	3.1%	0.0%	3.0%
	CLT2 Downstream	2.7%	3.0%	1.4%	-1.0%	6.5%	0.0%	7.3%
Oligochaeta (% of community)	Unnamed Reference Creek	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT2 Upstream	2.4%	3.4%	1.5%	-1.7%	6.6%	0.0%	6.4%
	CLT2 Downstream	1.1%	2.5%	1.1%	-2.0%	4.3%	0.0%	5.6%
Hydracarina (% of community)	Unnamed Reference Creek	3.3%	1.3%	0.6%	1.6%	4.9%	2.0%	5.3%
	CLT2 Upstream	4.7%	4.4%	2.0%	-0.8%	10.2%	0.0%	10.4%
	CLT2 Downstream	3.5%	4.0%	1.8%	-1.4%	8.4%	0.0%	9.3%
Ostracoda (% of community)	Unnamed Reference Creek	1.2%	1.0%	0.4%	-0.1%	2.4%	0.0%	2.7%
	CLT2 Upstream	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT2 Downstream	0.5%	1.2%	0.5%	-0.9%	2.0%	0.0%	2.6%
Ephemeroptera (% of community)	Unnamed Reference Creek	5.6%	2.1%	0.9%	3.0%	8.3%	3.9%	9.2%
	CLT2 Upstream	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT2 Downstream	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Chironomidae (% of community)	Unnamed Reference Creek	60.3%	4.5%	2.0%	54.8%	65.9%	55.0%	66.8%
	CLT2 Upstream	80.2%	3.9%	1.7%	75.4%	85.0%	76.8%	86.2%
	CLT2 Downstream	84.1%	6.0%	2.7%	76.7%	91.5%	74.2%	89.2%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	12.4%	4.2%	1.9%	7.1%	17.7%	6.9%	18.7%
	CLT2 Upstream	9.5%	5.0%	2.2%	3.3%	15.7%	3.0%	14.6%
	CLT2 Downstream	8.0%	7.0%	3.1%	-0.6%	16.6%	0.0%	16.8%
Simuliidae (% of community)	Unnamed Reference Creek	15.9%	4.6%	2.0%	10.2%	21.6%	11.2%	22.2%
	CLT2 Upstream	6.6%	5.5%	2.5%	-0.2%	13.4%	0.0%	14.2%
	CLT2 Downstream	0.9%	2.1%	0.9%	-1.6%	3.5%	0.0%	4.6%
Tipulidae (% of community)	Unnamed Reference Creek	2.8%	1.5%	0.7%	1.0%	4.6%	1.5%	4.7%
	CLT2 Upstream	2.3%	1.5%	0.7%	0.4%	4.1%	0.0%	3.7%
	CLT2 Downstream	2.6%	2.4%	1.1%	-0.4%	5.6%	0.0%	4.6%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	71.5%	4.0%	1.8%	66.5%	76.5%	67.2%	76.0%
	CLT2 Upstream	73.2%	8.6%	3.8%	62.6%	83.8%	65.0%	84.4%
	CLT2 Downstream	83.4%	6.5%	2.9%	75.4%	91.4%	74.5%	90.3%
Filterer FFG (% of community)	Unnamed Reference Creek	16.0%	4.5%	2.0%	10.4%	21.6%	11.2%	22.2%
	CLT2 Upstream	6.6%	5.5%	2.5%	-0.2%	13.4%	0.0%	14.2%
	CLT2 Downstream	0.9%	2.1%	0.9%	-1.6%	3.5%	0.0%	4.6%
Shredder FFG (% of community)	Unnamed Reference Creek	4.8%	2.8%	1.2%	1.4%	8.2%	1.5%	8.3%
	CLT2 Upstream	12.9%	5.3%	2.4%	6.4%	19.4%	4.1%	16.8%
	CLT2 Downstream	7.7%	7.2%	3.2%	-1.3%	16.7%	0.0%	19.6%
Clinger HPG (% of community)	Unnamed Reference Creek	22.6%	4.9%	2.2%	16.4%	28.7%	17.9%	29.2%
	CLT2 Upstream	24.2%	8.2%	3.7%	14.0%	34.4%	11.9%	31.9%
	CLT2 Downstream	12.5%	6.9%	3.1%	3.9%	21.0%	5.2%	19.6%
Sprawler HPG (% of community)	Unnamed Reference Creek	66.2%	5.0%	2.2%	60.0%	72.5%	61.8%	72.0%
	CLT2 Upstream	69.6%	6.5%	2.9%	61.5%	77.7%	62.2%	78.0%
	CLT2 Downstream	79.5%	8.4%	3.7%	69.2%	89.9%	70.7%	89.2%
Burrower HPG (% of community)	Unnamed Reference Creek	11.2%	1.9%	0.9%	8.8%	13.6%	9.0%	14.0%
	CLT2 Upstream	6.2%	2.5%	1.1%	3.1%	9.3%	3.2%	10.1%
	CLT2 Downstream	8.0%	2.8%	1.3%	4.5%	11.5%	5.4%	11.9%

Table F.14: **Statistical Comparison of Benthic Invertebrate Community Metrics at Camp Lake Tributary 2 Upstream (CLT2 US) Among Years of Mine Operation (2015 to 2018) and Baseline (2007) for the Mary River Project CREMP**

Metric	Data Transform-ation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0039	2007	3	364	205	-	a,b,c,d	Mann-Whitney U-test
				2015	5	741	416	1.8	a	
				2016	5	412	100	0.2	b	
				2017	5	216	30	-0.7	c	
				2018	5	168	65	-1.0	c,d	
Richness (No. of Taxa)	none	YES	0.0045	2007	3	12.7	2.1	-	a	Tukey's HSD
				2015	5	20.8	1.8	3.9	b	
				2016	5	17.2	2.9	2.2	a,b	
				2017	5	14.6	2.5	0.9	a	
				2018	5	15.0	3.7	1.1	a	
Simpson's Evenness	none	YES	0.0002	2007	3	0.825	0.008	-	a	Tukey's HSD
				2015	5	0.922	0.025	11.8	b,c,d	
				2016	5	0.898	0.035	9.0	b	
				2017	5	0.955	0.013	15.8	c,d	
				2018	5	0.922	0.042	11.8	d	
Nemata (% of community)	none	NO	0.9528	2007	3	1.1	0.6	-	a	Mann-Whitney U-test
				2015	5	0.9	0.9	-0.5	a	
				2016	5	1.0	0.8	-0.3	a	
				2017	5	1.0	1.4	-0.3	a	
				2018	5	1.1	1.6	0.0	a	
Oligochaeta (% of community)	modified probit	NO	0.4018	2007	3	2.1	0.8	-	a	Tamhane's
				2015	5	2.7	2.8	0.7	a	
				2016	5	4.9	3.5	3.5	a	
				2017	5	3.4	6.4	1.6	a	
				2018	5	2.4	3.4	0.4	a	
Hydracarina (% of community)	none	YES	0.0314	2007	3	2.9	2.1	-	a	Tamhane's
				2015	5	0.9	0.7	-1.0	a	
				2016	5	5.5	2.6	1.2	a	
				2017	5	8.0	4.2	2.4	a	
				2018	5	4.7	4.4	0.8	a	
Chironomidae (% of community)	none	NO	0.2272	2007	3	88.4	4.3	-	a	Mann-Whitney U-test
				2015	5	80.2	8.9	-1.9	a	
				2016	5	79.5	8.5	-2.1	a	
				2017	5	75.9	7.5	-2.9	a	
				2018	5	80.2	3.9	-1.9	a	
Metal Sensitive Taxa (% of community)	none	YES	0.0000	2007	3	5.3	0.6	-	a	Tukey's HSD
				2015	5	10.5	5.7	8.8	a	
				2016	5	5.3	3.3	0.0	a	
				2017	5	22.0	3.1	28.3	b	
				2018	5	9.5	5.0	7.1	a	
Tipulidae (% of community)	none	NO	0.1544	2007	3	5.2	2.0	-	a	Tukey's HSD
				2015	5	4.1	3.5	-0.5	a	
				2016	5	4.0	1.8	-0.6	a	
				2017	5	1.6	1.6	-1.8	a	
				2018	5	2.3	1.5	-1.5	a	
Collector-Gatherer FFG (% of community)	none	NO	0.1944	2007	3	68.5	6.5	-	a	Tamhane's
				2015	5	63.8	10.3	-0.7	a	
				2016	5	66.6	5.8	-0.3	a	
				2017	5	75.6	3.9	1.1	a	
				2018	5	73.2	8.6	0.7	a	
Filterer FFG (% of community)	none	YES	0.0038	2007	3	0.2	0.4	-	a,b	Mann-Whitney U-test
				2015	5	1.0	1.1	1.7	a,b,c	
				2016	5	0.2	0.4	-0.2	a,b	
				2017	5	6.5	3.1	14.3	c	
				2018	5	6.6	5.5	14.7	a,b,c	
Shredder FFG (% of community)	none	YES	0.0000	2007	3	27.6	5.8	-	a	Tukey's HSD
				2015	5	26.2	5.8	-0.3	a	
				2016	5	25.9	4.4	-0.3	a	
				2017	5	7.4	5.9	-3.5	b	
				2018	5	12.9	5.3	-2.5	b	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.15: Statistical Comparison of Benthic Invertebrate Community Metrics at Camp Lake Tributary 2 Downstream (CLT2 DS) Among Years of Mine Operation (2015 to 2018) and Baseline (2007) for the Mary River

Metric	Data Transform-ation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0146	2007	3	431	109	-	a	Tamhane's
				2015	5	447	258	0.1	a	
				2016	5	205	61	-2.1	a	
				2017	5	222	144	-1.9	a	
				2018	5	127	51	-2.8	a	
Richness (No. of Taxa)	none	NO	0.2038	2007	3	17.7	2.1	-	a	Tukey's HSD
				2015	5	14.2	3.3	-1.7	a	
				2016	5	14.0	4.0	-1.8	a	
				2017	5	13.2	4.7	-2.1	a	
				2018	5	11.2	1.9	-3.1	a	
Simpson's Evenness	none	YES	0.0576	2007	3	0.865	0.017	-	a,c	Mann-Whitney U-test
				2015	5	0.934	0.034	4.0	b	
				2016	5	0.838	0.079	-1.5	c	
				2017	5	0.913	0.052	2.8	a,b	
				2018	5	0.908	0.087	2.5	a,b	
Nemata (% of community)	none	NO	0.6529	2007	3	1.1	1.2	-	a	Tukey's HSD
				2015	5	4.2	2.4	2.6	a	
				2016	5	2.0	2.4	0.8	a	
				2017	5	3.2	4.4	1.8	a	
				2018	5	2.7	3.0	1.4	a	
Oligochaeta (% of community)	none	NO	0.1626	2007	3	2.6	0.6	-	a	Mann-Whitney U-test
				2015	5	8.8	12.8	10.1	a	
				2016	5	1.9	3.2	-1.1	a	
				2017	5	4.8	6.9	3.6	a	
				2018	5	1.1	2.5	-2.3	a	
Hydracarina (% of community)	modified probit	YES	0.0106	2007	3	1.8	1.2	-	a,b	Tamhane's
				2015	5	0.3	0.6	-1.2	b	
				2016	5	4.5	1.9	2.2	a	
				2017	5	3.3	4.0	1.3	a,b	
				2018	5	3.5	4.0	1.4	a,b	
Chironomidae (% of community)	none	NO	0.2782	2007	3	88.0	6.0	-	a	Tukey's HSD
				2015	5	75.6	10.4	-2.1	a	
				2016	5	82.4	6.3	-0.9	a	
				2017	5	81.8	8.4	-1.0	a	
				2018	5	84.1	6.0	-0.7	a	
Metal Sensitive Taxa (% of community)	none	NO	0.1125	2007	3	11.8	2.0	-	a	Tukey's HSD
				2015	5	10.6	10.6	-0.6	a	
				2016	5	5.4	0.9	-3.3	a	
				2017	5	20.2	12.6	4.3	a	
				2018	5	8.0	7.0	-1.9	a	
Tipulidae (% of community)	none	NO	0.2784	2007	3	6.4	6.6	-	a	Mann-Whitney U-test
				2015	5	5.8	5.1	-0.1	a	
				2016	5	2.2	1.6	-0.6	a	
				2017	5	0.8	1.9	-0.9	a	
				2018	5	2.6	2.4	-0.6	a	
Collector-Gatherer FFG (% of community)	none	NO	0.1548	2007	3	66.4	11.0	-	a	Tukey's HSD
				2015	5	69.3	10.9	0.3	a	
				2016	5	77.6	11.6	1.0	a	
				2017	5	77.1	10.5	1.0	a	
				2018	5	83.4	6.5	1.5	a	
Filterer FFG (% of community)	modified probit	NO	0.1591	2007	3	2.7	1.9	-	a	Tukey's HSD
				2015	5	0.8	0.9	-1.0	a	
				2016	5	1.1	1.0	-0.9	a	
				2017	5	3.5	3.1	0.4	a	
				2018	5	0.9	2.1	-1.0	a	
Shredder FFG (% of community)	none	YES	0.0641	2007	3	21.5	5.9	-	a,b	Tukey's HSD
				2015	5	25.7	11.6	0.7	b	
				2016	5	13.8	10.4	-1.3	a,b	
				2017	5	14.6	8.9	-1.2	a,b	
				2018	5	7.7	7.2	-2.3	a	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.16: Statistical Comparison of Physical Sediment Quality Between Littoral and Profundal Stations of Reference Lake 3, Mary River Project CREMP, August 2018

	Statistical Test Results			Summary Statistics							
Habitat Variable	**Significant Difference Between Habitats?**	**P-value**	**Statistical Analysis[a]**	**Station Type**	**Sample Size (n)**	**Mean**	**Standard Deviation**	**Standard Error**	**Minimum**	**Median**	**Maximum**
Sand-Sized Particles (% by weight)	YES	<0.001	α	Littoral	5	59.6	4.4	2.0	54.9	59.4	66.4
				Profundal	5	47.5	2.8	1.3	44.5	47.0	50.9
Silt-Sized Particles (% by weight)	YES	0.007	β	Littoral	5	31.4	3.3	1.5	26.6	32.6	34.7
				Profundal	5	39.0	3.1	1.4	33.8	40.4	41.5
Clay-Sized Particles (% by weight)	YES	0.022	β	Littoral	5	9.0	2.4	1.1	5.8	10.4	10.8
				Profundal	5	13.6	2.2	1.0	9.7	14.3	15.3
Total Organic Carbon (%)	NO	0.505	α	Littoral	5	4.7	2.3	1.0	1.8	5.1	7.4
				Profundal	5	3.8	1.7	0.8	0.8	4.5	4.9

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; ζ - data fourth root transformed, single factor ANOVA test conducted; Ŧ - data square root transformed, single factor ANOVA test conducted; η - data log-transformed, t-test assuming unequal variance; γ - data untransformed, Mann-Whitney U-test conducted.

Table F.17: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Reference Lake 3, August 2018

Taxa Study Area	Reference Lake 03 - Littoral Stations				
Replicate Station	REF-01	REF-02	REF-03	REF-04	REF-05
ROUNDWORMS					
P. Nemata	-	9	147	112	34
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Lumbriculidae					
Lumbriculus	-	-	-	-	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
F. Acalyptonotidae					
Acalyptonotus	43	17	-	9	-
F. Hygrobatidae					
Hygrobates	-	-	-	9	-
F. Lebertiidae					
Lebertia	34	-	-	-	17
F. Sperchontidae					
Sperchon	-	-	-	-	-
SEED SHRIMPS					
Cl. Ostracoda	284	164	172	621	34
INSECTS					
Cl. Insecta					
CADDISFLIES					
O. Trichoptera					
pupae	-	-	-	-	-
F. Apataniidae					
Apatania	-	-	-	-	-
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae	-	-	-	-	-
S.F. Chironominae					
Chironomus	-	-	-	-	-
Micropsectra	207	431	172	181	560
Paratanytarsus	-	-	-	-	-
Sergentia	-	-	-	-	-
Stictochironomus	95	52	-	-	69
Tanytarsus	86	60	-	-	-
S.F. Diamesinae					
Protanypus	-	9	9	17	17
Pseudodiamesa	9	26	9	9	17
S.F. Orthocladiinae					
Abiskomyia	284	69	129	155	78
Cricotopus/Orthocladius	-	-	-	-	-
Heterotrissocladius	60	17	-	9	60
Hydrobaenus	-	-	-	-	-
Limnophyes	-	-	-	-	-

Table F.17: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Reference Lake 3, August 2018

Taxa Study Area	Reference Lake 03 - Littoral Stations				
Replicate Station	REF-01	REF-02	REF-03	REF-04	REF-05
Mesocricotopus	-	-	-	-	-
Paracladius	60	43	-	-	17
Parakiefferiella	-	-	-	-	-
Psectrocladius	-	-	-	-	-
Zalutschia	129	60	52	34	86
S.F. Tanypodinae					
Arctopelopia	17	-	-	-	-
Procladius	69	-	-	9	-
F. Tipulidae					
Tipula	-	-	-	-	-
Density (No. organisms per m^2)	1,377	957	690	1,165	989
Richness (total number of taxa)[a]	13	12	7	11	11
Simpson's Evenness (E)	0.939	0.816	0.921	0.730	0.719
Bray-Curtis Index	0.467	0.408	0.371	0.493	0.516
Dominant Taxonomic Group Composition					
% Nemata	0.0%	0.9%	21.3%	9.6%	3.4%
% Hydracarina	5.6%	1.8%	0.0%	1.5%	1.7%
% Ostracods	20.6%	17.1%	24.9%	53.3%	3.4%
% Chironomids	73.8%	80.1%	53.8%	35.5%	91.4%
% Metal Sensitive Chironmids	21.9%	55.0%	27.5%	17.8%	60.1%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition					
% Collector - Gatherers	57.5%	40.6%	67.5%	79.2%	33.0%
% Filterers	21.3%	51.3%	24.9%	15.5%	56.6%
% Shredders	9.4%	6.3%	7.5%	2.9%	8.7%
Habitat Preference Group Composition					
% Clingers	26.9%	53.1%	24.9%	17.1%	58.3%
% Sprawlers	66.2%	39.6%	52.5%	71.8%	29.5%
% Burrowers	6.9%	7.3%	22.6%	11.1%	12.1%

[a] Bold entries excluded from taxa count

Table F.17: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Reference Lake 3, August 2018

Taxa Study Area	Reference Lake 03 - Profundal Stations				
Replicate Station	REF-06	REF-07	REF-08	REF-09	REF-10
ROUNDWORMS					
P. Nemata	9	-	17	-	-
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Lumbriculidae					
Lumbriculus	-	-	-	-	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
F. Acalyptonotidae					
Acalyptonotus	9	9	9	-	-
F. Hygrobatidae					
Hygrobates	-	-	-	-	-
F. Lebertiidae					
Lebertia	-	17	9	-	-
F. Sperchontidae					
Sperchon	-	-	-	-	-
SEED SHRIMPS					
Cl. Ostracoda	-	9	9	34	17
INSECTS					
Cl. Insecta					
CADDISFLIES					
O. Trichoptera					
pupae	-	-	-	-	-
F. Apataniidae					
Apatania	-	-	-	-	-
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae	-	-	-	**9**	-
S.F. Chironominae					
Chironomus	-	-	-	-	-
Micropsectra	26	17	-	17	-
Paratanytarsus	-	-	-	-	-
Sergentia	-	-	-	-	-
Stictochironomus	9	-	-	60	-
Tanytarsus	-	-	-	-	-
S.F. Diamesinae					
Protanypus	17	-	9	-	-
Pseudodiamesa	-	9	9	-	9
S.F. Orthocladiinae					
Abiskomyia	-	-	-	-	9
Cricotopus/Orthocladius	-	-	-	-	-
Heterotrissocladius	34	388	405	336	362
Hydrobaenus	-	-	-	-	-
Limnophyes	-	-	-	-	-

Table F.17: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Reference Lake 3, August 2018

Taxa Study Area	Reference Lake 03 - Profundal Stations				
Replicate Station	REF-06	REF-07	REF-08	REF-09	REF-10
Mesocricotopus	-	-	-	-	-
Paracladius	-	-	-	-	-
Parakiefferiella	-	-	-	-	-
Psectrocladius	-	-	-	-	-
Zalutschia	-	-	-	-	-
S.F. Tanypodinae					
Arctopelopia	-	-	-	-	-
Procladius	-	-	-	-	-
F. Tipulidae					
Tipula	-	-	-	-	-
Density (No. organisms per m^2)	104	449	467	456	397
Richness (total number of taxa)[a]	6	6	7	4	4
Simpson's Evenness (E)	0.938	0.299	0.286	0.545	0.221
Bray-Curtis Index	0.765	0.050	0.109	0.144	0.054
Dominant Taxonomic Group Comp					
% Nemata	8.7%	0.0%	3.6%	0.0%	0.0%
% Hydracarina	8.7%	5.8%	3.9%	0.0%	0.0%
% Ostracods	0.0%	2.0%	1.9%	7.5%	4.3%
% Chironomids	82.7%	92.2%	90.6%	92.5%	95.7%
% Metal Sensitive Chironmids	41.3%	5.8%	3.9%	3.7%	2.3%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Compos					
% Collector - Gatherers	66.3%	90.4%	96.1%	96.3%	100.0%
% Filterers	25.0%	3.8%	0.0%	3.7%	0.0%
% Shredders	0.0%	0.0%	0.0%	0.0%	0.0%
Habitat Preference Group Composi					
% Clingers	33.7%	9.6%	3.9%	3.7%	0.0%
% Sprawlers	32.7%	90.4%	90.6%	82.7%	100.0%
% Burrowers	33.7%	0.0%	5.6%	13.6%	0.0%

[a] Bold entries excluded from taxa cour

Table F.18: Statistical Comparison of Benthic Metrics at Reference Lake 3 Littoral (Shallow) Stations Among Years of Mine Operation (2015 to 2018) for the Mary River Project CREMP

Metric	Data Transformation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Mean	Standard Deviation	Effect Size			Pairwise Comparison	Statistical Test
							vs. Year 2015	vs. Year 2016	vs. Year 2017		
Density (No. per m^2)	log	NO	0.2773	2015	1,278	888	-	-0.8	-0.2	a	Tukey's HSD
				2016	2,390	1,396	1.3	-	1.1	a	
				2017	1,489	850	0.2	-0.6	-	a	
				2018	1,036	255	-0.3	-1.0	-0.5	a	
Richness (No. of Taxa)	none	NO	0.7194	2015	12.6	4.1	-	0.4	0.1	a	Tamhane's
				2016	12.2	1.1	-0.1	-	-0.1	a	
				2017	12.4	2.5	0.0	0.2	-	a	
				2018	10.8	2.3	-0.4	-1.3	-0.6	a	
Simpson's Evenness	none	NO	0.8206	2015	0.865	0.052	-	0.6	0.4	a	Mann-Whitney U-test
				2016	0.758	0.189	-2.0	-	-0.3	a	
				2017	0.807	0.142	-1.1	0.3	-	a	
				2018	0.825	0.103	-0.8	0.4	0.1	a	
Nemata (% of community)	modified probit	NO	0.8818	2015	8.1%	7.4%	-	0.7	1.3	a	Tukey's HSD
				2016	4.0%	5.6%	-0.6	-	0.0	a	
				2017	3.9%	3.3%	-0.6	0.0	-	a	
				2018	7.1%	8.8%	-0.1	0.5	0.9	a	
Hydracarina (% of community)	none	NO	0.2715	2015	4.2%	2.7%	-	0.3	-0.4	a	Tukey's HSD
				2016	3.6%	2.0%	-0.2	-	-0.6	a	
				2017	5.3%	3.0%	0.4	0.9	-	a	
				2018	2.1%	2.1%	-0.8	-0.7	-1.0	a	
Ostracoda (% of community)	none	NO	0.1159	2015	20.9%	18.5%	-	-1.5	-1.0	a	Mann-Whitney U-test
				2016	46.9%	17.5%	1.4	-	0.4	a	
				2017	38.8%	18.4%	1.0	-0.5	-	a	
				2018	23.9%	18.3%	0.2	-1.3	-0.8	a	
Chironomidae (% of community)	none	NO	0.2447	2015	66.5%	18.9%	-	1.1	0.8	a	Tukey's HSD
				2016	45.4%	18.8%	-1.1	-	-0.4	a	
				2017	51.8%	17.9%	-0.8	0.3	-	a	
				2018	66.9%	22.2%	0.0	1.1	0.8	a	
Metal Sensitive Taxa (% of community)	none	YES	0.0579	2015	11.4%	12.6%	-	-0.9	-0.3	a	Tukey's HSD
				2016	19.3%	8.3%	0.6	-	0.3	a,b	
				2017	15.5%	13.4%	0.3	-0.4	-	a,b	
				2018	36.5%	19.6%	2.0	2.1	1.6	b	
Collector-Gatherer FFG (% of community)	none	NO	0.1085	2015	81.4%	17.1%	-	0.6	0.5	a	Tukey's HSD
				2016	75.0%	11.4%	-0.4	-	0.1	a	
				2017	73.9%	16.0%	-0.4	-0.1	-	a	
				2018	55.6%	19.0%	-1.5	-1.7	-1.1	a	
Filterer FFG (% of community)	none	YES	0.0786	2015	11.4%	12.6%	-	-0.6	-0.2	a	Tukey's HSD
				2016	16.1%	8.4%	0.4	-	0.1	a,b	
				2017	14.7%	13.3%	0.3	-0.2	-	a,b	
				2018	33.9%	18.7%	1.8	2.1	1.5	b	

▨	Indicates a significant difference for respective comparison (p-value ≤ 0.1).
🟦	Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of initial year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.19: Statistical Comparison of Benthic Metrics at Reference Lake 3 Profundal (Deep) Stations Among Years of Mine Operation (2015 to 2018) for the Mary River Project CREMP

Metric	Data Transformation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Mean	Standard Deviation	Effect Size			Pairwise Comparison	Statistical Test
							vs. Year 2015	vs. Year 2016	vs. Year 2017		
Density (No. per m^2)	none	YES	0.0174	2015	180	39	-	-5.0	1.0	a	Mann-Whitney U-test
				2016	452	55	6.9	-	9.5	b	
				2017	149	32	-0.8	-5.5	-	a	
				2018	375	154	4.9	-1.4	7.1	a,b	
Richness (No. of Taxa)	none	YES	0.0485	2015	2.8	0.8	-	-0.9	-0.9	a	Tukey's HSD
				2016	4.2	1.5	1.7	-	0.0	a,b	
				2017	4.2	1.5	1.7	0.0	-	a,b	
				2018	5.4	1.3	3.1	0.8	0.8	b	
Simpson's Evenness	none	YES	0.0201	2015	0.397	0.232	-	3.2	-2.9	a,b	Tamhane's
				2016	0.267	0.041	-0.6	-	-4.2	a	
				2017	0.704	0.105	1.3	10.6	-	b	
				2018	0.458	0.295	0.3	4.6	-2.4	a,b	
Nemata (% of community)	none	NO	0.2544	2015	1.0%	2.2%	-	nc	nc	a	Mann-Whitney U-test
				2016	0.0%	0.0%	-0.4	-	nc	a	
				2017	0.0%	0.0%	-0.4	nc	-	a	
				2018	2.5%	3.8%	0.7	nc	nc	a	
Hydracarina (% of community)	none	NO	0.1199	2015	1.5%	3.3%	-	-0.3	-1.2	a	Mann-Whitney U-test
				2016	2.1%	2.1%	0.2	-	-1.1	a	
				2017	8.2%	5.5%	2.0	2.8	-	a	
				2018	3.7%	3.8%	0.7	0.7	-0.8	a	
Ostracoda (% of community)	none	NO	0.5312	2015	9.7%	13.1%	-	2.2	1.7	a	Mann-Whitney U-test
				2016	5.7%	1.8%	-0.3	-	0.7	a	
				2017	2.8%	4.1%	-0.5	-1.5	-	a	
				2018	3.1%	2.9%	-0.5	-1.4	0.1	a	
Chironomidae (% of community)	none	NO	0.2208	2015	87.4%	12.8%	-	-1.5	-0.2	a	Tukey's HSD
				2016	92.2%	3.2%	0.4	-	0.5	a	
				2017	88.8%	7.2%	0.1	-1.1	-	a	
				2018	90.7%	4.9%	0.3	-0.5	0.3	a	
Metal Sensitive Taxa (% of community)	none	NO	0.1211	2015	2.8%	2.6%	-	0.6	-1.0	a	Mann-Whitney U-test
				2016	1.7%	1.7%	-0.4	-	-1.2	a	
				2017	12.0%	8.9%	3.6	6.0	-	a	
				2018	11.4%	16.8%	3.3	5.6	-0.1	a	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0277	2015	96.2%	2.8%	-	-0.3	2.9	a,b	Tamhane's
				2016	96.9%	2.1%	0.2	-	3.0	a	
				2017	84.3%	4.1%	-4.2	-6.0	-	b	
				2018	89.6%	13.4%	-2.3	-3.5	1.3	a,b	
Filterer FFG (% of community)	modified probit	NO	0.1154	2015	1.9%	2.7%	-	nc	-0.5	a	Tamhane's
				2016	0.0%	0.0%	-0.7	-	-0.7	a	
				2017	6.5%	9.3%	1.7	nc	-	a	
				2018	6.5%	10.5%	1.7	nc	0.0	a	

▨ Indicates a significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of initial year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.20: Statistical Comparison of Physical Sediment Quality Between Camp Lake and Reference Lake 3 for Samples Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics							
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Littoral (Shallow) Stations	**Station Depth (m)**	NO	0.810	α	Reference	5	9.7	1.0	0.5	8.5	-	11.2
					Camp	5	9.4	2.7	1.2	6.3	-	12.4
	Sand-Sized Particles (% by weight)	NO	0.897	δ	Reference	5	59.6	4.4	2.0	54.9	59.4	66.4
					Camp	5	59.7	20.3	9.1	34.5	62.1	79.2
	Silt-Sized Particles (% by weight)	NO	0.685	δ	Reference	5	31.4	3.3	1.5	26.6	32.6	34.7
					Camp	5	36.9	18.8	8.4	18.6	34.7	60.6
	Clay-Sized Particles (% by weight)	YES	0.004	β	Reference	5	9.0	2.4	1.1	5.8	10.4	10.8
					Camp	5	3.4	1.6	0.7	1.6	3.2	5.2
	Total Organic Carbon (%)	YES	0.019	α	Reference	5	4.7	2.3	1.0	1.8	5.1	7.4
					Camp	5	1.5	0.9	0.4	0.7	1.4	2.9
Profundal (Deep) Stations	**Station Depth (m)**	NO	0.714	β	Reference	5	20.6	2.2	1.0	18.5	-	24.2
					Camp	5	23.5	9.7	4.3	16.2	-	35.1
	Sand-Sized Particles (% by weight)	NO	0.717	β	Reference	5	47.5	2.8	1.3	44.5	47.0	50.9
					Camp	5	51.0	34.1	15.3	21.5	31.2	89.8
	Silt-Sized Particles (% by weight)	NO	0.889	α	Reference	5	39.0	3.1	1.4	33.8	40.4	41.5
					Camp	5	40.8	28.3	12.7	8.3	55.5	68.8
	Clay-Sized Particles (% by weight)	NO	0.117	Ŧ	Reference	5	13.6	2.2	1.0	9.7	14.3	15.3
					Camp	5	8.2	6.4	2.9	1.3	9.6	15.0
	Total Organic Carbon (%)	YES	0.062	β	Reference	5	3.8	1.7	0.8	0.8	4.5	4.9
					Camp	5	1.2	1.0	0.4	0.1	1.6	2.3

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; ζ - data untransformed, t-test conducted assuming unequal variance; η - data log-transformed, t-test assuming unequal variance; δ - data square-root transformed, t-test assuming unequal variance conducted; Ŧ - data square-root transformed, single factor ANOVA conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table F.21: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake, August 2018

Taxa	Study Area	Camp Lake - Littoral Stations				
	Replicate Station	JLO-02	JLO-21	JLO-20	JLO-19	JLO-18
ROUNDWORMS						
P. Nemata		-	86	17	233	17
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Lumbriculidae						
Lumbriculus		17	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
F. Acalyptonotidae						
Acalyptonotus		17	17	43	78	-
F. Hygrobatidae						
Hygrobates		-	-	9	-	-
F. Lebertiidae						
Lebertia		-	-	9	-	-
F. Sperchontidae						
Sperchon		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		-	-	52	9	-
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
pupae		-	-	9	-	-
F. Apataniidae						
Apatania		-	-	17	9	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		**17**	**26**	**43**	**17**	-
S.F. Chironominae						
Chironomus		34	-	-	-	172
Micropsectra		69	52	155	534	-
Paratanytarsus		69	190	198	655	34
Sergentia		-	-	-	-	-
Stictochironomus		1,190	448	1,284	302	586
Tanytarsus		34	17	155	224	-
S.F. Diamesinae						
Protanypus		17	9	17	52	-
Pseudodiamesa		-	-	9	9	-
S.F. Orthocladiinae						
Abiskomyia		172	95	397	138	86
Cricotopus/Orthocladius		-	-	-	-	-
Heterotrissocladius		1,052	629	431	422	207
Hydrobaenus		-	-	-	-	-
Limnophyes		-	-	-	-	-

Table F.21: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake, August 2018

Taxa Study Area	Camp Lake - Littoral Stations				
Replicate Station	JLO-02	JLO-21	JLO-20	JLO-19	JLO-18
Mesocricotopus	-	-	-	-	-
Paracladius	52	9	9	17	-
Parakiefferiella	17	-	-	-	-
Psectrocladius	-	-	-	-	-
Zalutschia	121	43	112	112	17
S.F. Tanypodinae					
Arctopelopia	259	138	147	147	52
Procladius	207	181	397	60	17
F. Tipulidae					
Tipula	-	-	-	-	-
Density (No. organisms per m^2)	3,344	1,940	3,510	3,018	1,188
Richness (total number of taxa)[a]	15	13	18	16	9
Simpson's Evenness (E)	0.811	0.874	0.858	0.930	0.784
Bray-Curtis Index	0.839	0.791	0.777	0.735	0.838
Dominant Taxonomic Group Composition					
% Nemata	0.0%	4.4%	0.5%	7.7%	1.4%
% Hydracarina	0.5%	0.9%	1.7%	2.6%	0.0%
% Ostracods	0.0%	0.0%	1.5%	0.3%	0.0%
% Chironomids	99.0%	94.7%	95.6%	89.1%	98.6%
% Metal Sensitive Chironmids	5.7%	14.0%	15.4%	49.1%	2.9%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition					
% Collector - Gatherers	76.7%	66.6%	63.9%	39.4%	89.9%
% Filterers	5.2%	13.6%	14.7%	47.1%	2.9%
% Shredders	3.6%	2.2%	3.2%	3.7%	1.4%
Habitat Preference Group Composition					
% Clingers	3.6%	4.5%	11.4%	28.1%	0.0%
% Sprawlers	58.6%	67.2%	50.5%	52.4%	34.8%
% Burrowers	37.8%	28.3%	38.0%	19.5%	65.2%

[a] Bold entries excluded from taxa count

Table F.21: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake, August 2018

Taxa	Study Area	Camp Lake - Profundal Stations				
	Replicate Station	JLO-16	JLO-01	JLO-07	JLO-11	JLO-12
ROUNDWORMS						
P. Nemata		34	-	-	-	129
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Lumbriculidae						
Lumbriculus		-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
F. Acalyptonotidae						
Acalyptonotus		-	-	9	-	9
F. Hygrobatidae						
Hygrobates		-	-	-	-	-
F. Lebertiidae						
Lebertia		-	9	-	17	17
F. Sperchontidae						
Sperchon		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		-	-	-	-	34
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
pupae		-	-	-	-	-
F. Apataniidae						
Apatania		-	-	-	-	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		-	-	**17**	**34**	**9**
S.F. Chironominae						
Chironomus		207	-	741	810	-
Micropsectra		172	-	9	-	-
Paratanytarsus		-	-	9	17	-
Sergentia		86	-	-	-	-
Stictochironomus		1,724	9	34	43	-
Tanytarsus		34	-	-	26	-
S.F. Diamesinae						
Protanypus		34	52	9	9	43
Pseudodiamesa		17	9	-	26	9
S.F. Orthocladiinae						
Abiskomyia		34	-	43	26	-
Cricotopus/Orthocladius		-	-	-	-	-
Heterotrissocladius		-	931	9	26	741
Hydrobaenus		-	-	-	-	-
Limnophyes		-	-	-	-	-

Table F.21: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake, August 2018

Taxa Study Area	Camp Lake - Profundal Stations				
Replicate Station	JLO-16	JLO-01	JLO-07	JLO-11	JLO-12
Mesocricotopus	-	-	-	-	-
Paracladius	-	17	-	-	9
Parakiefferiella	-	-	-	-	-
Psectrocladius	-	-	-	-	-
Zalutschia	-	9	-	-	-
S.F. Tanypodinae					
Arctopelopia	-	-	-	-	-
Procladius	-	-	-	-	-
F. Tipulidae					
Tipula	-	-	-	-	-
Density (No. organisms per m^2)	2,342	1,036	880	1,034	1,000
Richness (total number of taxa)[a]	9	7	8	9	8
Simpson's Evenness (E)	0.498	0.221	0.294	0.380	0.479
Bray-Curtis Index	0.981	0.485	0.958	0.950	0.447
Dominant Taxonomic Group Compo					
% Nemata	1.5%	0.0%	0.0%	0.0%	12.9%
% Hydracarina	0.0%	0.9%	1.0%	1.6%	2.6%
% Ostracods	0.0%	0.0%	0.0%	0.0%	3.4%
% Chironomids	98.5%	99.1%	99.0%	98.4%	81.1%
% Metal Sensitive Chironmids	11.0%	5.9%	3.1%	7.8%	5.3%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Compos					
% Collector - Gatherers	91.2%	98.3%	96.9%	94.0%	97.4%
% Filterers	8.8%	0.0%	2.0%	4.4%	0.0%
% Shredders	0.0%	0.9%	0.0%	0.0%	0.0%
Habitat Preference Group Composi					
% Clingers	12.5%	0.9%	2.0%	4.3%	2.6%
% Sprawlers	2.2%	93.2%	7.0%	9.6%	80.1%
% Burrowers	85.4%	5.9%	90.9%	86.2%	17.3%

[a] Bold entries excluded from taxa cour

Table F.22: Statistical Comparison of Benthic Invertebrate Community Metrics at Camp Lake Littoral (Shallow) Statoins Among Years of Mine Operation (2015 to 2018) and Baseline (2013) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.3477	2013	3	7,752	3,849	-	a	Mann-Whitney U-test
				2015	5	3,671	1,891	-1.1	a	
				2016	5	2,639	668	-1.3	a	
				2017	5	3,642	1,449	-1.1	a	
				2018	5	2,600	998	-1.3	a	
Richness (No. of Taxa)	none	NO	0.1815	2013	3	18.0	4.4	-	a	Mann-Whitney U-test
				2015	5	12.8	3.7	-1.2	a	
				2016	5	15.8	3.3	-0.5	a	
				2017	5	12.8	2.3	-1.2	a	
				2018	5	14.2	3.4	-0.9	a	
Simpson's Evenness	none	YES	0.0002	2013	3	0.893	0.054	-	a	Tukey's HSD
				2015	5	0.712	0.063	-3.4	b	
				2016	5	0.917	0.034	0.4	a	
				2017	5	0.848	0.068	-0.8	a	
				2018	5	0.851	0.057	-0.8	a	
Nemata (% of community)	none	NO	0.8963	2013	3	5.6%	3.6%	-	a	Tukey's HSD
				2015	5	4.7%	4.6%	-0.2	a	
				2016	5	4.4%	4.8%	-0.3	a	
				2017	5	4.2%	4.2%	-0.4	a	
				2018	5	2.8%	3.2%	-0.8	a	
Ostracoda (% of community)	none	YES	0.0692	2013	3	0.7%	0.5%	-	a,b	Mann-Whitney U-test
				2015	5	0.2%	0.3%	-1.0	a	
				2016	5	1.8%	1.1%	2.5	b	
				2017	5	0.2%	0.3%	-1.1	a	
				2018	5	0.4%	0.6%	-0.7	a	
Chironomidae (% of community)	none	NO	0.2332	2013	3	90.1%	4.4%	-	a	Tukey's HSD
				2015	5	93.1%	4.7%	0.7	a	
				2016	5	87.4%	7.0%	-0.6	a	
				2017	5	92.2%	6.5%	0.5	a	
				2018	5	95.4%	4.0%	1.2	a	
Metal Sensitive Taxa (% of community)	none	NO	0.3710	2013	3	30.8%	14.6%	-	a	Tukey's HSD
				2015	5	38.5%	24.5%	0.5	a	
				2016	5	29.7%	11.8%	-0.1	a	
				2017	5	38.2%	17.3%	0.5	a	
				2018	5	17.4%	18.5%	-0.9	a	
Collector-Gatherer FFG (% of community)	none	NO	0.2665	2013	3	55.9%	12.4%	-	a	Tukey's HSD
				2015	5	51.1%	14.7%	-0.4	a	
				2016	5	65.7%	7.8%	0.8	a	
				2017	5	50.8%	17.4%	-0.4	a	
				2018	5	67.3%	18.6%	0.9	a	
Filterer FFG (% of community)	none	NO	0.2879	2013	3	30.8%	14.5%	-	a	Tukey's HSD
				2015	5	38.2%	24.3%	0.5	a	
				2016	5	25.0%	7.5%	-0.4	a	
				2017	5	37.3%	17.3%	0.4	a	
				2018	5	16.7%	17.8%	-1.0	a	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.23: Statistical Comparison of Benthic Metrics at Camp Lake Profundal (Deep) Stations Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2013) for the Mary River Project CREMP

Metric	Data Transformation	Overall 5-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2007	vs. Baseline Year 2013		
Density (No. per m^2)	none	NO	0.1685	2007	4	2,627	1,403	-	0.9	a	Mann-Whitney U-test
				2013	5	2,140	567	-0.3	-	a	
				2015	5	1,552	1,005	-0.8	-1.0	a	
				2017	5	1,510	844	-0.8	-1.1	a	
				2018	5	1,258	609	-1.0	-1.6	a	
Richness (No. of Taxa)	none	YES	0.0066	2007	4	9.0	1.7	-	-1.8	a	Tukey's HSD
				2013	5	14.2	2.9	3.0	-	b	
				2015	5	8.2	2.8	-0.5	-2.0	a	
				2017	5	10.8	3.3	1.0	-1.2	b	
				2018	5	8.2	0.8	-0.5	-2.0	a	
Simpson's Evenness	none	YES	0.0451	2007	4	0.602	0.114	-	-1.0	a,b	Tukey's HSD
				2013	5	0.720	0.122	1.0	-	a	
				2015	5	0.604	0.283	0.0	-0.9	a,b	
				2017	5	0.681	0.154	0.7	-0.3	a	
				2018	5	0.374	0.118	-2.0	-2.8	b	
Nemata (% of community)	modified probit	NO	0.4597	2007	4	3.5%	3.1%	-	-0.3	a	Tukey's HSD
				2013	5	4.4%	3.2%	0.3	-	a	
				2015	5	6.7%	10.4%	1.0	0.7	a	
				2017	5	7.1%	6.2%	1.2	0.9	a	
				2018	5	2.9%	5.6%	-0.2	-0.5	a	
Ostracoda (% of community)	none	NO	0.7498	2007	4	0.0%	0.1%	-	-0.8	a	Mann-Whitney U-test
				2013	5	0.4%	0.4%	4.9	-	a	
				2015	5	0.3%	0.7%	3.6	-0.2	a	
				2017	5	0.3%	0.6%	3.3	-0.3	a	
				2018	5	0.7%	1.5%	8.6	0.6	a	
Chironomidae (% of community)	none	NO	0.7144	2007	4	94.9%	4.3%	-	0.8	a	Mann-Whitney U-test
				2013	5	91.1%	4.7%	-0.9	-	a	
				2015	5	90.4%	11.3%	-1.1	-0.1	a	
				2017	5	90.0%	6.6%	-1.1	-0.2	a	
				2018	5	95.2%	7.9%	0.1	0.9	a	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0060	2007	4	34.8%	4.8%	-	-0.3	a	Tukey's HSD
				2013	5	39.5%	17.2%	1.0	-	a	
				2015	5	11.7%	7.3%	-4.9	-1.6	b,c,d	
				2017	5	33.3%	25.5%	-0.3	-0.4	a,c	
				2018	5	6.6%	3.0%	-5.9	-1.9	d	
Collector-Gatherer FFG (% of community)	none	YES	0.0027	2007	4	64.6%	6.1%	-	0.4	a	Mann-Whitney U-test
				2013	5	57.0%	19.9%	-1.3	-	a	
				2015	5	84.7%	7.3%	3.3	1.4	b	
				2017	5	64.2%	28.1%	-0.1	0.4	a,b	
				2018	5	95.6%	2.9%	5.1	1.9	c	
Filterer FFG (% of community)	none	YES	0.0061	2007	4	32.6%	4.0%	-	-0.3	a,c	Tamhane's
				2013	5	37.5%	16.8%	1.2	-	a,b,c	
				2015	5	11.4%	6.8%	-5.3	-1.6	b,d	
				2017	5	31.6%	26.4%	-0.2	-0.3	b,c	
				2018	5	3.0%	3.7%	-7.3	-2.1	b,d	

▨	Indicates a significant difference for respective comparison (p-value ≤ 0.1).
🟦	Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.24: Replicate Grab Habitat Data for Benthic Invertebrate Community Samples Collected at the Sheardown Lake Tributaries, Mary River Project CREMP, August 2018

Study Area	Station	Water Depth (cm)			Water Velocity (m/s)			Embeddedness			In-Stream Vegetation			Algae Presence		
		Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3
Unnamed Reference Creek	REF-CRK-B1	10	10	10	0.42	0.41	0.42	25%	25%	25%	scarce	scarce	scarce	scarce	scarce	scarce
	REF-CRK-B2	9	9	11	0.52	0.48	0.42	25%	25%	25%	scarce	scarce	scarce	scarce	common	common
	REF-CRK-B3	17	17	10	0.55	0.46	0.55	25%	25%	25%	scarce	scarce	scarce	common	common	common
	REF-CRK-B4	10	12	10	0.45	0.45	0.60	25%	25%	25%	scarce	common	scarce	common	common	common
	REF-CRK-B5	12	14	14	0.41	0.47	0.59	25%	25%	25%	scarce	scarce	scarce	common	common	common
Sheardown Tributary 1 **Reach 1**	SDLT1 - B1	15	18	17	0.40	0.40	0.55	25%	25%	75%	abundant	common	scarce	abundant	common	common
	SDLT1 - B2	18	10	12	0.43	0.45	0.35	25%	25%	25%	common	common	common	common	common	common
	SDLT1 - B3	21	15	14	0.60	0.41	0.54	25%	75%	50%	common	scarce	common	common	common	common
	SDLT1 - B4	12	21	17	0.53	0.42	0.49	25%	50%	25%	scarce	common	common	abundant	common	common
	SDLT1 - B5	15	15	16	0.39	0.39	0.35	50%	50%	50%	common	common	scarce	common	common	common
Sheardown Tributary 9	SDLT9 - B1	8	12	11	0.40	0.45	0.47	75%	25%	50%	common	common	common	common	common	common
	SDLT9 - B2	6	5	7	0.43	0.51	0.40	25%	50%	50%	scarce	scarce	scarce	common	common	common
	SDLT9 - B3	8	9	11	0.41	0.41	0.51	25%	50%	88%	none	none	none	common	common	common
	SDLT9 - B4	8	10	7	0.48	0.42	0.41	50%	63%	25%	none	scarce	none	common	common	common
	SDLT9 - B5	5	7	10	0.42	0.40	0.59	38%	25%	50%	scarce	scarce	none	common	common	common
Sheardown Tributary 12	SDLT12 - B1	8	10	10	0.11	0.16	0.14	25%	50%	50%	scarce	scarce	scarce	common	common	common
	SDLT12 - B2	14	5	8	0.11	0.09	0.45	25%	50%	50%	common	scarce	scarce	common	common	common
	SDLT12 - B3	7	12	15	0.12	0.10	0.11	50%	50%	50%	scarce	common	scarce	common	common	common

Table F.25: Replicate Station Habitat Feature Summary Statistics for the Sheardown Lake Tributary Benthic Stations, Mary River Project CREMP, August 2018

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Depth (cm)	Unnamed Reference Creek	11.7	2.2	1.0	8.9	14.4	9.7	14.7
	Sheardown Tributary 1 (SDLT1)	15.7	1.5	0.7	13.9	17.6	13.3	16.7
	Sheardown Tributary 12 (SDLT12)	9.9	1.3	0.7	6.8	13.0	9.0	11.3
	Sheardown Tributary 9 (SDLT9)	8.3	1.7	0.8	6.2	10.4	6.0	10.3
Water Velocity (cm/s)	Unnamed Reference Creek	48.0	3.9	1.8	43.1	52.9	41.7	52.0
	Sheardown Tributary 1 (SDLT1)	44.7	5.5	2.5	37.8	51.5	37.7	51.7
	Sheardown Tributary 12 (SDLT12)	15.4	5.6	3.2	1.7	29.2	11.0	21.7
	Sheardown Tributary 9 (SDLT9)	44.7	1.3	0.6	43.1	46.4	43.7	47.0
Substrate Embeddedness (%)	Unnamed Reference Creek	25	0	0	25	25	25	25
	Sheardown Tributary 1 (SDLT1)	40	11	5	27	53	25	50
	Sheardown Tributary 12 (SDLT12)	44	5	3	32	56	42	50
	Sheardown Tributary 9 (SDLT9)	46	7	3	38	54	38	54

Note: Five stations were sampled at Unnamed Reference Creek, SDLT1, and SDLT9, and three stations were sampled at SDLT12.

Table F.26: Benthic Station Habitat Feature Statistical Comparisons Between Individual Sheardown Lake Tributaries and Unnamed Reference Creek, Mary River Project CREMP, August 2018

Metric	Pair-wise comparisons[a]				
	(I) Area	(J) Area	Significant Difference Between Areas?	P-value	Statistical Test[b]
Water Depth (cm)	Unnamed Reference Creek	SDLT1	YES	0.0159	γ
	Unnamed Reference Creek	SDLT12	NO	0.2500	
	Unnamed Reference Creek	SDLT9	YES	0.0317	
Water Velocity (cm/s)	Unnamed Reference Creek	SDLT1	NO	0.6133	α , ζ
	Unnamed Reference Creek	SDLT12	YES	0.0000	
	Unnamed Reference Creek	SDLT9	NO	0.6278	
Substrate Embeddedness (%)	Unnamed Reference Creek	SDLT1	YES	0.0317	γ
	Unnamed Reference Creek	SDLT12	YES	0.0357	
	Unnamed Reference Creek	SDLT9	YES	0.0079	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; ζ - Tukey's HSD post-hoc test used; η - Tamhane's post-hoc test used; γ - non-parametric Kruskal Wallis (multiple group) and Mann-Whitney U-tests (pair-wise) used on untransformed data

Table F.27: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributaries 1 and 12, August 2018

Taxa Study Area	Sheardown Lake Tributary 1 (SDLT1)				
Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	7	29	29	22	-
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	-	57	7	14	43
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Trombidiformes					
F. Lebertiidae					
Lebertia	-	-	-	-	-
F. Sperchonidae					
Sperchon	14	86	14	14	29
SEED SHRIMPS					
Cl. Ostracoda	-	-	-	-	-
SPRINGTAILS					
Cl. Entognatha					
O. Collembola	-	29	-	-	-
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
Acentrella feropagus	-	-	-	7	-
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature	-	-	-	-	-
CADDISFLIES					
O. Trichoptera					
F. Limnephilidae					
immature	-	-	-	-	-
TRUE FLIES					
O. Diptera					
BITING-MIDGE					
F. Ceratopogonidae					
Culicoides	-	-	-	-	-
MIDGES					
F. Chironomidae					
chironomid pupae	**47**	**144**	**86**	**122**	**75**
S.F. Chironominae					
Paratanytarsus	-	-	-	-	4
Rheotanytarsus	4	86	7	7	-
Tanytarsus	-	-	-	-	-
Chironomini indeterminate	-	-	-	-	-
S.F. Diamesinae					
Diamesa	-	-	7	-	4

Table F.27: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributaries 1 and 12, August 2018

Taxa	Study Area	Sheardown Lake Tributary 1 (SDLT1)				
	Replicate Station	B1	B2	B3	B4	B5
Pseudokiefferiella		79	316	330	65	36
S.F. Orthocladiinae						
Chaetocladius		-	-	-	-	-
Corynoneura		-	-	-	-	-
Cricotopus		86	287	158	158	68
Cricotopus/Orthocladius		22	517	144	122	32
Diplocladius		-	-	-	-	-
Eukiefferiella		-	-	-	-	-
Hydrobaenus		-	-	22	7	-
Hydrosmittia		39	488	237	481	269
Krenosmittia		-	-	-	-	-
Limnophyes		-	-	-	-	-
Metriocnemus		-	-	-	-	-
Orthocladius (Euorthocladius)		4	57	22	50	7
Parakiefferiella		-	57	14	22	-
Paraphaenocladius		-	-	-	-	-
Thienemanniella		-	-	-	-	-
Tokunagaia		-	-	-	-	-
Tvetenia		7	115	36	22	22
indeterminate		-	-	-	-	-
S.F. Podonominae						
Trichotanypus		-	-	-	-	-
S.F. Tanypodinae						
Thienemannimyia complex		-	-	-	-	7
F. Empididae						
Chelifera/Metachela		-	-	-	-	4
Clinocera		-	-	-	-	-
pupae		-	-	-	-	-
F. Simuliidae						
Gymnopais		-	-	-	-	-
Metacnephia		-	-	-	-	-
Prosimulium		-	-	-	-	-
F. Tipulidae						
Tipula		4	57	14	7	25
Density (No. organisms per m^2)		313	2,325	1,127	1,120	625
Richness (total number of taxa)[a]		10	13	14	14	13
Simpson's Evenness (E)		0.854	0.915	0.862	0.770	0.772
Bray-Curtis Index		0.464	0.462	0.202	0.165	0.259
Dominant Group Composition						
% Nemata		2.2%	1.2%	2.6%	2.0%	0.0%
% Oligochaeta		0.0%	2.5%	0.6%	1.3%	6.9%
% Hydracarina		4.5%	3.7%	1.2%	1.3%	4.6%
% Ostracods		0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera		0.0%	0.0%	0.0%	0.6%	0.0%
% Chironomids		92.0%	88.9%	94.3%	94.3%	83.8%
% Metal Sensitive Chironmids		31.6%	18.6%	33.3%	7.2%	8.3%
% Simuliidae		0.0%	0.0%	0.0%	0.0%	0.0%
% Tipulidae		1.3%	2.5%	1.2%	0.6%	4.0%
Functional Feeding Group Composition						
% Collector - Gatherers		51.4%	52.7%	67.6%	69.1%	70.1%
% Filterers		1.6%	4.0%	0.7%	0.7%	0.8%
% Shredders		42.5%	39.6%	30.4%	28.9%	22.6%
Habitat Preference Group Composition						
% Clingers		47.3%	46.1%	31.1%	30.3%	23.8%
% Sprawlers		47.6%	45.2%	62.3%	60.8%	64.0%
% Burrowers		3.5%	6.2%	4.4%	3.8%	10.9%

[a] Bold entries excluded from taxa count

Table F.27: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributaries 1 and 12, August 2018

Taxa Study Area	Sheardown Tributary 12 (SDLT12)		
Replicate Station	B1	B2	B3
ROUNDWORMS			
P. Nemata	-	11	72
ANNELIDS			
P. Annelida			
WORMS			
Cl. Oligochaeta			
F. Enchytraeidae	144	54	50
ARTHROPODS			
P. Arthropoda			
MITES			
Cl. Arachnida			
O. Trombidiformes			
F. Lebertiidae			
Lebertia	-	-	-
F. Sperchonidae			
Sperchon	-	22	-
SEED SHRIMPS			
Cl. Ostracoda	-	-	7
SPRINGTAILS			
Cl. Entognatha			
O. Collembola	-	-	-
INSECTS			
Cl. Insecta			
MAYFLIES			
O. Ephemeroptera			
F. Baetidae			
Acentrella feropagus	-	-	-
STONEFLIES			
O. Plecoptera			
F. Capniidae			
immature			
CADDISFLIES			
O. Trichoptera			
F. Limnephilidae			
immature	-	-	-
TRUE FLIES			
O. Diptera			
BITING-MIDGE			
F. Ceratopogonidae			
Culicoides	-	-	-
MIDGES			
F. Chironomidae			
chironomid pupae	**57**	**7**	**36**
S.F. Chironominae			
Paratanytarsus	-	4	7
Rheotanytarsus	-	-	-
Tanytarsus	-	-	-
Chironomini indeterminate	-	**4**	-
S.F. Diamesinae			
Diamesa	-	4	-

Table F.27: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributaries 1 and 12, August 2018

Taxa Study Area	Sheardown Tributary 12 (SDLT12)		
Replicate Station	B1	B2	B3
Pseudokiefferiella	-	-	-
S.F. Orthocladiinae			
Chaetocladius	201	25	43
Corynoneura	29	-	-
Cricotopus	29	25	72
Cricotopus/Orthocladius	144	147	36
Diplocladius	3244	395	1119
Eukiefferiella	201	11	-
Hydrobaenus	-	29	-
Hydrosmittia	29	-	-
Krenosmittia	-	4	-
Limnophyes	86	-	7
Metriocnemus	86	61	-
Orthocladius (Euorthocladius)	29	-	-
Parakiefferiella	-	-	-
Paraphaenocladius	574	32	-
Thienemanniella	-	-	-
Tokunagaia	29	129	208
Tvetenia	-	7	-
indeterminate	**431**	**65**	**337**
S.F. Podonominae			
Trichotanypus	-	-	7
S.F. Tanypodinae			
Thienemannimyia complex	-	-	-
F. Empididae			
Chelifera/Metachela	-	-	-
Clinocera	-	-	-
pupae	-	-	-
F. Simuliidae			
Gymnopais	-	-	-
Metacnephia	-	-	-
Prosimulium	-	-	-
F. Tipulidae			
Tipula	29	25	75
Density (No. organisms per m^2)	5,342	1,061	2,076
Richness (total number of taxa)[a]	14	17	12
Simpson's Evenness (E)	0.571	0.835	0.571
Bray-Curtis Index	0.951	0.804	0.884
Dominant Group Composition			
% Nemata	0.0%	1.0%	3.5%
% Oligochaeta	2.7%	5.1%	2.4%
% Hydracarina	0.0%	2.1%	0.0%
% Ostracods	0.0%	0.0%	0.3%
% Ephemeroptera	0.0%	0.0%	0.0%
% Chironomids	96.8%	89.4%	90.2%
% Metal Sensitive Chironmids	0.0%	1.1%	0.7%
% Simuliidae	0.0%	0.0%	0.0%
% Tipulidae	0.5%	2.4%	3.6%
Functional Feeding Group Compos			
% Collector - Gatherers	95.9%	77.4%	89.5%
% Filterers	0.0%	0.8%	0.3%
% Shredders	4.1%	19.8%	10.1%
Habitat Preference Group Composi			
% Clingers	3.6%	19.5%	6.5%
% Sprawlers	90.8%	65.7%	84.0%
% Burrowers	5.0%	14.8%	9.5%

[a] Bold entries excluded from taxa count

Table F.28: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributary 9, August 2018

Taxa Study Area	Sheardown Lake Tributary 9 (SDLT9)				
Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	43	79	136	72	86
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	-	29	4	14	14
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Trombidiformes					
F. Lebertiidae					
Lebertia	-	-	11	-	-
F. Sperchonidae					
Sperchon	165	100	126	144	72
SEED SHRIMPS					
Cl. Ostracoda	-	22	39	14	29
SPRINGTAILS					
Cl. Entognatha					
O. Collembola	-	7	11	-	-
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
Acentrella feropagus	-	57	7	-	-
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature					
CADDISFLIES					
O. Trichoptera					
F. Limnephilidae					
immature	14	-	25	-	-
TRUE FLIES					
O. Diptera					
BITING-MIDGE					
F. Ceratopogonidae					
Culicoides	-	-	-	-	-
MIDGES					
F. Chironomidae					
chironomid pupae	**86**	**65**	**79**	**144**	**258**
S.F. Chironominae					
Paratanytarsus	-	-	-	-	-
Rheotanytarsus	-	-	-	-	14
Tanytarsus	-	-	-	-	-
Chironomini indeterminate	-	-	-	-	-
S.F. Diamesinae					
Diamesa	-	-	4	-	-

Table F.28: **Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributary 9, August 2018**

Taxa Study Area	Sheardown Lake Tributary 9 (SDLT9)				
Replicate Station	B1	B2	B3	B4	B5
Pseudokiefferiella	29	-	-	14	-
S.F. Orthocladiinae					
Chaetocladius	-	-	4	14	-
Corynoneura	57	-	7	29	-
Cricotopus	136	22	118	187	100
Cricotopus/Orthocladius	445	158	133	287	388
Diplocladius	-	7	7	-	-
Eukiefferiella	-	-	-	14	-
Hydrobaenus	-	-	-	-	-
Hydrosmittia	29	7	47	144	57
Krenosmittia	14	72	50	57	14
Limnophyes	-	14	11	43	29
Metriocnemus	-	-	-	-	-
Orthocladius (Euorthocladius)	7	158	7	-	43
Parakiefferiella	-	-	-	-	-
Paraphaenocladius	-	-	-	-	-
Thienemanniella	-	-	-	14	-
Tokunagaia	545	201	151	416	187
Tvetenia	14	14	4	14	29
indeterminate	**323**	-	**122**	**86**	**14**
S.F. Podonominae					
Trichotanypus	-	-	-	-	-
S.F. Tanypodinae					
Thienemannimyia complex	-	7	-	-	-
F. Empididae					
Chelifera/Metachela	-	-	-	-	-
Clinocera	-	-	-	-	-
pupae	7	7	-	-	-
F. Simuliidae					
Gymnopais	-	36	7	-	-
Metacnephia	-	7	7	14	-
Prosimulium	-	-	-	-	-
F. Tipulidae					
Tipula	86	79	43	14	32
Density (No. organisms per m^2)	2,000	1,148	1,160	1,735	1,366
Richness (total number of taxa)[a]	14	20	23	18	14
Simpson's Evenness (E)	0.821	0.937	0.929	0.892	0.866
Bray-Curtis Index	0.842	0.689	0.754	0.759	0.739
Dominant Group Composition					
% Nemata	2.2%	6.9%	11.7%	4.1%	6.3%
% Oligochaeta	0.0%	2.5%	0.3%	0.8%	1.0%
% Hydracarina	8.3%	8.7%	11.8%	8.3%	5.3%
% Ostracods	0.0%	1.9%	3.4%	0.8%	2.1%
% Ephemeroptera	0.0%	5.0%	0.6%	0.0%	0.0%
% Chironomids	84.3%	63.2%	64.1%	84.3%	82.9%
% Metal Sensitive Chironmids	1.6%	0.0%	0.3%	0.9%	1.3%
% Simuliidae	0.0%	3.7%	1.2%	0.8%	0.0%
% Tipulidae	4.3%	6.9%	3.7%	0.8%	2.3%
Functional Feeding Group Composition					
% Collector - Gatherers	47.9%	62.2%	51.5%	57.6%	44.0%
% Filterers	0.0%	3.7%	1.2%	0.8%	1.3%
% Shredders	43.5%	24.1%	35.5%	33.3%	49.4%
Habitat Preference Group Composition					
% Clingers	47.8%	30.9%	45.8%	41.6%	53.7%
% Sprawlers	45.4%	37.6%	37.6%	52.6%	32.5%
% Burrowers	6.5%	16.3%	15.8%	5.8%	9.7%

[a] Bold entries excluded from taxa count

Table F.29: **Benthic Invertebrate Community Summary Statistics for the Sheardown Lake Tributaries, Mary River Project CREMP, August 2018**

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unnamed Reference Creek	526	152	68	337	714	262	636
	Sheardown Tributary 1 (SDLT1)	1,102	766	343	151	2,053	313	2,325
	Sheardown Tributary 12 (SDLT12)	2,826	2,237	1,292	-2,731	8,383	1,061	5,342
	Sheardown Tributary 9 (SDLT9)	1,482	375	167	1,017	1,947	1,148	2,000
Richness (Number of Taxa)	Unnamed Reference Creek	19.8	3.0	1.4	16.0	23.6	16.0	24.0
	Sheardown Tributary 1 (SDLT1)	12.8	1.6	0.7	10.8	14.8	10.0	14.0
	Sheardown Tributary 12 (SDLT12)	14.3	2.5	1.5	8.1	20.6	12.0	17.0
	Sheardown Tributary 9 (SDLT9)	17.8	3.9	1.7	13.0	22.6	14.0	23.0
Simpson's Evenness	Unnamed Reference Creek	0.960	0.011	0.005	0.946	0.974	0.942	0.972
	Sheardown Tributary 1 (SDLT1)	0.834	0.062	0.028	0.757	0.912	0.770	0.915
	Sheardown Tributary 12 (SDLT12)	0.659	0.152	0.088	0.281	1.037	0.571	0.835
	Sheardown Tributary 9 (SDLT9)	0.889	0.047	0.021	0.830	0.947	0.821	0.937
Bray-Curtis Index	Unnamed Reference Creek	0.208	0.093	0.042	0.092	0.324	0.114	0.342
	Sheardown Tributary 1 (SDLT1)	0.310	0.143	0.064	0.132	0.489	0.165	0.464
	Sheardown Tributary 12 (SDLT12)	0.879	0.074	0.042	0.697	1.062	0.804	0.951
	Sheardown Tributary 9 (SDLT9)	0.757	0.055	0.025	0.688	0.825	0.689	0.842
Nemata (% of community)	Unnamed Reference Creek	6.0%	2.0%	0.9%	3.6%	8.5%	3.9%	9.3%
	Sheardown Tributary 1 (SDLT1)	1.6%	1.0%	0.5%	0.3%	2.9%	0.0%	2.6%
	Sheardown Tributary 12 (SDLT12)	1.5%	1.8%	1.0%	-2.9%	5.9%	0.0%	3.5%
	Sheardown Tributary 9 (SDLT9)	6.2%	3.6%	1.6%	1.8%	10.7%	2.2%	11.7%
Oligochaeta (% of community)	Unnamed Reference Creek	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 1 (SDLT1)	2.2%	2.7%	1.2%	-1.2%	5.7%	0.0%	6.9%
	Sheardown Tributary 12 (SDLT12)	3.4%	1.5%	0.9%	-0.3%	7.1%	2.4%	5.1%
	Sheardown Tributary 9 (SDLT9)	0.9%	1.0%	0.4%	-0.3%	2.1%	0.0%	2.5%
Hydracarina (% of community)	Unnamed Reference Creek	3.3%	1.3%	0.6%	1.6%	4.9%	2.0%	5.3%
	Sheardown Tributary 1 (SDLT1)	3.1%	1.7%	0.8%	1.0%	5.2%	1.2%	4.6%
	Sheardown Tributary 12 (SDLT12)	0.7%	1.2%	0.7%	-2.3%	3.7%	0.0%	2.1%
	Sheardown Tributary 9 (SDLT9)	8.5%	2.3%	1.0%	5.6%	11.3%	5.3%	11.8%
Ostracoda (% of community)	Unnamed Reference Creek	1.2%	1.0%	0.4%	-0.1%	2.4%	0.0%	2.7%
	Sheardown Tributary 1 (SDLT1)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 12 (SDLT12)	0.1%	0.2%	0.1%	-0.4%	0.6%	0.0%	0.3%
	Sheardown Tributary 9 (SDLT9)	1.6%	1.3%	0.6%	0.0%	3.2%	0.0%	3.4%
Ephemeroptera (% of community)	Unnamed Reference Creek	5.6%	2.1%	0.9%	3.0%	8.3%	3.9%	9.2%
	Sheardown Tributary 1 (SDLT1)	0.1%	0.3%	0.1%	-0.2%	0.5%	0.0%	0.6%
	Sheardown Tributary 12 (SDLT12)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 9 (SDLT9)	1.1%	2.2%	1.0%	-1.6%	3.8%	0.0%	5.0%
Chironomidae (% of community)	Unnamed Reference Creek	60.3%	4.5%	2.0%	54.8%	65.9%	55.0%	66.8%
	Sheardown Tributary 1 (SDLT1)	90.7%	4.4%	2.0%	85.2%	96.2%	83.8%	94.3%
	Sheardown Tributary 12 (SDLT12)	92.1%	4.0%	2.3%	82.1%	102.1%	89.4%	96.8%
	Sheardown Tributary 9 (SDLT9)	75.8%	11.1%	5.0%	62.0%	89.5%	63.2%	84.3%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	12.4%	4.2%	1.9%	7.1%	17.7%	6.9%	18.7%
	Sheardown Tributary 1 (SDLT1)	19.8%	12.4%	5.5%	4.4%	35.2%	7.2%	33.3%
	Sheardown Tributary 12 (SDLT12)	0.6%	0.6%	0.3%	-0.8%	2.0%	0.0%	1.1%
	Sheardown Tributary 9 (SDLT9)	0.8%	0.6%	0.3%	0.0%	1.6%	0.0%	1.6%
Simuliidae (% of community)	Unnamed Reference Creek	15.9%	4.6%	2.0%	10.2%	21.6%	11.2%	22.2%
	Sheardown Tributary 1 (SDLT1)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 12 (SDLT12)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 9 (SDLT9)	1.2%	1.5%	0.7%	-0.8%	3.1%	0.0%	3.7%
Tipulidae (% of community)	Unnamed Reference Creek	2.8%	1.5%	0.7%	1.0%	4.6%	1.5%	4.7%
	Sheardown Tributary 1 (SDLT1)	1.9%	1.3%	0.6%	0.3%	3.6%	0.6%	4.0%
	Sheardown Tributary 12 (SDLT12)	2.2%	1.5%	0.9%	-1.7%	6.0%	0.5%	3.6%
	Sheardown Tributary 9 (SDLT9)	3.6%	2.3%	1.0%	0.8%	6.4%	0.8%	6.9%

Table F.29: Benthic Invertebrate Community Summary Statistics for the Sheardown Lake Tributaries, Mary River Project CREMP, August 2018

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	71.5%	4.0%	1.8%	66.5%	76.5%	67.2%	76.0%
	Sheardown Tributary 1 (SDLT1)	62.2%	9.3%	4.2%	50.7%	73.7%	51.4%	70.1%
	Sheardown Tributary 12 (SDLT12)	87.6%	9.4%	5.4%	64.3%	110.9%	77.4%	95.9%
	Sheardown Tributary 9 (SDLT9)	52.6%	7.3%	3.3%	43.5%	61.7%	44.0%	62.2%
Filterer FFG (% of community)	Unnamed Reference Creek	16.0%	4.5%	2.0%	10.4%	21.6%	11.2%	22.2%
	Sheardown Tributary 1 (SDLT1)	1.6%	1.4%	0.6%	-0.2%	3.3%	0.7%	4.0%
	Sheardown Tributary 12 (SDLT12)	0.4%	0.4%	0.2%	-0.6%	1.3%	0.0%	0.8%
	Sheardown Tributary 9 (SDLT9)	1.4%	1.4%	0.6%	-0.3%	3.2%	0.0%	3.7%
Shredder FFG (% of community)	Unnamed Reference Creek	4.8%	2.8%	1.2%	1.4%	8.2%	1.5%	8.3%
	Sheardown Tributary 1 (SDLT1)	32.8%	8.2%	3.6%	22.7%	42.9%	22.6%	42.5%
	Sheardown Tributary 12 (SDLT12)	11.3%	7.9%	4.6%	-8.3%	31.0%	4.1%	19.8%
	Sheardown Tributary 9 (SDLT9)	37.2%	9.7%	4.3%	25.1%	49.2%	24.1%	49.4%
Clinger HPG (% of community)	Unnamed Reference Creek	22.6%	4.9%	2.2%	16.4%	28.7%	17.9%	29.2%
	Sheardown Tributary 1 (SDLT1)	35.7%	10.4%	4.7%	22.8%	48.6%	23.8%	47.3%
	Sheardown Tributary 12 (SDLT12)	9.9%	8.5%	4.9%	-11.2%	30.9%	3.6%	19.5%
	Sheardown Tributary 9 (SDLT9)	44.0%	8.5%	3.8%	33.4%	54.5%	30.9%	53.7%
Sprawler HPG (% of community)	Unnamed Reference Creek	58.4%	6.0%	2.7%	51.0%	65.8%	50.4%	65.3%
	Sheardown Tributary 1 (SDLT1)	56.0%	8.9%	4.0%	45.0%	67.0%	45.2%	64.0%
	Sheardown Tributary 12 (SDLT12)	80.2%	13.0%	7.5%	47.9%	112.4%	65.7%	90.8%
	Sheardown Tributary 9 (SDLT9)	41.1%	7.9%	3.5%	31.3%	50.9%	32.5%	52.6%
Burrower HPG (% of community)	Unnamed Reference Creek	11.2%	1.9%	0.9%	8.8%	13.6%	9.0%	14.0%
	Sheardown Tributary 1 (SDLT1)	5.8%	3.0%	1.4%	2.0%	9.5%	3.5%	10.9%
	Sheardown Tributary 12 (SDLT12)	9.8%	4.9%	2.8%	-2.4%	21.9%	5.0%	14.8%
	Sheardown Tributary 9 (SDLT9)	10.8%	5.0%	2.2%	4.6%	17.0%	5.8%	16.3%

Note: Sample size equals five for Unnamed Reference Creek, SDLT1, and SDLT9, and three for SDLT12.

Table F.30: Benthic Invertebrate Community Metric Statistical Comparisons between Individual Sheardown Lake Tributaries and Unnamed Reference Creek, Mary River Project CREMP, August 2018

Metric	Data Transformation	Overall 4-Area Comparison[a]		Pair-wise, post-hoc comparisons[a]					
		Significant Difference Among Areas?	P-value	Area	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Reference	Pairwise Comparison
Density (No. per m^2)	log	YES	0.010	Reference	5	526	152	-	a
				SDLT1	5	1,102	766	3.8	a,b
				SDLT12	3	2,826	2,237	15.2	b
				SDLT9	5	1,482	375	6.3	b
Richness (No. of Taxa)	none	YES	0.010	Reference	5	19.8	3.0	-	a
				SDLT1	5	12.8	1.6	-2.3	b
				SDLT12	3	14.3	2.5	-1.8	b,c
				SDLT9	5	17.8	3.9	-0.7	a,c
Simpson's Evenness	none	YES	< 0.001	Reference	5	0.960	0.011	-	a
				SDLT1	5	0.834	0.062	-11.2	b
				SDLT12	3	0.659	0.152	-26.9	c
				SDLT9	5	0.889	0.047	-6.4	a,b
Bray Curtis Index	none	YES	< 0.001	Reference	5	0.208	0.093	-	a
				SDLT1	5	0.310	0.143	1.1	b,c
				SDLT12	3	0.879	0.074	7.2	b
				SDLT9	5	0.757	0.055	5.9	c
Nemata (% of community)	square-root	YES	0.006	Reference	5	6.0%	2.0%	-	a
				SDLT1	5	1.6%	1.0%	-2.2	b
				SDLT12	3	1.5%	1.8%	-2.3	b
				SDLT9	5	6.2%	3.6%	0.1	a
Oligochaeta (% of community)	square-root	YES	0.007	Reference	5	0.0%	0.0%	-	a
				SDLT1	5	2.2%	2.7%	2.0	b
				SDLT12	3	3.4%	1.5%	2.9	b
				SDLT9	5	0.9%	1.0%	1.3	a,b
Hydracarina (% of community)	none	YES	< 0.001	Reference	5	3.3%	1.3%	-	a
				SDLT1	5	3.1%	1.7%	-0.1	a
				SDLT12	3	0.7%	1.2%	-1.9	a
				SDLT9	5	8.5%	2.3%	3.9	b
Ephemeroptera (% of community)	rank	YES	0.009	Reference	5	5.6%	2.1%	-	a
				SDLT1	5	0.1%	0.3%	-2.6	b
				SDLT12	3	0.0%	0.0%	-2.7	b
				SDLT9	5	1.1%	2.2%	-2.2	b
Chironomidae (% of community)	none	YES	< 0.001	Reference	5	60.3%	4.5%	-	a
				SDLT1	5	90.7%	4.4%	6.8	b
				SDLT12	3	92.1%	4.0%	7.1	b
				SDLT9	5	75.8%	11.1%	3.4	c
Metal Sensitive Chironomidae (% of community)	square-root	YES	< 0.001	Reference	5	12.4%	4.2%	-	a
				SDLT1	5	19.8%	12.4%	1.7	a
				SDLT12	3	0.6%	0.6%	-2.8	b
				SDLT9	5	0.8%	0.6%	-2.7	b
Simuliidae (% of community)	square-root	YES	< 0.001	Reference	5	15.9%	4.6%	-	a
				SDLT1	5	0.0%	0.0%	-3.5	b
				SDLT12	3	0.0%	0.0%	-3.5	b
				SDLT9	5	1.2%	1.5%	-3.2	b
Tipulidae (% of community)	square-root	NO	0.501	Reference	5	2.8%	1.5%	-	a
				SDLT1	5	1.9%	1.3%	-0.6	a
				SDLT12	3	2.2%	1.5%	-0.4	a
				SDLT9	5	3.6%	2.3%	0.6	a
Collector-Gatherer FFG (% of community)	log	YES	< 0.001	Reference	5	71.5%	4.0%	-	a,b
				SDLT1	5	62.2%	9.3%	-2.3	a,c
				SDLT12	3	87.6%	9.4%	4.0	b
				SDLT9	5	52.6%	7.3%	-4.7	c
Filterer FFG (% of community)	square root	YES	< 0.001	Reference	5	16.0%	4.5%	-	a
				SDLT1	5	1.6%	1.4%	-3.2	b
				SDLT12	3	0.4%	0.4%	-3.5	b
				SDLT9	5	1.4%	1.4%	-3.2	b
Shredder FFG (% of community)	none	YES	< 0.001	Reference	5	4.8%	2.8%	-	a
				SDLT1	5	32.8%	8.2%	10.1	b
				SDLT12	3	11.3%	7.9%	2.4	a
				SDLT9	5	37.2%	9.7%	11.7	b
Clinger HPG (% of community)	fourth-root	YES	< 0.001	Reference	5	22.6%	4.9%	-	a
				SDLT1	5	35.7%	10.4%	2.7	a,b
				SDLT12	3	9.9%	8.5%	-2.6	c
				SDLT9	5	44.0%	8.5%	4.3	b
Sprawler HPG (% of community)	none	YES	< 0.001	Reference	5	58.4%	6.0%	-	a
				SDLT1	5	56.0%	8.9%	-0.4	a
				SDLT12	3	80.2%	13.0%	3.7	b
				SDLT9	5	41.1%	7.9%	-2.9	c
Burrower HPG (% of community)	log	YES	0.065	Reference	5	11.2%	1.9%	-	a
				SDLT1	5	5.8%	3.0%	-2.8	b
				SDLT12	3	9.8%	4.9%	-0.7	a,b
				SDLT9	5	10.8%	5.0%	-0.2	a,b

▨ Indicates a statisitically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of reference mean, suggesting an ecologically meaningful difference in endpoint value relative to reference conditions.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.31: Statistical Comparison of Primary and Percent Compositional Benthic Metrics at Sheardown Lake Tributary 1 (SDLT1) Among Years of Mine Operation (2015 to 2018) and Baseline (2008, 2013) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]							
								Effect Size			
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	vs. Baseline Year 2008	vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0170	2008	3	300	52	-	-2.0	a,b,f	Mann-Whitney U-test
				2013	3	657	176	6.8	-	b,c,e,f	
				2015	5	722	485	8.1	0.4	c,e,f	
				2016	5	2,453	814	41.1	10.2	d	
				2017	5	1,660	1,643	25.9	5.7	d,e,f	
				2018	5	1,102	766	15.3	2.5	f	
Richness (No. of Taxa)	none	NO	0.2228	2008	3	12.0	1.0	-	-1.9	a	Tukey's HSD
				2013	3	16.7	2.5	4.7	-	a	
				2015	5	15.4	4.3	3.4	-0.5	a	
				2016	5	15.2	2.5	3.2	-0.6	a	
				2017	5	14.0	2.0	2.0	-1.1	a	
				2018	5	12.8	1.6	0.8	-1.5	a	
Simpson's Evenness	none	NO	0.5854	2008	3	0.894	0.034	-	0.1	a	Tukey's HSD
				2013	3	0.887	0.064	-0.2	-	a	
				2015	5	0.869	0.067	-0.7	-0.3	a	
				2016	5	0.872	0.032	-0.6	-0.2	a	
				2017	5	0.883	0.028	-0.3	-0.1	a	
				2018	5	0.834	0.062	-1.8	-0.8	a	
Oligochaeta (% of community)	none	YES	0.0783	2008	3	3.0%	2.5%	-	-1.3	a	Tukey's HSD
				2013	3	7.3%	3.3%	1.7	-	a	
				2015	5	14.4%	10.8%	4.6	2.1	a	
				2016	5	14.1%	8.8%	4.5	2.0	a	
				2017	5	8.6%	7.4%	2.3	0.4	a	
				2018	5	2.2%	2.7%	-0.3	-1.5	a	
Hydracarina (% of community)	modified probit	YES	0.0115	2008	3	12.1%	4.7%	-	2.6	a	Tukey's HSD
				2013	3	4.6%	2.9%	-1.6	-	b	
				2015	5	4.6%	1.6%	-1.6	0.0	b	
				2016	5	5.3%	1.3%	-1.4	0.2	a,b	
				2017	5	3.9%	2.0%	-1.7	-0.2	b	
				2018	5	3.1%	1.7%	-1.9	-0.5	b	
Chironomidae (% of community)	none	YES	0.0101	2008	3	69.2%	2.0%	-	-3.0	a	Tukey's HSD
				2013	3	81.1%	3.9%	6.0	-	a,b	
				2015	5	72.0%	9.0%	1.4	-2.3	a	
				2016	5	73.1%	11.9%	2.0	-2.0	a	
				2017	5	82.4%	10.1%	6.7	0.3	a,b	
				2018	5	90.7%	4.4%	10.9	2.4	b	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0135	2008	3	27.5%	5.4%	-	0.5	a	Tamhane's
				2013	3	19.9%	14.3%	-1.4	-	a,b	
				2015	5	6.1%	2.9%	-3.9	-1.0	b	
				2016	5	15.6%	4.4%	-2.2	-0.3	a	
				2017	5	26.1%	15.6%	-0.3	0.4	a	
				2018	5	19.8%	12.4%	-1.4	0.0	a,b	
Tipulidae (% of community)	none	YES	0.0404	2008	3	14.7%	2.7%	-	22.8	a	Mann-Whitney U-test
				2013	3	3.8%	0.5%	-4.0	-	b	
				2015	5	2.1%	1.3%	-4.7	-3.7	c	
				2016	5	3.5%	1.9%	-4.1	-0.6	b,c	
				2017	5	2.8%	2.7%	-4.4	-2.1	b,c	
				2018	5	1.9%	1.3%	-4.7	-4.0	b,c	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study ye

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.32: Statistical Comparison of Functional Feeding Group (FFG) Benthic Metrics at Sheardown Lake Tributary 1 (SDLT1) Among Years of Mine Operation (2015 to 2018) and Baseline (2008, 2013) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2008	vs. Baseline Year 2013		
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0147	2008	3	40.3%	2.9%	-	-2.0	a	Tukey's HSD
				2013	3	55.5%	7.5%	5.2	-	a,b	
				2015	5	64.2%	5.2%	8.2	1.2	b	
				2016	5	58.6%	10.7%	6.3	0.4	b	
				2017	5	55.3%	8.0%	5.2	0.0	a,b	
				2018	5	62.2%	9.3%	7.5	0.9	b	
Filterer FFG (% of community)	0.0634	YES	0.0266	2008	3	5.2%	3.5%	-	-2.0	a	Mann-Whitney U-test
				2013	3	8.5%	1.6%	0.9	-	a	
				2015	5	4.5%	1.4%	-0.2	-2.4	b	
				2016	5	7.6%	3.3%	0.7	-0.5	a,b	
				2017	5	8.9%	8.0%	1.1	0.2	a,b	
				2018	5	1.6%	1.4%	-1.0	-4.2	c	
Shredder FFG (% of community)	none	YES	0.0634	2008	3	40.6%	4.2%	-	1.6	a	Tukey's HSD
				2013	3	28.7%	7.4%	-2.8	-	a,b	
				2015	5	22.9%	4.5%	-4.2	-0.8	b	
				2016	5	27.4%	9.4%	-3.1	-0.2	a,b	
				2017	5	31.6%	7.7%	-2.1	0.4	a,b	
				2018	5	32.8%	8.2%	-1.9	0.6	a,b	

⬛	Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).
🟦	Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint values between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.33: **Statistical Comparison of Benthic Invertebrate Community Metrics at Sheardown Lake Tributary 12 (SDLT12) Among Years of Mine Operation (2015 to 2018) and Baseline (2007) for the Mary River Project CREMP**

Metric	Data Transform-ation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	log	NO	0.2482	2007	5	1,016	669	-	a	Tamhane's
				2015	3	841	575	-0.3	a	
				2016	3	894	502	-0.2	a	
				2017	3	783	561	-0.3	a	
				2018	3	2,826	2,237	2.7	a	
Richness (No. of Taxa)	none	YES	0.0145	2007	5	19.0	1.9	-	a	Mann-Whitney U-test
				2015	3	12.0	1.0	-3.7	b	
				2016	3	18.3	1.2	-0.4	a	
				2017	3	15.3	0.6	-2.0	c	
				2018	3	14.3	2.5	-2.5	b,c,d	
Simpson's Evenness	none	YES	0.0212	2007	5	0.854	0.020	-	a	Mann-Whitney U-test
				2015	3	0.884	0.041	1.5	a,b	
				2016	3	0.884	0.046	1.5	a,b	
				2017	3	0.931	0.021	3.9	b	
				2018	3	0.659	0.152	-9.9	c	
Oligochaeta (% of community)	modified probit	YES	0.0000	2007	5	0.7%	0.6%	-	a	
				2015	3	28.8%	8.8%	48.8	b	
				2016	3	31.6%	11.1%	53.6	b	
				2017	3	21.9%	8.4%	36.8	b	
				2018	3	3.4%	1.5%	4.7	c	
Hydracarina (% of community)	modified probit	NO	0.2205	2007	5	3.0%	2.9%	-	a	Tamhane's
				2015	3	0.0%	0.0%	-1.0	a	
				2016	3	0.4%	0.4%	-0.9	a	
				2017	3	0.0%	0.0%	-1.0	a	
				2018	3	0.7%	1.2%	-0.8	a	
Chironomidae (% of community)	none	YES	0.0281	2007	5	88.0%	10.2%	-	a	Mann-Whitney U-test
				2015	3	65.1%	6.7%	-2.3	b	
				2016	3	54.9%	18.0%	-3.2	b	
				2017	3	64.6%	7.2%	-2.3	b	
				2018	3	92.1%	4.0%	0.4	a	
Metal Sensitive Taxa (% of community)	none	YES	0.0004	2007	5	3.2%	2.0%	-	a	Tukey's HSD
				2015	3	1.4%	1.5%	-0.9	a	
				2016	3	2.6%	0.5%	-0.3	a	
				2017	3	12.7%	5.2%	4.7	a	
				2018	3	0.6%	0.6%	-1.3	a	
Tipulidae (% of community)	modified probit	YES	0.0058	2007	5	0.3%	0.5%	-	a	
				2015	3	3.4%	1.3%	6.3	b	
				2016	3	3.8%	3.1%	7.2	b	
				2017	3	3.4%	2.0%	6.5	b	
				2018	3	2.2%	1.5%	3.9	b	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0095	2007	5	57.8%	15.8%	-	a	Tukey's HSD
				2015	3	83.7%	11.4%	1.6	b	
				2016	3	87.0%	2.6%	1.8	b	
				2017	3	88.5%	3.2%	1.9	b	
				2018	3	87.6%	9.4%	1.9	b	
Filterer FFG (% of community)	none	NO	0.4131	2007	5	6.8%	9.2%	-	a	Tukey's HSD
				2015	3	0.0%	0.0%	-0.7	a	
				2016	3	2.1%	0.1%	-0.5	a	
				2017	3	3.5%	2.8%	-0.4	a	
				2018	3	0.4%	0.4%	-0.7	a	
Shredder FFG (% of community)	modified probit	YES	0.0992	2007	5	22.5%	8.9%	-	a	Tukey's HSD
				2015	3	16.3%	11.4%	-0.7	a	
				2016	3	9.3%	1.5%	-1.5	a	
				2017	3	8.0%	2.1%	-1.6	a	
				2018	3	11.3%	7.9%	-1.2	a	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.34: Statistical Comparison of Primary and Percent Compositional Benthic Metrics at Sheardown Lake Tributary 9 (SDLT9) Among Years of Mine Operation (2015 to 2018) and Baseline (2008, 2013) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2008	vs. Baseline Year 2013		
Density (No. per m^2)	none	YES	0.0048	2008	3	300	52	-	-2.0	a	Mann-Whitney U-test
				2013	3	657	176	6.8	-	b	
				2015	5	722	485	8.1	0.4	b	
				2016	5	2,453	814	41.1	10.2	c	
				2017	5	1,660	1,643	25.9	5.7	b,c	
				2018	5	1,482	375	22.5	4.7	d	
Richness (No. of Taxa)	none	NO	0.1976	2008	3	12.0	1.0	-	-1.9	a	Tukey's HSD
				2013	3	16.7	2.5	4.7	-	a	
				2015	5	15.4	4.3	3.4	-0.5	a	
				2016	5	15.2	2.5	3.2	-0.6	a	
				2017	5	14.0	2.0	2.0	-1.1	a	
				2018	5	17.8	3.9	5.8	0.5	a	
Simpson's Evenness	none	NO	0.9651	2008	3	0.894	0.034	-	0.1	a	Tukey's HSD
				2013	3	0.887	0.064	-0.2	-	a	
				2015	5	0.869	0.067	-0.7	-0.3	a	
				2016	5	0.872	0.032	-0.6	-0.2	a	
				2017	5	0.883	0.028	-0.3	-0.1	a	
				2018	5	0.889	0.047	-0.2	0.0	a	
Oligochaeta (% of community)	modified probit	NO	0.1339	2008	3	3.0%	2.5%	-	-1.3	a	Tukey's HSD
				2013	3	7.3%	3.3%	1.7	-	a	
				2015	5	14.4%	10.8%	4.6	2.1	a	
				2016	5	14.1%	8.8%	4.5	2.0	a	
				2017	5	8.6%	7.4%	2.3	0.4	a	
				2018	5	0.9%	1.0%	-0.8	-1.9	a	
Hydracarina (% of community)	modified probit	YES	0.0039	2008	3	12.1%	4.7%	-	2.6	a	Tukey's HSD
				2013	3	4.6%	2.9%	-1.6	-	b,c,d	
				2015	5	4.6%	1.6%	-1.6	0.0	b,c,d	
				2016	5	5.3%	1.3%	-1.4	0.2	b,c,d	
				2017	5	3.9%	2.0%	-1.7	-0.2	c	
				2018	5	8.5%	2.3%	-0.8	1.3	a,d	
Chironomidae (% of community)	none	NO	0.4291	2008	3	69.2%	2.0%	-	-3.0	a	Mann-Whitney U-test
				2013	3	81.1%	3.9%	6.0	-	a	
				2015	5	72.0%	9.0%	1.4	-2.3	a	
				2016	5	73.1%	11.9%	2.0	-2.0	a	
				2017	5	82.4%	10.1%	6.7	0.3	a	
				2018	5	75.8%	11.1%	3.3	-1.4	a	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0000	2008	3	27.5%	5.4%	-	0.5	a,c	Tukey's HSD
				2013	3	19.9%	14.3%	-1.4	-	a,b,c	
				2015	5	6.1%	2.9%	-3.9	-1.0	b	
				2016	5	15.6%	4.4%	-2.2	-0.3	b,c	
				2017	5	26.1%	15.6%	-0.3	0.4	c	
				2018	5	0.8%	0.6%	-4.9	-1.3	d	
Tipulidae (% of community)	none	YES	0.0591	2008	3	14.7%	2.7%	-	22.8	a	Mann-Whitney U-test
				2013	3	3.8%	0.5%	-4.0	-	b	
				2015	5	2.1%	1.3%	-4.7	-3.7	c	
				2016	5	3.5%	1.9%	-4.1	-0.6	b,c	
				2017	5	2.8%	2.7%	-4.4	-2.1	b,c	
				2018	5	3.6%	2.3%	-4.1	-0.4	b,c	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study ye

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.35: Statistical Comparison of Functional Feeding Group (FFG) Benthic Metrics at Sheardown Lake Tributary 9 (SDLT9) Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2013) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2008	vs. Baseline Year 2013		
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0127	2007	3	40.3%	2.9%	-	-2.0	a	Tukey's HSD
				2013	3	55.5%	7.5%	5.2	-	a,b	
				2015	5	64.2%	5.2%	8.2	1.2	b	
				2016	5	58.6%	10.7%	6.3	0.4	b	
				2017	5	55.3%	8.0%	5.2	0.0	a,b	
				2018	5	52.6%	7.3%	4.2	-0.4	a,b	
Filterer FFG (% of community)	modified probit	YES	0.0179	2007	3	5.2%	3.5%	-	-2.0	a,b	Tukey's HSD
				2013	3	8.5%	1.6%	0.9	-	a	
				2015	5	4.5%	1.4%	-0.2	-2.4	a,b	
				2016	5	7.6%	3.3%	0.7	-0.5	a	
				2017	5	8.9%	8.0%	1.1	0.2	a	
				2018	5	1.4%	1.4%	-1.1	-4.3	b	
Shredder FFG (% of community)	modified probit	YES	0.0350	2007	3	40.6%	4.2%	-	1.6	a	Tukey's HSD
				2013	3	28.7%	7.4%	-2.8	-	a,b	
				2015	5	22.9%	4.5%	-4.2	-0.8	b	
				2016	5	27.4%	9.4%	-3.1	-0.2	a,b	
				2017	5	31.6%	7.7%	-2.1	0.4	a,b	
				2018	5	37.2%	9.7%	-0.8	1.1	a	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint values between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.36: Statistical Comparison of Physical Sediment Quality Between Sheardown Lake NW and Reference Lake 3 for Samples Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics							
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Littoral (Shallow) Stations	Station Depth (m)	YES	0.011	β	Reference	5	9.74	1.04	0.46	8.50	-	11.20
					Sheardown NW	5	8.20	0.38	0.17	7.80	-	8.60
	Sand-Sized Particles (% by weight)	YES	0.029	β	Reference	5	59.6	4.4	2.0	54.9	59.4	66.4
					Sheardown NW	5	39.5	17.5	7.9	24.8	31.2	68.8
	Silt-Sized Particles (% by weight)	YES	0.025	α	Reference	5	31.4	3.3	1.5	26.6	32.6	34.7
					Sheardown NW	5	49.3	14.1	6.3	27.0	51.9	63.4
	Clay-Sized Particles (% by weight)	NO	0.346	α	Reference	5	9.0	2.4	1.1	5.8	10.4	10.8
					Sheardown NW	5	11.3	4.6	2.0	4.2	11.8	16.9
	Total Organic Carbon (%)	NO	0.208	α	Reference	5	4.7	2.3	1.0	1.8	5.1	7.4
					Sheardown NW	5	3.0	1.6	0.7	0.9	3.4	4.9
Profundal (Deep) Stations	Station Depth (m)	NO	0.775	α	Reference	5	20.56	2.17	0.97	18.50	-	24.20
					Sheardown NW	5	21.14	3.82	1.71	15.00	-	24.20
	Sand-Sized Particles (% by weight)	NO	0.151	γ	Reference	5	47.5	2.8	1.3	44.5	47.0	50.9
					Sheardown NW	5	21.6	18.8	8.4	11.0	14.0	55.2
	Silt-Sized Particles (% by weight)	YES	0.094	γ	Reference	5	39.0	3.1	1.4	33.8	40.4	41.5
					Sheardown NW	5	62.3	15.9	7.1	34.1	68.0	72.8
	Clay-Sized Particles (% by weight)	NO	0.266	α	Reference	5	13.6	2.2	1.0	9.7	14.3	15.3
					Sheardown NW	5	16.0	4.1	1.8	10.7	17.3	21.0
	Total Organic Carbon (%)	YES	0.095	γ	Reference	5	3.8	1.7	0.8	0.8	4.5	4.9
					Sheardown NW	5	1.7	0.7	0.3	0.5	1.6	2.4

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; ζ - data untransformed, t-test conducted assuming unequal variance; η - data log-transformed, t-test assuming unequal variance; δ - data square-root transformed, t-test assuming unequal variance conducted; Ŧ - data square-root transformed, single factor ANOVA conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table F.37: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake NW, August 2018

Taxa Study Area	Sheardown Lake NW - Littoral Stations				
Replicate Station	DLO-1-9	DLO-1-4	DLO-1-3	DLO-1-11	DLO-1-10
ROUNDWORMS					
P. Nemata	155	155	138	17	9
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Lumbriculidae					
Lumbriculus	-	-	-	9	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
F. Acalyptonotidae					
Acalyptonotus	-	-	-	34	69
F. Hygrobatidae					
Hygrobates	-	-	-	95	69
F. Lebertiidae					
Lebertia	-	17	-	9	9
F. Sperchontidae					
Sperchon	-	-	-	-	-
SEED SHRIMPS					
Cl. Ostracoda	638	1,586	1,759	302	284
INSECTS					
Cl. Insecta					
CADDISFLIES					
O. Trichoptera					
pupae	-	-	-	-	-
F. Apataniidae					
Apatania	-	-	34	-	-
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae	**34**	**17**	-	-	**9**
S.F. Chironominae					
Chironomus	1,241	-	34	-	-
Micropsectra	103	828	724	-	43
Paratanytarsus	379	1,310	3,276	9	9
Sergentia	103	-	34	-	-
Stictochironomus	1,207	1,621	4,069	2,078	1,888
Tanytarsus	638	276	138	-	17
S.F. Diamesinae					
Protanypus	17	-	34	26	52
Pseudodiamesa	-	-	-	9	17
S.F. Orthocladiinae					
Abiskomyia	759	1,534	414	198	95
Cricotopus/Orthocladius	-	-	-	-	-

Table F.37: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake NW, August 2018

Taxa Study Area	Sheardown Lake NW - Littoral Stations				
Replicate Station	DLO-1-9	DLO-1-4	DLO-1-3	DLO-1-11	DLO-1-10
Heterotrissocladius	121	466	552	138	250
Hydrobaenus	-	-	-	-	-
Limnophyes	-	-	-	-	-
Mesocricotopus	-	-	-	-	-
Paracladius	-	17	-	-	60
Parakiefferiella	-	-	103	-	9
Psectrocladius	-	17	-	-	-
Zalutschia	17	17	-	9	34
S.F. Tanypodinae					
Arctopelopia	52	379	345	26	-
Procladius	17	52	103	103	155
F. Tipulidae					
Tipula	-	-	-	-	-
Density (No. organisms per m^2)	5,481	8,292	11,757	3,062	3,078
Richness (total number of taxa)[a]	14	14	15	15	17
Simpson's Evenness (E)	0.910	0.914	0.827	0.558	0.638
Bray-Curtis Index	0.839	0.863	0.904	0.799	0.779
Dominant Group Composition					
% Nemata	2.8%	1.9%	1.2%	0.6%	0.3%
% Hydracarina	0.0%	0.2%	0.0%	4.5%	4.8%
% Ostracods	11.6%	19.1%	15.0%	9.9%	9.2%
% Chironomids	85.5%	78.8%	83.6%	84.8%	85.7%
% Metal Sensitive Chironmids	20.9%	29.2%	35.5%	1.4%	4.5%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition					
% Collector - Gatherers	77.8%	65.2%	60.7%	90.7%	86.8%
% Filterers	20.6%	29.2%	35.2%	0.3%	2.2%
% Shredders	0.3%	0.2%	0.0%	0.3%	1.1%
Habitat Preference Group Composition					
% Clingers	15.5%	13.6%	7.9%	4.5%	6.7%
% Sprawlers	36.3%	65.0%	55.7%	25.9%	29.8%
% Burrowers	48.1%	21.5%	36.4%	69.6%	63.5%

[a] Bold entries excluded from taxa count

Table F.37: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake NW, August 2018

Taxa	Study Area	Sheardown Lake NW - Profundal Stations				
	Replicate Station	DLO-1-5	DLO-1-14	DLO-1-15	DLO-1-2	DLO-1-12
ROUNDWORMS						
P. Nemata		9	-	-	-	34
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Lumbriculidae						
Lumbriculus		17	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
F. Acalyptonotidae						
Acalyptonotus		60	52	17	26	60
F. Hygrobatidae						
Hygrobates		34	9	17	9	34
F. Lebertiidae						
Lebertia		9	-	-	17	9
F. Sperchontidae						
Sperchon		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		26	69	-	26	43
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
pupae		-	-	-	-	-
F. Apataniidae						
Apatania		-	-	-	-	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		**52**	**17**	-	-	-
S.F. Chironominae						
Chironomus		862	647	-	-	-
Micropsectra		-	-	-	-	9
Paratanytarsus		-	9	-	-	-
Sergentia		-	-	-	-	-
Stictochironomus		103	155	-	-	-
Tanytarsus		43	-	-	-	-
S.F. Diamesinae						
Protanypus		9	-	60	17	26
Pseudodiamesa		-	-	-	-	17
S.F. Orthocladiinae						
Abiskomyia		17	26	-	-	-
Cricotopus/Orthocladius		-	17	-	-	-

Table F.37: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake NW, August 2018

Taxa	Study Area	Sheardown Lake NW - Profundal Stations				
	Replicate Station	DLO-1-5	DLO-1-14	DLO-1-15	DLO-1-2	DLO-1-12
Heterotrissocladius		9	-	853	621	1,216
Hydrobaenus		-	-	-	-	-
Limnophyes		-	9	-	-	-
Mesocricotopus		9	-	-	-	-
Paracladius		-	-	-	-	-
Parakiefferiella		-	-	-	-	-
Psectrocladius		-	-	-	-	-
Zalutschia		-	-	-	-	-
S.F. Tanypodinae						
Arctopelopia		-	-	-	-	9
Procladius		43	34	52	207	43
F. Tipulidae						
Tipula		-	-	-	-	-
Density (No. organisms per m^2)		1,302	1,044	999	923	1,500
Richness (total number of taxa)[a]		14	10	5	7	11
Simpson's Evenness (E)		0.545	0.633	0.330	0.577	0.372
Bray-Curtis Index		0.968	0.975	0.472	0.428	0.582
Dominant Group Composition						
% Nemata		0.7%	0.0%	0.0%	0.0%	2.3%
% Hydracarina		7.9%	5.8%	3.4%	5.6%	6.9%
% Ostracods		2.0%	6.6%	0.0%	2.8%	2.9%
% Chironomids		88.1%	87.5%	96.6%	91.5%	88.0%
% Metal Sensitive Chironmids		4.1%	0.9%	6.0%	1.8%	3.5%
% Tipulidae		0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition						
% Collector - Gatherers		85.2%	88.3%	91.4%	71.9%	89.1%
% Filterers		3.5%	0.9%	0.0%	0.0%	0.6%
% Shredders		0.0%	1.6%	0.0%	0.0%	0.0%
Habitat Preference Group Composition						
% Clingers		11.4%	7.5%	3.4%	5.6%	7.5%
% Sprawlers		8.3%	14.3%	90.6%	92.5%	88.5%
% Burrowers		80.3%	78.3%	6.0%	1.8%	4.0%

[a] Bold entries excluded from taxa count

Table F.38: Statistical Comparison of Benthic Metrics at Sheardown Lake NW Littoral (Shallow) Stations Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2008, 2013) for the Mary River Project CREMP

Metric	Data Transformation	Overall 7-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]								
								Effect Size				
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	vs. Baseline Year 2007	vs. Baseline Year 2008	vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	log	NO	0.6600	2007	4	5,974	3,000	-	-0.3	-1.5	a	Tukey's HSD
				2008	4	7,536	5,273	0.5	-	-0.9	a	
				2013	3	9,940	2,634	1.3	0.5	-	a	
				2015	5	5,665	3,230	-0.1	-0.4	-1.6	a	
				2016	5	5,503	4,184	-0.2	-0.4	-1.7	a	
				2017	5	5,216	2,398	-0.3	-0.4	-1.8	a	
				2018	5	6,334	3,717	0.1	-0.2	-1.4	a	
Richness (No. of Taxa)	none	NO	0.2829	2007	4	12.3	1.5	-	-1.3	-1.7	a	Mann-Whitney U-test
				2008	4	14.5	1.7	1.4	-	-1.0	a	
				2013	3	17.7	3.2	3.5	1.9	-	a	
				2015	5	13.8	1.9	1.0	-0.4	-1.2	a	
				2016	5	14.6	2.4	1.5	0.1	-1.0	a	
				2017	5	14.0	3.2	1.1	-0.3	-1.1	a	
				2018	5	15.0	1.2	1.8	0.3	-0.8	a	
Simpson's Evenness	none	NO	0.1080	2007	4	0.768	0.055	-	-0.7	-2.0	a	Mann-Whitney U-test
				2008	4	0.840	0.098	1.3	-	-0.5	a	
				2013	3	0.863	0.047	1.7	0.2	-	a	
				2015	5	0.759	0.096	-0.2	-0.8	-2.2	a	
				2016	5	0.893	0.024	2.3	0.5	0.6	a	
				2017	5	0.842	0.048	1.3	0.0	-0.5	a	
				2018	5	0.769	0.163	0.0	-0.7	-2.0	a	
Nemata (% of community)	none	NO	0.9123	2007	4	1.5%	1.6%	-	0.4	1.1	a	Mann-Whitney U-test
				2008	4	1.1%	1.0%	-0.3	-	0.6	a	
				2013	3	0.6%	0.8%	-0.6	-0.5	-	a	
				2015	5	0.9%	1.1%	-0.4	-0.2	0.3	a	
				2016	5	1.1%	0.7%	-0.2	0.1	0.6	a	
				2017	5	1.3%	1.5%	-0.2	0.2	0.8	a	
				2018	5	1.3%	1.0%	-0.1	0.3	0.9	a	
Ostracoda (% of community)	none	NO	0.1255	2007	4	11.9%	12.8%	-	0.1	-1.4	a	Tamhane's
				2008	4	10.8%	8.7%	-0.1	-	-1.5	a	
				2013	3	23.4%	8.1%	0.9	1.4	-	a	
				2015	5	7.8%	3.7%	-0.3	-0.3	-1.9	a	
				2016	5	9.2%	6.1%	-0.2	-0.2	-1.7	a	
				2017	5	19.5%	11.1%	0.6	1.0	-0.5	a	
				2018	5	13.0%	4.1%	0.1	0.2	-1.3	a	

Table F.38: Statistical Comparison of Benthic Metrics at Sheardown Lake NW Littoral (Shallow) Stations Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2008, 2013) for the Mary River Project CREMP

Metric	Data Transformation	Overall 7-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]								
								Effect Size				
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	vs. Baseline Year 2007	vs. Baseline Year 2008	vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Chironomidae (% of community)	modified probit	YES	0.0132	2007	4	83.0%	8.3%	-	0.3	1.3	a,b,c	Tukey's HSD
				2008	4	81.2%	6.7%	-0.2	-	1.1	a,b,c	
				2013	3	70.5%	9.6%	-1.5	-1.6	-	a,c	
				2015	5	89.8%	3.2%	0.8	1.3	2.0	b	
				2016	5	85.0%	6.6%	0.2	0.6	1.5	a,b,c	
				2017	5	73.5%	11.2%	-1.1	-1.2	0.3	c	
				2018	5	83.7%	2.9%	0.1	0.4	1.4	a,b,c	
Metal Sensitive Taxa (% of community)	none	NO	0.9668	2007	4	16.9%	16.8%	-	-0.2	-0.9	a	Tamhane's
				2008	4	20.7%	17.2%	0.2	-	-0.1	a	
				2013	3	21.0%	4.6%	0.2	0.0	-	a	
				2015	5	19.1%	7.2%	0.1	-0.1	-0.4	a	
				2016	5	24.6%	15.2%	0.5	0.2	0.8	a	
				2017	5	16.6%	7.9%	0.0	-0.2	-0.9	a	
				2018	5	18.3%	15.0%	0.1	-0.1	-0.6	a	
Collector-Gatherer FFG (% of community)	none	NO	0.1646	2007	4	71.6%	13.5%	-	0.7	0.7	a	Tukey's HSD
				2008	4	61.1%	15.0%	-0.8	-	-0.5	a	
				2013	3	65.3%	9.0%	-0.5	0.3	-	a	
				2015	5	68.9%	8.0%	-0.2	0.5	0.4	a	
				2016	5	56.8%	7.7%	-1.1	-0.3	-1.0	a	
				2017	5	69.4%	9.2%	-0.2	0.6	0.5	a	
				2018	5	76.2%	13.1%	0.3	1.0	1.2	a	
Filterer FFG (% of community)	none	NO	0.9880	2007	4	16.7%	17.1%	-	-0.2	-0.9	a	Tamhane's
				2008	4	19.9%	17.1%	0.2	-	-0.2	a	
				2013	3	21.0%	4.7%	0.3	0.1	-	a	
				2015	5	18.6%	6.8%	0.1	-0.1	-0.5	a	
				2016	5	23.0%	17.3%	0.4	0.2	0.4	a	
				2017	5	16.5%	8.0%	0.0	-0.2	-1.0	a	
				2018	5	17.5%	15.7%	0.0	-0.1	-0.7	a	

▒ Indicates a significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.39: Statistical Comparison of Benthic Metrics at Sheardown Lake NW Profundal (Deep) Stations Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2013) for the Mary River Project CREMP

Metric	Data Transformation	Overall 5-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2007	vs. Baseline Year 2013		
Density (No. per m^2)	none	YES	0.0000	2007	4	1,461	308	-	-4.3	a	Tukey's HSD
				2013	3	2,744	302	4.2	-	b	
				2015	5	1,425	210	-0.1	-4.4	a	
				2017	5	861	391	-1.9	-6.2	c	
				2018	5	1,154	240	-1.0	-5.3	a,c	
Richness (No. of Taxa)	none	NO	0.8178	2007	4	7.5	0.4	-	-0.9	a	Tamhane's
				2013	3	9.8	2.5	5.4	-	a	
				2015	5	8.4	3.0	2.1	-0.6	a	
				2017	5	9.2	3.5	4.0	-0.3	a	
				2018	5	9.4	3.5	4.4	-0.2	a	
Simpson's Evenness	none	YES	0.0288	2007	4	0.426	0.165	-	-0.6	a	Tukey's HSD
				2013	3	0.521	0.167	0.6	-	a,b	
				2015	5	0.355	0.212	-0.4	-1.0	a	
				2017	5	0.717	0.113	1.8	1.2	b	
				2018	5	0.491	0.133	0.4	-0.2	a,b	
Nemata (% of community)	none	NO	0.1691	2007	4	0.6%	0.5%	-	-1.2	a	Mann-Whitney U-test
				2013	3	3.6%	2.6%	5.8	-	a	
				2015	5	0.5%	0.3%	-0.2	-1.2	a	
				2017	5	1.4%	3.0%	1.4	-0.9	a	
				2018	5	0.6%	1.0%	-0.1	-1.2	a	
Ostracoda (% of community)	none	NO	0.2096	2007	4	0.3%	0.4%	-	-0.7	a	Tamhane's
				2013	3	6.2%	8.7%	16.4	-	a	
				2015	5	2.8%	3.7%	7.0	-0.4	a	
				2017	5	6.8%	4.6%	18.2	0.1	a	
				2018	5	2.9%	2.4%	7.1	-0.4	a	
Chironomidae (% of community)	none	NO	0.1208	2007	4	94.6%	1.9%	-	1.1	a	Tukey's HSD
				2013	3	84.9%	8.8%	-5.0	-	a	
				2015	5	93.2%	6.0%	-0.7	0.9	a	
				2017	5	85.1%	8.5%	-4.9	0.0	a	
				2018	5	90.4%	3.8%	-2.2	0.6	a	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0141	2007	4	0.5%	0.6%	-	-0.5	a	Tamhane's
				2013	3	1.4%	1.7%	1.4	-	a	
				2015	5	2.8%	2.8%	3.7	0.9	a	
				2017	5	6.3%	4.4%	9.2	2.9	a	
				2018	5	3.3%	2.0%	4.4	1.1	a	
Collector-Gatherer FFG (% of community)	none	YES	0.0452	2007	4	83.6%	8.4%	-	-0.6	a,b	Tukey's HSD
				2013	3	86.4%	4.8%	0.3	-	a,b	
				2015	5	90.5%	5.3%	0.8	0.9	a	
				2017	5	75.5%	7.3%	-1.0	-2.3	b	
				2018	5	85.2%	7.7%	0.2	-0.3	a,b	
Filterer FFG (% of community)	none	NO	0.3319	2007	4	0.1%	0.1%	-	-0.8	a	Mann-Whitney U-test
				2013	3	1.3%	1.6%	11.6	-	a	
				2015	5	1.9%	2.6%	16.7	0.3	a	
				2017	5	2.9%	2.5%	26.2	1.0	a	
				2018	5	1.0%	1.4%	8.5	-0.2	a	

▨	Indicates a significant difference for respective comparison (p-value ≤ 0.1).
🟦	Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.40: Statistical Comparison of Physical Sediment Quality Between Sheardown Lake SE and Reference Lake 3 for Samples Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics							
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Littoral (Shallow) Stations	Station Depth (m)	NO	0.423	β	Reference	5	9.74	1.04	0.46	8.50	-	11.20
					Sheardown NW	5	9.10	1.58	0.71	7.50	-	11.50
	Sand-Sized Particles (% by weight)	YES	0.001	Ŧ	Reference	5	59.6	4.4	2.0	54.9	59.4	66.4
					Sheardown NW	5	12.8	5.6	2.5	7.9	11.7	22.0
	Silt-Sized Particles (% by weight)	YES	0.001	β	Reference	5	31.4	3.3	1.5	26.6	32.6	34.7
					Sheardown NW	5	73.7	4.5	2.0	67.7	75.6	77.6
	Clay-Sized Particles (% by weight)	YES	0.014	α	Reference	5	9.0	2.4	1.1	5.8	10.4	10.8
					Sheardown NW	5	13.6	2.3	1.0	10.3	13.6	16.4
	Total Organic Carbon (%)	YES	0.005	Ŧ	Reference	5	4.7	2.3	1.0	1.8	5.1	7.4
					Sheardown NW	5	1.3	0.4	0.2	0.9	1.3	1.9
Profundal (Deep) Stations	Station Depth (m)	YES	0.001	β	Reference	5	20.56	2.17	0.97	18.50	-	24.20
					Sheardown NW	5	12.44	1.17	0.52	10.50	-	13.50
	Sand-Sized Particles (% by weight)	YES	0.001	α	Reference	5	47.5	2.8	1.3	44.5	47.0	50.9
					Sheardown NW	5	14.0	4.9	2.2	7.1	13.8	18.8
	Silt-Sized Particles (% by weight)	YES	0.001	Ŧ	Reference	5	39.0	3.1	1.4	33.8	40.4	41.5
					Sheardown NW	5	71.0	3.7	1.6	68.8	69.6	77.5
	Clay-Sized Particles (% by weight)	NO	0.385	α	Reference	5	13.6	2.2	1.0	9.7	14.3	15.3
					Sheardown NW	5	15.0	2.6	1.2	12.3	15.3	18.2
	Total Organic Carbon (%)	YES	0.151	γ	Reference	5	3.8	1.7	0.8	0.8	4.5	4.9
					Sheardown NW	5	1.2	0.1	0.1	1.0	1.1	1.4

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; ζ - data untransformed, t-test conducted assuming unequal variance; η - data log-transformed, t-test assuming unequal variance; δ - data square-root transformed, t-test assuming unequal variance conducted; Ŧ - data square-root transformed, single factor ANOVA conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table F.41: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake SE, August 2018

Taxa Study Area	Sheardown Lake SE - Littoral Stations				
Replicate Station	DLO-2-11	DLO-2-10	DLO-2-4	DLO-2-9	DLO-2-1
ROUNDWORMS					
P. Nemata	17	-	34	26	17
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Lumbriculidae					
Lumbriculus	-	-	-	-	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
F. Acalyptonotidae					
Acalyptonotus	17	-	-	17	9
F. Hygrobatidae					
Hygrobates	26	-	17	9	9
F. Lebertiidae					
Lebertia	-	34	-	9	9
F. Sperchontidae					
Sperchon	-	-	-	-	-
SEED SHRIMPS					
Cl. Ostracoda	164	1,310	9	86	43
INSECTS					
Cl. Insecta					
CADDISFLIES					
O. Trichoptera					
pupae	-	-	-	-	-
F. Apataniidae					
Apatania	-	69	-	-	-
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae	-	-	-	-	-
S.F. Chironominae					
Chironomus	-	69	-	-	-
Micropsectra	60	276	60	293	138
Paratanytarsus	-	828	-	26	-
Sergentia	-	172	-	9	-
Stictochironomus	2,681	517	1,586	1,974	1,759
Tanytarsus	578	379	78	224	-
S.F. Diamesinae					
Protanypus	-	-	-	-	-
Pseudodiamesa	-	-	-	-	-
S.F. Orthocladiinae					
Abiskomyia	-	-	-	9	-
Cricotopus/Orthocladius	-	-	-	-	-

Table F.41: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake SE, August 2018

Taxa Study Area	Sheardown Lake SE - Littoral Stations				
Replicate Station	DLO-2-11	DLO-2-10	DLO-2-4	DLO-2-9	DLO-2-1
Heterotrissocladius	26	-	-	26	-
Hydrobaenus	-	-	-	-	-
Limnophyes	-	-	-	-	-
Mesocricotopus	-	-	-	-	-
Paracladius	-	-	-	-	-
Parakiefferiella	-	-	-	-	-
Psectrocladius	-	-	-	-	-
Zalutschia	-	-	-	9	9
S.F. Tanypodinae					
Arctopelopia	9	586	-	-	-
Procladius	2,371	1,310	879	1,534	793
F. Tipulidae					
Tipula	-	-	-	-	-
Density (No. organisms per m^2)	5,949	5,550	2,663	4,251	2,786
Richness (total number of taxa)[a]	10	11	7	14	9
Simpson's Evenness (E)	0.697	0.922	0.624	0.696	0.582
Bray-Curtis Index	0.910	0.871	0.919	0.846	0.864
Dominant Group Composition					
% Nemata	0.3%	0.0%	1.3%	0.6%	0.6%
% Hydracarina	0.7%	0.6%	0.6%	0.8%	1.0%
% Ostracods	2.8%	23.6%	0.3%	2.0%	1.5%
% Chironomids	96.2%	74.5%	97.7%	96.5%	96.9%
% Metal Sensitive Chironmids	10.7%	26.7%	5.2%	12.8%	5.0%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition					
% Collector - Gatherers	48.5%	37.3%	61.2%	50.1%	65.3%
% Filterers	10.7%	26.7%	5.2%	12.8%	5.0%
% Shredders	0.0%	0.0%	0.0%	0.2%	0.3%
Habitat Preference Group Composition					
% Clingers	11.4%	16.8%	5.8%	13.2%	5.9%
% Sprawlers	43.2%	72.7%	33.3%	39.8%	30.3%
% Burrowers	45.4%	10.6%	60.8%	47.0%	63.7%

[a] Bold entries excluded from taxa count

Table F.41: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake SE, August 2018

Taxa Study Area	Sheardown Lake SE - Profundal Stations				
Replicate Station	DLO-2-12	DLO-2-8	DLO-2-13	DLO-2-2	DLO-2-3
ROUNDWORMS					
P. Nemata	-	9	60	-	-
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Lumbriculidae					
Lumbriculus	-	-	-	-	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
F. Acalyptonotidae					
Acalyptonotus	26	26	-	-	-
F. Hygrobatidae					
Hygrobates	17	-	9	-	-
F. Lebertiidae					
Lebertia	-	9	-	-	-
F. Sperchontidae					
Sperchon	-	-	-	-	-
SEED SHRIMPS					
Cl. Ostracoda	112	9	-	-	34
INSECTS					
Cl. Insecta					
CADDISFLIES					
O. Trichoptera					
pupae	-	-	-	-	-
F. Apataniidae					
Apatania	-	-	-	-	-
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae	-	-	-	-	-
S.F. Chironominae					
Chironomus	-	-	-	112	552
Micropsectra	181	52	9	26	621
Paratanytarsus	-	-	-	-	-
Sergentia	-	-	-	-	-
Stictochironomus	819	1,060	1,103	948	4,828
Tanytarsus	26	9	69	17	310
S.F. Diamesinae					
Protanypus	-	-	-	-	-
Pseudodiamesa	-	-	-	-	-
S.F. Orthocladiinae					
Abiskomyia	17	17	-	17	69
Cricotopus/Orthocladius	-	-	-	-	-

Table F.41: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake SE, August 2018

Taxa Study Area	Sheardown Lake SE - Profundal Stations				
Replicate Station	DLO-2-12	DLO-2-8	DLO-2-13	DLO-2-2	DLO-2-3
Heterotrissocladius	9	-	-	-	34
Hydrobaenus	-	-	-	-	-
Limnophyes	-	-	-	-	-
Mesocricotopus	-	-	-	-	-
Paracladius	-	-	-	-	-
Parakiefferiella	-	-	-	-	-
Psectrocladius	-	-	-	-	-
Zalutschia	-	9	-	-	34
S.F. Tanypodinae					
Arctopelopia	9	-	-	-	34
Procladius	2,440	543	284	164	1,310
F. Tipulidae					
Tipula	-	-	-	-	-
Density (No. organisms per m^2)	3,656	1,743	1,534	1,284	7,826
Richness (total number of taxa)[a]	10	10	6	6	10
Simpson's Evenness (E)	0.557	0.591	0.534	0.516	0.643
Bray-Curtis Index	0.978	0.967	0.991	0.980	0.985
Dominant Group Composition					
% Nemata	0.0%	0.5%	3.9%	0.0%	0.0%
% Hydracarina	1.2%	2.0%	0.6%	0.0%	0.0%
% Ostracods	3.1%	0.5%	0.0%	0.0%	0.4%
% Chironomids	95.8%	97.0%	95.5%	100.0%	99.6%
% Metal Sensitive Chironmids	5.7%	3.5%	5.1%	3.3%	11.9%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition					
% Collector - Gatherers	26.2%	62.8%	75.8%	83.9%	70.5%
% Filterers	5.7%	3.5%	5.1%	3.3%	11.9%
% Shredders	0.0%	0.5%	0.0%	0.0%	0.4%
Habitat Preference Group Composition					
% Clingers	6.8%	5.5%	5.7%	3.3%	11.9%
% Sprawlers	70.8%	33.2%	18.5%	14.1%	19.4%
% Burrowers	22.4%	61.3%	75.8%	82.6%	68.7%

[a] Bold entries excluded from taxa count

Table F.42: Statistical Comparison of Benthic Invertebrate Community Metrics at Sheardown Lake SE Littoral (Shallow) Statoins Among Years of Mine Operation (2015 to 2018) and Baseline (2013) for the Mary River Project

Metric	Data Transform-ation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	log	YES	0.0022	2013	5	10,649	4,062	-	a	Tukey's HSD
				2015	5	4,829	1,898	-1.4	b	
				2016	5	3,700	1,485	-1.7	b	
				2017	5	4,417	1,317	-1.5	b	
				2018	5	4,240	1,520	-1.6	b	
Richness (No. of Taxa)	log	YES	0.0764	2013	5	14.2	4.0	-	a	Tukey's HSD
				2015	5	10.6	2.5	-0.9	a,b	
				2016	5	11.4	2.3	-0.7	a,b	
				2017	5	9.0	0.7	-1.3	b	
				2018	5	10.2	2.6	-1.0	a,b	
Simpson's Evenness	log	NO	0.6122	2013	5	0.785	0.096	-	a	Tukey's HSD
				2015	5	0.759	0.123	-0.3	a	
				2016	5	0.772	0.089	-0.1	a	
				2017	5	0.712	0.055	-0.8	a	
				2018	5	0.704	0.131	-0.8	a	
Nemata (% of community)	none	NO	0.8755	2013	5	0.2%	0.2%	-	a	Mann-Whitney U-test
				2015	5	1.5%	2.9%	7.0	a	
				2016	5	1.1%	1.3%	4.4	a	
				2017	5	0.5%	0.6%	1.4	a	
				2018	5	0.6%	0.5%	1.8	a	
Ostracoda (% of community)	none	NO	0.6679	2013	5	5.9%	8.8%	-	a	Mann-Whitney U-test
				2015	5	5.5%	10.0%	0.0	a	
				2016	5	1.7%	2.5%	-0.5	a	
				2017	5	0.8%	0.8%	-0.6	a	
				2018	5	6.1%	9.9%	0.0	a	
Chironomidae (% of community)	none	NO	0.1549	2013	5	89.9%	7.5%	-	a	Mann-Whitney U-test
				2015	5	88.9%	9.4%	-0.1	a	
				2016	5	95.4%	3.9%	0.7	a	
				2017	5	95.6%	1.8%	0.8	a	
				2018	5	92.4%	10.0%	0.3	a	
Metal Sensitive Taxa (% of community)	modified probit	NO	0.5354	2013	5	15.1%	9.8%	-	a	Tukey's HSD
				2015	5	12.7%	10.4%	-0.2	a	
				2016	5	6.8%	4.2%	-0.8	a	
				2017	5	12.1%	4.2%	-0.3	a	
				2018	5	12.1%	8.9%	-0.3	a	
Collector-Gatherer FFG (% of community)	modified probit	NO	0.4486	2013	5	44.6%	8.2%	-	a	Tukey's HSD
				2015	5	59.1%	10.6%	1.8	a	
				2016	5	56.5%	12.8%	1.5	a	
				2017	5	48.4%	18.8%	0.5	a	
				2018	5	52.5%	11.1%	1.0	a	
Filterer FFG (% of community)	modified probit	NO	0.4544	2013	5	15.1%	9.8%	-	a	Tukey's HSD
				2015	5	12.5%	10.4%	-0.3	a	
				2016	5	6.7%	4.4%	-0.9	a	
				2017	5	12.1%	4.2%	-0.3	a	
				2018	5	12.1%	8.9%	-0.3	a	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.43: Statistical Comparison of Benthic Metrics at Sheardown Lake SE Profundal (Deep) Stations Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2013) for the Mary River Project CREMP

Metric	Data Transformation	Overall 5-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2007	vs. Baseline Year 2013		
Density (No. per m^2)	none	YES	0.0103	2007	3	4,998	348	-	-1.8	a	Tamhane's
				2013	4	6,602	874	4.6	-	a	
				2015	5	3,185	281	-5.2	-3.9	b	
				2017	5	3,234	880	-5.1	-3.9	b	
				2018	5	3,209	2,747	-5.1	-3.9	a,b	
Richness (No. of Taxa)	none	NO	0.6465	2007	3	9.0	2.8	-	-0.7	a	Mann-Whitney U-test
				2013	4	10.5	2.1	0.5	-	a	
				2015	5	8.8	1.8	-0.1	-0.8	a	
				2017	5	8.8	1.6	-0.1	-0.8	a	
				2018	5	8.4	2.2	-0.2	-1.0	a	
Simpson's Evenness	none	NO	0.1103	2007	3	0.607	0.093	-	-2.4	a	Mann-Whitney U-test
				2013	4	0.703	0.039	1.0	-	a	
				2015	5	0.588	0.130	-0.2	-2.9	a	
				2017	5	0.651	0.086	0.5	-1.3	a	
				2018	5	0.568	0.050	-0.4	-3.4	a	
Nemata (% of community)	none	NO	0.3782	2007	3	0.0%	0.1%	-	-0.9	a	Mann-Whitney U-test
				2013	4	0.1%	0.1%	1.6	-	a	
				2015	5	0.6%	1.1%	11.4	5.4	a	
				2017	5	0.0%	0.0%	-0.6	-1.2	a	
				2018	5	0.9%	1.7%	16.4	8.2	a	
Ostracoda (% of community)	none	NO	0.6343	2007	3	1.1%	1.5%	-	5.1	a	Mann-Whitney U-test
				2013	4	0.2%	0.2%	-0.7	-	a	
				2015	5	0.5%	0.4%	-0.4	1.8	a	
				2017	5	1.0%	1.4%	-0.1	4.5	a	
				2018	5	0.8%	1.3%	-0.2	3.3	a	
Chironomidae (% of community)	none	NO	0.7961	2007	3	97.0%	2.9%	-	-5.6	a	Tukey's HSD
				2013	4	98.6%	0.3%	0.6	-	a	
				2015	5	97.0%	2.9%	0.0	-5.5	a	
				2017	5	97.1%	1.6%	0.0	-5.3	a	
				2018	5	97.6%	2.1%	0.2	-3.7	a	
Metal Sensitive Taxa (% of community)	none	NO	0.1690	2007	3	13.5%	11.4%	-	-1.2	a	Tukey's HSD
				2013	4	16.8%	2.8%	0.3	-	a	
				2015	5	8.0%	4.7%	-0.5	-3.2	a	
				2017	5	12.3%	9.5%	-0.1	-1.6	a	
				2018	5	5.9%	3.5%	-0.7	-3.9	a	
Collector-Gatherer FFG (% of community)	none	NO	0.3004	2007	3	74.1%	15.7%	-	1.2	a	Tukey's HSD
				2013	4	64.9%	7.5%	-0.6	-	a	
				2015	5	60.2%	23.0%	-0.9	-0.6	a	
				2017	5	45.1%	17.4%	-1.8	-2.6	a	
				2018	5	63.8%	22.4%	-0.7	-0.1	a	
Filterer FFG (% of community)	none	NO	0.1701	2007	3	13.4%	11.5%	-	-1.2	a	Tukey's HSD
				2013	4	16.8%	2.8%	0.3	-	a	
				2015	5	7.8%	4.7%	-0.5	-3.2	a	
				2017	5	12.2%	9.6%	-0.1	-1.6	a	
				2018	5	5.9%	3.5%	-0.7	-3.9	a	

▨ Indicates a significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

Table F.44: Replicate Grab Data for Benthic Invertebrate Community Samples Collected at the Mary River, Mary River Project CREMP, August 2018

Study Area	Station	Water Depth (cm)			Water Velocity (m/s)			Embeddedness			In-Stream Vegetation			Algae Presence		
		Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3
Mary River **Upstream Reference (GO-09)** **(Reference)**	GO-09 B1	18	15	22	0.37	0.51	0.34	25%	25%	25%	none	none	none	common	common	common
	GO-09 B2	25	22	18	0.40	0.52	0.52	25%	25%	25%	none	none	none	scarce	scarce	scarce
	GO-09 B3	11	22	38	0.57	0.41	0.10	25%	25%	25%	none	none	none	scarce	none	scarce
	GO-09 B4	14	15	14	0.39	0.42	0.57	25%	25%	25%	none	none	none	scarce	scarce	scarce
	GO-09 B5	22	18	17	0.39	0.39	0.44	25%	0%	50%	none	none	none	none	none	none
Mary River **Upstream (GO-03)**	GO-03 B1	18	18	23	0.35	0.41	0.42	25%	50%	75%	none	scarce	common	scarce	scarce	scarce
	GO-03 B2	18	20	22	0.41	0.39	0.53	75%	50%	75%	none	none	none	scarce	scarce	scarce
	GO-03 B3	20	16	20	0.37	0.47	0.47	25%	25%	50%	none	none	none	scarce	scarce	scarce
	GO-03 B4	16	23	15	0.44	0.53	0.51	25%	25%	25%	none	none	none	scarce	scarce	scarce
	GO-03 B5	16	13	15	0.48	0.45	0.40	25%	25%	75%	none	none	none	scarce	scarce	scarce
Mary River **Upper Mine-Exposed (EO-01)**	EO-01 B1	24	29	26	0.26	0.34	0.35	25%	25%	25%	none	none	none	none	none	none
	EO-01 B2	16	10	13	0.53	0.47	0.56	25%	50%	50%	none	none	none	none	none	none
	EO-01 B3	28	28	23	0.46	0.56	0.34	50%	50%	50%	none	none	none	none	none	none
	EO-01 B4	16	20	22	0.46	0.50	0.43	50%	50%	25%	none	none	none	none	none	none
	EO-01 B5	13	14	23	0.43	0.46	0.53	25%	25%	25%	none	none	none	none	none	none
Mary River **Middle Mine-Exposed (EO-20)**	EO-20 B1	17	26	25	0.43	0.46	0.42	50%	50%	50%	none	none	none	none	none	none
	EO-20 B2	18	10	20	0.41	0.40	0.55	25%	25%	25%	none	none	none	none	none	none
	EO-20 B3	22	23	27	0.30	0.58	0.46	50%	50%	50%	none	none	none	none	none	none
	EO-20 B4	22	25	30	0.40	0.57	0.46	50%	50%	50%	none	none	none	none	none	none
	EO-20 B5	23	23	22	0.59	0.43	0.47	25%	25%	25%	none	none	none	none	none	none
Mary River **Lower Mine-Exposed (CO-05)**	CO-05 B1	13	15	14	0.47	0.42	0.54	50%	50%	50%	common	common	common	scarce	scarce	scarce
	CO-05 B2	14	13	10	0.41	0.60	0.40	50%	50%	50%	common	common	common	scarce	scarce	scarce
	CO-05 B3	12	6	10	0.53	0.55	0.41	50%	25%	25%	scarce	scarce	scarce	common	common	common
	CO-05 B4	10	12	12	0.40	0.57	0.56	75%	75%	63%	common	common	common	common	common	common
	CO-05 B5	10	12	20	0.42	0.42	0.52	50%	50%	50%	scarce	scarce	common	common	common	common

Table F.45: Replicate Station Habitat Feature Summary Statistics for Mary River Benthic Stations, Mary River Project CREMP, August 2018

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Depth (cm)	GO-09 Reference Area	19.4	3.5	1.6	15.0	23.8	14.3	23.7
	GO-03 Upstream Area	18.2	2.1	1.0	15.6	20.8	14.7	20.0
	EO-01 Upper Mine-Exposed Area	20.3	5.9	2.6	13.0	27.7	13.0	26.3
	EO-20 Middle Mine-Exposed Area	22.2	3.7	1.6	17.6	26.8	16.0	25.7
	CO-05 Lower Mine-Exposed Area	12.2	2.0	0.9	9.8	14.6	9.3	14.0
Water Velocity (cm/s)	GO-09 Reference Area	42.3	4.8	2.1	36.3	48.2	36.0	48.0
	GO-03 Upstream Area	44.2	3.5	1.6	39.8	48.6	39.3	49.3
	EO-01 Upper Mine-Exposed Area	44.5	7.6	3.4	35.1	54.0	31.7	52.0
	EO-20 Middle Mine-Exposed Area	46.2	2.4	1.1	43.2	49.2	43.7	49.7
	CO-05 Lower Mine-Exposed Area	48.1	2.2	1.0	45.4	50.9	45.3	51.0
Substrate Embeddedness (%)	GO-09 Reference Area	25	0	0	25	25	25	25
	GO-03 Upstream Area	43	16	7	23	63	25	67
	EO-01 Upper Mine-Exposed Area	37	11	5	23	51	25	50
	EO-20 Middle Mine-Exposed Area	40	14	6	23	57	25	50
	CO-05 Lower Mine-Exposed Area	51	13	6	34	67	33	71

Note: Five stations were sampled at each study area.

Table F.46: Benthic Station Habitat Feature Statistical Comparisons Among Mary River Reference and Mine-Exposed Study Areas, Mary River Project CREMP, August 2018

Metric	Overall 5-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test [b]	(I) Area	(J) Area	Significant Difference Between Areas?	P-value	Test
Water Depth (cm)	YES	0.0018	β	GO-09	GO-03	NO	0.9921	Tukey's HSD
				GO-09	EO-01	NO	0.9996	
				GO-09	EO-20	NO	0.8239	
				GO-09	CO-05	YES	0.0142	
				GO-03	EO-01	NO	0.9685	
				GO-03	EO-20	NO	0.5779	
				GO-03	CO-05	YES	0.0360	
				EO-01	EO-20	NO	0.9064	
				EO-01	CO-05	YES	0.0092	
				EO-20	CO-05	YES	0.0013	
Water Velocity (cm/s)	NO	0.3539	α	GO-09	GO-03	NO	0.9609	Tukey's HSD
				GO-09	EO-01	NO	0.9324	
				GO-09	EO-20	NO	0.6586	
				GO-09	CO-05	NO	0.2888	
				GO-03	EO-01	NO	1.0000	
				GO-03	EO-20	NO	0.9560	
				GO-03	CO-05	NO	0.6586	
				EO-01	EO-20	NO	0.9771	
				EO-01	CO-05	NO	0.7261	
				EO-20	CO-05	NO	0.9609	
Substrate Embeddedness (%)	YES	0.0394	γ	GO-09	GO-03	YES	0.0317	Mann-Whitney U-test
				GO-09	EO-01	NO	0.1508	
				GO-09	EO-20	NO	0.1508	
				GO-09	CO-05	YES	0.0079	
				GO-03	EO-01	NO	0.5476	
				GO-03	EO-20	NO	0.8413	
				GO-03	CO-05	NO	0.4206	
				EO-01	EO-20	NO	0.5476	
				EO-01	CO-05	YES	0.0952	
				EO-20	CO-05	NO	0.3095	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, Kruskal-Wallis H-test conducted.

Table F.47: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Mary River Upstream Reference (GO-09) Study Area, August 2018

Taxa Study Area	GO-09 (Upstream Reference)				
Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	11	-	-	18	-
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	-	-	-	-	-
F. Lumbriculidae					
Lumbriculus	-	-	-	-	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
immature	-	-	-	-	-
F. Sperchonidae					
Sperchon	4	-	-	-	-
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
Acentrella feropagus	-	-	4	4	4
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature	-	-	-	-	-
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae	**22**	**14**	**-**	**14**	**25**
S.F. Chironominae					
Chironomus	**-**	**-**	**-**	**-**	**-**
S.F. Diamesinae					
Diamesa	83	50	11	93	25
Pseudokiefferiella	-	4	-	18	7
S.F. Orthocladiinae					
Chaetocladius	7	-	-	-	4
Cardiocladius	-	-	-	-	-
Corynoneura	-	4	-	-	-
Cricotopus	-	-	-	-	-
Cricotopus/Orthocladius	-	4	-	18	-
Diplocladius	4	-	4	-	-
Eukiefferiella	22	7	4	22	4
Hydrobaenus	14	7	-	-	14
Hydrosmittia	-	-	-	-	-
Krenosmittia	22	18	7	22	11
Limnophyes	4	11	4	25	-
Orthocladius (Euorthocladius)	14	7	7	22	-
Parakiefferiella	-	-	-	-	-
Paraphaenocladius	-	-	-	-	-
Thienemanniella	-	-	-	-	-

Table F.47: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Mary River Upstream Reference (GO-09) Study Area, August 2018

Taxa	Study Area	GO-09 (Upstream Reference)				
	Replicate Station	B1	B2	B3	B4	B5
Tokunagaia		7	4	14	4	32
Tvetenia		-	-	-	-	-
indeterminate		-	-	-	-	**4**
S.F. Tanypodinae						
Thienemannimyia complex		-	-	-	-	-
F. Empididae						
pupae		-	-	-	-	-
F. Simuliidae						
Gymnopais		25	11	22	54	4
Metacnephia		4	-	-	7	-
Prosimulium		4	-	-	4	-
F. Tipulidae						
Tipula		-	4	-	36	4
Density (No. organisms per m^2)		247	145	77	361	138
Richness (total number of taxa)[a]		14	12	9	14	10
Simpson's Evenness (E)		0.876	0.879	0.942	0.932	0.907
Bray-Curtis Index		0.318	0.120	0.399	0.471	0.415
Dominant Group Composition						
% Nemata		4.5%	0.0%	0.0%	5.0%	0.0%
% Oligochaeta		0.0%	0.0%	0.0%	0.0%	0.0%
% Hydracarina		1.6%	0.0%	0.0%	0.0%	0.0%
% Ostracods		0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera		0.0%	0.0%	5.2%	1.1%	2.9%
% Chironomids		80.6%	89.7%	66.2%	65.9%	91.3%
% Metal Sensitive Chironmids		37.7%	41.4%	14.3%	32.7%	29.0%
% Simuliidae		13.4%	7.6%	28.6%	18.0%	2.9%
% Tipulidae		0.0%	2.8%	0.0%	10.0%	2.9%
Functional Feeding Group Composition						
% Collector - Gatherers		85.0%	86.9%	71.4%	66.8%	94.2%
% Filterers		13.4%	7.6%	28.6%	18.0%	2.9%
% Shredders		0.0%	5.5%	0.0%	15.2%	2.9%
Habitat Preference Group Composition						
% Clingers		15.0%	10.3%	28.6%	23.3%	2.9%
% Sprawlers		80.6%	86.9%	71.4%	61.8%	94.2%
% Burrowers		4.5%	2.8%	0.0%	15.0%	2.9%

[a] Bold entries excluded from taxa count

Table F.48: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary River Upstream of the Mine (GO-03) Study Area, August 2018

Taxa Study Area	GO-03 (Upstream of Mine)				
Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	7	7	11	4	4
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	-	-	-	4	-
F. Lumbriculidae					
Lumbriculus	-	-	-	-	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
immature	-	-	-	-	-
F. Sperchonidae					
Sperchon	14	-	4	11	-
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
Acentrella feropagus	-	-	18	7	4
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature	-	-	-	-	-
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae	**7**	**18**	**29**	**22**	**22**
S.F. Chironominae					
Chironomus	-	-	-	-	-
S.F. Diamesinae					
Diamesa	4	11	11	14	14
Pseudokiefferiella	83	25	18	14	11
S.F. Orthocladiinae					
Chaetocladius	-	-	-	-	-
Cardiocladius	-	-	-	4	-
Corynoneura	-	-	-	-	-
Cricotopus	-	-	-	4	4
Cricotopus/Orthocladius	-	7	32	18	7
Diplocladius	4	-	-	-	-
Eukiefferiella	-	-	7	-	-
Hydrobaenus	-	7	-	97	4
Hydrosmittia	4	-	-	4	7
Krenosmittia	4	4	-	-	-
Limnophyes	-	-	-	-	4
Orthocladius (Euorthocladius)	-	4	25	4	22
Parakiefferiella	-	-	-	-	-
Paraphaenocladius	-	-	-	-	-
Thienemanniella	-	-	-	4	-

Table F.48: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary River Upstream of the Mine (GO-03) Study Area, August 2018

Taxa Study Area	GO-03 (Upstream of Mine)				
Replicate Station	B1	B2	B3	B4	B5
Tokunagaia	11	7	14	7	22
Tvetenia	-	7	4	7	-
indeterminate	**7**	-	-	-	**4**
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
pupae	-	-	4	-	-
F. Simuliidae					
Gymnopais	-	-	11	-	7
Metacnephia	-	-	11	-	4
Prosimulium	-	-	-	-	-
F. Tipulidae					
Tipula	-	-	7	7	4
Density (No. organisms per m^2)	145	97	206	232	144
Richness (total number of taxa)[a]	8	9	14	16	14
Simpson's Evenness (E)	0.689	0.938	0.963	0.804	0.948
Bray-Curtis Index	0.856	0.638	0.653	0.741	0.579
Dominant Group Composition					
% Nemata	4.8%	7.2%	5.3%	1.7%	2.8%
% Oligochaeta	0.0%	0.0%	0.0%	1.7%	0.0%
% Hydracarina	9.7%	0.0%	1.9%	4.7%	0.0%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera	0.0%	0.0%	8.7%	3.0%	2.8%
% Chironomids	85.5%	92.8%	68.0%	85.8%	84.0%
% Metal Sensitive Chironmids	63.4%	46.4%	18.0%	13.8%	20.8%
% Simuliidae	0.0%	0.0%	10.7%	0.0%	7.6%
% Tipulidae	0.0%	0.0%	3.4%	3.0%	2.8%
Functional Feeding Group Composition					
% Collector - Gatherers	90.3%	90.7%	62.6%	79.7%	79.9%
% Filterers	0.0%	0.0%	10.7%	0.0%	7.6%
% Shredders	0.0%	9.3%	22.8%	13.8%	12.5%
Habitat Preference Group Composition					
% Clingers	9.7%	9.3%	34.0%	15.5%	17.4%
% Sprawlers	85.5%	83.5%	57.3%	76.3%	77.1%
% Burrowers	4.8%	7.2%	8.7%	8.2%	5.6%

[a] Bold entries excluded from taxa count

Table F.49: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Mary River Upper Mine-Exposed (EO-01) Study Area, August 2018

Taxa	Study Area	EO-01 (Upper Mine-Exposed)				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		-	4	14	-	25
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	-	-	-	4
F. Lumbriculidae						
Lumbriculus		-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		-	-	-	-	-
F. Sperchonidae						
Sperchon		-	7	-	4	11
INSECTS						
Cl. Insecta						
MAYFLIES						
O. Ephemeroptera						
F. Baetidae						
Acentrella feropagus		-	11	7	-	7
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		-	-	-	4	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		**4**	**7**	**4**	**7**	**43**
S.F. Chironominae						
Chironomus		-	-	-	-	-
S.F. Diamesinae						
Diamesa		-	18	7	11	50
Pseudokiefferiella		-	4	11	7	129
S.F. Orthocladiinae						
Chaetocladius		-	-	-	-	7
Cardiocladius		7	-	-	-	-
Corynoneura		-	-	-	-	-
Cricotopus		-	-	-	-	-
Cricotopus/Orthocladius		4	4	-	11	32
Diplocladius		-	-	-	4	7
Eukiefferiella		-	-	-	-	11
Hydrobaenus		-	-	-	-	7
Hydrosmittia		-	-	-	-	-
Krenosmittia		-	-	-	-	-
Limnophyes		-	-	-	-	18
Orthocladius (Euorthocladius)		-	-	7	4	14
Parakiefferiella		-	-	-	-	-
Paraphaenocladius		-	-	-	-	-
Thienemanniella		-	-	-	-	-

Table F.49: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Mary River Upper Mine-Exposed (EO-01) Study Area, August 2018

Taxa Study Area	EO-01 (Upper Mine-Exposed)				
Replicate Station	B1	B2	B3	B4	B5
Tokunagaia	-	-	-	-	29
Tvetenia	-	-	-	-	11
indeterminate	-	-	-	-	-
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
pupae	-	-	-	-	-
F. Simuliidae					
Gymnopais	4	4	-	-	-
Metacnephia	-	-	-	-	-
Prosimulium	-	-	4	-	-
F. Tipulidae					
Tipula	-	-	-	-	7
Density (No. organisms per m^2)	19	59	54	52	412
Richness (total number of taxa)[a]	3	7	6	7	16
Simpson's Evenness (E)	0.914	0.905	0.970	0.958	0.883
Bray-Curtis Index	0.952	0.659	0.760	0.778	0.627
Dominant Group Composition					
% Nemata	0.0%	6.8%	25.9%	0.0%	6.1%
% Oligochaeta	0.0%	0.0%	0.0%	0.0%	1.0%
% Hydracarina	0.0%	11.9%	0.0%	7.7%	2.7%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera	0.0%	18.6%	13.0%	0.0%	1.7%
% Chironomids	78.9%	55.9%	53.7%	84.6%	86.9%
% Metal Sensitive Chironmids	0.0%	47.5%	38.9%	40.4%	49.5%
% Simuliidae	21.1%	6.8%	7.4%	0.0%	0.0%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	1.7%
Functional Feeding Group Composition					
% Collector - Gatherers	0.0%	72.9%	92.6%	59.6%	86.9%
% Filterers	21.1%	6.8%	7.4%	0.0%	0.0%
% Shredders	26.3%	8.5%	0.0%	32.7%	10.4%
Habitat Preference Group Composition					
% Clingers	47.4%	27.1%	7.4%	32.7%	11.4%
% Sprawlers	0.0%	66.1%	66.7%	67.3%	79.9%
% Burrowers	52.6%	6.8%	25.9%	0.0%	8.7%

[a] Bold entries excluded from taxa count

Table F.50: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Mary River Middle Mine-Exposed (EO-20) Study Area, August 2018

Taxa Study Area	EO-20 (Middle Mine-Exposed)				
Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	-	7	-	-	-
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	-	-	-	-	-
F. Lumbriculidae					
Lumbriculus	-	-	-	-	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
immature	-	-	-	-	-
F. Sperchonidae					
Sperchon	-	4	-	-	-
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
Acentrella feropagus	4	4	4	-	4
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature	-	-	-	-	-
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae	**4**	**18**	**14**	**7**	**4**
S.F. Chironominae					
Chironomus	-	-	-	-	-
S.F. Diamesinae					
Diamesa	29	22	14	7	25
Pseudokiefferiella	-	-	4	7	-
S.F. Orthocladiinae					
Chaetocladius	-	-	-	-	-
Cardiocladius	-	-	-	-	-
Corynoneura	-	-	-	-	-
Cricotopus	-	-	-	-	-
Cricotopus/Orthocladius	-	7	7	4	-
Diplocladius	-	-	-	-	-
Eukiefferiella	4	-	-	-	7
Hydrobaenus	-	-	-	-	-
Hydrosmittia	-	-	4	-	-
Krenosmittia	-	-	4	-	7
Limnophyes	-	-	-	-	-
Orthocladius (Euorthocladius)	7	7	-	-	7
Parakiefferiella	-	-	-	-	-
Paraphaenocladius	-	-	-	-	-
Thienemanniella	-	-	-	-	-

Table F.50: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Mary River Middle Mine-Exposed (EO-20) Study Area, August 2018

Taxa Study Area	EO-20 (Middle Mine-Exposed)				
Replicate Station	B1	B2	B3	B4	B5
Tokunagaia	7	14	-	-	-
Tvetenia	-	-	-	-	-
indeterminate	-	-	-	-	-
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
pupae	-	-	-	-	-
F. Simuliidae					
Gymnopais	4	-	-	4	4
Metacnephia	7	-	-	-	-
Prosimulium	4	4	-	-	-
F. Tipulidae					
Tipula	-	4	-	-	4
Density (No. organisms per m^2)	70	91	51	29	62
Richness (total number of taxa)[a]	8	9	6	4	7
Simpson's Evenness (E)	0.840	0.914	0.917	0.951	0.852
Bray-Curtis Index	0.454	0.544	0.655	0.794	0.404
Dominant Group Composition					
% Nemata	0.0%	7.7%	0.0%	0.0%	0.0%
% Oligochaeta	0.0%	0.0%	0.0%	0.0%	0.0%
% Hydracarina	0.0%	4.4%	0.0%	0.0%	0.0%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera	5.7%	4.4%	7.8%	0.0%	6.5%
% Chironomids	72.9%	74.7%	92.2%	86.2%	80.6%
% Metal Sensitive Chironmids	47.1%	33.0%	49.0%	69.0%	46.8%
% Simuliidae	21.4%	4.4%	0.0%	13.8%	6.5%
% Tipulidae	0.0%	4.4%	0.0%	0.0%	6.5%
Functional Feeding Group Composition					
% Collector - Gatherers	78.6%	75.8%	80.4%	69.0%	87.1%
% Filterers	21.4%	4.4%	0.0%	13.8%	6.5%
% Shredders	0.0%	15.4%	19.6%	17.2%	6.5%
Habitat Preference Group Composition					
% Clingers	21.4%	19.8%	19.6%	31.0%	6.5%
% Sprawlers	78.6%	68.1%	80.4%	69.0%	87.1%
% Burrowers	0.0%	12.1%	0.0%	0.0%	6.5%

[a] Bold entries excluded from taxa count

Table F.51: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Mary River Lower Mine-Exposed (CO-05) Study Area, August 2018

Taxa Study Area	CO-05 (Lower Mine-Exposed)				
Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	108	4	7	22	18
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	7	4	-	-	7
F. Lumbriculidae					
Lumbriculus	-	-	-	-	4
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
immature	-	-	-	7	-
F. Sperchonidae					
Sperchon	7	4	29	22	-
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
Acentrella feropagus	7	39	50	29	11
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature	-	-	-	-	-
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae	**29**	**18**	**11**	**14**	**32**
S.F. Chironominae					
Chironomus	14	-	-	-	-
S.F. Diamesinae					
Diamesa	-	25	29	50	11
Pseudokiefferiella	1,392	344	219	2,146	316
S.F. Orthocladiinae					
Chaetocladius	-	-	-	-	-
Cardiocladius	50	22	39	7	14
Corynoneura	-	-	-	-	-
Cricotopus	-	-	11	-	14
Cricotopus/Orthocladius	22	22	11	50	25
Diplocladius	-	-	-	-	4
Eukiefferiella	-	-	7	-	4
Hydrobaenus	86	4	4	7	7
Hydrosmittia	50	11	-	36	4
Krenosmittia	7	-	-	-	4
Limnophyes	-	-	-	7	-
Orthocladius (Euorthocladius)	72	43	25	43	18
Parakiefferiella	7	-	-	-	-
Paraphaenocladius	-	-	-	-	4
Thienemanniella	-	-	-	-	-

Table F.51: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Mary River Lower Mine-Exposed (CO-05) Study Area, August 2018

Taxa Study Area	CO-05 (Lower Mine-Exposed)				
Replicate Station	B1	B2	B3	B4	B5
Tokunagaia	122	93	14	165	75
Tvetenia	65	22	4	22	7
indeterminate	**29**	-	**18**	**7**	-
S.F. Tanypodinae					
Thienemannimyia complex	36	11	7	14	4
F. Empididae					
pupae	-	-	-	-	-
F. Simuliidae					
Gymnopais	-	4	7	22	-
Metacnephia	14	36	14	129	11
Prosimulium	29	47	14	100	-
F. Tipulidae					
Tipula	7	7	7	14	-
Density (No. organisms per m^2)	2,160	760	527	2,913	594
Richness (total number of taxa)[a]	19	18	18	18	20
Simpson's Evenness (E)	0.591	0.795	0.833	0.469	0.689
Bray-Curtis Index	0.962	0.863	0.771	0.927	0.862
Dominant Group Composition					
% Nemata	5.0%	0.5%	1.3%	0.8%	3.0%
% Oligochaeta	0.3%	0.5%	0.0%	0.0%	1.9%
% Hydracarina	0.3%	0.5%	5.5%	1.0%	0.0%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera	0.3%	5.1%	9.5%	1.0%	1.9%
% Chironomids	91.7%	80.9%	75.7%	88.2%	91.4%
% Metal Sensitive Chironmids	65.4%	50.0%	48.4%	75.8%	58.6%
% Simuliidae	2.0%	11.4%	6.6%	8.6%	1.9%
% Tipulidae	0.3%	0.9%	1.3%	0.5%	0.0%
Functional Feeding Group Composition					
% Collector - Gatherers	92.1%	79.6%	71.3%	87.4%	87.9%
% Filterers	2.0%	11.4%	6.6%	8.6%	1.9%
% Shredders	1.4%	3.9%	6.5%	2.3%	7.1%
Habitat Preference Group Composition					
% Clingers	3.4%	15.0%	17.3%	11.4%	8.9%
% Sprawlers	87.8%	80.0%	71.3%	87.1%	83.7%
% Burrowers	8.8%	5.0%	11.4%	1.5%	7.4%

[a] Bold entries excluded from taxa count

Table F.52: Benthic Invertebrate Community Summary Statistics for Mary River, Mary River Project CREMP, August 2018

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	GO-09 Reference Area	194	112	50	55	332	77	361
	GO-03 Upstream Area	165	54	24	98	232	97	232
	EO-01 Upper Mine-Exposed Area	119	164	74	-85	323	19	412
	EO-20 Middle Mine-Exposed Area	61	23	10	32	89	29	91
	CO-05 Lower Mine-Exposed Area	1,391	1,083	484	47	2,735	527	2,913
Richness (Number of Taxa)	GO-09 Reference Area	11.8	2.3	1.0	9.0	14.6	9.0	14.0
	GO-03 Upstream Area	12.2	3.5	1.6	7.9	16.5	8.0	16.0
	EO-01 Upper Mine-Exposed Area	7.8	4.9	2.2	1.8	13.8	3.0	16.0
	EO-20 Middle Mine-Exposed Area	6.8	1.9	0.9	4.4	9.2	4.0	9.0
	CO-05 Lower Mine-Exposed Area	18.6	0.9	0.4	17.5	19.7	18.0	20.0
Simpson's Evenness	GO-09 Reference Area	0.907	0.030	0.013	0.870	0.945	0.876	0.942
	GO-03 Upstream Area	0.868	0.119	0.053	0.721	1.016	0.689	0.963
	EO-01 Upper Mine-Exposed Area	0.926	0.037	0.016	0.880	0.972	0.883	0.970
	EO-20 Middle Mine-Exposed Area	0.895	0.047	0.021	0.836	0.953	0.840	0.951
	CO-05 Lower Mine-Exposed Area	0.675	0.149	0.067	0.490	0.860	0.469	0.833
Bray-Curtis Index	GO-09 Reference Area	0.345	0.137	0.061	0.175	0.515	0.120	0.471
	GO-03 Upstream Area	0.693	0.108	0.048	0.560	0.827	0.579	0.856
	EO-01 Upper Mine-Exposed Area	0.755	0.127	0.057	0.597	0.913	0.627	0.952
	EO-20 Middle Mine-Exposed Area	0.570	0.158	0.070	0.375	0.766	0.404	0.794
	CO-05 Lower Mine-Exposed Area	0.877	0.073	0.033	0.786	0.968	0.771	0.962
Nemata (% of community)	GO-09 Reference Area	1.9%	2.6%	1.2%	-1.3%	5.1%	0.0%	5.0%
	GO-03 Upstream Area	4.4%	2.2%	1.0%	1.7%	7.1%	1.7%	7.2%
	EO-01 Upper Mine-Exposed Area	7.8%	10.7%	4.8%	-5.5%	21.0%	0.0%	25.9%
	EO-20 Middle Mine-Exposed Area	1.5%	3.4%	1.5%	-2.7%	5.8%	0.0%	7.7%
	CO-05 Lower Mine-Exposed Area	2.1%	1.9%	0.8%	-0.2%	4.5%	0.5%	5.0%
Hydracarina (% of community)	GO-09 Reference Area	0.3%	0.7%	0.3%	-0.6%	1.2%	0.0%	1.6%
	GO-03 Upstream Area	3.3%	4.1%	1.8%	-1.8%	8.3%	0.0%	9.7%
	EO-01 Upper Mine-Exposed Area	4.4%	5.2%	2.3%	-2.0%	10.9%	0.0%	11.9%
	EO-20 Middle Mine-Exposed Area	0.9%	2.0%	0.9%	-1.6%	3.3%	0.0%	4.4%
	CO-05 Lower Mine-Exposed Area	1.5%	2.3%	1.0%	-1.4%	4.3%	0.0%	5.5%
Ephemeroptera (% of community)	GO-09 Reference Area	1.8%	2.2%	1.0%	-0.9%	4.6%	0.0%	5.2%
	GO-03 Upstream Area	2.9%	3.6%	1.6%	-1.5%	7.3%	0.0%	8.7%
	EO-01 Upper Mine-Exposed Area	6.7%	8.6%	3.9%	-4.0%	17.4%	0.0%	18.6%
	EO-20 Middle Mine-Exposed Area	4.9%	3.0%	1.3%	1.2%	8.6%	0.0%	7.8%
	CO-05 Lower Mine-Exposed Area	3.6%	3.8%	1.7%	-1.2%	8.3%	0.3%	9.5%
Chironomidae (% of community)	GO-09 Reference Area	78.7%	12.3%	5.5%	63.5%	94.0%	65.9%	91.3%
	GO-03 Upstream Area	83.2%	9.2%	4.1%	71.8%	94.6%	68.0%	92.8%
	EO-01 Upper Mine-Exposed Area	72.0%	16.0%	7.1%	52.2%	91.9%	53.7%	86.9%
	EO-20 Middle Mine-Exposed Area	81.3%	8.0%	3.6%	71.4%	91.3%	72.9%	92.2%
	CO-05 Lower Mine-Exposed Area	85.6%	7.0%	3.1%	76.9%	94.3%	75.7%	91.7%
Metal-Sensitive Chironomidae (% of community)	GO-09 Reference Area	31.0%	10.5%	4.7%	18.0%	44.0%	14.3%	41.4%
	GO-03 Upstream Area	32.5%	21.5%	9.6%	5.8%	59.2%	13.8%	63.4%
	EO-01 Upper Mine-Exposed Area	35.2%	20.2%	9.0%	10.1%	60.4%	0.0%	49.5%
	EO-20 Middle Mine-Exposed Area	49.0%	12.9%	5.8%	33.0%	65.0%	33.0%	69.0%
	CO-05 Lower Mine-Exposed Area	59.6%	11.3%	5.1%	45.5%	73.7%	48.4%	75.8%
Simuliidae (% of community)	GO-09 Reference Area	14.1%	9.9%	4.4%	1.8%	26.4%	2.9%	28.6%
	GO-03 Upstream Area	3.7%	5.1%	2.3%	-2.7%	10.0%	0.0%	10.7%
	EO-01 Upper Mine-Exposed Area	7.0%	8.6%	3.8%	-3.6%	17.7%	0.0%	21.1%
	EO-20 Middle Mine-Exposed Area	9.2%	8.5%	3.8%	-1.3%	19.7%	0.0%	21.4%
	CO-05 Lower Mine-Exposed Area	6.1%	4.2%	1.9%	0.9%	11.3%	1.9%	11.4%

Table F.52: Benthic Invertebrate Community Summary Statistics for Mary River, Mary River Project CREMP, August 2018

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Tipulidae (% of community)	GO-09 Reference Area	3.1%	4.1%	1.8%	-1.9%	8.2%	0.0%	10.0%
	GO-03 Upstream Area	1.8%	1.7%	0.8%	-0.3%	3.9%	0.0%	3.4%
	EO-01 Upper Mine-Exposed Area	0.3%	0.8%	0.3%	-0.6%	1.3%	0.0%	1.7%
	EO-20 Middle Mine-Exposed Area	2.2%	3.1%	1.4%	-1.6%	6.0%	0.0%	6.5%
	CO-05 Lower Mine-Exposed Area	0.6%	0.5%	0.2%	0.0%	1.3%	0.0%	1.3%
Collector-Gatherer FFG (% of community)	GO-09 Reference Area	80.9%	11.4%	5.1%	66.7%	95.0%	66.8%	94.2%
	GO-03 Upstream Area	80.7%	11.4%	5.1%	66.5%	94.8%	62.6%	90.7%
	EO-01 Upper Mine-Exposed Area	62.4%	37.2%	16.6%	16.3%	108.5%	0.0%	92.6%
	EO-20 Middle Mine-Exposed Area	78.2%	6.6%	3.0%	70.0%	86.4%	69.0%	87.1%
	CO-05 Lower Mine-Exposed Area	83.7%	8.2%	3.7%	73.4%	93.9%	71.3%	92.1%
Filterer FFG (% of community)	GO-09 Reference Area	14.1%	9.9%	4.4%	1.8%	26.4%	2.9%	28.6%
	GO-03 Upstream Area	3.7%	5.1%	2.3%	-2.7%	10.0%	0.0%	10.7%
	EO-01 Upper Mine-Exposed Area	7.0%	8.6%	3.8%	-3.6%	17.7%	0.0%	21.1%
	EO-20 Middle Mine-Exposed Area	9.2%	8.5%	3.8%	-1.3%	19.7%	0.0%	21.4%
	CO-05 Lower Mine-Exposed Area	6.1%	4.2%	1.9%	0.9%	11.3%	1.9%	11.4%
Shredder FFG (% of community)	GO-09 Reference Area	4.7%	6.3%	2.8%	-3.1%	12.6%	0.0%	15.2%
	GO-03 Upstream Area	11.7%	8.2%	3.7%	1.5%	21.9%	0.0%	22.8%
	EO-01 Upper Mine-Exposed Area	15.6%	13.5%	6.0%	-1.2%	32.3%	0.0%	32.7%
	EO-20 Middle Mine-Exposed Area	11.7%	8.2%	3.7%	1.5%	22.0%	0.0%	19.6%
	CO-05 Lower Mine-Exposed Area	4.2%	2.5%	1.1%	1.1%	7.3%	1.4%	7.1%
Clinger HPG (% of community)	GO-09 Reference Area	16.0%	10.2%	4.6%	3.4%	28.7%	2.9%	28.6%
	GO-03 Upstream Area	17.2%	10.1%	4.5%	4.7%	29.6%	9.3%	34.0%
	EO-01 Upper Mine-Exposed Area	25.2%	16.3%	7.3%	5.0%	45.4%	7.4%	47.4%
	EO-20 Middle Mine-Exposed Area	19.7%	8.8%	3.9%	8.8%	30.5%	6.5%	31.0%
	CO-05 Lower Mine-Exposed Area	11.2%	5.4%	2.4%	4.5%	17.9%	3.4%	17.3%
Sprawler HPG (% of community)	GO-09 Reference Area	79.0%	12.7%	5.7%	63.1%	94.8%	61.8%	94.2%
	GO-03 Upstream Area	75.9%	11.2%	5.0%	62.1%	89.8%	57.3%	85.5%
	EO-01 Upper Mine-Exposed Area	56.0%	31.8%	14.2%	16.5%	95.5%	0.0%	79.9%
	EO-20 Middle Mine-Exposed Area	76.6%	8.0%	3.6%	66.7%	86.6%	68.1%	87.1%
	CO-05 Lower Mine-Exposed Area	82.0%	6.7%	3.0%	73.7%	90.3%	71.3%	87.8%
Burrower HPG (% of community)	GO-09 Reference Area	5.0%	5.8%	2.6%	-2.2%	12.2%	0.0%	15.0%
	GO-03 Upstream Area	6.9%	1.7%	0.7%	4.8%	9.0%	4.8%	8.7%
	EO-01 Upper Mine-Exposed Area	18.8%	21.2%	9.5%	-7.5%	45.1%	0.0%	52.6%
	EO-20 Middle Mine-Exposed Area	3.7%	5.5%	2.4%	-3.1%	10.5%	0.0%	12.1%
	CO-05 Lower Mine-Exposed Area	6.8%	3.8%	1.7%	2.1%	11.5%	1.5%	11.4%

Table F.53: Benthic Invertebrate Community Metric Statistical Comparison Results among Mary River Reference (GO-09), Upstream (GO-03) and Mine-Exposed (EO-01, EO-20, CO-05) Study Areas, Mary River Project CREMP, August 2018

Metric	Data Transformation	Overall 5-Area Comparison		Pair-wise, post-hoc comparisons[a]				
		Significant Difference Among Areas?	P-value	Area	Mean	Standard Deviation	Effect Size vs. GO-09 Reference	Pairwise Comparison
Density (No. per m^2)	log	YES	< 0.001	GO-09 Ref	194	112	-	a
				GO-03	165	54	-0.3	a
				EO-01	119	164	-0.7	a
				EO-20	61	23	-1.2	a
				CO-05	1,391	1,083	10.7	b
Richness (No. of Taxa)	square root	YES	< 0.001	GO-09 Ref	11.8	2.3	-	a
				GO-03	12.2	3.5	0.2	a
				EO-01	7.8	4.9	-1.8	a,b
				EO-20	6.8	1.9	-2.2	b
				CO-05	18.6	0.9	3.0	c
Simpson's Evenness	none	YES	0.0020	GO-09 Ref	0.907	0.030	-	a
				GO-03	0.868	0.119	-1.3	a
				EO-01	0.926	0.037	0.6	a
				EO-20	0.895	0.047	-0.4	a
				CO-05	0.675	0.149	-7.7	b
Bray-Curtis Index	none	YES	< 0.001	GO-09 Ref	0.345	0.137	-	a
				GO-03	0.693	0.108	2.5	b,c
				EO-01	0.755	0.127	3.0	b,c
				EO-20	0.570	0.158	1.6	b
				CO-05	0.877	0.073	3.9	c
Nemata (% of community)	fourth-root	NO	0.1280	GO-09 Ref	1.9%	2.6%	-	a
				GO-03	4.4%	2.2%	1.0	a
				EO-01	7.8%	10.7%	2.3	a
				EO-20	1.5%	3.4%	-0.1	a
				CO-05	2.1%	1.9%	0.1	a
Hydracarina (% of community)	fourth-root	NO	0.3270	GO-09 Ref	0.3%	0.7%	-	a
				GO-03	3.3%	4.1%	4.1	a
				EO-01	4.4%	5.2%	5.7	a
				EO-20	0.9%	2.0%	0.8	a
				CO-05	1.5%	2.3%	1.6	a
Ephemeroptera (% of community)	square root	NO	0.7740	GO-09 Ref	1.8%	2.2%	-	a
				GO-03	2.9%	3.6%	0.5	a
				EO-01	6.7%	8.6%	2.2	a
				EO-20	4.9%	3.0%	1.4	a
				CO-05	3.6%	3.8%	0.8	a
Chironomidae (% of community)	log	NO	0.3260	GO-09 Ref	78.7%	12.3%	-	a
				GO-03	83.2%	9.2%	0.4	a
				EO-01	72.0%	16.0%	-0.5	a
				EO-20	81.3%	8.0%	0.2	a
				CO-05	85.6%	7.0%	0.6	a
Metal Sensitive Chironomidae (% of community)	none	YES	0.0420	GO-09 Ref	31.0%	10.5%	-	a
				GO-03	32.5%	21.5%	0.1	a
				EO-01	35.2%	20.2%	0.4	a,b
				EO-20	49.0%	12.9%	1.7	a,b
				CO-05	59.6%	11.3%	2.7	b
Simuliidae (% of community)	fourth-root	NO	0.1940	GO-09 Ref	14.1%	9.9%	-	a
				GO-03	3.7%	5.1%	-1.1	a
				EO-01	7.0%	8.6%	-0.7	a
				EO-20	9.2%	8.5%	-0.5	a
				CO-05	6.1%	4.2%	-0.8	a

Table F.53: Benthic Invertebrate Community Metric Statistical Comparison Results among Mary River Reference (GO-09), Upstream (GO-03) and Mine-Exposed (EO-01, EO-20, CO-05) Study Areas, Mary River Project CREMP, August 2018

Metric	Data Transformation	Overall 5-Area Comparison		Pair-wise, post-hoc comparisons[a]				
		Significant Difference Among Areas?	P-value	Area	Mean	Standard Deviation	Effect Size vs. GO-09 Reference	Pairwise Comparison
Tipulidae (% of community)	square root	NO	0.5350	GO-09 Ref	3.1%	4.1%	-	a
				GO-03	1.8%	1.7%	-0.3	a
				EO-01	0.3%	0.8%	-0.7	a
				EO-20	2.2%	3.1%	-0.2	a
				CO-05	0.6%	0.5%	-0.6	a
Collector-Gatherer FFG (% of community)	rank	NO	0.7520	GO-09 Ref	80.9%	11.4%	-	a
				GO-03	80.7%	11.4%	0.0	a
				EO-01	62.4%	37.2%	-1.6	a
				EO-20	78.2%	6.6%	-0.2	a
				CO-05	83.7%	8.2%	0.2	a
Filterer FFG (% of community)	fourth-root	NO	0.1940	GO-09 Ref	14.1%	9.9%	-	a
				GO-03	3.7%	5.1%	-1.1	a
				EO-01	7.0%	8.6%	-0.7	a
				EO-20	9.2%	8.5%	-0.5	a
				CO-05	6.1%	4.2%	-0.8	a
Shredder FFG (% of community)	none	NO	0.1960	GO-09 Ref	4.7%	6.3%	-	a
				GO-03	11.7%	8.2%	1.1	a
				EO-01	15.6%	13.5%	1.7	a
				EO-20	11.7%	8.2%	1.1	a
				CO-05	4.2%	2.5%	-0.1	a
Clinger HPG (% of community)	none	NO	0.3640	GO-09 Ref	16.0%	10.2%	-	a
				GO-03	17.2%	10.1%	0.1	a
				EO-01	25.2%	16.3%	0.9	a
				EO-20	19.7%	8.8%	0.4	a
				CO-05	11.2%	5.4%	-0.5	a
Sprawler HPG (% of community)	rank	NO	0.1210	GO-09 Ref	79.0%	12.7%	-	a
				GO-03	75.9%	11.2%	-0.2	a
				EO-01	56.0%	31.8%	-1.8	a
				EO-20	76.6%	8.0%	-0.2	a
				CO-05	82.0%	6.7%	0.2	a
Burrower HPG (% of community)	square root	NO	0.2360	GO-09 Ref	5.0%	5.8%	-	a
				GO-03	6.9%	1.7%	0.3	a
				EO-01	18.8%	21.2%	2.4	a
				EO-20	3.7%	5.5%	-0.2	a
				CO-05	6.8%	3.8%	0.3	a

▨ Indicates a significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.54: Statistical Comparison of Benthic Invertebrate Community Metrics at the Mary River Reference Area (GO-09) Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transformation	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2007	vs. Baseline Year 2011		
Density (No. per m^2)	log	YES	0.0096	2006	3	404	149	-	-4.0	a,b	Tukey's HSD
				2007	3	739	84	2.3	-	a	
				2015	5	472	255	0.5	-3.2	a,b	
				2016	5	662	320	1.7	-0.9	a	
				2017	5	410	313	0.0	-3.9	a,b	
				2018	5	194	112	-1.4	-6.5	b	
Richness (No. of Taxa)	none	YES	0.0785	2006	3	7.3	2.9	-	-10.4	a	Mann-Whitney U-test
				2007	3	13.3	0.6	2.1	-	b,c,d,e	
				2015	5	11.4	3.2	1.4	-3.3	a	
				2016	5	14.0	1.6	2.3	1.2	a,c	
				2017	5	11.2	2.9	1.3	-3.7	d	
				2018	5	11.8	2.3	1.5	-2.7	e	
Simpson's Evenness	none	YES	0.0025	2006	3	0.324	0.095	-	-8.6	a	Mann-Whitney U-test
				2007	3	0.655	0.039	3.5	-	b	
				2015	5	0.878	0.049	5.8	5.8	c,d	
				2016	5	0.907	0.023	6.1	6.5	c	
				2017	5	0.770	0.097	4.7	3.0	d	
				2018	5	0.907	0.030	6.1	6.5	c,d	
Nemata (% of community)	none	NO	0.4398	2006	3	0.6%	0.5%	-	1.4	a	Mann-Whitney U-test
				2007	3	0.2%	0.3%	-0.8	-	a	
				2015	5	0.0%	0.0%	-1.1	-0.6	a	
				2016	5	1.0%	1.0%	0.8	2.9	a	
				2017	5	0.5%	1.0%	-0.1	1.2	a	
				2018	5	1.9%	2.6%	2.4	5.7	a	
Hydracarina (% of community)	modified probit	YES	0.0000	2006	3	0.5%	0.9%	-	1.2	a	Tukey's HSD
				2007	3	0.2%	0.3%	-0.4	-	a	
				2015	5	4.0%	5.5%	4.0	13.4	b	
				2016	5	4.3%	3.0%	4.4	14.6	b	
				2017	5	0.0%	0.0%	-0.6	-0.6	a	
				2018	5	0.3%	0.7%	-0.2	0.6	a	
Chironomidae (% of community)	modified probit	YES	0.0000	2006	3	98.7%	0.8%	-	nc	a	Tukey's HSD
				2007	3	100.0%	0.0%	1.7	-	a	
				2015	5	88.0%	4.5%	-13.2	nc	b	
				2016	5	84.8%	5.3%	-17.1	nc	b	
				2017	5	79.1%	6.4%	-24.3	nc	b	
				2018	5	78.7%	12.3%	-24.7	nc	b	
Metal Sensitive Taxa (% of community)	none	YES	0.0049	2006	3	62.1%	3.7%	-	1.7	a	Mann-Whitney U-test
				2007	3	30.7%	18.2%	-8.6	-	b,c	
				2015	5	13.7%	14.8%	-13.2	-0.9	b	
				2016	5	23.4%	12.3%	-10.6	-0.4	c	
				2017	5	59.7%	13.2%	-0.7	1.6	a	
				2018	5	31.0%	10.5%	-8.5	0.0	c	
Tipulidae (% of community)	none	NO	0.4476	2006	3	0.2%	0.4%	-	nc	a	Mann-Whitney U-test
				2007	3	0.0%	0.0%	-0.6	-	a	
				2015	5	4.0%	5.5%	9.2	nc	a	
				2016	5	1.4%	1.7%	2.9	nc	a	
				2017	5	1.5%	1.3%	3.1	nc	a	
				2018	5	3.1%	4.1%	7.0	nc	a	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0000	2006	3	98.6%	1.1%	-	0.9	a	Tukey's HSD
				2007	3	93.3%	5.8%	-4.7	-	b	
				2015	5	76.3%	10.9%	-19.8	-3.0	c	
				2016	5	74.5%	8.3%	-21.3	-3.3	c	
				2017	5	74.6%	6.6%	-21.3	-3.3	c	
				2018	5	80.9%	11.4%	-15.7	-2.2	b,c	
Filterer FFG (% of community)	modified probit	YES	0.0000	2006	3	0.1%	0.2%	-	nc	a,b	Tukey's HSD
				2007	3	0.0%	0.0%	-0.6	-	a	
				2015	5	0.0%	0.0%	-0.6	nc	b	
				2016	5	6.3%	5.4%	30.3	nc	c	
				2017	5	18.9%	5.2%	91.4	nc	c	
				2018	5	14.1%	9.9%	68.0	nc	c	
Shredder FFG (% of community)	modified probit	YES	0.0013	2006	3	0.2%	0.4%	-	nc	a	Tamhane's
				2007	3	0.0%	0.0%	-0.6	-	b	
				2015	5	14.0%	11.4%	33.5	nc	c	
				2016	5	12.4%	3.3%	29.5	nc	c	
				2017	5	5.8%	2.2%	13.6	nc	a,b,c	
				2018	5	4.7%	6.3%	10.9	nc	a,b,c	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.55: Statistical Comparison of Benthic Invertebrate Community Metrics at Mary River Upstream of Mine (GO-03) Among Years of Mine Operation (2015 to 2018) and Baseline (2007) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.1745	2007	3	136	29	-	a	Tamhane's
				2015	5	169	122	1.1	a	
				2016	5	287	92	5.1	a	
				2017	5	282	172	5.0	a	
				2018	5	165	54	1.0	a	
Richness (No. of Taxa)	none	YES	0.0249	2007	3	6.3	1.2	-	a	Mann-Whitney U-test
				2015	5	9.4	3.5	2.7	b	
				2016	5	14.4	1.8	7.0	b,c	
				2017	5	13.6	3.9	6.3	c	
				2018	5	12.2	3.5	5.1	b,c	
Simpson's Evenness	none	YES	0.0728	2007	3	0.591	0.003	-	a	Mann-Whitney U-test
				2015	5	0.921	0.045	114.3	b	
				2016	5	0.899	0.041	106.5	b	
				2017	5	0.873	0.142	97.7	b	
				2018	5	0.868	0.119	96.0	b	
Nemata (% of community)	modified probit	YES	0.0000	2007	3	0.0%	0.0%	-	a	Tamhane's
				2015	5	0.0%	0.0%	nc	a	
				2016	5	2.2%	1.3%	nc	b	
				2017	5	1.3%	1.2%	nc	a,b	
				2018	5	4.4%	2.2%	nc	c,b	
Hydracarina (% of community)	modified probit	YES	0.0106	2007	3	0.0%	0.0%	-	a	Tamhane's
				2015	5	8.0%	4.5%	nc	a	
				2016	5	10.3%	4.4%	nc	a	
				2017	5	1.9%	1.9%	nc	a	
				2018	5	3.3%	4.1%	nc	a	
Chironomidae (% of community)	none	YES	0.0030	2007	3	100.0%	0.0%	-	a	Tukey's HSD
				2015	5	71.9%	8.2%	nc	b	
				2016	5	77.9%	8.0%	nc	b	
				2017	5	75.3%	10.3%	nc	b	
				2018	5	83.2%	9.2%	nc	b	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0029	2007	3	6.6%	3.0%	-	a	Mann-Whitney U-test
				2015	5	7.9%	4.9%	0.4	a	
				2016	5	8.8%	5.9%	0.7	a	
				2017	5	46.9%	12.6%	13.3	b	
				2018	5	32.5%	21.5%	8.5	b	
Tipulidae (% of community)	none	YES	0.0005	2007	3	0.0%	0.0%	-	a	Tamhane's
				2015	5	18.0%	8.4%	nc	b	
				2016	5	8.3%	7.3%	nc	a,b	
				2017	5	2.9%	2.0%	nc	a,b	
				2018	5	1.8%	1.7%	nc	a,b	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0000	2007	3	93.3%	5.8%	-	a	Tukey's HSD
				2015	5	62.1%	11.0%	-5.4	b	
				2016	5	63.5%	6.4%	-5.2	b	
				2017	5	74.2%	10.6%	-3.3	b,c	
				2018	5	80.7%	11.4%	-2.2	c	
Filterer FFG (% of community)	modified probit	YES	0.0013	2007	3	0.0%	0.0%	-	a	Tamhane's
				2015	5	0.0%	0.0%	nc	a	
				2016	5	0.3%	0.7%	nc	a	
				2017	5	15.2%	5.4%	nc	b	
				2018	5	3.7%	5.1%	nc	a,b	
Shredder FFG (% of community)	modified probit	YES	0.0020	2007	3	6.7%	5.8%	-	a	Mann-Whitney U-test
				2015	5	30.0%	7.1%	4.0	b	
				2016	5	20.7%	5.5%	2.4	c	
				2017	5	5.7%	2.2%	-0.2	a	
				2018	5	11.7%	8.2%	0.9	a	

▨	Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).
🟦	Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.56: Statistical Comparison of Benthic Invertebrate Community Metrics at the Mary River Upper Mine-Exposed Area (EO-01) Among Years of Mine Operation (2015 to 2018) and Baseline (2007) for the Mary River

Metric	Data Transform-ation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	log	NO	0.1161	2007	3	797	648	-	a	Tukey's HSD
				2015	5	116	97	-1.1	a	
				2016	5	230	109	-0.9	a	
				2017	5	126	106	-1.0	a	
				2018	5	119	164	-1.0	a	
Richness (No. of Taxa)	none	NO	0.1147	2007	3	16.3	8.1	-	a	Tukey's HSD
				2015	5	7.8	2.7	-1.0	a	
				2016	5	13.2	4.1	-0.4	a	
				2017	5	10.6	5.3	-0.7	a	
				2018	5	7.8	4.9	-1.0	a	
Simpson's Evenness	none	YES	0.0254	2007	3	0.698	0.059	-	a	Mann-Whitney U-test
				2015	5	0.873	0.095	3.0	b,c,d	
				2016	5	0.865	0.037	2.8	c	
				2017	5	0.940	0.053	4.1	d	
				2018	5	0.926	0.037	3.9	d	
Nemata (% of community)	modified probit	NO	0.2421	2007	3	2.1%	3.6%	-	a	Tukey's HSD
				2015	5	2.0%	4.5%	0.0	a	
				2016	5	1.3%	1.3%	-0.2	a	
				2017	5	0.8%	1.8%	-0.4	a	
				2018	5	7.8%	10.7%	1.6	a	
Hydracarina (% of community)	none	NO	0.3633	2007	3	3.3%	5.8%	-	a	Mann-Whitney U-test
				2015	5	2.0%	4.5%	-0.2	a	
				2016	5	7.2%	4.6%	0.7	a	
				2017	5	2.2%	2.1%	-0.2	a	
				2018	5	4.4%	5.2%	0.2	a	
Chironomidae (% of community)	none	NO	0.1630	2007	3	90.0%	0.0%	-	a	Tamhane's
				2015	5	82.5%	8.3%	nc	a	
				2016	5	82.9%	7.3%	nc	a	
				2017	5	78.1%	7.2%	nc	a	
				2018	5	72.0%	16.0%	nc	a	
Metal Sensitive Taxa (% of community)	none	YES	0.0804	2007	3	36.4%	32.0%	-	a	Mann-Whitney U-test
				2015	5	7.4%	7.7%	-0.9	a	
				2016	5	5.7%	4.7%	-1.0	a	
				2017	5	29.0%	8.2%	-0.2	b	
				2018	5	35.2%	20.2%	0.0	b	
Tipulidae (% of community)	modified probit	YES	0.0237	2007	3	3.3%	5.8%	-	a,b	Tukey's HSD
				2015	5	10.0%	7.1%	1.2	b	
				2016	5	2.5%	2.6%	-0.2	a,b	
				2017	5	0.3%	0.6%	-0.5	a	
				2018	5	0.3%	0.8%	-0.5	a	
Collector-Gatherer FFG (% of community)	none	NO	0.1334	2007	3	40.0%	26.5%	-	a	Tukey's HSD
				2015	5	72.2%	16.5%	1.2	a	
				2016	5	77.9%	6.9%	1.4	a	
				2017	5	80.3%	8.5%	1.5	a	
				2018	5	62.4%	37.2%	0.8	a	
Filterer FFG (% of community)	modified probit	YES	0.0122	2007	3	36.7%	32.1%	-	a,b	Tamhane's
				2015	5	0.0%	0.0%	-1.1	a	
				2016	5	0.9%	0.8%	-1.1	a	
				2017	5	14.0%	11.2%	-0.7	b	
				2018	5	7.0%	8.6%	-0.9	a,b	
Shredder FFG (% of community)	modified probit	YES	0.0484	2007	3	6.7%	11.5%	-	a,b	Tukey's HSD
				2015	5	18.0%	17.9%	1.0	b	
				2016	5	7.4%	7.6%	0.1	a,b	
				2017	5	2.5%	5.5%	-0.4	a	
				2018	5	15.6%	13.5%	0.8	a,b	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.57: Statistical Comparison of Benthic Invertebrate Community Metrics at the Mary River Middle Mine-Exposed Area (EO-20) Among Years of Mine Operation (2015 to 2018) and Baseline (2011) for the Mary River

Metric	Data Transform-ation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2011	Pairwise Comparison	Statistical Test
Density (No. per m^2)	log	YES	0.0031	2011	3	854	348	-	a	Tukey's HSD
				2015	5	278	146	-1.7	a,c	
				2016	5	283	118	-1.6	a,b	
				2017	5	382	665	-1.4	b,c,d	
				2018	5	61	23	-2.3	d	
Richness (No. of Taxa)	none	YES	0.0454	2011	3	14.0	2.6	-	a	Mann-Whitney U-test
				2015	5	11.6	2.2	-0.9	a	
				2016	5	13.6	3.1	-0.2	a	
				2017	5	12.4	5.0	-0.6	a	
				2018	5	6.8	1.9	-2.7	b	
Simpson's Evenness	none	YES	0.0010	2011	3	0.483	0.247	-	a	Tamhane's
				2015	5	0.726	0.140	1.0	a	
				2016	5	0.835	0.038	1.4	a	
				2017	5	0.902	0.103	1.7	a	
				2018	5	0.895	0.047	1.7	a	
Nemata (% of community)	modified probit	NO	0.1223	2011	3	0.0%	0.0%	-	a	Tukey's HSD
				2015	5	0.0%	0.0%	nc	a	
				2016	5	1.4%	0.9%	nc	a	
				2017	5	0.6%	1.4%	nc	a	
				2018	5	1.5%	3.4%	nc	a	
Hydracarina (% of community)	modified probit	YES	0.0036	2011	3	0.2%	0.4%	-	a	Tukey's HSD
				2015	5	2.0%	4.5%	4.3	b	
				2016	5	7.2%	3.3%	17.1	c	
				2017	5	4.1%	2.8%	9.6	b	
				2018	5	0.9%	2.0%	1.6	a,b	
Chironomidae (% of community)	modified probit	YES	0.0046	2011	3	96.7%	5.8%	-	a	Tukey's HSD
				2015	5	88.6%	5.0%	-1.4	a,b	
				2016	5	86.1%	6.3%	-1.8	b	
				2017	5	71.4%	11.7%	-4.4	b	
				2018	5	81.3%	8.0%	-2.7	b	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0000	2011	3	3.1%	5.4%	-	a,b	Tamhane's
				2015	5	4.2%	4.0%	0.2	a	
				2016	5	4.3%	2.9%	0.2	a	
				2017	5	31.4%	22.5%	5.2	b	
				2018	5	49.0%	12.9%	8.4	b	
Tipulidae (% of community)	modified probit	NO	0.7179	2011	3	0.0%	0.0%	-	a	Tukey's HSD
				2015	5	4.0%	5.5%	nc	a	
				2016	5	3.9%	5.1%	nc	a	
				2017	5	2.7%	3.3%	nc	a	
				2018	5	2.2%	3.1%	nc	a	
Collector-Gatherer FFG (% of community)	none	YES	0.0000	2011	3	23.3%	15.3%	-	a	Tukey's HSD
				2015	5	78.3%	8.5%	3.6	b	
				2016	5	70.2%	7.5%	3.1	b	
				2017	5	68.2%	5.1%	2.9	b	
				2018	5	78.2%	6.6%	3.6	b	
Filterer FFG (% of community)	modified probit	YES	0.0003	2011	3	3.3%	5.8%	-	a,b	Tamhane's
				2015	5	0.0%	0.0%	-0.6	a	
				2016	5	0.4%	0.8%	-0.5	a	
				2017	5	17.0%	7.1%	2.4	b	
				2018	5	9.2%	8.5%	1.0	b	
Shredder FFG (% of community)	none	NO	0.5790	2011	3	6.7%	11.5%	-	a	Mann-Whitney U-test
				2015	5	12.0%	4.5%	0.5	a	
				2016	5	7.7%	6.3%	0.1	a	
				2017	5	7.0%	4.1%	0.0	a	
				2018	5	11.7%	8.2%	0.4	a	

▨ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.58: Statistical Comparison of Benthic Invertebrate Community Metrics at the Mary River Lower Mine-Exposed Area (CO-05) Among Years of Mine Operation (2015 to 2018) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons^a							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Effect Size vs. Baseline Year 2011	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0480	2007	3	311	230	-	-0.4	a	Tamhane's
				2011	3	491	455	0.8	-	a	
				2015	5	234	168	-0.3	-0.6	a	
				2016	5	1,161	584	3.7	1.5	a	
				2017	5	1,214	654	3.9	1.6	a	
				2018	5	1,391	1,083	4.7	2.0	a	
Richness (No. of Taxa)	none	YES	0.0050	2007	3	10.7	3.8	-	-2.1	a,b	Mann-Whitney U-test
				2011	3	19.0	4.0	2.2	-	a,c,d	
				2015	5	13.2	2.7	0.7	-1.5	b	
				2016	5	19.6	3.3	2.4	0.2	c,d,e	
				2017	5	22.0	3.2	3.0	0.8	d	
				2018	5	18.6	0.9	2.1	-0.1	e	
Simpson's Evenness	none	YES	0.0069	2007	3	0.668	0.022	-	-2.7	a	Tamhane's
				2011	3	0.879	0.079	9.8	-	a,b	
				2015	5	0.923	0.038	11.8	0.6	b	
				2016	5	0.849	0.015	8.4	-0.4	b	
				2017	5	0.798	0.161	6.0	-1.0	a,b	
				2018	5	0.675	0.149	0.4	-2.6	a,b	
Nemata (% of community)	modified probit	YES	0.0506	2007	3	0.2%	0.4%	-	-0.5	a	Tukey's HSD
				2011	3	1.6%	2.7%	3.2	-	b	
				2015	5	2.0%	4.5%	4.3	0.2	b	
				2016	5	1.0%	1.0%	1.9	-0.2	a,b	
				2017	5	2.1%	1.6%	4.5	0.2	a,b	
				2018	5	2.1%	1.9%	4.6	0.2	a,b	
Hydracarina (% of community)	modified probit	YES	0.0590	2007	3	0.5%	0.4%	-	3.6	a,b	Tukey's HSD
				2011	3	0.1%	0.1%	-1.0	-	a,b	
				2015	5	2.0%	4.5%	3.7	16.9	a,b	
				2016	5	5.5%	3.9%	12.2	47.8	b	
				2017	5	3.9%	4.7%	8.2	33.2	a,b	
				2018	5	1.5%	2.3%	2.4	12.3	a	
Chironomidae (% of community)	modified probit	YES	0.0000	2007	3	99.0%	0.8%	-	nc	a	Tukey's HSD
				2011	3	90.0%	0.0%	-10.9	-	b	
				2015	5	80.4%	11.4%	-22.4	nc	b,c	
				2016	5	87.8%	3.0%	-13.5	nc	b	
				2017	5	63.8%	12.6%	-42.5	nc	c	
				2018	5	85.6%	7.0%	-16.2	nc	b	
Metal Sensitive Taxa (% of community)	none	YES	0.0026	2007	3	37.2%	16.0%	-	2.2	a,b	Tukey's HSD
				2011	3	14.4%	10.4%	-1.4	-	a	
				2015	5	15.9%	11.5%	-1.3	0.1	a	
				2016	5	29.2%	13.6%	-0.5	1.4	a	
				2017	5	39.0%	23.3%	0.1	2.4	a,b	
				2018	5	59.6%	11.3%	1.4	4.3	b	
Tipulidae (% of community)	modified probit	NO	0.2541	2007	3	0.0%	0.0%	-	nc	a	Tukey's HSD
				2011	3	0.0%	0.0%	nc	-	a	
				2015	5	6.0%	8.9%	nc	nc	a	
				2016	5	1.7%	1.2%	nc	nc	a	
				2017	5	1.1%	1.6%	nc	nc	a	
				2018	5	0.6%	0.5%	nc	nc	a	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0012	2007	3	35.0%	15.3%	-	-2.7	a	Tukey's HSD
				2011	3	66.7%	11.5%	2.1	-	a,b,c	
				2015	5	82.9%	13.0%	3.1	1.4	b,c	
				2016	5	59.0%	10.2%	1.6	-0.7	a	
				2017	5	63.9%	13.5%	1.9	-0.2	a,b	
				2018	5	83.7%	8.2%	3.2	1.5	c	
Filterer FFG (% of community)	none	YES	0.0035	2007	3	21.0%	28.3%	-	0.7	a,c,d	Mann-Whitney U-test
				2011	3	13.3%	11.5%	-0.3	-	a,b,c,d	
				2015	5	0.0%	0.0%	-0.7	-1.2	b	
				2016	5	0.6%	0.7%	-0.7	-1.1	b	
				2017	5	19.9%	10.4%	0.0	0.6	c	
				2018	5	6.1%	4.2%	-0.5	-0.6	d	
Shredder FFG (% of community)	modified probit	YES	0.0025	2007	3	40.2%	20.9%	-	5.8	a	Tukey's HSD
				2011	3	6.7%	5.8%	-1.6	-	b	
				2015	5	16.0%	11.4%	-1.2	1.6	a,b	
				2016	5	8.9%	6.8%	-1.5	0.4	b	
				2017	5	6.7%	3.1%	-1.6	0.0	b	
				2018	5	4.2%	2.5%	-1.7	-0.4	b	

▩	Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).
🟦	Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.59: Statistical Comparison of Physical Sediment Quality Between Mary Lake and Reference Lake 3 for Samples Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2018

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics							
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Littoral (Shallow) Stations	Station Depth (m)	NO	0.751	α	Reference	5	9.74	1.04	0.46	8.50	-	11.20
					Mary Lake	4	9.38	2.22	1.11	6.60	-	12.00
	Sand-Sized Particles (% by weight)	YES	0.045	Ŧ	Reference	5	59.6	4.4	2.0	54.9	59.4	66.4
					Mary Lake	4	16.7	17.7	8.8	3.6	11.1	41.0
	Silt-Sized Particles (% by weight)	YES	< 0.001	Ŧ	Reference	5	31.4	3.3	1.5	26.6	32.6	34.7
					Mary Lake	4	64.0	9.5	4.8	50.5	66.3	72.8
	Clay-Sized Particles (% by weight)	NO	0.191	δ	Reference	5	9.0	2.4	1.1	5.8	10.4	10.8
					Mary Lake	4	19.3	12.4	6.2	8.6	19.1	30.5
	Total Organic Carbon (%)	YES	0.007	Ŧ	Reference	5	4.7	2.3	1.0	1.8	5.1	7.4
					Mary Lake	4	1.1	0.2	0.1	0.8	1.1	1.3
Profundal (Deep) Stations	Station Depth (m)	NO	0.748	β	Reference	5	20.56	2.17	0.97	18.50	-	24.20
					Mary Lake	6	21.58	4.50	1.84	15.00	-	29.00
	Sand-Sized Particles (% by weight)	YES	0.077	η	Reference	5	47.5	2.8	1.3	44.5	47.0	50.9
					Mary Lake	6	29.0	24.8	10.1	6.6	20.7	71.7
	Silt-Sized Particles (% by weight)	NO	0.320	ζ	Reference	5	39.0	3.1	1.4	33.8	40.4	41.5
					Mary Lake	6	48.8	21.6	8.8	16.8	47.0	77.4
	Clay-Sized Particles (% by weight)	NO	0.240	η	Reference	5	13.6	2.2	1.0	9.7	14.3	15.3
					Mary Lake	6	22.3	13.6	5.6	8.5	18.4	43.5
	Total Organic Carbon (%)	YES	0.052	γ	Reference	5	3.8	1.7	0.8	0.8	4.5	4.9
					Mary Lake	6	0.9	0.3	0.1	0.4	1.0	1.3

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data untransformed, Mann-Whitney U-test conducted; ζ - data untransformed, t-test conducted assuming unequal variance; η - data log-transformed, t-test assuming unequal variance; δ - data square-root transformed, t-test assuming unequal variance conducted; Ŧ - data square-root transformed, single factor ANOVA conducted.

▨ Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table F.60: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary Lake, August 2018

Taxa	Study Area Replicate Station	Mary Lake - Littoral Stations BLO-1	 BLO-11	 BLO-7	 BLO-6
ROUNDWORMS					
P. Nemata		17	9	-	95
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Lumbriculidae					
Lumbriculus		-	-	-	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
F. Acalyptonotidae					
Acalyptonotus		34	9	-	17
F. Hygrobatidae					
Hygrobates		-	-	-	-
F. Lebertiidae					
Lebertia		-	26	-	-
F. Sperchontidae					
Sperchon		-	-	-	-
SEED SHRIMPS					
Cl. Ostracoda		164	43	9	181
INSECTS					
Cl. Insecta					
CADDISFLIES					
O. Trichoptera					
pupae		-	-	-	-
F. Apataniidae					
Apatania		-	-	-	9
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae		**9**	-	-	-
S.F. Chironominae					
Chironomus		-	-	-	-
Micropsectra		233	-	-	9
Paratanytarsus		-	-	-	-
Sergentia		-	-	-	-
Stictochironomus		302	-	9	-
Tanytarsus		181	-	-	-
S.F. Diamesinae					
Protanypus		-	69	34	26
Pseudodiamesa		-	9	34	-
S.F. Orthocladiinae					
Abiskomyia		69	34	9	17
Cricotopus/Orthocladius		-	-	-	-

Table F.60: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary Lake, August 2018

Taxa Study Area	Mary Lake - Littoral Stations			
Replicate Station	BLO-1	BLO-11	BLO-7	BLO-6
Heterotrissocladius	34	2,888	164	345
Hydrobaenus	-	-	-	-
Limnophyes	-	-	-	-
Mesocricotopus	-	-	-	-
Paracladius	17	-	-	9
Parakiefferiella	-	-	-	-
Psectrocladius	-	-	-	-
Zalutschia	26	-	-	17
S.F. Tanypodinae				
Arctopelopia	9	-	-	-
Procladius	1,681	-	26	-
F. Tipulidae				
Tipula	-	-	-	-
Density (No. organisms per m^2)	2,776	3,087	285	725
Richness (total number of taxa)[a]	12	8	7	10
Simpson's Evenness (E)	0.658	0.142	0.734	0.767
Bray-Curtis Index	0.705	0.939	0.913	0.687
Dominant Group Composition				
% Nemata	0.6%	0.3%	0.0%	13.1%
% Hydracarina	1.2%	1.1%	0.0%	2.3%
% Ostracods	5.9%	1.4%	3.2%	25.0%
% Chironomids	92.3%	97.2%	96.8%	58.3%
% Metal Sensitive Chironmids	15.0%	2.5%	23.9%	4.8%
% Tipulidae	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition				
% Collector - Gatherers	21.8%	98.9%	90.9%	92.8%
% Filterers	15.0%	0.0%	0.0%	1.2%
% Shredders	0.9%	0.0%	0.0%	2.3%
Habitat Preference Group Composition				
% Clingers	16.2%	1.1%	0.0%	4.8%
% Sprawlers	72.3%	96.3%	84.9%	78.5%
% Burrowers	11.5%	2.5%	15.1%	16.7%

[a] Bold entries excluded from taxa count

Table F.60: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary Lake, August 2018

Taxa Study Area	Mary Lake - Profundal Stations					
Replicate Station	BLO-3	BLO-15	BLO-14	BLO-13	BLO-4	BLO-5
ROUNDWORMS						
P. Nemata	52	-	-	17	26	34
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Lumbriculidae						
Lumbriculus	-	-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
F. Acalyptonotidae						
Acalyptonotus	-	-	-	9	9	17
F. Hygrobatidae						
Hygrobates	9	-	-	-	-	-
F. Lebertiidae						
Lebertia	9	-	-	9	-	-
F. Sperchontidae						
Sperchon	-	-	-	-	-	34
SEED SHRIMPS						
Cl. Ostracoda	34	86	-	17	26	138
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
pupae	-	-	-	-	-	-
F. Apataniidae						
Apatania	-	-	-	-	-	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae	**17**	-	-	-	-	-
S.F. Chironominae						
Chironomus	-	-	-	-	-	241
Micropsectra	224	17	-	-	9	431
Paratanytarsus	-	-	-	-	-	-
Sergentia	9	-	9	-	-	103
Stictochironomus	414	-	-	-	-	690
Tanytarsus	34	-	-	-	-	17
S.F. Diamesinae						
Protanypus	-	-	9	-	9	-
Pseudodiamesa	9	-	26	9	9	-
S.F. Orthocladiinae						
Abiskomyia	9	-	-	-	-	17
Cricotopus/Orthocladius	-	-	-	-	-	17

Table F.60: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary Lake, August 2018

Taxa Study Area	Mary Lake - Profundal Stations					
Replicate Station	BLO-3	BLO-15	BLO-14	BLO-13	BLO-4	BLO-5
Heterotrissocladius	155	853	1,767	1,716	983	655
Hydrobaenus	-	-	-	-	-	52
Limnophyes	-	-	-	-	-	-
Mesocricotopus	-	-	-	9	-	-
Paracladius	-	-	-	-	-	-
Parakiefferiella	-	-	-	-	-	-
Psectrocladius	-	-	-	-	-	-
Zalutschia	9	-	-	-	-	-
S.F. Tanypodinae						
Arctopelopia	-	-	-	-	-	-
Procladius	26	26	-	-	-	-
F. Tipulidae						
Tipula	-	-	-	-	-	17
Density (No. organisms per m^2)	1,010	982	1,811	1,786	1,071	2,463
Richness (total number of taxa)[a]	13	4	4	7	7	14
Simpson's Evenness (E)	0.806	0.316	0.064	0.089	0.182	0.867
Bray-Curtis Index	0.727	0.441	0.665	0.645	0.461	0.723
Dominant Group Composition						
% Nemata	5.1%	0.0%	0.0%	1.0%	2.4%	1.4%
% Hydracarina	1.8%	0.0%	0.0%	1.0%	0.8%	2.1%
% Ostracods	3.4%	8.8%	0.0%	1.0%	2.4%	5.6%
% Chironomids	89.7%	91.2%	100.0%	97.1%	94.3%	90.3%
% Metal Sensitive Chironmids	26.9%	1.7%	1.9%	0.5%	2.5%	18.2%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%
Functional Feeding Group Composition						
% Collector - Gatherers	68.6%	95.6%	100.0%	99.0%	98.3%	78.4%
% Filterers	26.0%	1.7%	0.0%	0.0%	0.8%	18.2%
% Shredders	0.9%	0.0%	0.0%	0.0%	0.0%	1.4%
Habitat Preference Group Composition						
% Clingers	28.7%	1.7%	0.5%	1.0%	1.7%	25.1%
% Sprawlers	24.4%	98.3%	99.0%	98.0%	95.1%	35.0%
% Burrowers	46.9%	0.0%	0.5%	1.0%	3.3%	39.9%

[a] Bold entries excluded from taxa count

Table F.61: Statistical Comparison of Benthic Invertebrate Community Metrics at Mary Lake Littoral (Shallow) Statoins Among Years of Mine Operation (2015 to 2018) and Baseline (2007) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.9526	2007	3	2,667	1,454	-	a	Tukey's HSD
				2015	4	2,453	2,186	-0.1	a	
				2016	6	1,947	1,591	-0.5	a	
				2017	4	1,839	1,853	-0.6	a	
				2018	4	1,839	1,853	-0.6	a	
Richness (No. of Taxa)	none	NO	0.7876	2007	3	8.0	2.0	-	a	Mann-Whitney U-test
				2015	4	9.0	1.8	0.5	a	
				2016	6	8.7	0.5	0.3	a	
				2017	4	9.5	2.1	0.8	a	
				2018	4	9.5	2.1	0.8	a	
Simpson's Evenness	none	NO	0.2279	2007	3	0.718	0.041	-	a	Tamhane's
				2015	4	0.761	0.058	1.1	a	
				2016	6	0.574	0.299	-3.5	a	
				2017	4	0.818	0.110	2.4	a	
				2018	4	0.818	0.110	2.4	a	
Nemata (% of community)	modified probit	NO	0.8162	2007	3	7.3%	11.2%	-	a	Tukey's HSD
				2015	4	5.6%	6.3%	-0.1	a	
				2016	6	3.6%	7.5%	-0.3	a	
				2017	4	3.5%	6.2%	-0.3	a	
				2018	4	3.5%	6.2%	-0.3	a	
Ostracoda (% of community)	modified probit	NO	0.4530	2007	3	0.2%	0.4%	-	a	Tukey's HSD
				2015	4	1.9%	2.2%	4.3	a	
				2016	6	2.3%	2.2%	5.5	a	
				2017	4	2.1%	2.2%	5.0	a	
				2018	4	2.1%	2.2%	5.0	a	
Chironomidae (% of community)	modified probit	NO	0.7484	2007	3	90.8%	11.8%	-	a	Tukey's HSD
				2015	4	91.1%	7.7%	0.0	a	
				2016	6	90.6%	12.2%	0.0	a	
				2017	4	85.7%	13.1%	-0.4	a	
				2018	4	85.7%	13.1%	-0.4	a	
Metal Sensitive Taxa (% of community)	none	NO	0.9448	2007	3	22.4%	13.8%	-	a	Tukey's HSD
				2015	4	15.8%	14.6%	-0.5	a	
				2016	6	19.2%	13.3%	-0.2	a	
				2017	4	21.3%	7.7%	-0.1	a	
				2018	4	21.3%	7.7%	-0.1	a	
Collector-Gatherer FFG (% of community)	none	NO	0.5172	2007	3	66.0%	26.7%	-	a	Tukey's HSD
				2015	4	72.8%	23.1%	0.3	a	
				2016	6	73.5%	24.7%	0.3	a	
				2017	4	52.2%	23.6%	-0.5	a	
				2018	4	52.2%	23.6%	-0.5	a	
Filterer FFG (% of community)	none	NO	0.9190	2007	3	22.0%	14.5%	-	a	Tukey's HSD
				2015	4	14.4%	16.2%	-0.5	a	
				2016	6	12.4%	13.2%	-0.7	a	
				2017	4	13.3%	16.0%	-0.6	a	
				2018	4	13.3%	16.0%	-0.6	a	

▒ Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

🟦 Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.62: Statistical Comparison of Benthic Metrics at Mary Lake Profundal (Deep) Stations Among Years of Mine Operation (2015 to 2018) and Baseline (2007) for the Mary River Project CREMP

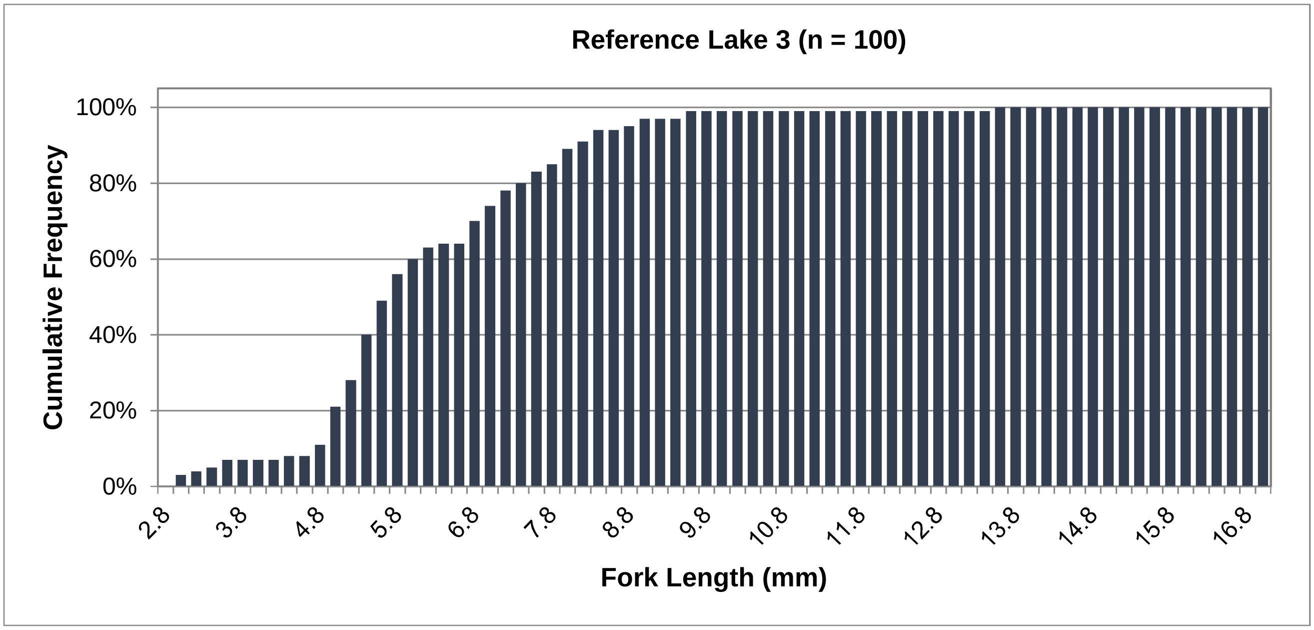
Metric	Data Transfor-mation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	log	YES	0.0313	2007	4	3,512	3,257	-	a	Tukey's HSD
				2015	6	775	748	-0.8	a,b	
				2017	6	536	497	-0.9	b	
				2018	6	536	497	-0.9	b	
Richness (No. of Taxa)	none	NO	0.9612	2007	4	8.0	6.2	-	a	Tamhane's
				2015	6	7.7	4.1	0.0	a	
				2017	6	7.0	1.5	-0.2	a	
				2018	6	7.0	1.5	-0.2	a	
Simpson's Evenness	none	NO	0.4078	2007	4	0.453	0.268	-	a	Mann-Whitney U-test
				2015	6	0.696	0.142	0.9	a	
				2017	6	0.604	0.236	0.6	a	
				2018	6	0.604	0.236	0.6	a	
Nemata (% of community)	none	NO	0.8357	2007	4	1.3%	1.8%	-	a	Tukey's HSD
				2015	6	2.0%	2.6%	0.4	a	
				2017	6	2.4%	1.9%	0.6	a	
				2018	6	2.4%	1.9%	0.6	a	
Ostracoda (% of community)	modified probit	NO	0.5326	2007	4	1.6%	2.2%	-	a	Tukey's HSD
				2015	6	11.1%	10.9%	4.4	a	
				2017	6	3.2%	6.2%	0.7	a	
				2018	6	3.2%	6.2%	0.7	a	
Chironomidae (% of community)	none	NO	0.4102	2007	4	96.4%	4.7%	-	a	Tukey's HSD
				2015	6	83.8%	12.2%	-2.7	a	
				2017	6	84.9%	13.8%	-2.5	a	
				2018	6	84.9%	13.8%	-2.5	a	
Metal Sensitive Taxa (% of community)	none	NO	0.2821	2007	4	33.7%	27.9%	-	a	Mann-Whitney U-test
				2015	6	9.5%	8.2%	-0.9	a	
				2017	6	5.6%	3.2%	-1.0	a	
				2018	6	5.6%	3.2%	-1.0	a	
Collector-Gatherer FFG (% of community)	modified probit	NO	0.9998	2007	4	64.4%	27.7%	-	a	Tamhane's
				2015	6	82.7%	5.9%	0.7	a	
				2017	6	80.7%	18.2%	0.6	a	
				2018	6	80.7%	18.2%	0.6	a	
Filterer FFG (% of community)	none	YES	0.0060	2007	4	33.1%	27.8%	-	a	Tamhane's
				2015	6	9.4%	7.9%	-0.9	a	
				2017	6	3.8%	2.7%	-1.1	a	
				2018	6	3.8%	2.7%	-1.1	a	

▨	Indicates a significant difference for respective comparison (p-value ≤ 0.1).
🟦	Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

APPENDIX G

FISH POPULATION SURVEY DATA



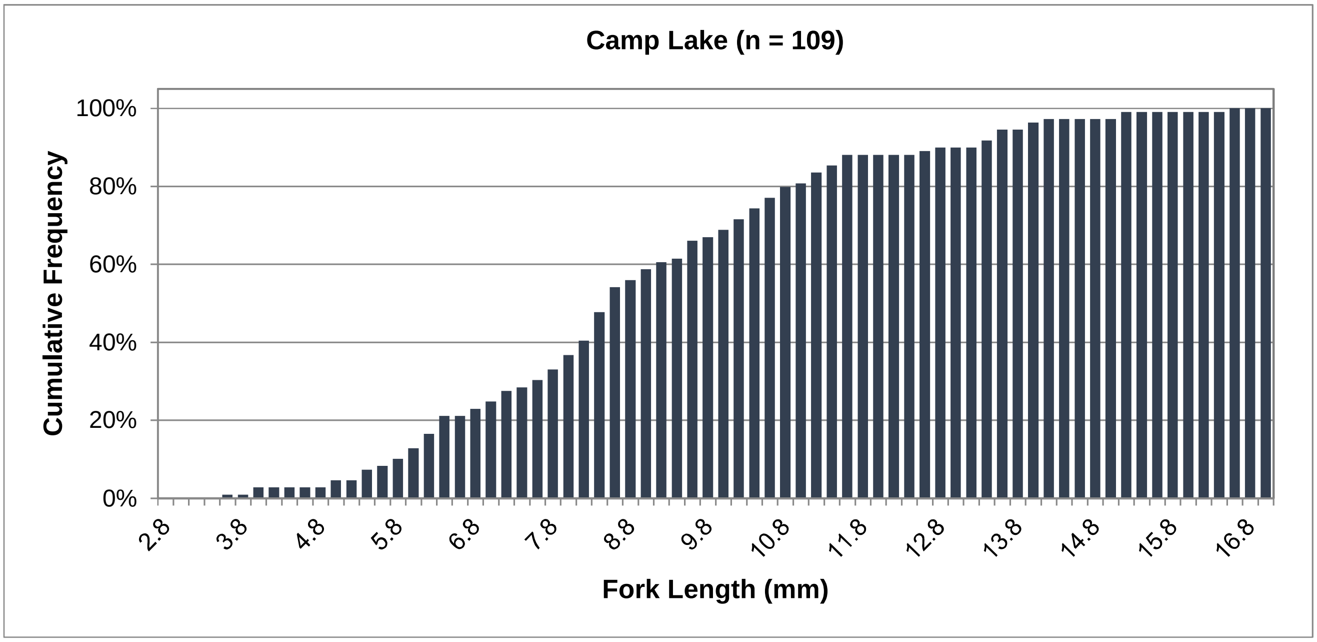


Figure G.1: **Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2018**

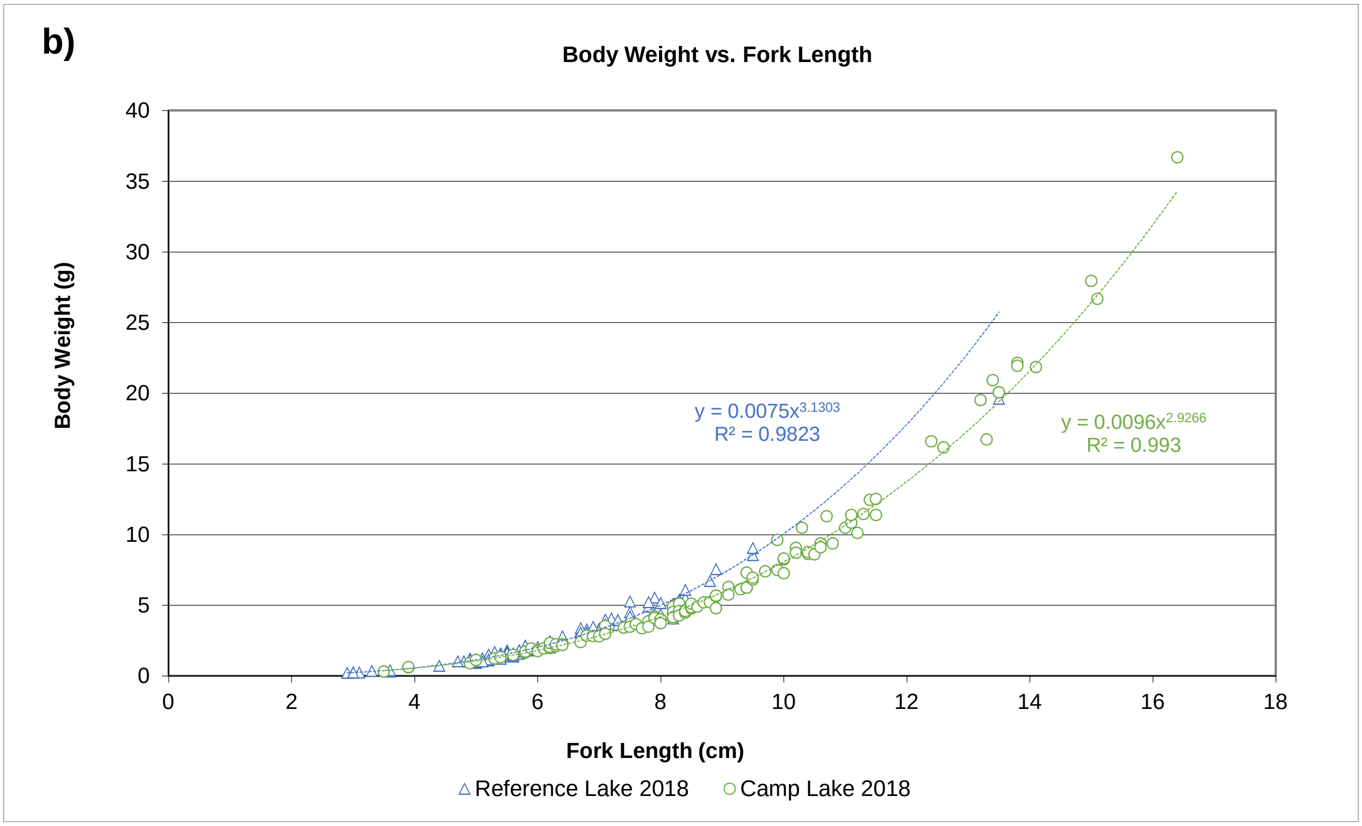


Figure G.2: **Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at the Nearshore Area of Camp Lake and Reference Lake 3 in August 2018 using Log-transformed (a) and Untransformed (b) Data, Mary River Project 2018 CREMP**

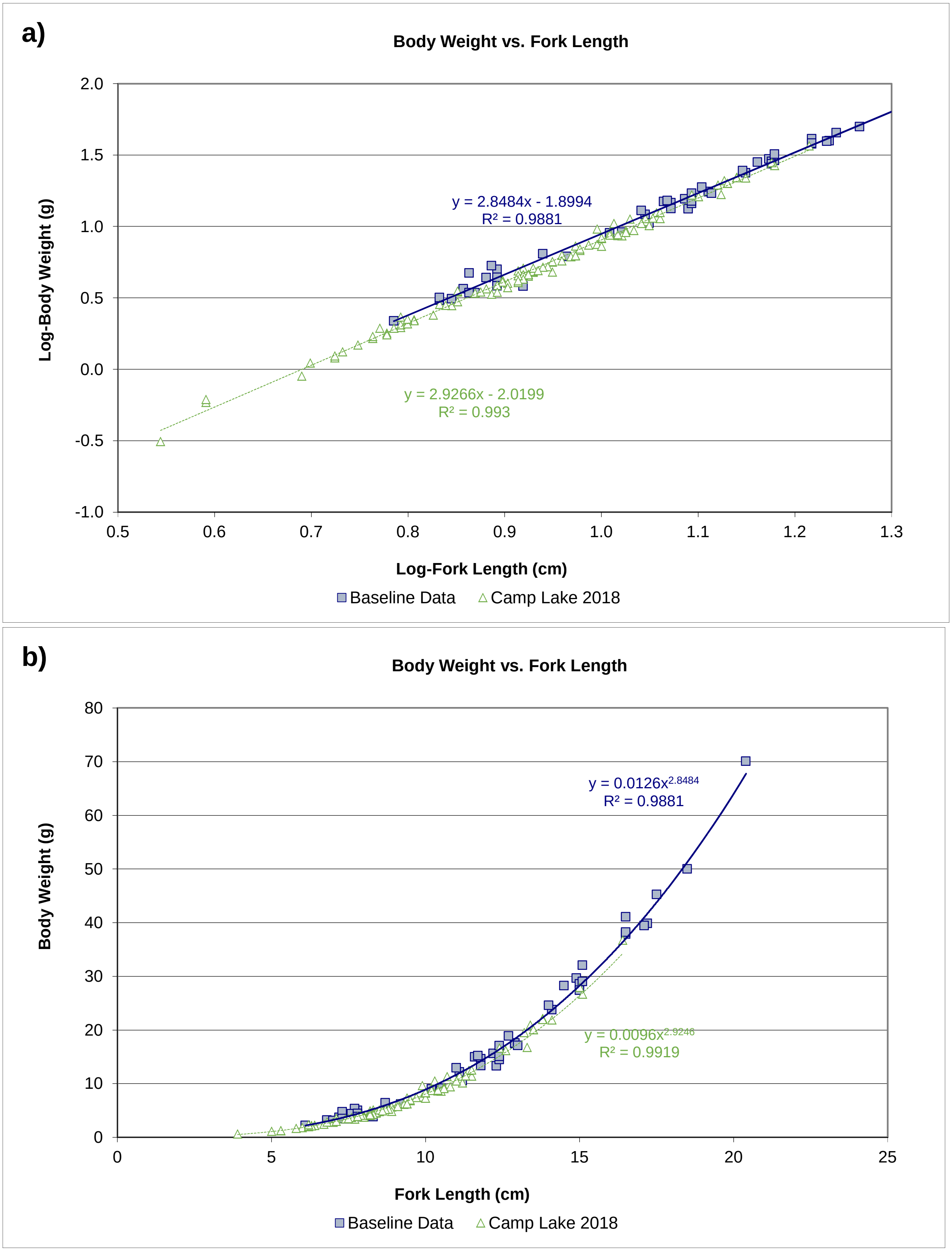
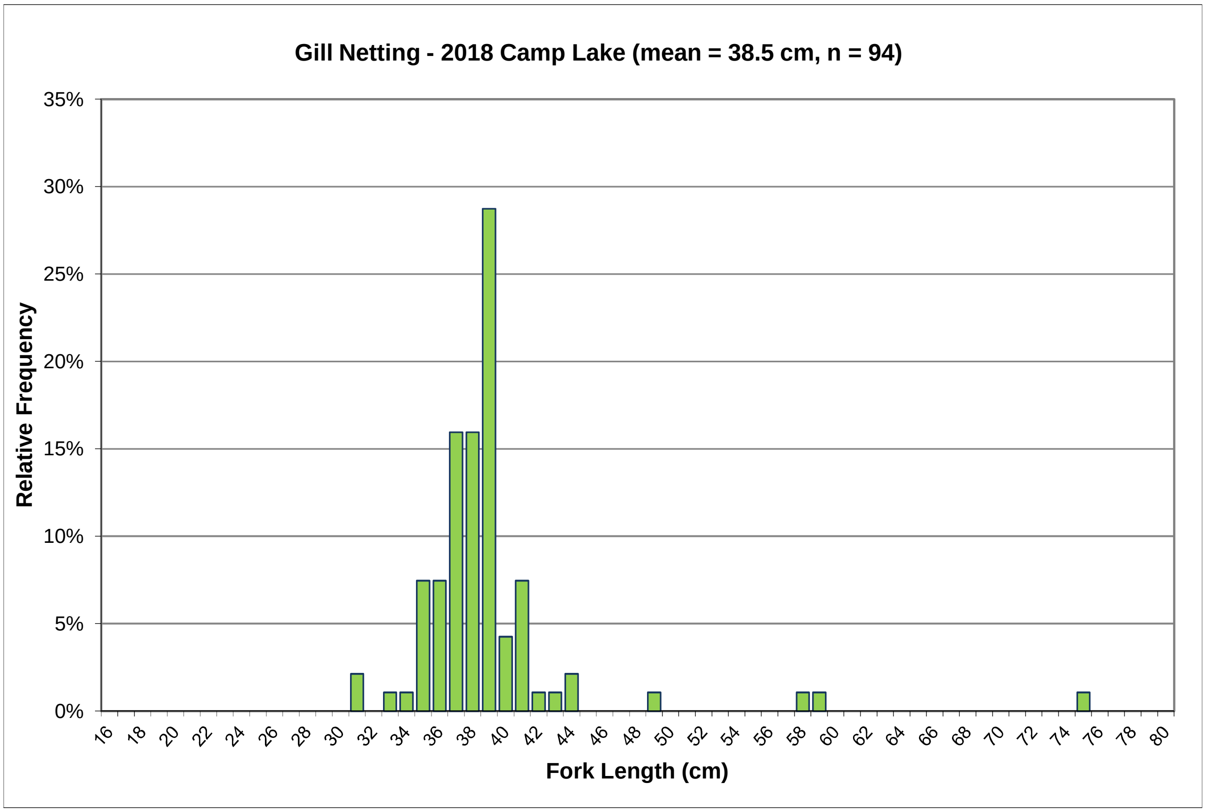


Figure G.3: **Comparison of Condition (Weight-at-fork length Relationship) for Arctic Charr Collected in Fall (August-September) at Camp Lake Nearshore Areas in 2018 and during the Mine Baseline Period (2013) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP**



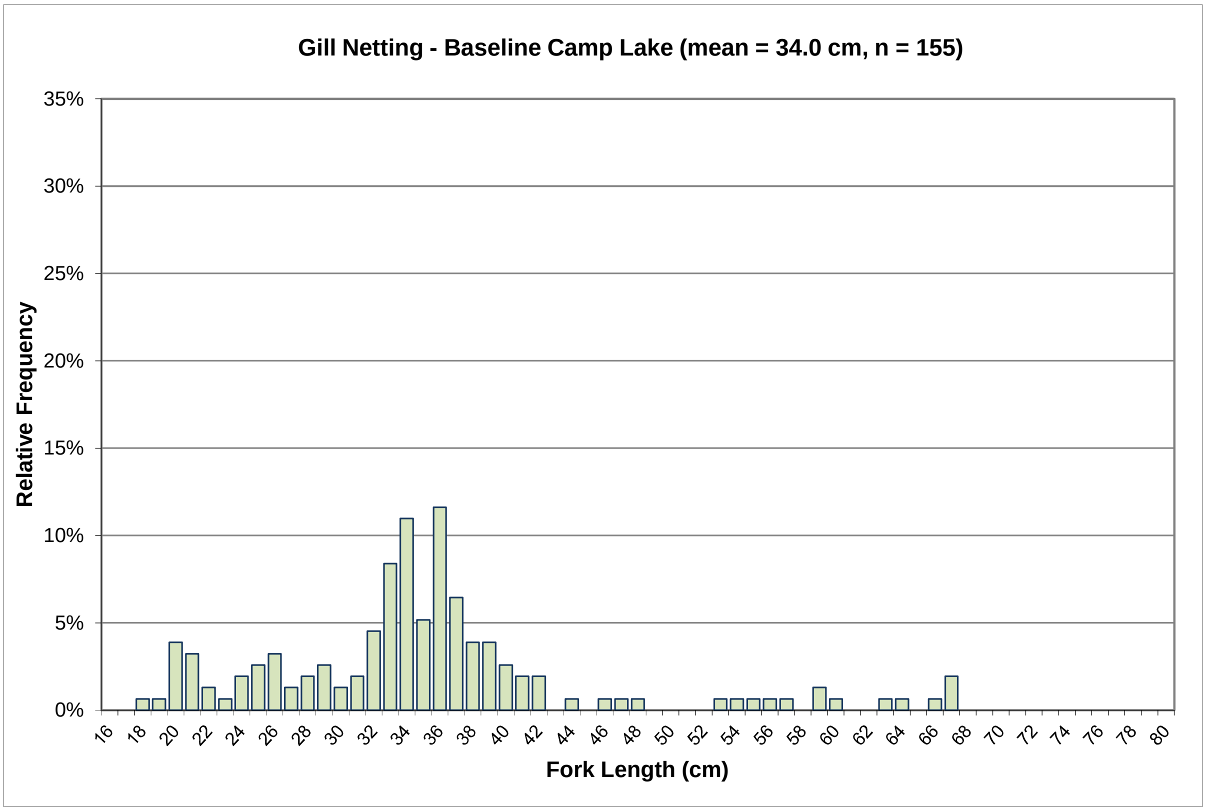
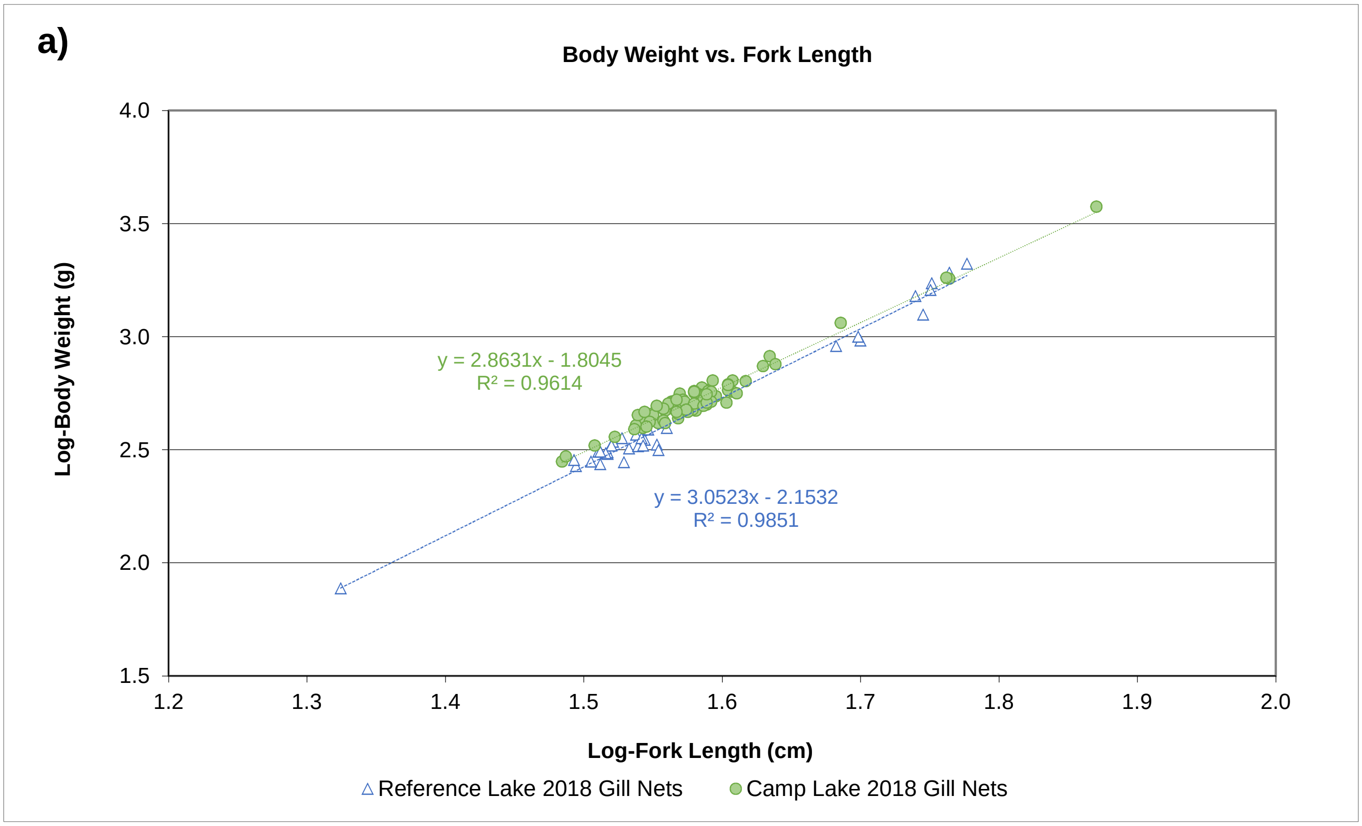


Figure G.4: Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Camp Lake (JLO) in 2018 and Baseline Studies Conducted in Fall, Mary River Project CREMP



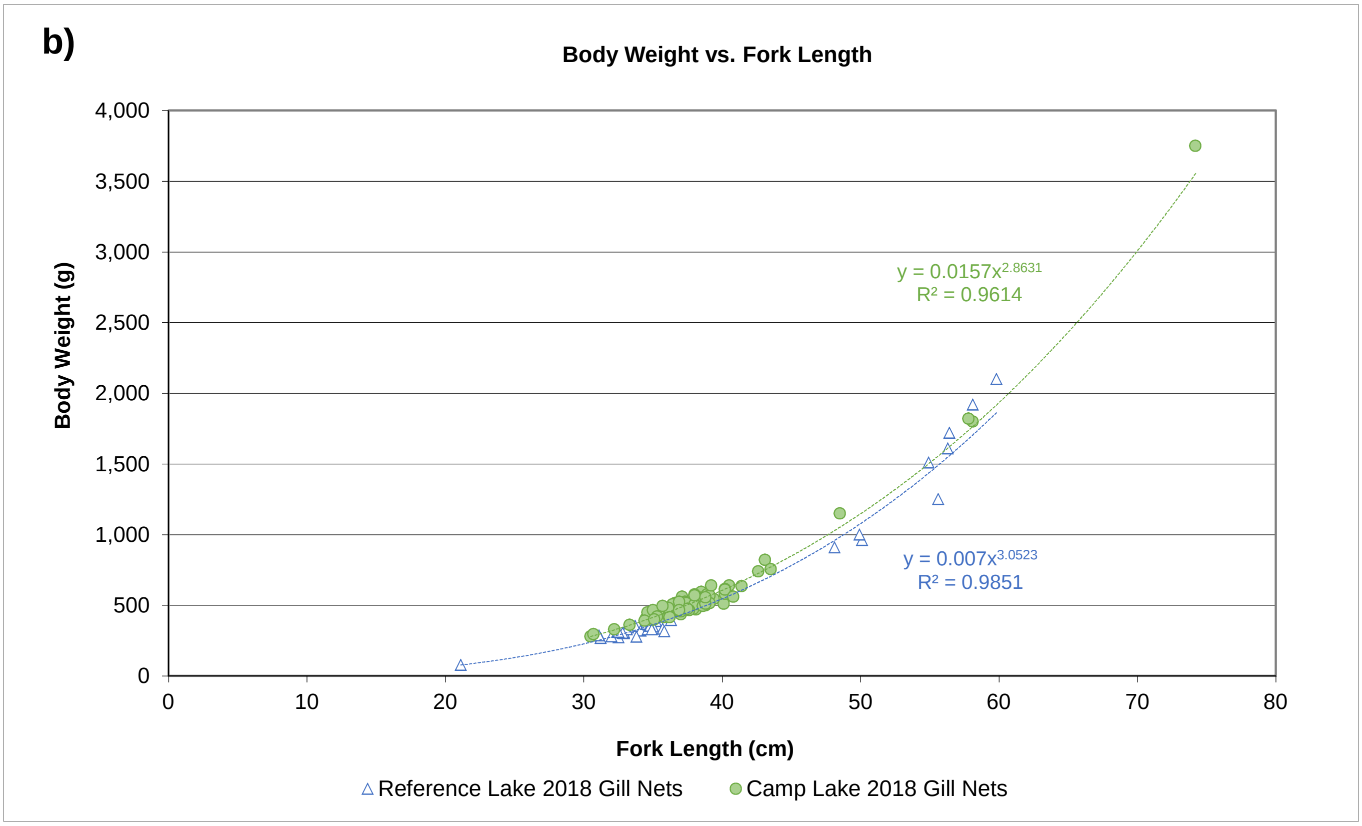


Figure G.5: **Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at Littoral/Profundal Areas of Camp Lake and Reference Lake 3 in August 2018 using Log-transformed (a) and Untransformed (b) Data, Mary River Project 2018 CREMP**

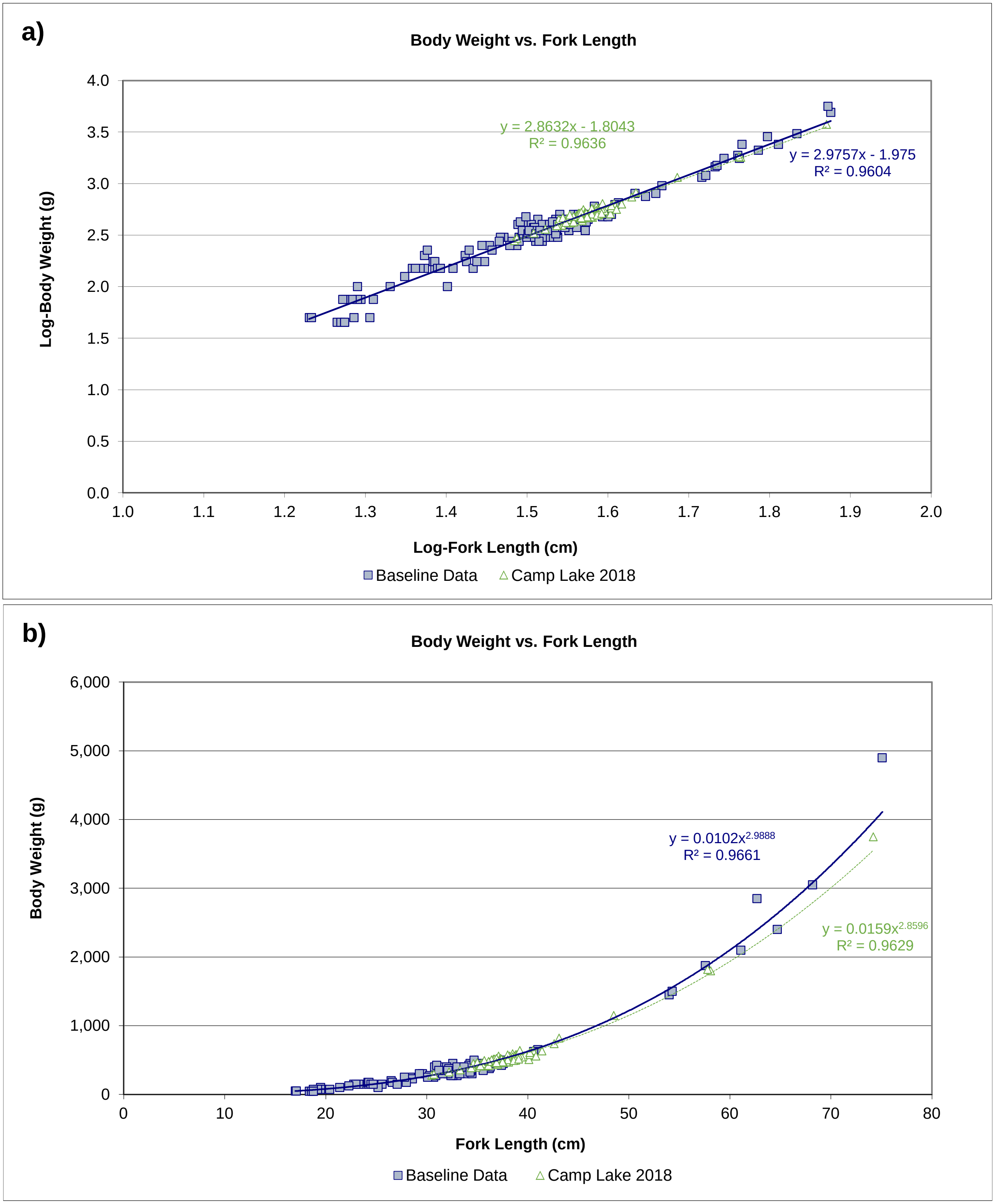
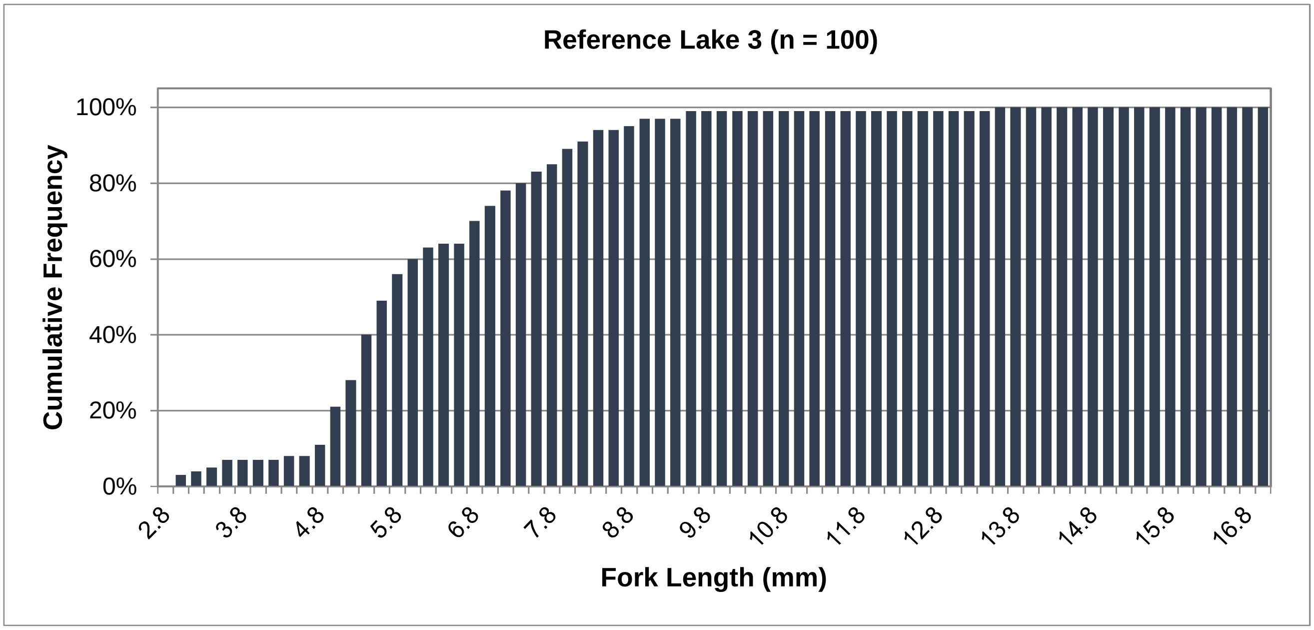


Figure G.6: **Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Camp Lake Littoral/Profundal Areas in 2018 and during the Mine Baseline Period (2006, 2007, 2008, 2013) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP**



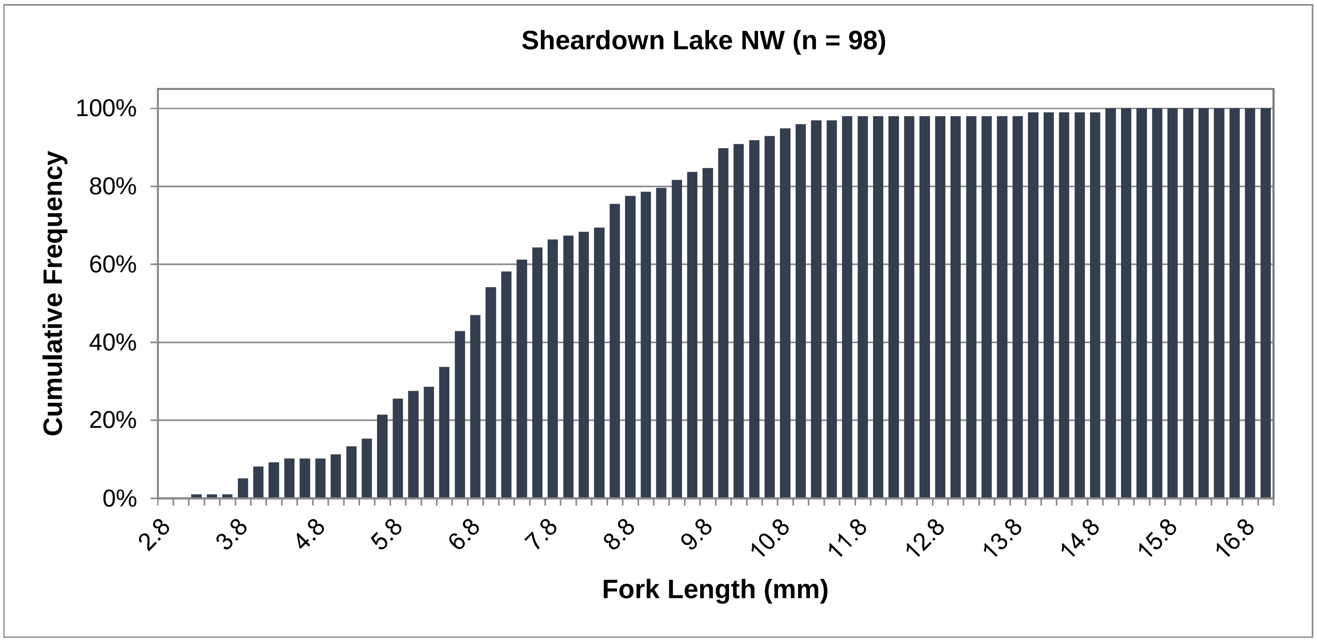


Figure G.7: Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2018

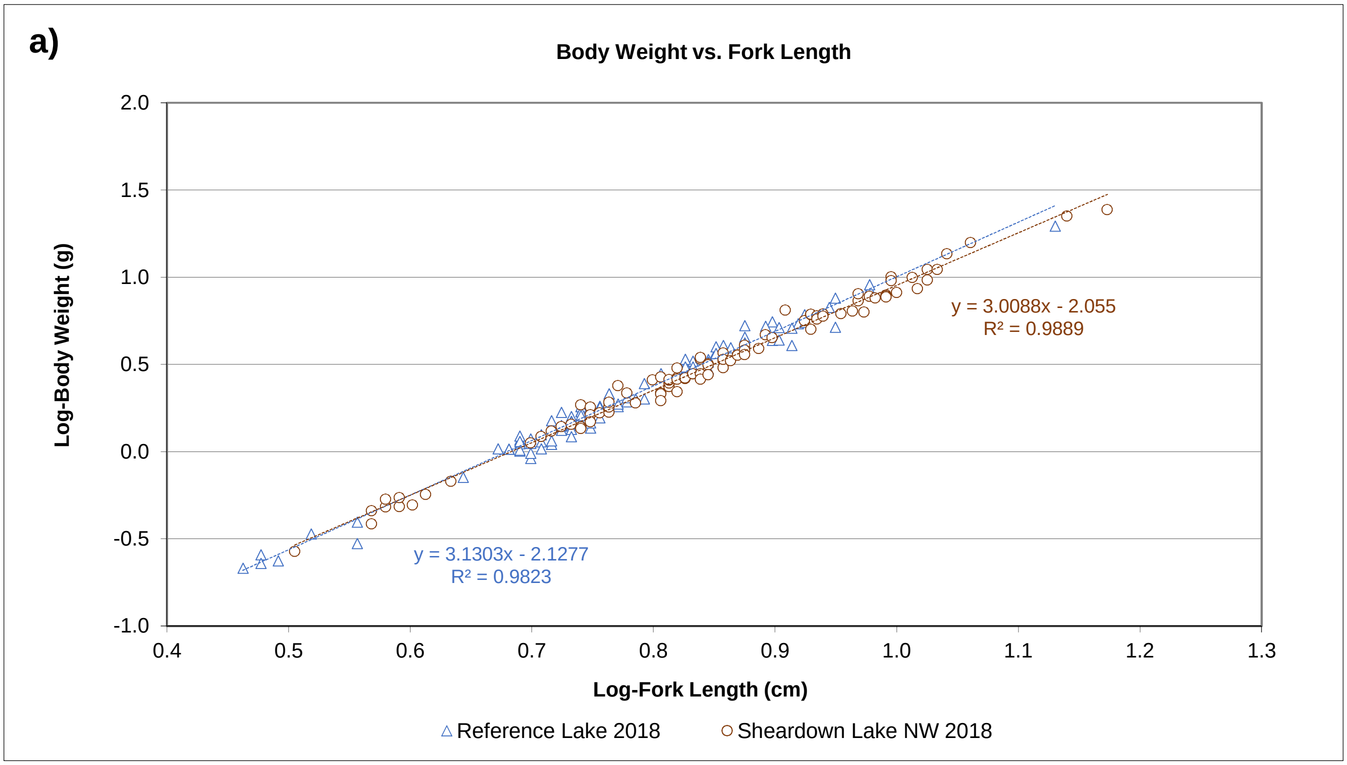


Figure G.8: **Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at the Nearshore Area of Sheardown Lake NW and Reference Lake 3 in August 2018 using Log-transformed (a) and Untransformed (b) Data, Mary River Project 2018 CREMP**

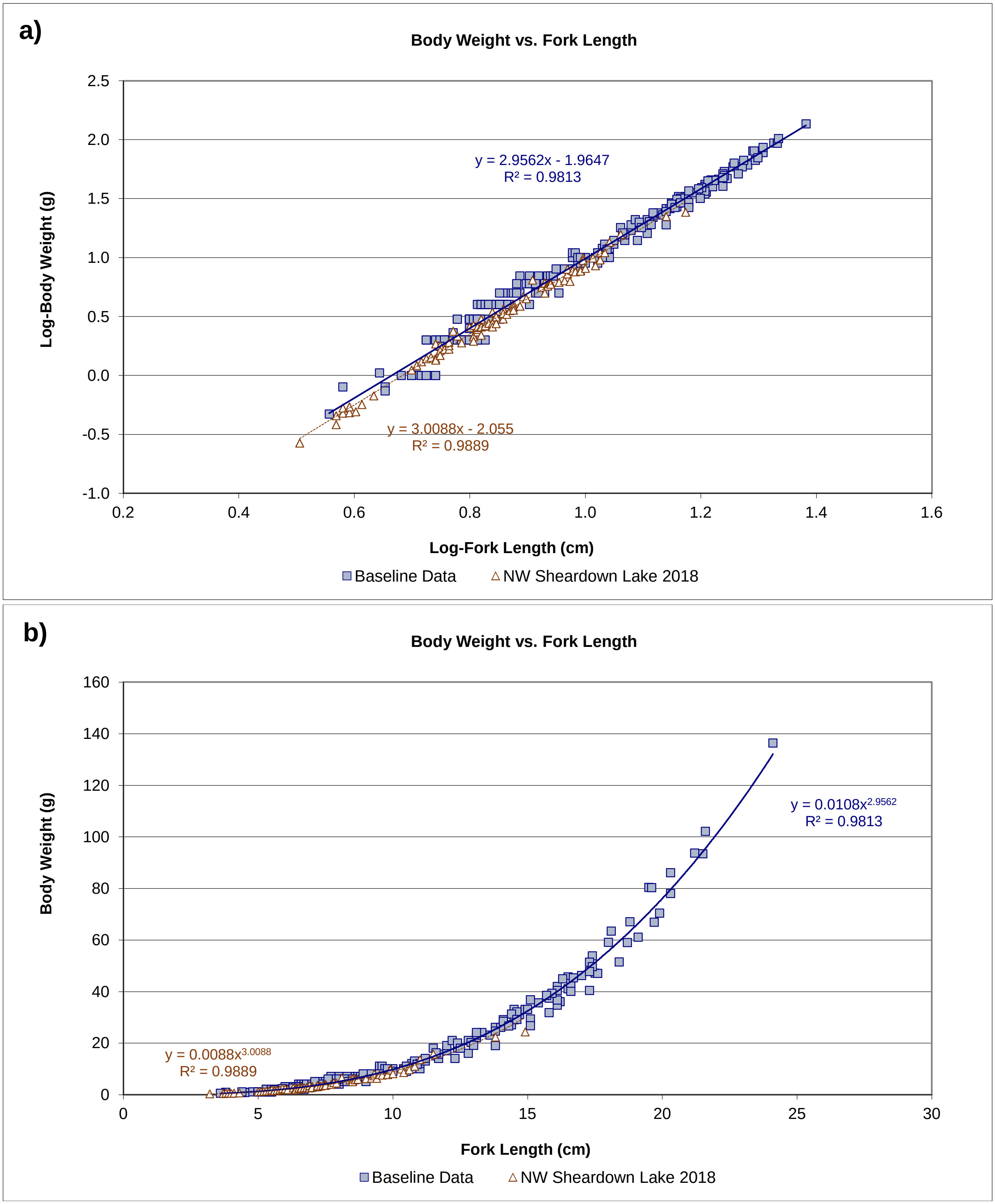
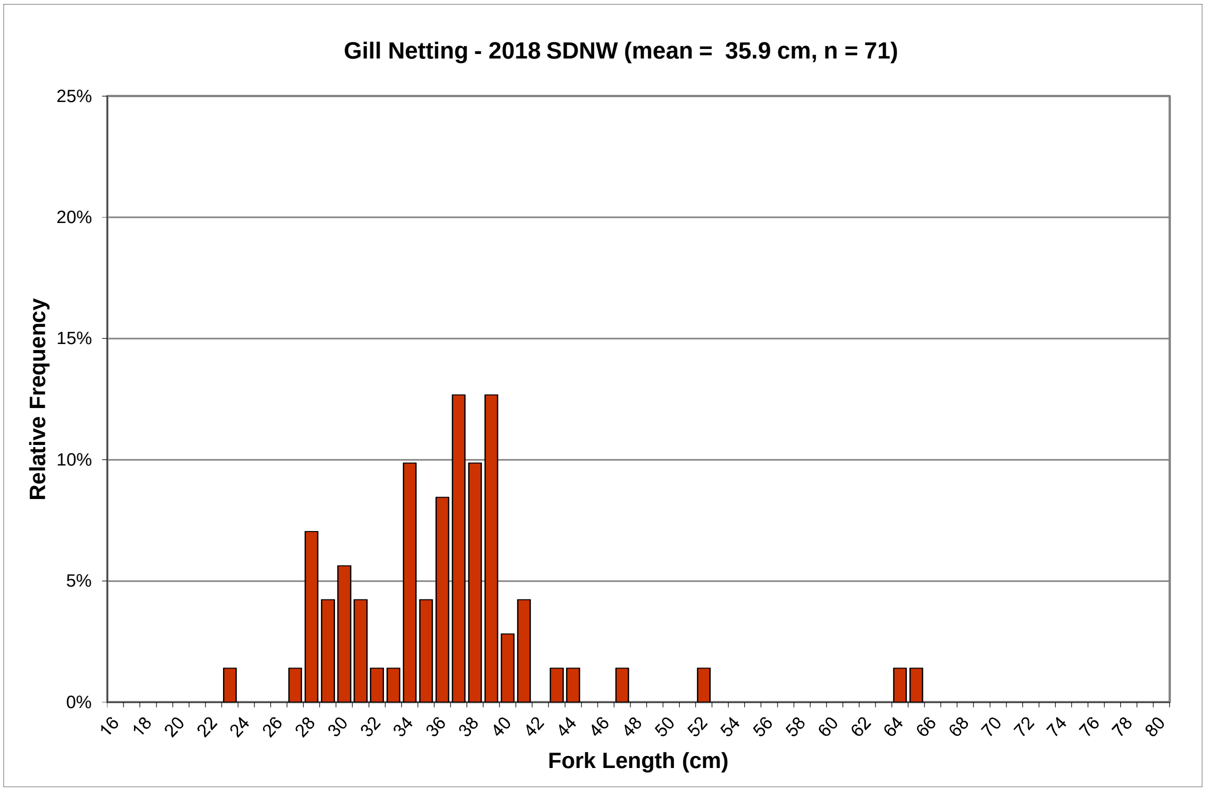


Figure G.9: **Comparison of Condition (Weight-at-fork length Relationship) for Arctic Charr Collected in Fall (August-September) at Sheardown Lake NW Nearshore Areas in 2018 and During the Mine Baseline Period (2007, 2008, 2013) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP**



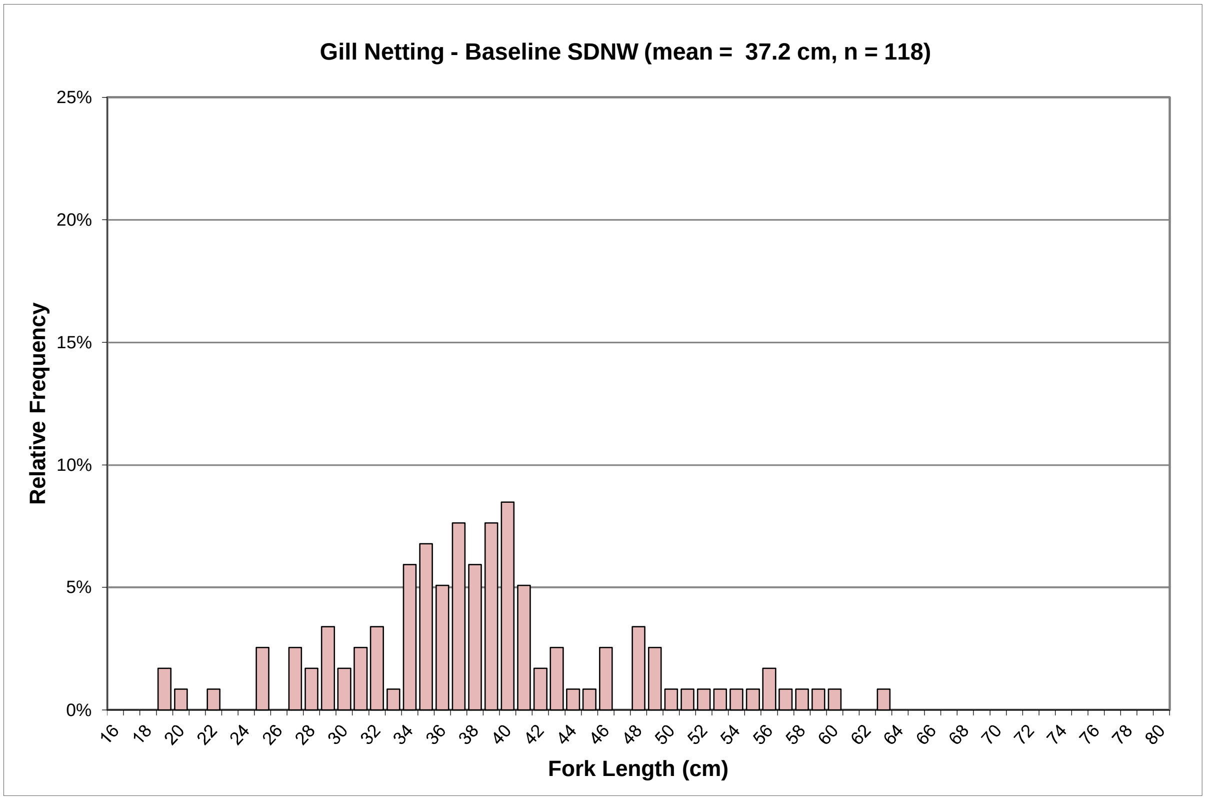


Figure G.10: **Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Sheardown Lake NW (DLO-01) in 2018 and Baseline Studies Conducted in Fall, Mary River Project CREMP**

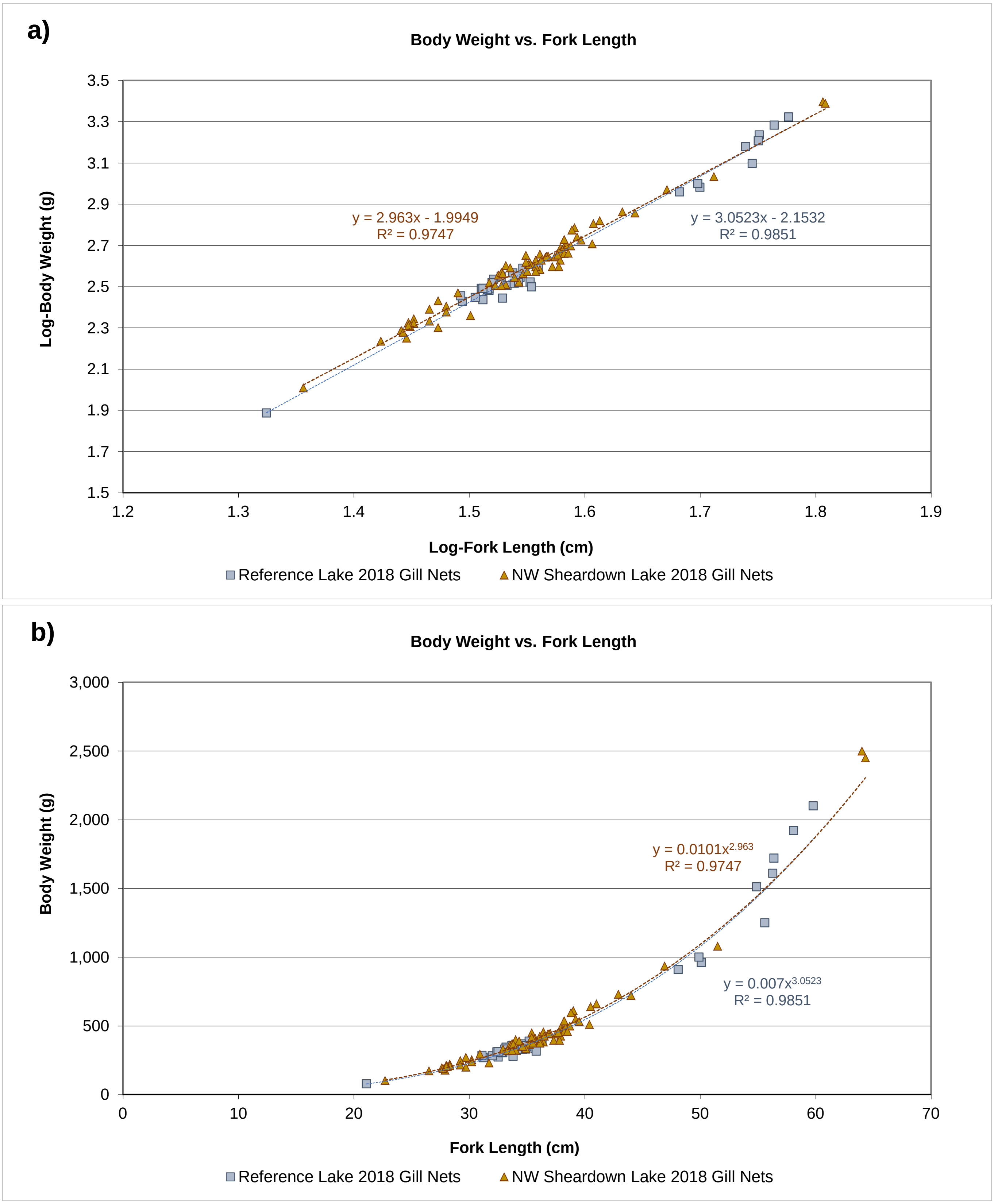
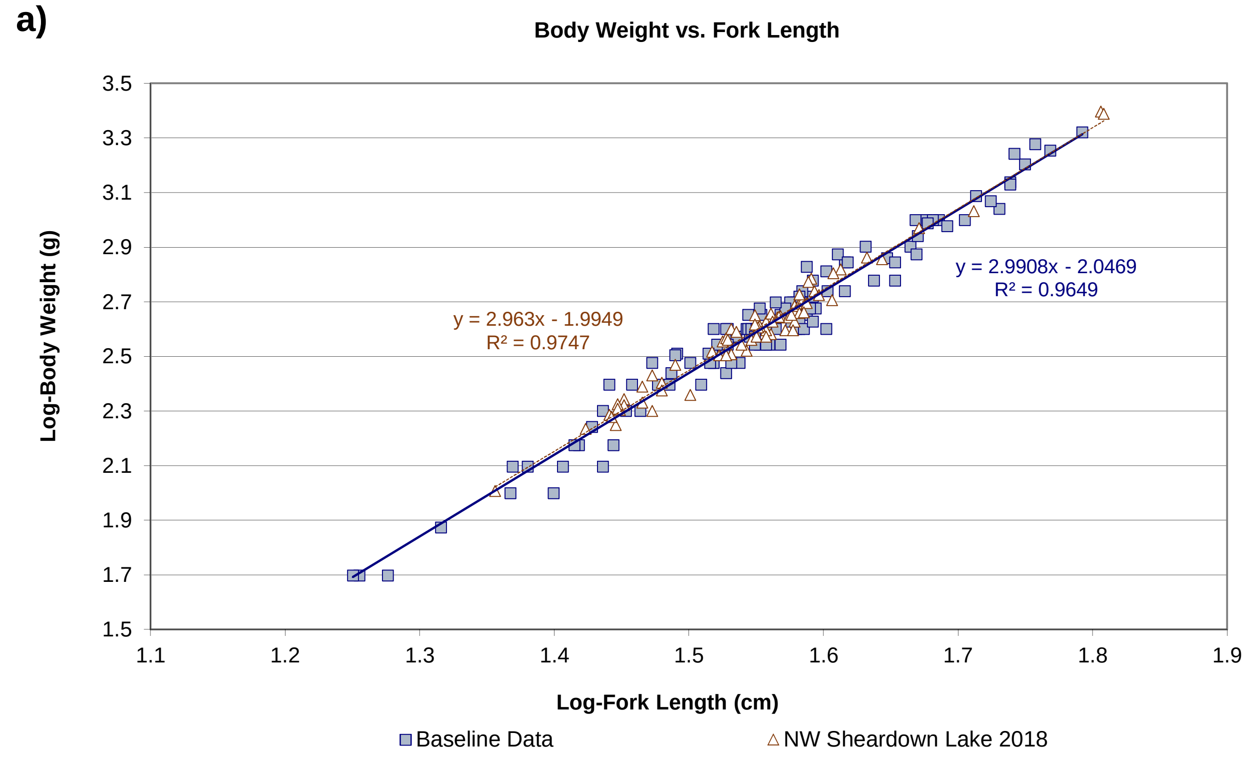


Figure G.11: **Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at Littoral/Profundal Areas of Sheardown Lake NW and Reference Lake 3 in August 2018 using Log-transformed (a) and Untransformed (b) Data, Mary River Project 2018 CREMP**

a)



b)

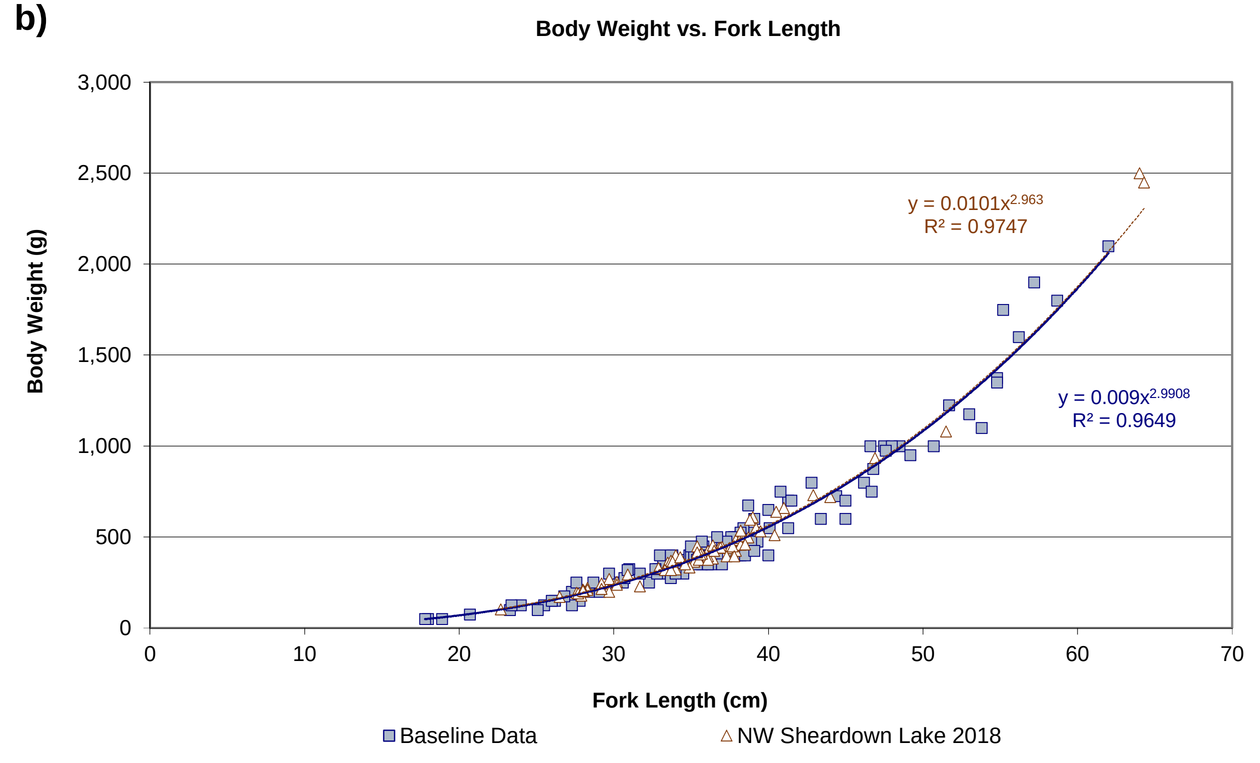
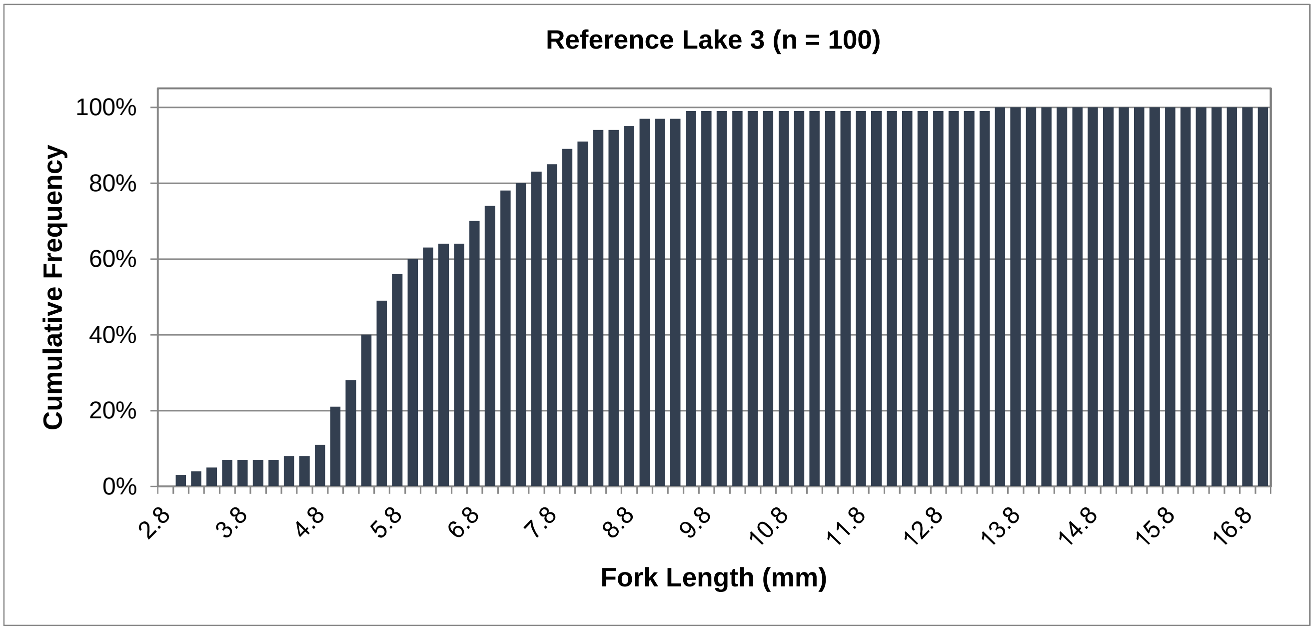


Figure G.12: **Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Sheardown Lake NW Nearshore Areas in 2018 and during the Mine Baseline Period (2006, 2007, 2008, 2013) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP**



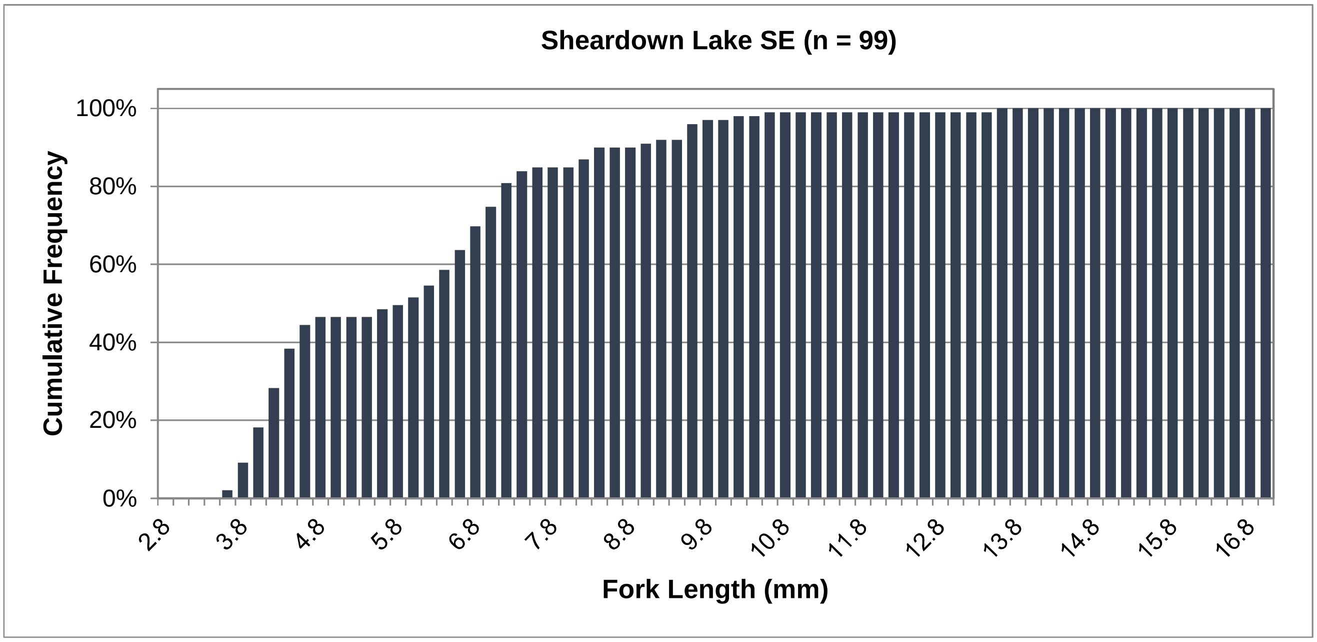


Figure G.13: **Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2018**

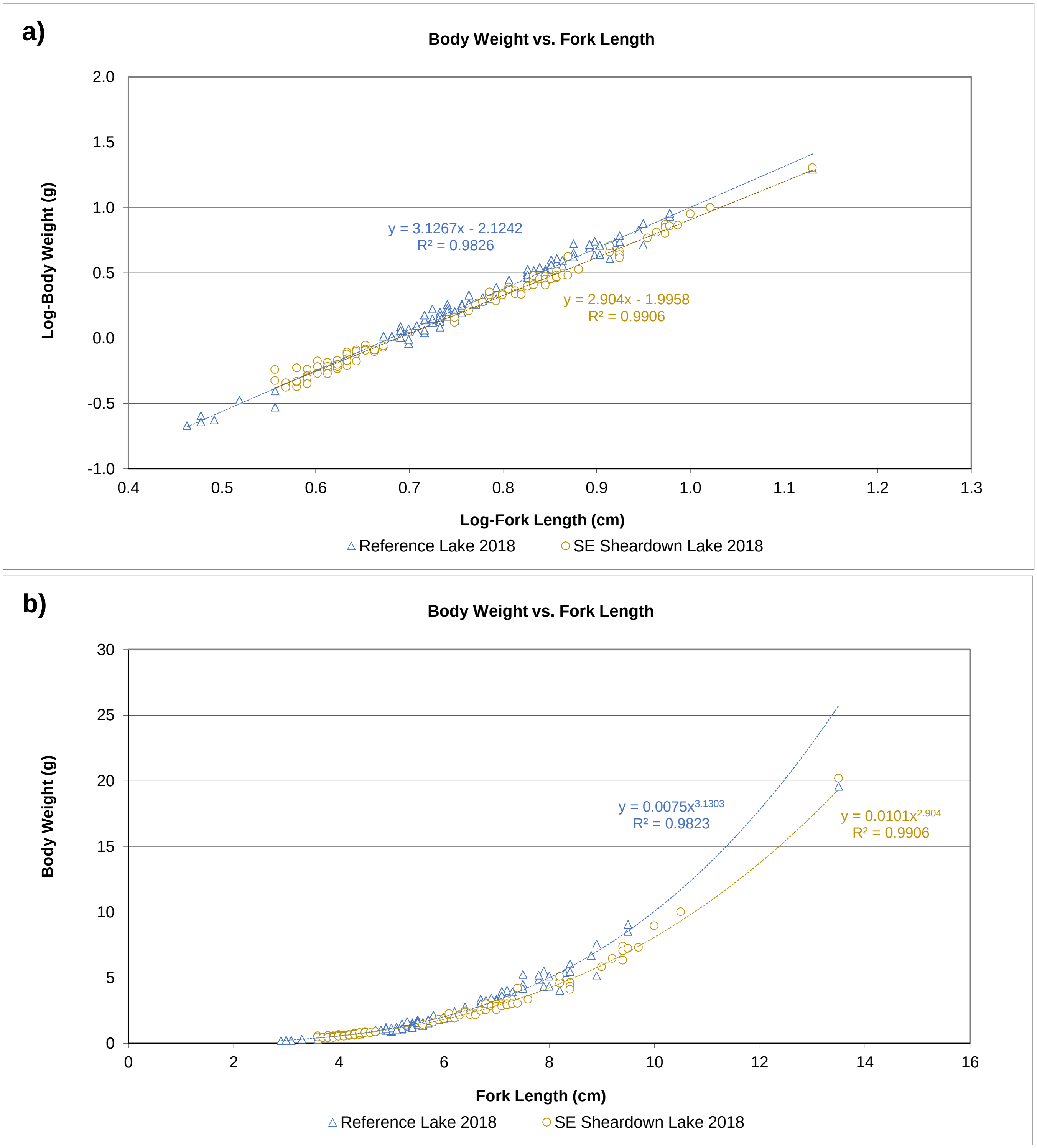
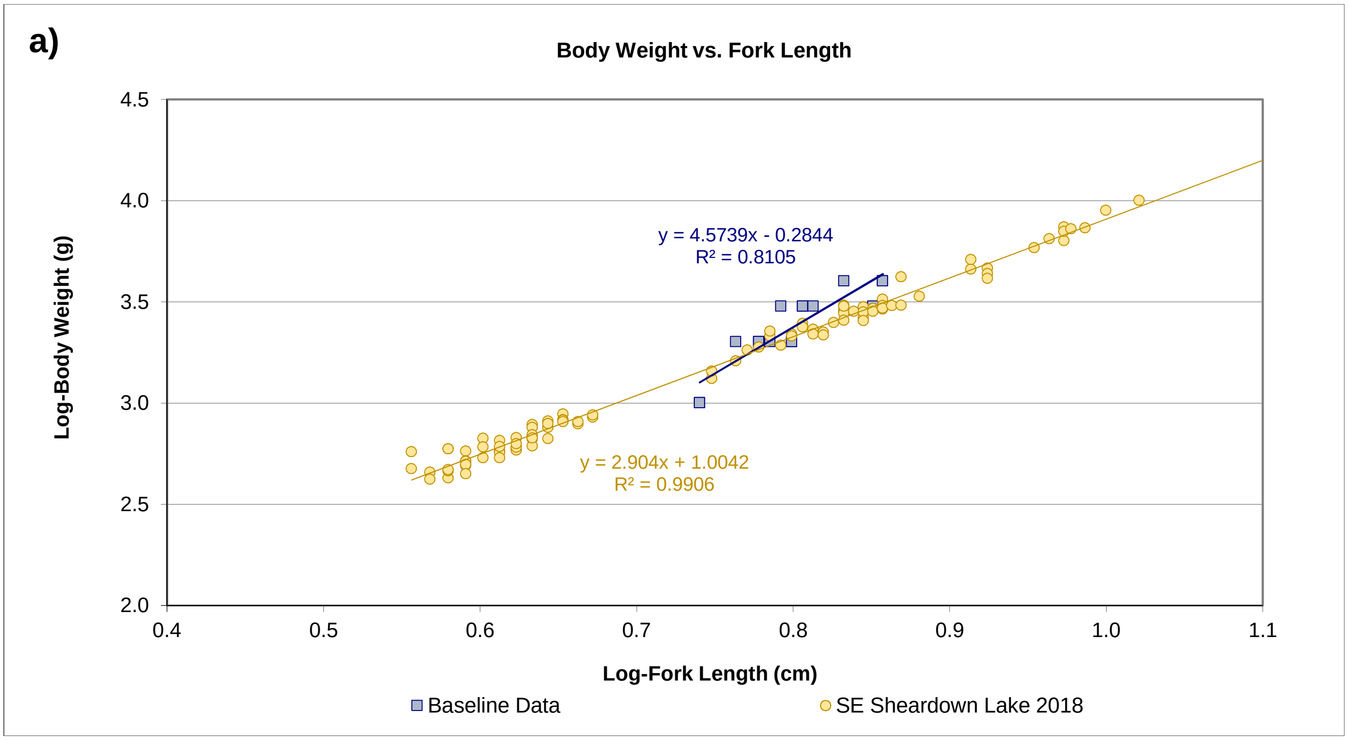


Figure G.14: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected at the Nearshore Area of Sheardown Lake SE and Reference Lake 3 in August 2018 using Log-transformed (a) and Untransformed (b) Data, Mary River Project 2018 CREMP



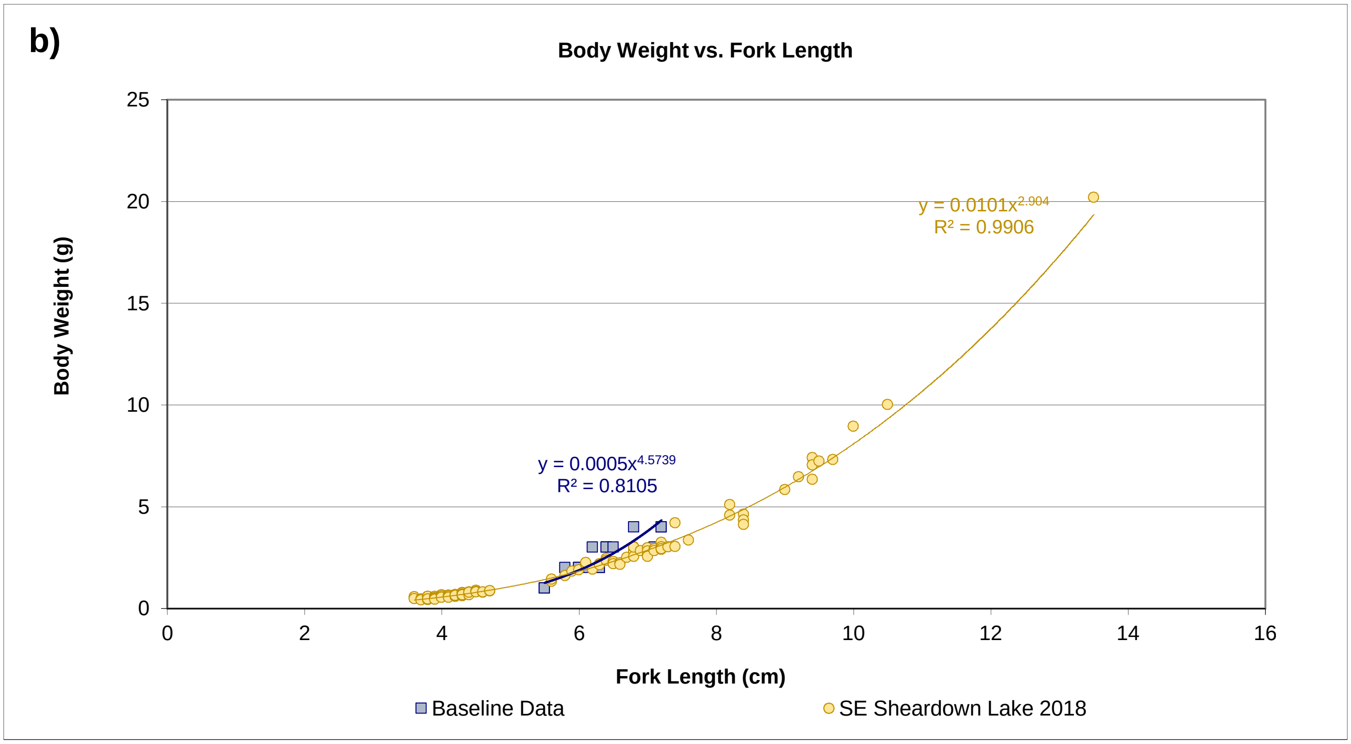
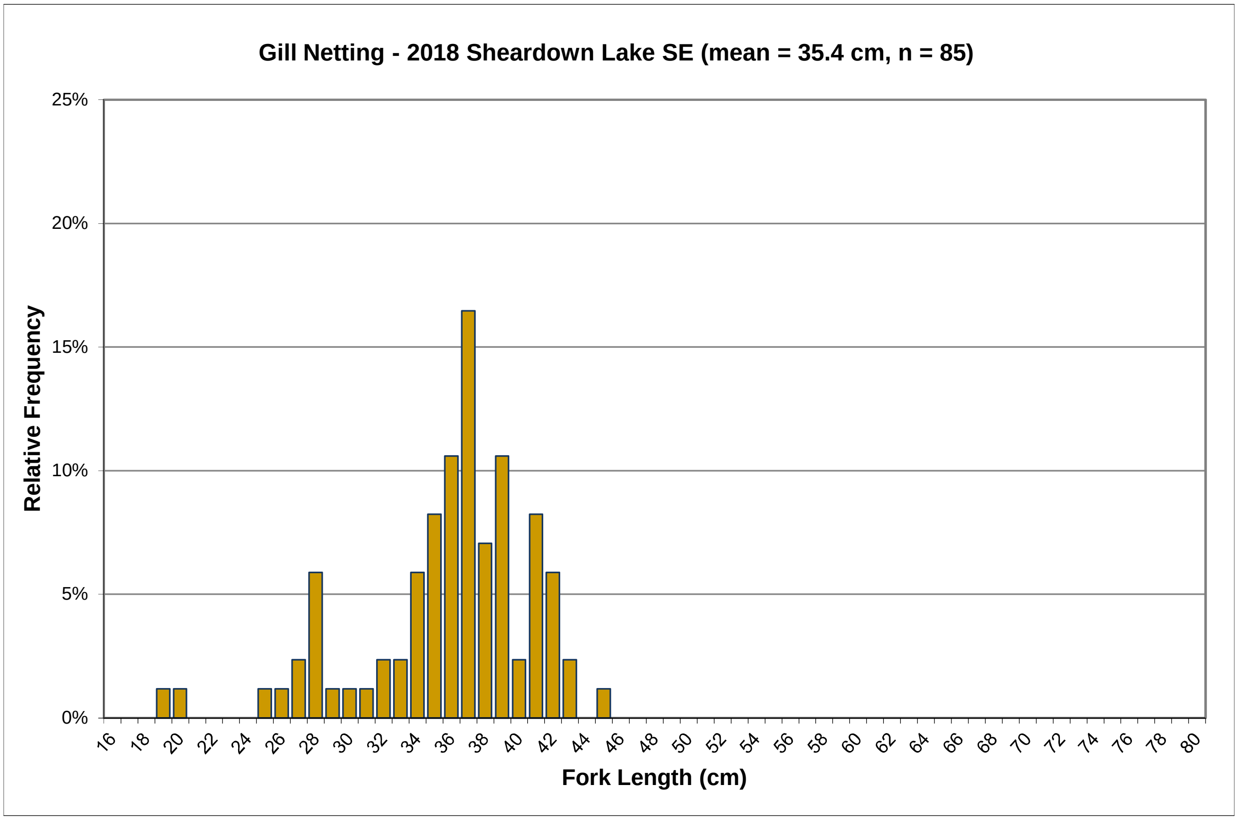


Figure G.15: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Sheardown Lake SE Nearshore Areas in 2018 and During the Mine Baseline Period (2007) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP



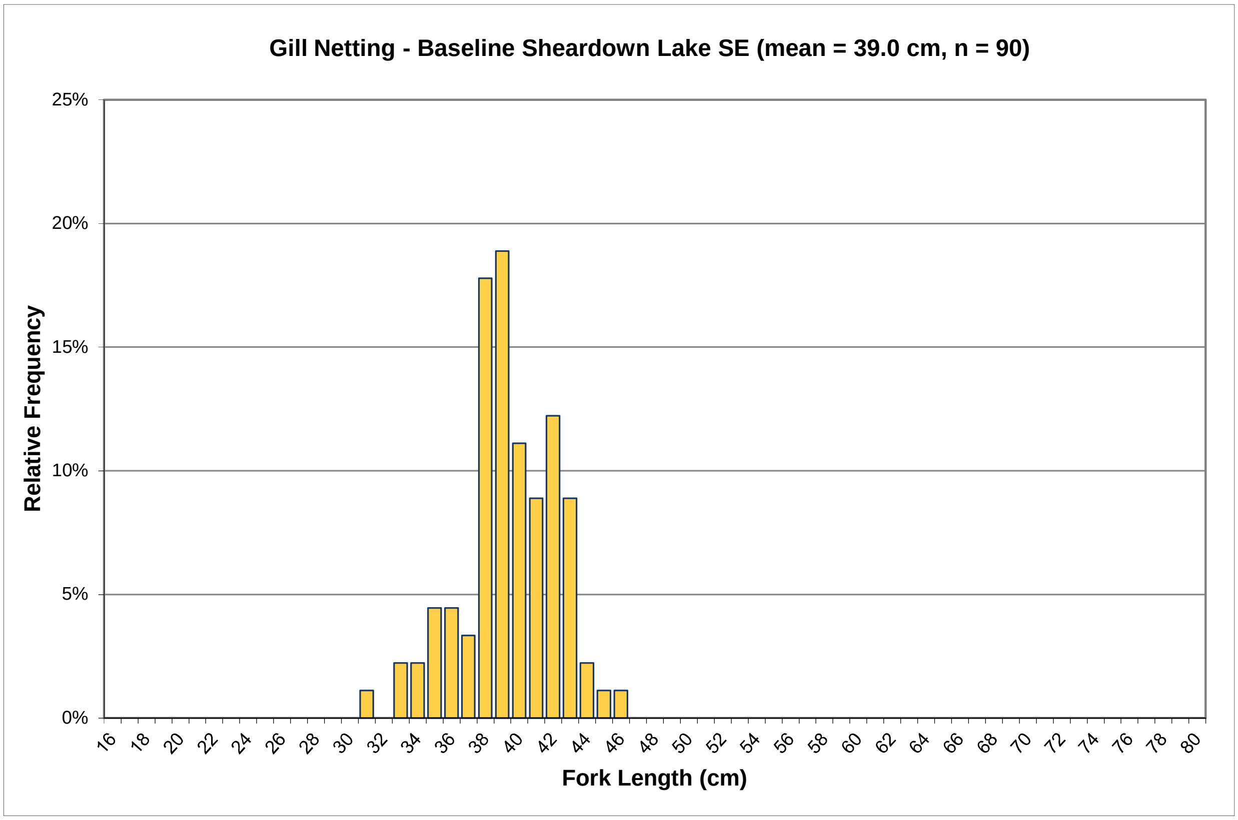


Figure G.16: **Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Sheardown Lake SE (DLO-02) in 2018 and Baseline Studies Conducted in Fall, Mary River Project CREMP**

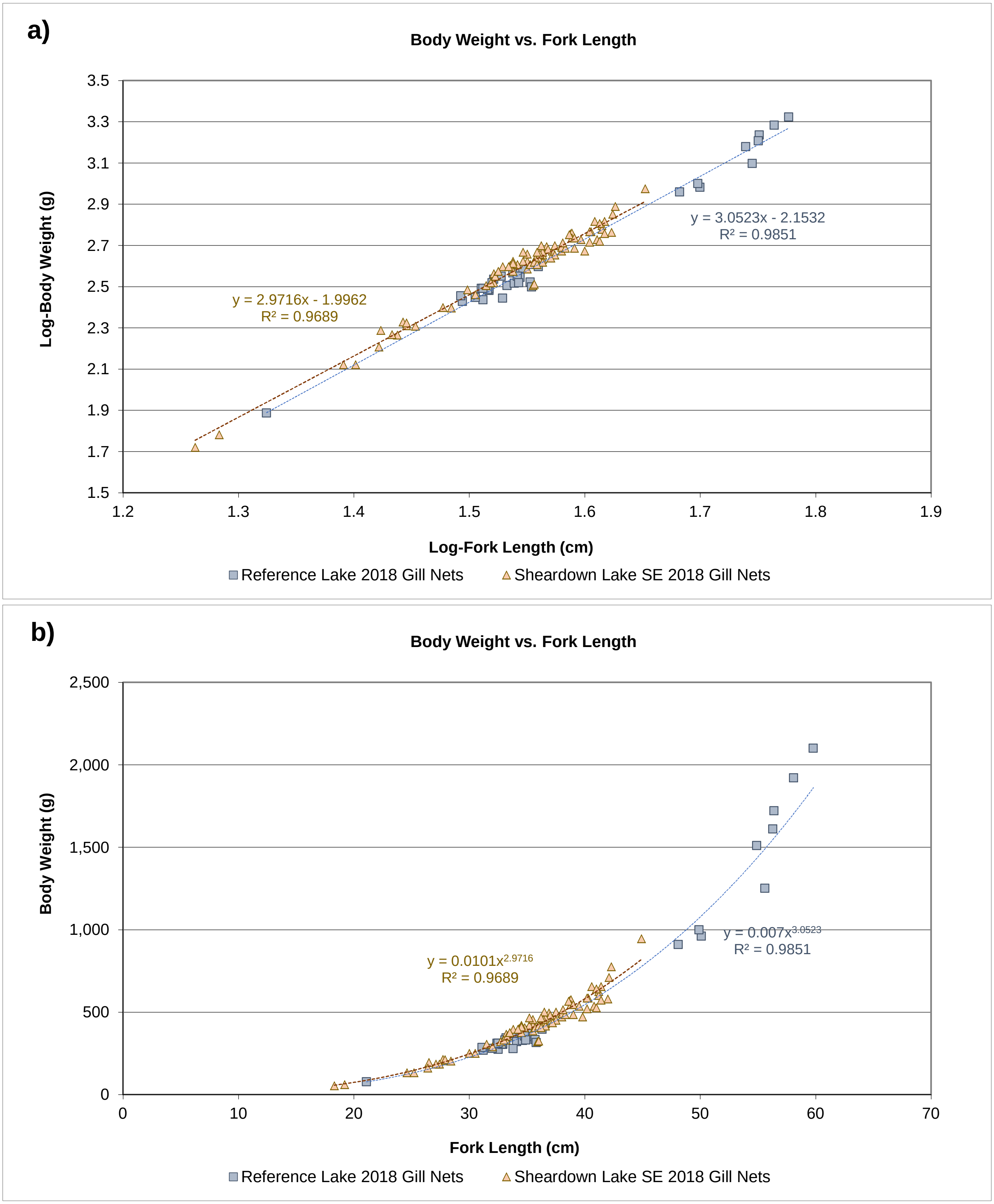


Figure G.17: **Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at Littoral/Profundal Areas of Sheardown Lake SE and Reference Lake 3 in August 2018 using Log-transformed (a) and Untransformed (b) Data, Mary River Project 2018 CREMP**

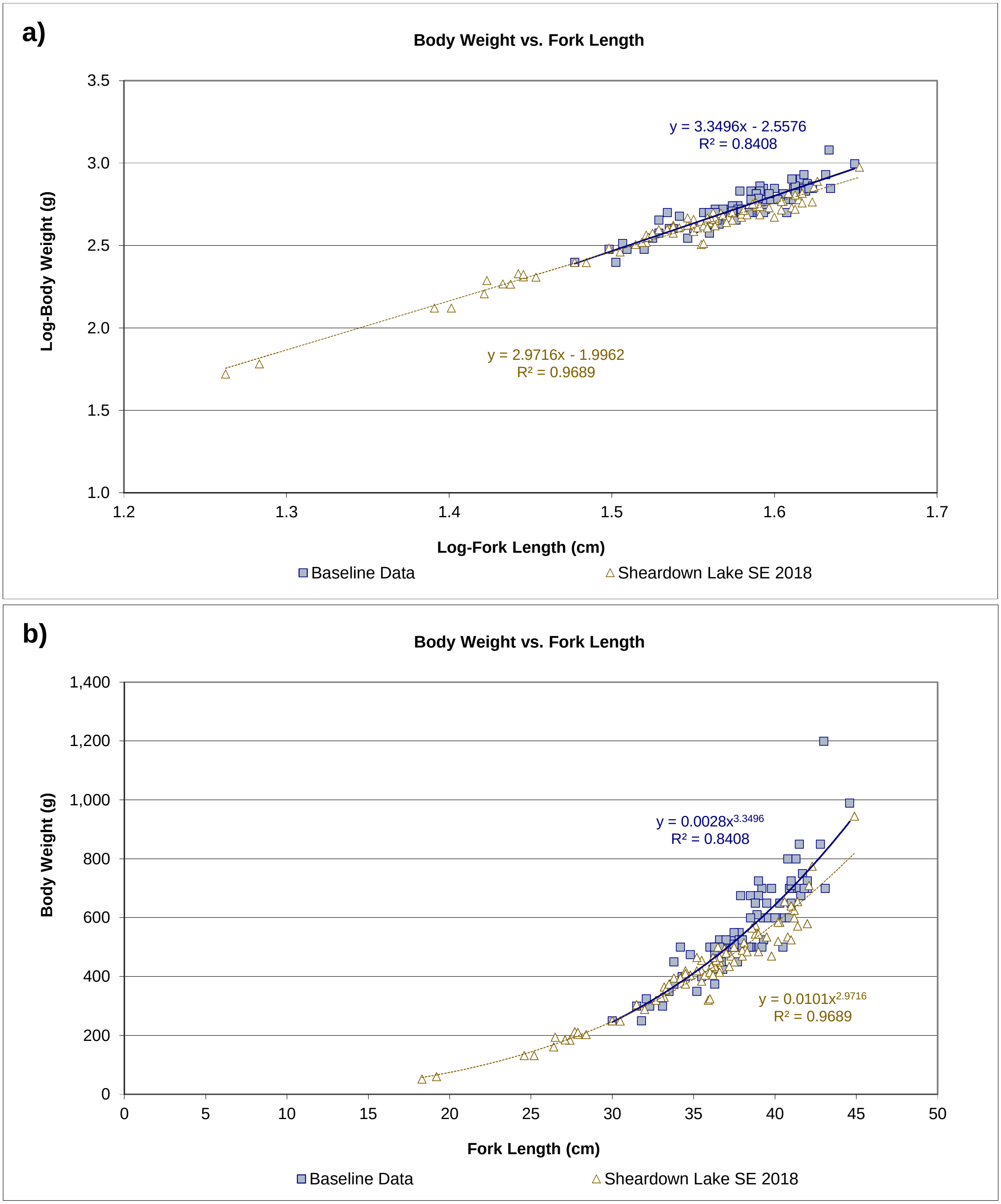


Figure G.18: **Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr collected in Fall (August-September) at Sheardown Lake SE Nearshore Areas in 2018 and During the Mine Baseline Period (2007, 2008) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP**

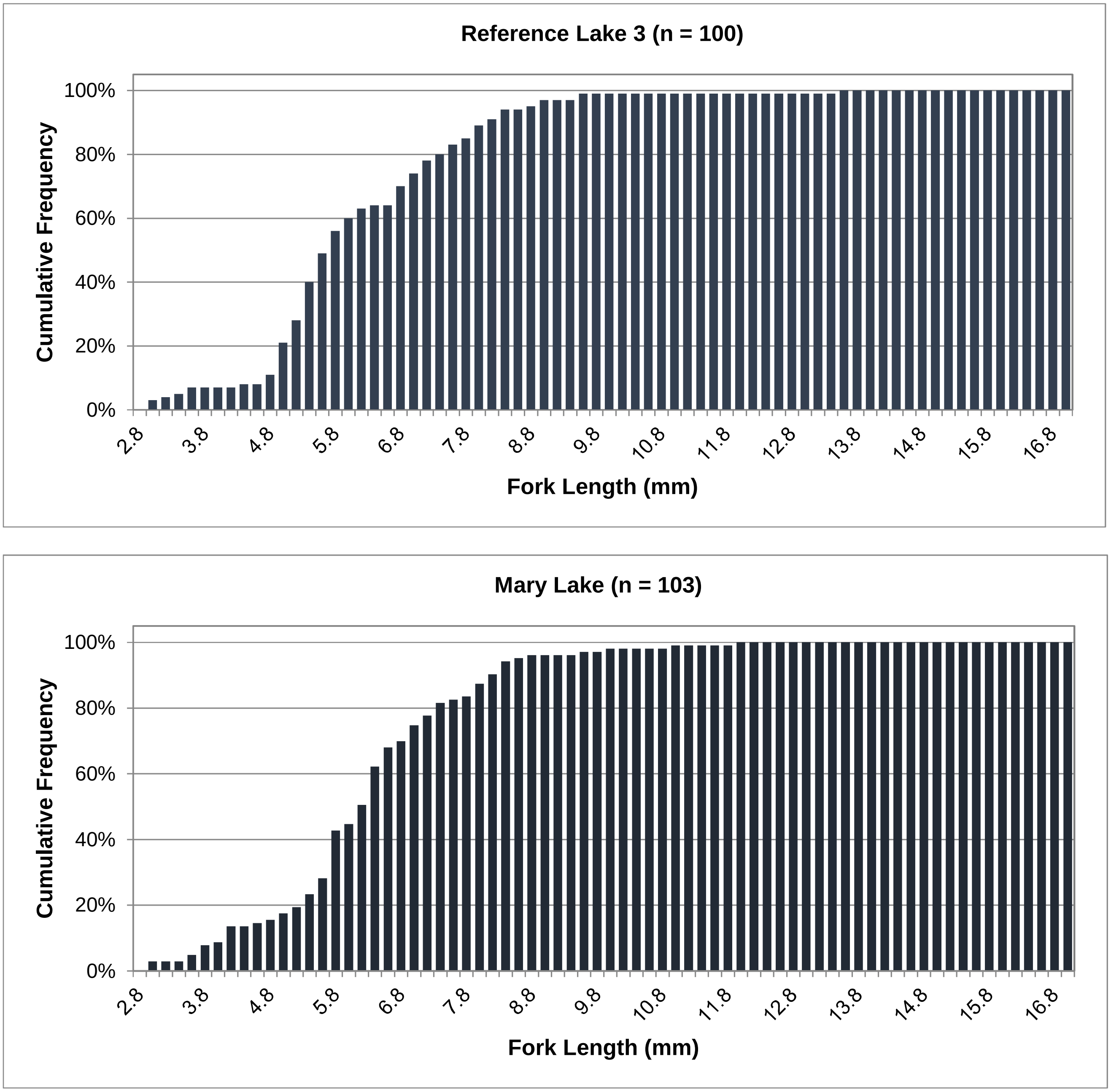


Figure G.19: **Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2018**

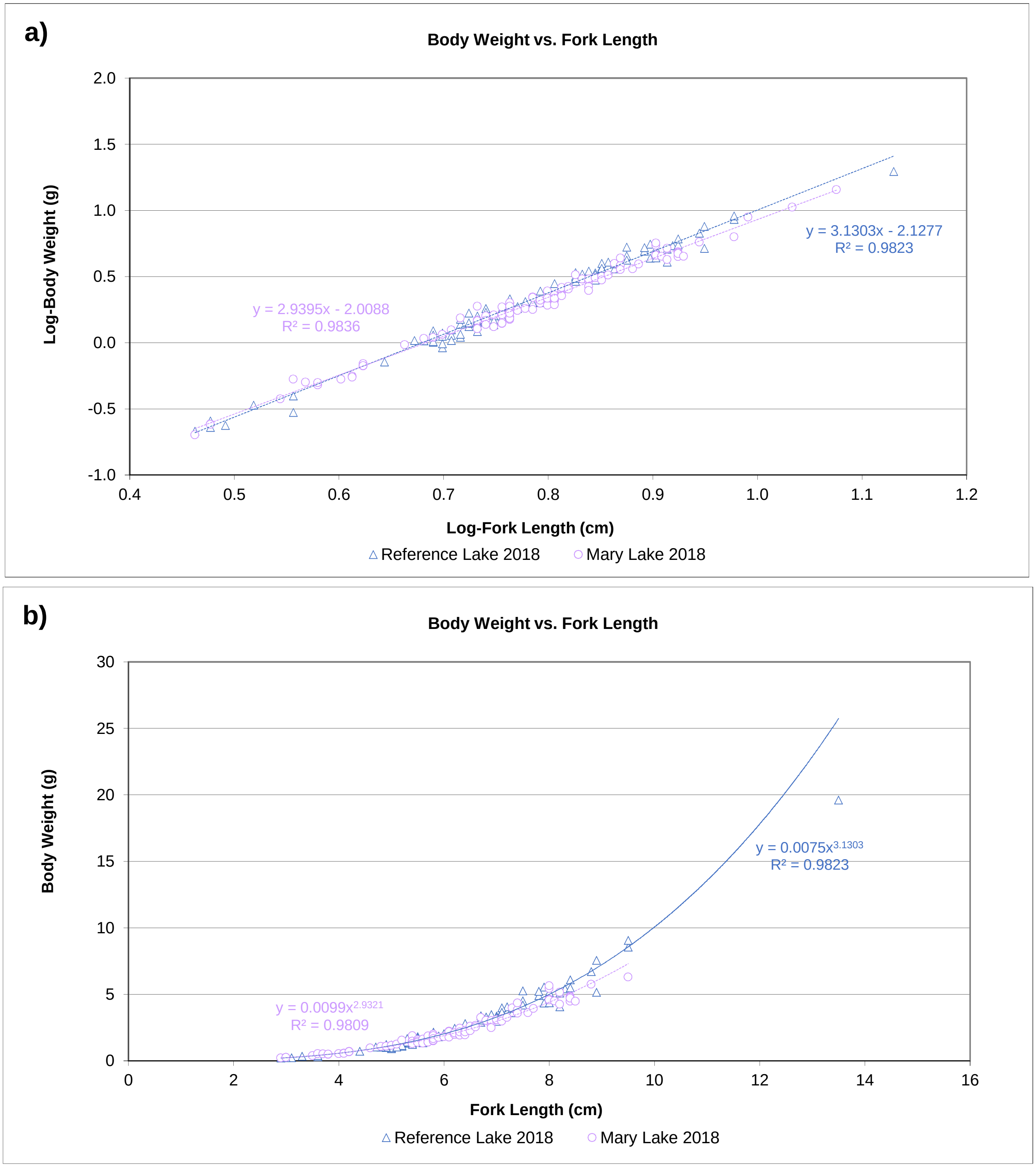
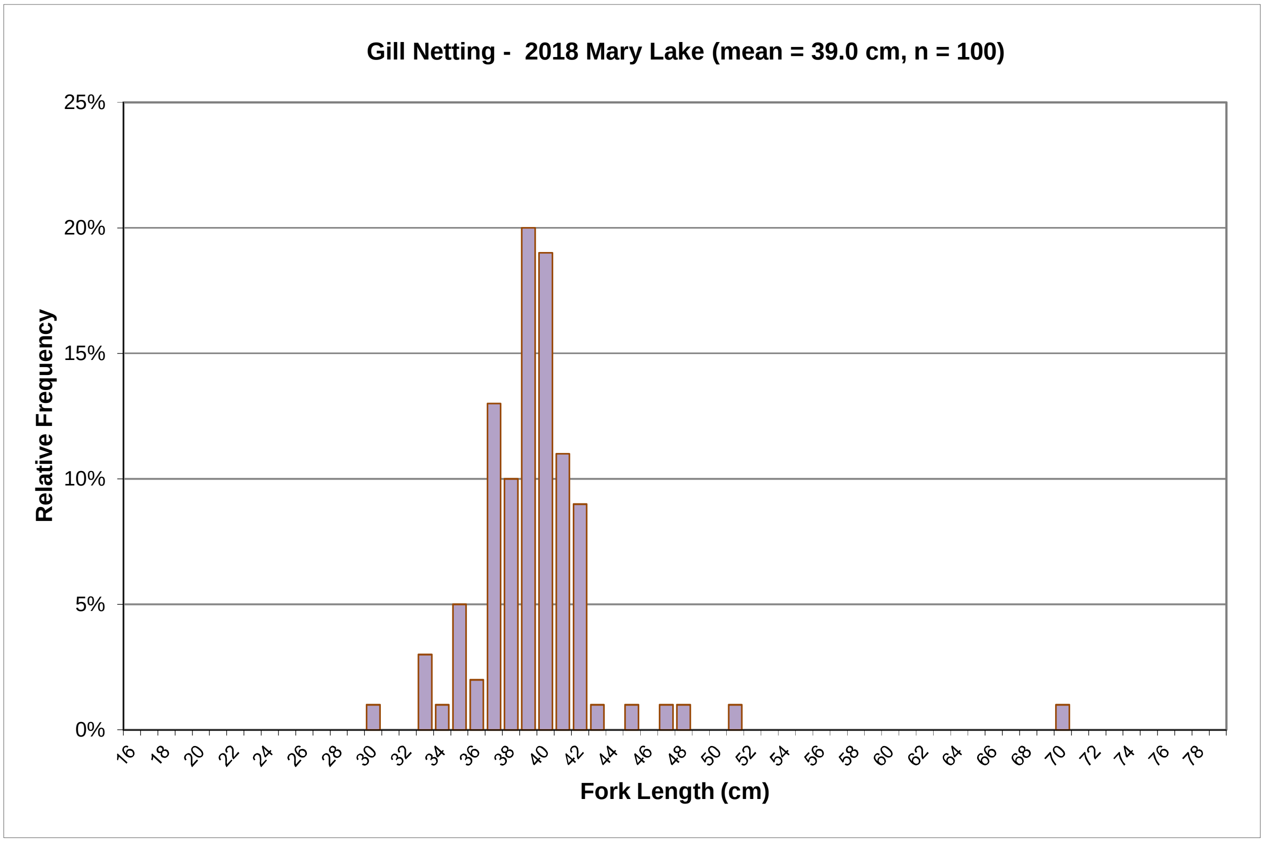


Figure G.20: **Comparison of Condition (Weight-at-fork-Length Relationship) for Arctic Charr Collected at the Nearshore Area of Mary Lake and Reference Lake 3 in August 2018 using Log-Transformed (a) and Untransformed (b) Data, Mary River Project 2018 CREMP**



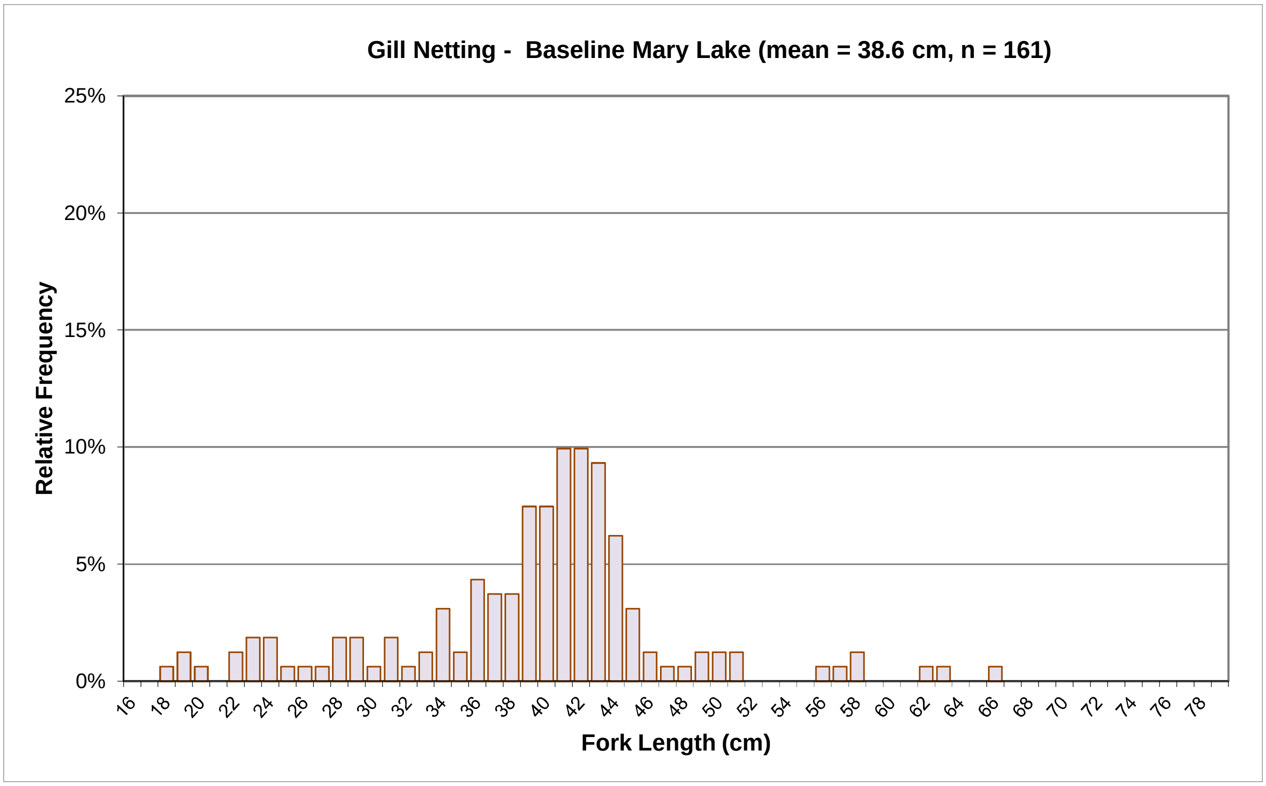


Figure G.21: Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Mary Lake (BLO) in 2018 and Baseline Studies Conducted in Fall, Mary River Project

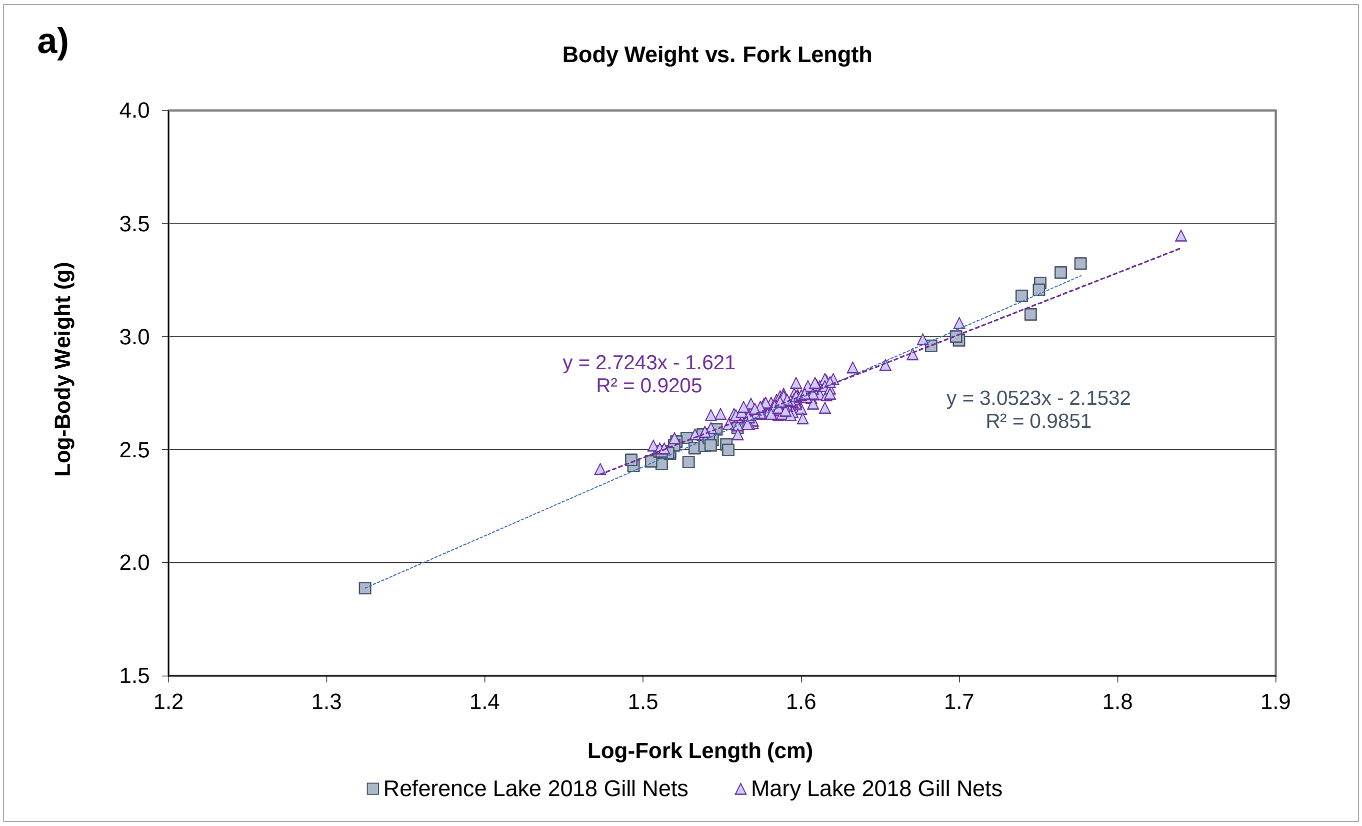


Figure G.22: **Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at Littoral/Profundal Areas of Mary Lake and Reference Lake 3 in August 2018 using Log-transformed (a) and Untransformed (b) Data, Mary River Project 2018 CREMP**

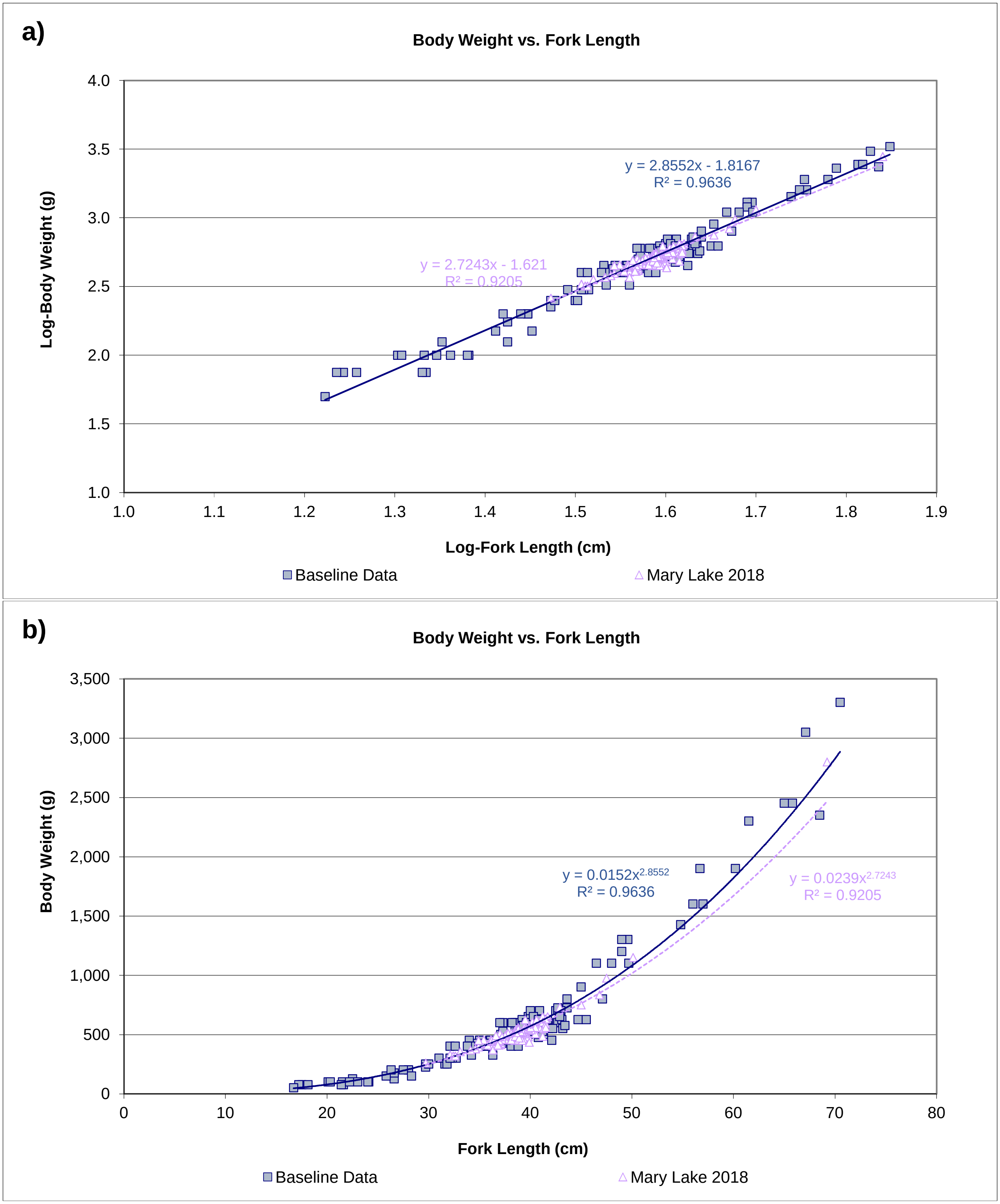


Figure G.23: **Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Mary Lake Nearshore Areas in 2018 and During the Mine Baseline Period (2006, 2007) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP**

Table G.1: **Electrofishing Catch Records, Mary River Project CREMP, August 2018**

Waterbody	Sample Station Identifier	Location (NAD83, UTM Zone 17W)				Fishing Date	Electrofisher Settings			Effort (seconds)	Fish Species						Total (all species)	
											Arctic Charr			Nine-spine Stickleback				
		Start		Finish			Output Voltage (volts)	Cycle Freq. (Hz)	Duty Cycle (%)		No. Captured	No. Mortalities / Retained	CPUE	No. Captured	No. Mortalities / Retained	CPUE	Total Catch	CPUE
		Easting	Northing	Easting	Northing													
Reference Lake 3	REF3-18-EF-1	574894	7853034	575052	7853060	23-Aug-18	500-600	30-50	-	3,153	68	23	1.29	2	0	0.04	103	1.61
	REF3-18-EF-2	575052	7853060	575120	785086	23-Aug-18	600	50	-	1,047	33	0	1.89	0	0	0.00		
Camp Lake	JLO-18-EF-1	557805	7914662	557798	7914646	15-Aug-18	500	30	12	837	109	11	7.81	1	0	0.07	110	7.89
Sheardown Lake NW	DLO1-18-EF-1	560272	7913489	560197	7913483	16-Aug-18	500	30	-	1,357	98	10	4.33	0	0	0.00	98	4.33
Sheardown Lake SE	DLO2-18-EF-1	560721	7912355	560763	7912313	16-Aug-18	-	-	-	1,102	99	10	5.39	1	0	0.05	100	5.44
Mary Lake	BLO-18-EF-1	555405	7905135	555507	7904989	16-Aug-18	500	30	12	2,988	103	10	2.07	4	0	0.08	107	2.15

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per electrofishing minute.

Table G.2: Gill Netting Catch Records for Reference Lake 3, Mary River Project CREMP, August 2018

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (m)	Set Date	Lift Date	Set Time	Lift Time	Fishing Hours	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE
	Easting	Northing								1½"	2"	3"		
REF318-GN-01	575233	7853040	91.4	25-Aug-18	25-Aug-18	13:05	16:00	2.92	2.67	0	0	0	0	0
REF318-GN-02	574636	7853005	91.4	25-Aug-18	25-Aug-18	13:15	15:40	2.42	2.21	0	5	1	6	2.72
REF318-GN-03	573850	7852686	91.4	25-Aug-18	25-Aug-18	13:25	16:20	2.92	2.67	1	1	1	3	1.12
REF318-GN-04	573717	7853819	91.4	25-Aug-18	25-Aug-18	13:35	16:40	3.08	2.82	0	0	0	0	0
REF318-GN-05	574130	7853547	91.4	25-Aug-18	25-Aug-18	13:45	16:40	2.92	2.67	0	2	0	2	0.75
REF318-GN-06	574636	7853005	91.4	25-Aug-18	25-Aug-18	15:55	17:30	1.58	1.45	1	1	1	3	2.07
REF318-GN-07	574932	7852983	91.4	25-Aug-18	25-Aug-18	16:10	17:10	1.00	0.91	0	0	0	0	0
REF318-GN-08	573850	7852686	91.4	25-Aug-18	25-Aug-18	16:30	17:20	0.83	0.76	0	0	0	0	0
REF318-GN-09	574543	7852952	91.4	27-Aug-18	27-Aug-18	8:45	12:10	3.42	3.12	0	0	0	0	0
REF318-GN-10	573887	7852680	91.4	27-Aug-18	27-Aug-18	9:00	11:35	2.58	2.36	0	0	0	0	0
REF318-GN-11	574122	7852281	91.4	27-Aug-18	27-Aug-18	9:10	11:45	2.58	2.36	0	0	0	0	0
REF318-GN-12	574295	7852483	61.0	27-Aug-18	27-Aug-18	9:30	12:00	2.50	1.52	0	0	0	0	0
REF318-GN-13	574512	7853046	91.4	27-Aug-18	27-Aug-18	10:15	12:40	2.42	2.21	0	0	0	0	0
REF318-GN-14	574249	7853518	91.4	27-Aug-18	27-Aug-18	10:25	13:30	3.08	2.82	0	1	0	1	0.35
REF318-GN-15	574451	7853682	91.4	27-Aug-18	27-Aug-18	10:30	13:45	3.25	2.97	1	0	0	1	0.34
REF318-GN-16	575530	7852911	91.4	27-Aug-18	27-Aug-18	10:50	14:00	3.17	2.90	0	1	0	1	0.35
REF318-GN-17	575622	7852435	91.4	27-Aug-18	27-Aug-18	11:00	14:15	3.25	2.97	1	2	0	3	1.01
REF318-GN-18	576087	7852489	91.4	27-Aug-18	27-Aug-18	11:10	14:30	3.33	3.05	2	0	0	2	0.66
REF318-GN-19	574972	7852512	91.4	27-Aug-18	27-Aug-18	11:20	14:55	3.58	3.28	0	0	0	0	0
REF318-GN-20	573887	7852680	91.4	27-Aug-18	27-Aug-18	11:35	15:30	3.92	3.58	0	1	0	1	0.28
REF318-GN-21	574122	7852281	91.4	27-Aug-18	27-Aug-18	11:45	15:50	4.08	3.73	0	0	0	0	0
REF318-GN-22	574295	7852483	61.0	27-Aug-18	27-Aug-18	12:00	16:00	4.00	2.44	0	0	0	0	0
REF318-GN-23	574543	7852952	91.4	27-Aug-18	27-Aug-18	12:10	16:15	4.08	3.73	0	4	1	5	1.34
REF318-GN-24	574512	7853046	91.4	27-Aug-18	27-Aug-18	12:40	16:25	3.75	3.43	0	0	0	0	0
REF318-GN-25	574249	7853518	91.4	27-Aug-18	27-Aug-18	13:30	17:00	3.50	3.20	0	2	2	4	1.25
REF318-GN-26	574451	7853682	91.4	27-Aug-18	27-Aug-18	13:45	17:10	3.42	3.12	0	1	0	1	0.32
REF318-GN-27	575530	7852911	91.4	27-Aug-18	27-Aug-18	14:00	16:40	2.67	2.44	0	0	0	0	0
REF318-GN-28	575622	7852435	91.4	27-Aug-18	27-Aug-18	14:15	16:45	2.50	2.29	0	0	0	0	0
REF318-GN-29	574073	7853622	91.4	27-Aug-18	27-Aug-18	15:18	17:25	2.12	1.94	0	0	0	0	0
REF318-GN-30	573634	7853664	91.4	27-Aug-18	27-Aug-18	15:20	17:30	2.17	1.98	0	0	1	1	0.50
REF318-GN-31	573887	7852680	91.4	27-Aug-18	27-Aug-18	15:35	17:45	2.17	1.98	0	0	0	0	0
REF318-GN-32	574122	7852281	91.4	27-Aug-18	27-Aug-18	15:50	17:50	2.00	1.83	0	0	0	0	0
REF318-GN-33	574295	7852483	61.0	27-Aug-18	27-Aug-18	16:00	18:00	2.00	1.22	0	0	0	0	0
REF318-GN-34	574543	7852952	91.4	27-Aug-18	27-Aug-18	16:15	18:10	1.92	1.75	0	0	0	0	0
								Total	**84.38**	**6**	**21**	**7**	**34**	**0.38**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.3: Summary of Arctic Charr Gill Net Catches by Mesh Size, Mary River Project CREMP, August 2018

Waterbody	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE	Mortalities
		1½"	2"	3"			
Reference Lake 3	84.38	6	21	7	34	0.38	12
Camp Lake	22.32	22	22	50	94	4.29	6
Sheardown Lake NW	108.20	17	52	22	91	0.63	8
Sheardown Lake SE	20.35	17	43	25	91	3.98	9
Mary Lake	18.14	5	54	70	129	7.30	20
Total	**253.38**	**67**	**192**	**174**	**439**	**3.31**	**55**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.4: Arctic Charr Measurements from Fish Captured at Reference Lake 3 by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF318-ACJ-01	4.4	4.7	0.712	0	0.836
REF318-ACJ-02	5.4	5.8	1.585	1	1.007
REF318-ACJ-03	9.5	10.4	8.542	2	0.996
REF318-ACJ-04	9.5	10.4	9.055	2	1.056
REF318-ACJ-05	8.8	9.4	6.705	1	0.984
REF318-ACJ-06	7.8	8.3	4.901	2	1.033
REF318-ACJ-07	6.7	7.2	3.172	1	1.055
REF318-ACJ-08	6.8	7.3	3.290	1	1.046
REF318-ACJ-09	5.5	5.8	1.806	-	1.085
REF318-ACJ-10	5.1	5.4	1.135	-	0.856
REF318-ACJ-11	3.6	3.7	0.296	-	0.634
REF318-ACJ-12	4.8	5.1	1.033	-	0.934
REF318-ACJ-13	5.4	5.7	1.415	-	0.899
REF318-ACJ-14	5.8	6.1	1.849	-	0.948
REF318-ACJ-15	8.2	8.8	4.051	-	0.735
REF318-ACJ-16	5.9	6.2	1.805	-	0.879
REF318-ACJ-17	8.3	8.9	5.406	-	0.945
REF318-ACJ-18	3.3	3.4	0.336	-	0.935
REF318-ACJ-19	5.1	5.4	1.247	-	0.940
REF318-ACJ-20	7.0	7.5	3.370	-	0.983
REF318-ACJ-21	5.5	5.8	1.696	-	1.019
REF318-ACJ-22	5.7	5.9	1.559	-	0.842
REF318-ACJ-23	7.3	7.7	3.610	-	0.928
REF318-ACJ-24	5.0	5.2	1.114	-	0.891
REF318-ACJ-25	4.9	5.2	1.167	-	0.992
REF318-ACJ-26	8.4	9.0	5.482	-	0.925
REF318-ACJ-27	7.9	8.5	4.344	-	0.881
REF318-ACJ-28	7.9	8.4	5.534	-	1.122
REF318-ACJ-29	5.2	5.4	1.097	-	0.780
REF318-ACJ-30	5.3	5.5	1.323	-	0.889
REF318-ACJ-31	6.2	6.6	2.448	-	1.027
REF318-ACJ-32	2.9	3.0	0.214	-	0.877
REF318-ACJ-33	5.0	5.2	0.912	-	0.730
REF318-ACJ-34	7.8	8.5	5.219	-	1.100
REF318-ACJ-35	6.7	7.2	2.898	-	0.964
REF318-ACJ-36	8.2	8.8	5.092	-	0.924
REF318-ACJ-37	8.9	9.6	7.559	-	1.072
REF318-ACJ-38	4.9	5.2	1.227	-	1.043
REF318-ACJ-39	5.3	5.6	1.398	-	0.939
REF318-ACJ-40	7.0	7.5	2.961	-	0.863
REF318-ACJ-41	5.2	5.5	1.377	-	0.979
REF318-ACJ-42	5.7	6.0	1.726	-	0.932
REF318-ACJ-43	7.0	7.4	3.259	-	0.950
REF318-ACJ-44	3.6	3.7	0.394	-	0.844
REF318-ACJ-45	7.1	7.6	3.706	-	1.035
REF318-ACJ-46	5.5	5.9	1.807	-	1.086
REF318-ACJ-47	5.2	5.5	1.499	-	1.066
REF318-ACJ-48	5.8	6.1	2.136	-	1.095
REF318-ACJ-49	5.9	6.3	1.868	-	0.910
REF318-ACJ-50	7.2	7.7	4.056	-	1.087
REF318-ACJ-51	3.0	3.1	0.256	-	0.948
REF318-ACJ-52	5.5	5.8	1.693	-	1.018
REF318-ACJ-53	6.7	7.1	3.373	-	1.121
REF318-ACJ-54	6.4	6.7	2.792	-	1.065
REF318-ACJ-55	6.8	7.3	3.060	-	0.973
REF318-ACJ-56	7.5	8.0	4.516	-	1.070
REF318-ACJ-57	4.9	5.2	1.107	-	0.941

Table G.4: Arctic Charr Measurements from Fish Captured at Reference Lake 3 by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF318-ACJ-58		5.0	5.3	0.978	-	0.782
REF318-ACJ-59		4.9	5.1	1.004	-	0.853
REF318-ACJ-60		8.0	8.5	5.138	-	1.004
REF318-ACJ-61		4.9	5.2	1.019	-	0.866
REF318-ACJ-62		6.2	6.5	2.003	-	0.840
REF318-ACJ-63		5.6	5.9	1.362	-	0.776
REF318-ACJ-64		3.1	3.2	0.236	-	0.792
REF318-ACJ-65		4.8	5.0	1.033	-	0.934
REF318-ACJ-66		3.0	3.1	0.228	-	0.844
REF318-ACJ-67		8.4	9.0	6.077	-	1.025
REF318-ACJ-68		7.5	8.0	4.193	-	0.994
REF318-ACJ-69		13.5	14.6	19.603	6	0.797
REF318-ACJ-70		7.5	8.0	5.265	1	1.248
REF318-ACJ-71		5.4	5.7	1.442	-	0.916
REF318-ACJ-72		5.5	5.8	1.471	-	0.884
REF318-ACJ-73		6.1	6.5	1.995	-	0.879
REF318-ACJ-74		8.0	8.5	4.360	-	0.852
REF318-ACJ-75		5.0	5.3	1.180	-	0.944
REF318-ACJ-76		5.4	5.7	1.488	-	0.945
REF318-ACJ-77		5.7	6.0	1.814	-	0.980
REF318-ACJ-78		7.1	7.6	3.977	-	1.111
REF318-ACJ-79		4.7	4.9	1.037	-	0.999
REF318-ACJ-80		5.3	5.6	1.408	-	0.946
REF318-ACJ-81		6.0	6.3	1.928	-	0.893
REF318-ACJ-82		6.7	7.1	3.058	-	1.017
REF318-ACJ-83		5.5	5.9	1.604	-	0.964
REF318-ACJ-84		5.7	6.0	1.789	-	0.966
REF318-ACJ-85		5.4	5.8	1.476	-	0.937
REF318-ACJ-86		5.4	5.7	1.484	-	0.942
REF318-ACJ-87		6.9	7.3	3.473	-	1.057
REF318-ACJ-88		5.4	5.7	1.340	-	0.851
REF318-ACJ-89		5.3	5.6	1.674	-	1.124
REF318-ACJ-90		5.2	5.4	1.153	-	0.820
REF318-ACJ-91		6.0	6.3	2.038	-	0.944
REF318-ACJ-92		7.3	7.8	3.938	-	1.012
REF318-ACJ-93		4.9	5.1	1.141	-	0.970
REF318-ACJ-94		8.9	9.4	5.152	-	0.731
REF318-ACJ-95		7.1	7.6	3.645	-	1.018
REF318-ACJ-96		5.4	5.6	1.214	-	0.771
REF318-ACJ-97		5.6	5.8	1.596	-	0.909
REF318-ACJ-98		5.6	5.8	1.459	-	0.831
REF318-ACJ-99		5.1	5.3	1.036	-	0.781
REF318-ACJ-100		5.8	6.1	2.138	-	1.096
Overall Catch Summary	Sample Size (N)	100	100	100	10.0	100
	Average	6.1	6.5	2.678	1.7	0.946
	Median	5.7	6.0	1.797	1.0	0.944
	Standard Deviation	1.6	1.8	2.517	1.6	0.107
	Standard Error	0.2	0.2	0.252	0.5	0.011
	Minimum	2.9	3.0	0.214	0.0	0.634
	Maximum	13.5	14.6	19.603	6.0	1.248
Young-of-the-Year Catch Summary	proportion of YOY	**8%**				
	Sample Size (N)	8	8	8	1	8
	Average	3.4	3.5	0.334	0	0.839
	Median	3.2	3.3	0.276	0	0.844
	Standard Deviation	0.5	0.6	0.164	-	0.098
	Standard Error	0.2	0.2	0.058	-	0.035
	Minimum	2.9	3.0	0.214	0	0.634
	Maximum	4.4	4.7	0.712	0	0.948

Table G.5: Arctic Charr Measurements from Fish Captured at Camp Lake by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
JLO-18-ACJ-01	10.3	10.9	10.474	3	0.959
JLO-18-ACJ-02	10.4	11.1	8.621	2	0.766
JLO-18-ACJ-03	7.7	8.3	3.356	2	0.735
JLO-18-ACJ-04	14.1	15.3	21.845	2	0.779
JLO-18-ACJ-05	6.4	6.7	2.224	1	0.848
JLO-18-ACJ-06	9.9	10.6	9.602	2	0.990
JLO-18-ACJ-07	6.4	6.8	2.191	1	0.836
JLO-18-ACJ-08	15.1	16.1	26.672	3	0.775
JLO-18-ACJ-09	6.7	7.0	2.396	1	0.797
JLO-18-ACJ-10	13.5	14.6	20.054	3	0.815
JLO-18-ACJ-11	3.9	4.2	0.586	0	0.988
JLO-18-ACJ-12	10.6	11.3	9.351	-	0.785
JLO-18-ACJ-13	8.3	8.9	5.108	-	0.893
JLO-18-ACJ-14	9.9	10.6	7.491	-	0.772
JLO-18-ACJ-15	7.9	8.3	4.203	-	0.852
JLO-18-ACJ-16	8.4	9.1	4.476	-	0.755
JLO-18-ACJ-17	11.5	12.4	11.367	-	0.747
JLO-18-ACJ-18	12.6	13.7	16.156	-	0.808
JLO-18-ACJ-19	10.5	11.3	8.584	-	0.742
JLO-18-ACJ-20	8.9	9.5	5.622	-	0.797
JLO-18-ACJ-21	11.1	12.0	10.824	-	0.791
JLO-18-ACJ-22	13.8	14.6	22.133	-	0.842
JLO-18-ACJ-23	10.8	11.6	9.373	-	0.744
JLO-18-ACJ-24	12.4	13.5	16.590	-	0.870
JLO-18-ACJ-25	11.4	12.3	12.448	-	0.840
JLO-18-ACJ-26	13.2	14.1	19.516	-	0.849
JLO-18-ACJ-27	10.0	10.8	8.235	-	0.824
JLO-18-ACJ-28	8.5	9.1	4.773	-	0.777
JLO-18-ACJ-29	13.4	14.3	20.915	-	0.869
JLO-18-ACJ-30	15.0	16.2	27.926	-	0.827
JLO-18-ACJ-31	11.1	12.0	11.367	-	0.831
JLO-18-ACJ-32	8.4	9.0	4.629	-	0.781
JLO-18-ACJ-33	11.2	12.1	10.113	-	0.720
JLO-18-ACJ-34	13.3	14.4	16.731	-	0.711
JLO-18-ACJ-35	13.8	14.9	21.944	-	0.835
JLO-18-ACJ-36	7.6	8.1	3.663	-	0.834
JLO-18-ACJ-37	8.0	8.5	3.995	-	0.780
JLO-18-ACJ-38	6.0	6.3	1.790	-	0.829
JLO-18-ACJ-39	8.0	8.6	3.727	-	0.728
JLO-18-ACJ-40	9.4	10.2	7.293	-	0.878
JLO-18-ACJ-41	10.6	11.4	9.091	-	0.763
JLO-18-ACJ-42	10.2	11.0	9.050	-	0.853
JLO-18-ACJ-43	16.4	17.7	36.690	-	0.832
JLO-18-ACJ-44	8.9	9.5	5.665	-	0.804
JLO-18-ACJ-45	6.2	6.5	1.964	-	0.824
JLO-18-ACJ-46	8.5	9.1	4.948	-	0.806
JLO-18-ACJ-47	9.3	9.8	6.130	-	0.762
JLO-18-ACJ-48	8.9	9.6	4.796	-	0.680
JLO-18-ACJ-49	9.7	10.3	7.390	-	0.810
JLO-18-ACJ-50	5.0	5.2	1.107	-	0.886
JLO-18-ACJ-51	8.8	9.5	5.225	-	0.767
JLO-18-ACJ-52	8.5	9.1	4.903	-	0.798
JLO-18-ACJ-53	7.0	7.4	2.789	-	0.813

Table G.5: Arctic Charr Measurements from Fish Captured at Camp Lake by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
JLO-18-ACJ-54	8.5	9.0	4.884	-	0.795
JLO-18-ACJ-55	11.5	12.3	12.501	-	0.822
JLO-18-ACJ-56	11.0	11.8	10.481	-	0.787
JLO-18-ACJ-57	13.5	14.7	20.059	-	0.815
JLO-18-ACJ-58	8.3	8.8	4.503	-	0.788
JLO-18-ACJ-59	7.9	8.4	4.078	-	0.827
JLO-18-ACJ-60	7.1	7.5	3.475	-	0.971
JLO-18-ACJ-61	7.4	7.8	3.406	-	0.841
JLO-18-ACJ-62	7.5	7.9	3.475	-	0.824
JLO-18-ACJ-63	8.3	8.7	4.568	-	0.799
JLO-18-ACJ-64	10.2	11.1	8.701	-	0.820
JLO-18-ACJ-65	8.2	8.7	4.888	-	0.887
JLO-18-ACJ-66	9.4	10.0	6.242	-	0.752
JLO-18-ACJ-67	9.5	10.1	6.792	-	0.792
JLO-18-ACJ-68	8.3	8.8	4.593	-	0.803
JLO-18-ACJ-69	10.7	11.4	11.278	-	0.921
JLO-18-ACJ-70	11.3	12.1	11.447	-	0.793
JLO-18-ACJ-71	6.8	7.1	2.844	-	0.904
JLO-18-ACJ-72	10.0	10.7	7.253	-	0.725
JLO-18-ACJ-73	10.0	10.7	8.300	-	0.830
JLO-18-ACJ-74	8.2	8.7	4.045	-	0.734
JLO-18-ACJ-75	9.1	9.7	6.271	-	0.832
JLO-18-ACJ-76	8.5	9.1	4.856	-	0.791
JLO-18-ACJ-77	8.4	9.0	4.586	-	0.774
JLO-18-ACJ-78	8.7	9.3	5.189	-	0.788
JLO-18-ACJ-79	10.4	11.2	8.747	-	0.778
JLO-18-ACJ-80	9.1	9.8	5.735	-	0.761
JLO-18-ACJ-81	9.5	10.2	6.945	-	0.810
JLO-18-ACJ-82	9.4	10.0	6.235	-	0.751
JLO-18-ACJ-83	8.5	9.1	5.109	-	0.832
JLO-18-ACJ-84	7.1	7.5	3.523	-	0.984
JLO-18-ACJ-85	8.3	8.9	4.275	-	0.748
JLO-18-ACJ-86	8.2	8.7	4.510	-	0.818
JLO-18-ACJ-87	8.6	9.2	4.909	-	0.772
JLO-18-ACJ-88	5.3	5.5	1.199	-	0.805
JLO-18-ACJ-89	6.3	6.7	2.189	-	0.875
JLO-18-ACJ-90	5.8	6.1	1.643	-	0.842
JLO-18-ACJ-91	7.8	8.5	3.861	-	0.814
JLO-18-ACJ-92	5.3	5.6	1.238	-	0.832
JLO-18-ACJ-93	8.2	8.6	4.162	-	0.755
JLO-18-ACJ-94	6.2	6.6	2.044	-	0.858
JLO-18-ACJ-95	7.1	7.5	2.966	-	0.829
JLO-18-ACJ-96	6.3	6.6	2.081	-	0.832
JLO-18-ACJ-97	6.2	6.5	2.321	-	0.974
JLO-18-ACJ-98	6.3	6.7	2.237	-	0.895
JLO-18-ACJ-99	5.4	5.6	1.326	-	0.842
JLO-18-ACJ-100	6.1	6.5	1.937	-	0.853
JLO-18-ACJ-101	7.8	8.3	3.464	-	0.730
JLO-18-ACJ-102	5.6	6.0	1.479	-	0.842
JLO-18-ACJ-103	5.8	6.1	1.694	-	0.868
JLO-18-ACJ-104	5.9	6.3	1.938	-	0.944
JLO-18-ACJ-105	6.0	6.4	1.741	-	0.806
JLO-18-ACJ-106	6.9	7.4	2.805	-	0.854

Table G.5: Arctic Charr Measurements from Fish Captured at Camp Lake by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
JLO-18-ACJ-107		4.9	5.2	0.895	-	0.761
JLO-18-ACJ-108		3.9	4.2	0.615	-	1.037
JLO-18-ACJ-109		3.5	3.6	0.312	-	0.728
Overall Catch Summary	Sample Size (N)	109	109	109	11	109
	Average	8.9	9.5	7.165	1.8	0.819
	Median	8.5	9.1	4.888	2	0.814
	Standard Deviation	2.6	2.8	6.519	1.0	0.065
	Standard Error	0.2	0.3	0.624	0.3	0.006
	Minimum	3.5	3.6	0.312	0	0.680
	Maximum	16.4	17.7	36.690	3	1.037
Young-of-the-Year Catch Summary	proportion of YOY	**3%**				
	Sample Size (N)	3	3	3	1	3
	Average	3.8	4.0	0.504	0	0.917
	Median	3.9	4.2	0.586	0	0.988
	Standard Deviation	0.2	0.3	0.167	-	0.166
	Standard Error	0.1	0.2	0.097	-	0.096
	Minimum	3.5	3.6	0.312	0	0.728
	Maximum	3.9	4.2	0.615	0	1.037

Table G.6: Results of Nearshore Arctic Charr Young-of-the-Year (YOY) and Non-YOY Health Endpoint Statistical Comparisons between Camp Lake (JLO) and Reference Lake 3 (REF), Mary River Project CREMP, August 2018

Group	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
			Response	Covariate	REF	JLO		Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]	Statistic	REF	JLO		
								Interaction P-value	Covariate P-value						
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	109	K-S	-	-	-	-	-	-	<0.001	-54
YOY	Body Size	Fork Length	log[Fork Length (cm)]	-	8	3	tequal	-	-	-	Geometric Mean	3.4	3.8	0.22	12
		Body Weight	log[Body Weight (g)]	-	8	3	tequal	-	-	-	Geometric Mean	0.334	0.504	0.162	51
	Energy Storage	Condition[e]	log[Body Weight (g)]	log[Fork Length (cm)]	7	3	ANCOVA	0.00525	<0.001	'3.50	Predicted Mean	0.352	0.312	0.489	-11
					7	3	ANCOVA	0.00525	<0.001	'3.90	Predicted Mean	0.473	0.6	0.489	27
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	92	106	K-S	-	-	-	-	-	-	<0.001	-54
	Body Size	Fork Length	Fork Length (cm)	-	92	106	tunequal	-	-	-	Median	6.2	8.7	<0.001	40
		Body Weight	Body Weight (g)	-	92	106	tunequal	-	-	-	Median	2.28	5.36	<0.001	135
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	92	106	ANCOVA[f]	0.00876	<0.001	'7.44	Adjusted Mean	4.46	3.84	<0.001	-14

▨ Area P-value < 0.1 or Interaction P-value < 0.05

🟦 Absolute Magnitude of Difference ≥ 10% for Condition (EEM effect endpoint)

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for log$_{10}$-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) / reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted mean - reference area predicted mean) / reference area predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

[e] One outlier (Fish ID:REF318-ACJ-11; Studentized residual = -4.3) was removed from the analysis

[f] ANCOVA proceeded under the assumption that the slopes are practically parallel (R2 of interaction model = 0.9888 and R2 of parallel slope model = 0.9884; a difference < 0.02) following Environment Canada (2012).

Table G.7: Results of Nearshore Arctic Charr Non-Young-of-the-Year (Non-YOY) Health Endpoint Statistical Comparisons between Samples Collected in 2018 and the Baseline Period at Individual Mine-Exposed Lakes, Mary River Project 2018 CREMP

Lake	Group	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
				Response	Covariate	Baseline	2018		Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]	Statistic	Baseline	2018		
									Interaction P-value	Covariate P-value						
Camp (JLO)	Non-YOY	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	51	106	K-S	-	-	-	-	-	-	<0.001	45
		Body Size	Fork Length	Fork Length (cm)	-	51	106	M-W	-	-	-	Median	11.8	8.5	<0.001	-28
			Body Weight	Body Weight (g)	-	51	106	tunequal	-	-	-	Geometric Mean	12.3	5.36	<0.001	-56
		Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	51	106	ANCOVA	0.0534	<0.001	9.44	Adjusted Mean	8.62	7.83	<0.001	-9.2
Sheardown NW (DLO-01)	Non-YOY	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	247	88	K-S	-	-	-	-	-	-	<0.001	32
		Body Size	Fork Length	Fork Length (cm)	-	247	88	M-W	-	-	-	Median	8.2	7.2	0.0017	-12
			Body Weight	Body Weight (g)	-	247	88	M-W	-	-	-	Median	6.00	3.00	<0.001	-50
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	247	88	ANCOVA	0.259	<0.001	8.68	Adjusted Mean	8.19	7.38	<0.001	-9.9
Sheardown SE (DLO-02)[e]	Non-YOY	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	16	53	K-S	-	-	-	-	-	-	0.009	-47
		Body Size	Fork Length	log[Fork Length (cm)]	-	16	53	M-W	-	-	-	Median	6.30	7.00	<0.001	11
			Body Weight	Body Weight (g)	-	16	53	M-W	-	-	-	Median	2.50	3.00	0.109	20
		Energy Storage	Condition[e]	log[Body Weight (g)]	log[Fork Length (cm)]	16	53	ANCOVA	0.00146	<0.001	7.08	Adjusted Mean	3.57	3.02	<0.001	-15

▨ Area P-value < 0.1 or Interaction P-value < 0.05

🟦 Absolute Magnitude of Difference ≥ 10% for Condition (EEM effect endpoint)

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for $\log_{10}$-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(2018 mean - baseline mean) / baseline area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(2018 predicted mean - baseline predicted mean) / baseline predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between groups. A negative difference implies that 2018 has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that 2017 has fewer fish less than the length where the maximum difference in CFRDs was observed.

[e] Poor accuracy in arctic charr weight measurements occurred during baseline studies (i.e., weight measurements to the nearest gram), and therefore greater uncertainty was associated with the statistical evaluation of data between the mine operational and baseline periods.

Table G.8: Arctic Charr Estimated Sample Sizes to Detect Various Effect Sizes as a Percentage Change in Respective Fish Health Endpoints at Camp Lake Using 2018 Data Relative to Reference Lake 3 Data (2018) or Camp Lake Baseline Data (2006 to 2013) with α=β=0.1, Mary River Project 2018 CREMP

Comparison	Group	Indicator	Endpoint	Variables		Test[c]	S[a]	COV (%)[b]	Minimum Sample Size to Detect an Effect Size (% Increase/Decrease Relative to Reference) with α=β=0.1									
				Response	Covariate				log(Response)	5%	10%	20%	25%	30%	33%	40%	50%	100%
										-5%	-9%	-17%	-20%	-23%	-25%	-29%	-33%	-50%
									Response	±5%	±10%	±20%	±25%	±30%	±33%	±40%	±50%	±100%
Nearshore Arctic Charr (Electrofishing) versus Ref. Lake 3, 2018 Data	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	tunequal	0.10533	-	log10(Response)	424	112	32	21	16	13	10	7	4
			Body Weight	Body Weight (g)	-	tunequal	0.31717	-	log10(Response)	3,839	1,007	276	185	134	112	82	57	20
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.03961	-	log10(Response)	62	18	7	5	5	4	4	4	3
Nearshore Arctic Charr (Electrofishing) 2018 versus Baseline	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.12518	4.05	Response	14	5	3	3	3	3	3	3	3
			Body Weight	Body Weight (g)	-	tunequal	0.36500	-	log10(Response)	5,083	1,333	365	244	177	147	108	75	26
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.03560	-	log10(Response)	51	15	6	5	4	4	4	3	3
Littoral/Profundal Arctic Charr (Gill Netting) versus Ref. Lake 3, 2018 Data	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.0685	5.63	Response	27	9	4	4	3	3	3	3	3
			Body Weight	Body Weight (g)	-	M-W	0.207	1.39	Response	4	3	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0324	-	log10(Response)	42	13	5	4	4	4	4	3	3
Littoral/Profundal Arctic Charr (Gill Netting) 2018 versus Baseline	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.104	3.79	Response	13	5	3	3	3	3	3	3	3
			Body Weight	Body Weight (g)	-	M-W	0.314	0.829	Response	3	3	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0627	-	log10(Response)	152	42	13	9	8	7	6	5	4

[a] Pooled standard deviation of the regression residuals

[b] Coefficient of variation (pooled standard deviation/reference mean)×100%

[c] Sample size estimates for the M-W test were estimated based for a two-sample t-test using sample sizes multiplied by 0.864. The 0.864 is the lower bound of the asymptotic relative efficiency of the Mann-Whitney test and the two-sample t-test (Hodges and Lehmann 1956). Estimates were generated for the response variable on the untransformed and log$_{10}$-transformed scales and the lowest sample size is reported.

Table G.9: Arctic Charr Measurements from Fish Captured at Reference Lake 3 by Gill Netting, Mary River Project CREMP, August 2018

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Fulton's Condition Factor (K)
REF318-AC-01	3	35.2	37.9	388	0.890
REF318-AC-02	2	35.7	38.0	333	0.732
REF318-AC-03	2	48.1	51.3	910	0.818
REF318-AC-04	2	35.0	37.6	350	0.816
REF318-AC-05	2	32.5	35.1	273	0.795
REF318-AC-06	2	32.9	35.2	303	0.851
REF318-AC-07	1½	32.9	35.7	308	0.865
REF318-AC-08	2	33.7	36.5	355	0.928
REF318-AC-09	3	59.8	63.1	2,100	0.982
REF318-AC-10	2	50.1	53.4	960	0.763
REF318-AC-11	2	35.8	38.3	315	0.687
REF318-AC-12	3	55.6	58.8	1,250	0.727
REF318-AC-13	2	34.1	36.6	320	0.807
REF318-AC-14	1½	54.9	58.0	1,510	0.913
REF318-AC-15	2	56.4	59.7	1,720	0.959
REF318-AC-16	1½	21.1	22.8	77	0.820
REF318-AC-17	2	33.2	37.1	343	0.937
REF318-AC-18	1½	33.1	35.8	330	0.910
REF318-AC-19	2	32.5	35.3	310	0.903
REF318-AC-20	2	34.5	37.8	368	0.896
REF318-AC-21	1½	58.1	61.2	1,920	0.979
REF318-AC-22	1½	33.8	36.2	278	0.720
REF318-AC-23	2	32.0	34.6	280	0.854
REF318-AC-24	2	31.2	33.4	268	0.882
REF318-AC-25	2	31.1	33.7	285	0.947
REF318-AC-26	2	49.9	52.9	999	0.804
REF318-AC-27	2	34.6	37.2	328	0.792
REF318-AC-28	3	34.8	37.5	355	0.842
REF318-AC-29	3	56.3	59.5	1,610	0.902
REF318-AC-30	3	36.3	39.0	395	0.826
REF318-AC-31	2	32.8	35.6	305	0.864
REF318-AC-32	2	32.4	34.9	310	0.911
REF318-AC-33	2	32.5	35.3	310	0.903
REF318-AC-34	3	34.9	38.1	330	0.776
Overall Catch Summary	**Sample Size (N)**	**34**	**34**	**34**	**34**
	Average	**38.8**	**41.6**	**612**	**0.853**
	Median	**34.6**	**37.4**	**332**	**0.859**
	Standard Deviation	**10.0**	**10.3**	**552**	**0.077**
	Standard Error	**1.7**	**1.8**	**95**	**0.013**
	Minimum	**21.1**	**22.8**	**77**	**0.687**
	Maximum	**59.8**	**63.1**	**2,100**	**0.982**

Table G.10: Gill Netting Catch Records for Camp Lake, Mary River Project CREMP, August 2018

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (m)	Set Date	Lift Date	Set Time	Lift Time	Hours	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE
	Easting	Northing								1½"	2"	3"		
JLO-18-GN-01	557726	7914710	91.4	19-Aug-18	19-Aug-18	9:00	10:35	1.58	1.45	2	3	2	7	4.84
JLO-18-GN-02	557759	7914591	91.4	19-Aug-18	19-Aug-18	9:15	11:00	1.75	1.60	2	3	2	7	4.38
JLO-18-GN-03	557741	7914293	91.4	19-Aug-18	19-Aug-18	9:30	12:00	2.50	2.28	1	1	5	7	3.06
JLO-18-GN-04	552685	7914324	91.4	19-Aug-18	19-Aug-18	9:40	12:20	2.67	2.44	0	0	1	1	0.41
JLO-18-GN-05	557375	7914878	91.4	19-Aug-18	19-Aug-18	9:50	12:15	2.42	2.21	8	4	11	23	10.41
JLO-18-GN-06	557726	7914710	91.4	19-Aug-18	19-Aug-18	10:45	13:30	2.75	2.51	4	1	9	14	5.57
JLO-18-GN-07	557759	7914591	91.4	19-Aug-18	19-Aug-18	11:20	14:30	3.17	2.89	2	1	3	6	2.07
JLO-18-GN-08	557741	7914293	91.4	19-Aug-18	19-Aug-18	11:45	14:45	3.00	2.74	1	4	9	14	5.11
JLO-18-GN-09	557375	7914878	91.4	19-Aug-18	19-Aug-18	13:20	15:50	2.50	2.28	2	3	5	10	4.4
JLO-18-GN-10	557726	7914710	91.4	19-Aug-18	19-Aug-18	14:55	17:00	2.08	1.90	0	2	3	5	2.63
								Total	**22.32**	**22**	**22**	**50**	**94**	**4.29**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.11: Arctic Charr Measurements from Fish Captured at Camp Lake by Gill Netting, Mary River Project CREMP, August 2018

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Fulton's Condition Factor (K)
JLO-18-AC-01	1½	38.9	42.4	580	0.985
JLO-18-AC-02	1½	35.4	38.4	455	1.026
JLO-18-AC-03	2	40.5	43.7	570	0.858
JLO-18-AC-04	2	30.5	33.2	280	0.987
JLO-18-AC-05	2	34.5	37.5	395	0.962
JLO-18-AC-06	3	37.0	40.5	485	0.957
JLO-18-AC-07	3	38.5	41.9	525	0.920
JLO-18-AC-08	1½	38.3	41.7	520	0.926
JLO-18-AC-09	1½	35.3	38.6	425	0.966
JLO-18-AC-10	2	34.9	37.9	395	0.929
JLO-18-AC-11	2	38.0	41.2	565	1.030
JLO-18-AC-12	2	37.5	40.6	490	0.929
JLO-18-AC-13	3	38.5	41.8	535	0.938
JLO-18-AC-14	3	36.6	40.0	515	1.050
JLO-18-AC-15	3	40.1	43.2	510	0.791
JLO-18-AC-16	3	35.8	39.1	415	0.904
JLO-18-AC-17	3	38.8	41.9	580	0.993
JLO-18-AC-18	3	41.4	44.3	635	0.895
JLO-18-AC-19	3	40.2	43.5	580	0.893
JLO-18-AC-20	2	38.5	41.9	495	0.867
JLO-18-AC-21	1½	38.3	41.5	505	0.899
JLO-18-AC-22	3	38.1	41.6	510	0.922
JLO-18-AC-23	3	38.5	42.0	565	0.990
JLO-18-AC-24	3	38.1	42.0	470	0.850
JLO-18-AC-25	3	38.4	41.9	520	0.918
JLO-18-AC-26	3	37.7	40.7	490	0.914
JLO-18-AC-27	3	39.4	42.6	545	0.891
JLO-18-AC-28	3	34.8	38.2	435	1.032
JLO-18-AC-29	3	34.5	37.5	405	0.986
JLO-18-AC-30	3	40.5	44.3	640	0.963
JLO-18-AC-31	3	38.2	41.1	520	0.933
JLO-18-AC-32	3	36.9	39.9	480	0.955
JLO-18-AC-33	3	37.1	40.4	560	1.097
JLO-18-AC-34	2	38.9	42.0	550	0.934
JLO-18-AC-35	2	37.3	40.1	525	1.012
JLO-18-AC-36	2	30.7	33.4	295	1.020
JLO-18-AC-37	2	38.6	42.9	530	0.922
JLO-18-AC-38	1½	37.6	41.9	500	0.941
JLO-18-AC-39	1½	37.2	41.2	510	0.991
JLO-18-AC-40	1½	34.6	37.6	450	1.086
JLO-18-AC-41	1½	38.8	42.4	545	0.933
JLO-18-AC-42	1½	38.2	41.5	540	0.969
JLO-18-AC-43	1½	38.5	41.5	595	1.043
JLO-18-AC-44	1½	37.9	41.9	475	0.873
JLO-18-AC-45	1½	43.1	46.7	820	1.024
JLO-18-AC-46	3	74.2	79.5	3,750	0.918

Table G.11: Arctic Charr Measurements from Fish Captured at Camp Lake by Gill Netting, Mary River Project CREMP, August 2018

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Fulton's Condition Factor (K)
JLO-18-AC-47	3	58.1	62.2	1,800	0.918
JLO-18-AC-48	3	42.6	45.7	740	0.957
JLO-18-AC-49	3	32.2	35.1	330	0.988
JLO-18-AC-50	3	36.4	39.8	490	1.016
JLO-18-AC-51	3	38.2	41.5	560	1.005
JLO-18-AC-52	3	38.5	41.5	550	0.964
JLO-18-AC-53	3	36.4	39.4	480	0.995
JLO-18-AC-54	2	38.8	42.1	525	0.899
JLO-18-AC-55	1½	38.7	47.9	555	0.958
JLO-18-AC-56	1½	35.5	38.6	450	1.006
JLO-18-AC-57	1½	35.0	37.7	465	1.085
JLO-18-AC-58	1½	57.8	61.6	1,820	0.943
JLO-18-AC-59	3	38.6	42.0	525	0.913
JLO-18-AC-60	3	38.9	42.3	575	0.977
JLO-18-AC-61	3	37.0	40.5	435	0.859
JLO-18-AC-62	2	36.7	40.3	515	1.042
JLO-18-AC-63	1½	37.0	40.9	455	0.898
JLO-18-AC-64	1½	48.5	52.5	1,150	1.008
JLO-18-AC-65	3	38.0	41.7	575	1.048
JLO-18-AC-66	3	39.1	42.7	570	0.954
JLO-18-AC-67	3	38.8	42.7	500	0.856
JLO-18-AC-68	3	37.3	401.1	505	0.973
JLO-18-AC-69	3	36.2	39.2	470	0.991
JLO-18-AC-70	3	36.1	39.4	425	0.903
JLO-18-AC-71	3	39.2	42.4	640	1.062
JLO-18-AC-72	3	37.4	41.4	515	0.984
JLO-18-AC-73	3	38.0	41.1	505	0.920
JLO-18-AC-74	2	40.2	43.6	615	0.947
JLO-18-AC-75	2	33.3	36.3	360	0.975
JLO-18-AC-76	2	36.4	39.5	505	1.047
JLO-18-AC-77	2	40.2	43.5	610	0.939
JLO-18-AC-78	1½	34.4	37.4	390	0.958
JLO-18-AC-79	1½	37.6	40.7	465	0.875
JLO-18-AC-80	1½	37.5	40.9	475	0.901
JLO-18-AC-81	2	38.6	42.1	495	0.861
JLO-18-AC-82	2	36.9	40.2	525	1.045
JLO-18-AC-83	2	36.1	39.2	480	1.020
JLO-18-AC-84	3	35.3	38.2	420	0.955
JLO-18-AC-85	3	36.9	39.8	465	0.925
JLO-18-AC-86	3	35.7	38.9	495	1.088
JLO-18-AC-87	3	39.1	41.9	515	0.862
JLO-18-AC-88	3	40.8	44.4	561	0.826
JLO-18-AC-89	3	35.1	38.1	400	0.925
JLO-18-AC-90	3	43.5	47.2	755	0.917
JLO-18-AC-91	3	38.8	42.2	510	0.873
JLO-18-AC-92	3	36.2	39.1	415	0.875

Table G.11: Arctic Charr Measurements from Fish Captured at Camp Lake by Gill Netting, Mary River Project CREMP, August 2018

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Fulton's Condition Factor (K)
JLO-18-AC-93	2	38.8	42.9	555	0.950
JLO-18-AC-94	2	38.0	41.3	570	1.039
Overall Catch Summary	**Sample Size (N)**	**94**	**94**	**94**	**94**
	Average	**38.5**	**45.7**	**579**	**0.955**
	Median	**38.0**	**41.5**	**513**	**0.954**
	Standard Deviation	**5.3**	**37.5**	**395**	**0.064**
	Standard Error	**0.6**	**3.9**	**41**	**0.007**
	Minimum	**30.5**	**33.2**	**280**	**0.791**
	Maximum	**74.2**	**401.1**	**3,750**	**1.097**

Table G.12: **Results of Littoral/Profundal Arctic Charr Health Endpoint Statistical Comparisons between 2018 Camp Lake (JLO) and 2018 Reference Lake 3 (REF) Data, and for Camp Lake between 2018 and the Mine Baseline Period (2005 to 2013), Mary River Project 2018 CREMP**

Comparison	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
			Response	Covariate	REF 2018 or JLO Base	JLO 2018		Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]	Statistic	REF 2018 or JLO Base	JLO 2018		
								Interaction P-value	Covariate P-value						
Camp Lake versus Reference Lake 3, 2018	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	34	94	K-S	-	-	-	-	-	-	<0.001	-52
	Body Size	Fork Length	Fork Length (cm)	-	34	94	M-W	-	-	-	Median	34.5	38	<0.001	10
		Body Weight	Body Weight (g)	-	34	94	M-W	-	-	-	Median	331	512	<0.001	55
	Energy Storage	Condition[e]	log[Body Weight (g)]	log[Fork Length (cm)]	34	94	ANCOVA	0.028	<0.001	38.1	Adjusted Mean	487	546	<0.001	12
Camp Lake 2018 versus Baseline	Survival	Length Frequency Distribution	Fork Length (cm)	-	155	94	K-S	-	-	-	-	-	-	<0.001	-57
	Body Size	Fork Length	Fork Length (cm)	-	155	94	M-W	-	-	-	Median	33	38	<0.001	15
		Body Weight	Body Weight (g)	-	155	94	M-W	-	-	-	Median	350	512	<0.001	46
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	155	94	ANCOVA	0.414	<0.001	34.6	Adjusted Mean	440	433	0.424	-1.6

▨ Area P-value < 0.1 or Interaction P-value < 0.05

🟦 Absolute Magnitude of Difference ≥ 10% for Condition (EEM effect endpoint)

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for $\log_{10}$-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) / reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted mean - reference area predicted mean) / reference area predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

Table G.13: Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
DLO1-18-ACJ-01	6.6	6.9	2.198	1	0.765
DLO1-18-ACJ-02	8.6	9.1	5.977	2	0.940
DLO1-18-ACJ-03	6.6	6.9	2.636	1	0.917
DLO1-18-ACJ-04	3.2	3.3	0.267	0	0.815
DLO1-18-ACJ-05	13.8	14.8	22.349	3	0.850
DLO1-18-ACJ-06	9.4	9.9	6.284	2	0.757
DLO1-18-ACJ-07	6.1	6.3	1.895	1	0.835
DLO1-18-ACJ-08	3.8	4.0	0.479	0	0.873
DLO1-18-ACJ-09	9.3	9.9	7.291	1	0.906
DLO1-18-ACJ-10	11.5	12.3	15.725	3	1.034
DLO1-18-ACJ-11	6.0	6.3	2.158	-	0.999
DLO1-18-ACJ-12	3.9	4.1	0.483	-	0.814
DLO1-18-ACJ-13	8.6	9.0	5.730	-	0.901
DLO1-18-ACJ-14	5.1	5.3	1.214	-	0.915
DLO1-18-ACJ-15	9.8	10.2	7.870	-	0.836
DLO1-18-ACJ-16	5.6	5.8	1.790	-	1.019
DLO1-18-ACJ-17	6.4	6.6	2.160	-	0.824
DLO1-18-ACJ-18	5.8	6.0	1.674	-	0.858
DLO1-18-ACJ-19	5.5	5.7	1.382	-	0.831
DLO1-18-ACJ-20	4.0	4.2	0.493	-	0.770
DLO1-18-ACJ-21	3.9	4.1	0.543	-	0.915
DLO1-18-ACJ-22	8.7	9.0	6.129	-	0.931
DLO1-18-ACJ-23	6.5	6.8	2.471	-	0.900
DLO1-18-ACJ-24	6.5	6.8	2.348	-	0.855
DLO1-18-ACJ-25	6.4	6.7	2.129	-	0.812
DLO1-18-ACJ-26	5.3	5.5	1.387	-	0.932
DLO1-18-ACJ-27	6.5	6.8	2.461	-	0.896
DLO1-18-ACJ-28	9.9	10.5	9.989	-	1.029
DLO1-18-ACJ-29	5.9	6.2	2.384	-	1.161
DLO1-18-ACJ-30	7.0	7.4	3.168	-	0.924
DLO1-18-ACJ-31	5.6	5.8	1.620	-	0.922
DLO1-18-ACJ-32	10.0	10.6	8.126	-	0.813
DLO1-18-ACJ-33	10.6	11.1	11.032	-	0.926
DLO1-18-ACJ-34	9.9	10.5	9.503	-	0.979
DLO1-18-ACJ-35	9.3	9.6	7.989	-	0.993
DLO1-18-ACJ-36	14.9	15.7	24.267	-	0.734
DLO1-18-ACJ-37	11.0	11.6	13.548	-	1.018
DLO1-18-ACJ-38	7.9	8.4	4.485	-	0.910
DLO1-18-ACJ-39	6.7	6.9	2.615	-	0.869
DLO1-18-ACJ-40	6.9	7.3	2.783	-	0.847
DLO1-18-ACJ-41	6.8	7.2	2.778	-	0.883
DLO1-18-ACJ-42	5.4	5.6	1.428	-	0.907
DLO1-18-ACJ-43	7.5	7.8	4.047	-	0.959
DLO1-18-ACJ-44	5.5	5.7	1.352	-	0.813

Table G.13: **Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Electrofishing, Mary River Project CREMP, August 2018**

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
DLO1-18-ACJ-45	7.0	7.4	3.138	-	0.915
DLO1-18-ACJ-46	3.8	4.0	0.531	-	0.968
DLO1-18-ACJ-47	7.2	7.5	3.660	-	0.981
DLO1-18-ACJ-48	4.1	4.3	0.567	-	0.823
DLO1-18-ACJ-49	3.7	3.9	0.457	-	0.902
DLO1-18-ACJ-50	6.4	6.7	2.664	-	1.016
DLO1-18-ACJ-51	6.6	6.9	3.006	-	1.046
DLO1-18-ACJ-52	6.4	6.6	1.952	-	0.745
DLO1-18-ACJ-53	8.1	8.6	6.461	-	1.216
DLO1-18-ACJ-54	8.5	9.0	6.069	-	0.988
DLO1-18-ACJ-55	10.8	11.5	11.010	-	0.874
DLO1-18-ACJ-56	6.5	6.7	2.553	-	0.930
DLO1-18-ACJ-57	6.9	7.2	3.376	-	1.028
DLO1-18-ACJ-58	9.2	9.5	6.367	-	0.818
DLO1-18-ACJ-59	7.4	7.7	3.570	-	0.881
DLO1-18-ACJ-60	6.5	6.8	2.574	-	0.937
DLO1-18-ACJ-61	5.0	5.2	1.115	-	0.892
DLO1-18-ACJ-62	9.0	9.5	6.169	-	0.846
DLO1-18-ACJ-63	6.7	7.0	2.638	-	0.877
DLO1-18-ACJ-64	7.0	7.4	2.750	-	0.802
DLO1-18-ACJ-65	10.6	11.1	9.595	-	0.806
DLO1-18-ACJ-66	6.9	7.2	2.588	-	0.788
DLO1-18-ACJ-67	8.5	8.9	6.068	-	0.988
DLO1-18-ACJ-68	9.8	10.4	7.756	-	0.824
DLO1-18-ACJ-69	8.7	9.0	5.943	-	0.903
DLO1-18-ACJ-70	6.6	6.9	2.588	-	0.900
DLO1-18-ACJ-71	7.2	7.5	3.325	-	0.891
DLO1-18-ACJ-72	8.5	8.9	6.105	-	0.994
DLO1-18-ACJ-73	7.3	7.6	3.303	-	0.849
DLO1-18-ACJ-74	9.6	10.0	7.585	-	0.857
DLO1-18-ACJ-75	5.8	6.1	1.796	-	0.920
DLO1-18-ACJ-76	7.4	7.6	3.556	-	0.878
DLO1-18-ACJ-77	9.8	10.4	7.682	-	0.816
DLO1-18-ACJ-78	9.5	10.0	7.749	-	0.904
DLO1-18-ACJ-79	7.5	7.8	3.809	-	0.903
DLO1-18-ACJ-80	7.2	7.5	3.013	-	0.807
DLO1-18-ACJ-81	10.3	10.7	9.928	-	0.909
DLO1-18-ACJ-82	10.4	10.7	8.547	-	0.760
DLO1-18-ACJ-83	7.7	8.0	3.878	-	0.849
DLO1-18-ACJ-84	8.4	8.8	5.609	-	0.946
DLO1-18-ACJ-85	8.5	8.9	5.003	-	0.815
DLO1-18-ACJ-86	6.3	6.6	2.566	-	1.026
DLO1-18-ACJ-87	5.5	5.7	1.848	-	1.111
DLO1-18-ACJ-88	7.5	7.9	3.587	-	0.850
DLO1-18-ACJ-89	7.2	7.5	3.361	-	0.900
DLO1-18-ACJ-90	6.9	7.2	3.449	-	1.050

Table G.13: Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
DLO1-18-ACJ-91		6.8	7.1	2.784	-	0.885
DLO1-18-ACJ-92		4.3	4.5	0.673	-	0.846
DLO1-18-ACJ-93		5.7	5.9	1.664	-	0.899
DLO1-18-ACJ-94		7.8	8.1	4.658	-	0.982
DLO1-18-ACJ-95		5.2	5.5	1.308	-	0.930
DLO1-18-ACJ-96		5.6	5.8	1.478	-	0.842
DLO1-18-ACJ-97		3.7	3.8	0.384	-	0.758
DLO1-18-ACJ-98		5.8	6.0	1.908	-	0.978
Overall Catch Summary	Sample Size (N)	98	98	98	10	98
	Average	7.3	8	4.432	1.4	0.900
	Median	6.9	7	3.010	1.0	0.900
	Standard Deviation	2.2	2	4.130	1.1	0.089
	Standard Error	0.2	0	0.417	0.3	0.009
	Minimum	3.2	3	0.267	0.0	0.734
	Maximum	14.9	16	24.267	3.0	1.216
Young-of-the-Year Catch Summary	proportion of YOY	**10%**				
	Sample Size (N)	10	10	10	2	10
	Average	3.8	4.0	0.488	0	0.848
	Median	3.9	4.1	0.488	0	0.835
	Standard Deviation	0.3	0.3	0.109	0	0.066
	Standard Error	0.1	0.1	0.034	0	0.021
	Minimum	3.2	3.3	0.267	0	0.758
	Maximum	4.3	4.5	0.673	0	0.968

Table G.14: Results of Nearshore Arctic Charr Young-of-the-Year (YOY) and Non-YOY Health Endpoint Statistical Comparisons between Sheardown Lake NW (DLO1) and Reference Lake 3 (REF), Mary River Project CREMP, August 2018

Group	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
			Response	Covariate	REF	DLO1		Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]	Statistic	REF	DLO1		
								Interaction P-value	Covariate P-value						
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	98	K-S	-	-	-	-	-	-	<0.001	-34
YOY	Body Size	Fork Length	Fork Length (cm)	-	8	10	tequal	-	-	-	Mean	3.4	3.8	0.0216	14
		Body Weight	Body Weight (g)	-	8	10	tequal	-	-	-	Mean	0.334	0.488	0.0298	46
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	8	10	ANCOVA	0.555	<0.001	3.60	Adjusted Mean	0.391	0.408	0.483	4
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	92	88	K-S	-	-	-	-	-	-	<0.001	-39
	Body Size	Fork Length	Fork Length (cm)	-	92	88	M-W	-	-	-	Median	5.8	7.2	<0.001	24
		Body Weight	Body Weight (g)	-	92	88	M-W	-	-	-	Median	1.83	3.34	<0.001	83
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	92	88	ANCOVA	0.0321	<0.001	6.81	Adjusted Mean	3.27	3.11	0.00243	-5

▨ Area P-value < 0.1 or Interaction P-value < 0.05

🟦 Absolute Magnitude of Difference ≥ 10% for Condition (EEM effect endpoint)

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for $\log_{10}$-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) / reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted mean - reference area predicted mean) / reference area predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

Table G.15: Arctic Charr Estimated Sample Sizes to Detect Various Effect Sizes as a Percentage Change in Respective Fish Health Endpoints at Sheardown Lake NW (DLO1) Using 2018 Data Relative to Reference Lake 3 Data (2018) or Sheardown Lake NW Baseline Data (2006 to 2013) with α=β=0.1, Mary River Project 2018 CREMP

Comparison	Group	Indicator	Endpoint	Variables		Test [c]	S[a]	COV (%)[b]	Minimum Sample Size to Detect an Effect Size (% Increase/Decrease Relative to Reference) with α=β=0.1									
				Response	Covariate				log(Response)	5%	10%	20%	25%	30%	33%	40%	50%	100%
										-5%	-9%	-17%	-20%	-23%	-25%	-29%	-33%	-50%
									Response	±5%	±10%	±20%	±25%	±30%	±33%	±40%	±50%	±100%
Nearshore Arctic Charr (Electrofishing) versus Ref. Lake 3, 2018 Data	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	tequal	-	8.50	Response	51	14	5	3	3	3	3	2	2
			Body Weight	Body Weight (g)	-	tequal	-	2.5	Response	5	3	2	2	2	2	2	2	2
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.04437	-	log10(Response)	77	22	8	6	5	5	4	4	3
Nearshore Arctic Charr (Electrofishing) 2018 versus Baseline	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.09542	3.74	Response	13	5	3	3	3	3	3	3	3
			Body Weight	Body Weight (g)	-	M-W	0.29004	0.85	Response	3	3	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.04497	-	log10(Response)	79	22	8	6	5	5	4	4	3
Littoral/Profundal Arctic Charr (Gill Netting) versus Ref. Lake 3, 2018 Data	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.0865	4.82	Response	20	6	4	3	3	3	3	3	3
			Body Weight	Body Weight (g)	-	M-W	0.263	1.37	Response	4	3	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0377	-	log10(Response)	57	16	6	5	4	4	4	4	3
Littoral/Profundal Arctic Charr (Gill Netting) 2018 versus Baseline	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.0943	4.62	Response	19	6	4	3	3	3	3	3	3
			Body Weight	Body Weight (g)	-	M-W	0.286	1.35	Response	4	3	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0519	-	log10(Response)	105	29	10	7	6	5	5	4	3

[a] Pooled standard deviation of the regression residuals

[b] Coefficient of variation (pooled standard deviation/reference mean)×100%

[c] Sample size estimates for the M-W test were estimated based for a two-sample t-test using sample sizes multiplied by 0.864. The 0.864 is the lower bound of the asymptotic relative efficiency of the Mann-Whitney test and the two-sample t-test (Hodges and Lehmann 1956). Estimates were generated for the response variable on the untransformed and $\log_{10}$-transformed scales and the lowest sample size is reported.

Table G.16: Gill Netting Catch Records for Sheardown Lake NW, Mary River Project CREMP, August 2018

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (ft)	Length (m)	Set Date	Lift Date	Set Time	Lift Time	Fishing Hours	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE
	Easting	Northing									1½"	2"	3"		
DLO1-18-GN-01	560276	7913384	300	91.4	18-Aug-18	18-Aug-18	9:05	10:38	1.55	1.42	0	1	0	1	0.706
DLO1-18-GN-02	560517	7913112	300	91.4	18-Aug-18	18-Aug-18	9:15	10:50	1.58	1.44	0	0	0	0	0
DLO1-18-GN-03	560563	7913029	300	91.4	18-Aug-18	18-Aug-18	9:25	11:10	1.75	1.60	0	2	0	2	1.250
DLO1-18-GN-04	560762	7913069	300	91.4	18-Aug-18	18-Aug-18	9:33	11:30	1.95	1.78	1	0	3	4	2.243
DLO1-18-GN-05	559982	7913513	300	91.4	18-Aug-18	18-Aug-18	9:45	11:53	2.13	1.95	1	1	0	2	1.027
DLO1-18-GN-06	560086	7913441	300	91.4	18-Aug-18	18-Aug-18	9:55	12:10	2.25	2.06	0	1	1	2	0.972
DLO1-18-GN-07	560276	7913384	300	91.4	18-Aug-18	18-Aug-18	10:44	12:50	1.10	1.01	0	0	0	0	0
DLO1-18-GN-08	560538	7913170	300	91.4	18-Aug-18	18-Aug-18	11:00	13:10	2.17	1.98	1	1	0	2	1.008
DLO1-18-GN-09	560563	7913029	300	91.4	18-Aug-18	18-Aug-18	11:16	13:30	2.23	2.04	0	0	0	0	0
DLO1-18-GN-10	560762	7913069	300	91.4	18-Aug-18	18-Aug-18	11:37	13:49	2.20	2.01	1	0	0	1	0.497
DLO1-18-GN-11	559982	7913513	300	91.4	18-Aug-18	18-Aug-18	11:57	14:02	2.08	1.90	1	0	0	1	0.526
DLO1-18-GN-12	560780	7913058	300	91.4	18-Aug-18	18-Aug-18	12:20	14:27	2.12	1.94	1	0	0	1	0.516
DLO1-18-GN-13	560501	7912552	300	91.4	18-Aug-18	18-Aug-18	12:58	14:50	1.87	1.71	1	0	0	1	0.585
DLO1-18-GN-14	560599	7912584	300	91.4	18-Aug-18	18-Aug-18	13:20	15:08	1.80	1.65	0	1	0	1	0.608
DLO1-18-GN-15	560175	7912874	300	91.4	18-Aug-18	18-Aug-18	13:35	15:30	1.92	1.76	1	1	1	3	1.709
DLO1-18-GN-16	560762	7913069	300	91.4	18-Aug-18	18-Aug-18	13:53	15:51	1.97	1.80	2	0	1	3	1.665
DLO1-18-GN-17	560514	7912502	300	91.4	18-Aug-18	18-Aug-18	14:12	16:08	1.93	1.76	0	2	0	2	1.133
DLO1-18-GN-18	560780	7913058	300	91.4	18-Aug-18	18-Aug-18	14:31	16:23	1.87	1.71	0	0	1	1	0.585
DLO1-18-GN-19	560501	7912552	300	91.4	18-Aug-18	18-Aug-18	14:57	16:40	1.72	1.57	0	1	0	1	0.636
DLO1-18-GN-20	560599	7912584	300	91.4	18-Aug-18	18-Aug-18	15:11	16:56	1.75	1.60	0	0	1	1	0.625
DLO1-18-GN-21	560175	7912874	300	91.4	18-Aug-18	18-Aug-18	15:35	17:06	1.52	1.39	0	0	0	0	0
DLO1-18-GN-22	560762	7913069	300	91.4	18-Aug-18	18-Aug-18	15:55	17:20	1.42	1.30	0	0	0	0	0
DLO1-18-GN-23	560514	7912502	300	91.4	18-Aug-18	18-Aug-18	16:13	17:32	1.32	1.21	0	0	1	1	0.828
DLO1-18-GN-24	560659	7913070	300	91.4	19-Aug-18	19-Aug-18	8:13	11:36	2.38	2.18	0	0	1	1	0.460
DLO1-18-GN-25	560823	7913084	300	91.4	19-Aug-18	19-Aug-18	8:19	11:40	3.35	3.06	0	1	0	1	0.326
DLO1-18-GN-26	560399	7912966	300	91.4	19-Aug-18	19-Aug-18	8:30	12:25	3.92	3.58	0	4	1	5	1.395
DLO1-18-GN-27	560125	7912823	300	91.4	19-Aug-18	19-Aug-18	8:36	12:39	4.05	3.70	0	1	0	1	0.270
DLO1-18-GN-28	560506	7912536	200	61.0	19-Aug-18	19-Aug-18	8:47	12:55	4.13	2.52	1	-	1	2	0.794
DLO1-18-GN-29	560586	7912578	300	91.4	19-Aug-18	19-Aug-18	8:51	13:14	3.38	3.09	0	2	0	2	0.647
DLO1-18-GN-30	560659	7913070	300	91.4	19-Aug-18	19-Aug-18	11:40	13:57	2.28	2.08	0	0	0	0	0
DLO1-18-GN-31	559809	7913274	300	91.4	19-Aug-18	19-Aug-18	11:57	14:10	2.22	2.03	0	0	0	0	0
DLO1-18-GN-32	560399	7912966	300	91.4	19-Aug-18	19-Aug-18	12:29	14:27	1.97	1.80	0	1	0	1	0.555
DLO1-18-GN-33	560399	7912966	300	91.4	19-Aug-18	19-Aug-18	12:44	14:35	1.85	1.69	1	0	0	1	0.591
DLO1-18-GN-34	560506	7912536	300	91.4	19-Aug-18	19-Aug-18	13:01	14:42	1.68	1.54	0	-	0	0	0
DLO1-18-GN-35	560495	7912539	200	61.0	20-Aug-18	20-Aug-18	13:41	16:07	2.43	1.48	0	-	0	0	0
DLO1-18-GN-36	560403	7913041	200	61.0	20-Aug-18	20-Aug-18	13:32	15:37	2.08	1.27	0	0	1	1	0.789
DLO1-18-GN-37	560385	7912945	300	91.4	20-Aug-18	20-Aug-18	13:36	15:56	2.33	2.13	0	1	2	3	1.408
DLO1-18-GN-39	560580	7912565	300	91.4	20-Aug-18	20-Aug-18	13:45	16:18	2.55	2.33	1	1	0	2	0.858
DLO1-18-GN-40	560573	7912860	300	91.4	20-Aug-18	20-Aug-18	13:57	16:29	2.53	2.31	0	1	0	1	0.432
DLO1-18-GN-41	560467	7912859	300	91.4	20-Aug-18	20-Aug-18	14:01	16:42	2.68	2.45	1	1	0	2	0.816

Table G.16: Gill Netting Catch Records for Sheardown Lake NW, Mary River Project CREMP, August 2018

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (ft)	Length (m)	Set Date	Lift Date	Set Time	Lift Time	Fishing Hours	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE
	Easting	Northing									1½"	2"	3"		
DLO1-18-GN-42	560245	7913473	300	91.4	21-Aug-18	21-Aug-18	8:50	11:15	2.42	2.21	0	1	1	2	0.904
DLO1-18-GN-43	560398	7913316	200	61.0	21-Aug-18	21-Aug-18	9:15	11:30	2.25	1.37	0	-	0	0	0
DLO1-18-GN-44	559917	7913193	300	91.4	21-Aug-18	21-Aug-18	9:35	11:45	2.17	1.98	0	0	0	0	0
DLO1-18-GN-45	560594	7912439	300	91.4	21-Aug-18	21-Aug-18	9:55	12:15	2.33	2.13	0	1	0	1	0.469
DLO1-18-GN-46	560838	7913037	300	91.4	21-Aug-18	21-Aug-18	10:20	12:40	2.33	2.13	0	1	1	2	0.939
DLO1-18-GN-47	559984	7913064	300	91.4	21-Aug-18	21-Aug-18	10:35	11:45	1.17	1.07	0	0	0	0	0
DLO1-18-GN-48	560479	7912800	300	91.4	21-Aug-18	21-Aug-18	12:30	14:50	2.33	2.13	3	0	3	6	2.816
DLO1-18-GN-49	560838	7913037	300	91.4	21-Aug-18	21-Aug-18	12:50	15:30	2.66	2.43	0	1	0	1	0.411
DLO1-18-GN-50	560047	7913428	300	91.4	21-Aug-18	21-Aug-18	13:35	16:10	2.58	2.36	0	0	0	0	0
DLO1-18-GN-51	560504	7913014	200	61.0	21-Aug-18	21-Aug-18	14:35	16:35	2.00	1.22	1	-	0	1	0.820
DLO1-18-GN-52	560594	7912439	300	91.4	21-Aug-18	21-Aug-18	14:50	16:20	1.50	1.37	0	0	0	0	0
DLO1-18-GN-53	560479	7912800	300	91.4	21-Aug-18	21-Aug-18	15:35	17:45	2.17	1.98	0	0	1	1	0.504
DLO1-18-GN-54	560479	7912800	300	91.4	21-Aug-18	21-Aug-18	16:00	18:00	2.00	1.83	0	1	1	2	1.094
DLO1-18-GN-55	560515	7912737	200	61.0	21-Aug-18	21-Aug-18	16:45	18:20	1.58	0.96	0	-	0	0	0
DLO1-18-GN-56	560451	7912846	300	91.4	21-Aug-18	21-Aug-18	17:10	18:45	1.58	1.44	0	0	0	0	0
DLO1-18-GN-57	560586	7912578	300	91.4	19-Aug-18	19-Aug-18	13:18	14:52	1.57	1.44	0	1	1	2	1.393
DLO1-18-GN-58	560245	7913473	300	91.4	21-Aug-18	21-Aug-18	13:30	16:00	2.50	2.29	0	0	0	0	0
									Total	**108.20**	**18**	**30**	**23**	**71**	**0.63**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.17: Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Gill Netting, Mary River Project CREMP, August 2018

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Fulton's Condition Factor (K)
DLO1-18-AC-01	2	27.9	30.0	178	0.820
DLO1-18-AC-02	2	31.7	33.7	229	0.719
DLO1-18-AC-03	2	37.0	40.5	445	0.879
DLO1-18-AC-04	1.5	27.6	30.1	194	0.923
DLO1-18-AC-05	3	36.4	39.3	383	0.794
DLO1-18-AC-06	3	46.9	49.9	935	0.906
DLO1-18-AC-07	3	38.2	41.5	535	0.960
DLO1-18-AC-08	1.5	64.0	67.8	2,500	0.954
DLO1-18-AC-09	2	33.5	36.8	360	0.958
DLO1-18-AC-10	3	42.9	46.1	730	0.925
DLO1-18-AC-11	2	35.4	38.4	449	1.012
DLO1-18-AC-12	2	28.3	30.7	221	0.975
DLO1-18-AC-13	1.5	37.9	41.2	458	0.841
DLO1-18-AC-14	1.5	51.5	55.0	1,080	0.791
DLO1-18-AC-15	1.5	29.7	32.3	270	1.031
DLO1-18-AC-16	1.5	36.1	39.5	395	0.840
DLO1-18-AC-17	1.5	37.9	40.3	485	0.891
DLO1-18-AC-18	2	29.2	31.6	246	0.988
DLO1-18-AC-19	3	22.7	24.6	102	0.872
DLO1-18-AC-20	2	36.1	39.0	425	0.903
DLO1-18-AC-21	1.5	32.9	35.6	330	0.927
DLO1-18-AC-22	1.5	35.2	38.6	365	0.837
DLO1-18-AC-23	1.5	35.5	38.7	375	0.838
DLO1-18-AC-24	3	33.7	36.4	370	0.967
DLO1-18-AC-25	2	38.2	41.3	495	0.888
DLO1-18-AC-26	2	40.4	43.7	510	0.773
DLO1-18-AC-27	3	39.2	42.4	550	0.913
DLO1-18-AC-28	2	26.5	28.8	172	0.924
DLO1-18-AC-29	3	37.5	40.3	441	0.836
DLO1-18-AC-30	3	37.9	40.6	425	0.781
DLO1-18-AC-31	3	30.2	32.6	254	0.922
DLO1-18-AC-32	2	36.4	39.5	455	0.943
DLO1-18-AC-33	3	39.5	41.5	532	0.863
DLO1-18-AC-34	2	27.7	30.1	190	0.894
DLO1-18-AC-35	2	64.3	68.5	2,450	0.922
DLO1-18-AC-36	2	28.3	30.8	210	0.927
DLO1-18-AC-37	2	34.0	36.9	323	0.822
DLO1-18-AC-38	2	29.7	32.2	200	0.763
DLO1-18-AC-39	3	36.8	39.9	440	0.883
DLO1-18-AC-40	1.5	38.2	41.5	458	0.822
DLO1-18-AC-41	2	29.2	31.7	215	0.864
DLO1-18-AC-42	2	28.1	30.4	202	0.910
DLO1-18-AC-43	2	38.4	41.3	505	0.892
DLO1-18-AC-44	1.5	38.2	41.5	535	0.960
DLO1-18-AC-45	3	37.7	40.4	450	0.840
DLO1-18-AC-46	2	33.3	36.1	320	0.867

Table G.17: Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Gill Netting, Mary River Project CREMP, August 2018

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Fulton's Condition Factor (K)
DLO1-18-AC-47	3	34.0	37.0	400	1.018
DLO1-18-AC-48	3	38.7	42.2	498	0.859
DLO1-18-AC-49	3	36.9	39.8	443	0.882
DLO1-18-AC-50	2	34.9	37.7	333	0.783
DLO1-18-AC-51	2	30.2	33.0	238	0.864
DLO1-18-AC-52	1.5	36.5	39.7	425	0.874
DLO1-18-AC-53	2	30.9	33.6	295	1.000
DLO1-18-AC-54	1.5	36.1	39.3	375	0.797
DLO1-18-AC-55	2	35.7	38.8	409	0.899
DLO1-18-AC-56	3	35.6	38.7	405	0.898
DLO1-18-AC-57	2	35.4	38.1	415	0.935
DLO1-18-AC-58	2	33.7	36.5	320	0.836
DLO1-18-AC-59	2	33.8	36.7	365	0.945
DLO1-18-AC-60	3	41.0	44.2	660	0.958
DLO1-18-AC-61	3	39.0	42.7	610	1.028
DLO1-18-AC-62	3	40.5	43.7	640	0.963
DLO1-18-AC-63	3	37.3	40.2	395	0.761
DLO1-18-AC-64	1.5	38.8	42.5	595	1.019
DLO1-18-AC-65	1.5	37.8	40.9	395	0.731
DLO1-18-AC-66	1.5	34.6	37.6	350	0.845
DLO1-18-AC-67	2	28.0	30.5	212	0.966
DLO1-18-AC-68	1.5	34.3	37.0	390	0.966
DLO1-18-AC-69	3	38.5	42.2	460	0.806
DLO1-18-AC-70	3	44.0	47.1	720	0.845
DLO1-18-AC-71	2	28.0	30.6	204	0.929
Overall Catch Summary	**Sample Size (N)**	**71**	**71**	**71**	**71**
	Average	**35.9**	**38.9**	**464**	**0.890**
	Median	**36.1**	**39.0**	**400**	**0.892**
	Standard Deviation	**6.9**	**7.2**	**384**	**0.074**
	Standard Error	**0.8**	**0.9**	**45.6**	**0.009**
	Minimum	**22.7**	**24.6**	**102**	**0.719**
	Maximum	**64.3**	**68.5**	**2,500**	**1.031**

Table G.18: Results of Littoral/Profundal Arctic Charr Health Endpoint Statistical Comparisons between 2018 Sheardown Lake NW (DLO1) and 2018 Reference Lake 3 (REF) Data, and for Sheardown Lake NW between 2018 and the Mine Baseline Period (2006 to 2013), Mary River Project 2018 CREMP

Comparison	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
			Response	Covariate	REF 2018 or DLO1 Base	DLO1 2018		Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]	Statistic	REF 2018 or DLO1 Base	DLO1 2018		
								Interaction P-value	Covariate P-value						
Sheardown Lake NW versus Reference Lake 3, 2018	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	34	71	K-S	-	-	-	-	-	-	0.197	-22
	Body Size	Fork Length	Fork Length (cm)	-	34	71	M-W	-	-	-	Median	34.5	36.1	0.875	4.5
		Body Weight	Body Weight (g)	-	34	71	M-W	-	-	-	Median	331	400	0.547	21
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	34	71	ANCOVA	0.302	<0.001	36.1	Adjusted Mean	425	443	0.021	4.4
Sheardown Lake NW 2018 versus Baseline	Survival	Length Frequency Distribution	Fork Length (cm)	-	118	71	K-S	-	-	-	-	-	-	0.252	15
	Body Size	Fork Length	Fork Length (cm)	-	118	71	M-W	-	-	-	Median	36.5	36.1	0.302	-1.1
		Body Weight	Body Weight (g)	-	118	71	M-W	-	-	-	Median	400	400	0.346	0
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	118	71	ANCOVA	0.767	<0.001	35.9	Adjusted Mean	430	439	0.260	2.1

▒ Area P-value < 0.1 or Interaction P-value < 0.05

🟦 Absolute Magnitude of Difference ≥ 10% for Condition (EEM effect endpoint)

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for $\log_{10}$-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) / reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted mean - reference area predicted mean) / reference area predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

Table G.19: Arctic Charr Measurements from Fish Captured at Sheardown Lake SE by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID	Fork Length (mm)	Total Length (mm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
DLO2-18-ACJ-01	3.7	3.9	0.455	0	0.898
DLO2-18-ACJ-02	4.4	4.6	0.757	0	0.889
DLO2-18-ACJ-03	13.5	14.4	20.198	3	0.821
DLO2-18-ACJ-04	8.4	8.8	4.624	2	0.780
DLO2-18-ACJ-05	10.5	11.2	10.010	2	0.865
DLO2-18-ACJ-06	6.3	6.6	2.188	1	0.875
DLO2-18-ACJ-07	9.5	10.0	7.232	2	0.844
DLO2-18-ACJ-08	6.3	6.6	2.138	1	0.855
DLO2-18-ACJ-09	7.3	7.6	3.026	1	0.778
DLO2-18-ACJ-10	4.2	4.4	0.596	0	0.804
DLO2-18-ACJ-11	8.2	8.6	4.577	-	0.830
DLO2-18-ACJ-12	9.4	9.8	7.406	-	0.892
DLO2-18-ACJ-13	4.2	4.4	0.673	-	0.908
DLO2-18-ACJ-14	4.3	4.5	0.663	-	0.834
DLO2-18-ACJ-15	4.0	4.2	0.667	-	1.042
DLO2-18-ACJ-16	7.4	7.8	4.200	-	1.036
DLO2-18-ACJ-18	7.2	7.5	3.245	-	0.869
DLO2-18-ACJ-18	8.2	8.6	5.094	-	0.924
DLO2-18-ACJ-19	9.4	9.7	6.334	-	0.763
DLO2-18-ACJ-20	9.2	9.6	6.457	-	0.829
DLO2-18-ACJ-21	3.9	4.1	0.578	-	0.974
DLO2-18-ACJ-22	7.0	7.3	2.975	-	0.867
DLO2-18-ACJ-23	4.2	4.4	0.583	-	0.787
DLO2-18-ACJ-24	9.7	10.1	7.308	-	0.801
DLO2-18-ACJ-25	6.0	6.3	1.885	-	0.873
DLO2-18-ACJ-26	3.6	3.8	0.574	-	1.230
DLO2-18-ACJ-27	6.4	6.6	2.463	-	0.940
DLO2-18-ACJ-28	6.8	7.1	2.862	-	0.910
DLO2-18-ACJ-29	9.0	9.4	5.836	-	0.801
DLO2-18-ACJ-30	9.4	9.7	7.041	-	0.848
DLO2-18-ACJ-31	10.0	10.5	8.945	-	0.895
DLO2-18-ACJ-32	6.8	7.1	3.028	-	0.963
DLO2-18-ACJ-33	4.0	4.2	0.605	-	0.945
DLO2-18-ACJ-34	3.9	4.1	0.516	-	0.870
DLO2-18-ACJ-35	4.2	4.4	0.604	-	0.815
DLO2-18-ACJ-36	7.0	7.3	2.628	-	0.766
DLO2-18-ACJ-37	4.3	4.5	0.613	-	0.771
DLO2-18-ACJ-38	8.4	8.7	4.346	-	0.733
DLO2-18-ACJ-39	6.8	7.1	2.768	-	0.880
DLO2-18-ACJ-40	6.6	6.8	2.236	-	0.778
DLO2-18-ACJ-41	3.9	4.1	0.514	-	0.867
DLO2-18-ACJ-42	7.4	7.6	3.032	-	0.748
DLO2-18-ACJ-43	6.8	7.1	2.552	-	0.812
DLO2-18-ACJ-44	8.4	8.7	4.115	-	0.694
DLO2-18-ACJ-45	4.1	4.3	0.577	-	0.837
DLO2-18-ACJ-46	4.1	4.3	0.567	-	0.823
DLO2-18-ACJ-47	5.8	6.0	1.613	-	0.827
DLO2-18-ACJ-48	3.9	4.1	0.491	-	0.828
DLO2-18-ACJ-49	7.2	7.5	3.026	-	0.811
DLO2-18-ACJ-50	4.2	4.4	0.628	-	0.848
DLO2-18-ACJ-51	4.6	4.8	0.788	-	0.810
DLO2-18-ACJ-52	4.3	4.5	0.780	-	0.981
DLO2-18-ACJ-53	4.1	4.3	0.651	-	0.945
DLO2-18-ACJ-54	7.0	7.3	2.815	-	0.821
DLO2-18-ACJ-55	6.9	7.3	2.830	-	0.861
DLO2-18-ACJ-56	4.5	4.7	0.882	-	0.968
DLO2-18-ACJ-57	6.7	7.0	2.495	-	0.830

Table G.19: Arctic Charr Measurements from Fish Captured at Sheardown Lake SE by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID		Fork Length (mm)	Total Length (mm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
DLO2-18-ACJ-58		4.3	4.5	0.755	-	0.950
DLO2-18-ACJ-59		5.9	6.1	1.822	-	0.887
DLO2-18-ACJ-60		4.5	4.7	0.824	-	0.904
DLO2-18-ACJ-61		3.8	4.0	0.425	-	0.775
DLO2-18-ACJ-62		4.4	4.6	0.813	-	0.954
DLO2-18-ACJ-63		4.7	4.9	0.848	-	0.817
DLO2-18-ACJ-64		7.0	7.3	2.550	-	0.743
DLO2-18-ACJ-65		3.7	3.9	0.419	-	0.827
DLO2-18-ACJ-66		6.6	6.8	2.159	-	0.751
DLO2-18-ACJ-67		7.6	7.9	3.356	-	0.765
DLO2-18-ACJ-68		7.1	7.4	2.929	-	0.818
DLO2-18-ACJ-69		4.7	4.9	0.872	-	0.840
DLO2-18-ACJ-70		3.6	3.8	0.472	-	1.012
DLO2-18-ACJ-71		6.4	6.6	2.365	-	0.902
DLO2-18-ACJ-72		6.8	7.0	3.002	-	0.955
DLO2-18-ACJ-73		7.1	7.4	2.833	-	0.792
DLO2-18-ACJ-74		6.1	6.3	2.142	-	0.944
DLO2-18-ACJ-75		6.2	6.4	1.922	-	0.806
DLO2-18-ACJ-76		6.5	6.7	2.288	-	0.833
DLO2-18-ACJ-77		4.1	4.3	0.607	-	0.881
DLO2-18-ACJ-78		5.6	5.8	1.320	-	0.752
DLO2-18-ACJ-79		7.2	7.5	2.903	-	0.778
DLO2-18-ACJ-80		3.8	4.0	0.593	-	1.081
DLO2-18-ACJ-81		3.8	4.0	0.592	-	1.079
DLO2-18-ACJ-82		4.5	4.7	0.822	-	0.902
DLO2-18-ACJ-83		4.3	4.5	0.695	-	0.874
DLO2-18-ACJ-84		4.3	4.5	0.671	-	0.844
DLO2-18-ACJ-85		4.4	4.6	0.665	-	0.781
DLO2-18-ACJ-86		6.1	6.3	2.256	-	0.994
DLO2-18-ACJ-87		3.9	4.1	0.495	-	0.834
DLO2-18-ACJ-88		4.5	4.7	0.806	-	0.884
DLO2-18-ACJ-89		3.9	4.1	0.446	-	0.752
DLO2-18-ACJ-90		3.8	4.0	0.461	-	0.840
DLO2-18-ACJ-91		6.5	6.7	2.306	-	0.840
DLO2-18-ACJ-92		4.1	4.3	0.534	-	0.775
DLO2-18-ACJ-93		7.2	7.5	2.932	-	0.786
DLO2-18-ACJ-94		4.4	4.6	0.790	-	0.927
DLO2-18-ACJ-95		3.8	4.0	0.467	-	0.851
DLO2-18-ACJ-96		4.6	4.8	0.807	-	0.829
DLO2-18-ACJ-97		4.0	4.2	0.535	-	0.836
DLO2-18-ACJ-98		6.5	6.8	2.186	-	0.796
DLO2-18-ACJ-99		5.6	5.9	1.435	-	0.817
Overall Catch Summary	Sample Size (N)	99	99	99	10.0	99
	Average	5.9	6.2	2.378	1.2	0.860
	Median	5.9	6.1	1.822	1.0	0.840
	Standard Deviation	2.0	2.1	2.740	1.0	0.086
	Standard Error	0.2	0.2	0.275	0.3	0.009
	Minimum	3.6	3.8	0.419	0.0	0.694
	Maximum	13.5	14.4	20.198	3.0	1.230
Young-of-the-Year Catch Summary	proportion of YOY	**46%**				
	Sample Size (N)	46	46	46	3	46
	Average	4.1	4.3	0.634	0	0.885
	Median	4.2	4.4	0.606	0	0.859
	Standard Deviation	0.3	0.3	0.132	0	0.095
	Standard Error	0.0	0.0	0.020	0	0.014
	Minimum	3.6	3.8	0.419	0	0.752
	Maximum	4.7	4.9	0.882	0	1.230

Table G.20: **Results of Nearshore Arctic Charr Young-of-the-Year (YOY) and Non-YOY Health Endpoint Statistical Comparisons between Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF), Mary River Project CREMP, August 2018**

Group	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
			Response	Covariate	REF	DLO-02		Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]	Statistic	REF	DLO-02		
								Interaction P-value	Covariate P-value						
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	99	K-S	-	-	-	-	-	-	<0.001	37
YOY	Body Size	Fork Length	Fork Length (cm)	-	8	46	tequal	-	-	-	Mean	3.4	4.1	<0.001	23
		Body Weight	Body Weight (g)	-	8	46	M-W	-	-	-	Median	0.276	0.606	<0.001	120
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	8	46	ANCOVA	0.735	<0.001	4.00	Adjusted Mean	0.508	0.58	0.0159	14
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	92	53	K-S	-	-	-	-	-	-	<0.001	-47
	Body Size	Fork Length	Fork Length (cm)	-	92	53	M-W	-	-	-	Median	5.8	7.0	<0.001	21
		Body Weight	Body Weight (g)	-	92	53	M-W	-	-	-	Median	1.83	2.90	<0.001	59
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	92	53	ANCOVA	0.107	<0.001	6.60	Adjusted Mean	2.94	2.57	<0.001	-13

▨ Area P-value < 0.1 or Interaction P-value < 0.05

🟦 Absolute Magnitude of Difference ≥ 10% for Condition (EEM effect endpoint)

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for $\log_{10}$-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) / reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted mean - reference area predicted mean) / reference area predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

Table G.21: Arctic Charr Estimated Sample Sizes to Detect Various Effect Sizes as a Percentage Change in Respective Fish Health Endpoints at Sheardown Lake SE (DLO-02) Using 2018 Data Relative to Reference Lake 3 Data (2018) or Sheardown Lake SE Baseline Data (2006 to 2013) with α=β=0.1, Mary River Project 2018 CREMP

Comparison	Group	Indicator	Endpoint	Variables		Test [c]	S[a]	COV (%)[b]	Minimum Sample Size to Detect an Effect Size (% Increase/Decrease Relative to Reference) with α=β=0.1									
				Response	Covariate				log(Response)	5%	10%	20%	25%	30%	33%	40%	50%	100%
										-5%	-9%	-17%	-20%	-23%	-25%	-29%	-33%	-50%
									Response	±5%	±10%	±20%	±25%	±30%	±33%	±40%	±50%	±100%
Nearshore Arctic Charr (Electrofishing) versus Ref. Lake 3, 2018 Data	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.08546	4.33	Response	17	6	4	3	3	3	3	3	3
			Body Weight	Body Weight (g)	-	M-W	0.26352	1.1	Response	4	3	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.04366	-	log10(Response)	75	21	8	6	5	5	4	4	3
Nearshore Arctic Charr (Electrofishing) 2018 versus Baseline	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.07109	4.74	Response	20	6	4	3	3	3	3	3	3
			Body Weight	Body Weight (g)	-	M-W	0.23243	0.96	Response	3	3	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.06847	-	log10(Response)	181	49	15	11	8	7	6	5	4
Littoral/Profundal Arctic Charr (Gill Netting) versus Ref. Lake 3, 2018 Data	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.0814	5.68	Response	27	9	4	4	3	3	3	3	3
			Body Weight	Body Weight (g)	-	M-W	0.248	1.9	Response	5	3	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0382	-	log10(Response)	58	17	6	5	4	4	4	4	3
Littoral/Profundal Arctic Charr (Gill Netting) 2018 versus Baseline	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.0544	9.32	Response	71	19	6	5	4	4	4	3	3
			Body Weight	Body Weight (g)	-	M-W	0.171	3.57	Response	12	5	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0445	-	log10(Response)	78	22	8	6	5	5	4	4	3

[a] Pooled standard deviation of the regression residuals

[b] Coefficient of variation (pooled standard deviation/reference mean)×100%

[c] Sample size estimates for the M-W test were estimated based for a two-sample t-test using sample sizes multiplied by 0.864. The 0.864 is the lower bound of the asymptotic relative efficiency of the Mann-Whitney test and the two-sample t-test (Hodges and Lehmann 1956). Estimates were generated for the response variable on the untransformed and log$_{10}$-transformed scales and the lowest sample size is reported.

Table G.22: Gill Netting Catch Records for Sheardown Lake SE, Mary River Project CREMP, August 2018

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (m)	Set Date	Lift Date	Set Time	Lift Time	Fishing Hours	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE
	Easting	Northing								1½"	2"	3"		
DLO2-18-GN-01	561266	7911890	91.4	18-Aug-18	18-Aug-18	9:30	11:15	1.75	1.60	2	3	0	5	3.12
DLO2-18-GN-02	561540	7911797	91.4	18-Aug-18	18-Aug-18	9:45	11:45	2.00	1.83	2	4	3	9	4.92
DLO2-18-GN-03	560982	7912041	91.4	18-Aug-18	18-Aug-18	10:10	12:30	2.33	2.13	0	6	6	12	5.62
DLO2-18-GN-04	560830	7912159	91.4	18-Aug-18	18-Aug-18	10:25	12:45	2.33	2.13	0	1	2	3	1.41
DLO2-18-GN-05	560787	7912249	91.4	18-Aug-18	18-Aug-18	10:30	13:00	2.50	2.29	3	9	3	15	6.56
DLO2-18-GN-06	561266	7911890	91.4	18-Aug-18	18-Aug-18	11:20	14:00	2.67	2.44	2	11	1	14	5.74
DLO2-18-GN-07	560982	7912041	91.4	18-Aug-18	18-Aug-18	13:30	15:30	2.00	1.83	1	5	3	9	4.92
DLO2-18-GN-08	560787	7912249	91.4	18-Aug-18	18-Aug-18	14:00	16:15	2.25	2.06	4	1	3	8	3.89
DLO2-18-GN-09	561540	7911797	91.4	18-Aug-18	18-Aug-18	15:20	17:00	1.67	1.52	0	1	2	3	1.97
DLO2-18-GN-10	560982	7912041	91.4	18-Aug-18	18-Aug-18	15:55	17:20	1.42	1.30	1	1	1	3	2.32
DLO2-18-GN-11	560787	7912249	91.4	18-Aug-18	18-Aug-18	16:25	17:45	1.33	1.22	2	1	1	4	3.28
								Total	**20.35**	**17**	**43**	**25**	**85**	**3.98**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.23: Arctic Charr Measurements from Fish Captured at Sheardown Lake SE by Gill Netting, Mary River Project CREMP, August 2018

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Fulton's Condition Factor (K)
DLO2-18-AC-01	2	38.7	41.9	570	0.983
DLO2-18-AC-02	2	35.9	38.9	320	0.692
DLO2-18-AC-03	2	18.3	19.7	53	0.857
DLO2-18-AC-04	1½	19.2	20.2	61	0.855
DLO2-18-AC-05	1½	24.6	26.6	132	0.887
DLO2-18-AC-06	3	41.2	44.9	625	0.894
DLO2-18-AC-07	3	39.0	41.7	485	0.818
DLO2-18-AC-08	3	42.1	45.9	710	0.952
DLO2-18-AC-09	2	33.2	36.0	365	0.997
DLO2-18-AC-10	2	32.7	35.7	320	0.915
DLO2-18-AC-11	2	34.4	37.4	405	0.995
DLO2-18-AC-12	2	30.5	32.7	249	0.878
DLO2-18-AC-13	1½	38.0	41.4	470	0.857
DLO2-18-AC-14	1½	36.3	40.2	450	0.941
DLO2-18-AC-15	3	38.2	41.4	495	0.888
DLO2-18-AC-16	3	36.6	39.7	430	0.877
DLO2-18-AC-18	3	35.5	38.6	420	0.939
DLO2-18-AC-18	3	30.0	32.5	250	0.926
DLO2-18-AC-19	3	34.3	37.4	400	0.991
DLO2-18-AC-20	3	36.9	40.3	495	0.985
DLO2-18-AC-21	2	38.8	42.1	575	0.984
DLO2-18-AC-22	2	35.2	38.1	420	0.963
DLO2-18-AC-23	2	33.8	36.6	395	1.023
DLO2-18-AC-24	2	37.3	40.7	470	0.906
DLO2-18-AC-25	2	38.8	42.0	545	0.933
DLO2-18-AC-26	2	33.2	36.7	330	0.902
DLO2-18-AC-27	3	38.0	41.4	490	0.893
DLO2-18-AC-28	3	36.0	40.2	325	0.697
DLO2-18-AC-29	3	36.4	39.8	430	0.892
DLO2-18-AC-30	3	42.0	45.7	580	0.783
DLO2-18-AC-31	3	38.6	42.5	565	0.982
DLO2-18-AC-32	3	36.6	39.7	450	0.918
DLO2-18-AC-33	1½	33.0	35.7	330	0.918
DLO2-18-AC-34	1½	36.3	39.2	435	0.909
DLO2-18-AC-35	1½	34.8	38.5	405	0.961
DLO2-18-AC-36	2	31.5	34.1	305	0.976
DLO2-18-AC-37	2	41.2	44.5	600	0.858
DLO2-18-AC-38	2	40.3	44.0	585	0.894
DLO2-18-AC-39	2	35.5	38.7	455	1.017
DLO2-18-AC-40	2	37.0	41.0	480	0.948
DLO2-18-AC-41	2	40.8	44.0	535	0.788
DLO2-18-AC-42	2	33.3	36.1	355	0.961
DLO2-18-AC-43	2	32.0	34.7	289	0.882
DLO2-18-AC-44	2	44.9	48.5	945	1.044
DLO2-18-AC-45	3	27.7	30.0	213	1.002
DLO2-18-AC-46	1½	27.9	30.2	204	0.939

Table G.23: Arctic Charr Measurements from Fish Captured at Sheardown Lake SE by Gill Netting, Mary River Project CREMP, August 2018

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Fulton's Condition Factor (K)
DLO2-18-AC-47	1½	36.6	39.7	465	0.948
DLO2-18-AC-48	2	36.6	40.2	415	0.846
DLO2-18-AC-49	2	25.2	27.3	132	0.825
DLO2-18-AC-50	2	38.3	41.3	485	0.863
DLO2-18-AC-51	2	36.5	40.1	500	1.028
DLO2-18-AC-52	2	40.2	43.5	585	0.900
DLO2-18-AC-53	2	37.5	40.4	450	0.853
DLO2-18-AC-54	2	27.9	30.4	211	0.972
DLO2-18-AC-55	2	34.5	37.4	420	1.023
DLO2-18-AC-56	2	26.5	30.9	194	1.042
DLO2-18-AC-57	2	35.5	38.4	385	0.861
DLO2-18-AC-58	2	35.7	38.8	405	0.890
DLO2-18-AC-59	1½	27.4	29.5	184	0.894
DLO2-18-AC-60	3	40.6	43.8	655	0.979
DLO2-18-AC-61	3	41.4	45.1	572	0.806
DLO2-18-AC-62	3	39.8	43.3	470	0.746
DLO2-18-AC-63	2	34.5	37.3	375	0.913
DLO2-18-AC-64	2	41.4	44.8	655	0.923
DLO2-18-AC-65	2	35.2	38.7	465	1.066
DLO2-18-AC-66	2	34.5	37.5	410	0.998
DLO2-18-AC-67	2	33.5	36.5	375	0.997
DLO2-18-AC-68	3	39.0	42.2	545	0.919
DLO2-18-AC-69	3	40.2	43.4	520	0.800
DLO2-18-AC-70	3	34.2	37.5	395	0.987
DLO2-18-AC-71	1½	39.5	42.7	535	0.868
DLO2-18-AC-72	1½	41.0	43.9	525	0.762
DLO2-18-AC-73	1½	37.5	40.9	500	0.948
DLO2-18-AC-74	1½	36.1	39.0	435	0.925
DLO2-18-AC-75	2	36.4	39.5	455	0.943
DLO2-18-AC-76	3	38.1	41.0	515	0.931
DLO2-18-AC-77	3	37.2	40.2	435	0.845
DLO2-18-AC-78	2	27.1	29.7	185	0.930
DLO2-18-AC-79	1½	26.4	28.6	161	0.875
DLO2-18-AC-80	2	28.4	31.0	203	0.886
DLO2-18-AC-81	3	42.3	45.2	775	1.024
DLO2-18-AC-82	3	36.2	39.4	465	0.980
DLO2-18-AC-83	2	36.0	39.7	415	0.889
DLO2-18-AC-84	1½	41.0	44.3	640	0.929
DLO2-18-AC-85	1½	36.2	39.0	405	0.854
Overall Catch Summary	**Sample Size (N)**	**85**	**85**	**85**	**85**
	Average	**35.4**	**38.5**	**427**	**0.915**
	Median	**36.3**	**39.7**	**435**	**0.918**
	Standard Deviation	**5.0**	**5.5**	**155**	**0.076**
	Standard Error	**0.5**	**0.6**	**16.83**	**0.008**
	Minimum	**18.3**	**19.7**	**53**	**0.692**
	Maximum	**44.9**	**48.5**	**945**	**1.066**

Table G.24: **Results of Littoral/Profundal Arctic Charr Health Endpoint Statistical Comparisons between 2018 Sheardown Lake SE (DLO-02) and 2018 Reference Lake 3 (REF) Data, and for Sheardown Lake SE between 2018 and the Mine Baseline Period (2006 to 2013), Mary River Project 2018 CREMP**

Comparison	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
			Response	Covariate	REF 2018 or DLO-02 Base	DLO-02 2018		Interaction Model Interaction P-value	Parallel Slope Model Covariate P-value	Covariate Value for Comparisons[a]	Statistic	REF 2018 or DLO-02 Base	DLO-02 2018		
Sheardown Lake SE versus Reference Lake 3, 2018	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	34	85	K-S	-	-	-	-	-	-	0.042	-28
	Body Size	Fork Length	Fork Length (cm)	-	34	85	M-W	-	-	-	Median	34.5	36.3	0.469	5.1
		Body Weight	Body Weight (g)	-	34	85	M-W	-	-	-	Median	331	435	0.158	31
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	34	85	ANCOVA	0.355	<0.001	35.7	Adjusted Mean	408	438	<0.001	7.4
Sheardown Lake SE 2018 versus Baseline	Survival	Length Frequency Distribution	Fork Length (cm)	-	90	85	K-S	-	-	-	-	-	-	<0.001	31
	Body Size	Fork Length	Fork Length (cm)	-	90	85	M-W	-	-	-	Median	37.9	36.3	<0.001	-4.1
		Body Weight	Body Weight (g)	-	90	85	M-W	-	-	-	Median	517	435	<0.001	-16
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	90	85	ANCOVA	0.016	<0.001	36.4	Adjusted Mean	488	452	<0.001	-7.3
					89[e]	85	ANCOVA	0.062	<0.001	36.4	Adjusted Mean	484	450	<0.001	-7.0

▨ Area P-value < 0.1 or Interaction P-value < 0.05

🟦 Absolute Magnitude of Difference ≥ 10% for Condition (EEM effect endpoint)

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for $\log_{10}$-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) / reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted mean - reference area predicted mean) / reference area predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

[e] One outlier (Fish ID:SDSE-08-005. 17; Studentized residual = 4.3) was removed from the analysis.

Table G.25: Arctic Charr Measurements from Fish Captured at Mary Lake by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID	Fork Length (cm)	Total Length (cm)	Total Weight (g)	Age (years)	Fulton's Condition Factor (K)
BLO-18-ACJ-01	4.0	4.2	0.529	0	0.827
BLO-18-ACJ-02	7.7	8.1	3.924	1	0.860
BLO-18-ACJ-03	7.1	7.4	3.154	1	0.881
BLO-18-ACJ-04	4.6	4.8	0.961	0	0.987
BLO-18-ACJ-05	11.9	12.8	14.309	3	0.849
BLO-18-ACJ-06	8.8	9.4	5.743	2	0.843
BLO-18-ACJ-07	5.8	6.0	1.492	1	0.765
BLO-18-ACJ-08	9.8	10.5	8.863	3	0.942
BLO-18-ACJ-09	4.1	4.3	0.557	0	0.808
BLO-18-ACJ-10	8.4	8.8	4.463	2	0.753
BLO-18-ACJ-11	3.0	3.1	0.242	-	0.896
BLO-18-ACJ-12	6.1	6.4	2.209	-	0.973
BLO-18-ACJ-13	8.2	8.6	4.241	-	0.769
BLO-18-ACJ-14	6.4	6.7	2.069	-	0.789
BLO-18-ACJ-15	4.2	4.4	0.664	-	0.896
BLO-18-ACJ-16	5.8	6.0	1.729	-	0.886
BLO-18-ACJ-17	8.0	8.5	5.427	-	1.060
BLO-18-ACJ-18	6.5	6.7	2.416	-	0.880
BLO-18-ACJ-19	6.1	6.3	2.187	-	0.964
BLO-18-ACJ-20	3.8	4.0	0.478	-	0.871
BLO-18-ACJ-21	5.7	5.9	1.395	-	0.753
BLO-18-ACJ-22	5.4	5.7	1.476	-	0.937
BLO-18-ACJ-23	6.3	6.6	2.132	-	0.853
BLO-18-ACJ-24	5.8	6.1	1.559	-	0.799
BLO-18-ACJ-25	2.9	3.0	0.200	-	0.820
BLO-18-ACJ-26	4.1	4.3	0.546	-	0.792
BLO-18-ACJ-27	6.9	7.2	2.921	-	0.889
BLO-18-ACJ-28	7.1	7.4	2.961	-	0.827
BLO-18-ACJ-29	5.4	5.6	1.878	-	1.193
BLO-18-ACJ-30	10.8	11.2	10.532	-	0.836
BLO-18-ACJ-31	6.9	7.2	2.651	-	0.807
BLO-18-ACJ-32	5.5	5.7	1.587	-	0.954
BLO-18-ACJ-33	6.1	6.3	1.775	-	0.782
BLO-18-ACJ-34	6.4	6.7	2.271	-	0.866
BLO-18-ACJ-35	5.6	5.8	1.613	-	0.918
BLO-18-ACJ-36	6.2	6.5	2.057	-	0.863
BLO-18-ACJ-37	4.2	4.4	0.693	-	0.935
BLO-18-ACJ-38	7.4	7.7	3.823	-	0.943
BLO-18-ACJ-39	6.5	6.8	2.495	-	0.909
BLO-18-ACJ-40	5.8	6.0	1.899	-	0.973
BLO-18-ACJ-41	6.3	6.5	2.315	-	0.926
BLO-18-ACJ-42	7.4	7.6	4.339	-	1.071
BLO-18-ACJ-43	6.9	7.2	3.015	-	0.918
BLO-18-ACJ-44	5.2	5.5	1.532	-	1.090
BLO-18-ACJ-45	6.2	6.4	1.976	-	0.829
BLO-18-ACJ-46	5.4	5.6	1.457	-	0.925

Table G.25: Arctic Charr Measurements from Fish Captured at Mary Lake by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID	Fork Length (cm)	Total Length (cm)	Total Weight (g)	Age (years)	Fulton's Condition Factor (K)
BLO-18-ACJ-47	7.3	7.6	3.956	-	1.017
BLO-18-ACJ-48	7.6	8.0	3.610	-	0.822
BLO-18-ACJ-49	7.4	7.7	3.560	-	0.879
BLO-18-ACJ-50	4.9	5.1	1.091	-	0.927
BLO-18-ACJ-51	6.4	6.6	2.086	-	0.796
BLO-18-ACJ-52	3.5	3.7	0.374	-	0.872
BLO-18-ACJ-53	5.7	6.0	1.632	-	0.881
BLO-18-ACJ-54	6.8	7.1	3.023	-	0.961
BLO-18-ACJ-55	6.3	6.6	2.449	-	0.979
BLO-18-ACJ-56	8.4	8.8	4.847	-	0.818
BLO-18-ACJ-57	3.8	4.0	0.496	-	0.904
BLO-18-ACJ-58	3.0	3.1	0.240	-	0.889
BLO-18-ACJ-59	9.5	9.9	6.301	-	0.735
BLO-18-ACJ-60	8.0	8.5	5.642	-	1.102
BLO-18-ACJ-61	5.8	6.0	1.655	-	0.848
BLO-18-ACJ-62	6.4	6.7	2.109	-	0.805
BLO-18-ACJ-63	5.8	6.1	1.563	-	0.801
BLO-18-ACJ-64	6.4	6.6	1.930	-	0.736
BLO-18-ACJ-65	5.4	5.6	1.272	-	0.808
BLO-18-ACJ-66	3.7	3.9	0.502	-	0.991
BLO-18-ACJ-67	8.1	8.4	4.485	-	0.844
BLO-18-ACJ-68	6.7	7.0	3.252	-	1.081
BLO-18-ACJ-69	5.8	6.0	1.996	-	1.023
BLO-18-ACJ-70	3.6	3.8	0.528	-	1.132
BLO-18-ACJ-71	6.5	6.7	2.599	-	0.946
BLO-18-ACJ-72	6.9	7.2	2.475	-	0.753
BLO-18-ACJ-73	5.5	5.8	1.467	-	0.882
BLO-18-ACJ-74	8.2	8.5	5.142	-	0.933
BLO-18-ACJ-75	5.8	6.1	1.882	-	0.965
BLO-18-ACJ-76	6.3	6.5	2.129	-	0.851
BLO-18-ACJ-77	5.9	6.1	1.746	-	0.850
BLO-18-ACJ-78	8.0	8.4	4.613	-	0.901
BLO-18-ACJ-79	6.5	6.8	2.259	-	0.823
BLO-18-ACJ-80	6.2	6.4	2.082	-	0.874
BLO-18-ACJ-81	5.0	5.2	1.148	-	0.918
BLO-18-ACJ-82	8.0	8.5	4.562	-	0.891
BLO-18-ACJ-83	5.5	5.7	1.367	-	0.822
BLO-18-ACJ-84	8.5	8.9	4.478	-	0.729
BLO-18-ACJ-85	8.4	8.9	4.788	-	0.808
BLO-18-ACJ-86	4.8	5.0	1.071	-	0.968
BLO-18-ACJ-87	5.6	5.8	1.314	-	0.748
BLO-18-ACJ-88	7.0	7.3	3.088	-	0.900
BLO-18-ACJ-89	6.6	6.8	2.654	-	0.923
BLO-18-ACJ-90	7.2	7.5	3.241	-	0.868
BLO-18-ACJ-91	8.4	8.7	4.692	-	0.792
BLO-18-ACJ-92	6.3	6.5	1.916	-	0.766

Table G.25: Arctic Charr Measurements from Fish Captured at Mary Lake by Electrofishing, Mary River Project CREMP, August 2018

Specimen ID		Fork Length (cm)	Total Length (cm)	Total Weight (g)	Age (years)	Fulton's Condition Factor (K)
BLO-18-ACJ-93		5.8	6.0	1.516	-	0.777
BLO-18-ACJ-94		6.6	6.8	2.538	-	0.883
BLO-18-ACJ-95		4.2	4.4	0.669	-	0.903
BLO-18-ACJ-96		5.1	5.3	1.242	-	0.936
BLO-18-ACJ-97		6.0	6.3	1.809	-	0.838
BLO-18-ACJ-98		5.8	6.0	1.663	-	0.852
BLO-18-ACJ-99		6.4	6.6	2.159	-	0.824
BLO-18-ACJ-100		5.7	5.9	1.618	-	0.874
BLO-18-ACJ-101		6.3	6.5	2.157	-	0.863
BLO-18-ACJ-102		5.7	5.9	1.856	-	1.002
BLO-18-ACJ-103		5.7	5.9	1.397	-	0.754
Overall Catch Summary	Sample Size (N)	103	103	103	10.0	103
	Average	6.3	6.5	2.570	1.3	0.883
	Median	6.2	6.5	2.069	1.0	0.874
	Standard Deviation	1.6	1.7	2.079	1.2	0.092
	Standard Error	0.2	0.2	0.205	0.4	0.009
	Minimum	2.9	3.0	0.200	0.0	0.729
	Maximum	11.9	12.8	14.309	3.0	1.193
Young-of-the-Year Catch Summary	proportion of YOY	**14%**				
	Sample Size (N)	14	14	14	2	14
	Average	3.7	3.9	0.480	0	0.895
	Median	3.8	4.0	0.515	0	0.893
	Standard Deviation	0.5	0.5	0.160	0	0.086
	Standard Error	0.1	0.1	0.043	0	0.023
	Minimum	2.9	3.0	0.200	0	0.792
	Maximum	4.2	4.4	0.693	0	1.132

Table G.26: **Results of Nearshore Arctic Charr Young-of-the-Year (YOY) and Non-YOY Health Endpoint Statistical Comparisons between Mary Lake (BLO) and Reference Lake 3 (REF), Mary River Project CREMP, August 2018**

Group	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
								Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]					
			Response	Covariate	REF	BLO		Interaction P-value	Covariate P-value		Statistic	REF	BLO		
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	103	K-S	-	-	-	-	-	-	0.024	-21
YOY	Body Size	Fork Length	Fork Length (cm)	-	8	14	tequal	-	-	-	Mean	3.4	3.7	0.106	11
		Body Weight	Body Weight (g)	-	8	14	tequal	-	-	-	Mean	0.334	0.480	0.0555	44
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	8	14	ANCOVA	0.485	<0.001	3.56	Adjusted Mean	0.382	0.414	0.127	8
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	92	89	K-S	-	-	-	-	-	-	0.002	-28
	Body Size	Fork Length	Fork Length (cm)	-	92	89	M-W	-	-	-	Median	5.8	6.4	0.0138	10
		Body Weight	Body Weight (g)	-	92	89	M-W	-	-	-	Median	1.83	2.16	0.129	18
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	92	89	ANCOVA	0.0202	<0.001	6.38	Adjusted Mean	2.62	2.42	<0.001	-8

▨ Area P-value < 0.1 or Interaction P-value < 0.05

🟦 Absolute Magnitude of Difference ≥ 10% for Condition (EEM effect endpoint)

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for $\log_{10}$-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) / reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted mean - reference area predicted mean) / reference area predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

Table G.27: Arctic Charr Estimated Sample Sizes to Detect Various Effect Sizes as a Percentage Change in Respective Fish Health Endpoints at Mary Lake (BLO) Using 2018 Data Relative to Reference Lake 3 Data (2018) or Mary Lake Baseline Data (2006 to 2013) with α=β=0.1, Mary River Project 2018 CREMP

Comparison	Group	Indicator	Endpoint	Variables		Test [c]	S[a]	COV (%)[b]	Minimum Sample Size to Detect an Effect Size (% Increase/Decrease Relative to Reference) with α=β=0.1									
				Response	Covariate				log(Response)	5%	10%	20%	25%	30%	33%	40%	50%	100%
										-5%	-9%	-17%	-20%	-23%	-25%	-29%	-33%	-50%
									Response	±5%	±10%	±20%	±25%	±30%	±33%	±40%	±50%	±100%
Nearshore Arctic Charr (Electrofishing) versus Ref. Lake 3, 2018 Data	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.08398	4.61	Response	19	6	4	3	3	3	3	3	3
			Body Weight	Body Weight (g)	-	M-W	0.25654	1.3	Response	4	3	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.04629	-	log10(Response)	84	24	8	6	5	5	4	4	3
Littoral/Profundal Arctic Charr (Gill Netting) versus Ref. Lake 3, 2018 Data	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.0637	6.24	Response	33	10	4	4	4	3	3	3	3
			Body Weight	Body Weight (g)	-	M-W	0.191	1.72	Response	5	3	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0364	-	log10(Response)	53	15	6	5	4	4	4	3	3
Littoral/Profundal Arctic Charr (Gill Netting) 2018 versus Baseline	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.0912	4.93	Response	21	7	4	3	3	3	3	3	3
			Body Weight	Body Weight (g)	-	M-W	0.265	1.41	Response	4	3	3	3	3	3	3	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0529	-	log10(Response)	109	30	10	7	6	5	5	4	3

[a] Pooled standard deviation of the regression residuals

[b] Coefficient of variation (pooled standard deviation/reference mean)×100%

[c] Sample size estimates for the M-W test were estimated based for a two-sample t-test using sample sizes multiplied by 0.864. The 0.864 is the lower bound of the asymptotic relative efficiency of the Mann-Whitney test and the two-sample t-test (Hodges and Lehmann 1956). Estimates were generated for the response variable on the untransformed and log$_{10}$-transformed scales and the lowest sample size is reported.

Table G.28: Gill Netting Catch Records for Mary Lake, Mary River Project CREMP, August 2018

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (m)	Set Date	Lift Date	Set Time	Lift Time	Fishing Hours	Effort (m*hrs/100 m)	Arctic Charr Catch per Mesh Size			Total Catch	CPUE
	Easting	Northing								1½"	2"	3"		
BLO-18-GN-01	554769	7906099	91.44	19-Aug-18	19-Aug-18	12:10	16:30	4.33	3.96	1	5	7	13	3.28
BLO-18-GN-02	554856	7906040	91.44	19-Aug-18	19-Aug-18	12:25	15:15	2.83	2.59	1	15	8	24	9.26
BLO-18-GN-03	554936	7906040	91.44	20-Aug-18	20-Aug-18	12:35	15:05	2.50	2.29	2	8	11	21	9.19
BLO-18-GN-04	556169	7903786	91.44	20-Aug-18	20-Aug-18	12:55	15:25	2.50	2.29	0	3	8	11	4.81
BLO-18-GN-05	556144	7903878	91.44	20-Aug-18	20-Aug-18	13:05	15:35	2.50	2.29	0	9	5	14	6.12
BLO-18-GN-06	554769	7906099	91.44	19-Aug-18	19-Aug-18	15:10	18:00	2.83	2.59	1	11	26	38	14.67
BLO-18-GN-07	554856	7906040	91.44	19-Aug-18	19-Aug-18	16:10	18:30	2.33	2.13	0	3	5	8	3.75
Total									**18.14**	**5**	**54**	**70**	**129**	**7.30**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.29: Arctic Charr Measurements from Fish Captured at Mary Lake by Gill Netting, Mary River Project CREMP, August 2018

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Fulton's Condition Factor
BLO-18-AC-01	3	40.4	43.7	535	0.811
BLO-18-AC-02	3	39.7	43.2	485	0.775
BLO-18-AC-03	2	39.6	43.4	550	0.886
BLO-18-AC-04	3	40.9	44.6	555	0.811
BLO-18-AC-05	3	38.4	42.4	510	0.901
BLO-18-AC-06	3	39.8	43.3	480	0.761
BLO-18-AC-07	3	38.1	42.3	510	0.922
BLO-18-AC-08	3	39.5	43.1	515	0.836
BLO-18-AC-09	2	37.9	40.4	455	0.836
BLO-18-AC-10	2	37.1	39.7	415	0.813
BLO-18-AC-11	2	38.4	41.4	525	0.927
BLO-18-AC-12	2	39.4	42.1	560	0.916
BLO-18-AC-13	1.5	40.5	44.2	590	0.888
BLO-18-AC-14	3	36.3	39.7	405	0.847
BLO-18-AC-15	3	36.5	39.2	440	0.905
BLO-18-AC-16	3	37.1	39.6	425	0.832
BLO-18-AC-17	3	40.9	44.1	605	0.884
BLO-18-AC-18	3	36.3	39.0	370	0.774
BLO-18-AC-19	3	34.9	37.9	395	0.929
BLO-18-AC-20	3	41.2	45.1	485	0.694
BLO-18-AC-21	3	39.5	42.9	505	0.819
BLO-18-AC-22	2	41.3	45.1	640	0.909
BLO-18-AC-23	2	32.1	35.7	330	0.998
BLO-18-AC-24	2	38.5	41.2	450	0.789
BLO-18-AC-25	2	32.4	35.1	320	0.941
BLO-18-AC-26	2	38.3	41.2	465	0.828
BLO-18-AC-27	2	38.6	41.6	545	0.948
BLO-18-AC-28	2	38.6	41.6	460	0.800
BLO-18-AC-29	2	36.9	39.4	410	0.816
BLO-18-AC-30	2	39.6	42.5	545	0.878
BLO-18-AC-31	2	39.3	42.5	465	0.766
BLO-18-AC-32	2	38.6	42.0	475	0.826
BLO-18-AC-33	2	33.1	36.9	355	0.979
BLO-18-AC-34	2	39.3	42.5	515	0.848
BLO-18-AC-35	2	39.0	41.9	495	0.834
BLO-18-AC-36	2	38.4	42.1	495	0.874
BLO-18-AC-37	1.5	38.3	41.6	495	0.881
BLO-18-AC-38	3	46.8	50.7	835	0.815
BLO-18-AC-39	3	37.7	41.1	505	0.942
BLO-18-AC-40	3	41.2	45.5	650	0.929
BLO-18-AC-41	3	34.6	37.2	380	0.917
BLO-18-AC-42	3	38.8	42.1	560	0.959
BLO-18-AC-43	3	37.6	40.7	455	0.856
BLO-18-AC-44	3	40.5	44.0	505	0.760
BLO-18-AC-45	3	41.7	45.2	650	0.896

Table G.29: Arctic Charr Measurements from Fish Captured at Mary Lake by Gill Netting, Mary River Project CREMP, August 2018

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Fulton's Condition Factor
BLO-18-AC-46	3	38.7	41.6	455	0.785
BLO-18-AC-47	3	39.5	42.6	545	0.884
BLO-18-AC-48	3	37.5	39.6	460	0.872
BLO-18-AC-49	2	38.8	42.1	545	0.933
BLO-18-AC-50	2	36.1	39.3	455	0.967
BLO-18-AC-51	2	38.1	40.9	455	0.823
BLO-18-AC-52	2	37.2	40.8	460	0.894
BLO-18-AC-53	2	34.6	37.4	380	0.917
BLO-18-AC-54	2	38.5	42.3	485	0.850
BLO-18-AC-55	2	39.4	42.8	530	0.867
BLO-18-AC-56	2	42.9	45.9	730	0.925
BLO-18-AC-57	1.5	36.8	40.2	445	0.893
BLO-18-AC-58	1.5	37.0	39.9	505	0.997
BLO-18-AC-59	3	37.8	41.1	510	0.944
BLO-18-AC-60	3	40.7	44.3	610	0.905
BLO-18-AC-61	3	41.3	44.5	550	0.781
BLO-18-AC-62	3	39.8	43.3	540	0.857
BLO-18-AC-63	3	41.2	46.1	605	0.865
BLO-18-AC-64	3	47.5	51.1	975	0.910
BLO-18-AC-65	3	36.9	39.4	440	0.876
BLO-18-AC-66	3	39.0	41.6	470	0.792
BLO-18-AC-67	2	35.4	38.1	455	1.026
BLO-18-AC-68	2	34.1	37.2	370	0.933
BLO-18-AC-69	2	41.5	35.0	590	0.825
BLO-18-AC-70	3	69.2	73.6	2,800	0.845
BLO-18-AC-71	3	45.0	49.2	750	0.823
BLO-18-AC-72	3	29.7	32.6	260	0.992
BLO-18-AC-73	3	40.5	43.6	555	0.835
BLO-18-AC-74	3	41.5	44.2	630	0.881
BLO-18-AC-75	2	36.2	39.1	450	0.949
BLO-18-AC-76	2	39.2	42.0	450	0.747
BLO-18-AC-77	2	40.2	43.3	605	0.931
BLO-18-AC-78	2	32.6	35.2	320	0.924
BLO-18-AC-79	2	39.2	42.7	520	0.863
BLO-18-AC-80	2	50.1	54.0	1,150	0.915
BLO-18-AC-81	2	41.5	45.4	560	0.784
BLO-18-AC-82	2	34.9	38.1	450	1.059
BLO-18-AC-83	2	40.6	43.5	625	0.934
BLO-18-AC-84	3	37.5	40.8	490	0.929
BLO-18-AC-85	3	39.9	43.3	435	0.685
BLO-18-AC-86	3	36.5	39.6	465	0.956
BLO-18-AC-87	3	39.5	43.1	625	1.014
BLO-18-AC-88	3	36.9	40.1	450	0.896
BLO-18-AC-89	3	39.5	42.5	545	0.884
BLO-18-AC-90	3	36.6	39.8	490	0.999

Table G.29: Arctic Charr Measurements from Fish Captured at Mary Lake by Gill Netting, Mary River Project CREMP, August 2018

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Fulton's Condition Factor
BLO-18-AC-91	3	38.9	42.0	470	0.798
BLO-18-AC-92	3	39.0	42.6	525	0.885
BLO-18-AC-93	3	37.2	39.7	480	0.932
BLO-18-AC-94	3	35.8	38.2	410	0.894
BLO-18-AC-95	3	38.6	41.2	515	0.895
BLO-18-AC-96	3	40.1	43.5	540	0.837
BLO-18-AC-97	3	39.8	43.9	550	0.872
BLO-18-AC-98	2	40.5	44.2	560	0.843
BLO-18-AC-99	2	36.8	39.8	410	0.823
BLO-18-AC-100	2	40.0	43.5	560	0.875
Overall Catch Summary	Sample Size (N)	100	100	100	100
	Average	39.0	42.1	535	0.876
	Median	38.8	42.1	500	0.881
	Standard Deviation	4.2	4.5	258	0.070
	Standard Error	0.4	0.5	26	0.007
	Minimum	29.7	32.6	260	0.685
	Maximum	69.2	73.6	2,800	1.059

Table G.30: Results of Littoral/Profundal Arctic Charr Health Endpoint Statistical Comparisons between 2018 Mary Lake (BLO) and 2018 Reference Lake 3 (REF) Data, and for Mary Lake between 2018 and the Mine Baseline Period (2006 to 2013), Mary River Project 2018 CREMP

Comparison	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
			Response	Covariate	REF 2018 or BLO Base	BLO 2018		Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]	Statistic	REF 2018 or BLO Base	BLO 2018		
								Interaction P-value	Covariate P-value						
Mary Lake versus Reference Lake 3, 2018	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	34	100	K-S	-	-	-	-	-	-	<0.001	-59
	Body Size	Fork Length	Fork Length (cm)	-	34	100	M-W	-	-	-	Median	34.5	38.8	<0.001	12
		Body Weight	Body Weight (g)	-	34	100	M-W	-	-	-	Median	331	500	<0.001	51
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	34	100	ANCOVA	0.002	<0.001	38.5	Adjusted Mean	499	514	0.089	2.9
Mary Lake 2018 versus Baseline	Survival	Length Frequency Distribution	Fork Length (cm)	-	161	100	K-S	-	-	-	-	-	-	0.017	20
	Body Size	Fork Length	Fork Length (cm)	-	161	100	M-W	-	-	-	Median	39.2	38.8	0.684	-1.0
		Body Weight	Body Weight (g)	-	161	100	M-W	-	-	-	Median	550	500	0.360	-9.1
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	161	100	ANCOVA	0.326	<0.001	37.9	Adjusted Mean	521	507	0.073	-2.8

▨ Area P-value < 0.1 or Interaction P-value < 0.05

🟦 Absolute Magnitude of Difference ≥ 10% for Condition (EEM effect endpoint)

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The median, mean (geometric mean for $\log_{10}$-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) / reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted mean - reference area predicted mean) / reference area predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

APPENDIX H

SUPPORTING CORRESPONDENCE

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March 17, 2016

Mr. Jim Millard
Environmental Manager
Baffinland Iron Mines Corporation
Mary River Project
2275 Upper Middle Road East, Suite 300
Burlington, Ontario L6H 0C3

Dear Mr. Millard,

Re: Mary River Project CREMP Recommendations for Future Monitoring

In 2015, the Mary River Project CREMP was implemented to evaluate potential mine-related influences on chemical and biological conditions at aquatic environments located near the mine following the first full year of mine operation. The 2015 study was conducted with no deviations from the original CREMP study design (KP 2014; NSC 2014). The key findings of the CREMP suggested a mine-related influence to water and/or sediment quality at Camp Lake system water bodies, and to water quality at a tributary to Sheardown Lake, but no influence to water and sediment quality of Sheardown Lake, Mary River and Mary Lake. In addition, no adverse mine-related influences on phytoplankton, benthic invertebrates or fish (Arctic charr) populations were indicated at any of the Camp Lake, Sheardown Lake and Mary River/Mary Lake systems based on comparisons to reference conditions and to baseline information.

The CREMP was designed as an iterative system of monitoring and interpretation stages, with the results of previous studies used to inform the direction of future monitoring. Therefore, based on the results of the 2015 study, this letter outlines 19 recommendations for modifications of the CREMP design. The suggested modifications are not only intended to provide greater efficiencies to the program, but will also improve the ability of the program to meet the overall objectives (i.e., to evaluate short- and long-term effects of the project on aquatic ecosystems). Accordingly, the following recommendations applicable to stream water quality monitoring, lake water quality monitoring, stream sediment quality and benthic invertebrate community monitoring, lake sediment and benthic invertebrate community sampling and lake fish population monitoring are provided in separate sub-sections herein.

Stream Water Quality Monitoring

1) **Discontinue water quality monitoring at Station L1-09 (Camp Lake Tributary 1)**. Currently, four water quality monitoring stations are located on the main stem of Camp Lake Tributary 1 (CLT1), with Stations L1-09 and L1-05 both located on the portion of the main stem between the confluence with the north branch and the mine tote road crossing. Monitoring conducted during the 2015 CREMP indicated that water chemistry at these stations was very similar, which can be expected since no sources of dilution occur between these stations. Therefore, the monitoring of two stations within this segment of the CLT1 is redundant.

2) **Add a water quality monitoring station to the lower Tom River**. Currently, water quality monitoring stations are located in the tributary exiting Camp Lake (Station J0-01) and on the Tom River upstream of the confluence with this tributary (Station I0-01), but not on the Tom River downstream of this confluence. Therefore, the addition of a water quality monitoring station on the Tom River downstream of the Camp Lake outlet stream confluence would provide information on potential mine-related influence on water quality of the Tom River (Figure 1).

3) **Add a water quality monitoring station to each of Sheardown Lake Tributary 12 and Sheardown Lake Tributary 9**. Although benthic invertebrate community sampling is conducted at both of these Sheardown Lake tributaries, no water quality monitoring is conducted on either tributary. Therefore, the addition of a water quality monitoring station on the lower segment of each of these tributaries would provide supporting information important to the interpretation of potential mine-related effects to benthic invertebrate communities of these tributaries (Figure 1).

4) **Discontinue water quality monitoring at Station D1-05 (Sheardown Lake Tributary 1)**. Currently, two water quality monitoring stations, upstream Station D1-05 and downstream Station D1-00, are located on Sheardown Lake Tributary 1 (SDLT1). Water quality monitoring data collected at the downstream station is sufficient for evaluating mine related effects to water quality of SDLT1. Therefore, water quality monitoring at upstream station D1-05 does not provide additional information important to evaluating effects at SDLT1.

5) **Discontinue water quality monitoring at upstream Mary River Stations G0-09A and G0-09B**. The G0-09 series of stations, including G0-09A, G0-09 and G0-09B, are located on Mary River well upstream of the area of mine influence, and thus act as reference stations. Due to the close proximity of all three G0-09 series stations to one another, the water quality data provided from all three stations is redundant. The sampling of a single station at this upstream area is sufficient for interpreting potential effects of the Mary River Project on water quality of Mary River.

6) **Discontinue water quality monitoring at Station C0-01 (Mary River)**. Because no substantial sources of dilution to Mary River occur between the current C0-05 and C0-01 water quality monitoring stations, Station C0-01 does not provide any additional, useful, information for the evaluation of potential mine influence on Mary River or Mary Lake.

Lake Water Quality Monitoring

7) **Reduce the number of water quality monitoring stations to three (3) in each of Camp, Sheardown NW and Sheardown SE lakes, and four (4) in Mary Lake**. No consistent spatial differences in water chemistry were evident in any of the mine-exposed or reference lakes in 2015, nor during any of the baseline studies. In addition, *in-situ* water quality profile data collected in 2015 indicates that all lakes are generally well mixed both laterally and vertically, and as a result, water chemistry is likely to be relatively uniform throughout these lakes during most sampling conditions. Therefore, the sampling of several water quality monitoring stations within these lakes is redundant. Accordingly, it is recommended that for each study lake, only three existing water quality monitoring stations be sampled at each lake using the locations provided in the table below and illustrated in Figure 2.

Lake	Station ID	Depth (m)	Description
Reference Lake 3	REF03-01	15.1	East end of southeast basin
	REF03-02	30.4	Centre of southeast basin
	REF03-03	37.5	Centre of northwest basin
Camp Lake	JLO-02	12.3	Littoral station near primary lake inlet (CLT1, CLT2)
	JLO-07	32.7	Deep basin, near centre of lake
	JLO-09	14.3	Near lake outlet
Sheardown Lake NW	DD-Hab9-Stn1	10.3	Near inlet from SDLT1
	DLO-01-2	17.5	Deep location, near centre of northwest basin
	DLO-01-7	11.4	Near lake outlet
Sheardown Lake SE	DLO-02-6	7.1	Near inlet from Sheardown Lake NW
	DLO-02-3	13.7	Deep location, near centre of southeast basin
	DLO-02-4	8.05	Near inlet from SDLT9
Mary Lake	BLO-1A	14.65	Deepest location at the north basin
	BLO-5	21	Near inlet from Mary River
	BLO-9	30	Deepest location at the south basin
	BLO-6	6.8	Near lake outlet

8) **Conduct water quality profiling at only a single station in each of Camp, Sheardown NW and Sheardown SE lakes, and two stations at Mary Lake**. No consistent spatial differences in *in-situ* water quality depth profiles were evident among stations at each mine-exposed and reference lake in 2015, nor would they be expected under typical mixing patterns driven by density gradients (Wetzel 2001). Therefore, it is recommended that water quality profiling be conducted only at the main (i.e., deepest) basin of each study lake, except at Mary Lake where water quality profiling is recommended at the north and south basins, to provide information on lake stratification. Stations recommended for the implementation of water quality profiling include:

   Camp Lake Station JL0-07;
   Sheardown Lake NW Station DL0-01-2;
   Sheardown Lake SE Station DL0-02-3;
   Mary Lake (north basin) Station BL0-1A;
   Mary Lake (south basin) Station BL0-9; and,
   Reference Lake 3 (northwest basin) Station REF03-3.

9) **Collect water samples only from mid-water column at each lake water quality monitoring station**. Currently, water chemistry and chlorophyll a samples are collected from approximately 1 m below the surface and 1 m above the bottom at each lake monitoring station (i.e., 2 samples per station). Water chemistry data collected during the 2015 CREMP, as well as during baseline studies, has generally shown only minor (i.e., <2-fold higher) differences in water chemistry and chlorophyll a concentrations between the surface and bottom at each station. Therefore, the collection of a single water sample from approximately mid-column will be sufficient for evaluating average water quality conditions at each lake water quality monitoring station unless it is determined that the lake is thermally (or otherwise) stratified, in which case the same sampling convention from previous studies will be applied (i.e., top-bottom). Interpretation of *in-situ* water quality profile data collected at the main basin of the lake will be used as the basis for determination of whether one or two water samples will be collected from each respective lake station during each winter, summer or fall sampling event.

Stream Sediment and Benthic Invertebrate Community Monitoring

10) **Discontinue stream sediment quality monitoring as part of the CREMP**. Stream sediment sampling was included in the Mary River Project CREMP to provide qualitative information to support the lake sediment quality data analysis (KP 2014, 2015). Streams and rivers in the Mary River Project local study area (LSA) contain very limited depositional habitat suitable for the collection of fine sediments. The general absence of any substantial accumulation of fine sediments within these watercourses precluded any meaningful assessment of potential mine-related influences on sediment quality within, along and/or between watercourses during the 2015 CREMP, as well as during baseline studies (KP

2015). Because the current sediment sampling program provides no ecologically meaningful information considered useful for the evaluation of potential mine-related effects, it is recommended that stream sediment sampling be discontinued.

11) **Add a benthic invertebrate community study area to the CLT1 upper main stem**. Elevated concentrations of chloride, iron, nitrate and other parameters were observed at the upper main stem area of CLT1 (Station L2-03) in 2015 compared to reference conditions and the mine baseline period, with iron concentrations above water quality guidelines and AEMP benchmarks at this area. Mine-related influence on water quality of CLT1 was consistent with blasting/quarrying activity at the QRM2 pit. Therefore, the addition of a benthic invertebrate community study area to CLT1 near Station L2-03 is recommended to evaluate potential biological effects associated with mine activity in the upper portion of the CLT1 watershed. The benthic invertebrate community sampling will follow the same approach as that employed elsewhere for the stream program (Figure 3).

12) **Discontinue benthic invertebrate community sampling at the two upper reaches of Sheardown Lake Tributary 1 (SDLT1)**. Currently, three benthic invertebrate community study areas are situated on SDLT1. Similar to sampling conducted at Sheardown Lake Tributary 9 and Tributary 12, one study area is sufficient for evaluating mine related effects to the benthic invertebrate community of SDLT1. This study area should be situated at the lower creek reach (Reach 1) to provide temporal continuity with previous studies, and because water chemistry data is also collected at this location (i.e., Station D1-00).

13) **Add a stream reference benthic invertebrate community study area**. No stream reference study area has been established for the stream benthic invertebrate community component of the CREMP (NSC 2014). Therefore, in order to provide a stronger basis for evaluating mine-related effects to biota residing in the mine-exposed tributaries of Camp and Sheardown lakes, it is recommended that a reference study area be incorporated into the program. The ideal reference area should share similar habitat features with the mine-exposed tributaries (e.g., similar width, water velocity, substrate size, etc.) and be outside the area of mine influence. It is recommended that one of the watercourses used as a lotic reference for water monitoring (i.e., CLT-REF4, MRY-REF2, MRY-REF3) also serve as a reference area for the stream benthic invertebrate community assessment (Figure 3). The determination of the most suitable reference watercourse, based on similarity in habitat characteristics to the mine-exposed tributaries, can be selected during the next CREMP biological field study (i.e., August 2016).

Lake Sediment and Benthic Invertebrate Community Monitoring

14) **Consider updating the AEMP sediment quality benchmarks**. On average, arsenic, copper and iron concentrations were elevated above respective AEMP sediment quality benchmarks within Reference Lake 3 littoral and/or profundal station sediment during the 2015 CREMP. In turn, this suggested that the AEMP benchmarks for these metals may

be overly conservative. Because reference lake information had not been available at the time of AEMP benchmark development, it is recommended that reference sediment quality data be factored into the derivation of AEMP benchmarks for arsenic, copper and iron to improve the applicability of these benchmarks as a tool for evaluating potential mine effects for the Mary River Project CREMP.

15) **Focus the lake benthic invertebrate community (benthic) survey only on the littoral zone**. Benthic invertebrate density, richness and relative abundance of dominant groups, including metal-sensitive taxa, differed significantly between littoral (shallow) and profundal (deep) stations of the reference lake during the 2015 CREMP, which is consistent with general distribution patterns of benthic invertebrates with depth in lakes (Ward 1992). Thus, the sampling of benthic invertebrates at profundal depths limits the ability to evaluate the occurrence and/or magnitude, of mine-related effects on biota due to natural factors being more important drivers of community structure than mine-related contaminants of concern at these depths (e.g., naturally lower oxygen and food resources with depth). Therefore, it is recommended that benthic sampling at mine-exposed lakes focus solely on littoral sampling depth (i.e., approximately 8 – 10 m depth). Consistent with Environmental Effects Monitoring (EEM) guidance under the Metal Mining Effluent Regulations (MMER), it is recommended that five stations be sampled at each mine-exposed lake (Environment Canada 2012) at littoral sampling depths. To the extent possible, the littoral sampling stations will be established at existing benthic stations at Camp, Sheardown NW, Sheardown SE and Mary mine-exposed lakes, as well as at Reference Lake 3 (Figures 2 and 3). However, in some cases, new stations will be need to be established to ensure sufficient coverage of the lake, and to ensure that substrate properties are comparable among and within lakes. Under this recommendation, benthic sampling would be discontinued at all profundal stations, resulting in a total of 25 lake benthic stations in the CREMP rather than 50 currently (Figures 2 and 3).

16) **Harmonize the lake sediment quality and benthic invertebrate community monitoring stations.** Currently, sediment chemistry data is not collected at all benthic invertebrate community sampling stations, limiting the ability to establish linkages between sediment metal concentrations and potential effects on benthic invertebrates. Therefore, it is recommended that sediment samples be collected at all benthic invertebrate community stations and analyzed for particle size, total organic carbon (TOC), and total metals concentrations as part of the CREMP.

17) **Restructure the lake sediment quality monitoring program to reflect changes in the benthic invertebrate community survey sampling station locations.** To accommodate the recommended changes to the lake benthic invertebrate community survey, it is recommended that sediment quality monitoring station locations be re-located to the same five littoral benthic sampling depths/stations per lake discussed above (Recommendation 15). In addition, to maintain proper coverage of each study lake and

ensure temporal continuity, it is recommended that three profundal sediment sampling stations be maintained in the program for each mine-exposed lake, resulting in a total of eight sediment quality monitoring stations at all mine-exposed lakes except Sheardown Lake SE, where the majority of the lake is less than 12 m deep (i.e., representative of littoral habitat). Under this approach, the total number of sediment quality monitoring stations sampled would be reduced from 33 currently to 29. The profundal sediment quality stations recommended for inclusion in the CREMP are provided in the table below, and are shown on Figures 2 and 3.

Lake	Station ID	Depth (m)	Sediment Profundal Station Description
Camp Lake	JLO-14	26.5	Central basin – east (inlet area)
	JLO-07	32.7	Central basin – middle
	JLO-11	28.8	Central basin – west (outlet area)
Sheardown Lake NW	DLO-01-5	23.1	Central basin – north
	DLO-01	20.8	Central basin – middle
	DLO-01-2	18.6	Central basin – south
Mary Lake	BLO-12	21.7	South basin – near Mary River inlet
	BLO-10	18.7	South basin – middle
	BLO-08	26.7	South basin – near lake outlet

Lake Fish Population Monitoring

18) **Reduce the non-lethal adult Arctic charr sample size to 50 fish per lake**. The adult Arctic charr fish population survey currently targets 100 fish from each study lake using a 'non-lethal' sampling approach (KP 2014, 2015). Based on data acquired during the 2015 CREMP, power analysis indicated that total sample sizes can be reduced by half (i.e., 50 fish) while still maintaining the ability to detect changes between lakes and/or between study periods with sufficient power. Therefore, it is recommended that sample sizes for adult Arctic charr be reduced from 100 to 50 in future CREMP studies. By doing so, the number of incidental mortalities would be reduced substantially. A total of 57 adult Arctic charr incidental mortalities were encountered during the 2015 CREMP under normal sampling conditions, and therefore, by reducing the amount of effort applied, the number of incidental mortalities may be reduced to less than 25 without affecting the ability of the program to meet study objectives.

19) **Focus the current collection gear for optimal capture rates for adult Arctic charr**. Currently, gang index gill nets with net mesh sizes ranging from 25 – 127 mm are prescribed to capture adult Arctic charr at all study lakes under the CREMP (NSC 2014, 2015). During the 2015 CREMP, the majority of Arctic charr were captured in net mesh

sizes ranging from 38 – 64 mm, which was also similar to the most efficient mesh size used to capture adult Arctic charr during the previous baseline studies. Therefore, it is recommended that the 38 – 64 mm mesh size be adopted as the ‘standard’ size used to collect fish samples for the CREMP. In doing so, it is anticipated that fewer incidental mortalities will be encountered (e.g., reduced handling time) and additional sampling efficiencies will be gained.

As mentioned previously, we believe the 19 suggested modifications outlined above will not only provide greater efficiencies to the CREMP, but are also scientifically defensible and will maintain and, in some cases, improve the ability of the program to meet the overall objectives set out under the AEMP. Should you have any questions, or require additional supporting information regarding these recommendations, please to not hesitate to contact me.

Sincere regards,

Minnow Environmental Inc.

Paul LePage, M.Sc.
Senior Project Manager

minnow
environmental inc.
A Trinity Consultants Company

Technical Memorandum

Date: April 11, 2018

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RE: Statistical Approach for Determining Water Quality Monitoring Sample Sizes at Lakes Sampled Under the CREMP

Introduction

Following the completion of the first Core Receiving Environment Monitoring Program (CREMP) study conducted after start-up of the Mary River Project mine operations, it was recommended that the number of water chemistry monitoring stations be reduced to three in each of Camp, Sheardown NW, and Sheardown SE lakes, and to four in Mary Lake (Minnow 2016). The rationale for this recommendation was that no consistent spatial differences in water chemistry were evident at any of the CREMP mine-exposed or reference lakes after commercial mine start-up in 2015, nor during pre-mining baseline studies. In addition, *in situ* water quality profile data indicated that all CREMP study lakes were generally well mixed, and as a result, spatially within each lake, water chemistry has been relatively uniform from the lake inlet to the outlet. Due to the limited spatial variability in water chemistry among stations within each lake, the sampling of five or more water quality monitoring stations within the lakes sampled for the CREMP was thus considered redundant (Minnow 2016).

During the Baffinland Iron Mines Corporation (Baffinland) Freshwater Workshop held in Iqaluit, Nunavut November 8th – 9th, 2017, Minnow proposed a two-way analysis-of-variance (ANOVA) model to evaluate lake-specific significant changes in water chemistry between baseline and mine operational periods (i.e., before-after analysis). Included as part of this approach was the use of power analysis to determine an appropriate number of sampling stations that would be required from each study lake in each year to be able to assess for significant changes in water chemistry between baseline and individual years of mine operation. This technical memorandum outlines the recommended before-after statistical approach that can be used to determine changes in water chemistry at lakes potentially influenced by the Mary River Project mine operations, as well as background information, methods, and results of power analysis conducted using data subject to the proposed before-after statistical approach.

Proposed Statistical Model to Evaluate Mine-Related Changes in Water Quality

The study design for the CREMP outlined a water chemistry sampling approach that included the collection of samples from at least five stations per mine-exposed lake during each of three seasons each year (i.e., 15 samples per year per lake). No statistical approach to evaluating temporal changes in water chemistry was indicated in the CREMP study design (KP 2014a), although a mixed linear effects model was suggested as a potential approach to compare annual parameter concentrations from years of mine operation (e.g., 2015 and onwards) to concentrations during the mine baseline period (2006 – 2013 data; KP 2014b). The general approach to the temporal analysis of lake water chemistry data proposed by KP (2014b) focused on station-specific changes over time. However, for the reasons stated above, data collected following commercial mine start-up have since indicated that a lake-specific analysis is appropriate for evaluating temporal changes in water chemistry (Minnow 2016). The transition from a station-specific to a lake-specific approach for assessing changes in water chemistry requires fewer number of lake water quality monitoring stations without losing the ability of the CREMP to detect mine-related influences on lake water chemistry over time. This premise provides the basis for the recommended statistical approach described below for evaluating mine-related changes in water quality at CREMP study lakes over time.

The recommended approach to assess changes in water quality between mine-operational and baseline periods provided herein and proposed by Minnow (2016) is a two-way ANOVA hypothesis test with factors Year and Season conducted separately for each mine-exposed lake. Parameters considered for the analysis should include those that have been shown to exceed water quality guidelines or AEMP benchmarks, and/or parameters that have shown higher mean concentrations over time based on visual evaluation of plotted data, at each individual lake. For this hypothesis test, if the interaction between Year and Season is not statistically significant (i.e., the difference in parameter concentration among years is consistent among winter, summer and fall seasons) then an appropriate ANOVA model will be used to assess an among-year difference in parameter concentration. In the event that the latter ANOVA hypothesis test indicates a significant among-year difference in parameter concentration, then *post-hoc* contrasts will be conducted to test the following hypotheses for a temporal change:

- Linear trend;
- Step Change after year 1: (mean in year 1 = mean for years 2,3,4);
- Step Change after year 2: (mean in years 1 and 2 = mean for years 3 and 4); and,
- Step Change after year 3: (mean in years 1, 2, 3 = mean for year 4).

These four contrasts will be conducted to assess temporal change, and if any of these models indicate a significant difference, the model with the best fit (i.e., lowest p-value) will be used to describe the type of temporal change as defined above. A significant interaction shown between Year and Season will indicate no consistent temporal change in parameter concentrations among seasons, necessitating that the data be evaluated separately by season using the same general sequence for the determination as provided above. Representative outputs using this approach are provided for Camp Lake total aluminum and total uranium concentration data in Annex 1.

Determination of Appropriate Station Number for the Recommended Before-After Analysis

In experimental design, power analysis is an important set of procedures and formulas that allows the determination of suitable sample sizes required to detect an effect of a given size with a given degree of confidence (given an assumed true difference between groups). Power analysis of lake water chemistry data was conducted as part of the Baffinland baseline studies to assist with the determination of appropriate sample sizes (i.e., number of stations) during development of the Mary River Project mine site CREMP (Baffinland 2014; KP 2014a,b). This original power analysis was used to estimate the number of samples required to statistically demonstrate a significant change in parameter concentrations between the baseline period (i.e., prior to the initiation of commercial mine operation) and following mine start-up at individual stations in each of the four mine-exposed lakes located adjacent to the Mary River Project mine site (i.e., Camp, Sheardown NW, Sheardown SE, and Mary lakes). Briefly, this analysis indicated that as few as five water chemistry samples would be sufficient to determine a significant change in concentrations of five potential mine indicator metals (aluminum, arsenic, cadmium, copper and iron) at each individual station following mine start-up compared to the baseline period (KP 2014b).

As indicated in the original review of baseline water quality data by KP (2014b), once data from the commercial mine operation period becomes available, alternative statistical models to test for differences in parameter concentrations between baseline and mine-operational periods becomes warranted and can trigger the requirement to review experimental sample sizes. The approach recommended herein to evaluate water chemistry changes at CREMP study lakes (i.e., two-way ANOVA) assesses for changes at a lake-specific level, rather than at a station-specific level from which the original study design was based. Therefore, an updated power analysis must now be used to determine a suitable number of samples (i.e., stations) required from each CREMP study lake to allow detection of changes in concentrations of mine-related parameters compared to the baseline period based on the recommended ANOVA model. For the power analysis, the ANOVA hypothesis test is used to determine if there is a significant difference in mine-related parameter concentrations among years, or stated differently, whether mean parameter concentrations in each year are equal:

e.g., H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$ where μ_i = the mean parameter concentration in year i

Two types of statistical errors can result during a hypothesis test as a result of chance. A Type I error, defined as α, occurs when the ANOVA hypothesis test (i.e., H_0 above) indicates a difference among samples (in this case, annual parameter concentrations) when in fact there is truly no difference among years. A Type II error, defined as β, occurs when the hypothesis test indicates no difference among years when there is truly a difference between at least two years of data. In environmental monitoring, α and β are typically set equal to each other (e.g., Environment Canada, 2012) to set the risk to industry (Type I error: concluding there is an effect when in fact there isn't) equal to the risk to the environment (Type II error: concluding there is no effect when in fact there is). To conduct a power analysis to determine the number of samples required to detect a change, the following parameters must be defined:

- The magnitude of the change that we wish to define as being significant (referred to as the critical effect size);
- The variability expected in the data;
- Probability of Type I error (α); and,
- Probability of Type II error (β).

Critical effect sizes (CES) have not be formally defined in the literature for assessing differences in water quality parameter concentrations. However, in biological studies, CES have been defined as a two standard deviation (±2 SD) change between mine-exposed and reference areas (Environment Canada, 2012). By definition, ninety-five percent (95%) of data values fall within ±2 SD of the mean for normally distributed data. In other words, a magnitude change of ±2 SD is equivalent to the mean of one group falling outside of the range of 95% of the data for another group. This magnitude of change could be considered relevant for assessing a temporal change in water quality and was used as the CES (or magnitude of effect) for power analysis of Camp Lake water chemistry data conducted herein[1]. Because the CES of ±2 SD is defined based on the observed variability in the data, no measure of variability was required in this power analysis. Consistent with Environment Canada (2012) recommendations for environmental monitoring, Type I (α) and II (β) errors were set equally to 0.1 for the power analysis.

The statistical comparison of the Year term in a two-way ANOVA is equivalent (with the exception of a loss of two degrees of freedom for the Season term) to the use of a one-way ANOVA on Year after adjusting for differences in season. Therefore, the power analysis conducted herein applied to the data as described in the description of power analysis provided above. Data collected at

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[1] The CREMP study design water quality baseline analysis used halfway between the station baseline mean and the AEMP benchmark as the CES for power analysis of the baseline data (KP 2014b). Although this same definition for CES can be applied to the approach recommended in this technical memorandum, application of a ±2 SD of the mean baseline to define CES allows analysis of those parameters to which AEMP benchmarks have not been developed.

Camp Lake from operational and baseline periods were used to estimate the sample size required to detect a ±2 SD (within year and season pooled SD; Table 1) change among years in selected parameter concentrations using ANOVA with α and β set equally at 0.1. Based on this analysis, a minimum sample size of 7 samples per year was determined to be sufficient for lake-specific detection of a ±2 SD change in parameter concentrations over time. However, in order to have an equal number of samples collected at each lake per season, and to accommodate the loss of two degrees of freedom for the Season term in the two-way ANOVA, a sample size of 9 samples per year (water samples collected at three stations on three separate occasions, winter, summer and fall, per year) is proposed for Camp, Sheardown NW and Sheardown SE lakes. At Mary Lake, a sample size of 9 samples per year is proposed for the south basin (water samples collected at three stations on three separate occasions, winter, summer and fall, per year), with an additional 3 samples collected each year collected over the same three seasonal sampling events at the north basin.

Table 1: Estimates of the Magnitude of a 2 SD Change for Select Parameters Using the Camp Lake Baseline Data

Parameter	Units	2 Standard Deviations (SD)
Chloride	mg/L	1.5
Sulphate	mg/L	1
Total Aluminum	µg/L	5.3
Total Copper	µg/L	1.8
Total Iron	µg/L	-
Total Manganese	µg/L	0.5
Total Molybdenum	µg/L	0.049
Total Nickel	µg/L	0.39
Total Potassium	mg/L	0.12
Total Sodium	mg/L	0.2
Total Strontium	µg/L	2.1
Total Uranium	µg/L	0.16
Dissolved Aluminum	mg/L	-
Dissolved Manganese	mg/L	0.0008

Notes: “-“ = estimate could not be made due to the high proportion of values below the detection limit. Estimates of the SD were conducted using the Kaplan-Meier method (Helsel 2012) to accommodate values below the laboratory reportable detection limit.

Conclusion

Using the statistical approach provided herein for determining the occurrence of significant changes in water chemistry over time in the CREMP study lakes and subsequent power analysis, the collection of water samples from three stations per mine-exposed lake, three times per calendar year (winter, summer and fall), is sufficient to statistically evaluate annual changes in lake water chemistry with high statistical power. This analysis corroborated the Minnow (2016) proposal that reducing the number of CREMP water chemistry monitoring stations to three in each of Camp, Sheardown NW and Sheardown SE lakes, and to four in Mary Lake, would not compromise the ability of the CREMP to track mine-related influences on water quality of these lakes.

References

Baffinland (Baffinland Iron Mines Corporation). 2014. Mary River Project Aquatic Effects Monitoring Plan. Document No. BAF-PH1-830-P16-0039. Rev 0. June 27, 2014.

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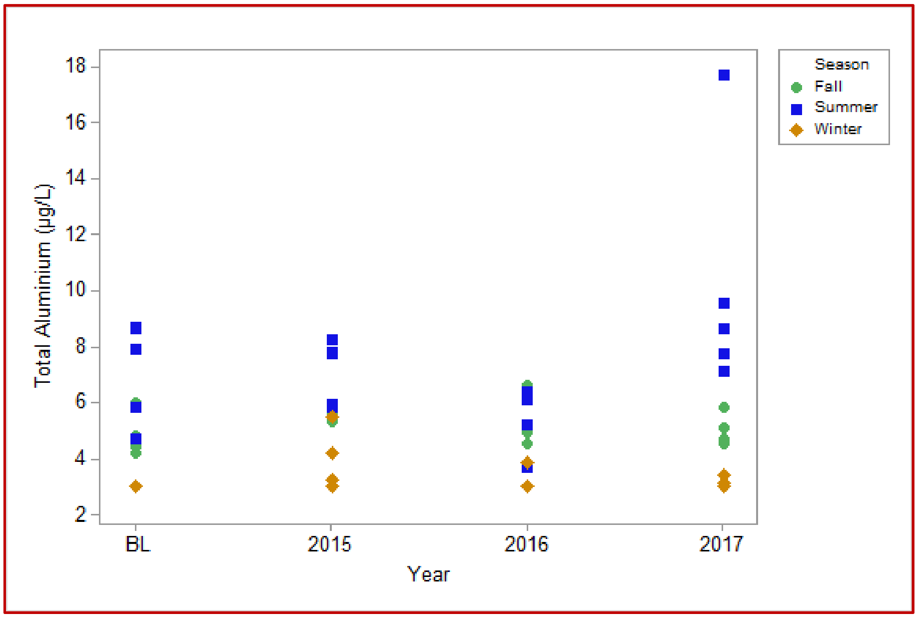
KP (Knight Piesold Ltd.) 2014b. Baffinland Iron Mines Corporation – Mary River Project – Detailed Review of Baseline Lake Water Quality. KP Ref. No. NB102-181/33-1B. May 30, 2014.

Minnow (Minnow Environmental Inc.). 2016. Mary River Project CREMP Recommendations for Future Monitoring. Letter report to Jim Millard, Baffinland Iron Mines Corp. March 17, 2016.

Annex 1

Example 1: Camp Lake total aluminum concentration two-way ANOVA. Step 1: The interaction term between year and season was shown to be significant (p-value of 0.021 was less than a 0.1 level of significance) indicating that aluminum concentrations from at least one season differed among mine baseline (BL) and mine-operational years.



Year x Season
p-value = 0.021

Step 2: Subsequent ANOVA of Camp Lake total aluminum concentrations over individual seasons indicated that aluminum concentrations did not differ significantly over time during fall and winter sampling seasons, but did differ significantly among study periods in summer (using a 0.1 p-value level of significance).

Season	P-value (YEAR)
Summer	**0.053**
Fall	0.320
Winter	0.378

Step 3: *Post hoc* analysis of the Camp Lake total aluminum concentrations during summer indicated a significant step change (increase) occurred after 2016. Notably, no significant change in summer aluminum concentrations was indicated over baseline, 2015, and 2016 periods.

Hypothesis *Post Hoc* Contrasts	Summer P-value
Linear	0.408
Step after BL	0.698
Step after 2015	0.585
Step after 2016	**0.004**

Example 2: Camp Lake total uranium concentration two-way ANOVA. Step 1: The interaction term between year and season was shown to be significant (p-value of 0.021 was less than a 0.1 level of significance) indicating that aluminum concentrations from at least one season differed among mine baseline (BL) and mine-operational years.

Year x Season
p-value < 0.001

Step 2: Subsequent ANOVA of Camp Lake total uranium concentrations over individual seasons indicated that uranium concentrations differed significantly over time for all summer, fall, and winter sampling seasons (using a 0.1 p-value level of significance).

Season	P-value (YEAR)
Summer	**< 0.001**
Fall	**< 0.001**
Winter	**< 0.001**

Step 3: *Post hoc* analysis of the Camp Lake total uranium concentrations for the winter data indicated a significant change (increase) has occurred since the baseline period. The model with the best fit (i.e., lowest p-value) indicated that a significant step change after 2015 most appropriately described the type of temporal change for uranium over time during winter sampling. Camp Lake uranium concentrations temporal post hoc analysis results for summer and fall seasons also indicated a significant step change after 2015 (values not shown here).

Hypothesis *Post Hoc* Contrasts	Winter P-value
Linear	**0.042**
Step after BL	**0.081**
Step after 2015	**< 0.001**
Step after 2016	**0.007**