Mary River Project 2019
Core Receiving Environment Monitoring Program Report

Part 1 of 2
(Main Body Sections 1 to 7)

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Mary River Project 2019
Core Receiving Environment
Monitoring Program Report

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EXECUTIVE SUMMARY

The Mary River Project (the 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 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 Project. Mine waste management facilities at the Mine Site consist of a surface water management pond and Water Treatment Plant (WTP) associated with a Waste Rock Facility (WRF), and a surface water management pond associated with the mine site ore crusher and stockpile pad. In addition to periodic discharge of treated effluent from these facilities to the Mary River system, other potential mine inputs to aquatic systems located adjacent to the Mine Site include runoff and dust from ore (crusher) stockpiles located within the Sheardown Lake catchment, treated sewage effluent discharge to Mary River, runoff and explosives residue deposition from quarry operations within the Camp Lake catchment, 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 Mine Site. In order to meet the AEMP objectives, 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 operation in 2015.

The results of the 2019 CREMP indicated mine-related influences on water and sediment quality at some of the primary receiving systems, but no ecologically significant, adverse, mine-related effects to biota were identified based on comparisons to applicable reference or baseline conditions. Within the Camp Lake system, mine-related effects on water quality were apparent as elevated concentrations of copper only at the north branch of Camp Lake Tributary 1 (CLT1), chloride, manganese, molybdenum, nitrate, potassium, sodium, sulphate, and uranium at the

CLT1 main stem, and chloride, manganese, molybdenum, sodium, strontium, sulphate, and uranium at Camp Lake, based on comparisons to reference conditions and/or to baseline data. Arsenic 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 2019, 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 at Sheardown Lake Tributary 1 (SDLT1) and both basins of Sheardown Lake. At SDLT1, aqueous concentrations of manganese, molybdenum, nitrate, sodium, strontium, sulphate, total dissolved solids, uranium, and zinc were elevated compared to concentrations at reference areas and during applicable baseline studies, but only copper concentrations were above WQG in 2019. At Sheardown Lake NW, aqueous concentrations of ammonia, chloride, molybdenum, nitrate, sulphate, and uranium were elevated compared to Reference Lake 3 and/or to baseline data, whereas at Sheardown Lake SE, manganese, molybdenum, nitrate, sulphate, and uranium concentrations were elevated compared to reference conditions and/or to baseline data. However, no parameters were elevated above WQG at either basin of Sheardown Lake in 2019. 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 2019, 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 2019, 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 primarily apparent as elevated concentrations of nitrate and sulphate at mine-exposed areas of Mary River. No mine-related effects on sediment quality were indicated at Mary Lake. No adverse effects to phytoplankton, benthic invertebrates, or arctic charr were indicated at mine-exposed areas of Mary River and/or Mary Lake in 2019 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

BAFFINLAND - Baffinland Iron Mines Corporation

BCWQG – British Columbia Water Quality Guidelines

CCME – Canadian Environmental Quality Guidelines

CES – Critical Effect Size

CES_{BIC} – Critical Effect Size (for the benthic invertebrate community)

CES_{C} – Critical Effect Size (for fish condition endpoint)

CES_{G} – Critical Effect Size (for fish growth endpoints)

CLT – Camp Lake Tributary

CPUE – Catch-Per-Unit-Effort

CREMP – Core Receiving Environment Monitoring Program

CSQG - Canadian Sediment Quality Guidelines

CWQG – Canadian Water Quality Guidelines

DELT – Deformities, Erosions, Lesions, and Tumours

DO – Dissolved Oxygen

DOC – Dissolved Organic Carbon

E – Simpson's Evenness Index

EEM – Environmental Effects Monitoring

ERP – Early Revenue Phase

FFG – Functional Feeding Group

GPS – Global Positioning System

HPG – Habit Preference Group

HSD – Honestly Significant Difference

KS – Kolmogorov-Smirnov (test)

MINNOW – Minnow Environmental Inc.

MRTF - Mary River Tributary-F

MT – Million Tonnes

NAD – North America Datum

NJ – New Jersey

NSES – North Shore Environmental Services

NON-YOY – Non-Young-of-the-Year

NU - Nunavut

NW – Northwest

ON - Ontario

PEL – Probable Effects Level

PSQG – Provincial Sediment Quality Guidelines

PWQO – Provincial Water Quality Objectives

QA/QC – Quality Assurance/Quality Control

SD – Standard Deviation

$SD_{BL\text{-}year}$ – Standard Deviations of the Baseline Year Mean

SD_{REF} – Reference Area Standard Deviations

SDLT – Sheardown Lake Tributary

SE – Southeast

SEL – Severe Effect Levels

SQG – Sediment Quality Guidelines

TDS – Total Dissolved Solids

TKN – Total Kjeldahl Nitrogen

TOC – Total Organic Carbon

TSS – Total Suspended Solids

UTM – Universal Transverse Mercator

WA- Washington

WQG – Water Quality Guidelines

WRF – Waste Rock Facility

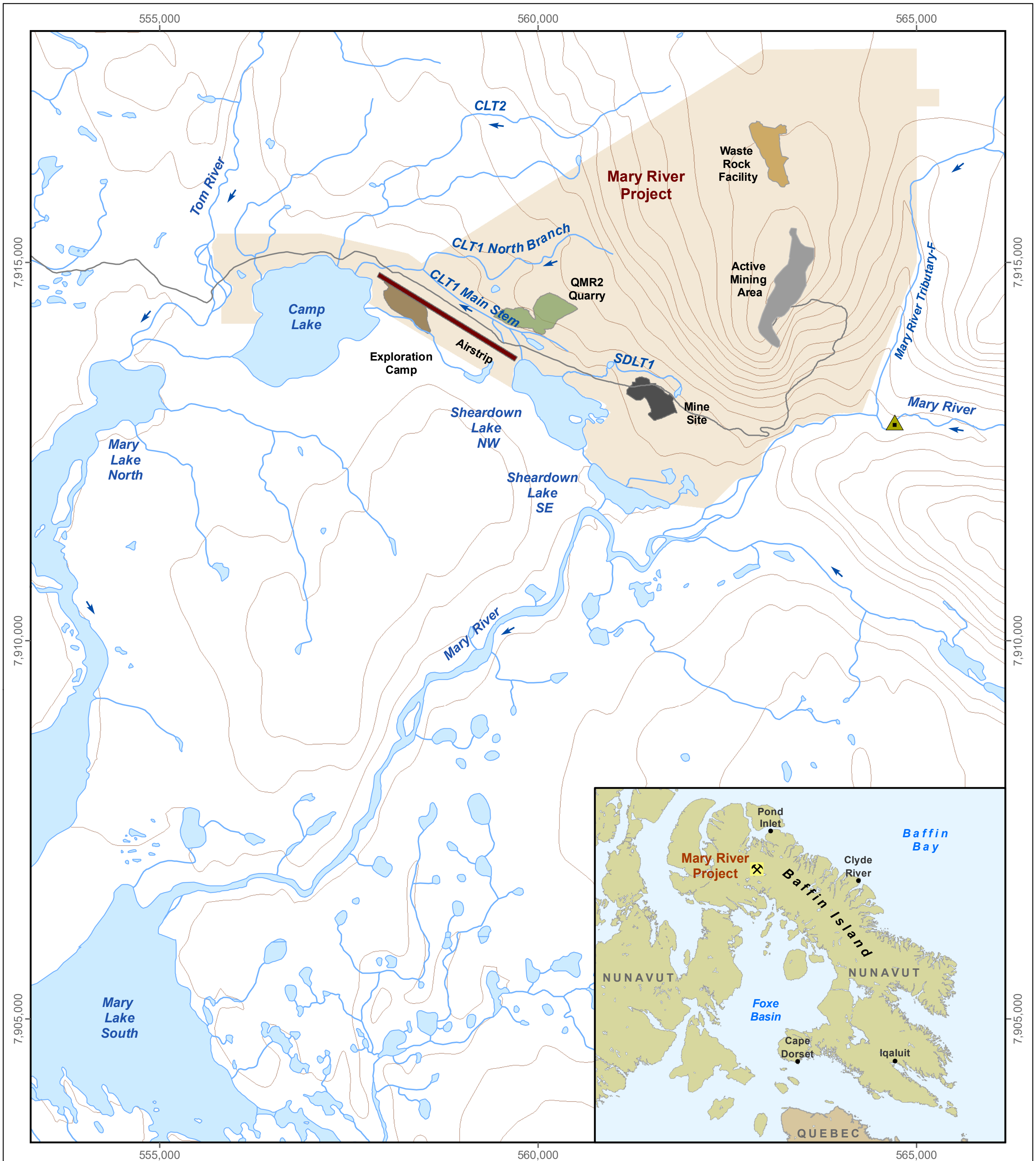
WTP – Water Treatment Plant

YOY – Young-of-the-Year

1 INTRODUCTION

The Mary River Project (the 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 (NU) (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 Project's Mine Site in mid-September 2014. Under the current mining phase, referred to as the Early Revenue Phase (ERP), up to 6 million tonnes (Mt) of crushed/screened ore is mined annually. Ore from the Mine Site is transported in haul trucks along the Milne Inlet Tote Road to Milne Port, located approximately 100 km north of the Mine Site, where it is stockpiled. At Milne Port, the stockpiled ore is loaded onto bulk carrier ships for transport to international markets during the shipping season. No milling or additional ore processing is conducted at the Mine Site, and thus no tailings are produced at the Project. Mine waste management facilities at the Mine Site include a surface water management pond and Water Treatment Plant (WTP) associated with a Waste Rock Facility (WRF), and a surface water management pond associated with the Mine Site's ore crusher and stockpile pad (Figure 1.1). In addition to periodic discharge of treated effluent from these facilities to the Mary River system, other potential mine inputs to aquatic systems located adjacent to the mine include runoff and dust from ore (crusher) stockpiles located on the Mine Site within the Sheardown Lake catchment, treated sewage effluent discharge to Mary River, runoff and explosives residue deposition from quarry operations to the Camp Lake catchment, 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 (No. 2AM-MRY1325 Amendment No. 1) issued by the Nunavut Water Board (NWB), Baffinland developed an Aquatic Effects Monitoring Plan (AEMP) for the Project. A key objective of the AEMP was to provide data and information to allow for 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 four years of mine operation, the CREMP studies have indicated only minimal effects of Project operations on the water quality and sediment quality of receiving waterbodies. Effects were confined to single tributaries feeding into each of Camp and Sheardown lakes, as well as near the immediate outlets



LEGEND

- Mary River Cascade Barrier
- QMR2 Quarry
- Airstrip
- Exploration Camp
- Mine Site
- Active Mining Area
- Waste Rock Facility
- Mary River Project

Baffinland Iron Mines Corporation, Mary River Project Location

0 1.25 2.5 5 km

N E S W

Map Projection: UTM Zone 17N NAD 1983
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Figure 1.1

Document Path: S:\Projects\197202\197202.0032 - Baffinland 2019 CREMP and EEM SD\4 - GIS\CEMP Report\19-32 Figure 1.1 Location.mxd of these tributaries to each respective lake (Minnow 2016a, 2017, 2018, 2019). No adverse mine-related effects to phytoplankton, benthic invertebrates, or fish were indicated at any of the Camp, Sheardown, or Mary lake systems from 2015 to 2018 based on comparisons to representative reference waterbodies and to available pre-mine baseline data for each lake system (Minnow 2016a, 2017, 2018, 2019).

This report presents the methods and results of the 2019 CREMP, including an evaluation of potential Project-related influences on chemical and biological conditions at mine-exposed waterbodies through the fifth full year of mine operation. As in the four previous years, the 2019 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 2019 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 added to the program in 2016 to provide improved ability for the evaluation of mine-related influences on stream biota (Minnow 2016b, 2017, 2018, 2019).

2 METHODS

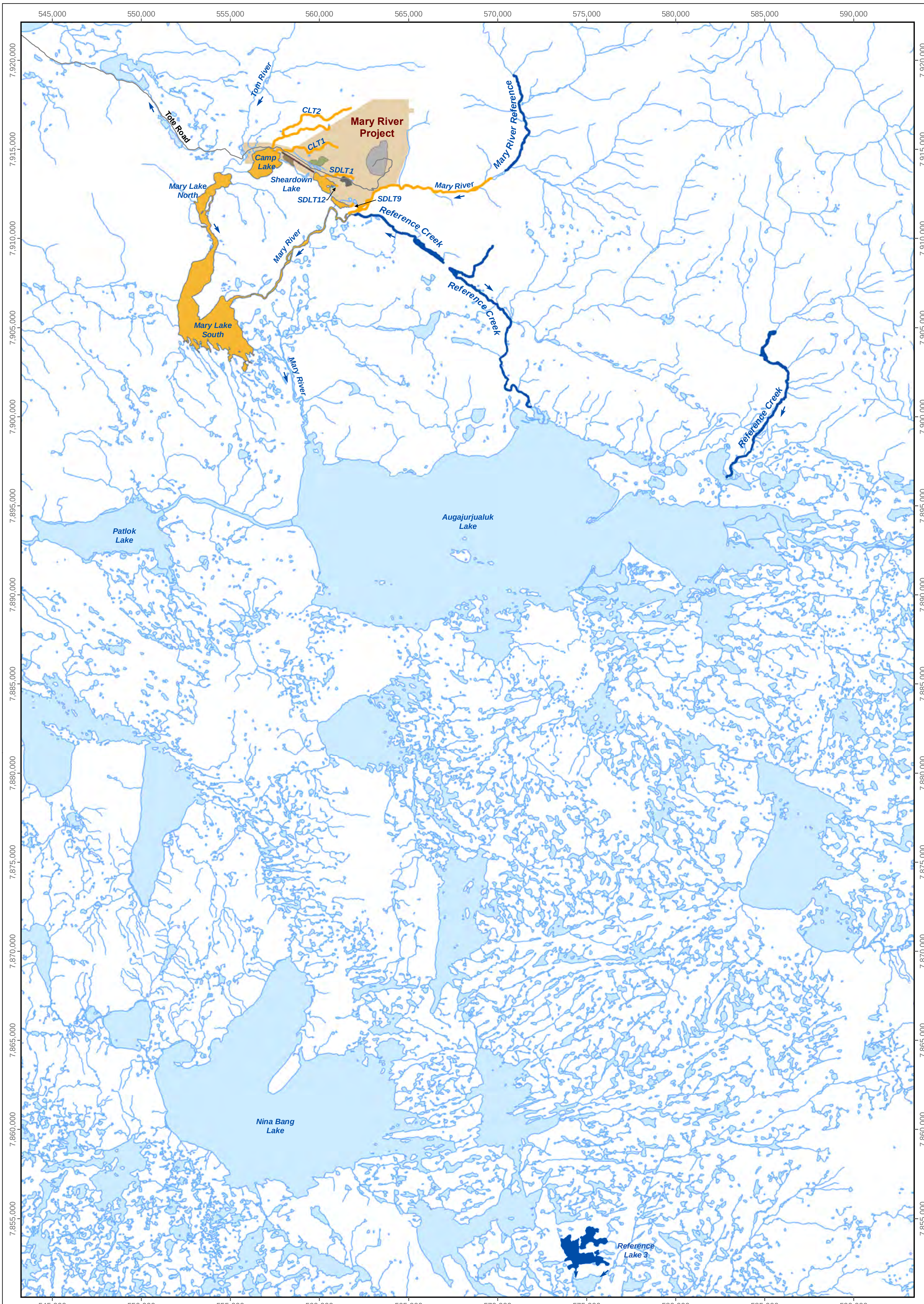
2.1 Overview

The CREMP includes water quality monitoring, sediment quality monitoring, phytoplankton (chlorophyll-a) monitoring, benthic invertebrate community assessment, and fish population assessment (Baffinland 2015). In 2019, 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 18th) and open-water season events corresponding to Arctic spring (freshet), summer, and fall (June 26th to 29th, July 24th to August 5th, and August 18th 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 personnel from August 15th to 29th 2019, the seasonal timing of which was consistent with monitoring conducted for previous baseline (2005 to 2013), mine construction (2014), and mine operational (2015 to 2018) studies. Similar to previous CREMP studies, the 2019 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 2019 CREMP study areas included the same mine-exposed and reference waterbodies established in the original design documents (Baffinland 2015) and the same reference 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 2019 study. Reference Lake 3 is located approximately 62 km south of the Mine Site (Figure 2.1), 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 Angajurjualuk Lake, all of which are located southeast of the Mine Site (Figure 2.1). Similar to previous CREMP studies, an area of Mary River located well upstream of current mine activity (i.e., GO-09) served as a reference area for the mine-exposed portion of Mary River in the 2019 study (Figure 2.1).



LEGEND

- Reference Stream/River System
- Mine Exposed Stream/River System
- Reference Lake
- Mine Exposed Lake
- QMR2 Quarry
- Airstrip
- Exploration Camp
- Mine Site
- Open Pit
- Mary River Project

Mary River Project CREMP Study Waterbodies

0 3.25 6.5 13 km

N W E S

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Figure 2.1

Document Path: S:\Projects\197202\197202.0032 - Baffinland 2019 CREMP and EEM SD\4 - GIS\CEMP Report\19-32 Figure 2.1 Study Waterbodies.mxd

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 CREMP design (Baffinland 2015). The surface water sampling was conducted at as many as 57 stations during each sampling event (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

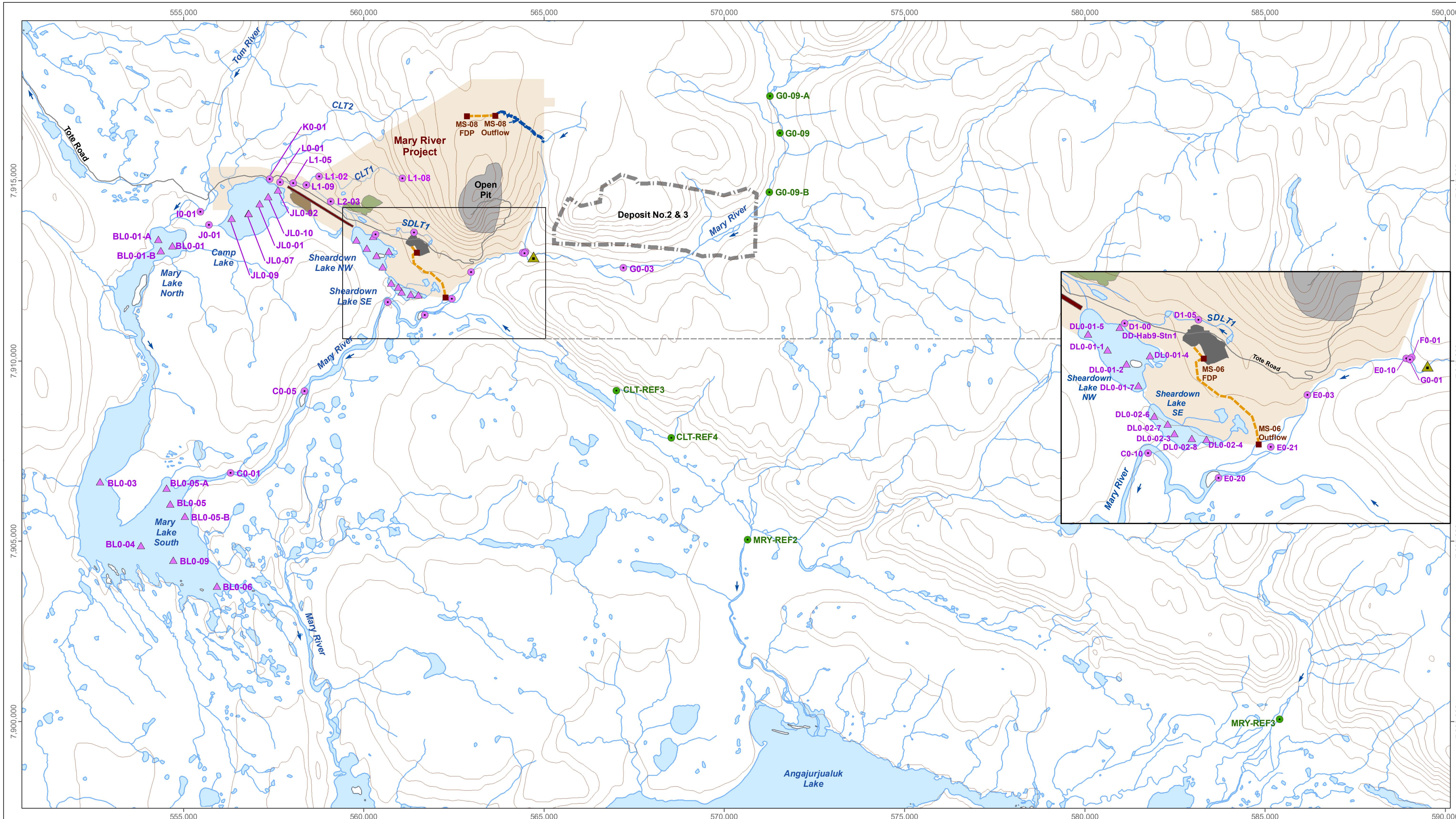
In situ measurements of water temperature, dissolved oxygen, pH, specific conductance (i.e., temperature standardized measurement of conductivity), and turbidity were taken at the bottom of the water column at all lotic (i.e., creek, river) stations and as a vertical profile at one metre (m) intervals at each lentic (i.e., lake) water quality monitoring station during routine monitoring conducted by Baffinland personnel. 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 biological sampling conducted in August by Minnow personnel, 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 the morning of the day in which sampling was to be completed, prior to field sampling. Dissolved oxygen concentration readings were checked and calibrated at 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 using the methods outlined in Wetzel and Likens (2000).

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

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.



LEGEND

Water Monitoring Stations

- Lake - Mine Exposed
- Stream - Mine Exposed
- Stream - Reference
- 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
- Lease Boundary For Deposit No. 2 & 3
- Contours (20 m)

0 1.5 3 6 km

N E S W

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

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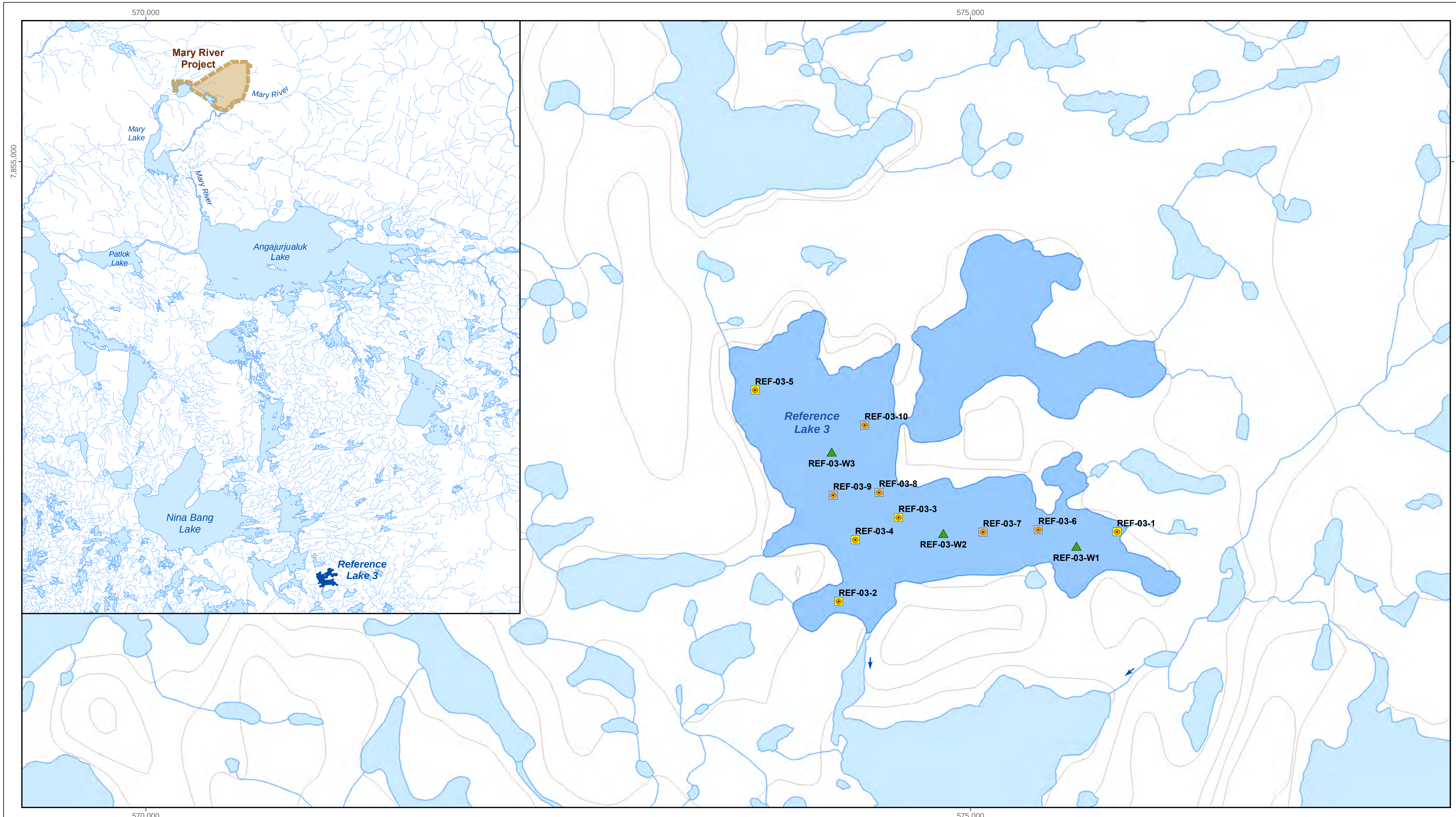
Figure 2.2

Document Path: S:\Projects\197202\197202.0032 - Baffinland 2019 CREMP and EEM SD\4 - GIS\CEMP Report\19-32 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 E S W

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Mary River Project CREMP Reference Lake 3 Monitoring Station Locations

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Figure 2.3

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(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-tests and Kruskal-Wallis H-tests were used to conduct pair-wise and multiple-group comparisons, respectively, on untransformed data. Similarly, in instances in which variances of normal data could not be homogenized by transformation, Student's t-tests assuming unequal variance were used for pair-wise comparisons. In cases in which multiple-group comparisons were conducted, normally distributed data were subject to Tukey's Honestly Significant Difference (HSD) and Tamhane's pair-wise *post hoc* tests 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 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 change in depth[2]. The vertical profile data collected at the mine-exposed study lakes were compared to those of the reference lake 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 lake profile data included comparisons to WQG[1].

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

[1] Canadian Environmental Quality Guidelines (CCME 1999, 2019) 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 change in depth. Through discussions regarding the CREMP in 2017, regulatory bodies requested that a ≥0.5˚C change in temperature per 1 m change in depth be used to conservatively define a thermally stratified condition.

mid-water column by hand directly into pre-labeled sample bottles that have been triple rinsed with ambient water. For samples requiring preservation, chemical preservatives are added to the samples before capping the bottles, or for those sample bottles that have been pre-dosed with the required chemical preservatives, the bottle is filled using a sample transferred from a separate sample taken in a triple rinsed bottle. 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 non-metallic, 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 pre-dosed with required chemical preservatives, where appropriate, except those requiring field filtration. In cases in which filtration of lotic and lentic station water samples 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 for at least 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 mean concentration in 2019 by the baseline (2005 to 2013 data) mean concentration for each parameter. The resulting magnitudes of elevation in

Table 2.2: Water Quality Guidelines Used for the Mary River Project 2015 to 2019 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	3	CWQG	-
	Nitrite	mg/L	0.06	CWQG	-
	Total Phosphorus	mg/L	0.020 or 0.030	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) = $10^{(0.83[\log(hardness] -2.46)}$. 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 * $e^{(0.8545[\ln(hardness)] - 1.463)}$. 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) = $e^{(1.273[\ln(hardness)] - 4.705)}$. 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) = $e^{(0.76[\ln(hardness)] + 1.06)}$. 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, 2019) 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 2019), as available.

parameter concentrations were 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 Categories for Water and Sediment Chemistry Comparisons

Categories	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, 2019) 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, 2019). 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 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. These 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(s) 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 among 2019, baseline (2005 to 2013 data), mine construction (2014), and mine operational (2015 to 2018) years.

2.3 Sediment Quality

2.3.1 General Design

Sediment quality monitoring for the CREMP was designed to assess potential mine-related effects to the sediment of lake environments using a gradient-based approach (Baffinland 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 cut-off depth of 12 m, the value of 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 2019.

2.3.2 Sample Collection and Laboratory Analysis

Sediment at the 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 (cm) 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. 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.

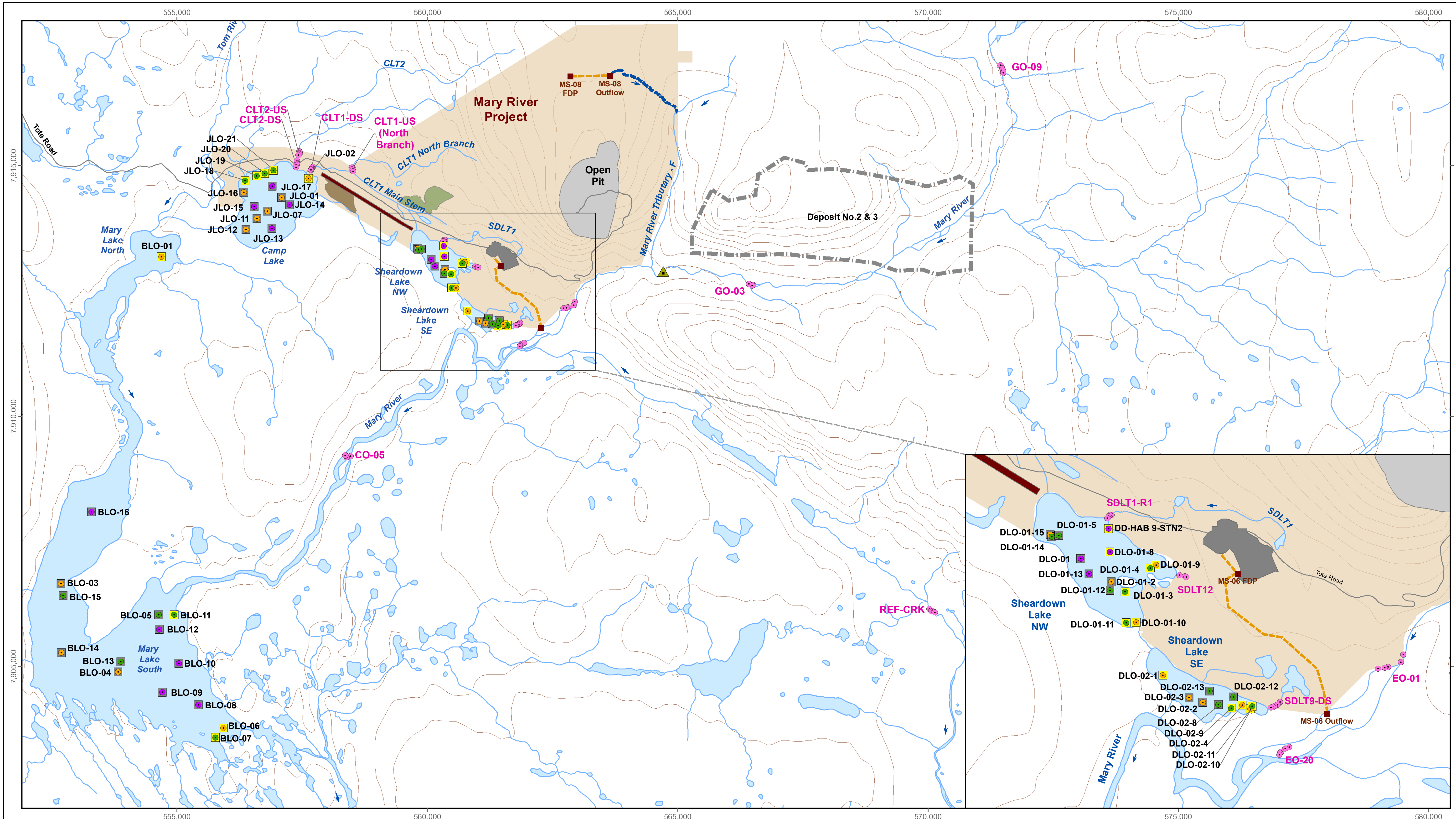
Upon completion of the biological monitoring field program, sediment samples were shipped to ALS (Waterloo, ON). Physical characterization of samples included percent moisture and particle size analyses, and chemical characterization included analyses of total organic carbon (TOC) and

[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 2019 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	574358	7853400	profundal	✓	-	✓
Camp Lake	JLO-02	557627	7914748	littoral	✓	-	✓
	JLO-01	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	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	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	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.



Mary River Project 2019 CREMP Mine Area Sediment Quality and Benthic Station Locations

Date: March 2020
Project 197202.0032

minnow environmental inc.

Figure 2.4

Document Path: S:\Projects\197202\197202.0032 - Baffinland 2019 CREMP and EEM SD\4 - GIS\CEMP Report\19-32 Figure 2.4 Sediment and Benthic.mxd 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 2019 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 2019 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 2019 data, baseline data (2005 to 2013), and previous 2015 to 2018 mine operation period data. In addition, as described previously, the magnitude of elevation was calculated for all parameters using the 2019 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 CREMP uses measures of aqueous chlorophyll-a concentrations to assess potential mine-related influences on 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, using 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 litre (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 on-site laboratory filtered the samples through a 0.45 micron cellulose acetate membrane filter assisted by 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 (Baffinland 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 2018). In 2019, phytoplankton community samples were collected using the same methods described in the CREMP (Baffinland 2015) and, as in the past, these samples were not processed, but were archived for potential future usage.

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 (Baffinland 2015), and therefore the 2019 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 defined 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 CREMP benthic invertebrate community (benthic) survey design outlines a habitat-based approach for characterizing potential mine-related effects to benthic biota of lotic (stream/river) and lentic (lake) environments (Baffinland 2015). 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 2019 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 studies conducted from 2016 to 2018, the level of replication used for lotic benthic sampling in 2019 was greater than specified under the original CREMP

Table 2.5: Stream and River Benthic Invertebrate Community Monitoring Station Coordinates Used for the Mary River Project CREMP 2019 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

design in order to provide consistency with EEM standards (Minnow 2016a). To the extent possible, previously established lotic benthic stations were incorporated into the 2019 sampling program to provide comparability to historical baseline information.

At lentic environments, benthic sampling was conducted at the 40 previously established stations described in the CREMP study design 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 2.4; Figures 2.3 and 2.4). Analysis of benthic data collected at Reference Lake 3 from 2015 to 2018 indicated that, similar to temperate lakes (Ward 1992), depth-related influences on benthic invertebrate community structure (e.g., density and richness) occur naturally in lakes of the study region (Minnow 2016a, 2017, 2018, 2019). Analysis of benthic data collected from Reference Lake 3 in 2019 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 (2-12 m depth) or profundal zone (>12 m depth) stations based on station depth (Table 2.4). 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. 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 using an equal α and β of 0.10 (Environment Canada 2012).

2.4.2.2 Sample Collection and Laboratory Analysis

Two types of equipment and methods were used during the 2019 CREMP benthic survey to sample the different types of habitat encountered 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 adequate representation of the habitat. A concerted effort was made to ensure

[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.

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 which was labelled with both an external and internal station identifier.

- 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 which was labelled with both an external and internal station identifier.

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 collection/recording of global positioning system (GPS) coordinates was conducted 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 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 American 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 2019 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 habit 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 habit 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, transformations[5] including $\log_{10}$ and $\log_{10}(x+1)$ were 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 for the pair-wise comparisons on rank transformation. 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 means. Because the benthic survey was designed to have sufficient power to detect a

[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.

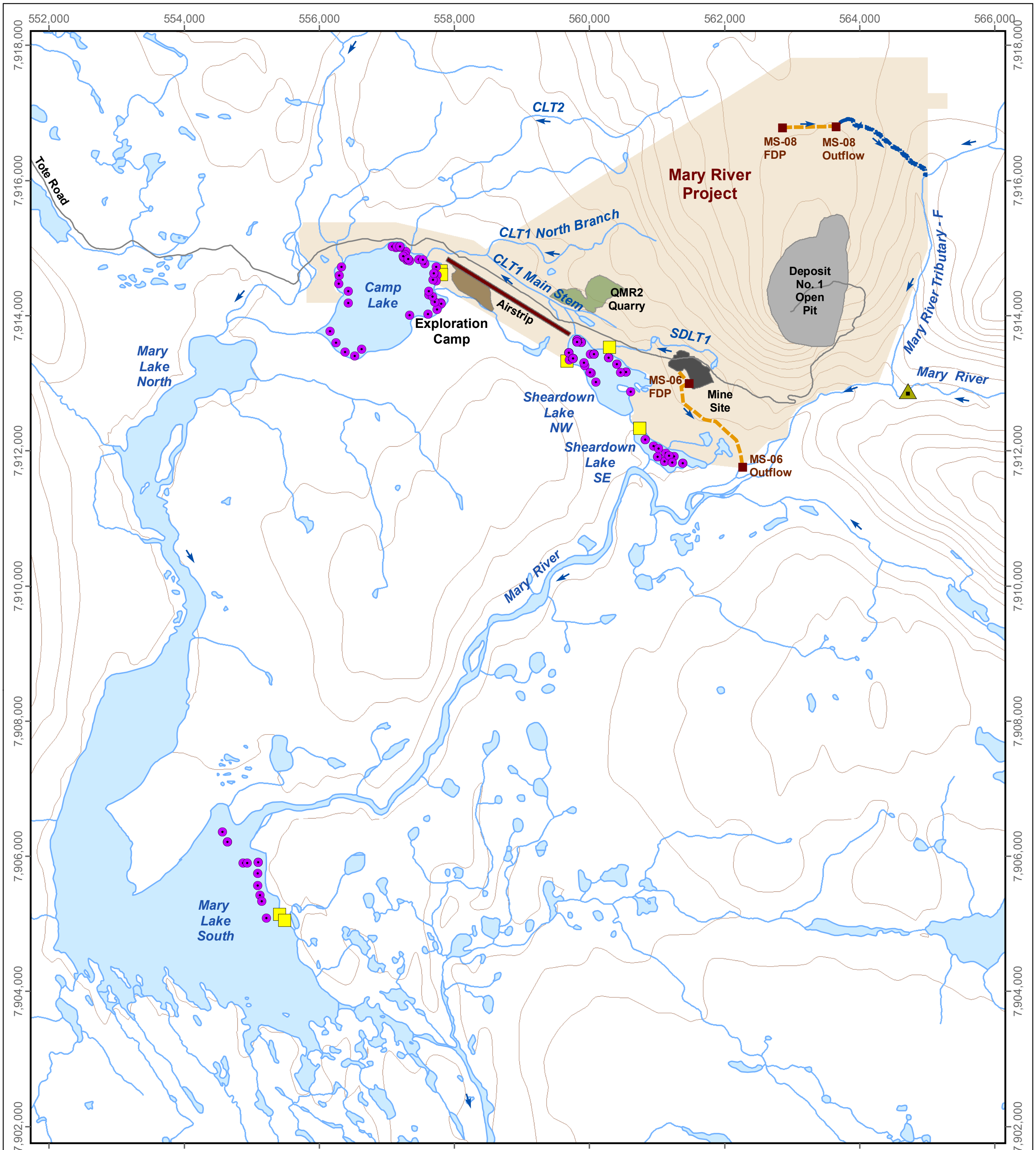
difference (effect size) of ± two standard deviations (SD), the magnitude of the difference was calculated to reflect the number of reference mean standard deviations (SD_{REF}) using equations provided by Environment Canada (2012). A Critical Effect Size for the benthic invertebrate community study (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 2019 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. The temporal statistical comparisons were conducted using the same tests, transformations, assumptions, and software described above for the *in situ* water quality comparisons based on a multiple group analysis (see Section 2.2.2). 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, for the multiple group temporal comparisons. Similar to the 2019 within-year statistical analyses, the magnitude of difference was calculated for endpoints that differed significantly between years in the *post hoc* tests, which was then 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 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 (Baffinland 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 and for which there exists sufficient baseline catch and measurement data 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 CREMP studies conducted from 2015 to 2017, a sufficient number of arctic charr were captured at Reference Lake 3



LEGEND

- Gill Net
- Electofishng
- Final Discharge Point (FDP)
- Mary River Cascade Barrier
- Discharge Line
- Overland Effluent Channel

Mary River Project 2019 CREMP Fish Survey Sampling Locations

0 1.25 2.5 5 km

Map Projection: UTM Zone 17W 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 2020

Project 197202.0032

minnow environmental inc.

Figure 2.5

Document Path: S:\Projects\197202\197202.0032 - Baffinland 2019 CREMP and EEM SD\4 - GIS\CEMP Report\19-32 Figure 2.5 Fish Survey Sampling Locations.mxd nearshore and littoral/profundal areas to allow statistical evaluation of potential health effects on arctic charr populations at the mine-exposed lakes. Therefore, the 2019 CREMP fish population survey included separate comparison of arctic charr collected at nearshore and littoral/profundal habitats in 2019 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 study lakes 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 up to two shoreline reaches of each study lake (Figure 2.5). The number of passes conducted at each lake was dependent upon catch success, with an additional pass required in instances in which target sample numbers were not cumulatively attained. All fish captured during each pass were retained in buckets containing 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, following which any non-target species were 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 boundaries of each electrofishing reach and a description of the habitat within the reach.

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 (range from 0.8 to 5.1 hours per set; average of 2.3 hours) during daylight hours. 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 size, 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 by electrofisher 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 by gill net, 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 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 separately 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 were 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 individual years of mine operation from 2015 to 2019.

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 endpoint comparisons between individual mine-exposed lakes and the reference lake. 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 using data collected in 2019, and between the combined baseline period and 2019 for individual lakes (i.e., before-after analysis), 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 using data collected in 2019, and between the mine baseline period and 2019 data from individual lakes. These data were evaluated for normality and homogeneity of variance before applying parametric statistical tests such as ANOVA. In cases where data did not meet the assumptions of ANOVA despite log-transformation, a non-parametric Mann-Whitney U-test was used to test for differences between study areas or study periods. 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 that there was adequate overlap between the 2019 mine-exposed and reference area data, or between the 2019 mine-exposed area data and baseline data for an individual study lake, and that there was a linear relationship between the variable and the covariate. In order to verify the existence of a linear relationship, each 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 2019 mine-exposed area and the reference data or mine-exposed baseline data, then the ANCOVA was not performed.

Once it was determined that ANCOVA could be used for statistical analysis, the first step in the ANCOVA was to test whether the slopes of the regression lines between 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

Table 2.6: Fish Population Survey Endpoints Examined for the Mary River Project CREMP 2019 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]	ANCOVA	25%
	Size-at-age (fork length against age)[b,f]	ANCOVA	25%
Energy Use (reproduction)	Relative abundance of YOY (% compos	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-tests were 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.

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). If the latter resulted in a statistically significant interaction effect (slopes are not equal), calculation of the magnitude of difference was determined at the minimum and maximum values of covariate overlap. 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 2019 mine-exposed and reference data or between 2019 and 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 formula 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 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. 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 near or above full 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 similar to those at the reference creek, with concentrations 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 2019 (Figure 3.1; Appendix Table C.12). No consistent spatial patterns in pH were shown with progression downstream through the CLT1 north branch (Stations L1-08 to L1-02) and main stem (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 higher at the CLT1 north branch study area compared to Unnamed Reference Creek, the incremental difference was small (average of 0.18 pH units) and no significant difference in pH was indicated between CLT1 lower main stem and Unnamed Reference Creek study areas in August 2019, 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 (Figure 3.1; Appendix Tables C.1 to C.3), 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 potential mine-related source affecting water quality of the CLT1 upper main stem (Appendix Tables C.1 to C.3, C.14). Specific conductance was typically 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 in 2019 (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 2019 biological study (Figure 3.1). In addition, specific conductance was significantly higher at the CLT1 lower main stem than at the north branch in August 2019 (Appendix Table C.13). These results further corroborated the occurrence of a potential mine-related influence 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 2019 with the exception of slightly higher (i.e., 3- to 5-fold) total copper, molybdenum, and potassium

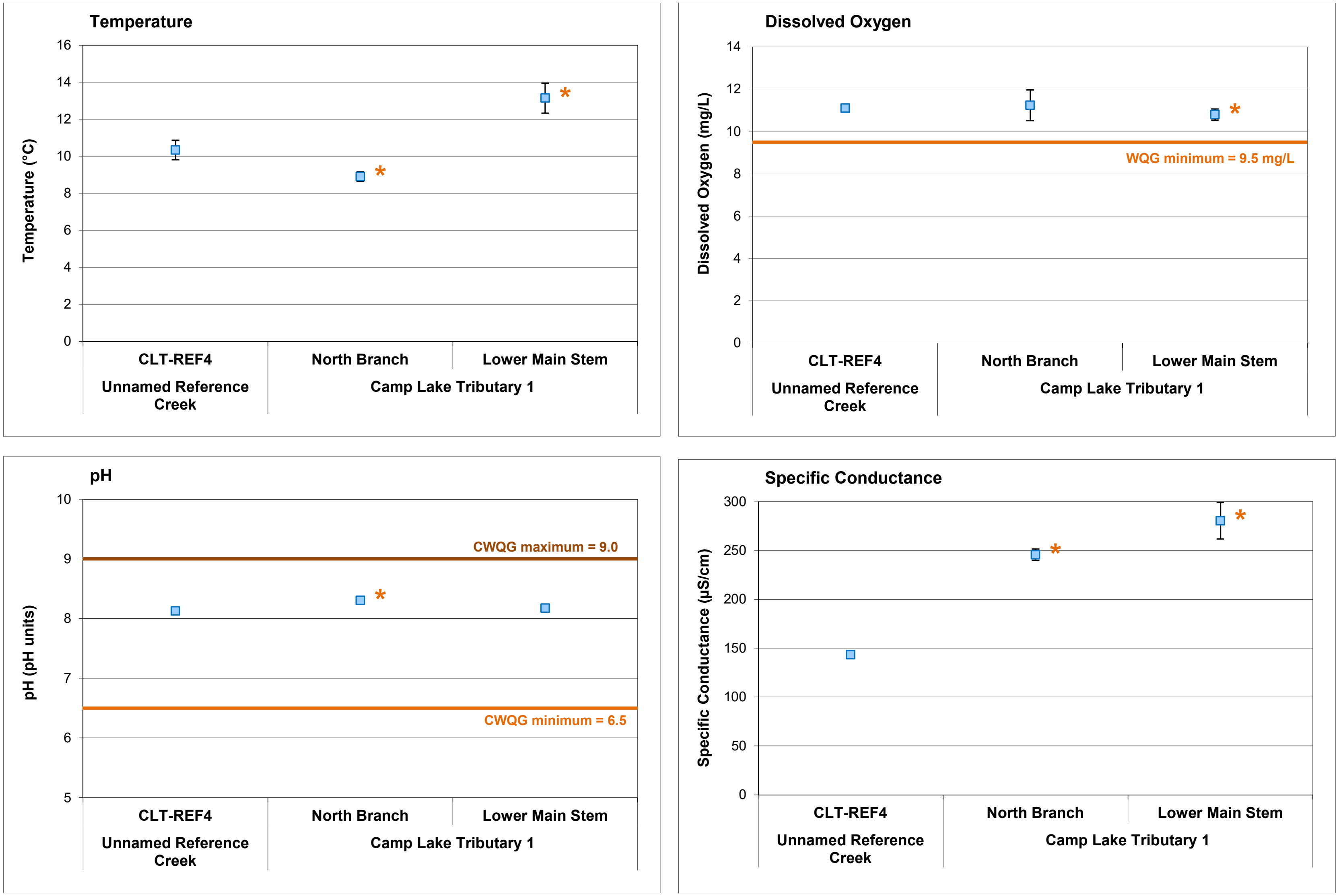


Figure 3.1: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Camp Lake Tributary 1 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2019

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

concentrations during the spring sampling event (Table 3.1; Appendix Tables C.14 and C.15). Parameter concentrations were below applicable WQG and watercourse-specific AEMP benchmarks at the CLT1 north branch in 2019 except for copper, which was generally above these benchmarks in all spring, 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 2019 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 higher in all years of commercial mine production since 2015 (Appendix Figure C.2; Figure 3.2). 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.

Conductivity and concentrations of total dissolved solids (TDS), total ammonia, nitrate, nitrite, total Kjeldahl nitrogen (TKN), dissolved organic carbon (DOC), chloride, sulphate, and several metals including iron, lithium, manganese, molybdenum, potassium, sodium, 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 reference creek average 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 TDS, nitrate, chloride, and total molybdenum, were elevated at the CLT1 lower main stem (i.e., stations L1-09, L1-05, and L0-01) compared to respective average concentrations among 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), nitrate and iron concentrations were above applicable WQG and the watercourse-specific AEMP benchmarks during the summer and fall sampling events, as was the concentration of iron in the spring sampling event, in 2019 (Table 3.1; Appendix Table C.14). Total aluminum concentrations were above one or both of these criteria in the spring and summer sampling events, and total uranium concentrations were consistently above WQG during all seasonal sampling events, at Station L2-03 in 2019 (Table 3.1; Appendix Table C.14). Total aluminum and iron concentrations were also above WQG and AEMP benchmarks at the MRY-REF3 lotic reference station during the summer and fall sampling events in 2019, suggesting natural elevation of these metals in regional watercourses (Appendix Table B.2). As in previous years, higher turbidity occurred at the CLT1 main stem and MRY-REF3 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

Table 3.1: Water Chemistry at Camp Lake Tributary (CLT) Monitoring Stations During Fall (late August and September) Sampling, Mary River Project CREMP, 2019

	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 2019	18-Aug-2019	19-Aug-2019	19-Aug-2019	19-Aug-2019	19-Aug-2019	19-Aug-2019	19-Aug-2019
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	168	170	238	430	302	301	307	317
	pH (lab)	pH	6.5 - 9.0	-	8.09	8.11	8.13	8.16	8.15	8.19	8.21	8.20
	Hardness (as $CaCO_3$)	mg/L	-	-	81.4	88.2	122	185	145	148	153	162
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	2.5	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	92	138	142	265	181	171	178	188
	Turbidity	NTU	-	-	4.82	0.30	0.49	3.29	1.44	1.10	1.51	0.27
	Alkalinity (as $CaCO_3$)	mg/L	-	-	67	79	112	150	125	124	128	139
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.0105	<0.010	<0.010	0.136	0.029	0.021	0.010	<0.010
	Nitrate	mg/L	3	3	0.029	0.088	<0.020	***3.13***	0.644	0.672	0.577	0.052
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	0.0213	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.15	0.64	0.23	0.26	0.22	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.36	1.75	2.24	4.50	2.90	2.94	2.92	2.71
	Total Organic Carbon	mg/L	-	-	1.68	2.06	2.55	4.87	3.20	3.34	3.19	3.04
	Total Phosphorus	mg/L	0.030^{α}	-	0.0053	0.0049	<0.0030	0.0064	0.0288	<0.0030	0.0063	<0.0030
	Phenols	mg/L	0.004^{α}	-	0.0021	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	`	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	7.7	1.86	5.27	29.4	15.1	16.1	16.5	14.9
	Sulphate (SO_4)	mg/L	218^{β}	218	9.01	7.34	6.36	18.80	9.18	9.27	9.09	9.42
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	***0.2085***	0.0113	0.0061	0.0547	0.0217	0.0247	0.0268	0.0105
	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	0.00011	<0.00010	<0.00010	0.00012	0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.01167	0.01230	0.01490	0.01720	0.01680	0.01720	0.01700	0.01820
	Beryllium (Be)	mg/L	0.011^{α}	-	<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
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	0.029	0.013	0.012	0.012	<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
	Calcium (Ca)	mg/L	-	-	16.6	17.2	23.9	35.2	28.9	29.3	30.1	30.9
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00062	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.0040	0.00012	<0.00010	<0.00010	0.00031	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.00108	***0.00234***	***0.00238***	0.00144	0.00202	0.00213	0.00198	0.00167
	Iron (Fe)	mg/L	0.30	0.326	0.143	<0.030	<0.030	***0.447***	0.131	0.123	0.104	<0.030
	Lead (Pb)	mg/L	0.001	0.001	0.000147	<0.000050	<0.000050	0.000100	<0.000050	<0.000050	<0.000050	0.000189
	Lithium (Li)	mg/L	-	-	0.0011	<0.0010	0.0015	0.0042	0.0032	0.0031	0.0030	0.0020
	Magnesium (Mg)	mg/L	-	-	9.53	11.2	15.1	23.1	17.8	18.1	18.6	19.7
	Manganese (Mn)	mg/L	0.935^{β}	-	0.00198	0.00073	0.00081	0.04710	0.00977	0.00758	0.00593	0.00105
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00053	0.00140	0.00093	0.00364	0.00144	0.00140	0.00120	0.00069
	Nickel (Ni)	mg/L	0.025	0.025	0.00065	<0.00050	0.00067	0.00131	0.00094	0.00106	0.00107	0.00077
	Potassium (K)	mg/L	-	-	1.14	2.65	2.46	4.31	2.90	2.91	2.78	2.40
	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	-	-	1.23	0.89	1.12	1.14	1.21	1.26	1.33	1.09
	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	-	-	3.53	0.78	2.32	17.50	6.50	6.40	6.24	6.47
	Strontium (Sr)	mg/L	-	-	0.01985	0.01160	0.01350	0.03980	0.03740	0.03780	0.03610	0.02100
	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	-	-	0.015	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.00551	0.00605	0.00391	0.02620	0.00860	0.00817	0.00701	0.00317
	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	0.0070	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[shaded box] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

[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.

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 2019) 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.

(Appendix Tables B.2 and C.14). This was corroborated by evaluation of the dissolved concentrations of aluminum, which showed similar average concentrations between CLT1 stations and the reference creek stations and suggested that mine operations were not a key source of aluminum to the system (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 that higher uranium concentrations at CLT1 likely reflected a mine-related influence (Appendix Table C.17).[6]

Within the CLT1 lower main stem, only total phosphorus and copper concentrations were above respective WQG at one or more of the three stations during the spring and fall sampling events (Table 3.1; Appendix Table C.14). No parameters were above the AEMP benchmarks at the CLT1 lower main stem during any of the sampling events in 2019 (Appendix Table C.14). Notably, the source of copper to the lower main stem was the north branch. Overall, despite mine-related influences to water quality of the CLT1 upper main stem and with the exception of copper, dilution from the north branch results in improved water quality of CLT1 prior to discharge to Camp Lake reflected as concentrations of all parameters being below applicable WQG and AEMP benchmarks.

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 2019, conductivity and concentrations of TDS, and chloride were within the range of respective 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 2019, 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 operation potentially reflected blasting/excavating activity (including associated dust generation) at the Mine Site QMR2 Quarry[7], as well as fugitive dust generation from increased truck usage on the Milne Inlet Tote Road, compared to the baseline period. The relatively high concentrations of nitrogen-based compounds (e.g., ammonia, nitrate, nitrite, TKN) over years of mine operation at CLT1 were consistent with the deposition of explosives residue from QMR2 as the source of these compounds. Concentrations of TDS, total molybdenum, and total uranium were highest at

[6] On average, dissolved concentrations of lithium, manganese, molybdenum, potassium, and sodium 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).

CLT1 main stem stations in 2019 compared to all previous years of mine operation for the fall sampling event, but because the reference creeks also showed highest concentrations of these parameters in 2019, this suggested a natural or analytical factor most likely accounted for the higher concentrations in 2019 (Figure 3.2; Appendix Figure C.2).

Overall, mine-related influences on water quality of the CLT1 main stem were primarily reflected as elevated conductivity and concentrations of nitrate, TKN, chloride, sulphate, and total metals including manganese, molybdenum, potassium, sodium, and uranium, at the upper main stem, although with the exception of uranium at Station L2-03, none were elevated above applicable WQG or AEMP benchmarks. Despite elevation of these parameters at the upper CLT1 upper main stem, none were elevated above applicable WQG or AEMP benchmarks at the lower main stem prior to discharge to Camp Lake.

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 2019 (Figure 3.3). However, chlorophyll-a concentrations farther downstream at the CLT1 north branch (i.e., Station L1-02), were generally comparable to reference creek chlorophyll-a concentrations for spring and summer sampling events, suggesting no marked differences in phytoplankton abundance between the CLT1 north branch and the reference creek stations (Figure 3.3).

Within the CLT1 main stem, chlorophyll-a concentrations were generally highest at upstream-most Station L2-03 during spring, summer, and fall sampling events in 2019 (Figure 3.3). On average, chlorophyll-a concentrations were higher, but did not differ significantly, between the CLT1 main stem and lotic reference creek stations during the spring and summer sampling events, but were significantly lower at the CLT1 main stem during the fall sampling event (Appendix Table E.2). Relatively high chlorophyll-a concentrations at Station L2-03 and in the CLT1 lower main stem during spring and summer sampling events 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 2019 (Figure 3.3). Similar to the reference creek stations, chlorophyll-a concentrations observed at all CLT1 stations in 2019 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

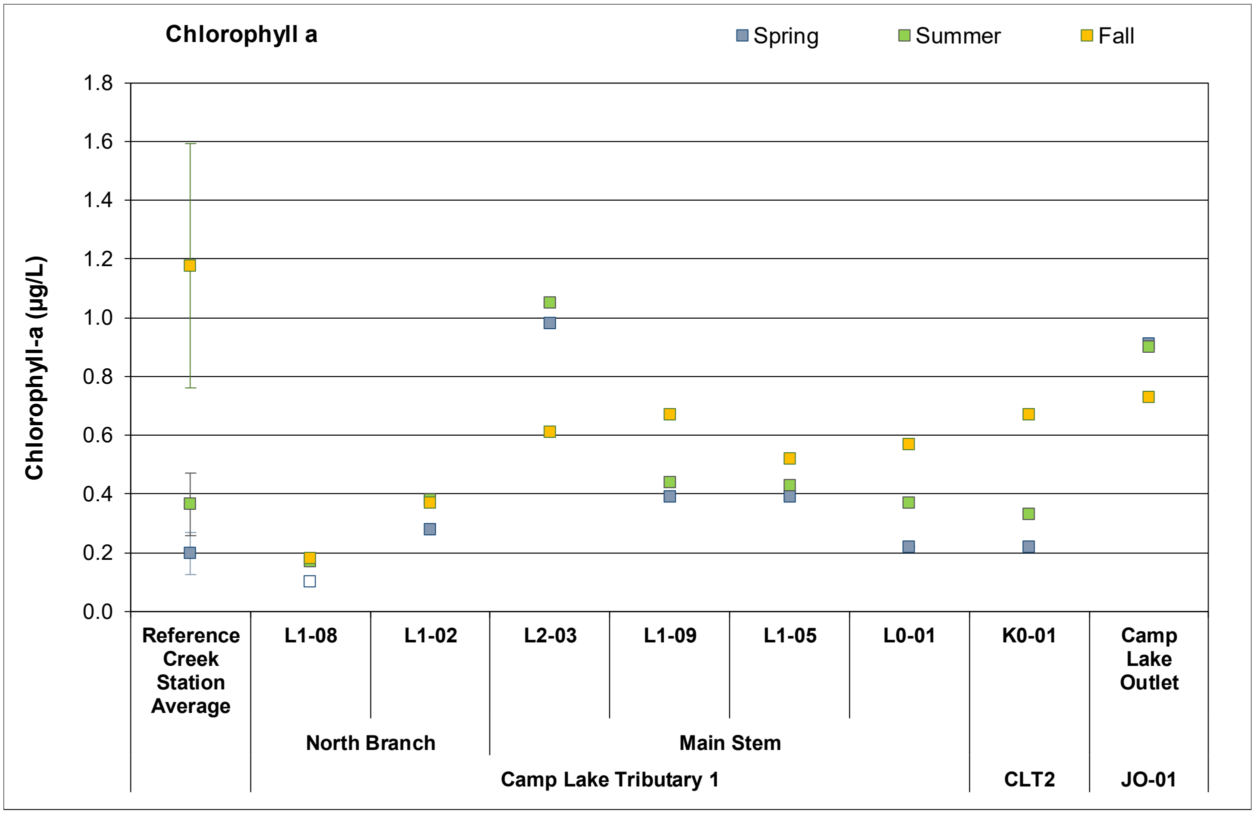


Figure 3.3: Chlorophyll-a Concentrations at Camp Lake Tributary 1 (CLT1) and Tributary 2 (CLT2) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2019

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

(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 2019 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 2019 than during the mine baseline period with the exception of at the CLT1 mouth (Station L0-01; Figure 3.4). However, no pattern of increasing chlorophyll-a concentrations was indicated among the years of mine operation at any of the CLT1 north branch or lower main stem stations, and concentrations were continuously lower than the AEMP benchmark of 3.7 µg/L from 2015 to 2019 (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

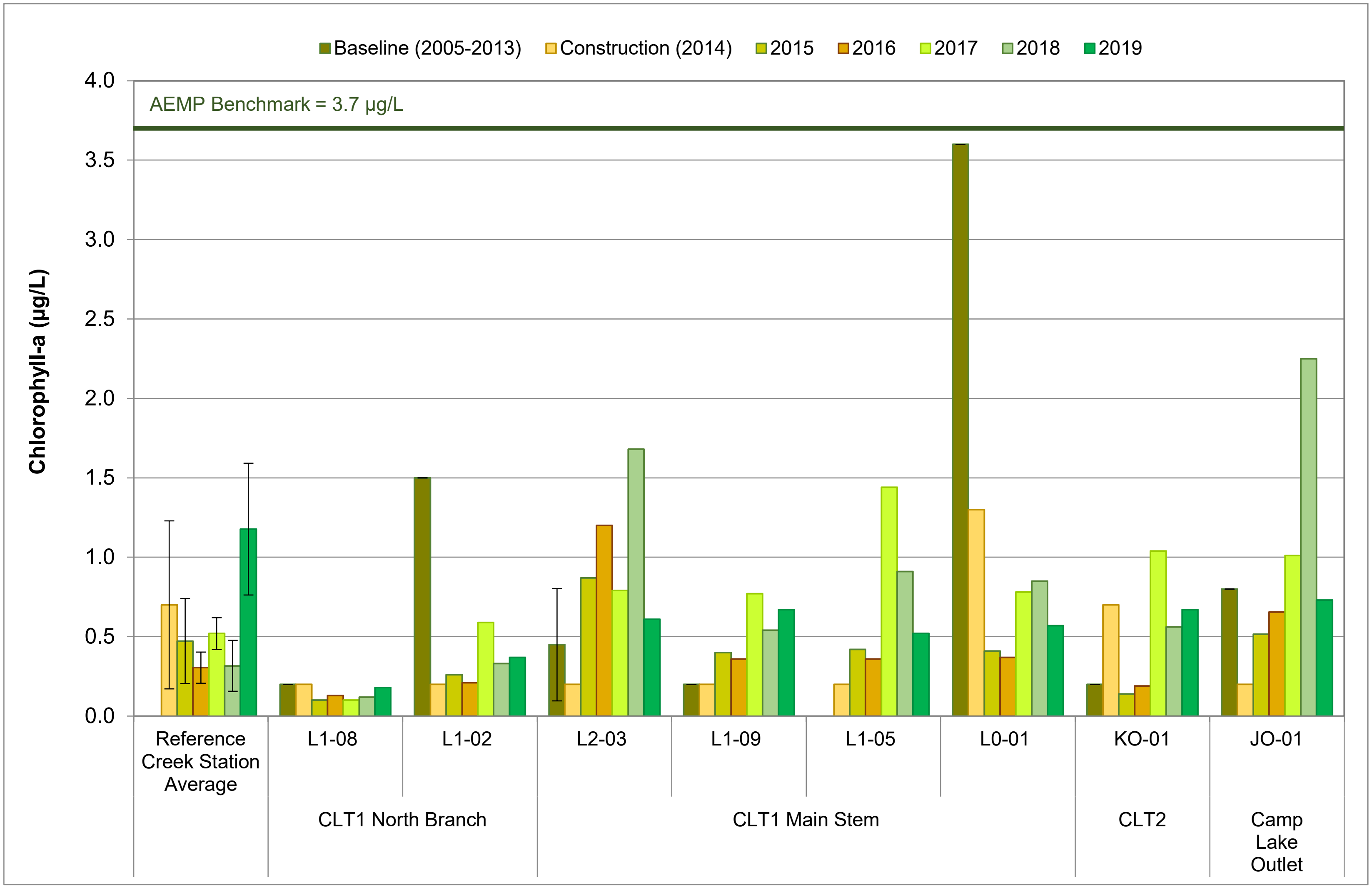


Figure 3.4: **Temporal Comparison of Chlorophyll-a Concentrations at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT 2) for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2019) Periods during Fall**

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

stations during spring and summer sampling events, 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 aqueous nutrient concentrations (e.g., nitrate) compared to water quality at the reference creeks. This suggested that slightly greater phytoplankton abundance at the CLT1 main stem was the result of current mine operations and specifically, the introduction of nutrients to the system as a result of active quarrying at the QMR2 pit. Despite slightly greater phytoplankton abundance at the CLT1 main stem stations than at the reference creeks in spring and summer of 2019, the CLT1 north branch and main stem have 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 community density, richness, and Simpson's Evenness did not differ significantly between the CLT1 upstream (north branch) study area and the Unnamed Reference Creek (Table 3.2). However, differences in benthic invertebrate community assemblage were suggested between the CLT1 north branch and Unnamed Reference Creek based on significant differences in Bray-Curtis Index between these study areas (Table 3.2). Evaluation of dominant taxonomic groups indicated significantly lower and higher relative abundance of Ostracoda (seed shrimp) and Tipulidae (crane flies), respectively, at the CLT1 north branch compared to the reference creek (Table 3.2). The magnitudes of difference for these endpoints were outside of the benthic invertebrate community critical effect size (CES_{BIC}) of ±2 reference area standard deviations (SD_{REF}; Table 3.2), suggesting the differences in these endpoints were ecologically meaningful. 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 a significantly higher relative abundance of the shredder FFG at the CLT1 north branch compared to Unnamed Reference Creek (Table 3.2). Shredders rely on in-stream vegetation as a food source, and thus the differences in shredder FFG composition between the CLT1 north branch and Unnamed Reference Creek potentially reflected differences in the type and/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 (mosses) 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: Benthic Invertebrate Community Metric Statistical Comparison Results among Camp Lake Tributary 1 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2019

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	NO	0.235	Reference Creek	1,110	472	-	a
				CLT1 Upstream	1,260	313	0.3	a
				CLT1 Downstream	843	293	-0.6	a
Richness (No. of Taxa)	none	NO	0.191	Reference Creek	18.0	2.3	-	a
				CLT1 Upstream	18.0	2.1	0.0	a
				CLT1 Downstream	15.8	1.6	-0.9	a
Simpson's Evenness	none	YES	0.086	Reference Creek	0.883	0.016	-	a
				CLT1 Upstream	0.884	0.036	0.1	a
				CLT1 Downstream	0.755	0.161	-8.0	b
Bray-Curtis Index	none	YES	0.002	Reference Creek	0.333	0.155	-	a
				CLT1 Upstream	0.664	0.127	2.1	b
				CLT1 Downstream	0.674	0.090	2.2	b
Oligochaeta (% of community)	log	NO	0.149	Reference Creek	0.7%	0.7%	-	a
				CLT1 Upstream	2.5%	3.2%	2.6	a
				CLT1 Downstream	4.0%	2.7%	4.7	a
Ostracoda (% of community)	rank	YES	0.005	Reference Creek	8.2%	3.2%	-	a
				CLT1 Upstream	0.1%	0.2%	-2.5	b
				CLT1 Downstream	0.4%	0.4%	-2.4	b
Chironomidae (% of community)	rank	NO	0.330	Reference Creek	80.2%	6.8%	-	a
				CLT1 Upstream	85.0%	5.1%	0.7	a
				CLT1 Downstream	87.4%	7.4%	1.1	a
Metal Sensitive Chironomids (% of community)	none	YES	0.027	Reference Creek	22.9%	7.5%	-	a
				CLT1 Upstream	14.4%	10.4%	-1.1	a,b
				CLT1 Downstream	7.7%	3.4%	-2.0	b
Tipulidae (% of community)	none	YES	0.010	Reference Creek	1.0%	1.1%	-	a
				CLT1 Upstream	5.4%	1.9%	3.9	b
				CLT1 Downstream	2.7%	2.4%	1.5	a,b
Collector-Gatherer FFG (% of community)	none	YES	0.024	Reference Creek	72.7%	16.4%	-	a,b
				CLT1 Upstream	58.8%	8.6%	-0.8	a
				CLT1 Downstream	81.5%	6.3%	0.5	b
Filterer FFG (% of community)	rank	NO	0.160	Reference Creek	6.6%	11.0%	-	a
				CLT1 Upstream	2.0%	2.4%	-0.4	a
				CLT1 Downstream	0.8%	1.9%	-0.5	a
Shredder FFG (% of community)	log	YES	0.016	Reference Creek	12.3%	7.7%	-	a
				CLT1 Upstream	33.8%	9.1%	2.8	b
				CLT1 Downstream	13.9%	6.1%	0.2	a
Clinger HPG (% of community)	log	YES	0.058	Reference Creek	21.8%	18.3%	-	a,b
				CLT1 Upstream	34.1%	7.6%	0.7	b
				CLT1 Downstream	14.9%	5.9%	-0.4	a
Sprawler HPG (% of community)	none	YES	0.080	Reference Creek	69.4%	16.1%	-	a,b
				CLT1 Upstream	55.8%	11.0%	-0.8	b
				CLT1 Downstream	75.0%	9.4%	0.3	a
Burrower FFG (% of community)	log	NO	0.308	Reference Creek	5.7%	4.6%	-	a
				CLT1 Upstream	9.3%	5.1%	0.8	a
				CLT1 Downstream	9.0%	5.5%	0.7	a

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.

(Table 3.2; Appendix Table F.1). The composition of habit preference groups (HPG) did not differ significantly between the CLT1 north branch and Unnamed Reference Creek (Table 3.2), suggesting that any differences in community composition were unrelated to differences in substrate features (i.e., size and embeddedness). 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 2019, 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 during mine operational years (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, 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 the benthic invertebrate community 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 Milne Inlet Tote Road crossing, did not differ significantly in density or richness, but showed significantly lower Simpson's Evenness compared to Unnamed Reference Creek in 2019 (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 (Table 3.2). Among the dominant taxonomic groups, a significantly lower relative abundance of Ostracoda (seed shrimp) and metal-sensitive chironomids occurred at the CLT1 lower main stem compared to Unnamed Reference Creek (Table 3.2). No significant differences in FFG or HPG were indicated between the CLT1 lower main stem and reference creek study areas, suggesting similar food sources and substrate features between these study areas (Table 3.2). Between the CLT1 lower main stem and the north branch study areas, no significant difference in benthic invertebrate density, richness, and relative abundance of dominant groups, including metal-sensitive chironomids, were indicated, but FFG and HPG composition differed significantly (Table 3.2). Specifically, lower relative abundance of the shredder FFG and clinger HPG were present at the CLT1 lower main stem compared to the CLT1 north branch (Table 3.2). Similar to differences in FFG composition

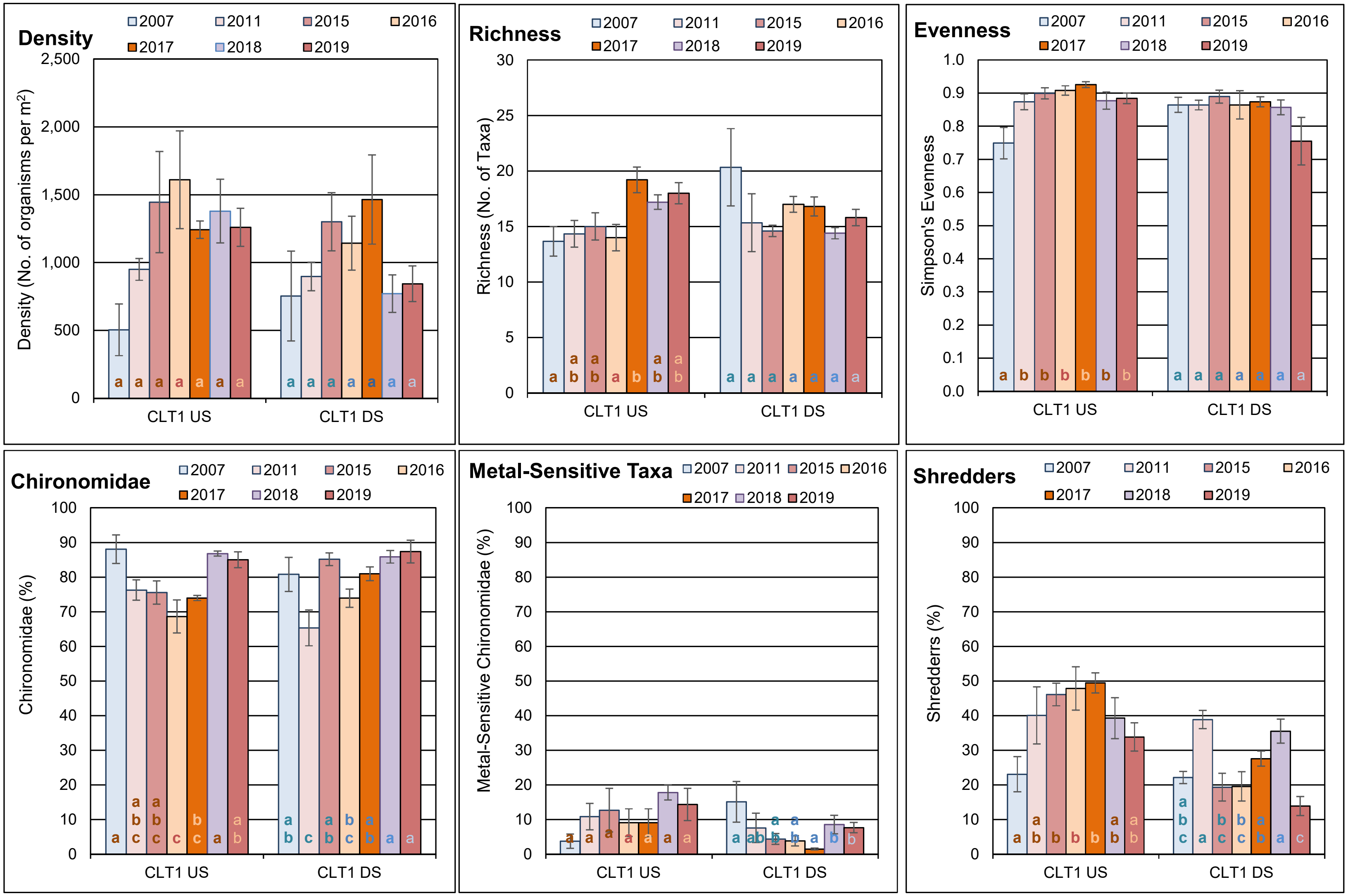


Figure 3.5: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Camp Lake Tributary 1 Study Areas among Mine Baseline (2007, 2011) and Operational (2015 to 2019) Periods

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

observed between the CLT1 north branch and reference creek, greater amounts and/or differing types of in-stream vegetation between the CLT1 lower main stem and north branch likely accounted for differing community composition between study areas. Notably, although aqueous copper concentrations were above WQG at the CLT1 lower main stem potentially contributing to a lower relative abundance of metal-sensitive chironomids compared to the reference creek, the relative abundance of this group did not differ between the CLT1 north branch and reference creek despite similar copper concentrations between the CLT1 north branch and lower main stem. In turn, this suggested that in-stream vegetation features were likely the key contributor to differences in benthic invertebrate community composition between the CLT1 lower main stem and reference creek study areas.

Temporal comparison of the CLT1 lower main stem data indicated no significant, ecologically meaningful, differences in benthic invertebrate density, richness, Simpson's Evenness, or the proportion of metal-sensitive chironomids for years of mine operation (2015 to 2019) 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 mine operational and baseline period data for the CLT1 lower main stem area (Figure 3.5; Appendix Tables F.9 and F.10). Overall, these results suggested no substantial changes in benthic invertebrate community compositional features between the mine operational and mine baseline periods at the CLT1 lower main stem.

3.1.4 Integrated Summary of Effects

3.1.4.1 Upstream North Branch (CLT1 US)

Potential mine-related effects on water quality of the CLT1 north branch in 2019 included elevated copper, molybdenum, and potassium concentrations compared to average concentrations at the reference creek, but only during the spring sampling event. Although total copper concentrations were not highly elevated at the CLT1 north branch compared to reference conditions, concentrations at the CLT1 north branch were consistently above WQG in 2019, and consistently above the watercourse-specific AEMP benchmark at upstream-most Station L1-08. Total copper concentrations at the CLT1 north branch were also consistently elevated in each of the five years of commercial mine operation (2015 to 2019) compared to concentrations shown during mine baseline studies, possibly 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, and potassium 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 similar to or lower than concentrations observed at the reference creek stations in 2019, 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 2019, and were indicative of oligotrophic conditions typical of Arctic watercourses. The benthic invertebrate community at the CLT1 north branch showed no significant differences in primary endpoints of density, richness, and Simpson's Evenness in 2019 compared to the reference creek. Although some differences in community composition were suggested between the CLT1 north branch and Unnamed Reference Creek, these differences were 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 these primary endpoints as well as the relative abundance of metal-sensitive chironomids, other dominant taxonomic groups, and FFG between years of mine operation (2015 to 2019) and the mine baseline period. 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 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 or AEMP benchmarks specific to the main stem 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 attributable to blasting/excavating activity (including associated dust generation) at the Mine Site QMR2 Quarry, but also to other sources of fugitive dust generation from the Mine Site since the mine baseline period.

Despite evidence of continued mine-related influence on water quality of the CLT1 main stem, chlorophyll-a concentrations were generally higher than at the reference creek in 2019, and were also higher in all years of mine operation from 2015 to 2019 than during the mine baseline period. The occurrence of relatively high chlorophyll-a concentrations at the CLT1 main stem suggested that concentrations of metals including uranium were not highly bioavailable to phytoplankton and that elevated nitrate concentrations may have contributed to 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 Simpson's Evenness and some compositional features differed significantly between the CLT1 lower main stem and Unnamed Reference Creek communities in 2019, 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 consistent type and/or direction of differences in benthic invertebrate community endpoints between the mine operational (2015 to 2019) and baseline studies. In addition, 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 on the benthic invertebrate community of CLT1 related to the Milne Inlet Tote Road crossing of this tributary. 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 2019, and were similar to mean saturation levels observed among the reference creek stations for each seasonal sampling event (Appendix Tables C.1 to C.3). *In situ* DO concentrations were significantly lower at the CLT2 upstream and downstream study areas than at Unnamed Reference Creek, but 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 2019 (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 in 2019 (Appendix Tables C.1 to C.3; 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 consistently higher at CLT2 compared to the reference creeks in 2019, and was also significantly higher upstream compared to downstream of the Milne Inlet Tote Road at CLT2 during August 2019 biological sampling (Figure 3.6; Appendix Table C.19), suggesting a dilution influence on water quality at CLT2.

Water chemistry at CLT2 (Station KO-01) exhibited moderately elevated (i.e., 5- to 10-fold) sulphate concentrations and slightly elevated (i.e., 3- to 5-fold) conductivity, hardness, and concentrations of total ammonia, barium, manganese, and potassium compared to average concentrations of these parameters at the reference creek stations during the spring 2019

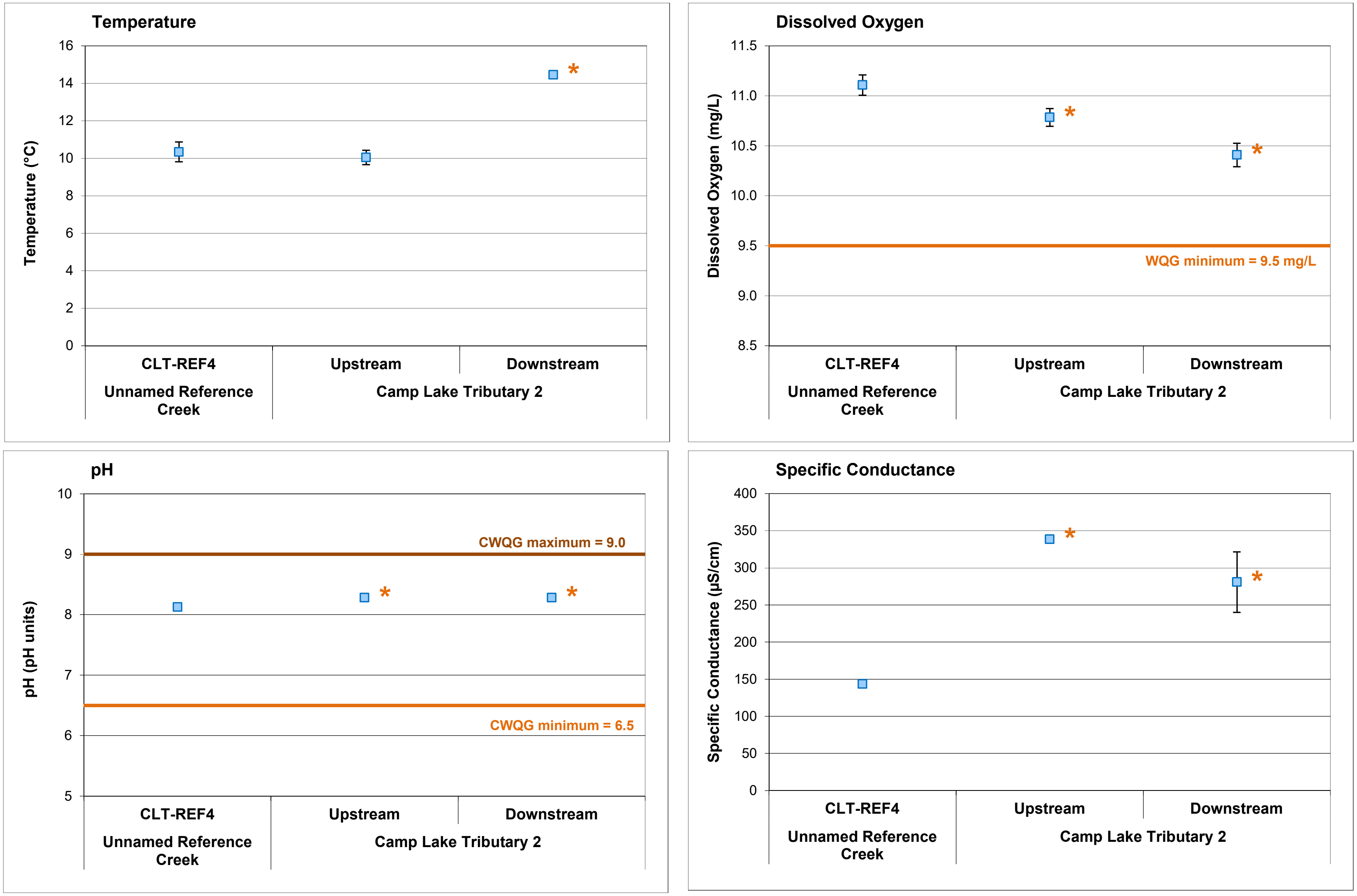


Figure 3.6: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Camp Lake Tributary 2 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2019

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

sampling event (Appendix Tables B.2, C.14, and C.15). However, similar water chemistry occurred between CLT2 and the reference creek stations during the summer and fall sampling events in 2019 (Table 3.1; 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 2019 (Table 3.1; Appendix Table C.14). Temporal comparisons of CLT2 water chemistry data indicated that conductivity, hardness, alkalinity, and concentrations of chloride, molybdenum, sodium, strontium, sulphate, TDS, and uranium in 2019 were generally outside of the range of concentrations shown during the mine baseline period (2005 to 2013) and over the 2015 to 2018 mine operation period for the fall sampling event (Figure 3.2; Appendix Figure C.2). However, similar occurrence of higher average concentrations of all of these parameters at the reference creeks in fall 2019 compared to all previous years suggested that a natural or laboratory factor likely accounted for this phenomenon. In consideration of all spatial and temporal data, the water chemistry data suggested no marked mine-related influence on water quality within the CLT2 system in 2019 based on comparison to reference conditions and to the mine baseline data.

3.2.2 Phytoplankton

Chlorophyll-a concentrations at CLT2 (Station KO-01) were within the range observed at the reference creeks during spring and summer sampling events, but were lower than concentrations at the reference creeks during the fall sampling event in 2019 (Figure 3.3). Concentrations of nutrients, including total ammonia, nitrate, and total phosphorus, were similar between CLT2 and the reference creek stations during the fall sampling event (Appendix Tables C.14 and C.15), and therefore the occurrence of lower chlorophyll-a concentrations at CLT2 in fall 2019 did not appear to be related to differing nutrient concentrations. In addition, concentrations of all parameters were below WQG at CLT2 in fall 2019, and thus the lower chlorophyll-a concentrations at CLT2 compared to the reference creeks may have reflected natural variability. Notably, chlorophyll-a concentrations were well below the AEMP benchmark of 3.7 µg/L for all sampling events in 2019 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 2017, 2018, and 2019 compared to the mine baseline period for the fall sampling event, but no suggestion of an increasing trend over time (Figure 3.4). For the reasons indicated above, higher chlorophyll-a concentrations at CLT2 in fall 2019 compared to the baseline period did not appear to be associated with a mine-related change in nutrient concentrations over time, and thus likely reflected natural seasonal/temporal variation in chlorophyll-a concentrations.

3.2.3 Benthic Invertebrate Community

Benthic invertebrate community sampling was conducted upstream and downstream of the Milne Inlet Tote Road (areas CLT2-US and CLT2-DS, respectively) to assess potential mine-related influences on biota of CLT2. Benthic invertebrate density and richness did not differ significantly at magnitudes of differences outside of the CES_{BIC} of ±2 SD_{REF} in 2019 (Table 3.3). However, differences in community composition were indicated between CLT2 and Unnamed Reference Creek based on the occurrence of significantly higher Simpson's Evenness and Bray-Curtis Index at one or both of the CLT2 study areas (Table 3.3). The only ecologically meaningful differences in community composition between CLT2 and the reference creek included significantly lower and higher relative abundance of Ostracoda (seed shrimp) and Oligochaeta (aquatic worms) dominant taxonomic groups, respectively, at CLT2 (Table 3.3). Although the relative abundance of the filterer FFG and clinger HPG differed significantly between CLT2 and Unnamed Reference Creek, the magnitudes of these differences were within the CES_{BIC} of ±2 SD_{REF} (Table 3.3). 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 to have been related to metal concentrations. In addition, 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 Milne Inlet Tote Road crossing (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 2019) 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 2019 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.

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 2019

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)	log	YES	0.092	Reference Creek	1,110	472	-	a
				CLT2 Upstream	745	282	-0.8	a,b
				CLT2 Downstream	546	366	-1.2	b
Richness (No. of Taxa)	log	NO	0.898	Reference Creek	18.0	2.3	-	a
				CLT2 Upstream	18.8	2.6	0.3	a
				CLT2 Downstream	18.4	3.1	0.2	a
Simpson's Evenness	none	YES	0.006	Reference Creek	0.883	0.016	-	a
				CLT2 Upstream	0.949	0.005	4.2	b
				CLT2 Downstream	0.885	0.048	0.1	a
Bray-Curtis Index	none	YES	< 0.001	Reference Creek	0.333	0.155	-	a
				CLT2 Upstream	0.679	0.060	2.2	b
				CLT2 Downstream	0.650	0.097	2.0	b
Nemata (% of community)	rank	NO	0.543	Reference Creek	3.6	5.1	-	a
				CLT2 Upstream	2.4	1.0	-0.2	a
				CLT2 Downstream	2.6	1.7	-0.2	a
Oligochaeta (% of community)	rank	YES	0.039	Reference Creek	0.7	0.7	-	a
				CLT2 Upstream	2.4	1.0	2.4	b
				CLT2 Downstream	4.3	3.3	5.1	b
Hydracarina (% of community)	log	NO	0.100	Reference Creek	4.5	3.2	-	a
				CLT2 Upstream	1.6	1.5	-0.9	a
				CLT2 Downstream	2.1	0.7	-0.7	a
Ostracoda (% of community)	rank	YES	0.004	Reference Creek	8.2	3.2	-	a
				CLT2 Upstream	0.2	0.5	-2.5	b
				CLT2 Downstream	0.2	0.4	-2.5	b
Chironomidae (% of community)	none	NO	0.350	Reference Creek	80.2	6.8	-	a
				CLT2 Upstream	80.0	5.9	0.0	a
				CLT2 Downstream	84.7	3.5	0.7	a
Metal Sensitive Chironomids (% of community)	none	NO	0.421	Reference Creek	22.9	7.5	-	a
				CLT2 Upstream	17.0	6.6	-0.8	a
				CLT2 Downstream	23.3	10.1	0.1	a
Collector-Gatherer FFG (% of community)	none	NO	0.203	Reference Creek	72.7	16.4	-	a
				CLT2 Upstream	54.0	6.0	-1.1	a
				CLT2 Downstream	56.8	23.0	-1.0	a
Filterer FFG (% of community)	log	YES	0.040	Reference Creek	6.6	11.0	-	a
				CLT2 Upstream	11.3	3.7	0.4	b
				CLT2 Downstream	15.4	11.3	0.8	b
Shredder FFG (% of community)	log	NO	0.199	Reference Creek	12.3	7.7	-	a
				CLT2 Upstream	21.9	5.8	1.2	a
				CLT2 Downstream	21.0	16.9	1.1	a
Clinger HPG (% of community)	log	YES	0.068	Reference Creek	21.8	18.3	-	a
				CLT2 Upstream	43.0	6.3	1.2	b
				CLT2 Downstream	38.0	21.9	0.9	a,b
Sprawler HPG (% of community)	none	NO	0.139	Reference Creek	69.4	16.1	-	a
				CLT2 Upstream	50.1	6.9	-1.2	a
				CLT2 Downstream	51.4	21.0	-1.1	a
Burrower FFG (% of community)	log	NO	0.103	Reference Creek	5.7	4.6	-	a
				CLT2 Upstream	6.4	1.8	0.2	a
				CLT2 Downstream	9.5	3.1	0.8	a

[Grey shading] Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

[Blue shading] 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.

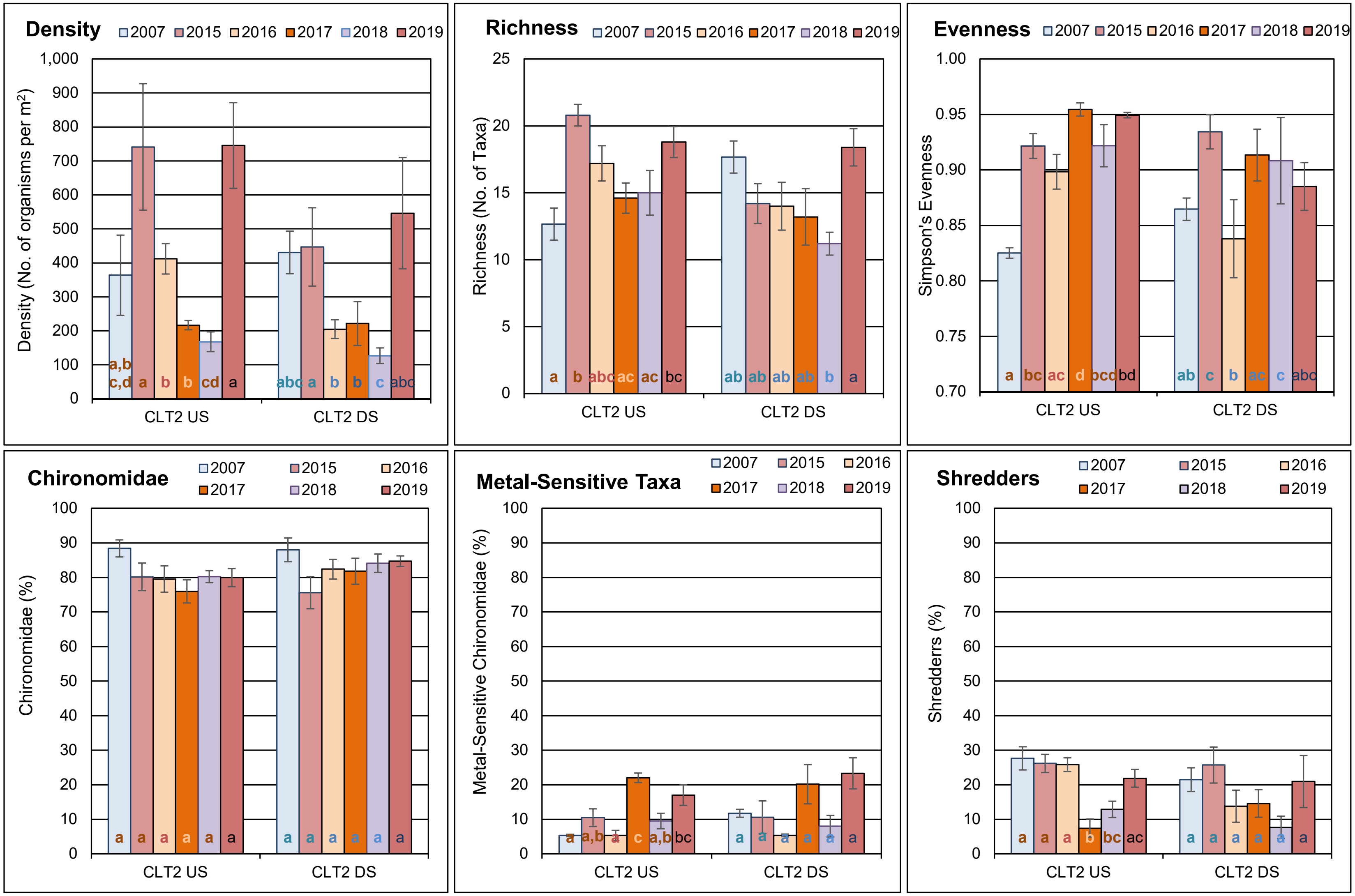


Figure 3.7: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Camp Lake Tributary 2 Study Areas among Mine Baseline (2007) and Operational (2015 to 2019) Periods

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

3.2.4 Integrated Summary of Effects

Potential mine-related effects on water quality of CLT2 in 2019 included slightly elevated conductivity, hardness, and concentrations of sulphate compared to respective averages from the reference creeks. However, water chemistry at CLT2 was comparable between 2019 and the mine baseline period taking temporal changes in water chemistry at the reference creeks into consideration. This suggested that natural regional variability in water chemistry among lotic environments likely accounted for differing hardness and concentrations of sulphate 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 2019. Based on an overall weight-of-evidence, the only mine-related influence on water quality at CLT2 in 2019 was a minor elevation in conductivity.

Chlorophyll-a concentrations at CLT2 in 2019 were consistently well below the AEMP benchmark and were indicative of oligotrophic conditions characteristic of Arctic watercourses. The concentrations of chlorophyll-a at CLT2 were comparable to those at the reference creeks in spring and summer, but lower than at the reference creeks in fall. In contrast, chlorophyll-a concentrations in the fall at CLT2 were greater in 2019 than during baseline. Because nutrient concentrations were comparable between CLT2 and the reference creeks in 2019, and between mine-operational years and mine baseline studies, as well as the fact that water quality consistently met WQG/AEMP benchmarks at CLT2, the differences in chlorophyll-a concentrations at CLT2 in 2019 compared to the reference creeks and the baseline studies likely reflected natural seasonal/temporal variation. The benthic invertebrate community of CLT2 exhibited significantly different composition than Unnamed Reference Creek in 2019. However, no significant difference in the relative abundance of metal-sensitive chironomids was indicated at CLT2 compared to the reference creek in 2019. 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. No significant differences in benthic invertebrate community endpoints occurred between the CLT2 upstream and downstream study areas, indicating no influences to the benthic invertebrate community associated with the Milne Inlet Tote Road crossing of CLT2. 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 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 2019 (Appendix Figures C.3 to C.6). The 2019 Camp Lake water column profiles indicated a slight increase in temperature from surface to bottom (i.e., <2˚C) during the winter sampling event, and distinct thermal stratification during the summer and fall sampling events (Figure 3.8). The average temperature profiles at Camp Lake in summer and fall sampling events roughly mirrored those observed at Reference Lake 3 in 2019 (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 2019 biological monitoring (Figure 3.9; Appendix Tables C.24 and C.25).

Dissolved oxygen profiles conducted at Camp Lake in 2019 showed declining saturation levels with increased depth beginning at approximately 10 m below surface in the winter, but otherwise showed relatively minor changes from surface to bottom during the summer and fall that closely reflected the DO profiles observed at Reference Lake 3 (Figure 3.8). The Camp Lake DO profiles from 2019 were comparable to those observed in winter, summer, and summer from 2015 to 2018 at Camp Lake. Dissolved oxygen levels near the bottom of the water column were nearly fully saturated at littoral and profundal sampling depths of Camp Lake, and concentrations were comparable or higher than those at Reference Lake 3, during biological sampling in August 2019 (Figure 3.9; Appendix Table C.25). In addition, dissolved oxygen concentrations 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) during all seasonal sampling events in 2019 except at water depths greater than approximately 25 m in winter (Figure 3.9; Appendix Tables C.20 to C.22). This suggested that dissolved oxygen concentrations were not likely to be limiting to biota at Camp Lake for the majority of the year with the exception of those areas greater than 25 m deep during the winter.

In situ profiles showed decreasing pH with increased depth at Camp Lake and Reference Lake 3, with the changes in pH through the water column at both lakes appearing to coincide with changes in water temperature and, to a lesser extent, DO levels (Figure 3.8). Although pH levels near the bottom at littoral and profundal stations of Camp Lake were significantly higher than at the reference lake during the August 2019 biological study, 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, Appendix Table C.25), suggesting that the pH difference between lakes was not ecologically meaningful. Specific conductance profiles showed no marked step changes from the

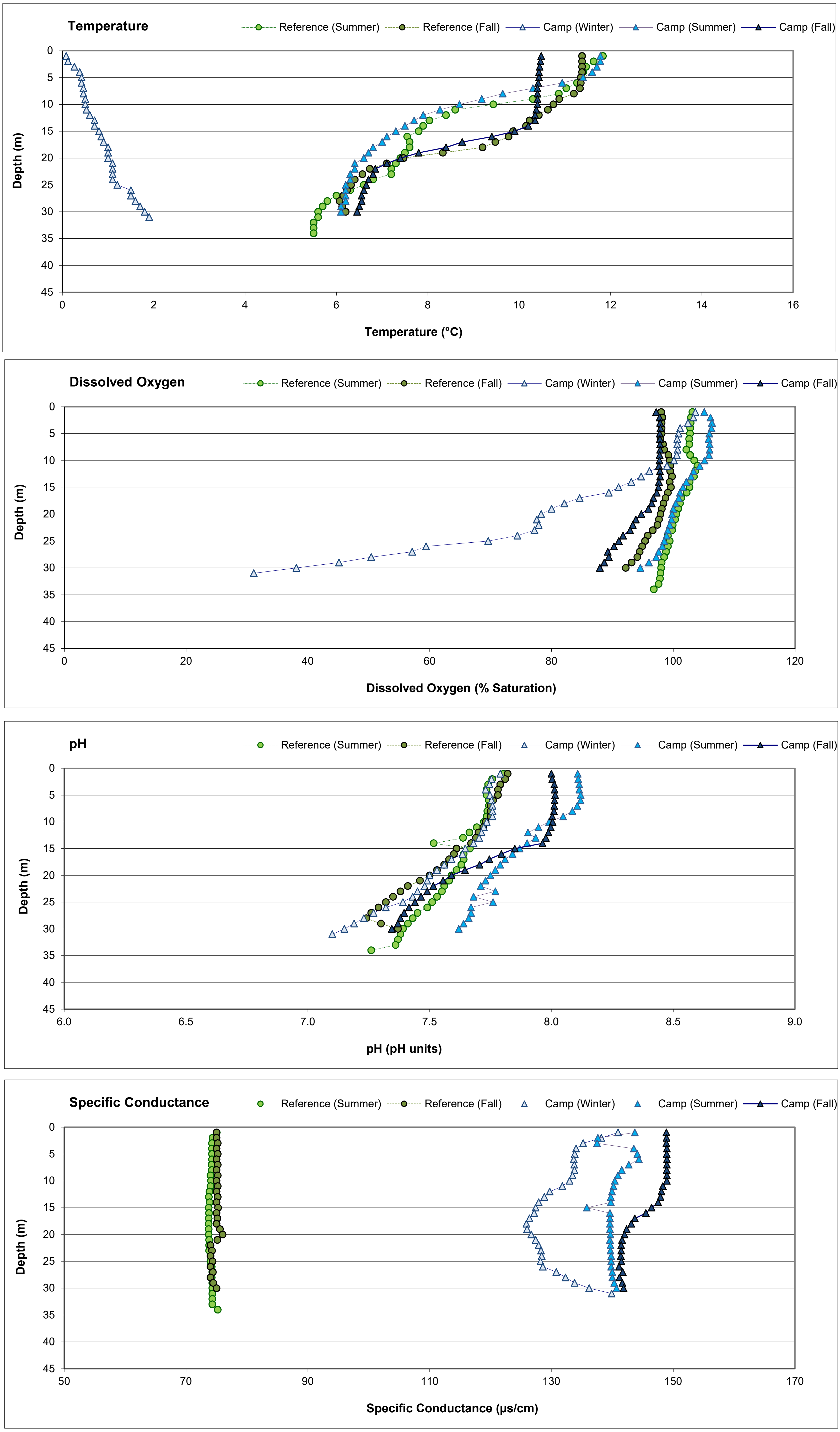


Figure 3.8: Average *In Situ* Water Quality with Depth from Surface at Camp Lake (JLO) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2019

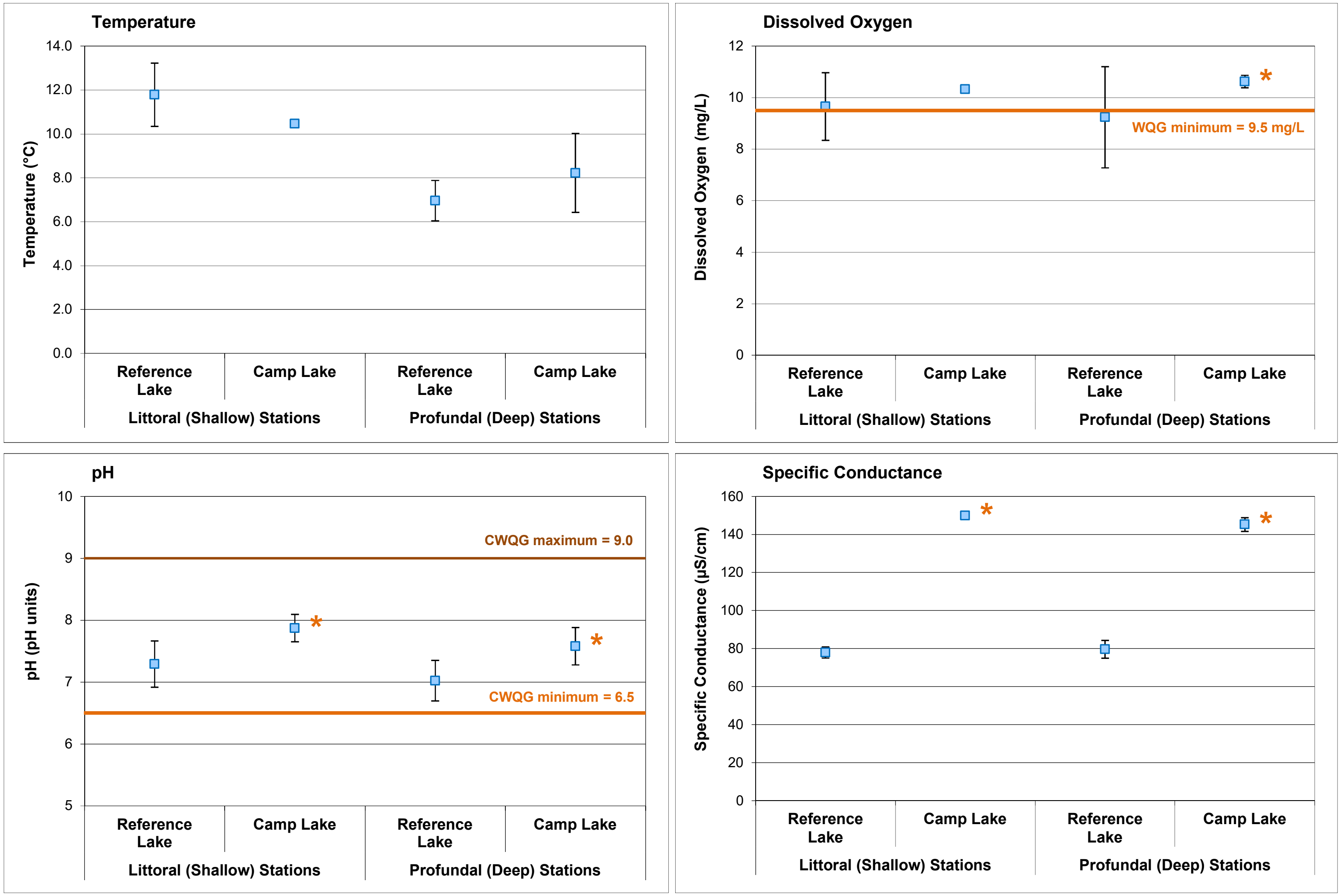


Figure 3.9: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Camp Lake (JLO) and Reference Lake 3 (REF3) Littoral and Profundal Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2019

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.

surface to bottom of the Camp Lake water column, indicating the absence of chemical stratification (Figure 3.8). Specific conductance was consistently higher at Camp Lake than at Reference Lake 3 in summer and fall 2019 (Figure 3.8), the difference of which was shown to be significant during the August 2019 biological study (Figure 3.9), and possibly reflected a mine-related influence on water quality. Secchi depth readings, which serve as a proxy for water clarity, did not differ significantly between Camp Lake and Reference Lake 3 during the August 2019 biological study (Appendix Figure C.7). In addition, no spatial gradient in Secchi depth readings was apparent with progression from the CLT inlets to the lake outlet stations in fall 2019 at Camp Lake (Appendix Table C.23), suggesting no substantial mine-related inputs of materials likely to remain suspended in the water column at Camp Lake at the time of the fall 2019 sampling event.

Water chemistry data collected at Camp Lake in 2019 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 concentrations of chloride, total manganese, nitrate, and total uranium was evident at Camp Lake compared to Reference Lake 3 during the summer and/or fall 2019 sampling events (Table 3.4; Appendix Table C.27). Concentrations of dissolved manganese and dissolved uranium also showed slight elevation at Camp Lake compared to the reference lake in 2019, suggesting a mine-related influence on the concentration of these metals. Despite higher concentrations of the parameters indicated above, concentrations of all parameters were below applicable WQG and AEMP benchmarks at Camp Lake during all sampling events in 2019 with the exception of total copper and phosphorus concentrations (Table 3.4; Appendix Table C.26). Concentrations of total copper were above WQG at a single station in each of the winter and fall sampling events, and concentrations of total phosphorus were above WQG at two stations during the fall sampling event, in 2019 (Table 3.4; Appendix Table C.26). In the cases in which copper and phosphorus concentrations were above WQG at Camp Lake in fall, the reported concentrations of these parameters were about an order of magnitude higher than at all other stations suggesting that the apparent elevation above WQG were an artifact of sampling or laboratory determinations.

Temporal comparisons of Camp Lake water chemistry data indicated that conductivity, hardness, and total concentrations of chloride, molybdenum, sodium, strontium, sulphate, and uranium showed near consistent increases over the mine-operational period (2015 to 2019) and since the baseline period (2005 to 2013) for fall sampling events (Figure 3.10; Appendix Figure C.8). These parameters have historically shown elevation in concentrations at the CLT1 lower main stem compared to reference and/or baseline conditions, indicating that the source of these parameters was mine-related. Despite increasing concentrations over time, parameter

Table 3.4: Water Chemistry at Camp Lake (JLO) and Reference Lake 3 (REF3) Monitoring Stations[a], Mary River Project CREMP, August 2019

	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 2019	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19
Conventionals	Conductivity (lab)	umho/cm	-	-	82	165	165	163	159	163	150
Conventionals	pH (lab)	pH	6.5 - 9.0	-	7.74	8.16	8.19	8.19	7.97	8.16	8.32
Conventionals	Hardness (as $CaCO_3$)	mg/L	-	-	36	70	70	70	67	69	78
Conventionals	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.1	<2.2	<2.3	<2.4	<2.0
Conventionals	Total Dissolved Solids (TDS)	mg/L	-	-	53	88	91	81	67	99	129
Conventionals	Turbidity	NTU	-	-	0.34	0.88	0.78	0.65	0.57	0.56	0.29
Conventionals	Alkalinity (as $CaCO_3$)	mg/L	-	-	34	69	69	69	67	68	69
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.010	0.017	<0.020	<0.010	0.023	<0.020	<0.010
Nutrients and Organics	Nitrate	mg/L	3	3	0.036	<0.020	<0.020	<0.020	0.030	<0.020	<0.020
Nutrients and Organics	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organics	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.18	0.21	0.16	<0.15	<0.15	<0.15	<0.15
Nutrients and Organics	Dissolved Organic Carbon	mg/L	-	-	2.7	1.9	1.9	2.0	1.9	2.0	1.9
Nutrients and Organics	Total Organic Carbon	mg/L	-	-	3.1	2.3	2.6	2.3	2.2	2.1	2.2
Nutrients and Organics	Total Phosphorus	mg/L	0.020$^{\alpha}$	-	**0.0210**	0.0032	0.0045	0.0036	**0.0293**	0.0175	0.0031
Nutrients and Organics	Phenols	mg/L	0.004$^{\alpha}$	-	<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
Anions	Chloride (Cl)	mg/L	120	120	1.4	4.3	4.3	4.2	4.1	4.2	4.1
Anions	Sulphate (SO_4)	mg/L	218$^{\beta}$	218	3.7	4.2	4.2	4.2	4.1	4.2	4.1
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0079	0.0081	0.0099	0.0064	0.0060	0.0151	0.0062
Total Metals	Antimony (Sb)	mg/L	0.020$^{\alpha}$	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Barium (Ba)	mg/L	-	-	0.0062	0.0072	0.0072	0.0071	0.0069	0.0074	0.0075
Total Metals	Beryllium (Be)	mg/L	0.011$^{\alpha}$	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Metals	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Metals	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total Metals	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Total Metals	Calcium (Ca)	mg/L	-	-	7.2	13.8	13.9	13.8	13.5	13.9	15.0
Total Metals	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Metals	Cobalt (Co)	mg/L	0.0009$^{\alpha}$	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Copper (Cu)	mg/L	0.002	0.0022	0.00085	0.00091	0.00091	0.00091	***0.00358***	0.00091	0.00095
Total Metals	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Total Metals	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Total Metals	Magnesium (Mg)	mg/L	-	-	4.5	8.5	8.6	8.6	8.3	8.6	9.6
Total Metals	Manganese (Mn)	mg/L	0.935$^{\beta}$	-	0.00060	0.00113	0.00128	0.00114	0.00138	0.00205	0.00178
Total Metals	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Total Metals	Molybdenum (Mo)	mg/L	0.073	-	0.00014	0.00038	0.00038	0.00037	0.00036	0.00038	0.00040
Total Metals	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00058	0.00060	0.00063	0.00062	0.00065	0.00067
Total Metals	Potassium (K)	mg/L	-	-	0.9	1.3	1.3	1.3	1.2	1.3	1.3
Total Metals	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Metals	Silicon (Si)	mg/L	-	-	0.48	0.29	0.30	0.28	0.35	0.30	0.28
Total Metals	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Total Metals	Sodium (Na)	mg/L	-	-	0.9	1.7	1.7	1.6	1.6	1.7	1.7
Total Metals	Strontium (Sr)	mg/L	-	-	0.0082	0.0111	0.0111	0.0109	0.0107	0.0111	0.0117
Total Metals	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total Metals	Uranium (U)	mg/L	0.015	-	0.00025	0.00106	0.00105	0.00097	0.00091	0.00099	0.00107
Total Metals	Vanadium (V)	mg/L	0.006$^{\alpha}$	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Metals	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the applicable AEMP benchmark.

[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.

Figure 3.10: Temporal Comparison of Water Chemistry at Camp Lake (JLO) for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2019) 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.

concentrations in 2019 generally remained within the upper range of baseline concentrations on a seasonal basis (Appendix Table C.27). Other parameters that have occurred at elevated concentrations at CLT1 historically, including iron, nitrate, TDS, and TKN, showed no consistent direction of change over the mine-operational period and since the baseline period (Figure 3.10; Appendix Figure C.8). It is noteworthy that changes in turbidity since the mine baseline have roughly mirrored the increase in parameter concentrations shown over time at Camp Lake, suggesting a potential causal link (i.e., higher parameter concentrations associated with increased suspended material potentially related to fugitive dust and/or erosion). Despite the changes in water chemistry over time, concentrations of all of the parameters indicated above have consistently been well below WQG and AEMP benchmarks through all years of mine operation at Camp Lake (Figure 3.10; Appendix Figure C.8).

3.3.2 Sediment Quality

Surficial sediment (i.e., top 2 cm) collected at the Camp Lake coring stations in 2019 was characterized primarily as 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 for like-habitat at littoral and profundal areas, compared to Reference Lake 3 (Appendix Table D.7). However, TOC content in sediment at littoral and profundal stations of Camp Lake was significantly lower, and sediment was significantly more compact (i.e., lower moisture content), than at the reference lake (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 and sulphidic odour was detected in sediment at some stations, suggesting occasional incidence of reducing conditions within substrates of the lake. However, no strongly defined redox boundaries were identified visually at Camp Lake littoral and profundal stations in 2019 (Appendix Tables D.5 and D.6). Qualitative observations suggestive of reducing sediment conditions were similar between Camp Lake and Reference Lake 3 in 2019 (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 2019

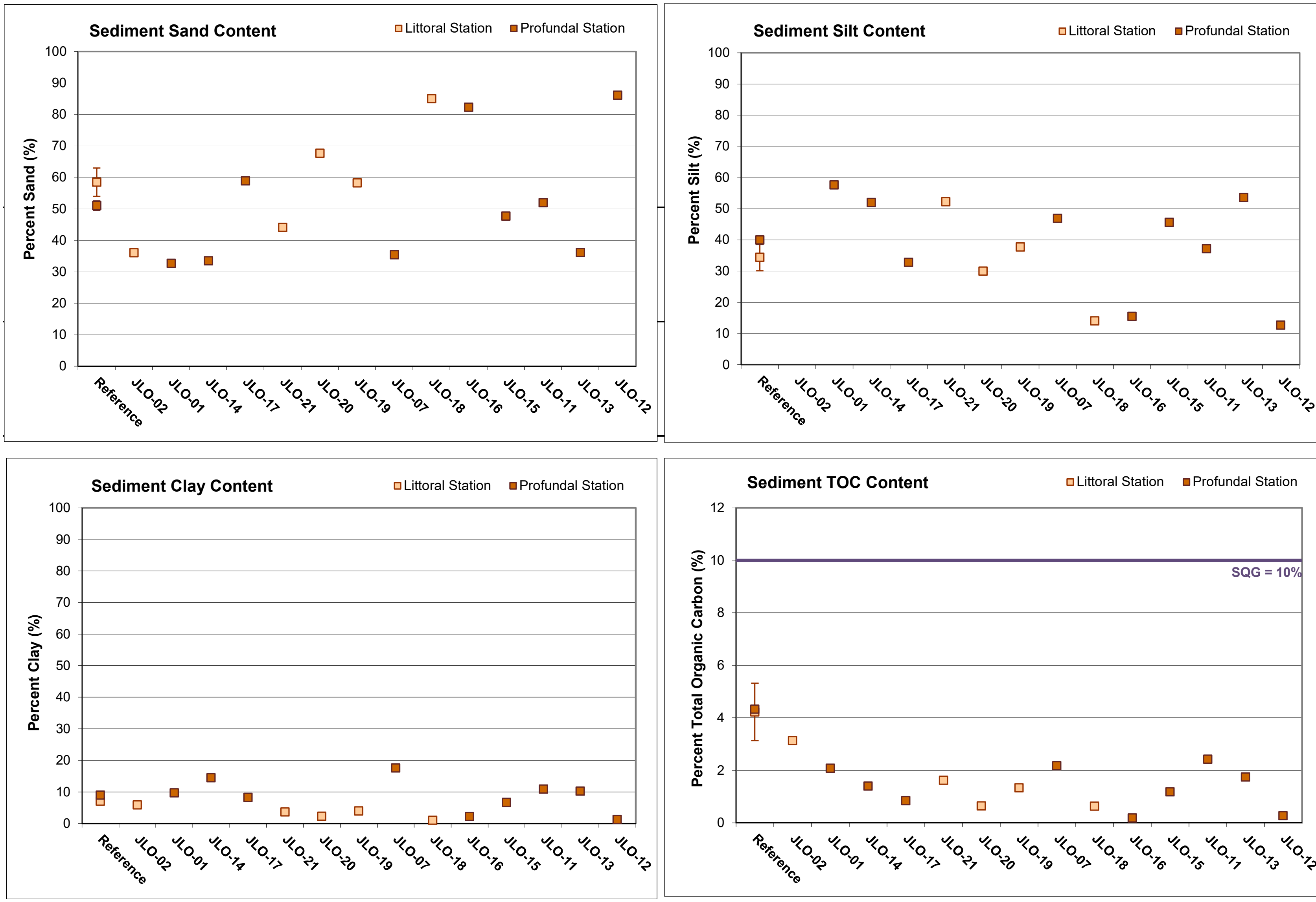


Figure 3.11: Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Camp Lake (JLO) Sediment Monitoring Stations and to Reference Lake 3 Averages (mean ± SE), Mary River Project CREMP, August 2019

(Appendix Table D.8). Metal concentrations in littoral and profundal sediment of Camp Lake were comparable (i.e., less than a factor of 3-fold higher) to those of the reference lake in 2019 (Table 3.5; Appendix Table D.8). Iron, manganese, and nickel concentrations were above respective SQG, and arsenic, copper, iron, and nickel concentrations were above respective AEMP benchmarks, in sediment at the Camp Lake littoral station in 2019 (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. 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 some profundal stations, but on average, were below the applicable benchmarks (Table 3.5; Appendix Table D.8). Of these latter metals, average concentrations of copper were also above the Camp Lake AEMP benchmark in profundal sediment at Reference Lake 3 (Table 3.5), indicating naturally high concentrations of copper 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 2019 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 concentrations in sediment at the single Camp Lake littoral station in 2019 (Figure 3.12; Appendix Table D.9).[8] Average metal concentrations in sediment at Camp Lake littoral and profundal stations in 2019 were typically within the range of those observed from 2015 to 2018 (Figure 3.12). In addition, no pattern of consistently higher metal concentrations has occurred in Camp Lake sediment over the 2015 to 2019 period of mine operation (Figure 3.12). Overall, with the exception of a step-increase in arsenic, manganese, and phosphorus 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

[8] Reported sediment boron concentrations from 2015 to 2019 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.

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 2019

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Littoral Stations: Reference Lake (n = 5) Average ± Std. Error	Littoral Stations: Camp Lake (n = 1)	Profundal Stations: Reference Lake (n = 5) Average ± Std. Error	Profundal Stations: Camp Lake (n = 9) Average ± Std. Error
	Total Organic Carbon	%	10^{α}	-	4.22 ± 1.09	3.13	4.32 ± 0.12	1.27 ± 0.27
Metals	Aluminum (Al)	mg/kg	-	-	13,660 ± 1,044	18,100	22,740 ± 609	16,588 ± 2,102
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0.0	<0.10	<0.10 ± 0.0	0.10 ± 0.0
	Arsenic (As)	mg/kg	17	5.9	4.68 ± 1.11	***9.36***	5.26 ± 0.12	4.09 ± 0.59
	Barium (Ba)	mg/kg	-	-	99 ± 19	135	127 ± 3	67 ± 9
	Beryllium (Be)	mg/kg	-	-	0.57 ± 0.05	0.86	0.89 ± 0.02	0.84 ± 0.12
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0.0	0.29	<0.20 ± 0.0	0.33 ± 0.05
	Boron (B)	mg/kg	-	-	11.8 ± 0.8	20.2	16.5 ± 0.7	21.8 ± 2.7
	Cadmium (Cd)	mg/kg	3.5	1.5	0.140 ± 0.034	0.284	0.164 ± 0.004	0.143 ± 0.024
	Calcium (Ca)	mg/kg	-	-	4,522 ± 399	5,720	5,492 ± 117	5,776 ± 1,343
	Chromium (Cr)	mg/kg	90	98	49.0 ± 3.5	75.7	74.2 ± 2.0	70.5 ± 7.1
	Cobalt (Co)	mg/kg	-	-	9.75 ± 0.54	21.70	16.48 ± 0.24	15.70 ± 1.86
	Copper (Cu)	mg/kg	110^{α}	50	***57.1*** ± 9.7	***55.6***	***91.9*** ± 2.0	42.4 ± 6.0
	Iron (Fe)	mg/kg	$40{,}000^{\alpha}$	52,400	***54,660*** ± 14,622	***55,000***	49,580 ± 1,299	33,722 ± 3,585
	Lead (Pb)	mg/kg	91	35	13.0 ± 0.8	20.4	19.0 ± 0.3	18.3 ± 2.6
	Lithium (Li)	mg/kg	-	-	22.7 ± 1.3	29.6	35.8 ± 0.9	28.7 ± 3.9
	Magnesium (Mg)	mg/kg	-	-	9,392 ± 521	14,900	14,840 ± 437	13,689 ± 1,106
	Manganese (Mn)	mg/kg	$1{,}100^{\alpha,\beta}$	4,370	544 ± 115	1,370	1,796 ± 610	1,712 ± 630
	Mercury (Hg)	mg/kg	0.486	0.17	0.0458 ± 0.0116	0.0580	0.0738 ± 0.0022	0.0365 ± 0.0077
	Molybdenum (Mo)	mg/kg	-	-	5.47 ± 1.87	1.70	3.06 ± 0.42	1.08 ± 0.16
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	72	35.1 ± 3.0	***84.4***	51.6 ± 1.4	63.8 ± 6.7
	Phosphorus (P)	mg/kg	$2{,}000^{\alpha}$	1,580	1,430 ± 409	1,360	1,025 ± 36	953 ± 83
	Potassium (K)	mg/kg	-	-	3,308 ± 238	4,640	5,502 ± 150	4,606 ± 601
	Selenium (Se)	mg/kg	-	-	0.62 ± 0.15	0.55	0.77 ± 0.04	0.37 ± 0.05
	Silver (Ag)	mg/kg	-	-	0.13 ± 0.03	0.13	0.26 ± 0.01	0.14 ± 0.01
	Sodium (Na)	mg/kg	-	-	258.6 ± 19	222	414 ± 16	223 ± 32
	Strontium (Sr)	mg/kg	-	-	10.7 ± 0.9	10.0	13.9 ± 0.3	12.4 ± 1.3
	Thallium (Tl)	mg/kg	-	-	0.363 ± 0.038	0.610	0.771 ± 0.010	0.420 ± 0.063
	Tin (Sn)	mg/kg	-	-	<2.0 ± 0.0	<2.0	2.0 ± 0.0	<2.0 ± 0.0
	Titanium (Ti)	mg/kg	-	-	964 ± 37	970	1,260 ± 50	883 ± 83
	Tungsten (W)	mg/kg	-	-	<0.50 ± 0	<0.50	<0.50 ± 0	<0.50 ± 0
	Uranium (U)	mg/kg	-	-	12.6 ± 1.8	7.27	23.9 ± 0.9	5.14 ± 0.8
	Vanadium (V)	mg/kg	-	-	46.0 ± 3.6	62.6	66.6 ± 1.5	55.8 ± 6.6
	Zinc (Zn)	mg/kg	315	135	64.8 ± 6.6	63.2	91.9 ± 1.7	53.2 ± 6.7
	Zirconium (Zr)	mg/kg	-	-	3.5 ± 0.4	8.7	4.0 ± 0.2	6.6 ± 1.0

[Shaded box] Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

[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.

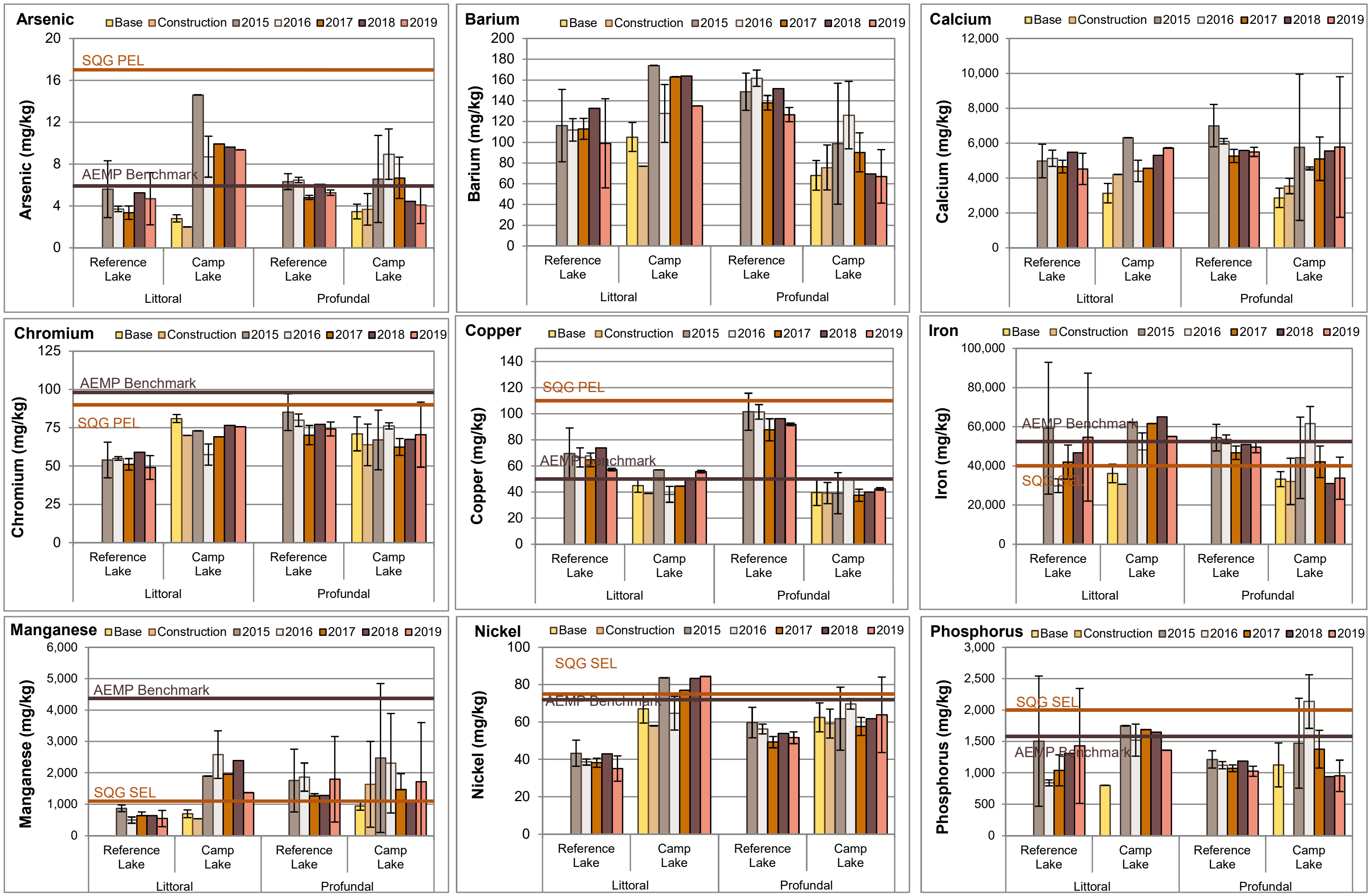


Figure 3.12: Temporal Comparison of Sediment Metal Concentrations (mean ± SD) at Littoral and Profundal Stations of Camp Lake and Reference Lake 3 for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2019) Periods, Mary River Project CREMP, 2019

concentrations were indicated at Camp Lake littoral and profundal stations following the commencement of Baffinland commercial mine operations in 2015.

3.3.3 Phytoplankton

Camp Lake chlorophyll-a concentrations showed no clear spatial gradients with distance from the CLT1 inlet to the lake outlet stations for the winter sampling event, but showed highest concentrations nearer the lake outlet in the summer and fall sampling events in 2019 (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; Appendix Table E.6). On average, chlorophyll-a concentrations at Camp Lake did not differ significantly from Reference Lake 3 in the summer sampling event, but were significantly higher at Camp Lake in the fall sampling event (Appendix Tables E.7 and E.8), suggesting greater phytoplankton abundance at Camp Lake in the fall. 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 2019 (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 2019) for seasonal data collected in winter, summer, or fall (Figure 3.14). The lack of any consistent directional changes in chlorophyll-a concentrations for any given season among years was consistent with no substantial changes in nutrient (e.g., nitrate) concentrations and water quality consistently achieving WQG at Camp Lake for the five years since mine operations commenced (Figure 3.10). No chlorophyll-a baseline (2005 to 2013) data are available for Camp Lake, precluding comparisons to conditions prior to the mine construction period.

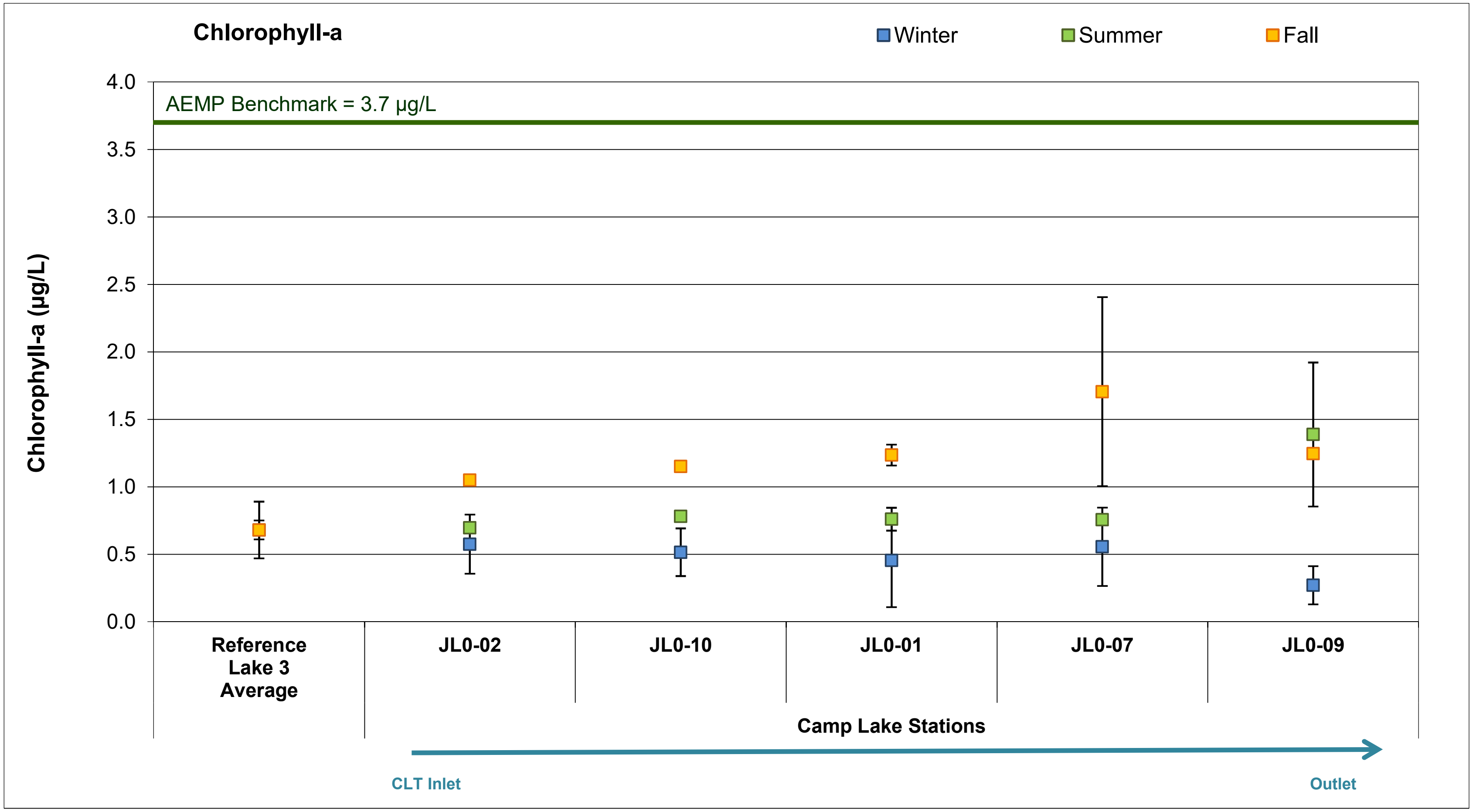


Figure 3.13: Chlorophyll a Concentrations at Camp Lake (JLO) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2019

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 2019.

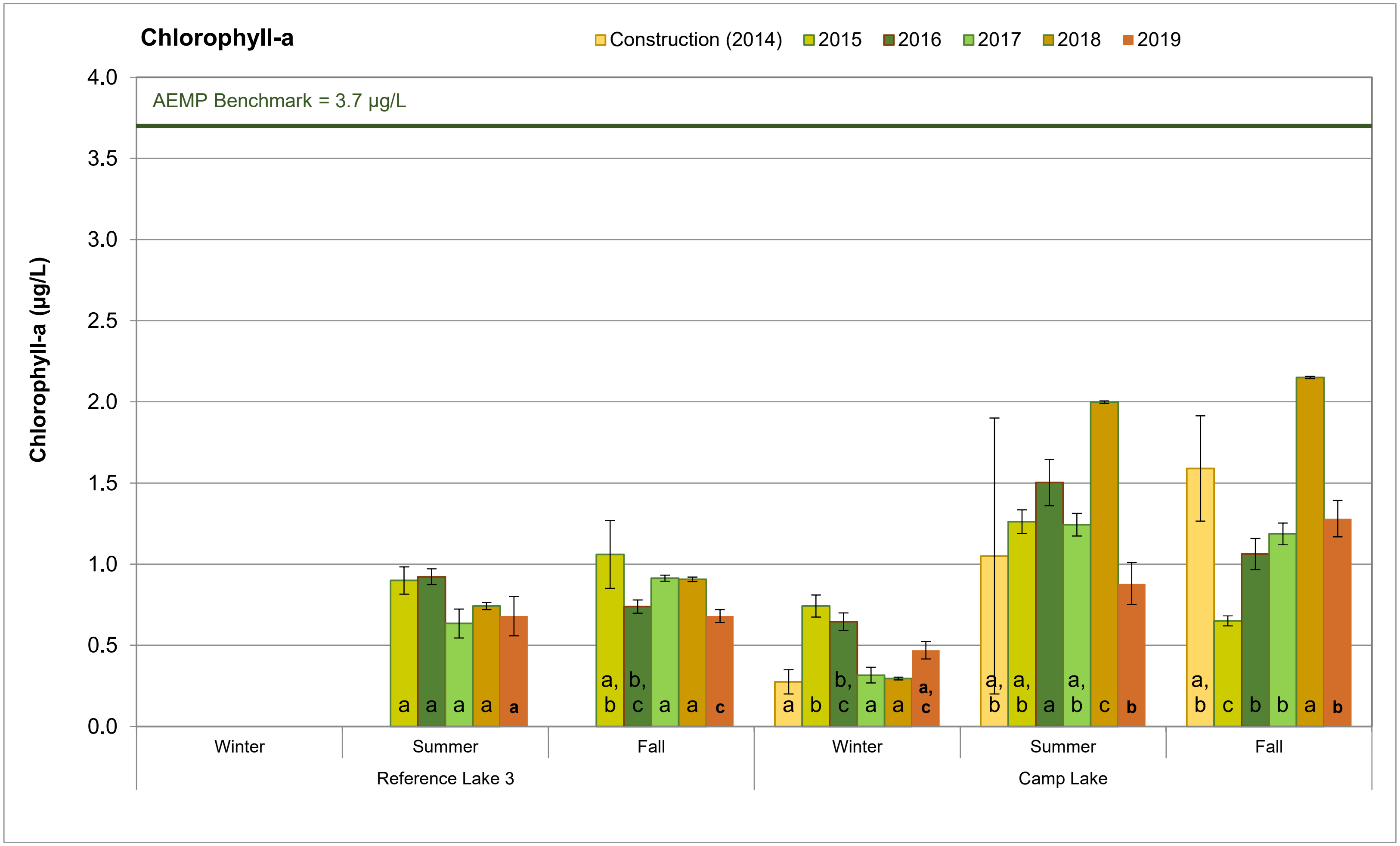


Figure 3.14: Temporal Comparison of Chlorophyll-a Concentrations Among Seasons between Camp Lake and Reference Lake 3 for Mine Construction (2014) and Operational (2015 to 2019) Periods (mean ± SE)

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

3.3.4 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 the reference lake 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). Because the relative abundance of metal-sensitive Chironomidae was significantly higher at littoral and profundal habitat of Camp Lake compared to Reference Lake 3, at magnitudes that were outside of the CES_{BIC} of ±2 SD_{REF}, the difference in benthic invertebrate community composition 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 the reference lake (Table 3.5), supporting this notion.

The key differences in benthic invertebrate community composition between lakes included significantly higher relative abundance of Chironomidae (non-biting midges) and lower relative abundance of Ostracoda (seed shrimp) at Camp Lake compared to Reference Lake 3, although the latter differed significantly only for littoral habitat (Tables 3.6 and 3.7). Ostracods are often associated with decaying organic matter (Henderson 1990), and therefore a lower relative abundance of this group at Camp Lake potentially reflected significantly lower sediment TOC content compared to the reference lake (Appendix Table F.20), which would serve as a food source for Ostracods. Ecologically meaningful differences in the relative abundance of benthic invertebrate HPG between lakes suggested that natural differences in substrate properties between Camp Lake and the reference lake may have also contributed to the differences in community composition between lakes. In addition to differing TOC content, a significantly lower moisture content was common to substrate of both littoral and profundal habitats at Camp Lake compared to Reference Lake 3 (Appendix Table F.20), suggesting that substrate at Camp Lake was more compact. 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 indicated relative to Reference Lake 3.

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 2019

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)	log10	YES	< 0.001	ANOVA	13.1	Reference Lake 3	1,247	297	133	871	1,156	1,594
						Camp Lake Littoral	5,126	1,390	621	3,685	4,568	7,240
Richness (Number of Taxa)	none	NO	0.139	ANOVA	1.2	Reference Lake 3	12.8	2.3	1.0	9.0	13.0	15.0
						Camp Lake Littoral	15.6	3.0	1.4	11.0	17.0	18.0
Simpson's Evenness (E)	none	NO	0.378	ANOVA	0.7	Reference Lake 3	0.865	0.041	0.018	0.811	0.862	0.924
						Camp Lake Littoral	0.893	0.053	0.024	0.803	0.906	0.933
Bray-Curtis Index	none	YES	< 0.001	ANOVA	5.1	Reference Lake 3	0.291	0.100	0.045	0.162	0.275	0.391
						Camp Lake Littoral	0.796	0.048	0.022	0.724	0.803	0.851
Nemata (%)	log10	NO	0.637	ANOVA	-0.5	Reference Lake 3	7.3	7.9	3.5	0.8	3.9	20.0
						Camp Lake Littoral	3.7	2.5	1.1	1.2	2.8	6.8
Ostracoda (%)	log10(x+1)	YES	< 0.001	ANOVA	-2.2	Reference Lake 3	25.1	11.0	4.9	13.8	21.8	41.8
						Camp Lake Littoral	1.3	0.8	0.4	0.0	1.2	2.1
Chironomidae (%)	none	YES	0.001	ANOVA	2.3	Reference Lake 3	62.9	12.9	5.8	48.4	71.2	73.0
						Camp Lake Littoral	92.6	3.6	1.6	87.2	92.6	97.0
Metal-Sensitive Chironomidae (%)	log10	YES	0.021	ANOVA	3.1	Reference Lake 3	10.5	7.8	3.5	4.8	6.9	24.1
						Camp Lake Littoral	34.6	16.1	7.2	8.5	41.6	50.3
Collector-Gatherers (%)	log10	YES	0.028	ANOVA	-1.5	Reference Lake 3	81.1	17.8	8.0	51.2	87.9	97.9
						Camp Lake Littoral	53.7	12.4	5.6	39.5	49.2	69.5
Filterers (%)	none	YES	0.012	ANOVA	3.9	Reference Lake 3	7.1	6.3	2.8	1.1	5.8	17.9
						Camp Lake Littoral	31.8	15.9	7.1	8.5	38.5	48.5
Shredders (%)	log10(x+1)	YES	0.055	ANOVA	-0.6	Reference Lake 3	6.5	9.5	4.2	0.0	2.9	23.2
						Camp Lake Littoral	0.4	0.6	0.3	0.0	0.0	1.3
Clingers (%)	none	YES	0.034	ANOVA	2.3	Reference Lake 3	11.9	7.9	3.5	2.1	10.0	23.3
						Camp Lake Littoral	30.1	13.9	6.2	9.1	35.3	42.0
Sprawlers (%)	log10	YES	< 0.001	ANOVA	-4.3	Reference Lake 3	74.1	8.3	3.7	60.4	75.7	81.2
						Camp Lake Littoral	38.6	5.2	2.3	33.6	36.9	45.1
Burrowers (%)	none	YES	0.029	ANOVA	2.5	Reference Lake 3	14.0	6.9	3.1	3.8	16.2	22.1
						Camp Lake Littoral	31.2	12.7	5.7	16.1	27.8	45.7

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.

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

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 2019

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)	log10	YES	< 0.001	ANOVA	17.4	Reference Lake 3	304	89	40	217	276	448
						Camp Lake Profundal	1,847	830	371	698	2,017	2,838
Richness (Number of Taxa)	log10	YES	0.013	ANOVA	2.1	Reference Lake 3	5.6	2.6	1.2	3.0	6.0	9.0
						Camp Lake Profundal	11.0	1.9	0.8	9.0	12.0	13.0
Simpson's Evenness (E)	none	NO	0.517	ANOVA	0.5	Reference Lake 3	0.534	0.174	0.078	0.278	0.584	0.701
						Camp Lake Profundal	0.615	0.206	0.092	0.389	0.645	0.919
Bray-Curtis Index	log10	YES	< 0.001	ANOVA	7.5	Reference Lake 3	0.187	0.088	0.039	0.086	0.208	0.305
						Camp Lake Profundal	0.848	0.084	0.038	0.713	0.848	0.939
Nemata (%)	log10(x+1)	NO	0.839	ANOVA	0.3	Reference Lake 3	3.6	2.7	1.2	0.0	3.3	7.6
						Camp Lake Profundal	4.4	5.7	2.5	0.0	0.8	12.7
Ostracoda (%)	none	NO	0.112	ANOVA	-0.9	Reference Lake 3	9.0	8.1	3.6	2.0	6.6	21.7
						Camp Lake Profundal	1.9	3.8	1.7	0.0	0.0	8.6
Chironomidae (%)	log10	YES	0.086	ANOVA	1.3	Reference Lake 3	82.9	6.8	3.0	75.0	82.6	93.4
						Camp Lake Profundal	91.4	7.1	3.2	82.8	90.6	99.2
Metal-Sensitive Chironomidae (%)	none	YES	0.008	ANOVA	5.1	Reference Lake 3	2.1	3.4	1.5	0.0	0.0	7.8
						Camp Lake Profundal	19.5	10.5	4.7	7.7	17.6	30.7
Collector-Gatherers (%)	none	NO	0.225	ANOVA	-0.8	Reference Lake 3	92.8	10.0	4.5	75.9	95.9	100.0
						Camp Lake Profundal	84.8	9.3	4.2	71.3	86.3	94.1
Filterers (%)	rank	YES	0.007	M-W	nc	Reference Lake 3	0.0	0.0	0.0	0.0	0.0	0.0
						Camp Lake Profundal	12.0	8.3	3.7	5.1	10.0	26.2
Shredders (%)	rank	NO	0.424	M-W	-0.4	Reference Lake 3	1.6	3.6	1.6	0.0	0.0	8.1
						Camp Lake Profundal	0.0	0.0	0.0	0.0	0.0	0.0
Clingers (%)	none	YES	0.070	ANOVA	2.0	Reference Lake 3	4.5	4.7	2.1	0.0	4.1	10.6
						Camp Lake Profundal	14.0	9.0	4.0	4.3	12.8	27.5
Sprawlers (%)	none	YES	0.027	tunequal	-6.1	Reference Lake 3	90.5	7.4	3.3	83.8	87.6	100.0
						Camp Lake Profundal	45.4	30.4	13.6	14.2	48.7	79.0
Burrowers (%)	log10(x+1)	YES	0.072	ANOVA	10.5	Reference Lake 3	5.0	3.4	1.5	0.0	5.6	8.3
						Camp Lake Profundal	40.6	37.4	16.7	2.0	34.0	81.2

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.

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

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 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 more routine significant differences in relative abundance of metal-sensitive chironomids and FFG in mine operational years compared to the 2007 baseline data for profundal habitat at Camp Lake, similar ecologically meaningful differences were not indicated for comparisons to the 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 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.

3.3.5 Fish Population

3.3.5.1 Camp Lake Fish Community

The Camp Lake fish community was represented by arctic charr (*Salvelinus alpinus*) and ninespine stickleback (*Pungitius*; Table 3.8), reflecting the same fish species composition as that observed historically at Reference Lake 3 (Minnow 2019). A higher density of arctic charr was suggested at Camp Lake compared to Reference Lake 3 based on greater electrofishing total catch-per-unit-effort (CPUE) from shallow rocky nearshore habitat and on 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 at Camp Lake in 2016 (Minnow 2017), were present at low abundance at rocky nearshore habitat of Camp Lake and were not captured at similar habitat of Reference Lake 3 in 2019 (Table 3.8). Electrofishing CPUE and gill netting CPUE for arctic charr at Camp Lake in 2019 were within the respective ranges shown during baseline studies (2005 to 2013; Figure 3.16). In addition, CPUE of arctic charr in 2019 was within the range of those observed over the previous four years of mine operation for each respective collection method (Figure 3.16). This suggested no decline in the relative

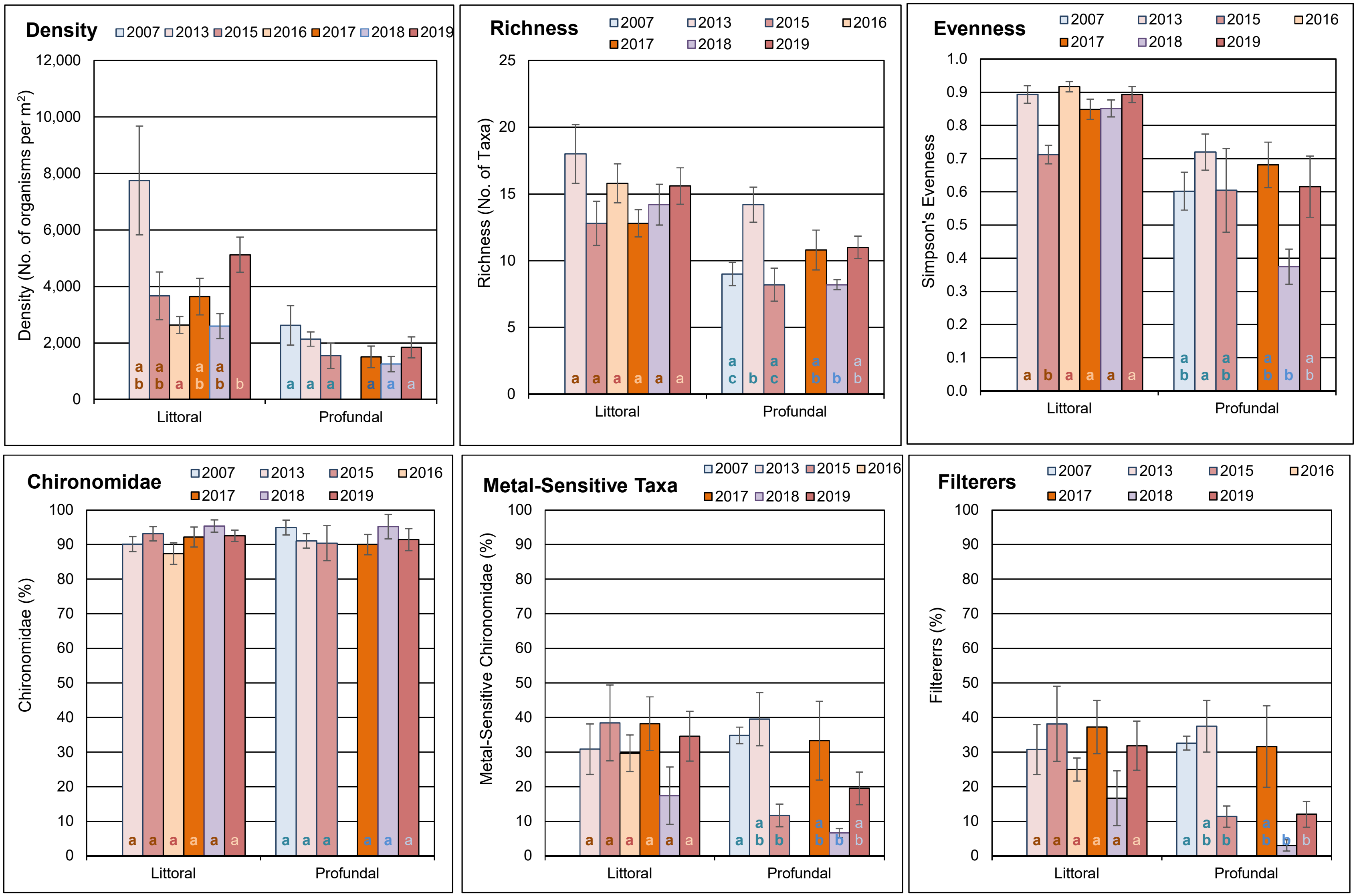


Figure 3.15: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Camp Lake Littoral and Profundal Study Areas among Mine Baseline (2007, 2013) and Operational (2015 to 2019) Periods

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

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 2019

Lake	Method [a]		Arctic Charr	Ninespine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	101	0	101	1
		CPUE	4.22	0	4.22	
	Gill netting	No. Caught	27	0	27	
		CPUE	0.33	0	0.33	
Camp Lake	Electrofishing	No. Caught	86	3	89	2
		CPUE	5.88	0.18	6.06	
	Gill netting	No. Caught	65	0	65	
		CPUE	0.85	0	0.85	

[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.

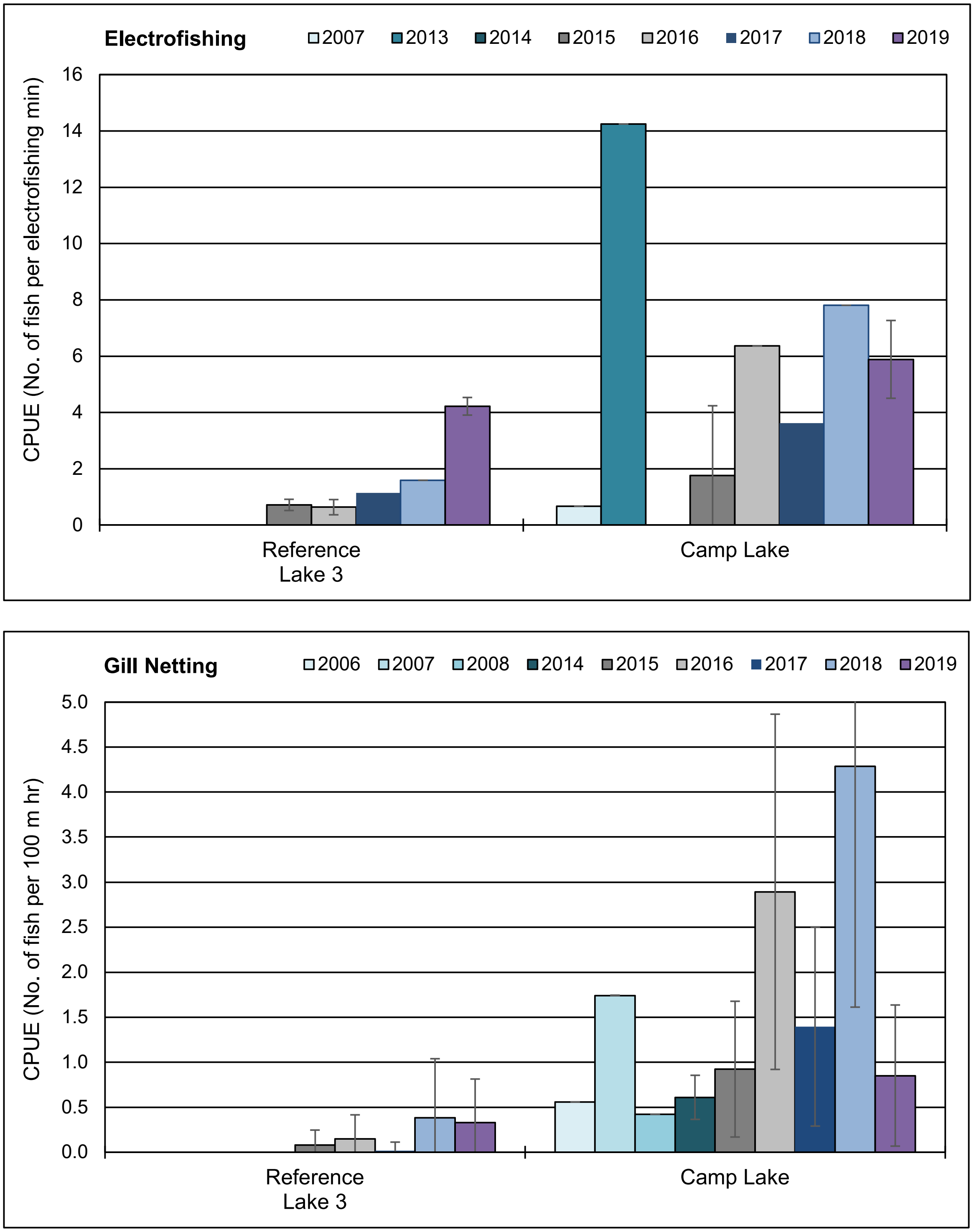


Figure 3.16: Catch-per-unit-effort (CPUE; mean ± SD) of Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Camp Lake (JLO) and Reference Lake 3 (REF3), Mary River Project CREMP, 2006 to 2019

Note: Data presented for fish sampling conducted in fall during baseline (2006, 2007, 2008, 2013), construction (2014) and operational (2015 to 2019) mine phases.

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.

3.3.5.2 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 2019 data from Camp Lake and Reference Lake 3, as well as a before-after analysis using Camp Lake 2019 and baseline (2013) data. A total of 86 and 101 arctic charr were sampled at nearshore habitat of Camp Lake and Reference Lake 3, respectively, in August 2019, 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) and historical evaluations. Due to an absence of arctic charr YOY captured at Camp Lake, fish population comparisons focused only on non-YOY individuals.

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 no YOY and smaller size range of individuals captured at Camp Lake (Figure 3.17). Non-YOY arctic charr captured at the Camp Lake nearshore were significantly longer (10%) and heavier (29%) than those captured at the reference lake nearshore (Table 3.9; Appendix Table G.6). Condition (i.e., weight-at-length relationship) of non-YOY arctic charr was significantly lower at Camp Lake than at the reference lake, although the magnitude of this difference was within the condition Critical Effect Size of ±10% (referred to herein as CES_C), suggesting that this difference was not ecologically significant (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 the reference lake.

Temporal comparisons of the Camp Lake nearshore non-YOY arctic charr data indicated significantly different length-frequency distribution between the 2019 study and the 2013 baseline study (Table 3.9). Non-YOY arctic charr captured at the nearshore of Camp Lake in 2019 did not differ significantly in length or weight, but had lower condition (-11%) than those captured during the 2013 baseline study (Table 3.9; Appendix Table G.7). Similar differences in nearshore

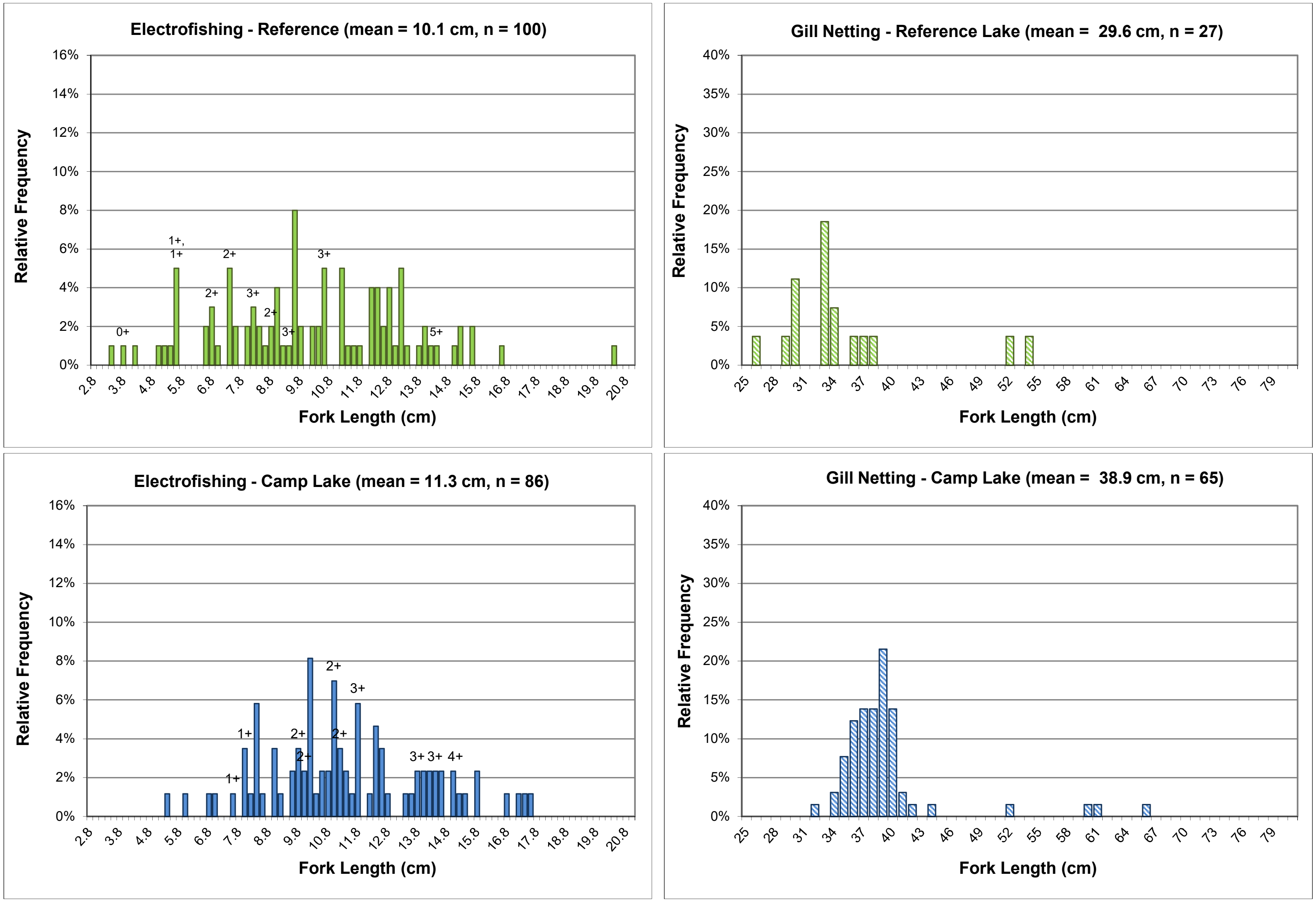


Figure 3.17: Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Camp Lake (JLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2019

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 2019, 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	2019	2015	2016	2017	2018	2019
Nearshore Electrofishing	Survival	Length-Frequency Distribution	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**
		Age	No	No	No	-	-	-	-	-	-	-
	Energy Use (non-YOY)	Size (mean fork length)	**Yes (+41%)**	No	**Yes (+17%)**	**Yes (+40%)**	**Yes (+10%)**	**Yes (-15%)**	**Yes (-32%)**	**Yes (- 35%)**	**Yes (-28%)**	No
		Size (mean weight)	**Yes (+176%)**	No	**Yes (+51%)**	**Yes (+135%)**	**Yes (+29%)**	**Yes (-42%)**	**Yes (-71%)**	**Yes (-74%)**	**Yes (-56%)**	No
	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	No	**Yes (-6%)**	No	**Yes (-14%)**	**Yes (-7%)**	**Yes (-6%)**	**Yes (-10%)**	**Yes (-10%)**	**Yes (- 9%)**	**Yes (- 11%)**
Littoral/Profundal Gill Netting [c]	Survival	Length Frequency Distribution	-	-	-	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
		Age	-	-	-	-	-	**Yes (+48%)**	**Yes (+58%)**	**Yes (+ 46%)**	-	-
	Energy Use	Size (mean fork length)	-	-	-	**Yes (+10%)**	**Yes (+28%)**	**Yes (+6%)**	No	**Yes (+12%)**	**Yes (+15%)**	**Yes (+17%)**
		Size (mean weight)	-	-	-	**Yes (+46%)**	**Yes (+130%)**	No	No	**Yes (+37%)**	**Yes (+46%)**	**Yes (+44%)**
	Energy Storage	Condition (body weight-at-fork length)	-	-	-	**Yes (+12%)**	**Yes (+6%)**	No	**Yes (-3%)**	No	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.

non-YOY arctic charr condition were indicated at Camp Lake from 2015 to 2018 compared to the 2013 baseline data (Table 3.9). In all studies from 2015 to 2019, the magnitude of difference in non-YOY arctic charr condition compared to the 2013 baseline data was near 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 the upper 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 2019, 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 significantly lower condition in 2019 compared to all previous years from 2015 to 2018, the magnitude of difference in size of which was well outside of the CES_S of ±25% (Appendix Table B.12). This suggested that year-to-year variability in size and condition of nearshore arctic charr can be naturally high at local study area lakes, and also that larger arctic charr naturally exhibit significantly lower condition than smaller fish.

Littoral/Profundal Arctic Charr

Mine-related influences on the Camp Lake littoral/profundal arctic charr population (i.e., fish captured by gill netting) were assessed based on a control-impact analysis using 2019 data from Camp Lake and Reference Lake 3, as well as a before-after analysis of Camp Lake 2019 versus baseline (combined 2006, 2007, and 2008) data. A total of 65 and 27 arctic charr were sampled from littoral/profundal habitat of Camp Lake and Reference Lake 3, respectively, in August 2019, 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 (28%) and heavier (130%) than those captured at the reference lake (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, but within an ecologically meaningful absolute magnitude of 10%, compared to those sampled at the reference lake (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 2019 compared to the combined baseline data set (i.e., 2006, 2007, and 2008 studies; Table 3.9). Although fork length and fresh body weight were significantly greater for arctic charr captured at Camp Lake in 2019 compared to the baseline period, no significant difference in condition was indicated between 2019 and the baseline period at Camp Lake (Table 3.9). The 2019 comparisons to baseline conditions were generally consistent with those of the four 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.

3.3.6 Integrated Summary of Effects

Potential mine-related influences on water quality of Camp Lake in 2019 included slightly elevated chloride, manganese, nitrate, and uranium concentrations compared to the reference lake, as well as slightly higher conductivity, hardness, and concentrations of chloride, manganese, molybdenum, sodium, strontium, sulphate, and uranium since mine operations commenced. In part, these influences may be related to inputs of suspended material to Camp Lake through fugitive dust and/or runoff sources, but concentrations nonetheless remained within the upper range of baseline conditions. In addition, parameter concentrations at Camp Lake were consistently well below WQG and AEMP benchmarks from 2015 to 2019.[9] In sediment of Camp Lake, concentrations of metals at littoral and profundal stations were comparable to concentrations in sediment at like-habitat stations of the reference lake in 2019, and only a slight elevation in the concentration of arsenic was indicated at the single Camp Lake littoral station in 2019 compared to the baseline period. Although spatial analysis was limited by the collection of sediment chemistry from only a single littoral station at Camp Lake under the AEMP, elevated arsenic concentrations at this station suggested that mine-influenced flow from CLT1 was likely the source. 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 the reference lake indicating natural elevation of these metals in sediments of regional lakes. Within Camp Lake, arsenic, copper, iron, and nickel concentrations were above AEMP benchmarks at the lone littoral station, as were arsenic, copper, and nickel concentrations in sediment at some profundal stations in 2019. Average concentrations of copper and iron were also above the Camp Lake AEMP benchmarks in littoral and/or 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 concentrations in sediment of Camp Lake. However, concentrations of these parameters generally remained below applicable water or sediment quality guidelines from 2015 to 2019, suggesting limited potential for adverse effects to biota of Camp Lake.

[9] Total phenol and phosphorus concentrations were reported as above WQG near the bottom of the water column at two stations at Camp Lake in 2018, as were total copper and phosphorus concentrations at two stations at Camp Lake in fall 2019, but all appeared to be anomalies (see Section 3.3.2).

Camp Lake chlorophyll-a concentrations were significantly higher than at the reference lake in fall 2019, suggesting greater primary production at Camp Lake at least on a seasonal basis. 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 no substantial changes in chlorophyll-a concentrations in 2019 compared to previous years of mine operation, and no changes to the trophic status of Camp Lake since mine operations commenced. Significantly higher benthic invertebrate density at Camp Lake and subtle differences in community composition compared to the reference lake in 2019 appeared to be related to naturally lower sediment TOC content and higher substrate compactness at Camp Lake. In addition, an ecologically meaningful higher relative abundance of metal-sensitive Chironomidae was indicated at Camp Lake compared to the reference lake in 2019, suggesting that the differences in community composition between lakes were unlikely related to the mine operation. An absence of any consistent ecologically significant differences in benthic invertebrate density, richness, Simpson's Evenness, and relative abundance of dominant taxonomic groups and FFG between individual years of mine operation from 2015 to 2019 and baseline (2007, 2013) at littoral and profundal areas of Camp Lake further corroborated no adverse mine-related influences to the benthic invertebrate community of Camp Lake since mine operations commenced in 2015.

Analysis of Camp Lake arctic charr populations suggested greater fish abundance compared to the reference lake in 2019, and no decline in the numbers of arctic charr in 2019 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 2019, as well as to those captured at Camp Lake during the mine baseline studies, the magnitude of these differences were near the upper 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 the reference lake, 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

Dissolved oxygen (DO) concentrations were consistently near full saturation at each of the Sheardown Lake tributaries during spring, summer, and fall monitoring events in 2019 (Appendix Tables C.1 to C.3; Figure 4.1). Dissolved oxygen concentrations at Sheardown Lake Tributary 1 (SDLT1) and Sheardown Lake Tributary 12 (SDLT12) did not differ significantly from those at Unnamed Reference Creek during the August 2019 biological study (Figure 4.1). Although DO concentrations were significantly lower at Sheardown Lake Tributary 9 (SDLT9) than at Unnamed Reference Creek, the DO concentrations at SDLT9, and both other Sheardown Lake tributaries, were well above the WQG minimum for supporting sensitive life stages of cold-water biota (i.e., 9.5 mg/L) during the August 2019 biological study (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 2019 biological study (Figure 4.1). Despite minor differences in pH among the Sheardown Lake tributaries, pH was consistently within WQG limits at each of the Sheardown Lake tributaries 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 the August 2019 biological study (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 potential 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, and concentrations of cadmium, chloride, copper, molybdenum, nitrate, potassium, sulphate, and total uranium were elevated (i.e., ≥3-fold) at both 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, with the exceptions of cadmium and nitrate, which showed highest elevation in summer and fall, respectively (Appendix Tables C.34 and C.35). In addition to the parameters listed above, alkalinity and concentrations of barium, manganese, nickel, sodium, strontium, and zinc were also elevated at the lower SDLT1 station

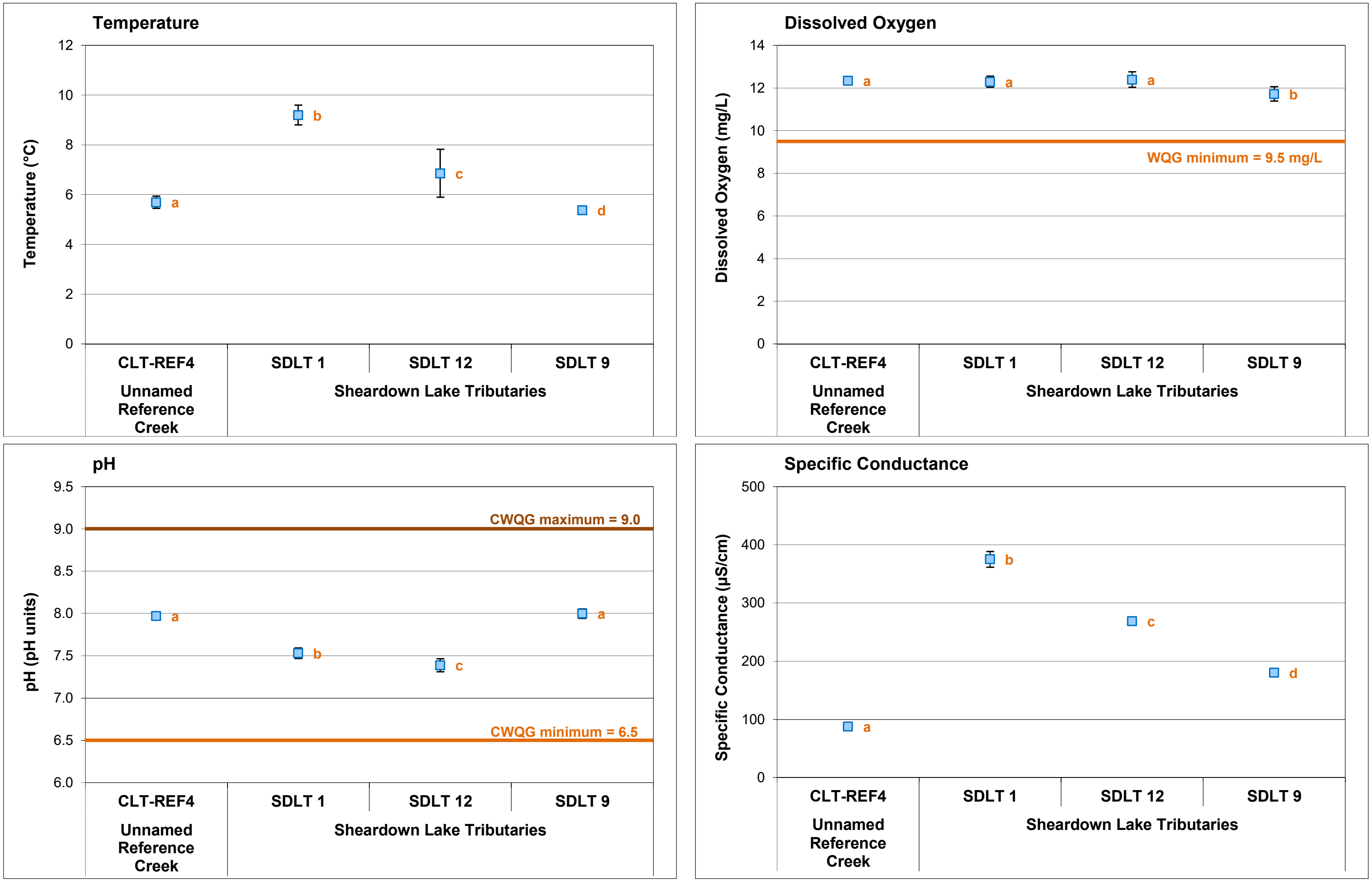


Figure 4.1: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Sheardown Lake Tributaries (SDLT) and Unnamed Reference Creek Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2019

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

compared to respective mean concentrations from the reference creek stations, with the highest magnitude of elevation occurring in the spring for each of these parameters (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 zinc were elevated at SDLT1 compared to respective average concentrations from the reference creek stations in at least two of the three seasonal sampling events in 2019, which strongly suggested 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 2019 (Table 4.1; Appendix Table C.34). Phenol concentrations were also above WQG at the upper-most station of SDLT1 at the time of the spring sampling event in 2019 (Appendix Table C.34). Phenol concentrations similar to those observed at SDLT1 and above WQG also occurred at reference creek, river, and lake locations in 2019 (Appendix Tables B.2 to B.4), suggesting a natural source of phenols to, or within, waterbodies that was unrelated to mine operations.

Temporal comparisons of SDLT1 water chemistry data indicated that many of the parameters shown to have concentrations elevated compared to those at the reference creek stations were also elevated in 2019 compared to the baseline period. At upper SDLT1, concentrations of molybdenum, sodium, sulphate, and uranium were elevated in 2019 compared to baseline conditions only during the spring sampling event (Appendix Table C.35). At lower SDLT1, conductivity, hardness, and concentrations of manganese, nitrate, sodium, strontium, sulphate, TDS, uranium, and zinc were elevated in at least one sampling season in 2019 compared to respective concentrations during the mine baseline (Appendix Table C.35; Appendix Figure C.9; Figure 4.2). Notably, total copper concentrations at SDLT1 in 2019 were generally comparable to those during the baseline period (Appendix Table C.35; Appendix Figure C.9), 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 lower 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 2019 (Figure 4.3). Ammonia, nitrate, phosphorus, and TKN concentrations were consistently higher near the mouth

Table 4.1: Water Chemistry at Sheardown Lake Tributary 1 (SDLT1) Monitoring Stations, Mary River Project CREMP, Fall 2019

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Bench-mark[b]	Reference Creek Average (n = 4) Fall 2019	Sheardown Lake Tributary 1 D1-05 (Upper) 19-Aug-2019	Sheardown Lake Tributary 1 D1-00 (Lower) 19-Aug-2019
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	168	230	375
	pH (lab)	pH	6.5 - 9.0	-	8.09	7.93	8.05
	Hardness (as $CaCO_3$)	mg/L	-	-	81	118	194
	Total Suspended Solids	mg/L	-	-	<2.0	<2.0	<2.0
	Total Dissolved Solids	mg/L	-	-	92	152	253
	Turbidity	NTU	-	-	4.82	0.36	0.66
	Alkalinity (as $CaCO_3$)	mg/L	-	-	67	92	122
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.011	<0.010	<0.010
	Nitrate	mg/L	3	3	0.029	0.254	1.320
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen	mg/L	-	-	<0.15	0.17	0.29
	Total Organic Carbon	mg/L	-	-	1.7	2.7	3.2
	Total Phosphorus	mg/L	0.030^{α}	-	0.0053	<0.0030	0.0033
	Phenols	mg/L	0.004^{α}	-	0.0021	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	7.7	5.8	11.0
	Sulphate (SO_4)	mg/L	218^{β}	218	9.0	17.9	55.7
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	***0.208***	0.010	0.013
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	0.00011	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0117	0.0122	0.0182
	Boron (B)	mg/L	1.5	-	<0.010	0.013	0.016
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	0.000039	0.000018
	Calcium (Ca)	mg/L	-	-	16.6	21.5	34.0
	Chromium (Cr)	mg/L	0.0089	0.00856	0.00062	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	0.00012	<0.00010	0.0001
	Copper (Cu)	mg/L	0.002	0.0022	0.0011	***0.0028***	0.0021
	Iron (Fe)	mg/L	0.30	0.326	0.143	<0.030	0.134
	Lead (Pb)	mg/L	0.001	0.001	0.00015	<0.000050	<0.000050
	Magnesium (Mg)	mg/L	-	-	9.53	14.8	25.5
	Manganese (Mn)	mg/L	0.935^{β}	-	0.00198	0.00084	0.00791
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00053	0.00467	0.00332
	Nickel (Ni)	mg/L	0.025	0.025	0.0006	0.0011	0.0016
	Potassium (K)	mg/L	-	-	1.14	2.82	3.03
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	1.23	1.39	1.74
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	3.53	2.61	4.80
	Strontium (Sr)	mg/L	-	-	0.0199	0.0150	0.0237
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010
	Uranium (U)	mg/L	0.015	-	0.00551	0.00802	0.00651
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	0.0070	<0.0030	0.0158

[shaded] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

[a] Canadian Water Quality Guideline except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]) and β (British Columbia Water Quality Guideline [BCWQG]). 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 Camp Lake Tributaries.

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 2019) 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.

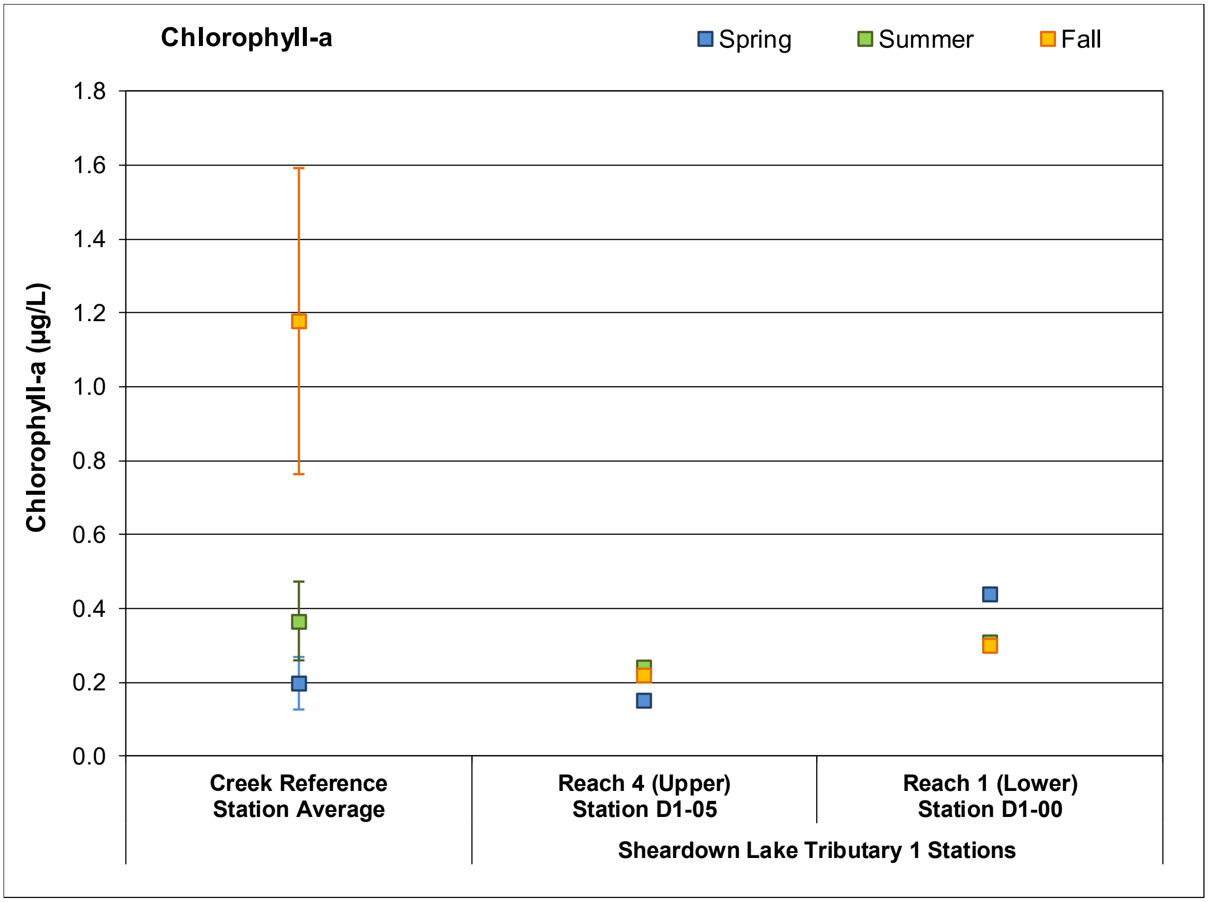


Figure 4.3: Chlorophyll-a Concentrations at Sheardown Lake Tributary 1 Phytoplankton Monitoring Stations, Mary River Project CREMP, 2019

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

of SDLT1 in 2019 (Appendix Table C.34), and thus higher chlorophyll-a concentrations near the mouth was in line with typical responses of phytoplankton to higher nutrient concentrations. Chlorophyll-a concentrations at SDLT1 were within the range of variability observed among reference creeks in spring and summer sampling events, but were considerably lower at SDLT1 compared to the reference creeks in the fall sampling event (Figure 4.3). Although the latter may have reflected a mine-related influence on phytoplankton abundance occurring seasonally at lower SDLT1, chlorophyll-a concentrations were unusually high at the reference creeks in the fall of 2019 compared to previous years, and thus may not reflect the norm. For all sampling events in 2019, 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 2019 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 2019 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 2019) periods (Figure 4.4). These results suggested no adverse mine-related influences on phytoplankton productivity at SDLT1 over the initial five years of mine operation.

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 Simpson's Evenness and significant differences in composition (as indicated by Bray-Curtis Index) compared to Unnamed Reference Creek in 2019 (Figure 4.5; Appendix Table F.30). The only difference in dominant taxonomic groups was an ecologically significant greater relative abundance of Oligochaeta (aquatic worms) at SDLT1 compared to Unnamed Reference Creek (Figure 4.5; Appendix Table F.30). Notably, the relative abundance of metal-sensitive Chironomidae did not differ significantly between SDLT1 and Unnamed Reference Creek, suggesting that metal concentrations were not biologically available and/or were not a large contributor to differences in community composition at SDLT1 compared to Unnamed Reference Creek. This result was consistent with concentrations of all metals below WQG at SDLT1 in 2019, with the exception of copper (see Appendix Table C.34). No significant differences in the relative abundance of any FFG or HPG were indicated between SDLT1 and Unnamed Reference Creek (Figure 4.5; Appendix Table F.30), suggesting no adverse influences on food resource base for benthic invertebrates at SDLT1, and that physical habitat alteration from factors such as sedimentation had not substantially affected benthic invertebrate community composition at SDLT1 relative to reference conditions.

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 2019) compared to baseline studies conducted in both 2008 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 over the years of mine operation compared to baseline at SDLT1 (Appendix Tables F.31 and F.32). The absence of any consistent, ecologically significant differences in benthic

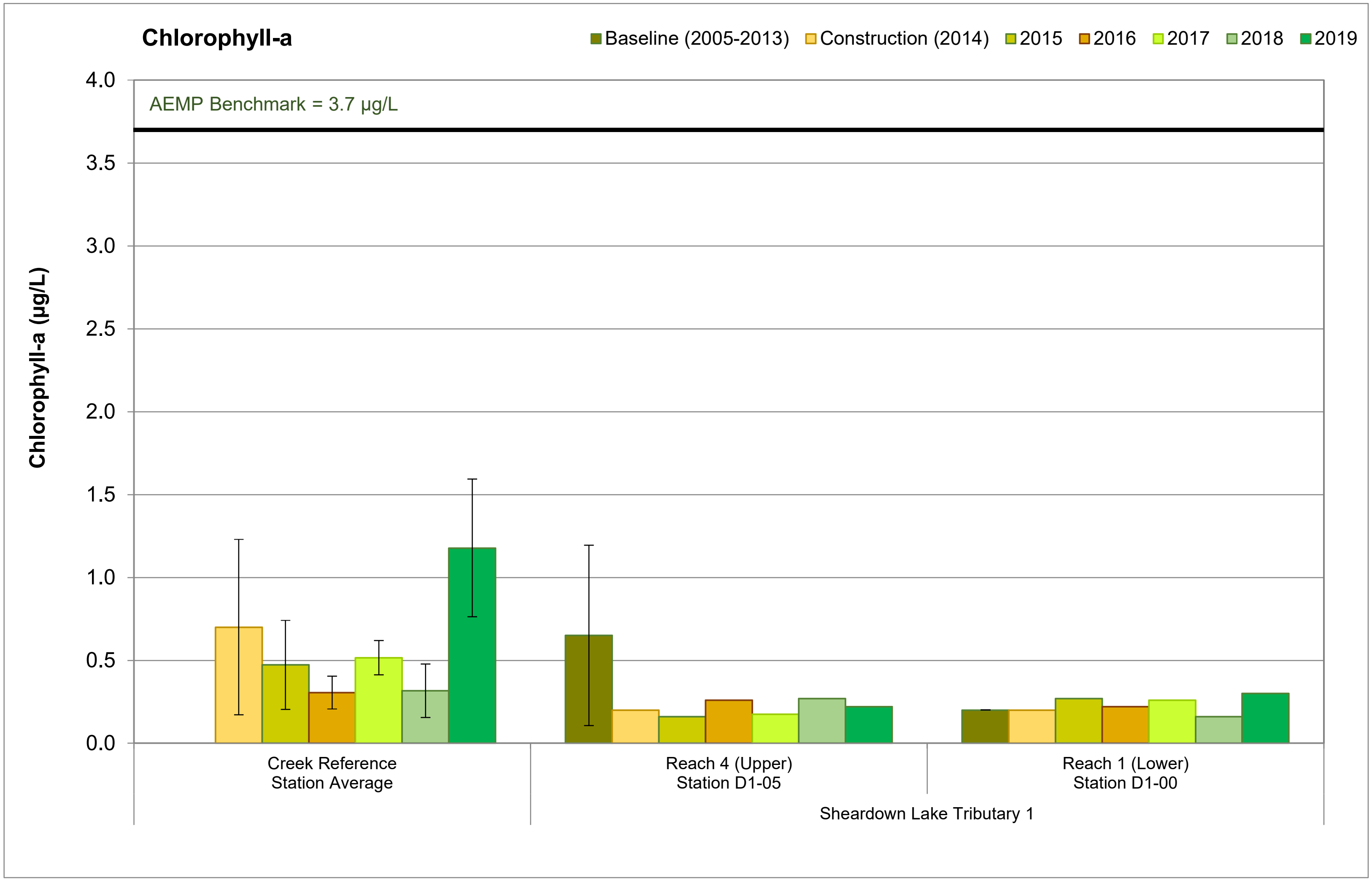


Figure 4.4: Temporal Comparison of Chlorophyll-a Concentrations at Sheardown Lake Tributary 1 for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2019) Periods in the Fall, Mary River Project CREMP

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

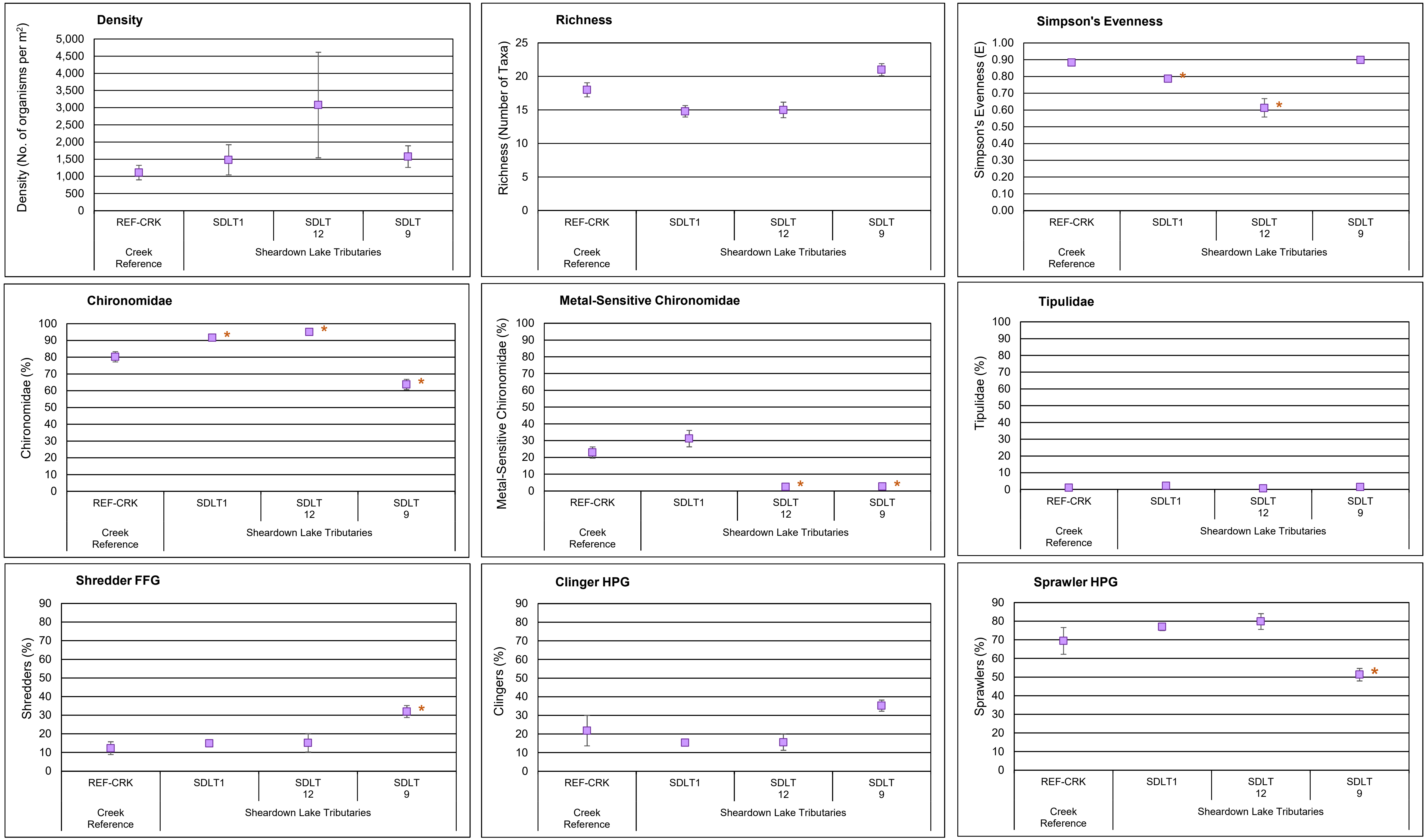


Figure 4.5: **Comparison of Benthic Invertebrate Community Metrics between Sheardown Lake Tributary and Unnamed Reference Creek Study Areas (mean ± SE), Mary River Project CREMP, August 2019**

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

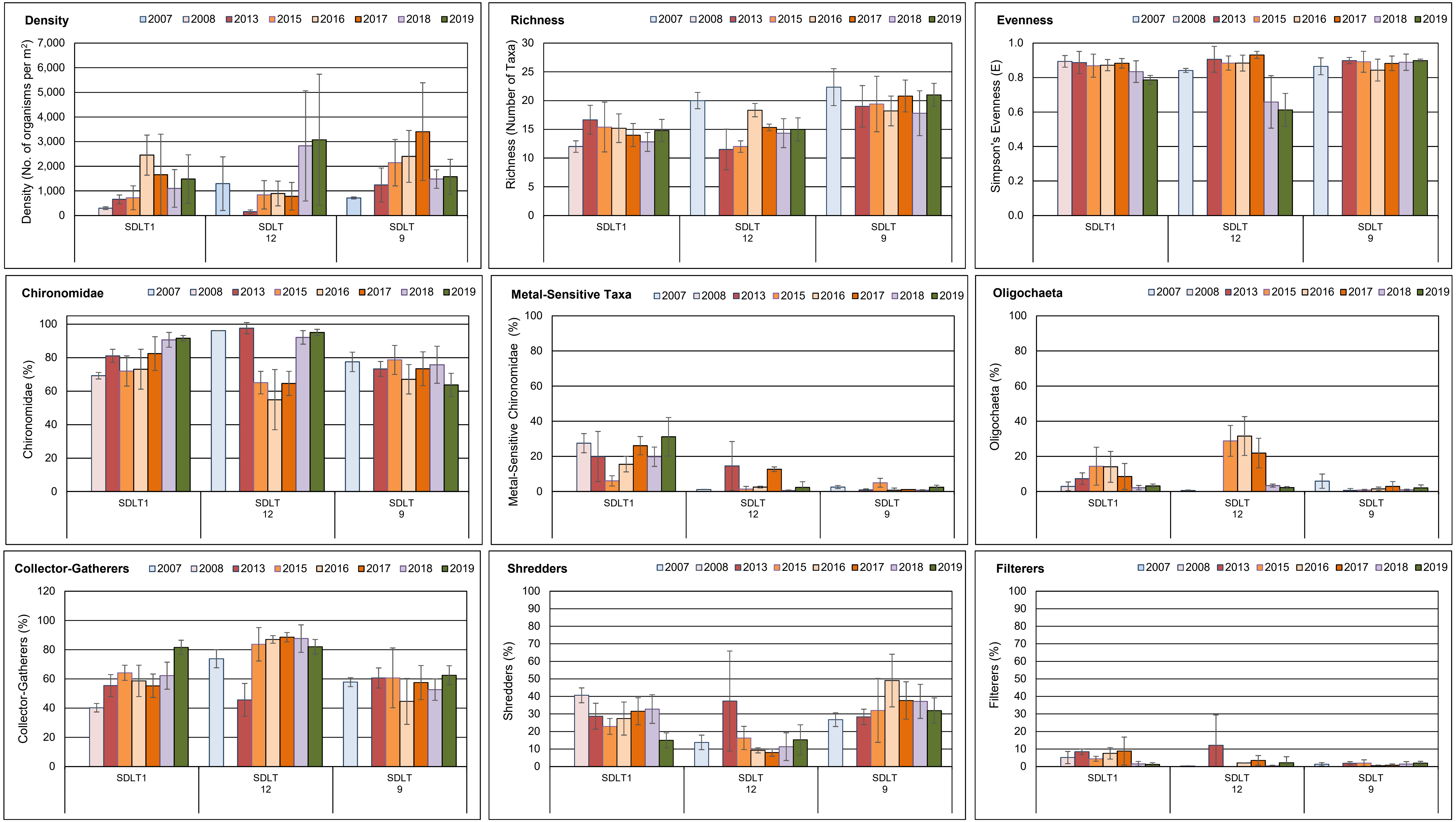


Figure 4.6: **Comparison of Benthic Invertebrate Community Metrics (mean ± SD) at Sheardown Lake Tributaries 1, 12, and 9 among Mine Operational (2015 to 2019) and Baseline (2007, 2008, 2013) Studies for the Mary River Project CREMP**

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 mine operations in 2015.

4.1.3.2 Sheardown Lake Tributary 12 (SDLT12)

The benthic invertebrate community at SDLT12 exhibited significantly lower Simpson's Evenness compared to Unnamed Reference Creek in 2019 (Figure 4.5; Appendix Table F.30). This difference 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 Simpson's Evenness indicated above. Differences in community composition were indicated between SDLT12 and Unnamed Reference Creek based on significant differences in Bray-Curtis Index, which reflected significantly higher relative abundance of Chironomidae but lower relative abundance of metal-sensitive Chironomidae at SDLT12 (Figure 4.5; Appendix Table F.30). However, no significant differences in the relative abundance of any FFG or HPG were indicated between SDLT12 and Unnamed Reference Creek (Figure 4.5; Appendix Table F.30), suggesting no mine-related influences on the food resource base for benthic invertebrates or on habitat from factors such as sedimentation at SDLT12 .

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). No consistent, on-going differences in relative abundance of dominant taxonomic groups or FFG were indicated between mine operational years and baseline (Appendix Table F.33), suggesting no adverse influences of the mine on community structure or food resources available to biota of SDLT12. In addition, the relative abundance of metal-sensitive chironomids did not differ significantly between most years of mine operation and baseline, suggesting that metals were largely biologically unavailable and/or did not account for lower richness at SDLT12 over time.

4.1.3.3 Sheardown Lake Tributary 9 (SDLT9)

The benthic invertebrate community of Sheardown Lake Tributary 9 (SDLT9) exhibited no significant differences in density, richness, and Simpson's Evenness, but differed significantly in community composition as indicated through Bray-Curtis Index compared to Unnamed Reference Creek in 2019 (Figure 4.5; Appendix Table F.30). The key differences in dominant taxonomic groups included significantly lower relative abundance of Chironomidae, including metal-sensitive representatives, at SDLT9 compared to reference conditions at magnitudes of difference of which were 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 possibly contributed to the differing benthic invertebrate community composition between watercourses as indicated by significant differences in FFG composition between SDLT9 and Unnamed Reference Creek. For instance, the relative abundance of the shredder FFG was significantly higher at SDLT9 compared to the reference creek, and was consistent with field observations of greater amounts of rooted in-stream vegetation, the primary food source for shredders, at SDLT9 compared to the reference creek (Appendix Tables F.24 and 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, dominant taxonomic groups, or FFG at SDLT9 between data collected from the 2015 to 2019 mine operational years and baseline period data collected in both 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 2019 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 of Effects

At Sheardown Lake Tributary 1 (SDLT1), aqueous concentrations of several parameters were elevated compared to average concentrations observed at the reference creek stations in 2019. Of those parameters that were elevated compared to reference conditions, conductivity, hardness, and concentrations of manganese, molybdenum, nitrate, sodium, strontium, sulphate, TDS, uranium and zinc were also elevated at SDLT1 in 2019 compared to the baseline period, suggesting a potential mine-related influence on aqueous concentrations of these parameters at SDLT1. Nevertheless, with the exception of naturally elevated concentrations of copper, no parameters were present at concentrations above WQG or AEMP benchmarks at SDLT1 in 2019. Chlorophyll-a concentrations at SDLT1 were greater near the creek mouth than at the upper reaches, and appeared to correspond with higher nutrient concentrations near the creek mouth. However, chlorophyll-a concentrations at SDLT1 were within the range of variability observed among the reference creeks except during the fall sampling events, potentially reflecting a seasonal mine influence on phytoplankton abundance. Because chlorophyll-a concentrations were similar between 2019 and the baseline period, no clear change to trophic status was indicated at SDLT1 since the commencement of mine operations in 2015. Significantly lower benthic invertebrate Simpson's Evenness and significant differences in community structure were indicated at SDLT1 in 2019 compared to Unnamed Reference Creek. However, no ecologically significant differences in the relative abundance of metal-sensitive taxa, FFG, or HPG were indicated between SDLT1 and Unnamed Reference Creek in 2019, nor were any consistent ecologically significant differences in primary benthic metrics, dominant taxonomic groups, or FFG shown for individual years of mine operation (2015 to 2019) compared to baseline studies conducted in 2008 and 2013. Therefore, no adverse influences on benthic invertebrates, including food resources and habitat available to benthic invertebrates, were indicated at SDLT1. Overall, similar to the findings of the four previous CREMP studies, no adverse mine-related effects to biota of SDLT1 were indicated in 2019 based on the chlorophyll-a and benthic invertebrate community data analyses.

At Sheardown Lake Tributary 12 (SDLT12), lower Simpson's Evenness and differences in benthic invertebrate community composition compared to the reference creek were consistent with a difference in habitat between watercourses that most notably included lower water velocity at SDLT12. No significant differences in organism density and relative abundance of FFG were indicated between SDLT12 and the reference creek in 2019, and no consistent differences in these endpoints or in the relative abundance of dominant taxonomic groups including metal-sensitive chironomids were indicated between mine operational years and baseline at SDLT12. This indicated no adverse mine-related influences on the food resource base for benthic invertebrates, on habitat from factors such as sedimentation, or direct influences on benthic invertebrates related to metal concentrations at SDLT12 in 2019 and since mine operations commenced in 2015.

At Sheardown Lake Tributary 9 (SLDT9), significant differences in community structure were indicated in 2019 compared to Unnamed Reference Creek. However, a significantly greater relative abundance of shredders 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 2019 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 mine operation in 2015.

4.2 Sheardown Lake Northwest (DLO-1)

4.2.1 Water Quality

Water quality profiles of *in situ* water temperature, dissolved oxygen, pH, and specific conductance conducted at Sheardown Lake NW in 2019 showed no substantial station-to-station differences during any of the winter, summer, or fall sampling events (Appendix Figures C.11 to C.14). Distinct thermal stratification was indicated at Sheardown Lake NW during the summer and fall sampling events in 2019, the epilimnion of which occurred to a depth of approximately 9 m and the hypolimnion established at depths greater than approximately 13 m (Figure 4.7). Reference Lake 3 also showed development of thermal stratification in summer and fall of 2019 (Figure 4.7). The average water temperature at the bottom of the water column at Sheardown Lake NW littoral stations was significantly warmer than at Reference Lake 3 during the August 2019 biological study, but no differences in bottom water temperature were indicated between lakes at profundal sampling depths (Figure 4.8). Dissolved oxygen profiles at Sheardown Lake NW showed a distinct oxycline at depths greater than approximately 4 m during the winter, and 9 m in summer and fall, that appeared to initiate at the bottom of the epilimnion and mirrored similar oxycline development at Reference Lake 3 (Figure 4.7; Appendix Figure C.12). Dissolved oxygen concentrations near the bottom of the water column were significantly higher at Sheardown Lake NW littoral and profundal stations than like habitat stations at Reference Lake 3 during the August 2019 biological study (Figure 4.8). Notably, dissolved oxygen concentrations were above the WQG of 9.5 mg/L at Sheardown Lake NW during the August 2019 biological monitoring period in 2019 (Figure 4.8; Appendix Table C.40).

Water column profiles showed decreasing pH with increased depth at Sheardown Lake NW and Reference Lake 3 in 2019, with the changes in pH through the water column at both lakes appearing to coincide with changes in water temperature and, to a lesser extent, DO saturation levels (Figure 4.7). The pH near the bottom at littoral and profundal stations of Sheardown Lake NW were significantly higher than at respective habitats at the reference lake during the August 2019 biological study (Figure 4.8). However, the mean incremental difference in bottom pH between lakes was less than a pH unit, and pH values were consistently within WQG limits at Sheardown Lake NW (Figure 4.8, Appendix Table C.42), suggesting that the pH difference between lakes was not ecologically meaningful. Specific conductance profiles at Sheardown Lake NW showed a distinct step-change with depth that was clearly linked to the changes in water temperature through the water column each season (Figure 4.7). Specific conductance near the bottom of the water column was significantly higher at Sheardown Lake NW littoral and profundal stations compared to the reference lake (Figure 4.8; Appendix Table C.42). Water clarity, as

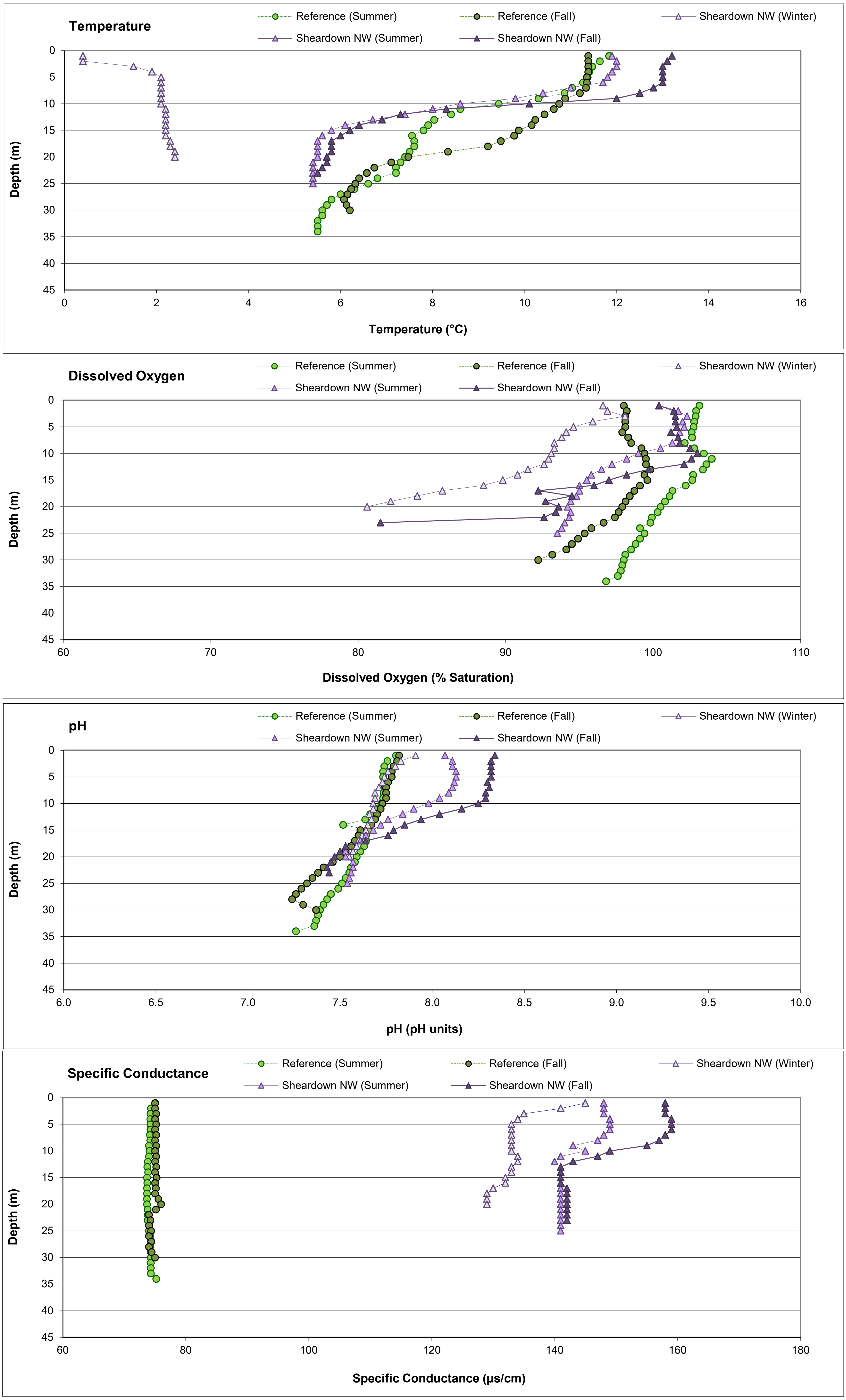


Figure 4.7: Average *In Situ* Water Quality with Depth from Surface at Sheardown Lake NW (DLO-01) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2019

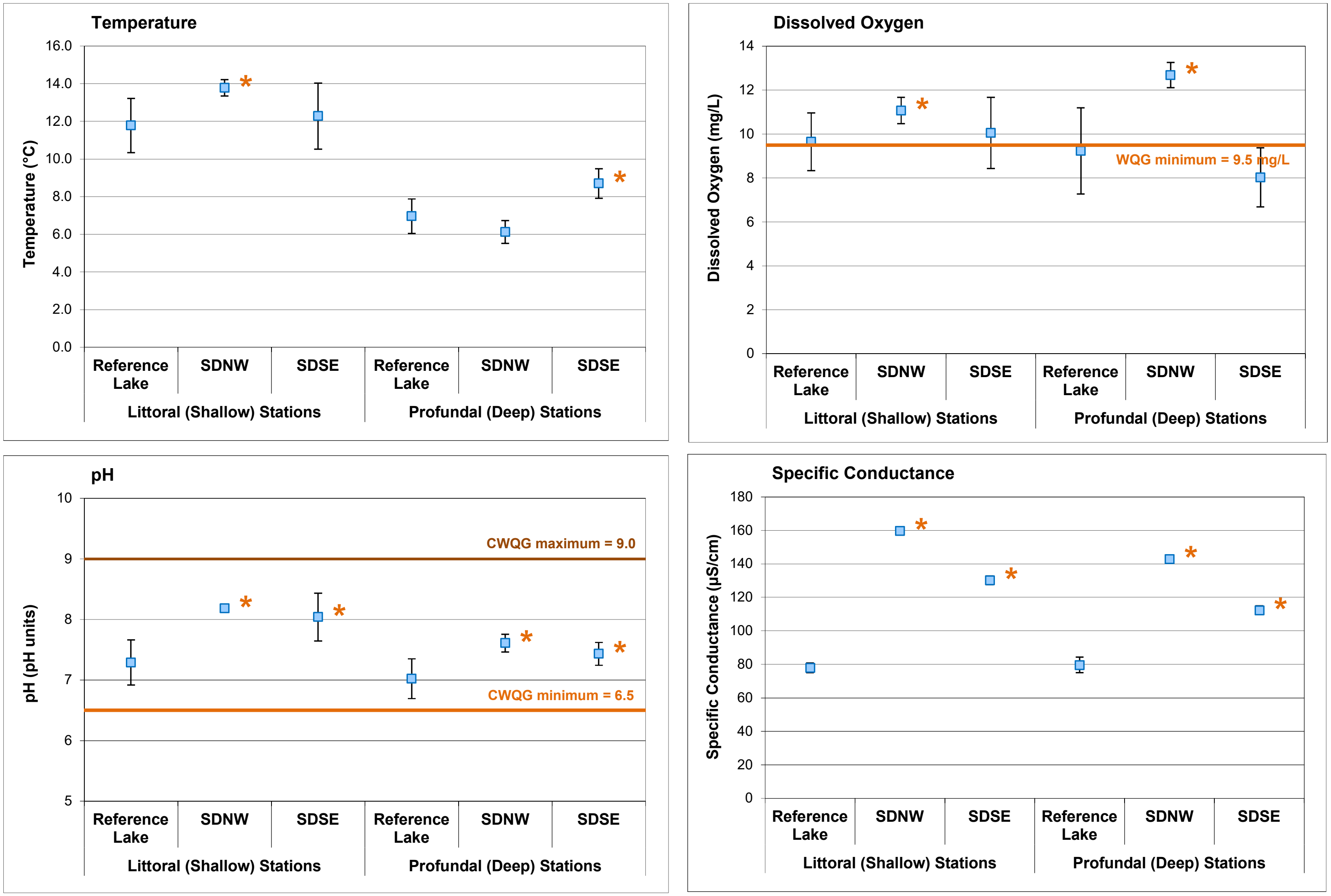


Figure 4.8: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Sheardown Lake Basins (SDNW and SDSE) and Reference Lake 3 (REF3) Littoral and Profundal Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2019

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.

determined through evaluation of Secchi depth, did not differ significantly between Sheardown Lake NW and Reference Lake 3 at the time of the August 2019 biological study (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).

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 2019 (Table 4.2; Appendix Table C.43), suggesting that the lake waters were laterally well mixed. Turbidity, total ammonia, chloride, nitrate, and sulphate concentrations, together with total concentrations of aluminum, manganese, molybdenum, and uranium were elevated (i.e., ≥3-fold higher) at one or more stations in Sheardown Lake NW compared to Reference Lake 3 during the summer and/or fall sampling events in 2019 (Table 4.2; Appendix Tables C.43 and C.44). Similar to previous studies, total aluminum and manganese concentrations showed a strong positive correlation with turbidity at Sheardown Lake NW in 2019 (rs = 0.81 and 0.79, respectively; Appendix Table C.47). This suggested that elevated total aluminum and manganese concentrations at Sheardown Lake NW may reflect influences associated with surface runoff and/or backflow received from Mary River that contain 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 the reference lake (Appendix Table C.46), and very weak 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 total fraction at Sheardown Lake NW. Other parameters that were elevated at Sheardown Lake NW compared to the reference area, including 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 elevated concentrations of the parameters indicated above at Sheardown Lake NW compared to Reference Lake 3, concentrations were well below applicable WQG and AEMP benchmarks at Sheardown Lake NW during all sampling events in 2019 (Table 4.2; Appendix Table C.43). Total phosphorus concentrations were above WQG at the bottom of the water column at four of the Sheardown Lake NW stations in fall 2019 (Appendix Table C.43), potentially reflecting mobilization of this metal from lake sediment to the hypolimnetic waters related to relatively low DO concentrations in this layer. Elevation in total phosphorus above WQG occurred at Reference Lake 3 in 2019 (Table 4.2), reflecting similar development of a thermally stratified condition and likely mobilization of phosphorus from the sediment to overlying water as that observed at Sheardown Lake NW.

Table 4.2: Water Chemistry at Sheardown Lake NW (DLO-01) and Reference Lake 3 (REF3) Monitoring Stations[a], Mary River Project CREMP, August 2019

	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 2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	82	175	174	170	174	171	177
	pH (lab)	pH	6.5 - 9.0	-	7.74	7.63	8.29	8.29	8.29	8.32	8.33
	Hardness (as $CaCO_3$)	mg/L	-	-	36	78	79	78	79	77	79
	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	-	-	53	81	79	74	84	81	83
	Turbidity	NTU	-	-	0.34	0.53	0.50	0.62	0.99	0.56	0.54
	Alkalinity (as $CaCO_3$)	mg/L	-	-	34	62	62	63	63	61	60
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.010	<0.010	0.011	0.015	0.016	0.0215	<0.010
	Nitrate	mg/L	3	3	0.036	0.157	0.127	0.128	0.156	0.131	0.547
	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	-	-	0.18	0.21	0.25	0.24	0.265	0.32	0.19
	Nitrate and Nitrite (as N)	mg/L	-	-	0.037	0.157	0.127	0.128	0.156	0.131	0.547
	Dissolved Organic Carbon	mg/L	-	-	2.7	2.0	1.8	1.8	1.9	1.7	1.9
	Total Organic Carbon	mg/L	-	-	3.1	2.2	2.3	2.2	2.4	2.1	2.2
	Total Phosphorus	mg/L	0.020$^{\alpha}$	-	0.021	0.005	0.014	0.013	0.014	0.011	0.019
	Phenols	mg/L	0.004$^{\alpha}$	-	<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
	Chloride (Cl)	mg/L	120	120	1.4	4.2	4.1	4.1	4.4	4.1	4.9
	Sulphate (SO_4)	mg/L	218$^{\beta}$	218	3.7	14.2	14.1	13.5	14.4	13.4	14.1
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[d]	0.0079	0.007	0.013	0.036	0.015	0.013	0.010
	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	<0.00010	0.000105	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0062	0.00710	0.00731	0.00740	0.00729	0.00699	0.00752
	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	<0.010	<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
	Calcium (Ca)	mg/L	-	-	7.2	14.4	14.9	13.7	15.1	13.8	15.0
	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$^{\alpha}$	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00085	0.0009	0.0010	0.0011	0.0010	0.0009	0.0009
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	0.0665	0.0505	<0.030	0.041
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	0.000206	0.000051	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.0010	0.0011	0.0012	0.0011	0.0013	0.0012	0.0014
	Magnesium (Mg)	mg/L	-	-	4.5	9.9	10.0	9.2	10.1	9.4	10.1
	Manganese (Mn)	mg/L	0.935$^{\beta}$	-	0.00060	0.00177	0.00152	0.00818	0.00454	0.00323	0.00169
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00014	0.00097	0.00096	0.00084	0.00095	0.00090	0.00111
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00074	0.00071	0.00081	0.00073	0.00073	0.00081
	Potassium (K)	mg/L	-	-	0.9	1.36	1.40	1.34	1.39	1.33	1.45
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.48	0.38	0.39	0.50	0.40	0.48	0.40
	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	-	-	0.9	1.82	1.83	1.69	1.86	1.70	1.88
	Strontium (Sr)	mg/L	-	-	0.0082	0.0102	0.0103	0.0096	0.0102	0.0096	0.0104
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)	mg/L	0.015	-	0.00025	0.00110	0.00102	0.00104	0.00113	0.00100	0.00101
	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

[shaded] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

[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).

Visual evaluation of plotted data indicated successively higher conductivity, hardness, and concentrations of chloride, molybdenum, nitrate, sodium, strontium, sulphate, and uranium at Sheardown Lake NW during fall sampling events since commencement of mine operations in 2015 (Figure 4.9; Appendix Figure C.19). Despite these increases over time, seasonal average total and dissolved concentrations of most parameters in 2019 were not substantially elevated (i.e., less than 3-fold higher) compared to concentrations reported during baseline (Appendix Tables C.44 and C.46). The only exceptions were sulphate and dissolved molybdenum, which showed slight elevation (i.e., 3- to 5-fold higher) in 2019 compared to the baseline data for two or more seasonal periods (Appendix Tables C.44 and C.46). The magnitude of these year-to-year changes were relatively minor and unlikely to be ecologically meaningful given parameter concentrations remained well below WQG, but nevertheless the sequential increases were consistent with greater mine-related influence on water quality over time at Sheardown Lake NW.

4.2.2 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 stations of Sheardown Lake NW did not differ significantly from stations sharing like-habitat at Reference Lake 3 (Appendix Table D.12). However, the TOC content of profundal sediment at Sheardown Lake NW was significantly lower than at the reference lake (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 2019 sampling event (Appendix Tables D.10 and D.11), suggesting the occurrence of reducing conditions in the sediment similar to that observed at the reference lake (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 2019 (Appendix Table D.13). However, the concentration of iron in sediment was highest at the Sheardown Lake NW station situated closest to the outlet of SDLT1 (Stations DD-HAB 9-STN2; Appendix Table D.13). This was consistent with the two previous CREMP studies, which indicated that SDLT1 was a source of iron loadings to the lake (Minnow 2018, 2019). Average metal concentrations in littoral and profundal sediment of

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 2019) 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).

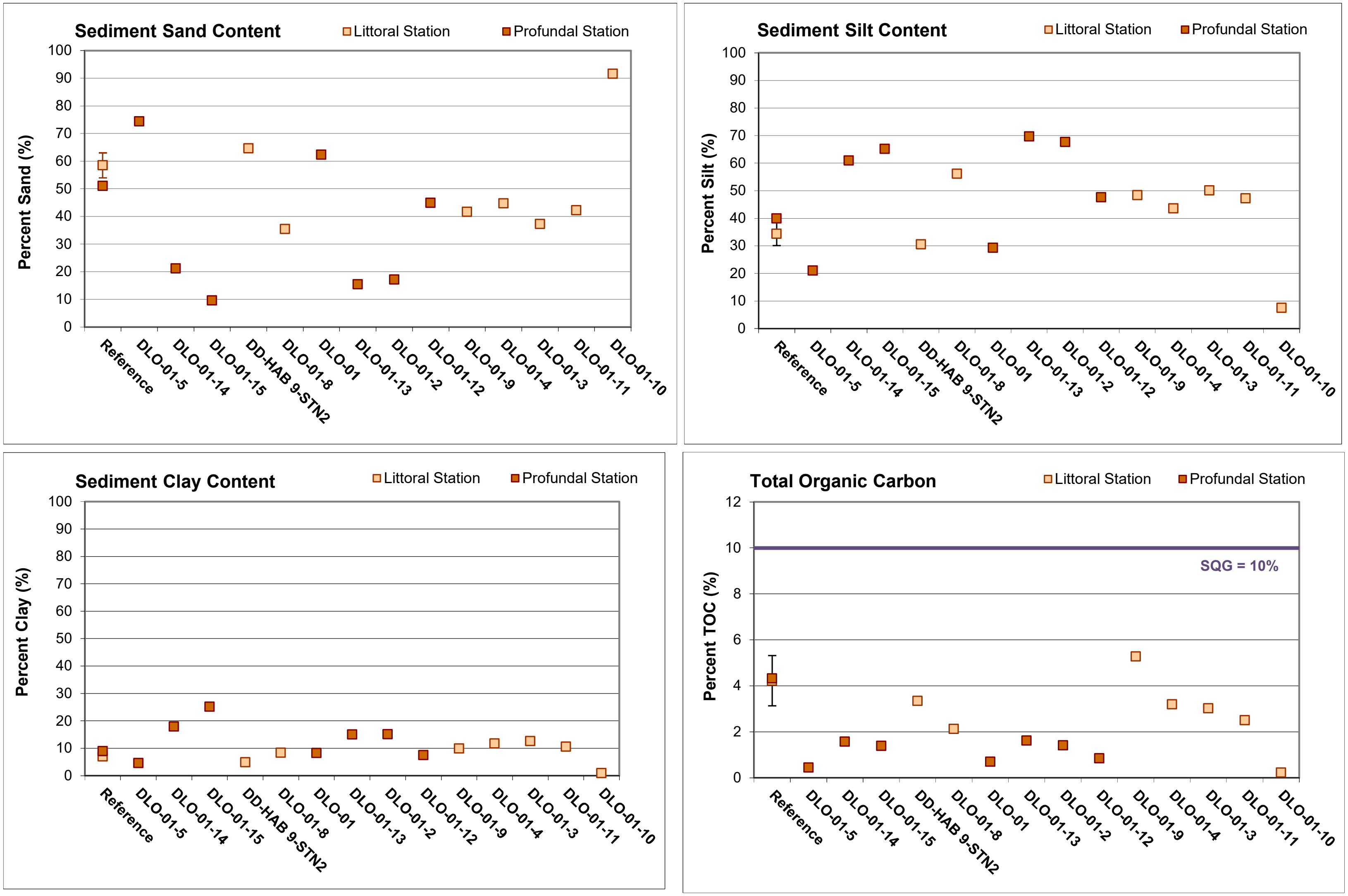


Figure 4.10: Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Sheardown Lake NW (DLO-01) Sediment Monitoring Stations and Reference Lake 3 (mean ± SE), Mary River Project CREMP, August 2019

Sheardown Lake NW were very similar to averages observed for like-habitat at Reference Lake 3 in 2019, the only exception being slightly elevated (i.e., 3- to 5-fold higher) concentrations of manganese at the Sheardown Lake NW littoral stations (Table 4.3; Appendix Table D.14). Although average concentrations of iron and manganese were above SQG in sediment at littoral stations of Sheardown Lake NW, the average concentration of these metals was also above SQG in sediment at Reference Lake 3 (Table 4.3) indicating naturally elevated concentrations of these metals. Nickel concentrations were also above SQG in sediment at individual littoral stations at Sheardown Lake NW (Appendix Table D.13). Only the average concentration of arsenic in littoral sediment of Sheardown Lake NW was above lake-specific AEMP benchmarks (but not SQG), whereas at the reference lake, average concentrations of copper, iron, and manganese were elevated above the Sheardown Lake NW AEMP benchmarks in littoral or profundal sediment (Table 4.3).

Metal concentrations in sediment at littoral and profundal stations of Sheardown Lake NW in 2019 were comparable to those observed during the mine baseline (2005 to 2013) period (Figure 4.11; Appendix Table D.14).[10] On average, metal concentrations in sediment of Sheardown Lake NW in 2019 were within the range of those observed at littoral stations, and lower than those observed at profundal stations, from 2015 to 2018 (Figure 4.11). No consecutive increase in average metal concentrations was apparent from 2015 to 2018 at the Sheardown Lake NW littoral or profundal stations (Figure 4.11). Overall, no substantial changes in sediment metal concentrations were indicated at Sheardown Lake NW littoral and profundal stations following the commencement of mine operations in 2015.

4.2.3 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 2019 (Figure 4.12). Chlorophyll-a concentrations differed significantly among seasons at Sheardown Lake NW, 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 the reference lake, where no substantial changes in chlorophyll-a concentrations occurred between summer and fall sampling events (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

[10] See footnote 8 regarding differences in the concentration of boron in sediment between baseline and recent CREMP studies.

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 2019

	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]	-	4.22 ± 1.09	2.82 ± 0.758	1.28 ± 0.128	4.32 ± 0.123	1.05 ± 0.323	1.02 ± 0.010
Metals	Aluminum (Al)	mg/kg	-	-	13,660 ± 1,044	14,730 ± 4,259	18,800 ± 1,100	22,740 ± 609	15,460 ± 3,105	19,650 ± 750
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0.0	<0.10 ± 0.0	<0.10 ± 0.0	<0.10 ± 0.0	0.10 ± 0.00	<0.10 ± 0
	Arsenic (As)	mg/kg	17	6.2, 5.9	4.68 ± 1.11	***6.22*** ± 2.62	5.63 ± 0.77	5.26 ± 0.117	3.26 ± 0.60	3.91 ± 0.13
	Barium (Ba)	mg/kg	-	-	98.9 ± 19.2	121 ± 50	117 ± 19	127 ± 3.06	64 ± 12	85 ± 5.5
	Beryllium (Be)	mg/kg	-	-	0.566 ± 0.046	0.760 ± 0.216	0.89 ± 0.060	0.888 ± 0.021	0.775 ± 0.147	0.87 ± 0.020
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0.0	0.29 ± 0.04	0.24 ± 0.017	<0.20 ± 0.0	0.24 ± 0.02	0.28 ± 0.0000
	Boron (B)	mg/kg	-	-	11.8 ± 0.837	23.1 ± 6.42	23.8 ± 1.88	16.5 ± 0.700	21.6 ± 4.71	22.8 ± 0.00
	Cadmium (Cd)	mg/kg	3.5	1.5, 1.5	0.140 ± 0.034	0.278 ± 0.097	0.115 ± 0.009	0.164 ± 0.004	0.182 ± 0.035	0.106 ± 0.005
	Calcium (Ca)	mg/kg	-	-	4,522 ± 399	4,182 ± 1,144	5,137 ± 488	5,492 ± 117	3,480 ± 645	6,135 ± 265
	Chromium (Cr)	mg/kg	90	97, 79	49.0 ± 3.47	58.1 ± 15.9	***79.1*** ± 5.11	74.2 ± 2.04	62.3 ± 10.6	76.0 ± 1.50
	Cobalt (Co)	mg/kg	-	-	9.75 ± 0.541	11.8 ± 3.43	15.0 ± 0.9	16.5 ± 0.244	12.2 ± 2.33	14.9 ± 0.750
	Copper (Cu)	mg/kg	110	58, 56	57.1 ± 9.70	40.9 ± 13.0	30.0 ± 1.92	***91.9*** ± 2.00	35.0 ± 5.61	29.9 ± 0.650
	Iron (Fe)	mg/kg	40,000[α]	52,200, 34,400	***54,660*** ± 14,622	51,373 ± 16,460	***53,833*** ± 4,403	49,580 ± 1,299	32,600 ± 6,322	***49,950*** ± 3,950
	Lead (Pb)	mg/kg	91.3	35	13.0 ± 0.806	17.0 ± 4.69	18.0 ± 1.38	19.0 ± 0.320	16.5 ± 3.3	17.5 ± 0.300
	Lithium (Li)	mg/kg	-	-	22.7 ± 1.31	24.7 ± 7.07	32.0 ± 2.12	35.8 ± 0.901	26.1 ± 5.68	31.6 ± 0.800
	Magnesium (Mg)	mg/kg	-	-	9,392 ± 521	10,120 ± 2,786	14,233 ± 260	14,840 ± 437	10,325 ± 2,039	15,550 ± 650.0
	Manganese (Mn)	mg/kg	1,100[α,β]	4,530, 657	544 ± 115	1,747 ± 867	***2,180*** ± 861	***1,796*** ± 610	974 ± 254	***865*** ± 255.5
	Mercury (Hg)	mg/kg	0.486	0.17	0.0458 ± 0.0116	0.0407 ± 0.0127	0.0270 ± 0.00223	0.0738 ± 0.0022	0.0265 ± 0.00784	0.0254 ± 0.0000
	Molybdenum (Mo)	mg/kg	-	-	5.47 ± 1.87	6.22 ± 2.33	2.86 ± 0.699	3.06 ± 0.42	1.73 ± 0.47	1.90 ± 0.340
	Nickel (Ni)	mg/kg	75[α,β]	77, 66	35.1 ± 3.04	58.9 ± 16.4	63.3 ± 4.71	51.6 ± 1.41	53.0 ± 9.69	56.8 ± 1.30
	Phosphorus (P)	mg/kg	2,000[α]	1,958, 1,278	1,430 ± 409	969 ± 341	1,230 ± 87	1,025 ± 36	747 ± 80	1,045 ± 5.0
	Potassium (K)	mg/kg	-	-	3,308 ± 238	3,853 ± 1,118	4,713 ± 331	5,502 ± 150	3,825 ± 804	4,880 ± 200
	Selenium (Se)	mg/kg	-	-	0.62 ± 0.15	0.49 ± 0.11	0.23 ± 0.02	0.77 ± 0.04	0.29 ± 0.06	0.24 ± 0.0250
	Silver (Ag)	mg/kg	-	-	0.13 ± 0.03	0.16 ± 0.023	0.13 ± 0.007	0.26 ± 0.011	0.14 ± 0.019	0.14 ± 0.0000
	Sodium (Na)	mg/kg	-	-	259 ± 19	231 ± 64	292 ± 22	414 ± 16	220 ± 45	285 ± 0.5
	Strontium (Sr)	mg/kg	-	-	10.7 ± 0.858	9.82 ± 2.07	11.7 ± 0.520	13.9 ± 0.293	9.44 ± 1.62	11.4 ± 0.300
	Sulphur (S)	mg/kg	-	-	1,400 ± 247	1,125 ± 125	<1,000 ± 0	1,320 ± 58.3	<1,000 ± 0	<1,000 ± 0
	Thallium (Tl)	mg/kg	-	-	0.363 ± 0.038	0.45 ± 0.13	0.45 ± 0.041	0.771 ± 0.010	0.43 ± 0.10	0.41 ± 0.0085
	Tin (Sn)	mg/kg	-	-	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0
	Titanium (Ti)	mg/kg	-	-	964 ± 37	913 ± 244	1,357 ± 35	1,260 ± 50	1,013 ± 192.2	1,435 ± 45.0
	Tungsten (W)	mg/kg	-	-	<0.50 ± 0.0	0.51 ± 0.0	0.5 ± 0.0	<0.50 ± 0.0	<0.50 ± 0.0	<0.50 ± 0.0
	Uranium (U)	mg/kg	-	-	12.6 ± 1.79	7.69 ± 2.61	5.95 ± 0.528	23.9 ± 0.94	6.34 ± 1.05	5.58 ± 0.085
	Vanadium (V)	mg/kg	-	-	46.0 ± 3.57	43.4 ± 12.1	52.6 ± 2.64	66.6 ± 1.54	45.3 ± 8.33	52.3 ± 1.400
	Zinc (Zn)	mg/kg	315	135	64.8 ± 6.60	55.0 ± 15.6	62.9 ± 3.23	91.9 ± 1.69	52.3 ± 9.95	64.8 ± 2.700
	Zirconium (Zr)	mg/kg	-	-	3.54 ± 0.375	10.0 ± 3.90	17.2 ± 0.46	3.96 ± 0.225	6.15 ± 1.36	19.2 ± 0.10

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

BOLD Indicates parameter concentration above the AEMP Benchmark.

[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

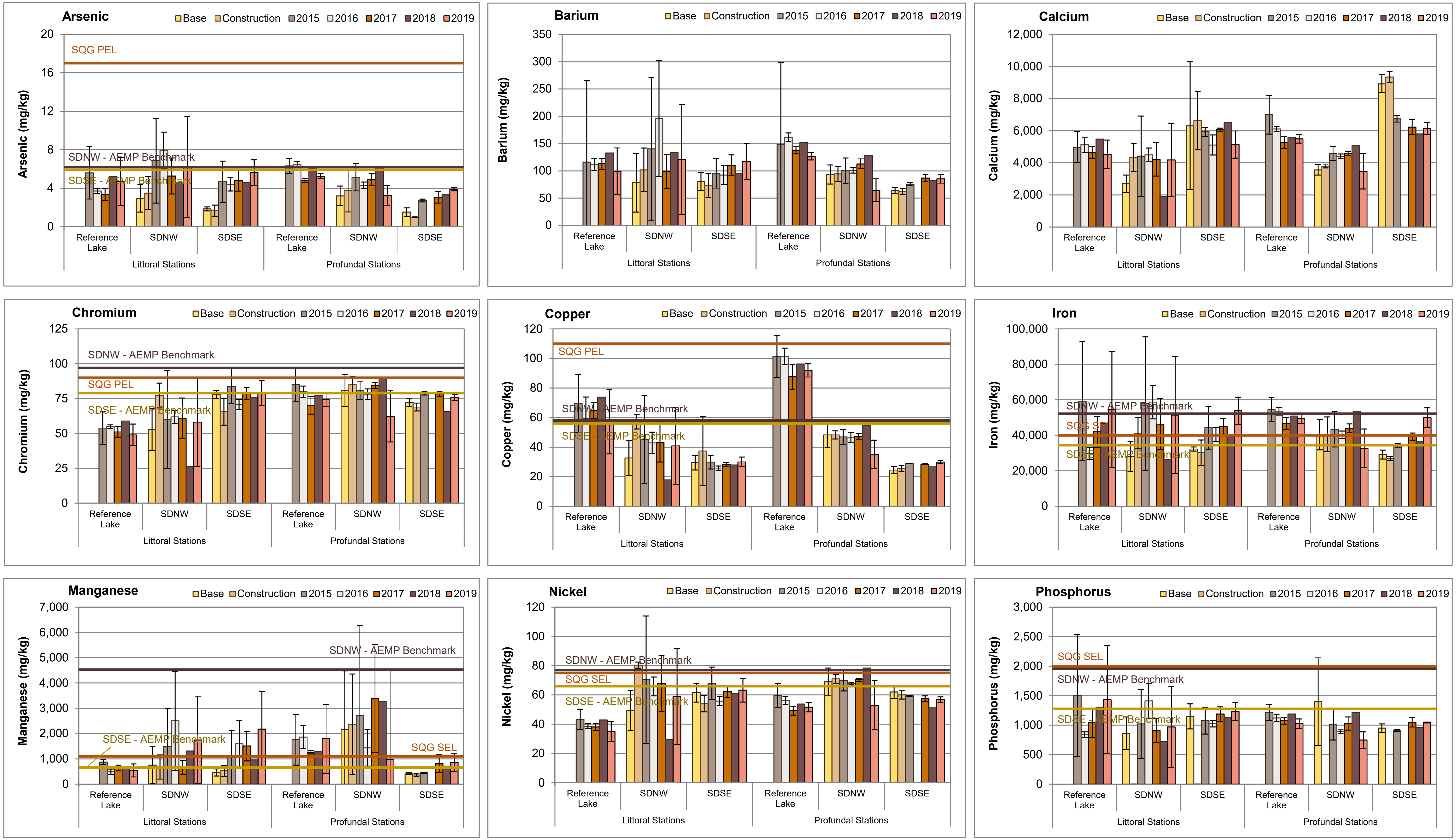


Figure 4.11: Temporal Comparison of Sediment Metal Concentrations (mean ± SD) at Littoral and Profundal Stations of Sheardown Lake NW (SDNW), Sheardown Lake SE (SDSE), and Reference Lake 3 for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2019) Periods

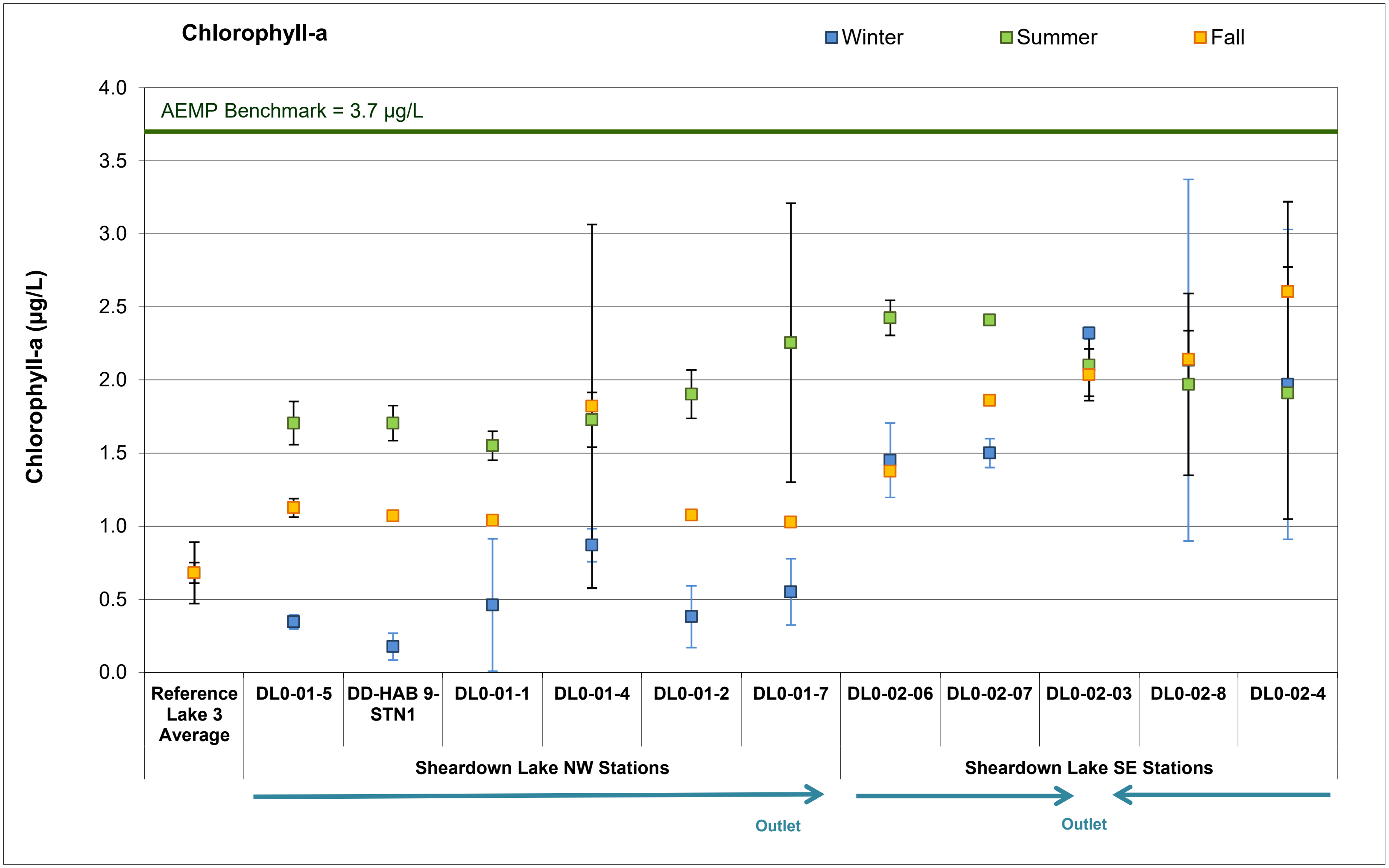


Figure 4.12: Chlorophyll-a Concentrations at Sheardown Lake NW (DLO-1) and Sheardown Lake SE (DLO-2) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2019

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 2019.

events in 2019 (Appendix Tables E.7 and E.8), chlorophyll-a concentrations during each of the winter, summer, and fall sampling events at Sheardown Lake NW 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 near the surface (i.e., concentrations below 10 µg/L; Table 4.2; Appendix Table C.43).

Temporally, chlorophyll-a concentrations at Sheardown Lake NW in 2019 were within the ranges shown among years of mine construction (2014) and previous mine operation (2015 to 2018), and showed no consistent direction of changes for any of 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 in 2015. 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.

4.2.4 Benthic Invertebrate Community

Benthic invertebrate density was significantly higher at littoral and profundal habitats of Sheardown Lake NW compared to like-habitat at Reference Lake 3 at magnitudes outside of the CES_{BIC} of ±2 SD_{REF} (Tables 4.4 and 4.5). In addition 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 differing 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 the reference lake for either habitat type, the difference in Bray-Curtis Index between lakes likely reflected substantially higher benthic invertebrate density 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 2019. This was supported by no significant differences in the relative abundance of metal-sensitive chironomids or FFG between lakes (Tables 4.4 and 4.5), which indicated no sediment metal-related influences or effects to available food resources, respectively, on the benthic invertebrate community of Sheardown Lake NW. Therefore, no adverse mine-related influences on the benthic invertebrate community of Sheardown Lake NW were indicated in 2019 based on comparisons to reference lake conditions.

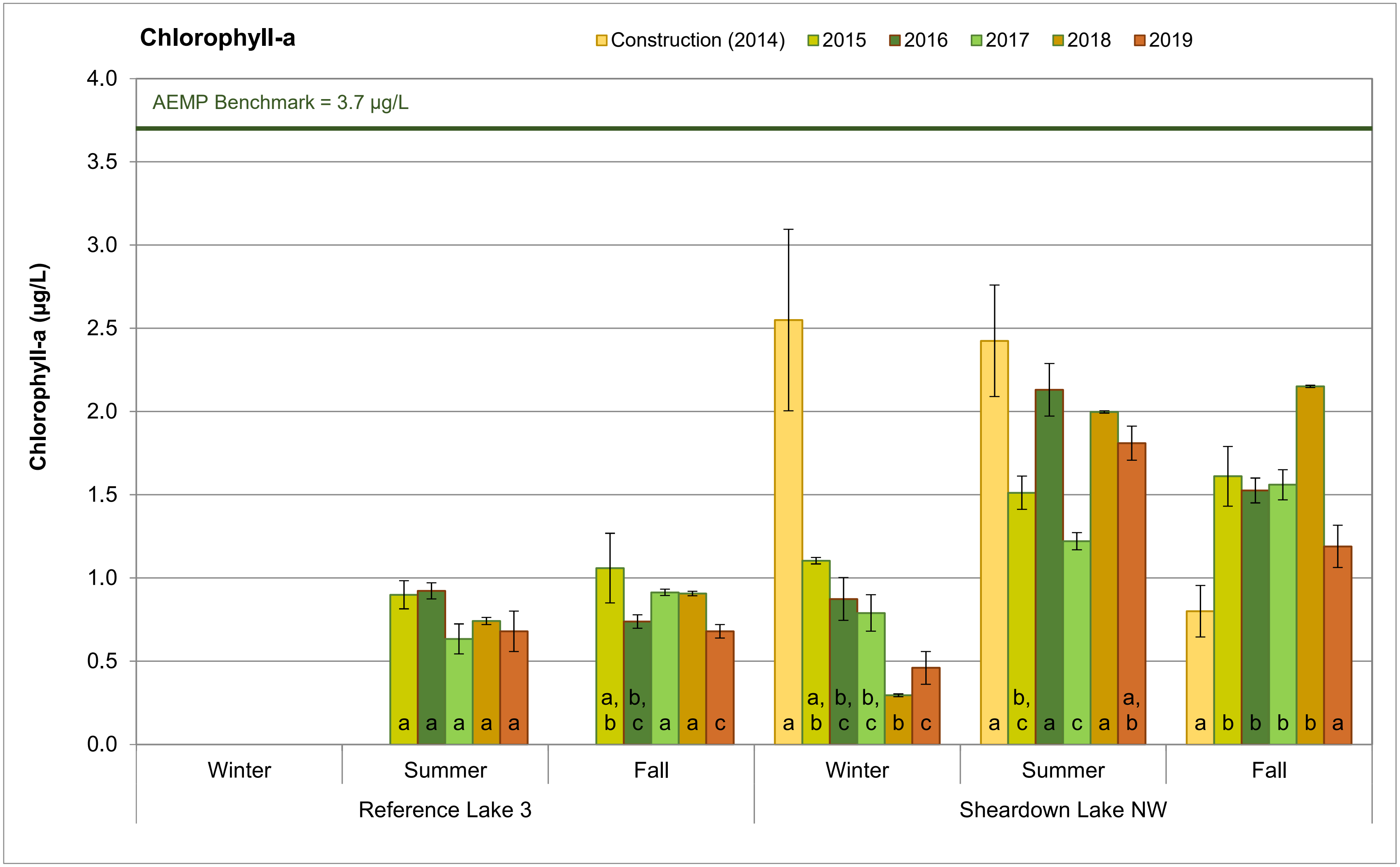


Figure 4.13: Temporal Comparison of Chlorophyll-a Concentrations Among Seasons between Sheardown Lake NW and Reference Lake 3 for Mine Construction (2014) and Operational (2015 to 2019) Periods (mean ± SE)

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 2019

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)	rank	YES	0.008	MW U-test	16.7	Reference Lake 3	1,247	297	133	871	1,156	1,594
						Sheardown NW Littoral	6,207	2,673	1,195	1,854	7,137	8,273
Richness (Number of Taxa)	log10	NO	0.898	ANOVA	0.2	Reference Lake 3	12.8	2.3	1.0	9.0	13.0	15.0
						Sheardown NW Littoral	13.2	3.6	1.6	10.0	12.0	19.0
Simpson's Evenness (E)	none	YES	0.011	ANOVA	-4.4	Reference Lake 3	0.865	0.041	0.018	0.811	0.862	0.924
						Sheardown NW Littoral	0.686	0.114	0.051	0.505	0.702	0.798
Bray-Curtis Index	none	YES	<0.001	ANOVA	5.6	Reference Lake 3	0.291	0.100	0.045	0.162	0.275	0.391
						Sheardown NW Littoral	0.845	0.049	0.022	0.776	0.872	0.889
Nemata (%)	log10(x+1)	YES	0.021	t-test unequal	-0.9	Reference Lake 3	7.3	7.9	3.5	0.8	3.9	20.0
						Sheardown NW Littoral	0.2	0.2	0.1	0.0	0.0	0.4
Ostracoda (%)	log10	NO	0.120	ANOVA	-0.8	Reference Lake 3	25.1	11.0	4.9	13.8	21.8	41.8
						Sheardown NW Littoral	16.0	5.7	2.6	11.5	12.6	23.8
Chironomidae (%)	log10	YES	0.025	ANOVA	1.5	Reference Lake 3	62.9	12.9	5.8	48.4	71.2	73.0
						Sheardown NW Littoral	82.1	5.9	2.7	73.3	83.9	87.4
Metal-Sensitive Chironomidae (%)	log10	NO	0.931	ANOVA	0.0	Reference Lake 3	10.5	7.8	3.5	4.8	6.9	24.1
						Sheardown NW Littoral	10.7	6.0	2.7	3.7	10.1	18.2
Collector-Gatherers (%)	none	NO	0.946	ANOVA	0.0	Reference Lake 3	81.1	17.8	8.0	51.2	87.9	97.9
						Sheardown NW Littoral	81.7	8.4	3.8	69.3	81.7	91.2
Filterers (%)	log10	NO	0.394	ANOVA	0.5	Reference Lake 3	7.1	6.3	2.8	1.1	5.8	17.9
						Sheardown NW Littoral	10.0	5.8	2.6	2.8	10.1	16.9
Shredders (%)	log10(x+1)	YES	0.054	ANOVA	-0.6	Reference Lake 3	6.5	9.5	4.2	0.0	2.9	23.2
						Sheardown NW Littoral	0.3	0.4	0.2	0.0	0.4	0.8
Clingers (%)	none	NO	0.296	ANOVA	-0.6	Reference Lake 3	11.9	7.9	3.5	2.1	10.0	23.3
						Sheardown NW Littoral	7.2	5.3	2.4	1.0	5.8	14.4
Sprawlers (%)	log10	YES	<0.001	ANOVA	-4.6	Reference Lake 3	74.1	8.3	3.7	60.4	75.7	81.2
						Sheardown NW Littoral	36.0	7.4	3.3	25.1	35.3	43.7
Burrowers (%)	none	YES	< 0.001	ANOVA	6.2	Reference Lake 3	14.0	6.9	3.1	3.8	16.2	22.1
						Sheardown NW Littoral	56.8	11.0	4.9	45.6	53.8	73.9

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.

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

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 2019

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)	log10	YES	< 0.001	ANOVA	15.4	Reference Lake 3	304	89	40	217	276	448
						Sheardown NW Profundal	1,670	302	135	1,338	1,648	2,025
Richness (Number of Taxa)	none	NO	0.102	ANOVA	1.4	Reference Lake 3	5.6	2.6	1.2	3.0	6.0	9.0
						Sheardown NW Profundal	9.2	3.5	1.6	3.0	11.0	11.0
Simpson's Evenness (E)	none	NO	0.485	ANOVA	-0.5	Reference Lake 3	0.534	0.174	0.078	0.278	0.584	0.701
						Sheardown NW Profundal	0.444	0.210	0.094	0.153	0.402	0.728
Bray-Curtis Index	none	YES	<0.001	ANOVA	6.4	Reference Lake 3	0.187	0.088	0.039	0.086	0.208	0.305
						Sheardown NW Profundal	0.748	0.046	0.021	0.695	0.736	0.809
Nemata (%)	log10(x+1)	YES	0.030	ANOVA	-1.2	Reference Lake 3	3.6	2.7	1.2	0.0	3.3	7.6
						Sheardown NW Profundal	0.4	0.4	0.2	0.0	0.5	0.8
Ostracoda (%)	log10(x+1)	YES	0.096	ANOVA	-0.8	Reference Lake 3	9.0	8.1	3.6	2.0	6.6	21.7
						Sheardown NW Profundal	2.5	1.6	0.7	0.0	3.2	3.9
Chironomidae (%)	log10	YES	0.033	ANOVA	1.5	Reference Lake 3	82.9	6.8	3.0	75.0	82.6	93.4
						Sheardown NW Profundal	93.0	5.7	2.5	85.8	94.2	100.0
Metal-Sensitive Chironomidae (%)	log10(x+1)	NO	0.554	ANOVA	0.0	Reference Lake 3	2.1	3.4	1.5	0.0	0.0	7.8
						Sheardown NW Profundal	2.2	2.1	0.9	0.9	1.3	5.9
Collector-Gatherers (%)	none	NO	0.457	ANOVA	-0.4	Reference Lake 3	92.8	10.0	4.5	75.9	95.9	100.0
						Sheardown NW Profundal	88.6	6.5	2.9	79.4	89.9	95.5
Filterers (%)	rank	NO	0.180	MW U-test	nc	Reference Lake 3	0.0	0.0	0.0	0.0	0.0	0.0
						Sheardown NW Profundal	1.3	2.6	1.2	0.0	0.0	5.9
Clingers (%)	none	NO	0.771	ANOVA	0.2	Reference Lake 3	4.5	4.7	2.1	0.0	4.1	10.6
						Sheardown NW Profundal	5.4	4.2	1.9	0.0	6.8	9.6
Sprawlers (%)	rank	NO	1.000	MW U-test	-1.6	Reference Lake 3	90.5	7.4	3.3	83.8	87.6	100.0
						Sheardown NW Profundal	78.7	29.5	13.2	26.7	87.8	99.1
Burrowers (%)	log10(x+1)	NO	0.727	ANOVA	3.2	Reference Lake 3	5.0	3.4	1.5	0.0	5.6	8.3
						Sheardown NW Profundal	15.9	27.6	12.3	0.8	2.6	64.7

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.

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

Temporal comparisons did not indicate any consistent ecologically significant differences in density, richness, or 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 mine operation (2015 to 2019; Figure 4.14; Appendix Tables F.38 and F.39). In addition, no significant differences in benthic invertebrate dominant taxonomic groups or FFG were 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.

4.2.5 Fish Population

4.2.5.1 Sheardown Lake NW Fish Community

The fish community of Sheardown Lake NW included arctic charr and ninespine stickleback in 2019 based on electrofishing and gill net sampling (Table 4.6), reflecting the same fish species composition as that observed historically at Reference Lake 3 (Minnow 2019). Arctic charr CPUE was higher at Sheardown Lake NW than at the reference lake for nearshore electrofishing and for littoral/profundal gill net sampling (Table 4.6), suggesting higher densities and/or productivity of this species at Sheardown Lake NW. 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.

Temporal comparison of the Sheardown Lake NW electrofishing catch data indicated that arctic charr CPUE in 2019 was within the range shown over the mine baseline period (2006 to 2013), and was higher than CPUE shown over previous years of mine operation (2015 to 2018), at nearshore rocky habitat of the lake (Figure 4.15). Gill netting CPUE for arctic charr in 2019 was also within the range shown during the baseline period, as well as in the range of that shown over the previous four 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 2019 was similar to baseline, in turn suggesting no mine-related influences to arctic charr numbers in the lake.

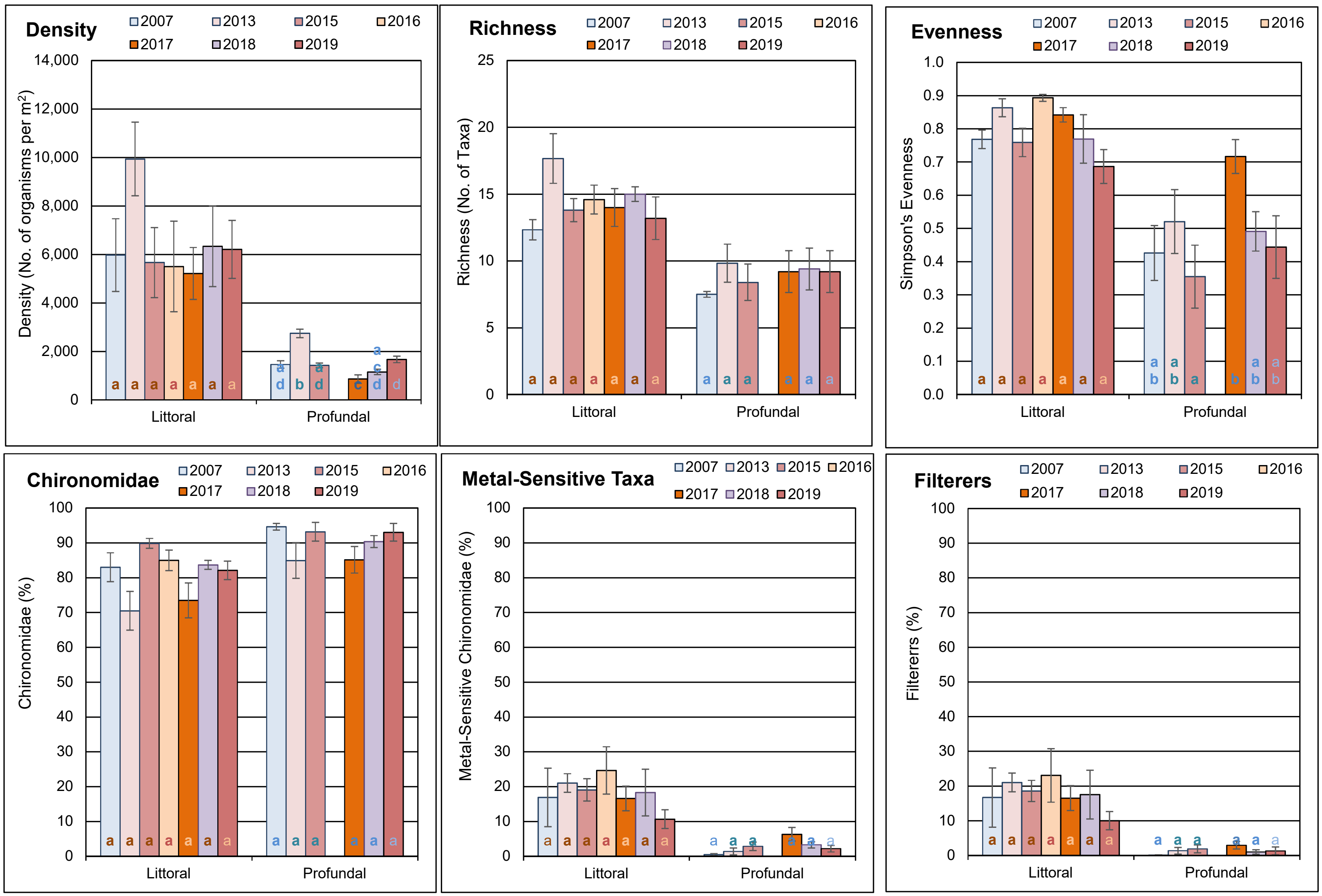


Figure 4.14: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Sheardown Lake NW Littoral and Profundal Study Areas among Mine Baseline (2007, 2013) and Operational (2015 to 2019) Periods

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

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 2019

Lake	Method [a]		Arctic Charr	Ninespine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	101	0	101	1
		CPUE	4.22	0	4.22	
	Gill netting	No. Caught	27	0	27	
		CPUE	0.33	0	0.33	
Sheardown Lake Northwest	Electrofishing	No. Caught	95	1	96	2
		CPUE	8.55	0	8.64	
	Gill netting	No. Caught	80	0	80	
		CPUE	0.93	0	0.93	
Sheardown Lake Southeast	Electrofishing	No. Caught	102	18	120	2
		CPUE	7.31	1.37	8.68	
	Gill netting	No. Caught	101	0	101	
		CPUE	3.06	0	3.06	

[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.

4.2.5.2 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 2019, as well as a before-after analysis using data collected from Sheardown Lake NW in 2019 and during 2013 baseline characterization. A total of 95 and 101 arctic charr were captured at nearshore habitat of Sheardown Lake NW and Reference Lake 3, respectively, in August 2019 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 5.8 cm and 4.8 cm for the Sheardown Lake NW and Reference Lake 3 data sets, respectively, based on evaluation of length-frequency distributions coupled with supporting age determinations (Figure 4.16).

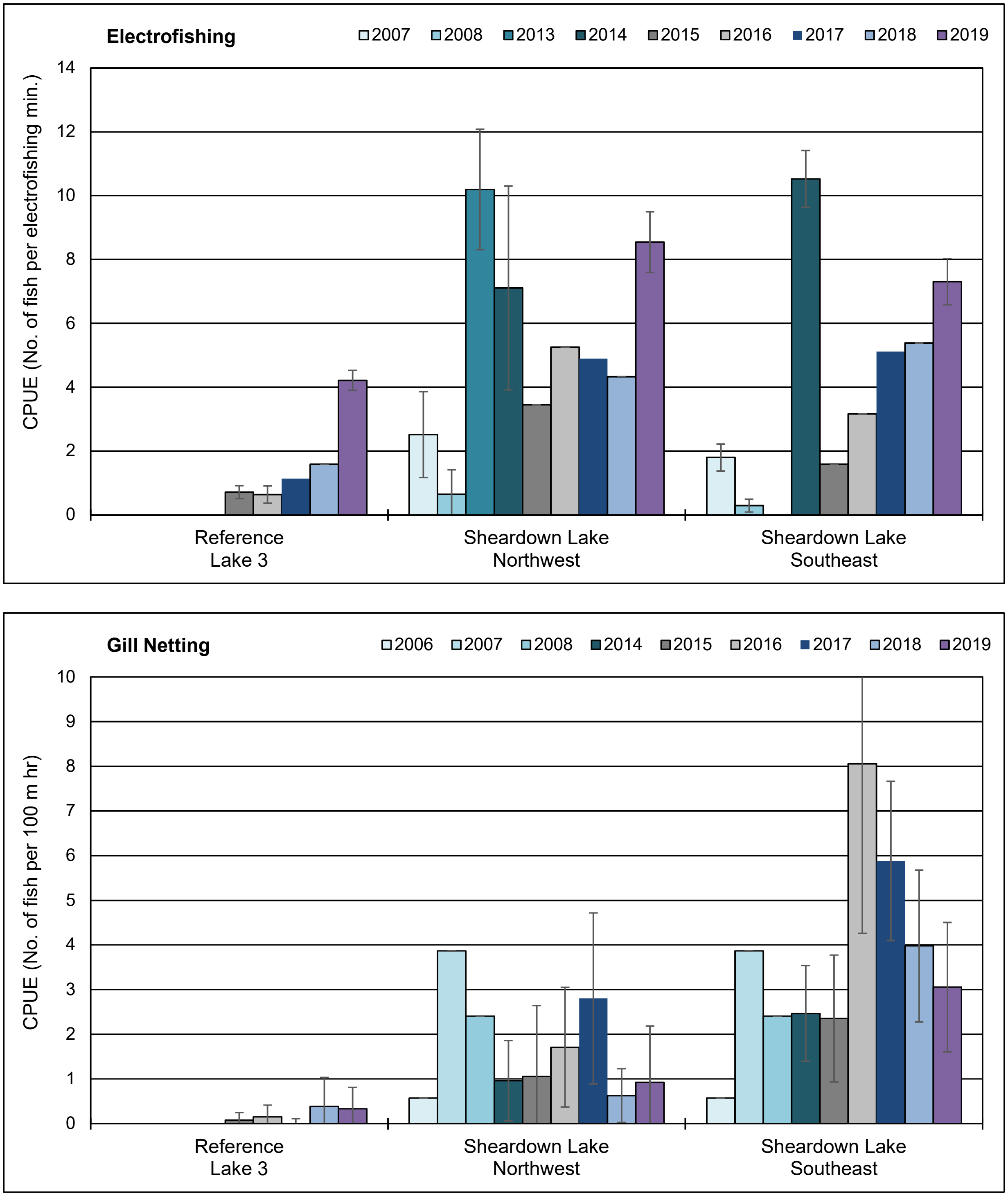


Figure 4.15: Catch-per-unit-effort (CPUE; mean ± SD) of Arctic Charr Captured by Back-pack Electrofishing and Gill Netting at Sheardown Lake NW (DLO-01) and Sheardown Lake SE (DLO-02), Mary River Project CREMP, 2006 to 2019

Notes: Data presented for fish sampling conducted in fall during baseline (2006, 2007, 2008, 2013), construction (2014) and operational (2015 to 2019) mine phases. Lake basins (i.e., NW or SE) were not differentiated historically for baseline gill netting catches.

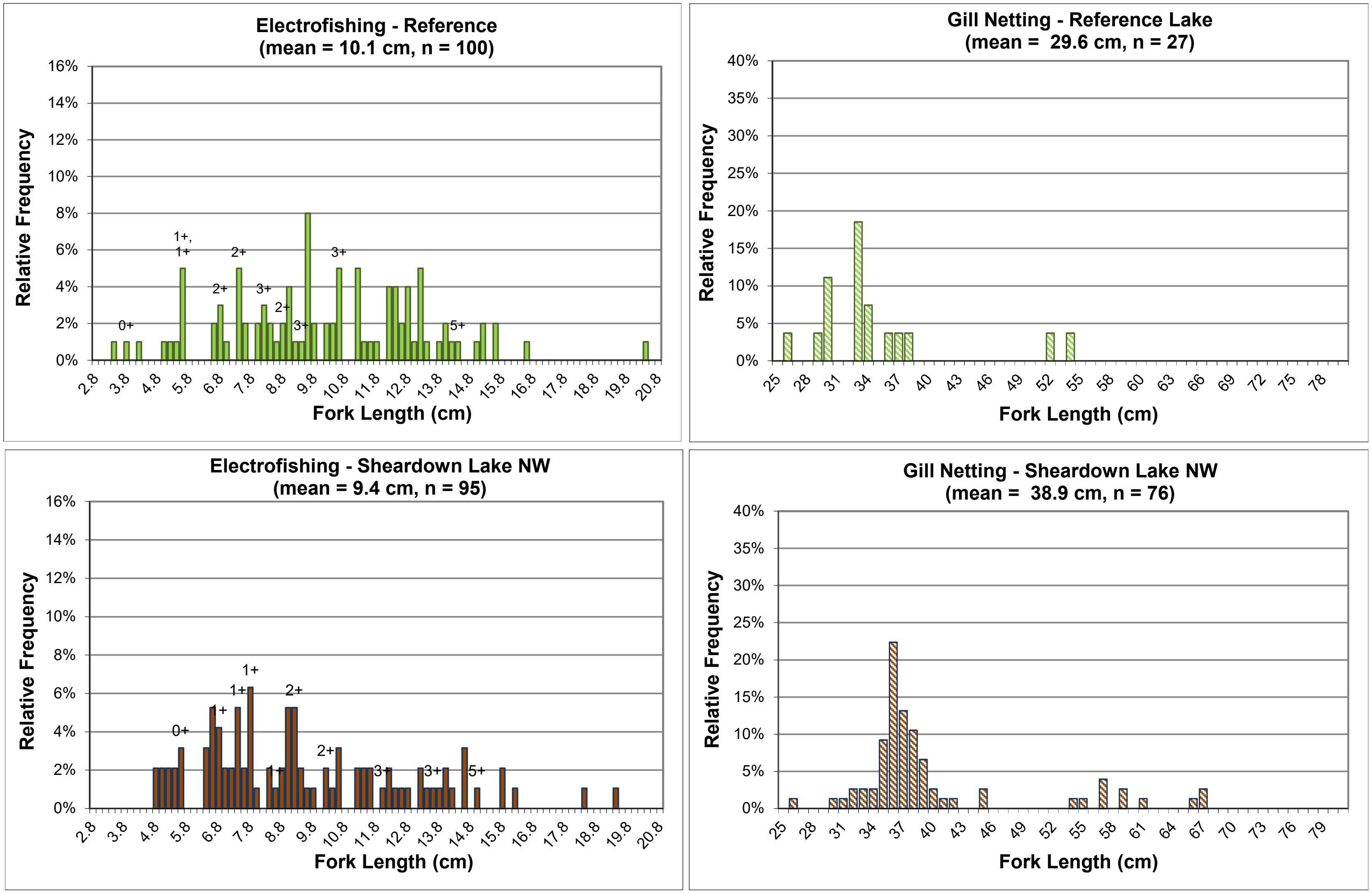


Figure 4.16: Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Sheardown Lake NW (DLO-01) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2019

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

Due to small sample size of nearshore arctic charr YOY at Reference Lake 3 (i.e., three fish), health comparisons involved assessment of only the non-YOY population.

Length-frequency distributions for the nearshore arctic charr differed significantly between Sheardown Lake NW and Reference Lake 3 (Table 4.7). Arctic charr non-YOY were significantly shorter and lighter at the Sheardown Lake NW nearshore than at the reference lake nearshore, and in contrast, condition of non-YOY captured at Sheardown Lake NW was significantly greater (Table 4.7; Appendix Table G.14). However, for all comparisons, the magnitudes of these difference were within applicable CES for size and condition (i.e., ±25% and ±10%, respectively) suggesting that the indicated differences were not ecologically significant (Table 4.7; Appendix Table G.14). Therefore, no substantial differences in the health of nearshore arctic charr were indicated between Sheardown Lake NW and Reference Lake 3 in 2019.

Temporal comparison of the Sheardown Lake NW nearshore arctic charr data indicated a significantly different length-frequency distribution between 2019 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 2019 did not differ significantly from non-YOY captured during the mine baseline (Table 4.7). However, the condition of arctic charr non-YOY was significantly lower in 2019 than during baseline studies (Table 4.7). Although the length and weight of non-YOY arctic charr in years of mine operation (i.e., 2015 to 2019) 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 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 until 2019, but no consistent differences in nearshore arctic charr condition from 2015 to 2019 (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 2019 data from Sheardown Lake NW and Reference Lake 3, as well as using a before-after analysis between data collected in 2019 and the baseline characterization studies (combined 2006, 2007, 2008, and 2013). A total of 76 and 27 arctic charr were sampled from littoral/profundal habitat of Sheardown Lake NW and Reference Lake 3, respectively, in August 2019, for the control-impact analysis. The length-frequency distribution for littoral/profundal arctic charr differed significantly between lakes,

Table 4.7: Summary of Statistical Results for Arctic Charr Population Comparisons between Sheardown Lake NW and Reference Lake 3 from 2015 to 2019, 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	2019	2015	2016	2017	2018	2019
Nearshore Electrofishing	Survival	Length-Frequency Distribution	**Yes**	**Yes**	**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%)**	**Yes (-10%)**	No	No	No	**Yes (-12%)**	No
		Size (mean weight)	**Yes (+121%)**	**Yes (+60%)**	No	**Yes (+83%)**	**Yes (-24%)**	No	**Yes (-29%)**	No	**Yes (-50%)**	No
	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	**Yes (+3%)**	No	**Yes (+7%)**	**Yes (-5%)**	**Yes (+4%)**	**Yes (-13%)**	**Yes (-12%)**	**Yes (-9%)**	**Yes (-10%)**	**Yes (-13%)**
Littoral/Profundal Gill Netting [c]	Survival	Length Frequency Distribution	-	-	-	No	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**
		Age	-	-	-	-	-	**Yes (-35%)**	**Yes (-28%)**	**Yes (-26%)**	-	-
	Energy Use	Size (mean fork length)	-	-	-	No	**Yes (+22%)**	**Yes (-21%)**	**Yes (-14%)**	**Yes (-6%)**	No	No
		Size (mean weight)	-	-	-	No	**Yes (+92%)**	**Yes (-47%)**	**Yes (-31%)**	**Yes (-9%)**	No	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%)**	No	**Yes (+8%)**	**Yes (+11%)**	**Yes (+6%)**	No	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.

reflecting greater numbers of larger fish captured at Sheardown Lake NW (Table 4.7; Figure 4.16). Arctic charr captured by gill net at Sheardown Lake NW were significantly longer and heavier than those captured at Reference Lake 3, but no difference in the condition of these fish was indicated between lakes (Table 4.7; Appendix Table G.18). Overall, this suggested no substantial differences in the heath of littoral/profundal arctic charr between the Sheardown Lake NW and Reference Lake 3 populations.

The length-frequency distribution for arctic charr captured at littoral/profundal habitat of Sheardown Lake NW differed significantly between 2019 and the baseline period (Table 4.7; Appendix Figure G.10). However, no significant differences in length, weight, or condition of arctic charr captured at littoral/profundal habitat were indicated between 2019 and the baseline period, reflecting similar results in 2018 (Table 4.7; Appendix Table G.18). From 2015 to 2017, arctic charr sampled from littoral/profundal habitat of Sheardown Lake NW were significantly shorter, lighter, and of greater condition than those captured during the baseline period (Table 4.7). The absence of differences in size and condition of arctic charr at Sheardown Lake NW in 2018 and 2019 compared to the baseline period appeared to reflect closer comparability in fish size between the most recent studies and baseline.[11] In turn, this suggested that arctic charr condition may show very strong size dependence and that the assessment of fish should consider methods that reduce variability in the size of fish sampled to assess the occurrence of mine-related effects. Nevertheless, 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 2019 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.

4.2.6 Integrated Summary of Effects

At Sheardown Lake NW, aqueous concentrations of total ammonia, chloride, molybdenum, nitrate, sulphate, and uranium were elevated compared to the reference lake in 2019, and dissolved molybdenum and sulphate concentrations were elevated compared to the baseline period, suggesting a mine-related source of these metals 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 although concentrations were higher at Sheardown Lake NW than at the reference lake, these metals were largely bound to/contained in suspended particulate matter and were not likely biologically available. The occurrence of relatively high turbidity in Sheardown Lake is hypothesized to reflect natural sources of suspended particulates originating from Mary River, upstream of the mine. Notably, none of the parameters

[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 subsequently 35.9 cm in 2018 and 38.9 cm in 2019.

indicated above were elevated above WQG or AEMP benchmarks at Sheardown Lake NW in 2019. 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 2019, suggesting no marked mine-related influences on sediment metal concentrations in Sheardown Lake NW. Concentrations of iron, manganese, and nickel were above SQG in sediment at littoral and profundal stations, and concentrations of arsenic were above site-specific AEMP benchmarks in sediment at littoral stations of Sheardown Lake in 2019. However, with the exception of nickel, concentrations of these metals were also above respective SQG and Sheardown Lake NW AEMP benchmarks at the reference lake, suggesting natural elevation of these metals in sediment of local study area lakes. Overall, some mine-related effects on water quality and sediment quality were evident at Sheardown Lake NW in 2019, 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 the reference lake in 2019 suggesting greater primary production at Sheardown Lake. However, chlorophyll-a concentrations remained well below the AEMP benchmark during all seasonal sampling events in 2019 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 mine operations. The benthic invertebrate community of Sheardown Lake NW showed significantly higher density, but no ecologically significant differences in richness, Simpson's Evenness, and relative abundance of dominant groups including metal-sensitive chironomids, compared to the reference lake in 2019. 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 2019 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 the reference lake in 2019, and similar abundance of arctic charr at Sheardown Lake NW in 2019 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 the reference lake in 2019. Although non-YOY arctic charr captured at nearshore habitat were of significantly lower condition in 2019 compared to those captured during mine baseline studies, condition has not differed consistently in all years at Sheardown Lake NW since 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 the reference lake in 2019, nor any ecologically meaningful difference in condition in 2019 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 on the biota of Sheardown Lake NW in the fifth year of mine operation.

4.3 Sheardown Lake Southeast (DLO-2)

4.3.1 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 2019 (Appendix Figures C.15 to C.18). Distinctly cooler water temperature was indicated with depth at the Sheardown Lake SE basin during the summer and fall sampling events in 2019 that roughly mirrored gradients observed at Reference Lake 3 during both seasons (Figure 4.17). The average water temperature at the bottom of the water column at Sheardown Lake SE littoral stations did not differ significantly from that at the reference lake, unlike at profundal stations where the water temperature was significantly warmer than at Reference Lake during the August 2019 biological study (Figure 4.8; Appendix Table C.53). 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 2019 showed a gradient of decreasing saturation levels with increased depth over all sampling seasons (Figure 4.17). However, dissolved oxygen concentrations at the bottom of the water column at littoral and profundal stations of Sheardown Lake SE did not differ significantly from those at Reference Lake 3 during the August 2019 biological sampling (Figure 4.8; Appendix Table C.53). Dissolved oxygen concentrations near the bottom of the water column at littoral stations met WQG for the protection of sensitive populations of cold-water species (i.e., 9.5 mg/L), whereas at profundal stations, concentrations were slightly below the minimum threshold at both Sheardown Lake SE and Reference Lake 3 in August 2019 (Figures 4.8 and 4.17).

Water column profiles showed decreasing pH with increased depth at Sheardown Lake SE and Reference Lake 3 in 2019, with the changes in pH through the water column at both lakes appearing to coincide with changes in water temperature (Figure 4.17). The pH near the bottom of the water column at littoral and profundal stations of Sheardown Lake SE were significantly higher than at respective station types/depths at the reference lake during the August 2019 biological study (Figure 4.8). However, the mean incremental difference in bottom pH between

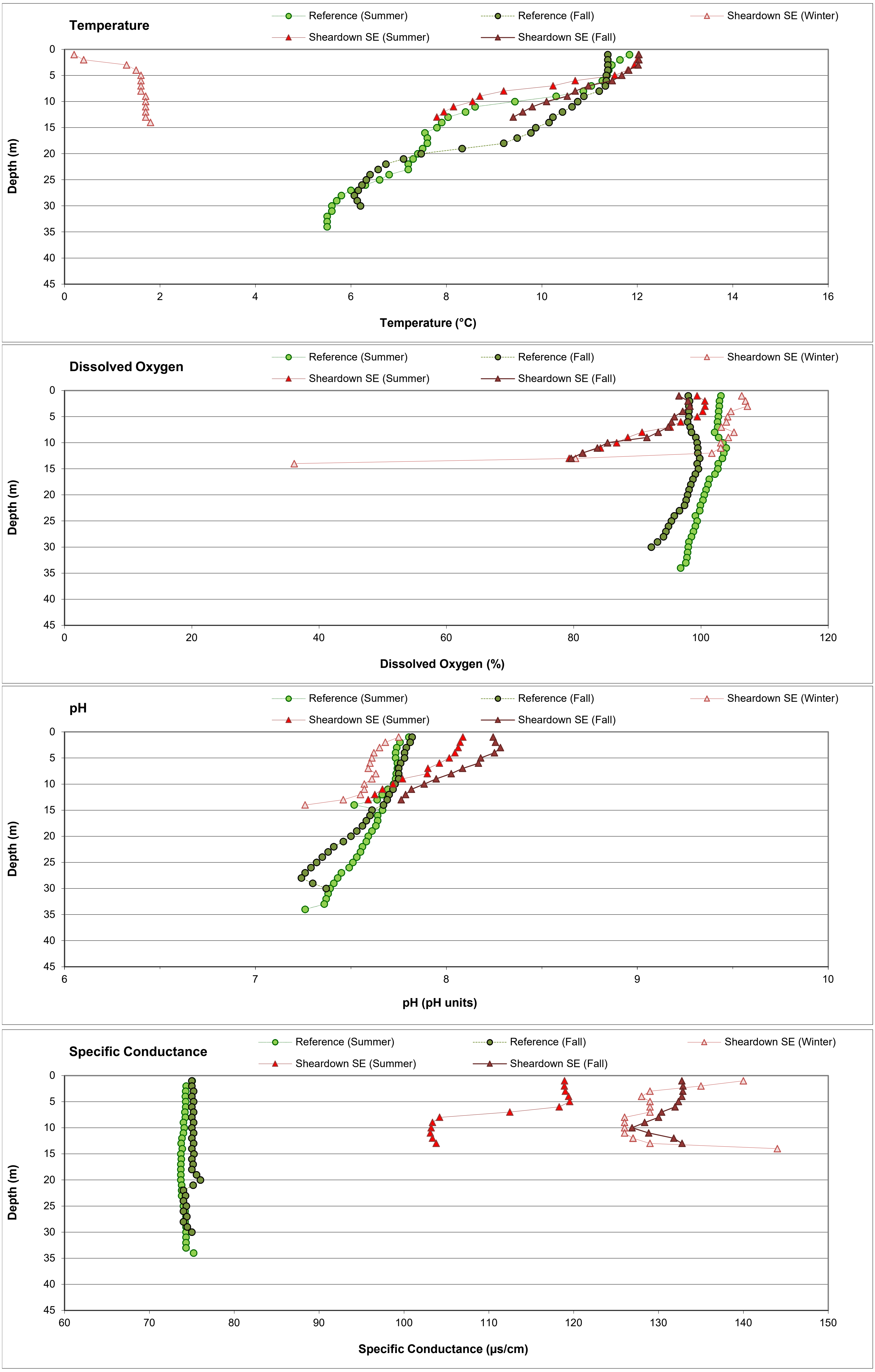


Figure 4.17: Average *In Situ* Water Quality with Depth from Surface at Sheardown Lake SE (DLO-02) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2019

lakes was less than a pH unit, and pH values were consistently within WQG limits at Sheardown Lake SE (Figure 4.8, Appendix Table C.54), suggesting that the pH difference between lakes was not ecologically meaningful. Specific conductance was generally lower near the bottom of the water column than near the surface at Sheardown Lake SE in all seasons (Figure 4.17), and was significantly higher at the littoral and profundal stations of Sheardown Lake SE than at Reference Lake 3 during the August 2019 biological study (Figure 4.8). Secchi depth readings from Sheardown Lake SE were significantly lower (shallower) than at Reference Lake 3 during the August 2019 biological study, but were relatively consistent among stations, suggesting no spatial differences in water clarity within 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 2019 (Table 4.8; Appendix Table C.54), suggesting that the lake waters were laterally well mixed. Turbidity, total aluminum, and total manganese concentrations were moderately (i.e., 5- to 10-fold) to highly elevated (i.e., ≥10-fold), and concentrations of total molybdenum, nitrate, and total uranium were slightly elevated (i.e., 3- to 5-fold), at Sheardown Lake SE compared to Reference Lake 3 in summer and fall sampling events of 2019 (Table 4.8; Appendix Tables C.44 and C.54). Dissolved aluminum, molybdenum, and uranium concentrations were also elevated at Sheardown Lake SE compared to the reference lake in both the summer and fall sampling events of 2019 (Appendix Table C.56). Similar to the northwest basin, total aluminum concentrations showed very strong positive correlations with turbidity for the Sheardown Lake SE combined data set (i.e., winter, summer, and fall data; rs = 0.85), suggesting that much of the total aluminum was associated with suspended particles (Appendix Table C.57). This was corroborated by comparison of total and dissolved fractions, which indicated that on average, approximately half of the aluminum (i.e., 57%) 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, total manganese, molybdenum, and uranium concentrations at Sheardown Lake SE were not positively correlated with turbidity, suggesting that 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 compared to the reference lake, on average, parameter concentrations were below established WQG and AEMP benchmarks during the winter, summer, and fall sampling events in 2019 (Table 4.8; Appendix Table C.54).

Similar to the northwest basin, visual evaluation of plotted data indicated highest conductivity, hardness, and concentrations of chloride, molybdenum, nitrate, sodium, strontium, sulphate, and

Table 4.8: Water Chemistry at Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3) Monitoring Stations[a], Mary River Project CREMP, August 2019

	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 2019	22-Aug-19	22-Aug-19	25-Aug-19	24-Aug-19	24-Aug-19
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	82	149	148	146	147	152
	pH (lab)	pH	6.5 - 9.0	-	7.74	8.45	8.44	8.17	8.12	8.12
	Hardness (as $CaCO_3$)	mg/L	-	-	36	68	73	68	71	69
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	5.4	10.8
	Total Dissolved Solids (TDS)	mg/L	-	-	53	71	63	66	68	79
	Turbidity	NTU	-	-	0.34	0.9	1.0	3.2	5.1	10.2
	Alkalinity (as $CaCO_3$)	mg/L	-	-	34	56	56	56	56	58
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.010	<0.010	<0.010	0.041	0.016	0.013
	Nitrate	mg/L	3	3	0.036	0.1065	0.1065	0.105	0.1015	0.098
	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	-	-	0.18	<0.15	0.16	0.165	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	0.037	0.1065	0.1065	0.105	0.1015	0.098
	Dissolved Organic Carbon	mg/L	-	-	2.7	1.63	1.67	1.54	1.63	1.66
	Total Organic Carbon	mg/L	-	-	3.1	2.08	1.99	2.04	2.32	2.01
	Total Phosphorus	mg/L	0.020[α]	-	0.021	0.0040	0.0058	0.0082	0.0089	0.0121
	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	1.4	3.28	3.21	3.44	3.41	3.90
	Sulphate (SO_4)	mg/L	218[β]	218	3.7	8.72	8.54	8.36	8.38	8.69
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[d]	0.0079	0.023	0.095	0.063	0.065	0.135
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	0.00048	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	0.000115	<0.00010	<0.00010	0.00014
	Barium (Ba)	mg/L	-	-	0.0062	0.0069	0.0073	0.0072	0.0072	0.0083
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	0.000011	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	7.2	12.95	15.15	12.70	12.75	13.40
	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	0.00015
	Copper (Cu)	mg/L	0.002	0.0024	0.00085	0.0008	0.0012	0.0009	0.0009	0.0011
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	0.043	0.060	0.071	0.166
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.0001755	0.000075	0.00009	0.0001835
	Lithium (Li)	mg/L	-	-	0.0010	0.00115	0.0013	0.00115	0.0012	0.00145
	Magnesium (Mg)	mg/L	-	-	4.55	8.43	8.42	8.23	8.32	8.57
	Manganese (Mn)	mg/L	0.935[β]	-	0.00060	0.00270	0.00377	0.00428	0.00527	0.00942
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00014	0.000648	0.000717	0.000565	0.000554	0.000514
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.000575	0.000825	0.000595	0.00062	0.000705
	Potassium (K)	mg/L	-	-	0.9	1.19	1.21	1.18	1.19	1.23
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.483	0.445	0.460	0.565	0.575	0.775
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.91	1.51	1.62	1.55	1.53	1.71
	Strontium (Sr)	mg/L	-	-	0.0082	0.0102	0.0117	0.0103	0.0104	0.0113
	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	0.01200
	Uranium (U)	mg/L	0.015	-	0.00025	0.00084	0.00085	0.00096	0.00092	0.00118
	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	0.0288	<0.0030	<0.0030	<0.0030

[shaded] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

[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).

uranium at Sheardown Lake SE during fall sampling events since commencement of mine operations in 2015 (Figure 4.9; Appendix Figure C.19). Despite these increases over time, seasonal average total and dissolved concentrations of most parameters in 2019 were not substantially elevated (i.e., less than 3-fold higher) compared to concentrations reported during baseline (Appendix Tables C.44 and C.56). The only exceptions were sulphate and dissolved aluminum and molybdenum concentrations, which were elevated in one or more seasons in 2019 (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 2019 compared to baseline at Sheardown Lake SE likely reflected natural phenomena. The magnitude of these year-to-year changes were relatively minor and unlikely to be ecologically meaningful given parameter concentrations remained well below WQG, but nevertheless the increases suggested greater mine-related influence on water quality at Sheardown Lake SE over time.

4.3.2 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 and profundal stations of Sheardown Lake SE contained significantly lower sand, moisture, and TOC content, and significantly greater silt and clay content, than like-habitat stations of Reference Lake 3 (Appendix Table D.17). The relatively high proportion of fines in substrate of Sheardown Lake SE potentially reflected 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 the reference lake, 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.

Sediment metal concentrations at Sheardown Lake SE showed no clear spatial gradients with progression towards the lake outlet in 2019, suggesting no 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

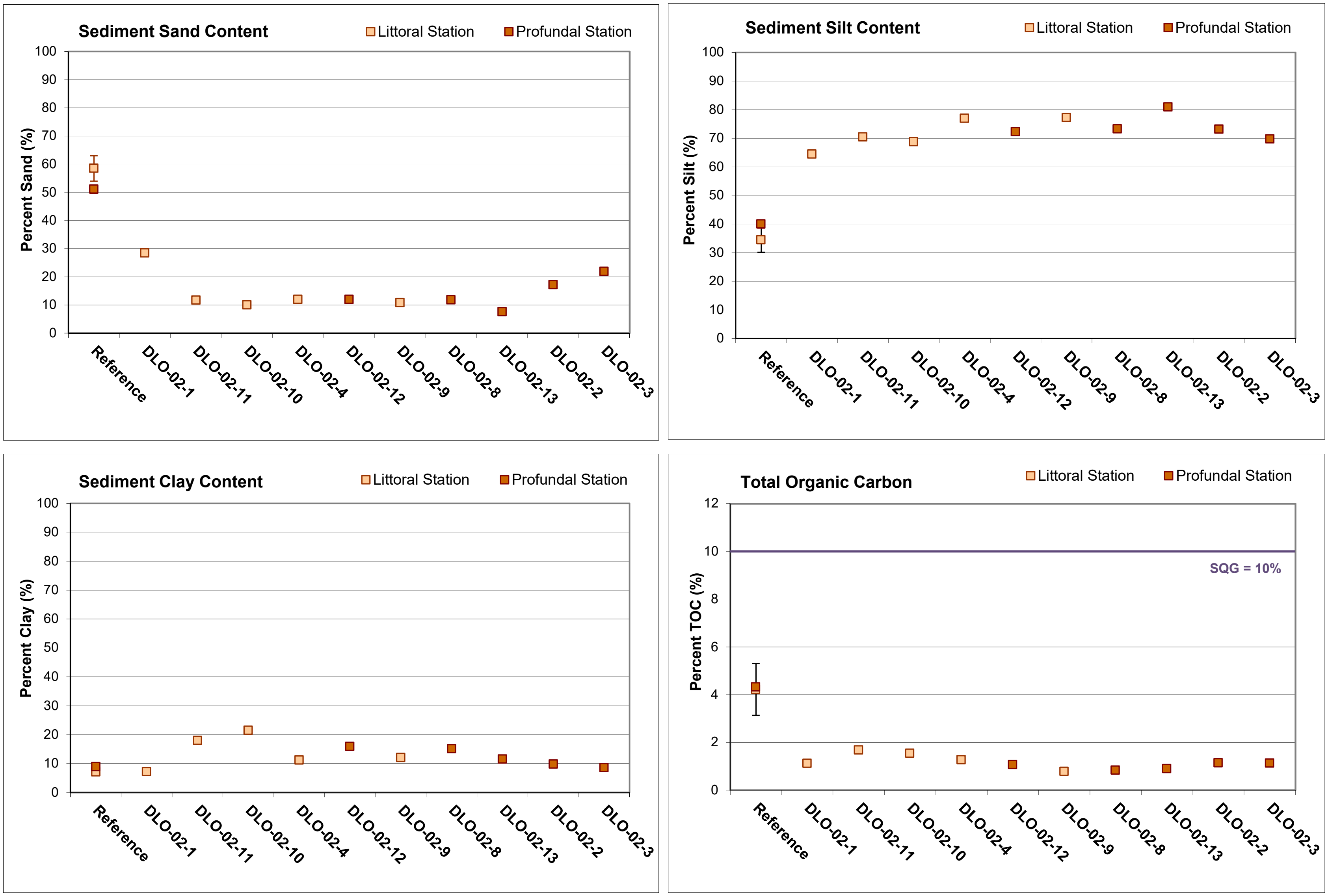


Figure 4.18: Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Sheardown Lake SE (DLO-02) Sediment Monitoring Stations and Reference Lake 3 Averages (mean ± SE), Mary River Project CREMP, August 2019

types at Reference Lake 3, the only exception of which included slight elevation (i.e., 3- to 5-fold) of manganese concentrations in sediment of littoral stations at Sheardown Lake SE (Table 4.3; Appendix Table D.19). On average, concentrations of iron and manganese were above SQG at littoral stations, as were iron concentrations at profundal stations at profundal stations, of Sheardown Lake SE (Table 4.3; Appendix Table D.18). Average concentrations of iron and manganese in sediment were also above AEMP benchmarks at littoral and profundal stations, as were average concentrations of chromium at littoral stations of Sheardown Lake SE in 2019 (Table 4.3; Appendix Table D.18). However, as indicated previously, average concentrations of iron and manganese were also above 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 relative to SQG and lake-specific AEMP benchmarks may be a natural phenomenon in lakes within the local study area of the mine. Arsenic, nickel, and phosphorus concentrations in sediment were also above lake-specific AEMP benchmarks at littoral Stations DLO-02-11 and/or 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), suggesting no marked mine-related influences on sediment metal concentrations at the southeast basin of Sheardown Lake.

Temporal comparisons indicated that metal concentrations in sediment at littoral and profundal stations of Sheardown Lake SE in 2019 were comparable to those observed during the mine baseline (2005 to 2013) period, the only exceptions of which included slightly higher arsenic and manganese concentrations at the littoral stations in 2019 (Figure 4.11; Appendix Table D.19).[12] On average, metal concentrations in sediment at littoral and profundal stations in 2019 were within the upper range of those observed from 2015 to 2018, with some indications of successively higher concentrations over time observed only for arsenic, iron, and manganese (Figure 4.11). Overall, no substantial changes in sediment metal concentrations were indicated at Sheardown Lake SE since the commencement of mine operations in 2015.

4.3.3 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 2019 (Figure 4.12). Chlorophyll-a concentrations did not differ significantly among the winter, summer, and fall sampling events in 2019, indicating relatively uniform phytoplankton abundance among seasons (Appendix Table E.6). Similar to Sheardown Lake NW, chlorophyll-a concentrations at

[12] See footnote 8 regarding differences in the concentration of boron in sediment between baseline and recent CREMP studies.

the Sheardown Lake SE were significantly greater than at the reference lake for both the summer and fall sampling events in 2019 (Appendix Table E.7 and E.8), but concentrations were 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 2019 and the mine construction (2014) period or previous years of mine operation (2015 to 2018) for winter, summer, and 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.

4.3.4 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). Although richness differed significantly between Sheardown Lake SE and the reference lake at profundal stations, the magnitude of this difference was not ecologically significant. In addition to these differences, benthic invertebrate community compositional 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, the only ecologically significant differences in dominant taxonomic groups included greater relative abundance of Chironomidae and metal-sensitive Chironomidae at littoral and profundal stations, respectively, at Sheardown Lake SE compared to Reference Lake 3 (Tables 4.9 and 4.10). As at Sheardown Lake NW, the occurrence of higher benthic invertebrate density without an accompanying difference in Simpson's Evenness or occurrence of a significantly lower relative abundance of metal-sensitive taxa suggested that Sheardown Lake SE was simply more productive than Reference Lake 3, and was not adversely influenced by mine operations in 2019.

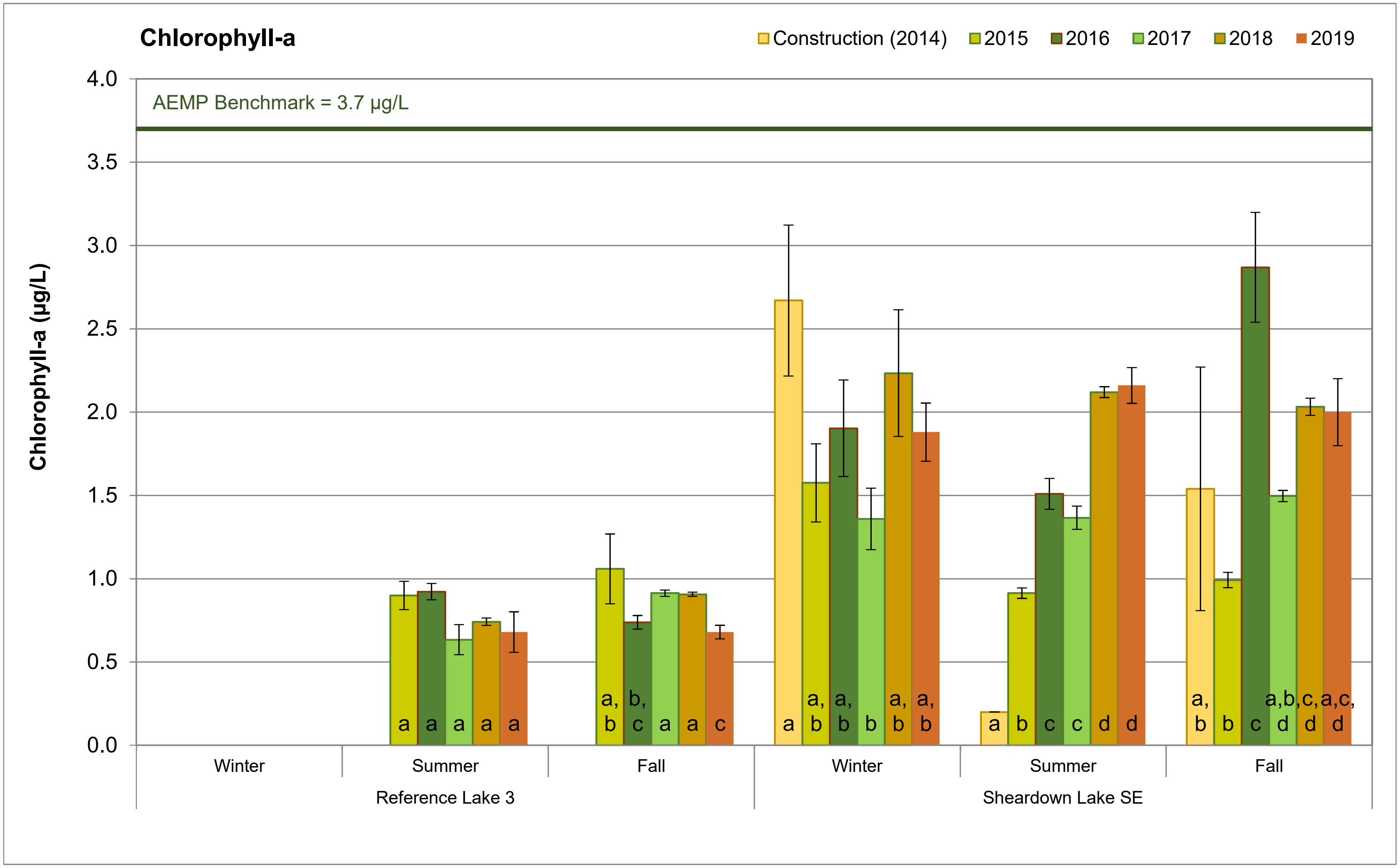


Figure 4.19: Temporal Comparison of Chlorophyll-a Concentrations Among Seasons between Sheardown Lake SE and Reference Lake 3 for Mine Construction (2014) and Operational (2015 to 2019) Periods (mean ± SE)

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 2019

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	0.002	t-test (unequal)	12.9	Reference Lake 3	1,247	297	133	871	1,156	1,594
						Sheardown SE Littoral	5,080	1,329	595	3,568	5,439	6,516
Richness (Number of Taxa)	none	NO	0.305	ANOVA	-0.5	Reference Lake 3	12.8	2.3	1.0	9.0	13.0	15.0
						Sheardown SE Littoral	11.6	0.9	0.4	11.0	11.0	13.0
Simpson's Evenness (E)	log10	NO	0.244	ANOVA	-0.9	Reference Lake 3	0.865	0.041	0.018	0.811	0.862	0.924
						Sheardown SE Littoral	0.826	0.058	0.026	0.781	0.804	0.920
Bray-Curtis Index	none	YES	< 0.001	ANOVA	5.4	Reference Lake 3	0.291	0.100	0.045	0.162	0.275	0.391
						Sheardown SE Littoral	0.830	0.042	0.019	0.770	0.822	0.882
Nemata (%)	log10(x+1)	YES	0.057	ANOVA	-0.8	Reference Lake 3	7.3	7.9	3.5	0.8	3.9	20.0
						Sheardown SE Littoral	1.1	1.3	0.6	0.0	1.1	3.2
Hydracarina (%)	log10	NO	0.395	ANOVA	-0.6	Reference Lake 3	4.6	2.9	1.3	1.1	4.7	9.0
						Sheardown SE Littoral	2.9	1.5	0.6	1.7	2.7	5.3
Ostracoda (%)	log10	YES	0.007	ANOVA	-1.8	Reference Lake 3	25.1	11.0	4.9	13.8	21.8	41.8
						Sheardown SE Littoral	5.4	7.7	3.5	0.8	2.4	19.0
Chironomidae (%)	rank	YES	0.008	Mann-Whitney	2.1	Reference Lake 3	62.9	12.9	5.8	48.4	71.2	73.0
						Sheardown SE Littoral	90.3	9.2	4.1	74.1	93.7	96.4
Metal-Sensitive Chironomidae (%)	log10	NO	0.291	ANOVA	0.7	Reference Lake 3	10.5	7.8	3.5	4.8	6.9	24.1
						Sheardown SE Littoral	16.3	7.8	3.5	4.3	15.9	24.0
Collector-Gatherers (%)	none	YES	0.022	ANOVA	-1.6	Reference Lake 3	81.1	17.8	8.0	51.2	87.9	97.9
						Sheardown SE Littoral	51.9	14.6	6.5	33.9	59.1	67.2
Filterers (%)	none	YES	0.075	ANOVA	1.5	Reference Lake 3	7.1	6.3	2.8	1.1	5.8	17.9
						Sheardown SE Littoral	16.3	7.8	3.5	4.3	15.9	24.0
Shredders (%)	rank	YES	0.025	Mann-Whitney	-0.7	Reference Lake 3	6.5	9.5	4.2	0.0	2.9	23.2
						Sheardown SE Littoral	0.0	0.0	0.0	0.0	0.0	0.0
Clingers (%)	none	NO	0.158	ANOVA	1.0	Reference Lake 3	11.9	7.9	3.5	2.1	10.0	23.3
						Sheardown SE Littoral	19.6	7.7	3.4	7.2	20.6	26.2
Sprawlers (%)	log10	YES	<0.001	ANOVA	-3.8	Reference Lake 3	74.1	8.3	3.7	60.4	75.7	81.2
						Sheardown SE Littoral	42.4	6.1	2.7	35.2	43.0	49.5
Burrowers (%)	none	YES	0.006	ANOVA	3.5	Reference Lake 3	14.0	6.9	3.1	3.8	16.2	22.1
						Sheardown SE Littoral	38.0	12.6	5.7	24.9	32.3	55.6

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.

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

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 2019

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)	log10	YES	<0.001	ANOVA	44.9	Reference Lake 3	304	89	40	217	276	448
						Sheardown SE Profundal	4,284	851	381	3,631	3,930	5,769
Richness (Number of Taxa)	log10	YES	0.025	ANOVA	1.8	Reference Lake 3	5.6	2.6	1.2	3.0	6.0	9.0
						Sheardown SE Profundal	10.2	2.3	1.0	8.0	10.0	13.0
Simpson's Evenness (E)	log10	NO	0.159	ANOVA	1.0	Reference Lake 3	0.534	0.174	0.078	0.278	0.584	0.701
						Sheardown SE Profundal	0.706	0.149	0.067	0.463	0.752	0.823
Bray-Curtis Index	none	YES	<0.001	ANOVA	8.9	Reference Lake 3	0.187	0.088	0.039	0.086	0.208	0.305
						Sheardown SE Profundal	0.970	0.022	0.010	0.937	0.971	0.991
Hydracarina (%)	log10(x+1)	NO	0.689	ANOVA	-0.5	Reference Lake 3	4.5	4.7	2.1	0.0	4.1	10.6
						Sheardown SE Profundal	2.3	2.4	1.1	0.5	1.3	6.4
Ostracoda (%)	log10	YES	0.046	ANOVA	-0.8	Reference Lake 3	9.0	8.1	3.6	2.0	6.6	21.7
						Sheardown SE Profundal	2.2	1.7	0.7	0.9	1.8	5.0
Chironomidae (%)	log10	YES	0.009	ANOVA	1.8	Reference Lake 3	82.9	6.8	3.0	75.0	82.6	93.4
						Sheardown SE Profundal	95.3	4.2	1.9	87.8	97.4	97.4
Metal-Sensitive Chironomidae (%)	none	YES	0.020	ANOVA	4.3	Reference Lake 3	2.1	3.4	1.5	0.0	0.0	7.8
						Sheardown SE Profundal	16.9	10.9	4.9	3.3	17.5	29.3
Collector-Gatherers (%)	none	YES	0.014	ANOVA	-4.0	Reference Lake 3	92.8	10.0	4.5	75.9	95.9	100.0
						Sheardown SE Profundal	52.7	26.8	12.0	24.5	50.5	85.5
Filterers (%)	none	YES	0.026	t-test (unequal)	nc	Reference Lake 3	0.0	0.0	0.0	0.0	0.0	0.0
						Sheardown SE Profundal	16.8	10.9	4.9	3.3	17.5	29.1
Clingers (%)	none	YES	0.038	ANOVA	3.1	Reference Lake 3	4.5	4.7	2.1	0.0	4.1	10.6
						Sheardown SE Profundal	19.3	12.4	5.6	4.5	18.8	31.9
Sprawlers (%)	none	YES	<0.001	ANOVA	-7.8	Reference Lake 3	90.5	7.4	3.3	83.8	87.6	100.0
						Sheardown SE Profundal	32.7	19.5	8.7	13.1	23.9	59.2
Burrowers (%)	none	YES	0.025	t-test (unequal)	12.7	Reference Lake 3	5.0	3.4	1.5	0.0	5.6	8.3
						Sheardown SE Profundal	48.1	27.8	12.4	21.1	44.7	82.4

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.

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

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 the reference lake (Appendix Table F.40). The occurrence of more stable, compact sediment likely accounted for significantly higher relative abundance of the burrower HPG 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 the reference lake (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 2019 (Appendix B) indicating 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 the reference lake 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 2019.

No ecologically significant differences in general community effect indicators of richness and Simpson's Evenness were shown for littoral or profundal habitats of Sheardown Lake SE between the mine baseline (2007, 2013) and individual years since the commencement of mine operation (2015 to 2019; 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 between years of mine operation from 2015 to 2019 and mine baseline data collected in 2007 (Figure 4.20; Appendix Tables F.42 and F.43). Because density was the only benthic invertebrate community metric that consistently differed significantly between mine-operational and baseline studies at

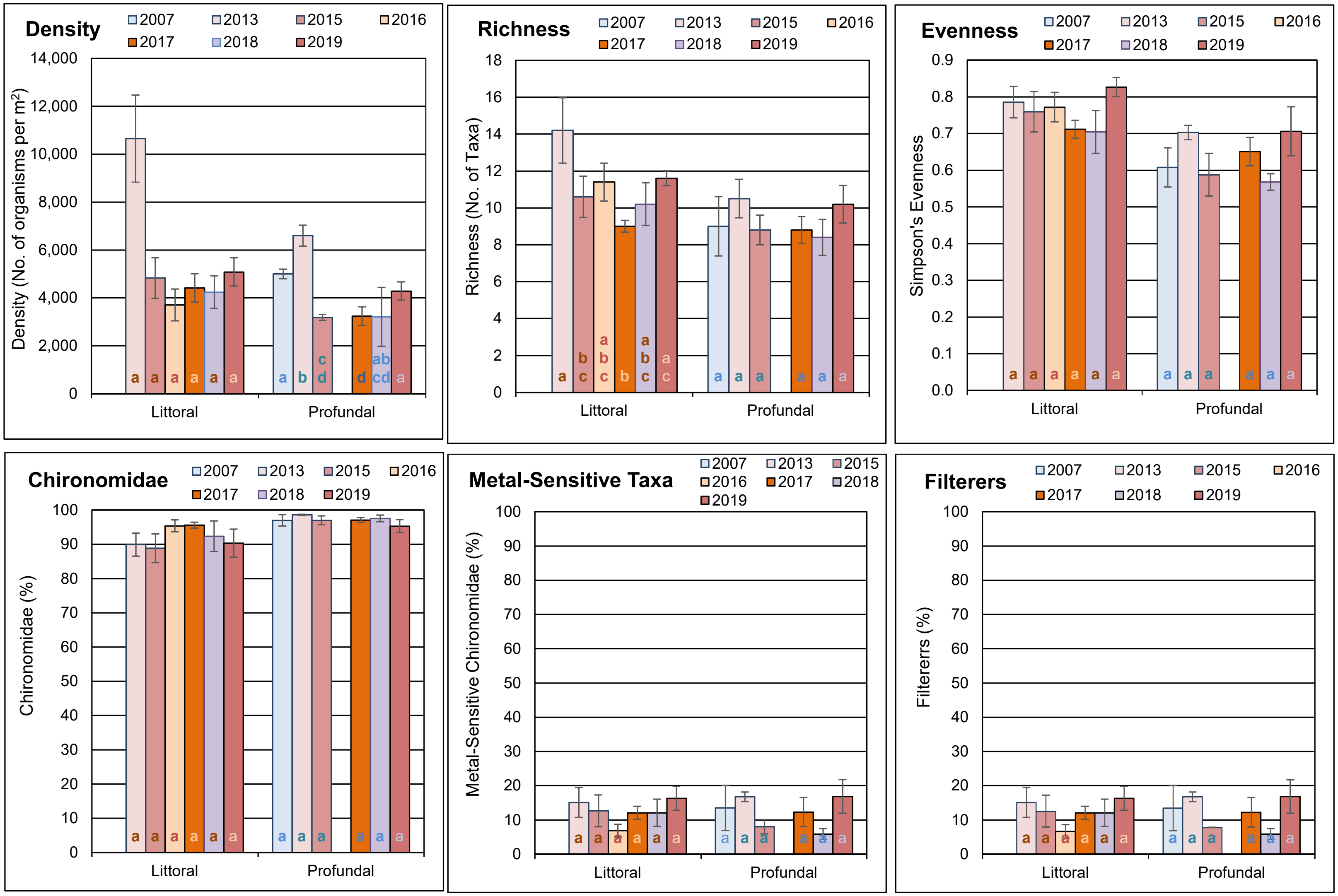


Figure 4.20: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Sheardown Lake SE Littoral and Profundal Study Areas among Mine Baseline (2007, 2013) and Operational (2015 to 2019) Periods

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

Sheardown Lake SE, natural temporal variability among studies (and in particular, high density during the 2007 baseline study) most likely accounted for the temporal difference 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 mine operation in 2015.

4.3.5 Fish Population

4.3.5.1 Sheardown Lake SE Fish Community

The Sheardown Lake SE fish community was composed of arctic charr and ninespine stickleback in 2019 (Table 4.6), reflecting the same fish species composition shown historically at the reference lake (Minnow 2018, 2019). 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.

Electrofishing CPUE in 2019 was higher than in the four previous years of mine operation (i.e., 2015 to 2018) at Sheardown Lake SE, and was within the range shown during baseline studies conducted in 2007, 2008, and 2013 (Figure 4.15). Gill netting CPUE for arctic charr in 2019 was also in the upper range shown over baseline studies conducted from 2006 to 2008, and comparable to that shown over the previous four years in which the mine was operating (Figure 4.15). 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 mine operation in 2015.

4.3.5.2 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 2019. Although before-after analysis of data collected at Sheardown Lake SE in 2019 (mine operation) and 2007 (baseline) was conducted (Appendix Table G.7), poor accuracy in fresh body weight measurements during baseline sampling precluded meaningful data interpretation, and therefore these results were not discussed further herein. A total of 100 arctic charr were captured at nearshore habitat at each of Sheardown Lake SE and

Reference Lake 3 in August 2019 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 5.8 cm and 4.8 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). However, due to small sample size of nearshore arctic charr YOY at Reference Lake 3 (i.e., three fish), health comparisons involved assessment of only the non-YOY population.

Length-frequency distributions for the nearshore arctic charr differed significantly between Sheardown Lake SE and Reference Lake 3 (Table 4.11), likely reflecting greater prevalence of YOY individuals captured at Sheardown Lake SE (Figure 4.21). Arctic charr non-YOY were significantly shorter and lighter at the Sheardown Lake SE nearshore than at the reference lake nearshore (Table 4.11; Appendix Table G.20). Although the condition of arctic charr non-YOY was significantly greater at Sheardown Lake SE compared to Reference Lake 3, the magnitude of difference in condition was within the CES_C of ±10%, suggesting that this difference was not ecologically significant (Table 4.11; Appendix Table G.20). Temporal comparisons indicated no consistent directional differences in nearshore non-YOY arctic charr size or condition between Sheardown Lake SE and the reference lake from 2015 to 2019 (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 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 2019 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 2019 and during baseline characterization studies (2006 and 2008 combined data). A total of 100 and 27 arctic charr were sampled from littoral/profundal habitat of Sheardown Lake SE and Reference Lake 3, respectively, in August 2019, for the control-impact analysis. The length-frequency distribution for littoral/profundal arctic charr differed significantly between lakes (Table 4.11; Figure 4.21). Although the mean length and weight of littoral/profundal arctic charr captured at Sheardown Lake SE were significantly greater than those captured at the reference lake, no difference in arctic charr condition was shown between lakes in 2019 (Table 4.11; Appendix Table G.24).

The length-frequency distribution of arctic charr captured at littoral/profundal habitat of Sheardown Lake SE did not differ significantly between 2019 and the baseline period (Table 4.11). Arctic charr captured at littoral/profundal habitat of Sheardown Lake SE in 2019 were significantly

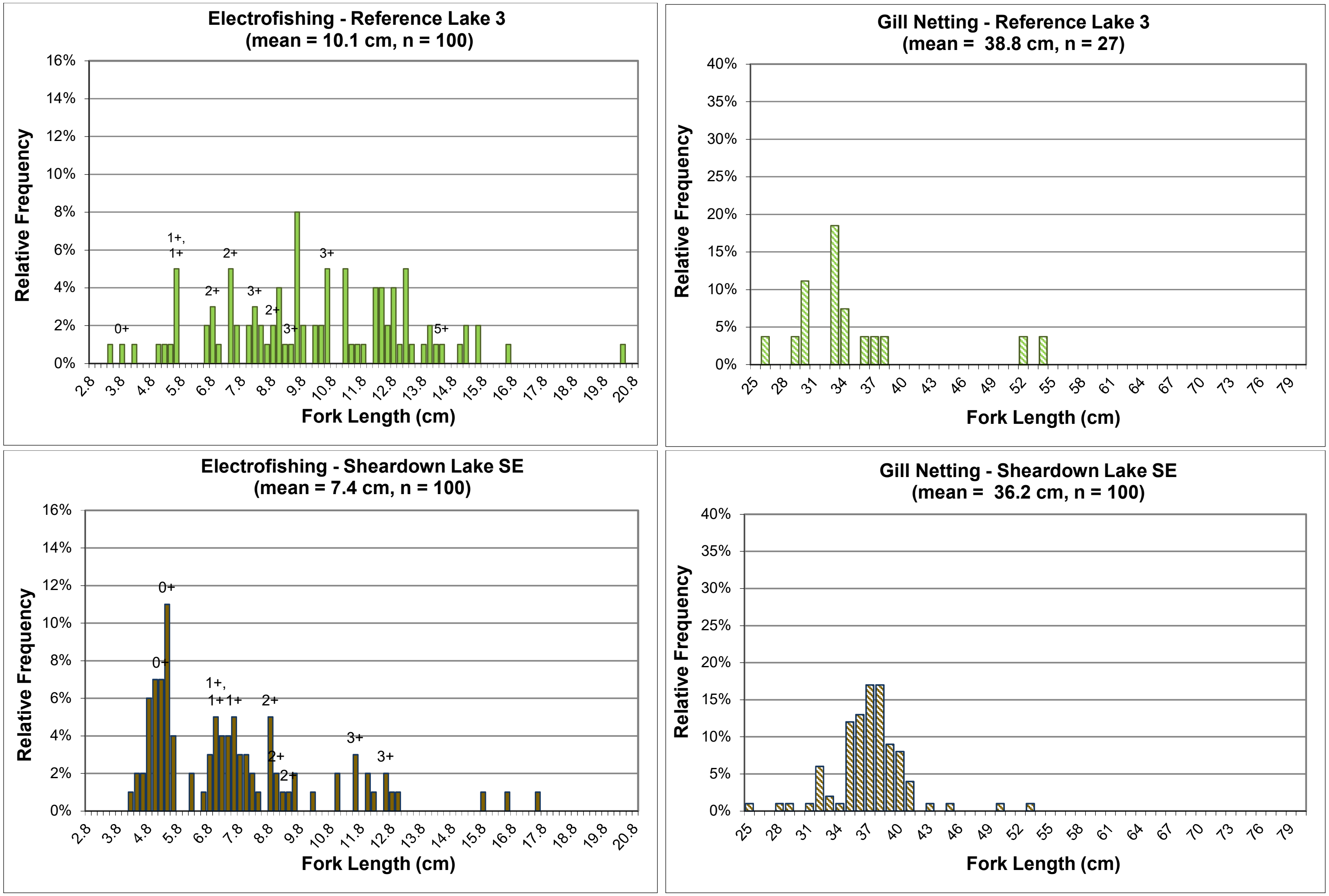


Figure 4.21: Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2019

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 2019, 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	2019	2015	2016	2017	2018	2019
Nearshore Electrofishing	Survival	Length-Frequency Distribution	No	Yes	Yes	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 (-28%)	Yes (+7%)	Yes (-15%)	Yes (+19%)	Yes (-47%)	No
		Size (mean weight)	No	No	Yes (+55%)	Yes (+59%)	Yes (-59%)	No	Yes (-43%)	Yes (+54%)	No	No
	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	Yes (+4%)	No	Yes (+9%)	Yes (-13%)	Yes (+4%)	Yes (-14%)	Yes (-16%)	No	Yes (-15%)	Yes (-13%)
Littoral/Profundal Gill Netting [c]	Survival	Length Frequency Distribution	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes	No
		Age	-	-	-	-	-	Yes (-13%)	No	No	-	-
	Energy Use	Size (mean fork length)	-	-	-	No	Yes (+23%)	Yes (-9%)	Yes (-7%)	Yes (-5%)	Yes (-4%)	Yes (-2%)
		Size (mean weight)	-	-	-	No	Yes (+102%)	Yes (-26%)	Yes (-20%)	Yes (-16%)	Yes (-16%)	Yes (-11%)
		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	No	Yes (-6%)	Yes (-7%)	Yes (-6%)

[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.

smaller and of lower condition compared to those captured during baseline studies, but the magnitude of these differences were well within applicable CES and thus not ecologically significant (Table 4.11; Appendix Table G.24). Arctic charr sampled at littoral/profundal habitat of Sheardown Lake SE in years of mine operation from 2015 to 2019 have consistently been significantly shorter and lighter compared to those captured during the mine baseline period, but significantly lower condition has only occurred since 2017 (Table 4.11). Notably, the differences in arctic charr condition in years from 2017 to 2019 compared to the baseline period were 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 five years of mine operation.

4.3.6 Integrated Summary of Effects

At Sheardown Lake SE, aqueous concentrations of manganese, molybdenum, nitrate, and uranium were elevated compared to the reference lake, and molybdenum and sulphate concentrations were elevated compared to the baseline period, in 2019. However, all of these water quality parameters were observed at concentrations below applicable WQG and AEMP benchmarks in 2019. Similar to the northwest basin, aluminum concentrations showed strong positive correlation with turbidity at Sheardown Lake SE in 2019 that, in turn, suggested that this metal was largely bound to/contained in suspended particulate matter and was not likely biologically available. High turbidity in Sheardown Lake SE 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 the reference lake in 2019. 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 the reference lake. Although arsenic, chromium, nickel, and phosphorus concentrations were above AEMP benchmarks at individual littoral and profundal stations, concentrations of all these metals except nickel were also above AEMP benchmarks specific to Sheardown Lake SE at the reference lake. Temporal comparisons indicated that metal concentrations in sediment of Sheardown Lake SE in 2019 were in the upper ranges of those shown during baseline studies with the exception of slight elevation of arsenic, iron, and manganese concentrations, 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 the reference lake in 2019 suggesting greater primary production at Sheardown Lake. However, chlorophyll-a concentrations remained well below the AEMP benchmark during all seasonal sampling events in 2019 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 mine operations in 2015. The benthic invertebrate community of Sheardown Lake SE showed significantly higher density and differences in community composition that included greater relative abundance of metal-sensitive and burrowing taxa compared to the reference lake in 2019. 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 2019 compared to the mine baseline period. These results indicated that the differences in community composition at Sheardown Lake SE in 2019 compared to the reference area were likely attributable to differing habitat (average and maximum depth, substrate compactness) between lakes. The size of the arctic charr population was greater at Sheardown Lake SE compared to the reference lake in 2019, but similar numbers of arctic charr were present at Sheardown Lake SE in 2019 compared to the baseline period. Arctic charr non-YOY captured at nearshore habitat of Sheardown Lake SE showed no ecologically significant difference in condition compared to those captured at the reference lake in 2019. In addition, no consistent directional differences in nearshore non-YOY arctic charr condition were indicated between Sheardown Lake SE and the reference lake from 2015 to 2019. 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 2019, nor at Sheardown Lake SE between 2019 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 on the biota of Sheardown Lake SE in the fifth 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) at Mary River stations was consistently at or above saturation during all spring, summer, and fall monitoring events, and was 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 in August 2019, 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.20; Appendix Table C.61). This suggested that slight differences in DO concentrations among the Mary River study areas were not ecologically meaningful.

In situ pH at all Mary River mine-exposed stations was similar to pH at the GO-09 series river reference stations during the spring and fall sampling events, but lower than at the reference stations just downstream of the mine (i.e., Stations EO-20 and EO-21) during the summer sampling event in 2019 (Figure 5.1; Appendix Tables C.1 to C.3). However, 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 proportion of flow from surface runoff (e.g., spring snowmelt) and baseflow/groundwater sources. Spatially, specific conductance was slightly higher at Mary River water quality stations located downstream than upstream of the Mary River Tributary-F confluence in 2019 (Figure 5.1). Specific conductance was considerably higher at Mary River Tributary-F than at all other monitoring stations, which suggested that this tributary was the primary receiver for mine-related inputs within the Mary River system (e.g., MS-08 effluent).

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, summer, or fall sampling events in 2019 with the exception of sulphate concentrations, which were elevated and decreased with distance downstream of the confluence with Mary River Tributary-F (Table 5.1; Appendix Table C.62). In addition to sulphate, Mary River Tributary-F appeared to contribute to elevated nitrate concentrations in Mary River at stations adjacent to the mine (Stations EO-10 and/or EO-03) during the summer and fall sampling events (Table 5.1 Appendix Tables C.61 and C.62). Slight (i.e., 3- to 5-fold) to moderate (i.e., 5- to 10-fold) elevation in nitrate concentrations in summer, and turbidity and concentrations of cobalt, iron, lead,

Figure 5.1: Comparison of *In Situ* Water Quality Variables Measured at Mary River Water Quality Monitoring Stations in Spring, Summer, and Fall 2019, Mary River Project CREMP

Table 5.1: Water Chemistry at Mary River Monitoring Stations, Mary River Project CREMP, August 2019

	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 2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019
Conventionals	Conductivity (lab)	umho/cm	-	-	168	230	231	228	218	210	571	255	232	255	252	258	255	251
	pH (lab)	pH	6.5 - 9.0	-	8.09	8.39	8.40	8.36	8.22	8.25	8.34	8.26	8.24	8.26	8.28	8.29	8.26	8.26
	Hardness (as $CaCO_3$)	mg/L	-	-	81	96	103	98	91	93.2	294	113	101	101.5	102	105	104	101
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	6.4	3.5	5.3	8.3	6.9	<2.0	6.2	9.2	10.7	8.4	4.6	2.5	2.3
	Total Dissolved Solids (TDS)	mg/L	-	-	92	134	150	142	133	129	399	157	148	154	154	144	139	143
	Turbidity	NTU	-	-	4.8	15.9	9.7	15.2	27.7	29.1	3.5	29.1	36.2	47.4	42.9	22.0	8.7	10.9
	Alkalinity (as $CaCO_3$)	mg/L	-	-	67	86	96	90	83	86	120	89	88	88	89	91	90	89
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	<0.010
	Nitrate	mg/L	3	3	0.029	<0.020	<0.020	<0.020	<0.020	<0.020	0.988	0.118	0.039	0.051	0.05	0.051	0.051	0.059
	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	0.16	<0.15	<0.15	0.15	<0.15	0.19	<0.15	<0.15	0.21	0.17	<0.15	0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.4	1.6	1.8	1.5	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.4	1.6	1.6
	Total Organic Carbon	mg/L	-	-	1.7	1.9	1.9	1.9	2.2	2.2	1.7	1.9	2.0	2.2	2.3	2.0	1.9	2.1
	Total Phosphorus	mg/L	0.020[α]	-	0.0053	0.0125	0.0080	0.0102	0.0134	0.0178	0.0049	0.0180	0.0283	0.0291	0.0971	0.0154	0.0077	0.0064
	Phenols	mg/L	0.004[α]	-	0.0021	<0.0010	0.0042	0.0031	0.0015	0.0017	<0.0010	0.0020	0.0108	0.0012	0.0050	<0.0010	0.0019	<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	7.7	17.1	13.7	15.8	14.3	13.0	17.2	13.5	13.3	13.5	12.7	13.1	12.6	12.3
	Sulphate (SO_4)	mg/L	218[β]	218	9.0	7.9	6.2	7.2	6.0	6.1	164.0	23.5	13.0	13.3	12.8	12.7	12.6	12.9
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.208	0.557	0.310	0.453	0.887	0.899	0.077	***3.150***	0.886	***1.140***	0.961	0.595	0.287	0.312
	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	0.00011	0.00013	<0.00010	0.00012	0.00017	0.00017	<0.00010	0.00015	0.00020	0.00022	0.00023	0.00014	0.00012	0.00011
	Barium (Ba)	mg/L	-	-	0.0117	0.0169	0.0144	0.0158	0.0176	0.0183	0.0247	0.0177	0.0194	0.0207	0.0199	0.0177	0.0159	0.0156
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	-	-	<0.00050	<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
	Boron (B)	mg/L	1.5	-	<0.010	0.01	<0.010	<0.010	<0.010	0.011	<0.010	0.01	0.01	0.011	0.011	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000074	<0.0000050	0.0000098	<0.0000050	0.00001255	0.0000068	0.0000085	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	-	-	16.6	20.0	21.6	20.5	18.7	19.2	47.9	22.2	20.2	20.2	20.5	20.5	20.9	20.4
	Chromium (Cr)	mg/L	0.0089	0.0089	0.000615	0.00227	0.00058	0.00086	0.00207	0.00190	<0.00050	0.00142	0.00196	0.00264	0.00214	0.00135	0.00057	0.00059
	Cobalt (Co)	mg/L	0.0009[α]	0.004	0.00012	0.00021	0.00012	0.00018	0.00036	0.00036	0.00018	0.00034	0.00047	0.00061	0.00050	0.00032	0.00012	0.00013
	Copper (Cu)	mg/L	0.002	0.0024	0.0011	0.0017	0.0021	0.0017	***0.0025***	0.0024	0.0012	0.0020	0.0024	***0.0028***	***0.0027***	0.0020	0.0015	0.0014
	Iron (Fe)	mg/L	0.30	0.874	0.143	0.450	0.249	0.387	0.820	0.835	0.088	0.652	***1.010***	***1.320***	***1.090***	0.666	0.225	0.255
	Lead (Pb)	mg/L	0.001	0.001	0.00015	0.00038	0.00023	0.00037	0.00069	0.00075	0.00013	0.00065	0.00085	***0.00102***	0.00094	0.00054	0.00020	0.00023
	Lithium (Li)	mg/L	-	-	0.0011	0.0014	<0.0010	0.0011	0.0018	0.0017	0.0026	0.0016	0.0019	0.0023	0.0021	0.0015	0.0011	0.0011
	Magnesium (Mg)	mg/L	-	-	9.5	11.1	11.7	11.2	10.8	11.0	41.6	13.8	12.2	12.4	12.4	12.4	12.8	12.4
	Manganese (Mn)	mg/L	0.935[β]	-	0.0020	0.0059	0.0033	0.0051	0.0099	0.0101	0.0016	0.0086	0.0128	0.0164	0.0138	0.0088	0.0037	0.0040
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	#DIV/0!	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00053	0.00069	0.00053	0.00059	0.00046	0.00051	0.00035	0.00051	0.00062	0.00060	0.00055	0.00064	0.00068	0.00067
	Nickel (Ni)	mg/L	0.025	0.025	0.00065	0.00092	0.00062	0.00081	0.00144	0.00177	0.00090	0.00129	0.00174	0.00228	0.00209	0.00151	0.00102	0.00098
	Potassium (K)	mg/L	-	-	1.14	1.97	1.67	1.81	1.81	1.86	1.81	1.74	1.87	2.01	1.92	1.84	1.73	1.66
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000241	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	1.23	1.79	1.29	1.47	2.47	2.46	0.74	1.86	2.18	2.74	2.50	1.68	1.15	1.21
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<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
	Sodium (Na)	mg/L	-	-	3.5	7.4	5.9	6.7	5.4	5.4	2.9	5.0	5.2	5.2	5.1	5.2	5.2	5.0
	Strontium (Sr)	mg/L	-	-	0.0199	0.0282	0.0253	0.0272	0.0251	0.0241	0.0603	0.0276	0.0258	0.0265	0.0258	0.0250	0.0243	0.0243
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	0.00001	<0.000010	0.00001	0.00002	0.00002	<0.000010	0.00002	0.00003	0.00003	0.00003	0.00002	<0.000010	0.00001
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.015	0.026	0.015	0.022	0.047	0.049	0.005	0.036	0.058	0.074	0.060	0.036	0.014	0.014
	Uranium (U)	mg/L	0.015	-	0.0055	0.0076	0.0065	0.0072	0.0057	0.0057	0.0044	0.0055	0.0055	0.0056	0.0055	0.0054	0.0052	0.0049
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	0.00120	0.00078	0.00103	0.0017	0.00178	<0.00050	0.00154	0.00208	0.00258	0.00222	0.00145	0.00072	0.00070
	Zinc (Zn)	mg/L	0.030	0.030	0.007025	<0.0030	<0.0030	<0.0030	0.0043	0.005	<0.0030	<0.0030	<0.0030	0.0067	0.0038	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	-	-		0.00117	0.00075	0.00110	0.00158	0.00171	0.00035	0.00137	0.00137	0.00172	0.00150	0.00107	0.00064	0.00068

(grey shading) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

[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.

manganese, total phosphorus, and titanium in fall, occurred at stations located just downstream of the mine compared to the GO-09 reference area (Table 5.1; Appendix Tables C.61 and C.62). These findings were consistent with a potential source originating from mine operations.

Total aluminum concentrations in spring, and total aluminum, copper, iron, and lead concentrations in summer and fall, were elevated above WQG at one or more Mary River mine-exposed stations in 2019 (Table 5.1; Appendix Table C.61). However, total concentrations of these metals 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 2019 (Appendix Table C.61), suggesting a natural source of these metals to the Mary River system unrelated to the mine.[13] Notably, turbidity showed a strong positive correlation with total concentrations of each of these metals, but not with the dissolved fraction, suggesting not only that these metals were likely bound to suspended inorganic material in the water and were not bioavailable, but also that the mine was not a key contributor to concentrations of these metals in Mary River (Appendix Table C.65). Therefore, although total concentrations of aluminum, copper, iron, and lead were above applicable watercourse-specific AEMP benchmarks at some Mary River stations in summer and fall (Table 5.1; Appendix Table C.61), elevation above these benchmarks was unrelated to the mine and was unlikely to result in an adverse biological response. Phenol concentrations were above WQG at Mary River mine-exposed stations EO-03 and EO-20 during the fall sampling event, but because phenol concentrations were also above WQG at the upstream-most reference station GO-09, phenol concentrations above WQG at Mary River were not likely attributable to mine operations (Appendix Table C.61).

Temporal evaluation of Mary River water chemistry data indicated that parameter concentrations at not only the mine-exposed stations, but also at the upstream reference stations within the Mary River system, were generally highest in 2019 compared to all previous years of monitoring, including the baseline, for data collected in the fall (Figure 5.2; Appendix Figure C.21). Because parameter concentrations appeared to be elevated at the upstream reference area, this suggested that higher parameter concentrations in fall 2019 compared to previous years reflected natural factors or were associated with the analytical determination In turn, this confounded the interpretation of changes in water quality over time at the Mary River stations associated with the fall sampling event . Except for slight to moderate elevation in sulphate concentrations at stations downstream of the confluence with Mary River Tributary-F in 2019 compared to baseline, no

[13] 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.

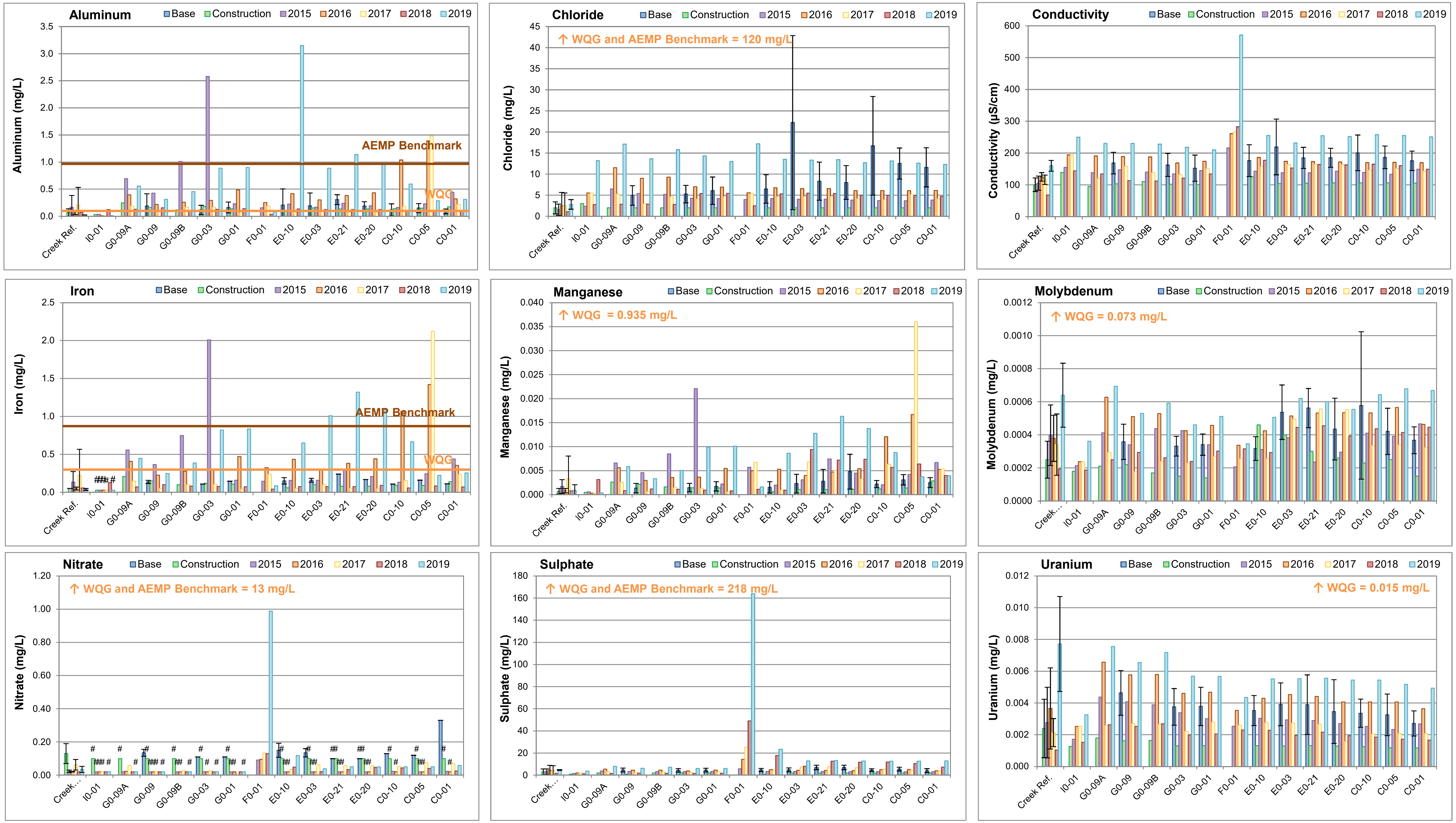


Figure 5.2: Temporal Comparison of Water Chemistry at Mary River Stations for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2019) Periods in the Fall

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.

parameters showed higher concentrations over time at Mary River during sampling events conducted in the spring and summer.

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 2019 spring, summer, and 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 2019, and were suggestive of low (i.e., oligotrophic) phytoplankton productivity based on Dodds et al (1998) trophic status classification for stream environments. Therefore, no adverse mine-related influences on phytoplankton abundance were indicated at Mary River or MRTF in 2019. Low to moderate phytoplankton productivity was expected for Mary River reference and mine-exposed stations in 2019 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.61).

Temporal comparisons of the Mary River chlorophyll-a data suggested that concentrations were generally higher at mine-exposed and reference stations in fall 2019 compared to all previous monitoring including over the mine baseline and operational periods (Figure 5.4). Chlorophyll-a concentrations in fall 2019 were not disproportionately higher or lower compared to baseline at the mine-exposed stations of Mary River compared to the reference stations, suggesting no change in mine-related influences over time.

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). At the upper mine-exposed study area EO-01, no ecologically significant differences in density or richness were indicated relative to both reference study areas (Figure 5.5; Appendix Table F.53). Differing Simpson's Evenness and Bray-Curtis Index suggested a differing community composition between EO-01 and upstream-most reference GO-09 that included significantly lower relative abundance of metal-sensitive Chironomidae at EO-01 (Figure 5.5).

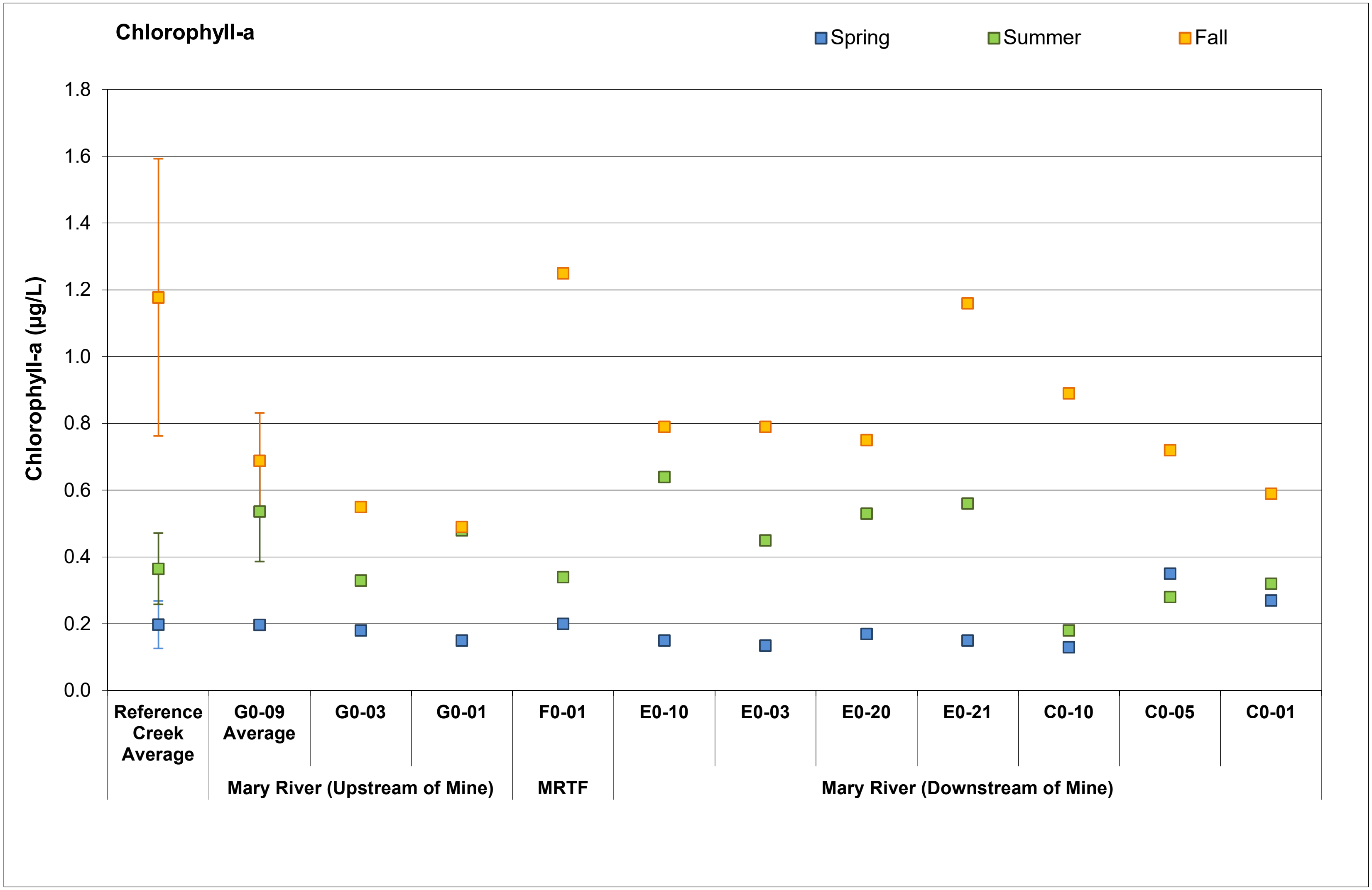


Figure 5.3: Chlorophyll-a Concentrations at Mary River Phytoplankton Monitoring Stations Located Upstream and Downstream of the Mine, Mary River Project CREMP, 2019

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

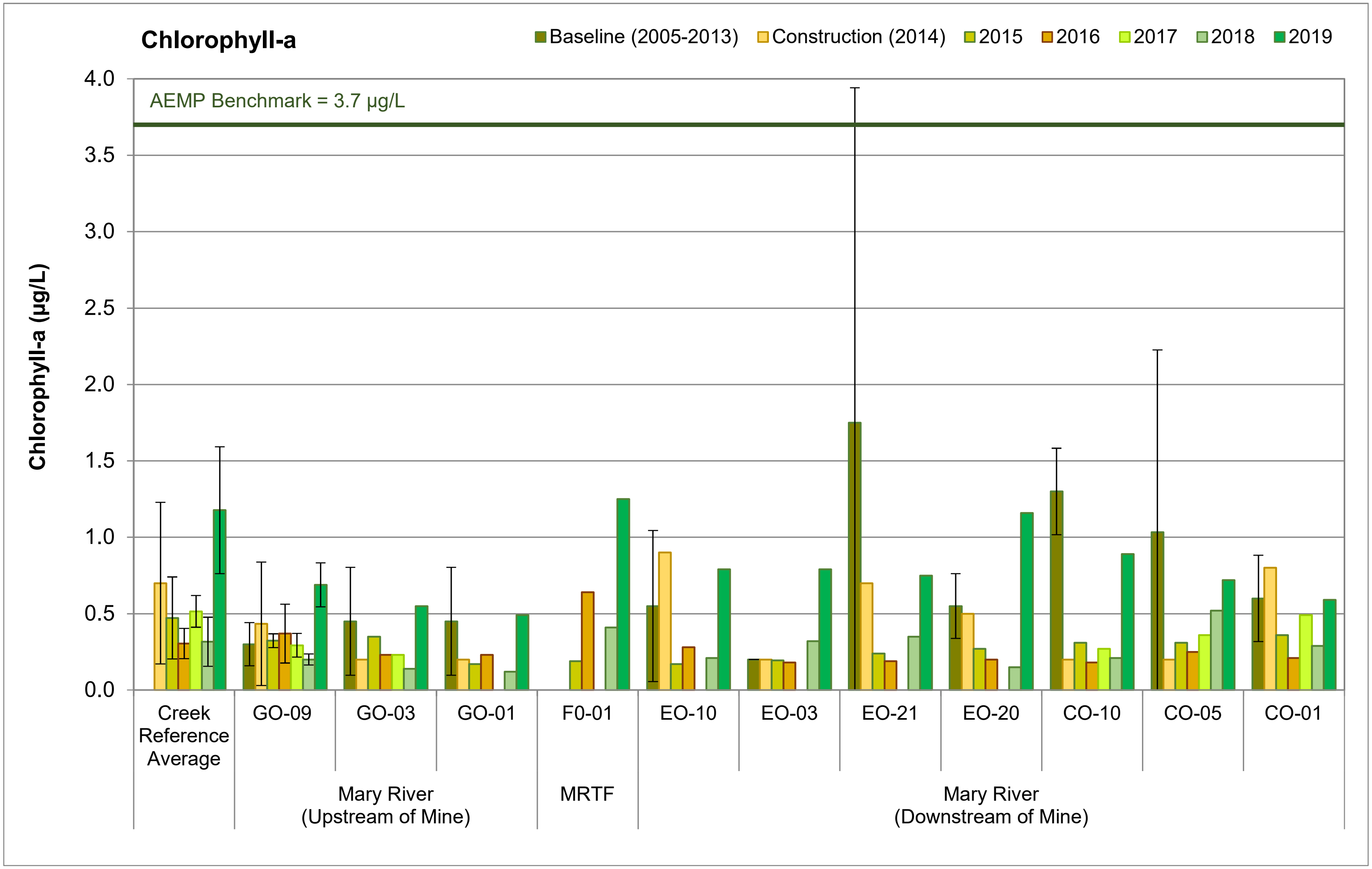


Figure 5.4: Temporal Comparison of Chlorophyll-a Concentrations at Mary River Stations for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2019) Periods during the Fall

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

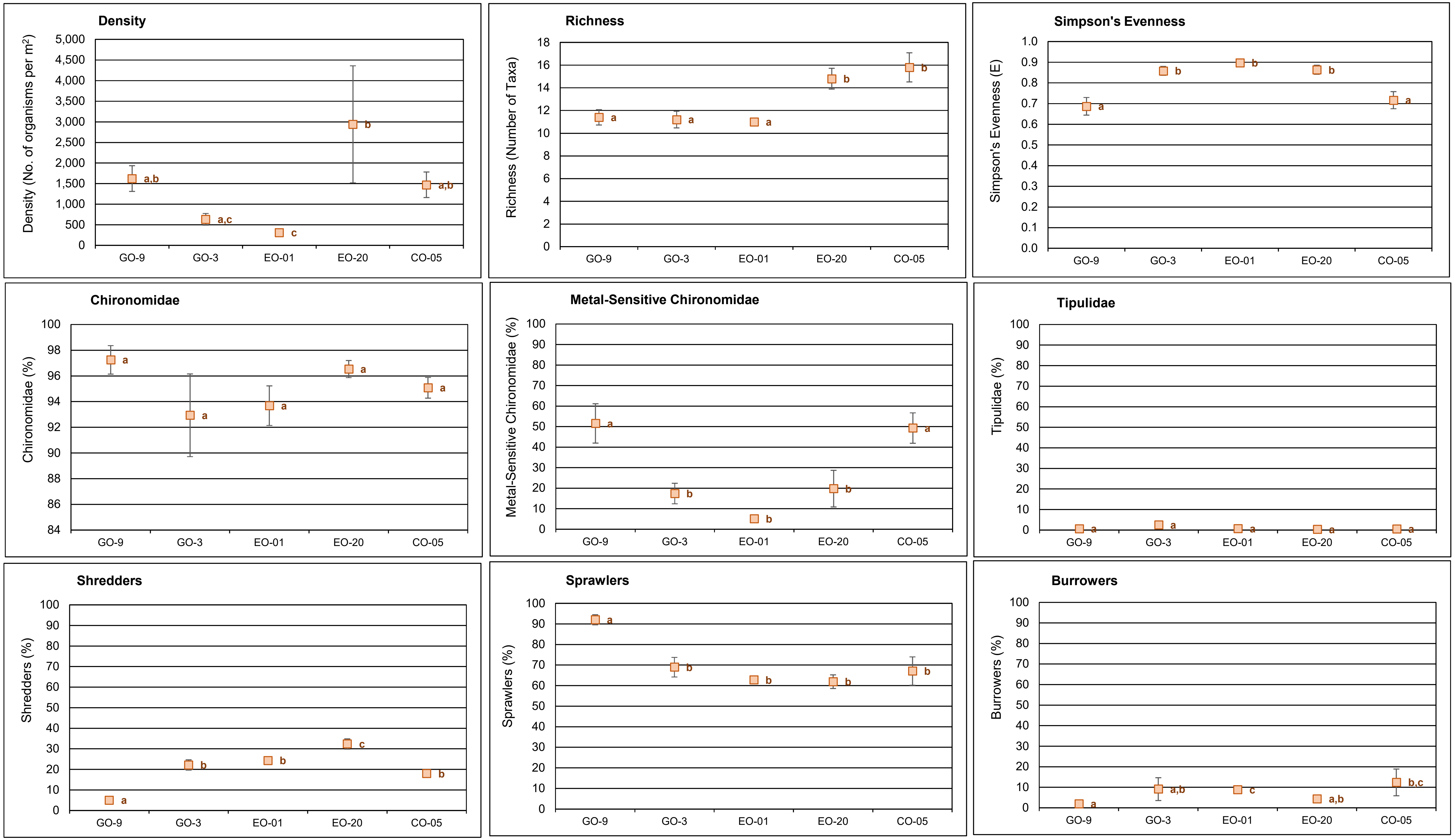


Figure 5.5: Comparison of Benthic Invertebrate Community Metrics among Mary River Study Areas (mean ± SE), Mary River Project CREMP, August 2019

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

However, no significant differences in the relative abundance of any dominant taxonomic groups, including metal-sensitive taxa, were indicated at the EO-01 study area compared to the GO-03 reference area (Appendix Table F.53). Similarly, despite significantly differing relative abundance of FFG and HPG between EO-01 and the upstream-most reference area GO-09, similar differences were not indicated between EO-01 and the GO-03 reference area (Figure 5.5; Appendix Table F.53). The absence of consistent differences in Simpson's Evenness, FFG, and HPG at the upper mine-exposed area EO-01 and both upstream reference areas suggested no marked influences of the mine operation on the benthic invertebrate community at this near-field mine-exposed area in 2019. No ecologically significant differences in density, richness, and relative abundance of dominant taxonomic groups or FFG were indicated between the mine operational years (2015 to 2019) and baseline (2007) at the Mary River EO-01 study area (Appendix Table F.56). Although Simpson's Evenness has consistently been significantly higher at an absolute magnitude greater than 2 SD_{REF} in years of mine operation compared to baseline, higher evenness is not associated with an adverse influence and thus was not consistent with effects to the benthic invertebrate community normally attributed to mine operations.

At near-field mine-exposed area EO-20 and far-field mine-exposed area CO-05, the only benthic invertebrate community metrics that differed at absolute magnitudes greater than the CES of 2 SD_{REF} compared to the GO-09 reference area were richness and Bray-Curtis Index (Figure 5.5; Appendix Table F.53). No ecologically significant differences in dominant taxonomic groups, including the relative abundance of metal sensitive taxa, were indicated between the EO-20/CO-05 and GO-09 reference areas, suggesting that natural habitat-related differences likely accounted for the differences indicated above. This was supported by no significant differences in density, Simpson's Evenness, or the relative abundance of most dominant taxonomic groups, FFG, and HPG between the individual EO-20/CO-05 mine-exposed areas and the GO-03 reference area in 2019 (Figure 5.5; Appendix Table F.53). No ecologically significant differences, and for areas that had two years of baseline data, no consistent direction of differences, in density, richness, Simpson's Evenness, and dominant taxonomic groups were indicated at either the EO-20 or CO-05 study areas on Mary River for all years of mine operation (2015 to 2019) compared to one or both years of available baseline period data (2007 and 2011; Figure 5.6 ; Appendix Tables F.57 and F.58). This suggested that year-to-year differences in these metrics between mine operational and baseline periods 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 since the commencement of mine operations in 2015.

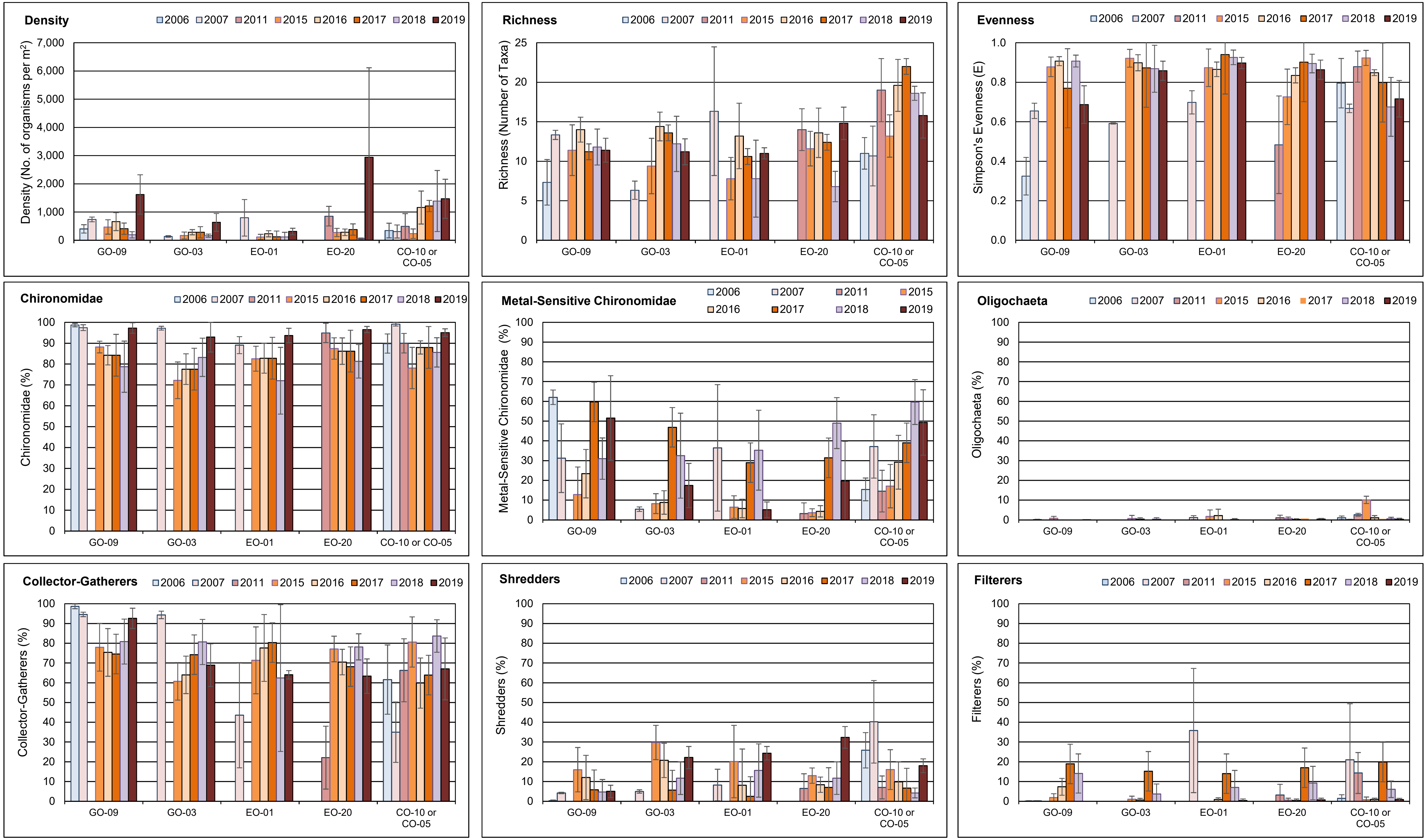


Figure 5.6: Comparison of Benthic Invertebrate Community Metrics (mean ± SD) at Mary River Study Areas among Mine Baseline (2006, 2007, 2011) and Operational (2015 to 2019) Years for the Mary River Project CREMP

5.1.4 Integrated Summary of Effects

Mine-related influences on water quality of Mary River in 2019 included elevation of conductivity and concentrations of nitrate and sulphate just downstream of the confluence with Mary River Tributary-F, as well as elevated turbidity and concentrations of cobalt, iron, lead, manganese, nitrate, total phosphorus, and titanium at stations located adjacent to the Mine Site. Although aluminum, copper, iron, and lead concentrations were above WQG and AEMP benchmarks at one or more Mary River mine-exposed stations in 2019, the elevation in concentrations of these parameters above WQG and watercourse-specific AEMP benchmarks was associated with naturally high turbidity within Mary River and not the mine operations. Aqueous concentrations of all other parameters were well below WQG and AEMP benchmarks at the Mary River mine-exposed stations in 2019. Temporal evaluation of changes in water quality at Mary River in 2019 was confounded by an analytical factor which resulted in a broadscale elevation of all reported parameter concentrations including those from the Mary River reference areas. Chlorophyll-a concentrations at Mary River phytoplankton monitoring stations were similar to the upstream reference over each of the spring, summer, and fall monitoring events in 2019. Temporally, chlorophyll-a concentrations were higher in fall 2019 at all mine-exposed and reference stations than in all previous monitoring conducted over baseline and mine-operational periods, but did not vary disproportionately between the mine-exposed and reference stations over time, suggesting no adverse responses associated with mine operation. No ecologically significant differences in benthic invertebrate community metrics were indicated at individual mine-exposed study areas compared to both reference areas on the Mary River in 2019. In addition, no ecologically significant differences in benthic invertebrate community metrics were consistently shown at individual mine-exposed study areas on Mary River in years of mine operation compared to baseline. Overall, the chlorophyll-a and benthic invertebrate community data suggested no adverse mine-related influences on Mary River biota since mine operations commenced in 2015.

5.2 Mary Lake

5.2.1 Water Quality

Water quality profiles conducted at the north and south basins of Mary Lake in 2019 showed increasing water temperature from the surface to bottom during the winter, and a gradient of decreasing water temperatures from the surface to bottom during the summer and fall that roughly mirrored the water temperature profiles observed at Reference Lake 3 (Figures 5.7 and 5.8). No distinct thermal layering was evident at the north basin of Mary Lake during summer or fall,

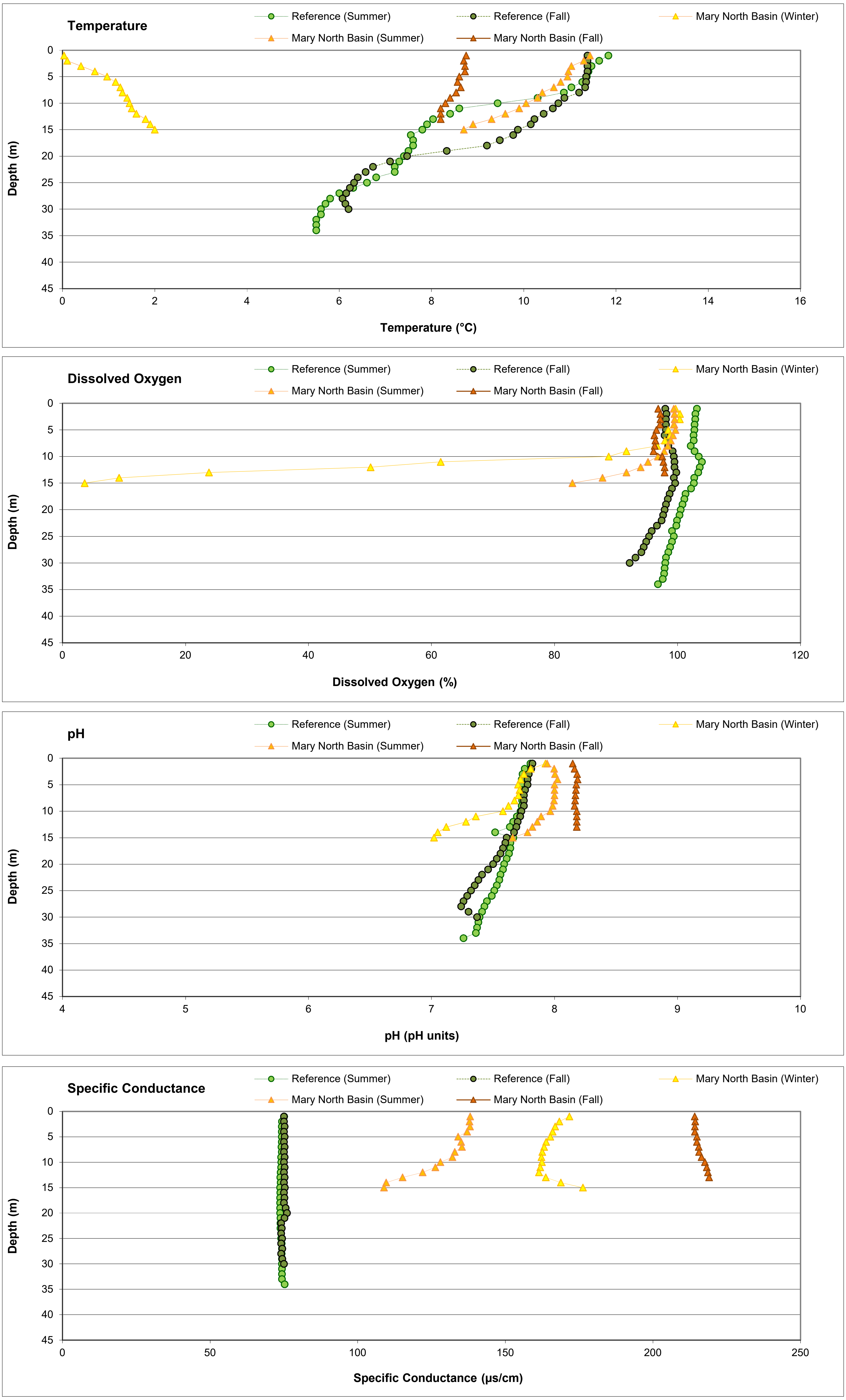


Figure 5.7: Average *In Situ* Water Quality with Depth from Surface at the Mary Lake North Basin (BLO) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2019

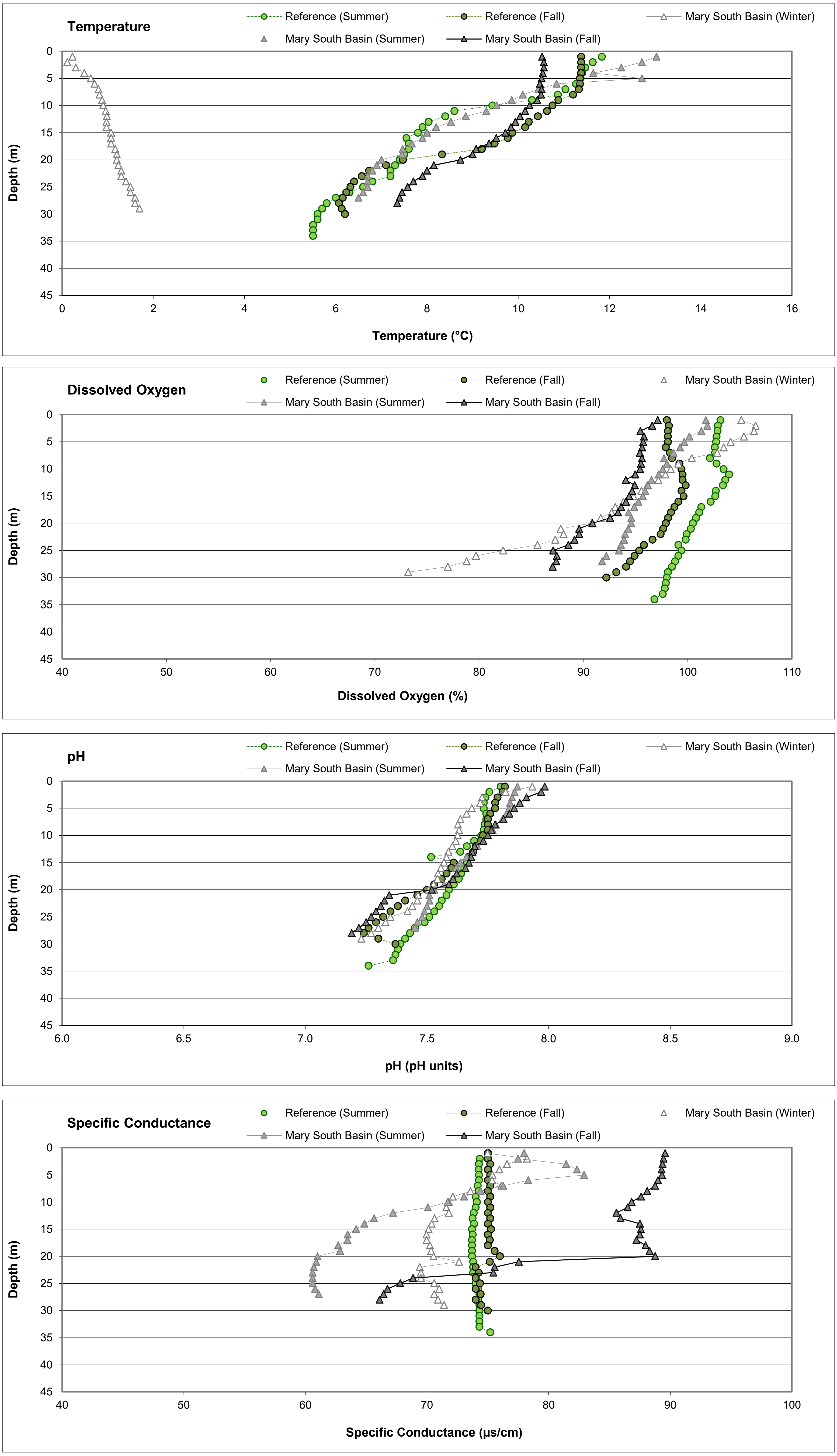


Figure 5.8: Average *In Situ* Water Quality with Depth from Surface at the Mary Lake South Basin (BLO) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2019

but at the south basin, development of an epilimnion occurred through the surficial 10 m of the water column in summer, and a hypolimnion was evident at depths greater than approximately 20 m during the summer and fall of 2019 (Figures 5.7 and 5.8). Water temperatures at the bottom of the water column at Mary Lake littoral and profundal stations did not differ significantly from those at like-habitat stations of Reference Lake 3 during the August 2019 biological study (Figure 5.9; Appendix Table C.72).

Dissolved oxygen profiles showed the development of moderate to strong oxyclines extending through the entire water column at both the Mary Lake north and south basins for winter, summer, and fall sampling events in 2019, the lone exception occurring at the north basin in summer, where no change in DO saturation levels occurred with depth through the water column (Figures 5.7 and 5.8). A similar decrease in DO saturation levels occurred with increased depth through the water column below depths of approximately 15 m at the Mary Lake south basin and reference lake. 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 north basin in summer and fall seasons, at the south basin in all seasons (Appendix Tables C.66 to C.68). 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; Appendix Table C.66). 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 2019 biological sampling (Figure 5.9; Appendix Table C.71).

In situ profiles showed slightly decreasing pH with increased depth from the surface to the bottom at both the north and south basins of Mary Lake during winter, summer, and fall sampling events in 2019 that appeared to mirror changes in dissolved oxygen concentrations, and hence redox conditions, with depth (Figures 5.7 and 5.8). Similar changes in pH were observed through the water column at Reference Lake 3 in 2019. Although pH near the bottom of the water column at littoral and profundal stations of Mary Lake was significantly greater than at the reference lake during the August 2019 biological study, pH values at Mary Lake were consistently within WQG limits (i.e., 6.5 to 9.0; 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.26). 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 variable changes from the surface to bottom of the water column at the north and south basins of Mary Lake over winter, summer, and fall sampling events in 2019, which may have reflected differing

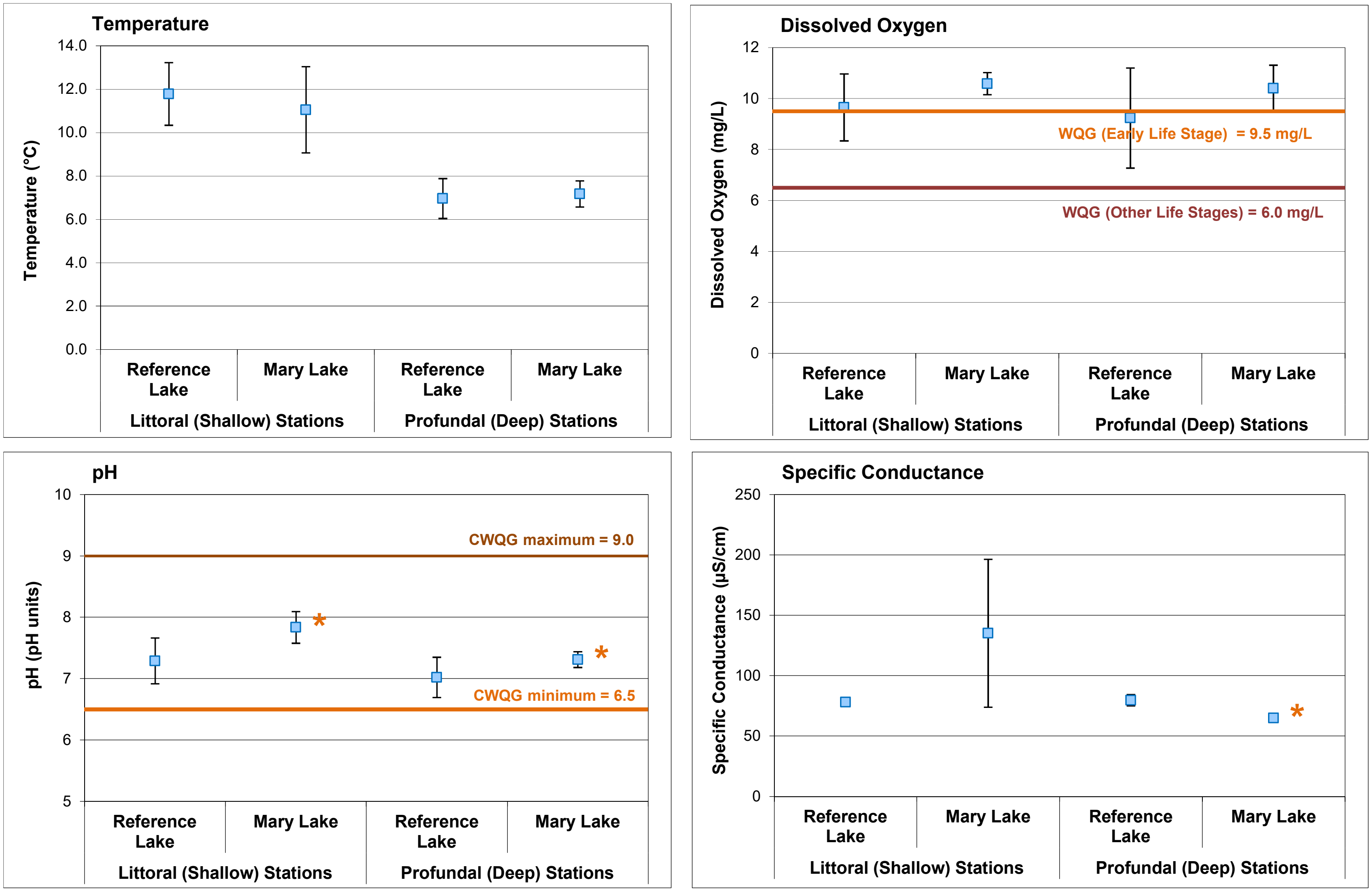


Figure 5.9: Comparison of *In Situ* Water Quality Variables (mean ± SD) Measured at Mary Lake (BLO) and Reference Lake 3 (REF3) Littoral and Profundal Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2019

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.

influence associated with each of the dominant inflows to the lake and the station location relative to these inflows (Appendix Figure C.26). Specific conductance near the bottom of the water column at littoral stations of Mary Lake did not differ significantly from those at Reference Lake 3, but significantly lower specific conductance was shown at profundal stations of Mary Lake, during the August 2019 biological study (Figure 5.9). Water clarity, as determined using Secchi depth readings, was significantly lower at Mary Lake compared to Reference Lake 3 in August 2019 (Appendix Table C.71; 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.69).

Water chemistry of the Mary Lake north basin showed elevated (i.e., ≥3-fold higher) turbidity and concentrations of chloride and total and dissolved aluminum, manganese, sodium, and uranium compared to Reference Lake 3 for summer and/or fall sampling events in 2019 (Table 5.2; Appendix Tables C.73 and C.75). 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 2019 (Table 5.2; Appendix Table C.73). Of these parameters, only total manganese concentrations showed a strong positive correlation with turbidity at the Mary Lake north basin stations using data collected in 2019, suggesting that much of the aqueous manganese was associated with suspended particles (Appendix Table C.76). Highest conductivity, hardness, and concentrations of chloride, molybdenum, sodium, strontium, sulphate, TDS, and uranium occurred at the Mary Lake north basin in 2019 compared all previous monitoring conducted in the fall (Figure 5.10; Appendix Figure C.27). Despite these increases over time, seasonal average total and dissolved concentrations of most parameters in 2019 were not substantially elevated (i.e., less than 3-fold higher) compared to concentrations reported during baseline (Appendix Tables C.73 and C.75). The only exceptions were total and dissolved manganese, which were elevated in the winter 2019 sampling event compared to baseline (Figure 5.10; Appendix Tables C.73 and C.75).

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 2019 (Table 5.2; Appendix Table C.77), suggesting that the south basin waters were well mixed. On average, turbidity and concentrations of total ammonia and uranium, and total and dissolved aluminum and manganese were elevated at the Mary Lake south basin compared to Reference Lake 3 during the 2019 summer and/or fall sampling events (Table 5.2; Appendix Tables C.73 and C.75). Total and dissolved concentrations of aluminum, and total concentrations of manganese, showed very strong positive correlation with turbidity for the Mary Lake south basin 2019 data (i.e., r_s ≥0.85; Appendix Table C.79), suggesting that these metals were associated with suspended particles. In addition, ratios of dissolved to

Table 5.2: Water Chemistry at Mary Lake North Basin (BLO-01) and South Basin (BLO) Monitoring Stations[a], Mary River Project CREMP, 2019

	Parameters	Units	Water Quality Guideline (WQG)[b]	AEMP Benchmark[c]	Reference Lake 3 Average (n = 3) Fall 2019	North Basin (Mine-exposed)			South Basin (Mine-exposed)						
						BL0-01-A 26-Aug-2019	BL0-01 26-Aug-2019	BL0-01-B 26-Aug-2019	BL0-05-A 26-Aug-2019	BL0-05 26-Aug-2019	BL0-05-B 26-Aug-2019	BL0-03 26-Aug-2019	BL0-04 26-Aug-2019	BL0-09 26-Aug-2019	BL0-06 26-Aug-2019
Conventionals	Conductivity (lab)	umho/cm	-	-	82	240	214	215	90	98	91	84	90	91	89
	pH (lab)	pH	6.5 - 9.0	-	7.74	8.22	8.22	8.23	7.89	7.93	7.95	7.83	7.88	7.91	7.86
	Hardness (as $CaCO_3$)	mg/L	-	-	36	100	98	96	41	43	42	39	41	41	40
	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	-	-	53	138	132	138	65	68	63	62	60	95	65
	Turbidity	NTU	-	-	0.34	1.1	1.4	1.3	2.7	3.2	2.6	1.3	3.0	3.1	3.2
	Alkalinity (as $CaCO_3$)	mg/L	-	-	34	97	96	96	42	44	41	42	41	43	41
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.010	<0.010	0.013	0.017	0.055	0.0475	0.013	0.0975	0.0895	0.01625	0.013
	Nitrate	mg/L	3	3	0.036	<0.020	<0.020	<0.020	0.023	0.020	<0.020	<0.020	0.021	0.022	0.021
	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	-	-	0.18	0.175	<0.15	0.16	<0.15	0.185	<0.15	0.16	0.175	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.7	1.9	2.0	2.0	1.5	1.6	1.4	1.7	1.4	1.4	1.5
	Total Organic Carbon	mg/L	-	-	3.1	2.3	2.3	2.3	1.8	1.8	1.7	2.1	1.8	1.8	1.8
	Total Phosphorus	mg/L	0.020[α]	-	0.021	0.004	0.005	0.004	0.045	0.005	0.007	0.005	0.005	0.005	0.005
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	0.001	0.0017	0.0013	0.0013	0.0012	0.0013	0.0024
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	1.4	10.40	9.85	9.90	2.39	2.99	2.43	1.79	2.65	2.38	2.31
	Sulphate (SO_4)	mg/L	218[β]	218	3.7	3.44	3.31	3.26	3.07	3.65	3.22	1.95	3.12	3.18	3.02
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.0079	0.028	0.033	0.030	0.058	0.066	0.046	0.028	0.068	0.057	0.047
	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	-	-	0.0062	0.0101	0.0098	0.0099	0.0053	0.0057	0.0054	0.0045	0.0053	0.0053	0.0052
	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	20.0	19.4	19.7	8.3	8.8	8.3	7.9	8.3	8.3	8.0
	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
	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
	Copper (Cu)	mg/L	0.002	0.0024	0.00085	0.00099	0.00098	0.00094	0.00068	0.00070	0.00067	0.00062	0.00069	0.00065	0.00073
	Iron (Fe)	mg/L	0.30	0.326	<0.030	0.031	0.033	0.031	0.046	0.055	0.040	<0.030	0.051	0.047	0.046
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	0.000055	0.000061	0.000053	<0.000050	0.000061	0.00005725	0.000070
	Lithium (Li)	mg/L	-	-	0.0010	0.0012	0.0011	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.55	12.0	11.8	11.9	4.9	5.3	4.9	4.6	5.0	4.9	4.8
	Manganese (Mn)	mg/L	0.935[β]	-	0.00060	0.00222	0.00248	0.00238	0.00140	0.00158	0.00137	0.00113	0.00154	0.00146	0.00147
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00014	0.00029	0.00029	0.00029	0.00018	0.00019	0.00018	0.00013	0.00019	0.00018	0.00017
	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
	Potassium (K)	mg/L	-	-	0.94	1.15	1.14	1.15	0.68	0.73	0.69	0.61	0.70	0.69	0.68
	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	-	-	0.483	0.88	0.86	0.86	0.57	0.62	0.54	0.50	0.59	0.57	0.54
	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	-	-	0.91	4.08	4.05	3.97	1.14	1.33	1.17	0.96	1.17	1.15	1.12
	Strontium (Sr)	mg/L	-	-	0.0082	0.0150	0.0148	0.0149	0.0075	0.0084	0.0076	0.0064	0.0075	0.0076	0.0073
	Titanium (Ti)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tungsten (W)	mg/L	0.030[α]	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Vanadium (V)	mg/L	0.006[α]	0.006	0.00025	0.00272	0.00247	0.00254	0.00073	0.00094	0.00076	0.00056	0.00075	0.00075	0.00070
	Zinc (Zn)	mg/L	0.030	0.030	<0.0010	<0.0010	<0.0010	<0.0010	<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	<0.0030	<0.0030	<0.0030	<0.0030

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

[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.

Figure 5.10: Temporal Comparison of Water Chemistry at Mary Lake (BLO) for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2019) 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.

total concentrations of aluminum and manganese indicated a low proportion of these metals were present in the dissolved fraction during the summer and fall sampling events (i.e., 33% and 23%, respectively), corroborating that these metals were mostly associated with suspended material. As indicated in previous CREMP, high turbidity in the Mary River originates from natural sources upstream of the mine which, in turn, contributes to 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 2019, with the exception of aluminum concentrations above the WQG and AEMP benchmark at one station in summer, and total phosphorus above WQG at one station during the fall monitoring event (Table 5.2; Appendix Table C.77). Temporal comparisons of the Mary Lake south basin water chemistry data did not indicate any substantial changes in average concentrations of mine-related parameters in 2019 compared to the baseline period (2005 to 2013; Figure 5.10; Appendix Figure C.27; Appendix Tables C.73 and C.75). 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 initiation of mine operations in 2015.

5.2.2 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 mainly 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 silt loam, clay loam, or 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 content, and significantly greater silt or clay content, 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, but no distinct redox boundaries were observed (Appendix Table D.21). Similar sub-surface reducing conditions were observed in sediment of the reference lake, 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.

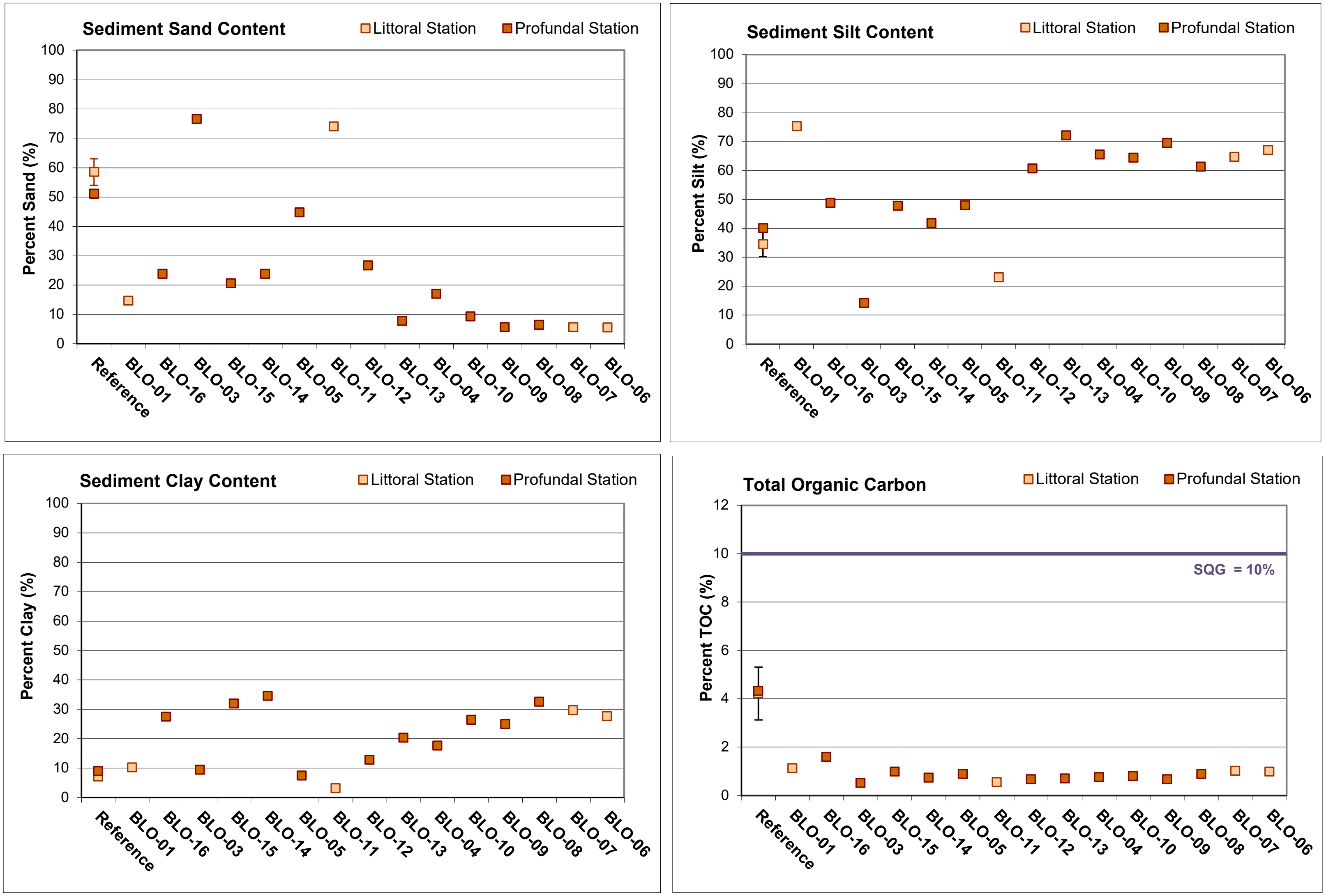


Figure 5.11: Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Mary Lake (BLO) North and South Basin Sediment Monitoring Stations and to Reference Lake 3 (mean ± SE), Mary River Project CREMP, August 2019

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 (Table 5.3; Appendix Table D.24). Concentrations of all metals in sediment were below applicable SQG and lake-specific AEMP benchmarks at the lone Mary Lake north basin station (i.e., BLO-01), whereas at the south basin, average concentrations of chromium (littoral station only), iron, and manganese were above applicable SQG but not lake-specific AEMP benchmarks, in 2019 (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),[14] suggesting that the Mary River was not a disproportionate source of metals. As indicated previously, average concentrations of iron and manganese were elevated above SQG in sediment at Reference Lake 3 (Table 5.3), suggesting that concentrations of iron and manganese above SQG at Mary Lake likely reflected a natural condition unrelated to mine activity.

Temporal comparisons indicated that metal concentrations in sediment at littoral and profundal stations of Mary Lake in 2019 had not changed substantially from those observed during the mine baseline (2005 to 2013) period (Figure 5.12; Appendix Table D.24).[15] On average, metal concentrations in sediment at Mary Lake littoral and profundal stations in 2019 were within the range of those observed from 2015 to 2018, and there was no occurrence of continual year-to-year increases in metal concentrations that would suggest an increasing trend over time (Figure 5.12). Overall, no substantial changes in sediment metal concentrations were indicated at Mary Lake littoral and profundal habitats since the initiation of mine operations in 2015.

5.2.3 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 2019 (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). Chlorophyll-a concentrations at the Mary Lake north and south basins did not differ significantly from those at Reference Lake 3 in summer but were significantly higher than at the reference lake during the fall sampling event (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 2019 (Figure 5.13)

[14] Spatially, sediment stations closest to the Mary River inlet to the outlet of Mary Lake 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.

[15] See footnote 8 regarding differences in the concentration of boron in sediment between baseline and recent CREMP studies.

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 2019

	Parameter	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Littoral: Reference Lake (n = 5) Average ± Std. Error	Littoral: Mary Lake (North Basin) (n = 1)	Littoral: Mary Lake (South Basin) (n = 1)	Profundal: Reference Lake (n = 5) Average ± Std. Error	Profundal: Mary Lake (South Basin) (n = 8) Average ± Std. Error
Non-metals	Sand	%	-	-	58.5 ± 4.51	14.6	5.5	51.1 ± 1.42	23.8 ± 6.3
	Silt	%	-	-	34.4 ± 4.28	75.2	66.9	40.0 ± 1.30	53.9 ± 4.99
	Clay	%	-	-	7.08 ± 0.546	10.2	27.6	8.98 ± 0.371	22.3 ± 2.9
	Moisture	%	-	-	84.0 ± 2.62	51.7	67.6	87.4 ± 0.437	52.2 ± 3.7
Total Organic Carbon		%	10[α]	-	4.22 ± 1.09	1.13	0.99	4.32 ± 0.123	0.84 ± 0.08
Metals	Aluminum (Al)	mg/kg	-	-	13,660 ± 1,044	15,700	27,200	22,740 ± 609	23,550 ± 1,720
	Arsenic (As)	mg/kg	17	5.9	4.68 ± 1.11	3.95	3.77	5.26 ± 0.117	4.90 ± 1.50
	Barium (Ba)	mg/kg	-	-	98.9 ± 19.2	70.5	94.3	126.6 ± 3.06	92.9 ± 9.28
	Beryllium (Be)	mg/kg	-	-	0.566 ± 0.05	0.80	1.33	0.888 ± 0.02	1.11 ± 0.08
	Boron (B)	mg/kg	-	-	11.8 ± 0.84	21.2	42.5	16.52 ± 0.70	31.8 ± 2.4
	Cadmium (Cd)	mg/kg	3.5	1.5	0.140 ± 0.034	0.093	0.132	0.164 ± 0.004	0.135 ± 0.009
	Chromium (Cr)	mg/kg	90	98	49.0 ± 3.5	66.9	93.6	74.2 ± 2.04	86.1 ± 5.3
	Cobalt (Co)	mg/kg	-	-	9.75 ± 0.541	14.1	17.5	16.5 ± 0.244	16.4 ± 0.94
	Copper (Cu)	mg/kg	110	50	***57.1*** ± 9.70	29.3	34.5	***91.9*** ± 2.00	32.9 ± 2.0
	Iron (Fe)	mg/kg	40,000[α]	52,400	***54,660*** ± 14,622	33,500	44,000	49,580 ± 1,299	44,600 ± 5,093
	Lead (Pb)	mg/kg	91.3	35	13.0 ± 0.81	15.6	25.3	19.0 ± 0.320	22.1 ± 1.3
	Manganese (Mn)	mg/kg	1,100[α,β]	4,370	544 ± 115	909	690	1,796 ± 610	1,563 ± 373
	Mercury (Hg)	mg/kg	0.486	0.17	0.0458 ± 0.0116	0.0227	0.0454	0.0738 ± 0.0022	0.0526 ± 0.0057
	Molybdenum (Mo)	mg/kg	-	-	5.47 ± 1.87	0.55	0.84	3.06 ± 0.422	1.18 ± 0.24
	Nickel (Ni)	mg/kg	75[α,β]	72	35.1 ± 3.04	54.8	60.3	51.6 ± 1.41	61.5 ± 3.5
	Phosphorus (P)	mg/kg	2,000[α]	1,580	1,430 ± 409	1,060	784	1,025 ± 36	1,034 ± 225
	Potassium (K)	mg/kg	-	-	3,308 ± 238	4,050	7,030	5,502 ± 150	6,028 ± 480
	Selenium (Se)	mg/kg	-	-	0.62 ± 0.15	<0.20	0.23	0.77 ± 0.04	0.24 ± 0.02
	Sodium (Na)	mg/kg	-	-	259 ± 19.2	265	425	414 ± 16.4	388 ± 31
	Strontium (Sr)	mg/kg	-	-	10.7 ± 0.858	15.4	16.4	13.9 ± 0.293	15.3 ± 1.2
	Thallium (Tl)	mg/kg	-	-	0.363 ± 0.038	0.340	0.680	0.771 ± 0.010	0.540 ± 0.035
	Titanium (Ti)	mg/kg	-	-	964 ± 37	1,070	1,940	1,260 ± 50	1,548 ± 113
	Uranium (U)	mg/kg	-	-	12.6 ± 1.79	4.01	9.76	23.9 ± 0.941	8.72 ± 0.400
	Vanadium (V)	mg/kg	-	-	46.0 ± 3.57	50.4	74.0	66.6 ± 1.54	64.3 ± 4.1
	Zinc (Zn)	mg/kg	315	135	64.8 ± 6.60	50.1	85.8	91.9 ± 1.69	73.7 ± 4.7

[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.

(grey shading) Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

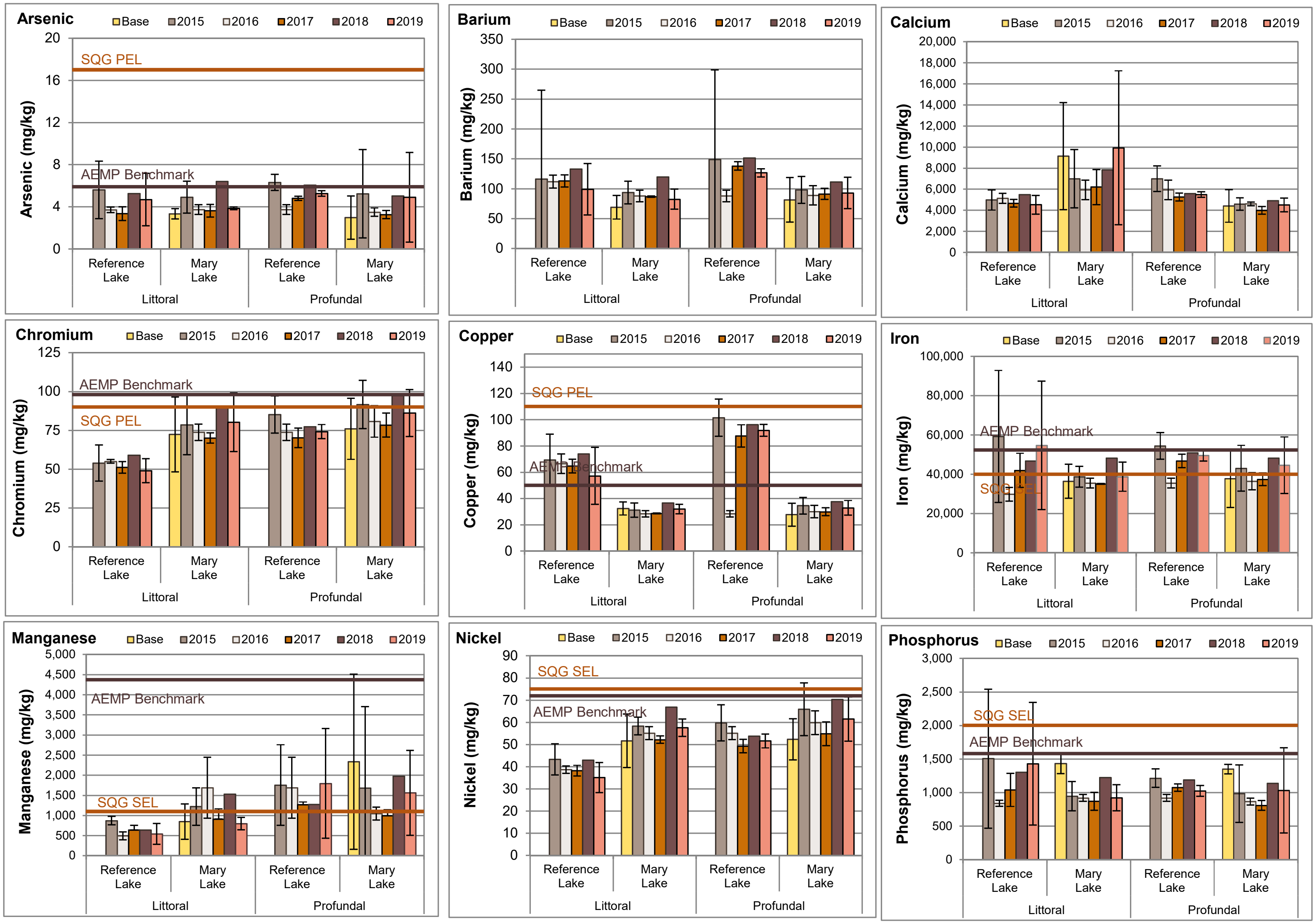


Figure 5.12: Temporal Comparison of Sediment Metal Concentrations (mean ± SD) at Littoral and Profundal Stations of Mary Lake and Reference Lake 3 for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2019) Periods

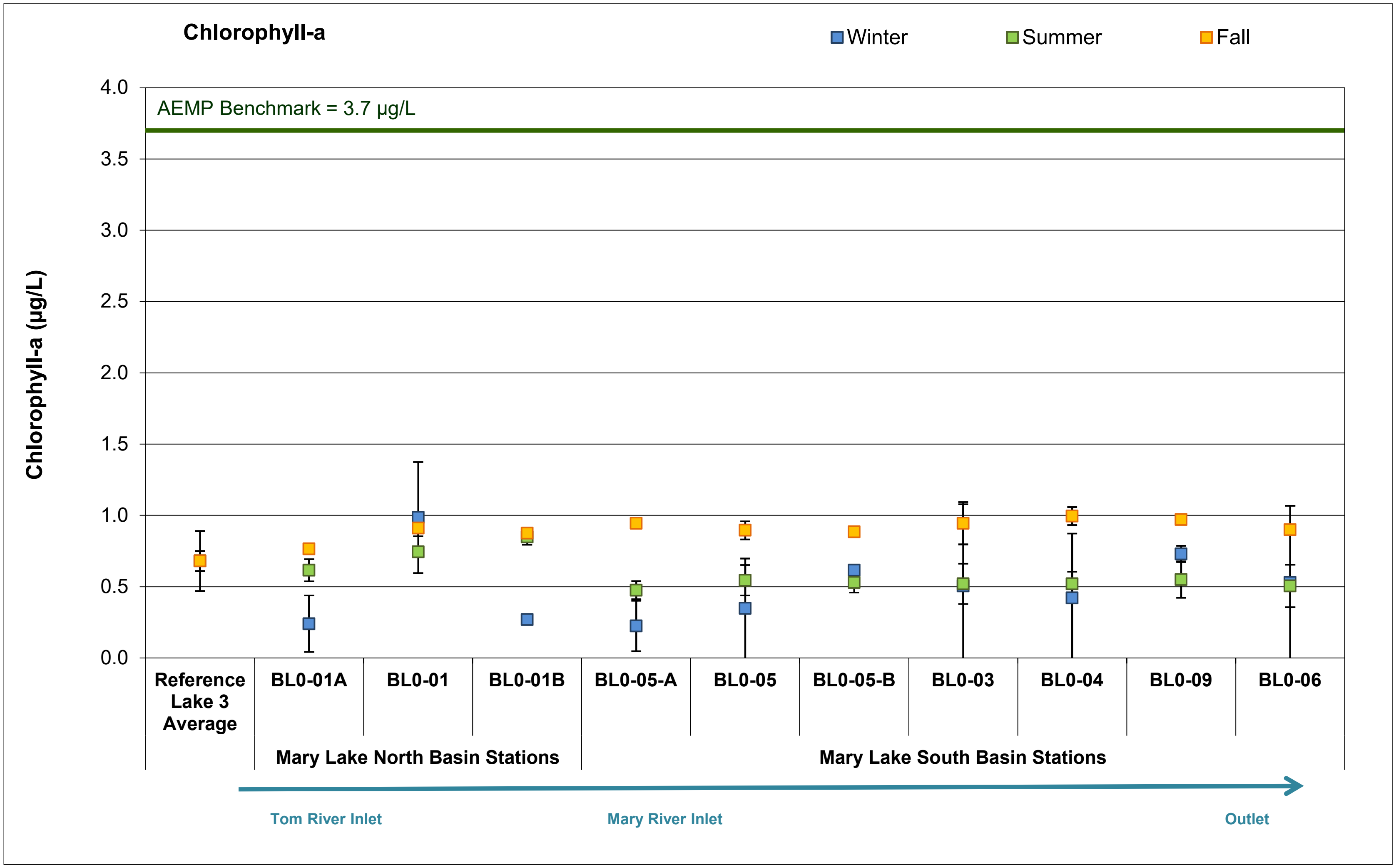


Figure 5.13: Chlorophyll-a Concentrations at Mary Lake (BLO) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2019

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 2019.

and reflected an 'oligotrophic' primary productivity categorization based on Wetzel (2001) classification. This oligotrophic categorization agreed with CWQG trophic status classification that is based on average aqueous total phosphorus concentrations below 10 µg/L (Table 5.2; Appendix Tables C.72 and C.77).

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 2019 data and data from the mine construction (2014) period or previous years of mine operation (2015 to 2018) 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 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.

5.2.4 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 2019 (Tables 5.4 and 5.5). *Heterotrissocladius* midges, which are characteristic of ultraoligotrophic to oligotrophic habitats, were the dominant benthic invertebrates observed at profundal stations of both Mary Lake and Reference Lake 3 and accounted for the differences in density indicated between lakes at profundal habitat (Appendix Tables F.17 and F.60). No significant differences in richness were indicated between Mary Lake and the reference lake for either habitat type (Tables 5.4 and 5.5). Differences in benthic invertebrate community composition were separately suggested for littoral and profundal habitat between Mary Lake and Reference Lake 3 based on differences in Simpson's Evenness and/or Bray-Curtis Index in 2019 (Tables 5.4 and 5.5). However, no significant differences in the relative abundance of metal-sensitive Chironomidae, FFG, or HPG were indicated between lakes for each habitat type, suggesting no adverse influences of mine operation on community composition related to metal concentrations or alteration of food sources and habitat (e.g., sedimentation). Therefore, the differences in Simpson' Evenness and Bray-Curtis Index indicated between lakes likely reflected considerably higher *Heterotrissocladius* density at Mary Lake, and suggested that Mary Lake was naturally more productive than the reference lake. Therefore, no adverse mine-related influences on the littoral or profundal benthic invertebrate community were indicated at Mary Lake in 2019.

No ecologically significant differences in benthic invertebrate community density, richness, or Simpson's Evenness were indicated at littoral or profundal habitats of Mary Lake between mine

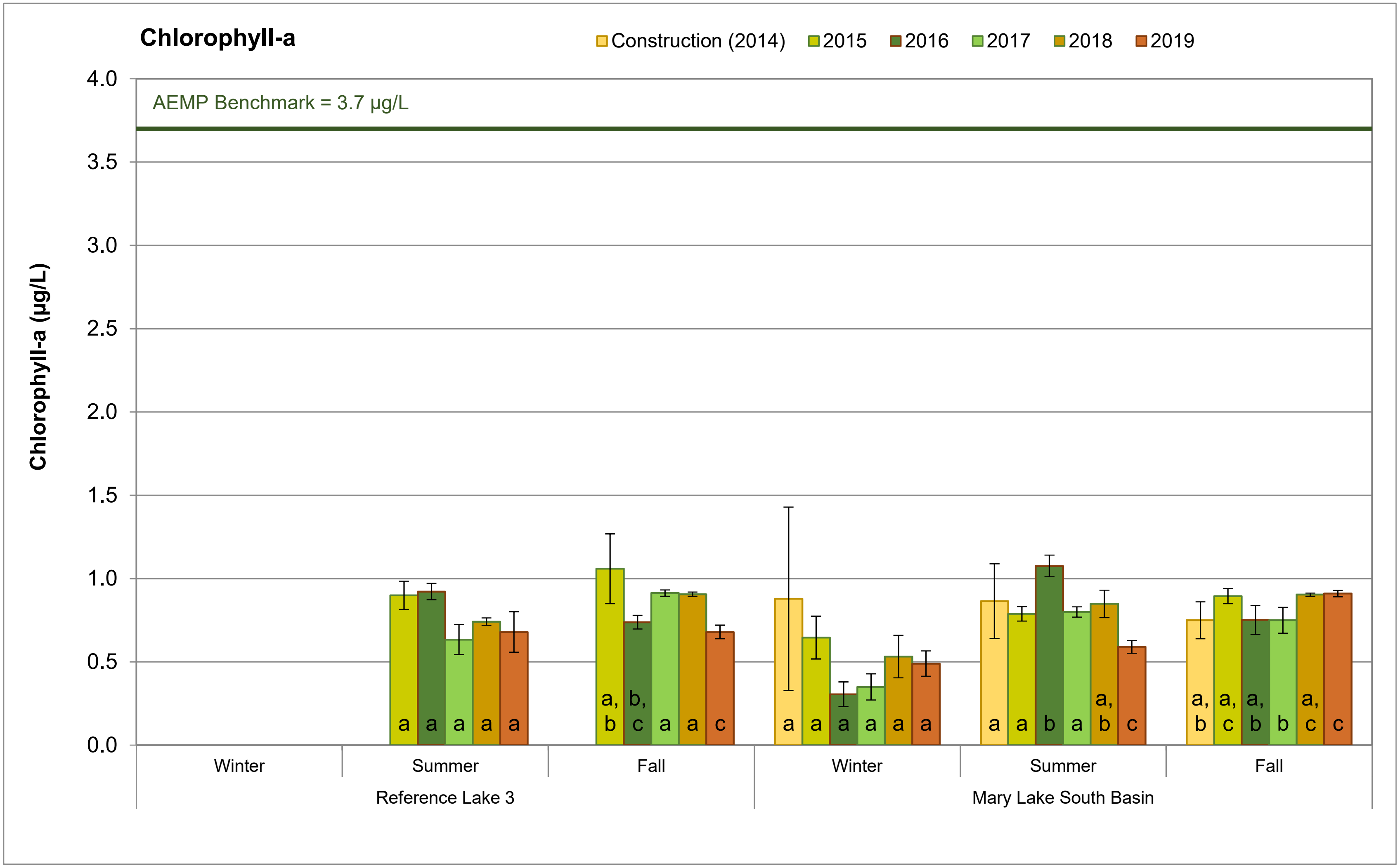


Figure 5.14: Temporal Comparison of Chlorophyll-a Concentrations Among Seasons between the Mary Lake South Basin and Reference Lake 3 for Mine Construction (2014) and Operational (2015 to 2019) Periods (mean ± SE)

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

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 2019

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)	log10	NO	0.471	t-test (unequal)	4.0	Reference Lake 3	1,247	297	133	871	1,156	1,594
						Mary Lake Littoral	2,448	2,313	1,034	856	1,582	5,773
Richness (Number of Taxa)	none	NO	0.617	ANOVA	-0.6	Reference Lake 3	12.8	2.3	1.0	9.0	13.0	15.0
						Mary Lake Littoral	11.5	5.0	2.2	6.0	11.0	18.0
Simpson's Evenness (E)	none	YES	0.094	t-test (unequal)	-5.0	Reference Lake 3	0.865	0.041	0.018	0.811	0.862	0.924
						Mary Lake Littoral	0.663	0.169	0.076	0.454	0.695	0.806
Bray-Curtis Index	none	YES	0.001	ANOVA	5.6	Reference Lake 3	0.291	0.100	0.045	0.162	0.275	0.391
						Mary Lake Littoral	0.847	0.052	0.023	0.779	0.853	0.904
Nemata (%)	log10	NO	0.294	ANOVA	-0.6	Reference Lake 3	7.3	7.9	3.5	0.8	3.9	20.0
						Mary Lake Littoral	2.4	2.4	1.1	1.0	1.3	6.0
Hydracarina (%)	none	NO	0.128	ANOVA	-1.0	Reference Lake 3	4.6	2.9	1.3	1.1	4.7	9.0
						Mary Lake Littoral	1.8	1.6	0.7	0.4	1.4	4.1
Ostracoda (%)	none	YES	0.004	ANOVA	-2.1	Reference Lake 3	25.1	11.0	4.9	13.8	21.8	41.8
						Mary Lake Littoral	2.0	1.1	0.5	1.0	2.0	3.0
Chironomidae (%)	none	YES	0.003	ANOVA	2.4	Reference Lake 3	62.9	12.9	5.8	48.4	71.2	73.0
						Mary Lake Littoral	93.4	4.0	1.8	87.8	94.4	97.0
Metal-Sensitive Chironomidae (%)	log10	NO	0.965	ANOVA	0.5	Reference Lake 3	10.5	7.8	3.5	4.8	6.9	24.1
						Mary Lake Littoral	14.2	12.2	5.5	1.9	13.6	27.6
Collector-Gatherers (%)	rank	NO	0.190	Mann-Whitney	-0.9	Reference Lake 3	81.1	17.8	8.0	51.2	87.9	97.9
						Mary Lake Littoral	65.1	24.9	11.1	28.0	76.0	80.5
Filterers (%)	none	NO	0.591	t-test (unequal)	0.7	Reference Lake 3	7.1	6.3	2.8	1.1	5.8	17.9
						Mary Lake Littoral	11.5	13.8	6.2	0.0	9.1	27.6
Shredders (%)	log10(x+1)	NO	0.202	ANOVA	-0.6	Reference Lake 3	6.5	9.5	4.2	0.0	2.9	23.2
						Mary Lake Littoral	0.9	0.6	0.3	0.0	1.1	1.5
Clingers (%)	log10	NO	0.990	ANOVA	1.6	Reference Lake 3	11.9	7.9	3.5	2.1	10.0	23.3
						Mary Lake Littoral	24.7	29.6	13.3	1.0	16.4	65.1
Sprawlers (%)	none	NO	0.567	ANOVA	-1.3	Reference Lake 3	74.1	8.3	3.7	60.4	75.7	81.2
						Mary Lake Littoral	63.0	41.2	18.4	7.1	74.3	96.1
Burrowers (%)	log10	NO	0.546	ANOVA	-0.2	Reference Lake 3	14.0	6.9	3.1	3.8	16.2	22.1
						Mary Lake Littoral	12.3	11.5	5.2	2.9	9.2	27.8

[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 ≤ 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 2019

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	0.002	t-test (unequal)	12.7	Reference Lake 3	304	89	40	217	276	448
						Mary Lake Profundal	1,428	506	226	956	1,341	2,237
Richness (Number of Taxa)	none	NO	0.290	ANOVA	1.0	Reference Lake 3	5.6	2.6	1.2	3.0	6.0	9.0
						Mary Lake Profundal	8.2	4.5	2.0	4.0	7.0	15.0
Simpson's Evenness (E)	log10	NO	0.528	ANOVA	-0.3	Reference Lake 3	0.534	0.174	0.078	0.278	0.584	0.701
						Mary Lake Profundal	0.479	0.273	0.122	0.165	0.493	0.868
Bray-Curtis Index	log10	YES	0.001	ANOVA	6.1	Reference Lake 3	0.187	0.088	0.039	0.086	0.208	0.305
						Mary Lake Profundal	0.725	0.104	0.047	0.599	0.718	0.889
Nemata (%)	log10(x+1)	YES	0.048	ANOVA	-1.0	Reference Lake 3	3.6	2.7	1.2	0.0	3.3	7.6
						Mary Lake Profundal	0.7	0.9	0.4	0.0	0.4	2.3
Hydracarina (%)	none	NO	0.260	t-test (unequal)	-0.6	Reference Lake 3	4.5	4.7	2.1	0.0	4.1	10.6
						Mary Lake Profundal	1.7	1.3	0.6	0.0	1.7	3.8
Ostracoda (%)	log10(x+1)	NO	0.671	ANOVA	0.2	Reference Lake 3	9.0	8.1	3.6	2.0	6.6	21.7
						Mary Lake Profundal	10.9	17.4	7.8	0.0	4.3	45.7
Chironomidae (%)	rank	NO	0.247	Mann-Whitney	0.6	Reference Lake 3	82.9	6.8	3.0	75.0	82.6	93.4
						Mary Lake Profundal	86.6	17.4	7.8	52.1	92.3	98.4
Metal-Sensitive Chironomidae (%)	rank	NO	0.311	Mann-Whitney	0.7	Reference Lake 3	2.1	3.4	1.5	0.0	0.0	7.8
						Mary Lake Profundal	4.5	4.5	2.0	0.8	2.2	12.2
Collector-Gatherers (%)	none	NO	0.919	ANOVA	0.0	Reference Lake 3	92.8	10.0	4.5	75.9	95.9	100.0
						Mary Lake Profundal	92.3	4.2	1.9	86.2	94.2	96.7
Filterers (%)	rank	NO	0.104	Mann-Whitney	nc	Reference Lake 3	0.0	0.0	0.0	0.0	0.0	0.0
						Mary Lake Profundal	2.9	4.1	1.8	0.0	0.8	9.2
Clingers (%)	log10(x+1)	NO	0.637	ANOVA	0.9	Reference Lake 3	4.5	4.7	2.1	0.0	4.1	10.6
						Mary Lake Profundal	8.8	12.9	5.8	0.0	3.0	33.9
Sprawlers (%)	rank	NO	0.931	Mann-Whitney	-2.8	Reference Lake 3	90.5	7.4	3.3	83.8	87.6	100.0
						Mary Lake Profundal	70.0	41.3	18.5	11.4	95.6	97.5
Burrowers (%)	log10(x+1)	NO	0.693	ANOVA	4.8	Reference Lake 3	5.0	3.4	1.5	0.0	5.6	8.3
						Mary Lake Profundal	21.2	30.8	13.8	0.0	2.6	66.7

[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.

operational years 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 or FFG were indicated between mine operational years and baseline 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 the benthic invertebrate communities of littoral and profundal habitat at Mary Lake were indicated following the initiation of mine operation in 2015.

5.2.5 Fish Population

5.2.5.1 Mary Lake (South) Fish Community

Arctic charr and ninespine stickleback were captured at Mary Lake in 2019 (Table 5.6), reflecting the same fish species composition reported at Reference Lake 3 historically (Minnow 2018, 2019). Arctic charr CPUE was similar between Mary Lake and Reference Lake 3 for sampling conducted at nearshore habitat (i.e., electrofishing), but was considerably higher for sampling of littoral/profundal habitat using gill netting collection methods in 2019 (Table 5.6), suggesting higher densities and/or productivity of arctic charr at Mary Lake. 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 2019, as well as in other years of mine operation, compared to baseline monitoring conducted in 2008 (Figure 5.16). Gill netting CPUE for arctic charr in 2019 was within the range of that shown during baseline (2006 and 2007) and previous years in which the mine was operational (2015 to 2018; Figure 5.16). Therefore, 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 mine start-up in 2015.

5.2.5.2 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 2019. No nearshore arctic charr baseline data were collected at Mary Lake, precluding data analysis using a before-after design. A total of 100 arctic charr were captured at nearshore habitat in each of Mary Lake and Reference Lake 3 in August 2019 for the control-impact analysis. Arctic charr YOY were distinguished from the older, non-YOY age class using a fork length cut-off of 4.8 cm

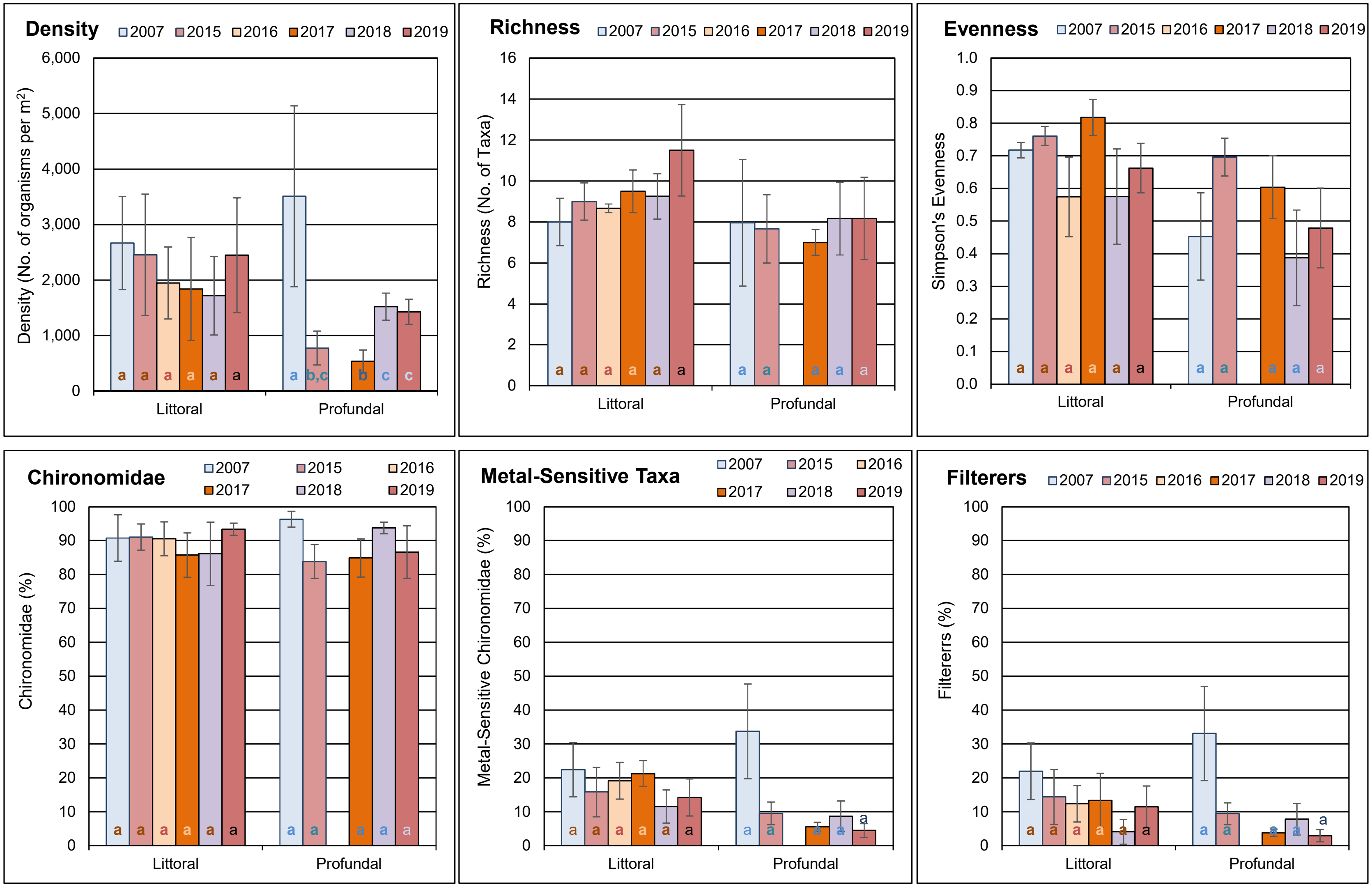


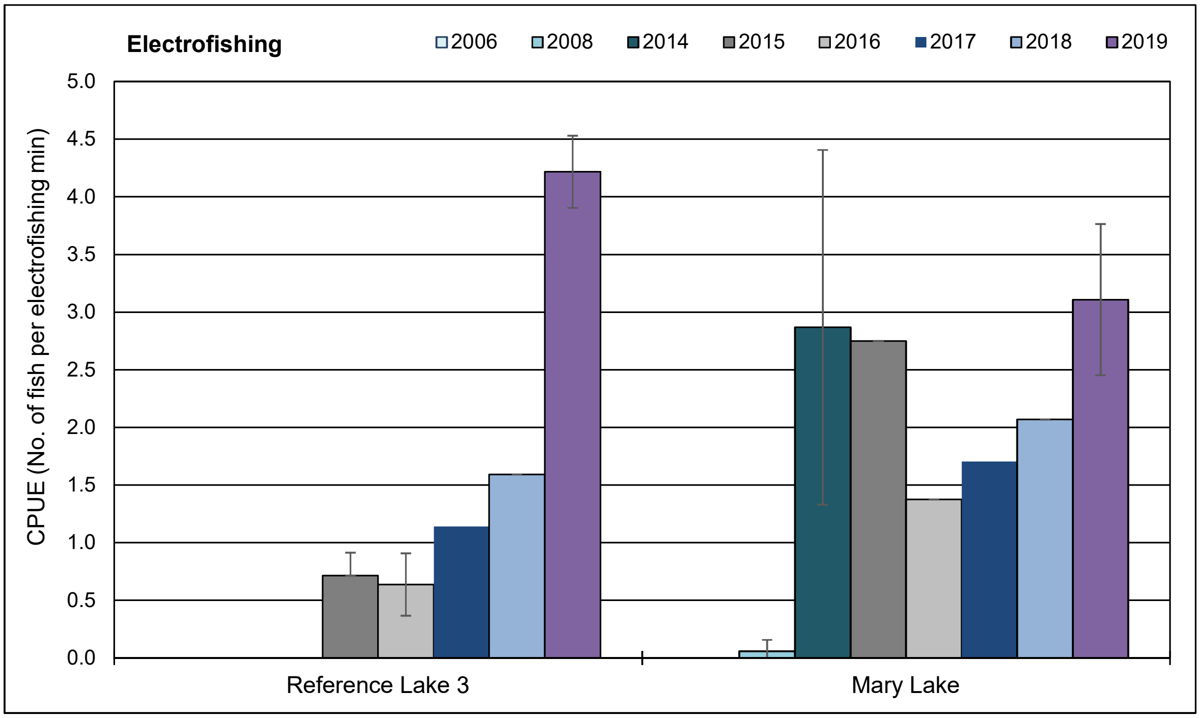
Figure 5.15: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Mary Lake Littoral and Profundal Study Areas among Mine Baseline (2007) and Operational (2015 to 2019) Periods

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 2019

Lake	Method [a]		Arctic Charr	Ninespine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	101	0	101	1
		CPUE	4.22	0	4.22	
	Gill netting	No. Caught	27	0	27	
		CPUE	0.33	0	0.33	
Mary Lake	Electrofishing	No. Caught	100	4	104	2
		CPUE	3.11	0.11	3.22	
	Gill netting	No. Caught	69	0	69	
		CPUE	2.81	0	2.81	

[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.



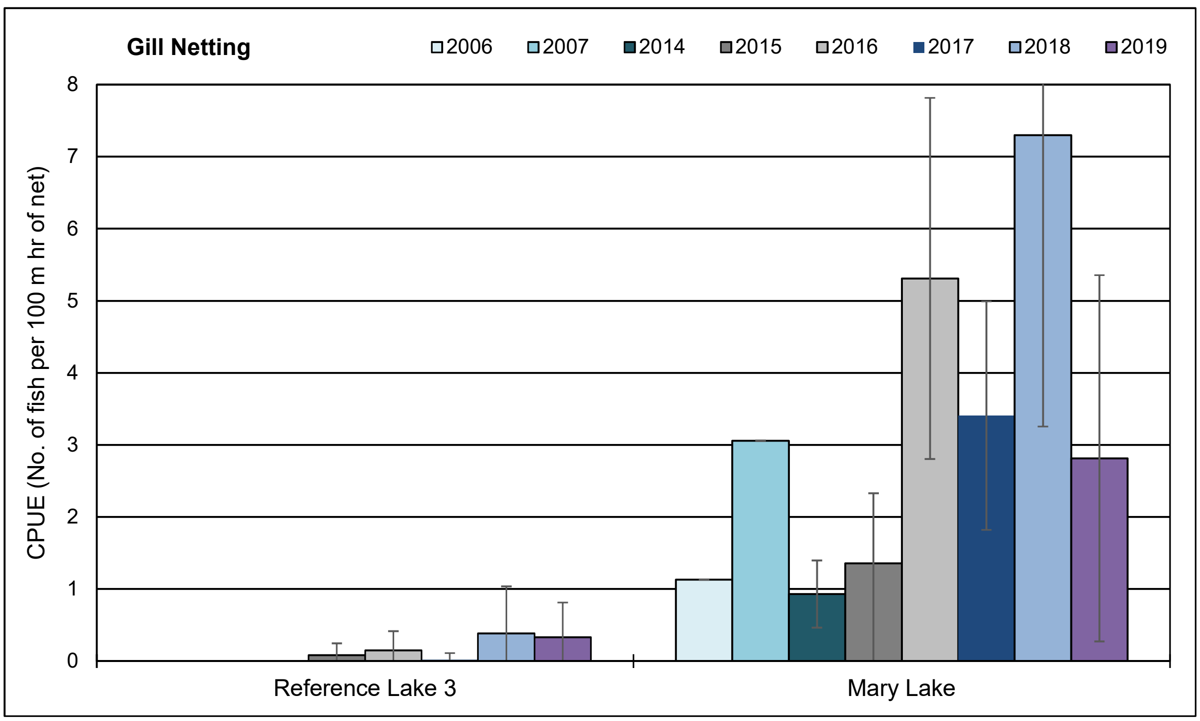


Figure 5.16: Catch-per-unit-effort (CPUE; mean ± SD) of Arctic Charr Captured by Back-pack Electrofishing and Gill Netting at Mary Lake (BLO), Mary River Project CREMP, 2006 to 2019

Note: Data presented for fish sampling conducted in fall during baseline (2006, 2007), construction (2014), and operational (2015 to 2019) mine phases.

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). However, due to small sample sizes of nearshore arctic charr YOY at Mary Lake and Reference Lake 3 (i.e., five and three fish, respectively), health comparisons involved assessment of only the non-YOY population.

Nearshore arctic charr length-frequency distributions differed significantly between Mary Lake and Reference Lake 3, reflecting the occurrence of a more limited size distribution of fish captured at Mary Lake (Table 5.7; Figure 5.17; Appendix Table G.26). Arctic charr non-YOY were significantly shorter and lighter, but exhibited significantly greater condition, at Mary Lake compared to the reference lake (Table 5.7; Appendix Table G.26). However, the magnitude of the difference in condition was within the CES_C of ±10%, indicating that this difference was not ecologically meaningful (Table 5.7; Appendix Table G.26). No consistent differences in size or condition of arctic charr non-YOY occurred at Mary Lake relative to the reference lake from 2015 to 2019, suggesting that the differences between lakes over time reflected natural variability (Table 5.7). Collectively, the data indicated no adverse response to arctic charr at Mary Lake nearshore areas since the commencement of mine operations in 2015.

Littoral/Profundal Arctic Charr

Mine-related influences on the littoral/profundal arctic charr population were evaluated based on a control-impact analysis using 2019 data collected at Mary Lake and Reference Lake 3, and based on a before-after analysis using data collected from Mary Lake in 2019 and during 2006 to 2007 baseline studies. A total of 69 and 27 arctic charr were sampled from littoral/profundal habitat of Mary Lake and Reference Lake 3, respectively, in August 2019, 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 2019 and the baseline period (Table 5.7; Appendix Table G.30). In addition, arctic charr sampled from littoral/profundal habitat were significantly shorter, lighter, and of lower condition in 2019 compared to the baseline period (Table 5.7). However, the magnitudes of these differences were within the CES for endpoints of size (i.e., ±25%) and condition (i.e., ±10%), suggesting that the differences were not ecologically significant. No consistent differences or direction in differences in health endpoints of size and condition were

Table 5.7: Summary of Statistical Results for Arctic Charr Population Comparisons between Mary Lake and Reference Lake 3 from 2015 to 2019, and between Mary Lake Mine Operational and Baseline Period Data, for Fish Captured by Electrofishing and Gill Netting Methods

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	2019	2015	2016	2017	2018	2019
Electrofishing Samples	Survival	Length-Frequency Distribution	No	**Yes**	**Yes**	**Yes**	**Yes**	-	-	-	-	-
		Age	**Yes (-43%)**	No	No	-	-	-	-	-	-	-
	Energy Use (non-YOY)	Size (mean fork length)	No	No	**Yes (+17%)**	**Yes (+10%)**	**Yes (-27%)**	-	-	-	-	-
		Size (mean weight)	No	No	**Yes (+51%)**	No	**Yes (-61%)**	-	-	-	-	-
	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	**Yes (+3%)**	No	No	**Yes (-8%)**	**Yes (+4%)**	-	-	-	-	-
Gill Netting Samples [c]	Survival	Length Frequency Distribution	-	-	-	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
		Age	-	-	-	-	-	No	**Yes (-14%)**	No	-	-
	Energy Use	Size (mean fork length)	-	-	-	**Yes (+12%)**	**Yes (+24%)**	**Yes (+6%)**	No	**Yes (-5%)**	No	**Yes (-4%)**
		Size (mean weight)	-	-	-	**Yes (+51%)**	**Yes (+96%)**	**Yes (+19%)**	No	**Yes (-9%)**	No	**Yes (-14%)**
		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%)**	**Yes (+3%)**	No	**Yes (+3%)**	**Yes (+5%)**	**Yes (-3%)**	**Yes (-5%)**

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

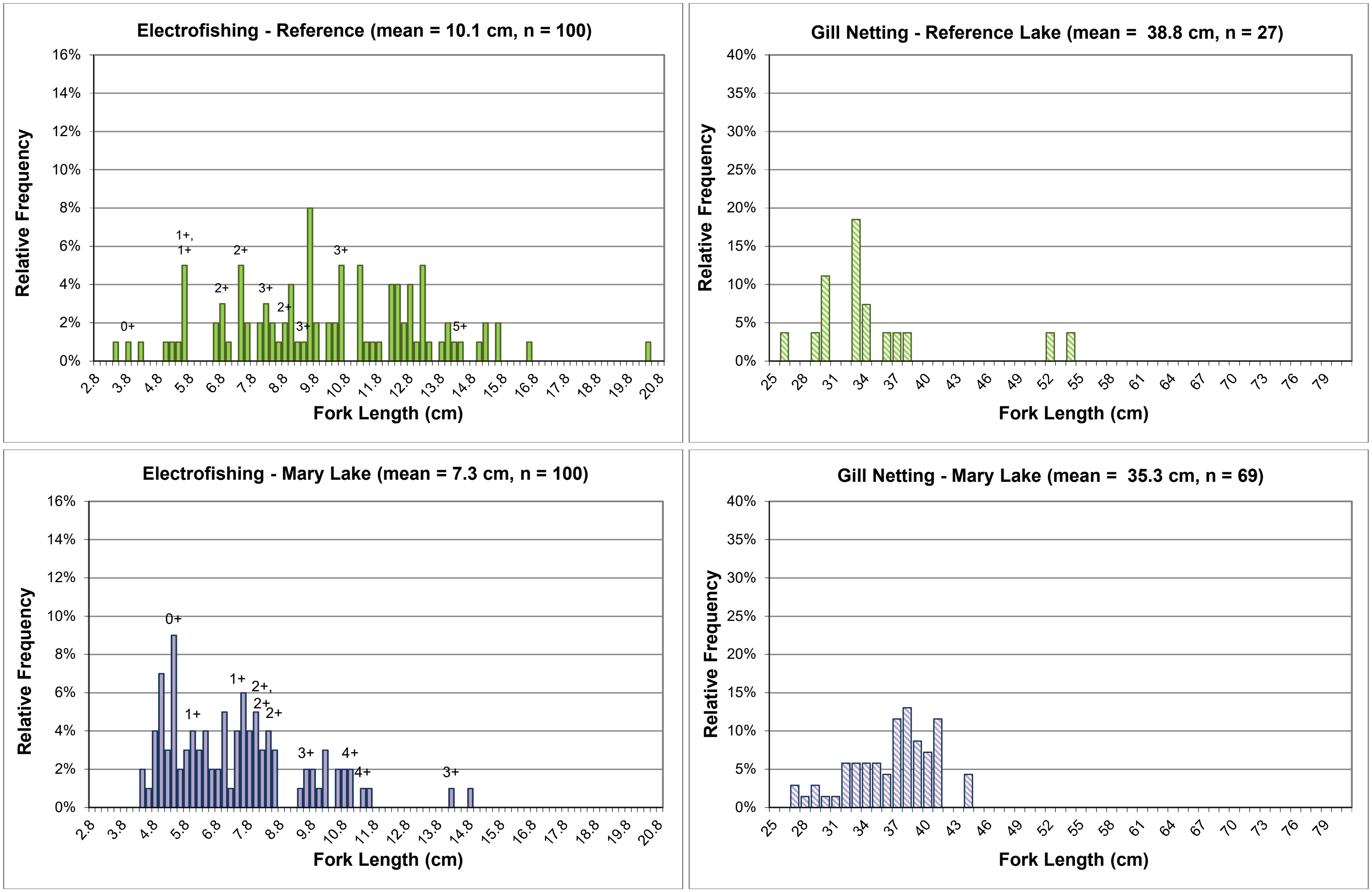


Figure 5.17: Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Mary Lake (BLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2019

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

indicated at Mary Lake for adult arctic charr over individual years of mine operation from 2015 to 2019 in comparison to the 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.

5.2.6 Integrated Summary of Effects

Turbidity and aqueous concentrations of aluminum, manganese, sodium, and uranium were elevated compared to the reference lake in 2019, 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 the reference lake 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 the reference lake in 2019 and to concentrations observed during the baseline period. Although chromium, iron, and manganese concentrations were above SQG at Mary Lake in 2019, iron and manganese concentrations were also above SQG at the reference lake suggesting natural elevation of these metals in study area lakes

Mary Lake chlorophyll-a concentrations were significantly greater than at the reference lake only during the fall sampling, suggesting greater primary production at Mary Lake on a seasonal basis. Mary Lake chlorophyll-a concentrations were continuously well below the AEMP benchmark during all seasonal sampling events in 2019, and were indicative of oligotrophic conditions typical of Arctic waterbodies. Temporal evaluation of the chlorophyll-a data indicated no changes to the trophic status of Mary Lake since commencement of mine operations in 2015. No significant differences in benthic invertebrate richness and relative abundance of metal-sensitive chironomids and FFG were indicated at littoral and profundal habitat of Mary Lake compared to the reference lake in 2019. In addition, no ecologically significant differences in any of the above benthic invertebrate community endpoints, density, and Simpson's Evenness occurred between years of mine operation and the mine baseline for either habitat type at Mary Lake. Analysis of Mary Lake arctic charr populations suggested greater abundance compared to the reference lake in 2019, and suggested no substantial changes in numbers of arctic charr at Mary Lake in 2019 relative to baseline monitoring. No ecologically significant differences in condition of non-YOY arctic charr captured at nearshore habitat occurred between Mary Lake and the reference lake in 2019. In addition, no ecologically significant difference in the condition of arctic charr captured at littoral/profundal habitat occurred between Mary Lake and Reference Lake 3 in 2019, nor between 2019 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 on the biota of Mary Lake since mine operations commenced in 2015.

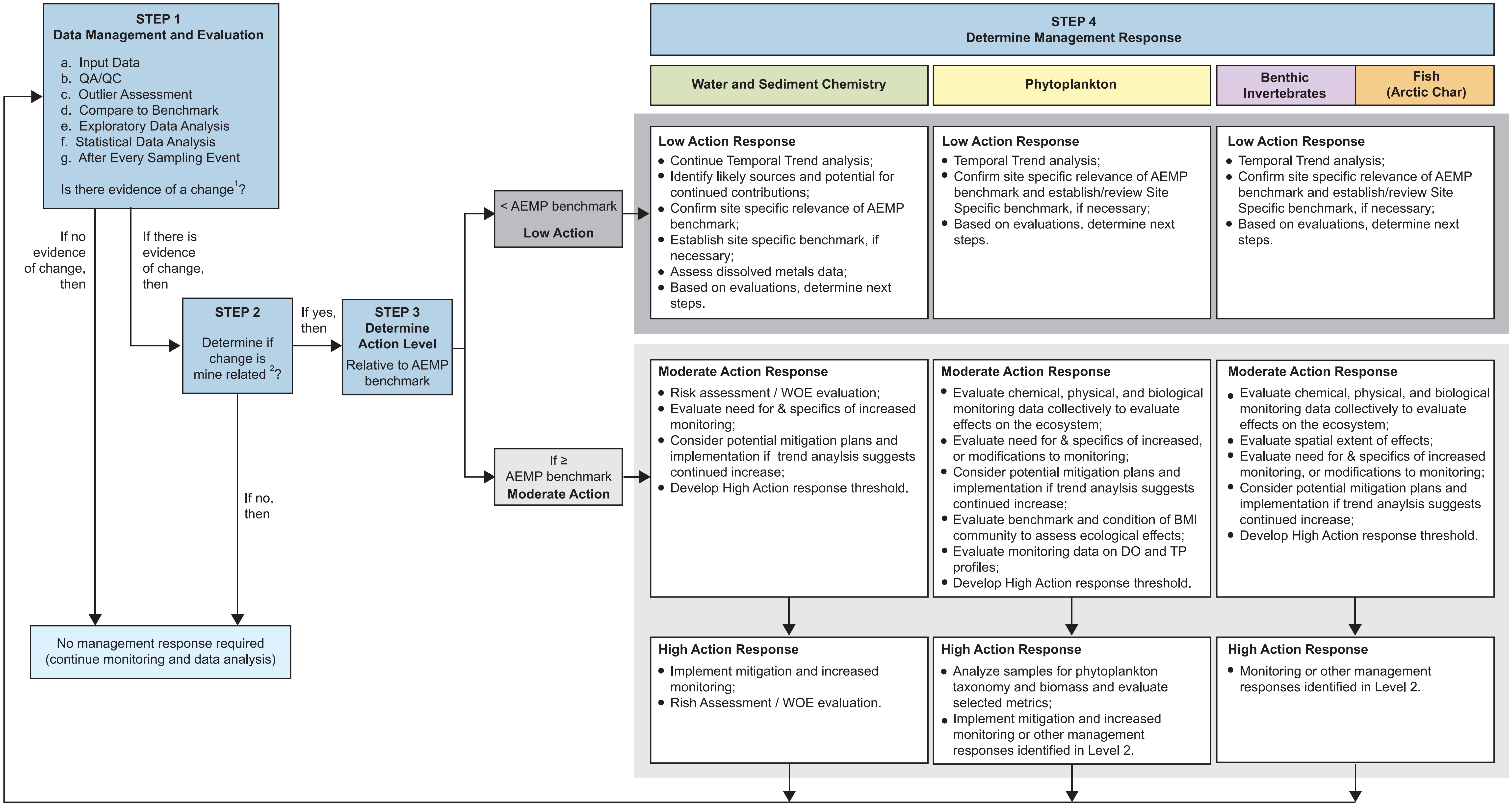
6 EFFECTS DETERMINATION AND RECOMMENDATIONS

6.1 Effects Determination Context

The objective of the 2019 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 fifth full year of mine operation. The 2019 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 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 2019 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, outlines potential 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 at the north branch and main stem channel of Camp Lake Tributary 1 (CLT1), the mouth of Camp Lake Tributary 2 (CLT2), and at Camp Lake (Table 6.1). At the CLT1 north branch, aqueous concentrations of copper were routinely elevated above the AEMP benchmark. No substantial mine development has occurred in the CLT1 north branch watershed, and therefore sources of copper potentially included fugitive dust from the mine and/or natural minerology of the bedrock/overburden in the region of the mine. At the CLT1 main stem, aqueous concentrations of aluminum, iron, and nitrate were elevated above their respective AEMP benchmarks, but only at the upstream-most station (i.e., Station L2-03; Table 6.1). Total aluminum and iron concentrations were also above the Camp Lake Tributary AEMP benchmarks at a lotic reference station in summer and fall sampling events in 2019, and similar to or higher than those at CLT1. Notably, higher turbidity was evident at the CLT1 main stem and the lotic reference station than



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 2019 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 (North Branch)	Aqueous total copper concentration greater than 0.0022 mg/L benchmark in spring, summer, and fall at north branch (0.0024 mg/L, 0.0023 mg/L, and 0.0024 mg/L, respectively).	Aqueous concentrations of total copper were below applicable Water Quality Guidelines (WQG).	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 Tributary 1 (Main Stem)	Aqueous total aluminum concentration greater than 0.179 mg/L benchmark in spring at upper main stem (0.298 mg/L). Aqueous total iron concentration greater than 0.326 mg/L benchmark in spring, summer, and fall at upper main stem (0.438 mg/L, 0.359 mg/L, and 0.447 mg/L, respectively). Aqueous nitrate concentration greater than 3.0 mg/L benchmark in summer and fall at upper main stem (3.76 mg/L and 3.13 mg/L, respectively).	Mean aluminum concentration (summer) = 0.165 mg/L (max = 0.529 mg/L) Mean aluminum concentration (fall) = 0.209 mg/L (max = 0.660 mg/L) Mean iron concentration (summer) = 0.154 mg/L (max = 0.498 mg/L) Mean iron concentration (fall) = 0.143 mg/L (max = 0.416 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 Tributary 2	Aqueous total zinc concentration greater than 0.030 mg/L benchmark in spring at mouth of tributary (0.049 mg/L).	Aqueous concentrations of total zinc were below applicable Water Quality Guidelines (WQG).	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 2019 except at one station (JLO-07) in fall, during which the concentration of copper (0.0063 mg/L) was above the benchmark. Sediment arsenic concentration > 5.9 mg/kg benchmark at single littoral monitoring station (9.4 mg/kg). Sediment copper concentration > 50 mg/kg benchmark at single littoral monitoring station (56 mg/kg). Sediment iron concentration > 52,400 mg/kg benchmark at single littoral monitoring station (55,000 mg/kg). Sediment nickel concentration > 72 mg/kg benchmark at single littoral monitoring station (84 mg/kg). Sediment arsenic, copper, manganese, and nickel concentrations above respective benchmarks at individual stations, but below benchmarks on average, at profundal stations.	Aqueous concentrations of total copper were below applicable Water Quality Guidelines (WQG). Reference lake sediment mean arsenic concentration = 4.97 mg/kg (maximum = 8.5 mg/kg) Reference lake sediment mean copper concentration = 75 mg/kg (maximum = 96 mg/kg). Reference lake sediment mean iron concentration = 52,120 mg/kg (maximum = 101,000 mg/kg). Reference lake sediment mean manganese concentration = 1,170 mg/kg (maximum = 4,230 mg/kg). Reference lake sediment mean nickel concentration = 43 mg/kg (maximum = 56 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 = 0.0029 mg/L; max = 0.0036 mg/L)	Mean aqueous total copper concentration (annual) = 0.0010 mg/L (max = 0.0020 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 2019 except at one station (DLO-01-1) in summer, during which the concentration of copper (0.0034 mg/L) was above the benchmark. Littoral sediment arsenic concentration > 6.2 mg/kg benchmark (mean = 6.2 mg/kg; maximum = 13.2 mg/kg). Littoral sediment copper concentration > 58 mg/kg benchmark (mean = 41 mg/kg; maximum = 65 mg/kg). Littoral sediment iron concentration > 34,400 mg/kg benchmark (mean = 51,372 mg/kg; maximum = 86,400 mg/kg). Littoral sediment nickel concentration > 77 mg/kg benchmark (mean = 59 mg/kg; maximum = 81 mg/kg).	Aqueous concentrations of total copper were below applicable Water Quality Guidelines (WQG). Reference lake sediment mean arsenic concentration = 4.97 mg/kg (maximum = 8.5 mg/kg) Reference lake sediment mean copper concentration = 75 mg/kg (maximum = 96 mg/kg). Reference lake sediment mean iron concentration = 52,120 mg/kg (maximum = 101,000 mg/kg). Reference lake sediment mean manganese concentration = 1,170 mg/kg (maximum = 4,230 mg/kg). Reference lake sediment mean nickel concentration = 43 mg/kg (maximum = 56 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.

Table 6.1: Summary of AEMP Benchmark Exceedances for the Mary River Project 2019 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
Sheardown Lake SE	No AEMP water quality benchmarks were exceeded at Sheardown Lake SE during spring, summer, or fall sampling events in 2019 except at one station in fall, during which the concentration of aluminum (0.235 mg/L) and zinc (0.055 mg/L) were above applicable benchmarks. Littoral sediment arsenic concentration > 5.9 mg/kg benchmark (mean = 6.4 mg/kg; maximum = 6.8 mg/kg). Littoral sediment chromium concentration > 79 mg/kg benchmark (mean = 83 mg/kg; maximum = 88 mg/kg). Mean sediment iron concentration for lake > 34,400 mg/kg benchmark (mean = 52,280 mg/kg; maximum = 61,800 mg/kg). Mean sediment manganese concentration for lake > 657 mg/kg benchmark (mean = 1,654 mg/kg; maximum = 3,680 mg/kg). Littoral sediment nickel concentration > 66 mg/kg benchmark (mean = 68 mg/kg; maximum = 70 mg/kg). Littoral sediment phosphorus concentration > 1,278 mg/kg benchmark (mean = 1,315 mg/kg; maximum = 1,350 mg/kg).	Mean aqueous aluminum concentration (summer) = 0.165 mg/L (maximum = 0.529 mg/L) Mean aqueous aluminum concentration (fall) = 0.209 mg/L (maximum = 0.660 mg/L) Aqueous concentrations of total copper were below applicable Water Quality Guidelines (WQG). Reference lake sediment mean arsenic concentration = 4.97 mg/kg (maximum = 8.5 mg/kg) Reference lake sediment mean chromium concentration = 62 mg/kg (maximum = 80 mg/kg). Reference lake sediment mean iron concentration = 52,120 mg/kg (maximum = 101,000 mg/kg). Reference lake sediment mean manganese concentration = 1,170 mg/kg (maximum = 4,230 mg/kg). Reference lake sediment mean nickel concentration = 43 mg/kg (maximum = 56 mg/kg). Reference lake sediment mean phosphorus concentration = 1,227 mg/kg (maximum = 2,580 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 2019 except for one station (BLO-05B) in summer, during which aluminum concentations were above the AEMP benchmark. Profundal sediment chromium concentration > 98 mg/kg benchmark (mean = 86 mg/kg; maximum = 102 mg/kg). Profundal sediment iron concentration > 52,400 mg/kg benchmark (mean = 44,600 mg/kg; maximum = 76,200 mg/kg). Profundal sediment phosphorus concentration > 1,580 mg/kg benchmark (mean = 1,034 mg/kg; maximum = 2,580 mg/kg).	Mean aqueous aluminum concentration (summer) = 0.165 mg/L (maximum = 0.529 mg/L) Mean aqueous aluminum concentration (fall) = 0.209 mg/L (maximum = 0.660 mg/L) Reference lake sediment mean chromium concentration = 62 mg/kg (maximum = 80 mg/kg). Reference lake sediment mean iron concentration = 52,120 mg/kg (maximum = 101,000 mg/kg). Reference lake sediment mean phosphorus concentration = 1,227 mg/kg (maximum = 2,580 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.

at the other mine-exposed and reference creek stations, which suggested that elevation in total aluminum and iron concentrations reflected association of these metals with suspended particulate matter. This was supported by the absence of any ecologically significant, adverse, effects on phytoplankton and benthic invertebrates within the CLT1 main stem in 2019 compared to reference area data and to baseline data. Based on these empirical results, a low action response to isolate the likely source(s) of aluminum, iron, and nitrate to the CLT1 main stem is recommended to meet obligations under the AEMP Management Response Framework.

At Camp Lake, AEMP benchmarks for water quality were exceeded on a single occasion, and benchmarks for sediment quality were exceeded for five metals, in 2019 (Table 6.1). The aqueous concentration of copper was above the AEMP benchmark near the surface of the water column at one centrally located station in Camp Lake during the fall sampling event. The isolated occurrence of this exceedance suggested that this measurement was likely an anomaly. Arsenic, copper, iron, and nickel concentrations were elevated above AEMP benchmarks in sediment at the lone littoral sediment quality monitoring station in Camp Lake in 2019. Arsenic, copper, manganese, and nickel concentrations were above AEMP benchmarks in sediment at individual profundal stations, but on average, were below benchmarks within the profundal sediments. Because the lone littoral sediment chemistry monitoring station is located near the inlet from CLT1, mine-influenced flow from this tributary likely contributed to elevation of the metals indicated above in sediment at this location. Notably, arsenic, copper, iron, and manganese concentrations in sediment of Reference Lake 3 were also above the Camp Lake AEMP benchmarks at individual stations, indicating natural elevation of these metals within lake sediments of the region (Appendix Table D.9). None of the metals indicated above were elevated in sediment of Camp Lake compared to sediment of the reference lake, and only the concentration of arsenic at sediment of the littoral station was slightly elevated compared to concentrations during baseline studies. 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 to meet obligations 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 - 17 provided by Minnow (2016b) 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 at Sheardown Lake Tributary 1 (SDLT1), Sheardown Lake NW, and Sheardown Lake SE, and AEMP benchmarks for sediment quality were exceeded at each of Sheardown Lake NW and Sheardown Lake SE, in 2019 (Table 6.1). At SDLT1, aqueous copper concentrations were elevated compared to the average concentration from reference creek stations in 2019, but not to concentrations observed at SDLT1 during baseline studies (2005 to 2013 data; Appendix Table C.35). Given the 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 2019 compared to baseline conditions, copper concentrations at SDLT1 may naturally be similar to the AEMP benchmark. Biological monitoring conducted at SDLT1 in 2019 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 to meet obligations under the AEMP Management Response Framework.

At Sheardown Lake NW, AEMP benchmarks for water quality were met except for a single occasion in summer during which the concentration of copper was above the benchmark. The isolated occurrence of this exceedance suggested that this measurement was likely an anomaly. Lake-specific AEMP benchmarks for sediment quality were exceeded for arsenic, copper, iron, and nickel at littoral habitat stations in 2019 (Table 6.1), but none of these metals were elevated in the sediment of Sheardown Lake NW compared to the reference lake, or to concentrations in Sheardown Lake NW during the baseline period (Appendix Table D.14). No adverse effects to benthic invertebrates and other biota were indicated at Sheardown Lake NW in 2019 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 to meet obligations 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 the reference lake, 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 met except for single incidences (at a single station) in fall during which the concentration of aluminum and zinc were above their respective benchmarks (Table 6.1). The isolated occurrence of these exceedances suggested that these results were likely anomalous. The lake-specific AEMP benchmarks for sediment quality were exceeded for arsenic, chromium, iron, manganese, nickel, and phosphorus concentrations at Sheardown Lake SE in 2019 (Table 6.1). Of these metals, only concentrations of arsenic and manganese were slightly elevated in sediment of Sheardown Lake SE compared to the reference lake, or to concentrations shown at Sheardown Lake SE during the baseline period (Appendix Table D.19). In addition, concentrations of these metals were above the Sheardown Lake SE AEMP benchmarks in sediment at the reference lake, suggesting naturally high concentrations of each of the indicated metals in sediments of area lakes. 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 2019 based on comparisons to reference conditions and to Sheardown Lake SE baseline conditions. Because no adverse effects to biota were associated with concentrations of metals above AEMP benchmarks in sediment at Sheardown Lake SE, a low action response is recommended to meet obligations 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 the reference lake 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 exceeded at the Mary Lake south basin, and AEMP benchmarks for sediment quality were exceeded at profundal stations of Mary Lake in 2019 (Table 6.1). On a single occasion during the summer sampling event, the water quality AEMP benchmark for aluminum was not met. Due to the isolated occurrence of this exceedance, and the fact that aluminum concentrations were also above the Mary Lake site-specific AEMP benchmark at the reference lake, no further action regarding this exceedance is recommended. The lake-specific AEMP benchmarks for sediment quality were exceeded for chromium, iron, and phosphorus concentrations at Mary Lake profundal stations in 2019 (Table 6.1). None of these metals were elevated in profundal sediment of Mary Lake compared to like-habitat at the reference lake, or to concentrations shown at Mary Lake during the baseline period (Appendix Table D.24). In addition, concentrations of these metals were above the Mary Lake AEMP benchmarks in sediment at the reference lake, suggesting naturally high concentrations of each of the indicated metals in sediments of area lakes. No adverse effects to benthic invertebrates and other biota were indicated at Mary Lake in 2019 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 to meet obligations 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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Mary River Project 2019
Core Receiving Environment Monitoring
Program Report

Part 2 of 2
(Appendices A to G)

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March 2020

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 2019 CREMP to define the overall quality of the data collected for the program, and by extension, the confidence with which the data could 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 2019 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, 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, and 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. Blank 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) allowed 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 to which de-ionized water has been added in a laboratory prior to the field

sample collections, which 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 during processing in the laboratory. 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 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 nine times during the 2019 CREMP, including two during the winter lake monitoring event (April), one during the spring stream monitoring event (June), two during the summer lake/stream monitoring event (July), and four during the fall lake/stream monitoring event (August). Of the 764 total number of analyses conducted on the trip blank samples, only 19 (2.5%) resulted in analyte detection above the trip blank DQO of less than five-times the RDL (Appendix Table A.1). No parameters showed concentrations that were consistently elevated above the trip blank DQO among sampling events, or between total and dissolved sample fractions (metals only; Appendix Table A.1), suggesting no widespread contamination from the bottle, bottle caps, or preservative or through the transport of the samples.

Field blank samples were assessed a total of nine times during the 2019 CREMP, including two during the winter lake monitoring event, one during the spring stream monitoring event, three during the summer lake/stream monitoring event, and three during the fall lake/stream monitoring event. Of the 756 determinations made, three (0.4%) resulted in analyte detections above the DQO of less than five-times the laboratory RDL (Appendix Table A.2). Turbidity, total aluminum, and total manganese each did not achieve the field blank DQO in a single instance during the summer monitoring event. Due to the infrequency of detected parameter concentrations in field blanks, no pervasive contamination of samples resulting from the handling technique or through exposure to the atmosphere was suggested by the field blank analyses.

Equipment blank samples were collected a total of six times during the 2019 CREMP, including two during the winter lake monitoring event, two during the summer lake monitoring event, and two during the fall lake monitoring event. Of the 504 determinations conducted, two (0.4%) resulted in analyte detection above the DQO of less than five-times the laboratory RDL (Appendix Table A.3). Total Kjeldahl Nitrogen (TKN) and total manganese each did not achieve the equipment blank DQO in a single instance during the winter and summer monitoring events, respectively (Appendix Table A.3). Due to the infrequency of detected parameter concentrations in field equipment blanks, minimal cross contamination of samples likely occurred in the field due to the use of the sampling device itself and/or the field sampling procedures.

Table A.1: Water Sample Trip Blank Results with Reference to Data Quality Objectives, Mary River CREMP, 2019

Client Sample ID		Lowest RDL[a]	BL0-09-B03	DL0-02-06-B03	C0-0503	BLO-06-B03	JL0-10-S03	C0-0503	DL0-02-4-S03	REF3-02-S03	JL0-09-S03
Date Sampled			15-Apr-2019	18-Apr-2019	28-Jun-2019	27-Jul-2019	28-Jul-2019	20-Aug-2019	25-Aug-2019	25-Aug-2019	27-Aug-2019
Time Sampled			13:45	10:30	14:15	16:40	13:30	10:50	16:55	9:30	12:05
ALS Sample ID			L2258890-7	L2260687-3	L2303747-20	L2318374-21	L2318398-10	L2334155-4	L2335725-3	L2335731-2	L2337947-12
	Units										
Physical Tests											
Conductivity	umhos/cm	3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	6.90	<3.0
Hardness (as $CaCO_3$)	mg/L	0.500	<0.50	<0.50	<0.50	0.620	<0.50	<0.50	<0.50	<0.50	3.28
Total Suspended Solids	mg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Dissolved Solids	mg/L	10.0	<10	33.0	<10	<10	71.0	<10	<10	<10	<10
Turbidity	NTU	0.100	<0.10	<0.10	0.390	<0.10	<0.10	0.120	<0.10	0.130	0.180
Anions and Nutrients (Water)											
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	<10	<10	<10	<10	<10	<10	<10	<10	<10
Ammonia, Total (as N)	mg/L	0.0100	<0.010	<0.010	0.0290	<0.010	0.0170	<0.010	<0.010	<0.010	<0.010
Bromide (Br)	mg/L	0.100	<0.10	<0.10	<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	<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	0.397	<0.021
Nitrate (as N)	mg/L	0.0200	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.397	<0.020
Nitrite (as N)	mg/L	0.00500	<0.0050	<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	<0.15	<0.15
Phosphorus, Total	mg/L	0.00300	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.00520	<0.0030	<0.0030
Sulfate (SO4)	mg/L	0.300	<0.30	<0.30	<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	0.520	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Organic Carbon	mg/L	0.500	<0.50	0.650	0.630	0.590	0.690	<0.50	0.570	0.560	<0.50
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0050	<0.0030	0.0407	<0.0030
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	<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	<0.00010	<0.00010
Barium (Ba)	mg/L	0.0000500	<0.000050	0.000139	<0.000050	<0.000050	0.0000850	<0.00010	0.0000600	0.000633	<0.000050
Beryllium (Be)	mg/L	0.000100	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<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	<0.010	<0.010
Cadmium (Cd)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.000010	0.0000130	<0.000010
Calcium (Ca)	mg/L	0.0500	<0.050	0.0520	<0.050	<0.050	0.0600	<0.050	0.0520	2.51	0.0850
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	<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	<0.00010	<0.00010
Copper (Cu)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	0.000620	<0.00050
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.010	<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	0.0000880	<0.000050
Lithium (Li)	mg/L	0.00100	<0.0010	<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	<0.0050	<0.050	0.0580	<0.050
Manganese (Mn)	mg/L	0.0000700	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.00050	<0.000070	0.00140	<0.000070
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000250	<0.000050
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Potassium (K)	mg/L	0.0500	<0.20	<0.20	<0.20	<0.20	<0.20	<0.050	<0.20	<0.20	<0.20
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.0010	<0.0010	<0.0010
Silicon (Si)	mg/L	0.100	<0.10	<0.10	<0.10	<0.10	0.200	<0.10	0.220	0.370	<0.10
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	0.0500	0.0880	<0.050	<0.050	<0.050	0.0720	<0.050	0.0670	0.329	<0.050
Strontium (Sr)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	0.000100	<0.0010	<0.00010	0.00165	<0.00010
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<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	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.00030	<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	<0.000010	<0.000010
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<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	0.0227	<0.0030
Dissolved Metals (Water)											
Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	0.0470	<0.0030	<0.0050	<0.0030	0.00500	0.0228
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	<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	<0.00010	<0.00010
Barium (Ba)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	0.000517	0.0000930	<0.00010	0.0000670	0.0000750	0.000436
Beryllium (Be)	mg/L	0.000100	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<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	<0.010	<0.010
Cadmium (Cd)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	0.0500	<0.050	<0.050	<0.050	0.250	0.0570	<0.050	0.0800	0.114	1.31
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	<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	<0.00010	<0.00010
Copper (Cu)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.010	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	0.0000960	<0.000050	<0.000050	<0.000050	<0.000050	0.0000760
Lithium (Li)	mg/L	0.00100	<0.0010	<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	<0.0050	<0.050	<0.050	<0.050
Manganese (Mn)	mg/L	0.0000700	<0.000070	<0.000070	<0.000070	0.00110	<0.000070	<0.00050	<0.000070	0.000111	0.000857
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000125	<0.000050
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	<0.00050	0.000520	<0.00050	<0.00050	<0.00050	<0.00050
Potassium (K)	mg/L	0.0500	<0.20	<0.20	<0.20	<0.20	<0.20	<0.050	<0.20	<0.20	<0.20
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.0010	<0.0010	<0.0010
Silicon (Si)	mg/L	0.100	<0.10	<0.10	<0.10	<0.10	0.200	<0.050	0.330	0.360	<0.10
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	0.0500	0.0870	<0.050	<0.050	0.122	0.0730	<0.050	0.104	0.110	0.107
Strontium (Sr)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	0.000340	<0.00010	<0.0010	0.000150	0.000140	0.000800
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<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	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.0100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.00030	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	0.0000160	<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	<0.00050	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	0.0308	<0.0030	<0.0010	<0.0030	<0.0030	0.0139
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	0.00110	0.00340	<0.0010	<0.0010	<0.0010
Plant Pigments (Water)											
Chlorophyll a	µg/L	0.100	<0.10	<0.10	<0.10	<0.10	<0.10	0.140	0.120	<0.10	<0.10
Phaeophytin a	µg/L	0.200	0.120	<0.10	0.100	<5.0	<0.50	0.640	0.350	0.220	0.300

(Shaded) Parameter concentration did not meet the data quality objective of ≤ 5x the RDL.

Note: RDL = Reportable Detection Limit.

[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, 2019

Parameter	Units	Lowest RDL[a]	JL0-07-S02	DD-HAB9-STN-1-B02	L2-0302	D1-0002	BLO-01-S02	JL0-07-S02	J0-0102	JL0-07-S02	JL0-10-S02
			14-Apr-2019	17-Apr-2019	29-Jun-2019	24-Jul-2019	27-Jul-2019	28-Jul-2019	18-Aug-2019	27-Aug-2019	27-Aug-2019
			9:45	16:10	7:55	17:00	11:10	12:30	14:00	11:30	10:40
			L2257965-2	L2260221-7	L2303747-3	L2317318-4	L2318374-22	L2318398-5	L2332360-3	L2337947-9	L2337947-4
Physical Tests	**Units**										
Conductivity	umhos/cm	3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Hardness (as CaCO3)	mg/L	10.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
pH	pH units	-	6.34	5.59	5.66	6.07	6.42	6.43	6.85	6.81	6.48
Total Suspended Solids	mg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Dissolved Solids	mg/L	20.0	<10	55.0	<10	<20	<10	<10	59.0	<10	<10
Turbidity	NTU	0.100	<0.10	0.120	0.820	<0.10	<0.10	0.110	0.250	0.210	0.250
Anions and Nutrients (Water)											
Alkalinity, Total (as CaCO3)	mg/L	10.0	<10	<10	<10	<10	<10	<10	<10	<10	<10
Ammonia, Total (as N)	mg/L	0.0200	<0.010	<0.010	0.0140	<0.010	<0.010	0.0130	<0.010	<0.010	<0.010
Bromide (Br)	mg/L	0.100	<0.10	<0.10	<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	<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	<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	<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	<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	<0.15	<0.15
Phosphorus, Total	mg/L	0.00300	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Sulfate (SO4)	mg/L	0.300	<0.30	<0.30	<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	<0.50	<0.50	0.690	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Organic Carbon	mg/L	0.500	0.530	0.580	0.850	0.940	0.560	0.960	0.530	0.530	0.520
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	0.0156	0.00740	<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	<0.00010	<0.00010
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	0.0000500	<0.000050	<0.000050	<0.000050	0.000211	0.000106	<0.000050	<0.000050	<0.000050	<0.000050
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	<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	<0.00050	<0.00050
Boron (B)	mg/L	0.0100	<0.010	<0.010	<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	<0.000010	<0.000010
Calcium (Ca)	mg/L	0.0500	<0.050	<0.050	<0.050	0.117	0.0860	<0.050	<0.050	<0.050	<0.050
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	<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	<0.00010	<0.00010
Copper (Cu)	mg/L	0.000500	<0.00050	<0.00050	<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	<0.030	<0.030
Lead (Pb)	mg/L	0.0000500	<0.000050	<0.000050	<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	<0.0010	<0.0010
Magnesium (Mg)	mg/L	0.0500	<0.050	<0.050	<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	0.000726	0.000148	<0.000070	<0.000070	<0.000070	<0.000070
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)	mg/L	0.0000500	<0.000050	<0.000050	<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	<0.00050	<0.00050
Potassium (K)	mg/L	0.200	<0.20	<0.20	<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	<0.0010	<0.0010
Silicon (Si)	mg/L	0.100	<0.10	<0.10	<0.10	<0.10	0.260	<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	<0.000010	<0.000010
Sodium (Na)	mg/L	0.0500	0.0760	<0.050	<0.050	0.0810	0.0880	<0.050	<0.050	0.123	0.0810
Strontium (Sr)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	0.000150	0.000110	<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	<0.00010	<0.00010
Tin (Sn)	mg/L	0.000100	<0.00010	<0.00010	<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	<0.010	<0.010
Uranium (U)	mg/L	0.0000100	<0.000010	<0.000010	0.0000170	<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	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	0.00460	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals (Water)											
Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	0.00510	0.00910	<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	<0.00010	<0.00010
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)	mg/L	0.0000500	<0.000050	<0.000050	0.0000810	0.0000710	0.000110	0.0000580	<0.000050	0.0000760	<0.000050
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	<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	<0.00050	<0.00050
Boron (B)	mg/L	0.0100	<0.010	<0.010	<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	<0.000010	<0.000010
Calcium (Ca)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	0.0910	<0.050	<0.050	<0.050	<0.050
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	<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	<0.00010	<0.00010
Copper (Cu)	mg/L	0.000500	<0.00050	<0.00050	<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	<0.030	<0.030
Lead (Pb)	mg/L	0.0000500	<0.000050	<0.000050	<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	<0.0010	<0.0010
Magnesium (Mg)	mg/L	0.0500	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Manganese (Mn)	mg/L	0.0000700	<0.000070	<0.000070	0.0000710	0.000339	0.000220	<0.000070	0.0000810	0.000206	<0.000070
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)	mg/L	0.0000500	<0.000050	<0.000050	<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	<0.00050	<0.00050
Potassium (K)	mg/L	0.200	<0.20	<0.20	<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	<0.0010	<0.0010
Silicon (Si)	mg/L	0.100	<0.10	<0.10	<0.10	<0.10	0.270	<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	<0.000010	<0.000010
Sodium (Na)	mg/L	0.0500	0.0740	<0.050	0.144	<0.050	0.0950	<0.050	<0.050	0.138	<0.050
Strontium (Sr)	mg/L	0.000100	<0.00010	<0.00010	<0.00010	0.000140	0.000160	<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	<0.00010	<0.00010
Tin (Sn)	mg/L	0.000100	<0.00010	<0.00010	<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	<0.010	<0.010
Uranium (U)	mg/L	0.0000100	<0.000010	<0.000010	<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	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	<0.0010	0.00240	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<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	<0.10	<0.10
Phaeophytin a	ug/L	0.200	0.140	0.120	0.140	<0.50	<5.0	<0.50	0.240	0.310	0.330

[grey box] Parameter concentration did not meet the data quality objective of ≤ 5x the RDL.

Note: RDL = Reportable Detection Limit.

[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, 2019

Client Sample ID		Lowest	JL0-01-S04	DL0-02-4-B04	BL0-0504	DL0-01-204	DL0-02-204	DL0-02-104
Date Sampled		RDL[a]	12-Apr-2019	18-Apr-2019	25-Jul-2019	25-Jul-2019	22-Aug-2019	22-Aug-2019
ALS Sample ID			L2257959-1	L2260687-13	L2317310-9	L2317310-8	L2334510-18	L2334510-19
	Units							
Physical Tests								
Conductivity	umhos/cm	3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Hardness (as $CaCO_3$)	mg/L	10.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Suspended Solids	mg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Dissolved Solids	mg/L	20.0	<10	37.0	<20	<20	<10	<10
Turbidity	NTU	0.100	<0.10	<0.10	<0.10	<0.10	0.110	0.230
Anions and Nutrients (Water)								
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	<10	<10	<10	<10	<10	<10
Ammonia, Total (as N)	mg/L	0.0200	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
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	0.00500	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Kjeldahl Nitrogen	mg/L	0.150	0.900	<0.15	<0.15	<0.15	<0.15	<0.15
Phosphorus, Total	mg/L	0.00300	<0.0030	<0.0030	<0.0030	<0.0030	0.00300	<0.0030
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	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Organic Carbon	mg/L	0.500	0.530	0.640	0.770	0.840	0.830	0.600
Total Metals (Water)								
Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	<0.0030	0.00370	0.00320
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	0.000129	0.000104	0.0000770	<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	0.0000110	<0.000010	<0.000010
Calcium (Ca)	mg/L	0.0500	<0.050	<0.050	0.0530	0.0680	<0.050	<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	0.000900	0.000860	<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	0.0000520	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00100	<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	0.000115	0.000129	<0.000070	<0.000070
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050
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	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)	mg/L	0.100	<0.10	<0.10	<0.10	0.130	0.220	0.240
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	0.103	0.0960	0.0690	0.0960
Strontium (Sr)	mg/L	0.000100	<0.00010	<0.00010	0.000250	0.000230	<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	<0.00010	<0.00010	0.000260	0.000320	<0.00010	0.000110
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	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0.00590	0.00690	<0.0030	<0.0030
Dissolved Metals (Water)								
Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	<0.0030	0.00640	<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	0.0000550	0.0000530	0.000184	<0.000050	<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	<0.050	0.0810	0.0510	0.0530
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	0.000640	0.000920	<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	0.0000670	<0.000050	<0.000050
Lithium (Li)	mg/L	0.00100	<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	0.000424	<0.000070	<0.000070
Mercury (Hg)	mg/L	0.0000100	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050
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	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)	mg/L	0.100	<0.10	<0.10	<0.10	0.140	0.240	0.240
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	0.103	0.103	0.100	0.0960
Strontium (Sr)	mg/L	0.000100	<0.00010	<0.00010	0.000260	0.000260	0.000110	<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	<0.00010	<0.00010	0.000180	0.000320	<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	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0.00330	0.00460	<0.0030	<0.0030
Aggregate Organics (Water)								
Phenols (4AAP)	mg/L	0.00100	<0.0010	<0.0010	<0.0010	0.00120	<0.0010	<0.0010
Plant Pigments (Water)								
Chlorophyll a	µg/L	0.100	<0.10	<0.10	<0.10	<0.10	<0.10	0.170
Phaeophytin a	µg/L	0.200	0.130	0.130	<0.50	<0.50	0.240	0.260

(shaded box) Parameter did not meet the data quality objective of ≤ 5x the RDL.

Note: RDL = Reportable Detection Limit.

[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, 12 field duplicates were collected over the course of the 2019 Mary River Project CREMP water quality monitoring, including two during the winter lake monitoring event, one during the spring stream monitoring event, four during the summer stream/lake monitoring event, and five during the fall stream/lake monitoring event. In general, close agreement in parameter concentrations was observed between duplicate samples, with 95% of field duplicate analyte pairs meeting the water quality field duplicate DQO of ≤25% Relative Percent Difference (RPD) in parameter concentrations of the 1,032 duplicate analyses conducted (Appendix Table A.4). Total ammonia, total aluminum, and dissolved aluminum were the key parameters that most frequently did not meet the DQO between 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. Total and dissolved aluminum often did not fail to meet the DQO in the same sample, and no seasonal patterns were suggested for those duplicate samples in which concentrations in duplicate samples failed to achieve the DQO, suggesting no consistent methodological issues. Overall, 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 Benthic Invertebrate Community Samples

A2.2.1 Subsampling Accuracy

Sub-sampling of benthic invertebrate community samples was conducted on 13 of 63 stream samples (21%) and 16 of 50 lake samples (32%; total of 26% for 2019 project) with the sorted fraction for these samples varying between 25% (1/4) and 50% (1/2) of the sample material (average of 41%; Appendix Table A.7). 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.5). This indicated that precision and accuracy for sub-sampling of the benthic invertebrate community samples was acceptable.

A2.2.2 Organism Recovery

Sorting efficiency (i.e., percent recovery) of benthic invertebrate samples was high, averaging 98% for eight lotic samples evaluated and 99.5% for the five lentic samples evaluated (Appendix Table A.6a,b). Sorting efficiency for these samples achieved the DQO of ≥ 90% recovery, and therefore the benthic invertebrate community sample recovery was considered acceptable.

Figure A.4: Water Sample Field Duplicate Results with Reference to the Data Quality Objective, Mary River CREMP, 2019

Sample ID	Units	LDL	E0-20	E0-2001	RPD	E0-21	E0-2101	RPD	E0-03	E0-0301	RPD
Date Sampled			28-Jul-2019	28-Jul-2019		20-Aug-2019	20-Aug-2019		27-Jun-2019	27-Jun-2019	
ALS Sample ID			L2318400-1	L2318400-2		L2334155-7	L2334155-8		L2301642-4	L2301642-5	
Conductivity	umhos/cm	3	161	161	0	254	255	0.4	41.5	40.2	3.2
Hardness (as $CaCO_3$)	mg/L	10.0	79.1	79.5	0.5	103	100	3.0	20.8	20.6	1.0
pH	pH units	0.100	8.27	8.25	0.2	8.26	8.26	0	7.66	7.57	1.2
Total Suspended Solids	mg/L	2	<2.0	3.30	49	10.4	10.9	4.7	<2.0	2.40	18
Total Dissolved Solids	mg/L	20.0	83.0	80.0	3.7	152	155	2.0	<20	<20	0
Turbidity	NTU	0.100	16.6	15.2	8.8	47.3	47.4	0.2	4.83	5.05	4.5
Anions and Nutrients (Water)											
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	67.0	67.0	0	88.0	88.0	0	21.0	21.0	0
Ammonia, Total (as N)	mg/L	0.0200	0.0250	0.0100	86	<0.010	<0.010	0	0.0270	0.0400	39
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	5.73	5.76	0.5	13.4	13.5	0.7	0.750	0.760	1.3
Nitrate and Nitrite as N	mg/L	0.0210	0.0630	0.0730	15	0.0510	0.0510	0	<0.021	<0.021	0
Nitrate (as N)	mg/L	0.0200	0.0630	0.0730	15	0.0510	0.0510	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	0.210	<0.15	33	<0.15	<0.15	0
Phosphorus, Total	mg/L	0.00300	0.0107	0.0105	1.9	0.0284	0.0297	4.5	0.00540	0.00670	21
Sulfate (SO4)	mg/L	0.300	10.3	10.3	0	13.3	13.3	0	1.23	1.23	0
Organic / Inorganic Carbon (Water)											
Dissolved Organic Carbon	mg/L	0.500	1.46	1.43	2.1	1.61	1.41	13	1	1	0
Total Organic Carbon	mg/L	0.500	2.06	1.77	15	2.15	2.22	3.2	1.77	1.66	6.4
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.202	0.191	5.6	1.08	1.20	11	0.108	0.0801	30
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.000100	<0.00010	0.000100	0	0.000220	0.000210	4.7	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.0000500	0.0112	0.0111	0.9	0.0203	0.0211	3.9	0.00334	0.00321	4.0
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00010	<0.00010	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.000500	<0.00050	<0.00050	0	<0.000050	<0.000050	0	<0.00050	<0.00050	0
Boron (B)	mg/L	0.0100	<0.010	<0.010	0	0.0110	0.0110	0	<0.010	<0.010	0
Cadmium (Cd)	mg/L	0.0000100	<0.000010	<0.000010	0	0.0000153	0.00000980	44	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	15.1	15.2	0.7	20.2	20.1	0.5	4.01	3.99	0.5
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	0	0.00248	0.00279	12	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.000100	0.000130	0.000120	8.0	0.000580	0.000630	8.3	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.000500	0.00133	0.00137	3.0	0.00280	0.00280	0	0.000630	0.000570	10
Iron (Fe)	mg/L	0.0300	0.237	0.242	2.1	1.26	1.38	9.1	0.0890	0.0680	27
Lead (Pb)	mg/L	0.0000500	0.000318	0.000308	3.2	0.00102	0.00102	0	0.000122	0.0000880	32
Lithium (Li)	mg/L	0.00100	0.00150	0.00150	0	0.00220	0.00240	8.7	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	9.53	9.42	1.2	12.4	12.4	0	2.56	2.54	0.8
Manganese (Mn)	mg/L	0.0000700	0.00374	0.00392	4.7	0.0158	0.0169	6.7	0.00184	0.00163	12
Mercury (Hg)	mg/L	0.0000100	<0.0000050	<0.0000050	0	<0.0000050	<0.0000050	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.0000500	0.000300	0.000308	2.6	0.000616	0.000586	5.0	0.0000620	0.0000570	8.4
Nickel (Ni)	mg/L	0.000500	0.000740	0.000750	1.3	0.00225	0.00230	2.2	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	1.24	1.21	2.4	1.98	2.03	2.5	0.420	0.420	0
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.000050	<0.000050	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	1.16	1.16	0	2.59	2.89	11	0.580	0.520	11
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	0	<0.000050	<0.000050	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	2.16	2.15	0.5	5.23	5.20	0.6	0.433	0.410	5.5
Strontium (Sr)	mg/L	0.000100	0.0235	0.0233	0.9	0.0265	0.0264	0.4	0.00423	0.00384	9.7
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	0	0.0000300	0.0000310	3.3	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	0.0120	0.0120	0	0.0694	0.0788	13	<0.010	<0.010	0
Uranium (U)	mg/L	0.0000100	0.00214	0.00215	0.5	0.00555	0.00558	0.5	0.000203	0.000173	16
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	0.00243	0.00273	12	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	0.00340	13	0.00910	0.00430	72	<0.0030	<0.0030	0
Dissolved Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.0301	0.0269	11	0.0218	0.0245	12	0.0368	0.0243	41
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.0000500	0.00973	0.00960	1.3	0.0139	0.0138	0.7	0.00277	0.00265	4.4
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00010	<0.00010	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.000500	<0.00050	<0.00050	0	<0.000050	<0.000050	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	0.0000100	<0.000010	<0.000010	0	<0.0000050	<0.0000050	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	15.6	15.7	0.6	20.5	20.2	1.5	3.96	3.96	0
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.000500	0.000960	0.000920	4.3	0.000970	0.000950	2.1	<0.00050	<0.00050	0
Iron (Fe)	mg/L	0.0300	<0.030	<0.030	0	<0.010	0.0100	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.0000500	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	0.00150	0.00150	0	0.00110	<0.0010	9.5	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	9.74	9.79	0.5	12.6	12.1	4.0	2.64	2.60	1.5
Manganese (Mn)	mg/L	0.0000700	0.000585	0.000488	18	<0.00050	<0.00050	0	0.000586	0.000516	13
Mercury (Hg)	mg/L	0.0000100	<0.0000050	<0.0000050	0	<0.0000050	<0.0000050	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.0000500	0.000495	0.000500	1.0	0.000722	0.000725	0.4	0.0000830	0.0000660	23
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	1.23	1.19	3.3	1.60	1.57	1.9	0.400	0.400	0
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.000050	0.0000520	3.9	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.930	0.920	1.1	0.582	0.580	0.3	0.430	0.400	7.2
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	0	<0.000050	<0.000050	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	2.25	2.23	0.9	5.56	5.33	4.2	0.423	0.414	2.2
Strontium (Sr)	mg/L	0.000100	0.0239	0.0241	0.8	0.0253	0.0252	0.4	0.00420	0.00388	7.9
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	0	<0.000010	<0.000010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.000100	<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	0.000570	0.000750	27	<0.010	<0.010	0
Uranium (U)	mg/L	0.0000100	0.00205	0.00208	1.5	0.00506	0.00509	0.6	0.000155	0.000146	6.0
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.00050	<0.00050	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0010	<0.0010	0	<0.0030	<0.0030	0
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	<0.0010	<0.0010	0	0.00130	0.00110	17	<0.0010	0.00120	18
Plant Pigments (Water)											
Chlorophyll a	µg/L	0.100	0.590	0.530	11	0.660	0.840	24	0.130	0.140	7.4
Phaeophytin a	µg/L	0.100	0.710	0.740	4.1	1.13	1.23	8.5	0.180	0.180	0

[shaded box] Values exceeding the DQO of ≤ 25% RPD.

Notes: LDL = Laboratory Detection Limit, RPD = Relative Percent Difference, DQO = Data Quality Objective.

Figure A.4: Water Sample Field Duplicate Results with Reference to the Data Quality Objective, Mary River CREMP, 2019

Sample ID	Units	LDL	G0-09	G0-0901	RPD	G0-09-B	G0-09-B01	RPD	BL0-05-S	BL0-05-S01	RPD
Date Sampled			20-Aug-2019	20-Aug-2019		1-Aug-2019	1-Aug-2019		16-Apr-2019	16-Apr-2019	
ALS Sample ID			L2334155-14	L2334155-15		L2323669-3	L2323669-8		L2259305-3	L2259305-4	
Conductivity	umhos/cm	3	230	231	0	142	141	1	97.2	97.3	0
Hardness (as $CaCO_3$)	mg/L	10.0	103	102	1	67.9	63.7	6	46.1	46.1	0
pH	pH units	0.100	8.40	8.40	0	7.95	8	1	7.65	7.59	1
Total Suspended Solids	mg/L	2	3.40	3.60	6	2.60	3.00	14	<2.0	<2.0	0
Total Dissolved Solids	mg/L	20.0	161	139	15	64.0	88.0	32	48.0	48.0	0
Turbidity	NTU	0.100	9.39	10.0	6	11.7	12.3	5	0.160	<0.10	46
Anions and Nutrients (Water)											
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	96.0	95.0	1	64.0	66.0	3	45.0	45.0	0
Ammonia, Total (as N)	mg/L	0.0200	<0.010	<0.010	0	0.0150	0.0180	18	<0.010	<0.010	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	13.6	13.7	1	4.99	4.91	2	2.17	2.17	0
Nitrate and Nitrite as N	mg/L	0.0210	<0.021	<0.021	0	<0.021	<0.021	0	0.0320	0.0310	3
Nitrate (as N)	mg/L	0.0200	<0.020	<0.020	0	<0.020	<0.020	0	0.0320	0.0310	3
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	0.00770	0.00830	8	0.0125	0.0117	7	0.00320	0.00650	68
Sulfate (SO4)	mg/L	0.300	6.23	6.24	0	2.89	2.88	0	2.84	2.83	0
Organic / Inorganic Carbon (Water)											
Dissolved Organic Carbon	mg/L	0.500	1.95	1.55	23	1.38	1.28	8	1.56	1.52	3
Total Organic Carbon	mg/L	0.500	1.91	1.92	1	1.59	1.74	9	1.92	1.85	4
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.316	0.304	4	0.510	0.517	1	0.00480	0.00330	37
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	0	0.000120	0.000110	9	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.0000500	0.0144	0.0144	0	0.0123	0.0117	5	0.00499	0.00485	3
Beryllium (Be)	mg/L	0.000500	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.000500	<0.000050	<0.000050	0	<0.000050	<0.000050	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	0.0000100	0.00000930	<0.0000050	60	<0.0000050	<0.0000050	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	21.5	21.7	1	13.3	13.7	3	9.84	9.46	4
Chromium (Cr)	mg/L	0.000500	0.000580	0.000570	2	0.000970	0.00117	19	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.000100	0.000120	0.000120	0	0.000230	0.000250	8	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.000500	0.00140	0.00270	63	0.00180	0.00160	12	0.000690	0.000690	0
Iron (Fe)	mg/L	0.0300	0.251	0.247	2	0.491	0.532	8	<0.030	<0.030	0
Lead (Pb)	mg/L	0.0000500	0.000236	0.000224	5	0.000457	0.000412	10	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	0	0.00110	0.00150	31	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	11.6	11.8	2	7.84	7.32	7	5.56	5.53	1
Manganese (Mn)	mg/L	0.0000700	0.00337	0.00331	2	0.00602	0.00667	10	0.000419	0.000374	11
Mercury (Hg)	mg/L	0.0000100	<0.0000050	<0.0000050	0	<0.0000050	<0.0000050	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.0000500	0.000529	0.000530	0	0.000406	0.000489	19	0.000169	0.000164	3
Nickel (Ni)	mg/L	0.000500	0.000600	0.000640	6	0.000860	0.000890	3	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	1.67	1.67	0	1.42	1.23	14	0.660	0.640	3
Selenium (Se)	mg/L	0.00100	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	1.29	1.29	0	1.78	1.72	3	0.420	0.410	2
Silver (Ag)	mg/L	0.0000100	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	5.90	5.97	1	3.17	2.87	10	1.12	1.16	4
Strontium (Sr)	mg/L	0.000100	0.0252	0.0253	0	0.0166	0.0174	5	0.00746	0.00724	3
Thallium (Tl)	mg/L	0.000100	<0.000010	<0.000010	0	0.000014	0.000015	7	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	0.0146	0.0146	0	0.0284	0.0312	9	<0.010	<0.010	0
Uranium (U)	mg/L	0.0000100	0.00649	0.00660	2	0.00373	0.00347	7	0.000619	0.000604	2
Vanadium (V)	mg/L	0.00100	0.000780	0.000770	1	0.00119	0.00131	10	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0030	<0.0030	0	<0.0030	<0.0030	0	0.00350	<0.0030	15
Dissolved Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.0187	0.0190	2	0.0411	0.0392	5	<0.0030	<0.0030	0
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.0000500	0.0131	0.0130	1	0.00904	0.00855	6	0.00491	0.00482	2
Beryllium (Be)	mg/L	0.000500	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.000500	<0.000050	<0.000050	0	<0.000050	<0.000050	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	0.0000100	<0.0000050	<0.0000050	0	<0.0000050	<0.0000050	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	21.5	21.3	1	14.5	12.9	12	9.42	9.18	3
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.000500	0.000980	0.000980	0	0.000950	0.000960	1	0.000610	0.000660	8
Iron (Fe)	mg/L	0.0300	<0.010	<0.010	0	0.0190	0.0190	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.0000500	<0.000050	<0.000050	0	0.000052	<0.000050	4	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	0.00100	0.00100	0	0.00130	<0.0010	26	<0.0010	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	12.0	11.9	1	7.69	7.67	0	5.49	5.63	3
Manganese (Mn)	mg/L	0.0000700	<0.00050	<0.00050	0	<0.00050	<0.00050	0	0.000266	0.000258	3
Mercury (Hg)	mg/L	0.0000100	<0.0000050	<0.0000050	0	<0.0000050	<0.0000050	0	<0.000010	<0.000010	0
Molybdenum (Mo)	mg/L	0.0000500	0.000545	0.000572	5	0.000470	0.000450	4	0.000165	0.000170	3
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Potassium (K)	mg/L	0.200	1.58	1.58	0	1.19	1.20	1	0.630	0.640	2
Selenium (Se)	mg/L	0.00100	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.0010	<0.0010	0
Silicon (Si)	mg/L	0.100	0.656	0.671	2	0.901	0.878	3	0.400	0.420	5
Silver (Ag)	mg/L	0.0000100	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	6.15	6.07	1	3.22	3.19	1	1.10	1.16	5
Strontium (Sr)	mg/L	0.000100	0.0244	0.0249	2	0.0168	0.0158	6	0.00704	0.00731	4
Thallium (Tl)	mg/L	0.000100	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Titanium (Ti)	mg/L	0.0100	0.000490	0.000510	4	0.00113	0.00118	4	<0.010	<0.010	0
Uranium (U)	mg/L	0.0000100	0.00606	0.00602	1	0.00336	0.00324	4	0.000628	0.000623	1
Vanadium (V)	mg/L	0.00100	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.0010	<0.0010	0
Zinc (Zn)	mg/L	0.00300	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0030	<0.0030	0
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	0.00610	0.00220	94	<0.0010	<0.0010	0	<0.0010	<0.0010	0
Plant Pigments (Water)											
Chlorophyll a	µg/L	0.100	0.560	0.590	5	0.440	0.440	0	0.570	0.620	8
Phaeophytin a	µg/L	0.100	0.880	0.960	9	<0.50	0.500	0	0.570	0.570	0

Values exceeding the DQO of ≤ 25% RPD.

Notes: LDL = Laboratory Detection Limit, RPD = Relative F

Figure A.4: Water Sample Field Duplicate Results with Reference to the Data Quality Objective, Mary River CREMP, 2019

Sample ID	Units	LDL	BL0-09-S	BL0-09-S01	RPD	DL0-01-2-B	DL0-01-2-B01	RPD	DL0-01-4-S	DL0-01-4-S01	RPD
Date Sampled			26-Aug-2019	26-Aug-2019		26-Jul-2019	26-Jul-2019		25-Jul-2019	25-Jul-2019	
ALS Sample ID			L2336455-7	L2336455-5		L2318373-15	L2318373-16		L2317310-6	L2317310-5	
Conductivity	umhos/cm	3	90.2	90.8	1	143	143	0	148	148	0
Hardness (as $CaCO_3$)	mg/L	10.0	41.1	41.0	0	66.9	67.1	0	67.9	67.5	1
pH	pH units	0.100	7.91	7.89	0	7.79	8.21	5	8.27	8.23	0
Total Suspended Solids	mg/L	2	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	
Total Dissolved Solids	mg/L	20.0	59.0	67.0	13	99.0	106	7	68.0	76.0	11
Turbidity	NTU	0.100	2.82	2.72	4	0.920	1	8	1.01	1.02	1
Anions and Nutrients (Water)											
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	44.0	42.0	5	61.0	63.0	3	62.0	61.0	2
Ammonia, Total (as N)	mg/L	0.0200	0.0200	0.0250	22	0.0120	0.0490	121	0.0110	0.114	165
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	2.39	2.39	0	3.72	3.68	1	3.79	3.79	0
Nitrate and Nitrite as N	mg/L	0.0210	<0.021	0.0240	13	0.126	0.120	5	0.119	0.118	1
Nitrate (as N)	mg/L	0.0200	<0.020	0.0240	18	0.126	0.120	5	0.119	0.118	1
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	<1.5	<0.15	164	<0.15	0.790	136
Phosphorus, Total	mg/L	0.00300	0.00700	0.00430	48	<0.0030	<0.0030	0	0.00490	0.00490	0
Sulfate (SO4)	mg/L	0.300	3.18	3.18	0	10.8	10.8	0	12.6	12.6	0
Organic / Inorganic Carbon (Water)											
Dissolved Organic Carbon	mg/L	0.500	1.43	1.54	7	1.78	1.79	1	1.66	1.63	2
Total Organic Carbon	mg/L	0.500	1.82	1.75	4	2.02	1.98	2	2.18	2.26	4
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.0611	0.0482	24	0.0106	0.0124	16	0.0146	0.0163	11
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.0000500	0.00529	0.00533	1	0.00697	0.00709	2	0.00700	0.00696	1
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00010	0
Bismuth (Bi)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.000050	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	0.0000100	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.0000050	0
Calcium (Ca)	mg/L	0.0500	8.24	8.32	1	12.9	13.2	2	12.5	12.7	2
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.000500	0.000650	0.000660	2	0.000910	0.000910	0	0.000890	<0.0010	12
Iron (Fe)	mg/L	0.0300	0.0480	0.0430	11	<0.030	<0.030	0	<0.030	0.0180	50
Lead (Pb)	mg/L	0.0000500	0.0000570	0.0000560	2	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	0	0.00110	0.00120	9	0.00100	<0.0010	0
Magnesium (Mg)	mg/L	0.0500	4.91	4.96	1	8.67	9.15	5	8.76	8.90	2
Manganese (Mn)	mg/L	0.0000700	0.00139	0.00148	6	0.00231	0.00245	6	0.00255	0.00220	15
Mercury (Hg)	mg/L	0.0000100	<0.0000050	<0.0000050	0	<0.0000050	<0.0000050	0	<0.0000050	<0.0000050	0
Molybdenum (Mo)	mg/L	0.0000500	0.000179	0.000181	1	0.000887	0.000921	4	0.000915	0.000951	4
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	0	0.000660	0.000730	10	0.000650	0.000750	14
Potassium (K)	mg/L	0.200	0.690	0.710	3	1.30	1.33	2	1.29	1.30	1
Selenium (Se)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.000050	0
Silicon (Si)	mg/L	0.100	0.580	0.550	5	0.570	0.430	28	0.450	0.450	0
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000050	0
Sodium (Na)	mg/L	0.0500	1.16	1.17	1	1.56	1.65	6	1.59	1.64	3
Strontium (Sr)	mg/L	0.000100	0.00756	0.00760	1	0.00916	0.00951	4	0.00926	0.00940	2
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.000010	0
Tin (Sn)	mg/L	0.000100	<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	0.000650	176
Uranium (U)	mg/L	0.0000100	0.000753	0.000750	0	0.000913	0.000957	5	0.00101	0.00109	8
Vanadium (V)	mg/L	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.00050	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	0.0198	0.0140	34	0.00360	0.0185	135	0.00420	0.00400	5
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.0000500	0.00517	0.00505	2	0.00687	0.00701	2	0.00680	0.00670	1
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.000500	<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	0.0000100	<0.000010	<0.000010	0	0.0000100	0.0000140	33	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	8.31	8.35	0	12.6	12.7	1	12.8	12.8	0
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.000500	0.000680	0.000660	3	0.00184	0.00186	1	0.00100	0.000830	19
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	0.0000500	<0.000050	<0.000050	0	<0.000050	0.0000830	50	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	<0.0010	<0.0010	0	0.00110	0.00110	0	0.00120	0.00130	8
Magnesium (Mg)	mg/L	0.0500	4.93	4.89	1	8.62	8.59	0	8.76	8.61	2
Manganese (Mn)	mg/L	0.0000700	0.000442	0.000422	5	0.000164	0.000695	124	0.000302	0.000357	17
Mercury (Hg)	mg/L	0.0000100	<0.0000050	<0.0000050	0	<0.0000050	<0.0000050	0	<0.0000050	<0.0000050	0
Molybdenum (Mo)	mg/L	0.0000500	0.000214	0.000191	11	0.000918	0.000937	2	0.000936	0.000972	4
Nickel (Ni)	mg/L	0.000500	<0.00050	<0.00050	0	0.000680	0.000790	15	0.000610	0.000600	2
Potassium (K)	mg/L	0.200	0.680	0.670	1	1.29	1.33	3	1.28	1.25	2
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	0.470	4	0.570	0.550	4	0.410	0.410	0
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	0	<0.000010	0.0000170	52	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	1.18	1.16	2	1.59	1.62	2	1.58	1.56	1
Strontium (Sr)	mg/L	0.000100	0.00771	0.00767	1	0.00907	0.0101	11	0.00941	0.00934	1
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.000100	<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	0.0000100	0.000753	0.000750	0	0.000897	0.000926	3	0.00103	0.00101	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	0.00770	88	<0.0030	<0.0030	0
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	0.00130	0.00160	21	<0.0010	<0.0010	0	0.00100	0.00110	10
Plant Pigments (Water)											
Chlorophyll a	µg/L	0.100	0.980	0.940	4	1.80	1.77	2	1.62	1.57	3
Phaeophytin a	µg/L	0.100	0.760	0.720	5	1.29	1.07	19	1.01	0.940	7

[shaded] Values exceeding the DQO of ≤ 25% RPD.

Notes: LDL = Laboratory Detection Limit, RPD = Relative F

Figure A.4: Water Sample Field Duplicate Results with Reference to the Data Quality Objective, Mary River CREMP, 2019

Sample ID	Units	LDL	DL0-01-7-S	DL0-01-7-S01	RPD	DL0-02-08-S	DL0-02-8-S01	RPD	JL0-09-B	JL0-09-B01	RPD
Date Sampled			22-Aug-2019	22-Aug-2019		18-Apr-2019	18-Apr-2019		28-Jul-2019	28-Jul-2019	
ALS Sample ID			L2334510-11	L2334510-12		L2260687-8	L2260687-9		L2318398-2	L2318398-3	
Conductivity	umhos/cm	3	178	175	2	164	162	1.2	140	140	0
Hardness (as $CaCO_3$)	mg/L	10.0	78.8	78.7	0	89.6	86.3	3.8	67.7	68.5	1.2
pH	pH units	0.100	8.34	8.32	0	7.65	7.72	0.9	7.97	7.94	0.4
Total Suspended Solids	mg/L	2	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
Total Dissolved Solids	mg/L	20.0	86.0	78.0	10	119	99.0	18	70.0	76.0	8.2
Turbidity	NTU	0.100	0.550	0.550	0	0.250	0.410	48	0.730	0.540	30
Anions and Nutrients (Water)											
Alkalinity, Total (as $CaCO_3$)	mg/L	10.0	58.0	62.0	7	74.0	74.0	0	66.0	66.0	0
Ammonia, Total (as N)	mg/L	0.0200	<0.010	<0.010	0	<0.010	<0.010	0	0.0200	0.0120	50
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	4.33	4.43	2	4.14	4.14	0	3.87	3.90	0.8
Nitrate and Nitrite as N	mg/L	0.0210	1.31	0.125	165	0.0790	0.0800	1.3	<0.021	0.0220	4.7
Nitrate (as N)	mg/L	0.0200	1.31	0.125	165	0.0790	0.0800	1.3	0.0200	0.0220	9.5
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	0.180	<0.15	18	<0.15	<0.15	0	<0.15	<0.15	0
Phosphorus, Total	mg/L	0.00300	0.00340	0.00360	6	0.00550	0.00590	7.0	0.00350	0.00340	2.9
Sulfate (SO4)	mg/L	0.300	14.1	14.1	0	8.33	8.35	0.2	4.06	4.08	0.5
Organic / Inorganic Carbon (Water)											
Dissolved Organic Carbon	mg/L	0.500	1.83	1.97	7	2.12	1.79	17	1.87	1.92	2.6
Total Organic Carbon	mg/L	0.500	2.24	2.15	4	2.37	2.36	0.4	2.17	2.15	0.9
Total Metals (Water)											
Aluminum (Al)	mg/L	0.00300	0.00600	0.0215	113	0.00690	<0.0030	79	0.00700	0.00610	14
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.0000500	0.00743	0.00724	3	0.00812	0.00822	1.2	0.00678	0.00686	1.2
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.000500	<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	0.0000100	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Calcium (Ca)	mg/L	0.0500	14.6	14.4	1	18.2	17.4	4.5	13.2	13.3	0.8
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.000500	0.000800	0.00101	23	0.000930	0.000860	7.8	0.000930	0.000940	1.1
Iron (Fe)	mg/L	0.0300	<0.030	0.0520	54	<0.030	<0.030	0	<0.030	<0.030	0
Lead (Pb)	mg/L	0.0000500	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
Lithium (Li)	mg/L	0.00100	0.00120	0.00140	15	0.00150	0.00150	0	0.00110	0.00110	0
Magnesium (Mg)	mg/L	0.0500	10.3	9.88	4	10.7	11.1	3.7	8.54	8.47	0.8
Manganese (Mn)	mg/L	0.0000700	0.000456	0.00434	162	0.00181	0.00178	1.7	0.00191	0.00191	0
Mercury (Hg)	mg/L	0.0000100	<0.0000050	<0.0000050	0	<0.000010	<0.000010	0	<0.0000050	<0.0000050	0
Molybdenum (Mo)	mg/L	0.0000500	0.00119	0.000951	22	0.000789	0.000806	2.1	0.000351	0.000341	2.9
Nickel (Ni)	mg/L	0.000500	0.000690	0.00102	39	0.000680	0.000680	0	0.000590	0.000580	1.7
Potassium (K)	mg/L	0.200	1.46	1.40	4	1.41	1.43	1.4	1.24	1.23	0.8
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	0.400	0.400	0	0.600	0.540	11	0.360	0.360	0
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	1.92	1.83	5	1.83	1.80	1.7	1.60	1.59	0.6
Strontium (Sr)	mg/L	0.000100	0.0103	0.0102	1	0.0122	0.0116	5.0	0.0104	0.0105	1.0
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.000100	<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	0.0000100	0.00101	0.00115	13	0.000857	0.000873	1.8	0.000870	0.000871	0.1
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	0.0155	0.0112	32	<0.0030	<0.0030	0	<0.0030	0.00430	36
Antimony (Sb)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Arsenic (As)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Barium (Ba)	mg/L	0.0000500	0.00741	0.00725	2	0.00839	0.00817	2.7	0.00674	0.00679	0.7
Beryllium (Be)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Bismuth (Bi)	mg/L	0.000500	<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	0.0000100	<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	1	17.8	16.8	5.8	13.2	13.4	1.5
Chromium (Cr)	mg/L	0.000500	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
Cobalt (Co)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Copper (Cu)	mg/L	0.000500	0.00102	0.000910	11	0.000870	0.000870	0	0.000870	0.000830	4.7
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	0.0000500	<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	0.00120	0.00120	0	0.00100	0.00110	9.5
Magnesium (Mg)	mg/L	0.0500	10.1	10.1	0	11.0	10.8	1.8	8.46	8.52	0.7
Manganese (Mn)	mg/L	0.0000700	0.000743	0.000590	23	0.000480	0.000529	9.7	0.000112	0.000159	35
Mercury (Hg)	mg/L	0.0000100	<0.0000050	<0.0000050	0	<0.000010	<0.000010	0	<0.0000050	<0.0000050	0
Molybdenum (Mo)	mg/L	0.0000500	0.00108	0.00105	3	0.000795	0.000782	1.6	0.000342	0.000364	6.2
Nickel (Ni)	mg/L	0.000500	0.000750	0.000800	6	0.000690	0.000680	1.5	0.000580	0.000590	1.7
Potassium (K)	mg/L	0.200	1.41	1.39	1	1.42	1.43	0.7	1.23	1.24	0.8
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	0.380	0.390	3	0.560	0.570	1.8	0.350	0.360	2.8
Silver (Ag)	mg/L	0.0000100	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
Sodium (Na)	mg/L	0.0500	1.85	1.84	1	1.89	1.83	3.2	1.58	1.60	1.3
Strontium (Sr)	mg/L	0.000100	0.0105	0.0104	1	0.0115	0.0113	1.8	0.0105	0.0106	0.9
Thallium (Tl)	mg/L	0.000100	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
Tin (Sn)	mg/L	0.000100	<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	0.0000100	0.00113	0.00115	2	0.000921	0.000908	1.4	0.000889	0.000895	0.7
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	0.00340	<0.0030	13	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Aggregate Organics (Water)											
Phenols (4AAP)	mg/L	0.00100	<0.0010	<0.0010	0	0.00150	0.00120	22	<0.0010	<0.0010	0
Plant Pigments (Water)											
Chlorophyll a	µg/L	0.100	1.10	0.990	11	3.39	2.63	25	1.76	1.77	0.6
Phaeophytin a	µg/L	0.100	0.750	0.630	17	1.05	1.36	26	1.24	1.07	15

Values exceeding the DQO of ≤ 25% RPD.

Notes: LDL = Laboratory Detection Limit, RPD = Relative F

Table A.5: Subsampling Error for Benthic Invertebrate Community Samples, 2019 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	Actual Density*	Precision		Accuracy	
							% range		min	max
REF-CRK-B2	1	212	233	-	-	445	9.0	-	4.7	-
CLT1-US-B2	5	170	189	-	-	359	10	-	5.3	-
SDLT12-B1	1	241	273	-	-	514	12	-	6.2	-
CO-05-B3	-	269	295	-	-	564	8.8	-	4.6	-

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	Actual Density*	Precision		Accuracy	
							% range		min	max
JLO-20	-	201	202	203	234	840	0.5	14	3.3	11
DL0-02-02	-	209	212	-	-	421	1.4	-	0.7	-

Notes: whole large organisms excluded in calculations; min = minimum absolute % error; max = maximum absolute % error.

Table A.6: Percent Recovery from Benthic Invertebrate Samples, Mary River Project CREMP, 2019

(a) Lotic (creek and river) samples

Station	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
CLT1-DS-B3	311	318	97.8%
CLT2-US-B1	158	159	99.4%
CLT2-DS-B5	108	112	96.4%
SDLT1-B3	341	346	98.6%
SDLT12-B2	344	350	98.3%
CO-05-B5	362	368	98.4%
EO-20-B4	252	258	97.7%
GO-03-B2	295	296	99.7%
		Average % Recovery	**98.3%**

b) Lentic (lake) samples

Station	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
REF-03-05	100	101	99.0%
BLO-15	186	188	98.9%
DLO-01-14	164	164	100.0%
DLO-02-10	188	189	99.5%
JLO-01	160	160	100.0%
		Average % Recovery	**99.5%**

Table A.7: Proportion of Benthic Invertebrates Samples Sorted for the 2019 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-B1	1/2	SDLT1-B2	1/2	EO-20-B1	1/2	BLO-05	1/ 2	DLO-02-03	1/ 4
CLT1-US-B3	1/2	SDLT9-B1	1/2	EO-20-B2	1/4	BLO-11	1/ 2	DLO-02-04	1/ 2
CLT1-US-B4	1/2	SDLT9-B2	1/2	JLO-21	1/2	DLO-01-03	1/ 4	DLO-02-01	1/ 2
CLT1-DS-B1	1/2	SDLT9-B4	1/4	JLO-02	1/4	DLO-01-04	1/ 4	DLO-02-10	1/ 4
CLT2-US-B2	1/2	SDLT9-B5	1/2	JLO-11	1/2	DLO-01-09	1/ 2	DLO-02-11	1/ 4
		SDLT12-B3	1/4	JLO-18	1/4	DLO-01-11	1/ 4	DLO-02-12	1/ 2

Notes: All samples not listed were sorted in their entirety (total of 63 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 the water and benthic invertebrate community data were of acceptable quality. Few water 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. The benthic invertebrate community data quality was also acceptable, meeting all precision, accuracy, and percent recovery benchmarks. Overall, the data associated with the 2019 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

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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 habitats (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 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 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 five studies conducted since commercial mine operations commenced at the Mary River Project (i.e., 2015 to 2019; see Table 2.1). From 2016 to 2019, 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 2019 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 reflecting 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 in comparisons to areas of the Mary River that are potentially influenced by mine activity. Mary River study area GO-03 also currently serves as a reference area, but 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 River 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 most applicable WQG and AEMP benchmarks for lotic environments in 2019, the exceptions to which included concentrations of phenols, total aluminum, and total iron (Appendix Table B.2). Concentrations of aluminum were elevated at reference creek station MRY-REF3 during spring, summer, and fall monitoring events, and at station MRY-REF2 during the fall monitoring event, in 2019 (Appendix Table B.2). Iron concentrations were also elevated at station MRY-REF3 during the summer and fall monitoring events. As reported in past studies, the occurrence of elevated concentrations of aluminum and iron at the reference creek stations appeared to be associated with naturally high turbidity at the time that samples were collected (Appendix Table B.2), which suggested that elevated turbidity and a corresponding elevation in aluminum and iron concentrations naturally occur in regional watercourses.

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 2019 (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 2018 water quality monitoring conducted at reference creek stations showed similar seasonal patterns (KP 2014b; Minnow 2016a, 2017, 2018a, 2019). Temporal comparison of mean water chemistry for the reference creek stations indicated that alkalinity, conductivity, hardness, and concentrations of molybdenum, total dissolved solids (TDS), and uranium were higher in 2019 compared to all previous years from 2014 to 2018 during fall monitoring events (Figure 3.2; Appendix Figure C.2). The reason for higher concentrations of these parameters compared to previous years potentially reflected a drier than normal fall in 2019 (i.e., lower flow and hence a greater groundwater to surface runoff ratio). This suggested that, although water chemistry at the reference creek stations was relatively consistent year-to-year taking seasonal sampling timing into account for most parameters (Figure 3.2; Appendix Figure C.2), higher parameter concentrations may occur naturally during periods of low flow. Overall, 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.

Table B.2: Water Chemistry at Reference Creek Stations, Mary River Project CREMP, 2019

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark	Spring Sampling Event CLT-REF4 28-Jun-2019	Spring CLT-REF3 28-Jun-2019	Spring MRY-REF3 27-Jun-2019	Spring MRY-REF2 27-Jun-2019	Summer Sampling Event CLT-REF4 1-Aug-2019	Summer CLT-REF3 1-Aug-2019	Summer MRY-REF3 1-Aug-2019	Summer MRY-REF2 1-Aug-2019	Fall Sampling Event CLT-REF4 21-Aug-2019	Fall CLT-REF3 21-Aug-2019	Fall MRY-REF3 21-Aug-2019	Fall MRY-REF2 21-Aug-2019
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	49.8	53.6	27.2	56.7	126.0	108.0	91.2	126.0	172	148	183	169
	pH (lab)	pH	6.5 - 9.0	-	7.28	7.23	7.43	7.74	7.98	7.91	7.58	7.95	8.27	7.96	7.97	8.17
	Hardness (as $CaCO_3$)	mg/L	-	-	26.5	28.6	11.4	28.1	68.2	58.4	38	66.6	89.1	77	74.6	84.8
	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	-	-	34	37	<20	<20	63	58	55	66	87	80	112	89
	Turbidity	NTU	-	-	1.0	0.4	5.5	0.7	0.7	0.7	9.9	1.2	0.6	0.6	15.6	2.5
	Alkalinity (as $CaCO_3$)	mg/L	-	-	28	30	<10	33	68	57	28	64	82	71	41	75
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.060	<0.010	<0.010	0.049	<0.010	0.028	<0.010	0.018	<0.010	<0.010	0.012	<0.010
	Nitrate	mg/L	3	3	<0.020	<0.020	<0.020	<0.020	<0.020	0.028	<0.020	<0.020	0.022	0.048	0.026	<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
	Dissolved Organic Carbon	mg/L	-	-	1.37	2.0	1.07	1.5	1.2	1.69	1.16	1.82	1.1	1.5	1.3	1.6
	Total Organic Carbon	mg/L	-	-	1.09	1.9	1.7	2.3	1.5	2.0	1.6	2.0	1.4	1.8	1.7	1.9
	Total Phosphorus	mg/L	0.020$^{\alpha}$	-	0.0033	<0.0030	0.0064	0.0039	<0.0030	<0.0030	0.0107	0.0042	0.0032	0.0039	0.0111	<0.0030
	Phenols	mg/L	0.004$^{\alpha}$	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0042	<0.0010	0.0020	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	<0.10
	Chloride (Cl)	mg/L	120	120	<0.50	<0.50	1.11	0.55	<0.50	<0.50	5.47	1.61	3.62	2.01	18.10	7.08
	Sulphate (SO_4)	mg/L	218$^{\beta}$	218	<0.30	0.46	1.99	0.39	1.05	1.43	9.44	1.57	4.43	4.94	21.5	5.16
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0444	0.0134	0.1260	0.0325	0.0396	0.0331	**0.529**	0.0597	0.0236	0.0252	**0.6600**	0.125
	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	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	0.00012	<0.00010
	Barium (Ba)	mg/L	-	-	0.00264	0.00331	0.00368	0.00316	0.00560	0.00628	0.01170	0.00734	0.00673	0.00805	0.0212	0.01070
	Beryllium (Be)	mg/L	0.011$^{\alpha}$	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<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	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	5.21	5.49	2.39	5.59	13.20	11.00	7.74	12.60	18.1	15.2	16.30	16.8
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00105	<0.00050	<0.00050	<0.00050	0.00096	<0.00050
	Cobalt (Co)	mg/L	0.0009$^{\alpha}$	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00021	<0.00010	<0.00010	<0.00010	0.00018	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	<0.00050	0.00104	0.00083	<0.00050	<0.0010	0.00130	0.00200	<0.0010	0.00063	0.00118	0.00174	0.00076
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	0.118	<0.030	0.020	0.042	**0.498**	0.054	<0.030	0.048	**0.416**	0.076
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.000077	0.000150	<0.000050	<0.000050	0.000114	0.000471	<0.000050	<0.000050	0.000072	0.000411	0.000054
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010
	Magnesium (Mg)	mg/L	-	-	3.32	3.67	1.350	3.45	7.76	6.85	4.15	7.62	10.30	9.53	8.31	9.98
	Manganese (Mn)	mg/L	0.935$^{\beta}$	-	0.000393	0.000251	0.00174	0.000324	<0.00050	0.00096	0.00564	0.000900	0.000106	0.00175	0.004770	0.00128
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.000068	0.000202	0.000140	0.000072	0.000250	0.000543	0.000446	0.000224	0.000503	0.000777	0.000518	0.000321
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00070	0.00077	<0.00050	<0.00050	0.00086	0.00072	<0.00050
	Potassium (K)	mg/L	-	-	0.38	0.42	0.46	0.47	0.67	0.71	1.13	0.84	0.81	0.90	1.77	1.090
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050	<0.000050	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.53	0.65	0.71	0.48	0.79	0.98	1.92	0.91	0.51	0.93	2.43	1.030
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.313	0.383	0.953	0.507	0.851	0.799	3.17	1.31	2.87	1.430	6.71	3.09
	Strontium (Sr)	mg/L	-	-	0.00383	0.00362	0.00515	0.00419	0.01020	0.00740	0.0180	0.01050	0.0145	0.01050	0.0382	0.0162
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	0.000015	<0.000010	<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	0.00088	0.0009	0.028	0.00209	<0.010	<0.010	0.028	<0.010
	Uranium (U)	mg/L	0.015	-	0.000278	0.000370	0.000324	0.000230	0.00457	0.003080	0.001550	0.001820	0.00983	0.00560	0.00374	0.00288
	Vanadium (V)	mg/L	0.006$^{\alpha}$	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	0.00106	<0.00050	<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	0.0191	<0.0030	<0.0030	<0.0030

[shaded] Indicates parameter concentration above applicable Water Qquality Guideline.

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

[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]) and β (British Columbia Water Quality Guideline [BCWQG]). See Table 2.2 for information regarding WQG criteria.

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

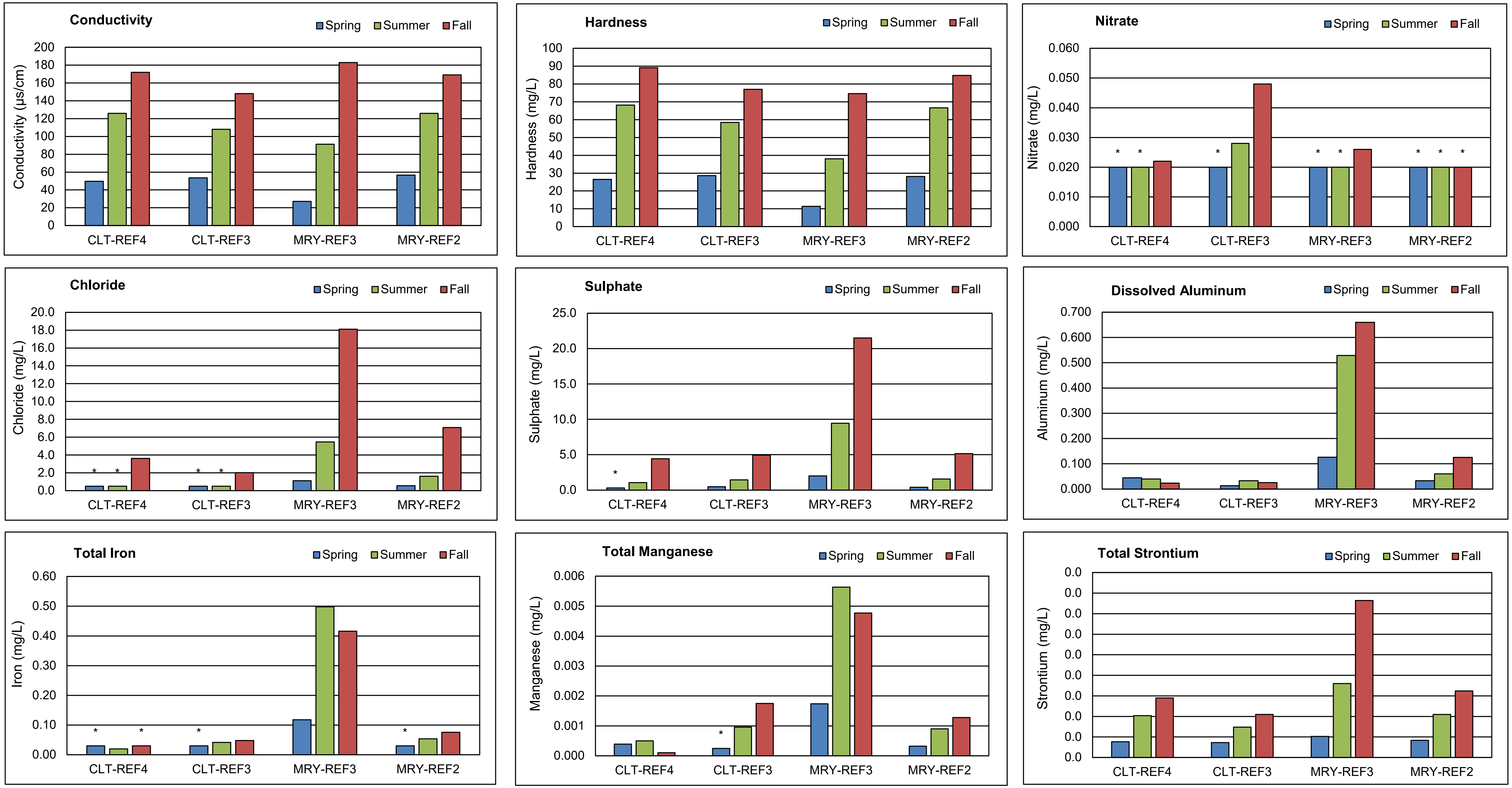


Figure B.1: Seasonal Variation in Water Chemistry at Stream/Tributary Reference Stations, Mary River Project CREMP, 2019

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

B3.2 River Environments

Water chemistry at the Mary River reference stations (GO-09 series) showed elevated concentrations of total aluminum, copper, iron, lead, and phosphorus at one or more stations during at least one monitoring event in summer and fall 2019 compared to WQG and/or AEMP benchmarks (Appendix Table B.3). As in previous CREMP studies, the WQG and/or AEMP benchmarks for aluminum and iron were generally exceeded at the Mary River reference area under highly turbid conditions (i.e., ≥ 5 NTU), with the magnitude of elevation appearing to correlate closely with higher turbidity (Appendix Table B.3). Comparison of the ratio between dissolved and total concentrations of aluminum indicated that a high proportion of aluminum was in the total (particulate) fraction (compare Appendix Tables B.3 and C.64), which can be expected for metals contained in particulate matter. Therefore, naturally high turbidity (and specifically, the chemical composition of suspended particulate matter) within the Mary River system can be expected to result in total concentrations of metals such as aluminum and iron being above WQG and/or AEMP benchmarks.

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 2019, and in previous baseline (2005 to 2013), and 2015 to 2018 water quality monitoring data collected at the Mary River GO-09 series reference stations (KP 2014b; Minnow 2016a, 2017, 2018a, 2019). 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 concentrations of the same parameters identified as elevated in fall 2019 at the reference creeks (Section B.3.1), as well as chloride, sodium, and strontium, were elevated at the GO-09 series stations in 2019 compared to baseline and all previous years of mine operation (Figure 5.2; Appendix Figure C.21). Higher concentrations of these parameters in fall 2019 potentially reflected a drier than normal fall season, and corroborated that higher parameter concentrations may occur naturally during periods of low flow. Overall, 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. receiving environments taking seasonality into consideration.

Table B.3: Water Chemistry at Mary River GO-09 Series Reference Stations, Mary River Project CREMP, 2019

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark	Spring Sampling Event			Summer Sampling Event			Fall Sampling Event		
					G0-09-A	G0-09	G0-09-B	G0-09-A	G0-09	G0-09-B	G0-09-A	G0-09	G0-09-B
					28-Jun-2019	28-Jun-2019	28-Jun-2019	1-Aug-2019	1-Aug-2019	1-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	60	45	34	133	144	142	230	231	228
	pH (lab)	pH	6.5 - 9.0	-	7.72	7.59	7.07	7.60	8.08	7.98	8.39	8.40	8.36
	Hardness (as $CaCO_3$)	mg/L	-	-	31	22	17	62	72	66	96	103	98
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	11.3	3.7	2.8	6.4	3.5	5.3
	Total Dissolved Solids (TDS)	mg/L	-	-	58	28	24	81	86	76	134	150	142
	Turbidity	NTU	-	-	1.0	2.8	6.4	39.3	11.3	12.0	15.9	9.7	15.2
	Alkalinity (as $CaCO_3$)	mg/L	-	-	32	25	18	58	69	65	86	96	90
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.029	0.013	0.016	<0.010	0.036	0.017	<0.010	<0.010	<0.010
	Nitrate	mg/L	3	3	<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	0.16	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.47	1.16	1.18	1.36	1.41	1.33	1.61	1.75	1.45
	Total Organic Carbon	mg/L	-	-	1.27	1.11	1.02	1.63	1.62	1.67	1.86	1.92	1.93
	Total Phosphorus	mg/L	0.020[α]	-	0.004	0.006	0.006	0.027	0.011	0.012	0.013	0.008	0.010
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0042	0.0031
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	<0.50	<0.50	<0.50	5.91	4.05	4.95	17.1	13.65	15.8
	Sulphate (SO_4)	mg/L	218[β]	218	<0.30	<0.30	<0.30	3.37	2.45	2.89	7.90	6.235	7.22
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.047	0.076	0.105	***1.550***	***0.452***	***0.514***	***0.557***	***0.310***	***0.453***
	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	0.00025	0.00012	0.00012	0.00013	<0.00010	0.00012
	Barium (Ba)	mg/L	-	-	0.00379	0.00316	0.0032	0.0186	0.0115	0.0120	0.0169	0.0144	0.0158
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.01	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	< 0.000006	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	-	-	6.0	4.5	3.4	12.4	14.1	13.5	20.0	21.6	20.5
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	0.0032	0.0008	0.0011	0.00227	0.000575	0.00086
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	0.00074	0.00022	0.00024	0.00021	0.00012	0.00018
	Copper (Cu)	mg/L	0.002	0.0022	0.00052	<0.00050	0.00058	***0.0029***	0.0015	0.0017	0.0017	0.0021	0.0017
	Iron (Fe)	mg/L	0.30	0.326	<0.030	0.070	0.109	***1.620***	***0.457***	***0.512***	***0.450***	0.249	***0.387***
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.000082	0.000133	***0.001190***	0.000379	0.000435	0.000376	0.000230	0.000372
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	0.00290	0.00120	0.00130	0.0014	<0.0010	0.0011
	Magnesium (Mg)	mg/L	-	-	3.9	2.6	2.0	7.6	8.1	7.6	11.1	11.7	11.2
	Manganese (Mn)	mg/L	0.935[β]	-	0.000677	0.00118	0.00195	0.02000	0.00574	0.00635	0.0059	0.0033	0.0051
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.000052	0.000054	<0.000050	0.00049	0.00032	0.00045	0.00069	0.00053	0.00059
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	0.0023	0.0008	0.0009	0.00092	0.00062	0.00081
	Potassium (K)	mg/L	-	-	0.5	0.42	0.4	1.88	1.31	1.33	1.97	1.67	1.81
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050	<0.0000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	0.56	0.49	0.49	3.67	1.69	1.75	1.79	1.29	1.47
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050	<0.0000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	0.515	0.399	0.421	3.7200	2.7900	3.0200	7.44	5.935	6.73
	Strontium (Sr)	mg/L	-	-	0.00482	0.00366	0.00325	0.019	0.016	0.017	0.0282	0.02525	0.0272
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	0.00004	0.00001	0.00001	0.000013	<0.000010	0.00001
	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	0.0925	0.0262	0.0298	0.0263	0.0146	0.0217
	Uranium (U)	mg/L	0.015	-	0.000236	0.00017	0.000181	0.0044	0.0033	0.0036	0.00756	0.006545	0.00718
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	0.0032	0.0011	0.0013	0.0012	0.000775	0.00103
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	0.0044	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

(shaded) Indicates parameter concentration above the applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

[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]) and β (British Columbia Water Quality Guideline [BCWQG]). See Table 2.2 for information regarding WQG criteria.

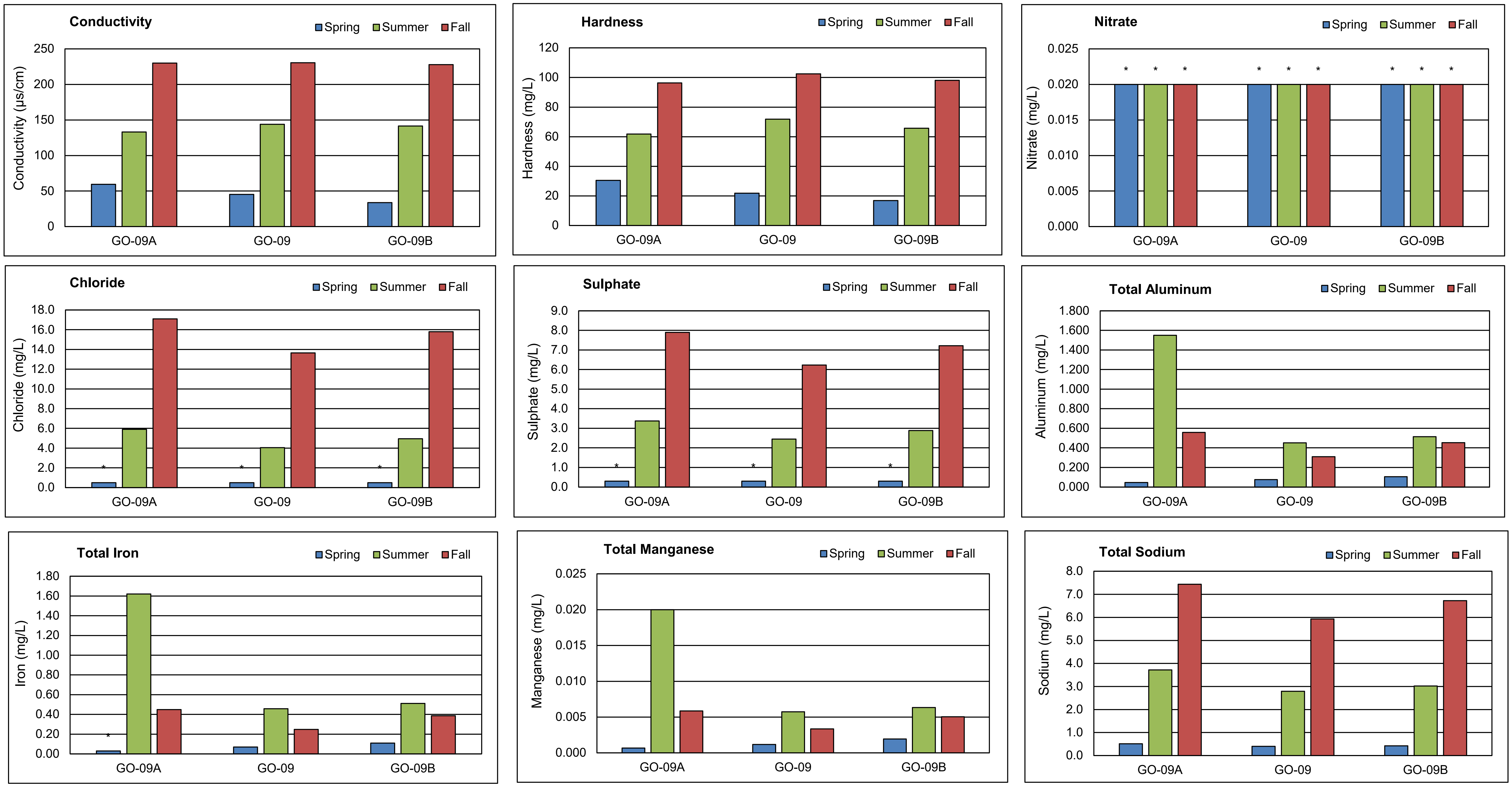


Figure B.2: Seasonal Variation in Water Chemistry at Mary River GO-09 Reference Stations, Mary River Project CREMP, 2019

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

B3.3 Lake Environments (Reference Lake 3)

In situ water temperature profiles conducted at Reference Lake 3 indicated thermally stratified conditions in the summer and fall of 2019 (Appendix Figure B.3). During the summer, the epilimnion extended to approximately 9 m below surface and the hypolimnion was established at depths greater than approximately 11 m, whereas in the fall, the corresponding depths for the epilimnion and hypolimnion were approximately the upper 17 m and depths below 20 m, respectively (Appendix Figure B.3). No marked changes in dissolved oxygen concentrations 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 2019 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 despite the development of thermally stratification, no substantial changes in dissolved oxygen, pH, or conductivity occurred with depth through the water column.

The evaluation of water chemistry at Reference Lake 3 indicated that all monitored parameters were below WQG in summer and fall 2019 with the exception of phenols and total phosphorus, which were each elevated at a single station during either the summer or fall monitoring event (Appendix Table B.4). 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 2019, 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 2018 (KP 2014a,c; Minnow 2016a, 2017, 2018a, 2019). Temporal comparisons also showed no substantial changes in water quality from 2015 to 2019 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 2019 (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,

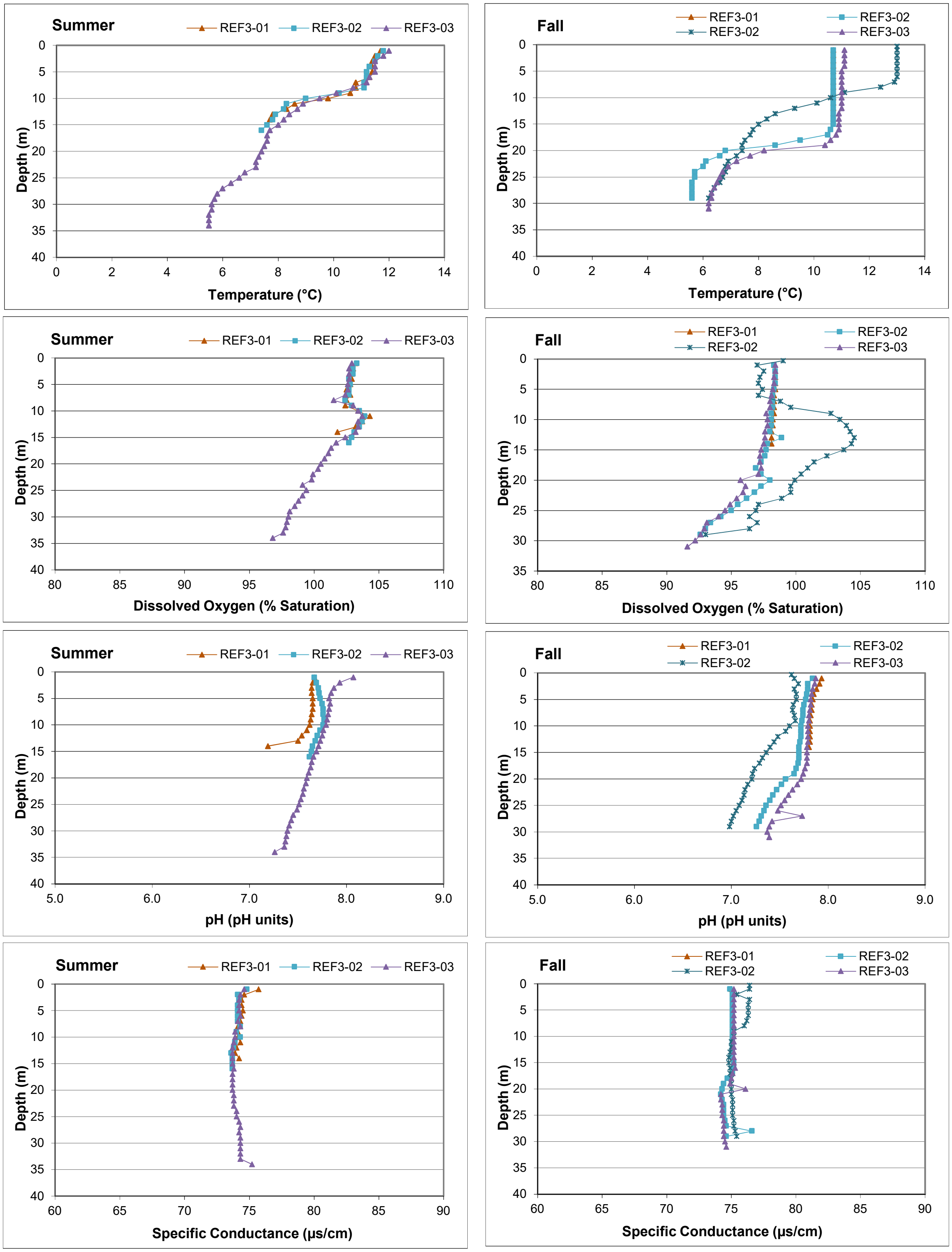


Figure B.3: ***In Situ* Water Quality with Depth from Surface at Reference Lake 3 during Summer and Fall Sampling Events, Mary River Project CREMP, 2019**

Table B.4: Water Chemistry at Reference Lake 3, Mary River Project CREMP, 2019

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event						Fall Sampling Event					
					REF3-01 bottom 2-Aug-2019	REF3-01 surface 2-Aug-2019	REF3-02 bottom 2-Aug-2019	REF3-02 surface 2-Aug-2019	REF3-03 bottom 2-Aug-2019	REF3-03 surface 2-Aug-2019	REF3-01 bottom 25-Aug-2019	REF3-01 surface 25-Aug-2019	REF3-02 bottom 25-Aug-2019	REF3-02 surface 25-Aug-2019	REF3-03 bottom 25-Aug-2019	REF3-03 surface 25-Aug-2019
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	73.9	74.8	73.3	74.3	73.7	73.4	83.3	82.3	81.7	82.4	81.5	82.5
	pH (lab)	pH	6.5 - 9.0	-	7.84	7.91	7.75	7.90	7.48	7.90	7.90	7.82	7.46	7.89	7.47	7.87
	Hardness (as $CaCO_3$)	mg/L	-	-	35.7	35.7	35.9	35.6	35.8	35.6	36.5	37.3	33.7	36.8	35.8	36.3
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	13.6	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	62	65	38	47	34	44	51	59	52	53	53	51
	Turbidity	NTU	-	-	0.34	0.25	0.29	0.23	0.20	0.22	0.30	0.32	0.26	0.34	0.28	0.53
	Alkalinity (as $CaCO_3$)	mg/L	-	-	35	34	35	33	33	34	33	33	33	35	33	34
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	<0.010	<0.010	<0.010
	Nitrate	mg/L	3	3	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.116	<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	0.17	0.16	0.20	<0.15	0.21	0.17
	Dissolved Organic Carbon	mg/L	-	-	2.81	2.68	2.73	2.74	2.52	3.08	2.58	3.28	2.53	2.58	2.55	2.67
	Total Organic Carbon	mg/L	-	-	3.02	2.90	3.05	3.22	2.94	3.14	3.02	3.35	3.11	2.86	2.97	3.04
	Total Phosphorus	mg/L	0.030[α]	-	0.0055	<0.0030	0.0088	<0.0030	<0.0030	0.0042	<0.0030	0.0041	0.0049	<0.0030	<0.0030	0.1080
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	0.0043	<0.0010	<0.0010	0.0012	<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	1.33	1.34	1.33	1.33	1.36	1.34	1.34	1.39	1.43	1.34	1.40	1.35
	Sulphate (SO_4)	mg/L	218[β]	218	3.76	3.75	3.76	3.73	3.79	3.71	3.72	3.74	3.79	3.72	3.80	3.71
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	<0.0030	<0.0030	0.0039	0.0047	<0.0030	<0.0030	0.0058	0.0049	0.0224	0.0056	<0.0030	0.0054
	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	-	-	0.00642	0.00687	0.00631	0.00634	0.00643	0.00642	0.00622	0.00611	0.00640	0.00625	0.00615	0.00626
	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	-	-	6.99	7.17	7.02	6.98	6.98	6.95	7.10	7.14	7.71	7.13	7.05	6.98
	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	0.00081	0.00069	0.00077	0.00079	0.00076	0.00086	0.00083	0.00081	0.00093	0.00082	0.00093	0.00079
	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	-	-	4.42	4.92	4.42	4.27	4.38	4.44	4.58	4.71	4.50	4.56	4.45	4.48
	Manganese (Mn)	mg/L	0.935[β]	-	0.000540	0.000418	0.000529	0.000536	0.000447	0.000435	0.000557	0.000596	0.000779	0.000667	0.000440	0.000570
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.000130	0.000128	0.000130	0.000148	0.000141	0.000145	0.000139	0.000142	0.000155	0.000144	0.000132	0.000143
	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	-	-	0.82	0.93	0.82	0.82	0.83	0.82	0.95	0.94	0.95	0.94	0.92	0.95
	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	-	-	0.42	0.42	0.42	0.41	0.50	0.41	0.45	0.46	0.54	0.45	0.54	0.46
	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	-	-	0.813	0.901	0.813	0.807	0.829	0.819	0.906	0.904	0.958	0.918	0.901	0.893
	Strontium (Sr)	mg/L	-	-	0.00774	0.00791	0.00741	0.00767	0.00761	0.00769	0.00818	0.00819	0.00847	0.00814	0.00822	0.00828
	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	-	0.000237	0.000204	0.000229	0.000247	0.000197	0.000244	0.000257	0.000255	0.000224	0.000257	0.000222	0.000255
	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	0.0102	0.0035	<0.0030	<0.0030

Indicates parameter concentration above applicable Water Quality Guideline.

[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]) and β (British Columbia Water Quality Guideline [BCWQG]). 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.

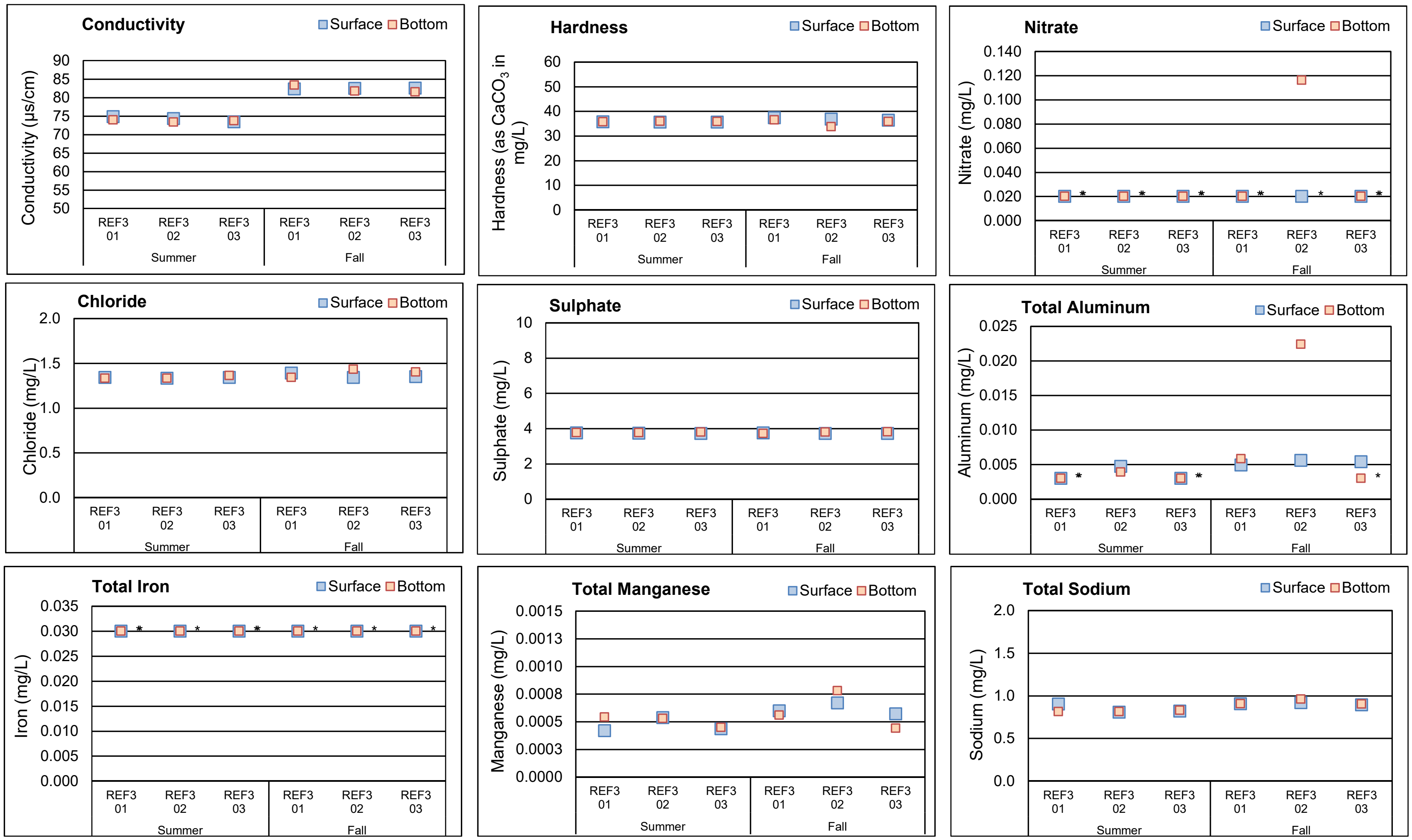


Figure B.4: Water Chemistry Comparison Between the Surface and the Bottom of the Water Column at Reference Lake 3 Routine Monitoring Stations during Summer and Fall, Mary River Project CREMP, 2019

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

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.

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 2019 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 2019, with significantly lower proportion of clay-sized material present at littoral stations compared to the profundal stations (Appendix Table F.16). No significant differences in sediment moisture or TOC content occurred between the littoral and profundal stations sampled at the reference lake in 2019 (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 2019 were consistent with those of the 2015 to 2018 studies (see Minnow 2016a, 2017, 2019a).

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 2019 (Appendix Table B.5). Phosphorus concentrations were also elevated above SQG in sediment at a single littoral station in 2019 (Appendix Table B.5). Therefore, compared to SQG, high concentrations of iron and manganese, 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 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 2019 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 2019

	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	%	-	-	68.9	66.4	43.3	57.4	56.4	58.5	4.51	54.0	49.4	52.6	46.3	53	51.1	1.00
	Silt	%	-	-	24.9	26.0	48.4	37.1	35.6	34.4	4.28	36.9	40.4	39.6	44.6	38.3	40.0	0.92
	Clay	%	-	-	6.20	7.6	8.20	5.40	8.00	7.1	0.55	9.1	10.2	7.9	9.0	8.7	9.0	0.26
	Moisture	%	-	-	77.8	91.4	81.5	80.4	89.0	84.0	2.62	87.5	87.0	87.9	88.6	86.0	87.4	0.31
	Total Organic Carbon	%	10[α]	-	2.72	7.41	2.17	2.52	6.30	4.22	1.09	4.59	3.86	4.35	4.44	4.38	4.32	0.087
Metals	Aluminum (Al)	mg/kg	-	-	12,700	17,300	12,500	14,500	11,300	13,660	1,044	24,500	22,500	20,800	22,500	23,400	22,740	430
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.00
	Arsenic (As)	mg/kg	17	5.9 - 6.2[c]	2.79	**6.01**	3.19	2.96	**8.46**	4.68	1.11	5.50	5.51	5.14	4.89	5.24	5.26	0.082
	Barium (Ba)	mg/kg	-	-	67.8	127	64.7	74.1	161	98.9	19.2	132	124	135	118	124	127	2.16
	Beryllium (Be)	mg/kg	-	-	0.49	0.72	0.53	0.62	0.47	0.57	0.05	0.94	0.87	0.82	0.89	0.92	0.89	0.015
	Bismuth (Bi)	mg/kg	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.0	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.0
	Boron (B)	mg/kg	-	-	10.7	14.6	9.6	12.1	12.0	11.8	0.8	18.5	17.0	15.3	14.6	17.2	16.5	0.495
	Cadmium (Cd)	mg/kg	3.5	1.5	0.091	0.252	0.077	0.090	0.188	0.140	0.034	0.169	0.176	0.165	0.155	0.157	0.164	0.003
	Calcium (Ca)	mg/kg	-	-	4,160	5,360	3,480	4,060	5,550	4,522	399	5,890	5,260	5,350	5,340	5,620	5,492	82.4
	Chromium (Cr)	mg/kg	90	79 - 98[c]	52.9	60.4	40.9	47.1	43.9	49.0	3.5	***79.8***	71.6	67.9	***75.5***	76.1	74.2	1.44
	Cobalt (Co)	mg/kg	-	-	8.82	11.20	8.2	10.1	10.4	9.7	0.54	17.4	16.2	16.5	16.0	16.3	16.5	0.172
	Copper (Cu)	mg/kg	197	50 - 58[c]	***44***	***94***	***40***	***57***	***52***	***57***	10	**95.8**	**94.9**	**84.5**	**91.6**	**92.7**	**91.9**	1.41
	Iron (Fe)	mg/kg	40,000[α]	34,400 - 52,400[c]	37,000	***77,000***	***26,300***	32,000	***101,000***	***54,660***	14,622	***50,600***	***48,200***	***54,200***	***47,000***	***47,900***	***49,580***	919
	Lead (Pb)	mg/kg	91.3	35	10.9	15.8	12.3	12.6	13.3	13.0	0.8	19.8	18.8	17.9	19.0	19.4	19.0	0.226
	Lithium (Li)	mg/kg	-	-	20.9	26.2	23.6	24.2	18.7	22.7	1.3	37.9	36.4	32.5	35.5	36.5	35.8	0.637
	Magnesium (Mg)	mg/kg	-	-	9,960	11,100	8,330	9,190	8,380	9,392	521	16,200	14,300	13,600	14,900	15,200	14,840	309
	Manganese (Mn)	mg/kg	1,100[α,β]	657 - 4,370	297	***556***	***328***	602	938	544	115	***1,190***	***1,300***	***4,230***	***1,190***	***1,070***	***1,796***	431
	Mercury (Hg)	mg/kg	0.486	0.17	0.0336	0.0775	0.0251	0.0227	0.0700	0.0458	0.0116	0.0718	0.0690	0.0704	0.0802	0.0778	0.0738	0.00155
	Molybdenum (Mo)	mg/kg	-	-	2.91	12.30	2.90	2.56	6.66	5.47	1.87	2.81	3.13	4.65	2.36	2.37	3.06	0.298
	Nickel (Ni)	mg/kg	75[α,β]	66 - 77[c]	35.1	46.5	28.8	31.6	33.5	35.1	3.0	56.2	49.6	47.9	51.8	52.5	51.6	1.00
	Phosphorus (P)	mg/kg	2,000[α]	1,278 - 1,958[c]	973	1,840	661	824	***2,850***	1,430	409	1,110	1,040	1,020	894	1,060	1,025	25.4
	Potassium (K)	mg/kg	-	-	2,760	4,050	3,240	3,610	2,880	3,308	238	5,960	5,470	5,060	5,360	5,660	5,502	106.2
	Selenium (Se)	mg/kg	-	-	0.53	1.10	0.31	0.34	0.83	0.62	0.15	0.81	0.63	0.75	0.80	0.85	0.77	0.027
	Silver (Ag)	mg/kg	-	-	0.10	0.25	<0.10	<0.10	0.11	0.13	0.03	0.28	0.25	0.22	0.27	0.27	0.26	0.008
	Sodium (Na)	mg/kg	-	-	240	326	209	256	262	259	19	464	390	373	405	437	414	11.6
	Strontium (Sr)	mg/kg	-	-	9.3	12.7	8.6	10.1	12.7	10.7	0.9	14.8	13.8	13.4	13.2	14.3	13.9	0.21
	Sulphur (S)	mg/kg	-	-	<1000	1900	<1000	<1000	2100	1,400	247	1400	1100	1400	1300	1400	1,320	41
	Thallium (Tl)	mg/kg	-	-	0.296	0.506	0.307	0.340	0.368	0.363	0.038	0.801	0.754	0.757	0.754	0.787	0.771	0.0069
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	0.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	0.000
	Titanium (Ti)	mg/kg	-	-	1,030	879	944	1,070	898	964	37	1,380	1,270	1,150	1,140	1,360	1,260	35.7
	Tungsten (W)	mg/kg			<0.50	<0.50	<0.50	<0.50	<0.50	0.50	0.0	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	0.0
	Uranium (U)	mg/kg	-	-	8.04	19.0	12.0	11.2	12.7	12.6	1.79	24.0	27.3	23.0	21.6	23.7	23.9	0.665
	Vanadium (V)	mg/kg	-	-	41.4	59.3	42.3	47.6	39.6	46.0	3.57	71.3	67.5	61.8	65.5	66.9	66.6	1.09
	Zinc (Zn)	mg/kg	315	123 - 135[c]	56.8	90.4	54.2	64.0	58.5	64.8	1.32	97	91.1	86.6	91.5	93.3	91.9	1.19
	Zirconium (Zr)	mg/kg	-	-	3.2	4.9	3.7	3.2	2.7	3.5	0.075	3.8	3.7	3.5	4.8	4.0	4.0	0.16

[shaded] Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

[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 benchmarks (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.

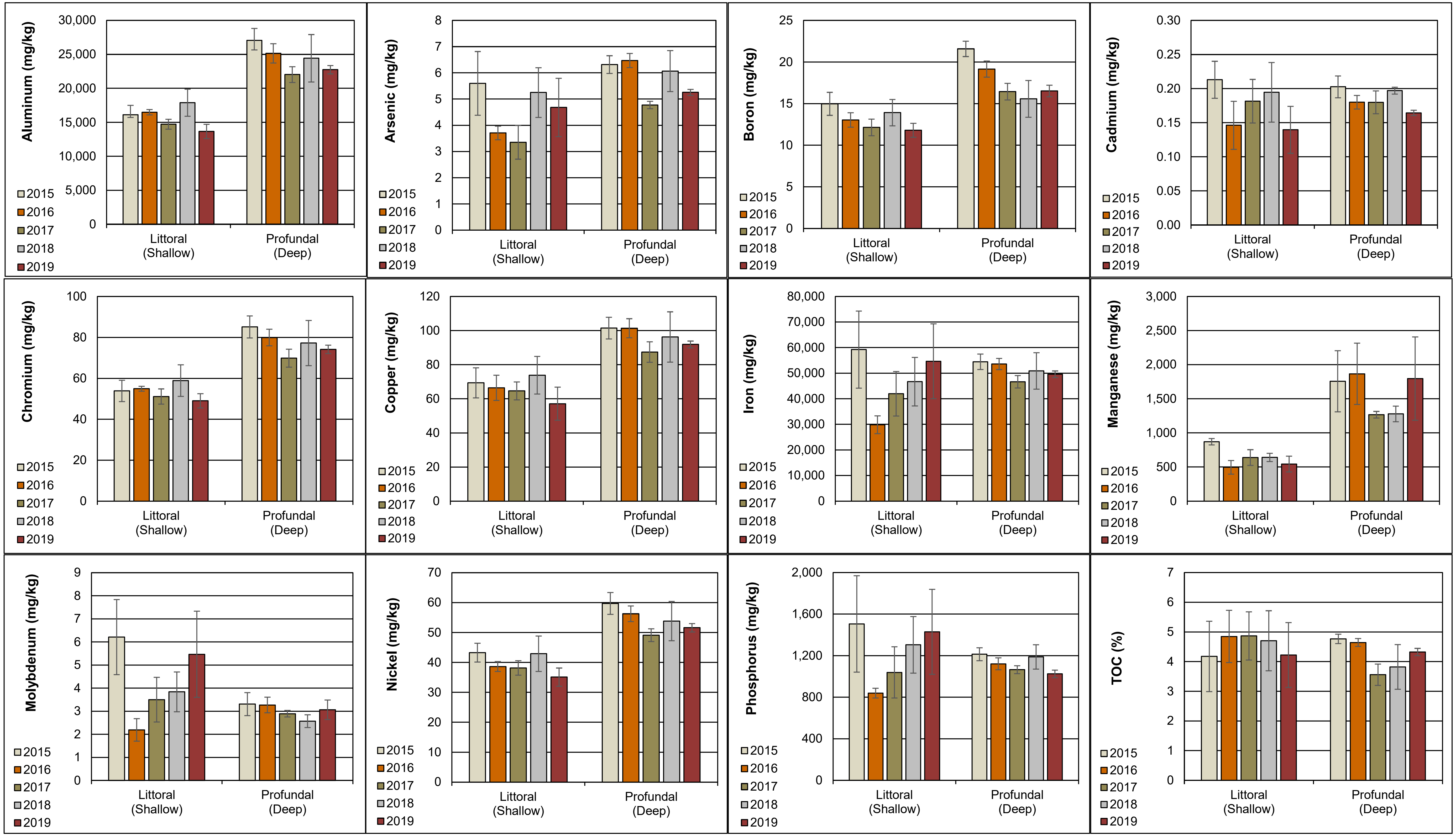


Figure B.5: **Sediment Metal Concentrations (mean ± SE) at Littoral (<12m depth) and Profundal (>12m depth) Monitoring Stations of Reference Lake 3 (REF03), Mary River Project CREMP, 2015 to 2019**

B5 PHYTOPLANKTON (CHLOROPHYLL-A)

B5.1 Lotic Environments

Chlorophyll-a concentrations, which were used as a surrogate for phytoplankton abundance, ranged from 0.12 to 1.41 µg/L at the reference creek and river stations among spring, summer, and fall sampling events in 2019 (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 2019 (Appendix Tables B.2 and B.3). Chlorophyll-a concentrations were significantly lower in the spring and summer than in the fall at the reference creeks, and were significantly lower in the spring than during the summer and fall at the at the Mary River GO-09 series reference stations, in 2019 (Appendix Tables B.6 and B.7).

Like-season chlorophyll-a concentrations from 2015 to 2019 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 occur 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 2019 (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 0.68 µg/L in summer and fall 2019, 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 2019 indicated low (i.e., oligotrophic)

Table B.6: Phytoplankton Monitoring Data Collected at Lotic Reference Stations, Mary River Project CREMP, 2019

	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	28-Jun-19	28-Jun-19	27-Jun-19	27-Jun-19	28-Jun-19	28-Jun-19	28-Jun-19
	Summer	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19
	Fall	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19
Chlorophyll-a (µg/L)	Spring	0.12	0.23	0.28	0.16	0.20	0.21	0.18
	Summer	0.28	0.52	0.34	0.32	0.71	0.46	0.44
	Fall	1.01	1.41	0.68	1.61	0.64	0.58	0.85
	Average	0.47	0.72	0.43	0.70	0.52	0.42	0.49
	Standard Deviation	0.47	0.61	0.22	0.80	0.28	0.19	0.34
	Standard Error	0.27	0.36	0.12	0.46	0.16	0.11	0.20
Phaeophytin-a (µg/L)	Spring	0.23	0.35	0.25	0.23	0.25	0.25	0.24
	Summer	<0.50	0.52	<0.50	0.55	0.89	<0.50	0.50
	Fall	0.61	0.87	0.73	0.93	1.05	0.92	1.03
	Average	0.45	0.58	0.49	0.57	0.73	0.56	0.59
	Standard Deviation	0.20	0.27	0.24	0.35	0.42	0.34	0.40
	Standard Error	0.11	0.15	0.14	0.20	0.24	0.20	0.23

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, 2019

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
Stream Reference Stations	YES	<0.001	ANOVA[c]	Spring	Summer	NO	0.627
				Spring	Fall	YES	<0.001
				Summer	Fall	YES	0.003
Mary River GO-09 Reference Stations	YES	0.006	ANOVA[c]	Spring	Summer	YES	0.0176
				Spring	Fall	YES	0.0042
				Summer	Fall	NO	0.2753
Reference Lake 3	-	-	-	Winter	Summer	not applicable	-
				Winter	Fall	not applicable	-
				Summer	Fall	NO	1.0000

[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.

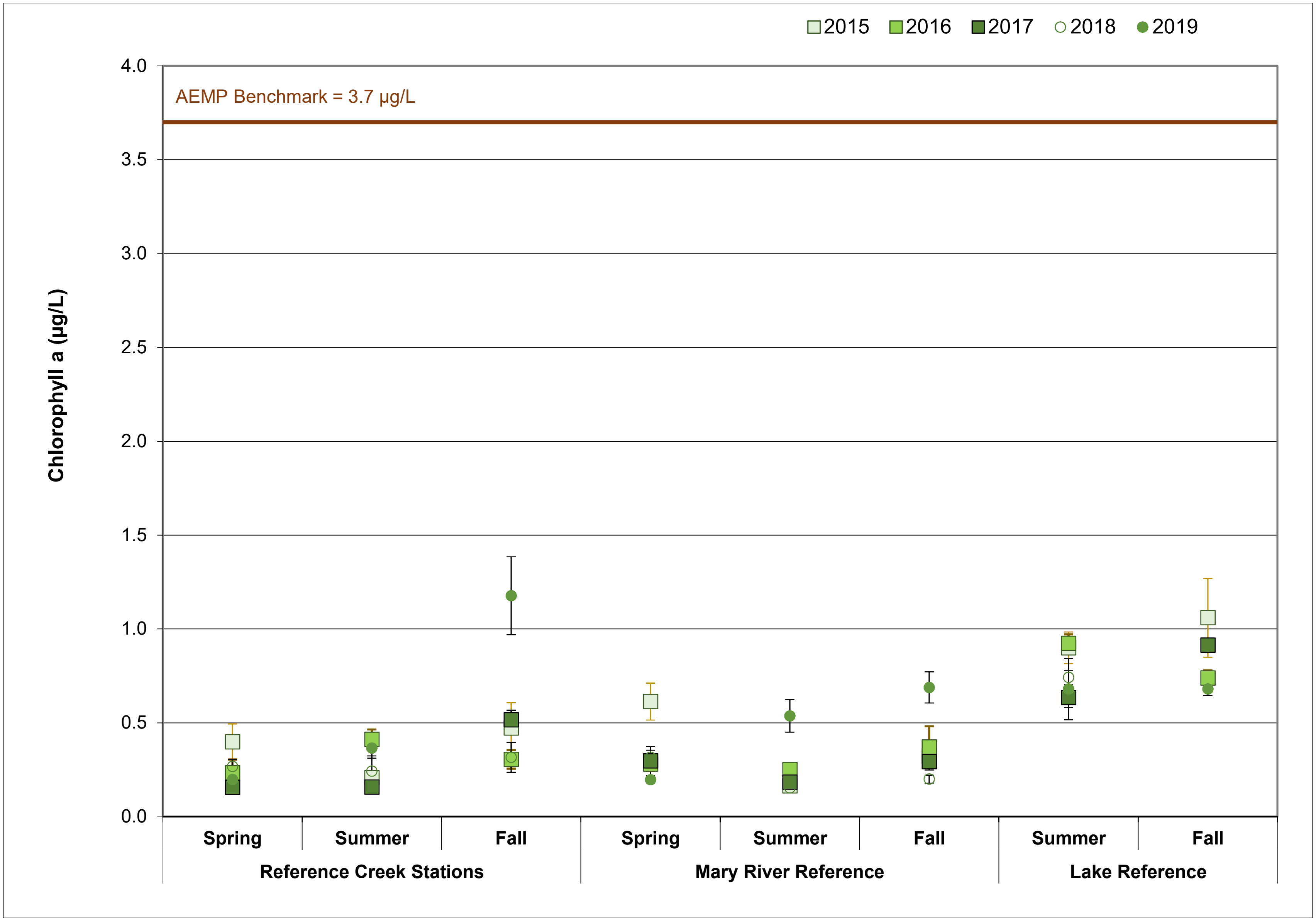


Figure B.6: Chlorophyll-a Concentration Seasonal Comparison from 2015 to 2019 at Creek, River, and Lake Reference Phytoplankton Monitoring Stations, Mary River Project CREMP

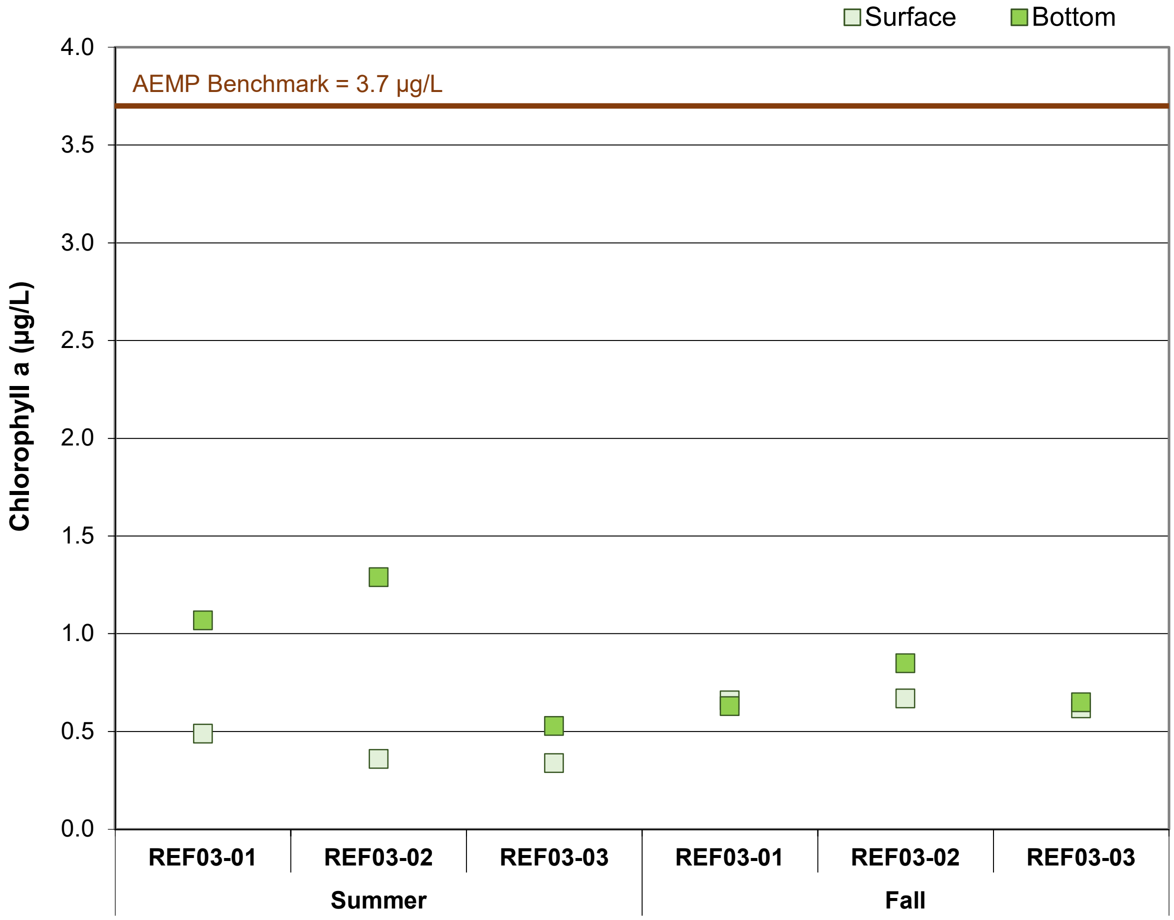


Figure B.7: Chlorophyll-a Concentrations at the Surface and Bottom of the Water Column at Reference Lake 3 Phytoplankton Monitoring Stations during Summer and Fall Sampling Events, Mary River Project CREMP, 2019

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 2019 (Appendix Table B.4). Chlorophyll-a concentrations did not differ significantly between the summer and fall at Reference Lake 3 in 2019 (Appendix Table B.7), which was similar to the results of the 2015 study, but differed from the results of the 2016 study (significantly higher chlorophyll-a concentrations in summer compared to fall) and the 2017 and 2018 studies (significantly lower chlorophyll-a concentrations in summer compared to fall). Therefore, although chlorophyll-a concentrations were generally comparable from 2015 to 2019 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.

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 2019 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 623 to 1,599 individuals/m^2 in 2019 (mean of 1,110 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 2019, 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). The dominant taxonomic group observed at Unnamed Reference Creek benthic stations in 2019 was Chironomidae (non-biting midges), collectively accounting for approximately 80% 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.8), 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 Reference

Table B.8: Benthic Invertebrate Community Summary Statistics for Unnamed Reference Creek and Mary River (GO-09) Reference Areas, Mary River Project CREMP, August 2019

Metric	Area	Sample Size	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density (no. organisms / m^2)	Unnamed Reference Creek	5	1,110	472	211	623	1,599
	Mary River GO-09 Reference	5	1,623	700	313	716	2,477
Richness (Number of Taxa)	Unnamed Reference Creek	5	18.0	2.3	1.0	14.0	20.0
	Mary River GO-09 Reference	5	11.4	1.5	0.7	9.0	13.0
Simpson's Evenness	Unnamed Reference Creek	5	0.883	0.016	0.007	0.870	0.907
	Mary River GO-09 Reference	5	0.687	0.095	0.043	0.583	0.809
Bray-Curtis Index	Unnamed Reference Creek	5	0.333	0.155	0.069	0.106	0.490
	Mary River GO-09 Reference	5	0.214	0.115	0.051	0.101	0.382
Nemata (% of community)	Unnamed Reference Creek	5	3.6%	5.1%	2.3%	1.0%	12.7%
	Mary River GO-09 Reference	5	0.6%	0.4%	0.2%	0.0%	1.0%
Hydracarina (% of community)	Unnamed Reference Creek	5	4.5%	3.2%	1.4%	1.8%	9.5%
	Mary River GO-09 Reference	5	0.9%	1.2%	0.6%	0.0%	3.1%
Ostracoda (% of community)	Unnamed Reference Creek	5	8.2%	3.2%	1.4%	4.8%	12.7%
	Mary River GO-09 Reference	5	0.0%	0.0%	0.0%	0.0%	0.0%
Chironomidae (% of community)	Unnamed Reference Creek	5	80.2%	6.8%	3.1%	69.3%	85.9%
	Mary River GO-09 Reference	5	97.2%	2.5%	1.1%	93.0%	99.5%
Metal Sensitive Chironomidae (% of community)	Unnamed Reference Creek	5	22.9%	7.5%	3.3%	10.6%	30.1%
	Mary River GO-09 Reference	5	51.5%	21.4%	9.6%	15.1%	67.1%
Tipulidae (% of community)	Unnamed Reference Creek	5	1.0%	1.1%	0.5%	0.0%	2.9%
	Mary River GO-09 Reference	5	0.6%	0.4%	0.2%	0.0%	1.0%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	5	72.7%	16.4%	7.3%	44.3%	83.8%
	Mary River GO-09 Reference	5	92.6%	5.1%	2.3%	83.9%	97.0%
Filterer FFG (% of community)	Unnamed Reference Creek	5	6.6%	11.0%	4.9%	0.6%	26.1%
	Mary River GO-09 Reference	5	0.0%	0.0%	0.0%	0.0%	0.0%
Shredder FFG (% of community)	Unnamed Reference Creek	5	12.3%	7.7%	3.4%	2.5%	21.4%
	Mary River GO-09 Reference	5	5.0%	3.1%	1.4%	2.5%	10.5%
Clinger HPG (% of community)	Unnamed Reference Creek	5	21.8%	18.3%	8.2%	7.3%	52.0%
	Mary River GO-09 Reference	5	5.9%	4.8%	2.2%	3.0%	14.5%
Sprawler HPG (% of community)	Unnamed Reference Creek	5	69.4%	16.1%	7.2%	42.8%	83.1%
	Mary River GO-09 Reference	5	92.0%	5.4%	2.4%	83.0%	97.0%
Burrower HPG (% of community)	Unnamed Reference Creek	5	5.7%	4.6%	2.1%	2.7%	13.8%
	Mary River GO-09 Reference	5	2.0%	1.6%	0.7%	0.0%	4.4%

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 2019 CREMP (see Table 2.5; Figure 2.4).

Benthic invertebrate density at the Mary River reference area in 2019 ranged from 716 to 2,477 individuals/m^2, which is considered 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 93% to nearly 100% of individuals (mean of 97%) and chironomid taxa considered metal-sensitive constituting 15% to 67% 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 2019) studies for key metrics indicated no consistent significant differences in density, richness, and relative abundance of metal-sensitive chironomids or the collector-gatherer FFG between the baseline and mine-operational periods (Figure 5.6; Appendix Table F.54). Although Simpson's Evenness had been significantly higher, and relative abundance of chironomids significantly lower, during prior years of mine operation compared to baseline, no significant differences in these endpoints were indicated at the Mary River reference area between 2019 and the baseline studies (Figure 5.6; Appendix Table F.54). Moreover, 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). The 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 2019. As in previous monitoring conducted from 2015 to 2018, significantly higher benthic invertebrate density, richness, and Simpson's Evenness was observed at littoral stations compared to profundal stations in 2019, all 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 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 near or within effect sizes that suggested the differences were not 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 2019 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 2019 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 (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 2019, whereas the benthic invertebrate community at profundal habitat can vary significantly from year-to-year for certain metrics (e.g., density, Simpson's Evenness).

Table B.9: Benthic Invertebrate Community Statistical Comparison Results between Littoral and Profundal Stations at Reference Lake 3, Mary River Project CREMP, August 2019

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	ANOVA	-3.2	Lake Littoral	1,247	297	133	871	1,156	1,594
						Lake Profundal	304	89	40	217	276	448
Richness (Number of Taxa)	none	YES	0.002	ANOVA	-3.2	Lake Littoral	12.8	2.3	1.0	9.0	13.0	15.0
						Lake Profundal	5.6	2.6	1.2	3.0	6.0	9.0
Simpson's Evenness (E)	none	YES	0.003	ANOVA	-8.2	Lake Littoral	0.865	0.041	0.018	0.811	0.862	0.924
						Lake Profundal	0.534	0.174	0.078	0.278	0.584	0.701
Bray-Curtis Index	log10	NO	0.125	ANOVA	-1.0	Lake Littoral	0.291	0.100	0.045	0.162	0.275	0.391
						Lake Profundal	0.187	0.088	0.039	0.086	0.208	0.305
Nemata (%)	log10(x+1)	NO	0.484	ANOVA	-0.5	Lake Littoral	7.3	7.9	3.5	0.8	3.9	20.0
						Lake Profundal	3.6	2.7	1.2	0.0	3.3	7.6
Hydracarina (%)	none	NO	0.963	ANOVA	0.0	Lake Littoral	4.6	2.9	1.3	1.1	4.7	9.0
						Lake Profundal	4.5	4.7	2.1	0.0	4.1	10.6
Ostracoda (%)	log10	YES	0.026	ANOVA	-1.5	Lake Littoral	25.1	11.0	4.9	13.8	21.8	41.8
						Lake Profundal	9.0	8.1	3.6	2.0	6.6	21.7
Chironomidae (%)	log10	YES	0.022	ANOVA	1.5	Lake Littoral	62.9	12.9	5.8	48.4	71.2	73.0
						Lake Profundal	82.9	6.8	3.0	75.0	82.6	93.4
Metal-Sensitive Chironomidae (%)	log10(x+1)	YES	0.015	ANOVA	-1.1	Lake Littoral	10.5	7.8	3.5	4.8	6.9	24.1
						Lake Profundal	2.1	3.4	1.5	0.0	0.0	7.8
Collector-Gatherers (%)	rank	NO	0.209	MW U-test	0.7	Lake Littoral	81.1	17.8	8.0	51.2	87.9	97.9
						Lake Profundal	92.8	10.0	4.5	75.9	95.9	100.0
Filterers (%)	rank	YES	0.007	MW U-test	-1.1	Lake Littoral	7.1	6.3	2.8	1.1	5.8	17.9
						Lake Profundal	0.0	0.0	0.0	0.0	0.0	0.0
Shredders (%)	rank	NO	0.181	MW U-test	-0.5	Lake Littoral	6.5	9.5	4.2	0.0	2.9	23.2
						Lake Profundal	1.6	3.6	1.6	0.0	0.0	8.1
Clingers (%)	none	NO	0.108	ANOVA	-0.9	Lake Littoral	11.9	7.9	3.5	2.1	10.0	23.3
						Lake Profundal	4.5	4.7	2.1	0.0	4.1	10.6
Sprawlers (%)	none	YES	0.011	ANOVA	2.0	Lake Littoral	74.1	8.3	3.7	60.4	75.7	81.2
						Lake Profundal	90.5	7.4	3.3	83.8	87.6	100.0
Burrowers (%)	none	YES	0.031	ANOVA	-1.3	Lake Littoral	14.0	6.9	3.1	3.8	16.2	22.1
						Lake Profundal	5.0	3.4	1.5	0.0	5.6	8.3

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.

[a] Magnitude calculated by comparing the difference between the lake littoral and profundal area means divided by the littoral area standard deviation.

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 has historically been 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 all previous studies (Minnow 2018a, 2019), and only arctic charr were captured at the reference lake in 2019 (Appendix Tables G.1 and G.2). 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 5+ age classes at a fork length of 4.7 cm based on the evaluation of length-frequency distributions coupled with supporting age determinations (Appendix Figure B.8). In 2015 and 2019, YOY arctic charr captured at nearshore habitat were not able to be distinguished from older age classes, or were captured in very low numbers, at Reference Lake 3 (Appendix Figure B.8). Therefore, population comparisons of nearshore arctic charr captured between the mine-exposed and reference lakes from 2015 to 2019 were completed only for the non-YOY data set in 2019. Temporal comparisons of the 2015 to 2019 nearshore arctic charr data indicated significantly larger sized fish were sampled in 2019 compared to all previous studies from 2015 to 2018 at the reference lake, the differences of which in fork length and fresh body weight were well outside of the critical effect size for growth endpoints of ±25% (Appendix Table B.10). However, condition of non-YOY nearshore arctic charr captured in 2019 differed significantly at magnitudes outside of the critical effect size of ±10% only relative to the 2018 data (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 that larger fish are likely to naturally exhibit lower condition than smaller sized fish.

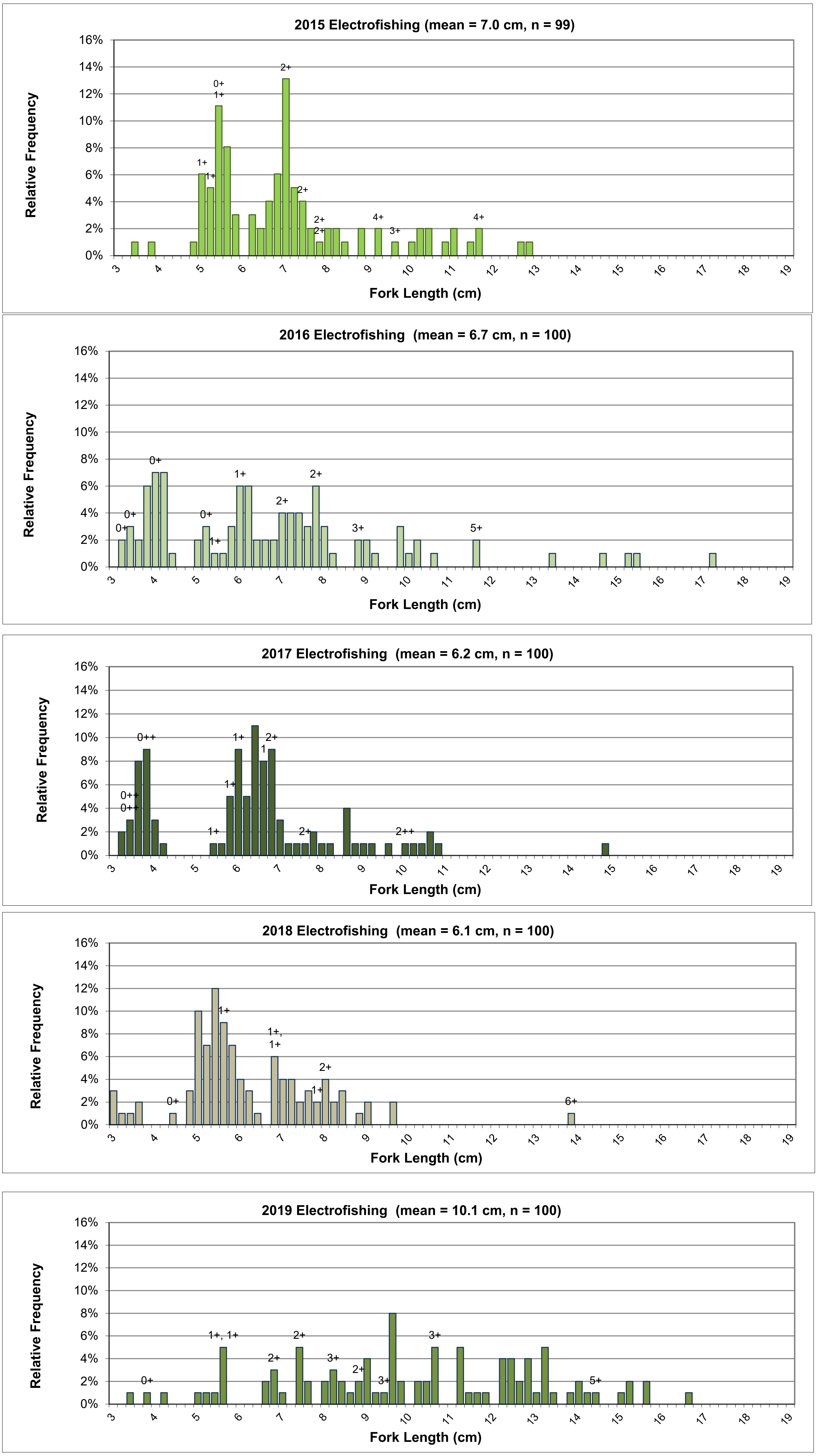


Figure B.8: Length-frequency Distributions for Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Reference Lake 3 (REF3) in August 2015 to 2019, Mary River Project CREMP

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

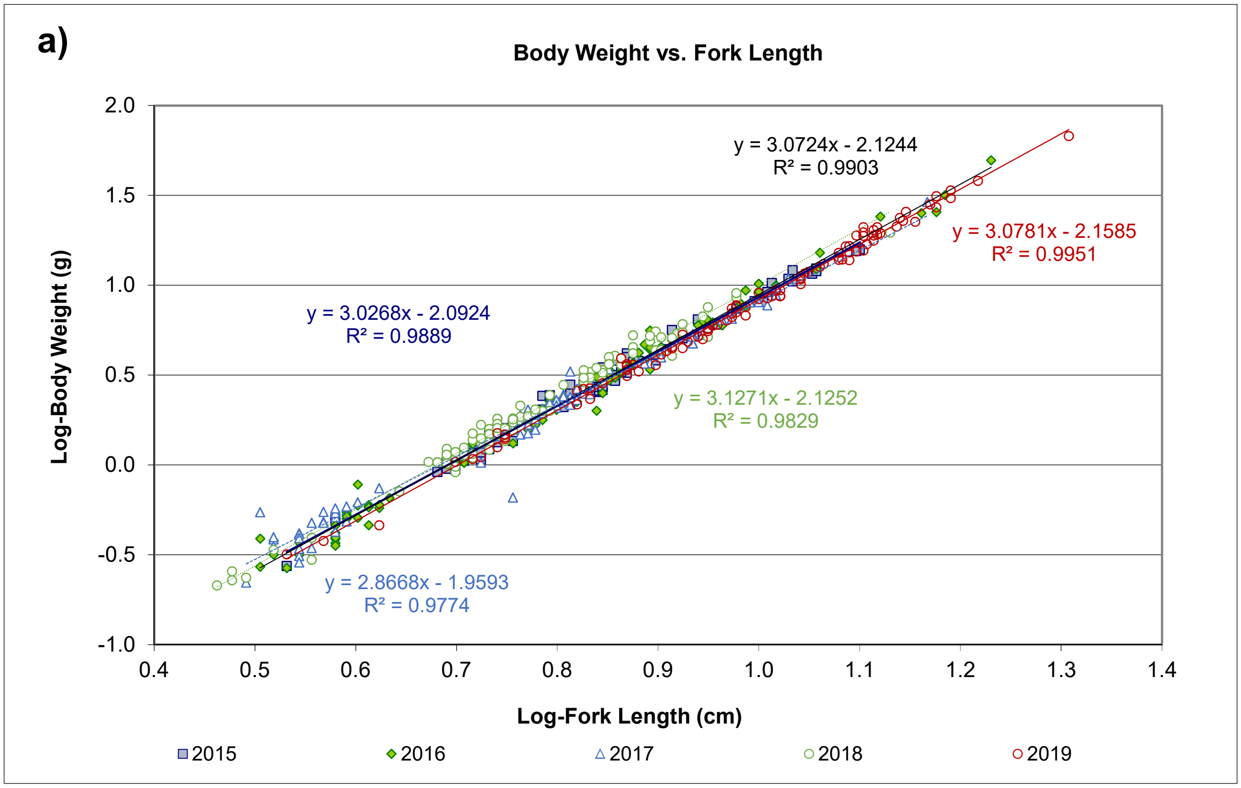
Table B.10: Statistical Comparisons For Length, Weight, and Condition Endpoints For non-Young-of-the-Year Arctic Charr from Reference Lake 3, 2015 to 2019

Endpoint	Variables		Sample Size					Test	Test P-value (Year)	Post-hoc Contrasts P-value and Magnitude of Difference (%)[a]																			
	Response	Covariate	2015	2016	2017	2018	2019			2015 vs. 2016		2015 vs. 2017		2015 vs. 2018		2015 vs. 2019		2016 vs. 2017		2016 vs. 2018		2016 vs. 2019		2017 vs. 2018		2017 vs. 2019		2018 vs. 2019	
										P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
Length Frequency Distribution	Fork Length (cm)	-	94	68	74	92	97	K-S	-	0.022	-	0.008	-	0.011	-	<0.001	-	0.004	-	0.0220	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-
Body Size	Fork Length (cm)	-	94	68	74	92	97	K-W	<0.001	0.023	6	0.718	-4	0.005	-16	<0.001	45	0.069	-10	<0.001	-20	<0.001	37	0.003	-12	<0.001	52	<0.001	72
Body Size	Weight (g)	-	94	68	74	92	97	K-W	<0.001	0.021	23	0.678	-8	0.074	-32	<0.001	211	0.073	-26	<0.001	-45	<0.001	153	0.036	-26	<0.001	240	0.014	362
Condition	log[Weight (g)]	log[Fork Length (cm)]	94	68	74	92	97	ANCOVA	<0.001	0.781	2	1.000	0	<0.001	12	0.055	-4	0.825	-2	<0.001	10	0.002	-6	<0.001	12	0.071	-4	<0.001	-14

Grey shading: Area P-value < 0.1 or Interaction P-value < 0.05

Blue shading: Magnitude of Difference greater than absolute Effect Size of 25% for length and weight endpoints, or 10% for condition endpoint.

[a] 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.



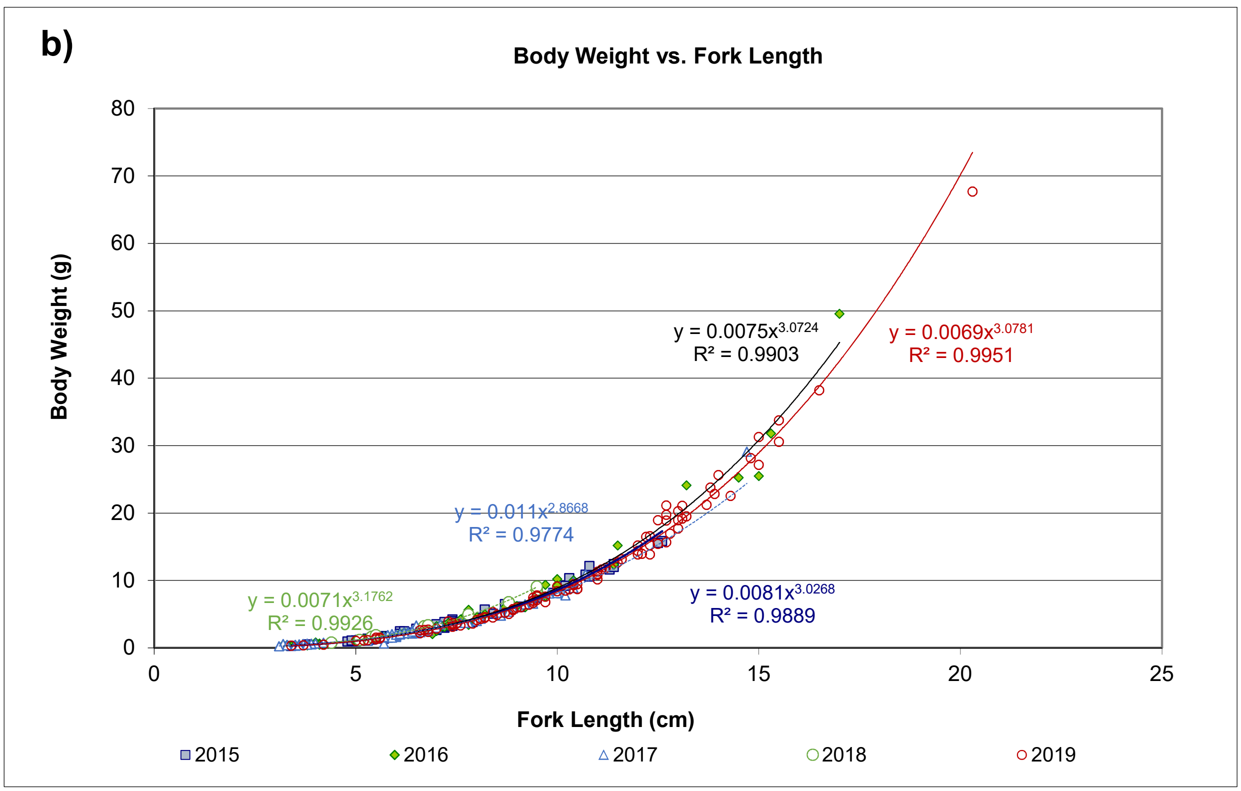


Figure B.9: Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at the Nearshore Area of Reference Lake 3 in August from 2015 to 2019 using Log-transformed (a) and Untransformed (b) Data, Mary River Project

Low numbers of arctic charr were captured at littoral/profundal areas of Reference Lake 3 in 2019 (i.e., 27 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 2019 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 2019 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 2019 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 periodically elevated, above WQG at creek, river, and/or lake reference areas used for the CREMP from 2015 to 2019, and historically in baseline studies. Significant positive correlations between total concentrations of these metals and turbidity were identified using the 2015 to 2019 data sets which suggested that these metals were likely bound to and/or composed the physical make-up of suspended particulate materials in water samples. This was supported by a low ratio of dissolved to total concentrations of metals such as aluminum, iron, and manganese in reference water samples from 2015 to 2019. 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 2019 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 2019.

- **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 2019. Therefore, the evaluation of water chemistry and phytoplankton productivity among stations and study areas for the 2016 to 2019 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 2019. 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 2019 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

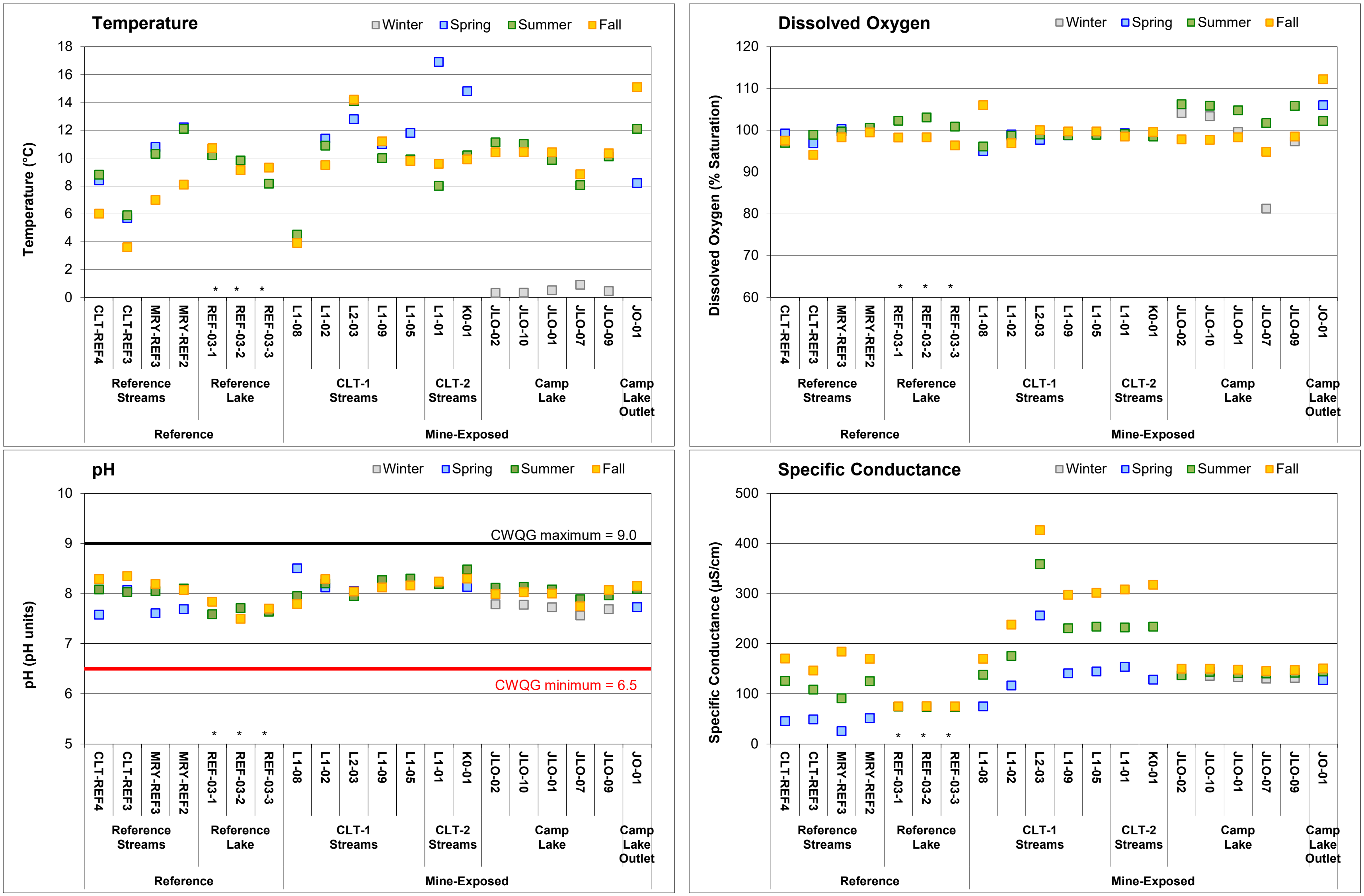


Figure C.1: Comparison of *In Situ* Water Quality Measured at Camp Lake System Water Quality Monitoring Stations in Winter, Spring, Summer, and Fall 2019, Mary River Project CREMP

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.

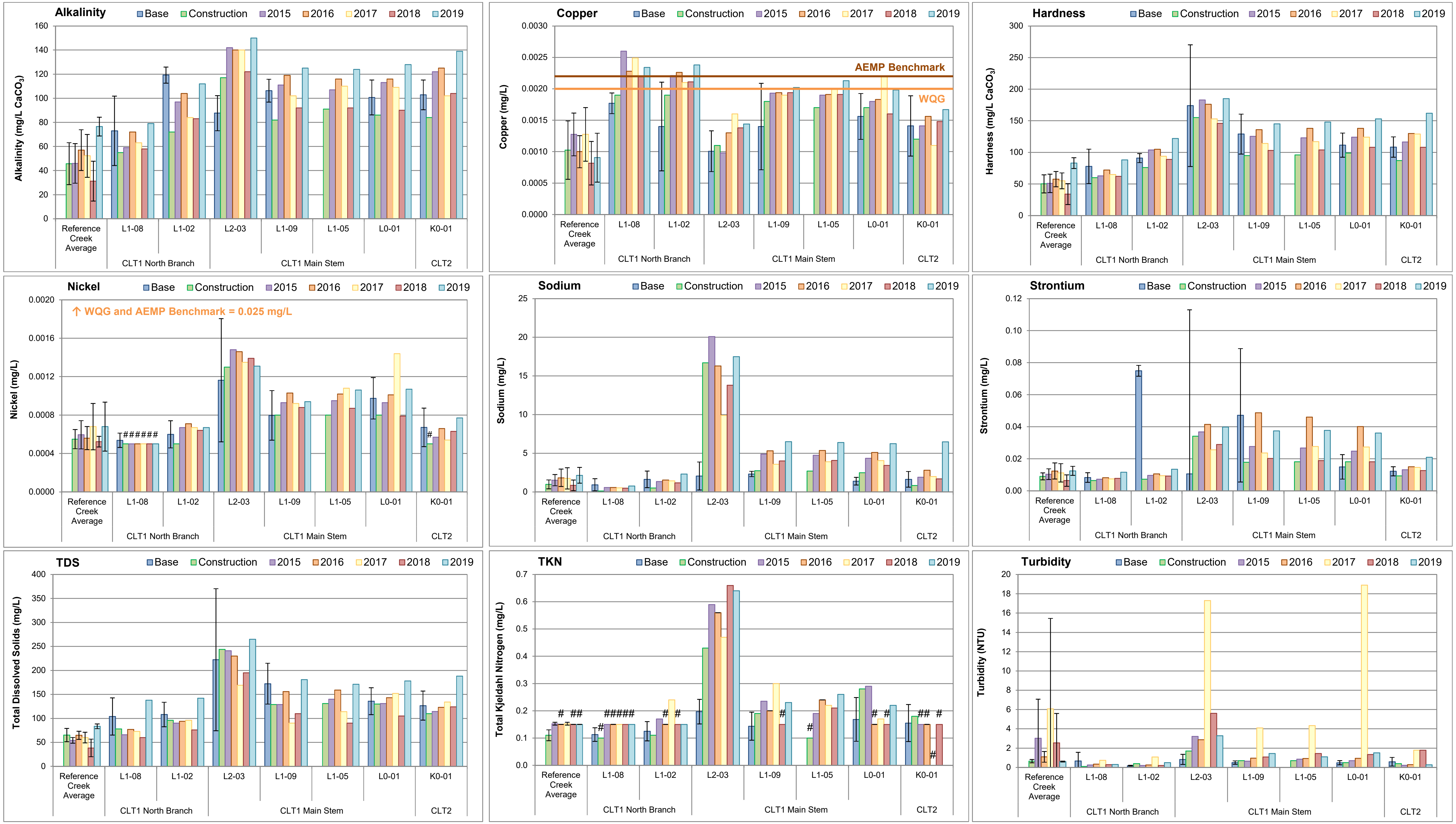
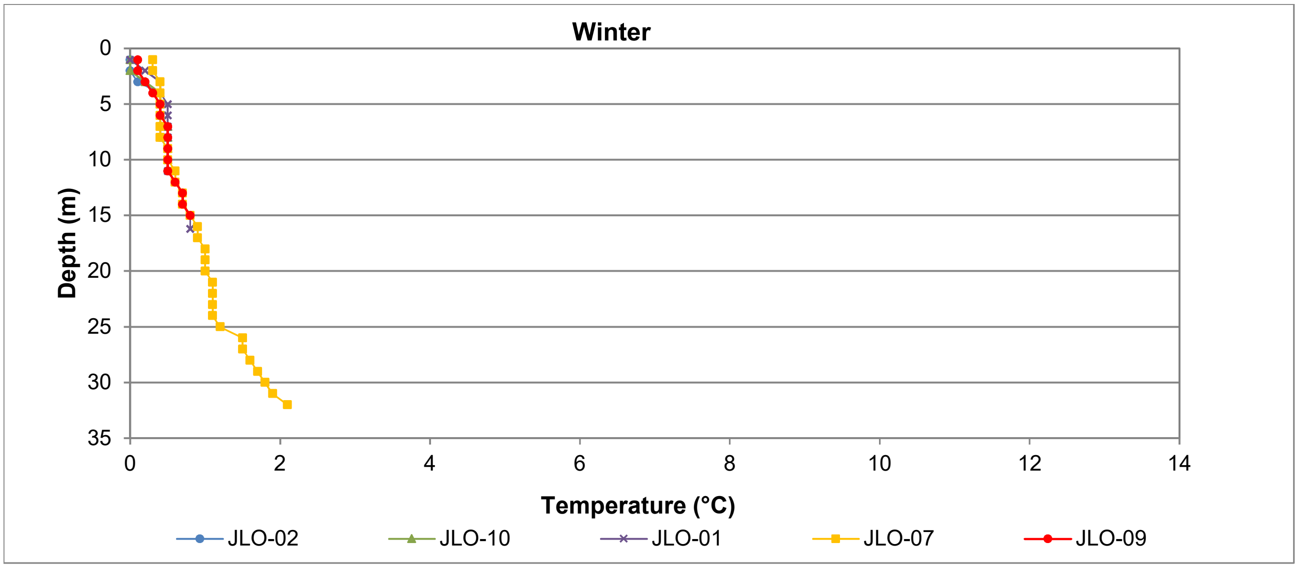
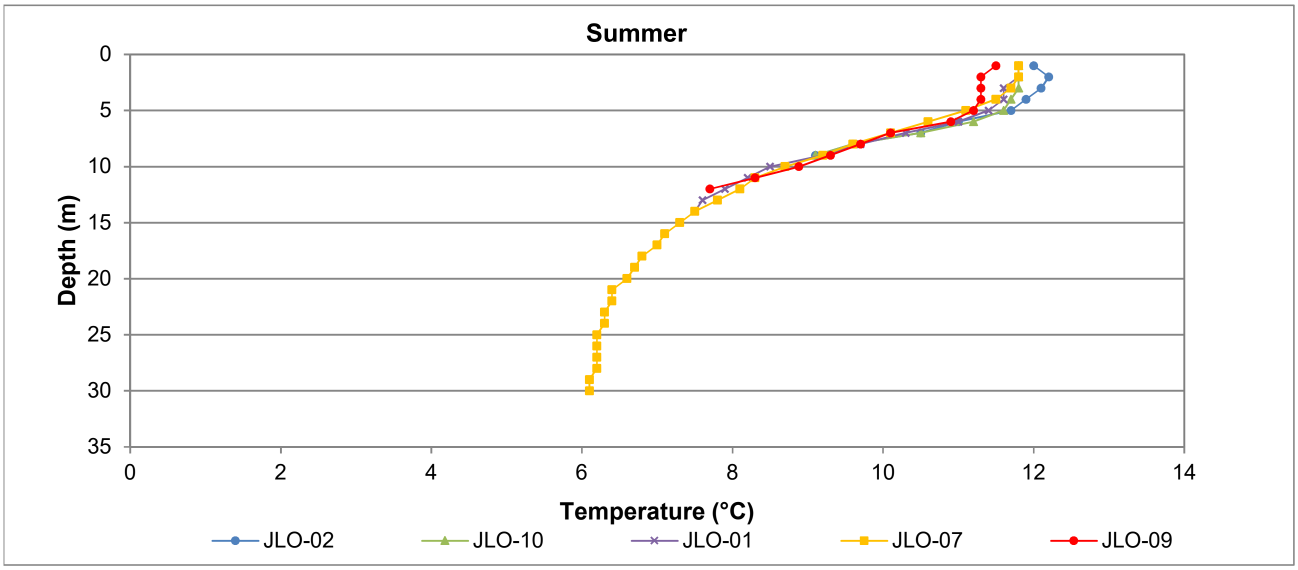


Figure C.2: Temporal Comparison of Water Chemistry at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2019) Periods During Fall

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.





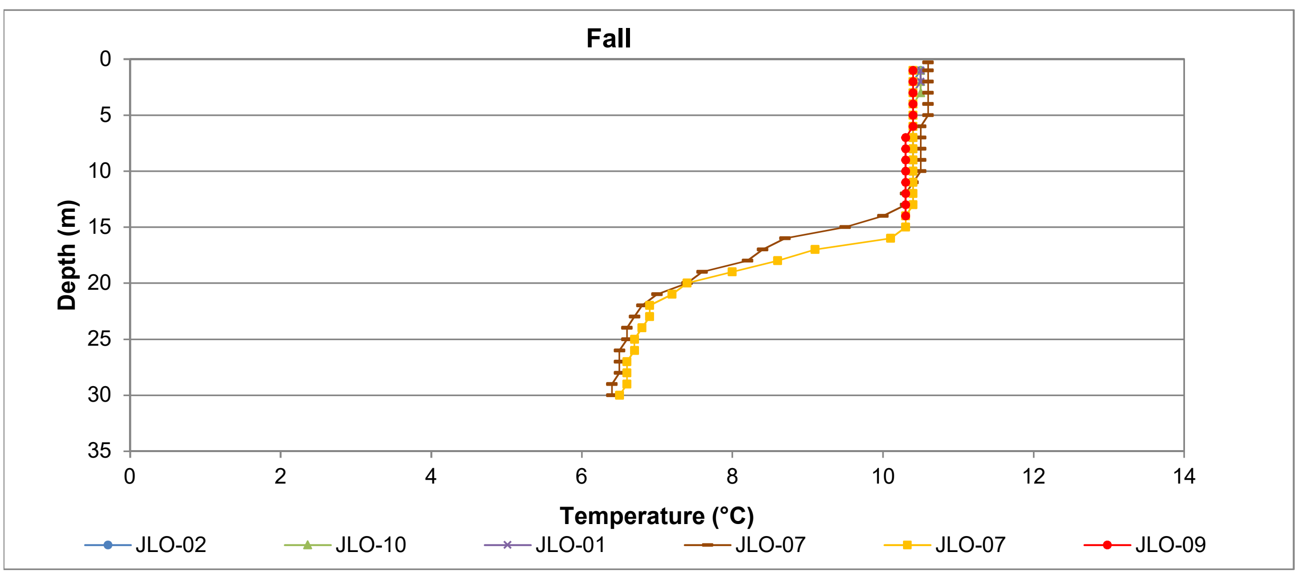


Figure C.3: Vertical Profiles of Temperature Measured at Camp Lake in Winter, Summer, and Fall, 2019

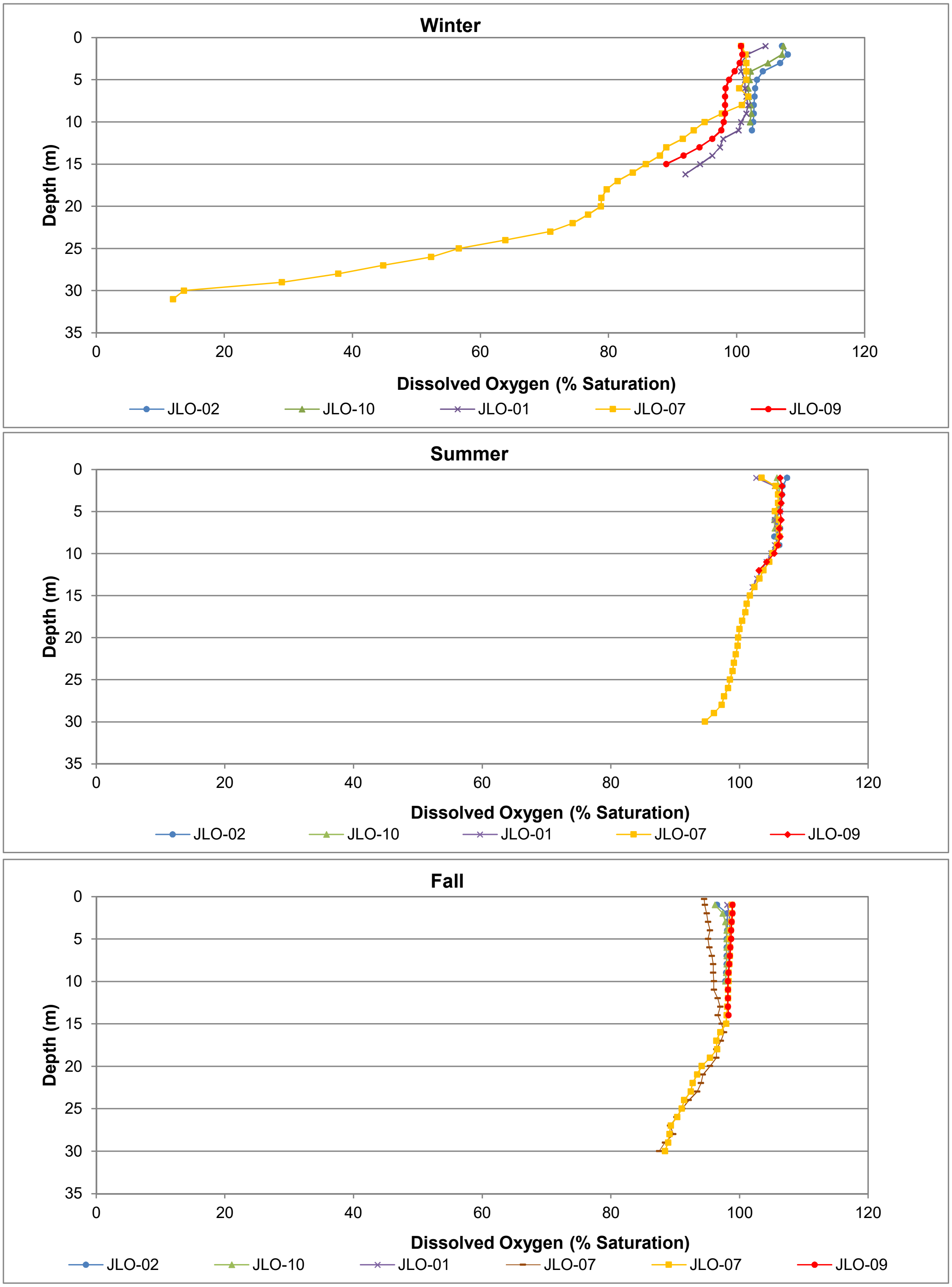


Figure C.4: Vertical Profiles of Dissolved Oxygen Measured at Camp Lake in Winter, Summer, and Fall, 2019

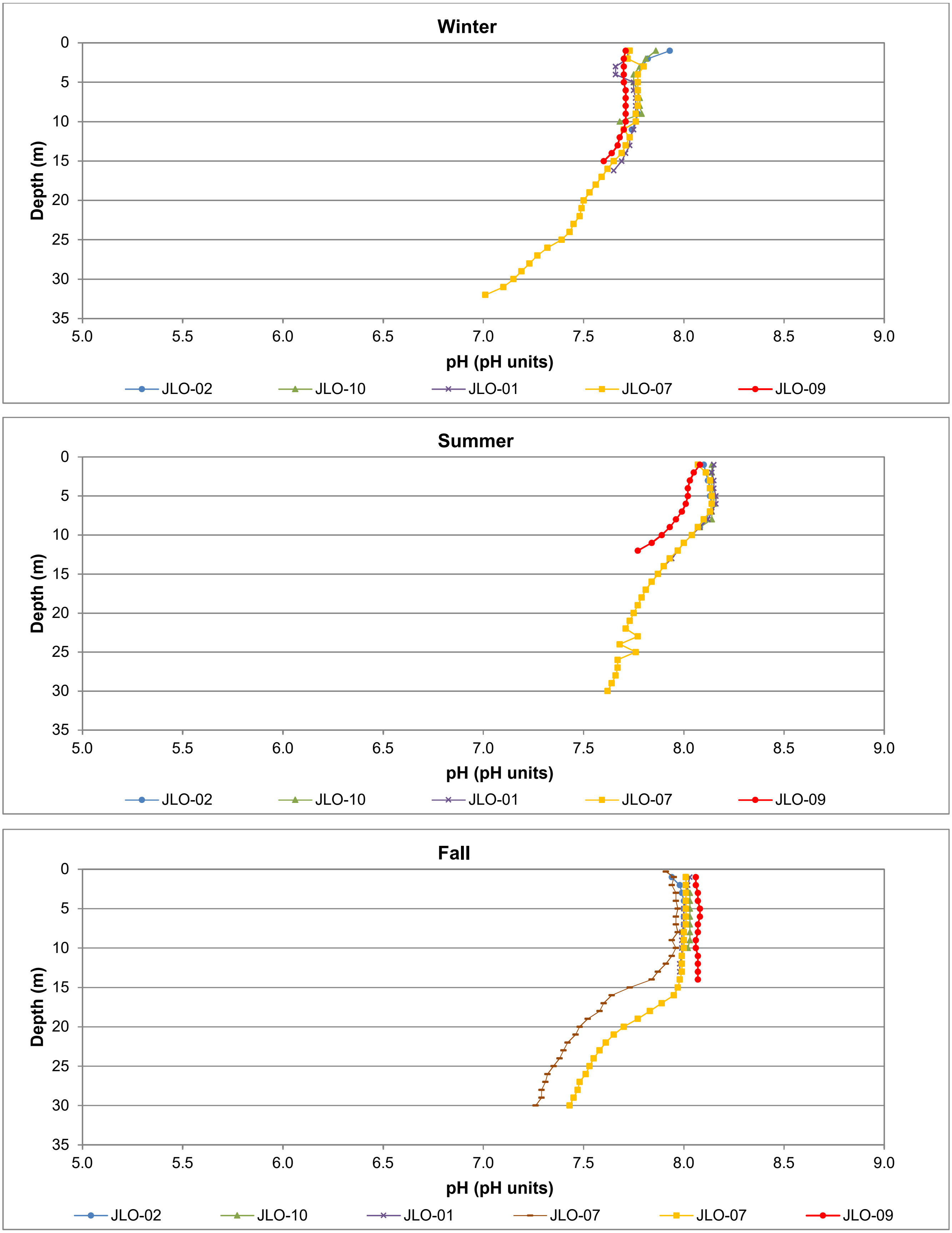


Figure C.5: Vertical Profiles of pH Measured at Camp Lake in Winter, Summer, and Fall, 2019

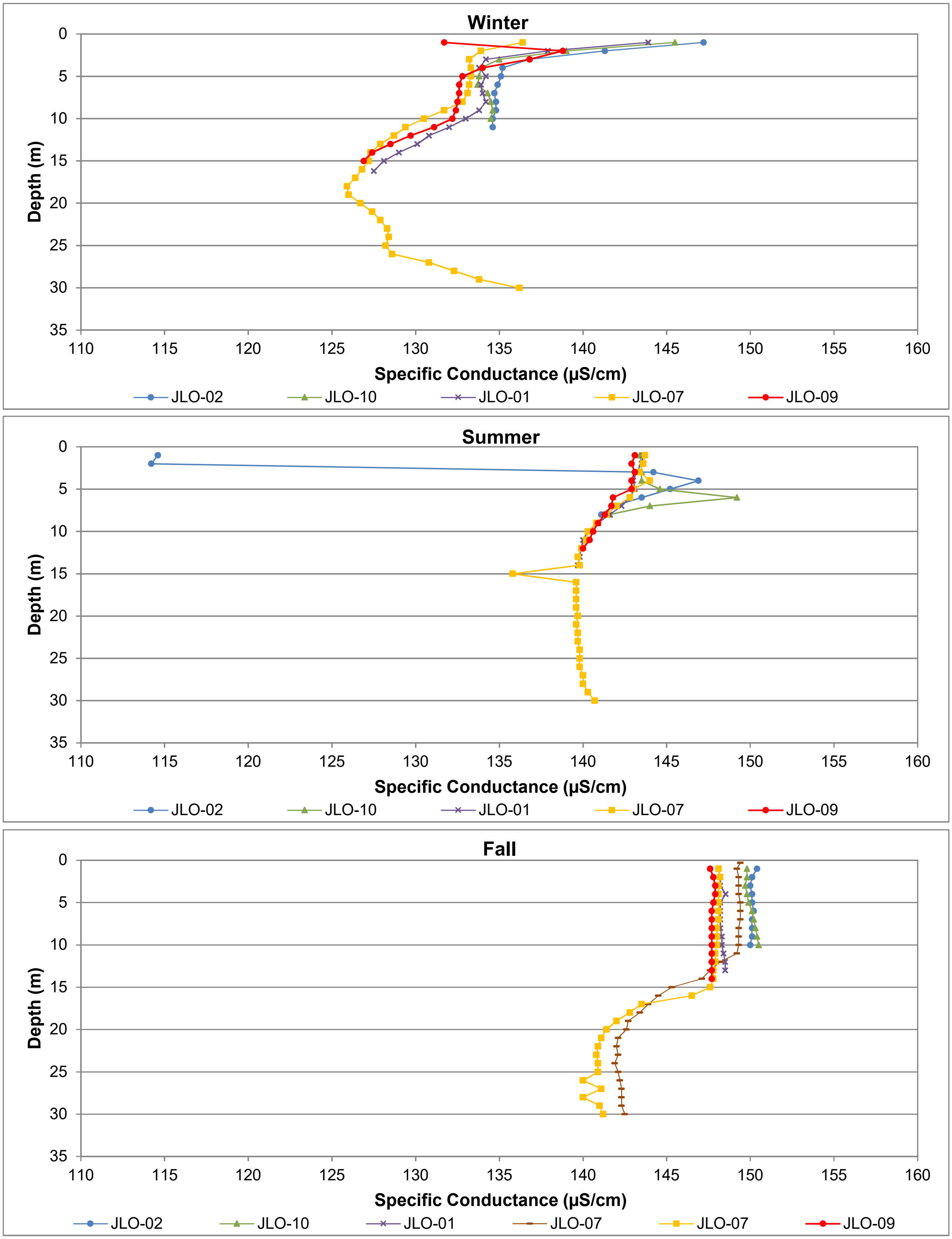


Figure C.6: Vertical Profiles of Specific Conductance Measured at Camp Lake in Winter, Summer, and Fall, 2019

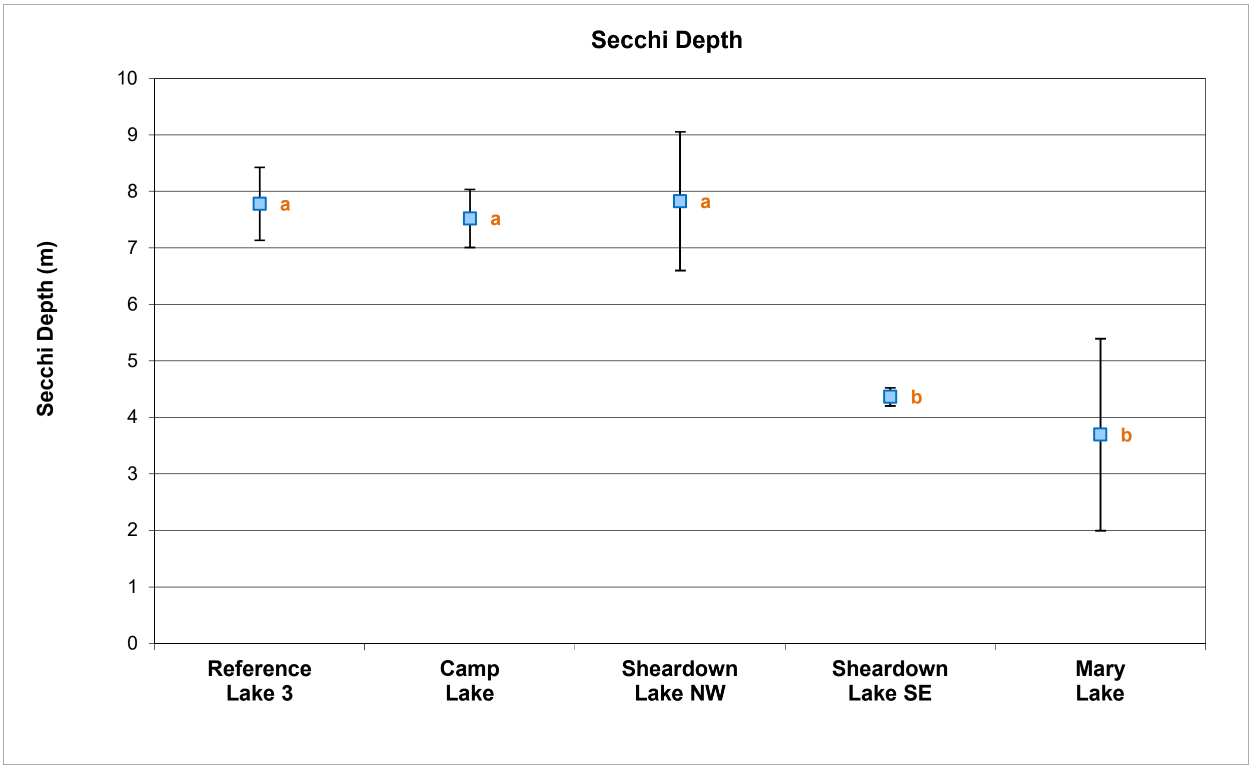


Figure C.7: Comparison of Secchi Depth (mean ± SD) Measured at the Mary River Project Lake Benthic Invertebrate Community Stations, August 2019

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 Camp Lake, where n was 9.

Figure C.8: Temporal Comparison of Water Chemistry at Camp Lake (JLO) for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2019) 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 2019, 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.

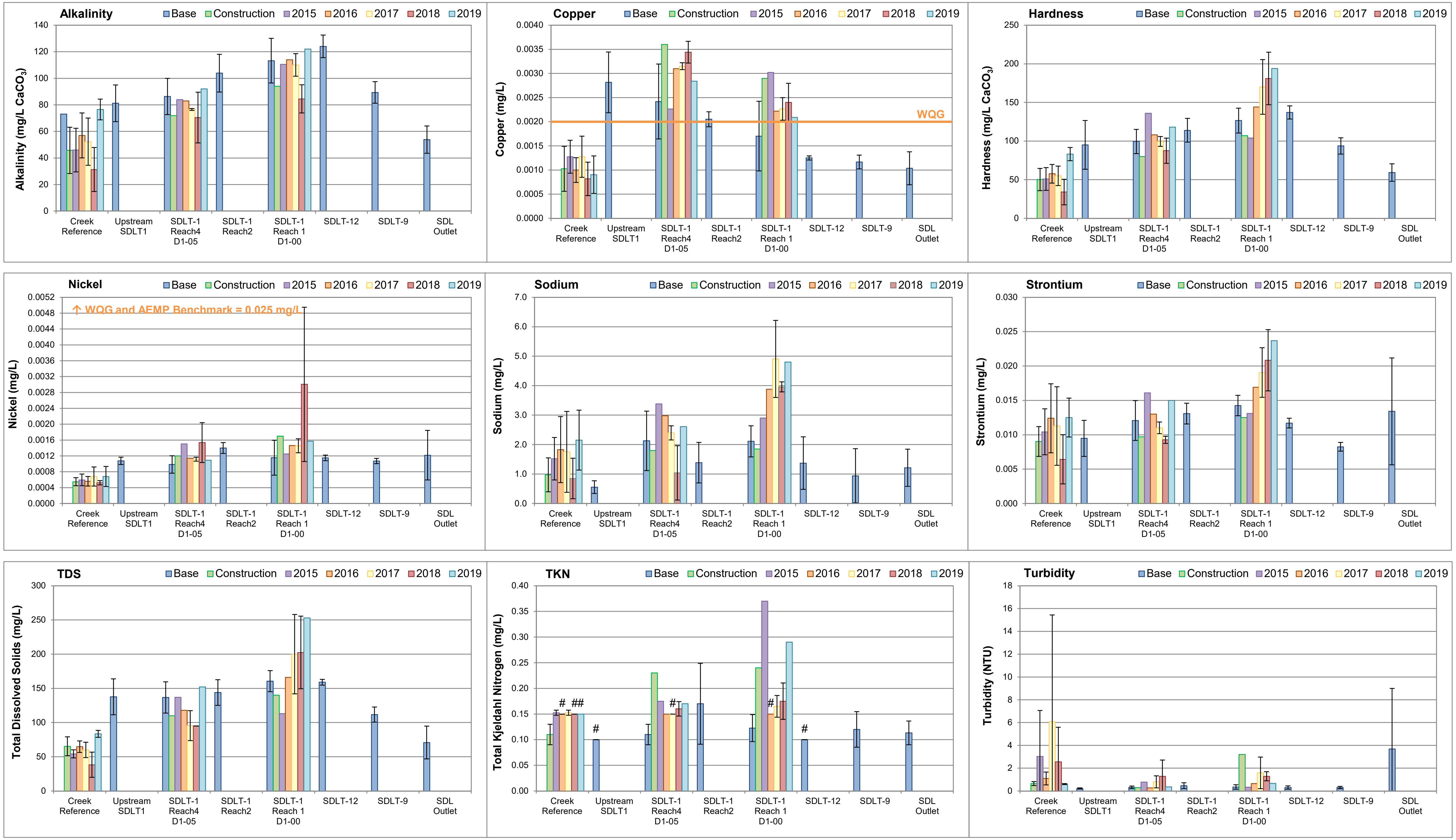


Figure C.10: **Temporal Comparison of Water Chemistry at Sheardown Lake Tributaries (SDLT) for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2019) Periods during Fall**

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.

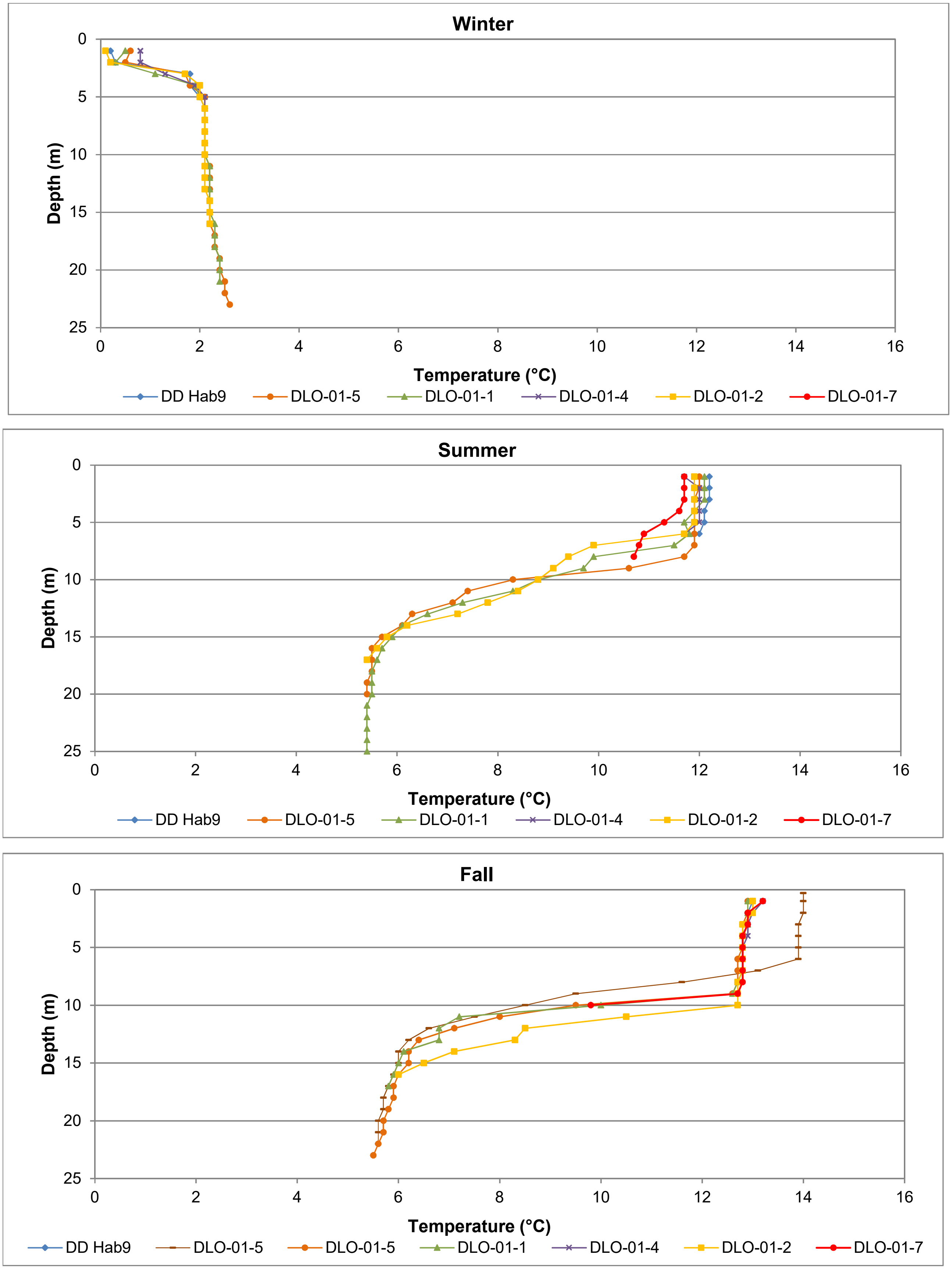


Figure C.11: Vertical Profiles of Temperature Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2019

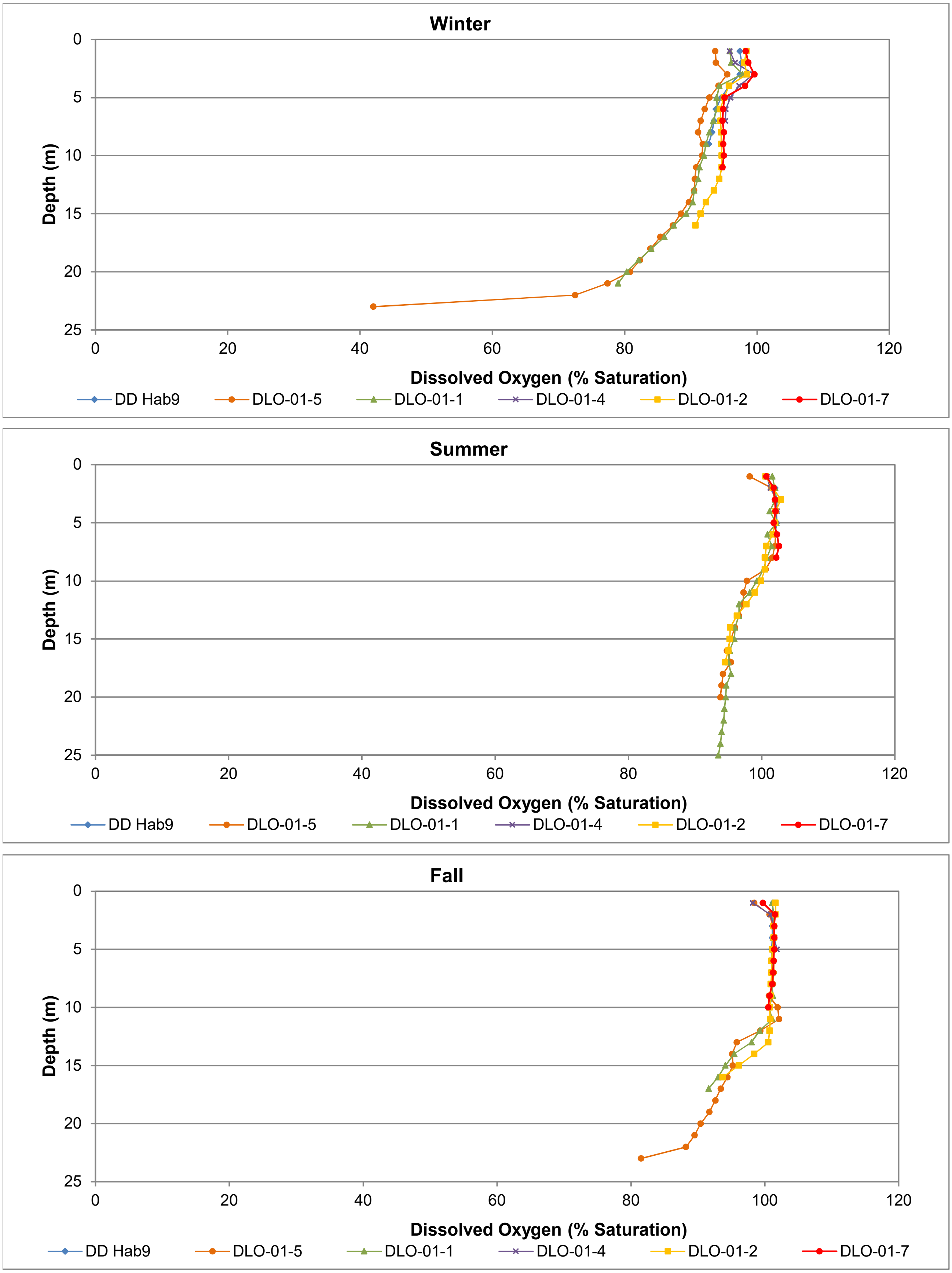


Figure C.12: Vertical Profiles of Dissolved Oxygen Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2019

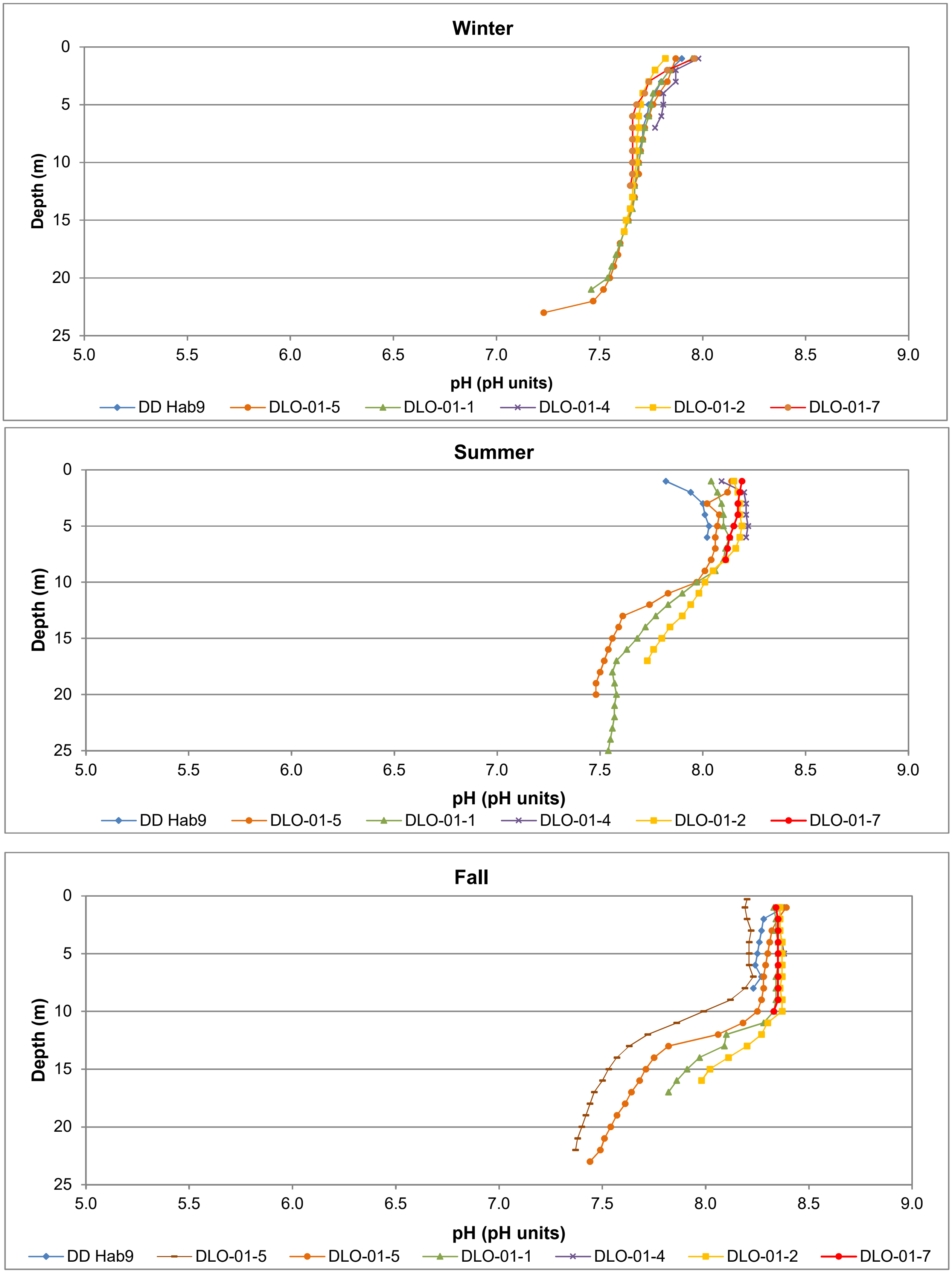


Figure C.13: Vertical Profiles of pH Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2019

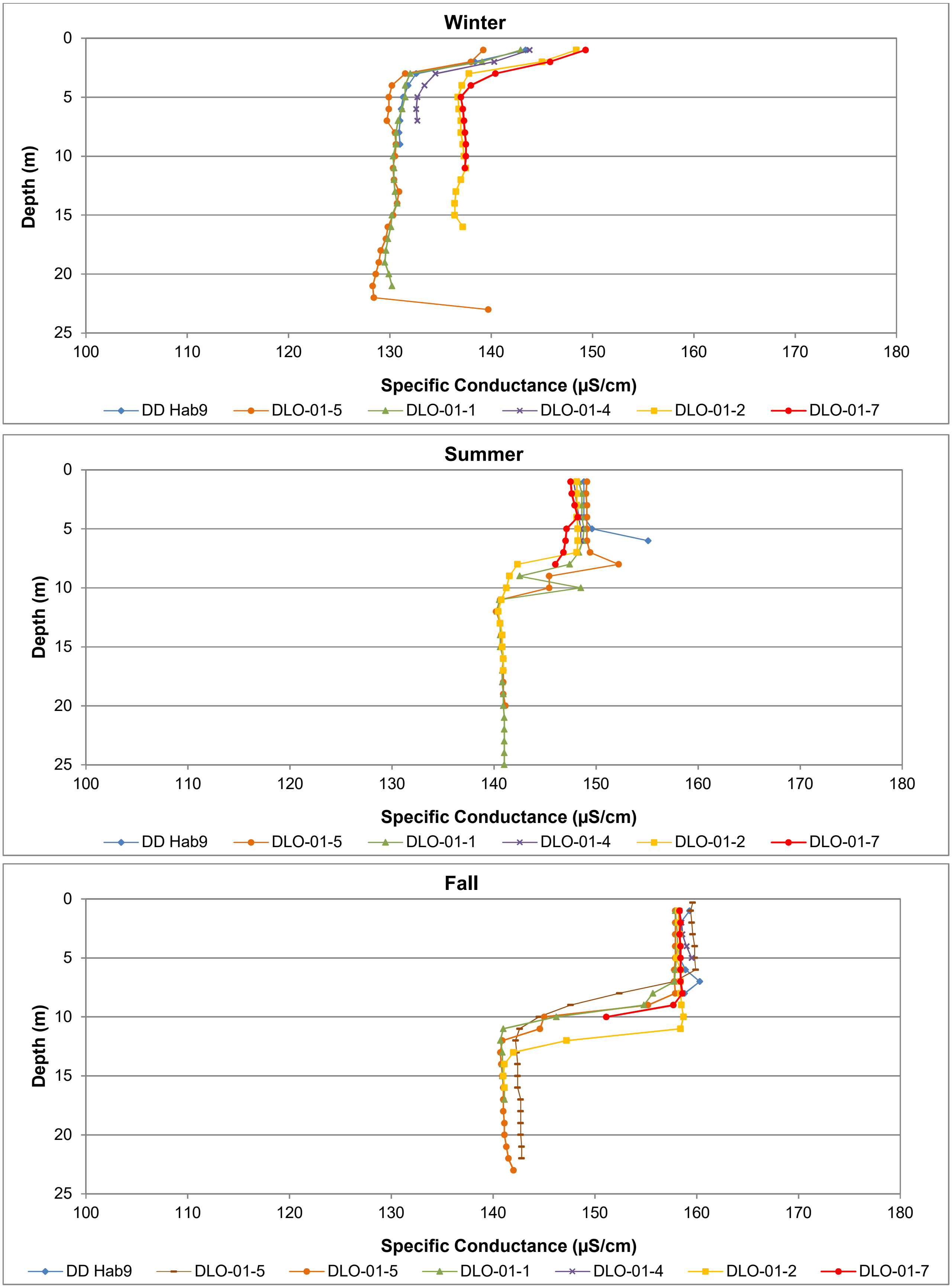


Figure C.14: Vertical Profiles of Specific Conductance Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2019

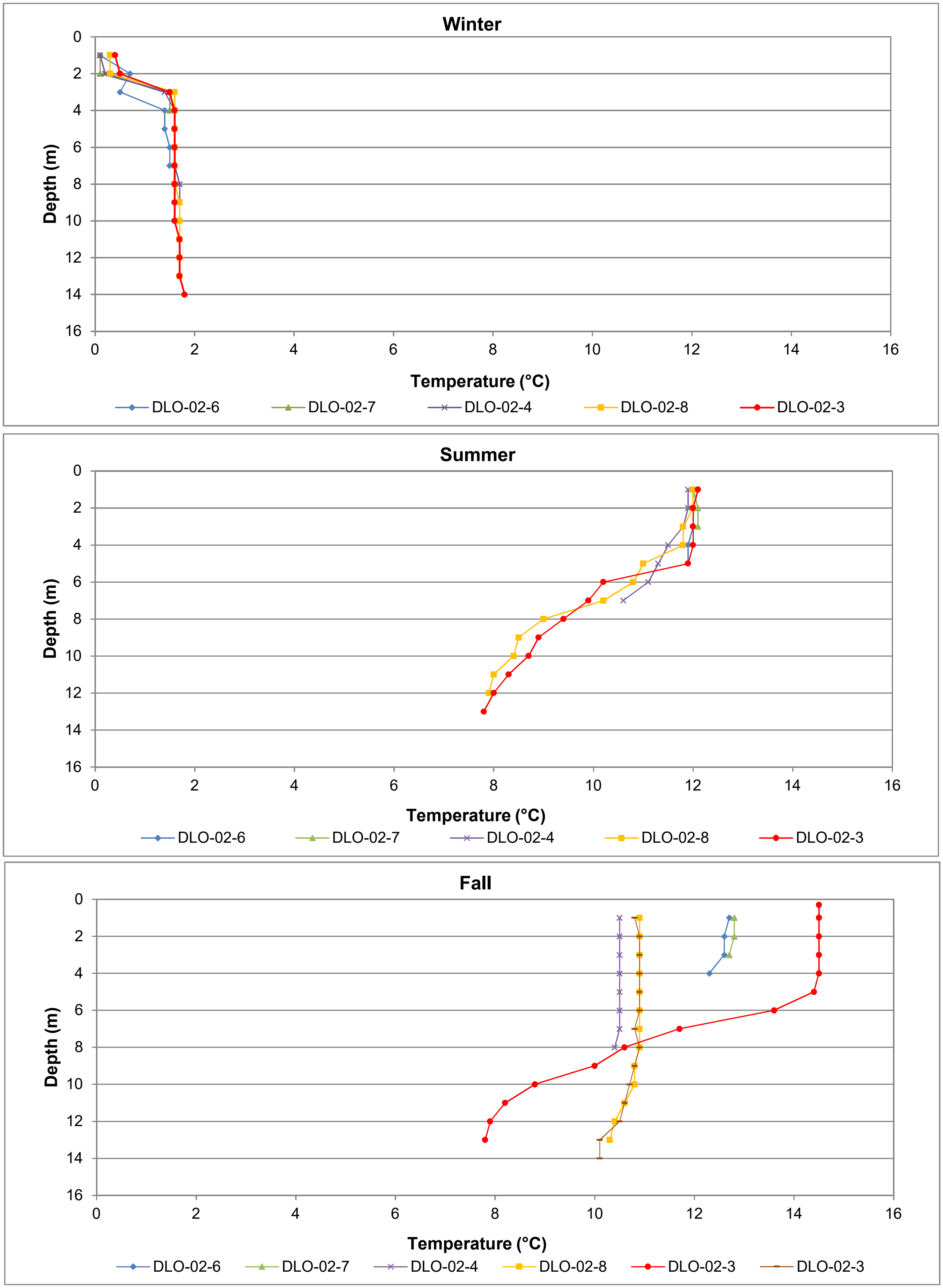


Figure C.15: Vertical Profiles of Temperature Measured at Sheardown Lake SE in Winter, Summer, and Fall, 2019

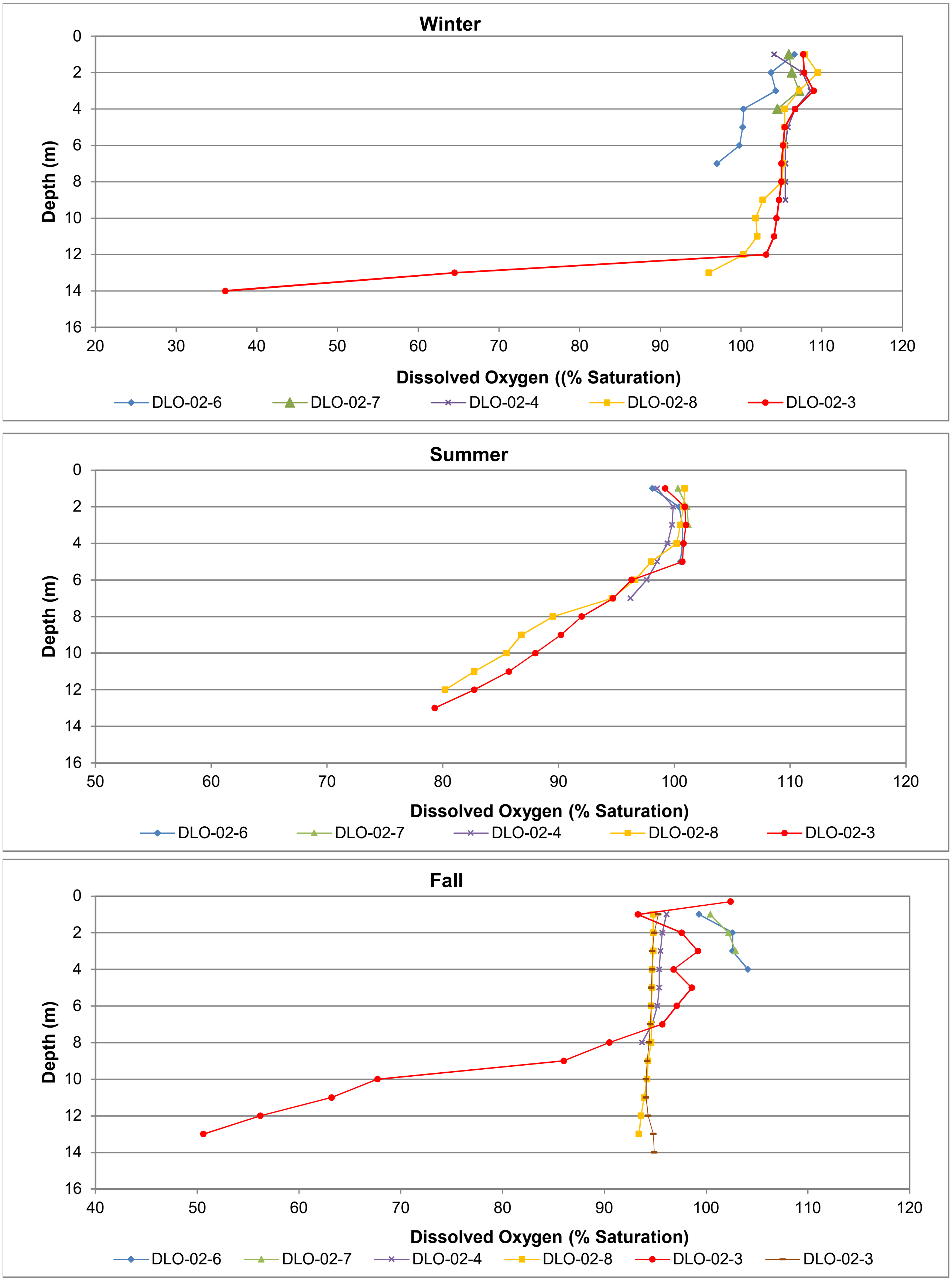


Figure C.16: Vertical Profiles of Dissolved Oxygen Measured at Sheardown Lake SE in Winter, Summer, and Fall, 2019

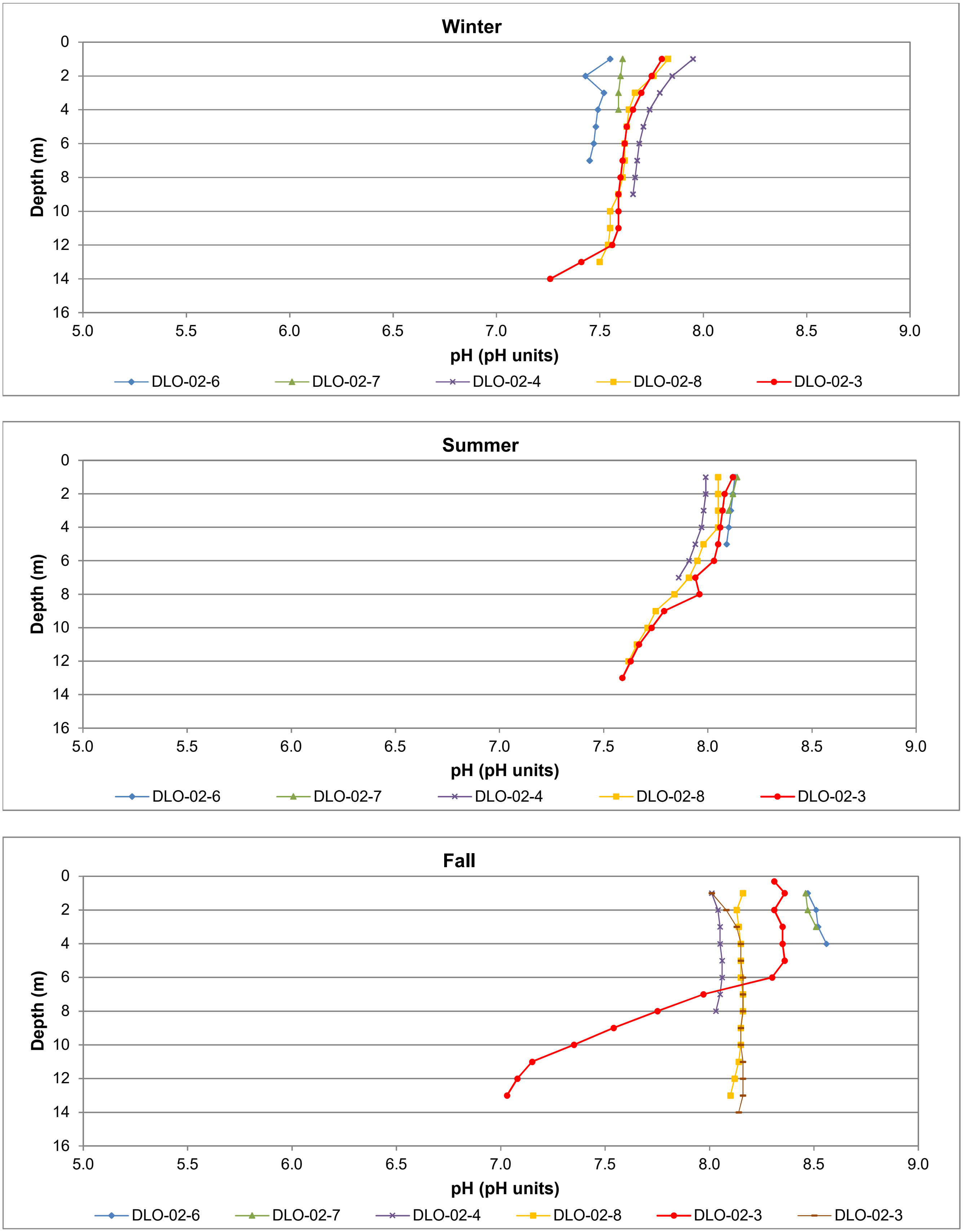


Figure C.17: Vertical Profiles of pH Measured at Sheardown Lake SE in Winter, Summer, and Fall 2019

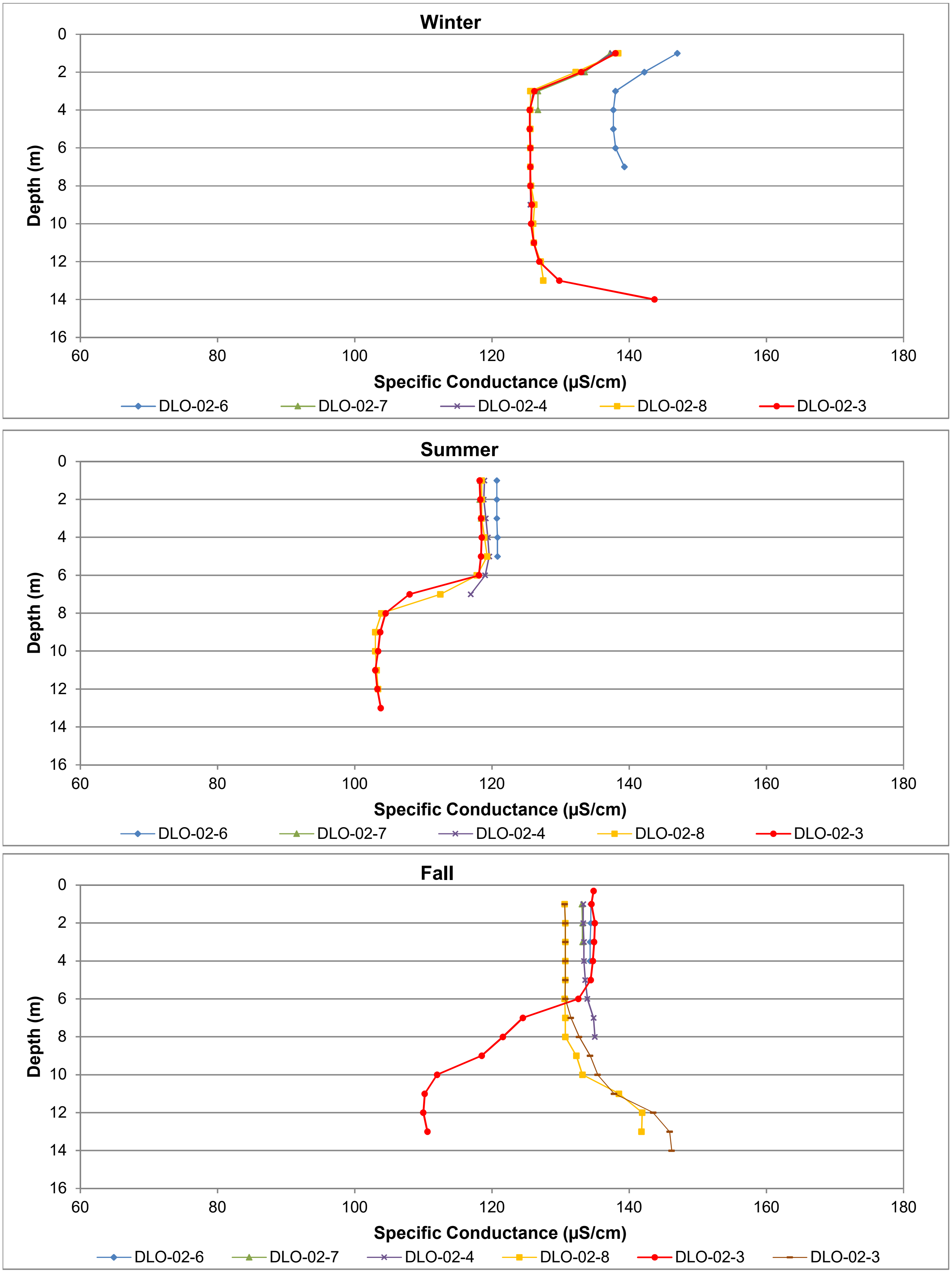


Figure C.18: Vertical Profiles of Conductivity Measured at Sheardown Lake SE in Winter, Summer, and Fall 2019

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 2019) 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).

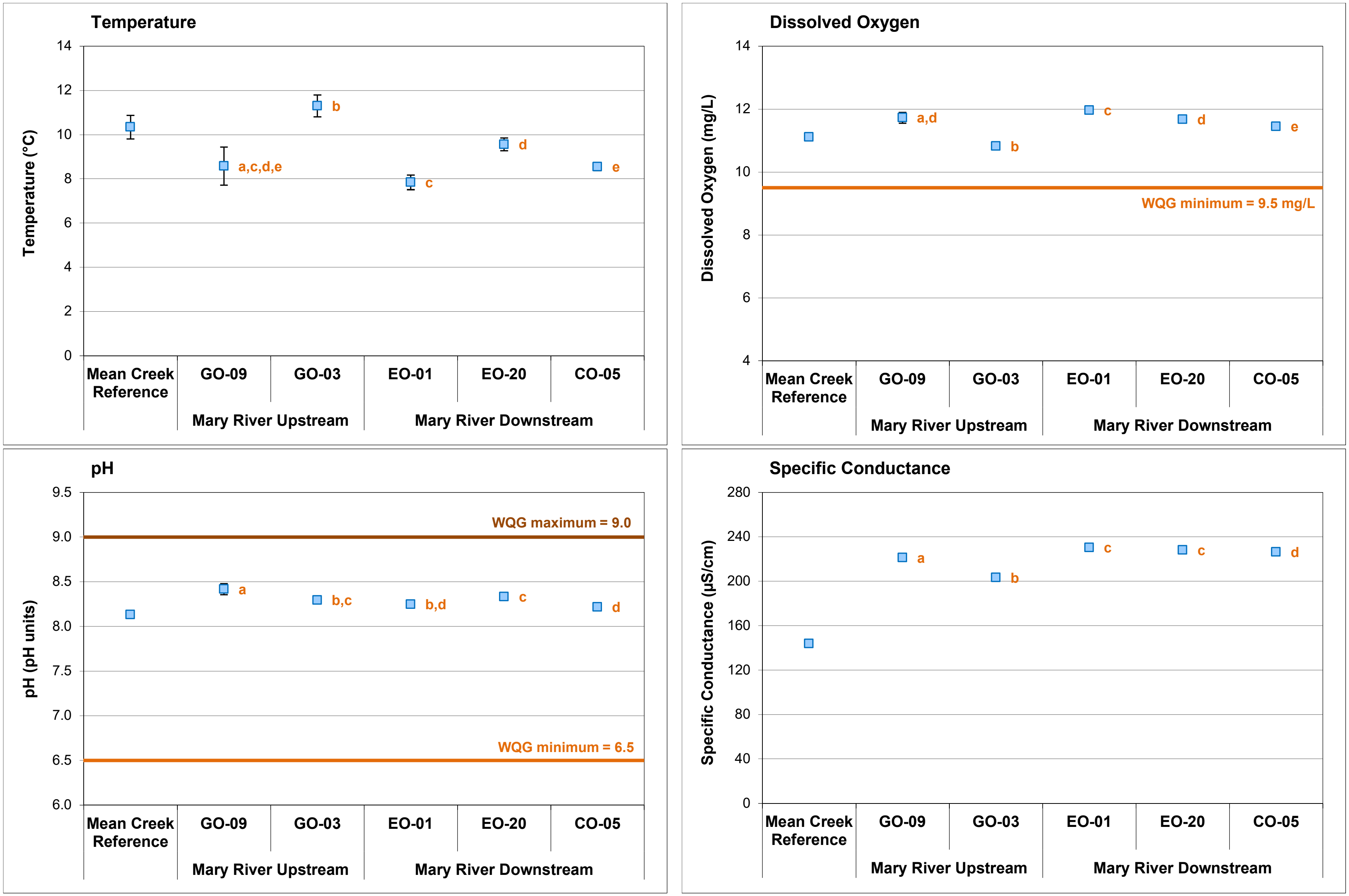


Figure C.20: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Mary River Mine-Exposed and Reference (GO-09) Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2019

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

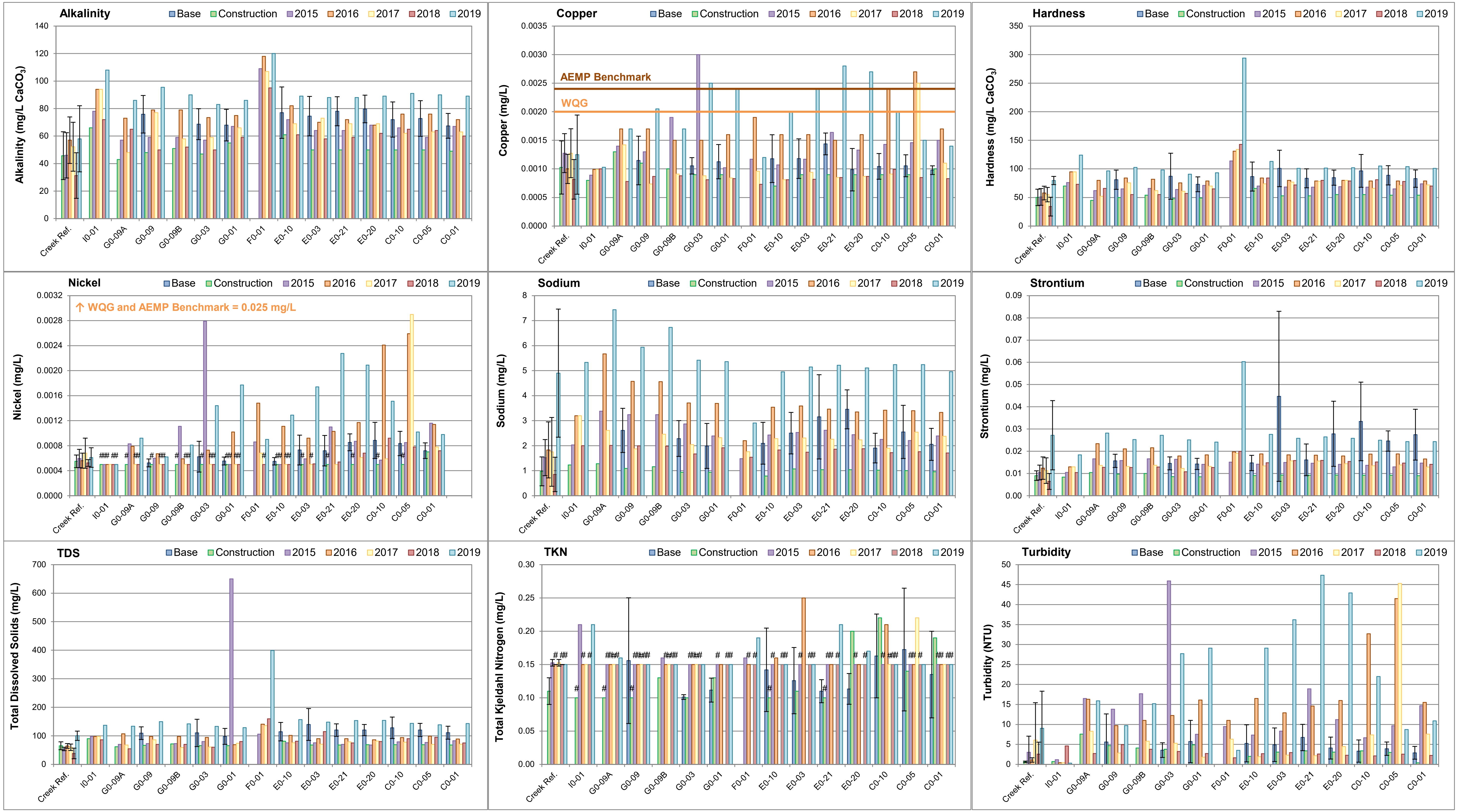


Figure C.21: **Temporal Comparison of Water Chemistry at Mary River Stations for Mine Baseline (2005 to 2013), Construction (2014) and Operational (2015 to 2019) Periods in the Fall**

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.

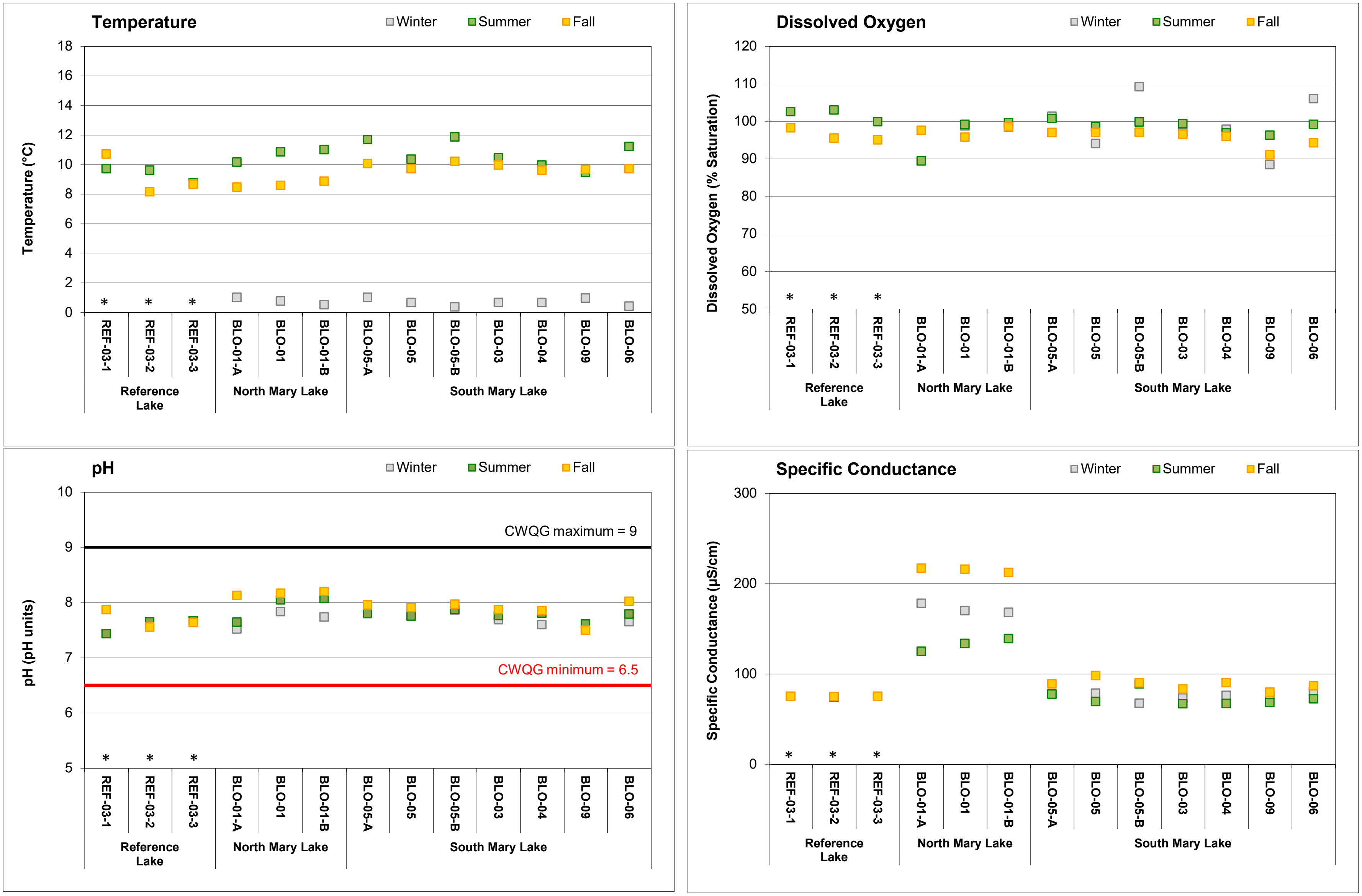


Figure C.22: Comparison of *In Situ* Water Quality Variables Measured at Mary Lake Water Quality Monitoring Stations in Winter, Summer, and Fall 2019, Mary River Project CREMP

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

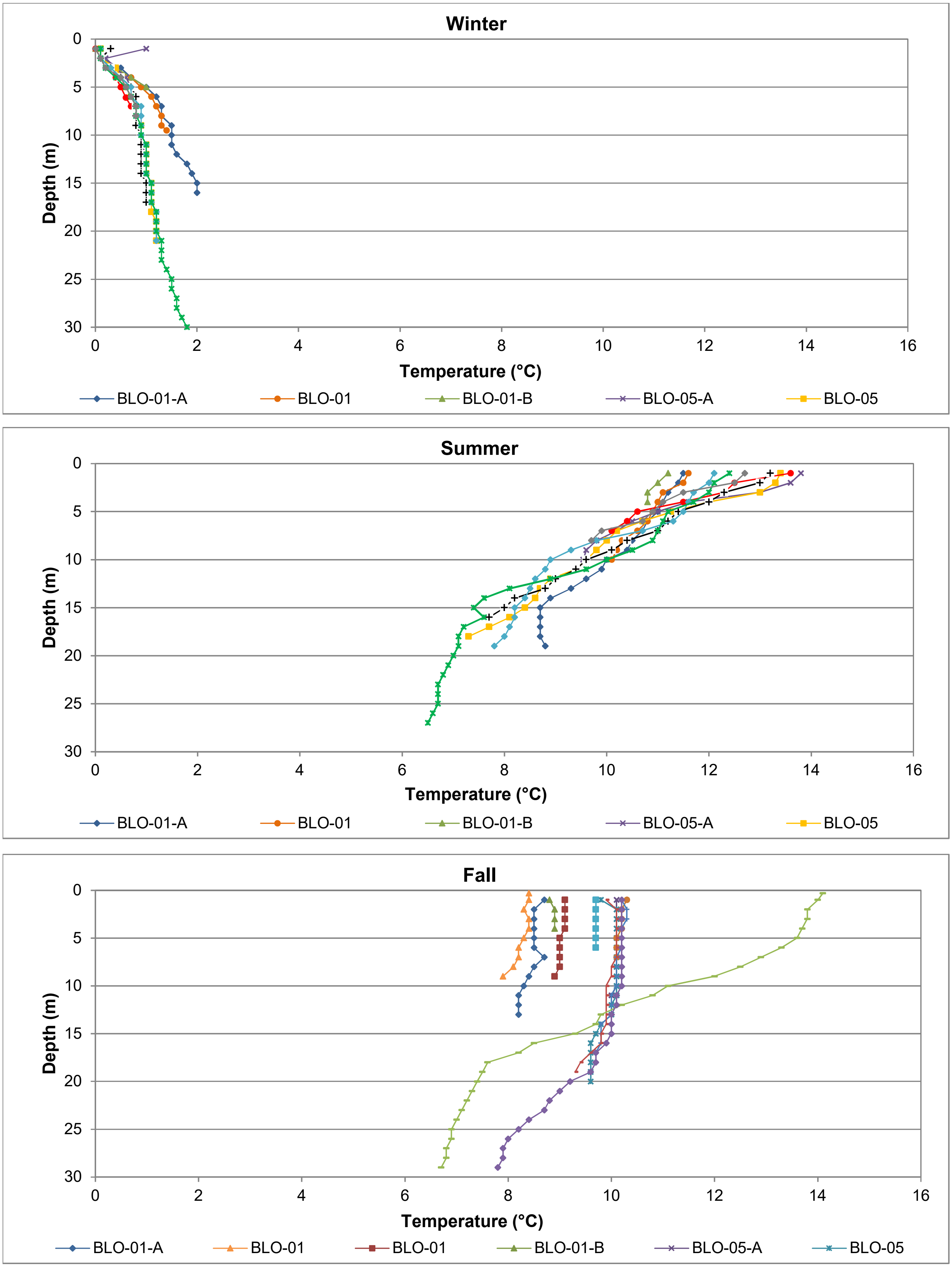


Figure C.23: Vertical Profiles of Temperature Measured at Mary Lake in Winter, Summer, and Fall, 2019

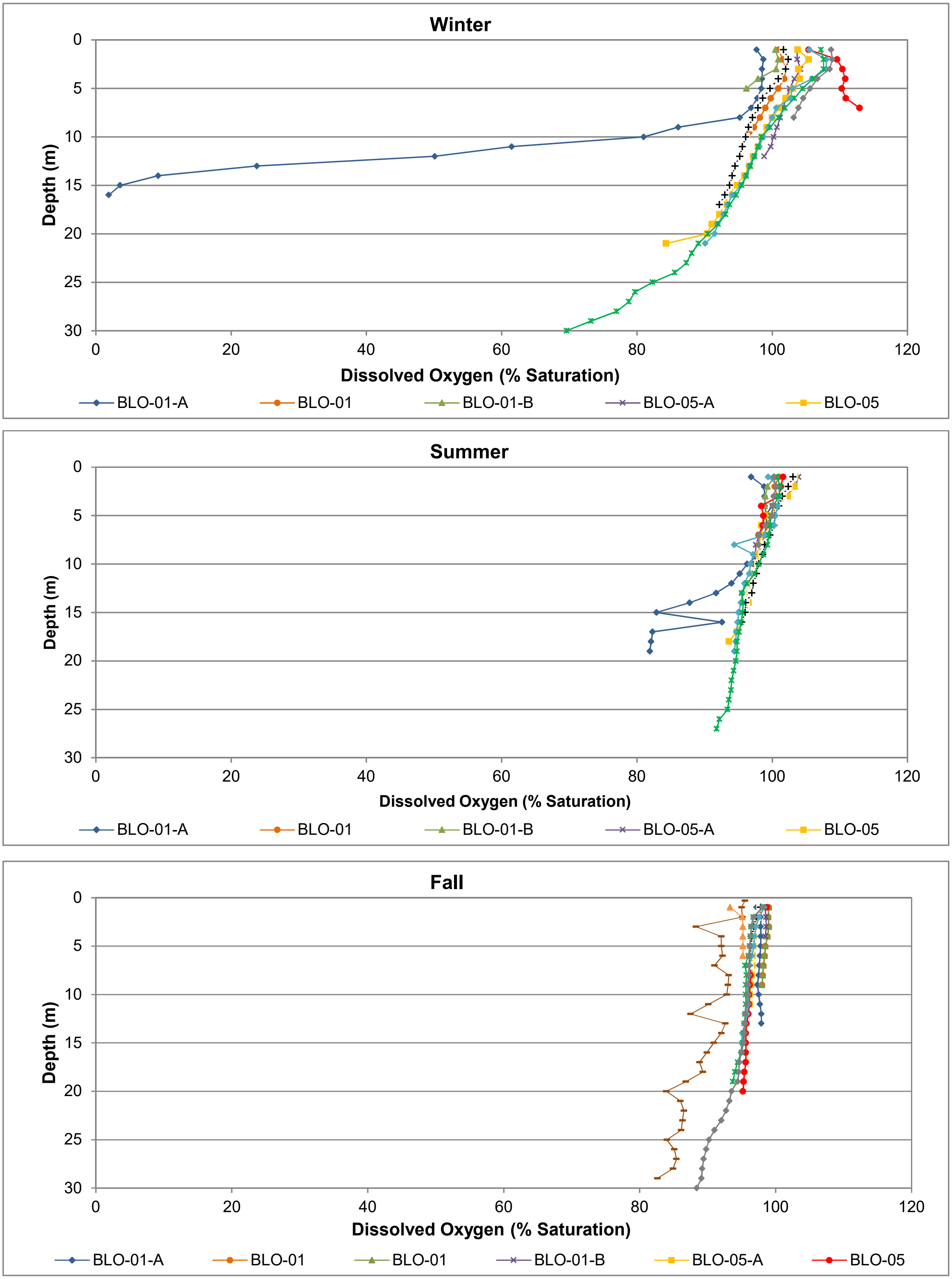


Figure C.24: Vertical Profiles of Dissolved Oxygen Measured at Mary Lake in Winter, Summer, and Fall, 2019

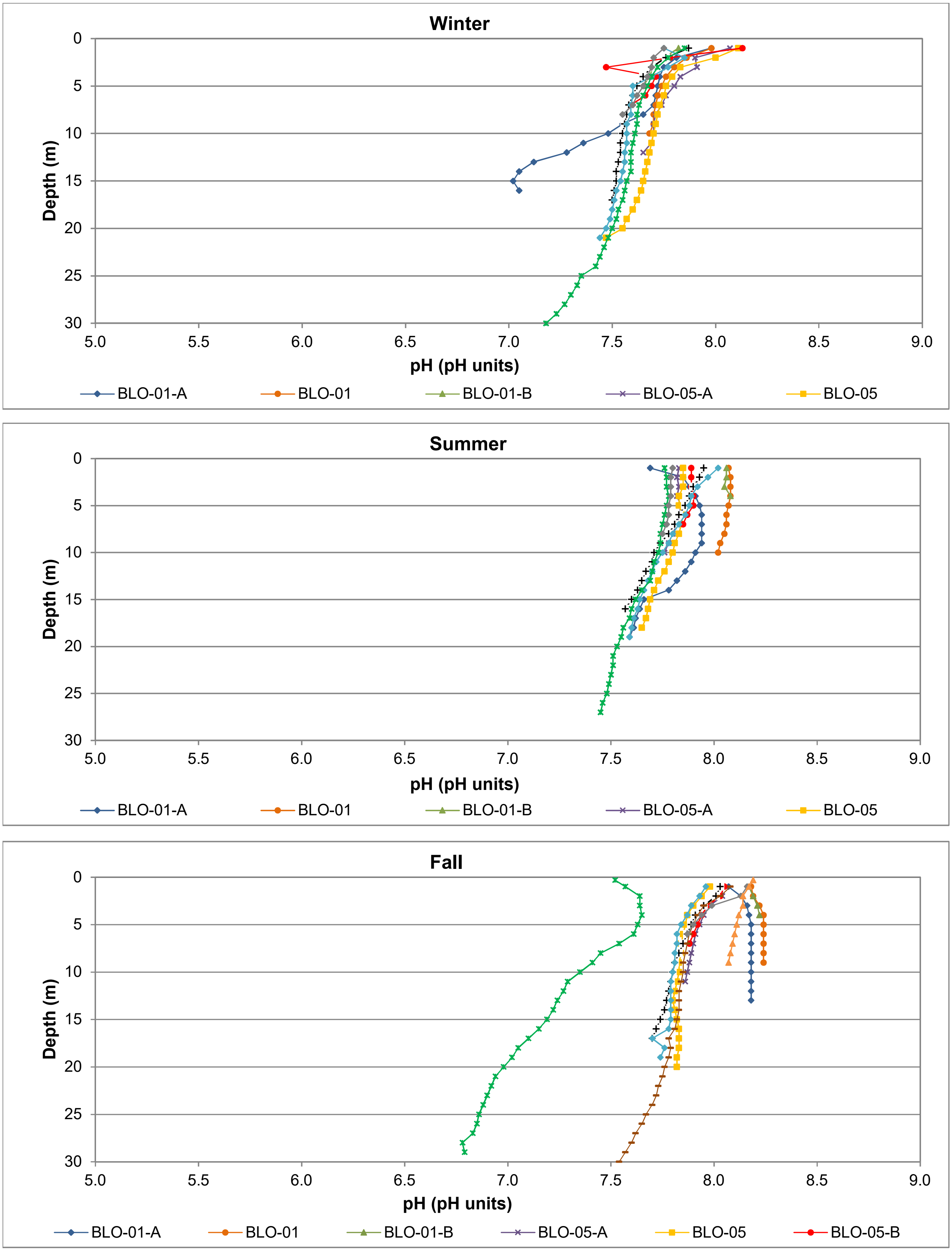


Figure C.25: Vertical Profiles of pH Measured at Mary Lake in Winter, Summer, and Fall, 2019

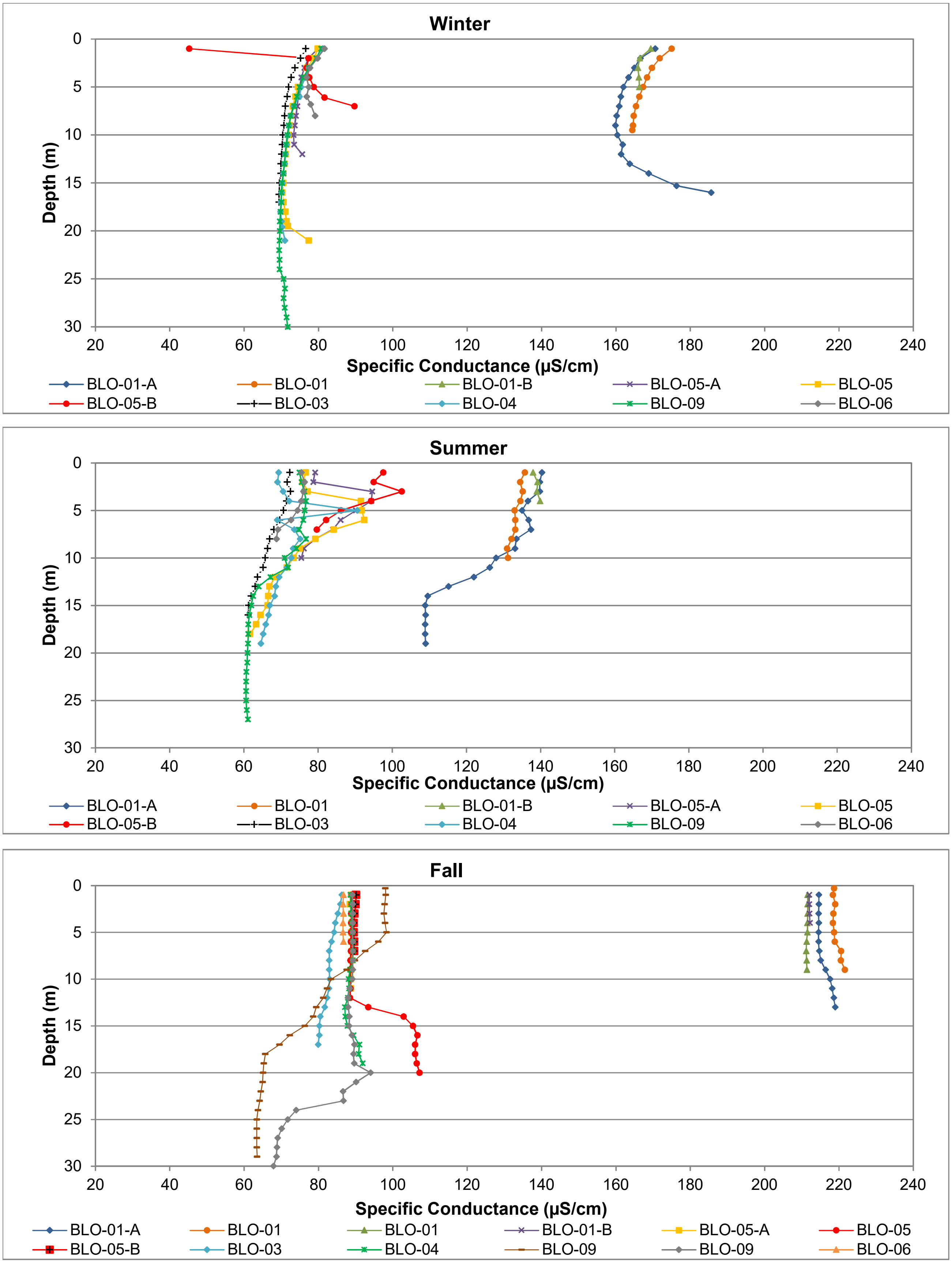


Figure C.26: Vertical Profiles of Specific Conductance Measured at Mary Lake in Winter, Summer, and Fall, 2019

Figure C.27: Temporal Comparison of Water Chemistry at Mary Lake (BLO) for Mine Baseline (2005 to 2013), Construction (2014), and Operational (2015 to 2019) 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 2019

Study Area		Station	Sampling Date	*In Situ* Water Quality Parameter					
				Temperature (°C)	Dissolved Oxygen		pH	Specific Conductance (µS/cm)	Turbidity (NTU)
					(% saturated)	(mg/L)			
Camp Lake System	Reference Creek Stations	CLT-REF4	28-Jun-19	8.4	99.2	11.6	7.58	45.5	-5.70
		CLT-REF3	28-Jun-19	5.7	96.9	12.2	8.07	49.2	-6.70
		MRY-REF3	27-Jun-19	10.8	100.3	11.1	7.61	25.5	1.25
		MRY-REF2	27-Jun-19	12.2	100.4	10.8	7.69	51.7	-5.70
	CLT-1	L1-08	28-Jun-19	4.0	95.0	12.6	8.50	75.0	-4.98
		L1-02	28-Jun-19	11.4	99.0	10.8	8.12	116.4	-4.38
		L2-03	28-Jun-19	12.8	97.7	10.3	8.05	256.4	6.80
		L1-09	28-Jun-19	11.0	98.8	11.0	8.15	141.1	-3.33
		L1-05	28-Jun-19	11.8	99.0	10.7	8.16	144.4	-3.58
		L0-01	28-Jun-19	16.9	99.3	9.6	8.19	153.4	-3.60
	CLT-2	K0-01	28-Jun-19	14.8	99.2	10.2	8.13	128.3	-0.50
	Camp Lake	J0-01	28-Jun-19	8.2	106.0	12.5	7.73	127.4	-5.45
Sheardown Lake System	SDL Tribs	D1-05	28-Jun-19	9.5	95.0	11.0	7.92	134.0	-5.98
		D1-00	28-Jun-19	17.9	99.9	9.5	8.13	248.6	-5.07
Mary River/Lake System	Tom River	I0-01	28-Jun-19	8.5	99.5	11.7	7.70	40.8	-3.00
	Mary River	G0-09-A	28-Jun-19	12.3	97.7	10.5	7.73	52.8	-5.58
		G0-09	28-Jun-19	10.8	98.3	10.9	7.87	40.1	-2.55
		G0-09-B	28-Jun-19	8.8	98.4	11.5	7.89	30.7	1.30
		G0-03	28-Jun-19	8.7	98.1	11.5	7.88	33.3	-0.50
		G0-01	26-Jun-19	8.9	99.9	-	8.15	38.1	-1.77
		F0-01	26-Jun-19	8.1	98.6	-	7.88	104.5	0.80
		E0-10	26-Jun-19	9.2	100.2	-	7.80	47.5	4.98
		E0-03	27-Jun-19	9.2	99.9	11.7	8.24	38.8	-1.05
		E0-20	27-Jun-19	10.0	101.0	11.4	7.91	43.1	-1.00
		E0-21	27-Jun-19	9.2	100.9	11.6	7.84	40.2	-0.80
		C0-10	27-Jun-19	11.0	103.2	11.4	7.94	41.0	-1.24
		C0-05	28-Jun-19	11.1	104.6	11.5	7.65	45.4	-0.67
		C0-01	28-Jun-19	10.8	103.3	11.5	7.65	40.3	0.35

Note: "-" indicates no data collected.

Table C.2: *In Situ* Water Quality Data Collected from Lotic Environments for the Mary River Project CREMP, Summer 2019

Study Area		Station	Sampling Date	*In Situ* Water Quality Parameter					
				Temperature (^oC)	Dissolved Oxygen		pH	Specific Conductance (µS/cm)	Turbidity (NTU)
					(% saturated)	(mg/L)			
Camp Lake System	Reference Creek Stations	CLT-REF4	1-Aug-19	8.8	97.0	11.3	8.08	125.7	-8.17
		CLT-REF3	1-Aug-19	5.9	98.9	12.3	8.03	108.2	-8.42
		MRY-REF3	1-Aug-19	10.3	99.7	11.2	8.05	91.0	5.08
		MRY-REF2	1-Aug-19	12.1	100.6	10.8	8.10	125.2	-7.45
	CLT-1	L1-08	5-Aug-19	4.5	96.1	12.5	7.95	137.7	-0.63
		L1-02	31-Jul-19	10.9	98.7	10.9	8.20	175.7	-0.58
		L2-03	24-Jul-19	14.1	99.0	10.2	7.95	359.0	1.07
		L1-09	29-Jul-19	10.0	98.8	11.2	8.27	230.6	-7.93
		L1-05	29-Jul-19	9.9	98.9	11.2	8.30	234.1	-8.05
		L0-01	31-Jul-19	8.0	99.1	11.1	8.19	232.3	-8.89
	CLT-2	K0-01	29-Jul-19	10.2	98.5	11.0	8.48	234.1	-8.60
	Camp Lake	J0-01	5-Aug-19	12.1	102.2	11.7	8.09	144.6	-0.70
Sheardown Lake System	SDL Tribs	D1-05	24-Jul-19	8.2	97.4	11.5	7.69	178.7	-2.60
		D1-00	24-Jul-19	12.5	98.9	10.5	7.98	403.4	-2.50
Mary River/Lake System	Tom River	I0-01	31-Jul-19	14.3	102.0	10.3	8.23	214.6	-4.30
	Mary River	G0-09-A	1-Aug-19	11.5	106.2	11.5	8.22	132.1	43.61
		G0-09	1-Aug-19	12.0	98.1	10.6	8.26	143.6	7.60
		G0-09-B	1-Aug-19	12.5	98.9	10.6	8.15	140.8	7.83
		G0-03	1-Aug-19	10.9	98.1	10.9	8.04	147.4	5.74
		G0-01	1-Aug-19	9.7	99.6	11.3	8.05	135.2	12.11
		F0-01	1-Aug-19	8.9	98.7	11.4	8.19	467.4	-5.88
		E0-10	1-Aug-19	9.4	98.4	11.3	7.78	181.2	13.57
		E0-03	28-Jul-19	11.1	99.8	10.5	8.10	161.7	2.80
		E0-20	28-Jul-19	11.0	100.4	11.1	7.31	161.9	7.77
		E0-21	28-Jul-19	11.0	101.0	11.1	7.48	165.8	4.63
		C0-10	27-Jul-19	13.7	101.1	10.5	8.34	153.2	124.00
		C0-05	27-Jul-19	12.6	103.5	11.0	8.17	146.0	189.44
		C0-01	27-Jul-19	13.5	102.3	10.7	8.19	143.8	183.50

Table C.3: *In Situ* Water Quality Data Collected From Lotic Environments for the Mary River Project CREMP, Fall 2019

Study Area		Station	Sampling Date	*In Situ* Water Quality Parameter					
				Temperature (°C)	Dissolved Oxygen		pH	Specific Conductance (µS/cm)	Turbidity (NTU)
					(% saturated)	(mg/L)			
Camp Lake System	Reference Creek Stations	CLT-REF4	21-Aug-19	6.0	97.5	12.2	8.29	170.3	-5.1
		CLT-REF3	21-Aug-19	3.6	94.1	12.5	8.35	146.6	-5.3
		MRY-REF3	21-Aug-19	7.0	98.3	11.9	8.19	184.0	8.8
		MRY-REF2	21-Aug-19	8.1	99.5	11.8	8.07	169.9	-3.8
	CLT-1	L1-08	18-Aug-19	3.9	106.0	14.1	7.79	169.8	-0.8
		L1-02	19-Aug-19	9.5	96.9	11.1	8.29	237.8	-2.5
		L2-03	19-Aug-19	14.2	100.0	10.3	8.04	426.6	0.1
		L1-09	19-Aug-19	11.2	99.7	10.9	8.12	297.5	-1.1
		L1-05	19-Aug-19	9.8	99.7	11.3	8.16	301.4	-1.0
		L0-01	19-Aug-19	9.6	98.5	11.3	8.24	308.1	-0.8
	CLT-2	K0-01	19-Aug-19	9.9	99.6	11.4	8.30	317.8	-2.6
	Camp Lake	J0-01	18-Aug-19	15.1	112.2	11.2	8.15	150.5	-0.8
Sheardown Lake System	SDL Tribs	D1-05	19-Aug-19	6.5	92.4	11.4	7.64	328.4	-2.5
		D1-00	19-Aug-19	10.2	98.8	11.1	8.04	378.5	-2.1
Mary River/Lake System	Tom River	I0-01	19-Aug-19	11.2	100.6	11.1	8.30	246.3	-2.6
	Mary River	G0-09-A	20-Aug-19	9.6	96.6	11.0	8.30	229.3	10.2
		G0-09	20-Aug-19	9.3	98.3	11.3	8.30	230.5	3.9
		G0-09-B	20-Aug-19	8.7	97.4	11.4	8.25	230.2	9.3
		G0-03	20-Aug-19	6.8	96.2	-	8.09	210.6	22.7
		G0-01	20-Aug-19	7.8	98.1	11.7	8.17	211.2	27.6
		F0-01	20-Aug-19	7.8	98.2	11.7	8.21	577.0	-2.4
		E0-10	20-Aug-19	7.7	98.1	11.8	8.12	254.7	23.9
		E0-03	20-Aug-19	10.4	99.7	12.0	8.11	229.6	31.1
		E0-20	20-Aug-19	8.0	98.9	11.7	8.21	229.3	36.8
		E0-21	20-Aug-19	7.6	99.1	11.9	8.17	231.1	37.3
		C0-10	20-Aug-19	8.7	101.3	11.8	8.20	233.4	17.3
		C0-05	20-Aug-19	8.8	100.0	11.6	8.11	231.1	2.9
		C0-01	20-Aug-19	8.9	99.0	11.5	8.21	228.3	4.0

Note: "-" indicates no data collected.

Table C.4: Dissolved Metal Concentrations at Reference Creek Monitoring Stations, Mary River Project CREMP, 2019

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
			28-Jun-19	28-Jun-19	27-Jun-19	27-Jun-19	01-Aug-19	01-Aug-19	01-Aug-19	01-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19
Dissolved Metals	Aluminum (Al)	mg/L	0.0122	0.0149	0.0540	0.0167	0.019	0.0135	0.1040	0.0171	0.0131	0.0100	0.0632	0.0313
	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	0.00231	0.00317	0.00279	0.00297	0.00594	0.00605	0.00866	0.00750	0.00669	0.00808	0.01620	0.01010
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<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	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	5.21	5.49	2.45	5.61	14.20	12.00	8.26	13.80	18.4	15.0	16.10	17.1
	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	0.00102	0.00069	<0.00050	0.00061	0.00118	0.00114	0.00072	0.00067	0.00102	0.00120	0.00070
	Iron (Fe)	mg/L	<0.030	<0.030	0.032	<0.030	<0.010	0.018	0.052	0.016	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	0.000058	<0.000050	<0.000050	<0.000050	<0.000050	0.000064	<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	3.28	3.63	1.27	3.43	7.94	6.94	4.22	7.80	10.5	9.60	8.33	10.3
	Manganese (Mn)	mg/L	<0.000070	0.000225	0.00033	0.0002	<0.00050	0.000680	0.000580	<0.00050	0.000072	0.00171	0.000347	0.000775
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000072	0.000199	0.000171	0.000065	0.000245	0.000578	0.000462	0.000230	0.000513	0.000752	0.000569	0.000336
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00060	<0.00050	<0.00050	<0.00050	0.00078	<0.00050	<0.00050
	Potassium (K)	mg/L	0.360	0.420	0.440	0.450	0.661	0.683	0.989	0.818	0.810	0.900	1.51	1.07
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050	<0.000050	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.450	0.650	0.590	0.450	0.743	0.940	1.220	0.823	0.490	0.940	1.02	0.840
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.308	0.384	0.952	0.500	0.865	0.816	3.27	1.32	2.94	1.44	6.88	3.05
	Strontium (Sr)	mg/L	0.00386	0.00360	0.00498	0.00413	0.01080	0.00810	0.0187	0.01120	0.0146	0.01030	0.0372	0.0161
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<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	0.00036	<0.00030	0.00334	0.00035	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000263	0.000371	0.000228	0.000220	0.00417	0.00282	0.00120	0.00173	0.00993	0.00561	0.00352	0.00296
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0010	<0.0010	<0.0010	<0.0010	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	-	-	-	-	<0.00020	<0.00020	0.00026	<0.00020	-	-	-	-

Note: "-" indicates no data reported.

Table C.5: ***In Situ*** **Water Quality Profile Data Collected at Reference Lake 3 Water Quality Monitoring Stations in Summer, Mary River Project CREMP, August 2019**

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	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19	2-Aug-19
1.0	12.0	11.8	11.7	11.09	11.19	11.19	102.9	103.3	103.2	8.07	7.67	7.67	74.6	74.8	75.7
2.0	11.8	11.6	11.5	11.18	11.22	11.23	102.7	103.0	103.0	7.93	7.69	7.65	74.3	74.1	74.6
3.0	11.5	11.5	11.4	11.19	11.24	11.24	102.7	103.0	102.9	7.87	7.71	7.64	74.2	74.2	74.4
4.0	11.5	11.3	11.4	11.20	11.25	11.25	102.7	102.7	102.9	7.84	7.72	7.64	74.2	74.1	74.4
5.0	11.5	11.2	11.4	11.19	11.29	11.25	102.6	102.8	102.8	7.82	7.73	7.65	74.2	74.1	74.5
6.0	11.3	11.2	11.3	11.23	11.28	11.27	102.6	102.7	102.5	7.83	7.75	7.65	74.3	74.1	74.4
7.0	11.2	11.1	10.8	11.25	11.30	11.38	102.4	102.7	102.8	7.82	7.76	7.65	74.1	74.1	74.3
8.0	10.7	11.1	10.8	11.48	11.29	11.39	101.5	102.4	102.5	7.81	7.76	7.64	74.3	74.3	74.1
9.0	10.1	10.2	10.6	11.66	11.56	11.45	103.0	102.9	102.4	7.80	7.77	7.63	73.9	74.0	74.1
10.0	9.5	9.0	9.8	11.85	12.01	11.72	103.4	103.5	103.4	7.79	7.76	7.62	73.9	74.3	74.1
11.0	8.9	8.3	8.6	12.03	12.23	12.16	103.7	103.9	104.3	7.76	7.73	7.59	73.8	73.9	74.3
12.0	8.7	8.2	8.3	12.09	12.28	12.25	103.4	103.7	103.7	7.75	7.70	7.54	73.7	73.8	74.0
13.0	8.4	7.9	7.8	12.18	12.30	12.28	103.4	103.5	103.2	7.73	7.68	7.50	73.7	73.6	73.9
14.0	8.2	7.8	7.7	12.19	12.30	12.13	103.2	103.1	101.8	7.71	7.65	7.19	73.7	73.7	74.2
15.0	8.0	7.6		12.16	12.31		102.4	102.9		7.69	7.64		73.7	73.7	
16.0	7.7	7.4		12.13	12.34		101.7	102.7		7.66	7.62		73.8	73.7	
17.0	7.6			12.11			101.3			7.64			73.7		
18.0	7.6			12.10			101.1			7.63			73.7		
19.0	7.5			12.09			100.8			7.61			73.7		
20.0	7.4			12.09			100.5			7.59			73.7		
21.0	7.3			12.08			100.3			7.58			73.8		
22.0	7.2			12.08			99.9			7.56			73.8		
23.0	7.2			12.08			99.8			7.55			73.8		
24.0	6.8			12.14			99.1			7.53			74.0		
25.0	6.6			12.20			99.4			7.51			74.0		
26.0	6.3			12.26			99.1			7.49			74.2		
27.0	6.0			12.33			98.8			7.45			74.3		
28.0	5.8			12.32			98.5			7.43			74.2		
29.0	5.7			12.33			98.1			7.41			74.3		
30.0	5.6			12.32			98.0			7.39			74.3		
31.0	5.6			12.32			97.9			7.38			74.3		
32.0	5.5			12.32			97.8			7.37			74.3		
33.0	5.5			12.29			97.6			7.36			74.3		
34.0	5.5			12.17			96.8			7.26			75.2		

Note: Total depth at stations REF3-03, REF3-02, and REF3-01 was 37.1, 17.1, and 15.4 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, August 2019

Depth (m)	Temperature (°C)				Dissolved Oxygen (mg/L)				Dissolved Oxygen (% Saturation)				pH (pH units)				Specific Conductance (µS/cm)			
	REF3-01	REF3-02	REF3-02	REF3-03	REF3-01	REF3-02	REF3-02	REF3-03	REF3-01	REF3-02	REF3-02	REF3-03	REF3-01	REF3-02	REF3-02	REF3-03	REF3-01	REF3-02	REF3-02	REF3-03
Date Collected	25-Aug-19	21-Aug-19	25-Aug-19	25-Aug-19	25-Aug-19	21-Aug-19	25-Aug-19	25-Aug-19	25-Aug-19	21-Aug-19	25-Aug-19	25-Aug-19	25-Aug-19	21-Aug-19	25-Aug-19	25-Aug-19	25-Aug-19	21-Aug-19	25-Aug-19	25-Aug-19
surface		13.0				10.33				99.0				7.62				76.4		
1.0	10.7	13.0	10.7	11.1	10.92	10.22	10.90	10.83	98.3	97.0	98.3	98.4	7.93	7.65	7.84	7.87	75.0	76.4	74.9	75.2
2.0	10.7	13.0	10.7	11.1	10.92	10.27	10.91	10.83	98.4	97.5	98.4	98.4	7.91	7.69	7.79	7.86	75.1	75.4	75.1	75.2
3.0	10.7	13.0	10.7	11.1	10.93	10.23	10.91	10.83	98.4	97.2	98.4	98.3	7.88	7.65	7.79	7.84	75.1	76.4	75.1	75.2
4.0	10.7	13.0	10.7	11.1	10.93	10.25	10.91	10.82	98.4	97.1	98.4	98.3	7.85	7.67	7.78	7.83	75.1	76.3	75.1	75.2
5.0	10.7	13.0	10.7	11.0	10.93	10.26	10.9	10.81	98.4	97.4	98.3	98.2	7.84	7.67	7.77	7.82	75.1	76.3	75.1	75.2
6.0	10.7	13.0	10.7	11.0	10.92	10.21	10.9	10.81	98.3	97.1	98.2	98.1	7.83	7.64	7.75	7.82	75.1	76.3	75.1	75.2
7.0	10.7	12.9	10.7	11.0	10.92	10.38	10.89	10.81	98.3	98.8	98.2	98.0	7.83	7.63	7.74	7.81	75.1	76.2	75.1	75.2
8.0	10.7	12.4	10.7	11.0	10.92	10.63	10.89	10.80	98.3	99.6	98.2	98.0	7.82	7.65	7.74	7.80	75.1	76.0	75.1	75.2
9.0	10.7	11.1	10.7	11.0	10.92	11.31	10.89	10.81	98.3	102.7	98.1	97.7	7.81	7.66	7.73	7.80	75.1	75.2	75.1	75.2
10.0	10.7	10.6	10.7	11.0	10.91	11.51	10.89	10.79	98.2	103.4	98.1	97.8	7.81	7.60	7.72	7.79	75.1	75.2	75.1	75.2
11.0	10.7	10.1	10.7	11.0	10.91	11.72	10.88	10.78	98.2	103.9	98.1	97.8	7.81	7.56	7.72	7.79	75.1	75.0	75.1	75.2
12.0	10.7	9.3	10.7	11.0	10.90	12.05	10.88	10.78	98.1	104.2	98.0	97.6	7.81	7.48	7.72	7.79	75.1	75.0	75.1	75.2
13.0	10.7	8.6	10.7	10.9	10.90	12.24	10.87	10.77	98.1	104.5	98.9	97.6	7.81	7.44	7.71	7.79	75.1	74.9	75.1	75.2
14.0	10.7	8.3	10.7	10.9	10.90	12.25	10.86	10.76	98.1	104.3	97.8	97.5	7.80	7.40	7.70	7.78	75.1	74.8	75.1	75.2
15.0		8.0	10.7	10.9		12.31	10.85	10.76		103.7	97.7	97.3		7.36	7.70	7.78		74.8	75.2	75.2
16.0		7.8	10.6	10.9		12.19	10.85	10.76		102.4	97.6	97.2		7.32	7.70	7.78		74.9	75.2	75.3
17.0		7.7	10.5	10.8		12.11	10.88	10.78		101.4	97.3	97.2		7.29	7.69	7.78		74.9	75.1	75.1
18.0		7.5	9.5	10.6		12.11	11.12	10.85		100.9	96.9	97.3		7.24	7.67	7.76		75.0	74.7	75.0
19.0		7.4	8.6	10.4		12.08	11.43	10.88		100.4	97.3	97.1		7.22	7.65	7.74		75.0	74.4	74.9
20.0		7.4	6.8	8.2		12.02	11.94	11.36		99.9	98.0	95.7		7.21	7.56	7.72		75.0	74.3	76.1
21.0		7.2	6.6	7.7		12.06	11.95	11.50		99.6	97.3	96.1		7.17	7.52	7.68		75.0	74.2	74.2
22.0		6.9	6.1	7.2		12.13	12.01	11.60		99.6	96.8	95.9		7.14	7.47	7.63		75.1	74.3	74.2
23.0		6.8	6.0	6.9		12.08	11.99	11.61		98.9	96.2	95.4		7.13	7.43	7.59		75.1	74.4	74.3
24.0		6.8	5.7	6.7		11.83	11.96	11.59		97.1	95.5	94.9		7.11	7.40	7.55		75.1	74.4	74.3
25.0		6.7	5.7	6.6		11.85	11.91	11.57		96.9	95.0	94.5		7.08	7.36	7.51		75.1	74.4	74.3
26.0		6.6	5.6	6.5		11.85	11.83	11.56		96.4	94.2	94.0		7.05	7.34	7.48		75.2	74.5	74.4
27.0		6.4	5.6	6.4		11.94	11.74	11.49		97.0	93.4	93.1		7.02	7.31	7.73		75.2	74.6	74.4
28.0		6.3	5.6	6.3		11.93	11.70	11.46		96.4	93.0	92.9		7.00	7.29	7.42		75.3	76.6	74.4
29.0		6.2	5.6	6.3		11.55	11.65	11.44		93.0	92.6	92.6		6.98	7.26	7.39		75.4	74.6	74.4
30.0				6.2				11.40				92.2				7.37				74.5
31.0				6.2				11.34				91.6				7.39				74.6

Notes: 21-Aug-19 sampling was conducted by Minnow. Reference Lake 3 water profile sampling on all other dates was conducted by Baffinland. Total depths at stations REF3-01, REF3-02, and REF3-03 were 14.6, 29.8, and 34.8 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 2019

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	21-Aug-19	9.9	7.8	clear, colourless	surface	13.3	10.47	100.6	7.64	76.6
					bottom	13.3	10.40	99.1	7.62	76.8
REF 03-2	21-Aug-19	10.6	8.0	clear, colourless	surface	13.1	10.10	96.1	7.61	76.4
					bottom	11.0	8.25	74.9	6.91	82.2
REF 03-3	21-Aug-19	7.3	7.3	clear, colourless	surface	13.1	10.08	96.0	7.69	76.2
					bottom	13.0	10.22	97.1	7.70	76.3
REF 03-4	21-Aug-19	8.6	7.8	clear, colourless	surface	13.1	10.38	98.8	7.67	76.3
					bottom	11.8	8.27	76.1	6.92	79.4
REF 03-5	21-Aug-19	10.4	7.5	clear, colourless	surface	12.8	10.11	95.5	7.63	76.2
					bottom	9.8	11.11	97.6	7.30	74.9
REF 03-6	21-Aug-19	18.0	8.3	clear, colourless	surface	13.3	10.44	99.8	7.68	76.4
					bottom	6.9	10.06	82.7	7.37	75.2
REF 03-7	21-Aug-19	21.9	6.5	clear, colourless	surface	13.2	10.30	99.3	7.61	76.4
					bottom	5.6	10.34	83.1	6.92	86.0
REF 03-8	21-Aug-19	16.0	8.0	clear, colourless	surface	13.1	10.36	98.5	7.61	76.4
					bottom	8.1	10.30	87.3	7.35	75.3
REF 03-9	21-Aug-19	21.5	9.0	clear, colourless	surface	13.1	10.37	98.6	7.60	76.4
					bottom	6.8	5.75	47.4	6.62	82.4
REF 03-10	21-Aug-19	19.2	7.8	clear, colourless	surface	12.9	10.40	98.5	7.63	76.3
					bottom	7.4	9.72	81.1	6.85	79.4

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 2019

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	0.714	α	Littoral	5	7.7	0.3	0.1	7.3	8.0
					Profundal	5	7.8	0.8	0.3	6.5	8.5
	Temperature (˚C)	YES	<0.001	α	Littoral	5	11.8	1.4	0.6	9.8	13.3
					Profundal	5	7.0	0.9	0.4	5.6	8.1
	Dissolved Oxygen (mg/L)	NO	0.690	γ	Littoral	5	9.7	1.3	0.6	8.3	11.1
					Profundal	5	9.2	2.0	0.9	5.8	10.3
	Dissolved Oxygen (% saturation)	NO	0.421	γ	Littoral	5	89.0	12.3	5.5	74.9	99.1
					Profundal	5	76.3	16.3	7.3	47.4	87.3
	pH (units)	NO	0.264	β	Littoral	5	7.29	0.37	0.17	6.91	7.70
					Profundal	5	7.02	0.33	0.15	6.62	7.37
	Specific Conductance (umho/cm)	NO	0.498	α	Littoral	5	77.9	2.9	1.3	74.9	82.2
					Profundal	5	79.7	4.7	2.1	75.2	86.0

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, 2019

Parameters		Units	Summer Sampling Event						Fall Sampling Event					
			REF3-01	REF3-01	REF3-02	REF3-02	REF3-03	REF3-03	REF3-01	REF3-01	REF3-02	REF3-02	REF3-03	REF3-03
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			02-Aug-19	02-Aug-19	02-Aug-19	02-Aug-19	02-Aug-19	02-Aug-19	25-Aug-19	25-Aug-19	25-Aug-19	25-Aug-19	25-Aug-19	25-Aug-19
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	0.0035	<0.0030	<0.0030	0.0052	0.0255	<0.0050	0.01930	<0.0030	0.0068
	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	0.00632	0.00622	0.00624	0.00640	0.00628	0.00615	0.00622	0.00635	0.0063	0.00637	0.00605	0.00622
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<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	<0.000050	<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	<0.0000050	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	6.93	7.10	6.98	7.02	6.99	7.03	7.15	7.29	7.05	7.25	7.03	7
	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	0.00080	0.00080	0.00078	0.00077	0.00082	0.00074	0.00085	0.00093	0.00074	0.00099	0.00082	0.00079
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.010	<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	4.45	4.36	4.48	4.40	4.46	4.37	4.52	4.64	3.91	4.53	4.43	4.58
	Manganese (Mn)	mg/L	0.000097	0.000195	0.000073	0.000211	0.000108	0.000178	0.000312	0.000535	<0.00050	0.000687	0.000104	0.000307
	Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000143	0.000152	0.000141	0.000135	0.000129	0.000166	0.000145	0.000206	0.000156	0.000166	0.000133	0.000145
	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	0.83	0.82	0.81	0.82	0.83	0.82	0.94	0.96	0.86	0.95	0.92	0.94
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.42	0.42	0.42	0.41	0.48	0.41	0.45	0.45	0.553	0.46	0.53	0.46
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.814	0.811	0.806	0.816	0.815	0.812	0.915	0.941	0.874	0.947	0.898	0.91
	Strontium (Sr)	mg/L	0.00767	0.00777	0.00760	0.00772	0.00746	0.00774	0.00828	0.00835	0.0083	0.00834	0.00811	0.00813
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<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	<0.00030	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000236	0.000254	0.000216	0.000236	0.000227	0.000240	0.000265	0.000264	0.000244	0.000266	0.000228	0.000265
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0075	<0.0010	0.0107	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	-	-	-	-	-	-	-	-	<0.00020	-	-	-

Note: "-" indicates no data reported.

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, 2019

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	1.1	3.3	1.1	1.0	6	2	1	3.4	5.7	3.3	1.3	8.0	0.7	5.8	11	3.9
	pH (lab)	2.8	3.9	2.0	0.7	1.3	1.5	1.0	0.4	1.1	2.5	0.9	3.0	1.8	0.2	1.3	2.3	0.5
	Hardness (as $CaCO_3$)	0.5	4.1	6.1	1.1	2.1	5.7	3.0	1.2	1.6	5.9	9.1	3.0	7.3	2.6	8.1	12	3.7
	Total Suspended Solids (TSS)	50	0	0	0	0	0	0	3.0	0	15	46	0	0	0	0	0	0
	Total Dissolved Solids (TDS)	17	6.8	4.5	12	18	7.3	16	9.7	8.5	18	9.5	14	18	14	11	9.5	15
	Turbidity	21	32	37	5.2	21	20	16	4.6	38	14	67	76	9.9	19	14	37	11
	Alkalinity (as $CaCO_3$)	3.9	3.0	4.7	1.5	1.5	6.1	4.2	1.6	2.2	4.9	2.5	1.0	7.9	1.0	5.8	11	3.4
Nutrients and Organics	Total Ammonia	0	0	32	40	51	27	9.3	35	110	28	50	50	32	43	59	27	106
	Nitrate	0	47	33	37	13	9.1	34	1.4	7.9	17	8.9	42	12	0	23	9.1	9.0
	Nitrite	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0
	Total Kjeldahl Nitrogen (TKN)	0	19	1.3	6.0	8.0	32	0	1.1	0	14	6.1	2.2	7.8	14	5.7	0	11
	Dissolved Organic Carbon	8.4	10	8.0	7.9	4.7	10	4.1	3.4	7.4	16	3.4	2.0	31	3.5	7.5	8.4	8.6
	Total Organic Carbon	5.4	7.0	5.8	7.0	10	11	9.3	3.7	5.7	4.0	7.9	21	3.2	5.5	5.3	7.1	5.9
	Total Phosphorus	63	89	18	15	88	19	16	31	27	31	42	36	32	16	23	22	47
	Phenols	48	0	26	10	0	1.6	65	20	55	8.7	1.9	66	5.7	0	0	39	44
Anions	Bromide (Br)	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0
	Chloride (Cl)	0.7	4.6	8.4	0.6	1.7	5.7	32	0.5	2.7	6.3	11	3.0	14	3.1	6.0	11	10.0
	Sulphate (SO_4)	1.1	1.6	5.0	0.8	1.0	5.5	17	0.6	5.7	15	3.2	13	8.8	2.4	6.1	22	4.9
Total Metals	Aluminum (Al)	6.2	65	6.2	31	38	0	19	30	24	29	90	4.2	21	27	25	36	17
	Antimony (Sb)	0	0	0	0	0	0	0	0	0	0	26	0	0	0	0	0	0
	Arsenic (As)	0	0	0	0	0	0	0	0	0	0	12	11	0	0	0	0	0
	Barium (Ba)	2.5	2.0	4.5	3.0	2.8	7.0	5.9	8.1	4.3	3.7	13	3.9	7.9	0.9	5.5	7.5	3.8
	Cadmium (Cd)	0	0	1.9	0	0	0	0	0	0	0	3.6	0	0	0	0	8.2	0
	Calcium (Ca)	1.2	3.1	5.4	1.1	1.6	4.3	4.0	2.1	4.5	4.3	9.4	1.4	6.8	1.2	5.2	9.2	3.2
	Chromium (Cr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.7	0
	Cobalt (Co)	0	0	0	0	0	0	0	4.3	0	0	8.0	6.1	0	0	0	0	0
	Copper (Cu)	10	10	29	4.5	36	10	11	20	8.6	9.5	25	18	7.8	2.1	10	3.7	8.3
	Iron (Fe)	0	0	0	0	0	0	0	20	0	19	69	44	11	6.2	0	22	13
	Lead (Pb)	0	0	0	0	0	0	0	18	0	16	79	0	0	0	0	13	13
	Magnesium (Mg)	5.2	1.6	4.7	1.5	2.8	6.9	3.5	4.8	3.6	4.7	3.3	1.7	9.6	1.7	7.7	8.8	3.8
	Manganese (Mn)	9.8	16	57	5.9	27	44	16	15	67	24	41	96	45	8.8	25	37	9.0
	Mercury (Hg)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Molybdenum (Mo)	5.8	5.8	11	4.9	4.2	5.2	9.4	6.6	7.2	8.6	16	13	13	2.4	13	21	9.4
	Nickel (Ni)	0	0	4.8	6.8	11	7.6	6.5	14	3.5	3.9	10	9.3	0	0	0	0	0
	Potassium (K)	4.6	1.8	6.3	0.9	2.6	7.8	3.0	5.0	3.7	1.5	4.8	3.4	7.5	2.6	8.3	5.7	3.1
	Selenium (Se)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Silicon (Si)	7.4	12	16	5.4	13	9.6	5.8	3.8	18	13	24	24	2.7	2.3	4.2	8.2	6.2
	Silver (Ag)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sodium (Na)	4.1	1.8	5.3	1.5	2.7	8.3	5.3	2.4	1.8	4.5	14	3.9	13	3.8	6.5	5.5	5.8
	Strontium (Sr)	2.2	1.6	4.3	1.4	1.5	5.3	3.9	1.5	2.1	5.3	12	2.5	7.6	0.5	5.8	10	4.4
	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	6.7	0	0	0	0	0	0
	Uranium (U)	15	9.4	11	4.3	6.0	5.8	11	2.7	8.0	10	20	16	17	2.7	6.5	18	8.4
	Vanadium (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zinc (Zn)	0	33	0	0	0	0	0	0	0	0	36	0	0	0	3.1	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 2019

Study Area	Station	Sampling Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Unnamed Reference Creek	REF-CRK-B1	20-Aug-19	10.9	11.00	99.6	8.13	143.7
	REF-CRK-B2	20-Aug-19	10.9	11.00	99.5	8.14	143.8
	REF-CRK-B3	20-Aug-19	10.2	11.14	99.3	8.12	143.7
	REF-CRK-B4	20-Aug-19	9.9	11.19	99.1	8.12	143.7
	REF-CRK-B5	20-Aug-19	9.8	11.21	98.9	8.14	143.6
Camp Lake Tributary 1 Upstream	CLT-1-US-B1	20-Aug-19	8.6	9.95	99.1	8.37	242.8
	CLT-1-US B2	20-Aug-19	8.7	11.59	99.7	8.29	242.6
	CLT-1-US-B3	20-Aug-19	8.9	11.58	100.0	8.27	243.4
	CLT-1-US-B4	20-Aug-19	9.1	11.63	100.9	8.34	243.8
	CLT-1-US-B5	20-Aug-19	9.2	11.44	99.6	8.26	256.0
Camp Lake Tributary 1 Downstream	CLT-1-DS-B1	16-Aug-19	14.2	10.46	102.0	8.20	259.0
	CLT-1-DS-B2	16-Aug-19	13.6	10.63	101.3	8.21	296.1
	CLT-1-DS-B3	16-Aug-19	13.2	10.81	103.5	8.18	261.4
	CLT-1-DS-B4	16-Aug-19	12.5	11.02	103.4	8.15	296.1
	CLT-1-DS-B5	16-Aug-19	12.2	11.08	104.0	8.13	289.9
Camp Lake Tributary 2 Upstream	CLT-2-US-B1	23-Aug-19	10.2	10.91	96.3	8.32	340.1
	CLT-2-US-B2	23-Aug-19	10.4	10.69	95.7	8.33	336.3
	CLT-2-US-B3	23-Aug-19	10.2	10.80	96.2	8.23	339.3
	CLT-2-US-B4	23-Aug-19	10.0	10.71	95.3	8.26	338.5
	CLT-2-US-B5	23-Aug-19	9.4	10.81	94.6	8.27	339.1
Camp Lake Tributary 2 Downstream	CLT-2-DS-B1	16-Aug-19	14.3	10.24	100.5	8.24	210.0
	CLT-2-DS-B2	16-Aug-19	14.4	10.33	101.3	8.25	304.2
	CLT-2-DS-B3	16-Aug-19	14.5	10.47	102.9	8.24	282.7
	CLT-2-DS-B4	16-Aug-19	14.6	10.52	103.5	8.38	303.6
	CLT-2-DS-B5	16-Aug-19	14.5	10.48	103.0	8.31	304.2

Table C.12: ***In Situ*** **Water Quality Summary Statistics for the Camp Lake Tributary Benthic Stations, Mary River Project CREMP, August 2019**

Metric	Study Area	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Water Temperature (°C)	Unnamed Reference Creek	5	10.3	0.5	0.2	9.7	11.0	9.8	10.9
	CLT1-US North Branch	5	8.9	0.3	0.1	8.6	9.2	8.6	9.2
	CLT1-DS Lower Main Stem	5	13.1	0.8	0.4	12.1	14.1	12.2	14.2
	CLT2-US Upstream	5	10.0	0.4	0.2	9.6	10.5	9.4	10.4
	CLT2-DS Downstream	5	14.5	0.1	0.1	14.3	14.6	14.3	14.6
Dissolved Oxygen (mg/L)	Unnamed Reference Creek	5	11.11	0.10	0.05	10.98	11.23	11.00	11.21
	CLT1-US North Branch	5	11.24	0.72	0.32	10.34	12.14	9.95	11.63
	CLT1-DS Lower Main Stem	5	10.80	0.26	0.12	10.48	11.12	10.46	11.08
	CLT2-US Upstream	5	10.78	0.09	0.04	10.67	10.89	10.69	10.91
	CLT2-DS Downstream	5	10.41	0.12	0.05	10.26	10.55	10.24	10.52
Dissolved Oxygen (% Saturation)	Unnamed Reference Creek	5	99.3	0.3	0.1	98.9	99.6	98.9	99.6
	CLT1-US North Branch	5	99.9	0.7	0.3	99.0	100.7	99.1	100.9
	CLT1-DS Lower Main Stem	5	102.8	1.1	0.5	101.4	104.3	101.3	104.0
	CLT2-US Upstream	5	95.6	0.7	0.3	94.8	96.5	94.6	96.3
	CLT2-DS Downstream	5	102.2	1.3	0.6	100.7	103.8	100.5	103.5
pH (units)	Unnamed Reference Creek	5	8.13	0.01	0.00	8.12	8.14	8.12	8.14
	CLT1-US North Branch	5	8.31	0.05	0.02	8.25	8.36	8.26	8.37
	CLT1-DS Lower Main Stem	5	8.17	0.03	0.02	8.13	8.22	8.13	8.21
	CLT2-US Upstream	5	8.28	0.04	0.02	8.23	8.33	8.23	8.33
	CLT2-DS Downstream	5	8.28	0.06	0.03	8.21	8.36	8.24	8.38
Specific Conductance (µS/cm)	Unnamed Reference Creek	5	144	0.1	0.0	144	144	144	144
	CLT1-US North Branch	5	246	5.8	2.6	239	253	243	256
	CLT1-DS Lower Main Stem	5	281	18.7	8.4	257	304	259	296
	CLT2-US Upstream	5	339	1.4	0.6	337	340	336	340
	CLT2-DS Downstream	5	281	40.7	18.2	230	331	210	304

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 2019

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	< 0.0001	α	Unnamed Reference Creek	CLT1 North Branch	YES	0.0052	Tukey's HSD
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0000	
				CLT1 North Branch	CLT1 Lower Main Stem	YES	0.0000	
Dissolved Oxygen (mg/L)	YES	0.0894	γ	Unnamed Reference Creek	CLT1 North Branch	NO	0.1508	Mann-Whitney U-test
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0952	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.1508	
Dissolved Oxygen (% saturation)	YES	< 0.0001	α	Unnamed Reference Creek	CLT1 North Branch	NO	0.3388	Tamhane's
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0047	
				CLT1 North Branch	CLT1 Lower Main Stem	YES	0.0056	
pH (units)	YES	< 0.0001	α	Unnamed Reference Creek	CLT1 North Branch	YES	0.0025	Tamhane's
				Unnamed Reference Creek	CLT1 Lower Main Stem	NO	0.1164	
				CLT1 North Branch	CLT1 Lower Main Stem	YES	0.0038	
Specific Conductance (µS/cm)	YES	0.0018	γ	Unnamed Reference Creek	CLT1 North Branch	YES	0.0079	Mann-Whitney U-test
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0079	
				CLT1 North Branch	CLT1 Lower Main Stem	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; γ - data untransformed, Kruskal Wallis H-test or Mann-Whitney U-test conducted, as appropriate.

Table C.14: Water Chemistry at Lotic Camp Lake Tributary (CLT) Monitoring Stations, Mary River Project CREMP, 2019

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
					28-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19
Conventionals	Conductivity (lab)	umho/cm	-	-	74.4	132	289	160	164	172	144
	pH (lab)	pH	6.5 - 9.0	-	7.42	8.09	8.13	8.11	8.13	8.15	8.08
	Hardness (as $CaCO_3$)	mg/L	-	-	38.9	68.7	118	78.3	79.9	85.9	73.5
	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	-	-	50	84	165	80	91	81	81
	Turbidity	NTU	-	-	1.28	0.52	9.16	0.77	1.00	0.69	0.27
	Alkalinity (as $CaCO_3$)	mg/L	-	-	38	69	98	75	77	81	71
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.011	0.011	0.303	0.074	0.032	0.024	0.102
	Nitrate	mg/L	3	3	0.073	<0.020	2.72	0.309	0.319	0.286	0.025
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	0.0399	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.85	0.16	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.28	2.93	4.60	3.13	3.34	3.28	2.13
	Total Organic Carbon	mg/L	-	-	1.99	3.17	4.69	3.46	3.81	3.70	2.44
	Total Phosphorus	mg/L	0.030[α]	-	0.0047	0.0031	0.0107	0.0030	0.1610	0.0081	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0023	<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	<0.50	0.53	17.8	3.27	3.76	4.11	0.79
	Sulphate (SO_4)	mg/L	218[β]	218	1.77	1.46	10.7	2.58	2.71	2.84	4.31
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.037	0.019	***0.298***	0.052	0.047	0.027	0.076
	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	0.00015	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0062	0.0086	0.0126	0.0096	0.0102	0.0101	0.0098
	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	0.028	<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	0.000013
	Calcium (Ca)	mg/L	-	-	7.32	13.6	21.8	14.9	15.2	16.8	15.0
	Chromium (Cr)	mg/L	0.0089	0.000856	<0.00050	<0.00050	0.00057	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	0.00034	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	***0.0024***	0.0022	0.0018	0.0021	0.0021	0.0020	0.0019
	Iron (Fe)	mg/L	0.30	0.326	0.04	<0.030	***0.438***	0.059	0.058	0.033	0.031
	Lead (Pb)	mg/L	0.001	0.001	0.000073	<0.000050	0.000512	0.000065	0.000053	<0.000050	0.000159
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0036	0.0013	0.0012	0.0014	0.0011
	Magnesium (Mg)	mg/L	-	-	5.26	8.92	15.7	9.77	10.6	10.50	9.92
	Manganese (Mn)	mg/L	0.935[β]	-	0.00124	0.00061	0.02620	0.00314	0.00225	0.00169	0.00227
	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	-	0.000342	0.000405	0.002700	0.000728	0.000719	0.000742	0.000317
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00065	0.00151	0.00077	0.00083	0.00087	0.00096
	Potassium (K)	mg/L	-	-	1.41	1.57	4.14	1.83	1.92	1.98	1.48
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.64	0.47	0.98	0.64	0.68	0.70	0.63
	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	-	-	0.371	0.835	12.8	2.40	2.57	2.35	1.41
	Strontium (Sr)	mg/L	-	-	0.00421	0.00697	0.02890	0.01280	0.01440	0.01540	0.00969
	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	-	0.000486	0.000601	0.01790	0.00235	0.00239	0.00204	0.000616
	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	0.0083	<0.0030	0.0039	<0.0030	<0.0030	***0.0487***

[shaded box] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.14: Water Chemistry at Lotic Camp Lake Tributary (CLT) Monitoring Stations, Mary River Project CREMP, 2019

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
					05-Aug-19	31-Jul-19	24-Jul-19	29-Jul-19	29-Jul-19	31-Jul-19	31-Jul-19
Conventionals	Conductivity (lab)	umho/cm	-	-	140	176	351	224	234	236	235
	pH (lab)	pH	6.5 - 9.0	-	8.13	8.15	8.16	8.32	8.32	8.18	8.36
	Hardness (as $CaCO_3$)	mg/L	-	-	66.6	92.3	140	112	112	116	124
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	3.6	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	159	96	189	332	156	137	162
	Turbidity	NTU	-	-	0.53	0.54	4.08	1.00	0.91	0.70	0.33
	Alkalinity (as $CaCO_3$)	mg/L	-	-	72	90	123	105	105	104	118
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	<0.010	<0.010	0.254	0.034	0.029	0.039	<0.010
	Nitrate	mg/L	3	3	0.063	<0.020	***3.760***	0.726	0.725	0.597	0.033
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	< 0.035	< 0.006	< 0.005	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	0.16000	0.53	0.30000	0.37	0.32000	0.21000
	Dissolved Organic Carbon	mg/L	-	-	1.91	2.43	4.21	3.08	3.10	3.18	2.78
	Total Organic Carbon	mg/L	-	-	2.26	2.71	5.35	3.38	3.35	3.36	3.12
	Total Phosphorus	mg/L	0.030^{α}	-	0.0041	<0.0030	0.0057	0.0042	0.0036	0.0076	<0.0030
	Phenols	mg/L	0.004^{α}	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0057	0.0013
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	1.10	1.10	25.4	7.61	8.34	8.91	2.92
	Sulphate (SO_4)	mg/L	218^{β}	218	4.14	3.97	13.20	5.42	5.56	5.80	6.98
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0123	0.0104	0.125	0.0178	0.0217	0.0169	0.0085
	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	-	-	0.0098	0.0117	0.0140	0.0128	0.0129	0.0129	0.0130
	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	0.029	<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	-	-	12.9	18.0	26.8	22.0	22.4	22.6	25.9
	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	0.00027	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	***0.0024***	0.0021	0.0016	0.0020	0.0020	0.0019	0.0015
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	***0.359***	0.069	0.068	0.055	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.000224	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0044	0.00200	0.00210	0.00190	0.00140
	Magnesium (Mg)	mg/L	-	-	8.42	11.1	17.4	14.0	13.8	14.3	14.9
	Manganese (Mn)	mg/L	0.935^{β}	-	0.0006	0.0006	0.0219	0.0047	0.0037	0.0033	0.0008
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00101	0.00065	0.00382	0.00127	0.00128	0.00104	0.00048
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.0006	0.00134	0.00082	0.00088	0.00088	0.0006
	Potassium (K)	mg/L	-	-	2.27	1.81	3.93	2.18	2.20	2.09	1.65
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.90	0.87	1.38	0.97	0.99	1.08	0.87
	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	-	-	0.605	1.02	15.6	4.58	4.46	4.01	1.92
	Strontium (Sr)	mg/L	-	-	0.009	0.010	0.034	0.019	0.021	0.019	0.014
	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	-	0.00333	0.00180	0.0242	0.00607	0.00598	0.00518	0.00177
	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

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.14: Water Chemistry at Lotic Camp Lake Tributary (CLT) Monitoring Stations, Mary River Project CREMP, 2019

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event						
					LI-08	L1-02	L2-03	L1-09	L0-05	L0-01	K0-01
					18-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19
Conventionals	Conductivity (lab)	umho/cm	-	-	170	238	430	302	301	307	317
	pH (lab)	pH	6.5 - 9.0	-	8.11	8.13	8.16	8.15	8.19	8.21	8.20
	Hardness (as $CaCO_3$)	mg/L	-	-	88.2	122	185	145	148	153	162
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	2.5	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	138	142	265	181	171	178	188
	Turbidity	NTU	-	-	0.30	0.49	3.29	1.44	1.10	1.51	0.27
	Alkalinity (as $CaCO_3$)	mg/L	-	-	79	112	150	125	124	128	139
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	<0.010	<0.010	0.136	0.029	0.021	0.010	<0.010
	Nitrate	mg/L	3	3	0.088	<0.020	***3.13***	0.644	0.672	0.577	0.052
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	0.0213	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	0.15	0.64	0.23	0.26	0.22	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.75	2.24	4.50	2.90	2.94	2.92	2.71
	Total Organic Carbon	mg/L	-	-	2.06	2.55	4.87	3.20	3.34	3.19	3.04
	Total Phosphorus	mg/L	0.030[α]	-	0.0049	<0.0030	0.0064	0.0288	<0.0030	0.0063	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	<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	<0.10
	Chloride (Cl)	mg/L	120	120	1.86	5.27	29.4	15.1	16.1	16.5	14.9
	Sulphate (SO_4)	mg/L	218[β]	218	7.34	6.36	18.8	9.18	9.27	9.09	9.42
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0113	0.0061	0.0547	0.0217	0.0247	0.0268	0.0105
	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	0.00012	0.0001	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0123	0.0149	0.0172	0.0168	0.0172	0.017	0.0182
	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	0.029	0.013	0.012	0.012	<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	-	-	17.2	23.9	35.2	28.9	29.3	30.1	30.9
	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	0.00031	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	***0.00234***	***0.00238***	0.00144	0.00202	0.00213	0.00198	0.00167
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	***0.447***	0.131	0.123	0.104	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.0001	<0.000050	<0.000050	<0.000050	0.000189
	Lithium (Li)	mg/L	-	-	<0.0010	0.0015	0.0042	0.0032	0.0031	0.0030	0.002
	Magnesium (Mg)	mg/L	-	-	11.2	15.1	23.1	17.8	18.1	18.6	19.7
	Manganese (Mn)	mg/L	0.935[β]	-	0.0007	0.0008	0.0471	0.0098	0.0076	0.0059	0.0011
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00140	0.00093	0.00364	0.00144	0.00140	0.00120	0.00069
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00067	0.00131	0.00094	0.00106	0.00107	0.00077
	Potassium (K)	mg/L	-	-	2.65	2.46	4.31	2.90	2.91	2.78	2.40
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.89	1.12	1.14	1.21	1.26	1.33	1.09
	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	-	-	0.78	2.32	17.50	6.50	6.40	6.24	6.47
	Strontium (Sr)	mg/L	-	-	0.0116	0.0135	0.0398	0.0374	0.0378	0.0361	0.0210
	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	-	0.00605	0.00391	0.0262	0.0086	0.00817	0.00701	0.00317
	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

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

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, 2019

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)	2.2	6.2	3.5	3.1	1.4	3.1	2.1	2.1	1.2	2.6	1.8	1.9
Hardness (as $CaCO_3$)	2.3	5.0	3.4	3.1	1.4	2.4	2.0	2.1	1.3	2.3	1.8	2.0
Total Suspended Solids (TSS)	1.0	1.0	1.0	1.0	1.0	1.8	1.0	1.0	1.0	1.3	1.0	1.0
Total Dissolved Solids (TDS)	2.4	5.9	3.0	2.9	2.1	3.1	3.4	2.7	1.5	2.9	1.9	2.0
Turbidity	0.5	4.9	0.4	0.1	0.2	1.3	0.3	0.1	0.1	0.7	0.3	0.1
Alkalinity (as $CaCO_3$)	2.1	3.9	3.1	2.8	1.5	2.3	1.9	2.2	1.4	2.2	1.9	2.1
Total Ammonia	0.3	9.4	1.3	3.2	0.6	15	2.1	0.6	1.0	13	1.9	1.0
Nitrate	2.3	136	15	1.3	1.9	171	31	1.5	1.9	108	22	1.8
Nitrite	1.0	8.0	1.0	1.0	1.0	6.9	1.0	1.0	1.0	4.3	1.0	1.0
Total Kjeldahl Nitrogen (TKN)	1.0	5.7	1.0	1.0	1.0	3.5	2.2	1.4	1.0	4.3	1.6	1.0
Dissolved Organic Carbon	1.8	3.1	2.2	1.4	1.5	2.9	2.1	1.9	1.5	3.3	2.2	2.0
Total Organic Carbon	1.5	2.7	2.1	1.4	1.4	3.1	1.9	1.8	1.4	2.9	1.9	1.8
Total Phosphorus	0.9	2.6	14	0.7	0.7	1.1	1.0	0.6	0.7	1.2	2.4	0.6
Phenols	1.0	1.0	1.4	1.0	1.0	1.0	2.6	1.3	0.5	0.5	0.5	0.5
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)	0.8	27	5.6	1.2	0.5	13	4.1	1.4	0.5	3.8	2.1	1.9
Sulphate (SO_4)	2.1	14	3.5	5.5	1.2	3.9	1.7	2.1	0.8	2.1	1.0	1.0
Aluminum (Al)	0.5	5.5	0.8	1.4	0.1	0.8	0.1	0.1	0.0	0.3	0.1	0.1
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
Arsenic (As)	1.0	1.5	1.0	1.0	1.0	1.4	1.0	1.0	1.0	1.1	1.0	1.0
Barium (Ba)	2.3	3.9	3.1	3.1	1.4	1.8	1.7	1.7	1.2	1.5	1.5	1.6
Beryllium (Be)	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	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
Boron (B)	1.0	2.8	1.0	1.0	1.0	2.9	1.0	1.0	1.0	2.9	1.2	1.0
Cadmium (Cd)	1.0	1.0	1.0	1.3	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0
Calcium (Ca)	2.2	4.7	3.3	3.2	1.4	2.4	2.0	2.3	1.2	2.1	1.8	1.9
Chromium (Cr)	1.0	1.1	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Cobalt (Co)	1.0	3.4	1.0	1.0	0.8	2.1	0.8	0.8	0.8	2.6	0.8	0.8
Copper (Cu)	3.2	2.6	2.9	2.6	1.7	1.2	1.5	1.2	2.2	1.3	1.9	1.5
Iron (Fe)	0.7	8.4	1.0	0.6	0.2	2.3	0.4	0.2	0.2	3.1	0.8	0.2
Lead (Pb)	0.8	6.3	0.7	1.9	0.3	1.3	0.3	0.3	0.3	0.7	0.3	1.3
Lithium (Li)	1.0	3.6	1.3	1.1	1.0	4.4	2.0	1.4	1.2	4.0	3.0	1.9
Magnesium (Mg)	2.4	5.3	3.5	3.4	1.5	2.6	2.1	2.3	1.4	2.4	1.9	2.1
Manganese (Mn)	1.4	39	3.5	3.4	0.3	11	1.9	0.4	0.4	24	3.9	0.5
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)	3.1	22	6.1	2.6	2.3	10	3.3	1.3	2.2	6.9	2.5	1.3
Nickel (Ni)	1.2	3.0	1.6	1.9	0.9	2.2	1.4	1.0	0.9	2.0	1.6	1.2
Potassium (K)	3.4	9.6	4.4	3.4	2.4	4.7	2.6	2.0	2.2	3.8	2.5	2.1
Selenium (Se)	1.0	1.0	1.0	1.0	-	-	-	-	1.0	1.0	1.0	1.0
Silicon (Si)	0.9	1.7	1.1	1.1	0.8	1.2	0.9	0.8	0.8	0.9	1.0	0.9
Silver (Ag)	1.0	1.0	1.0	1.0	0.2	0.2	0.2	0.2	1.0	1.0	1.0	1.0
Sodium (Na)	1.1	24	4.5	2.6	0.5	10	2.8	1.3	0.4	5.0	1.8	1.8
Strontium (Sr)	1.3	6.9	3.4	2.3	0.8	2.9	1.7	1.2	0.6	2.0	1.9	1.1
Thallium (Tl)	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	1.2	1.2	1.2	1.2	0.7	0.7	0.7	0.7
Uranium (U)	1.8	60	7.5	2.0	0.9	8.8	2.1	0.6	0.9	4.8	1.4	0.6
Vanadium (V)	1.0	1.0	1.0	1.0	1.6	1.6	1.6	1.6	1.0	1.0	1.0	1.0
Zinc (Zn)	1.9	1.0	1.1	16	1.0	1.0	1.0	1.0	0.4	0.4	0.4	0.4

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).

Denotes differences in method detection limit between the indicated study area and that of the reference creeks, precluding an evaluation of magnitude of elevation.

Table C.16: Dissolved Metal Concentrations at Camp Lake Tributary Water Quality Monitoring Stations, Mary River Project CREMP, 2019

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
			28-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	05-Aug-19	31-Jul-19	24-Jul-19	29-Jul-19	29-Jul-19	31-Jul-19	31-Jul-19	18-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19
Dissolved Metals	Aluminum (Al)	mg/L	0.0158	0.0128	0.0220	0.0596	0.0126	0.0111	0.0044	0.0092	0.0165	0.0174	0.0062	0.0072	0.0143	0.0097	0.0066	0.0043	0.0096	0.0072	0.0067	0.0131	0.0069
	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	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.00010	0.00011	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.0058	0.0087	0.0109	0.0097	0.0093	0.0102	0.0084	0.0098	0.0116	0.0133	0.0119	0.0122	0.0129	0.0127	0.0124	0.0150	0.0167	0.0164	0.0169	0.0171	0.0180
	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	0.029	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.029	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.029	0.013	0.013	0.011	<0.010
	Cadmium (Cd)	mg/L	<0.000010	0.000012	<0.000010	0.00001	<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	7.22	12.9	22.0	15.0	15.3	16.5	14.0	12.9	18.2	26.9	22.1	22.4	22.9	25.4	16.9	23.6	35.2	28.5	29.6	30.4	31.8
	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	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00022	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00026	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00224	0.00220	0.00159	0.00232	0.00206	0.00202	0.00118	0.00237	0.00213	0.00132	0.00193	0.00188	0.00185	0.00171	0.0022	0.00228	0.00137	0.00202	0.00199	0.00193	0.00175
	Iron (Fe)	mg/L	<0.030	<0.030	0.037	0.046	<0.030	<0.030	<0.030	<0.030	<0.030	0.102	0.037	0.035	0.055	<0.030	<0.030	<0.030	0.146	0.061	0.074	0.052	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	0.000094	<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	0.0037	0.0013	0.0014	0.0015	<0.0010	<0.0010	0.0054	0.0043	0.0019	0.0019	0.0019	0.0015	<0.0010	0.0015	0.0043	0.0032	0.0033	0.0031	0.0022
	Magnesium (Mg)	mg/L	5.06	8.89	15.3	9.92	10.1	10.9	9.36	8.36	11.4	17.8	13.7	13.7	14.2	14.7	11.1	15.4	23.6	18.0	18.0	18.7	20.1
	Manganese (Mn)	mg/L	0.00057	0.00051	0.01700	0.00453	0.00119	0.00108	0.00024	0.00054	0.00081	0.01790	0.00382	0.00299	0.00334	0.00092	0.00065	0.00065	0.04470	0.00755	0.00599	0.00446	0.00091
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.00038	0.00042	0.00330	0.00072	0.00068	0.00074	0.00029	0.00100	0.00066	0.00408	0.00127	0.00125	0.00103	0.00047	0.00140	0.00091	0.00366	0.00151	0.00141	0.00128	0.00069
	Nickel (Ni)	mg/L	<0.00050	0.00066	0.00101	0.00089	0.00073	0.00086	<0.00050	<0.00050	0.00094	0.00112	0.00081	0.00086	0.00093	0.00068	<0.00050	0.0007	0.00123	0.00091	0.00102	0.00105	0.00074
	Potassium (K)	mg/L	1.39	-	4.10	1.88	1.89	1.98	1.32	2.26	1.79	3.97	2.18	2.18	2.09	1.67	2.63	2.50	4.39	2.93	2.85	2.87	2.47
	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.60	0.60	0.53	0.64	0.62	0.69	0.56	0.88	0.86	1.15	0.96	0.98	1.06	0.87	0.88	1.13	1.09	1.17	1.23	1.31	1.06
	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	0.365	0.836	13.4	2.51	2.52	2.57	0.994	0.611	1.03	15.9	4.53	4.42	4.00	1.93	0.762	2.31	18.3	6.54	6.36	6.26	6.63
	Strontium (Sr)	mg/L	0.0043	0.0070	0.0291	0.0132	0.0137	0.0158	0.0089	0.0090	0.0096	0.0343	0.0195	0.0205	0.0188	0.0141	0.0116	0.0135	0.0386	0.0375	0.0375	0.0363	0.0217
	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	0.00048	0.00060	0.01760	0.00238	0.00237	0.00214	0.00058	0.00338	0.00181	0.02430	0.00577	0.00576	0.00490	0.00176	0.00593	0.00407	0.02670	0.00870	0.00789	0.00706	0.00322
	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	0.003	<0.0030	0.014	<0.0030	<0.0030	<0.0030	<0.0030	0.0098	<0.0030	<0.0030	<0.0030	<0.0030	0.0050	<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, 2019**

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)	0.6	0.6	0.8	0.2	0.3	0.5	0.3	0.3	0.2	0.3	0.4	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	1.2	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.3	1.0	1.0
Barium (Ba)	2.6	1.5	3.5	3.0	1.5	1.9	1.8	1.8	1.3	1.6	1.7	1.8
Beryllium (Be)	1.0	5.0	1.0	1.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0
Bismuth (Bi)	1.0	-	1.0	1.0	-	-	-	-	1.0	1.0	1.0	1.0
Boron (B)	1.0	2.9	1.0	1.0	1.0	2.9	1.0	1.0	1.0	2.9	1.2	1.0
Cadmium (Cd)	1.1	2.0	1.0	1.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0
Calcium (Ca)	2.1	1.8	3.4	3.0	1.3	2.2	1.9	2.1	1.2	2.1	1.8	1.9
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	1.7	1.0	1.0	1.0	2.2	1.0	1.0	1.0	2.6	1.0	1.0
Copper (Cu)	3.3	1.7	3.1	1.7	2.5	1.4	2.0	1.9	2.5	1.5	2.2	1.9
Iron (Fe)	1.0	1.5	1.1	1.0	1.3	4.3	2.0	1.3	1.0	4.9	1.9	1.0
Lead (Pb)	1.0	0.9	1.1	1.0	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0
Lithium (Li)	1.0	3.7	1.5	1.0	3.2	4.3	1.9	1.5	1.3	4.3	3.2	2.2
Magnesium (Mg)	2.4	2.3	3.7	3.2	1.5	2.6	2.1	2.2	1.4	2.4	1.9	2.1
Manganese (Mn)	2.7	30	8.3	1.2	1.2	32	5.9	1.6	0.9	62	7.2	1.2
Mercury (Hg)	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	3.2	8.7	5.8	2.3	2.2	11	2.9	1.2	2.1	6.7	2.5	1.3
Nickel (Ni)	1.2	1.9	1.7	1.0	1.4	2.1	1.7	1.3	1.1	2.2	1.8	1.3
Potassium (K)	3.3	5.2	4.7	3.2	2.6	5.0	2.7	2.1	2.4	4.1	2.7	2.3
Selenium (Se)	1.0	-	1.0	1.0	-	-	-	-	1.0	1.0	1.0	1.0
Silicon (Si)	1.1	0.6	1.3	1.0	0.9	1.2	1.1	0.9	1.2	1.3	1.5	1.3
Silver (Ag)	1.0	0.2	1.0	1.0	0.2	0.2	0.2	0.2	1.0	1.0	1.0	1.0
Sodium (Na)	1.1	8.5	4.8	1.9	0.5	10	2.7	1.2	0.4	5.1	1.8	1.9
Strontium (Sr)	1.4	2.4	3.6	2.2	0.8	2.8	1.6	1.2	0.6	2.0	1.9	1.1
Thallium (Tl)	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
Uranium (U)	2.0	7.1	8.2	2.2	1.0	9.8	2.1	0.7	0.9	4.9	1.4	0.6
Vanadium (V)	1.0	2.0	1.0	1.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	3.0	1.6	1.0	6.4	3.0	3.0	5.0	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).
Denotes differences in method detection limit between the indicated study area and that of the reference creeks, precluding an evaluation of magnitude of elevation.

Table C.18: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations at the Camp Lake Tributaries between 2019 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)	1.9	7.0	3.8	0.8	2.6	2.5	2.2	1.9	1.4	3.6	3.4	2.0
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	1.2	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.3	1.0	1.0
Barium (Ba)	2.3	2.4	2.6	1.5	1.6	1.5	1.4	1.5	1.4	1.0	1.2	1.7
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	2.9	1.0	0.6	0.6	2.9	1.0	1.0	1.0	2.9	1.2	1.0
Cadmium (Cd)	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9
Calcium (Ca)	2.3	1.9	2.3	1.9	1.5	1.3	1.6	1.8	1.3	0.8	1.1	1.5
Chromium (Cr)	-	-	-	-	-	-	-	0.5	-	-	-	-
Cobalt (Co)	0.6	1.7	1.0	0.6	0.8	2.1	1.0	0.6	0.8	2.5	1.0	0.6
Copper (Cu)	2.3	2.6	2.2	1.5	1.4	1.5	1.2	1.7	1.3	1.9	1.2	0.7
Iron (Fe)	1.2	1.1	1.4	1.1	1.6	0.5	1.4	1.4	1.8	1.4	1.4	1.4
Lead (Pb)	0.5	1.0	1.3	0.6	0.7	1.0	1.0	0.6	0.7	1.0	1.0	0.6
Lithium (Li)	0.7	3.6	2.6	0.5	1.3	1.3	0.8	0.6	0.6	0.7	0.9	0.7
Magnesium (Mg)	2.6	2.3	2.6	2.1	1.6	1.5	1.7	1.8	1.3	1.1	1.3	1.5
Manganese (Mn)	0.5	6.0	0.9	0.1	2.2	1.4	1.6	1.4	1.6	3.2	1.4	0.8
Mercury (Hg)	1.0	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0
Molybdenum (Mo)	2.3	23	4.8	1.9	2.1	20	2.8	1.7	1.7	14	2.3	1.6
Nickel (Ni)	0.9	1.3	1.1	0.2	1.2	1.1	1.5	0.3	1.0	1.0	1.2	0.4
Potassium (K)	2.3	5.2	2.7	2.3	1.7	4.1	1.6	1.7	1.5	2.9	1.6	1.8
Selenium (Se)	-	-	-	-	-	-	-	-	-	-	-	0.0
Silicon (Si)	1.6	0.9	1.5	1.3	1.6	1.4	1.5	1.4	1.3	0.8	1.2	1.7
Silver (Ag)	0.3	-	-	0.2	0.5	-	-	0.2	0.6	-	-	0.2
Sodium (Na)	1.8	13	4.3	2.6	1.3	8.9	3.9	1.7	1.5	5.4	2.8	3.7
Strontium (Sr)	2.5	2.3	2.5	2.5	1.8	1.0	1.5	1.8	1.5	0.3	0.7	1.8
Thallium (Tl)	1.3	-	-	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)	3.3	79	13	3.9	4.4	43	7.3	2.5	2.0	16	3.0	1.8
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	3.3	1.9	4.7	1.7	1.2	2.1	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).

Denotes differences in method detection limit between the 2019 and baseline data, precluding an evaluation of magnitude of elevation.

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 2019**

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	< 0.0001	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.7120	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0001	
				CLT2 Upstream	CLT2 Downstream	YES	0.0000	
Dissolved Oxygen (mg/L)	YES	< 0.0001	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0009	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0000	
				CLT2 Upstream	CLT2 Downstream	YES	0.0003	
Dissolved Oxygen (% saturation)	YES	< 0.0001	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0002	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0165	
				CLT2 Upstream	CLT2 Downstream	YES	0.0001	
pH (units)	YES	0.0001	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0027	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0131	
				CLT2 Upstream	CLT2 Downstream	NO	0.9999	
Specific Conductance (μS/cm)	YES	0.0018	γ	Unnamed Reference Creek	CLT2 Upstream	YES	0.0079	Mann-Whitney U-test
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0079	
				CLT2 Upstream	CLT2 Downstream	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; γ - data untransformed, Kruskal Wallis H-test or Mann-Whitney U-test conducted, 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, April 2019**

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	13-Apr-19	13-Apr-19	13-Apr-19	14-Apr-19	14-Apr-19	13-Apr-19	13-Apr-19	13-Apr-19	14-Apr-19	14-Apr-19	13-Apr-19	13-Apr-19	13-Apr-19	14-Apr-19	14-Apr-19	13-Apr-19	13-Apr-19	13-Apr-19	14-Apr-19	14-Apr-19	13-Apr-19	13-Apr-19	13-Apr-19	14-Apr-19	14-Apr-19
1.0	0.0	0.0	0.0	0.3	0.1	15.69	15.69	15.30	14.30	14.67	107.1	107.3	104.5	98.5	100.7	7.93	7.86	7.72	7.73	7.71	147.2	145.5	143.9	136.4	131.7
2.0	0.0	0.0	0.2	0.3	0.1	15.74	15.55	14.79	14.35	14.71	108.0	107.1	101.7	98.8	100.9	7.82	7.81	7.72	7.72	7.70	141.3	139.0	137.9	133.9	138.8
3.0	0.1	0.2	0.4	0.4	0.2	15.46	15.11	14.67	14.33	14.56	106.8	104.9	100.7	99.1	100.5	7.79	7.78	7.66	7.80	7.70	136.8	135.0	134.2	133.2	136.8
4.0	0.4	0.4	0.4	0.4	0.3	15.01	14.75	14.53	14.30	14.41	104.1	102.2	100.7	98.9	99.7	7.77	7.75	7.66	7.77	7.70	135.2	133.9	133.8	133.3	134.0
5.0	0.4	0.4	0.5	0.4	0.4	14.90	14.72	14.62	14.30	14.24	103.2	102.0	101.3	99.0	98.8	7.77	7.75	7.75	7.77	7.70	135.1	133.8	134.2	133.3	132.8
6.0	0.4	0.4	0.5	0.4	0.4	14.86	14.69	14.63	14.30	14.19	102.9	101.8	101.3	99.0	98.3	7.77	7.77	7.75	7.77	7.71	134.9	133.7	133.9	133.2	132.6
7.0	0.4	0.5	0.5	0.4	0.5	14.84	14.71	14.65	14.28	14.17	102.8	101.9	101.5	98.9	98.2	7.77	7.78	7.76	7.77	7.71	134.7	134.3	134.0	133.1	132.6
8.0	0.4	0.5	0.5	0.4	0.5	14.83	14.74	14.68	14.23	14.16	102.7	102.2	101.8	98.6	98.2	7.77	7.78	7.76	7.77	7.71	134.8	134.5	134.2	132.8	132.5
9.0	0.5	0.5	0.5	0.5	0.5	14.81	14.76	14.63	14.13	14.14	102.7	102.3	101.5	98.2	98.2	7.77	7.79	7.76	7.76	7.71	134.8	134.6	133.8	131.7	132.4
10.0	0.5	0.5	0.5	0.5	0.5	14.80	14.72	14.51	13.96	14.11	102.6	102.1	100.7	97.1	98.0	7.76	7.68	7.76	7.76	7.71	134.6	134.5	133.0	130.5	132.2
11.0	0.5		0.5	0.6	0.5	14.71		14.41	13.71	14.01	102.4		100.3	95.6	97.6	7.74		7.75	7.70	7.70	134.6		132.0	129.4	131.1
12.0			0.6	0.6	0.6			14.04	13.48	13.77			97.9	94.1	96.2			7.73	7.73	7.68			130.8	128.7	129.7
13.0			0.7	0.7	0.7			13.95	13.23	13.45			97.4	92.6	94.2			7.73	7.71	7.67			130.1	127.9	128.5
14.0			0.7	0.7	0.7			13.72	13.04	13.04			96.2	91.4	91.7			7.71	7.69	7.64			129.0	127.3	127.4
15.0			0.8	0.8	0.8			13.43	12.68	12.64			94.3	89.7	89.0			7.69	7.65	7.60			128.1	127.2	126.9
16.0			0.8	0.9				13.05	12.30				92.0	86.8				7.65	7.62				127.5	126.8	
17.0				0.9					11.96					84.6					7.59					126.4	
18.0				1.0					11.60					82.1					7.56					125.9	
19.0				1.0					11.27					80.0					7.53					126.0	
20.0				1.0					11.08					78.3					7.50					126.7	
21.0				1.1					11.06					77.6					7.49					127.4	
22.0				1.1					11.04					77.9					7.48					127.9	
23.0				1.1					10.82					77.2					7.45					128.3	
24.0				1.1					10.41					74.4					7.43					128.4	
25.0				1.2					9.65					69.6					7.39					128.2	
26.0				1.5					8.49					59.4					7.32					128.6	
27.0				1.5					7.71					57.1					7.27					130.8	
28.0				1.6					6.83					50.4					7.23					132.3	
29.0				1.7					6.06					45.1					7.19					133.8	
30.0				1.8					5.01					38.1					7.15					136.2	
31.0				1.9					4.04					31.1					7.10					139.9	

Notes: Total depth at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 11.6, 9.3, 16.4, 32.5, and 16.4 m, respectively, at the time of winter sampling. Ice thickness at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 1.80, 1.68, 1.52, 1.38, and 1.38 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, August 2019**

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	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19
1.0	12.0	11.8	11.8	11.8	11.5	11.50	11.44	11.14	11.21	11.58	107.4	105.8	102.6	103.4	106.3	8.10	8.14	8.15	8.07	8.08	144.6	143.4	143.6	143.7	143.1
2.0	12.2	11.8	11.8	11.8	11.3	11.46	11.48	11.45	11.44	11.67	106.7	106.1	105.5	105.6	106.6	8.11	8.14	8.14	8.11	8.05	114.6	143.5	143.5	143.6	142.9
3.0	12.1	11.8	11.6	11.7	11.3	11.46	11.52	11.55	11.50	11.68	106.6	106.3	106.3	106.0	106.6	8.12	8.14	8.15	8.13	8.03	114.2	143.5	143.2	143.4	143.1
4.0	11.9	11.7	11.6	11.5	11.3	11.49	11.52	11.57	11.56	11.67	106.4	106.3	106.2	106.0	106.5	8.13	8.14	8.15	8.13	8.02	144.2	143.5	143.0	144.0	142.9
5.0	11.7	11.6	11.4	11.1	11.2	11.48	11.52	11.61	11.63	11.66	105.6	105.9	106.3	105.5	106.3	8.13	8.15	8.16	8.14	8.02	146.9	144.6	143.1	143.0	142.9
6.0	11.0	11.2	11.0	10.6	10.9	11.67	11.62	11.67	11.85	11.90	105.5	105.4	105.5	106.1	106.5	8.14	8.15	8.16	8.14	8.01	145.2	149.2	142.8	142.8	141.8
7.0	10.5	10.5	10.3	10.1	10.1	11.88	11.83	11.91	11.99	11.98	106.3	105.5	105.8	106.1	106.2	8.13	8.14	8.14	8.13	7.99	143.5	144.0	142.3	142.0	141.7
8.0	9.6	9.6	9.7	9.6	9.7	12.09	12.08	12.08	12.13	12.11	105.4	105.9	106.1	106.2	106.3	8.11	8.14	8.12	8.10	7.96	141.8	141.6	141.6	141.4	141.3
9.0	9.1	9.1	9.2	9.2	9.3	12.23	12.22	12.18	12.19	12.19	106.2	105.8	105.5	105.8	106.0	8.08	8.08	8.08	8.07	7.93	141.1	140.9	140.9	140.8	140.9
10.0			8.5	8.7	8.9			12.29	12.25	12.26			104.9	105.1	105.4			8.04	8.04	7.89			140.3	140.3	140.6
11.0			8.2	8.3	8.3			12.28	12.29	12.26			104.2	104.6	104.2			8.00	8.00	7.84			140.0	140.2	140.4
12.0			7.9	8.1	7.7			12.28	12.26	12.29			103.3	103.7	103.0			7.97	7.97	7.77			139.9	139.9	140.0
13.0			7.6	7.8				12.26	12.26				102.7	103.1				7.94	7.93				139.8	139.7	
14.0			7.5	7.5				12.24	12.27				102.0	102.3				7.90	7.90				139.7	139.8	
15.0				7.3					12.25					101.6					7.87					135.8	
16.0				7.1					12.25					101.1					7.84					139.6	
17.0				7.0					12.25					100.9					7.81					139.6	
18.0				6.8					12.24					100.4					7.79					139.6	
19.0				6.7					12.24					100.0					7.77					139.6	
20.0				6.6					12.25					99.8					7.75					139.7	
21.0				6.4					12.26					99.7					7.73					139.6	
22.0				6.4					12.26					99.4					7.71					139.7	
23.0				6.3					12.24					99.1					7.77					139.7	
24.0				6.3					12.21					98.9					7.68					139.8	
25.0				6.2					12.17					98.5					7.76					139.8	
26.0				6.2					12.15					98.2					7.67					139.8	
27.0				6.2					12.09					97.6					7.67					140.0	
28.0				6.2					12.05					97.2					7.66					140.0	
29.0				6.1					11.90					96.0					7.64					140.3	
30.0				6.1					11.75					94.6					7.62					140.7	

Note: Total depth at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 10.2, 10.3, 14.7, 34.1, and 14.7 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, August 2019**

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	27-Aug-19	27-Aug-19	27-Aug-19	26-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	26-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	26-Aug-19	27-Aug-19	27-Aug-19
0.5				10.6						10.53						94.5		
1.0	10.5	10.5	10.5	10.6	10.4	10.4	10.80	10.75	10.96	10.55	11.03	11.1	96.5	96.2	98.1	94.6	98.8	98.9
2.0	10.4	10.5	10.5	10.6	10.4	10.4	10.96	10.87	10.99	10.56	11.03	11.1	98.1	97.4	98.4	94.9	98.8	98.9
3.0	10.4	10.5	10.4	10.6	10.4	10.4	10.96	10.93	11.00	10.58	11.03	11.1	98.1	97.8	98.5	95.1	98.7	98.8
4.0	10.4	10.4	10.4	10.6	10.4	10.4	10.96	10.95	11.00	10.61	11.02	11.0	98.1	98.0	98.5	95.4	98.6	98.7
5.0	10.4	10.4	10.4	10.6	10.4	10.4	10.95	10.95	11.00	10.59	11.01	11.1	98.0	98.0	98.4	95.1	98.5	98.7
6.0	10.4	10.4	10.4	10.5	10.4	10.4	10.96	10.96	11.00	10.64	11.01	11.0	98.0	98.0	98.4	95.3	98.5	98.6
7.0	10.4	10.4	10.4	10.5	10.4	10.3	10.95	10.96	10.99	10.65	11.01	11.0	98.0	98.0	98.3	95.7	98.5	98.5
8.0	10.4	10.4	10.4	10.5	10.4	10.3	10.95	10.95	10.99	10.69	11.00	11.0	98.0	98.0	98.3	95.9	98.4	98.4
9.0	10.4	10.4	10.4	10.5	10.4	10.3	10.94	10.95	10.99	10.69	11.00	11.0	97.9	97.9	98.3	95.9	98.3	98.3
10.0	10.4	10.4	10.4	10.5	10.4	10.3	10.94	10.94	10.98	10.70	11.00	11.0	97.8	97.8	98.2	96.0	98.3	98.2
11.0			10.4	10.4	10.4	10.3			10.98	10.74	10.99	11.0			98.2	96.0	98.2	98.2
12.0			10.4	10.3	10.4	10.3			10.97	10.83	10.99	11.0			98.2	96.6	98.2	98.2
13.0			10.4	10.3	10.4	10.3			10.97	10.80	10.98	11.0			98.1	97.0	98.1	98.2
14.0				10.0	10.3	10.3				10.81	10.98	11.0				96.6	98.0	98.3
15.0				9.5	10.3					11.06	10.97					97.2	97.9	
16.0				8.7	10.1					11.35	10.97					97.6	97.0	
17.0				8.4	9.1					11.36	11.14					97.1	96.4	
18.0				8.2	8.6					11.38	11.28					96.4	96.5	
19.0				7.6	8.0					11.57	11.33					96.4	95.4	
20.0				7.4	7.4					11.49	11.32					95.4	94.1	
21.0				7.0	7.2					11.50	11.28					94.3	93.4	
22.0				6.8	6.9					11.45	11.27					94.0	92.7	
23.0				6.7	6.9					11.42	11.25					93.4	92.4	
24.0				6.6	6.8					11.27	11.20					92.1	91.4	
25.0				6.6	6.7					11.19	11.11					91.1	91.0	
26.0				6.5	6.7					11.09	11.04					90.2	90.3	
27.0				6.5	6.6					10.99	10.94					89.2	89.3	
28.0				6.5	6.6					10.92	10.92					89.7	89.1	
29.0				6.4	6.6					10.89	10.80					88.4	88.9	
30.0				6.4	6.5					10.77	10.85					87.5	88.4	

Notes: 26-Aug-19 sampling was conducted by Minnow. Camp Lake water profile sampling on all other dates was conducted by Baffinland. Total depth at Stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 11.1, 11.2, 16.0, 31.0, and 15.4 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, August 2019

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	27-Aug-19	27-Aug-19	27-Aug-19	26-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	26-Aug-19	27-Aug-19	27-Aug-19
0.5				7.91						149.40		
1.0	7.94	8.01	8.03	7.95	8.01	8.06	150.4	149.8	148.1	149.2	148.1	147.6
2.0	7.98	8.01	8.02	7.94	8.01	8.06	150.1	149.8	148.2	149.3	148.2	147.8
3.0	7.99	8.03	8.01	7.96	8.01	8.07	150.0	149.7	148.2	149.3	148.1	147.9
4.0	8.00	8.03	8.01	7.96	8.01	8.07	150.1	149.8	148.5	149.3	148.1	147.9
5.0	8.00	8.03	8.00	7.97	8.01	8.08	150.1	149.9	148.2	149.4	148.1	147.8
6.0	8.00	8.03	8.00	7.96	8.01	8.08	150.2	150.1	148.2	149.4	148.1	147.7
7.0	8.00	8.03	8.00	7.96	8.01	8.07	150.1	150.2	148.2	149.4	148.1	147.7
8.0	8.00	8.03	7.99	7.97	8.00	8.07	150.1	150.3	148.2	149.3	148.0	147.7
9.0	8.00	8.03	7.99	7.94	8.00	8.06	150.1	150.4	148.3	149.3	148.0	147.7
10.0	8.00	8.02	7.99	7.96	8.00	8.06	150.0	150.5	148.3	149.3	148.0	147.7
11.0			7.99	7.94	7.99	8.07			148.4	149.2	147.9	147.7
12.0			7.98	7.91	7.99	8.07			148.5	148.2	147.9	147.7
13.0			7.98	7.87	7.99	8.07			148.5	147.6	147.8	147.7
14.0				7.84	7.98	8.07				147.1	147.8	147.7
15.0				7.73	7.97					145.3	147.6	
16.0				7.64	7.95					144.5	146.5	
17.0				7.60	7.89					143.9	143.5	
18.0				7.58	7.83					143.4	142.8	
19.0				7.52	7.77					142.7	142.0	
20.0				7.48	7.70					142.6	141.4	
21.0				7.46	7.65					142.1	141.1	
22.0				7.42	7.61					142.0	140.9	
23.0				7.40	7.58					142.1	140.8	
24.0				7.38	7.55					141.9	140.9	
25.0				7.35	7.53					142.1	140.9	
26.0				7.32	7.51					142.2	140.0	
27.0				7.31	7.48					142.3	141.1	
28.0				7.29	7.47					142.3	140.0	
29.0				7.29	7.45					142.3	141.0	
30.0				7.26	7.43					142.5	141.2	

Notes: 26-Aug-19 sampling was conducted by Minnow. Camp Lake water profile sampling on all other dates was conducted by Baffinland. Total depth at Stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 11.1, 11.2, 16.0, 31.0, and 15.4 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 2019

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Colour/ Clarity	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
								(mg/L)	(% sat.)		
Littoral (Shallow) Stations	JLO-02	26-Aug-19	11.3	7.2	clear, colourless	surface	10.6	10.38	93.3	8.02	151
						bottom	10.5	10.22	91.5	7.93	152
	JLO-21	26-Aug-19	10.0	7.2	clear, colourless	surface	10.5	10.49	94.3	7.99	149
						bottom	10.5	10.19	91.8	7.93	149
	JLO-20	26-Aug-19	7.0	7.0	clear, colourless	surface	10.5	10.27	92.3	8.01	149
						bottom	10.4	10.39	93.3	8.01	149
	JLO-19	26-Aug-19	7.0	7.7	clear, colourless	surface	10.6	10.39	93.4	8.00	149
						bottom	10.3	10.39	92.5	8.00	151
	JLO-18	26-Aug-19	12.1	7.4	clear, colourless	surface	10.6	10.46	94.1	8.01	149
						bottom	10.4	10.35	92.0	7.96	150
Profundal (Deep) Stations	JLO-01	26-Aug-19	18.0	7.6	clear, colourless	surface	10.6	10.29	93.1	8.00	150
						bottom	8.4	10.94	93.7	7.55	144
	JLO-07	26-Aug-19	30.0	-	clear, colourless	surface	10.6	10.53	94.5	7.91	149
						bottom	6.4	10.77	87.5	7.26	143
	JLO-16	26-Aug-19	7.0	7.0	clear, colourless	surface	10.5	10.51	94.4	8.02	149
						bottom	10.5	10.46	94.3	7.98	149
	JLO-11	26-Aug-19	29.0	8.1	clear, colourless	surface	10.6	10.12	91.5	8.02	149
						bottom	6.4	10.39	84.4	7.34	143
	JLO-12	26-Aug-19	16.5	8.5	clear, colourless	surface	10.5	9.96	89.2	8.04	149
						bottom	9.6	10.60	93.5	7.75	147

Table C.24: Statistical Comparison of Bottom *In Situ* Water Quality Between Camp Lake Littoral and Profundal Stations, Mary River Project CREMP, August 2019

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)	YES	0.005	α	Littoral	7.16	0.17	0.08	7.00	7.42
				Profundal	7.98	0.41	0.21	7.60	8.50
Temperature (˚C)	YES	0.008	γ	Littoral	10.46	0.05	0.02	10.40	10.50
				Profundal	8.22	1.79	0.80	6.40	10.30
Dissolved Oxygen (mg/L)	YES	0.037	α	Littoral	10.3	0.1	0.1	10.2	10.5
				Profundal	10.6	0.2	0.1	10.4	10.9
Dissolved Oxygen (% saturation)	NO	0.841	γ	Littoral	92.6	1.2	0.5	91.5	94.3
				Profundal	90.5	4.0	1.8	84.4	93.7
pH (units)	NO	0.222	γ	Littoral	7.87	0.22	0.10	7.48	8.01
				Profundal	7.58	0.30	0.14	7.26	8.00
Specific Conductance (umho/cm)	YES	0.095	γ	Littoral	149.9	1.0	0.5	149.2	151.6
				Profundal	145.3	3.6	1.6	142.5	151.0

Shaded 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.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 2019

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	0.310	β	Reference	5	9.36	1.39	0.62	7.30	10.60
					Camp	5	8.32	1.86	0.83	7.00	11.30
	Secchi Depth (m)	YES	0.008	α	Reference	5	7.66	0.27	0.12	7.30	8.00
					Camp	5	7.16	0.17	0.08	7.00	7.42
	Temperature (˚C)	NO	0.110	η	Reference	5	11.78	1.44	0.65	9.80	13.30
					Camp	5	10.46	0.05	0.02	10.40	10.50
	Dissolved Oxygen (mg/L)	NO	0.287	α	Reference	5	9.7	1.3	0.6	8.3	11.1
					Camp	5	10.3	0.1	0.1	10.2	10.5
	Dissolved Oxygen (% saturation)	NO	0.531	α	Reference	5	89.0	12.3	5.5	74.9	99.1
					Camp	5	92.6	1.2	0.5	91.5	94.3
	pH (units)	YES	0.017	α	Reference	5	7.29	0.37	0.17	6.91	7.70
					Camp	5	7.87	0.22	0.10	7.48	8.01
	Specific Conductance (umho/cm)	YES	<0.001	α	Reference	5	77.9	2.9	1.3	74.9	82.2
					Camp	5	149.9	1.0	0.5	149.2	151.6
Profundal (Deep) Stations	Station Depth (m)	YES	0.009	α	Reference	5	19.32	2.46	1.10	16.00	21.90
					Camp	5	26.62	4.13	1.85	21.20	31.00
	Secchi Depth (m)	NO	0.699	α	Reference	5	7.80	0.78	0.35	6.50	8.50
					Camp	4	7.98	0.41	0.21	7.60	8.50
	Temperature (˚C)	NO	0.200	α	Reference	5	6.96	0.92	0.41	5.60	8.10
					Camp	5	8.22	1.79	0.80	6.40	10.30
	Dissolved Oxygen (mg/L)	YES	0.012	γ	Reference	5	9.2	2.0	0.9	5.8	10.3
					Camp	5	10.6	0.2	0.1	10.4	10.9
	Dissolved Oxygen (% saturation)	YES	0.016	γ	Reference	5	76.3	16.3	7.3	47.4	87.3
					Camp	5	90.5	4.0	1.8	84.4	93.7
	pH (units)	YES	0.023	α	Reference	5	7.02	0.33	0.15	6.62	7.37
					Camp	5	7.58	0.30	0.14	7.26	8.00
	Specific Conductance (umho/cm)	YES	<0.001	β	Reference	5	79.7	4.7	2.1	75.2	86.0
					Camp	5	145.3	3.6	1.6	142.5	151.0

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.26: Water Chemistry at Camp Lake (JLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

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-19	13-Apr-19	13-Apr-19	13-Apr-19	13-Apr-19	13-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	28-Jun-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19
Conventionals	Conductivity (lab)	μmho/cm	-	-	164	171	162	165	160	162	163	160	153	165	146	143	145	141	141	139	143
	pH (lab)	pH	6.5 - 9.0	-	7.88	7.88	7.81	7.72	7.68	7.79	7.23	7.63	7.72	7.89	8.00	8.26	8.27	8.25	8.25	8.27	8.25
	Hardness (as $CaCO_3$)	mg/L	-	-	84.3	88.2	82.6	87.6	82.0	84.5	79.9	84.7	80.3	90.1	73.2	72.3	72.2	71.6	70.9	70.4	70.4
	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	-	-	81	78	83	80	85	86	90	87	83	92	71	73	79	77	76	75	71
	Turbidity	NTU	-	-	0.13	0.14	0.13	0.13	0.14	0.36	0.26	0.13	0.13	0.16	0.84	0.55	0.56	0.58	0.58	0.63	0.59
	Alkalinity (as $CaCO_3$)	mg/L	-	-	75	80	76	78	75	77	73	76	73	79	68	68	66	67	67	67	68
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.029	0.032	0.027	0.024	0.037	0.030	<0.010	0.036	0.024	0.023	0.026	0.016	0.022	0.027	0.035	0.024	0.012
	Nitrate	mg/L	3	3	0.023	0.026	0.024	0.025	0.024	0.025	0.099	0.026	0.036	0.027	0.037	0.034	0.646	<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	0.16	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.19	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.93	2.21	2.07	2.16	1.83	1.94	1.75	1.98	1.88	1.96	2.09	1.97	2.15	2.12	1.95	2.11	1.92
	Total Organic Carbon	mg/L	-	-	2.40	2.51	2.40	2.46	2.48	2.30	2.21	2.41	2.29	2.43	2.11	2.23	2.46	2.11	2.21	2.17	2.35
	Total Phosphorus	mg/L	0.020$^{\alpha}$	-	<0.0030	<0.0030	<0.0030	0.0035	<0.0030	0.0034	0.0056	<0.0030	<0.0030	<0.0030	0.0049	0.0032	0.0044	<0.0030	<0.0030	<0.0030	<0.0030
	Phenols	mg/L	0.004$^{\alpha}$	-	0.0021	<0.0010	0.0015	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	<0.0010	<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	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	4.58	4.79	4.57	4.72	4.55	4.68	5.82	4.62	4.33	4.71	3.76	4.02	3.96	3.92	3.91	3.92	3.91
	Sulphate (SO_4)	mg/L	218$^{\beta}$	218	4.68	4.90	4.68	4.82	4.67	4.77	4.43	4.73	4.41	4.81	3.80	4.17	4.24	4.13	4.15	4.15	4.15
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0041	<0.0030	<0.0030	<0.0030	<0.0030	0.017	0.014	0.006	0.011	0.007	0.007	0.008
	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	<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	-	-	0.00779	0.00836	0.00854	0.00805	0.00771	0.00793	0.00790	0.00788	0.00757	0.00807	0.00704	0.00726	0.00713	0.00777	0.00715	0.00708	0.00722
	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	<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	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	16.4	17.2	16.9	16.2	15.1	15.9	15.8	16.7	15.7	16.9	13.3	13.7	13.5	13.5	13.7	13.8	13.8
	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	<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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.004	0.00098	0.0011	0.00136	0.00099	0.00206	0.00108	0.00124	0.00101	0.00089	0.00108	0.00088	0.0011	0.0009	0.0009	0.0009	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	-	-	0.0015	0.0014	0.0014	0.0012	0.0011	0.0012	0.0015	0.0015	0.0016	0.0015	<0.0010	0.0011	0.001	0.0013	0.0012	0.0012	0.0012
	Magnesium (Mg)	mg/L	-	-	10.5	10.8	11.0	10.7	9.8	10.6	10.6	10.8	10.0	10.8	9.0	8.9	8.8	8.7	8.8	9.0	8.9
	Manganese (Mn)	mg/L	0.935$^{\beta}$	-	0.0004	0.0004	0.0002	0.0004	0.0005	0.0005	0.0093	0.0004	0.0006	0.0007	0.0041	0.0019	0.0018	0.0021	0.0018	0.0018	0.0017
	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	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.000428	0.000371	0.000354	0.000381	0.000346	0.000367	0.000335	0.000392	0.000348	0.000399	0.000341	0.000366	0.000372	0.000339	0.000368	0.000371	0.000364
	Nickel (Ni)	mg/L	0.025	0.025	0.00069	0.00074	0.00074	0.00072	0.00069	0.00067	0.00073	0.00070	0.00067	0.00072	0.00061	0.00064	0.00063	0.00063	0.00061	0.00067	0.00063
	Potassium (K)	mg/L	-	-	1.45	1.53	1.55	1.47	1.36	1.44	1.40	1.46	1.33	1.48	1.22	1.28	1.29	1.28	1.28	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.36	0.38	0.35	0.38	0.36	0.36	0.70	0.36	0.38	0.38	0.39	0.33	0.32	0.35	0.33	0.32	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	-	-	1.93	1.98	2.03	1.92	1.82	1.91	2.20	2.00	1.87	1.95	1.76	1.67	1.66	1.63	1.65	1.67	1.65
	Strontium (Sr)	mg/L	-	-	0.0117	0.0120	0.0120	0.0116	0.0109	0.0115	0.0115	0.0117	0.0110	0.0120	0.0104	0.0108	0.0108	0.0106	0.0108	0.0109	0.0108
	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	-	0.000998	0.00104	0.000882	0.00104	0.000982	0.00101	0.000858	0.000997	0.000898	0.001050	0.000856	0.001010	0.000980	0.000882	0.000956	0.000969	0.000971
	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	<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	0.003	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

(Shaded box) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.26: Water Chemistry at Camp Lake (JLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

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
					28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	5-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	2-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	18-Aug-19
Conventionals	Conductivity (lab)	umho/cm	-	-	144	144	140	142	146	165	165	165	165	163	163	155	163	163	163	150
	pH (lab)	pH	6.5 - 9.0	-	8.24	8.26	7.96	8.20	8.20	8.16	8.16	8.18	8.19	8.18	8.19	7.77	8.16	8.11	8.21	8.32
	Hardness (as $CaCO_3$)	mg/L	-	-	70.2	69.3	68.1	70.2	68.4	69.5	69.9	70.7	69.4	70.3	69.5	65.1	69.3	68.5	69.0	78.0
	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	-	-	75	50	73	70	95	91	84	97	85	86	75	52	82	93	105	129
	Turbidity	NTU	-	-	0.54	0.56	0.64	0.73	0.74	0.62	1.13	0.91	0.64	0.66	0.64	0.55	0.59	0.56	0.55	0.29
	Alkalinity (as $CaCO_3$)	mg/L	-	-	67	67	66	68	72	69	69	69	68	69	68	65	68	68	68	69
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.013	0.019	0.016	0.011	0.025	0.013	<0.020	<0.020	<0.010	<0.010	<0.010	0.023	<0.010	<0.020	<0.010	<0.010
	Nitrate	mg/L	3	3	<0.020	<0.020	0.021	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.039	<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	0.16	<0.15	<0.15	0.16	<0.15	0.21	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.89	2.03	1.90	2.01	1.85	1.96	1.88	1.83	1.90	2.09	1.94	1.80	1.93	1.98	1.96	1.92
	Total Organic Carbon	mg/L	-	-	2.20	2.15	2.16	2.39	2.35	2.16	2.34	2.14	3.04	2.27	2.25	2.14	2.24	2.10	2.14	2.24
	Total Phosphorus	mg/L	0.020[α]	-	0.0039	0.0038	0.0035	0.0051	0.0031	0.0034	<0.0030	<0.0030	0.0059	<0.0030	0.0036	<0.0030	0.0556	0.0319	<0.0030	0.0031
	Phenols	mg/L	0.001[α]	-	<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
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	3.91	3.92	3.89	3.91	3.89	4.30	4.32	4.39	4.28	4.19	4.24	4.02	4.18	4.17	4.15	4.13
	Sulphate (SO_4)	mg/L	218[β]	218	4.15	4.16	4.07	4.14	4.09	4.23	4.24	4.27	4.22	4.18	4.18	4.03	4.17	4.17	4.17	4.09
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	0.0069	0.0069	0.0066	0.0063	0.0092	0.0088	0.0074	0.0111	0.0086	0.0052	0.0076	0.0044	0.0076	0.0194	0.0108	0.0062
	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	-	-	0.00707	0.00707	0.00682	0.00703	0.00727	0.00727	0.00716	0.00726	0.00710	0.00704	0.00715	0.00668	0.00705	0.00749	0.00724	0.00748
	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	-	-	13.7	13.7	13.3	13.6	13.5	13.8	13.8	14.0	13.8	13.7	13.9	13.1	13.8	13.9	13.9	15.0
	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	<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	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0010	0.0009	0.0009	0.0009	0.0008	***0.0063***	0.0009	0.0009	0.0010
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	0.045	<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	-	-	0.0012	0.0012	0.0011	0.0012	0.0010	<0.0010	<0.0010	0.0010	0.0010	0.0011	0.0011	0.0011	0.0011	0.0012	0.0012	0.0011
	Magnesium (Mg)	mg/L	-	-	8.82	8.73	8.51	8.83	8.64	8.56	8.46	8.67	8.50	8.49	8.63	8.00	8.66	8.59	8.70	9.55
	Manganese (Mn)	mg/L	0.935[β]	-	0.00173	0.00173	0.00191	0.00185	0.00226	0.00112	0.00113	0.00137	0.00119	0.00107	0.00120	0.00155	0.00121	0.00291	0.00118	0.00178
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.000380	0.000360	0.000346	0.000372	0.000375	0.000384	0.000376	0.000367	0.000383	0.000370	0.000366	0.000338	0.000381	0.000378	0.000384	0.000399
	Nickel (Ni)	mg/L	0.025	0.025	0.00068	0.00059	0.00059	0.00064	0.00069	0.00058	0.00058	0.00063	0.00057	0.00061	0.00064	0.00054	0.00069	0.00070	0.00060	0.00067
	Potassium (K)	mg/L	-	-	1.27	1.26	1.24	1.27	1.26	1.27	1.25	1.28	1.26	1.26	1.28	1.2	1.28	1.27	1.29	1.33
	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	-	-	0.32	0.33	0.36	0.31	0.31	0.3	0.28	0.31	0.29	0.27	0.29	0.42	0.28	0.31	0.29	0.28
	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	-	-	1.65	1.63	1.60	1.65	1.59	1.67	1.65	1.73	1.65	1.64	1.65	1.57	1.65	1.64	1.67	1.72
	Strontium (Sr)	mg/L	-	-	0.0107	0.0108	0.0105	0.0108	0.0108	0.0111	0.0110	0.0111	0.0111	0.0109	0.0109	0.0104	0.0110	0.0110	0.0111	0.0117
	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	-	0.00095	0.00095	0.00087	0.00096	0.00101	0.00106	0.00106	0.00106	0.00104	0.00096	0.00097	0.00080	0.00101	0.00101	0.00097	0.00107
	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

[grey shading] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.27: Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentration Data Provided) Between Camp Lake and Reference Lake 3 in 2019, and Between Camp Lake 2019 and Baseline (2005 to 2013) Data, Mary River Project CREMP

Parameter	Camp Lake vs Reference Lake 3 in 2019		Camp Lake 2019 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	1.9	2.0	1.3	1.2	1.4
Hardness (as $CaCO_3$)	2.0	1.9	1.3	1.2	1.2
Total Suspended Solids (TSS)	0.5	1.0	1.0	1.0	1.0
Total Dissolved Solids (TDS)	1.5	1.6	1.0	1.0	1.1
Turbidity	2.3	2.0	0.9	1.1	2.2
Alkalinity (as $CaCO_3$)	2.0	2.0	1.2	1.2	1.2
Total Ammonia	2.0	1.5	0.5	0.3	0.5
Nitrate	4.2	0.6	0.3	0.8	0.2
Nitrite	1.0	1.0	1.9	0.2	1.0
Total Kjeldahl Nitrogen (TKN)	1.0	0.9	0.8	0.7	0.5
Dissolved Organic Carbon	0.7	0.7	1.0	1.1	1.1
Total Organic Carbon	0.7	0.7	1.2	1.1	1.2
Total Phosphorus	0.8	0.5	0.6	0.8	2.3
Phenols	0.7	1.0	1.2	0.8	1.0
Bromide (Br)	1.0	1.0	1.1	0.4	0.4
Chloride (Cl)	2.9	3.1	3.4	2.0	1.9
Sulphate (SO_4)	1.1	1.1	3.4	2.9	1.5
Aluminum (Al)	2.3	1.2	1.9	0.6	1.5
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)	1.1	1.1	1.4	1.3	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	1.3	1.2	1.2
Chromium (Cr)	1.0	1.0	-	1.0	1.0
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9
Copper (Cu)	1.2	1.7	1.1	0.3	1.6
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	0.3	0.3	
Magnesium (Mg)	2.0	1.9	1.4	1.2	1.2
Manganese (Mn)	3.8	2.3	1.6	0.9	0.9
Mercury (Hg)	1.0	1.0	1.0	0.5	0.5
Molybdenum (Mo)	2.7	2.6	1.8	1.9	1.8
Nickel (Ni)	1.3	1.2	1.0	0.9	1.0
Potassium (K)	1.5	1.3		1.5	1.5
Selenium (Se)	1.0	1.0	-	-	-
Silicon (Si)	0.8	0.6	0.8	0.7	0.7
Silver (Ag)	1.0	1.0	1.1	1.6	2.7
Sodium (Na)	2.0	1.8		1.8	1.6
Strontium (Sr)	1.4	1.3	1.6	1.5	1.4
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)	4.2	4.1	2.2	2.1	2.0
Vanadium (V)	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	0.7	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).

Denotes differences in method detection limit between the 2019 and baseline data, precluding an evaluation of magnitude of elevation.

Table C.28: Spearman's Rank Correlation Coefficients for Camp Lake (JLO) Water Quality Data Collected in Winter, Summer, and Fall 2019[a]

Parameters	Conventional Parameters										Total Metals										
	Conduct-ivity	Hardness	Total Dissolved Solids	Turbidity	Alkalinity	TKN	Total Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Manganese	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	1	0.183	0.641	-0.089	0.650	0.035	0.316	0.020	0.756	0.688	-0.108	0.430	0.171	-0.558	0.481	0.195	0.219	-0.099	0.408	0.748	0.697
Hardness	0.183	1	0.208	-0.649	0.734	-0.133	0.618	-0.374	0.646	0.758	-0.655	0.793	0.580	-0.514	0.081	0.683	0.859	0.578	0.810	0.573	0.214
Total Dissolved Solids	0.641	0.208	1	-0.135	0.560	-0.081	0.045	-0.092	0.619	0.577	-0.024	0.495	0.193	-0.350	0.393	0.225	0.298	-0.125	0.471	0.678	0.470
Turbidity	-0.089	-0.649	-0.135	1	-0.513	0.183	-0.333	0.205	-0.528	-0.562	0.659	-0.679	-0.470	0.486	-0.032	-0.666	-0.738	-0.751	-0.649	-0.456	0.118
Alkalinity	0.650	0.734	0.560	-0.513	1	-0.095	0.567	-0.264	0.896	0.903	-0.550	0.805	0.551	-0.752	0.268	0.633	0.709	0.319	0.807	0.872	0.481
TKN	0.035	-0.133	-0.081	0.183	-0.095	1	0.008	-0.036	0	-0.074	0.191	0.033	-0.293	-0.014	-0.147	-0.271	-0.232	-0.187	-0.226	-0.025	-0.050
Total Organic Carbon	0.316	0.618	0.045	-0.333	0.567	0.008	1	-0.050	0.476	1	-0.600	0.356	0.349	-0.601	0.285	0.381	0.518	0.191	0.517	0.459	0.340
Total Phosphorus	0.020	-0.374	-0.092	0.205	-0.264	-0.036	-0.050	1	-0.159	-0.159	0	-0.295	0.058	0.417	0.116	0.029	-0.305	-0.242	-0.241	-0.143	0.044
Chloride	0.756	0.646	0.619	-0.528	0.896	-0.048	0.476	-0.159	1	0.929	-0.553	1	0.504	-0.682	0.197	0.571	0.649	0.392	0.792	0.879	0.451
Sulphate	0.688	0.758	0.577	-0.562	0.903	-0.074	0.641	-0.159	0.929	1	-0.580	0.793	1	-0.750	0.308	0.598	0.738	0.338	0.842	0.874	0.529
Aluminum (total)	-0.108	-0.655	-0.024	0.659	-0.550	0.191	-0.600	0.260	-0.553	-0.580	1	-0.404	-0.367	1	0.051	-0.542	-0.602	-0.689	-0.589	-0.423	0.195
Barium (total)	0.430	0.793	0.495	-0.679	0.805	0.033	0.356	-0.295	0.776	0.793	-0.404	1	0.583	-0.503	0.099	0.679	0.830	0.508	0.804	0.758	0.318
Copper (total)	0.171	0.580	0.193	-0.470	0.551	-0.293	0.349	0.058	0.504	0.551	-0.367	0.583	1	-0.240	-0.004	1	0.678	0.378	0.635	0.489	0.250
Manganese (total)	-0.558	-0.514	-0.350	0.486	-0.752	-0.014	-0.601	0.417	-0.682	-0.750	0.569	-0.503	-0.240	1	-0.351	-0.313	-1	-0.178	-0.574	-0.692	-0.371
Molybdenum (total)	0.481	0.081	0.393	-0.032	0.268	-0.147	0.285	0.116	0.197	0.308	0.051	0.099	-0.004	-0.351	1	0.114	0.142	0	0.229	0.473	0.646
Nickel (total)	0.195	0.683	0.225	-0.666	0.633	-0.271	0.381	0.029	0.571	0.598	-0.542	0.679	0.777	-0.313	0.114	1	0.795	0.452	1	0.579	0.084
Potassium (total)	0.219	0.859	0.298	-0.738	0.709	-0.232	0.518	-0.305	0.649	0.738	-0.602	0.830	0.678	-0.534	0.142	0.795	1	0.520	0.881	1	0.159
Silicon (total)	-0.099	0.578	-0.125	-0.751	0.319	-0.187	0.191	-0.242	0.392	0.338	-0.689	0.508	0.378	-0.178	-0.343	0.452	0.520	1	0.450	0.188	-0.290
Sodium (total)	0.408	0.810	0.471	-0.649	0.807	-0.226	0.517	-0.241	0.792	0.842	-0.589	0.804	0.635	-0.574	0.229	0.703	0.881	0.450	1	0.820	0
Strontium (total)	0.748	0.573	0.678	-0.456	0.872	-0.025	0.459	-0.143	0.879	0.874	-0.423	0.758	0.489	-0.692	0.473	0.579	0.694	0.188	0.820	1	0.529
Uranium (total)	0.697	0.214	0.470	0.118	0.481	-0.050	0.340	0.044	0.451	0.529	0.195	0.318	0.250	-0.371	0.646	0.084	0.159	-0.290	0.304	0.529	1
Aluminum (dissolved)	0.427	-0.153	0.347	0.451	0.117	0.210	-0.195	-0.162	0.148	0.117	0.340	0.009	-0.145	-0.082	0.155	-0.360	-0.282	-0.365	0.013	0.139	0.520
Barium (dissolved)	0.348	0.584	0.214	-0.498	0.611	0.014	0.465	-0.249	0.696	0.681	-0.615	0.499	0.358	-0.629	-0.046	0.312	0.454	0.490	0.636	0.544	0.171
Copper (dissolved)	0.328	0.416	0.128	-0.319	0.469	0.121	0.318	-0.230	0.510	0.441	-0.329	0.466	0.102	-0.549	0.073	0.210	0.317	0.237	0.336	0.410	0.171
Manganese (dissolved)	-0.308	0.056	-0.333	0.247	-0.345	0.038	-0.149	0.125	-0.352	-0.309	0.203	-0.123	-0.025	0.600	-0.034	-0.122	-0.084	0.068	-0.096	-0.297	-0.073
Molybdenum (dissolved)	0.165	0.412	0.100	-0.565	0.491	-0.145	0.273	-0.082	0.465	0.453	-0.449	0.484	0.338	-0.543	0.018	0.478	0.472	0.316	0.381	0.382	0.034
Nickel (dissolved)	0.437	0.508	0.253	-0.565	0.640	-0.130	0.406	-0.070	0.730	0.677	-0.514	0.547	0.408	-0.642	0.066	0.462	0.529	0.367	0.668	0.580	0.209
Potassium (dissolved)	0.488	0.504	0.314	-0.378	0.642	0.032	0.485	-0.154	0.723	0.692	-0.469	0.492	0.274	-0.691	0.133	0.307	0.425	0.225	0.604	0.607	0.322
Silicon (dissolved)	0.483	0.558	0.463	-0.490	0.691	-0.017	0.368	-0.131	0.779	0.742	-0.407	0.663	0.381	-0.573	-0.001	0.400	0.545	0.292	0.680	0.619	0.243
Sodium (dissolved)	0.503	0.446	0.398	-0.468	0.661	-0.060	0.399	-0.029	0.768	0.704	-0.475	0.546	0.346	-0.617	0.034	0.359	0.501	0.275	0.652	0.639	0.179
Strontium (dissolved)	0.546	0.401	0.468	-0.497	0.699	-0.062	0.390	-0.019	0.770	0.724	-0.434	0.564	0.414	-0.642	0.098	0.411	0.468	0.266	0.617	0.666	0.301
Uranium (dissolved)	0.667	0.033	0.431	-0.030	0.438	0.131	0.171	-0.079	0.495	0.474	0.043	0.266	0.031	-0.604	0.399	-0.042	0.029	-0.205	0.187	0.517	0.616

(green) Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

Table C.28: Spearman's Rank Correlation Coefficients for Camp Lake (JLO) Water Quality Data Collected in Winter, Summer, and Fall 2019[a]

Parameters	Dissolved Metals										
	Aluminum	Barium	Copper	Manganese	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	0.427	0.348	0.328	-0.308	0.165	0.437	0.488	0.483	0.503	0.546	0.667
Hardness	-0.153	0.584	0.416	0.056	0.412	0.508	0.504	0.558	0.446	0.401	0.033
Total Dissolved Solids	0.347	0.214	0.128	-0.333	0.100	0.253	0.314	0.463	0.398	0.468	0.431
Turbidity	0.451	-0.498	-0.319	0.247	-0.565	-0.565	-0.378	-0.490	-0.468	-0.497	-0.030
Alkalinity	0.117	0.611	0.469	-0.345	0.491	0.640	0.642	0.691	0.661	0.699	0.438
Nitrate	0.210	0.014	0.121	0.038	-0.145	-0.130	0.032	-0.017	-0.060	-0.062	0.131
Total Organic Carbon	-0.195	0.465	0.318	-0.149	0.273	0.406	0.485	0.368	0.399	0.390	0.171
Total Phosphorus	-0.162	-0.249	-0.230	0.125	-0.082	-0.070	-0.154	-0.131	-0.029	-0.019	-0.079
Chloride	0.148	0.696	0.510	-0.352	0.465	0.730	0.723	0.779	0.768	0.770	0.495
Sulphate	0.117	0.681	0.441	-0.309	0.453	0.677	0.692	0.742	0.704	0.724	0.474
Aluminum (total)	0.340	-0.615	-0.329	0.203	-0.449	-0.514	-0.469	-0.407	-0.475	-0.434	0.043
Barium (total)	0.009	0.499	0.466	-0.123	0.484	0.547	0.492	0.663	0.546	0.564	0.266
Copper (total)	-0.145	0.358	0.102	-0.025	0.338	0.408	0.274	0.381	0.346	0.414	0.031
Manganese (total)	-0.082	-0.629	-0.549	0.600	-0.543	-0.642	-0.691	-0.573	-0.617	-0.642	-0.604
Molybdenum (total)	0.155	-0.046	0.073	-0.034	0.018	0.066	0.133	-0.001	0.034	0.098	0.399
Nickel (total)	-0.360	0.312	0.210	-0.122	0.478	0.462	0.307	0.400	0.359	0.411	-0.042
Potassium (total)	-0.282	0.454	0.317	-0.084	0.472	0.529	0.425	0.545	0.501	0.468	0.029
Silicon (total)	-0.365	0.490	0.237	0.068	0.316	0.367	0.225	0.292	0.275	0.266	-0.205
Sodium (total)	0	1	0	0	0	1	1	1	1	1	0.187
Strontium (total)	0.139	0.544	0.410	-0.297	0.382	0.580	0.607	0.619	0.639	0.666	0.517
Uranium (total)	0.520	0.171	0.171	-0.073	0.034	0.209	0.322	0.243	0.179	0.301	0.616
Aluminum (dissolved)	1	0.139	0.065	0.044	-0.238	0.079	0.229	0.174	0.059	0.145	0.467
Barium (dissolved)	0.139	1	0.622	-0.348	0.504	0.776	0.891	0.792	0.760	0.785	0.506
Copper (dissolved)	0.065	0.622	1	-0.412	0.748	0.742	0.794	0.679	0.692	0.624	0.628
Manganese (dissolved)	0.044	-0.348	-0.412	1	-0.574	-0.481	-0.475	-0.421	-0.502	-0.635	-0.607
Molybdenum (dissolved)	-0.238	0.504	0.748	-0.574	1	0.746	0.646	0.629	0.674	0.688	0.478
Nickel (dissolved)	0.079	0.776	0.742	-0.481	0.746	1	0.893	0.880	0.916	0.884	0.564
Potassium (dissolved)	0.229	0.891	0.794	-0.475	0.646	0.893	1	0.875	0.851	0.864	0.688
Silicon (dissolved)	0.174	0.792	0.679	-0.421	0.629	0.880	0.875	1	0.931	0.901	0.563
Sodium (dissolved)	0.059	0.760	0.692	-0.502	0.674	0.916	0.851	0.931	1	0.907	0.567
Strontium (dissolved)	0.145	0.785	0.624	-0.635	0.688	0.884	0.864	0.901	0.907	1	0.675
Uranium (dissolved)	0.467	0.506	0.628	-0.607	0.478	0.564	0.688	0.563	0.567	0.675	1

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.

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

Table C.29: **Dissolved Metal Concentrations at Camp Lake Water Quality Monitoring Stations, Mary River Project CREMP, 2019**

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-19	13-Apr-19	13-Apr-19	13-Apr-19	13-Apr-19	13-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	28-Jun-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19
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	0.0043	0.0093	0.0036	0.0041	0.0107	<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	0.00798	0.00827	0.00804	0.00835	0.00760	0.00833	0.00779	0.00786	0.00754	0.00820	0.00691	0.00731	0.00718	0.00713	0.00702	0.00695	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
	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	16.5	17.3	16.2	16.9	15.5	16.4	15.3	16.3	15.7	17.3	13.8	14.0	14.0	13.8	13.7	13.6	13.7
	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	0.00181	0.00115	0.00171	0.00117	0.00235	0.00114	0.00127	0.00102	0.00102	0.00104	0.00087	0.00095	0.00094	0.00090	0.00091	0.00088	0.00090
	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	0.0015	0.0016	0.0013	0.0015	0.0012	0.0013	0.0013	0.0015	0.0016	0.0014	0.0012	0.0013	0.0013	0.0013	0.0012	0.0013	0.0012
	Magnesium (Mg)	mg/L	10.40	10.90	10.20	11.00	10.50	10.50	10.10	10.70	9.98	11.40	9.42	9.04	9.05	9.00	8.87	8.83	8.80
	Manganese (Mn)	mg/L	0.00021	0.00017	0.000159	0.000124	0.000160	0.000155	0.007750	0.000121	0.000177	0.000167	0.002170	0.000900	0.00081	0.000698	0.000801	0.000693	0.000691
	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	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000379	0.000389	0.000370	0.000380	0.000365	0.000390	0.000331	0.000381	0.000364	0.000374	0.000329	0.000374	0.000400	0.000373	0.000387	0.000357	0.000379
	Nickel (Ni)	mg/L	0.00074	0.00075	0.00069	0.00076	0.00069	0.00069	0.00070	0.00071	0.00066	0.00072	0.00063	0.00065	0.00064	0.00065	0.00061	0.00060	0.00060
	Potassium (K)	mg/L	1.44	1.53	1.42	1.48	1.39	1.47	1.36	1.44	1.36	1.50	1.24	1.30	1.30	1.29	1.28	1.27	1.26
	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	0.35	0.37	0.35	0.36	0.37	0.37	0.72	0.35	0.39	0.37	0.38	0.33	0.33	0.32	0.33	0.32	0.31
	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	1.95	2.10	1.83	1.94	1.89	1.95	2.16	1.97	1.85	2.01	1.77	1.71	1.69	1.67	1.66	1.65	1.64
	Strontium (Sr)	mg/L	0.0116	0.0122	0.0115	0.0120	0.0110	0.0118	0.0111	0.0115	0.0110	0.0117	0.0104	0.0110	0.0110	0.0109	0.0109	0.0106	0.0108
	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	0.00103	0.00108	0.00102	0.00105	0.00099	0.00104	0.00086	0.00103	0.00093	0.00104	0.00088	0.00103	0.00101	0.00100	0.00097	0.00096	0.00098
	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	0.0034	<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, 2019

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
			28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	5-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	2-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	18-Aug-19
Dissolved Metals	Aluminum (Al)	mg/L	0.0032	<0.0030	0.0043	<0.0030	0.0040	0.0070	<0.0030	0.0036	<0.0030	0.0033	0.0129	<0.0030	0.0042	0.0033	0.0035	<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
	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	0.00700	0.00695	0.00677	0.00705	0.00706	0.00724	0.00700	0.00732	0.00706	0.00710	0.00695	0.00664	0.00708	0.00685	0.00706	0.00758
	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	13.6	13.5	13.3	13.4	13.4	13.7	13.8	13.9	13.8	14.0	13.9	12.9	13.8	13.6	13.6	15.2
	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
	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	0.00087	0.00084	0.00085	0.00090	0.00090	0.00090	0.00087	0.00087	0.00087	0.00087	0.00092	0.00080	0.00089	0.00084	0.00089	0.00092
	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	0.00105	<0.0010	<0.0010	<0.0010	0.0011	0.0011	0.0010	0.0012	0.0012	0.0011	0.0012	0.0012	0.0011	0.0012
	Magnesium (Mg)	mg/L	8.81	8.64	8.49	8.90	8.48	8.57	8.61	8.77	8.52	8.57	8.48	7.97	8.47	8.35	8.52	9.76
	Manganese (Mn)	mg/L	0.000670	0.000675	0.000136	0.000531	0.00125	0.000375	0.000185	0.000175	0.000227	0.000178	0.000388	0.000093	0.000411	0.000162	0.000194	0.00143
	Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000368	0.000360	0.000353	0.000340	0.000374	0.000383	0.000383	0.000400	0.000365	0.000387	0.000377	0.000337	0.000368	0.000366	0.000367	0.000429
	Nickel (Ni)	mg/L	0.00087	0.00060	0.00059	0.00061	0.00067	0.00061	0.00066	0.00059	0.00057	0.00057	0.00061	0.00058	0.00059	0.00056	0.00060	0.00067
	Potassium (K)	mg/L	1.27	1.24	1.24	1.27	1.23	1.27	1.26	1.29	1.25	1.26	1.26	1.19	1.25	1.25	1.27	1.32
	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	0.31	0.31	0.36	0.30	0.29	0.29	0.29	0.28	0.29	0.28	0.28	0.42	0.28	0.27	0.28	0.29
	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	1.64	1.61	1.59	1.66	1.59	1.69	1.70	1.72	1.66	1.67	1.65	1.58	1.62	1.62	1.65	1.72
	Strontium (Sr)	mg/L	0.0108	0.0107	0.0106	0.0106	0.0107	0.0110	0.0109	0.0112	0.0110	0.0111	0.0110	0.0103	0.0110	0.0110	0.0109	0.0117
	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	0.00099	0.00099	0.00089	0.00098	0.00104	0.00110	0.00107	0.00109	0.00106	0.00102	0.00100	0.00080	0.00102	0.00101	0.00100	0.00110
	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 2019, and Between Camp Lake 2019 and Baseline (2005 to 2013) Data, Mary River Project CREMP

Parameter	Camp Lake vs Reference Lake 3 in 2019		Camp Lake 2019 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	1.5	0.4	0.0	1.0	1.6
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)	1.1	1.1	0.0	1.4	1.2
Beryllium (Be)	1.0	1.2	1.2	1.2	2.1
Cadmium (Cd)	1.0	1.1	0.4	0.0	0.8
Calcium (Ca)	2.0	1.9	1.2	1.2	1.2
Chromium (Cr)	1.0	1.0	-	-	-
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9
Copper (Cu)	1.1	1.0	1.1	0.6	1.1
Iron (Fe)	1.0	1.1	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)	2.0	1.9	1.3	1.3	1.2
Manganese (Mn)	4.7	0.6	1.9	0.0	0.4
Mercury (Hg)	1.0	1.0	1.0	0.5	0.5
Molybdenum (Mo)	2.6	2.4	1.6	0.0	1.9
Nickel (Ni)	1.3	1.2	1.0	0.7	1.0
Potassium (K)	1.5	1.4	0.9	1.2	1.0
Selenium (Se)	1.0	1.2	-	-	-
Silicon (Si)	0.8	0.6	0.8	0.8	0.7
Silver (Ag)	1.0	0.6	1.2	1.8	2.7
Sodium (Na)	2.0	1.8	1.2	1.3	1.3
Strontium (Sr)	1.4	1.3	1.5	1.5	1.4
Thallium (Tl)	1.0	1.2	1.2	1.3	2.6
Tin (Sn)	1.0	1.0	0.1	0.2	0.1
Titanium (Ti)	1.0	1.2	1.0	1.0	1.0
Uranium (U)	4.2	4.0	2.0	2.2	2.0
Vanadium (V)	1.0	1.1	1.0	1.0	1.0
Zinc (Zn)	1.0	0.6	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).

Denotes differences in method detection limit between the 2019 and baseline data, precluding an evaluation of magnitude of elevation.

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 2019

Study Area	Station	Sampling Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Unnamed Reference Creek	REF-CRK-B1	20-Aug-19	10.9	11.00	99.6	8.13	143.7
	REF-CRK-B2	20-Aug-19	10.9	11.00	99.5	8.14	143.8
	REF-CRK-B3	20-Aug-19	10.2	11.14	99.3	8.12	143.7
	REF-CRK-B4	20-Aug-19	9.9	11.19	99.1	8.12	143.7
	REF-CRK-B5	20-Aug-19	9.8	11.21	98.9	8.14	143.6
Sheardown Lake Tributary 1 Reach 1	SDLT-1-R1 B1	17-Aug-19	12.7	10.49	99.1	8.17	336.1
	SDLT-1-R1-B2	17-Aug-19	12.8	10.50	99.3	8.20	315.0
	SDLT-1-R1-B3	17-Aug-19	12.9	10.52	99.6	8.18	316.6
	SDLT-1-R1-B4	17-Aug-19	12.9	10.56	100.1	8.23	311.8
	SDLT-1-R1-B5	17-Aug-19	12.8	10.56	99.8	8.33	318.3
Sheardown Lake Tributary 12 Downstream	SDLT-12-DS-B1	17-Aug-19	5.8	8.15	65.2	7.67	332.6
	SDLT-12-DS-B2	17-Aug-19	6.4	9.13	74.2	7.77	326.8
	SDLT-12-DS-B3	17-Aug-19	6.2	8.47	69.1	7.69	319.8
Sheardown Lake Tributary 9 Upstream	SDLT-9-DS-B1	17-Aug-19	8.6	9.14	78.4	7.64	298.3
	SDLT-9-DS-B2	17-Aug-19	8.6	9.77	83.7	7.71	292.1
	SDLT-9-DS-B3	17-Aug-19	8.5	10.01	85.7	7.74	295.7
	SDLT-9-DS-B4	17-Aug-19	8.2	10.52	89.3	7.81	298.4
	SDLT-9-DS-B5	17-Aug-19	8.0	10.61	89.7	7.82	298.4

Table C.32: ***In Situ* Water Quality Summary Statistics for the Sheardown Lake Tributary Benthic Stations, Mary River Project CREMP, August 2019**

Metric	Study Area	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Water Temperature (°C)	Unnamed Reference Creek	5	5.7	0.2	0.1	5.4	6.0	5.4	6.0
	Sheardown Lake Tributary 1 (SDLT1)	5	9.2	0.4	0.2	8.7	9.7	8.7	9.5
	Sheardown Lake Tributary 12 (SDLT12)	3	6.9	1.0	0.6	4.5	9.3	5.9	7.8
	Sheardown Lake Tributary 9 (SDLT9)	5	5.4	0.1	0.0	5.3	5.5	5.3	5.5
Dissolved Oxygen (mg/L)	Unnamed Reference Creek	5	12.35	0.06	0.03	12.27	12.42	12.27	12.42
	Sheardown Lake Tributary 1 (SDLT1)	5	12.30	0.26	0.12	11.98	12.62	12.03	12.66
	Sheardown Lake Tributary 12 (SDLT12)	3	12.40	0.36	0.21	11.50	13.30	12.10	12.80
	Sheardown Lake Tributary 9 (SDLT9)	5	11.73	0.34	0.15	11.31	12.14	11.26	12.12
Dissolved Oxygen (% Saturation)	Unnamed Reference Creek	5	98.5	0.2	0.1	98.3	98.6	98.3	98.6
	Sheardown Lake Tributary 1 (SDLT1)	5	107.1	1.4	0.6	105.4	108.8	105.5	109.0
	Sheardown Lake Tributary 12 (SDLT12)	3	100.9	1.1	0.6	98.3	103.5	99.8	101.9
	Sheardown Lake Tributary 9 (SDLT9)	5	92.8	2.9	1.3	89.2	96.4	88.8	96.0
pH (units)	Unnamed Reference Creek	5	7.97	0.03	0.01	7.93	8.01	7.92	7.99
	Sheardown Lake Tributary 1 (SDLT1)	5	7.53	0.06	0.03	7.45	7.61	7.43	7.59
	Sheardown Lake Tributary 12 (SDLT12)	3	7.39	0.08	0.04	7.19	7.58	7.30	7.45
	Sheardown Lake Tributary 9 (SDLT9)	5	8.00	0.06	0.02	7.93	8.07	7.93	8.07
Specific Conductance (µS/cm)	Unnamed Reference Creek	5	88	1.1	0.5	86.4	89.1	85.9	88.5
	Sheardown Lake Tributary 1 (SDLT1)	4	375	13	7	354	396	359	391
	Sheardown Lake Tributary 12 (SDLT12)	3	269	2	1	263	274	267	271
	Sheardown Lake Tributary 9 (SDLT9)	5	180	1	0	179	181	179	181

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 2019

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 (mg/L)	YES	0.0056	α	Unnamed Reference Creek	Sheardown Tributary 1	NO	0.9905	Tukey's HSD
				Unnamed Reference Creek	Sheardown Tributary 12	NO	0.9930	
				Unnamed Reference Creek	Sheardown Tributary 9	YES	0.0115	
				Sheardown Tributary 1	Sheardown Tributary 12	YES	0.9519	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0202	
				Sheardown Tributary 12	Sheardown Tributary 9	YES	0.0177	
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, 2019

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Spring Sampling Event		Summer Sampling Event		Fall Sampling Event	
					D1-05	D1-00	D1-05	D1-00	DI-05	DI-00
					28-Jun-19	29-Jun-19	24-Jul-19	24-Jul-19	19-Aug-19	19-Aug-19
Conventionals	Conductivity (lab)	umho/cm	-	-	154	273	175	390	230	375
	pH (lab)	pH	6.5 - 9.0	-	7.97	8.21	7.98	8.17	7.93	8.05
	Hardness (as $CaCO_3$)	mg/L	-	-	73.3	135	82.8	192	118	194
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	88	159	89	233	152	253
	Turbidity	NTU	-	-	0.91	1.39	0.62	0.73	0.36	0.66
	Alkalinity (as $CaCO_3$)	mg/L	-	-	63	87	77	103	92	122
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	<0.010	0.033	<0.010	0.024	<0.010	<0.010
	Nitrate	mg/L	3	3	0.120	0.459	0.145	1.450	0.254	1.320
	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	0.22	<0.15	0.18	0.17	0.29
	Dissolved Organic Carbon	mg/L	-	-	4.01	3.95	2.81	2.99	2.38	2.78
	Total Organic Carbon	mg/L	-	-	4.07	4.41	3.12	3.59	2.66	3.19
	Total Phosphorus	mg/L	0.030[α]	-	0.0033	0.0056	<0.0030	0.0031	<0.0030	0.0033
	Phenols	mg/L	0.004[α]	-	0.0045	0.0011	0.0011	0.0016	<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	2.64	5.49	3.52	10.00	5.76	11.0
	Sulphate (SO_4)	mg/L	218[β]	218	11.4	43.4	12.6	88.4	17.9	55.7
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0309	0.0514	0.0197	0.0174	0.0102	0.0128
	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	0.0001	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0085	0.0140	0.0092	0.0163	0.0122	0.0182
	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	0.014	0.011	0.015	0.013	0.016
	Cadmium (Cd)	mg/L	0.00012	0.00008	0.00005	0.00002	0.00003	0.00002	0.00004	0.00002
	Calcium (Ca)	mg/L	-	-	13.1	22.7	15.2	31.7	21.5	34.0
	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	0.00011	<0.00010	0.00013	<0.00010	0.00010
	Copper (Cu)	mg/L	0.002	0.0022	***0.0036***	***0.0032***	***0.0033***	***0.0024***	***0.0028***	0.0021
	Iron (Fe)	mg/L	0.30	0.326	0.032	0.103	<0.030	0.086	<0.030	0.134
	Lead (Pb)	mg/L	0.001	0.001	0.000131	0.000094	0.000077	0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.001	0.0019	0.0013	0.0026	0.0014	0.0021
	Magnesium (Mg)	mg/L	-	-	9.94	18.9	10.9	27.1	14.8	25.5
	Manganese (Mn)	mg/L	0.935[β]	-	0.00095	0.00671	0.00050	0.01030	0.00084	0.00791
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00343	0.00308	0.00441	0.00320	0.00467	0.00332
	Nickel (Ni)	mg/L	0.025	0.025	0.00128	0.00167	0.00110	0.00160	0.00109	0.00157
	Potassium (K)	mg/L	-	-	2.29	2.88	2.35	2.86	2.82	3.03
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	1.18	1.12	1.39	1.59	1.39	1.74
	Silver (Ag)	mg/L	0.00025	0.0001	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.55	3.15	1.78	4.25	2.61	4.80
	Strontium (Sr)	mg/L	-	-	0.0097	0.0177	0.0116	0.0225	0.0150	0.0237
	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	-	0.00207	0.00305	0.00405	0.00486	0.00802	0.00651
	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	0.0167	<0.0030	0.0108	<0.0030	0.0158

[shaded] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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

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

Table C.35: Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentration Data Provided) Between SDLT1 and Reference Creek Stations in 2019, and at SDLT1 Between 2019 and the Baseline Period, Mary River Project CREMP

Parameter	SDLT1 Station D1-05 (Reach 4)						SDLT1 Station D1-00 (Reach 1)					
	2019 vs Reference Creek			2019 vs Baseline			2019 vs Reference Creek			2019 vs Baseline		
	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
Conductivity (lab)	3.3	1.6	1.4	2.2	1.2	1.1	5.8	3.5	2.2	3.3	2.0	1.5
Hardness (as $CaCO_3$)	3.1	1.4	1.5	2.1	1.2	1.2	5.7	3.3	2.4	3.2	1.9	1.5
Total Suspended Solids (TSS)	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 Dissolved Solids (TDS)	3.2	1.5	1.7	2.0	1.0	1.1	5.7	3.9	2.8	3.0	1.8	1.6
Turbidity	0.5	0.2	0.1	1.3	1.8	1.1	0.7	0.2	0.1	0.3	1.1	1.9
Alkalinity (as $CaCO_3$)	2.5	1.4	1.4	2.1	1.2	1.1	3.4	1.9	1.8	2.3	1.1	1.1
Total Ammonia	0.3	0.6	1.0	0.1	0.1	0.2	1.0	1.5	1.0	0.2	0.4	0.3
Nitrate	6.0	6.6	8.8	1.4	1.5	1.8	23	66	46	4.6	15	13
Nitrite	1.0	1.0	1.0	1.0		0.7	1.0	1.0	1.0	1.0		0.8
Total Kjeldahl Nitrogen (TKN)	1.1	1.0	1.1	1.2	1.3	1.5	1.5	1.2	1.9	1.0	1.0	2.4
Dissolved Organic Carbon	2.7	1.9	1.8	1.1	1.2	1.1	2.7	2.0	2.1	0.9	1.0	1.1
Total Organic Carbon	2.3	1.8	1.6	1.2	1.2	1.2	2.5	2.0	1.9	0.9	1.2	1.2
Total Phosphorus	0.8	0.6	0.6	0.3	0.7	1.0	1.3	0.6	0.6	0.5	0.7	0.5
Phenols	4.5	1.1	0.5				1.1	1.6	0.5			
Bromide (Br)	1.0	1.0	1.0	0.4			1.0	1.0	1.0	0.4		
Chloride (Cl)	4.0	1.7	0.7	0.6	1.1	0.6	8.3	5.0	1.4		2.1	1.5
Sulphate (SO_4)	15	3.7	2.0	14	2.7	1.9	55	26	6.2	87	16	6.4
Aluminum (Al)	0.6	0.1	0.0	0.9	1.3	1.0	1.0	0.1	0.1	0.4	0.8	1.2
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)	2.7	1.2	1.0	2.0	1.2	1.2	4.4	2.1	1.6	2.6	1.5	1.5
Boron (B)	1.0	1.1	1.3	1.0	0.7	0.8	1.4	1.5	1.6	1.3	0.9	1.2
Cadmium (Cd)	4.5	6.4	3.9	1.5	1.0	1.1	1.8	3.4	1.8	1.3	0.9	1.3
Calcium (Ca)	2.8	1.4	1.3	2.0	1.1	1.1	4.9	2.8	2.0	2.8	1.6	1.4
Chromium (Cr)	1.0	0.8	0.8	3.0	2.4	3.8	1.0	0.8	0.8	1.0	1.7	3.3
Cobalt (Co)	1.0	0.8	0.8	0.6	0.8	0.8	1.1	1.0	0.8	0.9	1.3	1.0
Copper (Cu)	5.1	2.5	2.6	1.2	1.1	1.2	4.5	1.8	1.9	1.1	1.0	1.2
Iron (Fe)	0.6	0.2	0.2	0.6	1.2	1.2	2.0	0.6	0.9	0.6	0.8	2.5
Lead (Pb)	1.6	0.4	0.3	0.5	0.7	0.6	1.1	0.3	0.3	0.3	0.9	1.0
Lithium (Li)	1.0	1.3	1.3	2.0	1.5	1.5	1.9	2.6	2.0	3.8	2.1	1.8
Magnesium (Mg)	3.4	1.7	1.6	2.3	1.2	1.2	6.4	4.1	2.7	3.6	2.1	1.8
Manganese (Mn)	1.4	0.3	0.4	1.1	0.7	1.6	9.9	5.2	4.0	1.6	3.9	5.3
Mercury (Hg)	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		
Molybdenum (Mo)	28	12	8.8	3.9	1.8	1.6	26	8.7	6.3	2.4	1.6	1.7
Nickel (Ni)	2.6	1.8	1.7	0.8	1.0	1.1	3.3	2.6	2.4	0.8	1.2	1.4
Potassium (K)	5.3	2.8	2.5	2.6	1.5	1.5	6.7	3.4	2.7	3.0	1.6	1.8
Silicon (Si)	2.0	1.2	1.1	1.4	1.2	1.1	1.9	1.4	1.4	1.0	1.2	1.3
Silver (Ag)	1.1	0.2	1.0	1.0			1.0	0.2	1.0			
Sodium (Na)	2.9	1.2	0.7	5.3	1.8	1.2	5.8	2.8	1.4	6.2	3.4	2.3
Strontium (Sr)	2.3	1.0	0.8	2.9	1.5	1.2	4.2	2.0	1.2	3.5	1.9	1.7
Thallium (Tl)	1.0	-	1.0	-	-	-	1.0	-	1.0	-	-	-
Titanium (Ti)	1.0	1.2	0.7	1.0			1.0	1.2	0.7	1.0		
Uranium (U)	6.9	1.5	1.5	3.2	1.6	1.1	10	1.8	1.2	5.0	2.0	1.5
Vanadium (V)	1.0	1.6	1.0	1.0			1.0	1.6	1.0	1.0		
Zinc (Zn)	1.0	1.0	0.4	2.2	1.2	1.4	5.6	3.6	2.2	17	2.4	5.7

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).
Denotes differences in method detection limit between the 2019 and reference area or baseline data, precluding an evaluation of magnitude of elevation.

Table C.36: Dissolved Metal Concentrations at Sheardown Lake Tributary Water Quality Monitoring Stations, Mary River Project CREMP, 2019

Parameters		Units	Spring Sampling Event		Summer Sampling Event		Fall Sampling Event	
			D1-05	D1-00	D1-05	D1-00	D1-05	DI-00
			28-Jun-19	29-Jun-19	24-Jul-19	24-Jul-19	19-Aug-19	19-Aug-19
Dissolved Metals	Aluminum (Al)	mg/L	0.0133	0.0131	0.0089	0.0074	0.0063	0.0070
	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	0.0081	0.0137	0.0091	0.0163	0.0122	0.0182
	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	0.011	0.014	0.011	0.014	0.013	0.016
	Cadmium (Cd)	mg/L	0.000038	0.000014	0.000031	0.000014	0.000039	<0.000010
	Calcium (Ca)	mg/L	12.4	22.8	15.1	31.9	21.7	35.3
	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	0.00012	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00347	0.00292	0.00319	0.00242	0.00293	0.00207
	Iron (Fe)	mg/L	<0.030	0.045	<0.030	0.059	<0.030	0.082
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	0.0019	0.0012	0.0026	0.0015	0.0023
	Magnesium (Mg)	mg/L	10.2	18.9	10.9	27.3	15.4	25.8
	Manganese (Mn)	mg/L	0.00030	0.00520	0.00037	0.00963	0.00087	0.00775
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.00356	0.00294	0.00440	0.00320	0.00469	0.00340
	Nickel (Ni)	mg/L	0.00122	0.00144	0.00112	0.00164	0.00106	0.00148
	Potassium (K)	mg/L	2.31	2.78	2.33	2.88	2.84	3.08
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	1.18	1.03	1.37	1.53	1.41	1.71
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.58	3.11	1.80	4.30	2.72	4.82
	Strontium (Sr)	mg/L	0.0099	0.0175	0.0117	0.0229	0.0152	0.0240
	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	0.00011	<0.00010	<0.00010
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.0021	0.0030	0.0041	0.0050	0.0083	0.0067
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	0.0127	<0.0030	0.0104	<0.0030	0.0155

Table C.37: *In Situ* Water Quality Profile Data Collected at Sheardown Lake NW Water Quality Monitoring Stations in Winter, Mary River Project CREMP, April 2019

Depth (m)	Temperature (°C)						Dissolved Oxygen (mg/L)						Dissolved Oxygen (% Saturation)					
	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	17-Apr-19	17-Apr-19	17-Apr-19	18-Apr-19	16-Apr-19	16-Apr-19	17-Apr-19	17-Apr-19	17-Apr-19	18-Apr-19	16-Apr-19	16-Apr-19	17-Apr-19	17-Apr-19	17-Apr-19	18-Apr-19	16-Apr-19	16-Apr-19
1.0	0.2	0.6	0.5	0.8	0.1	0.2	14.17	13.45	13.84	13.76	14.32	14.31	97.4	93.7	95.9	95.9	98.4	98.3
2.0	0.3	0.5	0.3	0.8	0.2	0.2	14.16	13.55	13.98	13.98	14.24	14.33	97.7	93.8	96.1	96.7	98.1	98.7
3.0	1.8	1.7	1.1	1.3	1.7	1.3	13.54	13.29	13.50	13.82	13.64	13.82	97.4	95.5	97.8	99.5	98.5	99.6
4.0	1.8	1.8	1.9	1.9	2.0	1.8	13.25	13.02	13.03	13.45	13.22	13.58	95.8	94.2	94.3	97.3	95.8	98.2
5.0	2.0	2.1	2.0	2.1	2.0	2.1	13.04	12.78	12.96	13.23	13.10	13.10	94.6	92.8	93.9	96.0	95.0	95.1
6.0	2.1	2.1	2.1	2.1	2.1	2.1	12.93	12.68	12.95	13.14	13.03	13.09	93.8	92.1	94.0	95.3	94.5	94.9
7.0	2.1	2.1	2.1	2.1	2.1	2.1	12.88	12.60	12.86	13.13	13.03	13.08	93.5	91.5	93.4	95.2	94.5	94.8
8.0	2.1	2.1	2.1		2.1	2.1	12.84	12.56	12.77		13.05	13.10	93.2	91.1	92.8		94.6	95.0
9.0	2.1	2.1	2.1		2.1	2.1	12.76	12.66	12.70		13.05	13.09	92.7	91.8	92.3		94.6	94.9
10.0	2.1	2.1	2.1		2.1	2.1	12.67	12.62	12.62		13.06	13.10	92.1	91.7	92.0		94.7	95.0
11.0		2.2	2.2		2.1	2.1		12.50	12.56		13.04	13.07		90.8	91.3		94.7	94.8
12.0		2.2	2.2		2.1	2.1		12.47	12.52		12.97	13.00		90.6	91.1		94.3	94.3
13.0		2.2	2.2		2.1			12.45	12.45		12.83			90.5	90.5		93.5	
14.0		2.2	2.2		2.2			12.32	12.40		12.68			89.7	90.3		92.3	
15.0		2.2	2.2		2.2			12.13	12.22		12.56			88.5	89.3		91.5	
16.0		2.2	2.3		2.2			11.95	11.97		12.45			87.3	87.4		90.7	
17.0		2.3	2.3					11.67	11.73					85.4	86.0			
18.0		2.3	2.3					11.44	11.45					83.9	84.0			
19.0		2.4	2.4					11.22	11.20					82.3	82.1			
20.0		2.4	2.4					11.98	10.95					80.8	80.3			
21.0		2.5	2.4					10.42	10.76					77.4	79.0			
22.0		2.5						9.64						72.5				
23.0		2.6						4.04						42.0				

Notes: Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 9.9, 22.2, 20.1, 6.6, 16.1 and 11.5 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 1.50, 1.35, 1.58, 1.80, 1.60, and 1.65 m, respectively, at the time of winter sampling.

Table C.37: *In Situ* Water Quality Profile Data Collected at Sheardown Lake NW Water Quality Monitoring Stations in Winter, Mary River Project CREMP, April 2019

Depth (m)	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
Date Collected	17-Apr-19	17-Apr-19	17-Apr-19	18-Apr-19	16-Apr-19	16-Apr-19	17-Apr-19	17-Apr-19	17-Apr-19	18-Apr-19	16-Apr-19	16-Apr-19
1.0	7.90	7.87	7.95	7.98	7.82	7.96	143.4	139.2	142.9	143.8	148.4	149.3
2.0	7.84	7.85	7.84	7.87	7.77	7.83	138.4	138.0	139.1	140.3	145.0	145.8
3.0	7.80	7.83	7.80	7.87	7.74	7.74	132.6	131.5	132.0	134.5	137.8	140.4
4.0	7.77	7.79	7.76	7.81	7.71	7.72	131.8	130.2	131.5	133.4	137.1	138.0
5.0	7.74	7.76	7.75	7.81	7.70	7.68	131.3	129.9	131.5	132.7	136.7	137.0
6.0	7.73	7.74	7.74	7.80	7.69	7.66	131.1	129.9	131.2	132.6	136.8	137.2
7.0	7.71	7.72	7.72	7.77	7.69	7.66	131.0	129.7	130.8	132.7	137.0	137.3
8.0	7.71	7.71	7.71		7.68	7.66	130.9	130.5	130.6		137.0	137.4
9.0	7.69	7.70	7.70		7.68	7.66	131.0	130.6	130.6		137.2	137.5
10.0	7.68	7.69	7.69		7.68	7.66	131.2	130.5	130.3		137.3	137.5
11.0		7.69	7.68		7.67	7.66		130.3	130.4		137.5	137.4
12.0		7.67	7.67		7.66	7.65		130.4	130.4		137.0	137.3
13.0		7.67	7.67		7.66			130.9	130.5		136.5	
14.0		7.65	7.66		7.65			130.7	130.7		136.4	
15.0		7.64	7.64		7.63			130.3	130.2		136.4	
16.0		7.62	7.62		7.62			129.8	130.1		137.2	
17.0		7.60	7.60					129.6	129.8			
18.0		7.59	7.58					129.1	129.6			
19.0		7.57	7.56					128.9	129.5			
20.0		7.55	7.54					128.6	129.9			
21.0		7.52	7.46					128.3	130.2			
22.0		7.47						128.4				
23.0		7.23						139.7				

Notes: Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 9.9, 22.2, 20.1, 6.6, 16.1 and 11.5 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 1.50, 1.35, 1.58, 1.80, 1.60, and 1.65 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, July 2019**

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	25-Jul-19	26-Jul-19	25-Jul-19	25-Jul-19	26-Jul-19	26-Jul-19	25-Jul-19	26-Jul-19	25-Jul-19	25-Jul-19	26-Jul-19	26-Jul-19	25-Jul-19	26-Jul-19	25-Jul-19	25-Jul-19	26-Jul-19	26-Jul-19	25-Jul-19	26-Jul-19	25-Jul-19	25-Jul-19	26-Jul-19	26-Jul-19	25-Jul-19	26-Jul-19	25-Jul-19	25-Jul-19	26-Jul-19	26-Jul-19
1.0	12.2	12.0	12.1	11.7	11.9	11.7	10.82	10.68	10.93	10.91	10.89	10.93	100.5	98.2	101.6	100.8	100.6	100.7	7.82	8.14	8.04	8.09	8.15	8.19	148.8	149.1	148.3	147.8	148.1	147.5
2.0	12.2	12.0	12.1	12.0	11.9	11.7	10.95	10.95	10.97	11.03	10.99	11.05	102.0	101.5	102.0	101.3	101.7	101.8	7.94	8.12	8.07	8.20	8.17	8.18	148.8	149.0	148.6	148.0	148.1	147.6
3.0	12.2	11.9	12.1	12.0	11.9	11.7	10.97	11.01	10.98	11.03	11.02	11.08	102.2	102.0	102.1	102.3	102.9	102.0	8.00	8.02	8.09	8.21	8.18	8.17	148.8	149.1	148.6	148.1	148.1	147.9
4.0	12.1	11.9	11.9	12.0	11.9	11.6	10.97	11.02	11.03	11.03	11.03	11.11	102.2	102.1	101.2	102.3	102.1	102.1	8.01	8.08	8.10	8.21	8.18	8.17	148.8	149.1	148.6	148.3	148.1	148.2
5.0	12.1	11.9	11.7	12.0	11.9	11.3	10.99	11.02	11.11	11.02	11.03	11.17	102.3	102.1	102.2	102.0	102.0	101.8	8.03	8.07	8.10	8.22	8.19	8.15	149.6	149.1	148.8	148.5	148.2	147.1
6.0	12.0	11.9	11.8	11.7	11.7	10.9	11.01	11.02	10.97	11.03	11.05	11.33	102.0	102.1	100.9	101.7	101.7	102.3	8.02	8.06	8.13	8.21	8.18	8.13	155.1	149.1	148.7	148.5	148.2	147.0
7.0		11.9	11.5		9.9	10.8		11.02	11.08		11.42	11.36		102.0	101.5		100.7	102.6		8.06	8.11		8.16	8.12		149.4	148.3		148.1	146.8
8.0		11.7	9.9		9.4	10.7		11.03	11.43		11.52	11.35		101.6	100.8		100.5	102.2		8.04	8.10		8.11	8.11		152.2	147.4		142.3	146.0
9.0		10.6	9.7		9.1			11.25	11.44		11.59			100.6	100.3		100.5			8.01	8.06		8.05			145.4	142.5		141.5	
10.0		8.3	8.8		8.8			11.01	11.56		11.60			97.8	99.3		99.9			7.97	7.97		8.01			145.4	148.5		141.2	
11.0		7.4	8.3		8.4			11.75	11.55		11.60			97.3	98.2		99.0			7.83	7.90		7.98			140.6	140.5		140.7	
12.0		7.1	7.3		7.8			11.78	11.65		11.64			97.2	96.6		97.7			7.74	7.83		7.94			140.2	140.3		140.4	
13.0		6.3	6.6		7.2			11.94	11.85		11.69			96.6	96.6		96.3			7.61	7.77		7.90			140.6	140.6		140.6	
14.0		6.1	6.1		6.2			11.94	11.94		11.83			96.0	96.0		95.3			7.59	7.72		7.84			140.7	140.6		140.8	
15.0		5.7	5.9		5.8			11.95	11.95		11.92			95.4	95.9		95.2			7.56	7.68		7.80			140.8	140.6		140.8	
16.0		5.5	5.7		5.6			11.93	11.56		11.93			94.8	95.2		95.0			7.54	7.63		7.76			140.9	140.9		140.9	
17.0		5.5	5.6		5.4			11.90	11.95		11.91			95.4	95.0		94.5			7.52	7.58		7.73			140.9	140.8		140.9	
18.0		5.5	5.5					11.88	11.94					94.2	95.4					7.50	7.56					140.9	140.8			
19.0		5.4	5.5					11.87	11.93					94.0	94.7					7.48	7.57					140.9	140.9			
20.0		5.4	5.5					11.83	11.93					93.8	94.6					7.48	7.58					141.1	140.9			
21.0			5.4						11.93						94.4						7.57						141.0			
22.0			5.4						11.90						94.3						7.57						141.0			
23.0			5.4						11.88						94.0						7.56						141.0			
24.0			5.4						11.85						93.8						7.55						141.0			
25.0			5.4						11.82						93.5						7.54						141.0			

Note: Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 7.5, 21.5, 27.2, 7.6, 18.8, and 10.5 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, August 2019**

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	22-Aug-19	18-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	18-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	18-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
surface		14.0							10.66							103.2					
1.0	13.0	14.0	12.9	12.9	13.2	13.0	13.2	10.67	10.64	10.43	10.68	10.32	10.71	10.69	101.2	102.9	98.4	101.1	98.2	101.6	99.7
2.0	12.9	14.0	12.9	12.9	13.0	13.0	12.9	10.68	10.62	10.65	10.70	10.64	10.71	10.71	101.1	102.6	100.7	101.3	100.8	101.6	101.5
3.0	12.9	13.9	12.8	12.9	12.9	12.8	12.9	10.68	10.58	10.71	10.70	10.69	10.71	10.71	101.1	102.8	101.2	101.3	101.3	101.3	101.4
4.0	12.8	13.9	12.8	12.8	12.9	12.8	12.8	10.68	10.58	10.72	10.70	10.74	10.71	10.72	101.1	102.5	101.3	101.2	101.4	101.3	101.4
5.0	12.8	13.9	12.8	12.8	12.8	12.8	12.8	10.68	10.70	10.72	10.71	10.77	10.70	10.71	101.0	103.7	101.2	101.2	101.8	101.1	101.4
6.0	12.8	13.9	12.7	12.8		12.8	12.8	10.69	10.44	10.73	10.71		10.70	10.71	101.1	101.2	101.3	101.2		101.0	101.3
7.0	12.8	13.1	12.7	12.8		12.8	12.8	10.70	11.03	10.73	10.71		10.69	10.71	101.0	104.5	101.3	101.1		101.0	101.2
8.0	12.7	11.6	12.7	12.7		12.7	12.8	10.74	11.41	10.73	10.72		10.69	10.71	101.2	105.1	101.2	101.0		100.9	101.1
9.0		9.5	12.6	12.6		12.7	12.7		12.43	10.73	10.99		10.69	10.70		109.1	100.6	101.2		100.9	100.7
10.0		8.5	9.5	10.0		12.7	9.8		13.08	11.68	11.46		10.70	11.45		111.2	101.9	100.6		100.7	100.5
11.0		7.5	8.0	7.2		10.5			12.82	12.20	12.19		11.26			106.5	102.1	101.1		100.8	
12.0		6.6	7.1	6.8		8.5			13.35	12.07	12.07		11.77			109.0	99.3	99.2		100.7	
13.0		6.2	6.4	6.8		8.3			12.91	11.82	11.94		11.82			104.3	95.8	98.0		100.5	
14.0		6.0	6.2	6.1		7.1			12.91	11.78	11.83		11.93			103.7	95.1	95.4		98.4	
15.0		6.0	6.2	6.0		6.5			12.75	11.78	11.72		11.79			102.4	95.2	94.1		96.1	
16.0		5.9	6.0	5.9		6.0			12.82	11.72	11.60		11.61			102.9	94.4	93.0		93.7	
17.0		5.8	5.9	5.8					11.47	11.63	11.47					91.5	93.4	91.6			
18.0		5.7	5.9						12.04	11.55						96.3	92.6				
19.0		5.7	5.8						11.70	11.45						93.6	91.7				
20.0		5.6	5.7						12.15	11.32						96.7	90.4				
21.0		5.6	5.7						12.30	11.22						97.2	89.5				
22.0		5.6	5.6						12.20	11.06						97.0	88.2				
23.0			5.5							10.13							81.5				

Notes: 18-Aug-19 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 9.6, 24.3, 21.1, 7.0 , 17.6, and 11.5 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, August 2019**

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	22-Aug-19	18-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	18-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
surface		8.20							159.6					
1.0	8.38	8.19	8.39	8.33	8.36	8.36	8.34	159.3	159.4	157.9	157.9	158.3	158.2	158.3
2.0	8.28	8.20	8.35	8.34	8.36	8.36	8.35	158.4	159.5	157.9	158.0	158.5	158.2	158.4
3.0	8.27	8.22	8.32	8.34	8.36	8.36	8.35	158.4	159.6	157.9	158.1	158.6	158.3	158.3
4.0	8.26	8.21	8.31	8.35	8.37	8.37	8.35	158.3	159.8	157.9	158.1	159.0	158.3	158.4
5.0	8.25	8.21	8.30	8.35	8.38	8.37	8.35	158.3	159.8	157.9	158.0	159.5	158.0	158.4
6.0	8.24	8.21	8.29	8.35		8.37	8.35	158.9	159.9	157.8	157.9		158.4	158.4
7.0	8.27	8.23	8.28	8.34		8.37	8.35	160.3	157.8	157.8	157.8		158.4	158.4
8.0	8.23	8.19	8.28	8.34		8.36	8.35	158.8	152.4	157.9	155.7		158.4	158.6
9.0		8.12	8.27	8.34		8.37	8.35		147.6	155.2	154.8		158.5	157.7
10.0		7.99	8.25	8.33		8.37	8.33		144.5	145.0	146.2		158.7	151.1
11.0		7.86	8.18	8.28		8.30			142.6	144.6	141.0		158.4	
12.0		7.72	8.06	8.10		8.27			142.2	140.9	140.7		147.2	
13.0		7.63	7.82	8.09		8.20			142.3	140.7	140.9		142.0	
14.0		7.57	7.75	7.97		8.11			142.4	140.8	140.9		141.1	
15.0		7.53	7.71	7.91		8.02			142.4	140.9	140.9		141.0	
16.0		7.50	7.68	7.86		7.98			142.4	141.0	141.1		141.1	
17.0		7.46	7.64	7.82					142.7	141.0	141.1			
18.0		7.44	7.61						142.7	141.0				
19.0		7.42	7.57						142.7	141.1				
20.0		7.40	7.54						142.7	141.1				
21.0		7.38	7.51						142.8	141.3				
22.0		7.37	7.49						142.8	141.5				
23.0			7.44							142.0				

Notes: 18-Aug-19 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 9.6, 24.3, 21.1, 7.0 , 17.6, and 11.5 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 2019

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	18-Aug-2019	7.3	7.3	surface	14.3	11.43	111.6	8.05	160
					bottom	13.3	11.54	110.4	8.25	161
	DLO-01-4	18-Aug-2019	6.9	6.9	surface	14.4	11.42	111.4	8.12	160
					bottom	13.5	10.32	103.9	8.16	161
	DLO-01-3	18-Aug-2019	7.5	7.3	surface	14.2	10.88	106.1	8.24	159
					bottom	13.7	10.54	100.9	8.24	159
	DLO-01-11	18-Aug-2019	7.8	6.6	surface	14.4	11.48	112.2	8.13	160
					bottom	14.4	11.34	111.1	8.15	160
	DLO-01-10	18-Aug-2019	7.8	7.8	surface	14.5	11.31	110.0	8.12	160
					bottom	14.0	11.63	112.9	8.12	159
Profundal (Deep) Stations	DLO-01-5	18-Aug-2019	22.0	6.3	surface	14.0	10.66	103.2	8.20	160
					bottom	5.6	12.20	97.0	7.37	143
	DLO-01-14	18-Aug-2019	20.9	9.8	surface	14.1	10.62	103.2	8.19	160
					bottom	5.8	12.37	99.0	7.63	142
	DLO-01-15	18-Aug-2019	21.0	9.8	surface	14.2	11.17	109.0	8.26	160
					bottom	5.8	12.72	101.6	7.56	143
	DLO-01-2	18-Aug-2019	16.0	8.4	surface	14.4	10.77	105.2	8.13	160
					bottom	6.3	12.38	99.7	7.66	143
	DLO-01-12	18-Aug-2019	13.9	8.3	surface	14.3	11.21	109.2	8.23	160
					bottom	7.1	13.67	112.8	7.76	143

Table C.41: Statistical Comparison of Bottom *In Situ* Water Quality Between Sheardown Lake NW Littoral and Profundal Stations, Mary River Project CREMP, August 2019

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	0.088	α	Littoral	5	7.17	0.45	0.20	6.60	7.80
				Profundal	5	8.49	1.45	0.65	6.25	9.80
Temperature (˚C)	YES	< 0.001	α	Littoral	5	13.78	0.43	0.19	13.30	14.40
				Profundal	5	6.12	0.61	0.27	5.60	7.10
Dissolved Oxygen (mg/L)	YES	0.008	γ	Littoral	5	11.1	0.6	0.3	10.3	11.6
				Profundal	5	12.7	0.6	0.3	12.3	13.7
Dissolved Oxygen (% saturation)	NO	0.142	α	Littoral	5	108.0	5.3	2.4	100.9	112.9
				Profundal	5	102.1	6.2	2.8	97.2	112.8
pH (units)	YES	< 0.001	α	Littoral	5	8.18	0.06	0.03	8.12	8.25
				Profundal	5	7.61	0.15	0.07	7.38	7.76
Specific Conductance (umho/cm)	YES	< 0.001	α	Littoral	5	159.8	0.8	0.4	158.8	160.6
				Profundal	5	143.0	0.6	0.3	142.4	143.9

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; 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.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 2019

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	0.018	α	Reference	5	9.36	1.39	0.62	7.30	10.60
					Sheardown NW	5	7.46	0.38	0.17	6.90	7.80
	Secchi Depth (m)	YES	0.071	β	Reference	5	7.66	0.27	0.12	7.30	8.00
					Sheardown NW	5	7.17	0.45	0.20	6.60	7.80
	Temperature (˚C)	YES	0.018	α	Reference	5	11.78	1.44	0.65	9.80	13.30
					Sheardown NW	5	13.78	0.43	0.19	13.30	14.40
	Dissolved Oxygen (mg/L)	YES	0.063	β	Reference	5	9.7	1.3	0.6	8.3	11.1
					Sheardown NW	5	11.1	0.6	0.3	10.3	11.6
	Dissolved Oxygen (% saturation)	YES	0.018	β	Reference	5	89.0	12.3	5.5	74.9	99.1
					Sheardown NW	5	108.0	5.3	2.4	100.9	112.9
	pH (units)	YES	0.005	η	Reference	5	7.29	0.37	0.17	6.91	7.70
					Sheardown NW	5	8.18	0.06	0.03	8.12	8.25
	Specific Conductance (umho/cm)	YES	<0.001	α	Reference	5	77.9	2.9	1.3	74.9	82.2
					Sheardown NW	5	159.8	0.8	0.4	158.8	160.6
Profundal (Deep) Stations	Station Depth (m)	NO	0.864	α	Reference	5	19.32	2.46	1.10	16.00	21.90
					Sheardown NW	5	18.96	3.83	1.71	13.90	23.00
	Secchi Depth (m)	NO	0.378	α	Reference	5	7.80	0.78	0.35	6.50	8.50
					Sheardown NW	5	8.49	1.45	0.65	6.25	9.80
	Temperature (˚C)	NO	0.126	α	Reference	5	6.96	0.92	0.41	5.60	8.10
					Sheardown NW	5	6.12	0.61	0.27	5.60	7.10
	Dissolved Oxygen (mg/L)	YES	0.008	γ	Reference	5	9.2	2.0	0.9	5.8	10.3
					Sheardown NW	5	12.7	0.6	0.3	12.3	13.7
	Dissolved Oxygen (% saturation)	YES	0.008	γ	Reference	5	76.3	16.3	7.3	47.4	87.3
					Sheardown NW	5	102.1	6.2	2.8	97.2	112.8
	pH (units)	YES	0.006	α	Reference	5	7.02	0.33	0.15	6.62	7.37
					Sheardown NW	5	7.61	0.15	0.07	7.38	7.76
	Specific Conductance (umho/cm)	YES	<0.001	η	Reference	5	79.7	4.7	2.1	75.2	86.0
					Sheardown NW	5	143.0	0.6	0.3	142.4	143.9

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; 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.43: Water Chemistry at Sheardown Lake NW (DLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event											
					DD-HAB9-STN1 bottom 17-Apr-19	DD-HAB9-STN1 surface 17-Apr-19	DL0-01-5 bottom 17-Apr-19	DL0-01-5 surface 17-Apr-19	DL0-01-1 bottom 17-Apr-19	DL0-01-1 surface 17-Apr-19	DL0-01-4 bottom 18-Apr-19	DL0-01-4 surface 18-Apr-19	DL0-01-2 bottom 16-Apr-19	DL0-01-2 surface 16-Apr-19	DL0-01-7 bottom 16-Apr-19	DL0-01-7 surface 16-Apr-19
Conventionals	Conductivity (lab)	umho/cm	-	-	168	178	163	174	165	173	164	175	170	179	171	178
	pH (lab)	pH	6.5 - 9.0	-	7.71	7.69	7.74	7.79	7.77	7.81	7.67	7.68	7.95	7.97	7.58	7.71
	Hardness (as $CaCO_3$)	mg/L	-	-	80.7	84.6	76.8	83.6	77.2	82.8	88.4	93.1	81.4	83.4	76	83.4
	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	-	-	82	119	77	166	101	124	113	225	90	71	72	69
	Turbidity	NTU	-	-	0.12	0.14	0.17	0.13	0.18	0.13	0.15	0.14	0.47	0.15	0.22	0.16
	Alkalinity (as $CaCO_3$)	mg/L	-	-	69	72	67	71	67	71	68	71	69	73	70	72
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.014	0.027	0.019	<0.010	<0.010	0.032	0.020	0.021	<0.010	0.015	<0.010	<0.010
	Nitrate	mg/L	3	3	0.170	0.174	0.209	0.183	0.192	0.176	0.166	0.164	0.172	0.171	0.168	0.167
	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	-	-	0.16	<0.15	<0.15	<0.15	<0.15	0.29	<0.15	<0.15	0.17	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.76	2.08	1.71	1.77	1.64	1.74	1.68	1.64	1.74	1.95	1.68	1.71
	Total Organic Carbon	mg/L	-	-	3.19	2.28	2.03	2.25	3.13	2.32	2.17	2.01	2.01	2.02	2.02	1.96
	Total Phosphorus	mg/L	0.020[α]	-	0.0037	0.0041	0.0031	0.0047	0.0037	0.0075	0.0036	0.0051	0.0050	0.0072	0.0040	0.0042
	Phenols	mg/L	0.004[α]	-	0.0016	<0.0010	0.0020	0.0022	<0.0010	0.0052	<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	4.29	4.56	4.24	4.62	4.25	4.48	4.36	4.58	4.35	4.56	4.34	4.57
	Sulphate (SO_4)	mg/L	218[β]	218	12.4	13.1	12.0	13.1	12.2	12.9	12.6	13.2	12.6	13.1	12.5	13.1
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0032	<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	-	-	0.00749	0.00770	0.00749	0.00766	0.00745	0.00789	0.00765	0.00816	0.00773	0.00801	0.00776	0.00803
	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	-	-	14.7	15.9	14.5	15.5	15.2	17.4	18.0	17.3	15.8	16.3	15.4	15.1
	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	<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	0.00089	0.00089	0.00089	0.00094	0.00088	0.00101	0.00093	0.00095	0.00088	0.00086	0.00098	0.00087
	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	0.001	<0.0010	<0.0010	<0.0010	0.001	0.0018	0.0016	0.0010	0.0011	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	10.1	10.7	9.7	10.6	10.0	10.5	11.0	11.3	10.2	10.6	9.9	10.5
	Manganese (Mn)	mg/L	0.935[β]	-	0.00117	0.00090	0.00194	0.00081	0.00199	0.00102	0.00115	0.00099	0.00098	0.00087	0.00114	0.00083
	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	-	0.001060	0.001080	0.000986	0.001090	0.000966	0.001100	0.001180	0.001190	0.001080	0.001100	0.001060	0.001150
	Nickel (Ni)	mg/L	0.025	0.025	0.00075	0.00078	0.00072	0.00079	0.00067	0.00083	0.00075	0.00074	0.00069	0.00075	0.00069	0.00071
	Potassium (K)	mg/L	-	-	1.40	1.50	1.33	1.49	1.37	1.51	1.46	1.53	1.39	1.45	1.35	1.44
	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	0.56	0.87	0.55	0.77	0.56	0.53	0.56	0.51	0.53	0.51	0.53
	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	-	-	1.78	1.97	1.80	1.93	1.83	1.94	1.99	2.06	1.87	1.96	1.83	1.89
	Strontium (Sr)	mg/L	-	-	0.0102	0.0107	0.0101	0.0106	0.0099	0.0120	0.0114	0.0113	0.0105	0.0110	0.0106	0.0110
	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
	Uranium (U)	mg/L	0.015	-	0.00110	0.00112	0.00101	0.00121	0.00101	0.00113	0.00114	0.00115	0.00118	0.00119	0.00116	0.00121
	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

[grey box] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.43: Water Chemistry at Sheardown Lake NW (DLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event											
					DD-HAB9-STN1 bottom 25-Jul-19	DD-HAB9-STN1 surface 25-Jul-19	DL0-01-5 bottom 26-Jul-19	DL0-01-5 surface 26-Jul-19	DL0-01-1 bottom 25-Jul-19	DL0-01-1 surface 25-Jul-19	DL0-01-4 bottom 25-Jul-19	DL0-01-4 surface 25-Jul-19	DL0-01-2 bottom 26-Jul-19	DL0-01-2 surface 26-Jul-19	DL0-01-7 bottom 26-Jul-19	DL0-01-7 surface 26-Jul-19
Conventionals	Conductivity (lab)	umho/cm	-	-	156	149	143	151	141	148	148	148	143	150	149	149
	pH (lab)	pH	6.5 - 9.0	-	8.18	8.22	7.79	8.17	7.70	8.20	8.27	8.25	8.00	8.17	8.07	8.19
	Hardness (as $CaCO_3$)	mg/L	-	-	74.7	67.4	65.6	70.7	64.6	69.1	68.6	67.7	67.0	69.6	69.0	70.0
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	2.8	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	80	76	87	94	78	69	77	72	103	95	95	91
	Turbidity	NTU	-	-	1.30	1.05	0.87	0.92	1.11	1.11	1.10	1.02	0.96	1.03	1.02	1.07
	Alkalinity (as $CaCO_3$)	mg/L	-	-	64	59	63	64	61	62	64	62	62	64	64	63
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.028	0.024	0.034	0.02	0.119	0.02	0.012	0.0625	0.0305	<0.010	<0.010	<0.020
	Nitrate	mg/L	3	3	0.183	0.127	0.128	0.123	0.127	0.121	0.121	0.119	0.123	0.119	0.114	0.116
	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	0.16	<0.15	<0.15	<0.15	0.79	<0.15	<1.5	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.09	2.07	1.69	1.91	2.11	2.13	1.84	1.65	1.79	2.09	1.97	2.28
	Total Organic Carbon	mg/L	-	-	2.18	2.23	2.09	2.38	2.04	2.24	2.23	2.22	2.00	2.23	2.09	2.26
	Total Phosphorus	mg/L	0.020[α]	-	0.0047	0.0044	<0.0030	<0.0030	0.0047	0.0049	<0.0030	0.0049	<0.0030	<0.0030	<0.0030	0.0041
	Phenols	mg/L	0.004[α]	-	0.001	<0.0010	0.0011	0.0022	<0.0010	0.0017	<0.0010	0.0011	<0.0010	0.0013	0.0014	0.0016
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	4.11	3.82	3.71	3.84	3.69	3.81	3.80	3.79	3.70	3.88	3.79	3.84
	Sulphate (SO_4)	mg/L	218[β]	218	16.2	12.9	10.7	12.9	10.7	12.8	12.6	12.6	10.8	12.7	12.2	12.5
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.0209	0.0115	0.0094	0.0105	0.0181	0.0131	0.0135	0.0155	0.0115	0.0118	0.0184	0.0231
	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	-	-	0.00727	0.00698	0.00686	0.00702	0.00672	0.00707	0.00707	0.00698	0.00703	0.00736	0.00732	0.00724
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<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	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	13.6	12.8	12.6	13.1	12.2	12.7	12.7	12.6	13.1	13.3	12.8	13.0
	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
	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	0.00087	0.0008	0.00085	***0.0034***	0.0009	0.0010	0.00089	0.0009	0.0009	0.0014	0.00108
	Iron (Fe)	mg/L	0.30	0.300	0.024	<0.030	<0.030	<0.030	0.031	<0.030	<0.030	0.018	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	0.000065	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000066	0.00007
	Lithium (Li)	mg/L	-	-	0.0010	<0.0010	0.0011	0.0012	<0.0010	0.0010	0.0011	0.0010	0.00115	0.0012	0.0012	0.0012
	Magnesium (Mg)	mg/L	-	-	9.54	8.69	8.58	9.10	8.37	8.82	8.82	8.83	8.91	9.36	9.11	9.01
	Manganese (Mn)	mg/L	0.935[β]	-	0.00225	0.00237	0.00283	0.00238	0.00398	0.00238	0.00260	0.00238	0.00238	0.00243	0.00344	0.00284
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00104	0.000943	0.000861	0.000968	0.000834	0.000932	0.000921	0.000933	0.000904	0.000949	0.000920	0.000908
	Nickel (Ni)	mg/L	0.025	0.025	0.00082	0.00067	0.00068	0.00070	0.00069	0.00069	0.00064	0.00070	0.00070	0.00072	0.00078	0.00082
	Potassium (K)	mg/L	-	-	1.36	1.27	1.28	1.32	1.26	1.29	1.29	1.30	1.32	1.37	1.37	1.32
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.48	0.42	0.60	0.42	0.59	0.43	0.43	0.45	0.50	0.43	0.46	0.46
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.73	1.58	1.56	1.63	1.52	1.59	1.60	1.62	1.61	1.68	1.76	1.64
	Strontium (Sr)	mg/L	-	-	0.0100	0.00957	0.00902	0.00953	0.00887	0.00948	0.00932	0.00933	0.00934	0.00959	0.00945	0.00949
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<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
	Uranium (U)	mg/L	0.015	-	0.0012	0.00107	0.00089	0.00099	0.00093	0.00102	0.00101	0.00105	0.00094	0.00097	0.00094	0.00097
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<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	0.0061	0.0038

(Shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.43: Water Chemistry at Sheardown Lake NW (DLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

	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
					22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
Conventionals	Conductivity (lab)	umho/cm	-	-	174	176	174	174	167	173	174	174	166	175	177	177
	pH (lab)	pH	6.5 - 9.0	-	8.28	6.97	8.30	8.28	8.29	8.28	8.29	8.29	8.34	8.30	8.33	8.33
	Hardness (as $CaCO_3$)	mg/L	-	-	78.4	77.7	79.8	77.2	78.3	77.9	79.4	79.0	77.6	77.0	80.1	78.8
	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	-	-	78	84	83	74	77	70	83	85	78	84	84	82
	Turbidity	NTU	-	-	0.57	0.49	0.35	0.65	0.68	0.56	1.16	0.82	0.57	0.55	0.53	0.55
	Alkalinity (as $CaCO_3$)	mg/L	-	-	62	61	61	62	60	65	63	62	60	62	60	60
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	<0.010	<0.010	0.012	<0.010	0.020	<0.010	0.022	<0.010	0.025	0.018	<0.010	<0.010
	Nitrate	mg/L	3	3	0.125	0.189	0.127	0.126	0.130	0.125	0.129	0.183	0.135	0.126	0.376	0.718
	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	-	-	0.23	0.19	0.28	0.21	0.28	0.20	0.34	0.19	0.4	0.24	0.2	0.18
	Dissolved Organic Carbon	mg/L	-	-	2.30	1.76	1.82	1.71	1.84	1.83	1.90	1.96	1.77	1.68	1.83	1.90
	Total Organic Carbon	mg/L	-	-	2.33	2.10	2.22	2.38	2.09	2.32	2.55	2.29	1.98	2.27	2.16	2.20
	Total Phosphorus	mg/L	0.020[α]	-	0.0049	0.0041	0.0236	0.0043	0.0225	0.0034	0.0227	0.0054	0.0175	0.0042	0.0347	0.0035
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<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	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	4.15	4.20	4.13	4.14	4.06	4.22	4.34	4.46	4.03	4.16	5.46	4.38
	Sulphate (SO_4)	mg/L	218[β]	218	14.1	14.2	14.1	14.1	12.8	14.1	14.1	14.6	12.6	14.1	14.1	14.1
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.0065	0.0071	0.0187	0.0077	0.0654	0.0067	0.0204	0.0086	0.0204	0.0057	0.0072	0.0138
	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	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00714	0.00705	0.00739	0.00722	0.00758	0.00722	0.00741	0.00716	0.00680	0.00718	0.00771	0.00734
	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	-	-	14.3	14.4	15.1	14.7	12.7	14.6	15.0	15.2	13.3	14.3	15.4	14.5
	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	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00090	0.00088	0.00114	0.00087	0.00128	0.00087	0.00105	0.00093	0.00090	0.00089	0.00091	0.00091
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	0.103	<0.030	0.071	<0.030	<0.030	<0.030	<0.030	0.052
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	0.000206	<0.000050	0.000051	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.0011	0.0011	0.0012	0.0011	<0.0010	0.0011	0.0013	0.0012	0.0012	0.0011	0.0014	0.0013
	Magnesium (Mg)	mg/L	-	-	9.85	9.89	10.30	9.72	8.77	9.63	10.00	10.10	8.86	9.88	10.20	10.09
	Manganese (Mn)	mg/L	0.935[β]	-	0.00165	0.00188	0.00140	0.00164	0.01490	0.00146	0.00752	0.00156	0.00493	0.00153	0.00097	0.00240
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.000977	0.000955	0.000965	0.000957	0.000714	0.000974	0.000923	0.000981	0.000821	0.000984	0.001140	0.001071
	Nickel (Ni)	mg/L	0.025	0.025	0.00068	0.00079	0.00070	0.00071	0.00096	0.00066	0.00076	0.00070	0.00077	0.00069	0.00076	0.00086
	Potassium (K)	mg/L	-	-	1.37	1.34	1.44	1.36	1.32	1.35	1.38	1.40	1.29	1.37	1.46	1.43
	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	-	-	0.39	0.37	0.38	0.39	0.63	0.36	0.40	0.39	0.58	0.37	0.39	0.40
	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	-	-	1.83	1.81	1.86	1.80	1.61	1.76	1.86	1.85	1.60	1.79	1.88	1.88
	Strontium (Sr)	mg/L	-	-	0.0102	0.0101	0.0105	0.0100	0.0093	0.0100	0.0102	0.0101	0.0091	0.0101	0.0105	0.0103
	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
	Uranium (U)	mg/L	0.015	-	0.00111	0.00109	0.00098	0.00105	0.00097	0.00110	0.00115	0.00111	0.00088	0.00112	0.00094	0.00108
	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

[shaded] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

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 2019, and at the Sheardown Lake Basins Between 2019 and the Baseline Period

Variable	Sheardown Lake NW					Sheardown Lake SE				
	2019 vs Reference Lake 3		2019 vs Baseline			2019 vs Reference Lake 3		2019 vs Baseline		
	Summer	Fall	Winter	Summer	Fall	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	2.0	2.1	1.2	1.3	1.4	1.6	1.8	1.0	1.2	1.3
Hardness (as $CaCO_3$)	1.9	2.2	1.2	1.2	1.3	1.6	1.9	1.2	1.2	1.3
Total Suspended Solids (TSS)	0.5	1.0	1.0	0.5	0.8	0.6	1.6	0.9	0.9	1.3
Total Dissolved Solids (TDS)	1.8	1.5	1.2	1.1	1.0	1.6	1.3	1.1	1.2	1.0
Turbidity	4.1	1.8	0.8	1.3	1.2	18	12	0.8	2.7	2.3
Alkalinity (as $CaCO_3$)	1.8	1.8	1.0	1.1	1.1	1.6	1.7	1.0	1.1	1.1
Total Ammonia	3.3	1.4	0.1	0.7	0.3	2.0	1.8	0.3	0.8	0.6
Nitrate	6.3	5.8	1.8	1.3	2.0	4.0	2.9	0.9	0.8	1.0
Nitrite	1.0	1.0	1.3	0.1	1.1	1.0	1.0	1.4	0.4	1.1
Total Kjeldahl Nitrogen (TKN)	2.1	1.4	0.7	2.0	1.6	1.1	0.9	0.7	1.1	0.7
Dissolved Organic Carbon	0.7	0.7	1.0	1.1	1.1	0.6	0.6	1.0	1.1	1.1
Total Organic Carbon	0.7	0.7	1.3	1.2	1.3	0.7	0.7	1.2	1.3	1.3
Total Phosphorus	0.8	0.6	1.3	0.6	2.4	1.1	0.4	1.2	0.7	1.5
Phenols	0.8	1.0	1.6	1.3	1.0	0.8	1.0	2.2	1.2	1.0
Bromide (Br)	1.0	1.0	0.6	0.4	0.4	1.0	1.0	0.7	0.4	0.4
Chloride (Cl)	2.9	3.1	1.3	1.5	1.6	2.1	2.5	1.2	1.2	1.1
Sulphate (SO_4)	3.3	3.7	3.9	4.6	4.6	2.0	2.3	2.8	3.4	3.5
Aluminum (Al)	4.3	2.0	1.0	1.0	0.8	19	9.7	0.7	0.8	1.1
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.4	1.0	1.0	1.4
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.1
Barium (Ba)	1.1	1.2	1.3	1.4	1.4	1.1	1.2	1.2	1.2	1.2
Beryllium (Be)	0.9	1.0	2.0	1.2	1.5	1.0	1.0	1.5	1.2	1.3
Cadmium (Cd)	0.9	1.0	0.8	0.8	0.9	1.0	1.0	0.8	0.8	0.8
Calcium (Ca)	1.8	2.0	1.1	1.1	1.2	1.6	1.9	1.1	1.2	1.2
Chromium (Cr)	1.0	1.0	-	-	-	1.0	1.0	-	-	-
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9	1.0	1.1	1.0	0.9	0.9
Copper (Cu)	1.5	1.2	0.9	1.2	0.7	1.1	1.2	0.8	0.7	1.0
Iron (Fe)	1.0	1.4	1.2	1.0	1.1	2.3	2.5	0.6	0.7	1.0
Lead (Pb)	1.1	1.3	0.9	1.0	0.1	1.8	2.3	0.5	0.8	1.3
Lithium (Li)	1.1	1.2	0.5	0.3	0.0	1.0	1.3	0.4	0.2	0.3
Magnesium (Mg)	2.0	2.1	1.2	1.3	1.4	1.6	1.8	1.2	1.3	1.3
Manganese (Mn)	5.6	5.8	1.8	1.5	1.6	7.2	8.5	0.3	0.6	1.6
Mercury (Hg)	1.0	1.0	1.0	0.4	0.1	1.0	1.0	1.0	0.5	0.5
Molybdenum (Mo)	6.8	6.7	1.3	1.4	1.4	3.8	4.2	1.4	1.5	1.4
Nickel (Ni)	1.4	1.5	1.0	1.1	1.1	1.2	1.3	0.8	0.9	1.0
Potassium (K)	1.6	1.5	1.4	1.6	1.6	1.3	1.3	1.4	1.7	1.6
Selenium (Se)	0.8	1.0	-	-	-	1.0	1.0	-	-	-
Silicon (Si)	1.1	0.9	0.7	0.8	0.7	1.4	1.2	0.7	0.9	0.8
Silver (Ag)	1.7	1.0	2.5	1.7	1.3	1.0	1.0	1.6	1.4	1.4
Sodium (Na)	2.0	2.0	1.3	1.5	1.6	1.5	1.7	1.4	1.9	1.7
Strontium (Sr)	1.2	1.2	1.2	1.3	1.3	1.2	1.3	0.9	1.1	1.1
Thallium (Tl)	0.9	1.0	2.3	1.3	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)	0.8	1.0	1.0	0.8	1.0	1.0	1.0	1.0	0.9	0.9
Uranium (U)	4.4	4.3	1.2	1.4	1.3	3.3	3.9	1.0	1.4	1.3
Vanadium (V)	0.9	1.0	1.0	0.9	1.0	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.1	0.7	1.2	1.6	1.2	1.0	1.9	1.0	1.8	5.2

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).

Denotes differences in method detection limit between the 2019 and baseline data, precluding an evaluation of magnitude of elevation.

Table C.45: Dissolved Metal Concentrations at Sheardown Lake NW Water Quality Monitoring Stations, Mary River Project CREMP, 2019

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
			17-Apr-19	17-Apr-19	17-Apr-19	17-Apr-19	17-Apr-19	17-Apr-19	18-Apr-19	18-Apr-19	16-Apr-19	16-Apr-19	16-Apr-19	16-Apr-19	25-Jul-19	25-Jul-19	26-Jul-19	26-Jul-19	25-Jul-19	25-Jul-19
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	0.0042	0.0045	0.0034	0.0068	<0.0030	0.0041
	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	0.00716	0.00767	0.00750	0.00746	0.00723	0.00771	0.00813	0.00826	0.00789	0.00821	0.00773	0.00806	0.00735	0.00686	0.00668	0.00704	0.00671	0.00696
	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	15.1	15.8	14.4	16.1	14.6	15.8	17.3	18.2	16.1	16.1	14.6	15.8	13.8	12.6	12.4	13.2	12.2	12.9
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00106	<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	0.00086	0.00085	0.00089	0.00087	0.00090	0.00090	0.00096	0.00104	0.00085	0.00084	0.00088	0.00089	0.00103	0.00094	0.00098	0.00086	0.00093	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	<0.0010	<0.0010	<0.0010	0.0013	0.0014	0.0013	0.0011	<0.0010	0.00120	0.0013	0.0011	<0.0010	0.0011	<0.0010	0.0012
	Magnesium (Mg)	mg/L	10.5	11.0	9.89	10.6	9.91	10.5	11.0	11.6	10.0	10.5	9.60	10.7	9.79	8.72	8.41	9.18	8.30	8.97
	Manganese (Mn)	mg/L	0.000135	0.000188	0.000173	0.000141	0.000182	0.000135	0.000210	0.000192	0.000138	0.000188	0.000152	0.000220	0.000508	0.000296	0.000131	0.000251	0.000083	0.000237
	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	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.001030	0.001090	0.000995	0.001080	0.001030	0.001040	0.001230	0.001240	0.001130	0.001120	0.001050	0.001080	0.001050	0.000964	0.000906	0.000988	0.000927	0.000949
	Nickel (Ni)	mg/L	0.000740	0.00076	0.00069	0.00077	0.00073	0.00074	0.00101	0.00082	0.00070	0.00072	0.00069	0.00072	0.00068	0.00067	0.00065	0.00068	0.00063	0.00065
	Potassium (K)	mg/L	1.40	1.51	1.37	1.47	1.39	1.48	1.50	1.56	1.37	1.46	1.35	1.46	1.37	1.29	1.26	1.32	1.26	1.31
	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	0.56	0.55	0.82	0.54	0.72	0.54	0.54	0.53	0.54	0.50	0.51	0.54	0.47	0.41	0.57	0.42	0.56	0.42
	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	1.82	2.04	1.80	1.94	1.84	1.94	2.03	2.18	1.83	1.94	1.82	1.99	1.74	1.59	1.54	1.66	1.52	1.63
	Strontium (Sr)	mg/L	0.0102	0.0109	0.0101	0.0106	0.0102	0.0103	0.0113	0.0119	0.0110	0.0108	0.0103	0.0106	0.0102	0.0093	0.0091	0.0096	0.0089	0.0094
	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	0.00015	<0.00010	<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	0.00110	0.00119	0.00104	0.00120	0.00108	0.00112	0.00121	0.00125	0.00126	0.00125	0.00123	0.00127	0.00121	0.00104	0.00089	0.00103	0.00091	0.00102
	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, 2019

	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
			25-Jul-19	25-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
Dissolved Metals	Aluminum (Al)	mg/L	0.0042	0.0041	0.01105	0.0041	0.0041	0.005	0.0033	0.0042	0.0059	<0.0030	0.0044	0.0045	0.0060	0.0048	0.0053	0.0041	0.0192	0.01335
	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	0.00698	0.00675	0.00694	0.00692	0.00694	0.00708	0.00697	0.00706	0.00710	0.00710	0.00704	0.00720	0.00737	0.00721	0.00727	0.00725	0.00719	0.00733
	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	0.000012	<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	12.8	12.8	12.7	13.1	12.9	13.1	14.5	14.4	15.4	14.4	14.9	14.7	15.0	14.9	14.7	14.5	15.3	15.0
	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	0.00182	0.00092	0.00185	0.00100	0.00119	0.00085	0.00148	0.00091	0.00115	0.00087	0.00114	0.00095	0.00113	0.00096	0.00097	0.00085	0.00103	0.00097
	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	0.000083	<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	0.00125	0.0011	0.0012	0.0011	0.0011	0.0013	0.0014	0.0015	0.0014	0.0014	0.0014	0.0015	0.0015	0.0013	0.0013	0.0015	0.0014
	Magnesium (Mg)	mg/L	8.91	8.69	8.61	8.98	8.94	9.07	10.3	10.1	10.1	10.0	9.95	10.0	10.20	10.20	9.9	9.9	10.2	10.1
	Manganese (Mn)	mg/L	0.000169	0.000330	0.000430	0.000227	0.000112	0.000201	0.000377	0.000518	0.000409	0.000329	0.000378	0.000477	0.000625	0.000382	0.000400	0.000395	0.000661	0.000667
	Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000940	0.000954	0.000928	0.000947	0.000949	0.000929	0.001020	0.000991	0.001010	0.000961	0.000999	0.000969	0.000987	0.000988	0.001060	0.001020	0.001020	0.001065
	Nickel (Ni)	mg/L	0.00063	0.00061	0.00074	0.00068	0.00064	0.00068	0.00067	0.00083	0.00068	0.00065	0.00066	0.00068	0.00067	0.00067	0.00067	0.00069	0.00076	0.00078
	Potassium (K)	mg/L	1.29	1.27	1.31	1.31	1.30	1.30	1.38	1.38	1.39	1.38	1.38	1.38	1.40	1.40	1.38	1.39	1.41	1.40
	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	0.43	0.41	0.56	0.41	0.43	0.42	0.36	0.37	0.38	0.38	0.38	0.37	0.39	0.39	0.37	0.37	0.37	0.39
	Silver (Ag)	mg/L	<0.000010	<0.000010	0.000017	<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	1.61	1.57	1.61	1.62	1.60	1.63	1.85	1.83	1.85	1.81	1.83	1.85	1.85	1.84	1.81	1.79	1.84	1.85
	Strontium (Sr)	mg/L	0.0093	0.0094	0.0096	0.0096	0.0094	0.0095	0.0100	0.0101	0.0102	0.0101	0.0101	0.0101	0.0102	0.0103	0.0102	0.0102	0.0106	0.0105
	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	0.00101	0.00102	0.00091	0.00102	0.00096	0.00099	0.00113	0.00114	0.00113	0.00113	0.00113	0.00111	0.00115	0.00115	0.00115	0.00114	0.00113	0.00114
	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	0.0077	<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 2019, and at Sheardown Lake Northwest Between 2019 and the Baseline Period

Dissolved Metal	Sheardown Lake NW				
	2019 vs Reference Lake 3		2019 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	1.6	0.6	0.0	1.1	2.2
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)	1.1	1.1	0.0	1.3	1.2
Beryllium (Be)	1.0	1.2	1.2	1.2	2.1
Cadmium (Cd)	1.0	1.1	0.4	0.0	0.8
Calcium (Ca)	1.8	2.1	1.2	1.1	1.3
Chromium (Cr)	1.0	1.0	-	-	-
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9
Copper (Cu)	1.4	1.2	0.7	0.7	1.3
Iron (Fe)	1.0	1.1	1.2	1.2	1.7
Lead (Pb)	1.1	1.0	0.6	1.1	1.0
Lithium (Li)	1.1	1.4	0.3	0.0	0.6
Magnesium (Mg)	2.0	2.3	1.3	1.3	1.4
Manganese (Mn)	1.7	1.1	0.3	0.0	0.7
Mercury (Hg)	1.0	1.0	1.0	0.5	0.5
Molybdenum (Mo)	6.6	6.4	4.8	0.0	5.0
Nickel (Ni)	1.3	1.4	1.1	0.7	1.2
Potassium (K)	1.6	1.5	0.9	1.2	1.2
Selenium (Se)	1.0	1.2	-	-	-
Silicon (Si)	1.1	0.8	1.2	1.2	0.9
Silver (Ag)	1.1	0.6	1.2	1.9	2.7
Sodium (Na)	2.0	2.0	1.2	1.3	1.4
Strontium (Sr)	1.2	1.2	1.4	1.3	1.4
Thallium (Tl)	1.0	1.2	1.2	1.3	2.6
Tin (Sn)	1.0	1.0	0.1	0.2	0.1
Titanium (Ti)	1.0	1.2	1.0	1.0	1.0
Uranium (U)	4.3	4.4	2.4	2.2	2.3
Vanadium (V)	1.0	1.1	1.0	1.0	1.0
Zinc (Zn)	1.1	0.6	1.5	1.1	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).

Denotes differences in method detection limit between the 2019 and baseline data, precluding an evaluation of magnitude of elevation.

Table C.47: Spearman's Rank Correlation Coefficients for Sheardown Lake NW (DLO-1) Water Quality Data Collected in Winter, Summer, and Fall 2019[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	Iron	Manganese	Molybdenum	Nickel	Potassium	Sodium	Strontium	Uranium
Conductivity	1	0.804	0.021	-0.619	0.224	0.555	0.063	0.413	0.840	0.705	-0.451	0.593	-0.083	0.147	-0.651	0.665	0.333	0.751	0.801	0.760	0.552
Hardness	0.804	1	0.257	-0.770	0.471	0.567	0.051	0.442	0.904	0.453	-0.552	0.769	0.062	0.114	-0.715	0.769	0.412	0.886	0.897	0.857	0.617
Total Dissolved Solids	0.021	0.257	1	-0.264	0.252	0.155	0.127	-0.144	0.205	-0.095	-0.175	0.205	0.246	-0.003	-0.117	0.195	0.305	0.444	0.347	0.231	-0.022
Turbidity	-0.619	-0.770	-0.264	1	-0.560	-0.588	0.061	-0.100	-0.756	-0.059	0.812	-0.691	0.119	0.056	0.787	-0.740	-0.208	-0.707	-0.742	-0.754	-0.429
Alkalinity	0.224	0.471	0.252	-0.560	1	0.199	0.009	-0.217	0.501	-0.150	-0.697	0.669	-0.128	-0.244	-0.587	0.604	0.039	0.525	0.537	0.569	0.606
Nitrate	0.555	0.567	0.155	-0.588	0.199	1	-0.111	0.254	1	0.270	-0.469	0.494	0.012	0.104	-0.482	0.594	0.360	0.503	0.582	0.556	0.394
Total Organic Carbon	0.063	0.051	0.127	0.061	0.009	-0.111	1	-0.050	0.040	0.290	0.004	-0.129	-0.100	0.003	0.018	-0.007	-0.093	0.119	0.025	0.025	0.091
Total Phosphorus	0.413	0.442	-0.144	-0.100	-0.217	0.254	-0.050	1	0.355	0.443	0.130	0.245	0.296	0.110	-0.213	0.147	0.251	0.293	0.300	0.284	0.225
Chloride	0.840	0.904	0.205	-0.756	0.501	0.727	0.040	0.355	1	0.463	-0.661	1	-0.011	0.075	-0.778	0.866	0.345	0.865	0.914	0.890	0.671
Sulphate	0.705	0.453	-0.095	-0.059	-0.150	0.270	0.290	0.443	0.463	1	0.026	0.136	-0.038	-0.036	-0.333	0.376	0.226	0.433	0.433	0.428	0.472
Aluminum (total)	-0.451	-0.552	-0.175	0.812	-0.697	-0.469	0.004	0.130	-0.661	0.026	1	-0.572	0.393	0	0.815	-0.755	0.186	-0.533	-0.619	-0.677	-0.546
Barium (total)	0.593	0.769	0.205	-0.691	0.669	0.494	-0.129	0.245	0.808	0.136	-0.572	1	0.152	0.076	-1	0.751	0.375	0.807	0.814	0.812	0.575
Copper (total)	-0.083	0.062	0.246	0.119	-0.128	0.012	-0.100	0.296	-0.011	-0.038	0.393	0.152	1	0.277	0.211	-0.127	0.393	0.137	0.091	0.025	-0.051
Iron (total)	0.147	0.114	-0.003	0.056	-0.244	0.104	0.003	0.110	0.075	-0.036	0.191	0.076	0.277	1	0.343	-0.219	0.167	0.004	0.022	-0.046	-0.198
Manganese (total)	-0.651	-0.715	-0.117	0.787	-0.587	-0.482	0.018	-0.213	-0.778	-0.333	0.815	-0.668	0.211	0.343	1	-0.882	-0.003	-1	-0.761	-0.839	-0.669
Molybdenum (total)	0.665	0.769	0.195	-0.740	0.604	0.594	-0.007	0.147	0.866	0.376	-0.755	0.751	-0.127	-0.219	-0.882	1	0.184	0.822	1	0.912	0.732
Nickel (total)	0.333	0.412	0.305	-0.208	0.039	0.360	-0.093	0.251	0.345	0.226	0.186	0.375	0.393	0.167	-0.003	0.184	1	0.417	0.360	0.278	0.116
Potassium (total)	0.751	0.886	0.444	-0.707	0.525	0.503	0.119	0.293	0.865	0.433	-0.533	0.807	0.137	0.004	-0.727	0.822	0.417	1	0.942	0.889	0.585
Sodium (total)	0.801	0.897	0.347	-0.742	0.537	0.582	0.025	0.300	0.914	0.433	-0.619	0.814	0.091	0.022	-0.761	0.851	0.360	0.942	1	0.941	1
Strontium (total)	0.760	0.857	0.231	-0.754	0.569	0.556	0.025	0.284	0.890	0.428	-0.677	0.812	0.025	-0.046	-0.839	0.912	0.278	0.889	0.941	1	0.753
Uranium (total)	0.552	0.617	-0.022	-0.429	0.606	0.394	0.091	0.225	0.671	0.472	-0.546	0.575	-0.051	-0.198	-0.669	0.732	0.116	0.585	0.661	0.753	1
Aluminum (dissolved)	-0.103	-0.301	-0.039	0.546	-0.683	-0.215	0.075	0.055	-0.310	0.295	0.700	-0.456	0.135	0.169	0.498	-0.430	0.097	-0.290	-0.347	-0.389	-0.444
Barium (dissolved)	0.656	0.799	0.144	-0.677	0.632	0.619	-0.160	0.272	0.844	0.280	-0.591	0.785	0.069	-0.003	-0.655	0.781	0.328	0.712	0.814	0.814	0.726
Copper (dissolved)	-0.186	-0.171	0.116	0.334	-0.386	-0.165	-0.183	0.011	-0.259	0.064	0.466	-0.196	0.451	0.153	0.406	-0.319	-0.005	-0.090	-0.157	-0.248	-0.339
Iron (dissolved)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese (dissolved)	0.321	0.050	-0.203	0.263	-0.582	0.060	0.089	0.276	0.047	0.679	0.394	-0.223	-0.031	0.050	0.138	-0.076	0.158	-0.015	0.010	-0.025	-0.028
Molybdenum (dissolved)	0.678	0.836	0.173	-0.750	0.480	0.649	-0.175	0.339	0.808	0.313	-0.587	0.710	0.005	-0.062	-0.685	0.800	0.341	0.725	0.783	0.788	0.678
Nickel (dissolved)	0.572	0.675	0.482	-0.751	0.417	0.645	-0.088	-0.032	0.730	0.204	-0.631	0.611	-0.061	-0.006	-0.646	0.739	0.381	0.689	0.723	0.741	0.437
Potassium (dissolved)	0.826	0.940	0.302	-0.750	0.411	0.606	0.136	0.390	0.899	0.501	-0.533	0.707	0.066	0.133	-0.671	0.753	0.432	0.888	0.879	0.827	0.566
Sodium (dissolved)	0.814	0.947	0.208	-0.724	0.467	0.535	0.095	0.386	0.879	0.505	-0.536	0.729	0.063	0.150	-0.676	0.728	0.319	0.841	0.895	0.845	0.620
Strontium (dissolved)	0.767	0.903	0.284	-0.738	0.488	0.678	-0.135	0.375	0.919	0.390	-0.586	0.799	0.063	0.019	-0.739	0.831	0.380	0.858	0.895	0.863	0.655
Uranium (dissolved)	0.758	0.786	-0.001	-0.534	0.379	0.573	-0.206	0.453	0.788	0.538	-0.454	0.632	0.012	-0.021	-0.635	0.695	0.294	0.643	0.742	0.751	0.782

(green) Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

Table C.47: Spearman's Rank Correlation Coefficients for Sheardown Lake NW (DLO-1) Water Quality Data Collected in Winter, Summer, and Fall 2019[a]

Parameters	Dissolved Metals										
	Aluminum	Barium	Copper	Iron	Manganese	Molybdenum	Nickel	Potassium	Sodium	Strontium	Uranium
Conductivity	-0.103	0.656	-0.186	-	0.321	0.678	0.572	0.826	0.814	0.767	0.758
Hardness	-0.301	0.799	-0.171	-	0.050	0.836	0.675	0.940	0.947	0.903	0.786
Total Dissolved Solids	-0.039	0.144	0.116	-	-0.203	0.173	0.482	0.302	0.208	0.284	-0.001
Turbidity	0.546	-0.677	0.334	-	0.263	-0.750	-0.751	-0.750	-0.724	-0.738	-0.534
Alkalinity	-0.683	0.632	-0.386	-	-0.582	0.480	0.417	0.411	0.467	0.488	0.379
Nitrate	-0.215	0.619	-0.165	-	0.060	0.649	0.645	0.606	0.535	0.678	0.573
Total Organic Carbon	0.075	-0.160	-0.183	-	0.089	-0.175	-0.088	0.136	0.095	-0.135	-0.206
Total Phosphorus	0.055	0.272	0.011	-	0.276	0.339	-0.032	0.390	0.386	0.375	0.453
Chloride	-0.310	0.844	-0.259	-	0.047	0.808	0.730	0.899	0.879	0.919	0.788
Sulphate	0.295	0.280	0.064	-	0.679	0.313	0.204	0.501	0.505	0.390	0.538
Aluminum (total)	0.700	-0.591	0.466	-	0.394	-0.587	-0.631	-0.533	-0.536	-0.586	-0.454
Barium (total)	-0.456	0.785	-0.196	-	-0.223	0.710	0.611	0.707	0.729	0.799	0.632
Copper (total)	0.135	0.069	0.451	-	-0.031	0.005	-0.061	0.066	0.063	0.063	0.012
Iron (total)	0.169	-0.003	0.153	-	0.050	-0.062	-0.006	0.133	0.150	0.019	-0.021
Manganese (total)	0.498	-0.655	0.406	-	0.138	-0.685	-0.646	-0.671	-0.676	-0.739	-0.635
Molybdenum (total)	-0.430	0.781	-0.319	-	-0.076	0.800	0.739	0.753	0.728	0.831	0.695
Nickel (total)	0.097	0.328	-0.005	-	0.158	0.341	0.381	0.432	0.319	0.380	0.294
Potassium (total)	-0.290	0.712	-0.090	-	-0.015	0.725	0.689	0.888	0.841	0.858	0.643
Sodium (total)	-0.347	0.814	-0.157	-	0.010	0.783	0.723	0.879	0.895	0.895	0.742
Strontium (total)	-0.389	0.814	-0.248	-	-0.025	0.788	0.741	0.827	0.845	0.863	0.751
Uranium (total)	-0.444	0.726	-0.339	-	-0.028	0.678	0.437	0.566	0.620	0.655	0.782
Aluminum (dissolved)	1	-0.391	0.453	-	0.732	-0.388	-0.191	-0.234	-0.258	-0.293	-0.268
Barium (dissolved)	-0.391	1	-0.312	-	-0.045	0.867	0.652	0.776	0.785	0.905	0.849
Copper (dissolved)	0.453	-0.312	1	-	0.323	-0.245	-0.219	-0.136	-0.089	-0.213	-0.199
Iron (dissolved)	-	-	-	1	-	-	-	-	-	-	-
Manganese (dissolved)	0.732	-0.045	0.323	-	1	-0.009	0.073	0.151	0.134	0.074	0.189
Molybdenum (dissolved)	-0.388	0.867	-0.245	-	-0.009	1	0.690	0.787	0.784	0.909	0.875
Nickel (dissolved)	-0.191	0.652	-0.219	-	0.073	0.690	1	0.718	0.655	0.749	0.524
Potassium (dissolved)	-0.234	0.776	-0.136	-	0.151	0.787	0.718	1	0.929	0.882	0.725
Sodium (dissolved)	-0.258	0.785	-0.089	-	0.134	0.784	0.655	0.929	1	0.849	0.756
Strontium (dissolved)	-0.293	0.905	-0.213	-	0.074	0.909	0.749	0.882	0.849	1	0.877
Uranium (dissolved)	-0.268	0.849	-0.199	-	0.189	0.875	0.524	0.725	0.756	0.877	1

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.

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

Table C.48: ***In Situ*** **Water Quality Profile Data Collected at Sheardown Lake SE Water Quality Monitoring Stations in Winter, Mary River Project CREMP, April 2019**

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	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19
1.0	0.1	0.1	0.1	0.3	0.4	15.53	15.42	15.23	15.67	15.57	106.6	105.9	104.1	107.9	107.7	7.55	7.61	7.95	7.83	7.80	147.0	137.2	137.5	138.4	138.0
2.0	0.7	0.1	0.2	0.3	0.5	14.99	15.48	15.64	15.85	15.61	103.7	106.3	107.6	109.5	107.8	7.43	7.60	7.85	7.76	7.75	142.2	133.5	133.1	132.2	133.0
3.0	0.5	1.5	1.4	1.6	1.5	14.56	15.00	15.21	14.92	15.26	104.3	107.2	108.6	107.2	109.0	7.52	7.59	7.79	7.67	7.70	138.0	126.7	126.0	125.6	126.2
4.0	1.4	1.5	1.6	1.6	1.6	14.08	14.60	14.88	14.71	14.87	100.3	104.5	106.7	105.4	106.7	7.49	7.59	7.74	7.64	7.66	137.7	126.7	125.6	125.6	125.5
5.0	1.4		1.6	1.6	1.6	14.06		14.77	14.71	14.71	100.2		105.8	105.4	105.4	7.48		7.71	7.63	7.63	137.7		125.6	125.6	125.5
6.0	1.5		1.6	1.6	1.6	13.95		14.73	14.70	14.69	99.8		105.5	105.3	105.2	7.47		7.69	7.62	7.62	138.0		125.6	125.6	125.6
7.0	1.5		1.6	1.6	1.6	13.45		14.72	14.69	14.67	97.0		105.5	105.2	105.0	7.45		7.68	7.62	7.61	139.3		125.6	125.6	125.6
8.0			1.7	1.6	1.6			14.72	14.65	14.66			105.5	105.1	105.0			7.67	7.61	7.60			125.6	125.7	125.6
9.0			1.7	1.7	1.6			14.72	14.32	14.61			105.5	102.7	104.7			7.66	7.59	7.59			125.6	126.2	125.8
10.0				1.7	1.6				14.21	14.57				101.8	104.4				7.55	7.59				126.0	125.7
11.0				1.7	1.7				14.17	14.52				102.0	104.1				7.55	7.59				126.1	126.1
12.0				1.7	1.7				13.93	13.74				100.3	103.1				7.54	7.56				127.1	126.9
13.0				1.7	1.7				13.05	8.88				96.0	64.5				7.50	7.41				127.5	129.8
14.0					1.8					4.71					36.1					7.26					143.7
15.0																									

Notes: Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 6.8, 3.0, 9.6, 13.0, and 14.2 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 1.5, 1.8, 2.0, 1.9, and 1.7 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, July 2019**

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	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19
1.0	12.1	12.0	11.9	12.0	12.1	10.60	10.81	10.67	10.87	10.68	98.1	100.3	98.5	100.9	99.2	8.13	8.14	7.99	8.05	8.12	120.7	118.3	118.9	118.5	118.2
2.0	12.0	12.1	11.9	12.0	12.0	10.84	10.88	10.80	10.87	10.87	100.4	101.1	99.9	100.8	100.9	8.12	8.12	7.99	8.05	8.08	120.7	118.2	118.8	118.5	118.3
3.0	12.0	12.1	11.8	11.8	12.0	10.86	10.89	10.82	10.86	10.88	100.7	101.2	99.8	100.5	101.0	8.11	8.10	7.98	8.05	8.07	120.7	118.4	119.1	118.5	118.4
4.0	11.9		11.5	11.8	12.0	10.86		10.83	10.85	10.85	100.7		99.4	100.2	100.8	8.10		7.97	8.05	8.06	120.8		119.4	118.9	118.5
5.0	11.9		11.3	11.0	11.9	10.83		10.80	10.80	10.87	100.5		98.5	98.0	100.7	8.09		7.94	7.98	8.05	120.8		119.6	119.3	118.4
6.0			11.1	10.8	10.2			10.75	10.72	10.89			97.6	96.6	96.3			7.91	7.95	8.03			119.0	117.8	118.1
7.0			10.6	10.2	9.9			10.65	10.63	10.69			96.2	94.6	94.7			7.86	7.91	7.94			116.9	112.5	108.0
8.0				9.0	9.4				10.34	10.54				89.5	92.0				7.84	7.96				103.9	104.5
9.0				8.5	8.9				10.13	10.42				86.8	90.2				7.75	7.79				103.0	103.7
10.0				8.4	8.7				10.02	10.23				85.5	88.0				7.71	7.73				103.0	103.4
11.0				8.0	8.3				9.75	10.05				82.7	85.7				7.66	7.67				103.2	103.0
12.0				7.9	8.0				9.51	9.77				80.2	82.7				7.62	7.63				103.4	103.3
13.0					7.8					9.41					79.3					7.59					103.8

Note: Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 6.8, 4.2, 8.3, 13, and 14.5 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, August 2019**

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	22-Aug-19	23-Aug-19	25-Aug-19	24-Aug-19	17-Aug-19	24-Aug-19	22-Aug-19	23-Aug-19	25-Aug-19	24-Aug-19	17-Aug-19	24-Aug-19	22-Aug-19	23-Aug-19	25-Aug-19	24-Aug-19	17-Aug-19	24-Aug-19
surface					14.5						10.44						102.4	
1.0	12.7	12.8	10.5	10.9	14.5	10.8	10.6	10.6	10.7	10.5	9.52	10.52	99.3	100.4	96.1	94.8	93.3	95.3
2.0	12.6	12.8	10.5	10.9	14.5	10.9	10.9	10.8	10.7	10.5	9.96	10.48	102.6	102.2	95.7	94.8	97.6	94.9
3.0	12.6	12.7	10.5	10.9	14.5	10.9	10.9	10.9	10.7	10.5	10.15	10.46	102.6	102.9	95.5	94.8	99.2	94.7
4.0	12.3		10.5	10.9	14.5	10.9	11.2		10.6	10.5	9.85	10.46	104.1		95.4	94.7	96.8	94.7
5.0			10.5	10.9	14.4	10.9			10.6	10.5	10.07	10.45			95.4	94.7	98.6	94.6
6.0			10.5	10.9	13.6	10.9			10.6	10.5	10.09	10.45			95.2	94.6	97.1	94.6
7.0			10.5	10.9	11.7	10.8			10.6	10.4	10.40	10.45			94.7	94.6	95.7	94.5
8.0			10.4	10.9	10.6	10.9			10.5	10.4	10.05	10.43			93.7	94.6	90.5	94.4
9.0				10.8	10.0	10.8				10.4	9.64	10.45				94.3	86.0	94.2
10.0				10.8	8.8	10.7				10.4	7.88	10.45				94.2	67.7	94.1
11.0				10.6	8.2	10.6				10.5	7.44	10.48				93.9	63.2	94.1
12.0				10.4	7.9	10.5				10.5	6.61	10.56				93.6	56.2	94.3
13.0				10.3	7.8	10.1				10.5	6.00	10.68				93.4	50.6	94.8
14.0						10.1						10.69						94.9

Notes: 24-Aug-19 sampling was conducted by Baffinland. 17-Aug-19 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 4.9, 3.4, 8.6, 13.1, and 14.2 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, August 2019**

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	22-Aug-19	23-Aug-19	25-Aug-19	24-Aug-19	17-Aug-19	24-Aug-19	22-Aug-19	23-Aug-19	25-Aug-19	24-Aug-19	17-Aug-19	24-Aug-19
surface					8.31						134.8	
1.0	8.47	8.46	8.01	8.16	8.36	8.01	134.4	133.1	133.3	130.6	134.5	130.6
2.0	8.51	8.47	8.04	8.13	8.31	8.08	134.4	133.2	133.3	130.7	135.0	130.7
3.0	8.52	8.51	8.05	8.14	8.35	8.13	134.3	133.2	133.4	130.7	134.9	130.7
4.0	8.56		8.05	8.15	8.35	8.15	134.3		133.4	130.7	134.7	130.7
5.0			8.06	8.15	8.36	8.15			133.6	130.7	134.4	130.7
6.0			8.06	8.15	8.30	8.16			133.9	130.6	132.6	130.7
7.0			8.05	8.16	7.97	8.16			134.8	130.7	124.5	131.5
8.0			8.03	8.16	7.75	8.16			135.0	130.7	121.6	132.7
9.0				8.15	7.54	8.15				132.3	118.5	134.3
10.0				8.15	7.35	8.15				133.2	112.0	135.4
11.0				8.14	7.15	8.16				138.5	110.2	137.8
12.0				8.12	7.08	8.16				141.9	110.0	143.5
13.0				8.10	7.03	8.16				141.8	110.6	145.9
14.0						8.14						146.2

Notes: 24-Aug-19 sampling was conducted by Baffinland. 17-Aug-19 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 4.9, 3.4, 8.6, 13.1, and 14.2 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 2019

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	17-Aug-19	10.4	4.5	surface	14.4	10.00	97.5	8.36	136
					bottom	9.3	7.17	62.8	7.39	132
	DLO-02-11	17-Aug-19	7.1	4.4	surface	13.7	10.70	103.4	8.38	133
					bottom	13.5	10.49	101.9	8.36	133
	DLO-02-10	17-Aug-19	6.7	4.4	surface	13.6	10.69	103.2	8.37	132
					bottom	13.2	10.92	103.6	8.31	130
	DLO-02-4	17-Aug-19	7.3	4.1	surface	14.0	10.31	101.8	8.18	134
					bottom	13.3	10.74	102.4	8.18	131
	DLO-02-9	17-Aug-19	8.9	4.3	surface	14.2	10.28	100.8	8.18	134
					bottom	12.1	10.95	102.2	7.96	126
Profundal (Deep) Stations	DLO-02-12	17-Aug-19	10.7	4.7	surface	14.2	10.24	100.3	8.33	134
					bottom	9.6	9.34	82.3	7.70	116
	DLO-02-8	17-Aug-19	12.6	4.3	surface	14.4	9.83	96.4	8.39	135
					bottom	8.6	8.40	72.2	7.52	111
	DLO-02-13	17-Aug-19	10.4	4.4	surface	14.4	9.90	98.0	8.25	135
					bottom	9.4	9.19	80.3	7.42	115
	DLO-02-2	17-Aug-19	14.6	4.3	surface	14.4	10.33	101.2	8.33	135
					bottom	7.8	6.49	55.8	7.22	110
	DLO-02-3	17-Aug-19	13.3	4.5	surface	14.5	10.00	97.8	8.30	135
					bottom	8.1	6.73	56.6	7.30	110

Table C.52: Statistical Comparison of Bottom *In Situ* Water Quality Between Sheardown Lake SE Littoral and Profundal Stations, Mary River Project CREMP, August 2019

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	0.426	α	Littoral	5	4.32	0.14	0.06	4.12	4.50
				Profundal	5	4.41	0.18	0.08	4.25	4.67
Temperature (˚C)	YES	0.032	γ	Littoral	5	12.28	1.75	0.78	9.30	13.50
				Profundal	5	8.70	0.79	0.35	7.80	9.60
Dissolved Oxygen (mg/L)	YES	0.056	γ	Littoral	5	10.1	1.6	0.7	7.2	11.0
				Profundal	5	8.0	1.3	0.6	6.5	9.3
Dissolved Oxygen (% saturation)	YES	0.056	γ	Littoral	5	94.6	17.8	8.0	62.8	103.6
				Profundal	5	69.4	12.7	5.7	55.8	82.3
pH (units)	YES	0.015	α	Littoral	5	8.04	0.39	0.18	7.39	8.36
				Profundal	5	7.43	0.19	0.08	7.22	7.70
Specific Conductance (umho/cm)	YES	< 0.001	α	Littoral	5	130.2	2.6	1.2	126.0	132.5
				Profundal	5	112.3	2.7	1.2	109.9	115.8

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.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 2019

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	0.206	α	Reference	5	9.36	1.39	0.62	7.30	10.60
					Sheardown SE	5	8.08	1.54	0.69	6.70	10.40
	Secchi Depth (m)	YES	<0.001	α	Reference	5	7.66	0.27	0.12	7.30	8.00
					Sheardown SE	5	4.32	0.14	0.06	4.12	4.50
	Temperature (˚C)	NO	0.636	α	Reference	5	11.78	1.44	0.65	9.80	13.30
					Sheardown SE	5	12.28	1.75	0.78	9.30	13.50
	Dissolved Oxygen (mg/L)	NO	0.548	γ	Reference	5	9.7	1.3	0.6	8.3	11.1
					Sheardown SE	5	10.1	1.6	0.7	7.2	11.0
	Dissolved Oxygen (% saturation)	NO	0.151	γ	Reference	5	89.0	12.3	5.5	74.9	99.1
					Sheardown SE	5	94.6	17.8	8.0	62.8	103.6
	pH (units)	YES	0.016	β	Reference	5	7.29	0.37	0.17	6.91	7.70
					Sheardown SE	5	8.04	0.39	0.18	7.39	8.36
	Specific Conductance (umho/cm)	YES	<0.001	α	Reference	5	77.9	2.9	1.3	74.9	82.2
					Sheardown SE	5	130.2	2.6	1.2	126.0	132.5
Profundal (Deep) Stations	**Station Depth (m)**	YES	< 0.001	α	Reference	5	19.32	2.46	1.10	16.00	21.90
					Sheardown SE	5	12.32	1.77	0.79	10.40	14.60
	Secchi Depth (m)	YES	<0.001	β	Reference	5	7.80	0.78	0.35	6.50	8.50
					Sheardown SE	5	4.41	0.18	0.08	4.25	4.67
	Temperature (˚C)	YES	0.015	β	Reference	5	6.96	0.92	0.41	5.60	8.10
					Sheardown SE	5	8.70	0.79	0.35	7.80	9.60
	Dissolved Oxygen (mg/L)	NO	0.151	γ	Reference	5	9.2	2.0	0.9	5.8	10.3
					Sheardown SE	5	8.0	1.3	0.6	6.5	9.3
	Dissolved Oxygen (% saturation)	NO	0.222	γ	Reference	5	76.3	16.3	7.3	47.4	87.3
					Sheardown SE	5	69.4	12.7	5.7	55.8	82.3
	pH (units)	YES	0.042	β	Reference	5	7.02	0.33	0.15	6.62	7.37
					Sheardown SE	5	7.43	0.19	0.08	7.22	7.70
	Specific Conductance (umho/cm)	YES	< 0.001	β	Reference	5	79.7	4.7	2.1	75.2	86.0
					Sheardown SE	5	112.3	2.7	1.2	109.9	115.8

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.54: Water Chemistry at Sheardown Lake SE (DLO-02) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event									
					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
					18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19
Conventionals	Conductivity (lab)	umho/cm	-	-	169	175	152	160	153	156	156	163	158	155
	pH (lab)	pH	6.5 - 9.0	-	7.60	7.58	7.68	7.61	7.70	7.71	7.57	7.69	7.44	7.64
	Hardness (as $CaCO_3$)	mg/L	-	-	96.4	95.6	84.2	86.0	84.8	86.7	86.9	88.0	88.5	87.0
	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	-	-	118	115	110	119	101	112	130	109	119	114
	Turbidity	NTU	-	-	0.35	0.23	0.33	0.39	0.28	0.36	0.25	0.33	0.64	0.27
	Alkalinity (as $CaCO_3$)	mg/L	-	-	77	79	71	73	70	71	71	74	73	73
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	<0.010	0.057	<0.010	0.041	0.074	<0.010	0.03	<0.010	<0.010	0.014
	Nitrate	mg/L	3	3	0.106	0.102	0.078	0.083	0.077	0.078	0.084	0.080	0.098	0.078
	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	-	-	1.84	1.87	1.86	1.84	1.74	1.86	1.67	1.96	1.55	1.75
	Total Organic Carbon	mg/L	-	-	2.34	2.51	2.30	2.17	2.34	2.37	2.52	2.37	2.14	2.32
	Total Phosphorus	mg/L	0.020[α]	-	0.0041	0.0053	0.0049	0.0051	0.0048	0.0096	0.0062	0.0057	0.0046	0.0061
	Phenols	mg/L	0.004[α]	-	<0.0010	0.0056	0.0018	0.0016	0.0014	0.002	0.0033	0.0014	0.0018	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	4.23	4.39	3.93	4.09	3.90	3.96	4.01	4.14	4.09	4.04
	Sulphate (SO_4)	mg/L	218[β]	218	8.36	8.69	7.91	8.20	7.93	8.05	7.74	8.34	7.22	8.16
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	<0.0030	<0.0030	0.0034	0.0041	<0.0030	<0.0030	0.0054	0.0069	0.007	<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
	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	-	-	0.0089	0.0085	0.0078	0.0075	0.0077	0.0080	0.0076	0.0082	0.0076	0.0077
	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
	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	-	-	19.0	17.7	16.8	16.4	16.6	17.2	17.2	17.8	17.5	16.5
	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[α]	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	0.00089	0.00083	0.00087	0.00101	0.00089	0.00086	0.00090	0.00077	0.00085
	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
	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
	Lithium (Li)	mg/L	-	-	0.0018	0.0010	0.0014	<0.0010	0.0014	0.0016	0.0015	0.0015	0.0014	0.0014
	Magnesium (Mg)	mg/L	-	-	12.2	11.4	10.7	10.5	10.6	10.9	10.5	10.9	10.8	10.5
	Manganese (Mn)	mg/L	0.935[β]	-	0.00179	0.00383	0.00255	0.00193	0.00193	0.00169	0.00447	0.00180	0.00979	0.00192
	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	-	0.000822	0.000776	0.000736	0.000759	0.000771	0.000777	0.000700	0.000798	0.000656	0.000749
	Nickel (Ni)	mg/L	0.025	0.025	0.00068	0.00073	0.00066	0.00068	0.00063	0.00066	0.00066	0.00068	0.00063	0.00063
	Potassium (K)	mg/L	-	-	1.59	1.51	1.36	1.36	1.34	1.42	1.35	1.42	1.32	1.35
	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	-	-	0.69	0.65	0.55	0.54	0.56	0.58	0.64	0.57	1.06	0.54
	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	-	-	1.94	1.96	1.78	1.80	1.75	1.82	1.81	1.82	1.85	1.80
	Strontium (Sr)	mg/L	-	-	0.0127	0.0125	0.0112	0.0112	0.0114	0.0113	0.0112	0.0119	0.0113	0.0111
	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	-	0.00075	0.00097	0.00090	0.00090	0.00083	0.00088	0.00087	0.00087	0.00079	0.00086
	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
	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

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.54: Water Chemistry at Sheardown Lake SE (DLO-02) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event									
					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
					26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19
Conventionals	Conductivity (lab)	umho/cm	-	-	123	123	119	119	119	121	105	120	104	119
	pH (lab)	pH	6.5 - 9.0	-	8.07	8.12	8.08	8.03	7.94	8.07	7.66	8.04	7.70	8.07
	Hardness (as $CaCO_3$)	mg/L	-	-	59.4	59.1	57.3	56.4	58.1	57.5	50.1	56.8	49.3	56.7
	Total Suspended Solids (TSS)	mg/L	-	-	2	<2.0	<2.0	<2.0	2.0	2.8	3.6	2.8	2.4	2
	Total Dissolved Solids (TDS)	mg/L	-	-	96	65	78	70	68	74	78	66	75	87
	Turbidity	NTU	-	-	3.80	3.70	3.89	4.10	6.77	4.92	4.86	4.54	5.09	4.02
	Alkalinity (as $CaCO_3$)	mg/L	-	-	55	53	54	55	53	54	49	56	52	54
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	<0.020	0.018	0.026	<0.020	<0.020	0.020	<0.020	0.033	0.017	<0.010
	Nitrate	mg/L	3	3	0.069	0.080	0.065	0.066	0.118	0.114	0.059	0.093	0.058	0.070
	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	-	-	0.19	<0.15	<0.15	<0.15	<0.15	0.18	<0.15	<0.15	0.2	0.15
	Dissolved Organic Carbon	mg/L	-	-	2.27	1.71	1.85	1.91	2.04	1.64	1.59	1.67	1.32	1.66
	Total Organic Carbon	mg/L	-	-	2.08	2.14	2.36	2.63	2.12	2.08	1.99	2.04	1.93	1.97
	Total Phosphorus	mg/L	0.020[α]	-	0.0038	<0.0030	0.0047	0.0071	0.0061	0.0049	0.0051	0.0049	0.0084	0.0044
	Phenols	mg/L	0.001[α]	-	0.0014	0.0017	0.0014	0.0012	<0.0010	<0.0010	0.0011	0.0011	0.0011	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
	Chloride (Cl)	mg/L	120	120	2.89	2.87	2.83	2.82	2.89	2.90	2.44	2.85	2.44	2.82
	Sulphate (SO_4)	mg/L	218[β]	218	7.76	7.76	7.57	7.56	7.79	10.10	5.85	7.55	5.86	7.56
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.0440	0.0694	0.0544	0.0624	0.101	0.0685	0.0775	0.0514	0.0631	0.0681
	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
	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	-	-	0.0067	0.00695	0.00672	0.00677	0.00731	0.00697	0.00694	0.00698	0.00630	0.00688
	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
	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	-	-	11.2	11.9	11.2	11.0	11.1	11.1	11.3	11.4	9.5	10.8
	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
	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
	Copper (Cu)	mg/L	0.002	0.0024	0.00100	0.00084	0.00088	0.00082	0.00090	0.00085	0.00085	0.0009	0.0008	0.00086
	Iron (Fe)	mg/L	0.30	0.300	0.051	0.069	0.060	0.061	0.106	0.077	0.073	0.059	0.075	0.069
	Lead (Pb)	mg/L	0.001	0.001	0.000072	0.000083	0.000077	0.000076	0.000121	0.000089	0.000087	0.00009	0.000111	0.000081
	Lithium (Li)	mg/L	-	-	<0.0010	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	7.21	7.45	7.19	7.04	7.06	7.23	7.23	7.29	6.11	7.10
	Manganese (Mn)	mg/L	0.935[β]	-	0.00302	0.00331	0.00292	0.00286	0.00374	0.00310	0.00308	0.00293	0.00706	0.00283
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.000552	0.000574	0.000548	0.000531	0.000466	0.000512	0.000528	0.000543	0.000407	0.000516
	Nickel (Ni)	mg/L	0.025	0.025	0.00057	0.00057	0.00058	0.00057	0.00059	0.00057	0.00063	0.00061	0.00052	0.00058
	Potassium (K)	mg/L	-	-	1.07	1.11	1.07	1.06	1.06	1.07	1.09	1.09	1.04	1.06
	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	-	-	0.55	0.63	0.57	0.59	0.72	0.62	0.65	0.56	0.73	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	<0.000010
	Sodium (Na)	mg/L	-	-	1.26	1.30	1.26	1.25	1.26	1.27	1.27	1.30	1.08	1.26
	Strontium (Sr)	mg/L	-	-	0.00881	0.00924	0.00887	0.00874	0.00973	0.00908	0.00898	0.00908	0.00754	0.00853
	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	-	0.000769	0.000812	0.000780	0.000745	0.000817	0.000787	0.000761	0.000788	0.000528	0.000751
	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
	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

[shaded] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.54: Water Chemistry at Sheardown Lake SE (DLO-02) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event									
					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
					22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	25-Aug-19	25-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19
Conventionals	Conductivity (lab)	umho/cm	-	-	149	149	147	148	146	146	150	144	161	143
	pH (lab)	pH	6.5 - 9.0	-	8.45	8.44	8.39	8.48	8.12	8.21	8.07	8.17	8.15	8.09
	Hardness (as $CaCO_3$)	mg/L	-	-	67.8	67.6	80.4	65.2	66.8	68.4	76.0	66.2	71.4	65.9
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	5.4	<2.0	10.8	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	73	69	56	70	63	68	69	67	82	75
	Turbidity	NTU	-	-	0.92	0.91	0.89	1.06	3.40	2.90	8.47	1.67	18.70	1.78
	Alkalinity (as $CaCO_3$)	mg/L	-	-	56	56	56	56	56	56	57	55	60	55
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	<0.010	<0.010	<0.010	<0.010	0.071	<0.010	<0.010	0.021	0.011	0.015
	Nitrate	mg/L	3	3	0.092	0.121	0.101	0.112	0.105	0.105	0.1	0.103	0.096	0.100
	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	0.17	<0.15	0.18	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.65	1.61	1.66	1.67	1.48	1.60	1.60	1.65	1.68	1.63
	Total Organic Carbon	mg/L	-	-	2.06	2.10	2.02	1.95	2.10	1.97	2.04	2.60	2.04	1.97
	Total Phosphorus	mg/L	0.020[α]	-	0.0044	0.0035	0.0066	0.0050	0.0085	0.0079	0.0100	0.0077	0.0198	0.0043
	Phenols	mg/L	0.001[α]	-	<0.0010	0.0011	<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
	Chloride (Cl)	mg/L	120	120	3.26	3.29	3.21	3.21	3.43	3.44	3.66	3.15	4.62	3.17
	Sulphate (SO_4)	mg/L	218[β]	218	8.73	8.71	8.54	8.54	8.37	8.35	8.55	8.20	9.18	8.20
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.025	0.022	0.168	0.021	0.074	0.053	0.097	0.034	***0.235***	0.034
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	0.00048	<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	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00014	<0.00010
	Barium (Ba)	mg/L	-	-	0.00693	0.00693	0.00781	0.00676	0.00728	0.00712	0.00770	0.00677	0.00988	0.00679
	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
	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	0.011	<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	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	12.8	13.1	17.2	13.1	12.6	12.8	13.2	12.3	14.0	12.8
	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
	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	0.00015	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0008	0.0008	0.0014	0.0009	0.0009	0.0009	0.0010	0.0009	0.0015	0.0008
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	0.055	<0.030	0.069	0.051	0.108	0.034	0.290	0.041
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.000301	<0.000050	0.000068	0.000082	0.000130	<0.000050	0.000317	<0.000050
	Lithium (Li)	mg/L	-	-	0.0012	0.0011	0.0015	0.0011	0.0011	0.0012	0.0013	0.0011	0.0017	0.0012
	Magnesium (Mg)	mg/L	-	-	8.44	8.41	8.34	8.49	8.23	8.22	8.43	8.21	9.06	8.07
	Manganese (Mn)	mg/L	0.935[β]	-	0.0027	0.0027	0.0048	0.0027	0.0044	0.0042	0.0062	0.0043	0.0144	0.0044
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.000631	0.000664	0.000816	0.000617	0.000542	0.000588	0.000515	0.000592	0.000444	0.000584
	Nickel (Ni)	mg/L	0.025	0.025	0.00058	0.00057	0.00085	0.00080	0.00060	0.00059	0.00064	0.00060	0.00083	0.00058
	Potassium (K)	mg/L	-	-	1.18	1.20	1.25	1.17	1.18	1.18	1.21	1.16	1.30	1.16
	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	-	-	0.44	0.45	0.50	0.42	0.59	0.54	0.65	0.50	1.03	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
	Sodium (Na)	mg/L	-	-	1.51	1.51	1.77	1.47	1.57	1.53	1.64	1.41	2.02	1.40
	Strontium (Sr)	mg/L	-	-	0.0103	0.0100	0.0131	0.0103	0.0104	0.0102	0.0107	0.0100	0.0126	0.0100
	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	0.014	<0.010
	Uranium (U)	mg/L	0.015	-	0.000835	0.000842	0.000879	0.000823	0.000977	0.000937	0.00104	0.000797	0.00154	0.000816
	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
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	***0.0546***	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[shaded] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.55: Dissolved Metal Concentrations at Sheardown Lake SE Water Quality Monitoring Stations, Mary River Project CREMP, 2019

Parameters		Units	Winter Sampling Event										Summer Sampling Event					
			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	DL0-02-6	DL0-02-6	DL0-02-7	DL0-02-7	DL0-02-4	DL0-02-4
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19
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	0.0145	0.0209	0.0215	0.0181	0.0188	0.0165
	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	0.00860	0.00876	0.00769	0.00802	0.00775	0.00781	0.00778	0.00828	0.00740	0.00803	0.00666	0.00669	0.00631	0.00643	0.00646	0.00642
	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	19.4	18.9	16.6	16.8	17.1	17.1	17.1	17.3	17.5	17.5	11.5	11.4	11.1	11.0	11.5	11.2
	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
	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	0.00089	0.00091	0.00087	0.00083	0.00084	0.00084	0.00085	0.00087	0.00084	0.00083	0.00078	0.00083	0.00084	0.00081	0.00087	0.00076
	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	0.00120	0.00140	<0.0010	0.00100	0.00140	0.00120	0.00110	0.00120	0.00110	0.00130	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	11.6	11.8	10.4	10.7	10.2	10.6	10.7	10.9	10.9	10.5	7.45	7.46	7.16	7.01	7.12	7.16
	Manganese (Mn)	mg/L	0.000813	0.001420	0.000347	0.000462	0.000199	0.000370	0.000434	0.000505	0.002810	0.000306	0.000413	0.000422	0.000389	0.000395	0.000299	0.000369
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000806	0.000871	0.000792	0.000773	0.000781	0.000767	0.000742	0.000789	0.000656	0.000787	0.000605	0.000623	0.000557	0.000566	0.000542	0.000564
	Nickel (Ni)	mg/L	0.000730	0.000720	0.000670	0.000720	0.000650	0.000670	0.000640	0.000685	0.000620	0.000700	0.00054	0.00054	0.00055	0.00051	<0.00050	0.00051
	Potassium (K)	mg/L	1.48	1.53	1.37	1.41	1.36	1.37	1.34	1.43	1.32	1.39	1.09	1.08	1.05	1.03	1.02	1.05
	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	0.67	0.67	0.54	0.56	0.54	0.54	0.78	0.57	1.06	0.56	0.51	0.54	0.52	0.51	0.57	0.52
	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	1.84	1.99	1.71	1.80	1.74	1.76	1.77	1.86	1.80	1.79	1.30	1.31	1.28	1.25	1.27	1.28
	Strontium (Sr)	mg/L	0.01330	0.01310	0.01140	0.01190	0.01150	0.01130	0.01150	0.01140	0.01140	0.01190	0.00895	0.00885	0.00876	0.00875	0.01030	0.00929
	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	0.000987	0.001010	0.000937	0.000913	0.000886	0.000916	0.000871	0.000915	0.000797	0.000940	0.000768	0.000757	0.000766	0.000754	0.000826	0.000776
	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.55: Dissolved Metal Concentrations at Sheardown Lake SE Water Quality Monitoring Stations, Mary River Project CREMP, 2019

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
			26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	25-Aug-19	25-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19
Dissolved Metals	Aluminum (Al)	mg/L	0.0267	0.0231	0.0202	0.0242	0.0139	0.0159	0.2040	0.0133	0.0073	0.0315	0.0231	0.0280	0.0256	0.0081
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00079	<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	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.006	0.0065	0.00583	0.00629	0.00684	0.00677	0.00803	0.00673	0.00695	0.00726	0.00752	0.00677	0.00787	0.00663
	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	0.011	<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	0.000019	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	9.8	11.1	9.6	11.0	13.3	13.1	17.9	12.7	13.2	13.9	16.1	12.9	13.7	12.8
	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	0.0001	<0.00010	<0.00010	0.00018	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00086	0.00084	0.00092	0.00174	0.00084	0.00082	0.00196	0.00074	0.00073	0.00137	0.00107	0.00094	0.00081	0.00072
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.068	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	0.000069	<0.000050	<0.000050	0.000425	<0.000050	<0.000050	0.000072	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	0.0012	0.0016	0.0012	0.0013	0.0017	0.0013	0.0012	0.0012	0.0013
	Magnesium (Mg)	mg/L	6.25	7.09	6.15	7.12	8.39	8.48	8.63	8.16	8.22	8.17	8.71	8.29	9.02	8.26
	Manganese (Mn)	mg/L	0.000408	0.000312	0.000427	0.000464	0.000995	0.000916	0.004900	0.000674	0.001300	0.002320	0.002280	0.001940	0.001640	0.001660
	Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000503	0.000557	0.000472	0.000596	0.000718	0.000653	0.000828	0.000654	0.000643	0.000707	0.000621	0.000624	0.000599	0.000595
	Nickel (Ni)	mg/L	0.00055	0.00055	<0.00050	0.00056	0.00055	0.00059	0.00105	0.00057	0.00051	0.00098	0.00062	0.0006	0.00053	0.00055
	Potassium (K)	mg/L	1.03	1.03	1	1.04	1.18	1.19	1.33	1.15	1.18	1.23	1.22	1.16	1.22	1.15
	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	0.64	0.53	0.6	0.52	0.42	0.43	0.49	0.41	0.47	0.53	0.51	0.48	0.56	0.46
	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	1.11	1.26	1.08	1.26	1.50	1.48	1.91	1.46	1.58	1.96	1.84	1.43	2.10	1.42
	Strontium (Sr)	mg/L	0.00776	0.00889	0.00741	0.00868	0.01030	0.00998	0.01410	0.01020	0.01020	0.01170	0.01230	0.00989	0.01260	0.00995
	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	0.000545	0.000768	0.000518	0.000764	0.000863	0.000868	0.000909	0.000859	0.000923	0.000904	0.001020	0.000828	0.001510	0.000831
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<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	0.066	<0.0030	<0.0030	0.0048	0.0031	0.0042	<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 2019, and at Sheardown Lake Southeast Between 2019 and the Baseline Period**

Dissolved Metal	Sheardown Lake SE				
	2019 vs Reference Lake 3		2019 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	6.6	3.4	0.0	4.4	12
Antimony (Sb)	1.0	1.7	0.0	0.0	1.7
Arsenic (As)	1.0	1.1	1.0	0.8	1.1
Barium (Ba)	1.0	1.1	0.0	1.2	1.2
Beryllium (Be)	1.0	1.2	1.2	1.2	2.1
Cadmium (Cd)	1.0	1.2	0.4	0.0	0.9
Calcium (Ca)	1.6	2.0	1.3	1.0	1.2
Chromium (Cr)	1.0	1.0	-	-	-
Cobalt (Co)	1.0	1.1	1.0	1.0	1.0
Copper (Cu)	1.2	1.2	0.7	0.6	1.2
Iron (Fe)	1.0	1.3	1.2	1.2	1.9
Lead (Pb)	1.0	1.8	0.6	1.0	1.8
Lithium (Li)	1.0	1.3	0.3	0.0	0.6
Magnesium (Mg)	1.6	1.9	1.3	1.1	1.2
Manganese (Mn)	2.7	4.6	1.3	0.0	2.8
Mercury (Hg)	1.0	1.0	1.0	0.5	0.5
Molybdenum (Mo)	3.9	4.2	3.4	0.0	3.3
Nickel (Ni)	1.1	1.3	1.0	0.6	1.1
Potassium (K)	1.3	1.3	0.9	0.9	1.0
Selenium (Se)	1.0	1.2	-	-	-
Silicon (Si)	1.3	1.0	1.3	1.4	1.2
Silver (Ag)	1.0	0.6	1.2	1.8	2.7
Sodium (Na)	1.5	1.8	1.1	1.0	1.3
Strontium (Sr)	1.1	1.3	1.6	1.2	1.5
Thallium (Tl)	1.0	1.2	1.2	1.3	2.6
Tin (Sn)	1.0	1.0	0.1	0.2	0.1
Titanium (Ti)	1.0	1.2	1.0	1.0	1.0
Uranium (U)	3.1	3.7	1.9	1.6	1.9
Vanadium (V)	1.0	1.1	1.0	1.0	1.0
Zinc (Zn)	1.0	2.0	1.5	1.0	6.0

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).
Denotes differences in method detection limit between the 2019 and baseline data, precluding an evaluation of magnitude of elevation.

Table C.57: **Spearman's Rank Correlation Coefficients for Sheardown Lake SE (DLO-2) Water Quality Data Collected in Winter, Summer, and Fall 2019[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	Iron	Manganese	Molybdenum	Nickel	Potassium	Sodium	Strontium	Uranium
Conductivity	1	0.949	0.599	-0.698	0.947	0.269	0.406	0.061	0.975	0.480	-0.618	0.788	0.106	-0.644	-0.227	0.703	0.718	0.945	0.954	0.894	0.600
Hardness	0.949	1	0.589	-0.790	0.937	0.259	0.455	0.058	0.938	0.380	-0.653	0.799	0.058	-0.688	-0.214	0.790	0.678	0.947	0.928	0.899	0.565
Total Dissolved Solids	0.599	0.589	1	-0.563	0.628	-0.321	0.415	-0.156	0.572	-0.155	-0.696	0.388	-0.173	-0.549	-0.351	0.435	0.360	0.573	0.528	0.382	0.004
Turbidity	-0.698	-0.790	-0.563	1	-0.751	-0.026	-0.558	0.189	-0.629	-0.127	0.848	-0.461	0.136	0.914	0.466	-0.921	-0.459	-0.786	-0.644	-0.630	-0.300
Alkalinity	0.947	0.937	0.628	-0.751	1	0.185	0.439	0.083	0.928	0.337	-0.710	0.767	0.080	-0.705	-0.304	0.739	0.704	0.932	0.908	0.839	0.540
Nitrate	0.269	0.259	-0.321	-0.026	0.185	1	-0.096	0.042	0.325	0.673	0.073	0.233	0.075	-0.051	0.199	0.088	0.206	0.183	0.272	0.326	0.357
Total Organic Carbon	0.406	0.455	0.415	-0.558	0.439	-0.096	1	0.000	0.377	-0.060	-0.553	0.295	-0.166	-0.459	-0.319	0.489	0.127	0.439	0.332	0.302	0.052
Total Phosphorus	0.061	0.058	-0.156	0.189	0.083	0.042	0.000	1	0.167	0.145	0.264	0.264	0.324	0.317	0.400	-0.203	0.307	0.084	0.188	0.199	0.469
Chloride	0.975	0.938	0.572	-0.629	0.928	0.325	0.377	0.167	1	0.498	-0.547	0.820	0.124	-0.550	-0.140	0.609	0.698	0.915	0.955	0.888	0.662
Sulphate	0.480	0.380	-0.155	-0.127	0.337	0.673	-0.060	0.145	0.498	1	0.000	0.363	0.235	-0.110	-0.026	0.211	0.322	0.386	0.425	0.487	0.594
Aluminum (total)	-0.618	-0.653	-0.696	0.848	-0.710	0.073	-0.553	0.264	-0.547	0.000	1	-0.289	0.237	0.909	0.626	-0.755	-0.285	-0.663	-0.502	-0.409	-0.061
Barium (total)	0.788	0.799	0.388	-0.461	0.767	0.233	0.295	0.264	0.820	0.363	-0.289	1	0.270	-0.266	-0.096	0.526	0.748	0.828	0.874	0.893	0.613
Copper (total)	0.106	0.058	-0.173	0.136	0.080	0.075	-0.166	0.324	0.124	0.235	0.237	0.270	1	0.206	0.117	-0.020	0.431	0.070	0.127	0.249	0.442
Iron (total)	-0.644	-0.688	-0.549	0.914	-0.705	-0.051	-0.459	0.317	-0.550	-0.110	0.909	-0.266	0.206	1	0.579	-0.871	-0.369	-0.690	-0.538	-0.499	-0.168
Manganese (total)	-0.227	-0.214	-0.351	0.466	-0.304	0.199	-0.319	0.400	-0.140	-0.026	0.626	-0.096	0.117	0.579	1	-0.527	-0.087	-0.321	-0.095	-0.094	0.148
Molybdenum (total)	0.703	0.790	0.435	-0.921	0.739	0.088	0.489	-0.203	0.609	0.211	-0.755	0.526	-0.020	-0.871	-0.527	1	0.550	0.811	0.660	0.707	0.282
Nickel (total)	0.718	0.678	0.360	-0.459	0.704	0.206	0.127	0.307	0.698	0.322	-0.285	0.748	0.431	-0.369	-0.087	0.550	1	0.752	0.789	0.840	0.567
Potassium (total)	0.945	0.947	0.573	-0.786	0.932	0.183	0.439	0.084	0.915	0.386	-0.663	0.828	0.070	-0.690	-0.321	0.811	0.752	1	0.947	0.904	0.607
Sodium (total)	0.954	0.928	0.528	-0.644	0.908	0.272	0.332	0.188	0.955	0.425	-0.502	0.874	0.127	-0.538	-0.095	0.660	0.789	0.947	1	0.939	1
Strontium (total)	0.894	0.899	0.382	-0.630	0.839	0.326	0.302	0.199	0.888	0.487	-0.409	0.893	0.249	-0.499	-0.094	0.707	0.840	0.904	0.939	1	0.647
Uranium (total)	0.600	0.565	0.004	-0.300	0.540	0.357	0.052	0.469	0.662	0.594	-0.061	0.613	0.442	-0.168	0.148	0.282	0.567	0.607	0.656	0.647	1
Aluminum (dissolved)	-0.649	-0.660	-0.724	0.731	-0.703	0.030	-0.542	0.207	-0.610	-0.054	0.808	-0.396	0.222	0.724	0.516	-0.594	-0.284	-0.642	-0.527	-0.460	-0.155
Barium (dissolved)	0.927	0.942	0.439	-0.718	0.909	0.256	0.401	0.202	0.917	0.484	-0.523	0.852	0.219	-0.579	-0.199	0.770	0.768	0.938	0.925	0.937	0.665
Copper (dissolved)	-0.007	0.141	-0.005	-0.085	0.043	-0.044	-0.077	0.191	-0.005	-0.143	0.037	0.217	0.033	0.032	0.179	0.150	0.188	0.109	0.076	0.142	0.031
Iron (dissolved)	-0.023	0.090	-0.316	-0.090	-0.023	0.113	-0.204	0.136	-0.057	0.169	0.294	0.203	0.294	0.047	0.226	0.294	0.318	0.068	0.091	0.317	0.158
Manganese (dissolved)	0.320	0.294	-0.167	-0.030	0.220	0.431	-0.221	0.217	0.317	0.435	0.191	0.139	-0.003	-0.027	0.499	0.113	0.288	0.224	0.360	0.351	0.369
Molybdenum (dissolved)	0.813	0.882	0.420	-0.892	0.828	0.201	0.393	-0.045	0.762	0.414	-0.671	0.664	0.024	-0.781	-0.373	0.916	0.634	0.880	0.780	0.822	0.523
Nickel (dissolved)	0.671	0.775	0.403	-0.754	0.733	0.130	0.249	0.016	0.631	0.236	-0.596	0.587	0.111	-0.675	-0.323	0.838	0.641	0.789	0.685	0.689	0.430
Potassium (dissolved)	0.929	0.959	0.579	-0.822	0.926	0.169	0.445	0.063	0.908	0.422	-0.678	0.776	0.085	-0.707	-0.329	0.836	0.690	0.968	0.902	0.873	0.601
Sodium (dissolved)	0.866	0.869	0.317	-0.523	0.806	0.357	0.183	0.271	0.894	0.576	-0.306	0.793	0.292	-0.398	0.051	0.583	0.716	0.829	0.891	0.887	0.759
Strontium (dissolved)	0.827	0.861	0.325	-0.516	0.797	0.411	0.190	0.264	0.860	0.564	-0.324	0.831	0.319	-0.385	-0.002	0.584	0.755	0.809	0.847	0.901	0.703
Uranium (dissolved)	0.820	0.795	0.280	-0.456	0.795	0.386	0.222	0.362	0.868	0.658	-0.331	0.812	0.309	-0.334	-0.118	0.486	0.706	0.821	0.837	0.830	0.807

[green box] Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

[blue box] Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

Table C.57: Spearman's Rank Correlation Coefficients for Sheardown Lake SE (DLO-2) Water Quality Data Collected in Winter, Summer, and Fall 2019[a]

Parameters	Dissolved Metals										
	Aluminum	Barium	Copper	Iron	Manganese	Molybdenum	Nickel	Potassium	Sodium	Strontium	Uranium
Conductivity	-0.649	0.927	-0.007	-0.023	0.320	0.813	0.671	0.929	0.866	0.827	0.820
Hardness	-0.660	0.942	0.141	0.090	0.294	0.882	0.775	0.959	0.869	0.861	0.795
Total Dissolved Solids	-0.724	0.439	-0.005	-0.316	-0.167	0.420	0.403	0.579	0.317	0.325	0.280
Turbidity	0.731	-0.718	-0.085	-0.090	-0.030	-0.892	-0.754	-0.822	-0.523	-0.516	-0.456
Alkalinity	-0.703	0.909	0.043	-0.023	0.220	0.828	0.733	0.926	0.806	0.797	0.795
Nitrate	0.030	0.256	-0.044	0.113	0.431	0.201	0.130	0.169	0.357	0.411	0.386
Total Organic Carbon	-0.542	0.401	-0.077	-0.204	-0.221	0.393	0.249	0.445	0.183	0.190	0.222
Total Phosphorus	0.207	0.202	0.191	0.136	0.217	-0.045	0.016	0.063	0.271	0.264	0.362
Chloride	-0.610	0.917	-0.005	-0.057	0.317	0.762	0.631	0.908	0.894	0.860	0.868
Sulphate	-0.054	0.484	-0.143	0.169	0.435	0.414	0.236	0.422	0.576	0.564	0.658
Aluminum (total)	0.808	-0.523	0.037	0.294	0.191	-0.671	-0.596	-0.678	-0.306	-0.324	-0.331
Barium (total)	-0.396	0.852	0.217	0.203	0.139	0.664	0.587	0.776	0.793	0.831	0.812
Copper (total)	0.222	0.219	0.033	0.294	-0.003	0.024	0.111	0.085	0.292	0.319	0.309
Iron (total)	0.724	-0.579	0.032	0.047	-0.027	-0.781	-0.675	-0.707	-0.398	-0.385	-0.334
Manganese (total)	0.516	-0.199	0.179	0.226	0.499	-0.373	-0.323	-0.329	0.051	-0.002	-0.118
Molybdenum (total)	-0.594	0.770	0.150	0.294	0.113	0.916	0.838	0.836	0.583	0.584	0.486
Nickel (total)	-0.284	0.768	0.188	0.318	0.288	0.634	0.641	0.690	0.716	0.755	0.706
Potassium (total)	-0.642	0.938	0.109	0.068	0.224	0.880	0.789	0.968	0.829	0.809	0.821
Sodium (total)	-0.527	0.925	0.076	0.091	0.360	0.780	0.685	0.902	0.891	0.847	0.837
Strontium (total)	-0.460	0.937	0.142	0.317	0.351	0.822	0.689	0.873	0.887	0.901	0.830
Uranium (total)	-0.155	0.665	0.031	0.158	0.369	0.523	0.430	0.601	0.759	0.703	0.807
Aluminum (dissolved)	1	-0.520	0.298	0.323	0.260	-0.590	-0.319	-0.630	-0.294	-0.334	-0.386
Barium (dissolved)	-0.520	1	0.143	0.237	0.319	0.890	0.774	0.950	0.913	0.915	0.874
Copper (dissolved)	0.298	0.143	1	0.318	0.294	0.183	0.451	0.143	0.196	0.227	0.092
Iron (dissolved)	0.323	0.237	0.318	1	0.316	0.294	0.317	0.113	0.249	0.317	0.090
Manganese (dissolved)	0.260	0.319	0.294	0.316	1	0.262	0.298	0.259	0.550	0.386	0.314
Molybdenum (dissolved)	-0.590	0.890	0.183	0.294	0.262	1	0.850	0.929	0.768	0.769	0.705
Nickel (dissolved)	-0.319	0.774	0.451	0.317	0.298	0.850	1	0.845	0.730	0.722	0.594
Potassium (dissolved)	-0.630	0.950	0.143	0.113	0.259	0.929	0.845	1	0.865	0.835	0.819
Sodium (dissolved)	-0.294	0.913	0.196	0.249	0.550	0.768	0.730	0.865	1	0.930	0.860
Strontium (dissolved)	-0.334	0.915	0.227	0.317	0.386	0.769	0.722	0.835	0.930	1	0.881
Uranium (dissolved)	-0.386	0.874	0.092	0.090	0.314	0.705	0.594	0.819	0.860	0.881	1

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.

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

Table C.58: ***In Situ*** **Water Quality Measurements Collected at Mary River Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2019**

Study Area	Station	Date Sampled	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Mary River Upstream (GO-09)	GO-09 B1	18-Aug-19	9.7	11.48	101.1	8.47	222.7
	GO-09 B2	18-Aug-19	9.2	11.63	101.2	8.47	222.3
	GO-09 B3	18-Aug-19	8.4	11.79	100.5	8.42	221.6
	GO-09 B4	18-Aug-19	8.0	11.81	99.8	8.40	219.6
	GO-09 B5	18-Aug-19	7.6	11.92	99.6	8.32	219.1
Mary River Upstream (GO-03)	GO-03 B1	18-Aug-19	11.9	10.68	97.6	8.31	204.0
	GO-03 B2	18-Aug-19	11.6	10.74	98.8	8.29	203.5
	GO-03 B3	18-Aug-19	11.3	10.82	99.0	8.29	203.2
	GO-03 B4	18-Aug-19	11.1	10.92	99.3	8.30	202.8
	GO-03 B5	18-Aug-19	10.6	10.94	98.4	8.27	202.2
Mary River Downstream (EO-01)	EO-01 B1	19-Aug-19	8.2	11.88	100.9	8.26	227.9
	EO-01 B2	19-Aug-19	7.9	11.91	100.2	8.25	229.2
	EO-01 B3	19-Aug-19	8.1	12.02	101.4	8.30	230.2
	EO-01 B4	19-Aug-19	7.5	12.01	100.2	8.21	231.5
	EO-01 B5	19-Aug-19	7.5	12.00	100.0	8.21	232.2
Mary River Downstream (EO-20)	EO-20 B1	19-Aug-19	10.0	11.60	102.8	8.32	227.5
	EO-20 B2	19-Aug-19	9.7	11.62	102.4	8.33	227.2
	EO-20 B3	19-Aug-19	9.4	11.68	102.0	8.30	228.2
	EO-20 B4	19-Aug-19	9.4	11.71	102.3	8.38	228.7
	EO-20 B5	19-Aug-19	9.3	11.77	102.7	8.33	228.3
Mary River Downstream (CO-05)	CO-05 B1	20-Aug-19	8.8	11.56	99.6	8.24	226.6
	CO-05 B2	20-Aug-19	8.6	11.49	98.4	8.25	226.3
	CO-05 B3	20-Aug-19	8.5	11.47	98.0	8.19	226.1
	CO-05 B4	20-Aug-19	8.4	11.42	97.4	8.22	226.1
	CO-05 B5	20-Aug-19	8.4	11.28	96.3	8.18	226.1

Table C.59: *In Situ* Water Quality Summary for Mary River Benthic Invertebrate Community Study Areas, Mary River Project CREMP, August 2019

Metric	Station	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Temperature (˚C)	GO-09	5	8.58	0.86	0.39	7.51	9.65	7.60	9.70
	GO-03	5	11.30	0.49	0.22	10.69	11.91	10.60	11.90
	EO-01	5	7.84	0.33	0.15	7.43	8.25	7.50	8.20
	EO-20	5	9.56	0.29	0.13	9.20	9.92	9.30	10.00
	CO-05	5	8.54	0.17	0.07	8.33	8.75	8.40	8.80
Dissolved Oxygen (mg/L)	GO-09	5	11.7	0.2	0.1	11.5	11.9	11.5	11.9
	GO-03	5	10.8	0.1	0.1	10.7	11.0	10.7	10.9
	EO-01	5	12.0	0.1	0.0	11.9	12.0	11.9	12.0
	EO-20	5	11.7	0.1	0.0	11.6	11.8	11.6	11.8
	CO-05	5	11.4	0.1	0.0	11.3	11.6	11.3	11.6
Dissolved Oxygen (% saturation)	GO-09	5	100.4	0.7	0.3	99.5	101.3	99.6	101.2
	GO-03	5	98.6	0.7	0.3	97.8	99.4	97.6	99.3
	EO-01	5	100.5	0.6	0.3	99.8	101.3	100.0	101.4
	EO-20	5	102.4	0.3	0.1	102.0	102.8	102.0	102.8
	CO-05	5	97.9	1.2	0.5	96.4	99.5	96.3	99.6
pH (pH units)	GO-09	5	8.42	0.06	0.03	8.34	8.49	8.32	8.47
	GO-03	5	8.29	0.01	0.01	8.27	8.31	8.27	8.31
	EO-01	5	8.25	0.04	0.02	8.20	8.29	8.21	8.30
	EO-20	5	8.33	0.03	0.01	8.30	8.37	8.30	8.38
	CO-05	5	8.22	0.03	0.01	8.18	8.25	8.18	8.25
Specific Conductance (µS/cm)	GO-09	5	221.1	1.6	0.7	219.0	223.1	219.1	222.7
	GO-03	5	203.1	0.7	0.3	202.3	204.0	202.2	204.0
	EO-01	5	230.2	1.7	0.8	228.1	232.3	227.9	232.2
	EO-20	5	228.0	0.6	0.3	227.2	228.7	227.2	228.7
	CO-05	5	226.2	0.2	0.1	226.0	226.5	226.1	226.6

Table C.60: Statistical Comparison of *In Situ* Water Quality Variables Among Mary River Benthic Invertebrate Community Study Areas, Mary River Project CREMP, August 2019

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	< 0.0001	α	GO-09	GO-03	YES	0.007	Tamhane's
				GO-09	EO-01	NO	0.755	
				GO-09	EO-20	NO	0.472	
				GO-09	CO-05	NO	1.000	
				GO-03	EO-01	YES	0.000	
				GO-03	EO-20	YES	0.004	
				GO-03	CO-05	YES	0.001	
				EO-01	EO-20	YES	0.000	
				EO-01	CO-05	YES	0.054	
				EO-20	CO-05	YES	0.004	
Dissolved Oxygen (mg/L)	YES	< 0.0001	α	GO-09	GO-03	YES	0.000	Tukey's HSD
				GO-09	EO-01	YES	0.022	
				GO-09	EO-20	NO	0.952	
				GO-09	CO-05	YES	0.006	
				GO-03	EO-01	YES	0.000	
				GO-03	EO-20	YES	0.000	
				GO-03	CO-05	YES	0.000	
				EO-01	EO-20	YES	0.005	
				EO-01	CO-05	YES	0.000	
				EO-20	CO-05	YES	0.027	
Dissolved Oxygen (% Saturation)	YES	< 0.0001	α	GO-09	GO-03	YES	0.009	Tukey's HSD
				GO-09	EO-01	NO	1.000	
				GO-09	EO-20	YES	0.004	
				GO-09	CO-05	YES	0.000	
				GO-03	EO-01	YES	0.006	
				GO-03	EO-20	YES	0.000	
				GO-03	CO-05	NO	0.628	
				EO-01	EO-20	YES	0.006	
				EO-01	CO-05	YES	0.000	
				EO-20	CO-05	YES	0.000	
pH (pH units)	YES	< 0.0001	α	GO-09	GO-03	YES	0.000	Tukey's HSD
				GO-09	EO-01	YES	0.000	
				GO-09	EO-20	YES	0.018	
				GO-09	CO-05	YES	0.000	
				GO-03	EO-01	NO	0.346	
				GO-03	EO-20	NO	0.481	
				GO-03	CO-05	YES	0.036	
				EO-01	EO-20	YES	0.015	
				EO-01	CO-05	NO	0.727	
				EO-20	CO-05	YES	0.001	
Specific Conductance (uS/cm)	YES	< 0.0001	α	GO-09	GO-03	YES	0.000	Tamhane's
				GO-09	EO-01	YES	0.000	
				GO-09	EO-20	YES	0.003	
				GO-09	CO-05	YES	0.018	
				GO-03	EO-01	YES	0.000	
				GO-03	EO-20	YES	0.000	
				GO-03	CO-05	YES	0.000	
				EO-01	EO-20	NO	0.354	
				EO-01	CO-05	YES	0.063	
				EO-20	CO-05	YES	0.018	

Highlighted 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 or Mann-Whitney U-test, as appropriate.

Table C.61: Water Chemistry at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2019

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
					28-Jun-19	28-Jun-19	28-Jun-19	28-Jun-19	26-Jun-19	26-Jun-19	26-Jun-19	27-Jun-19	27-Jun-19	27-Jun-19	27-Jun-19	28-Jun-19	28-Jun-19
Conventionals	Conductivity (lab)	umho/cm	-	-	59.6	45.2	33.8	36.4	40.3	114.0	52.8	40.9	41.9	44.7	43.4	51.6	45.9
	pH (lab)	pH	6.5 - 9.0	-	7.72	7.59	7.07	7.07	7.45	7.82	7.39	7.62	7.59	7.65	7.54	7.59	7.61
	Hardness (as $CaCO_3$)	mg/L	-	-	30.5	21.9	16.9	18.2	20.3	57.2	25.9	20.7	20.5	22.3	21.5	25.2	21.4
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	4.8	<2.0	2.4	<2.0	2.4	2.0	2.3	2.7
	Total Dissolved Solids (TDS)	mg/L	-	-	58	28	24	30	<20	42	28	<20	<20	<20	<20	26	39
	Turbidity	NTU	-	-	0.96	2.78	6.38	4.43	3.01	2.84	3.27	4.94	4.91	4.55	4.47	4.64	5.49
	Alkalinity (as $CaCO_3$)	mg/L	-	-	32	25	18	17	22	46	25	21	21	23	23	25	23
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.029	0.013	0.016	0.01	0.015	0.010	<0.010	0.0335	0.082	0.018	0.013	0.011	0.055
	Nitrate	mg/L	3	3	<0.020	<0.020	<0.020	<0.020	<0.020	0.057	<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	-	-	1.47	1.16	1.18	1.11	1.37	0.96	1.16	1.00	1.35	1.12	1.09	1.34	1.25
	Total Organic Carbon	mg/L	-	-	1.27	1.11	1.02	1.16	1.86	1.64	1.62	1.72	1.62	1.61	1.71	1.41	1.43
	Total Phosphorus	mg/L	0.030[α]	-	0.0037	0.0055	0.0064	0.0064	0.0056	0.0088	0.0054	0.0061	0.0064	0.0056	0.0057	0.0053	0.0091
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0013	0.0012	<0.0010	0.0011	<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	<0.50	<0.50	<0.50	1.26	0.76	4.27	1.23	0.76	0.80	0.81	0.77	0.88	0.73
	Sulphate (SO_4)	mg/L	218[β]	218	<0.30	<0.30	<0.30	<0.30	<0.30	14.0	2.14	1.23	1.42	1.45	1.29	1.73	1.19
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.047	0.076	0.105	0.118	0.068	0.106	0.089	0.094	0.081	0.097	0.137	0.099	0.109
	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	-	-	0.0038	0.0032	0.0032	0.0034	0.0032	0.0048	0.0035	0.0033	0.0033	0.0036	0.0037	0.0040	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
	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
	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
	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	-	-	6.04	4.51	3.38	3.68	4.01	10.50	5.02	4.00	4.28	4.46	4.33	4.78	4.28
	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	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00052	<0.00050	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.00061	0.0006
	Iron (Fe)	mg/L	0.30	0.874	<0.030	0.07	0.109	0.108	0.058	0.135	0.068	0.079	0.077	0.083	0.094	0.107	0.114
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.000082	0.000133	0.000118	0.000079	0.000165	0.000081	0.000105	0.000094	0.000098	0.000102	0.000127	0.000135
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	3.85	2.60	2.03	2.21	2.43	7.71	3.26	2.55	2.65	2.91	2.77	3.30	2.72
	Manganese (Mn)	mg/L	0.935[β]	-	0.0007	0.0012	0.00195	0.0018	0.0009	0.0041	0.0012	0.0017	0.0016	0.0019	0.0019	0.0032	0.0029
	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	-	0.000052	0.000054	<0.000050	<0.000050	0.000062	0.000051	0.000057	0.0000595	0.000064	0.000068	0.00009	0.00011	0.00010
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00053	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.50	0.42	0.40	0.42	0.42	0.59	0.47	0.42	0.44	0.46	0.47	0.53	0.51
	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	-	-	0.56	0.49	0.49	0.55	0.52	0.55	0.56	0.55	0.50	0.54	0.66	0.52	0.53
	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	-	-	0.515	0.399	0.421	0.431	0.473	0.369	0.442	0.422	0.423	0.488	0.492	0.562	0.519
	Strontium (Sr)	mg/L	-	-	0.0048	0.0037	0.0033	0.0036	0.0040	0.0171	0.0058	0.0040	0.0038	0.0041	0.0041	0.0042	0.0039
	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	-	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002	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

[shaded box] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.61: Water Chemistry at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2019

	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
					01-Aug-19	01-Aug-19	01-Aug-19	01-Aug-19	01-Aug-19	01-Aug-19	01-Aug-19	28-Jul-19	28-Jul-19	28-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19
Conventionals	Conductivity (lab)	umho/cm	-	-	133	144	142	147	136	465	181	163	161	161	154	149	147
	pH (lab)	pH	6.5 - 9.0	-	7.60	8.08	7.98	7.98	7.97	8.13	8.04	8.22	8.24	8.26	8.26	8.24	8.17
	Hardness (as $CaCO_3$)	mg/L	-	-	61.8	71.9	65.8	71.0	66.6	249	89.8	79.5	78.7	79.3	73.2	69.4	67.2
	Total Suspended Solids (TSS)	mg/L	-	-	11.3	3.7	2.8	2.0	4.0	<2.0	6.2	4.9	<2.0	3.3	<2.0	2.3	2.1
	Total Dissolved Solids (TDS)	mg/L	-	-	81	86	76	85	83	304	118	96	96	82	94	85	88
	Turbidity	NTU	-	-	39.3	11.3	12.0	9.0	14.3	1.3	19.3	12.1	12.8	15.9	11.2	20.1	21.3
	Alkalinity (as $CaCO_3$)	mg/L	-	-	58	69	65	60	62	100	67	65	65	67	67	66	64
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	<0.010	0.036	0.017	0.018	0.015	0.016	0.018	0.011	0.020	0.018	0.022	0.019	0.021
	Nitrate	mg/L	3	3	<0.020	<0.020	<0.020	<0.020	<0.020	0.883	0.105	0.062	0.199	0.068	0.057	0.046	0.062
	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	0.17000	0.23000	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.36	1.41	1.33	1.28	1.29	1.43	1.39	1.31	1.43	1.45	1.57	1.61	1.50
	Total Organic Carbon	mg/L	-	-	1.63	1.62	1.67	1.55	1.71	1.31	1.57	2.11	1.86	1.92	2.57	2.16	1.92
	Total Phosphorus	mg/L	0.020[α]	-	0.0273	0.0114	0.0121	0.0082	0.0131	0.0039	0.0150	0.0097	0.0095	0.0106	0.0088	0.0137	0.0155
	Phenols	mg/L	0.004[α]	-	<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
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	5.91	4.05	4.95	10.2	5.41	14.2	6.43	6.08	6.07	5.75	4.73	4.37	4.24
	Sulphate (SO_4)	mg/L	218[β]	218	3.37	2.45	2.89	2.33	2.34	126	18.00	11.5	11.4	10.30	8.44	8.16	8.04
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	***1.55***	0.452	0.514	0.347	0.634	0.0887	0.790	0.154	0.152	0.197	0.263	0.473	0.719
	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	0.00025	0.00012	0.00012	0.00010	0.00014	<0.00010	0.00023	<0.00010	<0.00010	0.00010	0.00011	0.00014	0.00015
	Barium (Ba)	mg/L	-	-	0.0186	0.0115	0.0120	0.0119	0.0131	0.0197	0.0154	0.0106	0.0107	0.0112	0.0106	0.0118	0.0128
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050
	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
	Cadmium (Cd)	mg/L	0.00012	0.00006	< 0.000006	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	0.0000051	0.0000059	0.0000058
	Calcium (Ca)	mg/L	-	-	12.4	14.1	13.5	14.0	13.1	39.7	16.5	15.2	15.0	15.2	14.2	13.5	13.3
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00315	0.00084	0.00107	0.00069	0.00124	<0.00050	0.00178	<0.00050	<0.00050	<0.00050	0.00067	0.00107	***0.0145***
	Cobalt (Co)	mg/L	0.0009[α]	0.004	0.00074	0.00022	0.00024	0.00016	0.00029	0.00017	0.00041	<0.00010	< 0.00011	< 0.00013	< 0.00014	< 0.00025	< 0.00037
	Copper (Cu)	mg/L	0.002	0.0024	***0.0029***	0.0015	0.0017	0.0014	0.0018	0.0011	0.0022	0.0012	0.0012	0.0014	0.0014	0.0017	***0.0028***
	Iron (Fe)	mg/L	0.30	0.874	***1.62***	0.457	0.512	0.335	0.637	0.107	0.843	0.171	0.196	0.240	0.270	0.532	***0.878***
	Lead (Pb)	mg/L	0.001	0.001	***0.001190***	0.000379	0.000435	0.000314	0.000529	0.000118	0.000662	0.000225	0.000254	0.000313	0.000262	0.000452	0.000576
	Lithium (Li)	mg/L	-	-	0.0029	0.0012	0.0013	0.0010	0.0013	0.0042	0.0019	0.0015	0.0015	0.0015	<0.0010	0.0011	0.0014
	Magnesium (Mg)	mg/L	-	-	7.62	8.14	7.58	7.91	7.84	34.9	11.2	9.36	9.26	9.48	8.87	8.61	8.72
	Manganese (Mn)	mg/L	0.935[β]	-	0.0200	0.00574	0.00635	0.00411	0.00757	0.00297	0.01050	0.00277	0.00317	0.00383	0.00397	0.00757	0.0125
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000087	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.000489	0.000324	0.000448	0.000308	0.000331	0.000265	0.000353	0.000321	0.000334	0.000304	0.000365	0.000369	0.000435
	Nickel (Ni)	mg/L	0.025	0.025	0.00232	0.00084	0.00088	0.00074	0.00135	0.00067	0.00197	0.00056	0.00063	0.00075	0.00090	0.00130	0.00194
	Potassium (K)	mg/L	-	-	1.88	1.31	1.33	1.24	1.35	1.61	1.49	1.20	1.19	1.23	1.21	1.29	1.43
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.000050	<0.0000050	<0.000050	<0.000050	0.0002	0.0001	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	3.67	1.69	1.75	1.48	2.02	0.95	2.35	1.07	1.03	1.16	1.30	1.72	2.22
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000050	<0.000050	<0.0000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	3.72	2.79	3.02	2.51	2.49	1.82	2.33	2.18	2.14	2.16	2.05	1.96	1.98
	Strontium (Sr)	mg/L	-	-	0.0189	0.0157	0.0170	0.0181	0.0156	0.0752	0.0236	0.0246	0.0242	0.0234	0.0186	0.0170	0.0175
	Thallium (Tl)	mg/L	0.0008	0.0008	0.000038	0.000013	0.000015	0.000011	0.000018	<0.000010	0.000024	<0.00010	<0.00010	<0.00010	<0.000010	0.000015	0.000019
	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	-	-	0.0925	0.0262	0.0298	0.0186	0.0354	0.0055	0.0472	<0.010	0.0100	0.0120	0.0141	0.0280	0.0415
	Uranium (U)	mg/L	0.015	-	0.0044	0.0033	0.0036	0.0029	0.0028	0.0030	0.0029	0.0023	0.0023	0.0021	0.0021	0.0020	0.0020
	Vanadium (V)	mg/L	0.006[α]	0.006	0.0032	0.0011	0.0013	0.0009	0.0014	<0.00050	0.0018	<0.0010	<0.0010	<0.0010	0.0007	0.0012	0.0016
	Zinc (Zn)	mg/L	0.030	0.030	0.0044	<0.0030	<0.0030	<0.0030	0.0039	<0.0030	<0.0030	<0.0030	<0.0030	0.0034	<0.0030	<0.0030	0.0030

[grey box] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.61: Water Chemistry at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2019

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
					20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19
Conventionals	Conductivity (lab)	umho/cm	-	-	230	231	228	218	210	571	255	232	255	252	258	255	251
	pH (lab)	pH	6.5 - 9.0	-	8.39	8.40	8.36	8.22	8.25	8.34	8.26	8.24	8.26	8.28	8.29	8.26	8.26
	Hardness (as $CaCO_3$)	mg/L	-	-	96.4	103	98.1	90.6	93.2	294	113	101	102	102	105	104	101
	Total Suspended Solids (TSS)	mg/L	-	-	6.4	3.5	5.3	8.3	6.9	<2.0	6.2	9.2	10.65	8.4	4.6	2.5	2.3
	Total Dissolved Solids (TDS)	mg/L	-	-	134	150	142	133	129	399	157	148	154	154	144	139	143
	Turbidity	NTU	-	-	15.9	9.70	15.2	27.7	29.1	3.5	29.1	36.2	47.4	42.9	22.0	8.74	10.9
	Alkalinity (as $CaCO_3$)	mg/L	-	-	86	96	90	83	86	120	89	88	88	89	91	90	89
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	<0.010
	Nitrate	mg/L	3	3	<0.020	<0.020	<0.020	<0.020	<0.020	0.988	0.118	0.039	0.051	0.05	0.051	0.051	0.059
	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	-	-	0.16	<0.15	<0.15	0.15	<0.15	0.19	<0.15	<0.15	0.21	0.17	<0.15	0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.61	1.75	1.45	1.41	1.42	1.38	1.38	1.47	1.51	1.46	1.43	1.63	1.62
	Total Organic Carbon	mg/L	-	-	1.86	1.92	1.93	2.22	2.24	1.70	1.94	2.02	2.19	2.26	2.00	1.93	2.08
	Total Phosphorus	mg/L	0.020[α]	-	0.0125	0.0080	0.0102	0.0134	0.0178	0.0049	0.0180	0.0283	0.0291	0.0971	0.0154	0.0077	0.0064
	Phenols	mg/L	0.004[α]	-	<0.0010	0.00415	0.0031	0.0015	0.0017	<0.0010	0.0020	0.0108	0.0012	0.005	<0.0010	0.0019	<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	17.1	13.7	15.8	14.3	13.0	17.2	13.5	13.3	13.5	12.7	13.1	12.6	12.3
	Sulphate (SO_4)	mg/L	218[β]	218	7.90	6.24	7.22	6.04	6.10	164	23.5	13.0	13.3	12.8	12.7	12.6	12.9
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.557	0.310	0.453	0.887	0.899	0.0766	**3.150**	0.886	**1.140**	0.961	0.595	0.287	0.312
	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	0.00013	<0.00010	0.00012	0.00017	0.00017	<0.00010	0.00015	0.0002	0.000215	0.00023	0.00014	0.00012	0.00011
	Barium (Ba)	mg/L	-	-	0.0169	0.0144	0.0158	0.0176	0.0183	0.0247	0.0177	0.0194	0.0207	0.0199	0.0177	0.0159	0.0156
	Beryllium (Be)	mg/L	0.011[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
	Bismuth (Bi)	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
	Boron (B)	mg/L	1.5	-	0.01	<0.010	<0.010	<0.010	0.011	<0.010	0.01	0.01	0.011	0.011	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000074	<0.0000050	0.0000098	<0.0000050	0.00001255	0.0000068	0.0000085	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	-	-	20.0	21.6	20.5	18.7	19.2	47.9	22.2	20.2	20.2	20.5	20.5	20.9	20.4
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00227	0.000575	0.00086	0.00207	0.0019	<0.00050	0.00142	0.00196	0.002635	0.00214	0.00135	0.0006	0.00059
	Cobalt (Co)	mg/L	0.0009[α]	0.004	0.00021	0.00012	0.00018	0.00036	0.00036	0.00018	0.00034	0.00047	0.000605	0.0005	0.00032	0.00012	0.00013
	Copper (Cu)	mg/L	0.002	0.0024	0.0017	0.0021	0.0017	**0.0025**	0.0024	0.0012	0.0020	0.0024	**0.0028**	**0.0027**	0.0020	0.0015	0.0014
	Iron (Fe)	mg/L	0.30	0.874	0.450	0.249	0.387	0.82	0.835	0.088	0.652	**1.01**	**1.32**	**1.09**	0.666	0.225	0.255
	Lead (Pb)	mg/L	0.001	0.001	0.000376	0.000230	0.000372	0.000691	0.000751	0.000133	0.000645	0.000852	**0.001020**	0.000938	0.000543	0.000204	0.000227
	Lithium (Li)	mg/L	-	-	0.0014	<0.0010	0.0011	0.0018	0.0017	0.0026	0.0016	0.0019	0.0023	0.0021	0.0015	0.0011	0.0011
	Magnesium (Mg)	mg/L	-	-	11.1	11.7	11.2	10.8	11.0	41.6	13.8	12.2	12.4	12.4	12.4	12.8	12.4
	Manganese (Mn)	mg/L	0.935[β]	-	0.0059	0.0033	0.0051	0.0099	0.0101	0.0016	0.0086	0.0128	0.0164	0.0138	0.0088	0.0037	0.0040
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	#DIV/0!	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.000694	0.000530	0.000592	0.000460	0.000511	0.000346	0.000506	0.000621	0.000601	0.000554	0.000643	0.000679	0.000669
	Nickel (Ni)	mg/L	0.025	0.025	0.00092	0.00062	0.00081	0.00144	0.00177	0.00090	0.00129	0.00174	0.00228	0.00209	0.00151	0.00102	0.00098
	Potassium (K)	mg/L	-	-	1.97	1.67	1.81	1.81	1.86	1.81	1.74	1.87	2.005	1.92	1.84	1.73	1.66
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000241	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	1.79	1.29	1.47	2.47	2.46	0.74	1.86	2.18	2.74	2.5	1.68	1.15	1.21
	Silver (Ag)	mg/L	0.00025	0.0001	<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
	Sodium (Na)	mg/L	-	-	7.44	5.94	6.73	5.42	5.36	2.91	4.95	5.15	5.22	5.11	5.24	5.24	4.96
	Strontium (Sr)	mg/L	-	-	0.0282	0.0253	0.0272	0.0251	0.0241	0.060	0.0276	0.026	0.026	0.026	0.0250	0.0243	0.0243
	Thallium (Tl)	mg/L	0.0008	0.0008	0.000013	<0.000010	0.00001	0.000021	0.000022	<0.000010	0.000018	0.000025	0.0000305	0.000027	0.000018	<0.000010	0.000011
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.0263	0.0146	0.0217	0.0474	0.0485	0.0046	0.0359	0.0578	0.0741	0.06	0.0356	0.0136	0.0135
	Uranium (U)	mg/L	0.015	-	0.00756	0.00655	0.00718	0.00569	0.00568	0.00435	0.00552	0.00553	0.00557	0.00545	0.00544	0.00518	0.00494
	Vanadium (V)	mg/L	0.006[α]	0.006	0.0012	0.000775	0.00103	0.0017	0.00178	<0.00050	0.00154	0.00208	0.00258	0.00222	0.00145	0.0007	0.0007
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	0.0043	0.005	<0.0030	<0.0030	<0.0030	0.0067	0.0038	<0.0030	<0.0030	<0.0030

(shaded box) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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.

Table C.62: 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 2019

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)	0.8	0.9	2.5	1.1	0.9	0.9	1.0	0.9	1.1	1.0	1.1	1.0	3.3	1.3	1.2	1.2	1.2	1.1	1.1	1.1
Hardness (as $CaCO_3$)	0.8	0.9	2.5	1.1	0.9	0.9	1.0	0.9	1.1	0.9	1.1	1.0	3.7	1.4	1.2	1.2	1.2	1.1	1.0	1.0
Total Suspended Solids (TSS)	1.0	1.0	2.4	1.0	1.2	1.0	1.2	1.0	1.2	1.4	0.3	0.7	0.3	1.0	0.8	0.3	0.6	0.3	0.4	0.4
Total Dissolved Solids (TDS)	0.8	0.5	1.1	0.8	0.5	0.5	0.5	0.5	0.7	1.1	1.0	1.0	3.8	1.5	1.2	1.2	1.0	1.2	1.0	1.1
Turbidity	1.3	0.9	0.8	1.0	1.5	1.5	1.3	1.3	1.4	1.6	0.4	0.7	0.1	0.9	0.6	0.6	0.8	0.5	1.0	1.0
Alkalinity (as $CaCO_3$)	0.7	0.9	1.8	1.0	0.8	0.8	0.9	0.9	1.0	0.9	0.9	1.0	1.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total Ammonia	0.5	0.8	0.5	0.5	1.7	4.2	0.9	0.7	0.6	2.8	0.9	0.7	0.8	0.9	0.5	1.0	0.8	1.1	0.9	1.0
Nitrate	1.0	1.0	2.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	44	5.3	3.1	10.0	3.4	2.9	2.3	3.1
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	1.1	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Dissolved Organic Carbon	0.9	1.1	0.8	0.9	0.8	1.1	0.9	0.9	1.1	1.0	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.2	1.1
Total Organic Carbon	1.0	1.6	1.4	1.4	1.5	1.4	1.4	1.5	1.2	1.3	0.9	1.0	0.8	1.0	1.3	1.1	1.2	1.6	1.3	1.2
Total Phosphorus	1.2	1.1	1.7	1.0	1.2	1.2	1.1	1.1	1.0	1.8	0.5	0.8	0.2	0.9	0.6	0.6	0.6	0.5	0.8	0.9
Phenols	1.0	1.0	1.0	1.3	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	1.0	1.0
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)	2.5	1.5	8.5	2.5	1.5	1.6	1.6	1.5	1.8	1.5	2.1	1.1	2.9	1.3	1.2	1.2	1.2	1.0	0.9	0.9
Sulphate (SO_4)	1.0	1.0	47	7.1	4.1	4.7	4.8	4.3	5.8	4.0	0.8	0.8	43	6.2	4.0	3.9	3.5	2.9	2.8	2.8
Aluminum (Al)	1.6	0.9	1.4	1.2	1.2	1.1	1.3	1.8	1.3	1.4	0.4	0.8	0.1	0.9	0.2	0.2	0.2	0.3	0.6	0.9
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	0.6	0.9	0.6	1.4	0.6	0.6	0.6	0.7	0.9	0.9
Barium (Ba)	1.0	1.0	1.4	1.0	1.0	1.0	1.1	1.1	1.2	1.1	0.8	0.9	1.4	1.1	0.8	0.8	0.8	0.8	0.8	0.9
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	1.0	1.0	5.0	5.0	5.0	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	1.9	1.9	1.9	1.0	1.1	1.1
Calcium (Ca)	0.8	0.9	2.3	1.1	0.9	0.9	1.0	0.9	1.0	0.9	1.1	1.0	3.0	1.2	1.1	1.1	1.1	1.1	1.0	1.0
Chromium (Cr)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.4	0.7	0.3	1.1	0.3	0.3	0.3	0.4	0.6	8.6
Cobalt (Co)	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.4	0.7	0.4	1.0	0.3	0.3	0.3	0.4	0.6	0.9
Copper (Cu)	1.1	1.1	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.2	0.7	0.9	0.5	1.1	0.6	0.6	0.7	0.7	0.8	1.4
Iron (Fe)	1.6	0.8	1.9	1.0	1.1	1.1	1.2	1.3	1.5	1.6	0.4	0.7	0.1	1.0	0.2	0.2	0.3	0.3	0.6	1.0
Lead (Pb)	1.3	0.9	1.9	0.9	1.2	1.1	1.1	1.2	1.4	1.5	0.5	0.8	0.2	1.0	0.3	0.4	0.5	0.4	0.7	0.9
Lithium (Li)	1.0	1.0	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.7	2.3	1.1	0.8	0.8	0.8	0.6	0.6	0.8
Magnesium (Mg)	0.8	0.9	2.7	1.2	0.9	0.9	1.0	1.0	1.2	1.0	1.0	1.0	4.5	1.4	1.2	1.2	1.2	1.1	1.1	1.1
Manganese (Mn)	1.4	0.7	3.3	1.0	1.4	1.2	1.5	1.5	2.5	2.3	0.4	0.7	0.3	1.0	0.3	0.3	0.4	0.4	0.7	1.2
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	1.0	1.2	1.0	1.1	1.1	1.2	1.3	1.7	2.2	1.9	0.7	0.8	0.6	0.8	0.8	0.8	0.7	0.9	0.9	1.0
Nickel (Ni)	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	1.0	0.5	1.5	0.4	0.5	0.6	0.7	1.0	1.4
Potassium (K)	1.0	1.0	1.3	1.1	1.0	1.0	1.0	1.1	1.2	1.2	0.8	0.9	1.1	1.0	0.8	0.8	0.8	0.8	0.9	1.0
Selenium (Se)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.4	1.4	7.1	1.6	29	29	29	1.4	1.4	1.4
Silicon (Si)	1.1	1.0	1.1	1.1	1.1	1.0	1.1	1.3	1.0	1.0	0.6	0.9	0.4	1.0	0.5	0.4	0.5	0.5	0.7	0.9
Silver (Ag)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.4	1.4	1.4	1.4	0.3	0.3	0.3	1.4	1.4	1.4
Sodium (Na)	1.0	1.1	0.8	1.0	0.9	1.0	1.1	1.1	1.3	1.2	0.8	0.8	0.6	0.7	0.7	0.7	0.7	0.6	0.6	0.6
Strontium (Sr)	0.9	1.0	4.4	1.5	1.0	1.0	1.1	1.0	1.1	1.0	1.1	0.9	4.4	1.4	1.4	1.4	1.4	1.1	1.0	1.0
Thallium (Tl)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.8	0.5	1.1	4.6	4.6	4.6	0.5	0.7	0.9
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)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.4	0.7	0.1	1.0	0.2	0.2	0.2	0.3	0.6	0.8
Uranium (U)	0.9	0.9	1.6	1.0	1.0	1.0	1.0	1.0	1.2	1.0	0.8	0.7	0.8	0.8	0.6	0.6	0.6	0.6	0.5	0.5
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.8	0.3	0.9	0.5	0.5	0.5	0.4	0.6	0.8
Zinc (Zn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.1	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.9

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).

Table C.62: 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 2019

Variable	Fall									
	G0-03	G0-01	FO-01	E0-10	E0-03	E0-21	E0-20	C0-10	CO-05	CO-01
Conductivity (lab)	0.9	0.9	2.5	1.1	1.0	1.1	1.1	1.1	1.1	1.1
Hardness (as $CaCO_3$)	0.9	0.9	3.0	1.1	1.0	1.0	1.0	1.1	1.1	1.0
Total Suspended Solids (TSS)	1.6	1.4	0.4	1.2	1.8	2.1	1.7	0.9	0.5	0.5
Total Dissolved Solids (TDS)	0.9	0.9	2.8	1.1	1.0	1.1	1.1	1.0	1.0	1.0
Turbidity	2.0	2.1	0.3	2.1	2.7	3.5	3.2	1.6	0.6	0.8
Alkalinity (as $CaCO_3$)	0.9	1.0	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total Ammonia	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0
Nitrate	1.0	1.0	49	5.9	2.0	2.6	2.5	2.6	2.6	3.0
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	1.2	1.0	1.0	1.4	1.1	1.0	1.0	1.0
Dissolved Organic Carbon	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0
Total Organic Carbon	1.2	1.2	0.9	1.0	1.1	1.1	1.2	1.1	1.0	1.1
Total Phosphorus	1.3	1.7	0.5	1.8	2.8	2.8	9.5	1.5	0.8	0.6
Phenols	0.5	0.6	0.4	0.7	3.9	0.4	1.8	0.4	0.7	0.4
Bromide (Br)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Chloride (Cl)	0.9	0.8	1.1	0.9	0.9	0.9	0.8	0.8	0.8	0.8
Sulphate (SO_4)	0.8	0.9	23	3.3	1.8	1.9	1.8	1.8	1.8	1.8
Aluminum (Al)	2.0	2.0	0.2	7.2	2.0	2.6	2.2	1.4	0.7	0.7
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.5	1.5	0.9	1.3	1.7	1.8	2.0	1.2	1.0	0.9
Barium (Ba)	1.1	1.2	1.6	1.1	1.2	1.3	1.3	1.1	1.0	1.0
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	1.5	1.0	2.0	1.0	2.5	1.4	1.7	1.0	1.0
Calcium (Ca)	0.9	0.9	2.3	1.1	1.0	1.0	1.0	1.0	1.0	1.0
Chromium (Cr)	1.7	1.5	0.4	1.1	1.6	2.1	1.7	1.1	0.5	0.5
Cobalt (Co)	2.1	2.1	1.1	2.0	2.8	3.6	2.9	1.9	0.7	0.8
Copper (Cu)	1.4	1.3	0.7	1.1	1.3	1.5	1.5	1.1	0.8	0.8
Iron (Fe)	2.3	2.3	0.2	1.8	2.8	3.6	3.0	1.8	0.6	0.7
Lead (Pb)	2.1	2.3	0.4	2.0	2.6	3.1	2.9	1.7	0.6	0.7
Lithium (Li)	1.5	1.5	2.2	1.4	1.6	2.0	1.8	1.3	0.9	0.9
Magnesium (Mg)	1.0	1.0	3.7	1.2	1.1	1.1	1.1	1.1	1.1	1.1
Manganese (Mn)	2.1	2.1	0.3	1.8	2.7	3.4	2.9	1.8	0.8	0.8
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0
Molybdenum (Mo)	0.8	0.8	0.6	0.8	1.0	1.0	0.9	1.1	1.1	1.1
Nickel (Ni)	1.8	2.3	1.1	1.6	2.2	2.9	2.7	1.9	1.3	1.3
Potassium (K)	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.0	1.0	0.9
Selenium (Se)	1.0	1.0	4.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Silicon (Si)	1.6	1.6	0.5	1.2	1.4	1.8	1.6	1.1	0.8	0.8
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	0.8	0.4	0.7	0.8	0.8	0.8	0.8	0.8	0.7
Strontium (Sr)	0.9	0.9	2.2	1.0	1.0	1.0	1.0	0.9	0.9	0.9
Thallium (Tl)	1.9	2.0	0.9	1.6	2.3	2.8	2.5	1.6	0.9	1.0
Tin (Sn)	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Titanium (Ti)	2.3	2.3	0.2	1.7	2.8	3.6	2.9	1.7	0.7	0.6
Uranium (U)	0.8	0.8	0.6	0.8	0.8	0.8	0.8	0.8	0.7	0.7
Vanadium (V)	1.7	1.8	0.5	1.5	2.1	2.6	2.2	1.4	0.7	0.7
Zinc (Zn)	1.4	1.7	1.0	1.0	1.0	2.2	1.3	1.0	1.0	1.0

Denotes slight elevation Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).
Denotes moderate eleva Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
Denotes highly elevated Denotes highly elevated concentration (mean concentration ≥ 10 times higher than respective mean reference or baseline period value).

Table C.63: Dissolved Metal Concentrations at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2019

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
			28-Jun-19	28-Jun-19	28-Jun-19	28-Jun-19	26-Jun-19	26-Jun-19	26-Jun-19	27-Jun-19	27-Jun-19	27-Jun-19	27-Jun-19	28-Jun-19	28-Jun-19	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19
Dissolved Metals	Aluminum (Al)	mg/L	0.0209	0.0370	0.0538	0.0606	0.0455	0.0039	0.0115	0.0306	0.0418	0.0317	0.0499	0.0599	0.0315	0.0459	0.0292	0.0402	0.0356	0.0331	<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
	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	0.00346	0.00271	0.00255	0.00272	0.00306	0.00399	0.00281	0.00271	0.00282	0.00280	0.00290	0.00350	0.00291	0.00885	0.00911	0.00880	0.00966	0.00901	0.01990
	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	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	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	6.17	4.43	3.34	3.74	4.07	10.50	4.88	3.96	3.99	4.31	4.13	4.56	4.16	13.0	15.3	13.7	15.2	14.0	40.8
	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	0.00011
	Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00057	<0.00050	<0.00050	<0.00050	0.00050	<0.00050	<0.00050	0.00060	<0.00050	0.00089	0.00086	0.00096	0.00093	0.00089	0.00098
	Iron (Fe)	mg/L	<0.030	<0.030	0.031	0.033	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.049	<0.030	0.019	0.013	0.019	0.016	0.014	<0.010
	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	0.000078	<0.000050	<0.000050	<0.000050	0.000052	<0.000050	<0.000050	<0.000050
	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	0.0011	0.0010	0.0013	0.0012	0.0012	0.0046
	Magnesium (Mg)	mg/L	3.67	2.62	2.08	2.14	2.46	7.52	3.32	2.62	2.56	2.81	2.71	3.35	2.69	7.16	8.22	7.68	8.04	7.68	35.6
	Manganese (Mn)	mg/L	0.00016	0.00029	0.00040	0.00040	0.00030	0.00074	0.00022	0.00055	0.00063	0.00056	0.00065	0.00208	0.00089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00121
	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	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000056	0.000064	0.000068	0.00007	0.000079	0.000071	0.000066	0.0000745	0.000078	0.000079	0.000077	0.000156	0.000124	0.000578	0.000410	0.000460	0.000362	0.000390	0.000282
	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	0.49	0.41	0.39	0.39	0.41	0.54	0.43	0.40	0.42	0.44	0.44	0.52	0.45	1.26	1.13	1.20	1.10	1.07	1.54
	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000236
	Silicon (Si)	mg/L	0.530	0.460	0.460	0.480	0.490	0.370	0.400	0.415	0.450	0.440	0.480	0.480	0.420	0.884	0.874	0.890	0.876	0.900	0.772
	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	0.529	0.408	0.435	0.434	0.486	0.356	0.451	0.419	0.419	0.474	0.486	0.587	0.521	3.60	2.89	3.21	2.57	2.53	1.83
	Strontium (Sr)	mg/L	0.0046	0.0037	0.0032	0.0035	0.0042	0.0169	0.0056	0.0040	0.0040	0.0040	0.0039	0.0041	0.0037	0.0181	0.0159	0.0163	0.0186	0.0153	0.0767
	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	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	0.00158	0.00076	0.00116	0.00104	0.00097	<0.00030
	Uranium (U)	mg/L	0.000223	0.000148	0.000137	0.000128	0.000157	0.000289	0.000165	0.000151	0.000154	0.000168	0.000161	0.000208	0.000155	0.003500	0.002980	0.003300	0.002450	0.002480	0.002790
	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	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	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

Table C.63: Dissolved Metal Concentrations at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2019

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
			1-Aug-19	28-Jul-19	28-Jul-19	28-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19
Dissolved Metals	Aluminum (Al)	mg/L	0.0356	0.0347	0.0355	0.0285	0.0750	0.0231	0.0289	0.0226	0.0189	0.0237	0.0295	0.0226	0.0068	0.0169	0.0227	0.0232	0.0245	0.0171	0.0113	0.0302
	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	0.01050	0.00954	0.00979	0.00967	0.00917	0.00868	0.00851	0.01380	0.01305	0.01350	0.01350	0.01320	0.02480	0.01430	0.01370	0.01385	0.01390	0.01370	0.01420	0.01410
	Beryllium (Be)	mg/L	<0.00010	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	<0.000050	<0.00050	<0.00050	<0.00050	<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
	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	<0.0000050	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	0.0000217	0.0000067	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	17.5	15.8	15.7	15.7	15.2	14.2	13.8	20.1	21.4	20.4	18.7	19.3	48.0	22.1	20.1	20.4	20.4	21.1	20.7	20.1
	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	<0.00010	<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	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00098	0.00092	0.00148	0.00094	0.00103	0.0009	0.00096	0.00114	0.00098	0.00110	0.00124	0.00097	0.00081	0.00092	0.00097	0.00096	0.00096	0.00122	0.00112	0.00110
	Iron (Fe)	mg/L	0.016	<0.030	<0.030	<0.030	0.022	0.019	0.017	0.010	<0.010	0.011	0.039	<0.010	<0.010	<0.010	<0.010	0.010	0.012	0.011	0.011	0.018
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000094	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0015	0.0014	0.0014	0.0015	<0.0010	<0.0010	<0.0010	0.0012	0.0010	0.0010	<0.0010	<0.0010	0.0030	0.0011	<0.0010	0.0011	0.0012	0.0012	0.0010	<0.0010
	Magnesium (Mg)	mg/L	11.2	9.75	9.62	9.77	8.58	8.22	7.97	11.2	12.0	11.5	10.6	11.0	42.2	14.1	12.3	12.4	12.4	12.7	12.6	12.4
	Manganese (Mn)	mg/L	<0.00050	0.00042	0.00051	0.00054	0.00074	0.00108	0.00072	<0.00050	<0.00050	<0.00050	0.00091	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00051	0.00056	0.00096	0.00099
	Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000376	0.000450	0.000496	0.000498	0.000509	0.000468	0.000449	0.000741	0.000559	0.000666	0.000534	0.000565	0.000335	0.000573	0.000680	0.000724	0.000691	0.000685	0.000684	0.000659
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00053	0.00051	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00052	<0.00050	<0.00050	<0.00050	0.00057	0.00057	0.00063	0.00065
	Potassium (K)	mg/L	1.15	1.19	1.22	1.21	1.11	1.08	1.08	1.77	1.58	1.70	1.49	1.54	1.78	1.54	1.57	1.59	1.55	1.60	1.59	1.54
	Selenium (Se)	mg/L	<0.000050	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050	<0.000050	0.000056	<0.000050	0.00006	0.000059	<0.000050	0.000277	0.00008	0.000055	0.000052	<0.000050	0.000055	0.000051	0.000052
	Silicon (Si)	mg/L	0.898	0.920	0.890	0.925	0.904	0.860	0.835	0.582	0.664	0.553	0.562	0.597	0.598	0.580	0.582	0.581	0.640	0.550	0.530	0.570
	Silver (Ag)	mg/L	<0.000050	<0.000010	<0.000010	<0.000010	<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
	Sodium (Na)	mg/L	2.42	2.26	2.26	2.24	2.03	1.88	1.86	7.67	6.11	7.01	5.46	5.47	2.95	5.11	5.42	5.45	5.22	5.49	5.23	5.04
	Strontium (Sr)	mg/L	0.0241	0.0255	0.0250	0.0240	0.0183	0.0162	0.0162	0.0271	0.0247	0.0264	0.0228	0.0228	0.0605	0.0268	0.0248	0.0253	0.0241	0.0246	0.0240	0.0230
	Thallium (Tl)	mg/L	<0.000010	<0.00010	<0.00010	<0.00010	<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
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00032	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	0.00102	<0.010	<0.010	<0.010	0.00103	0.00071	0.00081	0.00061	0.0005	0.00061	0.00164	0.00068	<0.00030	0.00052	0.00064	0.00066	0.00071	0.00044	<0.00030	0.00071
	Uranium (U)	mg/L	0.002400	0.002230	0.002230	0.002065	0.002030	0.001810	0.001780	0.006880	0.006040	0.006590	0.005170	0.005040	0.004190	0.005040	0.005060	0.005075	0.004820	0.005130	0.004920	0.004680
	Vanadium (V)	mg/L	<0.00050	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)	mg/L	<0.0010	<0.0030	<0.0030	<0.0030	0.0126	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.003	0.002
	Zirconium (Zr)	mg/L	<0.00020	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00027	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

Table C.64: Summary of the Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Mary River Mine-Exposed and Reference (GO-09) Stations in 2019

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)	1.6	1.2	0.1	0.3	0.8	1.1	0.9	1.3	1.6	0.8	0.9	0.9	0.1	0.9	0.9	0.9	0.7	2.0	0.6	0.8	1.4	1.0	0.3	0.8	1.0	1.1	1.1	0.8	0.5	1.4
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)	0.9	1.1	1.4	1.0	0.9	1.0	1.0	1.0	1.2	1.0	1.1	1.0	2.2	1.2	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.8	1.1	1.0	1.0	1.0	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	5.0	5.0	5.0	1.0	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	2.0	2.0	2.0	1.0	1.0	4.3	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Calcium (Ca)	0.8	0.9	2.3	1.1	0.9	0.9	0.9	0.9	1.0	0.9	1.1	1.0	2.9	1.3	1.1	1.1	1.1	1.1	1.0	1.0	0.9	0.9	2.3	1.1	1.0	1.0	1.0	1.0	1.0	1.0
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	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Copper (Cu)	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.0	1.0	1.0	1.1	1.1	1.0	1.6	1.0	1.1	1.0	1.1	1.2	0.9	0.8	0.9	0.9	0.9	0.9	1.1	1.0	1.0
Iron (Fe)	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.6	1.0	0.9	0.8	0.6	0.9	1.8	1.8	1.8	1.3	1.1	1.0	3.8	1.0	1.0	1.0	1.0	1.0	1.2	1.1	1.1	1.7
Lead (Pb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lithium (Li)	1.0	1.0	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	4.1	1.3	1.2	1.2	1.3	0.9	0.9	0.9	0.9	0.9	2.8	1.0	0.9	1.0	1.1	1.1	0.9	0.9
Magnesium (Mg)	0.8	0.9	2.7	1.2	0.9	0.9	1.0	1.0	1.2	1.0	1.0	1.0	4.6	1.5	1.3	1.3	1.3	1.1	1.1	1.0	0.9	1.0	3.7	1.2	1.1	1.1	1.1	1.1	1.1	1.1
Manganese (Mn)	1.4	1.1	2.6	0.8	2.0	2.2	2.0	2.3	7.4	3.2	1.0	1.0	2.4	1.0	0.8	1.0	1.1	1.5	2.2	1.4	1.8	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.9	2.0
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	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	1.1	1.3	1.1	1.1	1.2	1.2	1.3	1.2	2.5	2.0	0.8	0.8	0.6	0.8	0.9	1.0	1.0	1.1	1.0	0.9	0.8	0.9	0.5	0.9	1.0	1.1	1.1	1.0	1.0	1.0
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	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.3	1.3
Potassium (K)	0.9	1.0	1.3	1.0	0.9	1.0	1.0	1.0	1.2	1.0	0.9	0.9	1.3	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9	1.1	0.9	0.9	0.9	0.9	1.0	0.9	0.9
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	4.7	1.0	-	-	-	1.0	1.0	1.0	1.1	0.9	5.0	1.4	1.0	0.9	0.9	1.0	0.9	0.9
Silicon (Si)	1.0	1.0	0.8	0.8	0.9	0.9	0.9	1.0	1.0	0.9	1.0	1.0	0.9	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.1	0.9	0.9	1.0
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	0.2	0.2	0.2	1.0	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)	0.9	1.1	0.8	1.0	0.9	0.9	1.0	1.1	1.3	1.1	0.8	0.8	0.6	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.8	0.8	0.4	0.7	0.8	0.8	0.8	0.8	0.8	0.7
Strontium (Sr)	0.9	1.1	4.4	1.5	1.1	1.0	1.0	1.0	1.1	1.0	1.1	0.9	4.6	1.4	1.5	1.5	1.4	1.1	1.0	1.0	0.9	0.9	2.3	1.0	1.0	1.0	0.9	0.9	0.9	0.9
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
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	3.2	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	0.9	0.8	0.3	0.9	-	-	-	0.9	0.6	0.7	2.9	1.2	0.5	0.9	1.1	1.2	1.2	0.8	0.5	1.2
Uranium (U)	0.8	0.9	1.7	1.0	0.9	0.9	1.0	1.0	1.2	0.9	0.8	0.8	0.9	0.7	0.7	0.7	0.6	0.6	0.6	0.5	0.8	0.8	0.6	0.8	0.8	0.8	0.7	0.8	0.8	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	2.0	2.0	2.0	1.0	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	-	-	-	13	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.0	2.0

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).
Denotes differences in method detection limit between the mine-exposed and reference area data, precluding an evaluation of magnitude of elevation.

Table C.65: **Spearman's Rank Correlation Coefficients for Mary River Water Quality Data Collected in Spring, Summer, and Fall 2019**[a]

Parameters	Conventional Parameters										Total Metals										
	Conduct-ivity	Hardness	Total Dissolved Solids	Turbidity	Alkalinity	Nitrate	Dissolved Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Iron	Manganese	Molybdenum	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	1	0.994	0.968	0.506	0.971	0.630	0.693	0.423	0.904	0.864	0.516	0.889	0.629	0.541	0.532	0.804	0.851	0.606	0.792	0.949	0.849
Hardness	0.994	1	0.966	0.490	0.980	0.605	0.677	0.404	0.909	0.851	0.509	0.879	0.621	0.526	0.515	0.789	0.842	0.601	0.798	0.950	0.859
Total Dissolved Solids	0.968	0.966	1	0.526	0.948	0.590	0.686	0.463	0.902	0.824	0.553	0.890	0.667	0.586	0.556	0.776	0.850	0.635	0.786	0.934	0.848
Turbidity	0.506	0.490	0.526	1	0.464	0.215	0.472	0.947	0.542	0.455	0.933	0.651	0.891	0.928	0.892	0.752	0.737	0.870	0.704	0.522	0.672
Alkalinity	0.971	0.980	0.948	0.464	1	0.534	0.722	0.385	0.886	0.803	0.490	0.863	0.624	0.522	0.511	0.804	0.840	0.589	0.814	0.918	0.867
Nitrate	0.630	0.605	0.590	0.215	0.534	1	0.371	0.196	0.431	0.848	0.152	0.439	0.220	0.228	0.238	0.285	0.317	0.219	0.139	0.569	0.226
Dissolved Organic Carbon	0.693	0.677	0.686	0.472	0.722	0.371	1	0.359	0.559	0.505	0.408	0.583	0.568	0.459	0.429	0.748	0.640	0.511	0.666	0.628	0.638
Total Phosphorus	0.423	0.404	0.463	0.947	0.385	0.196	0.359	1	0.458	0.440	0.933	0.595	0.856	0.940	0.919	0.658	0.684	0.856	0.604	0.435	0.597
Chloride	0.904	0.909	0.902	0.542	0.886	0.431	0.559	0.458	1	0.762	0.579	0.887	0.678	0.578	0.565	0.787	0.872	0.651	0.851	0.951	0.908
Sulphate	0.864	0.851	0.824	0.455	0.803	0.848	0.505	0.440	0.762	1	0.461	0.768	0.517	0.518	0.549	0.618	0.698	0.528	0.518	0.843	0.639
Aluminum (total)	0.516	0.509	0.553	0.933	0.490	0.152	0.408	0.933	0.579	0.461	1	0.701	0.924	0.972	0.952	0.762	0.778	0.931	0.737	0.526	0.725
Barium (total)	0.889	0.879	0.890	0.651	0.863	0.439	0.583	0.595	0.887	0.768	0.701	1	0.809	0.733	0.736	0.821	0.965	0.793	0.830	0.886	0.887
Copper (total)	0.629	0.621	0.667	0.891	0.624	0.220	0.568	0.856	0.678	0.517	0.924	0.809	1	0.940	0.906	0.834	0.859	0.940	0.814	0.630	0.784
Iron (total)	0.541	0.526	0.586	0.928	0.522	0.228	0.459	0.940	0.578	0.518	0.972	0.733	0.940	1	0.984	0.753	0.795	0.933	0.709	0.538	0.709
Manganese (total)	0.532	0.515	0.556	0.892	0.511	0.238	0.429	0.919	0.565	0.549	0.952	0.736	0.906	0.984	1	0.729	0.794	0.914	0.669	0.538	0.698
Molybdenum (total)	0.804	0.789	0.776	0.752	0.804	0.285	0.748	0.658	0.787	0.618	0.762	0.821	0.834	0.753	0.729	1	0.899	0.764	0.926	0.773	0.891
Potassium (total)	0.851	0.842	0.850	0.737	0.840	0.317	0.640	0.684	0.872	0.698	0.778	0.965	0.859	0.795	0.794	0.899	1	0.845	0.904	0.864	0.940
Silicon (total)	0.606	0.601	0.635	0.870	0.589	0.219	0.511	0.856	0.651	0.528	0.931	0.793	0.940	0.933	0.914	0.764	0.845	1	0.765	0.628	0.773
Sodium (total)	0.792	0.798	0.786	0.704	0.814	0.139	0.666	0.604	0.851	0.518	0.737	0.830	0.814	0.709	0.669	0.926	0.904	0.765	1	0.796	0.961
Strontium (total)	0.949	0.950	0.934	0.522	0.918	0.569	0.628	0.435	0.951	0.843	0.526	0.886	0.630	0.538	0.538	0.773	0.864	0.628	0.796	1	0.882
Uranium (total)	0.849	0.859	0.848	0.672	0.867	0.226	0.638	0.597	0.908	0.639	0.725	0.887	0.784	0.709	0.698	0.891	0.940	0.773	0.961	0.882	1
Aluminum (dissolved)	-0.648	-0.654	-0.597	-0.089	-0.646	-0.369	-0.393	-0.118	-0.531	-0.569	-0.125	-0.530	-0.186	-0.127	-0.180	-0.358	-0.500	-0.237	-0.377	-0.612	-0.512
Barium (dissolved)	0.970	0.965	0.946	0.502	0.940	0.587	0.672	0.419	0.919	0.835	0.530	0.902	0.637	0.544	0.537	0.803	0.860	0.615	0.816	0.943	0.864
Copper (dissolved)	0.783	0.769	0.757	0.598	0.776	0.424	0.743	0.490	0.782	0.625	0.586	0.688	0.682	0.613	0.591	0.828	0.727	0.634	0.801	0.768	0.783
Iron (dissolved)	-0.782	-0.799	-0.796	-0.451	-0.807	-0.330	-0.574	-0.445	-0.740	-0.636	-0.522	-0.801	-0.631	-0.539	-0.527	-0.731	-0.792	-0.608	-0.708	-0.749	-0.763
Manganese (dissolved)	0.207	0.174	0.102	0.069	0.188	0.299	0.214	0.028	0.114	0.313	0.074	0.174	0.109	0.116	0.202	0.220	0.125	0.028	0.044	0.133	0.070
Molybdenum (dissolved)	0.774	0.761	0.750	0.817	0.762	0.311	0.725	0.728	0.777	0.621	0.785	0.795	0.826	0.779	0.755	0.958	0.878	0.762	0.900	0.772	0.868
Potassium (dissolved)	0.937	0.935	0.906	0.569	0.938	0.444	0.693	0.481	0.924	0.763	0.571	0.904	0.687	0.589	0.578	0.879	0.919	0.644	0.901	0.940	0.933
Silicon (dissolved)	0.450	0.460	0.470	0.525	0.456	0.424	0.451	0.478	0.444	0.450	0.496	0.472	0.587	0.562	0.498	0.435	0.452	0.629	0.465	0.459	0.435
Sodium (dissolved)	0.794	0.800	0.794	0.715	0.816	0.146	0.670	0.615	0.847	0.521	0.740	0.832	0.813	0.717	0.676	0.922	0.905	0.765	0.996	0.799	0.961
Strontium (dissolved)	0.915	0.918	0.894	0.474	0.876	0.634	0.594	0.396	0.914	0.852	0.450	0.807	0.553	0.469	0.463	0.705	0.780	0.558	0.729	0.972	0.814
Uranium (dissolved)	0.860	0.870	0.848	0.649	0.881	0.237	0.649	0.575	0.911	0.643	0.699	0.881	0.770	0.685	0.676	0.897	0.933	0.753	0.962	0.884	0.991

(green) Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

Table C.65: **Spearman's Rank Correlation Coefficients for Mary River Water Quality Data Collected in Spring, Summer, and Fall 2019**[a]

Parameters	Dissolved Metals										
	Aluminum	Barium	Copper	Iron	Manganese	Molybdenum	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	-0.648	0.970	0.783	-0.782	0.207	0.774	0.937	0.450	0.794	0.915	0.860
Hardness	-0.654	0.965	0.769	-0.799	0.174	0.761	0.935	0.460	0.800	0.918	0.870
Total Dissolved Solids	-0.597	0.946	0.757	-0.796	0.102	0.750	0.906	0.470	0.794	0.894	0.848
Turbidity	-0.089	0.502	0.598	-0.451	0.069	0.817	0.569	0.525	0.715	0.474	0.649
Alkalinity	-0.646	0.940	0.776	-0.807	0.188	0.762	0.938	0.456	0.816	0.876	0.881
Nitrate	-0.369	0.587	0.424	-0.330	0.299	0.311	0.444	0.424	0.146	0.634	0.237
Dissolved Organic Carbon	-0.393	0.672	0.743	-0.574	0.214	0.725	0.693	0.451	0.670	0.594	0.649
Total Phosphorus	-0.118	0.419	0.490	-0.445	0.028	0.728	0.481	0.478	0.615	0.396	0.575
Chloride	-0.531	0.919	0.782	-0.740	0.114	0.777	0.924	0.444	0.847	0.914	0.911
Sulphate	-0.569	0.835	0.625	-0.636	0.313	0.621	0.763	0.450	0.521	0.852	0.643
Aluminum (total)	-0.125	0.530	0.586	-0.522	0.074	0.785	0.571	0.496	0.740	0.450	0.699
Barium (total)	-0.530	0.902	0.688	-0.801	0.174	0.795	0.904	0.472	0.832	0.807	0.881
Copper (total)	-0.186	0.637	0.682	-0.631	0.109	0.826	0.687	0.587	0.813	0.553	0.770
Iron (total)	-0.127	0.544	0.613	-0.539	0.116	0.779	0.589	0.562	0.717	0.469	0.685
Manganese (total)	-0.180	0.537	0.591	-0.527	0.202	0.755	0.578	0.498	0.676	0.463	0.676
Molybdenum (total)	-0.358	0.803	0.828	-0.731	0.220	0.958	0.879	0.435	0.922	0.705	0.897
Potassium (total)	-0.500	0.860	0.727	-0.792	0.125	0.878	0.919	0.452	0.905	0.780	0.933
Silicon (total)	-0.237	0.615	0.634	-0.608	0.028	0.762	0.644	0.629	0.765	0.558	0.753
Sodium (total)	-0.377	0.816	0.801	-0.708	0.044	0.900	0.901	0.465	0.996	0.729	0.962
Strontium (total)	-0.612	0.943	0.768	-0.749	0.133	0.772	0.940	0.459	0.799	0.972	0.884
Uranium (total)	-0.512	0.864	0.783	-0.763	0.070	0.868	0.933	0.435	0.961	0.814	0.991
Aluminum (dissolved)	1	-0.565	-0.273	0.595	-0.089	-0.303	-0.574	0.065	-0.379	-0.572	-0.523
Barium (dissolved)	-0.565	1	0.786	-0.770	0.203	0.790	0.935	0.471	0.815	0.911	0.872
Copper (dissolved)	-0.273	0.786	1	-0.538	0.273	0.822	0.796	0.550	0.800	0.756	0.797
Iron (dissolved)	0.595	-0.770	-0.538	1	0.035	-0.660	-0.786	-0.389	-0.722	-0.723	-0.766
Manganese (dissolved)	-0.089	0.203	0.273	0.035	1	0.213	0.145	-0.031	0.007	0.054	0.070
Molybdenum (dissolved)	-0.303	0.790	0.822	-0.660	0.213	1	0.862	0.480	0.900	0.720	0.873
Potassium (dissolved)	-0.574	0.935	0.796	-0.786	0.145	0.862	1	0.444	0.903	0.900	0.942
Silicon (dissolved)	0.065	0.471	0.550	-0.389	-0.031	0.480	0.444	1	0.471	0.525	0.430
Sodium (dissolved)	-0.379	0.815	0.800	-0.722	0.007	0.900	0.903	0.471	1	0.738	0.965
Strontium (dissolved)	-0.572	0.911	0.756	-0.723	0.054	0.720	0.900	0.525	0.738	1	0.821
Uranium (dissolved)	-0.523	0.872	0.797	-0.766	0.070	0.873	0.942	0.430	0.965	0.821	1

[green] Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

[blue] Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

Table C.66: ***In Situ*** **Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Winter, Mary River Project CREMP, April 2019**

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-19	14-Apr-19	14-Apr-19	16-Apr-19	16-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	16-Apr-19	16-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	16-Apr-19	16-Apr-19
1.0	0.0	0.1	0.0	1.0	0.1	0.0	0.3	0.1	0.1	0.0	14.26	14.72	14.69	14.75	15.18	15.56	14.82	15.42	15.63	15.90	97.7	100.9	100.5	103.7	103.8
2.0	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	14.32	14.80	14.70	15.12	15.38	16.01	14.89	15.74	15.68	15.87	98.7	101.6	100.9	103.7	105.4
3.0	0.5	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	14.17	14.72	14.30	15.05	15.01	16.03	14.72	15.53	15.36	15.72	98.5	102.0	100.6	104.2	103.9
4.0	0.7	0.7	0.7	0.6	0.5	0.4	0.5	0.5	0.4	0.5	14.06	14.55	13.97	14.80	15.00	15.96	14.48	15.22	15.23	15.31	98.5	101.8	97.9	103.3	104.1
5.0	1.0	0.9	1.0	0.7	0.6	0.5	0.7	0.7	0.6	0.6	13.89	14.32	13.51	14.69	14.77	15.87	14.26	14.75	14.97	15.14	98.4	100.9	96.2	102.6	103.1
6.0	1.2	1.1		0.8	0.7	0.6	0.8	0.7	0.7	0.7	13.78	14.10		14.60	14.58	15.97	14.09	14.71	14.77	14.96	97.8	99.8		102.1	102.0
7.0	1.3	1.2		0.8	0.8	0.7	0.8	0.9	0.8	0.8	13.64	13.96		14.52	14.39	15.76	13.97	14.34	14.55	14.85	96.9	99.0		101.6	101.0
8.0	1.3	1.3		0.8	0.8		0.8	0.9	0.8	0.8	13.20	13.81		14.43	14.24		13.85	14.22	14.37	14.72	95.2	98.2		101.2	100.0
9.0	1.5	1.3		0.9	0.9		0.8	0.9	0.9		11.84	13.68		14.34	14.11		13.77	14.14	14.20		86.1	97.3		100.7	99.2
10.0	1.5	1.4		0.9	0.9		0.9	0.9	0.9		11.03	13.57		14.27	14.01		13.70	14.04	13.99		81.0	96.6		100.2	98.5
11.0	1.5			0.9	1.0		0.9	1.0	1.0		8.55			14.21	13.90		13.63	13.93	13.92		61.5			99.8	97.9
12.0	1.6			1.0	1.0		0.9	1.0	1.0		6.81			14.00	13.80		13.55	13.80	13.83		50.1			98.8	97.2
13.0	1.8				1.0		0.9	1.0	1.0		3.22				13.70		13.45	13.71	13.73		23.8				96.6
14.0	1.9				1.0		0.9	1.0	1.0		1.25				13.54		13.38	13.63	13.64		9.2				95.9
15.0	2.0				1.1		1.0	1.1	1.1		0.47				13.40		13.31	13.50	13.54		3.6				94.6
16.0	2.0				1.1		1.0	1.1	1.1		0.25				13.25		13.22	13.32	13.40		1.9				93.6
17.0					1.1		1.0	1.1	1.1						13.14		13.09	13.21	13.25						92.9
18.0					1.1			1.2	1.2						13.02			13.11	13.15						92.2
19.0					1.2			1.2	1.2						12.88			12.98	12.98						91.1
20.0					1.2			1.2	1.2						12.76			12.89	12.74						90.4
21.0					1.2			1.2	1.3						11.61			12.62	12.55						84.3
22.0									1.3										12.39						
23.0									1.3										12.25						
24.0									1.4										11.98						
25.0									1.5										11.43						
26.0									1.5										11.14						
27.0									1.6										10.95						
28.0									1.6										10.61						
29.0									1.7										10.11						
30.0									1.8										9.61						

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 15.6, 9.4, 4.7, 11.6, 20.9, 7.2, 16.8, 20.8, 29.0, and 8.8 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 1.4, 1.5, 1.4, 1.3, 1.5, 1.5, 1.1, 1.5, 1.4, and 1.6 m, respectively, at the time of winter sampling.

Table C.66: ***In Situ*** **Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Winter, Mary River Project CREMP, April 2019**

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-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	16-Apr-19	16-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	16-Apr-19	16-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19
1.0	105.4	101.7	105.5	107.2	108.7	7.98	7.98	7.82	8.07	8.11	8.13	7.87	7.75	7.85	7.75	170.6	175.0	169.4	79.9	79.8	45.2	76.6	81.1	80.7	81.6
2.0	109.6	102.4	108.0	107.6	108.9	7.81	7.86	7.75	7.90	8.00	7.78	7.76	7.85	7.77	7.70	166.6	171.8	166.4	77.3	78.8	77.3	75.2	79.8	79.4	79.7
3.0	110.4	102.0	108.0	107.6	108.5	7.75	7.80	7.70	7.91	7.83	7.47	7.69	7.77	7.72	7.69	165.0	169.7	165.9	76.2	76.8	76.8	73.7	77.4	77.4	77.7
4.0	110.8	100.9	105.9	106.0	106.7	7.73	7.76	7.68	7.83	7.79	7.71	7.65	7.69	7.69	7.67	163.4	168.4	166.2	75.4	76.9	77.5	72.7	76.5	75.9	76.8
5.0	110.3	99.7	103.0	104.5	105.6	7.72	7.74	7.65	7.80	7.76	7.69	7.62	7.60	7.67	7.65	162.0	167.3	166.3	74.9	74.5	78.7	72.0	75.3	74.9	77.4
6.0	110.9	98.6	102.7	103.3	104.6	7.71	7.72		7.76	7.75	7.66	7.60	7.60	7.65	7.62	161.3	166.3		74.6	73.8	81.6	71.6	74.9	74.2	76.8
7.0	112.9	97.9	100.6	101.9	103.9	7.70	7.71		7.74	7.73	7.59	7.58	7.59	7.63	7.60	160.9	165.4		74.3	73.1	89.7	71.1	73.3	73.4	77.9
8.0		97.1	100.0	100.9	103.2	7.65	7.70		7.71	7.72		7.57	7.59	7.62	7.55	160.2	164.8		73.9	72.5		70.9	72.5	72.5	79.1
9.0		96.5	99.4	99.7		7.55	7.70		7.70	7.71		7.56	7.57	7.62		159.9	164.6		73.6	72.2		70.7	72.1	72.0	
10.0		96.1	98.7	98.4		7.48	7.68		7.70	7.70		7.55	7.57	7.61		160.4	164.4		73.3	71.9		70.4	71.8	71.6	
11.0		95.6	98.1	97.9		7.36			7.69	7.69		7.54	7.57	7.60		161.8			73.4	71.5		70.3	71.4	71.3	
12.0		95.2	97.3	97.4		7.28			7.65	7.68		7.54	7.56	7.59		161.4			75.6	71.2		70.1	71.1	71.0	
13.0		94.5	96.6	96.8		7.12				7.67		7.53	7.56	7.59		163.7				70.9		69.9	70.9	70.8	
14.0		94.1	96.1	96.2		7.05				7.66		7.52	7.55	7.59		168.8				70.6		69.9	70.5	70.5	
15.0		93.7	95.4	95.5		7.02				7.65		7.52	7.54	7.57		176.3				70.5		69.5	70.3	70.2	
16.0		93.0	94.1	94.7		7.05				7.64		7.51	7.52	7.56		185.6				70.3		69.4	70.1	70.0	
17.0		92.2	93.4	93.7						7.62		7.50	7.51	7.55						70.6		69.4	69.9	70.0	
18.0			92.8	93.1						7.60			7.50	7.53						71.1			69.8	69.8	
19.0			91.9	92.0						7.57			7.49	7.52						71.4			70.0	69.6	
20.0			91.5	90.5						7.55			7.47	7.50						71.8			70.2	69.6	
21.0			90.1	89.1						7.47			7.44	7.48						77.4			71.0	69.5	
22.0				88.1										7.46										69.4	
23.0				87.3										7.44										69.5	
24.0				85.6										7.42										69.5	
25.0				82.3										7.35										70.6	
26.0				79.7										7.33										71.0	
27.0				78.8										7.30										70.6	
28.0				77.0										7.27										70.9	
29.0				73.2										7.23										71.4	
30.0				69.6										7.18										71.7	

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 15.6, 9.4, 4.7, 11.6, 20.9, 7.2, 16.8, 20.8, 29.0, and 8.8 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 1.4, 1.5, 1.4, 1.3, 1.5, 1.5, 1.1, 1.5, 1.4, and 1.6 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 Summer, Mary River Project CREMP, July 2019

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	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19
1.0	11.5	11.6	11.2	13.8	13.4	13.6	13.2	12.1	12.4	12.7	10.68	10.97	11.00	10.76	10.81	10.57	10.80	10.59	10.82	10.65	96.9	101.0	100.3	103.9	103.4
2.0	11.4	11.5	11.0	13.6	13.3	12.5	13.0	12.0	12.1	12.5	10.82	10.97	10.96	10.77	10.81	10.84	10.80	10.89	10.88	10.77	98.8	100.4	99.3	103.4	103.3
3.0	11.2	11.1	10.8	13.0	13.0	12.3	12.3	11.7	12.0	11.5	10.86	11.07	10.95	11.00	10.80	10.85	10.87	10.98	10.89	10.94	98.9	100.7	99.0	102.0	102.3
4.0	11.1	11.0	10.8	11.6	12.0	11.5	12.0	11.6	11.7	11.1	10.88	11.09	10.96	10.88	10.85	10.80	10.88	10.96	10.89	11.01	98.9	100.6	98.9	100.0	100.7
5.0	11.0	10.9		11.0	11.3	10.6	11.4	11.5	11.2		10.95	11.05		10.93	10.88	11.00	10.97	10.96	10.97	11.03	99.2	100.1		99.0	99.3
6.0	10.8	10.8		10.5	10.7	10.4	11.2	11.3	11.1	10.7	10.99	11.01		11.02	10.94	11.03	11.02	10.98	10.98	11.02	99.1	99.4		98.6	98.4
7.0	10.7	10.6		10.2	10.2	10.1	11.0	10.7	11.0	9.9	10.98	11.02		11.04	11.05	11.04	11.00	11.00	10.99	11.11	98.9	98.9		98.1	98.2
8.0	10.5	10.3		9.8	10.0		10.4	9.8	10.9	9.7	10.96	11.02		11.08	11.07		11.09	11.08	11.00		98.4	98.4		97.6	98.2
9.0	10.4	10.2		9.6	9.8		10.1	9.3	10.5		10.96	10.98		11.00	11.12		11.13	11.17	11.01		98.0	97.7		97.5	98.0
10.0	10.0	10.1		9.5	9.6		9.6	8.9	10.0		10.86	10.97		11.14	11.14		11.18	11.21	11.07		96.3	97.3		97.5	97.8
11.0	9.9				9.4		9.4	8.8	9.6		10.77				11.15		11.19	11.21	11.12		95.2				97.2
12.0	9.6				8.9		9.0	8.6	8.9		10.68				11.22		11.23	11.19	11.19		94.0				96.7
13.0	9.3				8.7		8.8	8.5	8.1		10.50				11.26		11.26	11.18	11.31		91.7				96.7
14.0	8.9				8.6		8.2	8.4	7.6		10.14				11.27		11.33	11.18	11.46		87.8				96.5
15.0	8.7				8.4		8.0	8.2	7.4		9.64				11.27		11.39	11.19	11.48		82.9				96.2
16.0	8.7				8.1		7.7	8.2	7.6		9.61				11.28		11.43	11.19	11.49		92.6				95.3
17.0	8.7				7.7			8.1	7.2		9.57				11.31			11.21	11.50		82.3				94.8
18.0	8.7				7.3			8.0	7.1		9.55				11.30			11.22	11.49		82.1				93.6
19.0	8.8							7.8	7.1		9.51							11.24	11.49		81.9				
20.0									7.0										11.49						
21.0									6.9										11.47						
22.0									6.8										11.46						
23.0									6.7										11.47						
24.0									6.7										11.45						
25.0									6.7										11.43						
26.0									6.6										11.32						
27.0									6.5										11.27						

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 15.8, 10.0, 4.0, 10.2, 20.4, 7.3, 19.5, 21.4, 28.9, and 9.4 m, respectively, at the time of summer sampling.

Table C.67: *In Situ* Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Summer, Mary River Project CREMP, July 2019

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	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19
1.0	101.6	103.1	99.4	100.7	100.2	7.69	8.07	8.06	7.83	7.85	7.89	7.95	8.02	7.76	7.80	140.4	135.8	138.0	79.2	76.7	97.6	72.4	69.4	75.0	75.5
2.0	101.3	102.4	101.0	101.2	100.6	7.85	8.08	8.06	7.82	7.85	7.89	7.93	7.97	7.77	7.79	139.8	134.5	139.2	78.7	75.9	95.0	71.7	69.1	75.6	76.4
3.0	101.1	101.5	101.1	101.0	100.2	7.88	8.08	8.05	7.83	7.85	7.89	7.90	7.92	7.77	7.79	139.8	135.2	139.0	94.6	77.2	102.6	72.6	70.6	76.3	76.1
4.0	98.4	101.0	100.8	100.2	100.1	7.91	8.08	8.08	7.82	7.83	7.90	7.88	7.89	7.78	7.79	136.6	134.6	139.9	94.4	91.6	94.3	71.5	72.2	76.8	75.5
5.0	98.7	100.4	100.5	99.8	100.0	7.93	8.07		7.84	7.83	7.90	7.86	7.88	7.77	7.78	135.0	133.0		90.2	91.8	86.2	70.7	90.6	76.4	74.5
6.0	98.6	100.3	100.3	99.7	99.0	7.94	8.06		7.83	7.85	7.87	7.83	7.86	7.76	7.78	136.8	133.2		86.1	92.5	82.2	69.7	69.0	76.0	72.7
7.0	98.0	99.7	99.0	99.5	98.0	7.94	8.06		7.82	7.84	7.85	7.81	7.83	7.75	7.77	137.4	133.2		84.0	84.3	79.7	68.1	73.6	74.9	69.2
8.0		98.9	94.4	99.3	98.0	7.94	8.05		7.80	7.83		7.78	7.80	7.74	7.75	133.5	132.2		79.3	79.3		67.0	75.2	76.8	68.8
9.0		98.6	97.2	98.7		7.94	8.03		7.78	7.81		7.74	7.78	7.74		133.1	131.0		76.2	75.1		66.4	73.3	74.2	
10.0		98.0	96.8	98.0		7.91	8.02		7.76	7.80		7.71	7.75	7.73		128.0	131.2		75.5	73.4		65.8	72.8	71.0	
11.0		97.7	96.6	97.4		7.89				7.78		7.70	7.72	7.71		126.3				71.6		65.2	71.6	71.9	
12.0		97.2	95.9	96.3		7.86				7.76		7.67	7.70	7.70		122.0				68.4		63.7	69.5	67.2	
13.0		97.0	95.6	95.5		7.82				7.73		7.65	7.68	7.69		115.2				66.9		63.1	68.6	64.0	
14.0		96.1	95.4	95.7		7.78				7.71		7.63	7.66	7.65		109.6				66.6		62.0	68.3	62.5	
15.0		96.0	95.0	95.6		7.66				7.69		7.60	7.64	7.62		108.9				66.4		61.3	67.0	62.0	
16.0		95.5	94.9	95.4		7.64				7.68		7.57	7.63	7.60		109.0				64.5		61.2	66.7	61.5	
17.0			94.7	95.1		7.62				7.67			7.61	7.59		108.9				63.3			65.9	61.2	
18.0			94.6	94.8		7.61				7.65			7.60	7.56		108.9				61.7			65.2	61.2	
19.0			94.4	94.8		7.59							7.59	7.55		109.0							64.6	61.1	
20.0				94.6										7.53										61.0	
21.0				94.3										7.51										60.9	
22.0				94.0										7.51										60.7	
23.0				93.9										7.50										60.6	
24.0				93.6										7.49										60.6	
25.0				93.4										7.48										60.6	
26.0				92.2										7.46										60.8	
27.0				91.8										7.45										61.1	

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 15.8, 10.0, 4.0, 10.2, 20.4, 7.3, 19.5, 21.4, 28.9, and 9.4 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 Fall, Mary River Project CREMP, August 2019

Depth (m)	Temperature (°C)												Dissolved Oxygen (mg/L)												Dissolved Oxygen (% Saturation)				
	BLO-01-A	BLO-01	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	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	BLO-01-B	BLO-05-A
Date Collected	26-Aug-19	27-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	19-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	27-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	19-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	27-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19
surface		8.4								14.1				11.17								9.80				94.8			
1.0	8.7	8.4	9.1	8.8	10.1	9.8	10.3	10.2	9.9	14.0	10.2	9.7	11.32	10.90	11.41	11.46	10.99	11.14	10.96	11.04	11.06	9.80	11.01	10.63	97.2	92.8	99.0	98.4	97.7
2.0	8.5	8.3	9.1	8.9	10.1	10.1	10.2	10.3	10.1	13.8	10.2	9.7	11.43	10.91	11.41	11.43	10.94	10.92	10.90	10.92	10.88	9.84	10.88	10.86	97.8	93.6	98.9	98.6	97.2
3.0	8.5	8.4	9.1	8.9	10.1	10.1	10.2	10.3	10.1	13.8	10.2	9.7	11.43	10.96	11.41	11.43	10.91	10.88	10.87	10.89	10.85	9.15	10.88	10.82	97.8	93.4	99.0	98.6	97.0
4.0	8.5	8.4	9.1	8.9	10.1	10.1	10.2	10.2	10.1	13.7	10.2	9.7	11.43	10.96	11.40	11.42	10.90	10.87	10.85	10.87	10.84	9.55	10.82	10.82	97.8	93.4	98.8	98.5	96.8
5.0	8.5	8.3	9.0		10.1	10.1	10.1	10.2	10.1	13.6	10.2	9.7	11.43	10.89	11.38		10.89	10.86	10.84	10.87	10.83	9.59	10.81	10.82	97.8	93.4	98.5		96.7
6.0	8.5	8.2	9.0		10.1	10.1	10.1	10.2	10.1	13.3	10.2	9.7	11.42	10.93	11.36		10.88	10.85	10.84	10.85	10.81	9.66	10.81	10.82	97.7	92.6	98.4		96.6
7.0	8.7	8.2	9.0		10.1	10.1	10.1	10.1	10.1	12.9	10.2		11.41	11.64	11.35		10.88	10.85	10.84	10.83	10.80	9.61	10.80		97.6	93.4	98.2		96.6
8.0	8.5	8.1	9.0		10.1	10.1		10.1	10.0	12.5	10.2		11.41	11.07	11.34		10.87	10.85		10.82	10.80	9.92	10.79		97.5	93.3	98.1		96.5
9.0	8.4	7.9	8.9		10.1	10.1		10.1	10.0	12.0	10.2		11.42	11.04	11.34		10.86	10.84		10.81	10.80	10.03	10.78		97.3	93.0	98.0		96.4
10.0	8.3				10.1	10.1		10.1	9.9	11.1	10.2		11.47				10.85	10.83		10.82	10.80	10.21	10.78		97.5				96.2
11.0	8.2				10.0	10.1		10.0	9.9	10.8	10.1		11.51				10.85	10.83		10.82	10.80	9.97	10.77		97.7				96.2
12.0	8.2					10.0		10.0	9.9	10.2	10.1		11.52					10.82		10.80	10.79	9.81	10.76		97.9				
13.0	8.2					10.0		10.0	9.9	9.8	10.0		11.53					10.80		10.78	10.80	10.48	10.76		97.9				
14.0						9.8		9.8	9.9	9.7	10.0							10.84		10.78	10.80	10.48	10.77						
15.0						9.7		9.8	9.8	9.3	10.0							10.86		10.78	10.79	10.46	10.76						
16.0						9.6		9.8	9.8	8.5	9.9							10.87		10.77	10.78	10.53	10.75						
17.0						9.6		9.7	9.6	8.2	9.7							10.88		10.76	10.76	10.49	10.77						
18.0						9.6			9.4	7.6	9.7							10.87			10.76	10.67	10.76						
19.0						9.6			9.3	7.5	9.6							10.86			10.75	10.43	10.76						
20.0						9.6				7.4	9.2							10.86				10.10	10.76						
21.0										7.3	9.0											10.35	10.77						
22.0										7.2	8.8											10.45	10.77						
23.0										7.1	8.7											10.44	10.70						
24.0										7.0	8.4											10.45	10.67						
25.0										6.9	8.2											10.22	10.65						
26.0										6.9	8.0											10.37	10.62						
27.0										6.8	7.9											10.31	10.61						
28.0										6.8	7.9											10.36	10.60						
29.0										6.7	7.8											10.09	10.58						
30.0											7.7												10.55						

Notes: 26-Aug-19 sampling was conducted by Baffinland. 19-Aug-19 and 27-Aug-19 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 15.5, 10.0, 4.7, 11.8, 19.9, 8.2, 17.2, 20.0, 30.4, and 7.6 m, respectively, at the time of fall sampling.

Table C.68: *In Situ* Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2019

Depth (m)	Dissolved Oxygen (% Saturation)							pH (pH units)												Specific Conductance (µS/cm)											
	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-09	BLO-06	BLO-01-A	BLO-01	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	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-09	BLO-06
Date Collected	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	19-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	27-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	19-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	27-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	19-Aug-19	26-Aug-19	26-Aug-19
surface					95.5				8.19								7.52				218.7								98.0		
1.0	98.7	97.8	98.3	98.1	95.0	98.1	93.3	8.07	8.2	8.18	8.17	8.04	7.98	8.05	8.03	7.96	7.57	8.08	8.16	214.6	218.4	211.6	212.0	88.8	88.9	90.1	86.3	88.6	98.1	89.1	86.7
2.0	97.0	97.2	97.6	96.7	95.1	96.8	95.1	8.13	8.1	8.19	8.19	8.04	7.94	8.03	8.01	7.93	7.64	8.03	8.13	214.6	219.0	211.6	212.0	88.4	88.9	90.0	85.9	88.7	97.8	89.2	86.6
3.0	96.6	96.8	97.1	96.4	88.3	96.4	95.2	8.16	8.1	8.22	8.21	7.98	7.90	7.97	7.95	7.89	7.64	7.95	7.99	214.5	218.5	211.6	212.1	88.9	88.8	89.7	85.2	88.8	97.6	89.2	86.7
4.0	96.5	96.5	96.9	96.3	92.0	96.3	95.2	8.17	8.1	8.24	8.22	7.95	7.87	7.94	7.91	7.87	7.65	7.92	7.94	214.6	218.4	211.5	212.2	88.9	88.8	89.5	84.5	88.9	97.9	89.2	86.6
5.0	96.4	96.3	96.8	96.2	92.0	96.2	95.2	8.18	8.1	8.24		7.93	7.86	7.92	7.89	7.84	7.63	7.90	7.90	214.5	218.7	211.5		88.8	88.8	89.5	84.2	89.1	98.3	89.2	86.6
6.0	96.3	96.2	96.5	96.0	92.2	96.1	95.2	8.18	8.1	8.24		7.91	7.85	7.90	7.87	7.82	7.61	7.88	7.87	214.5	218.9	211.3		88.8	88.7	89.6	83.5	89.3	96.1	89.2	86.7
7.0	96.3	96.2	96.2	95.5	91.0	96.1		8.18	8.1	8.24		7.90	7.84	7.88	7.85	7.82	7.54	7.87		214.7	220.6	211.2		88.9	88.7	89.6	82.9	89.3	92.6	89.2	
8.0	96.3		96.1	95.7	93.1	96.0		8.18	8.1	8.24		7.89	7.84		7.83	7.81	7.45	7.86		215.1	220.5	211.3		88.9	88.6		82.9	89.2	89.8	89.2	
9.0	96.2		96.0	95.6	93.0	95.9		8.18	8.1	8.24		7.88	7.83		7.81	7.81	7.41	7.85		216.4	221.6	211.4		88.8	88.6		82.9	88.5	87.6	89.2	
10.0	96.1		96.0	95.6	92.8	95.9		8.18				7.87	7.83		7.80	7.80	7.35	7.85		217.6				88.7	88.6		83.0	88.1	83.4	89.1	
11.0	96.1		96.0	95.6	90.1	95.8		8.18				7.86	7.82		7.79	7.79	7.29	7.84		218.2				88.7	88.6		82.8	88.2	82.3	88.4	
12.0	96.0		95.8	95.5	87.5	95.5		8.18					7.81		7.78	7.79	7.27	7.83		218.6					88.5		82.3	87.9	81.3	87.9	
13.0	95.7		95.5	95.4	92.6	95.4		8.18					7.80		7.77	7.79	7.24	7.83		219.0					93.4		81.7	87.1	79.4	88.0	
14.0	95.6		95.1	95.3	92.0	95.4							7.81		7.76	7.79	7.22	7.83							102.9		80.5	87.2	78.6	88.3	
15.0	95.6		95.0	95.2	90.9	95.3							7.82		7.74	7.79	7.19	7.82							105.4		80.2	87.8	76.3	88.2	
16.0	95.6		94.9	95.0	89.9	95.0							7.83		7.72	7.78	7.15	7.81							106.6		80.2	89.4	72.3	89.0	
17.0	95.6		94.7	94.4	88.8	94.6							7.83		7.70	7.70	7.10	7.78							106.0		79.9	91.0	69.5	89.7	
18.0	95.4			94.0	89.3	94.6							7.83			7.76	7.05	7.79							106.0			90.8	65.7	89.4	
19.0	95.3			93.7	86.8	94.4							7.82			7.74	7.02	7.78							106.4			91.9	65.3	89.6	
20.0	95.2				83.9	93.5							7.82				6.98	7.76							107.2				65.1	94.0	
21.0					86.0	93.2											6.94	7.75											65.0	90.1	
22.0					86.5	92.7											6.92	7.73											64.5	86.6	
23.0					86.3	92.0											6.90	7.72											64.2	86.7	
24.0					86.1	91.0											6.88	7.70											63.7	74.0	
25.0					84.0	90.2											6.86	7.67											63.4	71.7	
26.0					85.1	89.8											6.85	7.65											63.4	70.1	
27.0					85.4	89.4											6.83	7.62											63.4	69.0	
28.0					84.9	89.2											6.78	7.60											63.4	68.8	
29.0					82.6	89.1											6.79	7.57											63.5	68.7	
30.0						88.4												7.54												67.9	

Notes: 26-Aug-19 sampling was conducted by Baffinland. 19-Aug-19 and 27-Aug-19 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 15.5, 10.0, 4.7, 11.8, 19.9, 8.2, 17.2, 20.0, 30.4, and 7.6 m, respectively, at the time of fall sampling.

Table C.69: 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 2019

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	27-Aug-19	9.5	5.3	surface	8.4	11.17	94.8	8.19	218.7
					bottom	7.9	11.04	93.0	8.07	221.6
	BLO-11	20-Aug-19	9.0	1.3	surface	11.8	10.53	97.4	7.77	119.0
					bottom	11.5	10.42	95.4	7.84	142.5
	BLO-07	19-Aug-19	12.1	2.3	surface	14.2	10.30	100.5	7.86	98.6
					bottom	11.1	10.55	95.9	7.59	83.3
	BLO-06	20-Aug-19	9.2	2.4	surface	13.6	10.26	98.6	7.86	98.1
					bottom	13.2	10.17	97.0	7.72	95.9
Profundal (Deep) Stations	BLO-03	19-Aug-19	15.9	6.1	surface	14.1	10.52	102.3	7.88	95.0
					bottom	8.1	11.25	95.2	7.45	65.5
	BLO-15	19-Aug-19	27.8	6.1	surface	14.1	10.29	100.0	7.85	95.0
					bottom	6.3	9.15	74.2	7.07	63.3
	BLO-14	19-Aug-19	18.7	4.7	surface	13.9	10.17	98.6	7.83	90.7
					bottom	6.9	11.25	92.3	7.35	63.7
	BLO-05	19-Aug-19	21.2	2.8	surface	13.9	10.13	98.1	7.86	76.8
					bottom	7.1	10.59	87.5	7.30	65.3
	BLO-13	19-Aug-19	21.8	3.3	surface	14.0	10.42	101.2	7.88	94.0
					bottom	7.1	10.75	88.8	7.34	65.1
	BLO-04	19-Aug-19	20.2	2.7	surface	13.9	10.38	100.4	7.84	94.9
					bottom	7.5	9.42	78.5	7.36	66.3

Table C.70: Statistical Comparison of Bottom *In Situ* Water Quality Between Mary Lake Littoral and Profundal Stations, Mary River Project CREMP, August 2019

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	0.199	α	Littoral	4	2.82	1.69	0.85	1.33	5.25
				Profundal	6	4.28	1.57	0.64	2.70	6.10
Temperature (˚C)	YES	0.002	α	Littoral	4	11.05	1.99	0.99	8.40	13.20
				Profundal	6	7.17	0.60	0.25	6.30	8.10
Dissolved Oxygen (mg/L)	NO	0.724	α	Littoral	4	10.6	0.4	0.2	10.2	11.2
				Profundal	6	10.4	0.9	0.4	9.2	11.3
Dissolved Oxygen (% saturation)	YES	0.027	η	Littoral	4	96.3	1.9	0.9	94.8	99.0
				Profundal	6	86.1	8.1	3.3	74.2	95.2
pH (units)	YES	0.003	α	Littoral	4	7.84	0.26	0.13	7.59	8.19
				Profundal	6	7.31	0.13	0.05	7.07	7.45
Specific Conductance (umho/cm)	NO	0.106	η	Littoral	4	135.1	61.3	30.6	83.3	218.7
				Profundal	6	64.9	1.1	0.5	63.3	66.3

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.71: 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 2019

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	0.554	α	Reference	5	9.36	1.39	0.62	7.30	10.60
					Mary Lake	4	9.95	1.45	0.72	9.00	12.10
	Secchi Depth (m)	YES	<0.001	α	Reference	5	7.66	0.27	0.12	7.30	8.00
					Mary Lake	4	2.82	1.69	0.85	1.33	5.25
	Temperature (˚C)	NO	0.542	α	Reference	5	11.78	1.44	0.65	9.80	13.30
					Mary Lake	4	11.05	1.99	0.99	8.40	13.20
	Dissolved Oxygen (mg/L)	NO	0.220	α	Reference	5	9.7	1.3	0.6	8.3	11.1
					Mary Lake	4	10.6	0.4	0.2	10.2	11.2
	Dissolved Oxygen (% saturation)	NO	0.284	α	Reference	5	89.0	12.3	5.5	74.9	99.1
					Mary Lake	4	96.3	1.9	0.9	94.8	99.0
	pH (units)	YES	0.044	β	Reference	5	7.29	0.37	0.17	6.91	7.70
					Mary Lake	4	7.84	0.26	0.13	7.59	8.19
	Specific Conductance (umho/cm)	NO	0.114	δ	Reference	5	77.9	2.9	1.3	74.9	82.2
					Mary Lake	4	135.1	61.3	30.6	83.3	218.7
Profundal (Deep) Stations	Station Depth (m)	NO	0.481	β	Reference	5	19.32	2.46	1.10	16.00	21.90
					Mary Lake	6	20.93	3.97	1.62	15.90	27.80
	Secchi Depth (m)	YES	0.006	δ	Reference	5	7.80	0.78	0.35	6.50	8.50
					Mary Lake	6	4.28	1.57	0.64	2.70	6.10
	Temperature (˚C)	NO	0.664	α	Reference	5	6.96	0.92	0.41	5.60	8.10
					Mary Lake	6	7.17	0.60	0.25	6.30	8.10
	Dissolved Oxygen (mg/L)	NO	0.234	γ	Reference	5	9.2	2.0	0.9	5.8	10.3
					Mary Lake	6	10.4	0.9	0.4	9.2	11.3
	Dissolved Oxygen (% saturation)	NO	0.247	γ	Reference	5	76.3	16.3	7.3	47.4	87.3
					Mary Lake	6	86.1	8.1	3.3	74.2	95.2
	pH (units)	YES	0.076	α	Reference	5	7.02	0.33	0.15	6.62	7.37
					Mary Lake	6	7.31	0.13	0.05	7.07	7.45
	Specific Conductance (umho/cm)	YES	<0.001	δ	Reference	5	79.7	4.7	2.1	75.2	86.0
					Mary Lake	6	64.9	1.1	0.5	63.3	66.3

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.72: Water Chemistry at Mary Lake North Basin (BLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

Parameter		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	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-19	14-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19
Conventionals	Conductivity (lab)	umho/cm	-	-	196	196	195	202	199	198	115	140	131	136	138	137	242	237	214	214	215	215
	pH (lab)	pH	6.5 - 9.0	-	7.23	7.85	7.84	7.80	7.79	7.78	7.85	8.22	8.13	8.17	8.16	8.19	8.23	8.20	8.22	8.22	8.22	8.24
	Hardness (as $CaCO_3$)	mg/L	-	-	109	109	107	114	107	110	57.2	69.5	66.8	67.6	70.0	69.2	101	98	96	100	97	96
	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	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	111	107	104	113	110	81	59	90	69	72	66	72	128	148	142	122	130	145
	Turbidity	NTU	-	-	1.81	0.17	0.13	0.23	0.14	0.15	1.13	0.86	0.84	0.84	0.80	0.78	1.25	1.00	1.32	1.48	1.14	1.45
	Alkalinity (as $CaCO_3$)	mg/L	-	-	104	104	102	104	101	102	60	74	69	71	73	73	98	96	95	96	96	96
Nutrients and Organics	Total Ammonia	mg/L	-	0.855	0.072	0.010	<0.010	<0.010	<0.010	<0.010	0.032	0.023	0.018	0.017	0.031	0.017	<0.010	<0.010	<0.010	0.016	0.024	<0.010
	Nitrate	mg/L	3	3	0.140	0.041	0.040	0.040	0.042	0.036	<0.020	<0.020	<0.020	0.029	<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	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.16	<0.15	<0.15	<0.15	0.19	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.20	<0.15	<0.15	0.17	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.96	2.01	2.00	2.04	2.05	2.08	4.21	1.95	1.69	1.98	1.79	1.72	1.94	1.94	1.91	2.04	2.01	1.93
	Total Organic Carbon	mg/L	-	-	2.61	2.54	2.53	2.70	3.98	2.33	2.06	2.12	2.21	2.15	2.26	2.17	2.32	2.30	2.36	2.21	2.42	2.21
	Total Phosphorus	mg/L	0.020[α]	-	0.0094	<0.0030	0.0031	<0.0030	<0.0030	<0.0030	0.0050	0.0032	0.0037	0.0031	<0.0030	0.0042	0.0043	0.0038	0.0042	0.0055	0.0043	0.0039
	Phenols	mg/L	0.004[α]	-	0.0025	<0.0010	<0.0010	0.0011	<0.0010	0.0031	<0.0010	<0.0010	0.0019	0.0016	<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	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	4.31	4.32	4.26	4.43	4.22	4.02	1.26	1.76	1.60	1.71	1.77	1.74	10.7	10.1	9.77	9.93	9.80	10.0
	Sulphate (SO_4)	mg/L	218[β]	218	1.72	2.38	2.36	2.43	2.35	2.28	1.00	1.25	1.16	1.20	1.22	1.21	3.54	3.34	3.28	3.33	3.26	3.26
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	<0.0030	0.0034	<0.0030	<0.0030	0.0034	0.003	0.0204	0.0271	0.0260	0.0248	0.0222	0.0296	0.0257	0.0310	0.0233	0.0423	0.0305	0.0291
	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	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	0.00014	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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	-	-	0.0102	0.00985	0.00937	0.00997	0.00951	0.00971	0.0055	0.0063	0.0067	0.0071	0.0072	0.0074	0.0101	0.0101	0.0097	0.0098	0.0100	0.0098
	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	<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	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	<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	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	20.8	20.2	21.7	21.9	20.8	20.9	12.0	14.6	13.9	14.0	13.9	13.9	20.2	19.8	19.3	19.5	19.7	19.6
	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	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	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
	Copper (Cu)	mg/L	0.002	0.0024	0.0007	0.0011	0.0012	0.0011	0.0010	0.0011	0.00078	0.00093	0.00089	0.00091	0.00082	0.00085	0.0010	0.0010	0.0010	0.0010	0.0010	0.0009
	Iron (Fe)	mg/L	0.30	0.326	0.148	<0.030	<0.030	<0.030	<0.030	<0.030	0.042	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.031	<0.030	0.035	0.031	0.031
	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	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	0.0012	0.0013	0.0014	0.0012	0.0013	0.0013	0.0015	0.0011	0.0011	<0.0010	<0.0010	0.0012	0.0012	<0.0010	0.0012	0.0012	0.0011
	Magnesium (Mg)	mg/L	-	-	13.7	13.4	13.5	13.4	13.5	13.2	7.19	8.80	7.13	7.67	7.79	7.69	12.2	11.8	11.8	11.8	12.0	11.8
	Manganese (Mn)	mg/L	0.935[β]	-	0.222	0.000749	0.00185	0.00111	0.00232	0.00157	0.00588	0.00178	0.00251	0.00191	0.00188	0.00185	0.0021	0.0024	0.0024	0.0026	0.0024	0.0023
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00022	0.00028	0.00028	0.00029	0.00026	0.00030	0.000143	0.000166	0.000175	0.000190	0.000173	0.000204	0.00029	0.00029	0.00030	0.00029	0.00028	0.00029
	Nickel (Ni)	mg/L	0.025	0.025	0.00077	0.00061	0.00061	0.00062	0.00062	0.00064	<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	-	-	1.16	1.21	1.16	1.23	1.20	1.20	0.68	0.81	0.76	0.80	0.79	0.79	1.16	1.13	1.13	1.15	1.17	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	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	1.96	0.98	0.96	0.98	0.98	1.00	0.78	0.79	0.71	0.74	0.73	0.75	0.88	0.88	0.83	0.88	0.86	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	2.65	2.80	2.71	2.83	2.71	2.76	1.07	1.42	1.20	1.28	1.24	1.28	4.18	3.97	3.96	4.13	4.01	3.93
	Strontium (Sr)	mg/L	-	-	0.0129	0.0130	0.0129	0.0137	0.0130	0.0131	0.00703	0.00866	0.00939	0.00956	0.00994	0.00997	0.0150	0.0150	0.0147	0.0149	0.0149	0.0149
	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	<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	0.015	-	0.00139	0.00203	0.00205	0.00207	0.00203	0.00185	0.00077	0.00117	0.00119	0.00131	0.00138	0.00140	0.00281	0.00262	0.00247	0.00247	0.00255	0.00252
	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	<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	<0.0030

[shaded box] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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 Mary Lake.

Table C.73: Summary of the Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentrations Provided) Between Mary Lake and Reference Lake 3 in 2019, and at Mary Lake Between 2019 and the Baseline Period

Parameter	Mary Lake North Basin					Mary Lake South Basin				
	2019 vs Reference Lake 3		2019 vs Baseline			2019 vs Reference Lake 3		2019 vs Baseline		
	Summer	Fall	Winter	Summer	Fall	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	1.8	2.7	0.8	1.3	1.3	1.0	1.1	1.0	1.1	1.1
Hardness (as $CaCO_3$)	1.9	2.7	0.9	1.2	1.1	1.0	1.1	1.0	1.1	1.1
Total Suspended Solids (TSS)	0.5	1.0	1.0	1.0	1.0	0.5	1.0	1.0	0.6	1.0
Total Dissolved Solids (TDS)	1.5	2.6	0.6	1.0	1.2	0.9	1.3	0.9	1.0	1.3
Turbidity	3.4	3.8	2.0	0.3	1.5	13	8.0	0.4	1.8	2.3
Alkalinity (as $CaCO_3$)	2.1	2.9	0.9	1.3	1.2	1.1	1.2	1.0	1.2	1.1
Total Ammonia	2.3	1.3	0.2	0.2	0.1	2.4	4.7	0.3	0.3	0.7
Nitrate	1.1	0.6	0.5	0.2	0.2	1.1	0.6	0.3	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	0.7	1.0	0.9	1.1	0.9	1.0
Dissolved Organic Carbon	0.8	0.7	1.0	1.6	1.1	0.5	0.6	1.1	1.0	1.1
Total Organic Carbon	0.7	0.8	1.3	1.3	1.3	0.7	0.6	1.2	1.3	1.2
Total Phosphorus	0.8	0.2	0.6	0.4	0.6	1.2	0.5	1.2	1.0	1.8
Phenols	0.8	1.0	1.6	1.3	1.0	0.9	1.5	1.0	1.4	1.5
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	7.3	0.5	0.9	2.5	1.2	1.8	0.7	0.7	0.9
Sulphate (SO_4)	0.3	0.9	0.4	0.5	0.8	0.7	0.8	1.5	1.2	1.0
Aluminum (Al)	7.3	3.9	0.6	0.3	0.4	20	6.8	0.3	1.0	1.6
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	0.5	1.0	1.0	1.0	1.0	0.9
Barium (Ba)	1.0	1.6	0.8	1.0	1.1	0.8	0.8	1.0	1.1	1.0
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	1.1	1.0	0.2	0.9	0.8
Calcium (Ca)	2.0	2.7	0.9	1.2	1.1	1.1	1.2	1.0	1.1	1.1
Chromium (Cr)	1.0	1.0	1.4	0.9	0.7	1.0	1.0	1.2	1.1	1.1
Cobalt (Co)	1.0	1.0	1.0	0.8	0.7	1.0	1.0	1.0	0.9	0.9
Copper (Cu)	1.1	1.1	0.9	0.9	0.3	0.9	0.8	0.9	0.8	0.8
Iron (Fe)	1.1	1.0	1.8	0.3	0.3	2.2	1.5	1.0	0.9	1.0
Lead (Pb)	1.0	1.0	0.9	0.7	0.7	1.8	1.2	0.9	1.1	1.0
Lithium (Li)	1.2	1.2	0.4	0.3	0.2	1.0	1.0	0.2	0.3	0.4
Magnesium (Mg)	1.7	2.6	0.9	1.2	1.2	0.9	1.1	1.1	1.1	1.1
Manganese (Mn)	5.4	3.9	6.2	0.7	0.2	4.0	2.4	0.4	0.9	1.2
Mercury (Hg)	1.0	1.0	1.0	0.5	0.5	1.0	1.0	1.0	0.5	0.5
Molybdenum (Mo)	1.3	2.0	0.9	1.3	1.3	1.1	1.2	1.1	1.5	1.2
Nickel (Ni)	1.0	1.0	0.8	0.9	0.8	1.0	1.0	1.0	1.0	1.0
Potassium (K)	0.9	1.2	0.9	1.3	1.5	0.7	0.7	0.9	1.2	1.3
Selenium (Se)	1.0	1.0	2.8	2.4	1.8	1.0	1.0	1.2	1.4	1.9
Silicon (Si)	1.7	1.8	0.9	1.1	0.9	1.3	1.2	0.9	1.0	1.3
Silver (Ag)	1.0	1.0	1.6	1.8	1.8	1.0	1.0	1.2	1.9	2.3
Sodium (Na)	1.5	4.4	0.6	1.5	1.9	1.0	1.3	0.8	1.0	1.1
Strontium (Sr)	1.2	1.8	0.8	1.3	1.3	0.9	0.9	0.7	1.1	1.0
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)	5.3	11	0.6	1.4	1.1	2.7	3.0	0.8	1.3	1.1
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	0.7	1.6	1.6	-	1.0	0.7	1.8	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).
Denotes differences in method detection limit between the 2019 and baseline data, precluding an evaluation of magnitude of elevation.

Table C.74: Dissolved Metal Concentrations at Mary Lake North Basin Water Quality Monitoring Stations, Mary River Project CREMP, 2019

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	BL0-01-A	BL0-01-A	BL0-01	BL0-01	BL0-01-B	BL0-01-B
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			14-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	14-Apr-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	0.0031	<0.0030	0.0100	0.0105	0.0106	0.0098	0.0088	0.0083	0.0075	0.0093	0.0078	0.0129	0.0106	0.0108
	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	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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	0.00949	0.00982	0.00970	0.01020	0.00976	0.00966	0.00580	0.00669	0.00640	0.00650	0.00682	0.00679	0.00995	0.00962	0.00962	0.01010	0.00965	0.00953
	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	21.7	21.3	20.8	22.5	21.6	21.5	11.4	13.8	13.3	13.4	13.7	13.6	20.3	19.7	19.2	19.5	19.5	19.4
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00069	<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	0.00115	0.00113	0.00111	0.00120	0.00109	0.00092	0.00088	0.00084	0.00080	0.00089	0.00084	0.00090	0.00100	0.00093	0.00098	0.00090	0.00092
	Iron (Fe)	mg/L	0.038	<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	0.0012	0.00120	0.0013	0.0014	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	0.0012	<0.0010	0.0012	0.0011	0.001
	Magnesium (Mg)	mg/L	13.3	13.6	13.3	13.9	12.9	13.6	6.95	8.51	8.15	8.31	8.69	8.58	12.1	11.9	11.6	12.4	11.7	11.6
	Manganese (Mn)	mg/L	0.10800	0.00041	0.00046	0.00042	0.00078	0.00087	0.00357	0.00101	0.00099	0.00111	0.00112	0.00117	0.00051	0.00045	0.00039	0.00056	0.00040	0.00041
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000222	0.000267	0.000280	0.000278	0.000274	0.000289	0.000153	0.000219	0.000192	0.000193	0.000161	0.000192	0.000332	0.000291	0.000287	0.000337	0.000296	0.000302
	Nickel (Ni)	mg/L	0.00078	0.00060	0.00056	0.00060	0.00064	0.00076	<0.00050	0.00058	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	1.16	1.22	1.18	1.23	1.20	1.23	0.71	0.84	0.81	0.82	0.85	0.84	1.15	1.14	1.12	1.19	1.12	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	<0.0010	<0.0010
	Silicon (Si)	mg/L	1.94	1.00	0.98	1.00	1.02	1.02	0.76	0.79	0.77	0.76	0.76	0.76	0.83	0.81	0.79	0.82	0.81	0.81
	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	2.64	2.75	2.72	2.79	2.70	2.69	1.07	1.44	1.35	1.39	1.46	1.43	4.12	4.00	3.94	4.34	3.89	3.87
	Strontium (Sr)	mg/L	0.0132	0.0129	0.0130	0.0133	0.0131	0.013	0.0076	0.0096	0.0091	0.0093	0.0094	0.0094	0.0151	0.0149	0.0146	0.0146	0.0147	0.0148
	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	0.00144	0.00203	0.00207	0.00212	0.00197	0.00191	0.00078	0.00128	0.00117	0.00119	0.00125	0.00121	0.00284	0.00261	0.00253	0.00251	0.00260	0.00259
	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.75: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Mary Lake and Reference Lake 3 in 2019, and at Mary Lake Between 2019 and the Baseline Period

Dissolved Metal	Mary Lake North Basin					Mary Lake South Basin				
	2019 vs Reference Lake 3		2019 vs Baseline			2019 vs Reference Lake 3		2019 vs Baseline		
	Summer	Fall	Winter	Summer	Fall	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	3.1	0.9	0.3	0.8	2.1	6.1	1.8	0.3	1.6	4.0
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)	1.0	1.6	1.1	0.7	2.2	0.7	0.8	0.5	0.5	1.1
Beryllium (Be)	1.0	1.2	1.0	1.4	2.1	1.0	1.2	1.0	1.4	2.1
Bismuth (Bi)	1.0	1.2	1.0	1.0	1.0	1.0	1.2	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	1.1	0.8	0.5	1.0	1.0	1.1	0.8	0.5	1.0
Calcium (Ca)	1.9	2.7	1.3	0.7	1.3	1.0	1.2	0.5	0.4	0.5
Chromium (Cr)	1.0	1.0	1.4	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)	1.1	1.1	0.7	0.7	1.2	0.8	0.8	0.5	0.5	0.8
Iron (Fe)	1.0	1.1	1.0	1.0	1.8	1.0	1.1	0.9	1.1	1.8
Lead (Pb)	1.0	1.0	1.0	0.8	1.0	1.0	1.0	1.0	0.8	1.0
Lithium (Li)	1.0	1.1	0.3	0.3	0.5	1.0	1.0	0.2	0.3	0.4
Magnesium (Mg)	1.9	2.7	1.3	0.8	1.3	1.0	1.1	0.6	0.4	0.5
Manganese (Mn)	10	1.1	14	1.0	0.1	4.1	0.8	0.2	0.4	0.1
Mercury (Hg)	1.0	1.0	1.0	0.5	0.5	1.0	1.0	1.0	0.5	0.5
Molybdenum (Mo)	1.3	1.9	1.1	0.8	1.8	1.1	1.3	0.6	0.7	1.2
Nickel (Ni)	1.0	1.0	1.0	0.7	0.9	1.0	1.0	0.8	0.7	0.9
Potassium (K)	1.0	1.2	1.4	0.9	1.5	0.7	0.7	0.8	0.7	0.9
Selenium (Se)	1.0	1.2	-	-	-	1.0	1.2	-	-	-
Silicon (Si)	1.8	1.7	1.3	0.8	0.9	1.2	1.0	0.5	0.5	0.5
Silver (Ag)	1.0	0.6	0.2	1.8	2.5	1.0	0.6	0.2	1.8	2.5
Sodium (Na)	1.7	4.4	1.6	0.6	1.9	1.1	1.3	0.7	0.4	0.5
Strontium (Sr)	1.2	1.8	1.2	0.8	1.5	0.9	0.9	0.6	0.6	0.8
Thallium (Tl)	1.0	1.2	1.0	1.4	2.5	1.0	1.2	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	1.2	1.0	1.0	1.0	1.0	1.2	1.0	1.0	1.0
Uranium (U)	4.9	10	1.0	0.5	1.7	2.1	2.9	0.3	0.2	0.5
Vanadium (V)	1.0	1.1	0.8	0.9	1.0	1.0	1.1	0.8	0.9	1.0
Zinc (Zn)	1.0	0.6	1.6	1.3	1.2	1.0	0.6	1.6	1.3	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).
Denotes differences in method detection limit between the 2019 and baseline data, precluding an evaluation of magnitude of elevation.

Table C.76: Spearman's Rank Correlation Coefficients for Mary Lake North Basin (BLO) Water Quality Data Collected in Winter, Summer, and Fall 2019[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	Iron	Manganese	Molybdenum	Nickel	Potassium	Uranium
Conductivity	1	0.518	0.934	0.363	0.507	-0.096	0.434	0.187	0.961	0.957	0.277	0.807	0.483	0.206	0.071	0.796	0.013	0.563	0.941
Hardness	0.518	1	0.426	-0.241	0.978	0.695	0.832	-0.287	0.522	0.516	-0.513	0.702	0.708	-0.043	-0.345	0.611	0.814	0.932	0.464
Total Dissolved Solids	0.934	0.426	1	0.463	0.464	-0.065	0.410	0.283	0.931	0.913	0.292	0.782	0.379	0.302	0.175	0.752	-0.016	0.479	0.889
Turbidity	0.363	-0.241	0.463	1	-0.196	-0.464	-0.277	0.840	0.419	0.327	0.476	0.342	-0.484	0.694	0.714	0.093	-0.435	-0.266	0.254
Alkalinity	0.507	0.978	0.464	-0.196	1	1	0.840	-0.228	0.536	0.510	-0.522	0.722	0.663	-0.007	-0.331	0.552	0.807	0.925	0.462
Nitrate	-0.096	0.695	-0.065	-0.464	1	1	0.706	-0.425	-0.082	-0.105	-0.803	0.246	0.383	-0.143	-0.292	0.075	0.918	0.660	-0.121
Total Organic Carbon	0.434	0.832	0.410	-0.277	0.840	0.706	1	-0.296	0.423	0.418	-0.583	0.626	0.569	-0.127	-0.158	0.464	0.751	0.844	0.431
Total Phosphorus	0.187	-0.287	0.283	0.840	-0.228	-0.425	-0.296	1	0.244	0.183	0.440	0.249	-0.474	0.723	0.772	-0.038	-0.384	-0.312	0.179
Chloride	0.961	0.522	0.931	0.419	0.536	-0.082	0.423	0.244	1	0.974	0.256	0.847	0.448	0.265	0.081	0.748	-0.011	0.527	0.944
Sulphate	0.957	0.516	0.913	0.327	0.510	-0.105	0.418	0.183	0.974	1	0.264	0.772	0.571	0.148	0.020	0.791	-0.031	0.545	0.950
Aluminum (total)	0.277	-0.513	0.292	0.476	-0.522	-0.803	-0.583	0.440	0.256	0.264	1	0.005	-0.272	0.265	0.306	0.047	-0.805	-0.427	0.290
Barium (total)	0.807	0.702	0.782	0.342	0.722	0.246	0.626	0.249	0.847	0.772	0.005	1	0.332	0.339	0.101	0.661	0.325	0.667	0.773
Copper (total)	0.483	0.708	0.379	-0.484	0.663	0.383	0.569	-0.474	0.448	0.571	-0.272	0.332	1	-0.405	-0.532	0.651	0.435	0.771	0.535
Iron (total)	0.206	-0.043	0.302	0.694	-0.007	-0.143	-0.127	0.723	0.265	0.148	0.265	0.339	-0.405	1	0.736	0.022	-0.088	-0.110	0.135
Manganese (total)	0.071	-0.345	0.175	0.714	-0.331	-0.292	-0.158	0.772	0.081	0.020	0.306	0.101	-0.532	0.736	1	-0.119	-0.287	-0.369	0.033
Molybdenum (total)	0.796	0.611	0.752	0.093	0.552	0.075	0.464	-0.038	0.748	0.791	0.047	0.661	0.651	0.022	-0.119	1	0.238	0.595	0.798
Nickel (total)	0.013	0.814	-0.016	-0.435	0.807	0.918	0.751	-0.384	-0.011	-0.031	-0.805	0.325	0.435	-0.088	-0.287	0.238	1	0.723	-0.057
Potassium (total)	0.563	0.932	0.479	-0.266	0.925	0.660	0.844	-0.312	0.527	0.545	-0.427	0.667	0.771	-0.110	-0.369	0.595	0.723	1	0.516
Uranium (total)	0.941	0.464	0.889	0.254	0.462	-0.121	0.431	0.179	0.944	0.950	0.290	0.773	0.535	0.135	0.033	0.798	-0.057	0.516	1
Aluminum (dissolved)	-0.006	-0.701	0.052	0.528	-0.700	-0.766	-0.700	0.429	-0.016	-0.035	0.825	-0.301	-0.459	0.387	0.490	-0.238	-0.806	-0.597	-0.026
Barium (dissolved)	0.689	0.832	0.561	-0.153	0.788	0.364	0.693	-0.185	0.701	0.756	-0.188	0.663	0.835	-0.115	-0.300	0.675	0.437	0.855	0.710
Copper (dissolved)	0.389	0.616	0.314	-0.465	0.571	0.372	0.558	-0.446	0.363	0.465	-0.320	0.234	0.825	-0.141	-0.333	0.531	0.442	0.646	0.423
Iron (dissolved)	-0.047	0.281	0.070	0.398	0.354	0.452	0.304	0.402	0.023	-0.117	-0.352	0.398	-0.398	0.475	0.398	-0.117	0.474	0.117	-0.164
Manganese (dissolved)	-0.717	-0.361	-0.747	-0.036	-0.385	0.060	-0.439	0.131	-0.715	-0.770	-0.141	-0.472	-0.647	0.109	0.168	-0.712	0.044	-0.527	-0.777
Molybdenum (dissolved)	0.913	0.511	0.846	0.330	0.491	-0.085	0.320	0.223	0.889	0.911	0.307	0.693	0.587	0.213	0.069	0.819	0.020	0.554	0.891
Nickel (dissolved)	-0.043	0.730	-0.059	-0.416	0.741	0.852	0.623	-0.413	-0.087	-0.092	-0.724	0.206	0.381	-0.143	-0.372	0.097	0.932	0.667	-0.190
Potassium (dissolved)	0.529	0.969	0.420	-0.292	0.920	0.636	0.798	-0.331	0.519	0.555	-0.433	0.634	0.793	-0.099	-0.361	0.659	0.750	0.925	0.491
Uranium (dissolved)	0.970	0.500	0.927	0.301	0.510	-0.108	0.440	0.168	0.971	0.979	0.254	0.777	0.551	0.152	0.008	0.777	-0.031	0.553	0.970

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.

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 18.

Table C.76: Spearman's Rank Correlation Coefficients for Mary Lake North Basin (BLO) Water Quality Data Collected in Winter, Summer and Fall 2019[a]

Parameters	Dissolved Metals								
	Aluminum	Barium	Copper	Iron	Manganese	Molybdenum	Nickel	Potassium	Uranium
Conductivity	-0.006	0.689	0.389	-0.047	-0.717	0.913	-0.043	0.529	0.970
Hardness	-0.701	0.832	0.616	0.281	-0.361	0.511	0.730	0.969	0.500
Total Dissolved Solids	0.052	0.561	0.314	0.070	-0.747	0.846	-0.059	0.420	0.927
Turbidity	0.528	-0.153	-0.465	0.398	-0.036	0.330	-0.416	-0.292	0.301
Alkalinity	-0.700	0.788	0.571	0.354	-0.385	0.491	0.741	0.920	0.510
Nitrate	-0.766	0.364	0.372	0.452	0.060	-0.085	0.852	0.636	-0.108
Total Organic Carbon	-0.700	0.693	0.558	0.304	-0.439	0.320	0.623	0.798	0.440
Total Phosphorus	0.429	-0.185	-0.446	0.402	0.131	0.223	-0.413	-0.331	0.168
Chloride	-0.016	0.701	0.363	0.023	-0.715	0.889	-0.087	0.519	0.971
Sulphate	-0.035	0.756	0.465	-0.117	-0.770	0.911	-0.092	0.555	0.979
Aluminum (total)	0.825	-0.188	-0.320	-0.352	-0.141	0.307	-0.724	-0.433	0.254
Barium (total)	-0.301	0.663	0.234	0.398	-0.472	0.693	0.206	0.634	0.777
Copper (total)	-0.459	0.835	0.825	-0.398	-0.647	0.587	0.381	0.793	0.551
Iron (total)	0.387	-0.115	-0.141	0.475	0.109	0.213	-0.143	-0.099	0.152
Manganese (total)	0.490	-0.300	-0.333	0.398	0.168	0.069	-0.372	-0.361	0.008
Molybdenum (total)	-0.238	0.675	0.531	-0.117	-0.712	0.819	0.097	0.659	0.777
Nickel (total)	-0.806	0.437	0.442	0.474	0.044	0.020	0.932	0.750	-0.031
Potassium (total)	-0.597	0.855	0.646	0.117	-0.527	0.554	0.667	0.925	0.553
Uranium (total)	-0.026	0.710	0.423	-0.164	-0.777	0.891	-0.190	0.491	0.970
Aluminum (dissolved)	1	-0.417	-0.400	-0.307	0.005	0.077	-0.718	-0.638	-0.030
Barium (dissolved)	-0.417	1	0.712	-0.117	-0.600	0.711	0.338	0.896	0.708
Copper (dissolved)	-0.400	0.712	1	-0.375	-0.572	0.409	0.368	0.726	0.433
Iron (dissolved)	-0.307	-0.117	-0.375	1	0.398	-0.117	0.452	0.117	-0.117
Manganese (dissolved)	0.005	-0.600	-0.572	0.398	1	-0.697	0.103	-0.422	-0.799
Molybdenum (dissolved)	0.077	0.711	0.409	-0.117	-0.697	1	-0.048	0.551	0.908
Nickel (dissolved)	-0.718	0.338	0.368	0.452	0.103	-0.048	1	0.664	-0.097
Potassium (dissolved)	-0.638	0.896	0.726	0.117	-0.422	0.551	0.664	1	0.510
Uranium (dissolved)	-0.030	0.708	0.433	-0.117	-0.799	0.908	-0.097	0.510	1

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.

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 18.

Table C.77: Water Chemistry at Mary Lake South Basin (BLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

Group	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event: BL0-05-A bottom 16-Apr-19	BL0-05-A surface 16-Apr-19	BL0-05 bottom 16-Apr-19	BL0-05 surface 16-Apr-19	BL0-05-B bottom 15-Apr-19	BL0-05-B surface 15-Apr-19	BL0-03 bottom 15-Apr-19	BL0-03 surface 15-Apr-19	BL0-04 bottom 15-Apr-19	BL0-04 surface 15-Apr-19	BL0-09 bottom 15-Apr-19	BL0-09 surface 15-Apr-19	BL0-06 bottom 15-Apr-19	BL0-06 surface 15-Apr-19
Conventionals	Conductivity (lab)	umho/cm	-	-	90.6	96.2	89.0	97.3	102	101	86.4	93.8	88.0	100	94.4	97.9	98.4	98.7
	pH (lab)	pH	6.5 - 9.0	-	7.94	7.98	7.83	7.62	7.65	7.70	7.60	7.75	7.53	7.67	7.63	7.61	7.63	7.74
	Hardness (as $CaCO_3$)	mg/L	-	-	44.2	46.6	42.2	46.1	51.4	49.3	40.2	45.7	43.1	49.9	41.5	45.0	46.4	45.2
	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	-	-	45	58	47	48	57	50	51	54	54	63	54	62	52	50
	Turbidity	NTU	-	-	0.12	0.16	0.21	0.16	0.18	0.21	0.30	0.29	0.38	0.35	0.18	0.16	0.20	0.21
	Alkalinity (as $CaCO_3$)	mg/L	-	-	44	45	42	45	50	49	41	44	40	46	46	45	49	46
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.010	0.012	<0.010	<0.010	0.104	0.05	<0.010	0.044	<0.010	0.018	<0.010	0.027	0.034	0.021
	Nitrate	mg/L	3	3	0.030	0.031	0.041	0.032	0.027	0.032	0.028	0.024	0.038	0.027	0.051	0.029	0.028	0.031
	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	0.16	<0.15	<0.15	<0.15	0.21	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.49	1.51	1.36	1.54	1.91	1.96	1.81	1.83	1.66	2.03	1.58	1.81	1.77	1.75
	Total Organic Carbon	mg/L	-	-	1.67	1.82	1.82	1.89	1.82	1.83	1.86	1.90	1.66	1.95	1.87	1.92	1.76	1.82
	Total Phosphorus	mg/L	0.020[α]	-	0.0034	0.0052	0.0035	0.0049	0.0042	0.0051	0.0046	0.0045	0.0038	0.0054	<0.0030	0.0033	<0.0030	0.0037
	Phenols	mg/L	0.004[α]	-	<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
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	2.02	2.14	1.96	2.17	2.27	2.27	1.88	2.03	1.93	2.20	2.28	2.18	2.16	2.18
	Sulphate (SO_4)	mg/L	218[β]	218	2.65	2.80	2.57	2.84	2.94	3.05	2.35	2.53	2.57	2.87	2.73	2.86	2.84	2.86
Total Metals	Aluminum (Al)	mg/L	0.100	0.130	0.0036	0.0051	0.0048	0.0041	0.0045	0.0030	0.0040	<0.0030	0.0033	<0.0030	0.0051	0.0031	<0.0030	0.003
	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	-	-	0.00464	0.00479	0.00462	0.00492	0.00524	0.00524	0.00438	0.00484	0.00457	0.00511	0.00529	0.00502	0.00507	0.00494
	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	-	-	8.57	8.75	8.47	9.65	9.67	9.56	8.35	8.69	8.14	9.28	9.26	9.32	9.42	9.22
	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	0.00079	0.00062	0.00078	0.00069	0.00078	0.00069	0.00061	0.00065	0.00070	0.00075	0.00066	0.00066	0.00075	0.00067
	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	<0.000050	<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	-	-	5.22	5.56	5.21	5.55	6.34	6.29	4.95	5.79	5.32	6.06	5.67	5.78	6.08	5.50
	Manganese (Mn)	mg/L	0.935[β]	-	0.000396	0.000377	0.000886	0.000397	0.000584	0.000384	0.000522	0.000584	0.000506	0.000389	0.000388	0.000345	0.000316	0.000338
	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	-	0.000144	0.000186	0.000159	0.000167	0.000177	0.000139	0.000139	0.000151	0.000140	0.000167	0.000156	0.000152	0.000161	0.000143
	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	0.64	0.58	0.65	0.72	0.71	0.57	0.65	0.60	0.70	0.67	0.66	0.70	0.65
	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	-	-	0.39	0.41	0.45	0.42	0.44	0.43	0.40	0.43	0.42	0.43	0.42	0.41	0.43	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	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.05	1.14	1.03	1.14	1.20	1.18	1.04	1.11	1.01	1.16	1.11	1.15	1.15	1.13
	Strontium (Sr)	mg/L	-	-	0.00667	0.00727	0.00641	0.00735	0.00720	0.00717	0.00646	0.00666	0.00625	0.00705	0.00720	0.0071	0.00710	0.00697
	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	0.00014	<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	-	0.00058	0.00060	0.00054	0.00061	0.00059	0.00057	0.00049	0.00053	0.00051	0.00058	0.00060	0.00059	0.00059	0.00057
	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	0.0035	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0032	<0.0030	<0.0030	<0.0030

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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 Mary Lake.

Table C.77: Water Chemistry at Mary Lake South Basin (BLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

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
					27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19
Conventionals	Conductivity (lab)	umho/cm	-	-	76.5	78.9	66.5	87.4	87.1	97.6	72.5	72.5	64.5	70.5	60.7	76.1	69.7	74.8
	pH (lab)	pH	6.5 - 9.0	-	7.75	7.92	7.62	7.90	7.95	8.01	7.93	7.95	7.61	7.89	7.55	7.88	7.78	7.89
	Hardness (as $CaCO_3$)	mg/L	-	-	37	38	31	42	42	47	36	36	31	34	29	37	34	36
	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	-	-	50	54	44	51	49	58	37	37	39	36	38	45	43	44
	Turbidity	NTU	-	-	3.30	2.92	2.77	4.94	7.04	9.73	1.01	0.75	2.54	1.10	1.86	2.82	2.45	2.28
	Alkalinity (as $CaCO_3$)	mg/L	-	-	37	37	31	41	43	48	39	40	32	36	31	38	35	37
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.031	0.028	0.027	0.026	0.026	0.024	0.03	0.021	0.033	0.022	0.023	0.015	0.013	0.022
	Nitrate	mg/L	3	3	0.021	<0.020	<0.020	<0.020	0.022	0.022	<0.020	<0.020	<0.020	<0.020	0.046	0.025	<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	-	-	1.39	1.86	1.28	1.45	1.36	1.42	1.53	1.60	1.29	1.38	1.30	1.32	1.47	1.46
	Total Organic Carbon	mg/L	-	-	1.80	1.93	1.95	2.05	2.02	2.01	2.08	2.09	2.26	1.98	1.75	1.92	1.84	2.13
	Total Phosphorus	mg/L	0.020[α]	-	0.0048	0.0052	0.0050	0.0046	0.0077	0.0083	<0.0030	0.0049	0.0067	0.0046	0.0060	0.0060	0.0060	0.0037
	Phenols	mg/L	0.004[α]	-	0.0014	0.0026	0.0019	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0023	<0.0010	<0.0010	<0.0010	0.0022	<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	1.77	1.72	1.47	2.01	2.09	2.43	1.17	1.19	1.46	1.28	1.48	1.63	1.53	1.60
	Sulphate (SO_4)	mg/L	218[β]	218	3.06	2.76	1.94	3.37	3.92	4.28	1.20	1.20	1.89	1.55	1.60	2.62	2.27	2.54
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.076	0.087	0.065	0.097	***0.154***	***0.136***	0.025	0.022	0.053	0.035	0.012	0.049	0.072	0.080
	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	-	-	0.00523	0.00514	0.00461	0.00544	0.00725	0.00746	0.00409	0.00418	0.00440	0.00426	0.00365	0.00469	0.00511	0.00504
	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	0.000018	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	7.56	7.65	6.54	7.91	10.1	10.4	7.72	7.50	6.22	7.04	5.87	7.32	7.46	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	0.00075	<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	0.00065	0.00065	0.0006	0.0007	0.00092	0.00095	0.00058	0.00059	0.0006	0.00059	0.0006	0.00061	0.00064	0.00063
	Iron (Fe)	mg/L	0.30	0.326	0.073	0.071	0.060	0.077	0.143	0.149	<0.030	<0.030	0.068	<0.030	<0.030	0.045	0.052	0.056
	Lead (Pb)	mg/L	0.001	0.001	0.000095	0.000086	0.000086	0.000094	0.000221	0.000233	<0.000050	<0.000050	0.000075	<0.000050	<0.000050	0.000063	0.000070	0.000066
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	0.001	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.05	4.18	3.59	4.34	5.39	5.58	3.99	3.90	3.45	3.84	3.23	4.00	4.07	4.01
	Manganese (Mn)	mg/L	0.935[β]	-	0.00267	0.00201	0.00261	0.00193	0.00306	0.00312	0.00130	0.00120	0.00273	0.00126	0.00041	0.00152	0.00147	0.00150
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.000151	0.000158	0.000132	0.000167	0.000187	0.000190	0.000111	0.000117	0.000325	0.000114	0.000111	0.000128	0.000154	0.000147
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	0.00055	0.00055	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.61	0.62	0.55	0.64	0.81	0.81	0.50	0.50	0.54	0.51	0.48	0.57	0.59	0.59
	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	-	-	0.57	0.61	0.51	0.61	0.81	0.80	0.44	0.42	0.47	0.46	0.39	0.50	0.56	0.56
	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	-	-	0.805	0.848	0.730	0.830	1.15	1.17	0.680	0.685	0.691	0.695	0.682	0.793	0.764	0.780
	Strontium (Sr)	mg/L	-	-	0.00761	0.00754	0.00596	0.00787	0.0109	0.0115	0.00566	0.00554	0.00556	0.00577	0.00504	0.00680	0.00689	0.00675
	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	-	0.00060	0.00064	0.00044	0.00070	0.00113	0.00124	0.00045	0.00046	0.00040	0.00044	0.00033	0.00057	0.00056	0.00055
	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	0.003	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

(grey shading) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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 Mary Lake.

Table C.77: Water Chemistry at Mary Lake South Basin (BLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2019

	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
					26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19
Conventionals	Conductivity (lab)	umho/cm	-	-	90.2	90.1	107.0	89.9	90.9	91.9	81.0	86.7	90.6	89.8	90.6	90.5	89.0	88.2
	pH (lab)	pH	6.5 - 9.0	-	7.91	7.87	7.94	7.92	7.93	7.97	7.79	7.86	7.86	7.90	7.91	7.90	7.84	7.87
	Hardness (as $CaCO_3$)	mg/L	-	-	40.6	41.3	46.0	40.5	42.0	41.2	37.3	40.5	41.0	41.0	40.7	41.1	39.7	39.8
	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	-	-	65	65	71	65	57	69	60	63	58	62	127	63	65	64
	Turbidity	NTU	-	-	2.81	2.51	3.49	2.83	2.63	2.55	1.30	1.23	3.19	2.80	3.35	2.77	3.33	3.09
	Alkalinity (as $CaCO_3$)	mg/L	-	-	40	43	46	42	41	41	42	42	41	41	42	43	40	42
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.10	<0.010	0.085	<0.010	0.016	<0.010	0.054	0.141	0.016	0.163	<0.010	0.0225	0.016	<0.010
	Nitrate	mg/L	3	3	0.026	<0.020	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.022	<0.020	0.024	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	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.22	<0.15	<0.15	<0.15	0.17	<0.15	<0.15	0.2	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.43	1.57	1.50	1.66	1.36	1.44	1.82	1.54	1.45	1.38	1.34	1.49	1.50	1.45
	Total Organic Carbon	mg/L	-	-	1.77	1.79	1.83	1.77	1.76	1.73	1.88	2.29	1.72	1.83	1.87	1.79	1.84	1.76
	Total Phosphorus	mg/L	0.020[α]	-	0.0045	0.0851	0.0052	0.0038	0.0088	0.0056	0.0052	0.0039	0.0055	0.0044	0.0052	0.0057	0.0057	0.0051
	Phenols	mg/L	0.004[α]	-	0.0019	<0.0010	0.0015	0.0019	0.0016	<0.0010	0.0013	0.0013	<0.0010	0.0014	0.0011	0.0015	0.0037	<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	2.38	2.40	3.59	2.38	2.40	2.46	1.73	1.84	2.41	2.89	2.37	2.39	2.30	2.32
	Sulphate (SO_4)	mg/L	218[β]	218	3.06	3.07	4.18	3.11	3.20	3.24	1.93	1.97	3.11	3.12	3.17	3.18	3.01	3.03
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.064	0.053	0.078	0.055	0.054	0.038	0.027	0.029	0.069	0.068	0.060	0.055	0.051	0.043
	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	-	-	0.0053	0.0052	0.0061	0.0053	0.0054	0.0054	0.0043	0.0046	0.0053	0.0054	0.0053	0.0053	0.0052	0.0052
	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	-	-	8.24	8.34	9.34	8.28	8.22	8.36	7.63	8.15	8.34	8.29	8.28	8.28	8.00	7.96
	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	0.00070	0.00066	0.00074	0.00066	0.00064	0.00069	0.00062	0.00062	0.00065	0.00073	0.00065	0.00066	0.00065	0.00080
	Iron (Fe)	mg/L	0.30	0.326	0.049	0.042	0.064	0.045	0.045	0.035	<0.030	<0.030	0.052	0.050	0.048	0.046	0.044	0.047
	Lead (Pb)	mg/L	0.001	0.001	0.000057	0.000052	0.000068	0.000053	0.000053	0.000052	<0.000050	<0.000050	0.000057	0.000065	0.000058	0.000057	0.000056	0.000084
	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	-	-	4.91	4.88	5.61	4.94	4.90	4.99	4.45	4.84	4.93	4.97	4.85	4.94	4.76	4.80
	Manganese (Mn)	mg/L	0.935[β]	-	0.0015	0.0013	0.0017	0.0014	0.0014	0.0013	0.0012	0.0011	0.0014	0.0016	0.0015	0.0014	0.0014	0.0015
	Mercury (Hg)	mg/L	0.000026	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.073	-	0.00018	0.00018	0.00021	0.00017	0.00017	0.00018	0.00013	0.00014	0.00018	0.00021	0.00018	0.00018	0.00016	0.00018
	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	-	-	0.68	0.68	0.77	0.69	0.69	0.69	0.59	0.62	0.69	0.70	0.68	0.70	0.67	0.68
	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	-	-	0.59	0.55	0.67	0.57	0.56	0.51	0.48	0.52	0.59	0.59	0.57	0.57	0.54	0.53
	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	-	-	1.14	1.14	1.50	1.16	1.16	1.18	0.929	1.00	1.15	1.18	1.14	1.17	1.11	1.12
	Strontium (Sr)	mg/L	-	-	0.00753	0.00751	0.00920	0.00755	0.00755	0.00761	0.00618	0.00661	0.00752	0.00755	0.00760	0.00758	0.00741	0.00721
	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	-	0.000728	0.000730	0.001140	0.000747	0.000750	0.000764	0.000524	0.000590	0.000744	0.000753	0.000757	0.000752	0.000698	0.000705
	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

[grey box] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Note: "-" indicates no WQG benchmark applicable.

[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 Mary Lake.

Table C.78: Dissolved Metal Concentrations at Mary Lake South Basin Water Quality Monitoring Stations, Mary River Project CREMP, 2019

	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
			16-Apr-19	16-Apr-19	16-Apr-19	16-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19
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	0.0038	<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
	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	0.00455	0.00474	0.00456	0.00487	0.00512	0.00511	0.00428	0.00473	0.00458	0.00510	0.00485	0.00500	0.00493	0.00498
	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	8.80	9.31	8.30	9.30	9.96	9.42	7.88	8.71	8.28	9.65	8.42	8.93	9.13	8.84
	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	0.00068	0.00064	0.00066	0.00064	0.00071	0.00066	0.00067	0.00068	0.00074	0.00068	0.00083	0.00069	0.00070	0.00069
	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	5.40	5.67	5.21	5.56	6.46	6.26	4.99	5.80	5.44	6.27	4.98	5.51	5.73	5.61
	Manganese (Mn)	mg/L	0.000252	0.000298	0.000493	0.000262	0.000393	0.000274	0.000235	0.000410	0.000305	0.000189	0.000353	0.000287	0.000452	0.000272
	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	0.000149	0.000166	0.000155	0.000168	0.000150	0.000152	0.000131	0.000133	0.000143	0.000163	0.000108	0.000150	0.000149	0.000144
	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	0.60	0.64	0.59	0.64	0.72	0.71	0.56	0.67	0.61	0.70	0.58	0.66	0.68	0.66
	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	0.39	0.41	0.44	0.41	0.43	0.44	0.38	0.43	0.43	0.44	0.74	0.41	0.43	0.42
	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	1.07	1.15	1.05	1.13	1.21	1.18	1.00	1.13	1.02	1.18	1.21	1.12	1.12	1.13
	Strontium (Sr)	mg/L	0.00677	0.00708	0.00661	0.00718	0.00739	0.00703	0.00608	0.00652	0.00629	0.00730	0.00665	0.00709	0.00683	0.00693
	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	0.000589	0.000612	0.000544	0.000626	0.000585	0.000591	0.000506	0.000562	0.000510	0.000581	0.000408	0.000573	0.000535	0.000579
	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.78: Dissolved Metal Concentrations at Mary Lake South Basin Water Quality Monitoring Stations, Mary River Project CREMP, 2019

Parameters		Units	Summer Sampling Event													
			BL0-05-A bottom 27-Jul-19	BL0-05-A surface 27-Jul-19	BL0-05 bottom 27-Jul-19	BL0-05 surface 27-Jul-19	BL0-05-B bottom 27-Jul-19	BL0-05-B surface 27-Jul-19	BL0-03 bottom 27-Jul-19	BL0-03 surface 27-Jul-19	BL0-04 bottom 27-Jul-19	BL0-04 surface 27-Jul-19	BL0-09 bottom 27-Jul-19	BL0-09 surface 27-Jul-19	BL0-06 bottom 27-Jul-19	BL0-06 surface 27-Jul-19
Dissolved Metals	Aluminum (Al)	mg/L	0.0210	0.0206	0.0157	0.0161	0.0251	0.0230	0.0096	0.0098	0.0161	0.0104	0.0361	0.0228	0.0248	0.0132
	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	0.00449	0.00447	0.00382	0.00492	0.00503	0.00562	0.00377	0.00382	0.00384	0.00371	0.00380	0.00443	0.00401	0.00434
	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	7.25	7.56	6.16	8.32	8.23	9.29	7.04	7.07	6.16	6.75	5.74	7.41	6.65	7.06
	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	0.00062	0.00061	0.00066	0.00067	0.00071	0.0006	0.0006	0.00063	0.00056	0.00067	0.00061	0.00062	0.00059
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.043	<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	0.000066	<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	4.52	4.66	3.90	5.09	5.10	5.66	4.34	4.39	3.80	4.17	3.59	4.51	4.20	4.48
	Manganese (Mn)	mg/L	0.000441	0.000525	0.000997	0.000453	0.000441	0.000461	0.000325	0.000351	0.000634	0.000360	0.002370	0.000375	0.000293	0.000315
	Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000174	0.000169	0.000130	0.000211	0.000213	0.000262	0.000148	0.000119	0.000150	0.000128	0.000099	0.000168	0.000143	0.000171
	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	0.63	0.65	0.56	0.68	0.69	0.76	0.53	0.54	0.56	0.54	0.55	0.61	0.59	0.60
	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	0.53	0.52	0.45	0.54	0.59	0.64	0.44	0.45	0.43	0.42	0.46	0.53	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	0.92	0.97	0.79	1.05	1.05	1.21	0.77	0.78	0.77	0.77	0.76	0.90	0.83	0.88
	Strontium (Sr)	mg/L	0.00709	0.00703	0.00541	0.00815	0.00854	0.00975	0.00527	0.00539	0.00536	0.00540	0.00480	0.00682	0.00606	0.00644
	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	0.000514	0.000563	0.000352	0.000688	0.000696	0.000883	0.000402	0.000401	0.000338	0.000382	0.000304	0.000518	0.000417	0.000486
	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.78: Dissolved Metal Concentrations at Mary Lake South Basin Water Quality Monitoring Stations, Mary River Project CREMP, 2019

Parameters		Units	Fall Sampling Event													
			BL0-05-A bottom 26-Aug-19	BL0-05-A surface 26-Aug-19	BL0-05 bottom 26-Aug-19	BL0-05 surface 26-Aug-19	BL0-05-B bottom 26-Aug-19	BL0-05-B surface 26-Aug-19	BL0-03 bottom 26-Aug-19	BL0-03 surface 26-Aug-19	BL0-04 bottom 26-Aug-19	BL0-04 surface 26-Aug-19	BL0-09 bottom 26-Aug-19	BL0-09 surface 26-Aug-19	BL0-06 bottom 26-Aug-19	BL0-06 surface 26-Aug-19
Dissolved Metals	Aluminum (Al)	mg/L	0.0165	0.0172	0.0256	0.0187	0.0190	0.0145	0.0133	0.0146	0.023	0.0248	0.0211	0.0169	0.0192	0.0228
	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	0.00490	0.00497	0.00577	0.00496	0.00538	0.00506	0.00419	0.00445	0.00502	0.00500	0.00498	0.00511	0.00492	0.00500
	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	8.38	8.38	9.27	8.26	8.27	8.37	7.51	8.23	8.31	8.36	8.27	8.33	8.11	8.14
	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	0.00063	0.00070	0.00061	0.00068	0.00063	0.00056	0.00065	0.00067	0.00069	0.00063	0.00067	0.00063	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	4.77	4.94	5.55	4.82	5.20	4.93	4.51	4.84	4.92	4.89	4.88	4.91	4.72	4.74
	Manganese (Mn)	mg/L	0.000376	0.000285	0.000445	0.000257	0.000291	0.000350	0.000223	0.000308	0.000310	0.000341	0.000292	0.000432	0.000259	0.000497
	Mercury (Hg)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	0.000351	0.000187	0.000217	0.000192	0.000198	0.000205	0.000159	0.000168	0.000205	0.000203	0.000190	0.000203	0.000187	0.000188
	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	0.65	0.67	0.74	0.66	0.70	0.66	0.59	0.61	0.68	0.67	0.67	0.68	0.66	0.68
	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	0.49	0.56	0.50	0.47	0.48	0.47	0.50	0.50	0.50	0.48	0.48	0.48	0.48
	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	1.14	1.15	1.49	1.14	1.23	1.17	0.95	1.01	1.18	1.16	1.15	1.17	1.11	1.14
	Strontium (Sr)	mg/L	0.00766	0.00747	0.00902	0.00764	0.00770	0.00772	0.00619	0.00670	0.00761	0.00755	0.00764	0.00769	0.00743	0.00751
	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	0.000751	0.000749	0.001130	0.000737	0.000762	0.000771	0.000525	0.000598	0.000749	0.000733	0.000747	0.000752	0.000705	0.000717
	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.79: Spearman's Rank Correlation Coefficients for Mary Lake South Basin (BLO) Water Quality Data Collected in Winter, Summer, and Fall 2019[a]

Parameters	Conventional Parameters										Total Metals									
	Conduct-ivity	Hardness	Total Dissolved Solids	Turbidity	Alkalinity	Nitrate	Dissolved Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Iron	Manganese	Molybdenum	Nickel	Potassium	Sodium	Uranium
Conductivity	1	0.917	0.541	-0.276	0.895	0.407	0.456	-0.142	0.741	0.578	-0.366	0.507	0.649	-0.245	-0.444	0.441	0.065	0.762	0.849	0.505
Hardness	0.917	1	0.370	-0.349	0.889	0.511	0.456	-0.160	0.575	0.502	-0.403	0.409	0.709	-0.277	-0.456	0.385	0.194	0.672	0.750	0.395
Total Dissolved Solids	0.541	0.370	1	0.311	0.412	-0.134	0.203	0.152	0.806	0.655	0.127	0.575	0.407	0.131	0.046	0.585	-0.028	0.676	0.684	0.724
Turbidity	-0.276	-0.349	0.311	1	-0.360	-0.600	-0.518	0.538	0.255	0.525	0.863	0.539	0.035	0.861	0.881	0.391	0.369	0.254	0.051	0.535
Alkalinity	0.895	0.889	0.412	0	1	0.433	0.534	-0.195	0.570	0.432	-0.423	0.368	0.646	-0.338	-0.483	0.327	0.222	0.683	0.733	0.391
Nitrate	0.407	0.511	-0.134	-0.600	0.433	1	0.245	-0.317	0.059	-0.073	-0.639	-0.136	0.333	-0.538	-0.647	-0.129	0.019	0.062	0.187	-0.185
Dissolved Organic Carbon	0.456	0.456	0.203	-0.518	0.534	0.245	1	-0.368	0.062	-0.113	-0.557	-0.116	0.155	-0.536	-0.603	-0.212	-0.221	0.195	0.244	-0.121
Total Phosphorus	-0.142	-0.160	0.152	0.538	-0.195	-0.317	-0.368	1	0.178	0.298	0.440	0.268	-0.127	0.462	0.466	0.347	0.333	0.181	0.105	0.289
Chloride	0.741	0.575	0.806	0.255	0.570	0.059	0.062	0.178	1	0.852	0.128	0.802	0.623	0.183	0.024	0.711	0.148	0.866	0.896	0.840
Sulphate	0.578	0.502	0.655	0.525	0.432	-0.073	-0.113	0.298	0.852	1	0.418	0.933	0.640	0.503	0.320	0.739	0.360	0.853	0.789	0.921
Aluminum (total)	-0.366	-0.403	0.127	0.863	-0.423	-0.639	-0.557	0.440	0.128	0.418	1	0.524	-0.040	0.922	0.914	0.411	0.369	0.144	-0.041	0.494
Barium (total)	0.507	0.409	0.575	0.539	0.368	-0.136	-0.116	0.268	0.802	0.933	0.524	1	0.592	0.586	0.401	0.739	0.369	0.847	0.727	0.891
Copper (total)	0.649	0.709	0.407	0.035	0.646	0.333	0.155	-0.127	0.623	0.640	-0.040	0.592	1	0.112	-0.037	0.548	0.370	0.719	0.685	0.559
Iron (total)	-0.245	-0.277	0.131	0.861	-0.338	-0.538	-0.536	0.462	0.183	0.503	0.922	0.586	0.112	1	0.929	0.512	0.391	0.240	0.044	0.497
Manganese (total)	-0.444	-0.456	0.046	0.881	-0.483	-0.647	-0.603	0.466	0.024	0.320	0.914	0.401	-0.037	0.929	1	0.377	0.369	0.062	-0.120	0.349
Molybdenum (total)	0.441	0.385	0.585	0.391	0.327	-0.129	-0.212	0.347	0.711	0.739	0.411	0.739	0.548	0.512	0.377	1	0.314	0.705	0.664	0.768
Nickel (total)	0.065	0.194	-0.028	0.369	0.222	0.019	-0.221	0.333	0.148	0.360	0.369	0.369	0.370	0.391	0.369	0.314	1	0.370	0.226	0.360
Potassium (total)	0.762	0.672	0.676	0.254	0.683	0.062	0.195	0.181	0.866	0.853	0.144	0.847	0.719	0.240	0.062	0.705	0.370	1	0.932	0.804
Sodium (total)	0.849	0.750	0.684	0.051	0.733	0.187	0.244	0.105	0.896	0.789	-0.041	0.727	0.685	0.044	-0.120	0.664	0.226	0.932	1	0.734
Uranium (total)	0.505	0.395	0.724	0.535	0.391	-0.185	-0.121	0.289	0.840	0.921	0.494	0.891	0.559	0.497	0.349	0.768	0.360	0.804	0.734	1
Aluminum (dissolved)	-0.338	-0.448	0.190	0.856	-0.390	-0.501	-0.587	0.593	0.207	0.378	0.808	0.442	-0.056	0.750	0.761	0.333	0.313	0.183	0.003	0.465
Barium (dissolved)	0.808	0.724	0.667	0.215	0.686	0.105	0.149	0.208	0.892	0.882	0.075	0.818	0.716	0.196	0.014	0.684	0.295	0.943	0.934	0.781
Copper (dissolved)	0.652	0.695	0.263	-0.199	0.621	0.563	0.214	-0.191	0.505	0.396	-0.297	0.376	0.633	-0.138	-0.309	0.323	0.213	0.541	0.558	0.287
Iron (dissolved)	-0.264	-0.264	-0.226	-0.019	-0.259	0.264	-0.238	0.187	-0.200	-0.226	-0.084	-0.264	-0.239	-0.150	-0.148	-0.258	-0.035	-0.265	-0.252	-0.264
Manganese (dissolved)	-0.287	-0.226	-0.238	0.358	-0.265	-0.113	-0.481	0.102	-0.178	0.006	0.381	0.095	0.042	0.450	0.491	0.176	0.226	-0.071	-0.214	-0.009
Molybdenum (dissolved)	0.263	0.200	0.627	0.702	0.136	-0.351	-0.277	0.374	0.665	0.836	0.648	0.779	0.438	0.655	0.570	0.723	0.341	0.638	0.552	0.863
Nickel (dissolved)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium (dissolved)	0.722	0.691	0.605	0.318	0.630	-0.006	0.174	0.263	0.771	0.845	0.151	0.787	0.676	0.297	0.120	0.636	0.324	0.916	0.833	0.732
Sodium (dissolved)	0.868	0.744	0.703	0.046	0.729	0.172	0.223	0.115	0.921	0.759	-0.033	0.748	0.617	0.037	-0.131	0.648	0.120	0.869	0.908	0.721
Uranium (dissolved)	0.598	0.499	0.784	0.421	0.458	-0.150	-0.033	0.305	0.888	0.878	0.314	0.779	0.560	0.323	0.206	0.717	0.249	0.791	0.795	0.911

Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings. (green)

Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings. (blue)

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 42.

Table C.79: Spearman's Rank Correlation Coefficients for Mary Lake South Basin (BLO) Water Quality Data Collected in Winter, Summer, and Fall 2019[a]

Parameters	Dissolved Metals									
	Aluminum	Barium	Copper	Iron	Manganese	Molybdenum	Nickel	Potassium	Sodium	Uranium
Conductivity	-0.338	0.808	0.652	-0.264	-0.287	0.263	-	0.722	0.868	0.598
Hardness	-0.448	0.724	0.695	-0.264	-0.226	0.200	-	0.691	0.744	0.499
Total Dissolved Solids	0.190	0.667	0.263	-0.226	-0.238	0.627	-	0.605	0.703	0.784
Turbidity	0.856	0.215	-0.199	-0.019	0.358	0.702	-	0.318	0.046	0.421
Alkalinity	-0.390	0.686	0.621	-0.259	-0.265	0.136	-	0.630	0.729	0.458
Nitrate	-0.501	0.105	0.563	0.264	-0.113	-0.351	-	-0.006	0.172	-0.150
Dissolved Organic Carbon	-0.587	0.149	0.214	-0.238	-0.481	-0.277	-	0.174	0.223	-0.033
Total Phosphorus	0.593	0.208	-0.191	0.187	0.102	0.374	-	0.263	0.115	0.305
Chloride	0.207	0.892	0.505	-0.200	-0.178	0.665	-	0.771	0.921	0.888
Sulphate	0.378	0.882	0.396	-0.226	0.006	0.836	-	0.845	0.759	0.878
Aluminum (total)	0.808	0.075	-0.297	-0.084	0.381	0.648	-	0.151	-0.033	0.314
Barium (total)	0.442	0.818	0.376	-0.264	0.095	0.779	-	0.787	0.748	0.779
Copper (total)	-0.056	0.716	0.633	-0.239	0.042	0.438	-	0.676	0.617	0.560
Iron (total)	0.750	0.196	-0.138	-0.150	0.450	0.655	-	0.297	0.037	0.323
Manganese (total)	0.761	0.014	-0.309	-0.148	0.491	0.570	-	0.120	-0.131	0.206
Molybdenum (total)	0.333	0.684	0.323	-0.258	0.176	0.723	-	0.636	0.648	0.717
Nickel (total)	0.313	0.295	0.213	-0.035	0.226	0.341	-	0.324	0.120	0.249
Potassium (total)	0.183	0.943	0.541	-0.265	-0.071	0.638	-	0.916	0.869	0.791
Sodium (total)	0.003	0.934	0.558	-0.252	-0.214	0.552	-	0.833	0.908	0.795
Uranium (total)	0.465	0.781	0.287	-0.264	-0.009	0.863	-	0.732	0.721	0.911
Aluminum (dissolved)	1	0.117	-0.146	0.267	0.383	0.533	-	0.192	-0.006	0.302
Barium (dissolved)	0.117	1	0.598	-0.238	-0.101	0.634	-	0.928	0.905	0.825
Copper (dissolved)	-0.146	0.598	1	0.065	0.079	0.040	-	0.531	0.596	0.282
Iron (dissolved)	0.267	-0.238	0.065	1	0.264	-0.264	-	-0.226	-0.264	-0.264
Manganese (dissolved)	0.383	-0.101	0.079	0.264	1	0.068	-	-0.001	-0.193	-0.153
Molybdenum (dissolved)	0.533	0.634	0.040	-0.264	0.068	1	-	0.649	0.506	0.854
Nickel (dissolved)	-	-	-	-	-	-	1	-	-	-
Potassium (dissolved)	0.192	0.928	0.531	-0.226	-0.001	0.649	-	1	0.794	0.776
Sodium (dissolved)	-0.006	0.905	0.596	-0.264	-0.193	0.506	-	0.794	1	0.780
Uranium (dissolved)	0.302	0.825	0.282	-0.264	-0.153	0.854	-	0.776	0.780	1

(green) Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 42.

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 2019

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
REF-03-1	9.9	thin oxidized layer of reddish silt over light grey-brown coloured silt with some sand intermixed	none detected	none observed
REF-03-2	10.6	thin oxidized layer of reddish silt over light grey-brown coloured silt with some sand intermixed	none detected	sparse algae (mare's eggs)
REF-03-3	7.3	light brown-coloured silt and clay	none detected	none observed
REF-03-4	8.6	medium brown-grey coloured silt with some sand intermixed at greater depth	none detected	sparse algae (mare's eggs)
REF-03-5	10.4	oxidized orange layer over medium grey-coloured silt; sediment grey-green at greater depths	none detected	sparse algae (mare's eggs)
REF-03-6	18.0	reddish-brown coloured silt	none detected	none observed
REF-03-7	21.9	medium brown-grey coloured silt over hard-packed clay pan	none detected	none observed
REF-03-8	16.0	medium brown-grey coloured silt with some sand intermixed	none detected	none observed
REF-03-9	21.5	medium brown-coloured	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 using a 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 2019

Sample Station	Station Depth (m)	Station Type	Core Number	Core Length (cm)	Surficial Substrate Texture Description
REF-03-1	8.0	Littoral	1	33	loosely compact, oxidized silt (0-4 cm) overlying loosely compact, gray brown silt with some CPOM and sand intermixed
			2	20	
			3	16	
			4	31	
REF-03-6	20.0	Profundal	1	26	loosely compact reddish-brown silt (0-22 cm) overlying gray brown silt with upper layer showing deep reddish oxidized colour
			2	24	
			3	22	
			4	22	
REF-03-2	9.4	Littoral	1	36	oxidized silt (0-5 cm) overlying loosely to moderately compact gray brown silt; no anoxia observed
			2	33	
			3	33	
			4	37	
REF-03-7	24.0	Profundal	1	7	loosely compact medium brown silt overlying loosely to moderately compact light brown silt
			2	14	
			3	13	
			4	12	
REF-03-3	10.2	Littoral	1	13	medium brown silt overlying moderately compact light brown silt-clay and dark gray-brown coloured silt
			2	10	
			3	23	
			4	-	
REF-03-8	18.5	Profundal	1	19	loosely compact medium brown silt over oxidized silt with black streaking or moderately compact gray-brown silt
			2	21	
			3	17	
			4	-	
REF-03-4	9.3	Littoral	1	25	light red brown silt overlying gray silt with some black streaking and moderately compact sand
			2	15	
			3	17	
			4	-	
REF-03-9	20.1	Profundal	1	19	loosely compact medium brown silt overlying loosely compact reddish silt and gray silt exhibiting some black streaking
			2	22	
			3	22	
			4	23	
REF-03-5	11.1	Littoral	1	35	loosely compact red oxidized silt overlying loosely to moderately compact gray-brown silt with some black streaking
			2	29	
			3	40	
			4	32	
REF-03-10	19.5	Profundal	1	29	loosely compact medium brown silt (0-18 cm) overlying loosely compact reddish-brown oxidized silt, and over loosely to moderately compact dark brown silt
			2	21	
			3	29	
			4	21	

Table D.3: Statistical Comparison of Substrate Physical Properties between Littoral and Profundal Sediment Stations of Individual Study Lakes, Mary River Project CREMP, August 2019

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	0.570	α	Littoral	5	58.2	19.4	8.7	36.0	85.0
					Profundal	9	51.6	20.6	6.9	32.7	86.1
	Silt (% by weight)	NO	0.923	α	Littoral	5	38.4	17.6	7.9	14.0	58.1
					Profundal	9	39.3	16.3	5.4	12.7	57.6
	Clay (% by weight)	YES	0.040	α	Littoral	5	3.4	1.8	0.8	1.0	5.9
					Profundal	9	9.1	5.3	1.8	1.3	17.6
	Moisture (%)	NO	0.919	α	Littoral	5	55.2	17.6	7.9	34.4	79.8
					Profundal	9	56.2	18.0	6.0	28.3	75.3
	TOC (%)	NO	0.835	α	Littoral	5	1.5	1.0	0.5	0.6	3.1
					Profundal	9	1.4	0.8	0.3	0.2	2.4
Sheardown Lake NW	Sand (% by weight)	NO	0.217	α	Littoral	7	51.1	20.3	7.7	35.4	91.6
					Profundal	7	35.0	25.6	9.7	9.6	74.4
	Silt (% by weight)	NO	0.273	α	Littoral	7	40.5	16.5	6.3	7.5	56.1
					Profundal	7	51.6	19.6	7.4	21.0	69.7
	Clay (% by weight)	NO	0.140	α	Littoral	7	8.5	4.1	1.6	1.0	12.6
					Profundal	7	13.4	7.1	2.7	4.6	25.2
	Moisture (%)	NO	0.238	α	Littoral	7	69.6	21.5	8.1	21.2	82.3
					Profundal	7	57.8	13.1	5.0	35.2	69.5
	TOC (%)	YES	0.016	α	Littoral	7	2.8	1.5	0.6	0.2	5.3
					Profundal	7	1.1	0.5	0.2	0.5	1.6
Sheardown Lake SE	Sand (% by weight)	NO	0.910	α	Littoral	5	14.5	7.8	3.5	9.9	28.4
					Profundal	5	14.0	5.5	2.5	7.5	21.8
	Silt (% by weight)	NO	0.479	α	Littoral	5	71.5	5.5	2.5	64.4	77.2
					Profundal	5	73.8	4.2	1.9	69.7	80.9
	Clay (% by weight)	NO	0.555	α	Littoral	5	14.0	5.7	2.5	7.2	21.5
					Profundal	5	12.2	3.2	1.4	8.6	15.9
	Moisture (%)	YES	0.077	α	Littoral	5	64.5	9.6	4.3	49.5	73.9
					Profundal	5	54.7	4.9	2.2	50.8	63.2
	TOC (%)	NO	0.159	α	Littoral	5	1.3	0.4	0.2	0.8	1.7
					Profundal	5	1.0	0.1	0.1	0.8	1.2
Mary Lake	Sand (% by weight)	NO	0.938	α	Littoral	4	24.9	33.0	16.5	5.5	74.0
					Profundal	11	23.8	20.9	6.3	5.6	76.5
	Silt (% by weight)	NO	0.748	α	Littoral	4	57.4	23.4	11.7	23.0	75.2
					Profundal	11	53.9	16.6	5.0	14.1	72.0
	Clay (% by weight)	NO	0.460	α	Littoral	4	17.7	13.1	6.5	3.1	29.7
					Profundal	11	22.3	9.5	2.9	7.4	34.5
	Moisture (%)	NO	0.817	α	Littoral	4	54.1	17.7	8.9	29.9	67.6
					Profundal	11	52.2	12.3	3.7	31.7	72.2
	TOC (%)	NO	0.608	α	Littoral	4	0.9	0.3	0.1	0.6	1.1
					Profundal	11	0.8	0.3	0.1	0.5	1.6

[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 2019

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	%	-	68.9	54.0	66.4	49.4	43.3	52.6	57.4	46.3	56.4	53.0	54.8	8.1	2.55
	Silt	%	-	24.9	36.9	26.0	40.4	48.4	39.6	37.1	44.6	35.6	38.3	37.2	7.28	2.30
	Clay	%	-	6.20	9.1	7.6	10.2	8.2	7.9	5.4	9.0	8.0	8.7	8.0	1.40	0.444
	Moisture	%	-	77.8	87.5	91.4	87.0	81.5	87.9	80.4	88.6	89.0	86.0	86	4.34	1.37
	Total Organic Carbon	%	10[α]	2.72	4.59	7.41	3.86	2.17	4.35	2.52	4.44	6.30	4.38	4.27	1.64	0.518
Metals	Aluminum (Al)	mg/kg	-	12,700	24,500	17,300	22,500	12,500	20,800	14,500	22,500	11,300	23,400	18,200	5,113	1,617
	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	2.79	5.50	6.01	5.51	3.19	5.14	2.96	4.89	8.46	5.24	4.97	1.70	0.536
	Barium (Ba)	mg/kg	-	67.8	132	127.0	124.0	65	135	74	118	161	124	113	32.5	10.3
	Beryllium (Be)	mg/kg	-	0.49	0.94	0.72	0.87	0.53	0.82	0.62	0.89	0.47	0.92	0.73	0.19	0.059
	Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.0	0.0
	Boron (B)	mg/kg	-	10.7	18.5	14.6	17.0	9.6	15.3	12.1	14.6	12.0	17.2	14.2	2.97	0.940
	Cadmium (Cd)	mg/kg	3.5	0.091	0.169	0.252	0.176	0.077	0.165	0.090	0.155	0.188	0.157	0.15	0.053	0.017
	Calcium (Ca)	mg/kg	-	4,160	5,890	5,360	5,260	3,480	5,350	4,060	5,340	5,550	5,620	5,007	804	254
	Chromium (Cr)	mg/kg	90	52.9	79.8	60.4	71.6	40.9	67.9	47.1	75.5	43.9	76.1	61.6	14.5	4.60
	Cobalt (Co)	mg/kg	-	8.82	17.4	11.20	16.2	8.2	16.5	10.1	16.0	10.4	16.3	13.1	3.66	1.16
	Copper (Cu)	mg/kg	197	43.6	95.8	94.1	95	39.7	85	56.5	91.6	51.8	92.7	74.5	23.5	7.44
	Iron (Fe)	mg/kg	40,000[α]	37,000	50,600	77,000	48,200	26,300	54,200	32,000	47,000	101,000	47,900	52,120	22,046	6,972
	Lead (Pb)	mg/kg	91.3	10.9	19.8	15.8	18.8	12.3	17.9	12.6	19.0	13.3	19.4	16.0	3.42	1.08
	Lithium (Li)	mg/kg	-	20.9	37.9	26.2	36.4	23.6	32.5	24.2	35.5	18.7	36.5	29.2	7.27	2.30
	Magnesium (Mg)	mg/kg	-	9,960	16,200	11,100	14,300	8,330	13,600	9,190	14,900	8,380	15,200	12,116	3,045	963
	Manganese (Mn)	mg/kg	1,100[α,β]	297	1,190	556	1,300	328	4,230	602	1,190	938	1,070	1,170	1,136	359
	Mercury (Hg)	mg/kg	0.486	0.0336	0.0718	0.0775	0.0690	0.0251	0.0704	0.0227	0.0802	0.0700	0.0778	0.0598	0.0230	0.0073
	Molybdenum (Mo)	mg/kg	-	2.91	2.81	12.30	3.13	2.90	4.65	2.56	2.36	6.66	2.37	4.27	3.12	0.987
	Nickel (Ni)	mg/kg	75[α,β]	35.1	56.2	46.5	49.6	28.8	47.9	31.6	51.8	33.5	52.5	43.4	10.0	3.17
	Phosphorus (P)	mg/kg	2,000[α]	973	1,110	1,840	1,040	661	1,020	824	894	2,850	1,060	1,227	648.7	205.1
	Potassium (K)	mg/kg	-	2,760	5,960	4,050	5,470	3,240	5,060	3,610	5,360	2,880	5,660	4,405	1,230	388.9
	Selenium (Se)	mg/kg	-	0.53	0.81	1.10	0.63	0.31	0.75	0.34	0.80	0.83	0.85	0.70	0.24	0.077
	Silver (Ag)	mg/kg	-	0.10	0.28	0.25	0.25	<0.10	0.22	<0.10	0.27	0.11	0.27	0.20	0.081	0.026
	Sodium (Na)	mg/kg	-	240	464	326	390	209	373	256	405	262	437	336	90.0	28.5
	Strontium (Sr)	mg/kg	-	9.26	14.8	12.70	13.8	8.6	13.4	10.1	13.2	12.7	14.3	12.3	2.17	0.686
	Sulphur (S)	mg/kg	-	<1000	1,400	1,900	1,100	<1000	1,400	<1000	1,300	2,100	1,400	1,360	381	120
	Thallium (Tl)	mg/kg	-	0.296	0.801	0.506	0.754	0.307	0.757	0.340	0.754	0.368	0.787	0.567	0.222	0.0703
	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	0.0	0.0
	Titanium (Ti)	mg/kg	-	1,030	1,380	879	1,270	944	1,150	1,070	1,140	898	1,360	1,112	182	57.5
	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	0.0
	Uranium (U)	mg/kg	-	8.04	24.0	19.0	27.3	12.0	23.0	11.20	21.6	12.7	23.7	18.3	6.69	2.12
	Vanadium (V)	mg/kg	-	41.4	71.3	59.3	67.5	42.3	61.8	47.6	65.5	39.6	66.9	56.3	12.3	3.89
	Zinc (Zn)	mg/kg	315	56.8	97.0	90.4	91.1	54.2	86.6	64.0	91.5	58.5	93.3	78.3	17.5	5.55
	Zirconium (Zr)	mg/kg	-	3.2	3.8	4.9	3.7	3.7	3.5	3.2	4.8	2.7	4.0	3.8	0.69	0.22

(Shaded box) Indicates parameter concentration above Sediment Quality Guideline (SQG).

Note: "-" indicates no SQG applicable.

[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)).

Table D.5: Field Observations of Sediment Properties at Camp Lake (JLO) Benthic Stations[a], Mary River Project CREMP, August 2019

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	medium brown-coloured silt with some sand intermixed	none detected	sparse algae (mare's eggs)
JLO-21	10.0	medium brown- to gray-coloured silt with moderate amount of sand intermixed	none detected	algae common (mare's eggs and filamentous green algae)
JLO-20	7.0	medium brown-coloured sandy silt	hydrogen sulphide odour, no blackening	algae sparse (mare's eggs and filamentous green algae)
JLO-19	7.0	compact, medium brown-coloured sandy-silt	none detected	sparse algae (mare's eggs)
JLO-07	31.4	medium brown-coloured silt with some sand intermixed	none detected	sparse algae (mare's eggs)
JLO-18	12.2	brown sandy-silt with lots of terrestrial organics (from eroding banks) intermixed	none detected	sparse algae (mare's eggs)
JLO-16	16.0	fine sand-silt mix with organics present	hydrogen sulphide odour, no blackening	none observed
JLO-11	29.0	medium gray-brown coloured silt, with some sand and organics intermixed	none detected	sparse algae (mare's eggs)
JLO-12	15.3	moderately compact sandy silt with some gravel; ferricrete-like layer present in some grabs	none detected	sparse algae (mare's eggs)

[a] Sediment particle size and benthic invertebrate community samples were collected using a 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 2019

Sample Station	Station Depth (m)	Station Type	Core Number	Core Length (cm)	Surficial Substrate Texture Description
JLO-02	11.3	Littoral	1	20	loosely compact, reddish brown oxidized silt overlying moderately compact medium gray brown silt/sand mix overlying moderately compact dark gray brown silt-sand with some black streaking
			2	21	
			3	22	
			4	25	
JLO-01	16.5	Profundal	1	11	moderately compact medium brown silt overlying gray brown silt-sand with black streaking and then dark brown silt-sand with black streaking
			2	25	
			3	20	
JLO-14	26.1	Profundal	1	16	moderately compact light brown silt overlying medium brown silt intermixed with sand
			2	15	
			3	12	
JLO-17	14.4	Profundal	1	5	medium brown silt overlying highly compact sand
			2	7	
			3	10	
JLO-07	32.8	Profundal	1	11	moderately compact medium brown silt overlying gray brown sandy silt with some black streaking
			2	19	
			3	18	
JLO-16	16.1	Profundal	1	8	brown sand with reddish brown oxidized layer at surface
			2	8	
			3	6	
JLO-15	17.3	Profundal	1	16	moderately compact medium brown silt with some black streaking overlying gray brown silt (with black streaking) and then medium brown sandy silt (no black streaking)
			2	13	
			3	13	
JLO-11	28.8	Profundal	1	25	loosely compact brown silt overlying moderately compact medium brown silt intermixed with sand and dark brown silt-sand with black streaking in both deep layers
			2	22	
			3	25	
JLO-13	16.6	Profundal	1	16	red brown silt transitioning to gray brown silt layer with some black streaking
			2	17	
			3	21	
JLO-12	16.2	Profundal	1	8	moderately compact brown sandy silt with black streaking at ~3 cm, overlying brown sandy silt with an orange oxidized area, and gray sandy silt to silty sand
			2	9	
			3	16	

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 2019

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	0.834	β	Reference	5	58.5	10.1	4.5	43.3	68.9
					Camp	5	58.2	19.4	8.7	36.0	85.0
	Silt-Sized Material (%)	NO	0.668	α	Reference	5	34.4	9.6	4.3	24.9	48.4
					Camp	5	38.4	17.6	7.9	14.0	58.1
	Clay-Sized Material (%)	YES	0.006	α	Reference	5	7.1	1.2	0.5	5.4	8.2
					Camp	5	3.4	1.8	0.8	1.0	5.9
	Moisture (%)	YES	0.008	α	Reference	5	84.0	5.9	2.6	77.8	91.4
					Camp	5	55.2	17.6	7.9	34.4	79.8
	Total Organic Carbon (TOC) Content (%)	YES	0.048	α	Reference	5	4.2	2.4	1.1	2.2	7.4
					Camp	5	1.5	1.0	0.5	0.6	3.1
Profundal (Deep) Stations	**Sand-Sized Material (%)**	NO	0.592	η	Reference	5	51.1	3.2	1.4	46.3	54.0
					Camp	5	57.7	25.3	11.3	32.7	86.1
	Silt-Sized Material (%)	NO	0.534	η	Reference	5	40.0	2.9	1.3	36.9	44.6
					Camp	5	34.0	19.6	8.7	12.7	57.6
	Clay-Sized Material (%)	NO	0.374	β	Reference	5	9.0	0.8	0.4	7.9	10.2
					Camp	5	8.3	6.7	3.0	1.3	17.6
	Moisture (%)	YES	0.016	α	Reference	5	87.4	1.0	0.4	86.0	88.6
					Camp	5	55.3	23.4	10.5	28.3	75.3
	Total Organic Carbon (TOC) Content (%)	YES	<0.001	α	Reference	5	4.3	0.3	0.1	3.9	4.6
					Camp	5	1.4	1.1	0.5	0.2	2.4

Highlighted values indicate significant difference between study areas based on statistical 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 D.8: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Camp Lake (JLO) Sediment Stations, Mary River Project CREMP, August 2019

	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	%	-	-	36.0	32.7	33.5	58.9	35.4	82.3	47.7	51.9	36.1	86.1	50.1	20.0
	Silt	%	-	-	58.1	57.6	52.0	32.8	46.9	15.5	45.6	37.2	53.6	12.7	41.2	16.5
	Clay	%	-	-	5.9	9.7	15	8.3	18	2.2	6.7	10.9	10.3	1.3	8.7	5.1
	Moisture	%	-	-	79.8	75.3	63.8	42.8	72.2	28.3	53.4	69.5	69.1	31.4	58.6	18.6
	Total Organic Carbon	%	10[α]	-	3.13	2.08	1.40	0.84	2.17	0.18	1.18	2.42	1.74	0.27	1.54	0.951
Metals	Aluminum (Al)	mg/kg	-	-	18,100	21,800	20,700	16,200	21,300	6,210	16,100	19,900	21,100	5,980	16,739	5,965
	Antimony (Sb)	mg/kg	-	-	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.101	0.003
	Arsenic (As)	mg/kg	17	5.9	***9.36***	***6.47***	5.73	4.28	4.50	1.27	3.89	2.97	5.76	1.94	4.62	2.36
	Barium (Ba)	mg/kg	-	-	135	98.6	84.4	63.3	76.9	25.0	54.8	70.9	96.4	33.4	73.9	32.5
	Beryllium (Be)	mg/kg	-	-	0.86	1.15	1.09	0.76	1.12	0.27	0.80	1.04	1.09	0.28	0.85	0.33
	Bismuth (Bi)	mg/kg	-	-	0.29	0.35	0.29	0.25	0.33	0.70	0.22	0.33	0.31	<0.20	0.33	0.14
	Boron (B)	mg/kg	-	-	20.2	29.6	26.5	18.3	29.2	9.7	21.2	27.1	25.7	8.9	21.6	7.52
	Cadmium (Cd)	mg/kg	3.5	1.5	0.284	0.247	0.177	0.128	0.135	0.047	0.123	0.215	0.180	0.036	0.16	0.080
	Calcium (Ca)	mg/kg	-	-	5,720	5,540	4,680	3,900	4,990	16,100	3,920	5,550	5,290	2,010	5,770	3,799
	Chromium (Cr)	mg/kg	90	98	75.7	89	83	68.0	86.4	40.2	69.9	81.2	86.5	30.9	71.1	20.1
	Cobalt (Co)	mg/kg	-	-	21.7	22.3	20.4	16.5	17.3	6.71	15.3	14.6	20.9	7.29	16.3	5.59
	Copper (Cu)	mg/kg	197	50	***55.6***	***58.7***	***52.0***	39.0	***56.6***	14.8	36.0	***58.3***	***53.1***	13.1	43.7	17.5
	Iron (Fe)	mg/kg	40,000[α]	52,400	***55,000***	43,100	39,600	31,300	45,900	15,000	32,100	35,300	42,300	18,900	35,850	12,170
	Lead (Pb)	mg/kg	91.3	35	20.4	26.3	23.1	16.0	24.8	6.23	15.9	22.9	23.80	5.52	18.5	7.49
	Lithium (Li)	mg/kg	-	-	29.6	39.5	36.2	24.8	38.5	10.0	26.6	35.1	37.1	10.4	28.8	11.0
	Magnesium (Mg)	mg/kg	-	-	14,900	15,900	14,900	11,800	15,400	15,600	12,800	15,600	15,500	5,700	13,810	3,151
	Manganese (Mn)	mg/kg	1,100[α,β]	4,370	1,370	***5,610***	1,170	1,110	457	204	900	326	4,210	1,420	1,678	1,786.1
	Mercury (Hg)	mg/kg	0.486	0.17	0.0580	0.0513	0.0434	0.0176	0.0597	0.0056	0.0305	0.0719	0.0403	0.0079	0.0386	0.0227
	Molybdenum (Mo)	mg/kg	-	-	1.70	2.02	0.82	0.84	0.91	0.52	0.92	0.81	1.76	1.10	1.14	0.50
	Nickel (Ni)	mg/kg	75[α,β]	72	***84.4***	***92.4***	***73.0***	57.4	71.1	38.8	62.8	68.5	***82.5***	28.1	65.9	20.1
	Phosphorus (P)	mg/kg	2,000[α]	1,580	1,360	1,150	1,120	981	1,270	554	871	895	1,140	600	994	268
	Potassium (K)	mg/kg	-	-	4,640	6,090	5,830	4,430	6,060	1,770	4,320	5,530	5,900	1,520	4,609	1,700
	Selenium (Se)	mg/kg	-	-	0.55	0.56	0.35	0.22	0.56	<0.20	0.26	0.54	0.41	<0.20	0.39	0.16
	Silver (Ag)	mg/kg	-	-	0.13	0.16	0.14	<0.10	0.20	<0.10	<0.10	0.20	0.14	<0.10	0.14	0.039
	Sodium (Na)	mg/kg	-	-	222	273	270	199	379	98	196	286	236	73	223	90
	Strontium (Sr)	mg/kg	-	-	10.0	13.8	15.7	11.6	18.6	9.9	10.0	12.8	14.2	5.2	12.2	3.73
	Sulphur (S)	mg/kg	-	-	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1,000	0
	Thallium (Tl)	mg/kg	-	-	0.610	0.692	0.552	0.370	0.458	0.123	0.398	0.461	0.576	0.150	0.439	0.187
	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	-	-	970	1,060	1,030	918	1,060	479	896	1,030	1,040	431	891	237
	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	-	-	7.3	7.7	6.9	4.6	7.1	1.1	4.3	6.8	6.5	1.4	5.4	2.4
	Vanadium (V)	mg/kg	-	-	62.6	74.3	69.2	56.2	67.8	22.9	54.3	63.9	71.3	22.7	56.5	18.8
	Zinc (Zn)	mg/kg	315	135	63.2	70.2	65.4	48.7	69.4	20.9	49.9	67.8	66.3	20.3	54.2	19.2
	Zirconium (Zr)	mg/kg	-	-	8.7	6.0	7.0	4.2	9.9	6.2	5.2	12.1	6.9	2.0	6.8	2.9

[shaded] Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

Note: "-" indicates no SQG applicable.

[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)).

Table D.9: Magnitude of Elevation in Sediment Metal Concentrations between Camp Lake and Reference Lake 3 2019 Data, and between Camp Lake 2019 and Baseline Data, Mary River Project CREMP, 2019

Parameter	Camp Lake versus Reference Lake 3, 2019				Camp Lake 2019 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	1.3	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	2.0	6.1	0.8	2.8	3.3	3.5	1.2
Barium (Ba)	133	1.4	152	0.5	105	1.3	68	1.0
Beryllium (Be)	0.7	1.5	0.9	1.0	1.0	0.9	1.0	0.8
Bismuth (Bi)	<0.20	1.5	0.20	1.7	-	-	-	-
Boron (B)	13.9	1.7	15.6	1.3	0.7	27.5	1.8	11.9
Cadmium (Cd)	0.2	2.0	0.2	0.9	0.5	0.6	0.5	0.3
Calcium (Ca)	5,480	1.3	5,584	1.1	3,130	1.8	2,857	2.0
Chromium (Cr)	59	1.5	77	1.0	81	0.9	71	1.0
Cobalt (Co)	12	2.2	17	1.0	18	1.2	17	1.0
Copper (Cu)	74	1.0	96	0.5	45	1.2	40	1.1
Iron (Fe)	46,700	1.0	50,900	0.7	36,133	1.5	33,206	1.0
Lead (Pb)	16	1.6	20	1.0	18	1.1	19	1.0
Lithium (Li)	26	1.3	36	0.8	-	-	-	-
Magnesium (Mg)	11,104	1.6	15,394	0.9	13,967	1.1	10,113	1.4
Manganese (Mn)	640	2.5	1,279	1.0	699	2.0	942	1.8
Mercury (Hg)	0.0433	1.3	0.0650	0.5	0.100	0.6	0.100	0.4
Molybdenum (Mo)	3.838	0.3	2.570	0.4	1.0	1.7	1.0	1.1
Nickel (Ni)	43	2.4	54	1.2	67	1.3	63	1.0
Phosphorus (P)	1,305	1.0	1,188	0.9	800	1.7	1,125	0.8
Potassium (K)	4,134	1.4	5,660	0.8	3,450	1.3	3,771	1.2
Selenium (Se)	0.7	0.9	0.8	0.5	1.0	0.6	1.0	0.4
Silver (Ag)	0.1	1.0	0.3	0.5	0.3	0.5	0.3	0.4
Sodium (Na)	320	0.9	433	0.5	279	0.8	254	0.9
Strontium (Sr)	12	0.9	14	0.9	9.3	1.1	12.0	1.0
Sulphur (S)	1,780	0.7	1,400	0.8	-	-	-	-
Thallium (Tl)	0.450	1.7	0.754	0.5	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	1	1.0	-	-	-	-
Uranium (U)	13	0.6	24	0.2	-	-	-	-
Vanadium (V)	58	1.4	73	0.8	69	0.9	57	1.0
Zinc (Zn)	81	1.0	99	0.6	67	0.9	57	0.9
Zirconium (Zr)	4.1	2.5	3.9	1.7	-	-	-	-

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,

Table D.10: Field Observations of Sediment Properties at Sheardown Lake Northwest (DLO-01) Benthic Stations [a], Mary River Project CREMP, August 2019

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
DLO-01-9	7.3	thin oxidized layer over medium brown-coloured silt	none detected	abundant macrophytes and algae (mare's eggs)
DLO-01-4	6.7	some iron oxide precipitate over medium brown-grey coloured silt	none detected	common macrophytes and algae (mare's eggs)
DLO-01-3	7.5	medium dark brown-grey coloured silt	none detected	common macrophytes and algae (mare's eggs)
DLO-01-11	7.8	thin iron oxide precipitate over brown coloured silt	none detected	sparse algae (mare's eggs)
DLO-01-10	7.8	reddish-brown coloured silt over sand-silt	none detected	none observed
DLO-01-5	23.0	brown-coloured silt, with some decaying organics	none detected	sparse algae
DLO-01-14	20.9	brown-coloured silt, with some decaying organics	none detected	sparse algae
DLO-01-15	21.0	reddish-brown coloured silt	some blackened substrate	none observed
DLO-01-2	16.0	reddish-brown coloured silt	none detected	none observed
DLO-01-12	13.9	reddish-brown coloured silt	none detected	none observed

[a] Sediment particle size and benthic invertebrate community samples were collected using a 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 2019

Sample Station	Station Depth (m)	Station Type	Core Number	Core Length (cm)	Surficial Substrate Texture Description
DLO-01-05	23.2	Profundal	1	12	moderately compact medium brown silt overlying compact light brown silt intermixed with fine sand
			2	12	
			3	10	
DD-HAB 9-STN2	10.5	Littoral	1	19	loosely compact reddish iron oxide silt overlying moderately compact gray-brown silt
			2	23	
			3	20	
			4	22	
DLO-01-08	12.1	Littoral	1	16	reddish brown oxidized silt overlying moderately compact medium brown silt intermixed with fine sand and with some black streaking, and then medium green-brown silt
			2	20	
			3	19	
			4	17	
DLO-01	22.0	Profundal	1	20	reddish oxidized layer overlying moderately compact medium brown silt intermixed with sand
			2	15	
			3	12	
			4	13	
DLO-01-13	17.8	Profundal	1	21	moderately compact reddish brown oxidized silt overlying medium brown silt intermixed with sand and then a greenish-brown manganese coloured layer
			2	9	
			3	19	
DLO-01-2	16.8	Profundal	1	16	loosely compact oxidized reddish silt transitioning to loosely compact gray silt
			2	13	
			3	19	
DLO-01-9	7.7	Littoral	1	30	loosely compact medium brown organic silt with oxidized material at surface overlying moderately compact light brown silt with some black streaking
			2	24	
DLO-01-10	7.8	Littoral	1	11	moderately compact sandy silt with oxidized surface layer overlying dark silty sand
			2	10	
			3	10	

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 2019

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	0.365	β	Reference	5	58.5	10.1	4.5	43.3	68.9
					Sheardown NW	5	51.5	22.6	10.1	37.3	91.6
	Silt-Sized Material (%)	NO	0.601	α	Reference	5	34.4	9.6	4.3	24.9	48.4
					Sheardown NW	5	39.4	18.0	8.0	7.5	50.1
	Clay-Sized Material (%)	NO	0.151	γ	Reference	5	7.1	1.2	0.5	5.4	8.2
					Sheardown NW	5	9.2	4.7	2.1	1.0	12.6
	Moisture (%)	NO	0.151	γ	Reference	5	84.0	5.9	2.6	77.8	91.4
					Sheardown NW	5	66.7	25.7	11.5	21.2	82.3
	Total Organic Carbon (TOC) Content (%)	NO	0.341	α	Reference	5	4.2	2.4	1.1	2.2	7.4
					Sheardown NW	5	2.8	1.8	0.8	0.2	5.3
Profundal (Deep) Stations	Sand-Sized Material (%)	NO	0.134	β	Reference	5	51.1	3.2	1.4	46.3	54.0
					Sheardown NW	5	33.5	26.4	11.8	9.6	74.4
	Silt-Sized Material (%)	NO	0.188	α	Reference	5	40.0	2.9	1.3	36.9	44.6
					Sheardown NW	5	52.5	19.2	8.6	21.0	67.7
	Clay-Sized Material (%)	NO	0.392	β	Reference	5	9.0	0.8	0.4	7.9	10.2
					Sheardown NW	5	14.1	8.3	3.7	4.6	25.2
	Moisture (%)	YES	0.008	γ	Reference	5	87.4	1.0	0.4	86.0	88.6
					Sheardown NW	5	59.2	14.5	6.5	35.2	69.5
	Total Organic Carbon (TOC) Content (%)	YES	<0.001	α	Reference	5	4.3	0.3	0.1	3.9	4.6
					Sheardown NW	5	1.1	0.5	0.2	0.5	1.6

Highlighted values indicate significant difference between study areas based on statistical 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 D.13: Sediment Particle Size, Total Organic Carbon, Metal Concentrations at Sheardown Lake Northwest (DLO-01) Sediment Stations, Mary River Project CREMP, August 2019

	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-01-13 (profundal)	DLO-01-2 (profundal)	DLO-01-9 (littoral)	DLO-01-10 (littoral)	Mean	Standard Deviation
Non-metals	Sand	%	-	-	74.4	64.6	35.4	62.3	15.4	17.2	41.7	91.6	50.3	27.4
	Silt	%	-	-	21.0	30.5	56.1	29.3	69.7	67.7	48.4	7.5	41.3	22.6
	Clay	%	-	-	4.6	4.9	8.4	8.3	15.0	15.1	9.9	<1.0	8.4	5.0
	Moisture	%	-	-	35.2	76.8	76.9	45.2	63.3	66.7	80.6	21.2	58.2	21.9
	Total Organic Carbon	%	10[α]	-	0.45	3.35	2.13	0.70	1.62	1.41	5.28	0.23	1.90	1.70
Metals	Aluminum (Al)	mg/kg	-	-	9,040	16,000	20,200	13,100	20,700	19,000	20,400	2,320	15,095	6,607
	Antimony (Sb)	mg/kg	-	-	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	0.0035
	Arsenic (As)	mg/kg	17	6.2	2.07	***13.2***	***6.22***	2.71	4.33	3.91	4.92	0.54	4.74	3.85
	Barium (Ba)	mg/kg	-	-	40.1	254	117	54.1	85.1	78.2	102	10.0	92.6	73.7
	Beryllium (Be)	mg/kg	-	-	0.46	0.83	1.02	0.68	1.01	0.95	1.06	0.13	0.768	0.328
	Bismuth (Bi)	mg/kg	-	-	<0.20	0.39	0.28	<0.20	0.26	0.28	0.29	<0.20	0.26	0.065
	Boron (B)	mg/kg	-	-	10.6	23.0	30.8	20.4	28.9	26.5	33.5	<5.0	22.3	10.0
	Cadmium (Cd)	mg/kg	3.5	1.5	0.121	0.382	0.245	0.143	0.250	0.214	0.463	<0.020	0.230	0.142
	Calcium (Ca)	mg/kg	-	-	2,360	4,900	4,720	2,680	4,410	4,470	6,210	897	3,831	1,709
	Chromium (Cr)	mg/kg	90	97	43.3	62.3	79.1	49.9	78.6	77.2	79.1	11.9	60.2	24.1
	Cobalt (Co)	mg/kg	-	-	7.68	13.4	17.9	9.86	16.0	15.1	14.1	1.98	12.0	5.22
	Copper (Cu)	mg/kg	197	58	23.9	50.4	44.1	30.3	45.5	40.3	***64.9***	4.09	37.9	18.45
	Iron (Fe)	mg/kg	40,000[α]	52,200	20,200	***86,400***	***55,400***	26,700	43,100	40,400	***56,800***	6,890	41,986	24,830
	Lead (Pb)	mg/kg	91.3	35	9.76	21.6	22.0	14.0	21.4	21.0	21.6	2.96	16.8	7.18
	Lithium (Li)	mg/kg	-	-	13.9	26.9	34.2	22.4	34.9	33.2	33.7	4.1	25.4	11.3
	Magnesium (Mg)	mg/kg	-	-	6,390	11,600	13,200	8,310	13,600	13,000	13,800	1,880	10,223	4,320
	Manganese (Mn)	mg/kg	1,100[α,β]	4,530	524	3,080	3,400	680	1,260	1,430	421	86.7	1,360	1,242
	Mercury (Hg)	mg/kg	0.486	0.17	0.0103	0.0518	0.0421	0.0212	0.0413	0.0331	0.064	<0.0050	0.0336	0.0203
	Molybdenum (Mo)	mg/kg	-	-	0.85	11.4	8.12	1.26	2.16	2.63	4.92	0.45	3.97	3.93
	Nickel (Ni)	mg/kg	75[α,β]	77	35.5	68.6	75.6	41.7	67.6	67.1	***81.2***	10.2	55.9	24.4
	Phosphorus (P)	mg/kg	2,000[α]	1,958	670	1,890	925	590	874	852	811	248	858	471
	Potassium (K)	mg/kg	-	-	2,080	4,130	5,310	3,360	5,170	4,690	5,360	610	3,839	1,724
	Selenium (Se)	mg/kg	-	-	<0.20	0.57	0.49	<0.20	0.40	0.34	0.71	<0.20	0.39	0.19
	Silver (Ag)	mg/kg	-	-	<0.10	0.17	0.17	0.12	0.17	0.16	0.21	<0.10	0.15	0.039
	Sodium (Na)	mg/kg	-	-	129	232	307	184	298	270	335	<50	226	98
	Strontium (Sr)	mg/kg	-	-	6.28	10.5	12.2	7.87	11.9	11.7	12.8	3.77	9.63	3.28
	Sulphur (S)	mg/kg	-	-	<1000	<1000	<1000	<1000	<1000	<1000	1500	<1000	1,062.5	176.8
	Thallium (Tl)	mg/kg	-	-	0.214	0.519	0.627	0.361	0.589	0.553	0.597	0.059	0.440	0.208
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0
	Titanium (Ti)	mg/kg	-	-	629	947	1,220	841	1,320	1,260	1,270	213	963	390
	Tungsten (W)	mg/kg	-	-	<0.50	0.53	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	0.01
	Uranium (U)	mg/kg	-	-	4.30	10.9	6.54	5.33	8.12	7.60	12.5	0.83	7.01	3.69
	Vanadium (V)	mg/kg	-	-	29.2	47.1	58.7	37.1	59.4	55.3	59.8	8.06	44.3	18.5
	Zinc (Zn)	mg/kg	315	123	33.3	64.8	70.6	42.4	69.7	63.7	75.9	8.5	53.6	23.4
	Zirconium (Zr)	mg/kg	-	-	3.6	8.8	7.2	4.7	8.1	8.2	21.1	2.9	8.1	5.7

Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD5 Indicates parameter concentration above the AEMP Benchmark.

Note: "-" indicates no SQG applciable.

[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

[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.

Table D.14: Magnitude of Elevation in Sediment Metal Concentrations between Sheardown Lake NW and Reference Lake 3 2019 Data, and between Sheardown Lake NW 2019 and Baseline Data, Mary River Project CREMP, 2019

Parameter	Sheardown Lake NW versus Reference Lake 3 in 2019				Sheardown Lake NW 2019 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)	13,660	1.1	22,740	0.7	11,792	1.2	17,745	0.9
Antimony (Sb)	<0.10	1.0	<0.10	1.0	1.0	0.1	1.0	0.1
Arsenic (As)	4.7	1.3	5.3	0.6	3.0	2.1	3.2	1.0
Barium (Ba)	99	1.2	127	0.5	78	1.5	93	0.7
Beryllium (Be)	0.6	1.3	0.9	0.9	1.0	0.8	1.0	0.8
Bismuth (Bi)	<0.20	1.5	0.20	1.2	-	-	-	-
Boron (B)	11.8	2.0	16.5	1.3	3	8.1	3	6.9
Cadmium (Cd)	0.1	2.0	0.2	1.1	0.5	0.6	0.5	0.4
Calcium (Ca)	4,522	0.9	5,492	0.6	2,697	1.6	3,558	1.0
Chromium (Cr)	49	1.2	74	0.8	53	1.1	81	0.8
Cobalt (Co)	10	1.2	16	0.7	10	1.1	15	0.8
Copper (Cu)	57	0.7	92	0.4	33	1.3	48	0.7
Iron (Fe)	54,660	0.9	49,580	0.7	28,120	1.8	40,382	0.8
Lead (Pb)	13	1.3	19	0.9	13	1.3	20	0.8
Lithium (Li)	23	1.1	36	0.7	-	-	-	-
Magnesium (Mg)	9,392	1.1	14,840	0.7	7,448	1.4	11,498	0.9
Manganese (Mn)	544	3.2	1,796	0.5	756	2.3	2,164	0.4
Mercury (Hg)	0.0458	0.9	0.0738	0.4	0.100	0.4	0.100	0.3
Molybdenum (Mo)	5.466	1.1	3.064	0.6	3.4	1.8	3.5	0.5
Nickel (Ni)	35	1.7	52	1.0	49	1.2	69	0.8
Phosphorus (P)	1,430	0.7	1,025	0.7	863	1.1	1,400	0.5
Potassium (K)	3,308	1.2	5,502	0.7	2,681	1.4	4,612	0.8
Selenium (Se)	0.6	0.8	0.8	0.4	1.0	0.5	1.0	0.3
Silver (Ag)	0.1	1.2	0.3	0.5	0.3	0.6	0.3	0.5
Sodium (Na)	259	0.9	414	0.5	249	0.9	342	0.6
Strontium (Sr)	11	0.9	14	0.7	7.2	1.4	11.4	0.8
Sulphur (S)	1,400	0.8	1,320	0.8	-	-	-	-
Thallium (Tl)	0.363	1.2	0.771	0.6	1.0	0.5	1.0	0.4
Tin (Sn)	2	1.0	2	1.0	-	-	-	-
Titanium (Ti)	964	0.9	1,260	0.8	-	-	-	-
Tungsten (W)	1		1					
Uranium (U)	13	0.6	24	0.3	-	-	-	-
Vanadium (V)	46	0.9	67	0.7	37	1.2	58	0.8
Zinc (Zn)	65	0.8	92	0.6	51	1.1	76	0.7
Zirconium (Zr)	3.5	2.8	4.0	1.6	-	-	-	-

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 respective mean reference area value or baseline period value).

Denotes high elevation (mean parameter concentration is ≥ 10 times higher than respective mean reference area value or baseline period value).

Table D.15: Field Observations of Sediment Properties at Sheardown Lake Southeast (DLO-02) Benthic Stations [a], Mary River Project CREMP, August 2019

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
DLO-02-11	7.1	reddish-brown coloured silt-clay	none detected	sparse algae
DLO-02-10	6.7	greyish-brown coloured silt-clay	none detected	sparse marcrophytes and algae (mare's eggs)
DLO-02-4	7.3	reddish-brown coloured silt-clay	none detected	sparse algae (mare's eggs)
DLO-02-9	8.9	reddish-brown coloured silt-clay	none detected	none observed
DLO-02-1	10.4	brownish-grey coloured silt	none detected	sparse algae
DLO-02-12	10.7	reddish-brown coloured silt-clay	none detected	sparse algae
DLO-02-8	12.6	brownish-grey coloured silt	none detected	sparse algae
DLO-02-13	10.4	brownish-red coloured silt-clay	none detected	sparse algae
DLO-02-2	14.6	brownish-grey coloured silt	none detected	sparse algae
DLO-02-3	13.3	brownish-grey clay	none detected	sparse marcrophytes and algae

[a] Sediment particle size and benthic invertebrate community samples were collected using a 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 2019

Sample Station	Station Depth (m)	Station Type	Core Number	Core Length (cm)	Surficial Substrate Texture Description
DLO-02-1	11.5	Littoral	1	10	loosely compact reddish oxidized floc overlying compact gray-brown silt with some black streaking
			2	17	
			3	16	
DLO-02-11	7.8	Littoral	1	14	iron oxide floc-like silt overlying gray brown silt with faint black streaking
			2	11	
			3	13	
DLO-02-4	8.5	Littoral	1	7	loosely compact reddish oxide floc overlying moderatly compact gray silt and compacted brown silt
			2	19	
			3	17	
DLO-02-2	13.4	Profundal	1	16	loosely compact iron oxide silt overlying moderately compact gray brown silt with black streaking
			2	12	
			3	12	
DLO-02-3	13.0	Profundal	1	10	loosely compact reddish brown oxidized silt overlying moderately compact gray-brown silt with black streaking
			2	12	
			3	11	

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 2019

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	58.5	10.1	4.5	43.3	68.9
					Sheardown SE	5	14.5	7.8	3.5	9.9	28.4
	Silt-Sized Material (%)	YES	< 0.001	α	Reference	5	34.4	9.6	4.3	24.9	48.4
					Sheardown SE	5	71.5	5.5	2.5	64.4	77.2
	Clay-Sized Material (%)	YES	0.017	β	Reference	5	7.1	1.2	0.5	5.4	8.2
					Sheardown SE	5	14.0	5.7	2.5	7.2	21.5
	Moisture (%)	YES	0.005	α	Reference	5	84.0	5.9	2.6	77.8	91.4
					Sheardown SE	5	64.5	9.6	4.3	49.5	73.9
	Total Organic Carbon (TOC) Content (%)	YES	0.005	β	Reference	5	4.2	2.4	1.1	2.2	7.4
					Sheardown SE	5	1.3	0.4	0.2	0.8	1.7
Profundal (Deep) Stations	**Sand-Sized Material (%)**	YES	< 0.001	α	Reference	5	51.1	3.2	1.4	46.3	54.0
					Sheardown SE	5	14.0	5.5	2.5	7.5	21.8
	Silt-Sized Material (%)	YES	<0.001	β	Reference	5	40.0	2.9	1.3	36.9	44.6
					Sheardown SE	5	73.8	4.2	1.9	69.7	80.9
	Clay-Sized Material (%)	YES	0.077	δ	Reference	5	9.0	0.8	0.4	7.9	10.2
					Sheardown SE	5	12.2	3.2	1.4	8.6	15.9
	Moisture (%)	YES	0.008	γ	Reference	5	87.4	1.0	0.4	86.0	88.6
					Sheardown SE	5	54.7	4.9	2.2	50.8	63.2
	Total Organic Carbon (TOC) Content (%)	YES	<0.001	β	Reference	5	4.3	0.3	0.1	3.9	4.6
					Sheardown SE	5	1.0	0.1	0.1	0.8	1.2

[grey box] Highlighted values indicate significant difference between study areas based on statistical 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 D.18: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Sheardown Lake Southeast (DLO-02) Sediment Stations, Mary River Project CREMP, August 2019

	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	%	-	-	28.4	11.6	11.9	17.1	21.8	18.2	7.10	3.17
	Silt	%	-	-	64.4	70.4	76.9	73.1	69.7	70.9	4.60	2.06
	Clay	%	-	-	7.2	18.0	11.2	9.8	8.6	11.0	4.20	1.88
	Moisture	%	-	-	71.1	73.9	66.6	50.8	52.3	62.9	10.73	4.80
	Total Organic Carbon	%	10^{α}	-	1.12	1.68	1.27	1.15	1.13	1.27	0.24	0.106
Metals	Aluminum (Al)	mg/kg	-	-	16,600	19,900	19,900	18,900	20,400	19,140	1,521	680
	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	4.18	***6.78***	***5.94***	3.78	4.04	4.94	1.33	0.597
	Barium (Ba)	mg/kg	-	-	79.9	145.0	126	79.7	90.7	104.3	29.6	13.3
	Beryllium (Be)	mg/kg	-	-	0.77	0.95	0.95	0.85	0.89	0.88	0.08	0.03
	Bismuth (Bi)	mg/kg	-	-	0.21	0.26	0.26	0.28	0.28	0.26	0.0286	0.0128
	Boron (B)	mg/kg	-	-	20.3	24.5	26.7	22.8	22.8	23.4	2.37	1.06
	Cadmium (Cd)	mg/kg	3.5	1.5	0.096	0.123	0.125	0.101	0.111	0.111	0.013	0.006
	Calcium (Ca)	mg/kg	-	-	6,090	4,480	4,840	5,870	6,400	5,536	831	371.8
	Chromium (Cr)	mg/kg	90	79	70.8	78.0	***88.4***	74.5	77.5	77.8	6.6	2.94
	Cobalt (Co)	mg/kg	-	-	13.3	16.2	15.4	14.1	15.6	14.9	1.19	0.530
	Copper (Cu)	mg/kg	110	56	26.2	32.5	31.2	29.2	30.5	29.9	2.40	1.07
	Iron (Fe)	mg/kg	$40,000^{\alpha}$	34,400	***46,600***	***61,800***	***53,100***	***46,000***	***53,900***	***52,280***	6,435	2,878
	Lead (Pb)	mg/kg	91.3	35	15.2	19.3	19.4	17.2	17.8	17.8	1.73	0.77
	Lithium (Li)	mg/kg	-	-	27.8	34.3	34.0	30.8	32.4	31.9	2.67	1.19
	Magnesium (Mg)	mg/kg	-	-	13,800	14,200	14,700	14,900	16,200	14,760	913	408
	Manganese (Mn)	mg/kg	$1,100^{\alpha,\beta}$	657	***699***	***3,680***	***2,160***	609	***1,120***	***1,654***	1,289	577
	Mercury (Hg)	mg/kg	0.486	0.17	0.0230	0.0307	0.0274	0.0254	0.0253	0.0264	0.0029	0.0013
	Molybdenum (Mo)	mg/kg	-	-	1.85	4.20	2.52	1.56	2.24	2.47	1.03	0.46
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	66	54.2	65.6	***70.0***	55.5	58.1	60.7	6.83	3.05
	Phosphorus (P)	mg/kg	$2,000^{\alpha}$	1,278	1,060	***1,350***	***1,280***	1,040	1,050	1,156	147	65.9
	Potassium (K)	mg/kg	-	-	4,070	5,170	4,900	4,680	5,080	4,780	439	196
	Selenium (Se)	mg/kg	-	-	<0.20	0.26	0.23	0.21	0.26	0.23	0.028	0.012
	Silver (Ag)	mg/kg	-	-	0.12	0.14	0.14	0.14	0.14	0.14	0.009	0.004
	Sodium (Na)	mg/kg	-	-	248	306	321	285	284	289	27.5	12.3
	Strontium (Sr)	mg/kg	-	-	10.8	11.7	12.6	11.1	11.7	11.6	0.69	0.31
	Sulphur (S)	mg/kg	-	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
	Thallium (Tl)	mg/kg	-	-	0.369	0.499	0.480	0.402	0.419	0.434	0.054	0.024
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
	Titanium (Ti)	mg/kg	-	-	1,300	1,350	1,420	1,390	1,480	1,388	68.3	30.6
	Tungsten (W)	mg/kg	-	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0	0
	Uranium (U)	mg/kg	-	-	5.20	6.97	5.69	5.49	5.66	5.80	0.68	0.30
	Vanadium (V)	mg/kg	-	-	47.3	54.8	55.6	50.9	53.7	52.5	3.4	1.5
	Zinc (Zn)	mg/kg	315	135	56.5	67.0	65.1	62.1	67.5	63.6	4.5	2.0
	Zirconium (Zr)	mg/kg	-	-	16.6	18.1	16.9	19.3	19.1	18.0	1.2	0.6

[shaded] Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

Note: "-" indicates no SGQ applicable.

[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.

Table D.19: **Magnitude of Elevation in Sediment Metal Concentrations between Sheardown Lake SE and Reference Lake 3 2019 Data, and between Sheardown Lake SE 2019 and Baseline Data, Mary River Project CREMP, 2019**

Parameter	Sheardown Lake SE versus Reference Lake 3 in 2019				Sheardown Lake SE 2019 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	1.1	24,420	0.8	14,950	1.3	13,133	1.5
Antimony (Sb)	<0.10	1.0	<0.10	1.0	1.0	0.1	1.0	0.1
Arsenic (As)	5.3	1.1	6.1	0.6	1.9	3.0	1.5	2.6
Barium (Ba)	133	0.9	152	0.6	81	1.5	64	1.3
Beryllium (Be)	0.7	1.3	0.9	1.0	1.0	0.9	1.0	0.9
Bismuth (Bi)	<0.20	1.2	0.20	1.4	-	-	-	-
Boron (B)	13.9	1.7	15.6	1.5	2.5	9.5	1.4	16.9
Cadmium (Cd)	0.2	0.6	0.2	0.5	0.5	0.2	0.6	0.2
Calcium (Ca)	5,480	0.9	5,584	1.1	6,310	0.8	8,925	0.7
Chromium (Cr)	59	1.3	77	1.0	78	1.0	72	1.1
Cobalt (Co)	12	1.3	17	0.9	13	1.2	12	1.2
Copper (Cu)	74	0.4	96	0.3	30	1.0	25	1.2
Iron (Fe)	46,700	1.2	50,900	1.0	32,284	1.7	29,117	1.7
Lead (Pb)	16	1.1	20	0.9	17	1.1	14	1.3
Lithium (Li)	26	1.2	36	0.9	-	-	-	-
Magnesium (Mg)	11,104	1.3	15,394	1.0	12,634	1.1	13,742	1.1
Manganese (Mn)	640	3.4	1,279	0.7	462	4.7	410	2.1
Mercury (Hg)	0.0433	0.6	0.0650	0.4	0.100	0.3	0.100	0.3
Molybdenum (Mo)	3.838	0.7	2.570	0.7	1.5	1.9	1.0	1.9
Nickel (Ni)	43	1.5	54	1.1	62	1.0	62	0.9
Phosphorus (P)	1,305	0.9	1,188	0.9	1,150	1.1	950	1.1
Potassium (K)	4,134	1.1	5,660	0.9	3,947	1.2	3,317	1.5
Selenium (Se)	0.7	0.3	0.8	0.3	1.0	0.2	1.0	0.2
Silver (Ag)	0.1	0.9	0.3	0.5	0.4	0.3	0.3	0.5
Sodium (Na)	320	0.9	433	0.7	353	0.8	330	0.9
Strontium (Sr)	12.2	1.0	13.8	0.8	16.0	0.7	11.0	1.0
Sulphur (S)	1,780	0.6	1,400	0.7	-	-	-	-
Thallium (Tl)	0.450	1.0	0.754	0.5	1.0	0.4	1.0	0.4
Tin (Sn)	<2	1.0	<2	1.0	-	-	-	-
Titanium (Ti)	1,155	1.2	1,388	1.0	-	-	-	-
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	1.2
Zinc (Zn)	81	0.8	99	0.7	51	1.2	51	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 respective mean reference area value or baseline period value).

Denotes high elevation (mean parameter concentration is ≥ 10 times higher than respective mean reference area value or baseline period

Table D.20: Field Observations of Sediment Properties at Mary Lake (BLO) Benthic Stations[a], Mary River Project CREMP, August 2019

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
BLO-01	9.5	clay silt, sticky with some sand intermixed	some blackened substrate	none observed
BLO-11	9.0	dark brown silt with some CPOM, some sand intermixed	none detected	none observed
BLO-7	12.1	medium brown silt	none detected	none observed
BLO-6	9.2	medium brown silt	some blackened substrate	none observed
BLO-3	15.9	sand or sandy-silt with organic matter, ferricrete layer of oxidized material at surface	none detected	none observed
BLO-15	27.8	reddish-brown oxidized silt layer (reduced layer ~0.5 cm thick and 5 cm deep) over brown silt with some sand intermixed	some blackened substrate	none observed
BLO-14	18.7	medium brown silt, some fine sand intermixed	none detected	none observed
BLO-13	21.8	medium brown, compact silt	none detected	none observed
BLO-4	20.2	medium brown silt	none detected	none observed
BLO-5	21.2	medium brown to dark gray-brown silt, some fine sand intermixed, some organics at surface originated from Mary River	none detected	none observed

[a] Sediment particle size and benthic invertebrate community samples were collected using a 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 2019

Sample Station	Station Depth (m)	Station Type	Core Number	Core Length (cm)	Surficial Substrate Texture Description
BLO-01	9.6	Littoral	1	10	reddish brown silt overlying moderately compact gray-brown silt with some black streaking
			2	14	
			3	19	
BLO-16	30.5	Profundal	1	17	loosely compact reddish oxidizing silt transitioning to moderately compact medium brown silt with black streaking
			2	21	
			3	23	
BLO-03	16.0	Profundal	1	9	loosely compact brown silt-sand overlying reddish-brown oxidized silt-sand and medium brown sandy silt with black streaking
			2	17	
			3	16	
BLO-14	20.0	Profundal	1	10	moderately compact medium brown silt intermixed with fine sand and showing black streaking
			2	11	
			3	11	
BLO-12	20.0	Profundal	1	12	reddish-brown silt overlying moderately compact medium brown silt with slight black streaking and fine sand
			2	5	
			3	5	
BLO-04	19.5	Profundal	1	16	moderately compact medium brown silt with some black streaking
			2	14	
			3	17	
BLO-10	9.8	Profundal	1	10	medium brown silt with some black streaking
			2	13	
			3	14	
BLO-09	30.0	Profundal	1	25	moderately compact reddish brown silt overlying medium brown silt with black streaking; distinct band of dark substrate at top of layer
			2	14	
			3	10	
BLO-08	25.8	Profundal	1	22	red-brown silt overlying moderately compact brown silt with black streaking and gray brown silt with black specks
			2	18	
			3	23	
BLO-06	5.5	Littoral	1	15	reddish brown oxidized silt overlying moderately compact brown silt with black streaking
			2	17	
			3	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 2019

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	0.032	β	Reference	5	58.5	10.1	4.5	43.3	68.9
					Mary	4	24.9	33.0	16.5	5.5	74.0
	Silt-Sized Material (%)	YES	0.082	α	Reference	5	34.4	9.6	4.3	24.9	48.4
					Mary	4	57.4	23.4	11.7	23.0	75.2
	Clay-Sized Material (%)	NO	0.204	η	Reference	5	7.1	1.2	0.5	5.4	8.2
					Mary	4	17.7	13.1	6.5	3.1	29.7
	Moisture (%)	YES	0.009	α	Reference	5	84.0	5.9	2.6	77.8	91.4
					Mary	4	54.1	17.7	8.9	29.9	67.6
	Total Organic Carbon (TOC) Content (%)	YES	0.003	β	Reference	5	4.2	2.4	1.1	2.2	7.4
					Mary	4	0.9	0.3	0.1	0.6	1.1
Profundal (Deep) Stations	**Sand-Sized Material (%)**	YES	0.082	γ	Reference	5	51.1	3.2	1.4	46.3	54.0
					Mary	6	27.7	24.6	10.0	7.7	76.5
	Silt-Sized Material (%)	NO	0.120	γ	Reference	5	40.0	2.9	1.3	36.9	44.6
					Mary	6	48.1	20.3	8.3	14.1	72.0
	Clay-Sized Material (%)	YES	0.013	η	Reference	5	9.0	0.8	0.4	7.9	10.2
					Mary	6	24.3	10.0	4.1	9.4	34.5
	Moisture (%)	YES	0.008	γ	Reference	5	87.4	1.0	0.4	86.0	88.6
					Mary	6	52.9	12.3	5.0	31.7	64.5
	Total Organic Carbon (TOC) Content (%)	YES	<0.001	α	Reference	5	4.3	0.3	0.1	3.9	4.6
					Mary	6	0.8	0.2	0.1	0.5	1.0

Highlighted values indicate significant difference between study areas based on statistical 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 D.23: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Mary Lake (BLO) Sediment Stations, Mary River Project CREMP, August 2019

	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	%	-	-	14.6	23.8	76.5	23.8	26.6	17.0	9.3	5.6	6.4	5.5	20.9	21.1	6.68
	Silt	%	-	-	75.2	48.7	14.1	41.7	60.6	65.4	64.3	69.4	61.2	66.9	56.8	17.9	5.66
	Clay	%	-	-	10.2	27.4	9.4	34.5	12.8	17.6	26.4	24.9	32.5	27.6	22.3	9.16	2.90
	Moisture	%	-	-	51.7	72.2	31.7	55.4	41.8	53.5	60.7	53.6	58.0	67.6	54.6	11.7	3.69
	Total Organic Carbon	%	10$^{\alpha}$	-	1.13	1.59	0.52	0.74	0.67	0.76	0.80	0.67	0.89	0.99	0.88	0.30	0.096
Metals	Aluminum (Al)	mg/kg	-	-	15,700	24,600	16,200	33,100	19,600	22,600	23,800	23,300	25,200	27,200	23,130	5,152	1,629
	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	3.95	***15.3***	2.68	4.55	2.67	3.18	3.52	3.57	3.70	3.77	4.69	3.77	1.19
	Barium (Ba)	mg/kg	-	-	71	134	55.6	126	70.4	82.5	94.3	92.8	87.5	94.3	90.8	24.2	7.66
	Beryllium (Be)	mg/kg	-	-	0.80	1.14	0.80	1.53	0.90	1.02	1.13	1.12	1.25	1.33	1.10	0.233	0.0738
	Bismuth (Bi)	mg/kg	-	-	<0.20	0.23	<0.20	0.27	0.25	0.28	0.27	0.28	0.31	0.26	0.26	0.036	0.011
	Boron (B)	mg/kg	-	-	21.2	32.9	23.9	43.6	25.4	28.9	27.5	33.6	38.6	42.5	31.8	7.80	2.47
	Cadmium (Cd)	mg/kg	3.5	1.5	0.093	0.183	0.096	0.140	0.1080	0.130	0.142	0.140	0.143	0.132	0.131	0.0265	0.00839
	Calcium (Ca)	mg/kg	-	-	15,100	4,300	3,110	5,390	4,690	4,570	4,350	4,760	4,810	4,760	5,584	3,394	1,073.3
	Chromium (Cr)	mg/kg	90	98	66.9	83.8	54.2	***102***	77.6	90.2	88.2	94.3	***98.8***	93.6	85.0	14.9	4.73
	Cobalt (Co)	mg/kg	-	-	14.1	18.1	11.3	20.1	14.1	16.2	16.9	17.0	17.5	17.5	16.3	2.50	0.789
	Copper (Cu)	mg/kg	110	50	29.3	36.4	22.6	40.9	27.8	32.3	34.4	33.2	35.4	34.5	32.7	5.08	1.61
	Iron (Fe)	mg/kg	40,000$^{\alpha}$	52,400	33,500	***76,200***	27,500	52,000	37,400	40,700	40,900	40,500	41,600	44,000	43,430	13,175	4,166
	Lead (Pb)	mg/kg	91.3	35	15.6	22.2	16.0	27.2	18.0	21.0	24.1	23.4	25.1	25.3	21.8	4.05	1.28
	Lithium (Li)	mg/kg	-	-	31.2	41.7	29.4	57.8	33.5	39.4	44.0	42.5	45.8	49.2	41.5	8.6	2.73
	Magnesium (Mg)	mg/kg	-	-	18,000	15,500	10,100	19,400	14,400	16,100	16,400	16,100	17,000	17,500	16,050	2,507	793
	Manganese (Mn)	mg/kg	1,100$^{\alpha,\beta}$	4,370	909	1,750	1,720	845	693	966	720	3,850	1,960	690	1,410	986	312
	Mercury (Hg)	mg/kg	0.486	0.17	0.0227	0.0876	0.0458	0.0460	0.0357	0.0427	0.0638	0.0475	0.0518	0.0454	0.0489	0.0172	0.00544
	Molybdenum (Mo)	mg/kg	-	-	0.55	2.75	0.59	0.73	1.10	1.15	0.83	1.25	1.03	0.84	1.08	0.63	0.20
	Nickel (Ni)	mg/kg	75$^{\alpha,\beta}$	72	54.8	63.7	39.7	67.4	55.0	63.4	63.4	68.9	70.5	60.3	60.7	9.07	2.87
	Phosphorus (P)	mg/kg	2,000$^{\alpha}$	1,580	1,060	***2,580***	566	970	872	833	793	841	815	784	1,011	566	179
	Potassium (K)	mg/kg	-	-	4,050	6,570	4,440	8,850	4,750	5,490	5,860	5,840	6,420	7,030	5,930	1,404	444
	Selenium (Se)	mg/kg	-	-	<0.20	0.37	<0.20	0.26	<0.20	0.24	0.23	0.22	<0.20	0.23	0.24	0.052	0.016
	Silver (Ag)	mg/kg	-	-	<0.10	0.13	0.10	0.19	0.14	0.16	0.17	0.17	0.17	0.16	0.15	0.031	0.010
	Sodium (Na)	mg/kg	-	-	265	454	257	533	300	358	383	400	422	425	380	87.1	27.6
	Strontium (Sr)	mg/kg	-	-	15.4	20.1	10.9	20.0	12.3	13.6	13.8	15.6	16.1	16.4	15.4	2.99	0.945
	Sulphur (S)	mg/kg	-	-	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1,000	0	0
	Thallium (Tl)	mg/kg	-	-	0.340	0.49	0.380	0.690	0.448	0.523	0.613	0.574	0.604	0.680	0.534	0.120	0.0380
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	2.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.000	0.000
	Titanium (Ti)	mg/kg	-	-	1,070	1,220	972	1,970	1,480	1,630	1,610	1,700	1,800	1,940	1,539	350	111
	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	-	-	4.01	9.44	6.55	9.53	7.58	9.32	9.87	8.53	8.94	9.76	8.35	1.85	0.586
	Vanadium (V)	mg/kg	-	-	50.4	67.6	44.4	84.4	54.1	62.8	66.5	64.9	69.8	74.0	63.9	11.7	3.71
	Zinc (Zn)	mg/kg	315	135	50.1	76.6	49.0	95.1	63.7	73.6	80.2	73.5	78.2	85.8	72.6	14.6	4.63
	Zirconium (Zr)	mg/kg	-	-	13.2	13.1	14.1	30.8	18.6	21.8	25.3	23.9	27.2	26.0	21.4	6.34	2.01

[shaded box] Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

Note: "-" indicates no SQG applicable.

[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.

Table D.24: Magnitude of Elevation in Sediment Metal Concentrations between Mary Lake and Reference Lake 3 2019 Data, and between Mary Lake 2019 and Baseline Data, Mary River Project CREMP, 2019

Parameter	Mary Lake versus Reference Lake 3 in 2019				Mary Lake 2019 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	1.5	24,420	1.0	18,267	1.5	17,000	1.4
Antimony (Sb)	<0.10	1.0	0.10	1.0	1.0	0.1	1.0	0.1
Arsenic (As)	5.3	0.7	6.1	0.8	2.8	1.3	3.7	1.3
Barium (Ba)	133	0.7	152	0.6	105	0.9	76	1.2
Beryllium (Be)	0.7	2.0	0.9	1.3	1.0	1.3	1.0	1.1
Bismuth (Bi)	<0.20	1.3	0.20	1.3	-	-	-	-
Boron (B)	13.9	3.1	15.6	2.0	1	58.0	2	15.2
Cadmium (Cd)	0.2	0.7	0.2	0.7	0.5	0.3	0.5	0.3
Calcium (Ca)	5,480	0.9	5,584	0.8	3,130	1.5	2,934	1.5
Chromium (Cr)	59	1.6	77	1.1	81	1.2	76	1.1
Cobalt (Co)	12	1.5	17	0.9	18	1.0	18	0.9
Copper (Cu)	74	0.5	96	0.3	45	0.8	44	0.7
Iron (Fe)	46,700	0.9	50,900	0.9	36,133	1.2	35,654	1.3
Lead (Pb)	16	1.5	20	1.1	18	1.4	21	1.0
Lithium (Li)	26	1.9	36	1.2	-	-	-	-
Magnesium (Mg)	11,104	1.6	15,394	1.0	13,967	1.3	10,903	1.4
Manganese (Mn)	640	1.1	1,279	1.2	699	1.0	991	1.6
Mercury (Hg)	0.0433	1.0	0.0650	0.8	0.100	0.5	0.100	0.5
Molybdenum (Mo	3.838	0.2	2.570	0.5	1.0	0.8	1.0	1.2
Nickel (Ni)	43	1.4	54	1.1	67	0.9	65	0.9
Phosphorus (P)	1,305	0.6	1,188	0.9	800	1.0	1,325	0.8
Potassium (K)	4,134	1.7	5,660	1.1	3,450	2.0	4,287	1.4
Selenium (Se)	0.7	0.3	0.8	0.3	1.0	0.2	1.0	0.2
Silver (Ag)	0.1	1.1	0.3	0.6	0.3	0.6	0.4	0.4
Sodium (Na)	320	1.3	433	0.9	279	1.5	284	1.4
Strontium (Sr)	12.2	1.3	13.8	1.1	9.3	1.8	13.3	1.2
Sulphur (S)	1,780	0.6	1,400	0.7	-	-	-	-
Thallium (Tl)	0.450	1.5	0.754	0.7	1.0	0.7	1.0	0.5
Tin (Sn)	2	1.0	2	1.0	-	-	-	-
Titanium (Ti)	1,155	1.7	1,388	1.1	-	-	-	-
Tungsten (W)	1	1.0	1	1.0	-	-	-	-
Uranium (U)	13	0.7	24	0.4	-	-	-	-
Vanadium (V)	58	1.3	73	0.9	69	1.1	63	1.0
Zinc (Zn)	81	1.1	99	0.7	67	1.3	64	1.2

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

APPENDIX E
PHYTOPLANKTON DATA

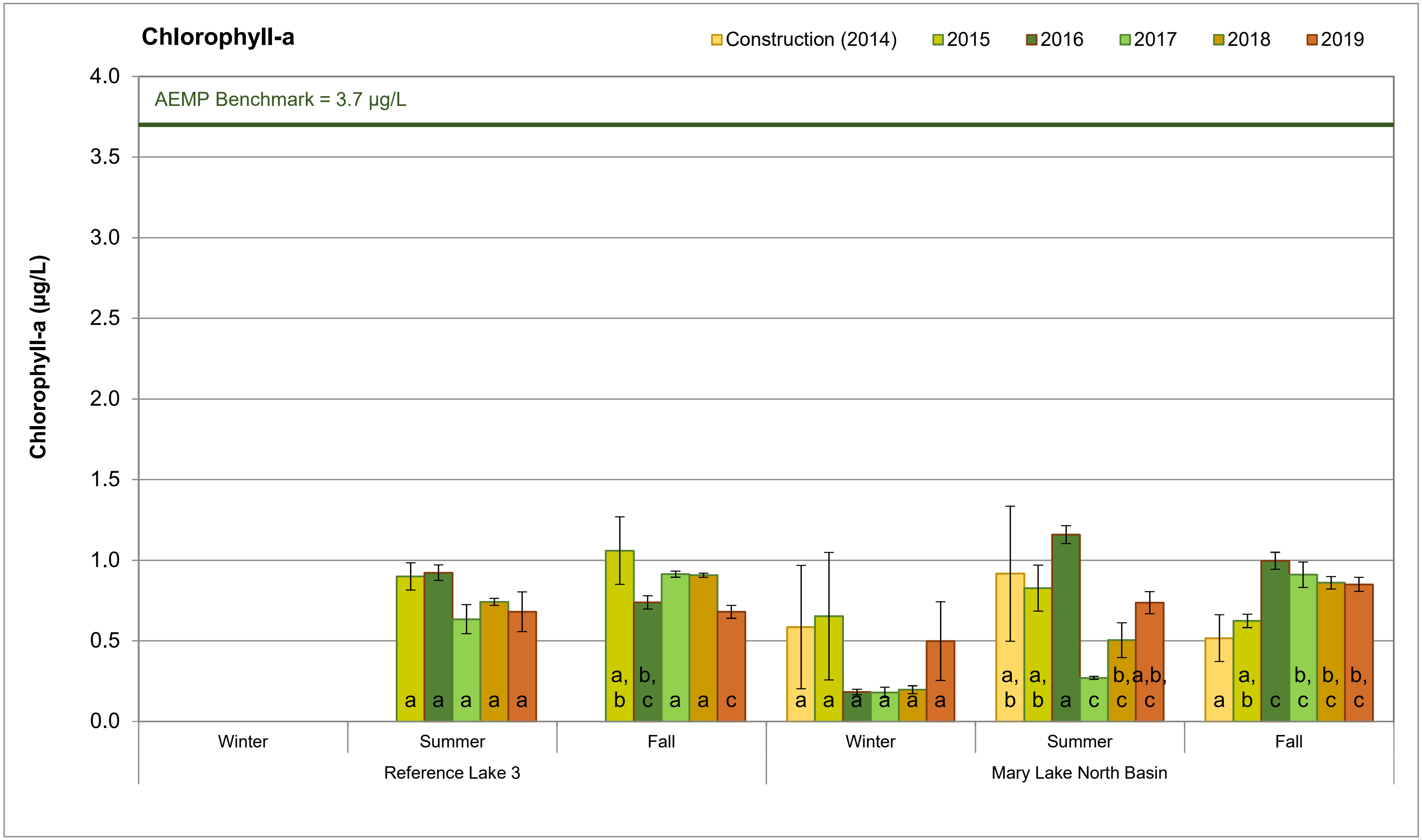


Figure E.1: Temporal Comparison of Chlorophyll-a Concentrations Among Seasons between the Mary Lake North Basin and Reference Lake 3 for Mine Construction (2014) and Operational (2015 to 2019) Periods (mean ± SE)

Note: Bars with the same letter at the base do not differ significantly 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 2019 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	28-Jun-19	28-Jun-19	27-Jun-19	27-Jun-19	28-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	29-Jun-19	28-Jun-19	28-Jun-19	29-Jun-19	29-Jun-19 31-Jul-19
	Summer	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19	5-Aug-19	31-Jul-19	24-Jul-19	29-Jul-19	29-Jul-19	31-Jul-19	31-Jul-19	5-Aug-19	24-Jul-19	24-Jul-19	4-Aug-19
	Fall	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	18-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	18-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19
Chlorophyll-a (µg/L)	Spring	0.12	0.23	0.28	0.16	<0.10	0.28	0.98	0.39	0.39	0.22	0.22	0.91	0.15	0.44	0.17 0.65
	Summer	0.28	0.52	0.34	0.32	0.17	0.38	1.05	0.44	0.43	0.37	0.33	0.90	0.24	0.31	0.31
	Fall	1.01	1.41	0.68	1.61	0.18	0.37	0.61	0.67	0.52	0.57	0.67	0.73	0.22	0.30	0.43
	Average	0.47	0.72	0.43	0.70	0.18	0.34	0.88	0.50	0.45	0.39	0.41	0.85	0.20	0.35	0.39
	Standard Deviation	0.47	0.61	0.22	0.80	0.01	0.06	0.24	0.15	0.07	0.18	0.23	0.10	0.05	0.08	0.20
	Standard Error	0.27	0.36	0.12	0.46	0.00	0.03	0.14	0.09	0.04	0.10	0.14	0.06	0.03	0.05	0.12
Phaeophytin-a (µg/L)	Spring	0.23	0.35	0.25	0.23	0.19	0.39	0.73	0.44	0.43	0.32	0.33	0.86	0.26	0.37	0.26 <0.50
	Summer	<0.50	0.52	<0.50	0.55	0.19	<0.50	0.80	0.50	<0.50	<0.50	<0.50	0.74	<0.50	<0.50	<0.50
	Fall	0.61	0.87	0.73	0.93	0.34	0.33	0.44	0.58	0.43	0.44	0.45	0.46	0.20	0.29	0.34
	Average	0.42	0.58	0.49	0.57	0.24	0.36	0.66	0.51	0.43	0.38	0.39	0.69	0.23	0.33	0.30
	Standard Deviation	0.27	0.27	0.34	0.35	0.09	0.04	0.19	0.07	0.00	0.08	0.08	0.21	0.04	0.06	0.06
	Standard Error	0.16	0.15	0.20	0.20	0.05	0.02	0.11	0.04	0.00	0.05	0.05	0.12	0.02	0.03	0.03

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 2019

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	0.253	β	Reference	4	0.198	0.071	0.036	0.120	0.280
				CLT1 Main Stem	4	0.495	0.333	0.167	0.220	0.980
Summer	NO	0.658	β	Reference	4	0.365	0.106	0.053	0.280	0.520
				CLT1 Main Stem	4	0.573	0.320	0.160	0.370	1.050
Fall	YES	0.006	α	Reference	4	1.178	0.415	0.208	0.680	1.610
				CLT1 Main Stem	4	0.593	0.063	0.032	0.520	0.670

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) in 2019, Mary River Project 2019 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	2-Aug-19			-	-	-	2-Aug-19			-	-	-
	Fall	25-Aug-19			-	-	-	25-Aug-19			-	-	-
Summer	Surface	0.49	0.36	0.34	0.40	0.08	0.05	<0.50	<0.50	<0.50	0.50	0.00	0.00
	Bottom	1.07	1.29	0.53	0.96	0.39	0.23	0.85	0.86	0.65	0.79	0.12	0.07
	Average	0.78	0.83	0.44	0.68	0.21	0.12	0.68	0.68	0.58	0.64	0.06	0.03
Fall	Surface	0.66	0.67	0.62	0.65	0.03	0.02	0.60	0.55	0.59	0.58	0.03	0.02
	Bottom	0.63	0.85	0.65	0.71	0.12	0.07	0.6	0.73	0.66	0.66	0.07	0.04
	Average	0.65	0.76	0.64	0.68	0.07	0.04	0.60	0.64	0.63	0.62	0.02	0.01

Table E.4: Statistical Comparisons of Chlorophyll-a Concentrations Among Years at Reference Lake 3, Mary River Project CREMP

Season	Data Transform-ation	Overall 5-group Comparison			Summary				Pairwise Comparison[a, c]
		Significant Difference Among Years?	P-value	Statistical Treatment[b]	Year	Sample Size (n)	Mean Concentration (mg/L)	Standard Deviation (mg/L)	
Summer	none	YES	0.0780	α	2015	3	0.899	0.146	a
					2016	3	0.923	0.085	a
					2017	3	0.634	0.090	a
					2018	3	0.742	0.066	a
					2019	3	0.680	0.213	a
Fall	rank	YES	0.0310	γ	2015	3	1.059	0.363	a,b
					2016	3	0.738	0.071	b,c
					2017	3	0.913	0.019	a
					2018	3	0.907	0.039	a
					2019	3	0.680	0.069	c

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.

[c] Annual data sets sharing the same letter do not differ significantly.

Table E.5: Phytoplankton Monitoring Data (i.e., chlorophyll-a and phaeophytin-a concentrations) Collected at Camp Lake (JLO), Mary River Project CREMP, 2019

	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	13-Apr-19	13-Apr-19	13-Apr-19	14-Apr-19	14-Apr-19	-	-	-
	Summer	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	-	-	-
	Fall	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	-	-	-
Winter	Surface	0.73	0.64	0.70	0.76	0.37	0.64	0.16	0.07
	Bottom	0.42	0.39	0.21	0.35	0.17	0.31	0.11	0.05
	Average	0.58	0.52	0.46	0.56	0.27	0.47	0.12	0.05
Summer	Surface	0.68	0.79	0.82	0.73	1.01	0.81	0.13	0.06
	Bottom	0.71	0.77	0.70	0.78	1.77	0.95	0.46	0.21
	Average	0.70	0.78	0.76	0.76	1.39	0.88	0.29	0.13
Fall	Surface	1.04	1.12	1.18	1.21	1.23	1.16	0.08	0.03
	Bottom	1.06	1.18	1.29	2.20	1.26	1.40	0.46	0.20
	Average	1.05	1.15	1.24	1.71	1.25	1.28	0.25	0.11

	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	13-Apr-19	13-Apr-19	13-Apr-19	14-Apr-19	14-Apr-19	-	-	-
	Summer	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	28-Jul-19	-	-	-
	Fall	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	27-Aug-19	-	-	-
Winter	Surface	0.61	0.44	0.44	0.32	0.43	0.45	0.10	0.05
	Bottom	0.46	0.51	0.29	0.36	0.32	0.39	0.09	0.04
	Average	0.54	0.48	0.37	0.34	0.38	0.42	0.08	0.04
Summer	Surface	0.67	0.68	0.67	0.69	0.74	0.69	0.03	0.01
	Bottom	0.67	0.60	0.68	0.72	1.16	0.77	0.22	0.10
	Average	0.67	0.64	0.68	0.71	0.95	0.73	0.13	0.06
Fall	Surface	0.62	0.68	0.64	0.71	0.62	0.65	0.04	0.02
	Bottom	0.77	0.69	0.72	1.11	0.74	0.81	0.17	0.08
	Average	0.70	0.69	0.68	0.91	0.68	0.73	0.10	0.05

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, 2019

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 3 Seasons?	P-value
Reference Creek Stations	YES	<0.001	ANOVA[a]	Spring	Summer	NO	0.6270
				Spring	Fall	YES	<0.001
				Summer	Fall	YES	0.0030
Mary River GO-09 Reference Stations	YES	0.0065	ANOVA[a]	Spring	Summer	YES	0.0176
				Spring	Fall	YES	0.0042
				Summer	Fall	NO	0.2753
Reference Lake 3	-	-	-	Winter	Summer	not applicable	-
				Winter	Fall	not applicable	-
				Summer	Fall	NO	1.0000
Camp Lake	YES	<0.001	ANOVA[a]	Winter	Summer	YES	0.0209
				Winter	Fall	YES	0.0002
				Summer	Fall	YES	0.0469
Sheardown Lake NW	YES	<0.001	ANOVA[a]	Winter	Summer	YES	<0.001
				Winter	Fall	YES	0.0098
				Summer	Fall	YES	0.0034
Sheardown Lake SE	NO	0.4856	ANOVA[a]	Winter	Summer	NO	0.1953
				Winter	Fall	NO	0.6407
				Summer	Fall	NO	0.5012
Mary Lake North Basin	NO	0.3026	ANOVA[a]	Winter	Summer	NO	0.3992
				Winter	Fall	NO	0.2282
				Summer	Fall	NO	0.2333
Mary Lake South Basin	YES	<0.001	ANOVA[b]	Winter	Summer	NO	0.5564
				Winter	Fall	YES	<0.001
				Summer	Fall	YES	<0.001

[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).

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, 2019

Study Lake	Two-Group Comparison to Reference				Number of Stations (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
	Significant Difference between Areas?	P-value	Statistical Test[a]	Magnitude of Difference[b]						
Reference Lake 03	-	-	-	-	3	0.78	0.83	0.44	0.44	0.83
Camp Lake	NO	0.297	β	0.1	5	0.88	0.29	0.13	0.70	1.39
Sheardown Lake NW	YES	<0.001	β	1.2	6	1.81	0.25	0.10	1.55	2.26
Sheardown Lake SE	YES	<0.001	β	1.7	5	2.16	0.24	0.11	1.91	2.43
Mary Lake North	NO	0.651	β	-0.1	3	0.74	0.12	0.07	0.62	0.85
Mary Lake South	No	0.106	β	-0.3	7	0.52	0.03	0.01	0.48	0.55

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

Notes: δ - data untransformed, t-test assuming unequal variance conducted

[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

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

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, 2019

Study Lake	Two-Group Comparison to Reference				Number of Stations (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
	Significant Difference between Areas?	P-value	Statistical Test[a]	Magnitude of Difference[b]						
Reference Lake 03	-	-	-	-	3	0.65	0.76	0.64	0.64	0.76
Camp Lake	YES	0.002	β	0.8	5	1.28	0.25	0.11	1.05	1.71
Sheardown Lake NW	YES	0.024	γ	0.7	6	1.19	0.31	0.13	1.03	1.82
Sheardown Lake SE	YES	<0.001	β	1.8	5	2.00	0.45	0.20	1.38	2.61
Mary Lake North	YES	0.045	β	0.3	3	0.85	0.08	0.04	0.77	0.91
Mary Lake South	YES	<0.001	β	0.4	7	0.93	0.04	0.02	0.89	1.00

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

Notes: δ - data untransformed, t-test assuming unequal variance conducted

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed,

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

Table E.9: Statistical Comparison of Chlorophyll-a Concentrations at Camp Lake Among Years of Mine Operation (2015 to 2019)

Season	Data Transformation	Statistical Test	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]				
			Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Pairwise Comparison
Winter	none	ANOVA	YES	0.000	2014	4	0.275	0.150	a
					2015	5	0.742	0.152	b
					2016	5	0.646	0.120	b,c
					2017	5	0.316	0.108	a
					2018	5	0.385	0.041	a
					2019	5	0.474	0.123	a,c
Summer	rank	KW H-test	YES	0.003	2014	2	1.050	1.202	a,b
					2015	5	1.262	0.163	a,b
					2016	5	1.503	0.319	a
					2017	5	1.243	0.154	a,b
					2018	5	1.998	0.035	c
					2019	5	0.876	0.288	b
Fall	log10	ANOVA	YES	0.006	2014	5	1.590	0.726	a,b
					2015	5	0.651	0.070	c
					2016	5	1.063	0.214	b
					2017	5	1.187	0.149	b
					2018	5	2.151	0.035	a
					2019	5	1.277	0.252	b
Annual	none	ANOVA	YES	<0.001	2014	11	1.014	0.864	a,b
					2015	15	0.885	0.305	b
					2016	15	1.070	0.421	a,b
					2017	15	0.915	0.458	b
					2018	15	1.511	0.828	a
					2019	15	0.876	0.402	b

[shaded box] Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

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

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, 2019

	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	17-Apr-19	17-Apr-19	17-Apr-19	18-Apr-19	16-Apr-19	16-Apr-19	-	-	-
	Summer	25-Jul-19	26-Jul-19	25-Jul-19	25-Jul-19	26-Jul-19	26-Jul-19	-	-	-
	Fall	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	-	-	-
Winter	Surface	0.38	0.24	0.78	0.95	0.53	0.71	0.60	0.26	0.11
	Bottom	0.31	0.11	0.14	0.79	0.23	0.39	0.33	0.25	0.10
	Average	0.35	0.18	0.46	0.87	0.38	0.55	0.46	0.24	0.10
Summer	Surface	1.60	1.62	1.62	1.60	2.02	1.58	1.67	0.17	0.07
	Bottom	1.81	1.79	1.48	1.86	1.79	2.93	1.94	0.50	0.21
	Average	1.71	1.71	1.55	1.73	1.90	2.26	1.81	0.25	0.10
Fall	Surface	1.08	1.07	1.02	0.94	1.06	1.05	1.04	0.05	0.02
	Bottom	1.17	1.07	1.06	2.70	1.09	1.01	1.35	0.66	0.27
	Average	1.13	1.07	1.04	1.82	1.08	1.03	1.19	0.31	0.13

	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	17-Apr-19	17-Apr-19	17-Apr-19	18-Apr-19	16-Apr-19	16-Apr-19	-	-	-
	Summer	25-Jul-19	26-Jul-19	25-Jul-19	25-Jul-19	26-Jul-19	26-Jul-19	-	-	-
	Fall	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	-	-	-
Winter	Surface	0.23	0.22	0.45	0.55	<0.50	<0.50	0.41	0.15	0.06
	Bottom	0.30	0.20	0.20	0.51	<0.50	<0.50	0.37	0.15	0.06
	Average	0.27	0.21	0.33	0.53	0.50	0.50	0.39	0.14	0.06
Summer	Surface	0.96	1.19	0.97	0.98	0.91	1.21	1.04	0.13	0.05
	Bottom	1.08	1.07	1.07	1.27	1.18	1.57	1.21	0.20	0.08
	Average	1.02	1.13	1.02	1.12	1.05	1.39	1.12	0.14	0.06
Fall	Surface	0.60	0.56	0.61	0.58	0.66	0.69	0.62	0.05	0.02
	Bottom	0.70	0.73	0.59	1.47	0.63	0.62	0.79	0.34	0.14
	Average	0.65	0.65	0.60	1.03	0.65	0.66	0.70	0.16	0.06

Table E.11: Statistical Comparison of Chlorophyll-a Concentrations at Sheardown Lake NW Among Years of Mine Operation (2015 to 2019)

Season	Data Transform-ation	Statistical Test	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]				
			Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Pairwise Comparison
Winter	rank	KW H-test	YES	0.004	2014	6	2.550	1.336	a
					2015	6	1.104	0.047	a,b
					2016	6	0.874	0.316	b,c
					2017	6	0.790	0.268	b,c
					2018	6	1.028	0.495	b
					2019	6	0.463	0.235	c
Summer	rank	KW H-test	YES	0.002	2014	6	2.425	0.821	a
					2015	6	1.512	0.244	b,c
					2016	6	2.131	0.387	a
					2017	6	1.220	0.126	c
					2018	6	2.007	0.183	a
					2019	6	1.808	0.246	a,b
Fall	rank	KW H-test	YES	0.001	2014	6	0.800	0.379	a
					2015	6	1.611	0.440	b
					2016	6	1.526	0.183	b
					2017	6	1.560	0.222	b
					2018	6	1.753	0.136	b
					2019	6	1.193	0.309	a
Annual	none	ANOVA	YES	0.010	2014	18	1.925	1.199	a
					2015	18	1.409	0.355	a,b
					2016	18	1.510	0.602	a,b
					2017	18	1.190	0.381	b
					2018	18	1.596	0.519	a,b
					2019	18	1.155	0.618	b

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

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

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, 2019

	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	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	-	-	-
	Summer	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	-	-	-
	Fall	22-Aug-19	22-Aug-19	25-Aug-19	24-Aug-19	24-Aug-19	-	-	-
Winter	Surface	1.63	1.43	2.35	3.01	2.72	2.23	0.68	0.31
	Bottom	1.27	1.57	2.29	1.26	1.22	1.52	0.45	0.20
	Average	1.45	1.50	2.32	2.14	1.97	1.88	0.39	0.17
Summer	Surface	2.34	2.41	2.25	2.41	2.52	2.39	0.10	0.04
	Bottom	2.51	2.41	1.95	1.53	1.30	1.94	0.53	0.24
	Average	2.43	2.41	2.10	1.97	1.91	2.16	0.24	0.11
Fall	Surface	1.39	1.88	2.16	2.00	2.17	1.92	0.32	0.14
	Bottom	1.36	1.84	1.91	2.28	3.04	2.09	0.63	0.28
	Average	1.38	1.86	2.04	2.14	2.61	2.00	0.45	0.20

	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	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	18-Apr-19	-	-	-
	Summer	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	26-Jul-19	-	-	-
	Fall	22-Aug-19	22-Aug-19	25-Aug-19	24-Aug-19	24-Aug-19	-	-	-
Winter	Surface	0.60	1.08	0.99	1.21	1.17	1.01	0.24	0.11
	Bottom	0.59	0.74	1.17	0.80	0.47	0.75	0.27	0.12
	Average	0.60	0.91	1.08	1.00	0.82	0.88	0.19	0.08
Summer	Surface	1.05	1.12	0.98	1.04	1.09	1.06	0.05	0.02
	Bottom	1.16	1.14	0.89	1.11	1.06	1.07	0.11	0.05
	Average	1.11	1.13	0.94	1.08	1.08	1.06	0.08	0.03
Fall	Surface	0.73	0.87	1.09	1.10	1.13	0.98	0.18	0.08
	Bottom	0.73	0.82	1.01	1.19	1.59	1.07	0.34	0.15
	Average	0.73	0.85	1.05	1.15	1.36	1.03	0.25	0.11

Table E.13: Statistical Comparison of Chlorophyll-a Concentrations at Sheardown Lake SE Among Years of Mine Operation (2015 to 2019)

Season	Data Transform-ation	Statistical Test	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]				
			Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Pairwise Comparison
Winter	log10	ANOVA	YES	0.057	2014	5	2.670	1.013	a
					2015	5	1.576	0.525	a,b
					2016	5	1.903	0.648	a,b
					2017	5	1.359	0.412	b
					2018	5	2.234	0.851	a,b
					2019	5	1.875	0.386	a,b
Summer	log10	ANOVA	YES	<0.001	2014	5	0.203	0.004	a
					2015	5	0.914	0.070	b
					2016	5	1.509	0.208	c
					2017	5	1.366	0.156	c
					2018	5	2.120	0.073	d
					2019	5	2.163	0.242	d
Fall	rank	KW H-test	YES	0.003	2014	5	1.540	1.635	a,b
					2015	5	0.992	0.103	b
					2016	5	2.869	0.737	c
					2017	5	1.496	0.076	a,b,d
					2018	5	2.032	0.115	c,d
					2019	5	2.003	0.446	a,c,d
Annual	rank	KW H-test	YES	<0.001	2014	15	1.471	1.465	a
					2015	15	1.160	0.420	a
					2016	15	2.094	0.798	b
					2017	15	1.407	0.248	a
					2018	15	2.129	0.468	b
					2019	15	2.014	0.362	b

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

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

Table E.14: Phytoplankton Monitoring Data (i.e., chlorophyll-a and phaeophytin-a concentrations) Collected at the Mary River, Mary River Project CREMP, 2019

	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	28-Jun-19	28-Jun-19	28-Jun-19	28-Jun-19	26-Jun-19	26-Jun-19	26-Jun-19	27-Jun-19	27-Jun-19	27-Jun-19	27-Jun-19	28-Jun-19	28-Jun-19
	Summer	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19	1-Aug-19	28-Jul-19	28-Jul-19	28-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19
	Fall	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19
Chlorophyll-a (µg/L)	Spring	0.20	0.21	0.18	0.18	0.15	0.20	0.15	0.14	0.17	0.15	0.13	0.35	0.27
	Summer	0.71	0.46	0.44	0.33	0.48	0.34	0.64	0.45	0.53	0.56	0.18	0.28	0.32
	Fall	0.64	0.58	0.85	0.55	0.49	1.25	0.79	0.79	0.75	1.16	0.89	0.72	0.59
	Average	0.52	0.42	0.49	0.35	0.37	0.60	0.53	0.46	0.48	0.62	0.40	0.45	0.39
	Standard Deviation	0.28	0.19	0.34	0.19	0.19	0.57	0.33	0.33	0.29	0.51	0.43	0.24	0.17
	Standard Error	0.16	0.11	0.20	0.11	0.112	0.33	0.19	0.19	0.17	0.29	0.25	0.14	0.10
Phaeophytin-a (µg/L)	Spring	0.25	0.25	0.24	0.24	0.21	0.20	0.15	0.18	0.22	0.15	0.16	0.39	0.28
	Summer	0.89	<0.50	0.50	<0.50	0.55	<0.50	0.59	0.79	0.74	0.73	<5.0	<5.0	<5.0
	Fall	1.05	0.92	1.03	1.00	0.95	0.82	1.02	1.12	1.18	0.88	1.08	0.97	0.98
	Average	0.73	0.56	0.59	0.58	0.57	0.51	0.59	0.70	0.71	0.59	2.08	2.12	2.09
	Standard Deviation	0.42	0.34	0.40	0.39	0.37	0.31	0.44	0.48	0.48	0.38	2.57	2.51	2.55
	Standard Error	0.24	0.20	0.23	0.22	0.21	0.18	0.25	0.275	0.28	0.22	1.48	1.45	1.47

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, 2019

	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	14-Apr-19	14-Apr-19	14-Apr-19	16-Apr-19	16-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	-	-	-
	Summer	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	-	-	-
	Fall	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	-	-	-
Winter	Surface	0.38	1.26	0.29	0.35	0.60	0.61	0.91	0.74	0.77	0.91	0.68	0.30	0.10
	Bottom	<0.10	0.71	0.25	<0.10	<0.10	0.62	<0.10	<0.10	0.69	0.15	0.29	0.27	0.08
	Average	0.24	0.99	0.27	0.23	0.35	0.62	0.51	0.42	0.73	0.53	0.49	0.24	0.08
Summer	Surface	0.67	0.77	0.89	0.43	0.47	0.48	0.42	0.46	0.46	0.40	0.55	0.17	0.05
	Bottom	0.56	0.72	0.81	0.52	0.62	0.58	0.62	0.58	0.64	0.61	0.63	0.08	0.03
	Average	0.62	0.75	0.85	0.48	0.55	0.53	0.52	0.52	0.55	0.51	0.59	0.12	0.04
Fall	Surface	0.74	0.87	0.88	0.93	0.94	0.88	1.05	1.04	0.96	0.92	0.92	0.09	0.03
	Bottom	0.79	0.95	0.87	0.96	0.85	0.89	0.84	0.95	0.98	0.88	0.90	0.06	0.02
	Average	0.77	0.91	0.88	0.95	0.90	0.89	0.95	1.00	0.97	0.90	0.91	0.06	0.02

	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	14-Apr-19	14-Apr-19	14-Apr-19	16-Apr-19	16-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	15-Apr-19	-	-	-
	Summer	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	27-Jul-19	-	-	-
	Fall	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	-	-	-
Winter	Surface	0.26	0.36	0.25	<0.50	0.57	0.39	0.45	0.37	0.38	0.46	0.40	0.10	0.03
	Bottom	0.18	0.37	0.22	<0.50	<0.50	0.44	0.15	0.16	0.39	0.20	0.31	0.14	0.05
	Average	0.22	0.37	0.24	0.50	0.54	0.42	0.30	0.27	0.39	0.33	0.36	0.11	0.03
Summer	Surface	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.00	0.00	0.00
	Bottom	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.76	<5.0	4.58	1.34	0.42
	Average	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	2.9	5.0	4.79	0.67	0.21
Fall	Surface	0.68	0.69	0.73	0.72	0.74	0.67	0.76	0.73	0.74	0.78	0.72	0.04	0.01
	Bottom	0.66	0.74	0.77	0.70	0.63	0.74	0.74	0.76	0.72	0.73	0.72	0.04	0.01
	Average	0.67	0.72	0.75	0.71	0.69	0.71	0.75	0.75	0.73	0.76	0.72	0.03	0.01

Table E.16: Statistical Comparison of Chlorophyll-a Concentrations at the Mary Lake North Basin Among Years of Mine Operation (2015 to 2019)

Season	Data Transform-ation	Statistical Test	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]				
			Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Pairwise Comparison
Winter	rank	KW H-test	NO	0.106	2014	3	0.585	0.663	a
					2015	3	0.653	0.684	a
					2016	2	0.183	0.025	a
					2017	3	0.178	0.055	a
					2018	3	0.197	0.043	a
					2019	3	0.498	0.422	a
Summer	rank	KW H-test	YES	0.093	2014	3	0.917	0.725	a,b
					2015	3	0.827	0.246	a,b
					2016	3	1.159	0.096	a
					2017	3	0.266	0.017	c
					2018	3	0.504	0.187	b,c
					2019	3	0.737	0.118	a,b,c
Fall	none	ANOVA	YES	0.006	2014	3	0.517	0.252	a
					2015	3	0.623	0.072	a,b
					2016	3	0.997	0.091	c
					2017	3	0.905	0.136	b,c
					2018	3	0.860	0.066	b,c
					2019	3	0.850	0.076	b,c
Annual	none	ANOVA	NO	0.331	2014	9	0.673	0.540	a
					2015	9	0.701	0.378	a
					2016	8	0.854	0.427	a
					2017	9	0.450	0.351	a
					2018	9	0.520	0.305	a
					2019	9	0.695	0.271	a

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

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

Table E.17: Statistical Comparison of Chlorophyll-a Concentrations at the Mary Lake South Basin Among Years of Mine Operation (2015 to 2019)

Season	Data Transform-ation	Statistical Test	Overall 6-Year Comparison		Pair-wise, post-hoc comparisons[a]				
			Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Pairwise Comparison
Winter	rank	KW H-test	NO	0.195	2014	7	0.879	1.455	a
					2015	7	0.646	0.340	a
					2016	7	0.306	0.197	a
					2017	7	0.351	0.209	a
					2018	7	0.533	0.337	a
					2019	7	0.482	0.168	a
Summer	rank	KW H-test	YES	0.004	2014	7	0.864	0.594	a
					2015	7	0.789	0.116	a
					2016	7	1.076	0.172	b
					2017	7	0.803	0.083	a
					2018	7	0.848	0.218	a,b
					2019	7	0.521	0.025	c
Fall	rank	KW H-test	YES	0.086	2014	7	0.750	0.294	a,b
					2015	7	0.895	0.120	a,c
					2016	7	0.752	0.231	a,b
					2017	7	0.750	0.077	b
					2018	7	0.904	0.025	a,c
					2019	7	0.934	0.042	c
Annual	rank	KW H-test	NO	0.449	2014	21	0.831	0.878	a
					2015	21	0.777	0.232	a
					2016	21	0.711	0.376	a
					2017	21	0.634	0.244	a
					2018	21	0.762	0.277	a
					2019	21	0.645	0.230	a

[grey box] Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

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

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 2019

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	0.14	0.12	0.18	0.34	0.25	0.48	0%	25%	0%	none	sparse	none	common	abundant	common
	REF-CRK-B2	0.16	0.15	0.12	0.32	0.52	0.57	25%	25%	-	abundant	common	sparse	abundant	abundant	common
	REF-CRK-B3	0.10	0.10	0.12	0.32	0.29	0.32	25%	0%	25%	common	none	none	common	common	common
	REF-CRK-B4	0.13	0.12	0.10	0.62	0.53	0.40	0%	0%	25%	sparse	sparse	none	common	abundant	common
	REF-CRK-B5	0.19	0.15	0.16	0.55	0.61	0.65	0%	0%	0%	sparse	sparse	sparse	sparse	sparse	sparse
Camp Lake Tributary 1 Upstream	CLT-1-US-B1	0.14	0.08	0.08	0.28	0.45	0.36	-	25%	25%	-	sparse	sparse	-	common	common
	CLT-1-US-B2	0.24	0.12	0.18	0.33	0.27	0.28	0%	25%	25%	none	sparse	common	abundant	abundant	abundant
	CLT-1-US-B3	0.16	0.18	0.13	0.46	0.26	0.27	0%	50%	50%	sparse	none	sparse	abundant	abundant	abundant
	CLT-1-US-B4	0.10	0.15	0.08	0.30	0.45	0.27	50%	75%	25%	abundant	sparse	common	common	abundant	abundant
	CLT-1-US-B5	0.08	0.08	0.08	0.29	0.45	0.56	25%	50%	25%	common	common	common	abundant	abundant	abundant
Camp Lake Tributary 1 Downstream	CLT-1-DS-B1	0.10	0.12	0.14	0.30	0.46	0.43	25%	25%	-	none	sparse	sparse	sparse	abundant	sparse
	CLT-1-DS-B2	0.14	0.14	0.10	0.44	0.39	0.45	25%	50%	50%	sparse	sparse	sparse	common	sparse	common
	CLT-1-DS-B3	0.08	0.12	0.10	0.36	0.43	0.48	50%	25%	50%	none	sparse	sparse	sparse	common	common
	CLT-1-DS-B4	0.07	0.07	0.10	0.35	0.42	0.43	50%	50%	25%	common	none	none	common	abundant	common
	CLT-1-DS-B5	0.12	0.07	-	0.49	0.51	0.39	50%	25%	50%	sparse	sparse	common	common	abundant	common
Camp Lake Tributary 2 Upstream	CLT-2-US-B1	0.10	0.08	0.06	0.38	0.30	0.42	25%	25%	50%	none	none	none	common	common	common
	CLT-2-US-B2	0.10	0.10	0.09	0.39	0.35	0.35	25%	25%	75%	none	none	none	common	common	common
	CLT-2-US-B3	0.08	0.06	0.09	0.39	0.31	0.29	25%	25%	25%	none	none	none	sparse	common	common
	CLT-2-US-B4	0.10	0.07	0.09	0.40	0.31	0.35	25%	25%	25%	none	none	none	sparse	common	common
	CLT-2-US-B5	0.10	0.10	0.06	0.38	0.48	0.31	25%	25%	50%	none	none	sparse	abundant	sparse	abundant
Camp Lake Tributary 2 Downstream	CLT-2-DS-B1	0.13	0.14	0.17	0.48	0.45	0.42	50%	25%	25%	sparse	none	none	common	sparse	sparse
	CLT-2-DS-B2	0.10	0.10	0.09	0.32	0.40	0.32	50%	50%	50%	none	sparse	sparse	common	abundant	abundant
	CLT-2-DS-B3	0.90	0.12	0.13	0.40	0.32	0.33	25%	50%	50%	none	common	common	common	abundant	abundant
	CLT-2-DS-B4	0.09	0.11	0.10	0.38	0.42	0.45	50%	25%	25%	sparse	none	none	sparse	sparse	sparse
	CLT-2-DS-B5	0.12	0.11	0.11	0.36	0.45	0.54	0%	25%	0%	none	none	none	sparse	sparse	none

Table F.2: Replicate Station Habitat Feature Summary Statistics for the Camp Lake Tributary Benthic Stations, Mary River Project CREMP, August 2019

Metric	Study Area	Sample Size	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Water Depth (m)	Unnamed Reference Creek	5	0.14	0.02	0.01	0.11	0.17
	CLT1-US North Branch	5	0.13	0.04	0.02	0.08	0.18
	CLT1-DS Lower Main Stem	5	0.10	0.02	0.01	0.08	0.13
	CLT2-US Upstream	5	0.09	0.01	0.00	0.08	0.10
	CLT2-DS Downstream	5	0.17	0.12	0.05	0.10	0.38
Water Velocity (m/s)	Unnamed Reference Creek	5	0.45	0.12	0.05	0.31	0.60
	CLT1-US North Branch	5	0.35	0.05	0.02	0.29	0.43
	CLT1-DS Lower Main Stem	1	0.42	0.03	0.01	0.40	0.46
	CLT2-US Upstream	5	0.36	0.02	0.01	0.33	0.39
	CLT2-DS Downstream	5	0.40	0.05	0.02	0.35	0.45
Substrate Embeddedness (%)	Unnamed Reference Creek	5	11.7%	9.5%	4.2%	0.0%	25.0%
	CLT1-US North Branch	5	31.7%	12.4%	5.5%	16.7%	50.0%
	CLT1-DS Lower Main Stem	5	38.3%	7.5%	3.3%	25.0%	41.7%
	CLT2-US Upstream	5	31.7%	7.0%	3.1%	25.0%	41.7%
	CLT2-DS Downstream	5	33.3%	15.6%	7.0%	8.3%	50.0%

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 2019

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
Water Depth (cm)	NO	0.261	β	Unnamed Reference Creek	CLT1 Upstream	No	0.749
				Unnamed Reference Creek	CLT1 Downstream	No	0.235
				CLT1 Upstream	CLT1 Downstream	No	0.594
Water Velocity (cm/s)	NO	0.147	β	Unnamed Reference Creek	CLT1 Upstream	No	0.158
				Unnamed Reference Creek	CLT1 Downstream	No	0.936
				CLT1 Upstream	CLT1 Downstream	No	0.267
Substrate Embeddedness (%)	YES	0.003	α	Unnamed Reference Creek	CLT1 Upstream	Yes	0.020
				Unnamed Reference Creek	CLT1 Downstream	Yes	0.003
				CLT1 Upstream	CLT1 Downstream	No	0.557

[shaded] 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 2019

Taxa	Study Area	Unnamed Reference Creek				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		11	25	11	79	18
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		14	22	7	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina		-	-	-	-	-
F. Hygrobatidae						
Hygrobates		-	-	4	4	-
F. Sperchonidae						
Sperchon		104	68	29	7	29
F. Pionidae						
indeterminate		-	-	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		61	158	32	79	129
SPRINGTAILS						
Cl. Entognatha						
O. Collembola		-	-	-	-	-
INSECTS						
Cl. Insecta						
MAYFLIES						
O. Ephemeroptera						
F. Baetidae						
Acentrella feropagus		-	-	-	-	-
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		4	7	7	11	7
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
Culicoides		-	-	-	7	7
MIDGES						
F. Chironomidae						
chironomid pupae		**11**	**18**	**4**	**4**	**4**
S.F. Chironominae						
Micropsectra		280	14	7	-	14
Paratanytarsus		-	-	-	-	-
Rheotanytarsus		-	-	-	-	39
Tanytarsus		-	-	-	-	-
Tanytarsini indeterminate		-	-	-	-	-
S.F. Diamesinae						
Diamesa		-	-	-	-	-
Pseudokiefferiella		11	370	140	65	420
S.F. Orthocladiinae						
Cardiocladius		-	-	11	43	108

Table F.4: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Unnamed Reference Creek Study Area, August 2019

Taxa — Study Area	Unnamed Reference Creek				
Replicate Station	B1	B2	B3	B4	B5
Chaetocladius	4	7	-	-	39
Corynoneura	4	-	7	-	-
Cricotopus	115	323	54	47	14
Cricotopus/Orthocladius	50	-	-	-	-
Diplocladius	-	-	-	-	-
Eukiefferiella	-	-	18	-	14
Hydrobaenus	90	-	-	-	-
Hydrosmittia	-	7	-	-	14
Krenosmittia	7	7	4	-	-
Limnophyes	22	14	32	18	97
Orthocladius (Euorthocladius)	50	72	7	25	-
Parakiefferiella	-	7	-	-	-
Paraphaenocladius	-	-	-	-	-
Synorthocladius	-	11	-	-	-
Thienemanniella	-	179	79	-	161
Tokunagaia	205	276	208	226	423
Tvetenia	-	-	-	-	-
indeterminate	-	-	-	-	-
S.F. Podonominae					
Trichotanypus	-	-	-	-	-
S.F. Tanypodinae					
Thienemannimyia complex	4	7	-	4	-
F. Empididae					
Chelifera/Metachela	-	-	-	-	-
Clinocera	11	-	-	-	4
F. Muscidae	-	-	-	-	-
F. Simuliidae					
Metacnephia	-	-	-	4	11
Prosimulium	-	-	-	-	4
F. Tipulidae					
Dicranota	-	-	-	-	-
Tipula	32	7	4	-	18
Number of Organisms (No. organisms per m^2)	1,090	1,599	665	623	1,574
Richness (total number of taxa)[a]	19	19	18	14	20
Simpson's Evenness (E)	0.907	0.892	0.874	0.870	0.871
Bray-Curtis Index	0.490	0.386	0.106	0.247	0.433
Percent Composition					
% Nemata	1.0%	1.6%	1.7%	12.7%	1.1%
% Oligochaeta	1.3%	1.4%	1.1%	0.0%	0.0%
% Hydracarina	9.5%	4.3%	5.0%	1.8%	1.8%
% Ostracods	5.6%	9.9%	4.8%	12.7%	8.2%
% Chironomids	78.3%	82.1%	85.9%	69.3%	85.6%
% Metal Sensitive Chironmids	27.1%	24.3%	22.3%	10.6%	30.1%
% Tipulidae	2.9%	0.4%	0.6%	0.0%	1.1%
Functional Feeding Group Composition					
% Collector - Gatherers	44.3%	73.0%	82.6%	79.6%	83.8%
% Filterers	26.1%	0.9%	1.1%	0.6%	4.3%
% Shredders	18.7%	21.4%	9.8%	9.3%	2.5%
Habitat Preference Group Composition					
% Clingers	52.0%	25.6%	14.1%	10.0%	7.3%
% Sprawlers	42.8%	71.0%	80.9%	69.3%	83.1%
% Burrowers	5.2%	3.4%	3.3%	13.8%	2.7%

[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 2019

Taxa	Study Area	North Branch Upstream (CLT1-US)				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		14	32	29	7	4
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	11	129	7	32
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina		-	-	-	-	-
F. Hygrobatidae						
Hygrobates		-	-	-	-	-
F. Sperchonidae						
Sperchon		50	54	7	7	11
F. Pionidae						
indeterminate		-	-	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	7	-	-
SEED SHRIMPS						
Cl. Ostracoda		-	7	-	-	-
SPRINGTAILS						
Cl. Entognatha						
O. Collembola		-	4	-	7	4
INSECTS						
Cl. Insecta						
MAYFLIES						
O. Ephemeroptera						
F. Baetidae						
Acentrella feropagus		-	-	-	-	-
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		22	7	-	7	11
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
Culicoides		-	-	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		**-**	**11**	**7**	**-**	**7**
S.F. Chironominae						
Micropsectra		18	72	-	-	22
Paratanytarsus		-	-	-	-	-
Rheotanytarsus		-	-	-	-	-
Tanytarsus		-	-	-	-	11
Tanytarsini indeterminate		-	-	-	-	-
S.F. Diamesinae						
Diamesa		-	-	-	-	-
Pseudokiefferiella		334	215	25	43	158
S.F. Orthocladiinae						
Cardiocladius		-	-	-	-	29

Table F.5: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 1 Study Areas, August 2019

Taxa Study Area	North Branch Upstream (CLT1-US)				
Replicate Station	B1	B2	B3	B4	B5
Chaetocladius	11	-	-	-	-
Corynoneura	-	-	14	7	-
Cricotopus	240	309	441	280	176
Cricotopus/Orthocladius	-	47	115	36	29
Diplocladius	-	-	-	-	11
Eukiefferiella	-	-	-	22	-
Hydrobaenus	29	25	14	14	11
Hydrosmittia	18	47	201	79	57
Krenosmittia	-	14	7	-	-
Limnophyes	29	32	11	-	-
Orthocladius (Euorthocladius)	194	154	391	258	226
Parakiefferiella	-	-	-	-	-
Paraphaenocladius	-	-	-	-	-
Synorthocladius	-	-	7	14	-
Thienemanniella	-	-	18	-	-
Tokunagaia	431	61	50	22	39
Tvetenia	11	-	-	-	-
indeterminate	**7**	**39**	**11**	**22**	**18**
S.F. Podonominae					
Trichotanypus	-	54	-	-	11
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	18
F. Empididae					
Chelifera/Metachela	-	11	-	-	-
Clinocera	7	7	36	14	68
F. Muscidae	-	-	-	-	-
F. Simuliidae					
Metacnephia	-	-	-	-	-
Prosimulium	-	-	-	-	-
F. Tipulidae					
Dicranota	-	-	-	-	-
Tipula	43	93	122	36	57
Number of Organisms (No. organisms per m^2)	1,458	1,306	1,642	882	1,010
Richness (total number of taxa)[a]	15	20	18	17	20
Simpson's Evenness (E)	0.868	0.920	0.882	0.834	0.917
Bray-Curtis Index	0.502	0.608	0.808	0.777	0.626
Percent Composition					
% Nemata	1.0%	2.5%	1.8%	0.8%	0.4%
% Oligochaeta	0.0%	0.8%	7.9%	0.8%	3.2%
% Hydracarina	3.4%	4.1%	0.4%	0.8%	1.1%
% Ostracods	0.0%	0.5%	0.0%	0.0%	0.0%
% Chironomids	90.7%	82.7%	79.9%	90.4%	81.5%
% Metal Sensitive Chironmids	24.1%	22.2%	1.6%	4.9%	19.0%
% Tipulidae	2.9%	7.1%	7.4%	4.1%	5.6%
Functional Feeding Group Composition					
% Collector - Gatherers	73.8%	52.1%	55.6%	55.9%	56.3%
% Filterers	1.2%	5.6%	0.0%	0.0%	3.3%
% Shredders	21.1%	36.8%	41.8%	41.7%	27.8%
Habitat Preference Group Composition					
% Clingers	21.7%	40.2%	37.0%	39.2%	32.2%
% Sprawlers	74.3%	49.1%	46.0%	54.3%	55.2%
% Burrowers	3.9%	10.4%	17.1%	5.7%	9.2%

[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 2019

Taxa	Study Area	Lower Main Stem (CLT1-DS)				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		22	18	14	18	7
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		65	7	29	29	29
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina		-	-	-	-	-
F. Hygrobatidae						
Hygrobates		-	-	-	-	-
F. Sperchonidae						
Sperchon		7	18	22	18	14
F. Pionidae						
indeterminate		-	4	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	4	-	-
SEED SHRIMPS						
Cl. Ostracoda		7	-	4	4	-
SPRINGTAILS						
Cl. Entognatha						
O. Collembola		7	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		-	-	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		**7**	**4**	**14**	**7**	**4**
S.F. Chironominae						
Micropsectra		-	-	47	-	-
Paratanytarsus		-	-	-	-	-
Rheotanytarsus		-	-	-	-	-
Tanytarsus		-	-	-	-	-
Tanytarsini indeterminate		-	-	-	-	-
S.F. Diamesinae						
Diamesa		-	-	-	4	-
Pseudokiefferiella		100	65	14	11	83
S.F. Orthocladiinae						
Cardiocladius		-	11	22	-	7

Table F.5: **Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 1 Study Areas, August 2019**

Taxa	Study Area	Lower Main Stem (CLT1-DS)				
	Replicate Station	B1	B2	B3	B4	B5
Chaetocladius		-	-	-	-	7
Corynoneura		7	4	-	-	-
Cricotopus		93	32	54	43	72
Cricotopus/Orthocladius		79	7	90	4	-
Diplocladius		-	-	-	-	-
Eukiefferiella		-	-	-	-	-
Hydrobaenus		29	14	14	-	-
Hydrosmittia		222	341	710	104	732
Krenosmittia		-	-	-	-	-
Limnophyes		7	4	-	4	32
Orthocladius (Euorthocladius)		72	43	75	68	65
Parakiefferiella		14	-	-	-	7
Paraphaenocladius		-	-	-	-	7
Synorthocladius		-	-	-	-	-
Thienemanniella		7	-	-	-	-
Tokunagaia		100	43	22	97	14
Tvetenia		-	4	-	11	-
indeterminate		-	-	-	-	-
S.F. Podonominae						
Trichotanypus		-	-	-	-	-
S.F. Tanypodinae						
Thienemannimyia complex		-	-	-	-	-
F. Empididae						
Chelifera/Metachela		-	-	-	-	-
Clinocera		7	-	-	11	-
F. Muscidae		-	-	-	-	-
F. Simuliidae						
Metacnephia		-	-	-	-	-
Prosimulium		-	-	-	-	-
F. Tipulidae						
Dicranota		-	-	-	-	-
Tipula		22	11	7	32	22
Number of Organisms (No. organisms per m^2)		874	634	1,142	465	1,102
Richness (total number of taxa)[a]		18	17	15	15	14
Simpson's Evenness (E)		0.923	0.722	0.627	0.919	0.581
Bray-Curtis Index		0.576	0.663	0.793	0.603	0.734
Percent Composition						
% Nemata		2.5%	2.8%	1.2%	3.9%	0.6%
% Oligochaeta		7.4%	1.1%	2.5%	6.2%	2.6%
% Hydracarina		0.8%	3.5%	1.9%	3.9%	1.3%
% Ostracods		0.8%	0.0%	0.4%	0.9%	0.0%
% Chironomids		84.3%	90.2%	93.0%	75.9%	93.5%
% Metal Sensitive Chironmids		11.6%	10.4%	5.4%	3.4%	7.5%
% Tipulidae		2.5%	1.7%	0.6%	6.9%	2.0%
Functional Feeding Group Composition						
% Collector - Gatherers		76.0%	86.9%	78.5%	76.6%	89.6%
% Filterers		0.0%	0.0%	4.2%	0.0%	0.0%
% Shredders		22.4%	7.9%	13.4%	17.2%	8.5%
Habitat Preference Group Composition						
% Clingers		21.5%	9.6%	18.9%	16.6%	7.8%
% Sprawlers		65.2%	82.3%	74.8%	66.5%	86.3%
% Burrowers		12.5%	5.7%	4.4%	17.0%	5.3%

[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 2019

Metric	Area	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density (no. organisms / m^2)	Unnamed Reference Creek	1,110	472	211	623	1,599
	CLT1 Upstream	1,260	313	140	882	1,642
	CLT1 Downstream	843	293	131	465	1,142
Richness (Number of Taxa)	Unnamed Reference Creek	18.0	2.3	1.0	14.0	20.0
	CLT1 Upstream	18.0	2.1	0.9	15.0	20.0
	CLT1 Downstream	15.8	1.6	0.7	14.0	18.0
Simpson's Evenness	Unnamed Reference Creek	0.883	0.016	0.007	0.870	0.907
	CLT1 Upstream	0.884	0.036	0.016	0.834	0.920
	CLT1 Downstream	0.755	0.161	0.072	0.581	0.923
Bray-Curtis Index	Unnamed Reference Creek	0.333	0.155	0.069	0.106	0.490
	CLT1 Upstream	0.664	0.127	0.057	0.502	0.808
	CLT1 Downstream	0.674	0.090	0.040	0.576	0.793
Nemata (% of community)	Unnamed Reference Creek	3.6%	5.1%	2.3%	1.0%	12.7%
	CLT1 Upstream	1.3%	0.8%	0.4%	0.4%	2.5%
	CLT1 Downstream	2.2%	1.3%	0.6%	0.6%	3.9%
Oligochaeta (% of community)	Unnamed Reference Creek	0.7%	0.7%	0.3%	0.0%	1.4%
	CLT1 Upstream	2.5%	3.2%	1.4%	0.0%	7.9%
	CLT1 Downstream	4.0%	2.7%	1.2%	1.1%	7.4%
Hydracarina (% of community)	Unnamed Reference Creek	4.5%	3.2%	1.4%	1.8%	9.5%
	CLT1 Upstream	2.0%	1.7%	0.8%	0.4%	4.1%
	CLT1 Downstream	2.3%	1.3%	0.6%	0.8%	3.9%
Ostracoda (% of community)	Unnamed Reference Creek	8.2%	3.2%	1.4%	4.8%	12.7%
	CLT1 Upstream	0.1%	0.2%	0.1%	0.0%	0.5%
	CLT1 Downstream	0.4%	0.4%	0.2%	0.0%	0.9%
Ephemeroptera (% of community)	Unnamed Reference Creek	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT1 Upstream	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT1 Downstream	0.0%	0.0%	0.0%	0.0%	0.0%
Chironomidae (% of community)	Unnamed Reference Creek	80.2%	6.8%	3.1%	69.3%	85.9%
	CLT1 Upstream	85.0%	5.1%	2.3%	79.9%	90.7%
	CLT1 Downstream	87.4%	7.4%	3.3%	75.9%	93.5%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	22.9%	7.5%	3.3%	10.6%	30.1%
	CLT1 Upstream	14.4%	10.4%	4.6%	1.6%	24.1%
	CLT1 Downstream	7.7%	3.4%	1.5%	3.4%	11.6%
Simuliidae (% of community)	Unnamed Reference Creek	0.3%	0.5%	0.2%	0.0%	1.0%
	CLT1 Upstream	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT1 Downstream	0.0%	0.0%	0.0%	0.0%	0.0%
Tipulidae (% of community)	Unnamed Reference Creek	1.0%	1.1%	0.5%	0.0%	2.9%
	CLT1 Upstream	5.4%	1.9%	0.9%	2.9%	7.4%
	CLT1 Downstream	2.7%	2.4%	1.1%	0.6%	6.9%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	72.7%	16.4%	7.3%	44.3%	83.8%
	CLT1 Upstream	58.8%	8.6%	3.8%	52.1%	73.8%
	CLT1 Downstream	81.5%	6.3%	2.8%	76.0%	89.6%
Filterer FFG (% of community)	Unnamed Reference Creek	6.6%	11.0%	4.9%	0.6%	26.1%
	CLT1 Upstream	2.0%	2.4%	1.1%	0.0%	5.6%
	CLT1 Downstream	0.8%	1.9%	0.8%	0.0%	4.2%
Shredder FFG (% of community)	Unnamed Reference Creek	12.3%	7.7%	3.4%	2.5%	21.4%
	CLT1 Upstream	33.8%	9.1%	4.1%	21.1%	41.8%
	CLT1 Downstream	13.9%	6.1%	2.7%	7.9%	22.4%
Clinger HPG (% of community)	Unnamed Reference Creek	21.8%	18.3%	8.2%	7.3%	52.0%
	CLT1 Upstream	34.1%	7.6%	3.4%	21.7%	40.2%
	CLT1 Downstream	14.9%	5.9%	2.7%	7.8%	21.5%
Sprawler HPG (% of community)	Unnamed Reference Creek	69.4%	16.1%	7.2%	42.8%	83.1%
	CLT1 Upstream	55.8%	11.0%	4.9%	46.0%	74.3%
	CLT1 Downstream	75.0%	9.4%	4.2%	65.2%	86.3%
Burrower HPG (% of community)	Unnamed Reference Creek	5.7%	4.6%	2.1%	2.7%	13.8%
	CLT1 Upstream	9.3%	5.1%	2.3%	3.9%	17.1%
	CLT1 Downstream	9.0%	5.5%	2.5%	4.4%	17.0%

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 2019) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 7-Year Comparison: Significant Difference Among Years?	Overall 7-Year Comparison: P-value	Pair-wise, post-hoc comparisons[a]: Year	Sample Size (n)	Mean	Standard Deviation	Effect Size: vs. Baseline Year 2007	Effect Size: vs. Baseline Year 2011	Pairwise Comparison
Density (No. per m^2)	none	NO	0.500	2007	3	505	330	-	-3.2	a
				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
				2019	5	1,260	313	2.3	2.2	a
Richness (No. of Taxa)	log10	YES	0.009	2007	3	13.7	2.3	-	-0.3	a
				2011	3	14.3	2.1	0.3	-	a,b
				2015	5	15.0	2.7	0.6	0.3	a,b
				2016	5	14.0	2.6	0.1	-0.2	a
				2017	5	19.2	2.6	2.4	2.3	b
				2018	5	17.2	1.5	1.5	1.4	a,b
				2019	5	18.0	2.1	1.9	1.8	a,b
Simpson's Evenness	log10	YES	<0.001	2007	3	0.749	0.082	-	-3.0	a
				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
				2019	5	0.884	0.036	1.6	0.3	b
Nemata (% of community)	none	YES	<0.001	2007	3	0.1	0.3	-	-0.7	a
				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	b
				2018	5	1.6	0.7	5.5	1.1	a
				2019	5	1.3	0.8	4.4	0.8	a
Hydracarina (% of community)	log10(x+1)	YES	<0.001	2007	3	0.8	1.0	-	-2.0	a
				2011	3	14.4	6.7	13.3	-	b
				2015	5	2.3	1.7	1.5	-1.8	a,c
				2016	5	9.8	3.2	8.8	-0.7	b
				2017	5	7.6	1.1	6.7	-1.0	b
				2018	5	5.3	1.3	4.4	-1.4	b,c
				2019	5	2.0	1.7	1.2	-1.9	a
Chironomidae (% of community)	none	YES	<0.001	2007	3	88.1	7.1	-	2.3	a
				2011	3	76.3	5.1	-1.7	-	a,b,c
				2015	5	75.6	7.5	-1.8	-0.1	a,b,c
				2016	5	68.6	10.6	-2.7	-1.5	c
				2017	5	74.0	1.7	-2.0	-0.5	b,c
				2018	5	86.8	4.2	-0.2	2.1	a
				2019	5	85.0	5.1	-0.4	1.7	a,b
Metal Sensitive Taxa (% of community)	log10	NO	0.346	2007	3	3.7	3.6	-	-1.1	a
				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
				2019	5	14.4	10.4	3.0	0.5	a
Tipulidae (% of community)	log10	YES	<0.001	2007	3	8.9	4.1	-	0.9	a,b
				2011	3	6.9	2.1	-0.5	-	a,b,c
				2015	5	16.8	4.7	2.0	4.6	a
				2016	5	16.9	11.8	2.0	4.7	a
				2017	5	8.4	1.5	-0.1	0.7	a,b
				2018	5	2.9	2.3	-1.5	-1.9	c
				2019	5	5.4	1.9	-0.8	-0.7	b,c

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

(blue) Indicates magnitude of difference outside of a ± 2 SD effect size of respective baseline year mean indicating an ecologically meaningful difference between study years.

[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 2019) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 7-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
								vs. Baseline Year 2007	vs. Baseline Year 2011	
Collector-Gatherer FFG (% of community)	none	YES	0.002	2007	3	72.6	11.0	-	2.2	a
				2011	3	41.4	14.1	-2.8	-	b,c
				2015	5	50.2	7.3	-2.0	0.6	b,c
				2016	5	40.8	11.4	-2.9	0.0	b,c
				2017	5	38.8	7.1	-3.1	-0.2	b
				2018	5	54.6	13.5	-1.6	0.9	a,b,c
				2019	5	58.8	8.6	-1.3	1.2	a,c
Filterer FFG (% of community)	log10(x+1)	NO	0.107	2007	3	0.3	0.3	-	nc	a
				2011	3	0.0	0.0	-1.2	-	a
				2015	5	0.0	0.0	-1.2	nc	a
				2016	5	0.5	0.6	0.9	nc	a
				2017	5	1.3	1.5	3.9	nc	a
				2018	5	0.5	0.5	0.8	nc	a
				2019	5	2.0	2.4	6.5	nc	a
Shredder FFG (% of community)	none	YES	0.031	2007	3	23.1	8.8	-	-1.2	a
				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
				2019	5	33.8	9.1	1.2	-0.4	a,b

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 2019) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 7-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
								vs. Baseline Year 2007	vs. Baseline Year 2011	

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

(blue) 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 Camp Lake Tributary 1 Lower Main Stem (CLT1 DS) Among Years of Mine Operation (2015 to 2019) and Baseline (2007, 2011)

Metric	Data Transform-ation	Overall 7-Year Comparison: Significant Difference Among Years?	Overall 7-Year Comparison: P-value	Pair-wise, post-hoc comparisons[a]: Year	Sample Size (n)	Mean	Standard Deviation	Effect Size: vs. Baseline Year 2007	Effect Size: vs. Baseline Year 2011	Pairwise Comparison
Density (No. per m^2)	none	NO	0.500	2007	3	754	573	-	-0.8	a
				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
				2019	5	843	293	0.2	-0.3	a
Richness (No. of Taxa)	log10	NO	0.107	2007	3	20.3	6.0	-	1.1	a
				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
				2019	5	15.8	1.6	-0.8	0.1	a
Simpson's Evenness	none	NO	0.251	2007	3	0.864	0.040	-	0.0	a
				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
				2019	5	0.755	0.161	-2.8	-4.3	a
Nemata (% of community)	log10(x+1)	NO	0.164	2007	3	1.0	1.3	-	1.7	a
				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
				2019	5	2.2	1.3	0.9	5.0	a
Oligochaeta (% of community)	log10(x+1)	YES	<0.001	2007	3	7.3	6.2	-	3.9	a
				2011	3	1.1	1.6	-1.0	-	b
				2015	5	5.6	3.1	-0.3	2.9	a
				2016	5	9.7	3.7	0.4	5.5	a
				2017	5	5.0	2.7	-0.4	2.5	a
				2018	5	1.2	1.0	-1.0	0.1	b
				2019	5	4.0	2.7	-0.5	1.8	a,b
Hydracarina (% of community)	log10(x+1)	YES	<0.001	2007	3	2.9	1.4	-	-3.4	a,b
				2011	3	24.7	6.4	15.4	-	c
				2015	5	1.7	1.6	-0.8	-3.6	b
				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,b
				2019	5	2.3	1.3	-0.4	-3.5	a,b
Chironomidae (% of community)	log10	YES	<0.001	2007	3	80.8	8.5	-	1.7	a,b
				2011	3	65.3	9.0	-1.8	-	c
				2015	5	85.2	4.0	0.5	2.2	a
				2016	5	73.9	5.9	-0.8	1.0	b,c
				2017	5	80.9	4.5	0.0	1.7	a,b
				2018	5	85.9	4.0	0.6	2.3	a
				2019	5	87.4	7.4	0.8	2.5	a
Metal Sensitive Taxa (% of community)	log10(x+1)	YES	0.009	2007	3	15.1	10.2	-	1.0	a
				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	a
				2018	5	8.6	6.0	-0.6	0.1	b
				2019	5	7.7	3.4	-0.7	0.0	b
Tipulidae (% of community)	log10	NO	0.129	2007	3	6.4	2.6	-	-0.6	a
				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
				2019	5	2.7	2.4	-1.4	-1.7	a

(grey) Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).
(blue) Indicates magnitude of difference outside of a ± 2 SD effect size of respective baseline year mean indicating an ecologically meaningful difference between study years.

[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 Camp Lake Tributary 1 Lower Main Stem (CLT1 DS) Among Years of Mine Operation (2015 to 2019) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 7-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
								vs. Baseline Year 2007	vs. Baseline Year 2011	
Collector-Gatherer FFG (% of community)	none	YES	<0.001	2007	3	51.7	24.3	-	1.5	a,b
				2011	3	35.6	10.5	-0.7	-	b
				2015	5	78.4	9.5	1.1	4.1	c,d
				2016	5	73.8	9.9	0.9	3.7	a,c,d
				2017	5	67.2	6.4	0.6	3.0	a,c,d
				2018	5	59.5	8.3	0.3	2.3	a,d
				2019	5	81.5	6.3	1.2	4.4	c
Filterer FFG (% of community)	rank	NO	0.409	2007	3	10.2	13.1	-	nc	a
				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	nc	a
				2018	5	0.4	0.5	-0.7	nc	a
				2019	5	0.8	1.9	-0.7	nc	a
Shredder FFG (% of community)	log10	YES	<0.001	2007	3	22.1	3.1	-	-3.7	a,b,c
				2011	3	38.9	4.5	5.5	-	a
				2015	5	19.3	9.0	-0.9	-4.3	b,c
				2016	5	19.6	9.5	-0.8	-4.2	b,c
				2017	5	27.6	4.9	1.8	-2.5	a,b
				2018	5	35.5	7.7	4.4	-0.7	a
				2019	5	13.9	6.1	-2.7	-5.5	c

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

(blue) 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 2019

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
Water Depth (cm)	YES	0.0100	γ	Unnamed Reference Creek	CLT2 Upstream	YES	0.005
				Unnamed Reference Creek	CLT2 Downstream	NO	0.645
				CLT2 Upstream	CLT2 Downstream	YES	0.018
Water Velocity (cm/s)	NO	0.2550	β	Unnamed Reference Creek	CLT2 Upstream	NO	0.227
				Unnamed Reference Creek	CLT2 Downstream	NO	0.7
				CLT2 Upstream	CLT2 Downstream	NO	0.63
Substrate Embeddedness (%)	YES	0.0180	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.039
				Unnamed Reference Creek	CLT2 Downstream	YES	0.026
				CLT2 Upstream	CLT2 Downstream	NO	0.97

[shaded] 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 2019

Taxa	Study Area / Replicate Station	Upstream (CLT2-US) B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		7	22	14	22	22
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		11	29	7	22	22
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina		-	-	-	-	-
F. Hygrobatidae						
Hygrobates		-	-	-	-	-
F. Sperchonidae						
Sperchon		18	-	14	14	-
F. Pionidae						
indeterminate		-	-	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	-	-	-
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		11	14	-	7	7
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
Culicoides		-	-	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		**-**	**-**	**-**	**14**	**4**
S.F. Chironominae						
Micropsectra		61	201	79	39	65
Paratanytarsus		-	-	-	-	-
Rheotanytarsus		-	-	-	-	-
Tanytarsus		-	-	-	-	-
Tanytarsini indeterminate		**-**	**-**	**-**	**-**	**4**
S.F. Diamesinae						
Diamesa		18	-	11	4	-
Pseudokiefferiella		11	144	11	18	29
S.F. Orthocladiinae						
Cardiocladius		7	-	-	7	-

Table F.12: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 2 Study Areas, August 2019

Taxa — Study Area	Upstream (CLT2-US)				
Replicate Station	B1	B2	B3	B4	B5
Chaetocladius	11	22	7	4	11
Corynoneura	4	-	-	-	-
Cricotopus	18	65	11	47	57
Cricotopus/Orthocladius	43	179	83	90	129
Diplocladius	-	-	-	-	-
Eukiefferiella	-	43	-	-	14
Hydrobaenus	104	230	61	43	29
Hydrosmittia	4	43	14	18	43
Krenosmittia	22	29	47	4	-
Limnophyes	7	14	4	7	22
Orthocladius (Euorthocladius)	68	93	100	86	72
Parakiefferiella	-	-	-	-	-
Paraphaenocladius	-	-	-	-	-
Synorthocladius	-	-	-	14	-
Thienemanniella	11	-	11	50	-
Tokunagaia	50	22	32	32	54
Tvetenia	-	-	-	-	-
indeterminate	-	-	**11**	**4**	-
S.F. Podonominae					
Trichotanypus	-	-	-	-	-
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
Chelifera/Metachela	-	-	-	-	-
Clinocera	79	72	54	36	140
F. Muscidae	-	-	-	-	-
F. Simuliidae					
Metacnephia	-	-	-	-	-
Prosimulium	-	-	-	-	-
F. Tipulidae					
Dicranota	-	-	-	-	-
Tipula	7	14	14	7	14
Number of Organisms (No. organisms per m^2)	572	1,236	585	596	738
Richness (total number of taxa)[a]	21	17	18	22	16
Simpson's Evenness (E)	0.947	0.943	0.948	0.957	0.952
Bray-Curtis Index	0.699	0.678	0.758	0.590	0.673
Percent Composition					
% Nemata	1.2%	1.8%	2.4%	3.7%	3.0%
% Oligochaeta	1.9%	2.3%	1.2%	3.7%	3.0%
% Hydracarina	3.1%	0.0%	2.4%	2.3%	0.0%
% Ostracods	0.0%	0.0%	0.0%	1.2%	0.0%
% Chironomids	76.7%	87.8%	82.4%	80.7%	72.2%
% Metal Sensitive Chironmids	15.7%	27.9%	17.3%	10.6%	13.4%
% Tipulidae	1.2%	1.1%	2.4%	1.2%	1.9%
Functional Feeding Group Composition					
% Collector - Gatherers	57.3%	55.9%	55.9%	57.4%	43.2%
% Filterers	10.7%	16.3%	13.5%	6.7%	9.5%
% Shredders	13.8%	22.0%	19.0%	26.3%	28.3%
Habitat Preference Group Composition					
% Clingers	38.3%	41.8%	41.7%	39.1%	53.9%
% Sprawlers	56.1%	52.9%	52.3%	51.2%	38.2%
% Burrowers	4.4%	5.3%	6.0%	8.6%	7.9%

[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 2019

Taxa	Study Area / Replicate Station	Downstream (CLT2-DS) B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		4	-	50	18	7
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		4	4	50	18	39
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina		-	-	4	4	-
F. Hygrobatidae						
Hygrobates		-	-	-	-	-
F. Sperchonidae						
Sperchon		4	14	18	7	4
F. Pionidae						
indeterminate		-	-	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		-	-	-	-	4
SPRINGTAILS						
Cl. Entognatha						
O. Collembola		-	-	-	-	-
INSECTS						
Cl. Insecta						
MAYFLIES						
O. Ephemeroptera						
F. Baetidae						
Acentrella feropagus		-	-	-	-	4
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		-	4	18	4	-
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
Culicoides		-	22	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		**4**	**7**	**22**	**7**	**11**
S.F. Chironominae						
Micropsectra		4	83	194	158	22
Paratanytarsus		4	-	-	-	-
Rheotanytarsus		-	-	-	-	-
Tanytarsus		-	-	-	-	-
Tanytarsini indeterminate		-	-	-	-	-
S.F. Diamesinae						
Diamesa		-	-	-	-	11
Pseudokiefferiella		25	4	79	25	18
S.F. Orthocladiinae						
Cardiocladius		4	-	-	7	-

Table F.12: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 2 Study Areas, August 2019

Taxa — Study Area / Replicate Station	Downstream (CLT2-DS) B1	B2	B3	B4	B5
Chaetocladius	4	7	43	4	4
Corynoneura	-	-	7	-	-
Cricotopus	7	29	83	43	14
Cricotopus/Orthocladius	4	240	57	36	22
Diplocladius	4	-	18	-	-
Eukiefferiella	-	-	57	-	7
Hydrobaenus	-	-	244	18	14
Hydrosmittia	-	-	25	-	-
Krenosmittia	-	7	11	-	7
Limnophyes	11	65	-	-	7
Orthocladius (Euorthocladius)	18	25	18	36	25
Parakiefferiella	-	-	-	-	-
Paraphaenocladius	-	-	18	-	-
Synorthocladius	-	-	-	-	-
Thienemanniella	-	4	22	-	-
Tokunagaia	32	29	57	75	158
Tvetenia	-	-	-	-	-
indeterminate	-	-	-	-	-
S.F. Podonominae					
Trichotanypus	-	-	-	-	-
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
Chelifera/Metachela	-	-	-	-	-
Clinocera	4	14	22	11	11
F. Muscidae	-	4	4	4	-
F. Simuliidae					
Metacnephia	-	-	-	-	-
Prosimulium	-	-	-	-	-
F. Tipulidae					
Dicranota	-	-	-	-	4
Tipula	-	14	11	7	11
Number of Organisms (No. organisms per m^2)	137	576	1,132	482	404
Richness (total number of taxa)[a]	15	17	23	17	20
Simpson's Evenness (E)	0.930	0.825	0.934	0.887	0.849
Bray-Curtis Index	0.722	0.748	0.665	0.609	0.507
Percent Composition					
% Nemata	2.9%	0.0%	4.4%	3.7%	1.7%
% Oligochaeta	2.9%	0.7%	4.4%	3.7%	9.7%
% Hydracarina	2.9%	2.4%	1.9%	2.3%	1.0%
% Ostracods	0.0%	0.0%	0.0%	0.0%	1.0%
% Chironomids	88.3%	86.8%	84.4%	84.9%	79.2%
% Metal Sensitive Chironmids	24.8%	15.3%	24.7%	38.6%	13.1%
% Tipulidae	0.0%	2.4%	1.0%	1.5%	3.7%
Functional Feeding Group Composition					
% Collector - Gatherers	77.4%	25.7%	63.0%	40.7%	77.5%
% Filterers	5.8%	14.6%	17.6%	33.4%	5.7%
% Shredders	8.0%	50.3%	15.2%	19.1%	12.1%
Habitat Preference Group Composition					
% Clingers	16.8%	66.7%	33.7%	53.9%	18.8%
% Sprawlers	74.5%	25.7%	55.7%	34.0%	67.1%
% Burrowers	5.8%	7.6%	10.2%	9.8%	14.1%

[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 2019

Metric	Area	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density (no. organisms / m^2)	Unnamed Reference Creek	1,110	472	211	623	1,599
	CLT2 Upstream	745	282	126	572	1,236
	CLT2 Downstream	546	366	164	137	1,132
Richness (Number of Taxa)	Unnamed Reference Creek	18.0	2.3	1.0	14.0	20.0
	CLT2 Upstream	18.8	2.6	1.2	16.0	22.0
	CLT2 Downstream	18.4	3.1	1.4	15.0	23.0
Simpson's Evenness	Unnamed Reference Creek	0.883	0.016	0.007	0.870	0.907
	CLT2 Upstream	0.949	0.005	0.002	0.943	0.957
	CLT2 Downstream	0.885	0.048	0.022	0.825	0.934
Bray-Curtis Index	Unnamed Reference Creek	0.333	0.155	0.069	0.106	0.490
	CLT2 Upstream	0.679	0.060	0.027	0.590	0.758
	CLT2 Downstream	0.650	0.097	0.043	0.507	0.748
Nemata (% of community)	Unnamed Reference Creek	3.6%	5.1%	2.3%	1.0%	12.7%
	CLT2 Upstream	2.4%	1.0%	0.4%	1.2%	3.7%
	CLT2 Downstream	2.6%	1.7%	0.8%	0.0%	4.4%
Oligochaeta (% of community)	Unnamed Reference Creek	0.7%	0.7%	0.3%	0.0%	1.4%
	CLT2 Upstream	2.4%	1.0%	0.4%	1.2%	3.7%
	CLT2 Downstream	4.3%	3.3%	1.5%	0.7%	9.7%
Hydracarina (% of community)	Unnamed Reference Creek	4.5%	3.2%	1.4%	1.8%	9.5%
	CLT2 Upstream	1.6%	1.5%	0.7%	0.0%	3.1%
	CLT2 Downstream	2.1%	0.7%	0.3%	1.0%	2.9%
Ostracoda (% of community)	Unnamed Reference Creek	8.2%	3.2%	1.4%	4.8%	12.7%
	CLT2 Upstream	0.2%	0.5%	0.2%	0.0%	1.2%
	CLT2 Downstream	0.2%	0.4%	0.2%	0.0%	1.0%
Ephemeroptera (% of community)	Unnamed Reference Creek	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT2 Upstream	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT2 Downstream	0.2%	0.4%	0.2%	0.0%	1.0%
Chironomidae (% of community)	Unnamed Reference Creek	80.2%	6.8%	3.1%	69.3%	85.9%
	CLT2 Upstream	80.0%	5.9%	2.6%	72.2%	87.8%
	CLT2 Downstream	84.7%	3.5%	1.5%	79.2%	88.3%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	22.9%	7.5%	3.3%	10.6%	30.1%
	CLT2 Upstream	17.0%	6.6%	3.0%	10.6%	27.9%
	CLT2 Downstream	23.3%	10.1%	4.5%	13.1%	38.6%
Simuliidae (% of community)	Unnamed Reference Creek	0.3%	0.5%	0.2%	0.0%	1.0%
	CLT2 Upstream	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT2 Downstream	0.0%	0.0%	0.0%	0.0%	0.0%
Tipulidae (% of community)	Unnamed Reference Creek	1.0%	1.1%	0.5%	0.0%	2.9%
	CLT2 Upstream	1.6%	0.6%	0.3%	1.1%	2.4%
	CLT2 Downstream	1.7%	1.4%	0.6%	0.0%	3.7%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	72.7%	16.4%	7.3%	44.3%	83.8%
	CLT2 Upstream	54.0%	6.0%	2.7%	43.2%	57.4%
	CLT2 Downstream	56.8%	23.0%	10.3%	25.7%	77.5%
Filterer FFG (% of community)	Unnamed Reference Creek	6.6%	11.0%	4.9%	0.6%	26.1%
	CLT2 Upstream	11.3%	3.7%	1.6%	6.7%	16.3%
	CLT2 Downstream	15.4%	11.3%	5.1%	5.7%	33.4%
Shredder FFG (% of community)	Unnamed Reference Creek	12.3%	7.7%	3.4%	2.5%	21.4%
	CLT2 Upstream	21.9%	5.8%	2.6%	13.8%	28.3%
	CLT2 Downstream	21.0%	16.9%	7.6%	8.0%	50.3%
Clinger HPG (% of community)	Unnamed Reference Creek	21.8%	18.3%	8.2%	7.3%	52.0%
	CLT2 Upstream	43.0%	6.3%	2.8%	38.3%	53.9%
	CLT2 Downstream	38.0%	21.9%	9.8%	16.8%	66.7%
Sprawler HPG (% of community)	Unnamed Reference Creek	69.4%	16.1%	7.2%	42.8%	83.1%
	CLT2 Upstream	50.1%	6.9%	3.1%	38.2%	56.1%
	CLT2 Downstream	51.4%	21.0%	9.4%	25.7%	74.5%
Burrower HPG (% of community)	Unnamed Reference Creek	5.7%	4.6%	2.1%	2.7%	13.8%
	CLT2 Upstream	6.4%	1.8%	0.8%	4.4%	8.6%
	CLT2 Downstream	9.5%	3.1%	1.4%	5.8%	14.1%

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 2019) and Baseline (2007) 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	Pairwise Comparison
Density (No. per m^2)	none	YES	0.000	2007	3	364	205	-	a,b,c,d
				2015	5	741	416	1.8	a
				2016	5	412	100	0.2	b
				2017	5	216	30	-0.7	b
				2018	5	168	65	-1.0	c,d
				2019	5	745	282	1.9	a
Richness (No. of Taxa)	log10	YES	0.003	2007	3	12.7	2.1	-	a
				2015	5	20.8	1.8	3.9	b
				2016	5	17.2	2.9	2.2	a,b,c
				2017	5	14.6	2.5	0.9	a,c
				2018	5	15.0	3.7	1.1	a,c
				2019	5	18.8	2.6	2.9	b,c
Simpson's Evenness	rank	YES	0.006	2007	3	0.825	0.008	-	a
				2015	5	0.922	0.025	11.8	b,c
				2016	5	0.898	0.035	9.0	a,c
				2017	5	0.955	0.013	15.8	d
				2018	5	0.922	0.042	11.8	b,c,d
				2019	5	0.949	0.005	15.2	b,d
Nemata (% of community)	rank	NO	0.309	2007	3	1.1	0.6	-	a
				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
				2019	5	2.4	1.0	2.2	a
Oligochaeta (% of community)	rank	NO	0.569	2007	3	2.1	0.8	-	a
				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
				2019	5	2.4	1.0	0.4	a
Hydracarina (% of community)	none	YES	0.010	2007	3	2.9	2.1	-	a,b
				2015	5	0.9	0.7	-1.0	b
				2016	5	5.5	2.6	1.2	a,b
				2017	5	8.0	4.2	2.4	a
				2018	5	4.7	4.4	0.8	a,b
				2019	5	1.6	1.5	-0.6	b
Chironomidae (% of community)	none	NO	0.333	2007	3	88.4	4.3	-	a
				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
				2019	5	80.0	5.9	-2.0	a
Metal Sensitive Taxa (% of community)	none	YES	<0.001	2007	3	5.3	0.6	-	a
				2015	5	10.5	5.7	8.8	a,b
				2016	5	5.3	3.3	0.0	a
				2017	5	22.0	3.1	28.3	c
				2018	5	9.5	5.0	7.1	a,b
				2019	5	17.0	6.6	19.7	b,c

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 2019) and Baseline (2007) 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	Pairwise Comparison
Tipulidae (% of community)	log10(x+1)	YES	0.075	2007	3	5.2	2.0	-	a
				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
				2019	5	1.6	0.6	-1.8	a
Collector-Gatherer FFG (% of community)	none	YES	0.002	2007	3	68.5	6.5	-	a,b
				2015	5	63.8	10.3	-0.7	a,b
				2016	5	66.6	5.8	-0.3	a,b
				2017	5	75.6	3.9	1.1	a
				2018	5	73.2	8.6	0.7	a
				2019	5	54.0	6.0	-2.2	b
Filterer FFG (% of community)	none	YES	<0.001	2007	3	0.2	0.4	-	a,b,c
				2015	5	1.0	1.1	1.7	b,c
				2016	5	0.2	0.4	-0.2	c
				2017	5	6.5	3.1	14.3	a,b,d
				2018	5	6.6	5.5	14.7	a,d
				2019	5	11.3	3.7	25.6	d
Shredder FFG (% of community)	none	YES	<0.001	2007	3	27.6	5.8	-	a
				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,c
				2019	5	21.9	5.8	-1.0	a,c

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

(blue) 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 2019) and Baseline (2007) 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	Pairwise Comparison
Density (No. per m^2)	none	YES	0.004	2007	3	431	109	-	a,b,c,d
				2015	5	447	258	0.1	a
				2016	5	205	61	-2.1	b
				2017	5	222	144	-1.9	b
				2018	5	127	51	-2.8	c,d
				2019	5	546	366	1.1	a,b,c,d
Richness (No. of Taxa)	none	YES	0.004	2007	3	17.7	2.1	-	a,b
				2015	5	14.2	3.3	-1.7	a,b
				2016	5	14.0	4.0	-1.8	a,b
				2017	5	13.2	4.7	-2.1	a,b
				2018	5	11.2	1.9	-3.1	b
				2019	5	18.4	3.1	0.4	a
Simpson's Evenness	rank	YES	0.073	2007	3	0.865	0.017	-	a,b
				2015	5	0.934	0.034	4.0	c
				2016	5	0.838	0.079	-1.5	b
				2017	5	0.913	0.052	2.8	a,c
				2018	5	0.908	0.087	2.5	c
				2019	5	0.885	0.048	1.2	a,b,c
Nemata (% of community)	log10(x+1)	NO	0.645	2007	3	1.1	1.2	-	a
				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
				2019	5	2.6	1.7	1.2	a
Oligochaeta (% of community)	log10(x+1)	NO	0.440	2007	3	2.6	0.6	-	a
				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
				2019	5	4.3	3.3	2.8	a
Hydracarina (% of community)	log10(x+1)	YES	0.078	2007	3	1.8	1.2	-	a,b
				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
				2019	5	2.1	0.7	0.3	a,b
Chironomidae (% of community)	none	NO	0.255	2007	3	88.0	6.0	-	a
				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
				2019	5	84.7	3.5	-0.6	a
Metal Sensitive Taxa (% of community)	log10(x+1)	YES	0.066	2007	3	11.8	2.0	-	a
				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
				2019	5	23.3	10.1	5.9	a

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 2019) and Baseline (2007) 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	Pairwise Comparison
Tipulidae (% of community)	log10(x+1)	NO	0.157	2007	3	6.4	6.6	-	a
				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
				2019	5	1.7	1.4	-0.7	a
Collector-Gatherer FFG (% of community)	none	YES	0.066	2007	3	66.4	11.0	-	a,b
				2015	5	69.3	10.9	0.3	a,b
				2016	5	77.6	11.6	1.0	a,b
				2017	5	77.1	10.5	1.0	a,b
				2018	5	83.4	6.5	1.5	a
				2019	5	56.8	23.0	-0.9	b
Filterer FFG (% of community)	log10(x+1)	YES	0.001	2007	3	2.7	1.9	-	a
				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
				2019	5	15.4	11.3	6.7	b
Shredder FFG (% of community)	none	NO	0.183	2007	3	21.5	5.9	-	a
				2015	5	25.7	11.6	0.7	a
				2016	5	13.8	10.4	-1.3	a
				2017	5	14.6	8.9	-1.2	a
				2018	5	7.7	7.2	-2.3	a
				2019	5	21.0	16.9	-0.1	a

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

(blue box) 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 2019

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Habitats?	P-value	Statistical Analysis[a]	Station Type	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Sand-Sized Particles (% by weight)	NO	0.155	α	Littoral	5	58.5	10.1	4.5	43.3	68.9
				Profundal	5	51.1	3.2	1.4	46.3	54.0
Silt-Sized Particles (% by weight)	NO	0.198	β	Littoral	5	34.4	9.6	4.3	24.9	48.4
				Profundal	5	40.0	2.9	1.3	36.9	44.6
Clay-Sized Particles (% by weight)	YES	0.021	α	Littoral	5	7.1	1.2	0.5	5.4	8.2
				Profundal	5	9.0	0.8	0.4	7.9	10.2
Moisture (% by weight)	NO	0.239	α	Littoral	5	84.0	5.9	2.6	77.8	91.4
				Profundal	5	87.4	1.0	0.4	86.0	88.6
Total Organic Carbon (%)	NO	0.564	β	Littoral	5	4.2	2.4	1.1	2.2	7.4
				Profundal	5	4.3	0.3	0.1	3.9	4.6

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 2019

Taxa	Study Area / Replicate Station	Reference Lake 03 - Littoral Stations				
		REF-01	REF-02	REF-03	REF-04	REF-05
ROUNDWORMS						
P. Nemata		43	9	147	319	17
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	-	-	-	-
F. Lumbriculidae						
Lumbriculus		-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		-	-	-	-	-
F. Acalyptonotidae						
Acalyptonotus		9	52	17	-	26
F. Hygrobatidae						
Hygrobates		17	9	17	17	9
F. Lebertiidae						
Lebertia		26	43	17	-	9
F. Sperchontidae						
Sperchon		-	-	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		207	483	207	474	190
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
immature		-	-	-	-	-
F. Apataniidae						
Apatania		-	-	-	-	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		-	-	9	-	-
S.F. Chironominae						
Chironomus		-	-	-	-	-
Lipiniella		-	-	-	-	-

Table F.17: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Reference Lake 3, August 2019

Taxa (Study Area / Replicate Station)	Reference Lake 03 - Littoral Stations				
	REF-01	REF-02	REF-03	REF-04	REF-05
Micropsectra	121	43	60	17	9
Paratanytarsus	-	-	-	-	-
Polypedilum	-	-	-	-	-
Sergentia	9	-	-	-	-
Stictochironomus	78	26	-	-	129
Tanytarsus	78	26	26	-	34
S.F. Diamesinae					
Protanypus	60	9	17	34	-
Pseudodiamesa	9	34	-	26	17
Pseudokiefferiella	-	-	-	-	-
S.F. Orthocladiinae					
Abiskomyia	164	284	578	491	276
Eukiefferiella	-	-	-	-	-
Heterotrissocladius	-	43	138	95	17
Hydrobaenus	-	-	-	-	-
Mesocricotopus	-	-	-	-	-
Paracladius	-	43	216	121	121
Parakiefferiella	-	-	-	-	-
Psectrocladius	-	-	9	-	-
Zalutschia	259	52	43	-	17
Orthocladiinae Genus "Greenland'	-	-	-	-	-
S.F. Tanypodinae					
Arctopelopia	17	-	-	-	-
Procladius	17	-	-	-	-
Density (No. organisms per m^2)	1,114	1,156	1,501	1,594	871
Richness (total number of taxa)[a]	15	14	13	9	13
Simpson's Evenness (E)	0.924	0.811	0.853	0.862	0.874
Bray-Curtis Index	0.390	0.236	0.275	0.391	0.162
Dominant Taxonomic Group Composition					
% Nemata	3.9%	0.8%	9.8%	20.0%	2.0%
% Hydracarina	4.7%	9.0%	3.4%	1.1%	5.1%
% Ostracods	18.6%	41.8%	13.8%	29.7%	21.8%
% Chironomids	72.9%	48.4%	73.0%	49.2%	71.2%
% Metal Sensitive Chironmids	24.1%	9.7%	6.9%	4.8%	6.9%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition					
% Collector - Gatherers	51.2%	80.5%	87.9%	97.9%	88.1%
% Filterers	17.9%	6.0%	5.8%	1.1%	4.9%
% Shredders	23.2%	4.5%	2.9%	0.0%	2.0%
Habitat Preference Group Composition					
% Clingers	23.3%	15.0%	9.2%	2.1%	10.0%
% Sprawlers	60.4%	81.2%	79.9%	75.7%	73.2%
% Burrowers	16.2%	3.8%	10.9%	22.1%	16.8%

[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 2019

Taxa	Study Area	Reference Lake 03 - Profundal Stations				
	Replicate Station	REF-06	REF-07	REF-08	REF-09	REF-10
ROUNDWORMS						
P. Nemata		9	-	34	9	9
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	-	-	-	-
F. Lumbriculidae						
Lumbriculus		-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		**-**	**-**	**9**	**-**	**-**
F. Acalyptonotidae						
Acalyptonotus		17	-	9	-	-
F. Hygrobatidae						
Hygrobates		-	-	-	-	-
F. Lebertiidae						
Lebertia		17	-	17	-	9
F. Sperchontidae						
Sperchon		-	-	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		9	17	9	60	26
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
immature		-	-	-	-	-
F. Apataniidae						
Apatania		-	-	-	-	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		**-**	**-**	**-**	**-**	**-**
S.F. Chironominae						
Chironomus		-	-	-	-	-
Lipiniella		-	-	-	-	-

Table F.17: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Reference Lake 3, August 2019

Taxa — Study Area / Replicate Station	Reference Lake 03 - Profundal Stations REF-06	REF-07	REF-08	REF-09	REF-10
Micropsectra	-	-	-	-	-
Paratanytarsus	-	-	-	-	-
Polypedilum	-	-	-	-	-
Sergentia	-	-	-	-	-
Stictochironomus	-	-	-	-	9
Tanytarsus	-	-	-	-	-
S.F. Diamesinae					
Protanypus	9	-	-	-	-
Pseudodiamesa	-	-	-	-	17
Pseudokiefferiella	-	-	-	-	-
S.F. Orthocladiinae					
Abiskomyia	26	9	17	-	9
Eukiefferiella	-	-	-	-	-
Heterotrissocladius	190	233	353	207	138
Hydrobaenus	-	-	-	-	-
Mesocricotopus	-	-	-	-	-
Paracladius	-	-	-	-	-
Parakiefferiella	-	-	-	-	-
Psectrocladius	-	-	-	-	-
Zalutschia	26	-	-	-	-
Orthocladiinae Genus "Greenla	-	-	-	-	-
S.F. Tanypodinae					
Arctopelopia	-	-	-	-	-
Procladius	17	-	-	-	-
Density (No. organisms per m^2)	320	259	448	276	217
Richness (total number of taxa)[a]	9	3	6	3	7
Simpson's Evenness (E)	0.701	0.278	0.442	0.584	0.663
Bray-Curtis Index	0.208	0.086	0.305	0.116	0.222
Dominant Taxonomic Group Compo					
% Nemata	2.8%	0.0%	7.6%	3.3%	4.1%
% Hydracarina	10.6%	0.0%	7.8%	0.0%	4.1%
% Ostracods	2.8%	6.6%	2.0%	21.7%	12.0%
% Chironomids	83.8%	93.4%	82.6%	75.0%	79.7%
% Metal Sensitive Chironmids	2.8%	0.0%	0.0%	0.0%	7.8%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Compos					
% Collector - Gatherers	75.9%	100.0%	92.2%	100.0%	95.9%
% Filterers	0.0%	0.0%	0.0%	0.0%	0.0%
% Shredders	8.1%	0.0%	0.0%	0.0%	0.0%
Habitat Preference Group Composi					
% Clingers	10.6%	0.0%	7.8%	0.0%	4.1%
% Sprawlers	83.8%	100.0%	84.6%	96.7%	87.6%
% Burrowers	5.6%	0.0%	7.6%	3.3%	8.3%

[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 2019) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 5-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	vs. Year 2018		
Density (No. per m^2)	log	NO	0.3121	2015	1,278	888	-	-0.8	-0.2	0.9	a	Tukey's HSD
				2016	2,390	1,396	1.3	-	1.1	5.3	a	
				2017	1,489	850	0.2	-0.6	-	1.8	a	
				2018	1,036	255	-0.3	-1.0	-0.5	-	a	
				2019	1,247	297	0.0	-0.8	-0.3	0.8	a	
Richness (No. of Taxa)	none	NO	0.7695	2015	12.6	4.1	-	0.4	0.1	0.8	a	Tamhane's
				2016	12.2	1.1	-0.1	-	-0.1	0.6	a	
				2017	12.4	2.5	0.0	0.2	-	0.7	a	
				2018	10.8	2.3	-0.4	-1.3	-0.6	-	a	
				2019	12.8	2.3	0.0	0.5	0.2	0.9	a	
Simpson's Evenness	none	NO	0.7410	2015	0.865	0.052	-	0.6	0.4	0.4	a	Mann-Whitney U-test
				2016	0.758	0.189	-2.0	-	-0.3	-0.6	a	
				2017	0.807	0.142	-1.1	0.3	-	-0.2	a	
				2018	0.825	0.103	-0.8	0.4	0.1	-	a	
				2019	0.865	0.041	0.0	0.6	0.4	0.4	a	
Nemata (% of community)	modified probit	NO	0.8480	2015	8.1%	7.4%	-	0.7	1.3	0.1	a	Tukey's HSD
				2016	4.0%	5.6%	-0.6	-	0.0	-0.4	a	
				2017	3.9%	3.3%	-0.6	0.0	-	-0.4	a	
				2018	7.1%	8.8%	-0.1	0.5	0.9	-	a	
				2019	7.3%	7.9%	-0.1	0.6	1.0	0.0	a	
Hydracarina (% of community)	none	NO	0.3822	2015	4.2%	2.7%	-	0.3	-0.4	1.0	a	Tukey's HSD
				2016	3.6%	2.0%	-0.2	-	-0.6	0.7	a	
				2017	5.3%	3.0%	0.4	0.9	-	1.5	a	
				2018	2.1%	2.1%	-0.8	-0.7	-1.0	-	a	
				2019	4.6%	2.9%	0.2	0.5	-0.2	1.2	a	
Ostracoda (% of community)	none	NO	0.1228	2015	20.9%	18.5%	-	-1.5	-1.0	-0.2	a	Mann-Whitney U-test
				2016	46.9%	17.5%	1.4	-	0.4	1.3	a	
				2017	38.8%	18.4%	1.0	-0.5	-	0.8	a	
				2018	23.9%	18.3%	0.2	-1.3	-0.8	-	a	
				2019	25.1%	11.0%	0.2	-1.2	-0.7	0.1	a	
Chironomidae (% of community)	none	NO	0.2769	2015	66.5%	18.9%	-	1.1	0.8	0.0	a	Mann-Whitney U-test
				2016	45.4%	18.8%	-1.1	-	-0.4	-1.0	a	
				2017	51.8%	17.9%	-0.8	0.3	-	-0.7	a	
				2018	66.9%	22.2%	0.0	1.1	0.8	-	a	
				2019	62.9%	12.9%	-0.2	0.9	0.6	-0.2	a	

Table F.18: Statistical Comparison of Benthic Metrics at Reference Lake 3 Littoral (Shallow) Stations Among Years of Mine Operation (2015 to 2019) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 5-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	vs. Year 2018		
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0894	2015	11.4%	12.6%	-	-0.9	-0.3	-1.3	a	Tukey's HSD
				2016	19.3%	8.3%	0.6	-	0.3	-0.9	a,b	
				2017	15.5%	13.4%	0.3	-0.4	-	-1.1	a,b	
				2018	36.5%	19.6%	2.0	2.1	1.6	-	b	
				2019	10.5%	7.8%	-0.1	-1.1	-0.4	-1.3	a,b	
Collector-Gatherer FFG (% of community)	none	NO	0.1265	2015	81.4%	17.1%	-	0.6	0.5	1.4	a	Tukey's HSD
				2016	75.0%	11.4%	-0.4	-	0.1	1.0	a	
				2017	73.9%	16.0%	-0.4	-0.1	-	1.0	a	
				2018	55.6%	19.0%	-1.5	-1.7	-1.1	-	a	
				2019	81.1%	17.8%	0.0	0.5	0.5	1.3	a	
Filterer FFG (% of community)	none	YES	0.0307	2015	11.4%	12.6%	-	-0.6	-0.2	-1.2	a	Tukey's HSD
				2016	16.1%	8.4%	0.4	-	0.1	-1.0	a,b,c	
				2017	14.7%	13.3%	0.3	-0.2	-	-1.0	a,b,c	
				2018	33.9%	18.7%	1.8	2.1	1.5	-	b	
				2019	7.1%	6.3%	-0.3	-1.1	-0.6	-1.4	c	

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 2019) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 5-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	vs. Year 2018		
Density (No. per m^2)	none	YES	0.0053	2015	180	39	-	-5.0	1.0	-1.3	a	Mann-Whitney U-test
				2016	452	55	6.9	-	9.5	0.5	b	
				2017	149	32	-0.8	-5.5	-	-1.5	a	
				2018	375	154	4.9	-1.4	7.1	-	a,b	
				2019	304	89	3.2	-2.7	4.9	-0.5	b	
Richness (No. of Taxa)	none	YES	0.0928	2015	2.8	0.8	-	-0.9	-0.9	-1.9	a	Tukey's HSD
				2016	4.2	1.5	1.7	-	0.0	-0.9	a,b	
				2017	4.2	1.5	1.7	0.0	-	-0.9	a,b	
				2018	5.4	1.3	3.1	0.8	0.8	-	a,b	
				2019	5.6	2.6	3.3	0.9	0.9	0.1	b	
Simpson's Evenness	none	YES	0.0235	2015	0.397	0.232	-	3.2	-2.9	-0.2	a,b	Tamhane's
				2016	0.267	0.041	-0.6	-	-4.2	-0.6	a	
				2017	0.704	0.105	1.3	10.6	-	0.8	b	
				2018	0.458	0.295	0.3	4.6	-2.4	-	a,b	
				2019	0.534	0.174	0.6	6.5	-1.6	0.3	a,b	
Nemata (% of community)	modified probit	YES	0.0267	2015	1.0%	2.2%	-	nc	nc	-0.4	a	Mann-Whitney U-test
				2016	0.0%	0.0%	-0.4	-	nc	-0.6	b	
				2017	0.0%	0.0%	-0.4	nc	-	-0.6	a	
				2018	2.5%	3.8%	0.7	nc	nc	-	a,b	
				2019	3.6%	2.7%	1.2	nc	nc	0.3	b	
Hydracarina (% of community)	none	NO	0.1996	2015	1.5%	3.3%	-	-0.3	-1.2	-0.6	a	Mann-Whitney U-test
				2016	2.1%	2.1%	0.2	-	-1.1	-0.4	a	
				2017	8.2%	5.5%	2.0	2.8	-	1.2	a	
				2018	3.7%	3.8%	0.7	0.7	-0.8	-	a	
				2019	4.5%	4.7%	0.9	1.1	-0.7	0.2	a	
Ostracoda (% of community)	none	NO	0.4184	2015	9.7%	13.1%	-	2.2	1.7	2.3	a	Mann-Whitney U-test
				2016	5.7%	1.8%	-0.3	-	0.7	0.9	a	
				2017	2.8%	4.1%	-0.5	-1.5	-	-0.1	a	
				2018	3.1%	2.9%	-0.5	-1.4	0.1	-	a	
				2019	9.0%	8.1%	-0.1	1.8	1.5	2.1	a	
Chironomidae (% of community)	none	NO	0.3850	2015	87.4%	12.8%	-	-1.5	-0.2	-0.7	a	Tukey's HSD
				2016	92.2%	3.2%	0.4	-	0.5	0.3	a	
				2017	88.8%	7.2%	0.1	-1.1	-	-0.4	a	
				2018	90.7%	4.9%	0.3	-0.5	0.3	-	a	
				2019	82.9%	6.8%	-0.4	-2.9	-0.8	-1.6	a	

Table F.19: Statistical Comparison of Benthic Metrics at Reference Lake 3 Profundal (Deep) Stations Among Years of Mine Operation (2015 to 2019) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 5-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	vs. Year 2018		
Metal Sensitive Taxa (% of community)	none	NO	0.1291	2015	2.8%	2.6%	-	0.6	-1.0	-0.5	a	Mann-Whitney U-test
				2016	1.7%	1.7%	-0.4	-	-1.2	-0.6	a	
				2017	12.0%	8.9%	3.6	6.0	-	0.0	a	
				2018	11.4%	16.8%	3.3	5.6	-0.1	-	a	
				2019	2.1%	3.4%	-0.2	0.3	-1.1	-0.6	a	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0999	2015	96.2%	2.8%	-	-0.3	2.9	0.5	a,b	Tamhane's
				2016	96.9%	2.1%	0.2	-	3.0	0.5	a	
				2017	84.3%	4.1%	-4.2	-6.0	-	-0.4	b	
				2018	89.6%	13.4%	-2.3	-3.5	1.3	-	a,b	
				2019	92.8%	10.0%	-1.2	-1.9	2.0	0.2	a,b	
Filterer FFG (% of community)	modified probit	YES	0.0486	2015	1.9%	2.7%	-	nc	-0.5	-0.4	a	Tamhane's
				2016	0.0%	0.0%	-0.7	-	-0.7	-0.6	a	
				2017	6.5%	9.3%	1.7	nc	-	0.0	a	
				2018	6.5%	10.5%	1.7	nc	0.0	-	a	
				2019	0.0%	0.0%	-0.7	nc	-0.7	-0.6	a	

[grey box] Indicates a significant difference for respective comparison (p-value ≤ 0.1).

[blue box] 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 Sediment Physical Properties Between Camp Lake and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2019

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	Station Depth (m)	NO	0.310	β	Reference	5	9.4	1.4	0.6	7.3	10.6
					Camp	5	8.3	1.9	0.8	7.0	11.3
	Sand-Sized Material (%)	NO	0.834	β	Reference	5	58.5	10.1	4.5	43.3	68.9
					Camp	5	58.2	19.4	8.7	36.0	85.0
	Silt-Sized Material (%)	NO	0.668	α	Reference	5	34.4	9.6	4.3	24.9	48.4
					Camp	5	38.4	17.6	7.9	14.0	58.1
	Clay-Sized Material (%)	YES	0.006	α	Reference	5	7.1	1.2	0.5	5.4	8.2
					Camp	5	3.4	1.8	0.8	1.0	5.9
	Moisture (%)	YES	0.008	α	Reference	5	84.0	5.9	2.6	77.8	91.4
					Camp	5	55.2	17.6	7.9	34.4	79.8
	Total Organic Carbon (TOC) Content (%)	YES	0.048	α	Reference	5	4.2	2.4	1.1	2.2	7.4
					Camp	5	1.5	1.0	0.5	0.6	3.1
Profundal (Deep) Stations	Station Depth (m)	YES	0.009	α	Reference	5	19.3	2.5	1.1	16.0	21.9
					Camp	5	26.6	4.1	1.8	21.2	31.0
	Sand-Sized Material (%)	NO	0.592	η	Reference	5	51.1	3.2	1.4	46.3	54.0
					Camp	5	57.7	25.3	11.3	32.7	86.1
	Silt-Sized Material (%)	NO	0.534	η	Reference	5	40.0	2.9	1.3	36.9	44.6
					Camp	5	34.0	19.6	8.7	12.7	57.6
	Clay-Sized Material (%)	NO	0.374	β	Reference	5	9.0	0.8	0.4	7.9	10.2
					Camp	5	8.3	6.7	3.0	1.3	17.6
	Moisture (%)	YES	0.016	α	Reference	5	87.4	1.0	0.4	86.0	88.6
					Camp	5	55.3	23.4	10.5	28.3	75.3
	Total Organic Carbon (TOC) Content (%)	YES	<0.001	α	Reference	5	4.3	0.3	0.1	3.9	4.6
					Camp	5	1.4	1.1	0.5	0.2	2.4

Highlighted values indicate significant difference between study areas based on statistical 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 F.21: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake, August 2019

Taxa	Study Area	Camp Lake - Littoral Stations				
	Replicate Station	JLO-02	JLO-21	JLO-20	JLO-19	JLO-18
ROUNDWORMS						
P. Nemata		69	259	121	310	103
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	-	-	-	-
F. Lumbriculidae						
Lumbriculus		-	-	9	-	34
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		**-**	**-**	**-**	**-**	**-**
F. Acalyptonotidae						
Acalyptonotus		-	52	60	155	34
F. Hygrobatidae						
Hygrobates		-	17	-	26	34
F. Lebertiidae						
Lebertia		-	-	9	34	34
F. Sperchontidae						
Sperchon		-	-	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		69	-	155	52	69
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
immature		-	-	-	-	-
F. Apataniidae						
Apatania		34	-	52	9	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		**69**	**17**	**-**	**17**	**-**
S.F. Chironominae						
Chironomus		-	-	-	-	-
Lipiniella		-	-	-	-	-

Table F.21: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake, August 2019

Taxa	Study Area / Replicate Station	Camp Lake - Littoral Stations JLO-02	JLO-21	JLO-20	JLO-19	JLO-18
Micropsectra		276	603	1,603	543	310
Paratanytarsus		-	293	586	112	103
Polypedilum		-	-	-	-	-
Sergentia		-	-	-	-	-
Stictochironomus		2,517	931	1,474	284	1,207
Tanytarsus		207	879	1,319	1,095	448
S.F. Diamesinae						
Protanypus		-	34	103	138	241
Pseudodiamesa		-	17	34	9	34
Pseudokiefferiella		-	-	-	-	-
S.F. Orthocladiinae						
Abiskomyia		207	155	164	336	103
Eukiefferiella		-	-	-	-	-
Heterotrissocladius		1,034	483	578	560	483
Hydrobaenus		-	-	-	-	-
Mesocricotopus		-	-	-	-	-
Paracladius		34	172	224	552	69
Parakiefferiella		-	-	-	-	-
Psectrocladius		-	-	-	-	-
Zalutschia		-	-	34	60	-
Orthocladiinae Genus "Greenland'		-	-	-	-	-
S.F. Tanypodinae						
Arctopelopia		1,000	276	474	112	310
Procladius		207	224	241	164	69
Density (No. organisms per m^2)		5,723	4,412	7,240	4,568	3,685
Richness (total number of taxa)[a]		11	14	18	18	17
Simpson's Evenness (E)		0.803	0.933	0.906	0.931	0.891
Bray-Curtis Index		0.851	0.803	0.825	0.724	0.780
Dominant Taxonomic Group Composition						
% Nemata		1.2%	5.9%	1.7%	6.8%	2.8%
% Hydracarina		0.0%	1.6%	1.0%	4.7%	2.8%
% Ostracods		1.2%	0.0%	2.1%	1.1%	1.9%
% Chironomids		97.0%	92.6%	94.4%	87.2%	91.6%
% Metal Sensitive Chironmids		8.5%	41.6%	50.3%	41.7%	30.8%
% Tipulidae		0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition						
% Collector - Gatherers		69.5%	46.7%	39.5%	49.2%	63.6%
% Filterers		8.5%	40.4%	48.5%	38.5%	23.4%
% Shredders		0.0%	0.0%	0.5%	1.3%	0.0%
Habitat Preference Group Composition						
% Clingers		9.1%	35.3%	42.0%	40.9%	23.3%
% Sprawlers		45.1%	36.9%	34.4%	43.0%	33.6%
% Burrowers		45.7%	27.8%	23.6%	16.1%	43.0%

[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 2019

Taxa Study Area / Replicate Station	Camp Lake - Profundal Stations JLO-16	JLO-01	JLO-07	JLO-11	JLO-12
ROUNDWORMS					
P. Nemata	293	9	-	17	224
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	-	-	-	-	-
F. Lumbriculidae					
Lumbriculus	-	-	-	-	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
immature	-	-	-	-	-
F. Acalyptonotidae					
Acalyptonotus	-	-	34	-	9
F. Hygrobatidae					
Hygrobates	-	-	9	-	9
F. Lebertiidae					
Lebertia	-	17	17	-	26
F. Sperchontidae					
Sperchon	-	-	-	-	-
HARPACTICOIDS					
O. Harpacticoida	-	-	-	-	-
SEED SHRIMPS					
Cl. Ostracoda	17	-	60	-	-
INSECTS					
Cl. Insecta					
CADDISFLIES					
O. Trichoptera					
immature	-	-	-	-	-
F. Apataniidae					
Apatania	-	-	-	-	-
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae	-	-	**9**	-	-
S.F. Chironominae					
Chironomus	1,388	-	181	1,621	-
Lipiniella	-	-	-	-	-

Table F.21: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake, August 2019

Taxa — Study Area / Replicate Station	Camp Lake - Profundal Stations JLO-16	JLO-01	JLO-07	JLO-11	JLO-12
Micropsectra	60	362	-	17	241
Paratanytarsus	17	-	9	17	-
Polypedilum	-	-	-	-	-
Sergentia	34	-	-	-	-
Stictochironomus	69	9	52	-	-
Tanytarsus	95	-	60	69	78
S.F. Diamesinae					
Protanypus	34	9	-	-	9
Pseudodiamesa	198	52	138	52	-
Pseudokiefferiella	-	-	-	-	-
S.F. Orthocladiinae					
Abiskomyia	43	86	103	52	69
Eukiefferiella	-	-	-	-	-
Heterotrissocladius	43	819	17	155	2,121
Hydrobaenus	-	-	-	-	-
Mesocricotopus	-	-	-	-	-
Paracladius	-	-	-	-	26
Parakiefferiella	-	-	-	-	-
Psectrocladius	-	-	-	-	-
Zalutschia	-	-	-	-	-
Orthocladiinae Genus "Greenla	-	-	-	-	-
S.F. Tanypodinae					
Arctopelopia	-	-	-	-	9
Procladius	9	17	9	17	17
Density (No. organisms per m^2)	2,300	1,380	698	2,017	2,838
Richness (total number of taxa)[a]	13	9	12	9	12
Simpson's Evenness (E)	0.658	0.645	0.919	0.389	0.465
Bray-Curtis Index	0.939	0.713	0.890	0.847	0.848
Dominant Taxonomic Group Compo					
% Nemata	12.7%	0.7%	0.0%	0.8%	7.9%
% Hydracarina	0.0%	1.2%	8.6%	0.0%	1.6%
% Ostracods	0.7%	0.0%	8.6%	0.0%	0.0%
% Chironomids	86.5%	98.1%	82.8%	99.2%	90.6%
% Metal Sensitive Chironmids	17.6%	30.7%	30.1%	7.7%	11.6%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Compos					
% Collector - Gatherers	92.1%	71.3%	80.1%	94.1%	86.3%
% Filterers	7.5%	26.2%	10.0%	5.1%	11.2%
% Shredders	0.0%	0.0%	0.0%	0.0%	0.0%
Habitat Preference Group Composi					
% Clingers	8.2%	27.5%	17.3%	4.3%	12.8%
% Sprawlers	14.2%	70.6%	48.7%	14.5%	79.0%
% Burrowers	77.6%	2.0%	34.0%	81.2%	8.2%

[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 2019) and Baseline (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 vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0806	2013	4	7,752	3,849	-	a,b	Mann-Whitney U-test
				2015	5	3,671	1,891	-1.1	a,b	
				2016	5	2,639	668	-1.3	a	
				2017	5	3,642	1,449	-1.1	a,b	
				2018	5	2,600	998	-1.3	a,b	
				2019	5	5,126	1,390	-0.7	b	
Richness (No. of Taxa)	none	NO	0.2189	2013	4	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	
				2019	5	15.6	3.0	-0.5	a	
Simpson's Evenness	none	YES	0.0001	2013	4	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	
				2019	5	0.893	0.053	0.0	a	
Nemata (% of community)	none	NO	0.9302	2013	4	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	
				2019	5	3.7%	2.5%	-0.5	a	
Ostracoda (% of community)	none	YES	0.0382	2013	4	0.7%	0.5%	-	a,b,c,d	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,c	
				2018	5	0.4%	0.6%	-0.7	a,c,d	
				2019	5	1.3%	0.8%	1.3	b,d	
Chironomidae (% of community)	none	NO	0.2687	2013	4	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	
				2019	5	92.6%	3.6%	0.6	a	
Metal Sensitive Taxa (% of community)	none	NO	0.4543	2013	4	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	
				2019	5	34.6%	16.1%	0.3	a	
Collector-Gatherer FFG (% of community)	none	NO	0.3072	2013	4	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	
				2019	5	53.7%	12.4%	-0.2	a	
Filterer FFG (% of community)	none	NO	0.3746	2013	4	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	
				2019	5	31.8%	15.9%	0.1	a	

[grey box] Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

[blue box] 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 2019) and Baseline (2007, 2013) for the Mary River Project CREMP

Metric	Data Transformation	Overall 6-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	Effect Size: vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.2788	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	
				2019	5	1,847	830	-0.6	-0.5	a	
Richness (No. of Taxa)	none	YES	0.0058	2007	4	9.0	1.7	-	-1.8	a,c	Tukey's HSD
				2013	5	14.2	2.9	3.0	-	b	
				2015	5	8.2	2.8	-0.5	-2.0	a,c	
				2017	5	10.8	3.3	1.0	-1.2	a,b	
				2018	5	8.2	0.8	-0.5	-2.0	a,c	
				2019	5	11.0	1.9	1.2	-1.1	a,b,c	
Simpson's Evenness	none	YES	0.0843	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,b	
				2018	5	0.374	0.118	-2.0	-2.8	b	
				2019	5	0.615	0.206	0.1	-0.9	a,b	
Nemata (% of community)	modified probit	NO	0.5855	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	
				2019	5	4.4%	5.7%	0.3	0.0	a	
Ostracoda (% of community)	none	NO	0.8266	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	
				2019	5	1.9%	3.8%	24.4	3.3	a	
Chironomidae (% of community)	none	NO	0.8182	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	
				2019	5	91.4%	7.1%	-0.8	0.1	a	

Table F.23: Statistical Comparison of Benthic Metrics at Camp Lake Profundal (Deep) Stations Among Years of Mine Operation (2015 to 2019) and Baseline (2007, 2013) for the Mary River Project CREMP

Metric	Data Transformation	Overall 6-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	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Metal Sensitive Taxa (% of community)	none	YES	0.0050	2007	4	34.8%	4.8%	-	-0.3	a	Tamhane's
				2013	5	39.5%	17.2%	1.0	-	a,b	
				2015	5	11.7%	7.3%	-4.9	-1.6	b	
				2017	5	33.3%	25.5%	-0.3	-0.4	a,b	
				2018	5	6.6%	3.0%	-5.9	-1.9	b	
				2019	5	19.5%	10.5%	-3.2	-1.2	a,b	
Collector-Gatherer FFG (% of community)	none	YES	0.0016	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,d	
				2018	5	95.6%	2.9%	5.1	1.9	c	
				2019	5	84.8%	9.3%	3.3	1.4	b,d	
Filterer FFG (% of community)	none	YES	0.0028	2007	4	32.6%	4.0%	-	-0.3	a	Tamhane's
				2013	5	37.5%	16.8%	1.2	-	a,b	
				2015	5	11.4%	6.8%	-5.3	-1.6	b	
				2017	5	31.6%	26.4%	-0.2	-0.3	a,b	
				2018	5	3.0%	3.7%	-7.3	-2.1	b	
				2019	5	12.0%	8.3%	-5.1	-1.5	b	

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

(blue) 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 2019

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	0.14	0.12	0.18	0.34	0.25	0.48	0%	25%	0%	none	sparse	none	common	abundant	common
	REF-CRK-B2	0.16	0.15	0.12	0.32	0.52	0.57	25%	25%	-	abundant	common	sparse	abundant	abundant	common
	REF-CRK-B3	0.10	0.10	0.12	0.32	0.29	0.32	25%	0%	25%	common	none	none	common	common	common
	REF-CRK-B4	0.13	0.12	0.10	0.62	0.53	0.40	0%	0%	25%	sparse	sparse	none	common	abundant	common
	REF-CRK-B5	0.19	0.15	0.16	0.55	0.61	0.65	0%	0%	0%	sparse	sparse	sparse	sparse	sparse	sparse
Sheardown Tributary 1 Reach 1	SDLT1 - B1	0.12	0.09	0.15	0.36	0.45	0.38	50%	25%	50%	sparse	sparse	common	common	common	common
	SDLT1 - B2	0.09	0.14	0.13	0.54	0.27	0.36	25%	75%	0%	sparse	sparse	common	common	common	common
	SDLT1 - B3	0.14	0.12	0.12	0.47	0.59	0.48	25%	25%	25%	sparse	common	sparse	common	common	common
	SDLT1 - B4	0.08	0.12	0.06	0.32	0.43	0.56	25%	25%	25%	sparse	sparse	sparse	sparse	sparse	sparse
	SDLT1 - B5	0.12	0.12	0.10	0.41	0.47	0.33	25%	50%	25%	sparse	sparse	sparse	sparse	sparse	sparse
Sheardown Tributary 9	SDLT9 - B1	0.06	0.05	0.05	0.22	0.30	0.23	50%	50%	50%	sparse	sparse	sparse	common	common	common
	SDLT9 - B2	0.10	0.07	0.07	0.28	0.28	0.28	50%	50%	50%	sparse	common	sparse	common	common	common
	SDLT9 - B3	0.08	0.08	0.06	0.36	0.41	0.27	50%	50%	50%	common	sparse	sparse	common	sparse	common
	SDLT9 - B4	0.08	0.07	0.07	0.34	0.31	0.37	50%	50%	50%	sparse	sparse	none	common	common	abundant
	SDLT9 - B5	0.08	0.05	0.03	0.38	0.48	0.33	50%	50%	50%	none	none	none	abundant	abundant	abundant
Sheardown Tributary 12	SDLT12 - B1	0.15	0.12	0.04	0.00	0.05	0.14	25%	0%	25%	none	none	none	common	common	sparse
	SDLT12 - B2	0.16	0.16	0.05	0.03	0.03	0.04	25%	25%	25%	common	sparse	sparse	common	common	common
	SDLT12 - B3	0.09	0.08	0.07	0.22	0.08	0.05	-	75%	75%	-	sparse	sparse	abundant	abundant	abundant

Table F.25: Replicate Station Habitat Feature Summary Statistics for the Sheardown Lake Tributary Benthic Stations, Mary River Project CREMP, August 2019

Metric	Study Area	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Water Depth (cm)	Unnamed Reference Creek	13.6	2.4	1.1	10.7	14.3	16.7
	Sheardown Tributary 1 (SDLT1)	11.3	1.6	0.7	8.7	12.0	12.7
	Sheardown Tributary 12 (SDLT12)	10.2	2.2	1.3	8.0	10.3	12.3
	Sheardown Tributary 9 (SDLT9)	6.7	1.2	0.6	5.3	7.3	8.0
Water Velocity (cm/s)	Unnamed Reference Creek	45.1	11.9	5.3	31.0	47.0	60.3
	Sheardown Tributary 1 (SDLT1)	42.8	5.1	2.3	39.0	40.3	51.3
	Sheardown Tributary 12 (SDLT12)	7.1	4.2	2.4	3.3	6.3	11.7
	Sheardown Tributary 9 (SDLT9)	32.3	5.8	2.6	25.0	34.0	39.7
Substrate Embeddedness (%)	Unnamed Reference Creek	11.7%	9.5%	4.2%	0.0%	8.3%	25.0%
	Sheardown Tributary 1 (SDLT1)	31.7%	7.0%	3.1%	25.0%	33.3%	41.7%
	Sheardown Tributary 12 (SDLT12)	38.9%	31.5%	18.2%	16.7%	25.0%	75.0%
	Sheardown Tributary 9 (SDLT9)	50.0%	0.0%	0.0%	50.0%	50.0%	50.0%

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 2019

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	NO	0.264	α
	Unnamed Reference Creek	SDLT12	NO	0.108	
	Unnamed Reference Creek	SDLT9	YES	<0.001	
Water Velocity (cm/s)	Unnamed Reference Creek	SDLT1	NO	0.963	α
	Unnamed Reference Creek	SDLT12	YES	<0.001	
	Unnamed Reference Creek	SDLT9	YES	0.083	
Substrate Embeddedness (%)	Unnamed Reference Creek	SDLT1	YES	0.074	β
	Unnamed Reference Creek	SDLT12	YES	0.054	
	Unnamed Reference Creek	SDLT9	YES	0.001	

[Grey box] 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 2019

Taxa	Study Area	Sheardown Lake Tributary 1 (SDLT1)				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		25	65	18	14	7
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		50	86	22	47	22
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		-	14	-	-	-
F. Hygrobatidae						
Hygrobates		-	-	-	-	-
F. Lebertiidae						
Lebertia		-	-	-	-	-
F. Pionidae						
indeterminate		-	-	4	4	-
F. Sperchonidae						
Sperchon		22	7	18	22	-
HARPACTICOIDS						
O. Harpacticoida		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		-	-	-	-	-
SPRINGTAILS						
Cl. Entognatha						
O. Collembola		-	-	-	-	-
INSECTS						
Cl. Insecta						
BEETLES						
O. Coleoptera						
F. Staphylinidae		-	-	-	-	-
MAYFLIES						
O. Ephemeroptera						
F. Baetidae						
Acentrella feropagus		-	-	4	-	-
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		-	-	-	-	-
CADDISFLIES						
O. Trichoptera						
immature		-	-	-	-	-

Table F.27: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributaries 1 and 12, August 2019

Taxa	Study Area	Sheardown Lake Tributary 1 (SDLT1)				
	Replicate Station	B1	B2	B3	B4	B5
F. Apataniidae						
Apatania		-	-	-	-	-
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
Culicoides		-	-	-	-	-
Probezzia		-	-	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		7	22	-	7	-
S.F. Chironominae						
Chironomus		-	-	-	-	-
Micropsectra		-	-	29	7	-
Paratanytarsus		-	-	-	-	-
Rheotanytarsus		22	29	-	7	-
Tanytarsus		-	-	-	-	-
Tanytarsini indeterminate		-	-	-	-	-
S.F. Diamesinae						
Diamesa		-	-	-	-	-
Pseudodiamesa		-	-	-	-	-
Pseudokiefferiella		233	1335	477	380	108
S.F. Orthocladiinae						
Cardiocladius		-	14	36	-	-
Chaetocladius		-	-	-	-	-
Corynoneura		-	-	-	-	-
Cricotopus		122	434	194	97	79
Cricotopus/Orthocladius		7	14	11	-	7
Diplocladius		-	-	-	18	4
Doncricotopus		7	14	-	-	-
Eukiefferiella		-	-	-	-	-
Hydrobaenus		-	29	-	18	-
Hydrosmittia		524	843	294	477	298
Krenosmittia		-	-	-	-	-
Limnophyes		-	-	-	18	4
Metriocnemus		-	-	-	-	-
Orthocladius (Euorthocladius)		22	72	36	57	11
Parakiefferiella		7	47	36	-	18
Paraphaenocladius		-	-	-	-	-
Synorthocladius		-	14	-	-	-
Thienemanniella		-	-	-	-	-
Tokunagaia		39	104	36	90	18
Tvetenia		-	-	-	-	-
indeterminate		-	-	-	-	-
S.F. Podonominae						
Trichotanypus		-	-	-	-	-
S.F. Tanypodinae						
Procladius		-	-	-	-	-
Thienemannimyia complex		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 2019

Taxa	Study Area	Sheardown Lake Tributary 1 (SDLT1)				
	Replicate Station	B1	B2	B3	B4	B5
F. Empididae						
Chelifera/Metachela		-	-	-	-	-
Clinocera		-	7	-	-	-
pupae		-	-	-	-	-
F. Muscidae		-	-	-	-	-
F. Simuliidae						
Gymnopais holopticoides		-	-	-	-	-
Metacnephia		-	-	-	-	-
Prosimulium		-	-	-	-	-
F. Tipulidae						
Dicranota		-	-	-	-	-
Tipula		18	22	29	14	29
Density (No. organisms per m^2)		1,112	3,172	1,244	1,281	605
Richness (total number of taxa)[a]		14	17	15	16	12
Simpson's Evenness (E)		0.767	0.772	0.822	0.806	0.766
Bray-Curtis Index		0.660	0.801	0.665	0.613	0.678
Dominant Group Composition						
% Nemata		2.2%	2.0%	1.4%	1.1%	1.2%
% Oligochaeta		4.5%	2.7%	1.8%	3.7%	3.6%
% Hydracarina		2.0%	0.7%	1.8%	2.0%	0.0%
% Ostracods		0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera		0.0%	0.0%	0.3%	0.0%	0.0%
% Chironomids		89.7%	93.7%	92.4%	92.1%	90.4%
% Metal Sensitive Chironmids		23.1%	43.3%	40.7%	30.9%	17.9%
% Simuliidae		0.0%	0.0%	0.0%	0.0%	0.0%
% Tipulidae		1.6%	0.7%	2.3%	1.1%	4.8%
Functional Feeding Group Composition						
% Collector - Gatherers		82.1%	82.8%	74.2%	87.8%	81.0%
% Filterers		2.0%	0.9%	2.3%	1.1%	0.0%
% Shredders		13.3%	14.9%	18.8%	8.7%	19.0%
Habitat Preference Group Composition						
% Clingers		15.6%	16.0%	20.6%	10.8%	14.2%
% Sprawlers		76.0%	78.1%	71.0%	83.4%	76.2%
% Burrowers		8.4%	5.9%	8.4%	5.9%	9.6%

[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 2019**

Taxa	Study Area / Replicate Station	Sheardown Tributary 12 (SDLT12)		
		B1	B2	B3
ROUNDWORMS				
P. Nemata		47	14	43
ANNELIDS				
P. Annelida				
WORMS				
Cl. Oligochaeta				
F. Enchytraeidae		50	32	100
ARTHROPODS				
P. Arthropoda				
MITES				
Cl. Arachnida				
O. Acarina				
immature		-	-	-
F. Hygrobatidae				
Hygrobates		-	-	-
F. Lebertiidae				
Lebertia		-	11	-
F. Pionidae				
indeterminate		-	-	-
F. Sperchonidae				
Sperchon		-	4	-
HARPACTICOIDS				
O. Harpacticoida		-	-	-
SEED SHRIMPS				
Cl. Ostracoda		4	-	-
SPRINGTAILS				
Cl. Entognatha				
O. Collembola		-	-	-
INSECTS				
Cl. Insecta				
BEETLES				
O. Coleoptera				
F. Staphylinidae		-	-	-
MAYFLIES				
O. Ephemeroptera				
F. Baetidae				
Acentrella feropagus		-	-	-
STONEFLIES				
O. Plecoptera				
F. Capniidae				
immature		-	-	-
CADDISFLIES				
O. Trichoptera				
immature		-	-	-

Table F.27: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributaries 1 and 12, August 2019

Taxa — Study Area / Replicate Station	Sheardown Tributary 12 (SDLT12) B1	B2	B3
F. Apataniidae			
Apatania	-	4	-
TRUE FLIES			
O. Diptera			
BITING-MIDGE			
F. Ceratopogonidae			
Culicoides	-	-	-
Probezzia	-	-	-
MIDGES			
F. Chironomidae			
chironomid pupae	25	11	-
S.F. Chironominae			
Chironomus	14	-	-
Micropsectra	-	11	32
Paratanytarsus	-	65	-
Rheotanytarsus	-	-	-
Tanytarsus	-	-	-
Tanytarsini indeterminate	-	-	-
S.F. Diamesinae			
Diamesa	-	-	-
Pseudodiamesa	-	-	-
Pseudokiefferiella	7	-	-
S.F. Orthocladiinae			
Cardiocladius	-	-	-
Chaetocladius	25	7	316
Corynoneura	-	7	-
Cricotopus	**57**	**25**	**190**
Cricotopus/Orthocladius	183	39	1019
Diplocladius	1005	782	2899
Doncricotopus	-	-	-
Eukiefferiella	-	-	-
Hydrobaenus	14	122	129
Hydrosmittia	14	7	-
Krenosmittia	-	-	-
Limnophyes	14	-	32
Metriocnemus	79	-	222
Orthocladius (Euorthocladius)	-	-	-
Parakiefferiella	-	7	-
Paraphaenocladius	-	11	129
Synorthocladius	-	-	-
Thienemanniella	-	-	-
Tokunagaia	-	-	287
Tvetenia	-	-	-
indeterminate	287	93	700
S.F. Podonominae			
Trichotanypus	-	-	-
S.F. Tanypodinae			
Procladius	4	-	-
Thienemannimyia complex	-	-	-

Table F.27: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributaries 1 and 12, August 2019

Taxa	Study Area	Sheardown Tributary 12 (SDLT12)		
	Replicate Station	B1	B2	B3
F. Empididae				
Chelifera/Metachela		-	-	-
Clinocera		-	-	-
pupae		-	-	-
F. Muscidae		-	-	-
F. Simuliidae				
Gymnopais holopticoides		-	-	-
Metacnephia		-	-	-
Prosimulium		-	-	-
F. Tipulidae				
Dicranota		-	-	-
Tipula		18	4	32
Density (No. organisms per m^2)		1,847	1,256	6,130
Richness (total number of taxa)[a]		15	17	13
Simpson's Evenness (E)		0.574	0.544	0.722
Bray-Curtis Index		0.908	0.929	0.897
Dominant Group Composition				
% Nemata		2.5%	1.1%	0.7%
% Oligochaeta		2.7%	2.5%	1.6%
% Hydracarina		0.0%	1.2%	0.0%
% Ostracods		0.2%	0.0%	0.0%
% Ephemeroptera		0.0%	0.0%	0.0%
% Chironomids		93.6%	94.5%	97.1%
% Metal Sensitive Chironmids		0.4%	6.1%	0.5%
% Simuliidae		0.0%	0.0%	0.0%
% Tipulidae		1.0%	0.3%	0.5%
Functional Feeding Group Compos				
% Collector - Gatherers		82.9%	86.5%	76.6%
% Filterers		0.0%	6.1%	0.5%
% Shredders		16.9%	5.9%	22.9%
Habitat Preference Group Composi				
% Clingers		15.9%	8.0%	22.9%
% Sprawlers		77.1%	88.1%	74.3%
% Burrowers		7.0%	4.0%	2.9%

[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 2019

Taxa / Study Area	Sheardown Lake Tributary 9 (SDLT9)				
Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	158	179	4	144	100
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	7	22	18	29	50
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
immature	-	-	4	14	-
F. Hygrobatidae					
Hygrobates	-	-	-	-	-
F. Lebertiidae					
Lebertia	-	-	-	-	7
F. Pionidae					
indeterminate	-	-	-	-	-
F. Sperchonidae					
Sperchon	36	29	25	57	22
HARPACTICOIDS					
O. Harpacticoida	-	-	-	-	-
SEED SHRIMPS					
Cl. Ostracoda	366	366	158	287	273
SPRINGTAILS					
Cl. Entognatha					
O. Collembola	22	22	25	129	7
INSECTS					
Cl. Insecta					
BEETLES					
O. Coleoptera					
F. Staphylinidae	7	-	-	-	-
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
Acentrella feropagus	-	-	-	-	-
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature	-	-	-	-	-
CADDISFLIES					
O. Trichoptera					
immature	-	-	4	-	-

Table F.28: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributary 9, August 2019

Taxa	Study Area	Sheardown Lake Tributary 9 (SDLT9)				
	Replicate Station	B1	B2	B3	B4	B5
F. Apataniidae						
Apatania		-	-	-	-	-
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
Culicoides		-	-	-	-	-
Probezzia		-	7	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		50	7	7	-	14
S.F. Chironominae						
Chironomus		-	-	-	-	-
Micropsectra		32	14	11	72	22
Paratanytarsus		-	-	4	-	-
Rheotanytarsus		-	-	-	-	-
Tanytarsus		-	-	-	-	-
Tanytarsini indeterminate		-	-	-	-	-
S.F. Diamesinae						
Diamesa		14	-	-	-	-
Pseudodiamesa		-	-	4	-	-
Pseudokiefferiella		-	-	-	-	14
S.F. Orthocladiinae						
Cardiocladius		-	-	-	-	-
Chaetocladius		-	14	4	-	7
Corynoneura		-	-	-	14	7
Cricotopus		79	165	72	72	22
Cricotopus/Orthocladius		502	266	79	531	201
Diplocladius		47	43	-	14	7
Doncricotopus		-	7	-	-	-
Eukiefferiella		-	-	-	-	-
Hydrobaenus		47	14	-	14	-
Hydrosmittia		111	165	68	72	93
Krenosmittia		65	72	4	72	29
Limnophyes		14	50	-	43	7
Metriocnemus		-	-	-	29	36
Orthocladius (Euorthocladius)		32	7	4	43	-
Parakiefferiella		-	-	-	-	-
Paraphaenocladius		-	-	4	-	-
Synorthocladius		-	-	-	-	-
Thienemanniella		-	-	-	-	-
Tokunagaia		187	7	118	86	72
Tvetenia		-	7	7	-	14
indeterminate		517	136	54	301	14
S.F. Podonominae						
Trichotanypus		32	36	4	43	7
S.F. Tanypodinae						
Procladius		-	-	-	-	-
Thienemannimyia complex		-	-	-	-	-

Table F.28: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributary 9, August 2019

Taxa — Study Area / Replicate Station	Sheardown Lake Tributary 9 (SDLT9) B1	B2	B3	B4	B5
F. Empididae					
Chelifera/Metachela	-	-	-	-	-
Clinocera	-	-	-	-	-
pupae	-	7	-	-	7
F. Muscidae	-	4	-	-	-
F. Simuliidae					
Gymnopais holopticoides	-	-	4	-	-
Metacnephia	-	-	-	-	-
Prosimulium	-	-	-	-	-
F. Tipulidae					
Dicranota	-	-	-	-	7
Tipula	65	22	7	14	7
Density (No. organisms per m^2)	2,390	1,668	693	2,080	1,046
Richness (total number of taxa)[a]	19	23	21	19	23
Simpson's Evenness (E)	0.889	0.911	0.901	0.894	0.900
Bray-Curtis Index	0.688	0.789	0.521	0.736	0.690
Dominant Group Composition					
% Nemata	6.6%	10.7%	0.6%	6.9%	9.6%
% Oligochaeta	0.3%	1.3%	2.6%	1.4%	4.8%
% Hydracarina	1.5%	1.7%	4.2%	3.4%	2.8%
% Ostracods	15.3%	21.9%	22.8%	13.8%	26.1%
% Ephemeroptera	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	72.3%	60.6%	64.1%	67.6%	54.1%
% Metal Sensitive Chironmids	2.0%	0.8%	2.7%	3.5%	3.5%
% Simuliidae	0.0%	0.0%	0.6%	0.0%	0.0%
% Tipulidae	2.7%	1.3%	1.0%	0.7%	1.3%
Functional Feeding Group Composition					
% Collector - Gatherers	57.2%	64.4%	65.9%	54.6%	70.5%
% Filterers	1.4%	0.8%	2.2%	3.5%	2.2%
% Shredders	39.7%	31.9%	26.6%	38.5%	23.2%
Habitat Preference Group Composition					
% Clingers	40.1%	33.6%	32.5%	44.7%	28.2%
% Sprawlers	49.3%	51.1%	59.7%	40.1%	56.1%
% Burrowers	9.6%	14.0%	4.2%	9.0%	15.0%

[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 2019

Metric	Area	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (no. organisms / m^2)	Unnamed Reference Creek	1,110	472	211	623	1,090	1,599
	Sheardown Tributary 1 (SDLT1)	1,483	982	439	605	1,244	3,172
	Sheardown Tributary 12 (SDLT12)	3,078	2,660	1,536	1,256	1,847	6,130
	Sheardown Tributary 9 (SDLT9)	1,575	705	315	693	1,668	2,390
Richness (Number of Taxa)	Unnamed Reference Creek	18.0	2.3	1.0	14.0	19.0	20.0
	Sheardown Tributary 1 (SDLT1)	14.8	1.9	0.9	12.0	15.0	17.0
	Sheardown Tributary 12 (SDLT12)	15.0	2.0	1.2	13.0	15.0	17.0
	Sheardown Tributary 9 (SDLT9)	21.0	2.0	0.9	19.0	21.0	23.0
Simpson's Evenness	Unnamed Reference Creek	0.883	0.016	0.007	0.870	0.874	0.907
	Sheardown Tributary 1 (SDLT1)	0.787	0.026	0.012	0.766	0.772	0.822
	Sheardown Tributary 12 (SDLT12)	0.613	0.095	0.055	0.544	0.574	0.722
	Sheardown Tributary 9 (SDLT9)	0.899	0.008	0.004	0.889	0.900	0.911
Bray-Curtis Index	Unnamed Reference Creek	0.333	0.155	0.069	0.106	0.386	0.490
	Sheardown Tributary 1 (SDLT1)	0.683	0.070	0.031	0.613	0.665	0.801
	Sheardown Tributary 12 (SDLT12)	0.911	0.016	0.009	0.897	0.908	0.929
	Sheardown Tributary 9 (SDLT9)	0.685	0.100	0.045	0.521	0.690	0.789
Nemata (% of community)	Unnamed Reference Creek	3.6%	5.1%	2.3%	1.0%	1.6%	12.7%
	Sheardown Tributary 1 (SDLT1)	1.6%	0.5%	0.2%	1.1%	1.4%	2.2%
	Sheardown Tributary 12 (SDLT12)	1.5%	1.0%	0.6%	0.7%	1.1%	2.5%
	Sheardown Tributary 9 (SDLT9)	6.9%	3.9%	1.8%	0.6%	6.9%	10.7%
Oligochaeta (% of community)	Unnamed Reference Creek	0.7%	0.7%	0.3%	0.0%	1.1%	1.4%
	Sheardown Tributary 1 (SDLT1)	3.3%	1.0%	0.5%	1.8%	3.6%	4.5%
	Sheardown Tributary 12 (SDLT12)	2.3%	0.6%	0.3%	1.6%	2.5%	2.7%
	Sheardown Tributary 9 (SDLT9)	2.1%	1.7%	0.8%	0.3%	1.4%	4.8%
Hydracarina (% of community)	Unnamed Reference Creek	4.5%	3.2%	1.4%	1.8%	4.3%	9.5%
	Sheardown Tributary 1 (SDLT1)	1.3%	0.9%	0.4%	0.0%	1.8%	2.0%
	Sheardown Tributary 12 (SDLT12)	0.4%	0.7%	0.4%	0.0%	0.0%	1.2%
	Sheardown Tributary 9 (SDLT9)	2.7%	1.1%	0.5%	1.5%	2.8%	4.2%
Ostracoda (% of community)	Unnamed Reference Creek	8.2%	3.2%	1.4%	4.8%	8.2%	12.7%
	Sheardown Tributary 1 (SDLT1)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 12 (SDLT12)	0.1%	0.1%	0.1%	0.0%	0.0%	0.2%
	Sheardown Tributary 9 (SDLT9)	20.0%	5.2%	2.3%	13.8%	21.9%	26.1%
Ephemeroptera (% of community)	Unnamed Reference Creek	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 1 (SDLT1)	0.1%	0.1%	0.1%	0.0%	0.0%	0.3%
	Sheardown Tributary 12 (SDLT12)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 9 (SDLT9)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Chironomidae (% of community)	Unnamed Reference Creek	80.2%	6.8%	3.1%	69.3%	82.1%	85.9%
	Sheardown Tributary 1 (SDLT1)	91.6%	1.6%	0.7%	89.7%	92.1%	93.7%
	Sheardown Tributary 12 (SDLT12)	95.1%	1.9%	1.1%	93.6%	94.5%	97.1%
	Sheardown Tributary 9 (SDLT9)	63.7%	6.9%	3.1%	54.1%	64.1%	72.3%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	22.9%	7.5%	3.3%	10.6%	24.3%	30.1%
	Sheardown Tributary 1 (SDLT1)	31.2%	11.0%	4.9%	17.9%	30.9%	43.3%
	Sheardown Tributary 12 (SDLT12)	2.3%	3.3%	1.9%	0.4%	0.5%	6.1%
	Sheardown Tributary 9 (SDLT9)	2.5%	1.1%	0.5%	0.8%	2.7%	3.5%
Simuliidae (% of community)	Unnamed Reference Creek	0.3%	0.5%	0.2%	0.0%	0.0%	1.0%
	Sheardown Tributary 1 (SDLT1)	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%
	Sheardown Tributary 9 (SDLT9)	0.1%	0.3%	0.1%	0.0%	0.0%	0.6%
Tipulidae (% of community)	Unnamed Reference Creek	1.0%	1.1%	0.5%	0.0%	0.6%	2.9%
	Sheardown Tributary 1 (SDLT1)	2.1%	1.6%	0.7%	0.7%	1.6%	4.8%
	Sheardown Tributary 12 (SDLT12)	0.6%	0.3%	0.2%	0.3%	0.5%	1.0%
	Sheardown Tributary 9 (SDLT9)	1.4%	0.8%	0.3%	0.7%	1.3%	2.7%

Note: Sample size equals five for Unnamed Reference Creek, SDLT1, and SDLT9, and three for SDLT12.

Table F.29: Benthic Invertebrate Community Summary Statistics for the Sheardown Lake Tributaries, Mary River Project CREMP, August 2019

Metric	Area	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	72.7%	16.4%	7.3%	44.3%	79.6%	83.8%
	Sheardown Tributary 1 (SDLT1)	81.6%	4.9%	2.2%	74.2%	82.1%	87.8%
	Sheardown Tributary 12 (SDLT12)	82.0%	5.0%	2.9%	76.6%	82.9%	86.5%
	Sheardown Tributary 9 (SDLT9)	62.5%	6.5%	2.9%	54.6%	64.4%	70.5%
Filterer FFG (% of community)	Unnamed Reference Creek	6.6%	11.0%	4.9%	0.6%	1.1%	26.1%
	Sheardown Tributary 1 (SDLT1)	1.3%	0.9%	0.4%	0.0%	1.1%	2.3%
	Sheardown Tributary 12 (SDLT12)	2.2%	3.4%	2.0%	0.0%	0.5%	6.1%
	Sheardown Tributary 9 (SDLT9)	2.0%	1.0%	0.4%	0.8%	2.2%	3.5%
Shredder FFG (% of community)	Unnamed Reference Creek	12.3%	7.7%	3.4%	2.5%	9.8%	21.4%
	Sheardown Tributary 1 (SDLT1)	15.0%	4.3%	1.9%	8.7%	14.9%	19.0%
	Sheardown Tributary 12 (SDLT12)	15.2%	8.6%	5.0%	5.9%	16.9%	22.9%
	Sheardown Tributary 9 (SDLT9)	32.0%	7.2%	3.2%	23.2%	31.9%	39.7%
Clinger HPG (% of community)	Unnamed Reference Creek	21.8%	18.3%	8.2%	7.3%	14.1%	52.0%
	Sheardown Tributary 1 (SDLT1)	15.4%	3.5%	1.6%	10.8%	15.6%	20.6%
	Sheardown Tributary 12 (SDLT12)	15.6%	7.5%	4.3%	8.0%	15.9%	22.9%
	Sheardown Tributary 9 (SDLT9)	35.2%	6.7%	3.0%	27.5%	33.2%	44.0%
Sprawler HPG (% of community)	Unnamed Reference Creek	69.4%	16.1%	7.2%	42.8%	71.0%	83.1%
	Sheardown Tributary 1 (SDLT1)	76.9%	4.5%	2.0%	71.0%	76.2%	83.4%
	Sheardown Tributary 12 (SDLT12)	79.8%	7.3%	4.2%	74.3%	77.1%	88.1%
	Sheardown Tributary 9 (SDLT9)	51.3%	7.5%	3.3%	40.1%	51.1%	59.7%
Burrower HPG (% of community)	Unnamed Reference Creek	5.7%	4.6%	2.1%	2.7%	3.4%	13.8%
	Sheardown Tributary 1 (SDLT1)	7.6%	1.7%	0.7%	5.9%	8.4%	9.6%
	Sheardown Tributary 12 (SDLT12)	4.6%	2.1%	1.2%	2.9%	4.0%	7.0%
	Sheardown Tributary 9 (SDLT9)	10.4%	4.3%	1.9%	4.2%	9.6%	15.0%

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 2019

Metric	Data Transform-ation	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)	log10	NO	0.275	Reference	5	1,110	472	-	a
				SDLT1	5	1,483	982	0.8	a
				SDLT12	3	3,078	2,660	4.2	a
				SDLT9	5	1,575	705	1.0	a
Richness (No. of Taxa)	log10	YES	0.002	Reference	5	18.0	2.3	-	a,b
				SDLT1	5	14.8	1.9	-1.4	b
				SDLT12	3	15.0	2.0	-1.3	b
				SDLT9	5	21.0	2.0	1.3	a
Simpson's Evenness	rank	YES	0.002	Reference	5	0.883	0.016	-	a
				SDLT1	5	0.787	0.026	-6.0	b
				SDLT12	3	0.613	0.095	-16.9	b
				SDLT9	5	0.899	0.008	1.0	a
Bray Curtis Index	none	YES	< 0.001	Reference	5	0.333	0.155	-	a
				SDLT1	5	0.683	0.070	2.3	b
				SDLT12	3	0.911	0.016	3.7	c
				SDLT9	5	0.685	0.100	2.3	b
Nemata (% of community)	log10	NO	0.169	Reference	5	3.6%	5.1%	-	a
				SDLT1	5	1.6%	0.5%	-0.4	a
				SDLT12	3	1.5%	1.0%	-0.4	a
				SDLT9	5	6.9%	3.9%	0.6	a
Oligochaeta (% of community)	log10(x+1)	YES	0.029	Reference	5	0.7%	0.7%	-	a
				SDLT1	5	3.3%	1.0%	2.0	b
				SDLT12	3	2.3%	0.6%	2.9	a,b
				SDLT9	5	2.1%	1.7%	1.3	a,b
Hydracarina (% of community)	rank	YES	0.033	Reference	5	4.5%	3.2%	-	a
				SDLT1	5	1.3%	0.9%	-1.0	b,c
				SDLT12	3	0.4%	0.7%	-1.3	c
				SDLT9	5	2.7%	1.1%	-0.6	a,b
Chironomidae (% of community)	none	YES	< 0.001	Reference	5	80.2%	6.8%	-	a
				SDLT1	5	91.6%	1.6%	1.7	b
				SDLT12	3	95.1%	1.9%	2.2	b
				SDLT9	5	63.7%	6.9%	-2.4	c
Metal Sensitive Chironomidae (% of community)	none	YES	< 0.001	Reference	5	22.9%	7.5%	-	a
				SDLT1	5	31.2%	11.0%	1.1	a
				SDLT12	3	2.3%	3.3%	-2.7	b
				SDLT9	5	2.5%	1.1%	-2.7	b
Tipulidae (% of community)	rank	NO	0.130	Reference	5	1.0%	1.1%	-	a
				SDLT1	5	2.1%	1.6%	0.9	a
				SDLT12	3	0.6%	0.3%	-0.4	a
				SDLT9	5	1.4%	0.8%	0.3	a
Collector-Gatherer FFG (% of community)	rank	YES	0.032	Reference	5	72.7%	16.4%	-	a,b
				SDLT1	5	81.6%	4.9%	0.5	a
				SDLT12	3	82.0%	5.0%	0.6	a
				SDLT9	5	62.5%	6.5%	-0.6	b
Filterer FFG (% of community)	rank	NO	0.732	Reference	5	6.6%	11.0%	-	a
				SDLT1	5	1.3%	0.9%	-0.5	a
				SDLT12	3	2.2%	3.4%	-0.4	a
				SDLT9	5	2.0%	1.0%	-0.4	a
Shredder FFG (% of community)	none	YES	0.002	Reference	5	12.3%	7.7%	-	a
				SDLT1	5	15.0%	4.3%	0.3	a
				SDLT12	3	15.2%	8.6%	0.4	a
				SDLT9	5	32.0%	7.2%	2.6	b
Clinger HPG (% of community)	log10	YES	0.052	Reference	5	21.8%	18.3%	-	a,b
				SDLT1	5	15.4%	3.5%	-0.4	b
				SDLT12	3	15.6%	7.5%	-0.3	a,b
				SDLT9	5	35.2%	6.7%	0.7	a
Sprawler HPG (% of community)	none	YES	0.004	Reference	5	69.4%	16.1%	-	a
				SDLT1	5	76.9%	4.5%	0.5	a
				SDLT12	3	79.8%	7.3%	0.6	a
				SDLT9	5	51.3%	7.5%	-1.1	b
Burrower HPG (% of community)	log10	YES	0.093	Reference	5	5.7%	4.6%	-	a
				SDLT1	5	7.6%	1.7%	0.4	a
				SDLT12	3	4.6%	2.1%	-0.2	a
				SDLT9	5	10.4%	4.3%	1.0	a

(grey box) Indicates a statisitically significant difference for respective comparison (p-value ≤ 0.1).

(blue box) 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 2019) and Baseline (2008, 2013)

Metric	Data Transform-ation	Overall 7-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 2008	Effect Size vs. Baseline Year 2013	Pairwise Comparison
Density (No. per m^2)	log10	YES	0.003	2008	3	300	52	-	-2.0	a
				2013	3	657	176	6.8	-	a,b
				2015	5	722	485	8.1	0.4	a,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	1,102	766	15.3	2.5	a,b,c
				2019	5	1,483	982	22.6	4.7	b,c
Richness (No. of Taxa)	none	NO	0.250	2008	3	12.0	1.0	-	-1.9	a
				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
				2019	5	14.8	1.9	2.8	-0.7	a
Simpson's Evenness	none	YES	0.028	2008	3	0.894	0.034	-	0.1	a
				2013	3	0.887	0.064	-0.2	-	a
				2015	5	0.869	0.067	-0.7	-0.3	a,b
				2016	5	0.872	0.032	-0.6	-0.2	a,b
				2017	5	0.883	0.028	-0.3	-0.1	a
				2018	5	0.834	0.062	-1.8	-0.8	a,b
				2019	5	0.787	0.026	-3.2	-1.6	b
Oligochaeta (% of community)	log10(x+1)	YES	0.030	2008	3	3.0%	2.5%	-	-1.3	a,b
				2013	3	7.3%	3.3%	1.7	-	a,b
				2015	5	14.4%	10.8%	4.6	2.1	a
				2016	5	14.1%	8.8%	4.5	2.0	a,b
				2017	5	8.6%	7.4%	2.3	0.4	a,b
				2018	5	2.2%	2.7%	-0.3	-1.5	b
				2019	5	3.3%	1.0%	0.1	-1.2	a,b
Hydracarina (% of community)	log10(x+1)	YES	<0.001	2008	3	12.1%	4.7%	-	2.6	a
				2013	3	4.6%	2.9%	-1.6	-	b,c
				2015	5	4.6%	1.6%	-1.6	0.0	b,c
				2016	5	5.3%	1.3%	-1.4	0.2	b
				2017	5	3.9%	2.0%	-1.7	-0.2	b,c
				2018	5	3.1%	1.7%	-1.9	-0.5	b,c
				2019	5	1.3%	0.9%	-2.3	-1.1	c
Chironomidae (% of community)	none	YES	<0.001	2008	3	69.2%	2.0%	-	-3.0	a
				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
				2019	5	91.6%	1.6%	11.4	2.7	b
Metal Sensitive Taxa (% of community)	log10	YES	0.002	2008	3	27.5%	5.4%	-	0.5	a
				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,b
				2017	5	26.1%	15.6%	-0.3	0.4	a
				2018	5	19.8%	12.4%	-1.4	0.0	a
				2019	5	31.2%	11.0%	0.7	0.8	a
Tipulidae (% of community)	log10(x+1)	YES	<0.001	2008	3	14.7%	2.7%	-	22.8	a
				2013	3	3.8%	0.5%	-4.0	-	b
				2015	5	2.1%	1.3%	-4.7	-3.7	b
				2016	5	3.5%	1.9%	-4.1	-0.6	b
				2017	5	2.8%	2.7%	-4.4	-2.1	b
				2018	5	1.9%	1.3%	-4.7	-4.0	b
				2019	5	2.1%	1.6%	-4.6	-3.6	b

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

Indicates magnitude of difference outside of a ± 2 SD effect size of respective baseline year mean indicating an ecologically meaningful difference between study years.

[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 2019) and Baseline (2008, 2013) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 7-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
								vs. Baseline Year 2008	vs. Baseline Year 2013	
Collector-Gatherer FFG (% of community)	none	YES	<0.001	2008	3	40.3%	2.9%	-	-2.0	a
				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
				2019	5	81.6%	4.9%	14.2	3.5	c
Filterer FFG (% of community)	log10(x+1)	YES	0.016	2008	3	5.2%	3.5%	-	-2.0	a,b
				2013	3	8.5%	1.6%	0.9	-	a,b
				2015	5	4.5%	1.4%	-0.2	-2.4	a,b
				2016	5	7.6%	3.3%	0.7	-0.5	a,b
				2017	5	8.9%	8.0%	1.1	0.2	a
				2018	5	1.6%	1.4%	-1.0	-4.2	b
				2019	5	1.3%	0.9%	-1.1	-4.4	b
Shredder FFG (% of community)	log10	YES	<0.001	2008	3	40.6%	4.2%	-	1.6	a
				2013	3	28.7%	7.4%	-2.8	-	a,b
				2015	5	22.9%	4.5%	-4.2	-0.8	b,c
				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
				2019	5	15.0%	4.3%	-6.1	-1.9	c

[grey box] Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

[blue box] 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 2019) and Baseline (2007) 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	Pairwise Comparison
Density (No. per m^2)	log10	NO	0.128	2007	5	1,016	669	-	a
				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
				2019	3	3,078	2,660	3.1	a
Richness (No. of Taxa)	none	YES	<0.001	2007	5	19.0	1.9	-	a
				2015	3	12.0	1.0	-3.7	b
				2016	3	18.3	1.2	-0.4	a,c
				2017	3	15.3	0.6	-2.0	b,c
				2018	3	14.3	2.5	-2.5	b
				2019	3	15.0	2.0	-2.1	b,c
Simpson's Evenness	none	YES	<0.001	2007	5	0.854	0.020	-	a
				2015	3	0.884	0.041	1.5	a
				2016	3	0.884	0.046	1.5	a
				2017	3	0.931	0.021	3.9	a
				2018	3	0.659	0.152	-9.9	b
				2019	3	0.613	0.095	-12.2	b
Oligochaeta (% of community)	log10(x+1)	YES	<0.001	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	a
				2019	3	1.5%	1.0%	1.3	a
Hydracarina (% of community)	rank	NO	0.128	2007	5	3.0%	2.9%	-	a
				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
				2019	3	0.4%	0.7%	-0.9	a
Chironomidae (% of community)	none	YES	<0.001	2007	5	88.0%	10.2%	-	a
				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
				2019	3	95.1%	1.9%	0.7	a
Metal Sensitive Taxa (% of community)	none	YES	<0.001	2007	5	3.2%	2.0%	-	a
				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	b
				2018	3	0.6%	0.6%	-1.3	a
				2019	3	2.3%	3.3%	-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.33: Statistical Comparison of Benthic Invertebrate Community Metrics at Sheardown Lake Tributary 12 (SDLT12) Among Years of Mine Operation (2015 to 2019) and Baseline (2007) 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	Pairwise Comparison
Tipulidae (% of community)	log10(x+1)	YES	0.037	2007	5	0.3%	0.5%	-	a
				2015	3	3.4%	1.3%	6.3	a,b
				2016	3	3.8%	3.1%	7.2	b
				2017	3	3.4%	2.0%	6.5	a,b
				2018	3	2.2%	1.5%	3.9	a,b
				2019	3	0.6%	0.3%	0.6	a,b
Collector-Gatherer FFG (% of community)	none	YES	0.005	2007	5	57.8%	15.8%	-	a
				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
				2019	3	82.0%	5.0%	1.5	b
Filterer FFG (% of community)	rank	YES	0.077	2007	5	6.8%	9.2%	-	a,b
				2015	3	0.0%	0.0%	-0.7	c
				2016	3	2.1%	0.1%	-0.5	a,b
				2017	3	3.5%	2.8%	-0.4	a
				2018	3	0.4%	0.4%	-0.7	b,c
				2019	3	2.2%	3.4%	-0.5	a,b,c
Shredder FFG (% of community)	log10	NO	0.187	2007	5	22.5%	8.9%	-	a
				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
				2019	3	15.2%	8.6%	-0.8	a

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

(blue box) 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 2019) and Baseline (2008, 2013)

Metric	Data Transform-ation	Overall 7-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 2008	Effect Size vs. Baseline Year 2013	Pairwise Comparison
Density (No. per m²)	log10	YES	<0.001	2008	3	300	52	-	-2.0	a
				2013	3	657	176	6.8	-	a,b
				2015	5	722	485	8.1	0.4	a,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	b,c
				2019	5	1,575	705	24.3	5.2	b,c
Richness (No. of Taxa)	none	YES	0.006	2008	3	12.0	1.0	-	-1.9	a
				2013	3	16.7	2.5	4.7	-	a,b
				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,b
				2019	5	21.0	2.0	9.0	1.7	b
Simpson's Evenness	none	NO	0.928	2008	3	0.894	0.034	-	0.1	a
				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
				2019	5	0.899	0.008	0.1	0.2	a
Oligochaeta (% of community)	rank	YES	0.017	2008	3	3.0%	2.5%	-	-1.3	a,b,c
				2013	3	7.3%	3.3%	1.7	-	a,b,d
				2015	5	14.4%	10.8%	4.6	2.1	d
				2016	5	14.1%	8.8%	4.5	2.0	a,d
				2017	5	8.6%	7.4%	2.3	0.4	a,b,d
				2018	5	0.9%	1.0%	-0.8	-1.9	c
				2019	5	2.1%	1.7%	-0.4	-1.6	b,c
Hydracarina (% of community)	log10	YES	<0.001	2008	3	12.1%	4.7%	-	2.6	a
				2013	3	4.6%	2.9%	-1.6	-	b,c
				2015	5	4.6%	1.6%	-1.6	0.0	b,c
				2016	5	5.3%	1.3%	-1.4	0.2	a,b,c
				2017	5	3.9%	2.0%	-1.7	-0.2	c
				2018	5	8.5%	2.3%	-0.8	1.3	a,b
				2019	5	2.7%	1.1%	-2.0	-0.6	c
Chironomidae (% of community)	none	YES	0.072	2008	3	69.2%	2.0%	-	-3.0	a,b
				2013	3	81.1%	3.9%	6.0	-	a,b
				2015	5	72.0%	9.0%	1.4	-2.3	a,b
				2016	5	73.1%	11.9%	2.0	-2.0	a,b
				2017	5	82.4%	10.1%	6.7	0.3	a
				2018	5	75.8%	11.1%	3.3	-1.4	a,b
				2019	5	63.7%	6.9%	-2.8	-4.4	b
Metal Sensitive Taxa (% of community)	rank	YES	<0.001	2008	3	27.5%	5.4%	-	0.5	a
				2013	3	19.9%	14.3%	-1.4	-	a,b
				2015	5	6.1%	2.9%	-3.9	-1.0	b,c
				2016	5	15.6%	4.4%	-2.2	-0.3	a,b
				2017	5	26.1%	15.6%	-0.3	0.4	a
				2018	5	0.8%	0.6%	-4.9	-1.3	d
				2019	5	2.5%	1.1%	-4.6	-1.2	c,d
Tipulidae (% of community)	log10(x+1)	YES	<0.001	2008	3	14.7%	2.7%	-	22.8	a
				2013	3	3.8%	0.5%	-4.0	-	b
				2015	5	2.1%	1.3%	-4.7	-3.7	b
				2016	5	3.5%	1.9%	-4.1	-0.6	b
				2017	5	2.8%	2.7%	-4.4	-2.1	b
				2018	5	3.6%	2.3%	-4.1	-0.4	b
				2019	5	1.4%	0.8%	-4.9	-5.0	b

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

(Blue) Indicates magnitude of difference outside of a ± 2 SD effect size of respective baseline year mean indicating an ecologically meaningful difference between study years.

[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 2019) and Baseline (2008, 2013) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 7-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
								vs. Baseline Year 2008	vs. Baseline Year 2013	
Collector-Gatherer FFG (% of community)	none	YES	0.006	2008	3	40.3%	2.9%	-	-2.0	a
				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
				2019	5	62.5%	6.5%	7.7	0.9	b
Filterer FFG (% of community)	log10(x+1)	YES	0.024	2008	3	5.2%	3.5%	-	-2.0	a,b
				2013	3	8.5%	1.6%	0.9	-	a,b
				2015	5	4.5%	1.4%	-0.2	-2.4	a,b
				2016	5	7.6%	3.3%	0.7	-0.5	a,b
				2017	5	8.9%	8.0%	1.1	0.2	a
				2018	5	1.4%	1.4%	-1.1	-4.3	b
				2019	5	2.0%	1.0%	-0.9	-3.9	a,b
Shredder FFG (% of community)	none	YES	0.049	2008	3	40.6%	4.2%	-	1.6	a
				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
				2019	5	32.0%	7.2%	-2.1	0.4	a,b

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

(blue) 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 Sediment Physical Properties Between Sheardown Lake NW and Reference Lake 3 Benthic Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2019

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	0.365	β	Reference	5	58.5	10.1	4.5	43.3	68.9
					Sheardown NW	5	51.5	22.6	10.1	37.3	91.6
	Silt-Sized Material (%)	NO	0.601	α	Reference	5	34.4	9.6	4.3	24.9	48.4
					Sheardown NW	5	39.4	18.0	8.0	7.5	50.1
	Clay-Sized Material (%)	NO	0.151	γ	Reference	5	7.1	1.2	0.5	5.4	8.2
					Sheardown NW	5	9.2	4.7	2.1	1.0	12.6
	Moisture (%)	NO	0.151	γ	Reference	5	84.0	5.9	2.6	77.8	91.4
					Sheardown NW	5	66.7	25.7	11.5	21.2	82.3
	Total Organic Carbon (TOC) Content (%)	NO	0.341	α	Reference	5	4.2	2.4	1.1	2.2	7.4
					Sheardown NW	5	2.8	1.8	0.8	0.2	5.3
Profundal (Deep) Stations	Sand-Sized Material (%)	NO	0.134	β	Reference	5	51.1	3.2	1.4	46.3	54.0
					Sheardown NW	5	33.5	26.4	11.8	9.6	74.4
	Silt-Sized Material (%)	NO	0.188	α	Reference	5	40.0	2.9	1.3	36.9	44.6
					Sheardown NW	5	52.5	19.2	8.6	21.0	67.7
	Clay-Sized Material (%)	NO	0.392	β	Reference	5	9.0	0.8	0.4	7.9	10.2
					Sheardown NW	5	14.1	8.3	3.7	4.6	25.2
	Moisture (%)	YES	0.008	γ	Reference	5	87.4	1.0	0.4	86.0	88.6
					Sheardown NW	5	59.2	14.5	6.5	35.2	69.5
	Total Organic Carbon (TOC) Content (%)	YES	<0.001	α	Reference	5	4.3	0.3	0.1	3.9	4.6
					Sheardown NW	5	1.1	0.5	0.2	0.5	1.6

Highlighted values indicate significant difference between study areas based on statistical 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 F.37: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Northwest, August 2019

Taxa	Study Area / Replicate Station	Sheardown Lake NW - Littoral Stations				
		DLO-1-9	DLO-1-4	DLO-1-3	DLO-1-11	DLO-1-10
ROUNDWORMS						
P. Nemata		-	-	-	34	34
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	-	-	-	-
F. Lumbriculidae						
Lumbriculus		9	34	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		-	-	-	-	-
F. Acalyptonotidae						
Acalyptonotus		-	-	-	34	103
F. Hygrobatidae						
Hygrobates		9	-	-	34	69
F. Lebertiidae						
Lebertia		-	-	-	103	138
F. Sperchontidae						
Sperchon		-	-	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	-	-	17
SEED SHRIMPS						
Cl. Ostracoda		216	1,138	897	1,966	948
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
immature		-	-	-	-	-
F. Apataniidae						
Apatania		-	-	34	34	17
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		-	**34**	-	-	-
S.F. Chironominae						
Chironomus		-	-	-	-	-
Lipiniella		-	-	-	-	-

Table F.37: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Northwest, August 2019

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
Micropsectra		9	379	207	138	793
Paratanytarsus		43	345	345	345	319
Polypedilum		-	-	-	-	-
Sergentia		-	-	-	-	-
Stictochironomus		1,345	2,448	4,310	4,379	4,043
Tanytarsus		-	207	172	-	60
S.F. Diamesinae						
Protanypus		17	34	-	34	60
Pseudodiamesa		-	34	-	-	-
Pseudokiefferiella		-	-	-	-	-
S.F. Orthocladiinae						
Abiskomyia		-	34	69	103	543
Eukiefferiella		-	-	-	-	-
Heterotrissocladius		103	69	552	724	698
Hydrobaenus		-	-	-	-	-
Mesocricotopus		-	-	-	-	-
Paracladius		-	-	-	-	95
Parakiefferiella		-	-	-	-	60
Psectrocladius		-	-	-	-	-
Zalutschia		-	-	34	69	34
Orthocladiinae Genus "Greenland'		-	34	-	-	-
S.F. Tanypodinae						
Arctopelopia		86	759	448	276	95
Procladius		17	-	69	-	95
Density (No. organisms per m^2)		1,854	5,549	7,137	8,273	8,221
Richness (total number of taxa)[a]		10	12	11	14	19
Simpson's Evenness (E)		0.505	0.798	0.666	0.702	0.761
Bray-Curtis Index		0.776	0.872	0.889	0.877	0.812
Dominant Taxonomic Group Composition						
% Nemata		0.0%	0.0%	0.0%	0.4%	0.4%
% Hydracarina		0.5%	0.0%	0.0%	2.1%	3.8%
% Ostracods		11.7%	20.5%	12.6%	23.8%	11.5%
% Chironomids		87.4%	78.9%	87.0%	73.3%	83.9%
% Metal Sensitive Chironmids		3.7%	18.2%	10.1%	6.2%	15.0%
% Tipulidae		0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition						
% Collector - Gatherers		91.2%	69.3%	81.7%	87.5%	79.0%
% Filterers		2.8%	16.9%	10.1%	5.8%	14.3%
% Shredders		0.0%	0.0%	0.5%	0.8%	0.4%
Habitat Preference Group Composition						
% Clingers		1.0%	10.7%	5.8%	4.1%	14.4%
% Sprawlers		25.1%	43.7%	33.8%	42.1%	35.3%
% Burrowers		73.9%	45.6%	60.4%	53.8%	50.3%

[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 Northwest, August 2019

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	-	-	9	17
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	-	-	-	-
F. Lumbriculidae						
Lumbriculus		-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		-	-	-	-	-
F. Acalyptonotidae						
Acalyptonotus		26	9	-	86	60
F. Hygrobatidae						
Hygrobates		-	17	-	26	43
F. Lebertiidae						
Lebertia		9	-	-	17	26
F. Sperchontidae						
Sperchon		-	-	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		52	26	-	52	78
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
immature		-	-	-	-	-
F. Apataniidae						
Apatania		-	-	-	-	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		**34**	-	-	-	-
S.F. Chironominae						
Chironomus		871	-	-	-	-
Lipiniella		-	-	-	-	-

Table F.37: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Northwest, August 2019

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
Micropsectra		-	-	-	-	9
Paratanytarsus		-	-	-	-	-
Polypedilum		-	-	-	-	-
Sergentia		9	-	-	-	-
Stictochironomus		164	138	-	17	-
Tanytarsus		95	-	-	-	-
S.F. Diamesinae						
Protanypus		-	9	17	9	-
Pseudodiamesa		-	17	-	9	9
Pseudokiefferiella		-	-	-	-	-
S.F. Orthocladiinae						
Abiskomyia		69	9	-	-	17
Eukiefferiella		-	-	-	-	-
Heterotrissocladius		276	1,121	1,819	940	1,603
Hydrobaenus		-	-	-	-	-
Mesocricotopus		-	-	-	-	-
Paracladius		-	-	-	-	-
Parakiefferiella		-	-	-	26	-
Psectrocladius		-	-	-	-	-
Zalutschia		-	-	-	-	34
Orthocladiinae Genus "Greenla		-	-	-	-	-
S.F. Tanypodinae						
Arctopelopia		-	9	-	-	-
Procladius		34	60	86	147	129
Density (No. organisms per m^2)		1,648	1,415	1,922	1,338	2,025
Richness (total number of taxa)[a]		11	10	3	11	11
Simpson's Evenness (E)		0.728	0.400	0.153	0.536	0.402
Bray-Curtis Index		0.736	0.720	0.809	0.695	0.779
Dominant Taxonomic Group Compo						
% Nemata		0.5%	0.0%	0.0%	0.7%	0.8%
% Hydracarina		2.1%	1.8%	0.0%	9.6%	6.4%
% Ostracods		3.2%	1.8%	0.0%	3.9%	3.9%
% Chironomids		94.2%	96.3%	100.0%	85.8%	88.9%
% Metal Sensitive Chironmids		5.9%	1.8%	0.9%	1.3%	0.9%
% Tipulidae		0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Compos						
% Collector - Gatherers		89.9%	93.3%	95.5%	79.4%	85.1%
% Filterers		5.9%	0.0%	0.0%	0.0%	0.4%
% Shredders		0.0%	0.0%	0.0%	0.0%	1.7%
Habitat Preference Group Composi						
% Clingers		8.6%	1.8%	0.0%	9.6%	6.8%
% Sprawlers		26.7%	87.8%	99.1%	87.7%	92.3%
% Burrowers		64.7%	10.4%	0.9%	2.6%	0.8%

[a] Bold entries excluded from taxa cour

Table F.38: Statistical Comparison of Benthic Metrics at Sheardown Lake NW Littoral (Shallow) Stations Among Years of Mine Operation (2015 to 2019) 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]								
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Effect Size vs. Baseline Year 2008	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.6966	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	
				2019	5	6,207	2,673	0.1	-0.3	-1.4	a	
Richness (No. of Taxa)	log10	NO	0.2405	2007	4	12.3	1.5	-	-1.3	-1.7	a	Tukey's HSD
				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	
				2019	5	13.2	3.6	0.6	-0.8	-1.4	a	
Simpson's Evenness	log10	YES	0.0589	2007	4	0.768	0.055	-	-0.7	-2.0	a	Tamhane's
				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	
				2019	5	0.686	0.114	-1.5	-1.6	-3.8	a	
Nemata (% of community)	modified probit	NO	0.4785	2007	4	1.5%	1.6%	-	0.4	1.1	a	Tukey's HSD
				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	
				2019	5	0.2%	0.2%	-0.9	-0.9	-0.5	a	
Ostracoda (% of community)	none	NO	0.1227	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	
				2019	5	16.0%	5.7%	0.3	0.6	-0.9	a	

Table F.38: Statistical Comparison of Benthic Metrics at Sheardown Lake NW Littoral (Shallow) Stations Among Years of Mine Operation (2015 to 2019) 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]								
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Effect Size vs. Baseline Year 2008	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Chironomidae (% of community)	none	YES	0.0130	2007	4	83.0%	8.3%	-	0.3	1.3	a	Tamhane's
				2008	4	81.2%	6.7%	-0.2	-	1.1	a	
				2013	3	70.5%	9.6%	-1.5	-1.6	-	a	
				2015	5	89.8%	3.2%	0.8	1.3	2.0	a	
				2016	5	85.0%	6.6%	0.2	0.6	1.5	a	
				2017	5	73.5%	11.2%	-1.1	-1.2	0.3	a	
				2018	5	83.7%	2.9%	0.1	0.4	1.4	a	
				2019	5	82.1%	5.9%	-0.1	0.1	1.2	a	
Metal Sensitive Taxa (% of community)	none	NO	0.7984	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	
				2019	5	10.7%	6.0%	-0.4	-0.6	-2.2	a	
Collector-Gatherer FFG (% of community)	none	YES	0.0289	2007	4	71.6%	13.5%	-	0.7	0.7	a,b	Tukey's HSD
				2008	4	61.1%	15.0%	-0.8	-	-0.5	a,b	
				2013	3	65.3%	9.0%	-0.5	0.3	-	a,b	
				2015	5	68.9%	8.0%	-0.2	0.5	0.4	a,b	
				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,b	
				2018	5	76.2%	13.1%	0.3	1.0	1.2	a,b	
				2019	5	81.7%	8.4%	0.8	1.4	1.8	b	
Filterer FFG (% of community)	none	NO	0.8649	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	
				2019	5	10.0%	5.8%	-0.4	-0.6	-2.4	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 2019) 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 vs. Baseline Year 2007	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0000	2007	4	1,461	308	-	-4.3	a,d	Tukey's HSD
				2013	3	2,744	302	4.2	-	b	
				2015	5	1,425	210	-0.1	-4.4	a,d	
				2017	5	861	391	-1.9	-6.2	c	
				2018	5	1,154	240	-1.0	-5.3	a,c,d	
				2019	5	1,670	302	0.7	-3.6	d	
Richness (No. of Taxa)	rank	NO	0.9104	2007	4	7.5	0.4	-	-0.9	a	Mann-Whitney U-test
				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	
				2019	5	9.2	3.5	4.0	-0.3	a	
Simpson's Evenness	none	YES	0.0574	2007	4	0.426	0.165	-	-0.6	a,b	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	
				2019	5	0.444	0.210	0.1	-0.5	a,b	
Nemata (% of community)	rank	NO	0.1932	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	
				2019	5	0.4%	0.4%	-0.4	-1.2	a	
Ostracoda (% of community)	none	NO	0.1923	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	
				2019	5	2.5%	1.6%	6.3	-0.4	a	
Chironomidae (% of community)	none	NO	0.1226	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	
				2019	5	93.0%	5.7%	-0.8	0.9	a	

Table F.39: Statistical Comparison of Benthic Metrics at Sheardown Lake NW Profundal (Deep) Stations Among Years of Mine Operation (2015 to 2019) 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 vs. Baseline Year 2007	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0109	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	
				2019	5	2.2%	2.1%	2.7	0.5	a	
Collector-Gatherer FFG (% of community)	none	YES	0.0396	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	
				2019	5	88.6%	6.5%	0.6	0.5	a	
Filterer FFG (% of community)	rank	NO	0.4335	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	
				2019	5	1.3%	2.6%	11.1	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 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 Sediment Physical Properties Between Sheardown Lake SE and Reference Lake 3 Benthic Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2019

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	58.5	10.1	4.5	43.3	68.9
					Sheardown SE	5	14.5	7.8	3.5	9.9	28.4
	Silt-Sized Material (%)	YES	< 0.001	α	Reference	5	34.4	9.6	4.3	24.9	48.4
					Sheardown SE	5	71.5	5.5	2.5	64.4	77.2
	Clay-Sized Material (%)	YES	0.017	β	Reference	5	7.1	1.2	0.5	5.4	8.2
					Sheardown SE	5	14.0	5.7	2.5	7.2	21.5
	Moisture (%)	YES	0.005	α	Reference	5	84.0	5.9	2.6	77.8	91.4
					Sheardown SE	5	64.5	9.6	4.3	49.5	73.9
	Total Organic Carbon (TOC) Content (%)	YES	0.005	β	Reference	5	4.2	2.4	1.1	2.2	7.4
					Sheardown SE	5	1.3	0.4	0.2	0.8	1.7
Profundal (Deep) Stations	Sand-Sized Material (%)	YES	< 0.001	α	Reference	5	51.1	3.2	1.4	46.3	54.0
					Sheardown SE	5	14.0	5.5	2.5	7.5	21.8
	Silt-Sized Material (%)	YES	<0.001	β	Reference	5	40.0	2.9	1.3	36.9	44.6
					Sheardown SE	5	73.8	4.2	1.9	69.7	80.9
	Clay-Sized Material (%)	YES	0.077	δ	Reference	5	9.0	0.8	0.4	7.9	10.2
					Sheardown SE	5	12.2	3.2	1.4	8.6	15.9
	Moisture (%)	YES	0.008	γ	Reference	5	87.4	1.0	0.4	86.0	88.6
					Sheardown SE	5	54.7	4.9	2.2	50.8	63.2
	Total Organic Carbon (TOC) Content (%)	YES	<0.001	β	Reference	5	4.3	0.3	0.1	3.9	4.6
					Sheardown SE	5	1.0	0.1	0.1	0.8	1.2

Highlighted values indicate significant difference between study areas based on statistical 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 F.41: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Southeast, August 2019

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		69	69	121	-	-
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	-	-	-	-
F. Lumbriculidae						
Lumbriculus		-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		-	-	-	-	-
F. Acalyptonotidae						
Acalyptonotus		34	241	-	52	-
F. Hygrobatidae						
Hygrobates		34	103	34	60	69
F. Lebertiidae						
Lebertia		34	-	34	34	34
F. Sperchontidae						
Sperchon		-	-	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		241	1,241	34	43	86
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
immature		34	-	-	-	-
F. Apataniidae						
Apatania		-	34	17	9	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		-	-	-	-	-
S.F. Chironominae						
Chironomus		-	414	-	17	466
Lipiniella		-	-	-	-	17

Table F.41: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Southeast, August 2019

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
Micropsectra		966	828	603	1,224	69
Paratanytarsus		-	-	-	-	-
Polypedilum		-	-	-	-	-
Sergentia		-	-	-	17	-
Stictochironomus		2,759	1,621	1,052	1,336	1,500
Tanytarsus		-	138	310	-	86
S.F. Diamesinae						
Protanypus		-	-	-	-	-
Pseudodiamesa		-	-	-	-	-
Pseudokiefferiella		-	-	-	-	-
S.F. Orthocladiinae						
Abiskomyia		-	241	172	259	310
Eukiefferiella		-	-	-	-	-
Heterotrissocladius		517	345	103	172	17
Hydrobaenus		-	-	-	-	-
Mesocricotopus		-	-	-	-	-
Paracladius		-	-	-	-	-
Parakiefferiella		-	-	-	-	-
Psectrocladius		-	-	-	-	-
Zalutschia		-	-	-	-	-
Orthocladiinae Genus "Greenland'		-	-	-	-	-
S.F. Tanypodinae						
Arctopelopia		34	207	-	-	-
Procladius		1,345	1,034	1,328	2,216	914
Density (No. organisms per m^2)		6,067	6,516	3,808	5,439	3,568
Richness (total number of taxa)[a]		11	13	11	12	11
Simpson's Evenness (E)		0.781	0.920	0.843	0.785	0.804
Bray-Curtis Index		0.882	0.822	0.822	0.854	0.770
Dominant Taxonomic Group Composition						
% Nemata		1.1%	1.1%	3.2%	0.0%	0.0%
% Hydracarina		1.7%	5.3%	1.8%	2.7%	2.9%
% Ostracods		4.0%	19.0%	0.9%	0.8%	2.4%
% Chironomids		92.6%	74.1%	93.7%	96.4%	94.7%
% Metal Sensitive Chironmids		15.9%	14.8%	24.0%	22.5%	4.3%
% Tipulidae		0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition						
% Collector - Gatherers		59.1%	60.3%	38.9%	33.9%	67.2%
% Filterers		15.9%	14.8%	24.0%	22.5%	4.3%
% Shredders		0.0%	0.0%	0.0%	0.0%	0.0%
Habit Preference Group Composition						
% Clingers		18.2%	20.6%	26.2%	25.7%	7.2%
% Sprawlers		35.2%	47.1%	43.0%	49.5%	37.2%
% Burrowers		46.6%	32.3%	30.8%	24.9%	55.6%

[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 Southeast, August 2019

Taxa	Study Area / Replicate Station	Sheardown Lake SE - Profundal Stations				
		DLO-2-12	DLO-2-8	DLO-2-13	DLO-2-2	DLO-2-3
ROUNDWORMS						
P. Nemata		17	9	34	-	-
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	-	-	-	-
F. Lumbriculidae						
Lumbriculus		-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		**-**	**-**	**9**	**-**	**-**
F. Acalyptonotidae						
Acalyptonotus		34	69	129	17	34
F. Hygrobatidae						
Hygrobates		-	52	52	-	-
F. Lebertiidae						
Lebertia		17	9	78	-	-
F. Sperchontidae						
Sperchon		-	-	-	-	-
HARPACTICOIDS						
O. Harpacticoida		-	-	-	-	-
SEED SHRIMPS						
Cl. Ostracoda		34	60	207	78	69
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
immature		-	-	-	-	-
F. Apataniidae						
Apatania		-	-	-	-	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		**-**	**-**	**-**	**-**	**-**
S.F. Chironominae						
Chironomus		-	9	-	2,759	1,241
Lipiniella		-	-	-	-	-

Table F.41: **Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Southeast, August 2019**

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
Micropsectra		672	1,578	879	-	207
Paratanytarsus		-	-	-	-	-
Polypedilum		-	-	-	-	-
Sergentia		-	-	-	26	-
Stictochironomus		845	2,552	845	233	1,517
Tanytarsus		17	103	181	121	138
S.F. Diamesinae						
Protanypus		-	9	-	-	-
Pseudodiamesa		-	-	-	-	-
Pseudokiefferiella		-	-	-	-	-
S.F. Orthocladiinae						
Abiskomyia		34	233	17	-	69
Eukiefferiella		-	-	-	9	-
Heterotrissocladius		34	43	95	-	-
Hydrobaenus		-	-	-	-	-
Mesocricotopus		-	-	9	-	-
Paracladius		-	-	-	-	-
Parakiefferiella		-	-	-	-	-
Psectrocladius		-	-	-	-	-
Zalutschia		-	-	-	-	-
Orthocladiinae Genus "Greenla		-	-	-	-	-
S.F. Tanypodinae						
Arctopelopia		-	-	-	-	-
Procladius		2,224	1,043	1,629	388	655
Density (No. organisms per m^2)		3,928	5,769	4,164	3,631	3,930
Richness (total number of taxa)[a]		10	13	12	8	8
Simpson's Evenness (E)		0.671	0.752	0.823	0.463	0.821
Bray-Curtis Index		0.963	0.971	0.937	0.991	0.988
Dominant Taxonomic Group Compo						
% Nemata		0.4%	0.2%	0.8%	0.0%	0.0%
% Hydracarina		1.3%	2.3%	6.4%	0.5%	0.9%
% Ostracods		0.9%	1.0%	5.0%	2.1%	1.8%
% Chironomids		97.4%	96.6%	87.8%	97.4%	97.4%
% Metal Sensitive Chironmids		17.5%	29.3%	25.5%	3.3%	8.8%
% Tipulidae		0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Compos						
% Collector - Gatherers		24.5%	50.5%	29.0%	85.5%	73.7%
% Filterers		17.5%	29.1%	25.5%	3.3%	8.8%
% Shredders		0.0%	0.0%	0.0%	0.0%	0.0%
Habit Preference Group Compositic						
% Clingers		18.8%	31.4%	31.9%	4.5%	9.6%
% Sprawlers		59.2%	23.9%	47.0%	13.1%	20.2%
% Burrowers		21.9%	44.7%	21.1%	82.4%	70.2%

[a] Bold entries excluded from taxa cour

Table F.42: Statistical Comparison of Benthic Invertebrate Community Metrics at Sheardown Lake SE Littoral (Shallow) Stations Among Years of Mine Operation (2015 to 2019) and Baseline (2013)

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 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0003	2013	5	10,649	4,062	-	a	Tamhane's
				2015	5	4,829	1,898	-1.4	a	
				2016	5	3,700	1,485	-1.7	a	
				2017	5	4,417	1,317	-1.5	a	
				2018	5	4,240	1,520	-1.6	a	
				2019	5	5,080	1,329	-1.4	a	
Richness (No. of Taxa)	rank	YES	0.0998	2013	5	14.2	4.0	-	a	Mann-Whitney U-test
				2015	5	10.6	2.5	-0.9	b,c	
				2016	5	11.4	2.3	-0.7	a,b,c	
				2017	5	9.0	0.7	-1.3	b	
				2018	5	10.2	2.6	-1.0	a,b,c	
				2019	5	11.6	0.9	-0.7	a,c	
Simpson's Evenness	none	NO	0.3635	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	
				2019	5	0.826	0.058	0.4	a	
Nemata (% of community)	rank	NO	0.9314	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	
				2019	5	1.1%	1.3%	4.5	a	
Ostracoda (% of community)	rank	NO	0.5774	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	
				2019	5	5.4%	7.7%	-0.1	a	
Chironomidae (% of community)	rank	NO	0.1657	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	
				2019	5	90.3%	9.2%	0.0	a	
Metal Sensitive Taxa (% of community)	none	NO	0.5252	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	
				2019	5	16.3%	7.8%	0.1	a	
Collector-Gatherer FFG (% of community)	none	NO	0.5561	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	
				2019	5	51.9%	14.6%	0.9	a	
Filterer FFG (% of community)	none	NO	0.5082	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	
				2019	5	16.3%	7.8%	0.1	a	

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

(blue) 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 2019) 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)	rank	YES	0.0117	2007	3	4,998	348	-	-1.8	a	Tukey's HSD
				2013	4	6,602	874	4.6	-	b	
				2015	5	3,185	281	-5.2	-3.9	c,d	
				2017	5	3,234	880	-5.1	-3.9	d	
				2018	5	3,209	2,747	-5.1	-3.9	a,b,c,d	
				2019	5	4,284	851	-2.1	-2.7	a	
Richness (No. of Taxa)	rank	NO	0.6364	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	
				2019	5	10.2	2.3	0.4	-0.1	a	
Simpson's Evenness	rank	NO	0.1340	2007	3	0.607	0.093	-	-2.4	a	Tukey's HSD
				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	
				2019	5	0.706	0.149	1.1	0.1	a	
Nemata (% of community)	rank	NO	0.4352	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	
				2019	5	0.3%	0.3%	4.8	1.8	a	
Ostracoda (% of community)	rank	NO	0.1046	2007	3	1.1%	1.5%	-	5.1	a	Tamhane's
				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	
				2019	5	2.2%	1.7%	0.7	10.4	a	
Chironomidae (% of community)	rank	NO	0.4404	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	
				2019	5	95.3%	4.2%	-0.6	-11.5	a	

(Grey shading) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(Blue shading) 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 2019) 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		
Metal Sensitive Taxa (% of community)	none	NO	0.1986	2007	3	13.5%	11.4%	-	-1.2	a	Tamhane's
				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	
				2019	5	16.9%	10.9%	0.3	0.0	a	
Collector-Gatherer FFG (% of community)	none	NO	0.4419	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	
				2019	5	52.7%	26.8%	-1.4	-1.6	a	
Filterer FFG (% of community)	rank	NO	0.1964	2007	3	13.4%	11.5%	-	-1.2	a	Mann-Whitney U-test
				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	
				2019	5	16.8%	10.9%	0.3	0.0	a	

(grey box) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue box) 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.44: Replicate Grab Data for Benthic Invertebrate Community Samples Collected at the Mary River, Mary River Project CREMP, August 2019

Study Area	Station	Water Depth (m)			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	0.13	0.12	0.24	0.43	0.34	0.28	50%	50%	75%	none	sparse	none	common	common	abundant
	GO-09 B2	0.10	0.22	0.12	0.56	0.48	0.36	75%	25%	25%	sparse	sparse	none	common	common	common
	GO-09 B3	0.12	0.22	0.20	0.43	0.49	0.48	-	25%	25%	-	sparse	none	-	common	abundant
	GO-09 B4	0.20	0.20	0.15	0.49	0.36	0.42	25%	25%	25%	common	sparse	sparse	abundant	abundant	abundant
	GO-09 B5	0.14	0.18	0.20	0.80	0.74	0.32	25%	25%	25%	sparse	common	common	abundant	abundant	abundant
Mary River Upstream (GO-03)	GO-03 B1	0.10	0.12	0.08	0.31	0.52	0.65	25%	25%	50%	none	none	none	sparse	sparse	sparse
	GO-03 B2	0.08	0.10	0.12	0.44	0.52	0.34	75%	50%	50%	none	none	sparse	common	common	common
	GO-03 B3	0.12	0.12	0.10	0.62	0.27	0.39	50%	50%	75%	none	none	none	common	sparse	sparse
	GO-03 B4	0.15	0.13	0.10	0.32	0.37	0.43	75%	75%	75%	none	none	none	common	common	common
	GO-03 B5	0.13	0.16	0.12	0.35	0.65	0.44	25%	25%	25%	sparse	none	none	sparse	sparse	sparse
Mary River Upper Mine-Exposed (EO-01)	EO-01 B1	0.22	0.19	0.16	0.26	0.55	0.44	25%	0%	0%	none	none	none	sparse	sparse	sparse
	EO-01 B2	0.26	0.32	0.65	0.15	0.20	0.22	25%	25%	0%	none	none	none	common	common	sparse
	EO-01 B3	0.47	0.21	0.14	0.16	0.43	0.34	50%	25%	25%	none	none	none	sparse	common	abundant
	EO-01 B4	0.20	0.13	0.10	0.43	0.42	0.66	25%	50%	25%	none	none	none	sparse	sparse	common
	EO-01 B5	0.15	0.15	0.14	0.40	0.34	0.63	0%	25%	50%	none	sparse	sparse	sparse	common	common
Mary River Middle Mine-Exposed (EO-20)	EO-20 B1	0.19	0.12	0.10	0.32	0.31	0.39	-	-	50%	-	-	common	abundant	abundant	abundant
	EO-20 B2	0.10	0.10	0.14	0.36	0.43	0.45	-	25%	25%	-	common	common	-	abundant	abundant
	EO-20 B3	0.14	0.11	0.10	0.33	0.32	0.32	75%	50%	50%	none	none	none	abudant	abundant	abundant
	EO-20 B4	0.14	0.11	0.20	0.25	0.29	0.46	75%	50%	75%	none	none	none	abudant	abundant	common
	EO-20 B5	0.10	0.14	0.13	0.37	0.28	0.58	50%	50%	25%	none	none	none	common	common	common
Mary River Lower Mine-Exposed (CO-05)	CO-05 B1	0.12	0.19	0.15	0.30	0.36	0.45	25%	25%	50%	sparse	none	sparse	abundant	common	abundant
	CO-05 B2	0.17	0.10	0.16	0.35	0.37	0.50	25%	25%	25%	sparse	none	none	sparse	sparse	sparse
	CO-05 B3	0.11	0.13	0.10	0.32	0.46	0.44	50%	50%	75%	sparse	common	common	sparse	sparse	common
	CO-05 B4	0.08	0.11	0.14	0.36	0.29	0.49	-	25%	50%	-	none	common	-	sparse	common
	CO-05 B5	0.12	0.20	0.14	0.43	0.62	0.37	50%	25%	25%	sparse	common	none	common	common	common

Table F.45: Replicate Station Habitat Feature Summary Statistics for Mary River Benthic Stations, Mary River Project CREMP, August 2019

Metric	Study Area	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Water Depth (cm)	GO-09 Reference Area	16.9	1.5	0.7	14.7	17.3	18.3
	GO-03 Upstream Area	11.5	1.6	0.7	10.0	11.3	13.7
	EO-01 Upper Mine-Exposed Area	23.3	11.2	5.0	14.3	19.0	41.0
	EO-20 Middle Mine-Exposed Area	12.8	1.5	0.7	11.3	12.3	15.0
	CO-05 Lower Mine-Exposed Area	13.5	2.1	1.0	11.0	14.3	15.3
Water Velocity (cm/s)	GO-09 Reference Area	46.5	9.9	4.4	35.0	46.7	62.0
	GO-03 Upstream Area	44.1	4.8	2.1	37.3	43.3	49.3
	EO-01 Upper Mine-Exposed Area	37.5	12.6	5.6	19.0	41.7	50.3
	EO-20 Middle Mine-Exposed Area	36.4	4.4	2.0	32.3	34.0	41.3
	CO-05 Lower Mine-Exposed Area	40.7	4.0	1.8	37.0	40.7	47.3
Substrate Embeddedness (%)	GO-09 Reference Area	35.0%	14.9%	6.7%	25.0%	25.0%	58.3%
	GO-03 Upstream Area	50.0%	20.4%	9.1%	25.0%	58.3%	75.0%
	EO-01 Upper Mine-Exposed Area	23.3%	10.9%	4.9%	8.3%	25.0%	33.3%
	EO-20 Middle Mine-Exposed Area	48.3%	16.0%	7.2%	25.0%	50.0%	66.7%
	CO-05 Lower Mine-Exposed Area	37.5%	12.5%	5.6%	25.0%	33.3%	58.3%

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 2019

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
Water Depth (cm)	YES	0.003	β	GO-09	GO-03	YES	0.098
				GO-09	EO-01	NO	0.505
				GO-09	EO-20	NO	0.336
				GO-09	CO-05	NO	0.506
				GO-03	EO-01	YES	0.003
				GO-03	EO-20	NO	0.947
				GO-03	CO-05	NO	0.834
				EO-01	EO-20	YES	0.016
				EO-01	CO-05	YES	0.030
				EO-20	CO-05	NO	0.998
Water Velocity (cm/s)	NO	0.250	α	GO-09	GO-03	NO	0.988
				GO-09	EO-01	NO	0.403
				GO-09	EO-20	NO	0.292
				GO-09	CO-05	NO	0.775
				GO-03	EO-01	NO	0.684
				GO-03	EO-20	NO	0.548
				GO-03	CO-05	NO	0.959
				EO-01	EO-20	NO	0.999
				EO-01	CO-05	NO	0.967
				EO-20	CO-05	NO	0.906
Substrate Embeddedness (%)	YES	0.074	α	GO-09	GO-03	NO	0.544
				GO-09	EO-01	NO	0.748
				GO-09	EO-20	NO	0.648
				GO-09	CO-05	NO	0.999
				GO-03	EO-01	YES	0.080
				GO-03	EO-20	NO	1.000
				GO-03	CO-05	NO	0.699
				EO-01	EO-20	NO	0.112
				EO-01	CO-05	NO	0.596
				EO-20	CO-05	NO	0.794

[grey box] 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 2019**

Taxa	Study Area	GO-09 (Upstream Reference)				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		7	7	11	-	11
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	4	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		-	-	-	-	-
F. Hygrobatidae						
Hygrobates		-	-	-	-	-
F. Sperchonidae						
Sperchon		22	-	4	7	14
SEED SHRIMPS						
Cl. Ostracoda		-	-	-	-	-
INSECTS						
Cl. Insecta						
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		-	-	-	-	-
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
indeterminate		-	-	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		**4**	**11**	**14**	**4**	**4**
S.F. Chironominae						
Micropsectra		-	-	-	-	-
Rheotanytarsus		-	-	-	-	-
S.F. Diamesinae						
Diamesa		14	29	36	29	79
Pseudodiamesa		-	-	-	-	14
Pseudokiefferiella		93	1,564	649	1,417	743
S.F. Orthocladiinae						
Cardiocladius		4	14	-	-	39
Chaetocladius		-	43	-	-	-
Corynoneura		-	-	-	-	-
Cricotopus		50	90	22	54	25
Cricotopus/Orthocladius		14	-	25	-	14
Diplocladius		-	-	-	-	-
Eukiefferiella		14	43	97	25	39
Hydrobaenus		-	-	14	14	-

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 2019

Taxa — Study Area / Replicate Station	GO-09 (Upstream Reference) B1	B2	B3	B4	B5
Hydrosmittia	-	-	-	-	-
Krenosmittia	-	-	-	-	-
Limnophyes	-	-	-	-	-
Metriocnemus	-	-	-	-	-
Orthocladius (Euorthocladius)	161	165	97	161	39
Paraphaenocladius	-	-	-	-	-
Synorthocladius	-	-	-	-	-
Thienemanniella	-	-	-	-	-
Tokunagaia	283	445	405	445	344
Tvetenia	-	-	-	-	-
indeterminate	**29**	**29**	-	-	-
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
pupae	-	4	-	-	-
F. Simuliidae					
Gymnopais holopticoides	14	14	-	4	-
Metacnephia	-	-	-	-	-
Prosimulium	-	-	-	-	-
pupae	-	**4**	-	-	-
indeterminate	-	-	-	-	-
F. Tipulidae					
Dicranota	-	-	-	-	-
Tipula	7	11	11	-	11
Density (No. organisms per m^2)	716	2,477	1,385	2,160	1,376
Richness (total number of taxa)[a]	12	13	11	9	12
Simpson's Evenness (E)	0.809	0.602	0.745	0.583	0.695
Bray-Curtis Index	0.382	0.261	0.101	0.213	0.115
Dominant Group Composition					
% Nemata	1.0%	0.3%	0.8%	0.0%	0.8%
% Oligochaeta	0.0%	0.2%	0.0%	0.0%	0.0%
% Hydracarina	3.1%	0.0%	0.3%	0.3%	1.0%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	93.0%	98.2%	98.1%	99.5%	97.4%
% Metal Sensitive Chironmids	15.1%	64.6%	50.0%	67.1%	61.0%
% Simuliidae	2.0%	0.7%	0.0%	0.2%	0.0%
% Tipulidae	1.0%	0.4%	0.8%	0.0%	0.8%
Functional Feeding Group Composition					
% Collector - Gatherers	83.9%	94.3%	95.5%	97.0%	92.5%
% Filterers	0.0%	0.0%	0.0%	0.0%	0.0%
% Shredders	10.5%	4.2%	4.3%	2.5%	3.6%
Habitat Preference Group Composition					
% Clingers	14.5%	4.5%	3.8%	3.0%	3.9%
% Sprawlers	83.0%	93.8%	94.7%	97.0%	91.7%
% Burrowers	2.5%	1.5%	1.6%	0.0%	4.4%

[a] Bold entries excluded from taxa count

Table F.48: **Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Mary River Upstream of the Mine (GO-03) Study Area, August 2019**

Taxa	Study Area	GO-03 (Upstream of Mine)				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		7	-	-	-	11
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		-	-	-	-	-
F. Hygrobatidae						
Hygrobates		-	-	-	-	-
F. Sperchonidae						
Sperchon		-	14	11	14	18
SEED SHRIMPS						
Cl. Ostracoda		-	-	-	-	-
INSECTS						
Cl. Insecta						
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		-	-	7	-	4
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
indeterminate		-	-	-	4	-
MIDGES						
F. Chironomidae						
chironomid pupae		**4**	**14**	**-**	**7**	**4**
S.F. Chironominae						
Micropsectra		-	-	-	-	-
Rheotanytarsus		-	-	-	-	-
S.F. Diamesinae						
Diamesa		4	11	-	-	-
Pseudodiamesa		-	-	-	-	-
Pseudokiefferiella		122	294	14	194	29
S.F. Orthocladiinae						
Cardiocladius		4	18	14	11	79
Chaetocladius		7	-	-	-	-
Corynoneura		-	-	-	-	-
Cricotopus		108	230	54	179	36
Cricotopus/Orthocladius		-	18	-	-	-
Diplocladius		-	7	4	-	-
Eukiefferiella		-	7	-	4	-
Hydrobaenus		-	-	-	-	4

Table F.48: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Mary River Upstream of the Mine (GO-03) Study Area, August 2019

Taxa	Study Area	GO-03 (Upstream of Mine)				
	Replicate Station	B1	B2	B3	B4	B5
Hydrosmittia		-	7	-	-	-
Krenosmittia		7	-	-	-	7
Limnophyes		-	-	-	4	-
Metriocnemus		-	-	-	-	4
Orthocladius (Euorthocladius)		144	190	61	111	93
Paraphaenocladius		-	-	-	-	-
Synorthocladius		-	-	-	-	**-**
Thienemanniella		**-**	**-**	-	4	**-**
Tokunagaia		337	248	75	158	79
Tvetenia		-	-	-	-	-
indeterminate		**-**	**-**	**-**	**-**	**4**
S.F. Tanypodinae						
Thienemannimyia complex		-	-	-	-	-
F. Empididae						
pupae		-	-	-	-	-
F. Simuliidae						
Gymnopais holopticoides		4	-	-	4	7
Metacnephia		-	-	-	-	-
Prosimulium		-	-	-	-	-
pupae		-	**-**	-	-	-
indeterminate		-	-	-	-	-
F. Tipulidae						
Dicranota		-	-	-	-	-
Tipula		-	4	7	4	36
Density (No. organisms per m^2)		748	1,062	247	698	415
Richness (total number of taxa)[a]		10	12	9	12	13
Simpson's Evenness (E)		0.788	0.854	0.887	0.845	0.916
Bray-Curtis Index		0.392	0.364	0.745	0.501	0.709
Dominant Group Composition						
% Nemata		0.9%	0.0%	0.0%	0.0%	2.7%
% Oligochaeta		0.0%	0.0%	0.0%	0.0%	0.0%
% Hydracarina		0.0%	1.3%	4.5%	2.0%	4.3%
% Ostracods		0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids		98.5%	98.3%	89.9%	96.3%	81.7%
% Metal Sensitive Chironmids		17.0%	29.1%	5.7%	28.2%	7.0%
% Simuliidae		0.5%	0.0%	0.0%	0.6%	1.7%
% Tipulidae		0.0%	0.4%	2.8%	0.6%	8.7%
Functional Feeding Group Composition						
% Collector - Gatherers		84.5%	72.9%	62.3%	68.8%	56.1%
% Filterers		0.0%	0.0%	0.0%	0.0%	0.0%
% Shredders		14.4%	24.0%	27.5%	26.5%	18.3%
Habitat Preference Group Composition						
% Clingers		15.0%	25.0%	26.3%	28.5%	14.7%
% Sprawlers		83.6%	72.9%	65.2%	68.8%	54.5%
% Burrowers		1.5%	2.2%	8.5%	2.7%	30.8%

[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 2019

Taxa	Study Area	EO-01 (Upper Mine-Exposed)				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		-	11	4	4	-
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		-	-	-	-	-
F. Hygrobatidae						
Hygrobates		-	-	-	-	-
F. Sperchonidae						
Sperchon		14	14	-	14	11
SEED SHRIMPS						
Cl. Ostracoda		-	-	-	-	-
INSECTS						
Cl. Insecta						
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		-	-	-	-	-
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
indeterminate		-	-	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		**4**	**32**	**4**	**4**	**7**
S.F. Chironominae						
Micropsectra		-	4	-	-	-
Rheotanytarsus		-	-	-	-	-
S.F. Diamesinae						
Diamesa		-	-	25	-	-
Pseudodiamesa		-	-	-	-	4
Pseudokiefferiella		-	4	29	11	18
S.F. Orthocladiinae						
Cardiocladius		7	11	29	11	36
Chaetocladius		4	-	-	14	11
Corynoneura		-	4	-	-	-
Cricotopus		22	25	72	39	50
Cricotopus/Orthocladius		14	36	57	14	-
Diplocladius		-	-	-	-	-
Eukiefferiella		7	-	-	-	-
Hydrobaenus		11	47	14	7	7

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 2019**

Taxa — Study Area / Replicate Station	EO-01 (Upper Mine-Exposed) B1	B2	B3	B4	B5
Hydrosmittia	-	-	4	-	-
Krenosmittia	-	-	4	-	4
Limnophyes	-	-	-	-	-
Metriocnemus	-	-	-	-	-
Orthocladius (Euorthocladius)	54	54	39	47	47
Paraphaenocladius	-	-	-	-	-
Synorthocladius	-	-	-	-	-
Thienemanniella	-	4	-	-	-
Tokunagaia	22	25	183	79	72
Tvetenia	-	-	-	-	-
indeterminate	**54**	**7**	**47**	**14**	**22**
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
pupae	-	-	-	-	-
F. Simuliidae					
Gymnopais holopticoides	-	-	-	-	-
Metacnephia	-	-	-	-	-
Prosimulium	-	-	-	-	-
pupae	-	-	-	-	-
indeterminate	-	-	-	-	4
F. Tipulidae					
Dicranota	-	-	-	-	-
Tipula	4	-	-	4	-
Density (No. organisms per m^2)	217	278	511	262	293
Richness (total number of taxa)[a]	10	12	11	11	11
Simpson's Evenness (E)	0.898	0.934	0.855	0.895	0.906
Bray-Curtis Index	0.791	0.821	0.619	0.745	0.756
Dominant Group Composition					
% Nemata	0.0%	4.0%	0.8%	1.5%	0.0%
% Oligochaeta	0.0%	0.0%	0.0%	0.0%	0.0%
% Hydracarina	6.5%	5.0%	0.0%	5.3%	3.8%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	91.7%	91.0%	99.2%	91.6%	94.9%
% Metal Sensitive Chironmids	0.0%	3.6%	10.6%	4.2%	7.2%
% Simuliidae	0.0%	0.0%	0.0%	0.0%	0.0%
% Tipulidae	1.8%	0.0%	0.0%	1.5%	0.0%
Functional Feeding Group Composition					
% Collector - Gatherers	64.1%	62.2%	65.4%	66.8%	61.8%
% Filterers	0.0%	1.8%	0.0%	0.0%	0.0%
% Shredders	24.9%	25.9%	28.4%	23.3%	19.1%
Habitat Preference Group Composition					
% Clingers	29.5%	32.7%	28.4%	27.1%	22.9%
% Sprawlers	64.1%	58.3%	64.6%	65.3%	61.8%
% Burrowers	6.5%	9.0%	7.0%	7.6%	14.0%

[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 2019

Taxa	Study Area	EO-20 (Middle Mine-Exposed)				
	Replicate Station	B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		158	57	7	4	-
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		29	57	-	4	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		-	-	-	-	**4**
F. Hygrobatidae						
Hygrobates		-	14	-	-	-
F. Sperchonidae						
Sperchon		36	29	-	4	14
SEED SHRIMPS						
Cl. Ostracoda		-	-	-	-	-
INSECTS						
Cl. Insecta						
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		-	-	-	-	-
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
indeterminate		-	-	18	7	4
MIDGES						
F. Chironomidae						
chironomid pupae		**86**	**129**	**36**	**25**	**22**
S.F. Chironominae						
Micropsectra		-	-	7	18	4
Rheotanytarsus		-	-	-	-	-
S.F. Diamesinae						
Diamesa		-	-	-	-	4
Pseudodiamesa		-	-	-	-	-
Pseudokiefferiella		1,812	3,265	36	43	11
S.F. Orthocladiinae						
Cardiocladius		-	122	-	18	32
Chaetocladius		-	-	-	11	-
Corynoneura		-	-	-	-	-
Cricotopus		664	1,783	68	201	93
Cricotopus/Orthocladius		301	309	165	104	122
Diplocladius		61	61	-	-	-
Eukiefferiella		-	61	18	11	29
Hydrobaenus		391	431	54	226	36

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 2019

Taxa — Study Area / Replicate Station	EO-20 (Middle Mine-Exposed) B1	B2	B3	B4	B5
Hydrosmittia	61	61	7	-	-
Krenosmittia	-	-	18	11	4
Limnophyes	-	-	-	-	-
Metriocnemus	-	122	-	7	-
Orthocladius (Euorthocladius)	179	861	201	68	126
Paraphaenocladius	29	-	-	-	-
Synorthocladius	-	-	-	-	-
Thienemanniella	61	61	-	25	-
Tokunagaia	334	370	86	97	83
Tvetenia	-	-	-	-	-
indeterminate	**334**	-	**50**	**43**	**36**
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
pupae	-	-	-	-	-
F. Simuliidae					
Gymnopais holopticoides	-	-	-	-	-
Metacnephia	-	-	-	-	-
Prosimulium	-	-	-	-	-
pupae	-	-	-	-	-
indeterminate	-	-	-	-	-
F. Tipulidae					
Dicranota	-	-	-	-	-
Tipula	32	4	7	-	-
Density (No. organisms per m^2)	4,568	7,797	778	927	624
Richness (total number of taxa)[a]	14	17	13	17	13
Simpson's Evenness (E)	0.838	0.790	0.888	0.888	0.912
Bray-Curtis Index	0.539	0.696	0.648	0.740	0.660
Dominant Group Composition					
% Nemata	3.5%	0.7%	0.9%	0.4%	0.0%
% Oligochaeta	0.6%	0.7%	0.0%	0.4%	0.0%
% Hydracarina	0.8%	0.6%	0.0%	0.4%	2.9%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	94.4%	97.9%	95.9%	98.0%	96.5%
% Metal Sensitive Chironmids	40.5%	42.6%	5.8%	6.8%	3.0%
% Simuliidae	0.0%	0.0%	0.0%	0.0%	0.0%
% Tipulidae	0.7%	0.1%	0.9%	0.0%	0.0%
Functional Feeding Group Composition					
% Collector - Gatherers	73.5%	70.5%	61.8%	58.9%	52.1%
% Filterers	0.0%	0.0%	0.9%	2.0%	0.6%
% Shredders	25.7%	27.3%	35.0%	35.7%	38.1%
Habitat Preference Group Composition					
% Clingers	25.8%	27.8%	35.0%	38.2%	41.7%
% Sprawlers	69.4%	69.1%	60.9%	58.0%	52.1%
% Burrowers	4.8%	3.1%	4.1%	3.8%	6.3%

[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 2019

Taxa	Study Area / Replicate Station	CO-05 (Lower Mine-Exposed) B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		11	4	14	7	4
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	7	-	7	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature		-	-	-	-	-
F. Hygrobatidae						
Hygrobates		-	-	4	-	-
F. Sperchonidae						
Sperchon		14	18	7	75	25
SEED SHRIMPS						
Cl. Ostracoda		4	7	18	14	32
INSECTS						
Cl. Insecta						
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		-	-	-	-	-
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
indeterminate		-	-	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		**4**	**-**	**7**	**7**	**-**
S.F. Chironominae						
Micropsectra		-	4	-	14	7
Rheotanytarsus		-	4	-	-	-
S.F. Diamesinae						
Diamesa		-	-	-	-	-
Pseudodiamesa		-	-	-	-	-
Pseudokiefferiella		492	126	1,249	1,270	804
S.F. Orthocladiinae						
Cardiocladius		57	212	111	136	50
Chaetocladius		-	4	14	-	-
Corynoneura		-	-	-	-	-
Cricotopus		255	86	330	305	194
Cricotopus/Orthocladius		-	11	-	97	-
Diplocladius		-	-	-	-	-
Eukiefferiella		-	4	-	-	-
Hydrobaenus		-	-	-	14	-

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 2019

Taxa	Study Area	CO-05 (Lower Mine-Exposed)				
	Replicate Station	B1	B2	B3	B4	B5
Hydrosmittia		14	4	14	29	-
Krenosmittia		-	-	-	-	-
Limnophyes		-	-	-	-	4
Metriocnemus		-	-	-	-	-
Orthocladius (Euorthocladius)		79	61	83	54	22
Paraphaenocladius		-	-	-	-	-
Synorthocladius		7	-	-	14	**-**
Thienemanniella		-	-	29	68	14
Tokunagaia		144	22	97	165	161
Tvetenia		-	-	14	14	-
indeterminate		**-**	**-**	**-**	**-**	**-**
S.F. Tanypodinae						
Thienemannimyia complex		7	14	14	-	4
F. Empididae						
pupae		-	-	-	-	-
F. Simuliidae						
Gymnopais holopticoides		-	-	-	4	-
Metacnephia		4	4	7	-	-
Prosimulium		-	-	4	-	-
pupae		-	**-**	**4**	-	-
indeterminate		-	-	**4**	-	-
F. Tipulidae						
Dicranota		4	-	-	7	-
Tipula		7	7	-	4	-
Density (No. organisms per m^2)		1,103	599	2,024	2,305	1,321
Richness (total number of taxa)[a]		14	18	16	19	12
Simpson's Evenness (E)		0.775	0.842	0.620	0.700	0.644
Bray-Curtis Index		0.385	0.713	0.432	0.440	0.289
Dominant Group Composition						
% Nemata		1.0%	0.7%	0.7%	0.3%	0.3%
% Oligochaeta		0.0%	1.2%	0.0%	0.3%	0.0%
% Hydracarina		1.3%	3.0%	0.5%	3.3%	1.9%
% Ostracods		0.4%	1.2%	0.9%	0.6%	2.4%
% Chironomids		96.0%	92.2%	96.9%	94.9%	95.4%
% Metal Sensitive Chironmids		44.8%	22.4%	62.0%	55.9%	61.4%
% Simuliidae		0.4%	0.7%	0.9%	0.2%	0.0%
% Tipulidae		1.0%	1.2%	0.0%	0.5%	0.0%
Functional Feeding Group Composition						
% Collector - Gatherers		68.4%	39.9%	76.0%	72.1%	78.8%
% Filterers		0.4%	2.0%	0.9%	0.6%	0.5%
% Shredders		23.8%	17.4%	16.4%	17.7%	14.7%
Habitat Preference Group Composition						
% Clingers		24.8%	21.2%	17.8%	21.5%	17.1%
% Sprawlers		68.4%	40.4%	76.0%	71.8%	78.8%
% Burrowers		6.8%	38.4%	6.2%	6.7%	4.1%

[a] Bold entries excluded from taxa count

Table F.52: Benthic Invertebrate Community Summary Statistics for Mary River, Mary River Project CREMP, August 2019

Metric	Area	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (no. organisms / m^2)	GO-09 Reference Area	1,623	700	313	716	1,385	2,477
	GO-03 Upstream Area	634	315	141	247	698	1,062
	EO-01 Upper Mine-Exposed Area	312	115	51	217	278	511
	EO-20 Middle Mine-Exposed Area	2,939	3,175	1,420	624	927	7,797
	CO-05 Lower Mine-Exposed Area	1,470	693	310	599	1,321	2,305
Richness (Number of Taxa)	GO-09 Reference Area	11.4	1.5	0.7	9.0	12.0	13.0
	GO-03 Upstream Area	11.2	1.6	0.7	9.0	12.0	13.0
	EO-01 Upper Mine-Exposed Area	11.0	0.7	0.3	10.0	11.0	12.0
	EO-20 Middle Mine-Exposed Area	14.8	2.0	0.9	13.0	14.0	17.0
	CO-05 Lower Mine-Exposed Area	15.8	2.9	1.3	12.0	16.0	19.0
Simpson's Evenness	GO-09 Reference Area	0.687	0.095	0.043	0.583	0.695	0.809
	GO-03 Upstream Area	0.858	0.048	0.022	0.788	0.854	0.916
	EO-01 Upper Mine-Exposed Area	0.898	0.028	0.013	0.855	0.898	0.934
	EO-20 Middle Mine-Exposed Area	0.863	0.049	0.022	0.790	0.888	0.912
	CO-05 Lower Mine-Exposed Area	0.716	0.092	0.041	0.620	0.700	0.842
Bray-Curtis Index	GO-09 Reference Area	0.214	0.115	0.051	0.101	0.213	0.382
	GO-03 Upstream Area	0.542	0.177	0.079	0.364	0.501	0.745
	EO-01 Upper Mine-Exposed Area	0.746	0.077	0.034	0.619	0.756	0.821
	EO-20 Middle Mine-Exposed Area	0.657	0.075	0.033	0.539	0.660	0.740
	CO-05 Lower Mine-Exposed Area	0.452	0.158	0.071	0.289	0.432	0.713
Nemata (% of community)	GO-09 Reference Area	0.6%	0.4%	0.2%	0.0%	0.8%	1.0%
	GO-03 Upstream Area	0.7%	1.2%	0.5%	0.0%	0.0%	2.7%
	EO-01 Upper Mine-Exposed Area	1.3%	1.6%	0.7%	0.0%	0.8%	4.0%
	EO-20 Middle Mine-Exposed Area	1.1%	1.4%	0.6%	0.0%	0.7%	3.5%
	CO-05 Lower Mine-Exposed Area	0.6%	0.3%	0.1%	0.3%	0.7%	1.0%
Hydracarina (% of community)	GO-09 Reference Area	0.9%	1.2%	0.6%	0.0%	0.3%	3.1%
	GO-03 Upstream Area	2.4%	1.9%	0.9%	0.0%	2.0%	4.5%
	EO-01 Upper Mine-Exposed Area	4.1%	2.5%	1.1%	0.0%	5.0%	6.5%
	EO-20 Middle Mine-Exposed Area	0.9%	1.1%	0.5%	0.0%	0.6%	2.9%
	CO-05 Lower Mine-Exposed Area	2.0%	1.1%	0.5%	0.5%	1.9%	3.3%
Chironomidae (% of community)	GO-09 Reference Area	97.2%	2.5%	1.1%	93.0%	98.1%	99.5%
	GO-03 Upstream Area	92.9%	7.2%	3.2%	81.7%	96.3%	98.5%
	EO-01 Upper Mine-Exposed Area	93.7%	3.4%	1.5%	91.0%	91.7%	99.2%
	EO-20 Middle Mine-Exposed Area	96.5%	1.5%	0.7%	94.4%	96.5%	98.0%
	CO-05 Lower Mine-Exposed Area	95.1%	1.8%	0.8%	92.2%	95.4%	96.9%
Metal-Sensitive Chironomidae (% of community)	GO-09 Reference Area	51.5%	21.4%	9.6%	15.1%	61.0%	67.1%
	GO-03 Upstream Area	17.4%	11.2%	5.0%	5.7%	17.0%	29.1%
	EO-01 Upper Mine-Exposed Area	5.1%	4.0%	1.8%	0.0%	4.2%	10.6%
	EO-20 Middle Mine-Exposed Area	19.7%	20.0%	8.9%	3.0%	6.8%	42.6%
	CO-05 Lower Mine-Exposed Area	49.3%	16.6%	7.4%	22.4%	55.9%	62.0%
Tipulidae (% of community)	GO-09 Reference Area	0.6%	0.4%	0.2%	0.0%	0.8%	1.0%
	GO-03 Upstream Area	2.5%	3.6%	1.6%	0.0%	0.6%	8.7%
	EO-01 Upper Mine-Exposed Area	0.7%	0.9%	0.4%	0.0%	0.0%	1.8%
	EO-20 Middle Mine-Exposed Area	0.3%	0.4%	0.2%	0.0%	0.1%	0.9%
	CO-05 Lower Mine-Exposed Area	0.5%	0.5%	0.2%	0.0%	0.5%	1.2%

Table F.52: **Benthic Invertebrate Community Summary Statistics for Mary River, Mary River Project CREMP, August 2019**

Metric	Area	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Collector-Gatherer FFG (% of community)	GO-09 Reference Area	92.6%	5.1%	2.3%	83.9%	94.3%	97.0%
	GO-03 Upstream Area	68.9%	10.8%	4.8%	56.1%	68.8%	84.5%
	EO-01 Upper Mine-Exposed Area	64.0%	2.1%	0.9%	61.8%	64.1%	66.8%
	EO-20 Middle Mine-Exposed Area	63.4%	8.7%	3.9%	52.1%	61.8%	73.5%
	CO-05 Lower Mine-Exposed Area	67.0%	15.7%	7.0%	39.9%	72.1%	78.8%
Filterer FFG (% of community)	GO-09 Reference Area	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	GO-03 Upstream Area	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	EO-01 Upper Mine-Exposed Area	0.4%	0.8%	0.4%	0.0%	0.0%	1.8%
	EO-20 Middle Mine-Exposed Area	0.7%	0.8%	0.4%	0.0%	0.6%	2.0%
	CO-05 Lower Mine-Exposed Area	0.9%	0.7%	0.3%	0.4%	0.6%	2.0%
Shredder FFG (% of community)	GO-09 Reference Area	5.0%	3.1%	1.4%	2.5%	4.2%	10.5%
	GO-03 Upstream Area	22.2%	5.6%	2.5%	14.4%	24.0%	27.5%
	EO-01 Upper Mine-Exposed Area	24.3%	3.4%	1.5%	19.1%	24.9%	28.4%
	EO-20 Middle Mine-Exposed Area	32.4%	5.5%	2.5%	25.7%	35.0%	38.1%
	CO-05 Lower Mine-Exposed Area	18.0%	3.5%	1.6%	14.7%	17.4%	23.8%
Clinger HPG (% of community)	GO-09 Reference Area	5.9%	4.8%	2.2%	3.0%	3.9%	14.5%
	GO-03 Upstream Area	21.9%	6.6%	2.9%	14.7%	25.0%	28.5%
	EO-01 Upper Mine-Exposed Area	28.1%	3.6%	1.6%	22.9%	28.4%	32.7%
	EO-20 Middle Mine-Exposed Area	33.7%	6.8%	3.0%	25.8%	35.0%	41.7%
	CO-05 Lower Mine-Exposed Area	20.5%	3.1%	1.4%	17.1%	21.2%	24.8%
Sprawler HPG (% of community)	GO-09 Reference Area	92.0%	5.4%	2.4%	83.0%	93.8%	97.0%
	GO-03 Upstream Area	69.0%	10.6%	4.8%	54.5%	68.8%	83.6%
	EO-01 Upper Mine-Exposed Area	62.8%	2.8%	1.3%	58.3%	64.1%	65.3%
	EO-20 Middle Mine-Exposed Area	61.9%	7.4%	3.3%	52.1%	60.9%	69.4%
	CO-05 Lower Mine-Exposed Area	67.1%	15.4%	6.9%	40.4%	71.8%	78.8%
Burrower HPG (% of community)	GO-09 Reference Area	2.0%	1.6%	0.7%	0.0%	1.6%	4.4%
	GO-03 Upstream Area	9.1%	12.5%	5.6%	1.5%	2.7%	30.8%
	EO-01 Upper Mine-Exposed Area	8.8%	3.0%	1.4%	6.5%	7.6%	14.0%
	EO-20 Middle Mine-Exposed Area	4.4%	1.2%	0.5%	3.1%	4.1%	6.3%
	CO-05 Lower Mine-Exposed Area	12.4%	14.6%	6.5%	4.1%	6.7%	38.4%

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 2019

Metric	Data Transform-ation	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)	log10	YES	0.002	GO-09 Ref	1,623	700	-	a,b
				GO-03	634	315	-1.4	a,c
				EO-01	312	115	-1.9	c
				EO-20	2,939	3,175	1.9	b
				CO-05	1,470	693	-0.2	a,b
Richness (No. of Taxa)	none	YES	<0.001	GO-09 Ref	11.4	1.5	-	a
				GO-03	11.2	1.6	-0.1	a
				EO-01	11.0	0.7	-0.3	a
				EO-20	14.8	2.0	2.2	b
				CO-05	15.8	2.9	2.9	b
Simpson's Evenness	log10	YES	<0.001	GO-09 Ref	0.687	0.095	-	a
				GO-03	0.858	0.048	1.8	b
				EO-01	0.898	0.028	2.2	b
				EO-20	0.863	0.049	1.9	b
				CO-05	0.716	0.092	0.3	a
Bray-Curtis Index	log10	YES	<0.001	GO-09 Ref	0.214	0.115	-	a
				GO-03	0.542	0.177	2.8	b
				EO-01	0.746	0.077	4.6	b
				EO-20	0.657	0.075	3.8	b
				CO-05	0.452	0.158	2.1	b
Nemata (% of community)	rank	NO	0.953	GO-09 Ref	0.6%	0.4%	-	a
				GO-03	0.7%	1.2%	0.4	a
				EO-01	1.3%	1.6%	1.7	a
				EO-20	1.1%	1.4%	1.3	a
				CO-05	0.6%	0.3%	0.1	a
Hydracarina (% of community)	none	YES	0.041	GO-09 Ref	0.9%	1.2%	-	a
				GO-03	2.4%	1.9%	1.2	a,b
				EO-01	4.1%	2.5%	2.5	b
				EO-20	0.9%	1.1%	0.0	a
				CO-05	2.0%	1.1%	0.8	a,b
Chironomidae (% of community)	rank	NO	0.367	GO-09 Ref	97.2%	2.5%	-	a
				GO-03	92.9%	7.2%	-1.7	a
				EO-01	93.7%	3.4%	-1.4	a
				EO-20	96.5%	1.5%	-0.3	a
				CO-05	95.1%	1.8%	-0.9	a
Metal Sensitive Chironomidae (% of community)	log10(x+1)	YES	<0.001	GO-09 Ref	51.5%	21.4%	-	a
				GO-03	17.4%	11.2%	-1.6	b
				EO-01	5.1%	4.0%	-2.2	b
				EO-20	19.7%	20.0%	-1.5	b
				CO-05	49.3%	16.6%	-0.1	a

[grey box] Indicates a significant difference for respective comparison (p-value ≤ 0.1).

[blue box] 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.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 2019

Metric	Data Transform-ation	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)	rank	NO	0.830	GO-09 Ref	0.6%	0.4%	-	a
				GO-03	2.5%	3.6%	4.9	a
				EO-01	0.7%	0.9%	0.2	a
				EO-20	0.3%	0.4%	-0.7	a
				CO-05	0.5%	0.5%	-0.2	a
Collector-Gatherer FFG (% of community)	none	YES	<0.001	GO-09 Ref	92.6%	5.1%	-	a
				GO-03	68.9%	10.8%	-4.6	b
				EO-01	64.0%	2.1%	-5.6	b
				EO-20	63.4%	8.7%	-5.7	b
				CO-05	67.0%	15.7%	-5.0	b
Shredder FFG (% of community)	none	YES	<0.001	GO-09 Ref	5.0%	3.1%	-	a
				GO-03	22.2%	5.6%	5.5	b
				EO-01	24.3%	3.4%	6.2	b
				EO-20	32.4%	5.5%	8.7	c
				CO-05	18.0%	3.5%	4.1	b
Clinger HPG (% of community)	none	YES	<0.001	GO-09 Ref	5.9%	4.8%	-	a
				GO-03	21.9%	6.6%	3.3	b
				EO-01	28.1%	3.6%	4.6	b,c
				EO-20	33.7%	6.8%	5.7	c
				CO-05	20.5%	3.1%	3.0	b
Sprawler HPG (% of community)	rank	YES	0.010	GO-09 Ref	92.0%	5.4%	-	a
				GO-03	69.0%	10.6%	-4.3	b
				EO-01	62.8%	2.8%	-5.4	b
				EO-20	61.9%	7.4%	-5.6	b
				CO-05	67.1%	15.4%	-4.6	b
Burrower HPG (% of community)	rank	YES	0.018	GO-09 Ref	2.0%	1.6%	-	a
				GO-03	9.1%	12.5%	4.4	a,b
				EO-01	8.8%	3.0%	4.2	c
				EO-20	4.4%	1.2%	1.5	a,b
				CO-05	12.4%	14.6%	6.4	b,c

[grey box] Indicates a significant difference for respective comparison (p-value ≤ 0.1).

[blue box] 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 Primary and Percent Compositional Benthic Metrics at the Mary River Reference Area (GO-09) Among Years of Mine Operation (2015 to 2019) and Baseline (2006, 2007)

Metric	Data Transform-ation	Overall 7-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 2006	Effect Size vs. Baseline Year 2007	Pairwise Comparison
Density (No. per m^2)	log10	YES	<0.001	2006	3	404	149	-	-4.0	a,b
				2007	3	739	84	2.3	-	a,c
				2015	5	472	255	0.5	-3.2	a,b
				2016	5	662	320	1.7	-0.9	a,c
				2017	5	410	313	0.0	-3.9	a,b
				2018	5	194	112	-1.4	-6.5	b
				2019	5	1,623	700	8.2	10.5	c
Richness (No. of Taxa)	none	YES	0.032	2006	3	7.3	2.9	-	-10.4	a
				2007	3	13.3	0.6	2.1	-	b
				2015	5	11.4	3.2	1.4	-3.3	a,b
				2016	5	14.0	1.6	2.3	1.2	b
				2017	5	11.2	2.9	1.3	-3.7	a,b
				2018	5	11.8	2.3	1.5	-2.7	a,b
				2019	5	11.4	1.5	1.4	-3.3	a,b
Simpson's Evenness	none	YES	<0.001	2006	3	0.324	0.095	-	-8.6	a
				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	b,d
				2018	5	0.907	0.030	6.1	6.5	c
				2019	5	0.687	0.095	3.8	0.8	b
Nemata (% of community)	rank	NO	0.571	2006	3	0.6%	0.5%	-	1.4	a
				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
				2019	5	0.6%	0.4%	-0.1	1.3	a
Hydracarina (% of community)	log10(x+1)	YES	<0.001	2006	3	0.5%	0.9%	-	1.2	a
				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
				2019	5	0.9%	1.2%	0.5	2.7	a
Chironomidae (% of community)	none	YES	<0.001	2006	3	98.7%	0.8%	-	not calculable	a
				2007	3	100.0%	0.0%	1.7	-	a
				2015	5	88.0%	4.5%	-13.2	not calculable	a,b
				2016	5	84.8%	5.3%	-17.1	not calculable	b
				2017	5	79.1%	6.4%	-24.3	not calculable	b
				2018	5	78.7%	12.3%	-24.7	not calculable	b
				2019	5	97.2%	2.5%	-1.8	not calculable	a
Metal Sensitive Taxa (% of community)	none	YES	<0.001	2006	3	62.1%	3.7%	-	1.7	a
				2007	3	30.7%	18.2%	-8.6	-	a,b,c
				2015	5	13.7%	14.8%	-13.2	-0.9	c
				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	b,c
				2019	5	51.5%	21.4%	-2.9	1.1	a,b
Tipulidae (% of community)	rank	NO	0.101	2006	3	0.2%	0.4%	-	not calculable	a
				2007	3	0.0%	0.0%	-0.6	-	a
				2015	5	4.0%	5.5%	9.2	not calculable	a
				2016	5	1.4%	1.7%	2.9	not calculable	a
				2017	5	1.5%	1.3%	3.1	not calculable	a
				2018	5	3.1%	4.1%	7.0	not calculable	a
				2019	5	0.6%	0.4%	0.9	not calculable	a

Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1). [grey shading]
Indicates magnitude of difference outside of a ± 2 SD effect size of respective baseline year mean indicating an ecologically meaningful difference between study years. [blue shading]

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

Table F.54: Statistical Comparison of Primary and Percent Compositional Benthic Metrics at the Mary River Reference Area (GO-09) Among Years of Mine Operation (2015 to 2019) and Baseline (2006, 2007)

Metric	Data Transform-ation	Overall 7-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 2006	Effect Size vs. Baseline Year 2007	Pairwise Comparison
Collector-Gatherer FFG (% of community)	none	YES	<0.001	2006	3	98.6%	1.1%	-	0.9	a
				2007	3	93.3%	5.8%	-4.7	-	a,b
				2015	5	76.3%	10.9%	-19.8	-3.0	b,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	a,b,c
				2019	5	92.6%	5.1%	-5.3	-0.1	a,b
Filterer FFG (% of community)	rank	YES	<0.001	2006	3	0.1%	0.2%	-	not calculable	a
				2007	3	0.0%	0.0%	-0.6	-	a
				2015	5	0.0%	0.0%	-0.6	not calculable	a,b
				2016	5	6.3%	5.4%	30.3	not calculable	b,c
				2017	5	18.9%	5.2%	91.4	not calculable	c
				2018	5	14.1%	9.9%	68.0	not calculable	c
				2019	5	0.0%	0.0%	-0.6	not calculable	a
Shredder FFG (% of community)	rank	YES	0.017	2006	3	0.2%	0.4%	-	not calculable	a
				2007	3	0.0%	0.0%	-0.6	-	a,b,c
				2015	5	14.0%	11.4%	33.5	not calculable	b,d
				2016	5	12.4%	3.3%	29.5	not calculable	d
				2017	5	5.8%	2.2%	13.6	not calculable	b,c,d
				2018	5	4.7%	6.3%	10.9	not calculable	a,c
				2019	5	5.0%	3.1%	11.6	not calculable	a,c

(grey) Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).
(blue) Indicates magnitude of difference outside of a ± 2 SD effect size of respective baseline year mean indicating an ecologically meaningful difference 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 the Mary River Upstream of the Mine (GO-03) Among Years of Mine Operation (2015 to 2019) and Baseline (2007) 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	Pairwise Comparison
Density (No. per m^2)	log10	YES	0.004	2007	3	136	29	-	a
				2015	5	169	122	1.1	a
				2016	5	287	92	5.1	a,b
				2017	5	282	172	5.0	a,b
				2018	5	165	54	1.0	a
				2019	5	634	315	17.0	b
Richness (No. of Taxa)	none	YES	0.010	2007	3	6.3	1.2	-	a
				2015	5	9.4	3.5	2.7	a,b
				2016	5	14.4	1.8	7.0	b
				2017	5	13.6	3.9	6.3	b
				2018	5	12.2	3.5	5.1	a,b
				2019	5	11.2	1.6	4.2	a,b
Simpson's Evenness	rank	YES	0.049	2007	3	0.591	0.003	-	a
				2015	5	0.921	0.045	114.3	b
				2016	5	0.899	0.041	106.5	b,c
				2017	5	0.873	0.142	97.7	b,c
				2018	5	0.868	0.119	96.0	b,c
				2019	5	0.858	0.048	92.4	a,c
Nemata (% of community)	log10(x+1)	YES	<0.001	2007	3	0.0%	1.2%	-	a
				2015	5	0.0%	0.0%	0.0	a
				2016	5	2.2%	1.3%	1.9	b,c
				2017	5	1.3%	1.2%	1.1	a,c
				2018	5	4.4%	2.2%	3.7	b
				2019	5	0.7%	1.2%	0.6	a,c
Hydracarina (% of community)	log10(x+1)	YES	0.001	2007	3	0.0%	3.4%	-	a
				2015	5	8.0%	4.5%	2.4	b,c
				2016	5	10.3%	4.4%	3.1	b
				2017	5	1.9%	1.9%	0.6	a,c
				2018	5	3.3%	4.1%	1.0	a,c
				2019	5	2.4%	1.9%	0.7	a,c
Chironomidae (% of community)	none	YES	0.001	2007	3	100.0%	8.6%	-	a
				2015	5	71.9%	8.2%	-3.3	b
				2016	5	77.9%	8.0%	-2.6	b
				2017	5	75.3%	10.3%	-2.9	b
				2018	5	83.2%	9.2%	-2.0	a,b
				2019	5	92.9%	7.2%	-0.8	a
Metal Sensitive Taxa (% of community)	log10(x+1)	YES	<0.001	2007	3	6.6%	3.0%	-	a
				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,c
				2019	5	17.4%	11.2%	3.5	a,c
Tipulidae (% of community)	none	YES	<0.001	2007	3	0.0%	4.6%	-	a
				2015	5	18.0%	8.4%	3.9	b
				2016	5	8.3%	7.3%	1.8	a
				2017	5	2.9%	2.0%	0.6	a
				2018	5	1.8%	1.7%	0.4	a
				2019	5	2.5%	3.6%	0.5	a

Table F.55: Statistical Comparison of Benthic Invertebrate Community Metrics at the Mary River Upstream of the Mine (GO-03) Among Years of Mine Operation (2015 to 2019) and Baseline (2007) 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	Pairwise Comparison
Collector-Gatherer FFG (% of community)	none	YES	<0.001	2007	3	93.3%	5.8%	-	a
				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	a,c
				2019	5	68.9%	10.8%	-4.2	b,c
Filterer FFG (% of community)	rank	YES	0.004	2007	3	0.0%	2.2%	-	a
				2015	5	0.0%	0.0%	0.0	a
				2016	5	0.3%	0.7%	0.1	a
				2017	5	15.2%	5.4%	6.8	b
				2018	5	3.7%	5.1%	1.6	a
				2019	5	0.0%	0.0%	0.0	a
Shredder FFG (% of community)	log10(x+1)	YES	<0.001	2007	3	6.7%	5.8%	-	a
				2015	5	30.0%	7.1%	4.0	b
				2016	5	20.7%	5.5%	2.4	b,c
				2017	5	5.7%	2.2%	-0.2	a
				2018	5	11.7%	8.2%	0.9	a,c
				2019	0.05	22.2%	5.6%	2.7	b

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

[Blue] 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 2019) and Baseline (2007) 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	Pairwise Comparison
Density (No. per m^2)	log10	YES	0.044	2007	3	797	648	-	a
				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
				2019	5	312	115	-0.7	a
Richness (No. of Taxa)	none	NO	0.103	2007	3	16.3	8.1	-	a
				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
				2019	5	11.0	0.7	-0.7	a
Simpson's Evenness	none	YES	<0.001	2007	3	0.698	0.059	-	a
				2015	5	0.873	0.095	3.0	b
				2016	5	0.865	0.037	2.8	b
				2017	5	0.940	0.053	4.1	b
				2018	5	0.926	0.037	3.9	b
				2019	5	0.898	0.028	3.4	b
Nemata (% of community)	rank	NO	0.464	2007	3	2.1%	3.6%	-	a
				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
				2019	5	1.3%	1.6%	-0.2	a
Hydracarina (% of community)	log10(x+1)	NO	0.249	2007	3	3.3%	5.8%	-	a
				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
				2019	5	4.1%	2.5%	0.1	a
Chironomidae (% of community)	none	YES	0.014	2007	3	90.0%	0.1%	-	a,b
				2015	5	82.5%	8.3%	-74.8	a,b
				2016	5	82.9%	7.3%	-70.9	a,b
				2017	5	78.1%	7.2%	-118.7	a
				2018	5	72.0%	16.0%	-179.8	a
				2019	5	93.7%	3.4%	36.8	b
Metal Sensitive Taxa (% of community)	rank	YES	0.064	2007	3	36.4%	32.0%	-	a,b
				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
				2019	5	5.1%	4.0%	-1.0	a
Tipulidae (% of community)	rank	YES	0.004	2007	3	3.3%	5.8%	-	a,b,c
				2015	5	10.0%	7.1%	1.2	a
				2016	5	2.5%	2.6%	-0.2	a,b
				2017	5	0.3%	0.6%	-0.5	d
				2018	5	0.3%	0.8%	-0.5	c,d
				2019	5	0.7%	0.9%	-0.5	b,c,d

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 2019) and Baseline (2007) 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	Pairwise Comparison
Collector-Gatherer FFG (% of community)	rank	NO	0.159	2007	3	40.0%	26.5%	-	a
				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
				2019	5	64.0%	2.1%	0.9	a
Filterer FFG (% of community)	rank	YES	0.014	2007	3	36.7%	32.1%	-	a,b
				2015	5	0.0%	0.0%	-1.1	c
				2016	5	0.9%	0.8%	-1.1	a,c,d
				2017	5	14.0%	11.2%	-0.7	b
				2018	5	7.0%	8.6%	-0.9	a,b,d
				2019	5	0.4%	0.8%	-1.1	c,d
Shredder FFG (% of community)	rank	YES	0.018	2007	3	6.7%	11.5%	-	a,b
				2015	5	18.0%	17.9%	1.0	a,c
				2016	5	7.4%	7.6%	0.1	a,b
				2017	5	2.5%	5.5%	-0.4	b
				2018	5	15.6%	13.5%	0.8	a,c
				2019	5	24.3%	3.4%	1.5	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.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 2019) and Baseline (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 2011	Pairwise Comparison
Density (No. per m^2)	rank	YES	0.002	2011	3	854	348	-	a,b
				2015	5	278	146	-1.7	a,c
				2016	5	283	118	-1.6	a,c
				2017	5	382	665	-1.4	c,d
				2018	5	61	23	-2.3	d
				2019	5	2,939	3,175	6.0	b
Richness (No. of Taxa)	none	YES	0.007	2011	3	14.0	2.6	-	a
				2015	5	11.6	2.2	-0.9	a,b
				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
				2019	5	14.8	2.0	0.3	a
Simpson's Evenness	none	YES	<0.001	2011	3	0.483	0.247	-	a
				2015	5	0.726	0.140	1.0	b
				2016	5	0.835	0.038	1.4	b
				2017	5	0.902	0.103	1.7	b
				2018	5	0.895	0.047	1.7	b
				2019	5	0.863	0.049	1.5	b
Nemata (% of community)	rank	NO	0.228	2011	3	0.0%	0.0%	-	a
				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
				2019	5	1.1%	1.4%	nc	a
Hydracarina (% of community)	rank	YES	0.012	2011	3	0.2%	0.4%	-	a,b
				2015	5	2.0%	4.5%	4.3	a,c
				2016	5	7.2%	3.3%	17.1	c
				2017	5	4.1%	2.8%	9.6	a,c
				2018	5	0.9%	2.0%	1.6	b
				2019	5	0.9%	1.1%	1.7	b
Chironomidae (% of community)	none	YES	<0.001	2011	3	96.7%	5.8%	-	a,b
				2015	5	88.6%	5.0%	-1.4	a,b
				2016	5	86.1%	6.3%	-1.8	a,b
				2017	5	71.4%	11.7%	-4.4	c
				2018	5	81.3%	8.0%	-2.7	a,c
				2019	5	96.5%	1.5%	0.0	b
Metal Sensitive Taxa (% of community)	log10(x+1)	YES	<0.001	2011	3	3.1%	5.4%	-	a
				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,c
				2018	5	49.0%	12.9%	8.4	b
				2019	5	19.7%	20.0%	3.0	a,c
Tipulidae (% of community)	log10(x+1)	NO	0.270	2011	3	0.0%	0.0%	-	a
				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
				2019	5	0.3%	0.4%	nc	a

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 2019) and Baseline (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 2011	Pairwise Comparison
Collector-Gatherer FFG (% of community)	none	YES	<0.001	2011	3	23.3%	15.3%	-	a
				2015	5	78.3%	8.5%	3.6	b,c
				2016	5	70.2%	7.5%	3.1	b,c
				2017	5	68.2%	5.1%	2.9	b,c
				2018	5	78.2%	6.6%	3.6	b
				2019	5	63.4%	8.7%	2.6	c
Filterer FFG (% of community)	rank	YES	0.008	2011	3	3.3%	5.8%	-	a,b
				2015	5	0.0%	0.0%	-0.6	b
				2016	5	0.4%	0.8%	-0.5	b
				2017	5	17.0%	7.1%	2.4	c
				2018	5	9.2%	8.5%	1.0	a,c
				2019	5	0.7%	0.8%	-0.5	a,b
Shredder FFG (% of community)	log10(x+1)	YES	<0.001	2011	3	6.7%	11.5%	-	a
				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
				2019	5	32.4%	5.5%	2.2	b

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

(blue) 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 Primary and Percent Compositional Benthic Metrics at the Mary River Lower Mine-Exposed Area (CO-05) Among Years of Mine Operation (2015 to 2019) and Baseline (2007, 2011)

Metric	Data Transform-ation	Overall 7-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
Density (No. per m^2)	none	YES	0.031	2007	3	311	230	-	-0.4	a,b
				2011	3	491	455	0.8	-	a,b
				2015	5	234	168	-0.3	-0.6	a
				2016	5	1,161	584	3.7	1.5	a,b
				2017	5	1,214	654	3.9	1.6	a,b
				2018	5	1,391	1,083	4.7	2.0	a,b
				2019	5	1,470	693	5.0	2.2	b
Richness (No. of Taxa)	log10	YES	<0.001	2007	3	10.7	3.8	-	-2.1	a
				2011	3	19.0	4.0	2.2	-	b,c,d
				2015	5	13.2	2.7	0.7	-1.5	a,c
				2016	5	19.6	3.3	2.4	0.2	b,d
				2017	5	22.0	3.2	3.0	0.8	b
				2018	5	18.6	0.9	2.1	-0.1	b,d
				2019	5	15.8	2.9	1.4	-0.8	c,d
Simpson's Evenness	rank	YES	0.005	2007	3	0.668	0.022	-	-2.7	a
				2011	3	0.879	0.079	9.8	-	b,c
				2015	5	0.923	0.038	11.8	0.6	b
				2016	5	0.849	0.015	8.4	-0.4	b,c
				2017	5	0.798	0.161	6.0	-1.0	a,c
				2018	5	0.675	0.149	0.4	-2.6	a
				2019	5	0.716	0.092	2.3	-2.1	a
Nemata (% of community)	log10(x+1)	YES	0.046	2007	3	0.2%	0.4%	-	-0.5	a
				2011	3	1.6%	2.7%	3.2	-	a
				2015	5	2.0%	4.5%	4.3	0.2	a
				2016	5	1.0%	1.0%	1.9	-0.2	a
				2017	5	2.1%	1.6%	4.5	0.2	a
				2018	5	2.1%	1.9%	4.6	0.2	a
				2019	5	0.6%	0.3%	0.9	-0.4	a
Hydracarina (% of community)	rank	YES	0.048	2007	3	0.5%	0.4%	-	3.6	a
				2011	3	0.1%	0.1%	-1.0	-	a
				2015	5	2.0%	4.5%	3.7	16.9	a
				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
				2019	5	2.0%	1.1%	3.6	16.9	a,b
Chironomidae (% of community)	none	YES	<0.001	2007	3	99.0%	0.8%	-	90.4	a
				2011	3	90.0%	0.1%	-10.9	-	a,b
				2015	5	80.4%	11.4%	-22.4	-95.8	b
				2016	5	87.8%	3.0%	-13.5	-21.7	a,b
				2017	5	63.8%	12.6%	-42.5	-262.1	c
				2018	5	85.6%	7.0%	-16.2	-44.2	a,b
				2019	5	95.1%	1.8%	-4.8	50.7	a
Metal Sensitive Taxa (% of community)	none	YES	0.002	2007	3	37.2%	16.0%	-	2.2	a,b,c
				2011	3	14.4%	10.4%	-1.4	-	c
				2015	5	15.9%	11.5%	-1.3	0.1	c
				2016	5	29.2%	13.6%	-0.5	1.4	b,c
				2017	5	39.0%	23.3%	0.1	2.4	a,b,c
				2018	5	59.6%	11.3%	1.4	4.3	a
				2019	5	49.3%	16.6%	0.8	3.4	a,b
Tipulidae (% of community)	rank	NO	0.156	2007	3	0.0%	0.1%	-	0.0	a
				2011	3	0.0%	0.1%	0.0	-	a
				2015	5	6.0%	8.9%	60.0	60.0	a
				2016	5	1.7%	1.2%	17.1	17.1	a
				2017	5	1.1%	1.6%	11.0	11.0	a
				2018	5	0.6%	0.5%	6.1	6.1	a
				2019	5	0.5%	0.5%	5.3	5.3	a

Table F.58: Statistical Comparison of Primary and Percent Compositional Benthic Metrics at the Mary River Lower Mine-Exposed Area (CO-05) Among Years of Mine Operation (2015 to 2019) and Baseline (2007, 2011)

Metric	Data Transform-ation	Overall 7-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
Collector-Gatherer FFG (% of community)	log10	YES	<0.001	2007	3	35.0%	15.3%	-	-2.7	a
				2011	3	66.7%	11.5%	2.1	-	b
				2015	5	82.9%	13.0%	3.1	1.4	b
				2016	5	59.0%	10.2%	1.6	-0.7	b
				2017	5	63.9%	13.5%	1.9	-0.2	b
				2018	5	83.7%	8.2%	3.2	1.5	b
				2019	5	67.0%	15.7%	2.1	0.0	b
Filterer FFG (% of community)	rank	YES	0.001	2007	3	21.0%	28.3%	-	0.7	a
				2011	3	13.3%	11.5%	-0.3	-	a
				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	a
				2018	5	6.1%	4.2%	-0.5	-0.6	a
				2019	5	0.9%	0.7%	-0.7	-1.1	b
Shredder FFG (% of community)	log10	YES	0.001	2007	3	40.2%	20.9%	-	5.8	a
				2011	3	6.7%	5.8%	-1.6	-	b,c
				2015	5	16.0%	11.4%	-1.2	1.6	a,b
				2016	5	8.9%	6.8%	-1.5	0.4	a,b,c
				2017	5	6.7%	3.1%	-1.6	0.0	b,c
				2018	5	4.2%	2.5%	-1.7	-0.4	b
				2019	5	18.0%	3.5%	-1.1	2.0	a,b

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

(Blue shading) Indicates magnitude of difference outside of a ± 2 SD effect size of respective baseline year mean indicating an ecologically meaningful difference between study years.

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

Table F.59: Statistical Comparison of Sediment Physical Properties Between Mary Lake and Reference Lake 3 Benthic Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2019

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	0.032	β	Reference	5	58.5	10.1	4.5	43.3	68.9
					Mary	4	24.9	33.0	16.5	5.5	74.0
	Silt-Sized Material (%)	YES	0.082	α	Reference	5	34.4	9.6	4.3	24.9	48.4
					Mary	4	57.4	23.4	11.7	23.0	75.2
	Clay-Sized Material (%)	NO	0.204	η	Reference	5	7.1	1.2	0.5	5.4	8.2
					Mary	4	17.7	13.1	6.5	3.1	29.7
	Moisture (%)	YES	0.009	α	Reference	5	84.0	5.9	2.6	77.8	91.4
					Mary	4	54.1	17.7	8.9	29.9	67.6
	Total Organic Carbon (TOC) Content (%)	YES	0.003	β	Reference	5	4.2	2.4	1.1	2.2	7.4
					Mary	4	0.9	0.3	0.1	0.6	1.1
Profundal (Deep) Stations	Sand-Sized Material (%)	YES	0.082	γ	Reference	5	51.1	3.2	1.4	46.3	54.0
					Mary	6	27.7	24.6	10.0	7.7	76.5
	Silt-Sized Material (%)	NO	0.12	γ	Reference	5	40.0	2.9	1.3	36.9	44.6
					Mary	6	48.1	20.3	8.3	14.1	72.0
	Clay-Sized Material (%)	YES	0.013	η	Reference	5	9.0	0.8	0.4	7.9	10.2
					Mary	6	24.3	10.0	4.1	9.4	34.5
	Moisture (%)	YES	0.008	γ	Reference	5	87.4	1.0	0.4	86.0	88.6
					Mary	6	52.9	12.3	5.0	31.7	64.5
	Total Organic Carbon (TOC) Content (%)	YES	<0.001	α	Reference	5	4.3	0.3	0.1	3.9	4.6
					Mary	6	0.8	0.2	0.1	0.5	1.0

Highlighted values indicate significant difference between study areas based on statistical 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 F.60: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary Lake, August 2019

Taxa	Study Area / Replicate Station	Mary Lake - Littoral Stations BLO-1	BLO-11	BLO-7	BLO-6
ROUNDWORMS					
P. Nemata		34	345	9	9
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae		-	17	-	-
F. Lumbriculidae					
Lumbriculus		-	-	-	-
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
immature		-	-	-	-
F. Acalyptonotidae					
Acalyptonotus		9	17	-	26
F. Hygrobatidae					
Hygrobates		-	-	-	-
F. Lebertiidae					
Lebertia		-	-	9	9
F. Sperchontidae					
Sperchon		-	86	-	-
HARPACTICOIDS					
O. Harpacticoida		-	69	-	-
SEED SHRIMPS					
Cl. Ostracoda		69	172	9	9
INSECTS					
Cl. Insecta					
CADDISFLIES					
O. Trichoptera					
immature		-	-	-	-
F. Apataniidae					
Apatania		-	-	-	-
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae		-	-	-	-
S.F. Chironominae					
Chironomus		-	388	-	-
Lipiniella		-	-	-	-

Table F.60: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary Lake, August 2019

Taxa / Study Area: Replicate Station	Mary Lake - Littoral Stations: BLO-1	BLO-11	BLO-7	BLO-6
Micropsectra	543	914	-	-
Paratanytarsus	-	-	-	-
Polypedilum	-	34	-	-
Sergentia	17	2,569	-	-
Stictochironomus	293	716	-	-
Tanytarsus	86	138	-	-
S.F. Diamesinae				
Protanypus	-	138	17	26
Pseudodiamesa	-	34	-	26
Pseudokiefferiella	-	-	-	-
S.F. Orthocladiinae				
Abiskomyia	69	34	-	9
Eukiefferiella	-	-	-	-
Heterotrissocladius	138	34	681	552
Hydrobaenus	17	-	-	-
Mesocricotopus	-	-	-	-
Paracladius	-	-	-	-
Parakiefferiella	-	-	-	-
Psectrocladius	-	-	-	-
Zalutschia	34	34	-	9
Orthocladiinae Genus "Greenland'	-	-	-	-
S.F. Tanypodinae				
Arctopelopia	-	-	-	-
Procladius	966	34	164	181
Density (No. organisms per m^2)	2,275	5,773	889	856
Richness (total number of taxa)[a]	12	18	6	10
Simpson's Evenness (E)	0.806	0.795	0.454	0.596
Bray-Curtis Index	0.779	0.862	0.904	0.844
Dominant Taxonomic Groups				
% Nemata	1.5%	6.0%	1.0%	1.1%
% Hydracarina	0.4%	1.8%	1.0%	4.1%
% Ostracods	3.0%	3.0%	1.0%	1.1%
% Chironomids	95.1%	87.8%	97.0%	93.8%
% Metal Sensitive Chironmids	27.6%	21.2%	1.9%	6.1%
% Tipulidae	0.0%	0.0%	0.0%	0.0%
Functional Feeding Groups				
% Collector - Gatherers	28.0%	78.2%	80.5%	73.7%
% Filterers	27.6%	18.2%	0.0%	0.0%
% Shredders	1.5%	1.2%	0.0%	1.1%
Habit Preference Groups				
% Clingers	28.8%	65.1%	1.0%	4.1%
% Sprawlers	56.8%	7.1%	96.1%	91.8%
% Burrowers	14.4%	27.8%	2.9%	4.1%

[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 2019

Taxa	Study Area / Replicate Station	Mary Lake - Profundal Stations					
		BLO-3	BLO-15	BLO-14	BLO-13	BLO-4	BLO-5
ROUNDWORMS							
P. Nemata		14	-	-	-	9	52
ANNELIDS							
P. Annelida							
WORMS							
Cl. Oligochaeta							
F. Enchytraeidae		-	-	-	-	-	-
F. Lumbriculidae							
Lumbriculus		-	-	-	-	-	-
ARTHROPODS							
P. Arthropoda							
MITES							
Cl. Arachnida							
O. Acarina							
immature		-	-	-	-	-	-
F. Acalyptonotidae							
Acalyptonotus		-	26	-	17	-	-
F. Hygrobatidae							
Hygrobates		14	-	-	-	-	-
F. Lebertiidae							
Lebertia		-	9	-	-	17	-
F. Sperchontidae							
Sperchon		-	-	-	-	-	86
HARPACTICOIDS							
O. Harpacticoida		-	-	-	-	-	-
SEED SHRIMPS							
Cl. Ostracoda		101	741	26	-	95	34
INSECTS							
Cl. Insecta							
CADDISFLIES							
O. Trichoptera							
immature		-	-	-	-	-	-
F. Apataniidae							
Apatania		-	-	-	-	-	-
TRUE FLIES							
O. Diptera							
MIDGES							
F. Chironomidae							
chironomid pupae		-	-	-	-	-	-
S.F. Chironominae							
Chironomus		-	-	-	-	-	603
Lipiniella		-	-	-	-	-	-

Table F.60: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary Lake, August 2019

Taxa — Study Area / Replicate Station	Mary Lake - Profundal Stations BLO-3	BLO-15	BLO-14	BLO-13	BLO-4	BLO-5
Micropsectra	101	26	-	-	-	155
Paratanytarsus	-	-	-	-	-	34
Polypedilum	-	-	-	-	-	-
Sergentia	57	9	-	-	-	500
Stictochironomus	1,092	-	-	-	-	534
Tanytarsus	14	-	-	-	-	17
S.F. Diamesinae						
Protanypus	14	-	26	9	17	34
Pseudodiamesa	-	-	-	-	-	-
Pseudokiefferiella	-	-	-	-	-	34
S.F. Orthocladiinae						
Abiskomyia	-	-	-	-	-	17
Eukiefferiella	-	-	-	-	-	-
Heterotrissocladius	187	776	931	991	784	103
Hydrobaenus	-	-	-	-	-	-
Mesocricotopus	14	-	-	-	-	-
Paracladius	-	-	-	-	-	-
Parakiefferiella	-	-	-	-	-	17
Psectrocladius	-	-	-	-	-	-
Zalutschia	14	17	-	-	-	-
Orthocladiinae Genus "Greenla	-	-	-	-	-	-
S.F. Tanypodinae						
Arctopelopia	-	-	-	-	-	-
Procladius	57	17	34	43	34	17
Density (No. organisms per m^2)	1,679	1,621	1,017	1,060	956	2,237
Richness (total number of taxa)[a]	12	8	4	4	6	15
Simpson's Evenness (E)	0.607	0.641	0.213	0.165	0.379	0.868
Bray-Curtis Index	0.781	0.751	0.647	0.684	0.599	0.889
Dominant Taxonomic Groups						
% Nemata	0.9%	0.0%	0.0%	0.0%	0.9%	2.3%
% Hydracarina	0.9%	2.2%	0.0%	1.6%	1.8%	3.8%
% Ostracods	5.9%	45.7%	2.6%	0.0%	9.9%	1.5%
% Chironomids	92.3%	52.1%	97.4%	98.4%	87.3%	92.3%
% Metal Sensitive Chironmids	7.7%	1.6%	2.6%	0.8%	1.8%	12.2%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Groups						
% Collector - Gatherers	88.0%	94.1%	96.7%	94.3%	94.7%	86.2%
% Filterers	6.8%	1.6%	0.0%	0.0%	0.0%	9.2%
% Shredders	0.9%	1.0%	0.0%	0.0%	0.0%	0.0%
Habit Preference Groups						
% Clingers	11.1%	4.3%	0.0%	1.6%	1.8%	33.9%
% Sprawlers	22.2%	95.7%	97.4%	97.5%	95.5%	11.4%
% Burrowers	66.7%	0.0%	2.6%	0.8%	2.7%	54.7%

[a] Bold entries excluded from taxa cour

Table F.61: Statistical Comparison of Benthic Invertebrate Community Metrics at Mary Lake Littoral (Shallow) Stations Among Years of Mine Operation (2015 to 2019) and Baseline (2007)

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	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.9693	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	1,718	1,418	-0.7	a	
				2019	4	2,448	2,313	-0.2	a	
Richness (No. of Taxa)	rank	NO	0.7808	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	9.3	2.2	0.6	a	
				2019	4	11.5	5.0	1.8	a	
Simpson's Evenness	none	NO	0.4514	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	0.575	0.293	-3.5	a	
				2019	4	0.663	0.169	-1.3	a	
Nemata (% of community)	modified probit	NO	0.8099	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%	6.4%	-0.3	a	
				2019	4	2.4%	2.4%	-0.4	a	
Ostracoda (% of community)	rank	NO	0.2291	2007	3	0.2%	0.4%	-	a	Mann-Whitney U-test
				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	8.9%	10.9%	22.8	a	
				2019	4	2.0%	1.1%	4.8	a	
Chironomidae (% of community)	modified probit	NO	0.9266	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	86.2%	18.7%	-0.4	a	
				2019	4	93.4%	4.0%	0.2	a	
Metal Sensitive Taxa (% of community)	none	NO	0.8010	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	11.6%	9.8%	-0.8	a	
				2019	4	14.2%	12.2%	-0.6	a	
Collector-Gatherer FFG (% of community)	rank	NO	0.5120	2007	3	66.0%	26.7%	-	a	Mann-Whitney U-test
				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	76.1%	36.4%	0.4	a	
				2019	4	65.1%	24.9%	0.0	a	
Filterer FFG (% of community)	modified probit	NO	0.5847	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	4.1%	7.3%	-1.2	a	
				2019	4	11.5%	13.8%	-0.7	a	

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

(blue box) 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 Invertebrate Community Metrics at Mary Lake Profundal (Deep) Stations Among Years of Mine Operation (2015 to 2019) and Baseline (2007)

Metric	Data Transformation	Overall 5-Year Comparison: Significant Difference Among Years?	Overall 5-Year Comparison: P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	log10	YES	0.0051	2007	4	3,512	3,257	-	a	Tukey's HSD
				2015	6	775	748	-0.8	b,c	
				2017	6	536	497	-0.9	b	
				2018	6	1,521	599	-0.6	c	
				2019	6	1,428	506	-0.6	c	
Richness (No. of Taxa)	none	NO	0.9877	2007	4	8.0	6.2	-	a	Tukey's HSD
				2015	6	7.7	4.1	0.0	a	
				2017	6	7.0	1.5	-0.2	a	
				2018	6	8.2	4.4	0.0	a	
				2019	6	8.2	4.5	0.0	a	
Simpson's Evenness	rank	NO	0.3667	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	0.387	0.359	-0.2	a	
				2019	6	0.479	0.273	0.1	a	
Nemata (% of community)	none	NO	0.6134	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	1.7%	1.9%	0.2	a	
				2019	6	0.7%	0.9%	-0.3	a	
Ostracoda (% of community)	rank	NO	0.3534	2007	4	1.6%	2.2%	-	a	Mann-Whitney U-test
				2015	6	11.1%	10.9%	4.4	a	
				2017	6	3.2%	6.2%	0.7	a	
				2018	6	3.5%	3.2%	0.9	a	
				2019	6	10.9%	17.4%	4.3	a	
Chironomidae (% of community)	rank	NO	0.3075	2007	4	96.4%	4.7%	-	a	Mann-Whitney U-test
				2015	6	83.8%	12.2%	-2.7	a	
				2017	6	84.9%	13.8%	-2.5	a	
				2018	6	93.8%	4.1%	-0.6	a	
				2019	6	86.6%	17.4%	-2.1	a	
Metal Sensitive Taxa (% of community)	rank	NO	0.4460	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	8.6%	11.2%	-0.9	a	
				2019	6	4.5%	4.5%	-1.1	a	
Collector-Gatherer FFG (% of community)	modified probit	NO	0.2711	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	90.0%	13.2%	0.9	a	
				2019	6	92.3%	4.2%	1.0	a	
Filterer FFG (% of community)	rank	NO	0.2286	2007	4	33.1%	27.8%	-	a	Mann-Whitney U-test
				2015	6	9.4%	7.9%	-0.9	a	
				2017	6	3.8%	2.7%	-1.1	a	
				2018	6	7.8%	11.4%	-0.9	a	
				2019	6	2.9%	4.1%	-1.1	a	

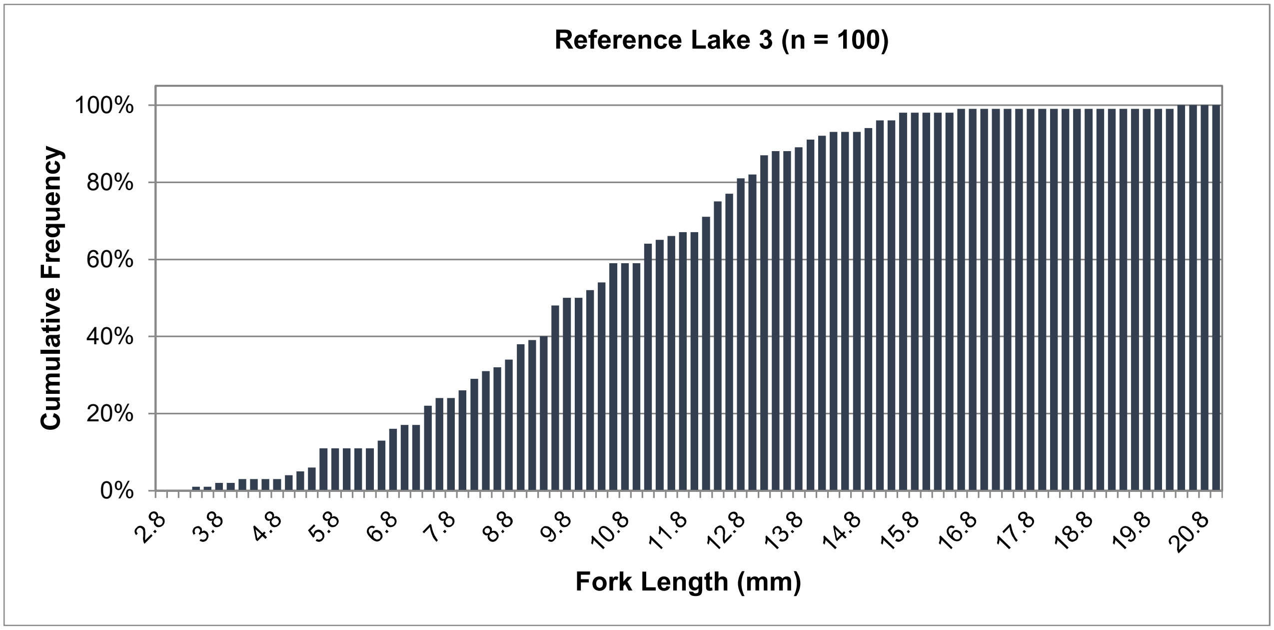
Pair-wise, post-hoc comparisons[a]

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

(Blue) 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



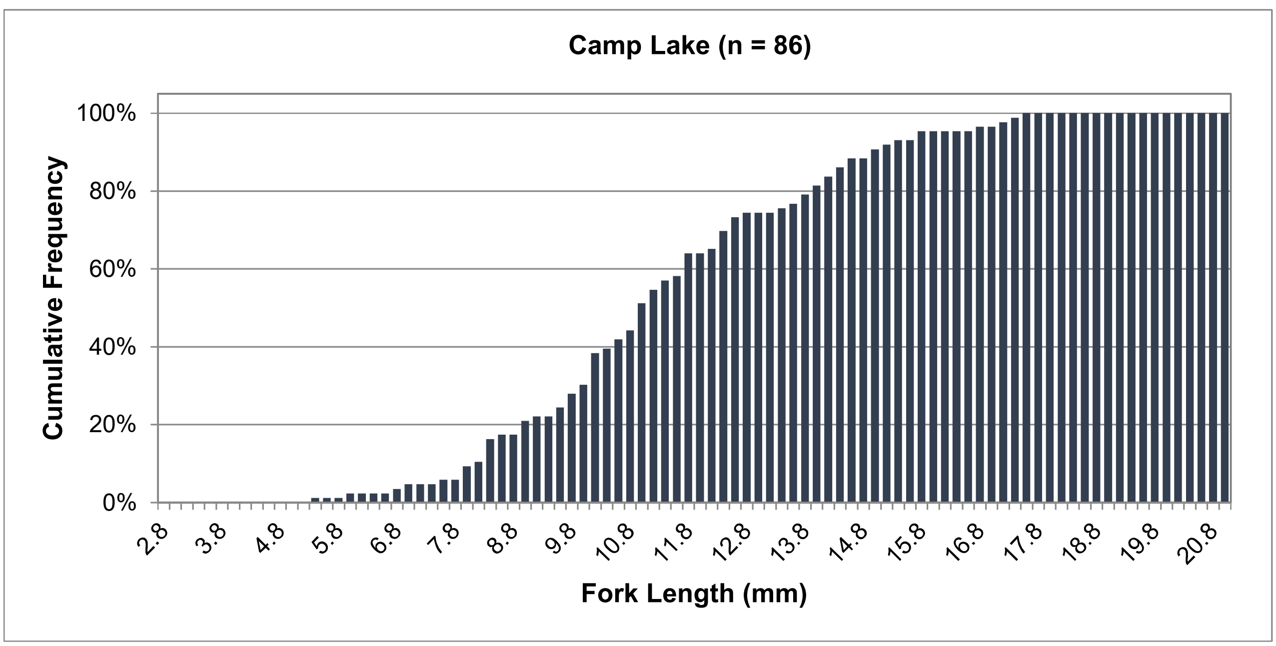


Figure G.1: Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2019

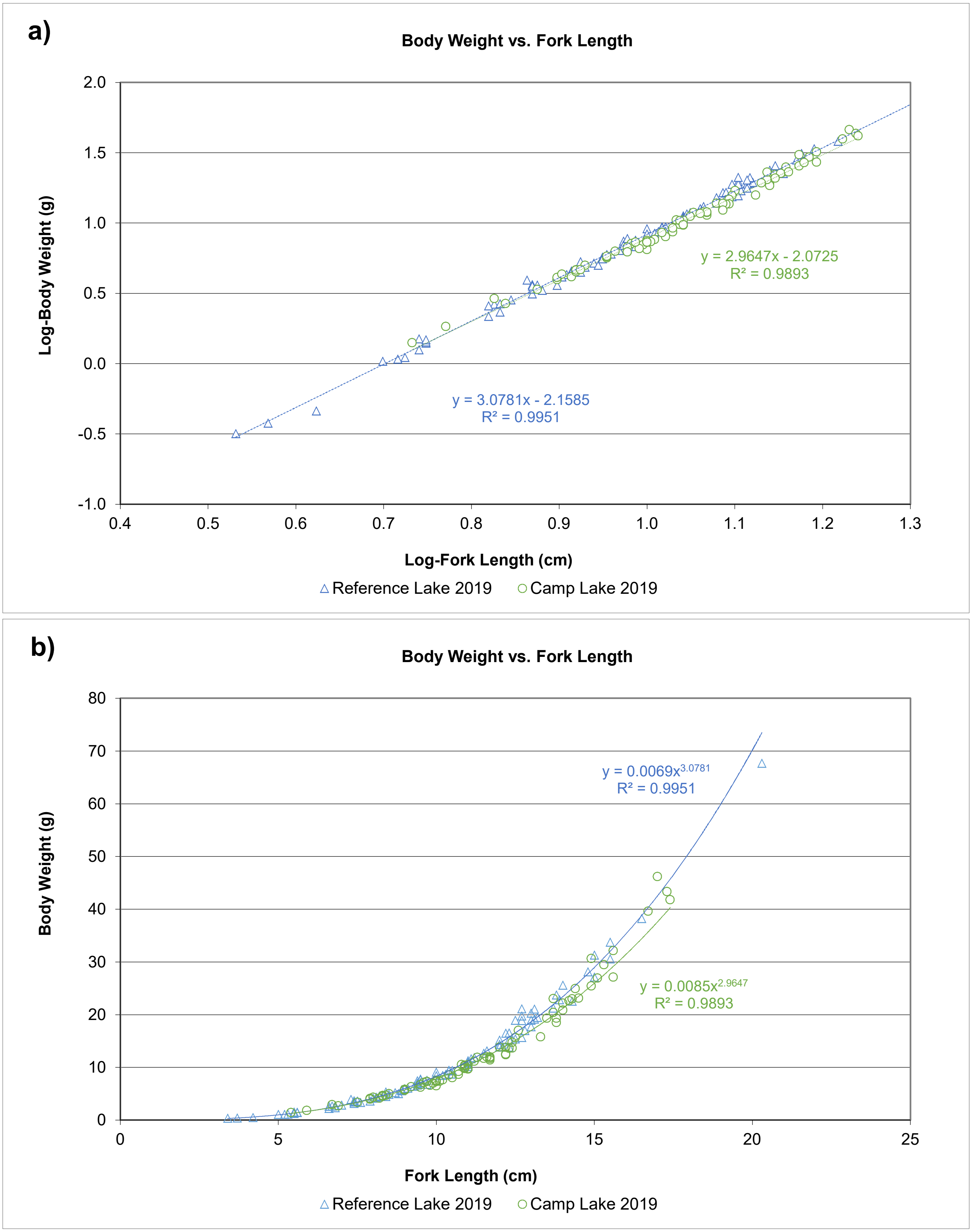
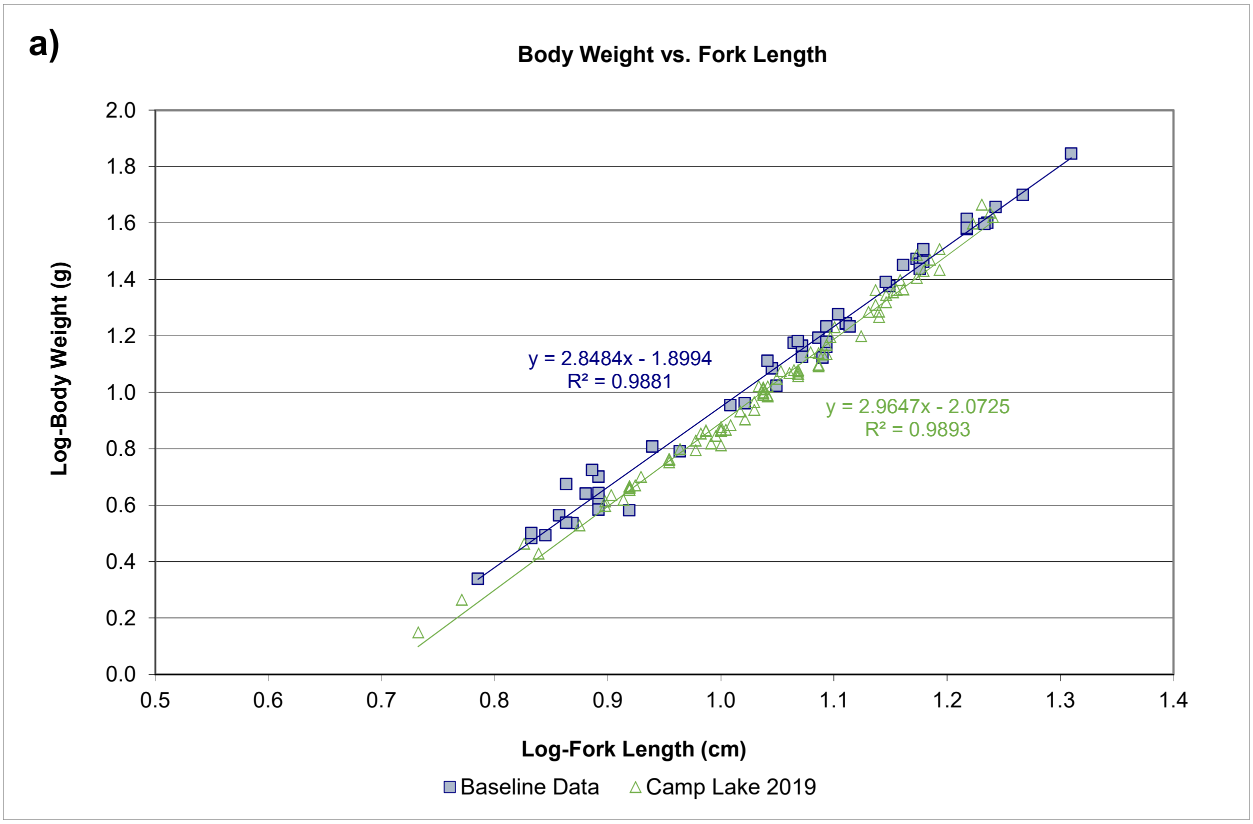


Figure G.2: **Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at the Nearshore Area of Camp Lake and Reference Lake 3 in August 2019 using Log-transformed (a) and Untransformed (b) Data**



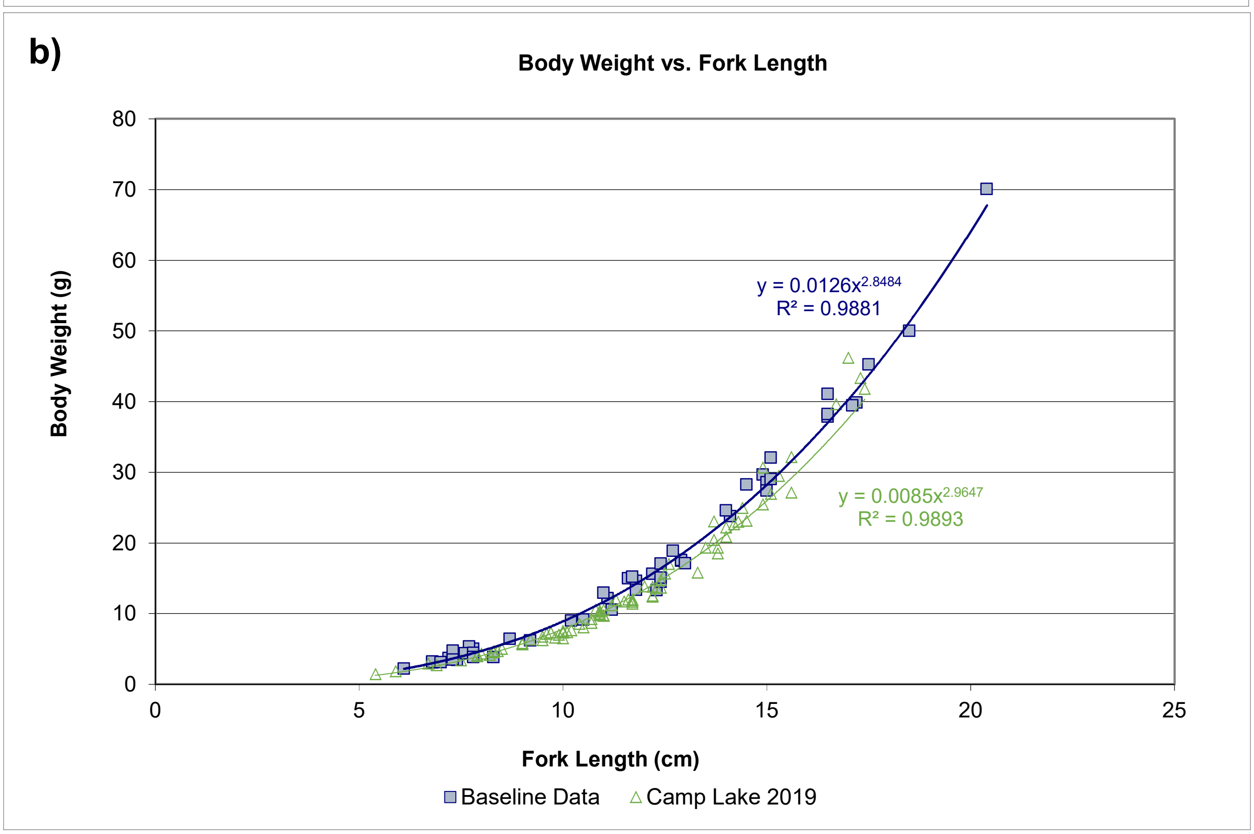
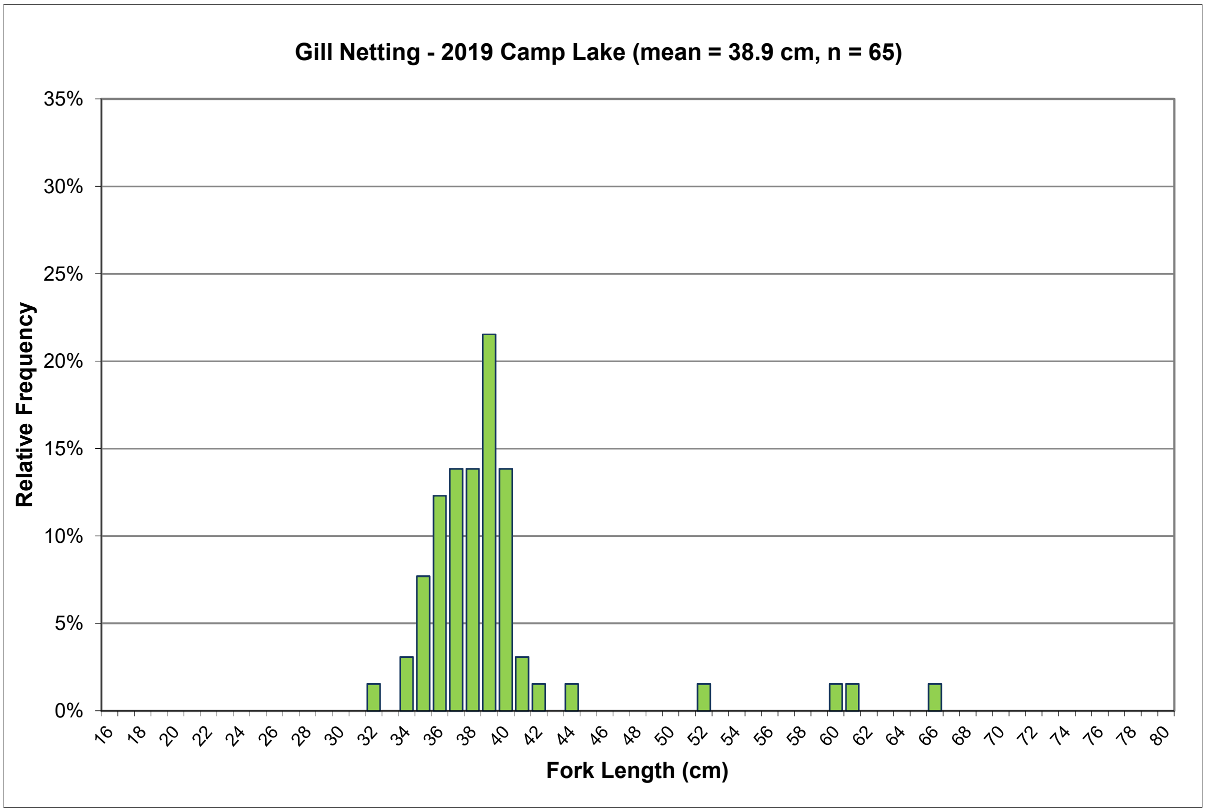


Figure G.3: Comparison of Condition (Weight-at-fork length Relationship) for Arctic Charr Collected in Fall (August-September) at Camp Lake Nearshore Areas in 2019 and during the Mine Baseline Period (2013) using Log-transformed (a) and Untransformed (b) Data



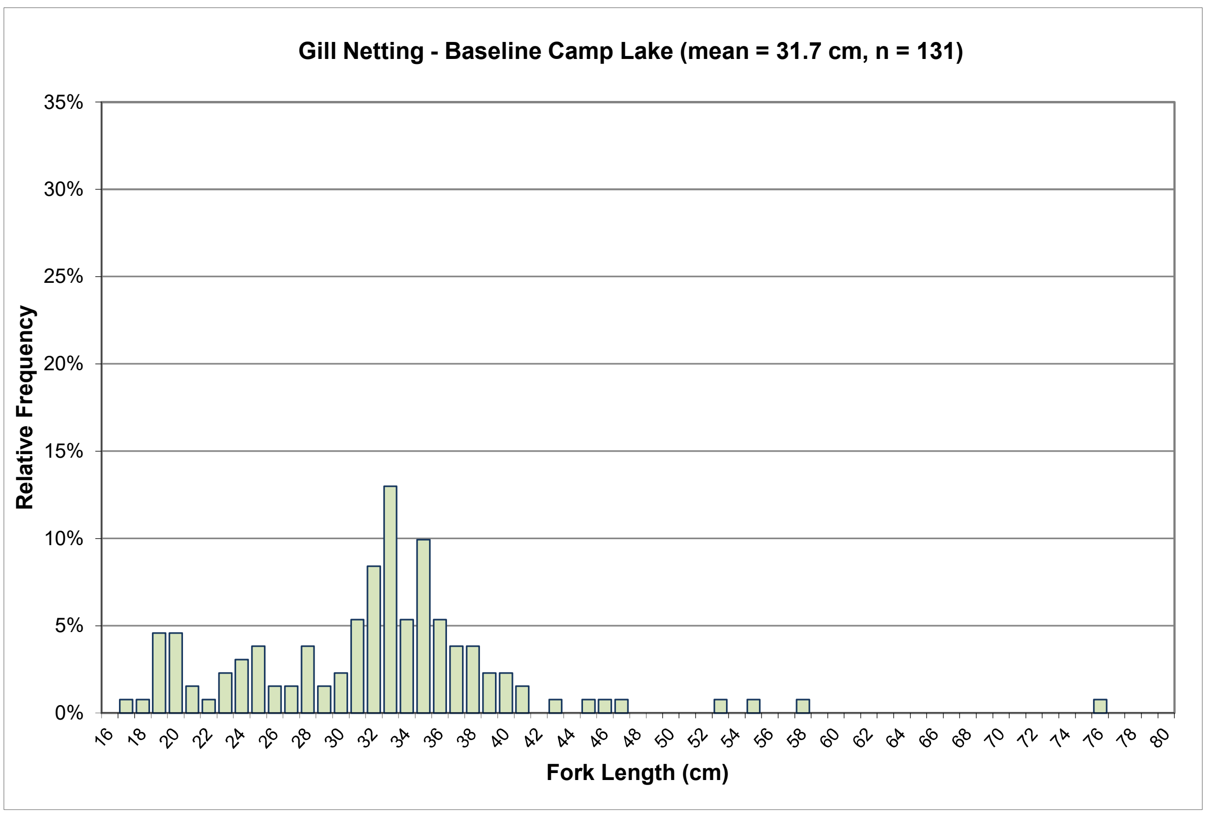
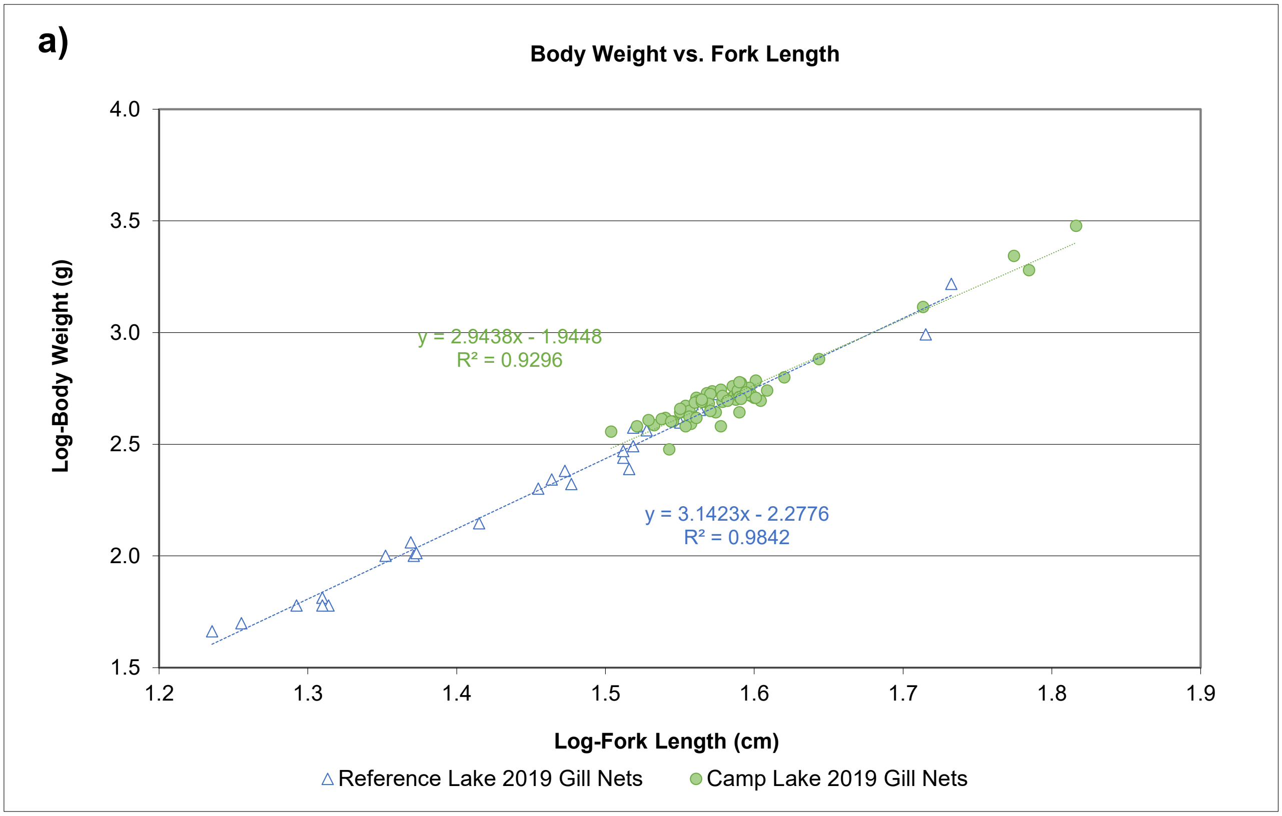


Figure G.4: Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Camp Lake (JLO) in 2019 and Baseline Studies Conducted in Fall, Mary River Project CREMP

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



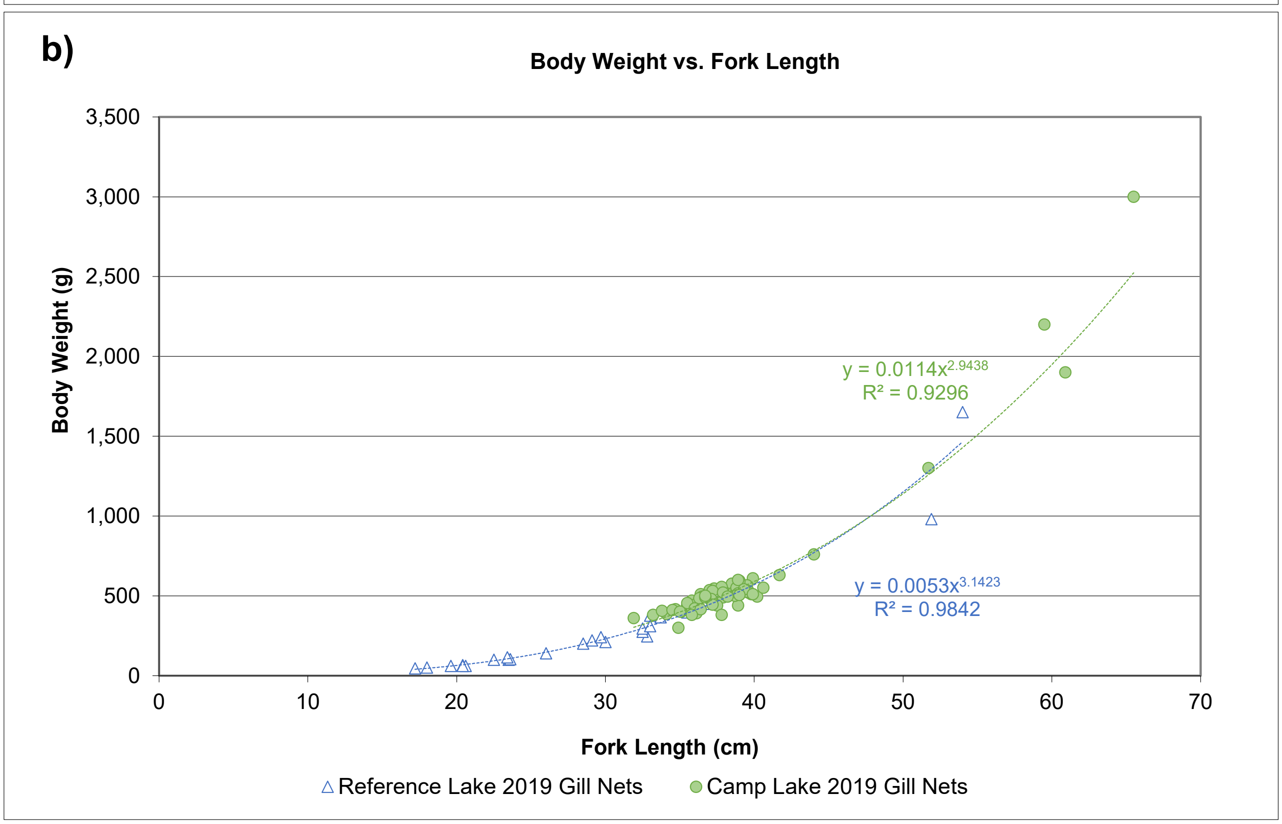


Figure G.5: Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at Littoral/Profundal Areas of Camp Lake and Reference Lake 3 in August 2019 using Log-transformed (a) and Untransformed (b) Data

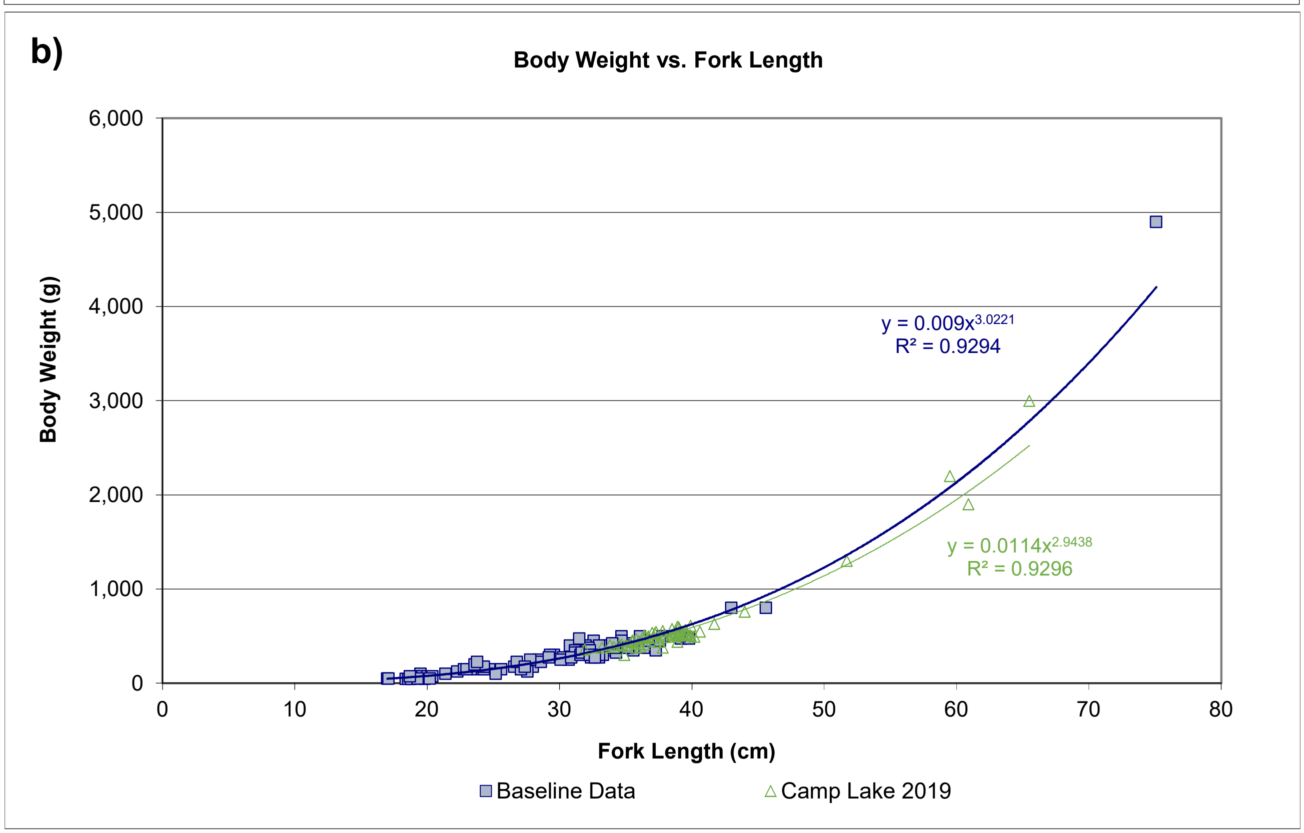
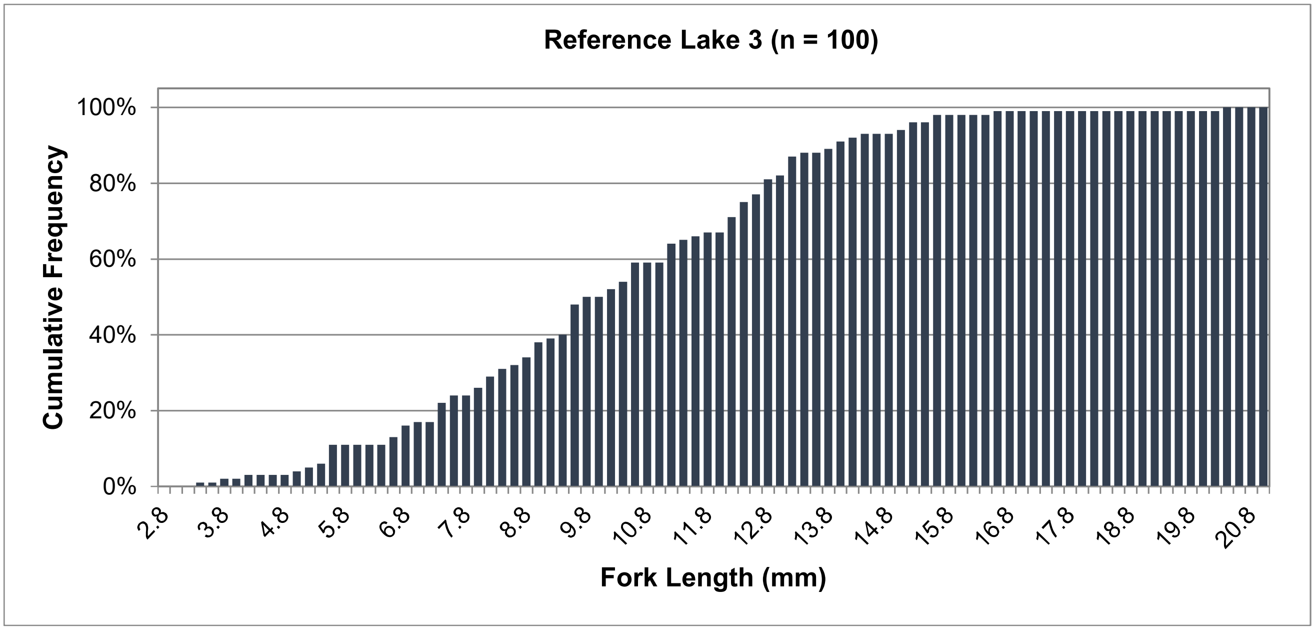


Figure G.6: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Camp Lake Littoral/Profundal Areas in 2019 and during the Mine Baseline Period (2006, 2007, 2008, 2013) using Log-transformed (a) and Untransformed (b) Data



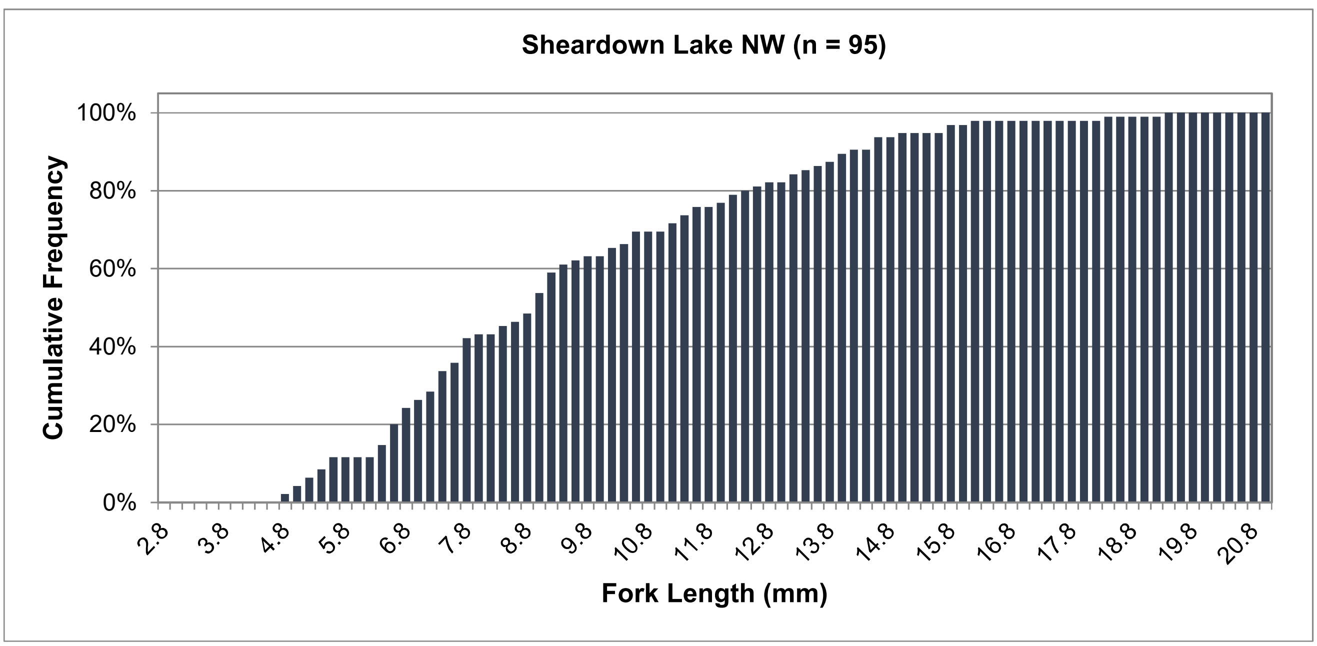
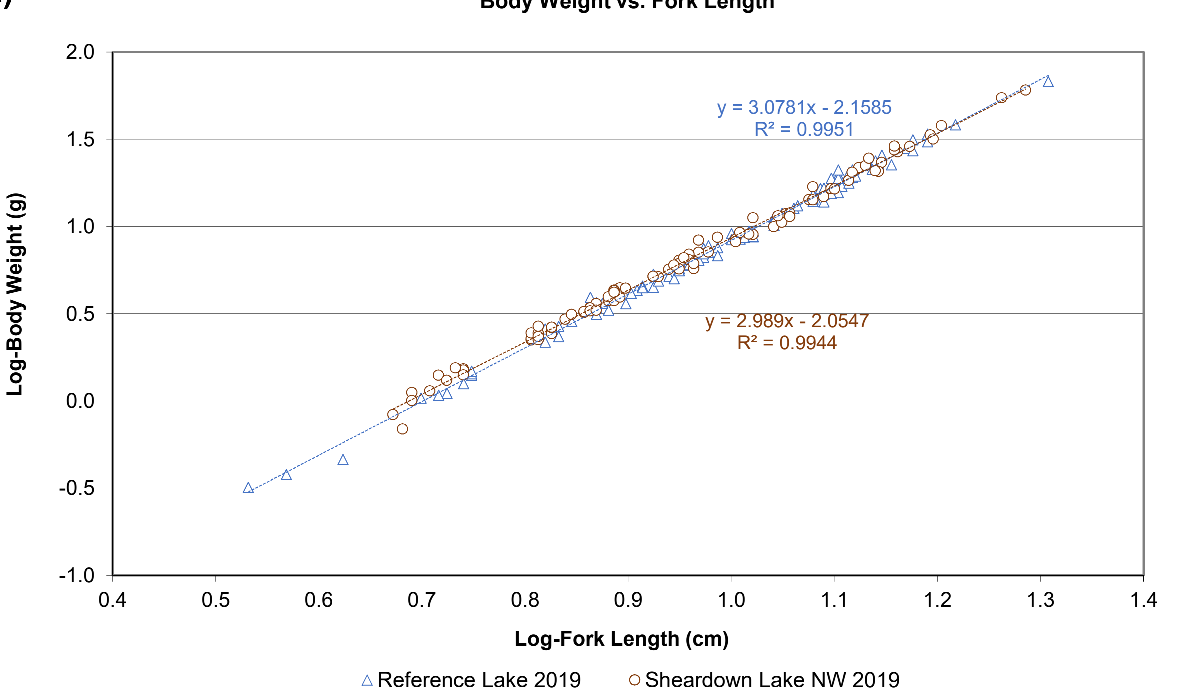


Figure G.7: Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2019

a)



b)

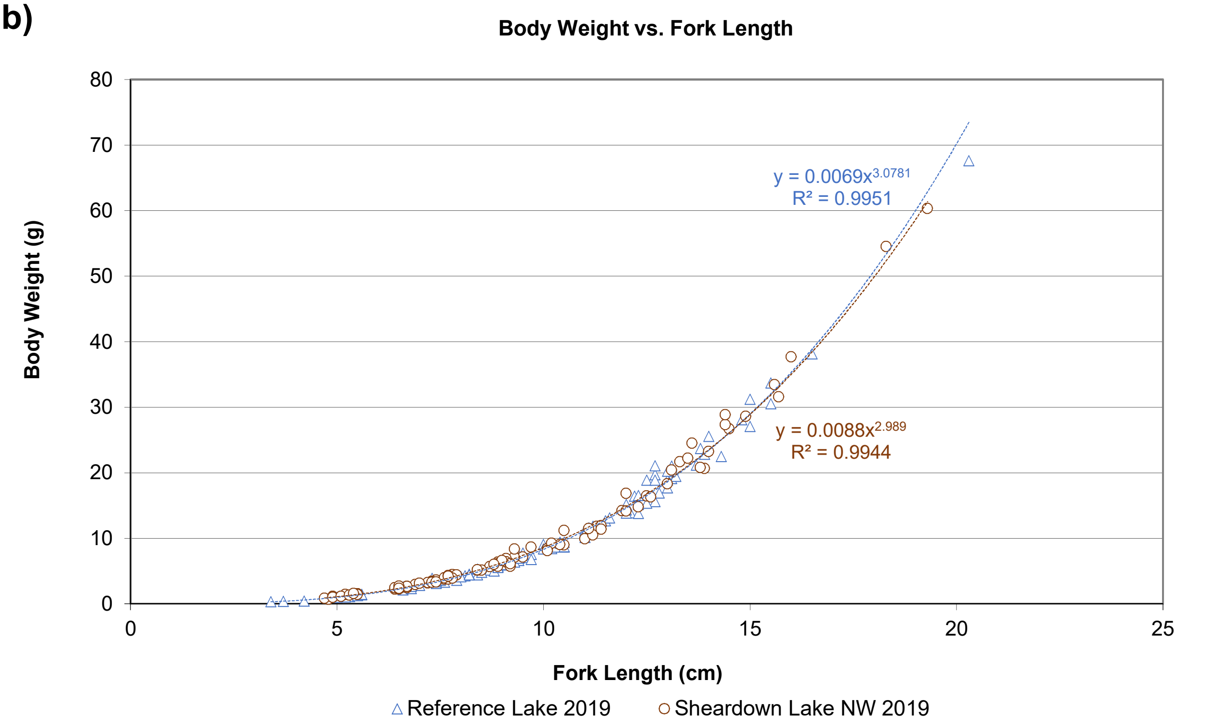
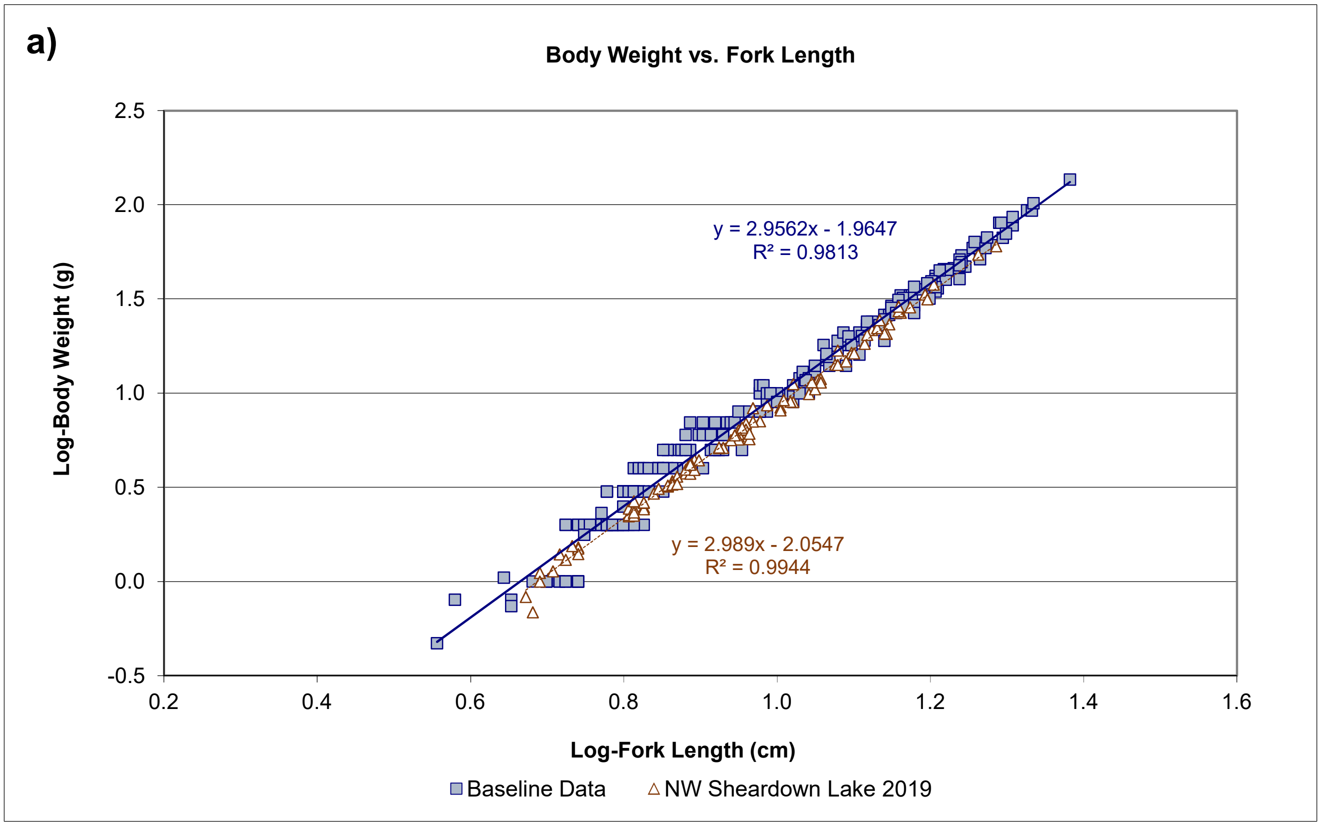


Figure G.8: Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at the Nearshore Area of Sheardown Lake NW and Reference Lake 3 in August 2019 using Log-transformed (a) and Untransformed (b) Data



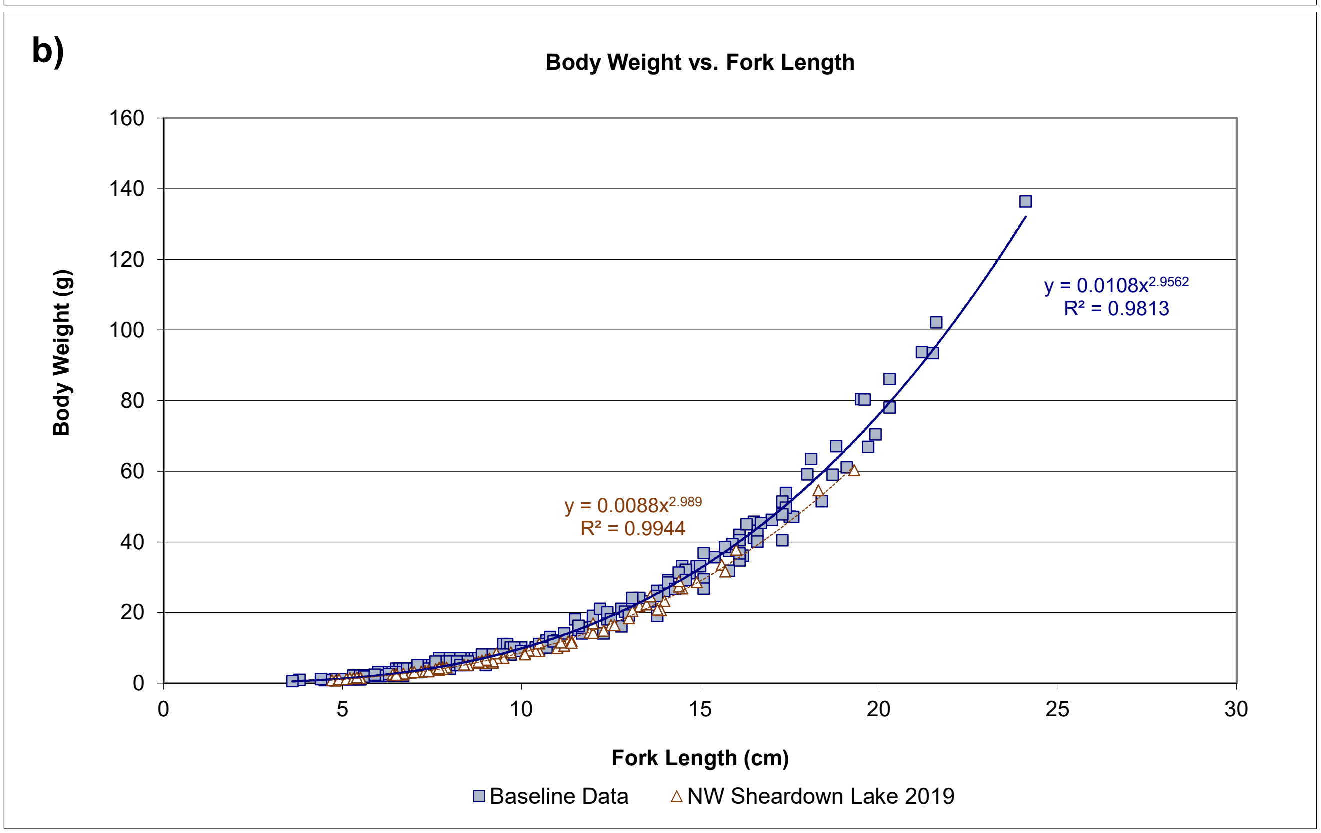
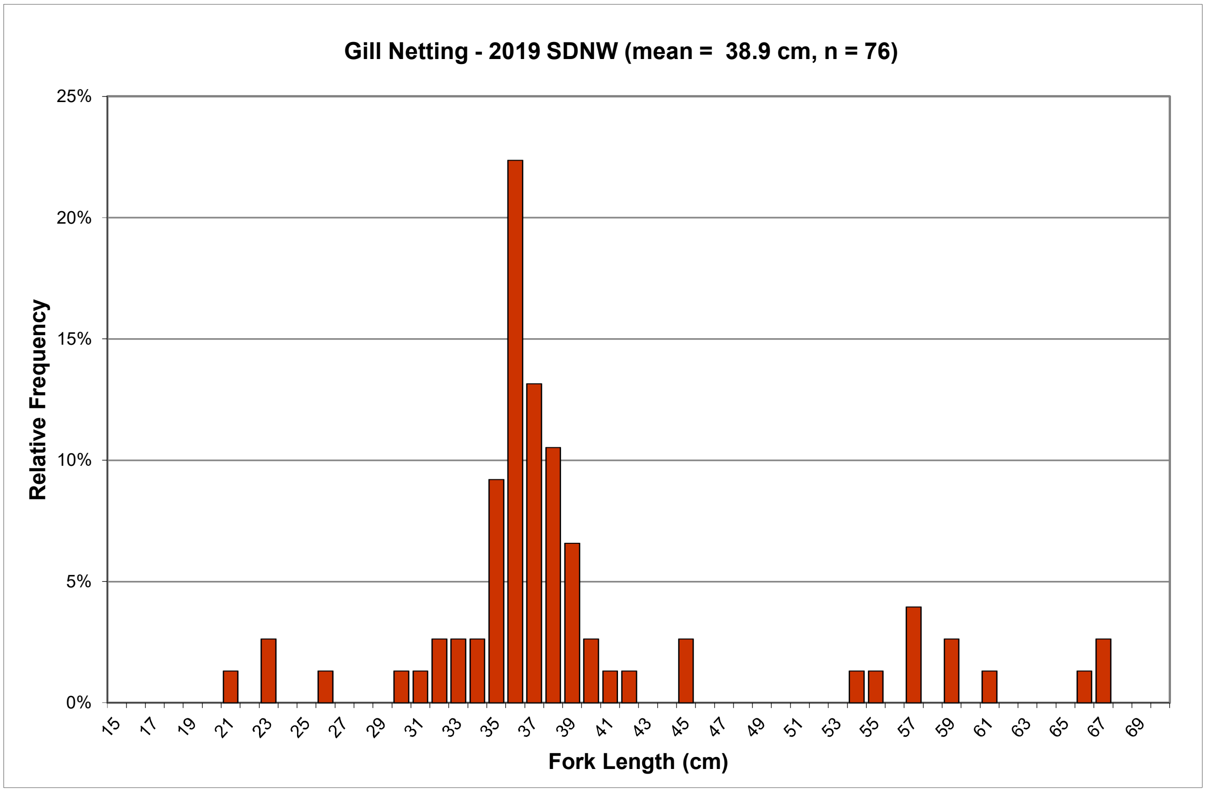


Figure G.9: Comparison of Condition (Weight-at-fork length Relationship) for Arctic Charr Collected in Fall (August-September) at Sheardown Lake NW Nearshore Areas in 2019 and During the Mine Baseline Period (2007, 2008, 2013) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP



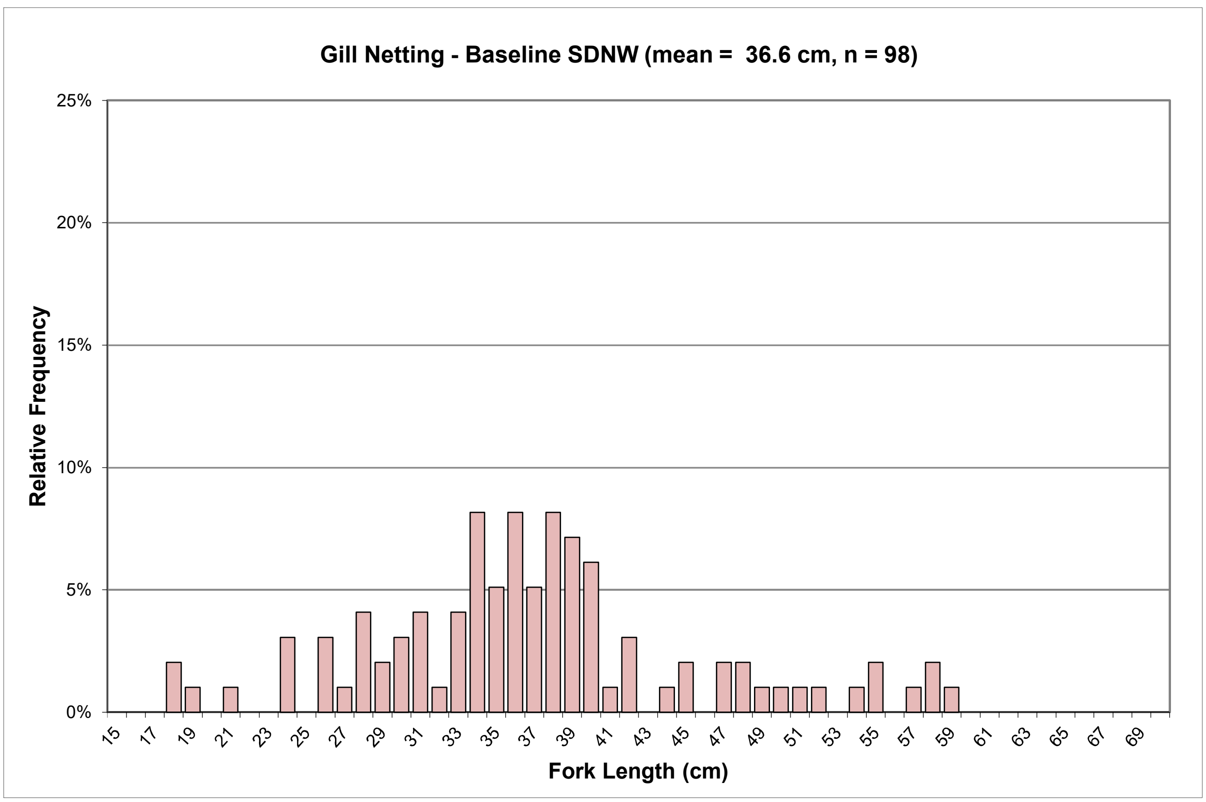
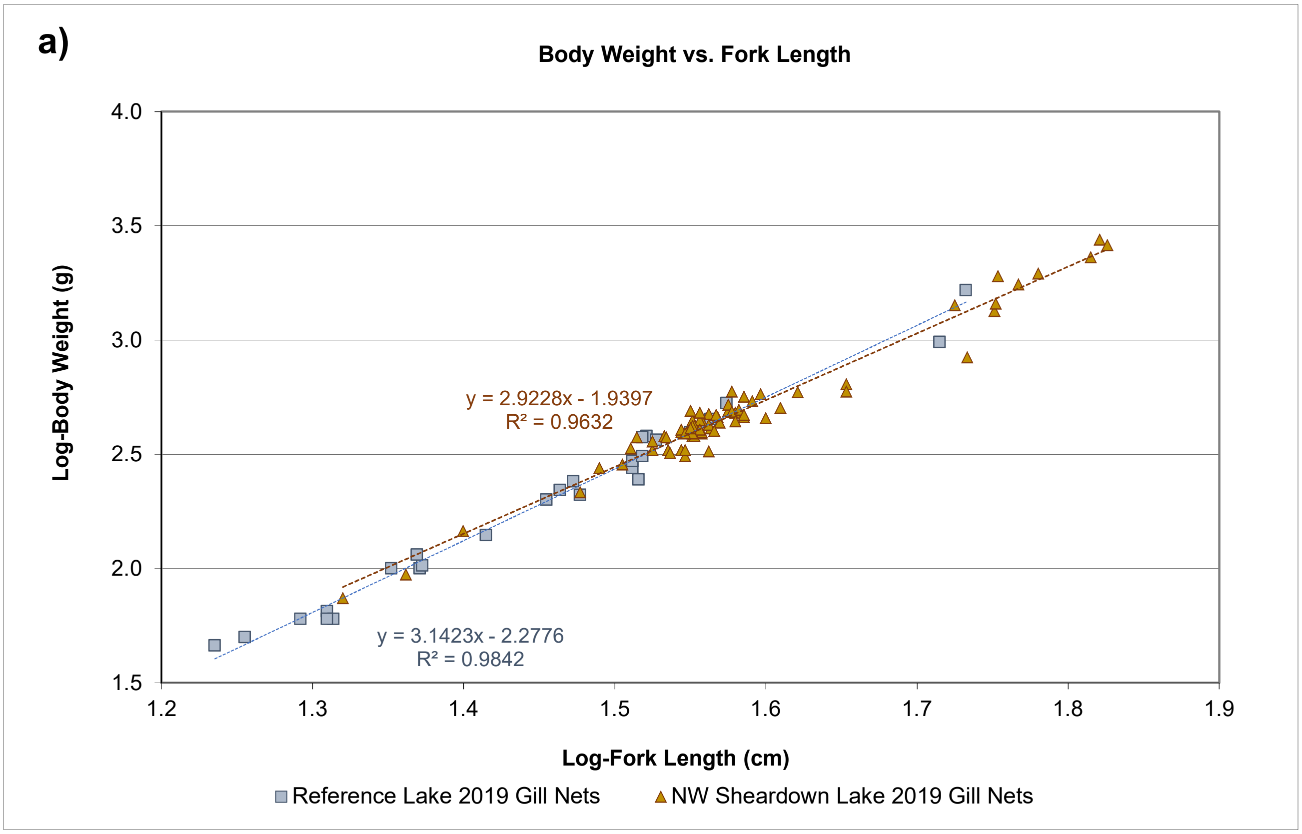


Figure G.10: Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Sheardown Lake NW (DLO-01) in 2019 and Baseline Studies Conducted in Fall, Mary River Project CREMP

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



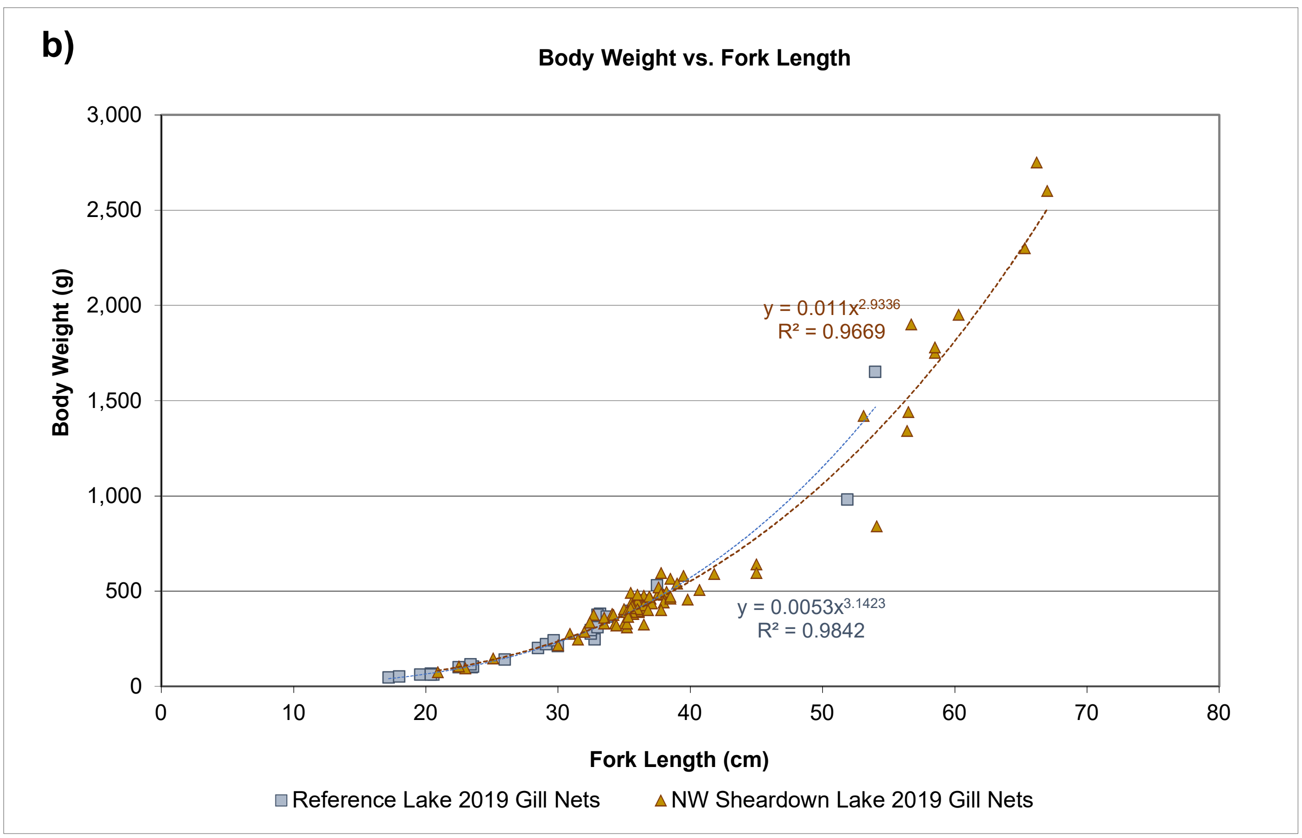
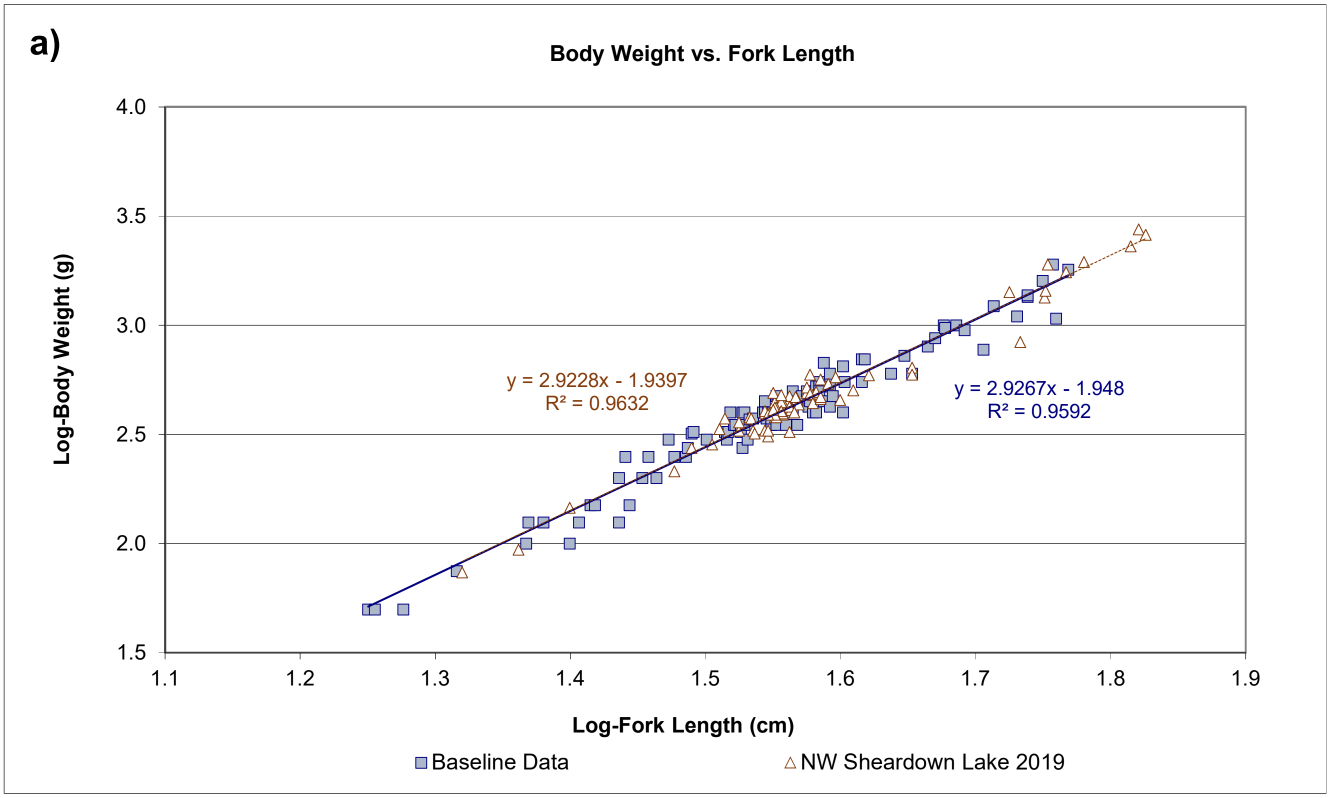


Figure G.11: Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at Littoral/Profundal Areas of Sheardown Lake NW and Reference Lake 3 in August 2019 using Log-transformed (a) and Untransformed (b) Data



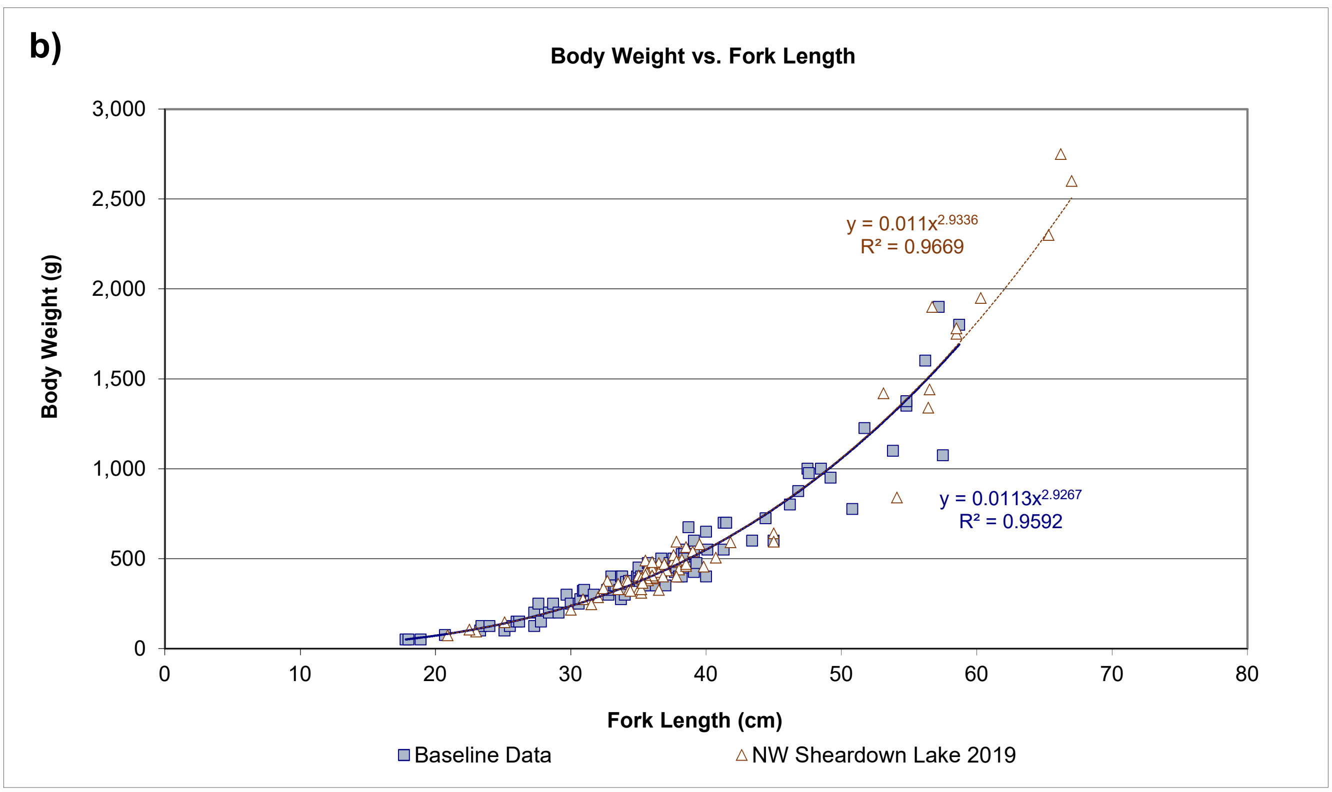
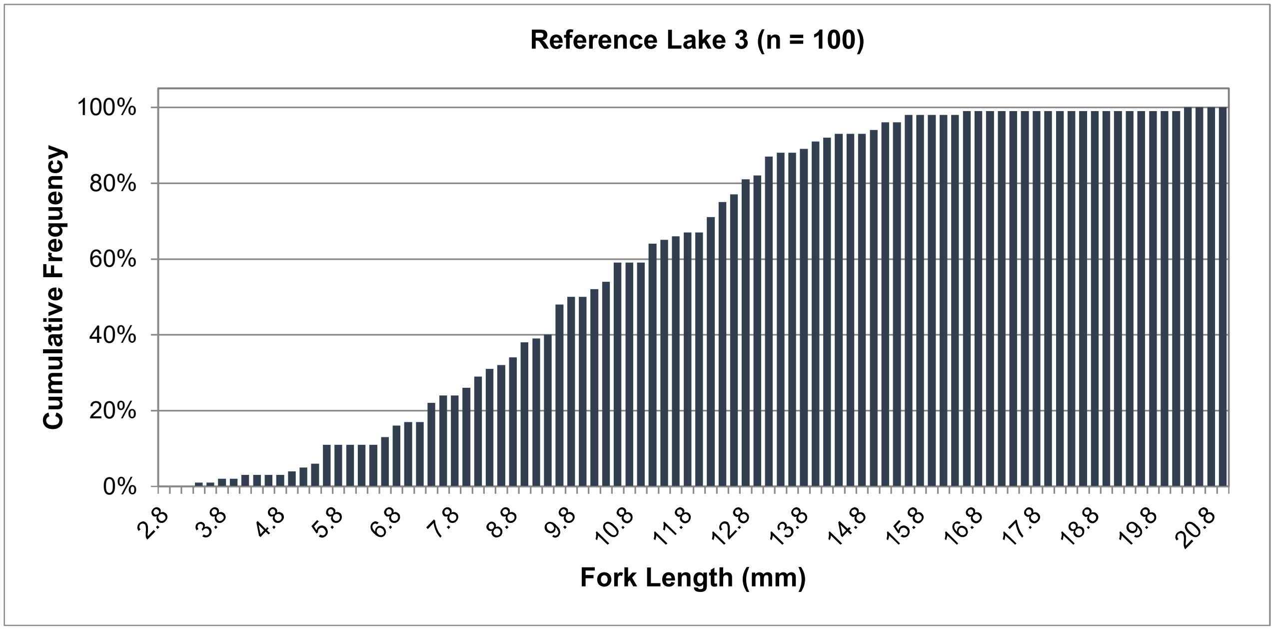


Figure G.12: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Sheardown Lake NW Nearshore Areas in 2019 and during the Mine Baseline Period (2006, 2007, 2008, 2013) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP



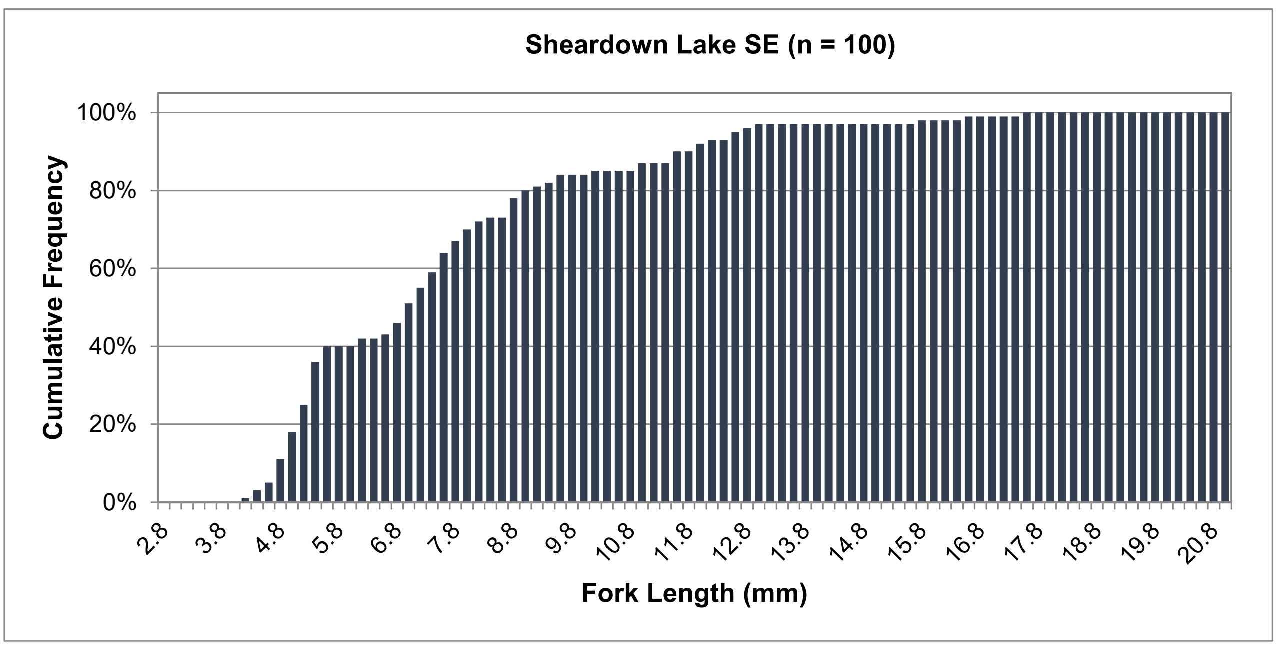
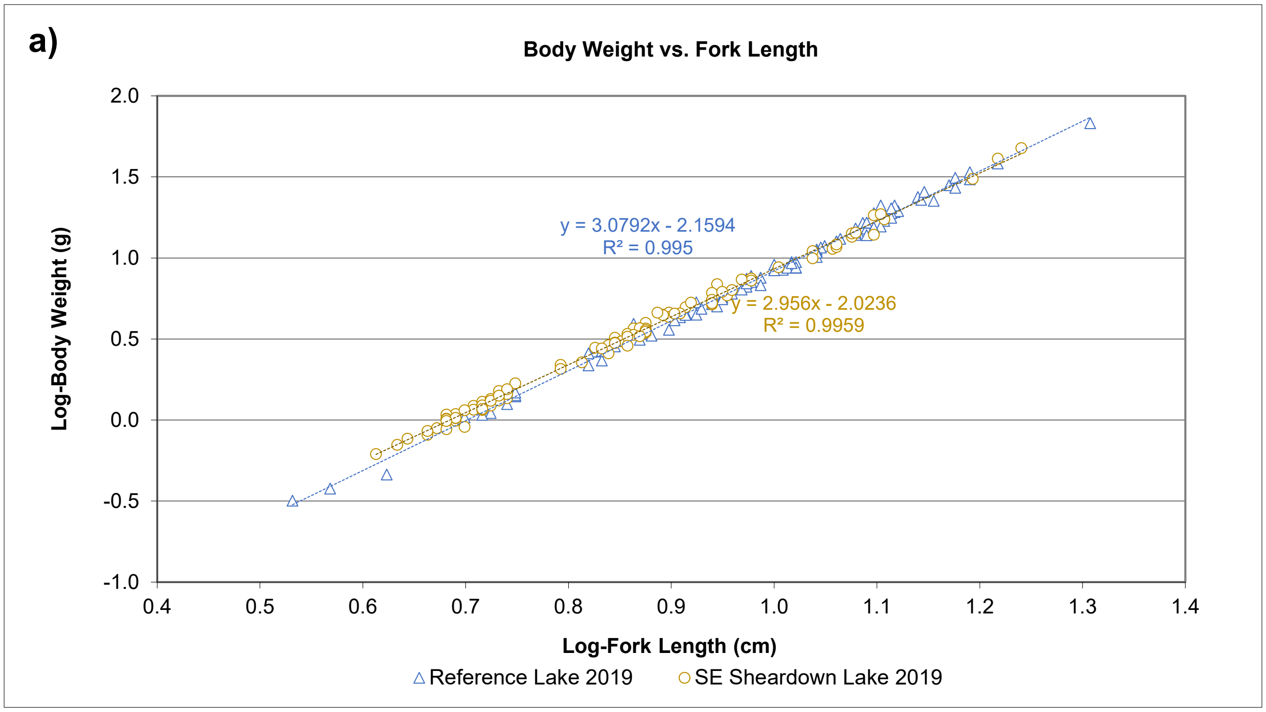


Figure G.13: Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2019



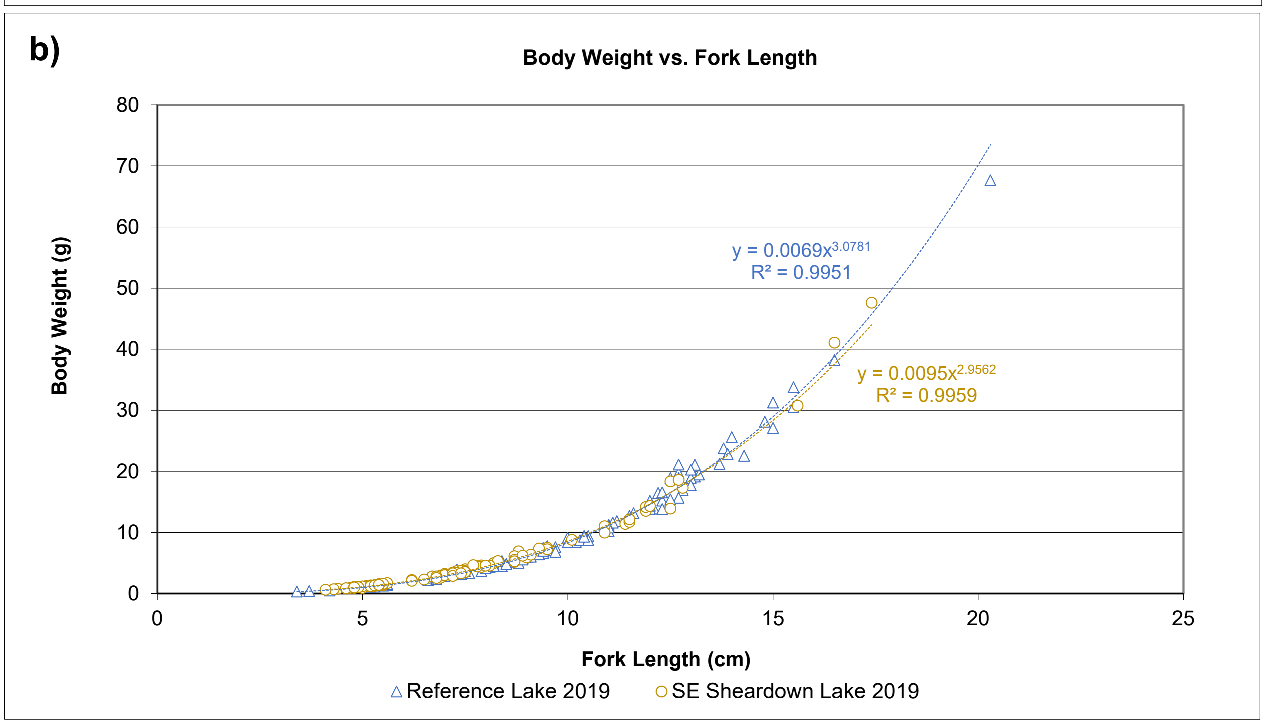


Figure G.14: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected at the Nearshore Area of Sheardown Lake SE and Reference Lake 3 in August 2019 using Log-transformed (a) and Untransformed (b) Data

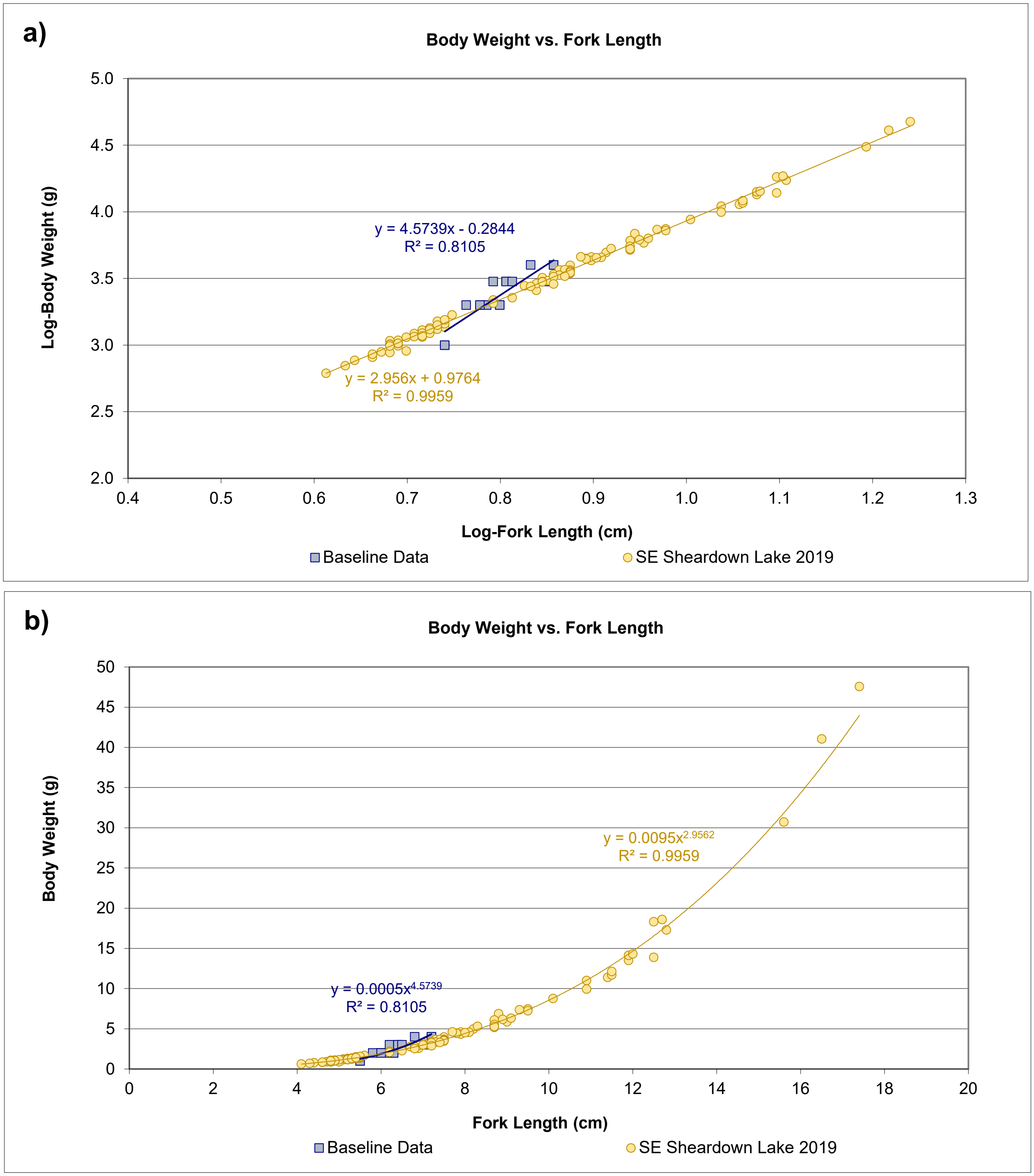
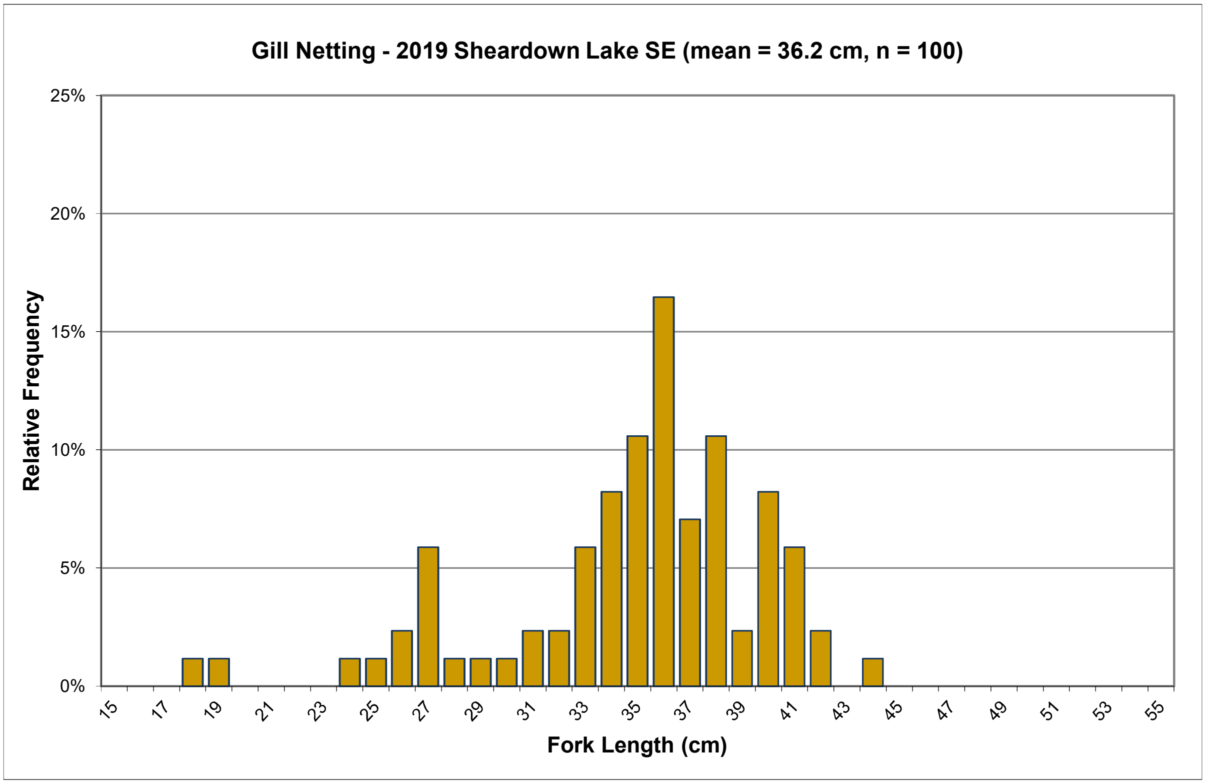


Figure G.15: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Sheardown Lake SE Nearshore Areas in 2019 and During the Mine Baseline Period (2007) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP



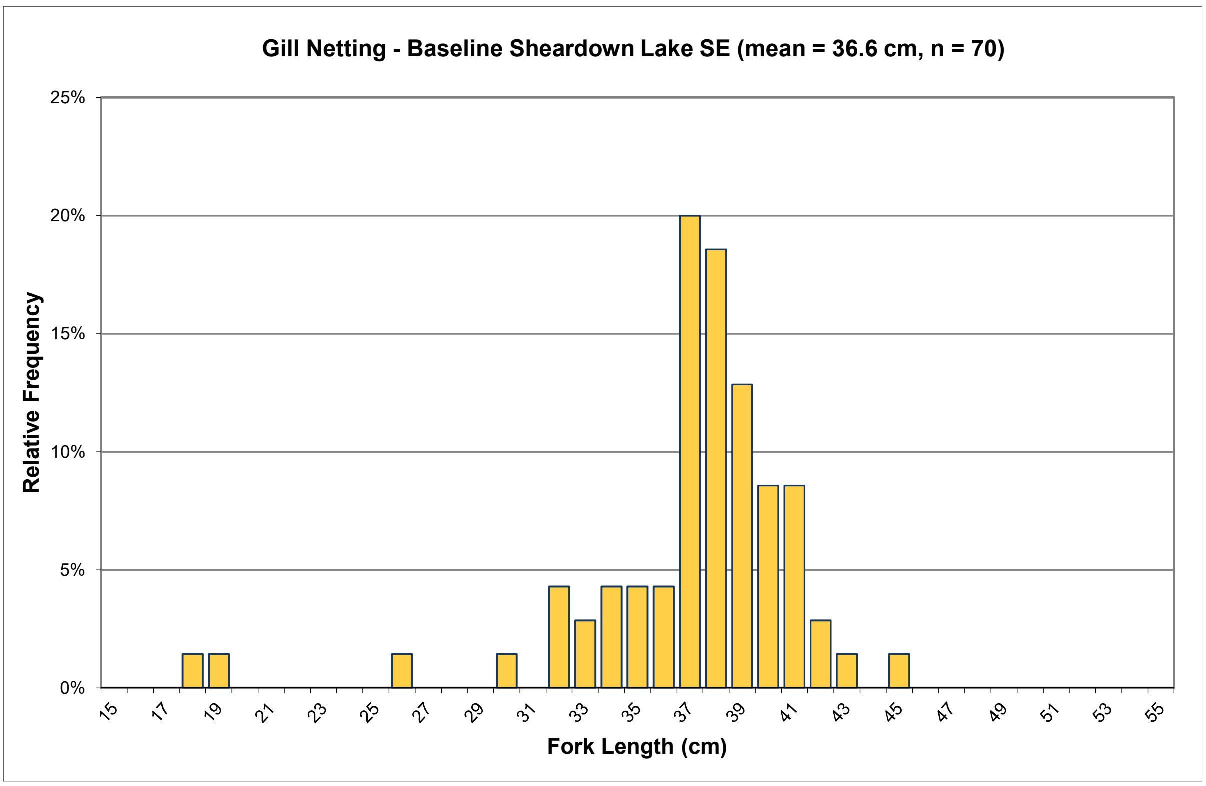
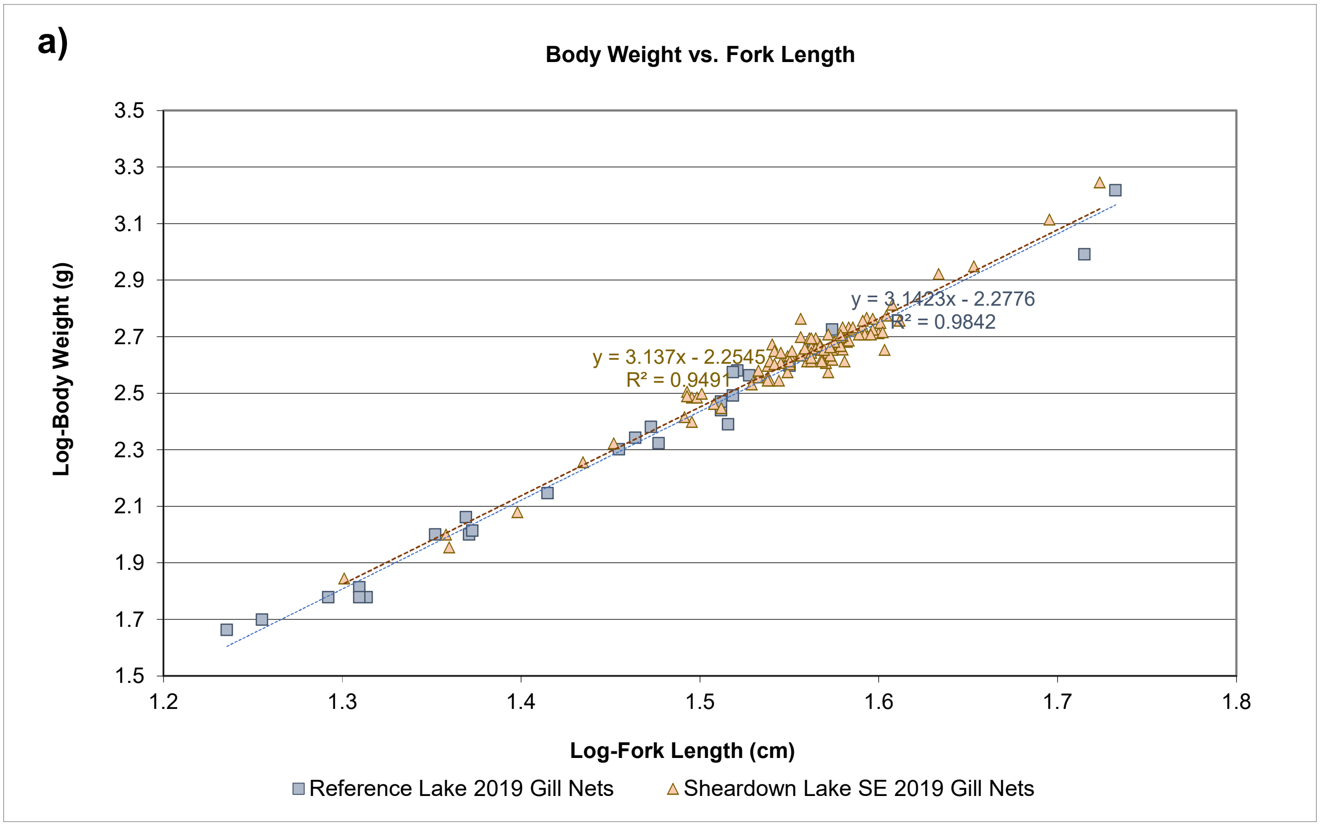


Figure G.16: Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Sheardown Lake SE (DLO-02) in 2019 and Baseline Studies Conducted in Fall, Mary River Project CREMP

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



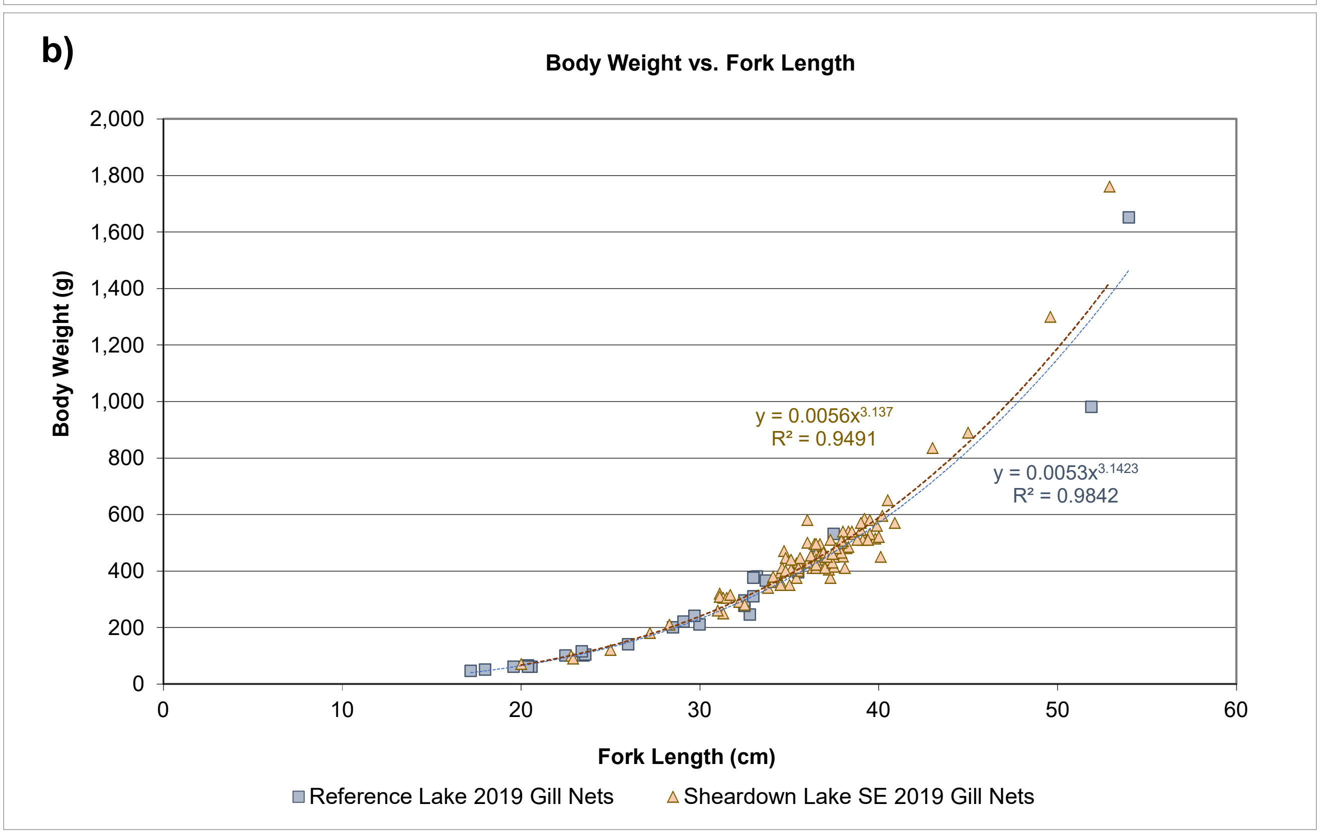
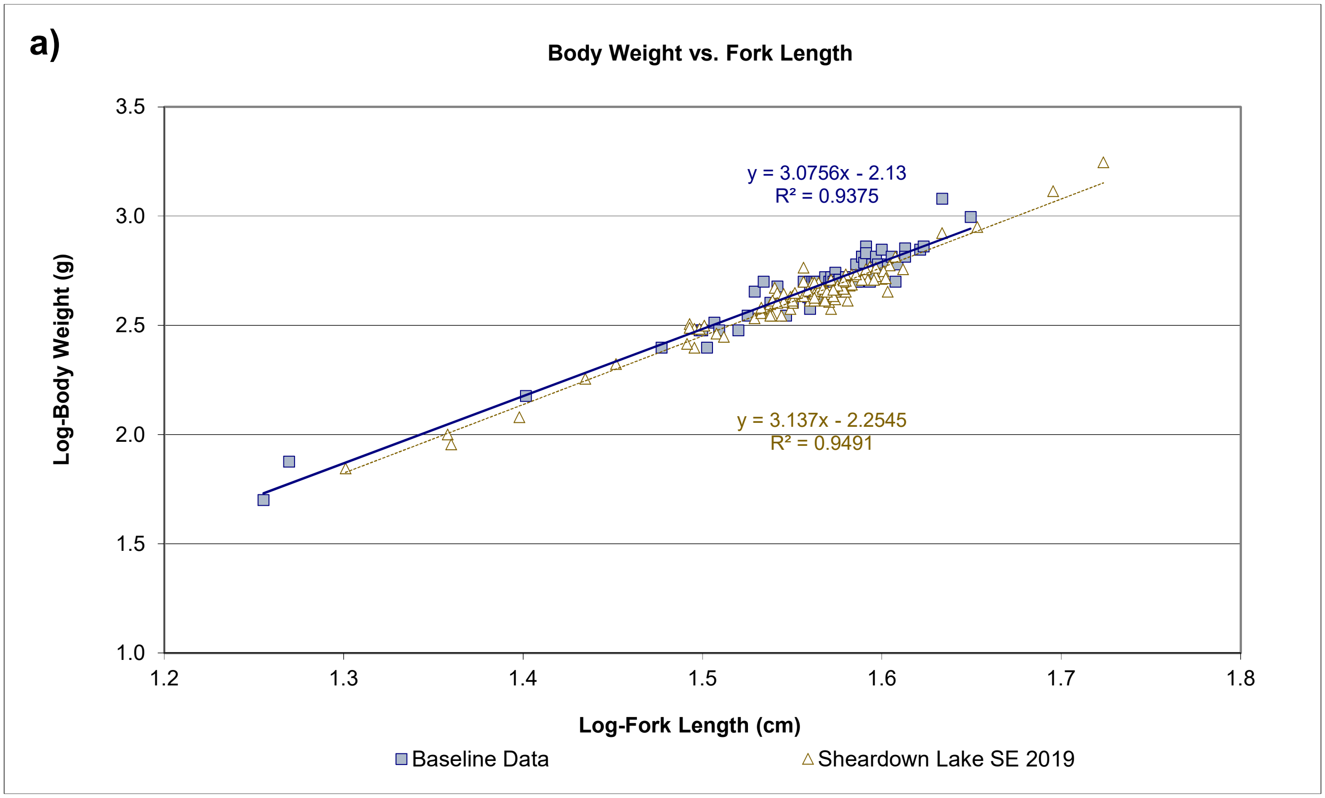


Figure G.17: Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at Littoral/Profundal Areas of Sheardown Lake SE and Reference Lake 3 in August 2019 using Log-transformed (a) and Untransformed (b) Data



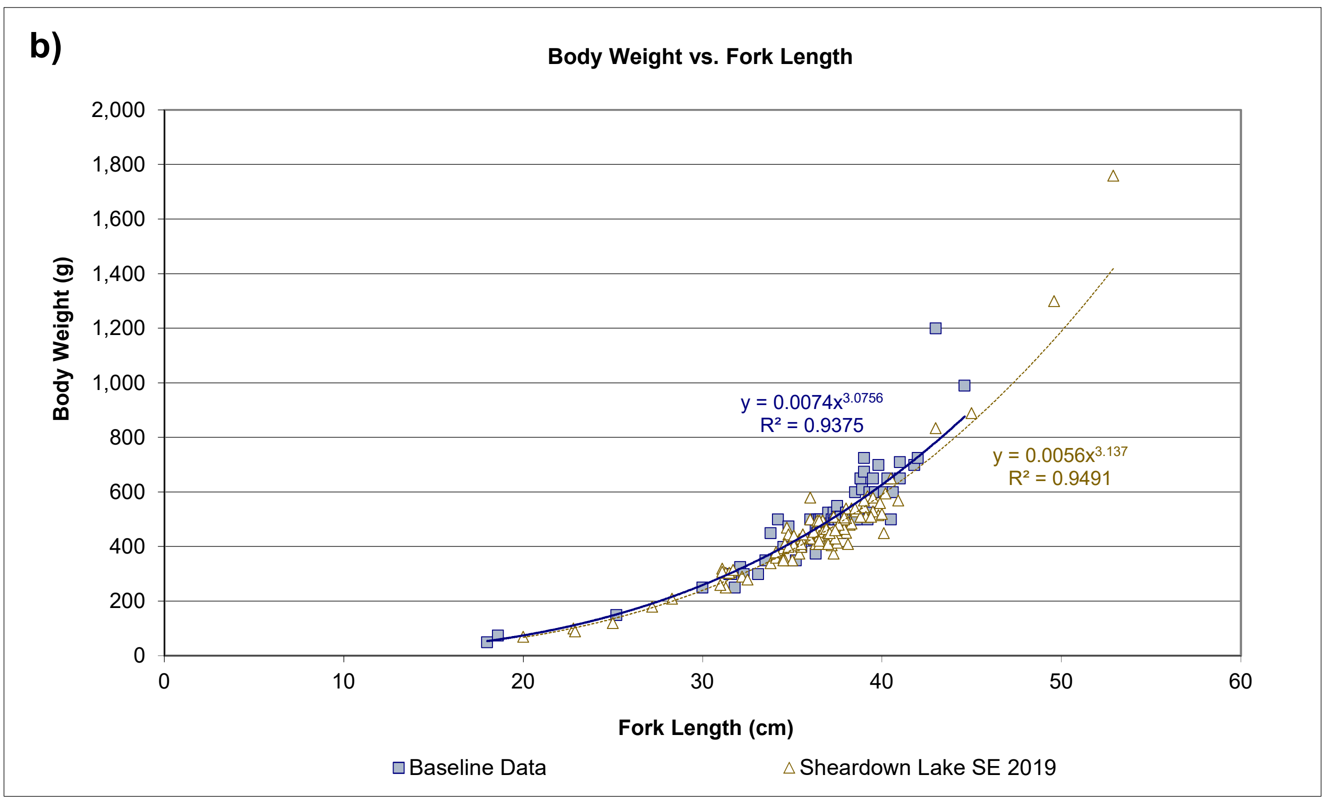
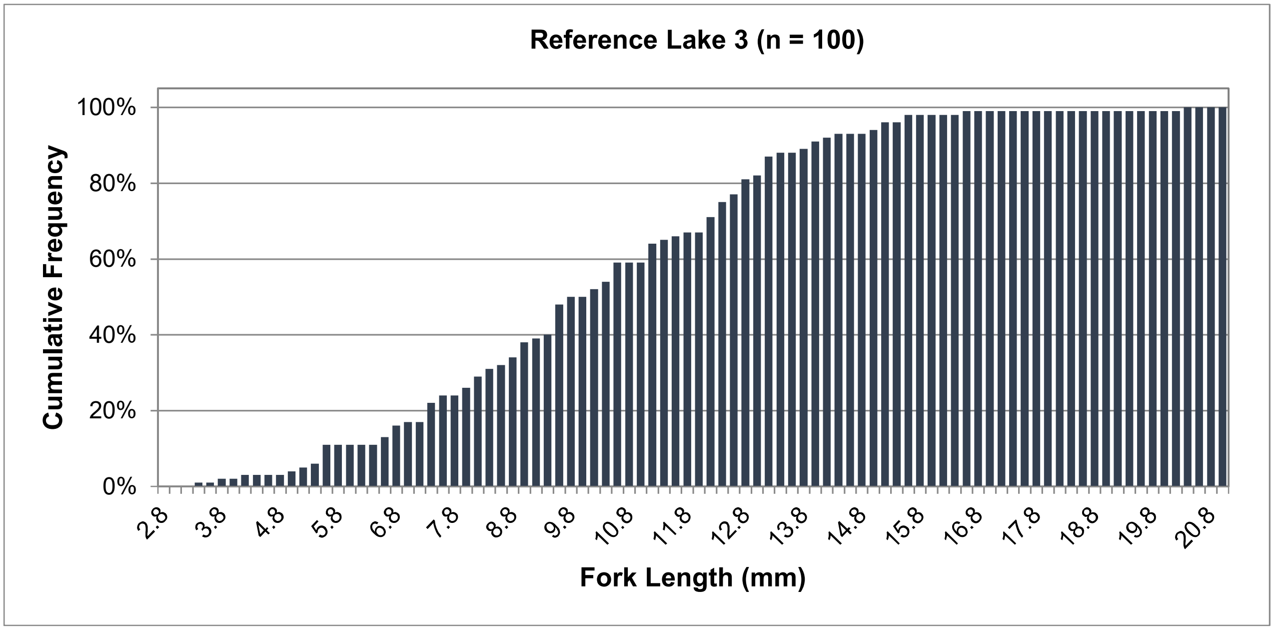


Figure G.18: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr collected in Fall (August-September) at Sheardown Lake SE Nearshore Areas in 2019 and During the Mine Baseline Period (2007, 2008) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP



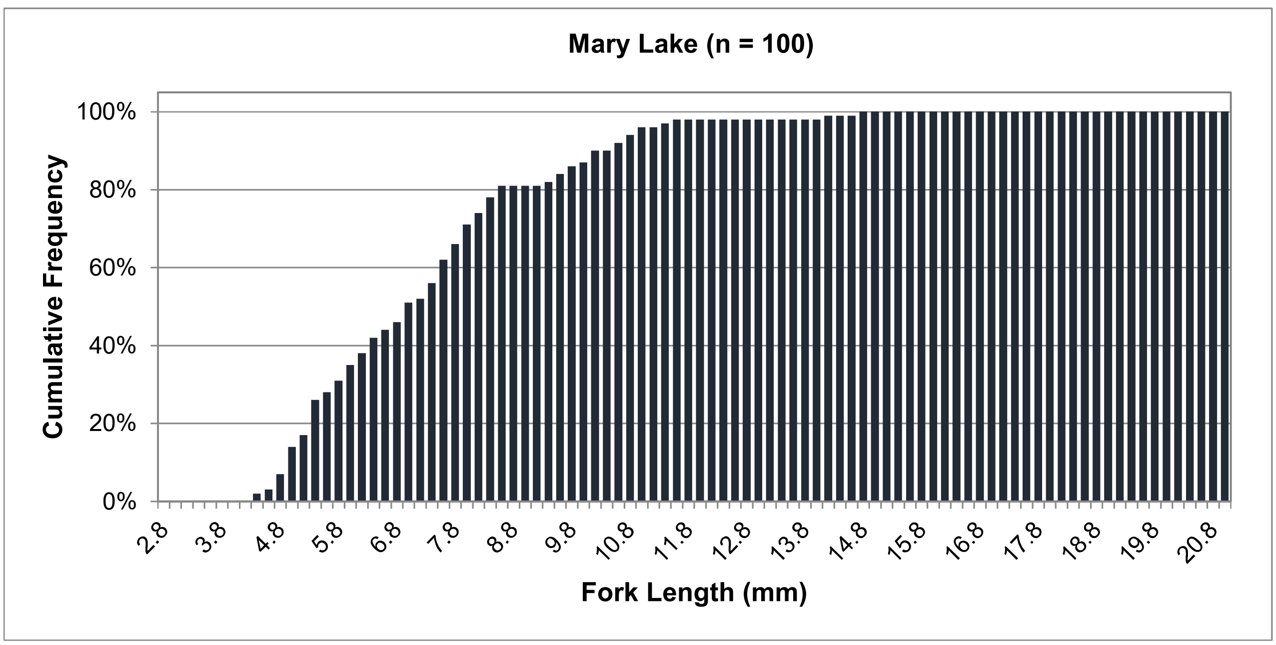
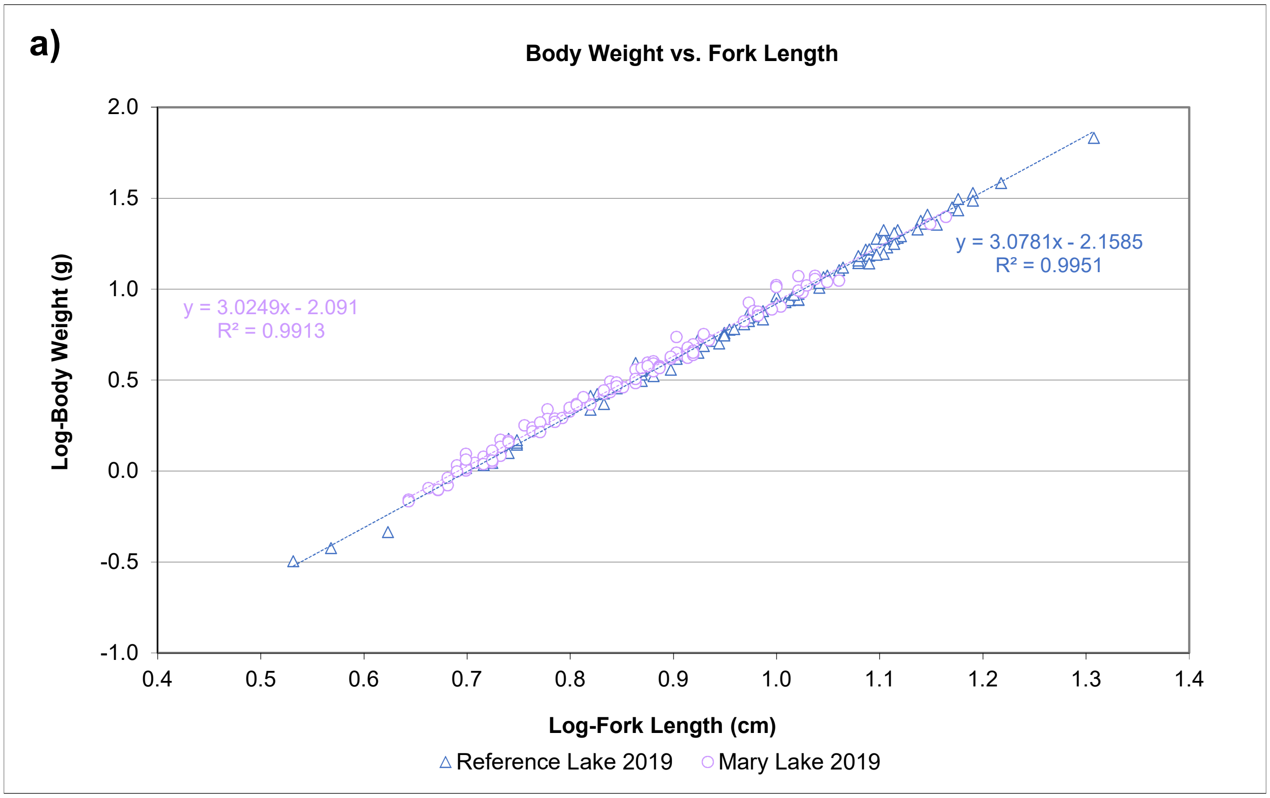


Figure G.19: Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2019



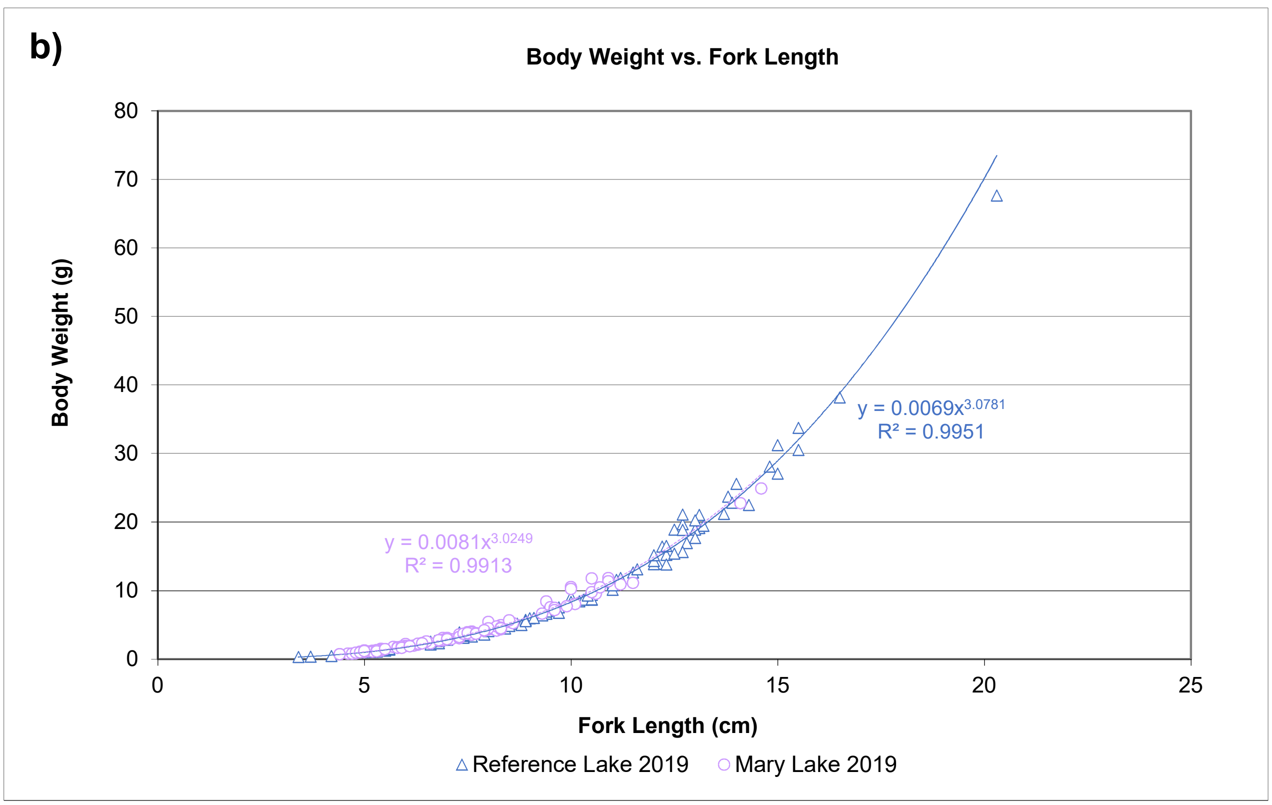
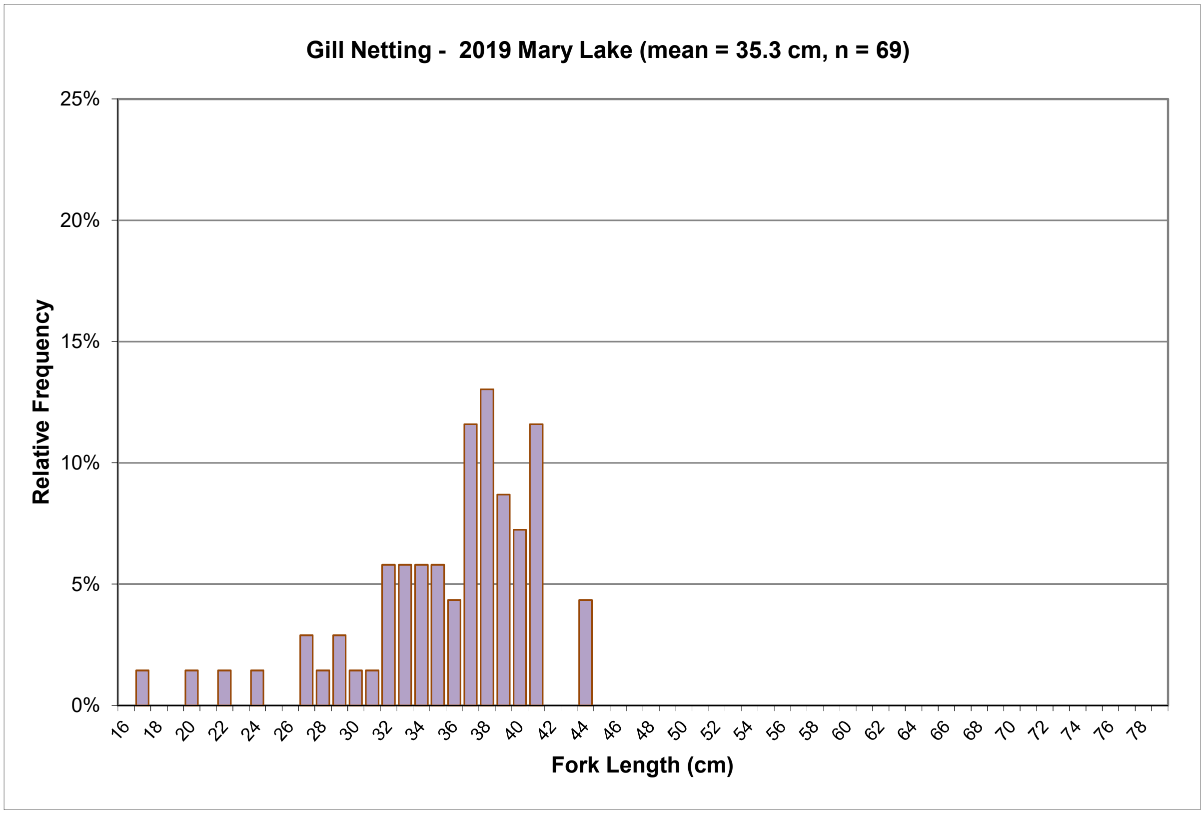


Figure G.20: **Comparison of Condition (Weight-at-fork-Length Relationship) for Arctic Charr Collected at the Nearshore Area of Mary Lake and Reference Lake 3 in August 2019 using Log-Transformed (a) and Untransformed (b) Data, Mary River Project 2019 CREMP**



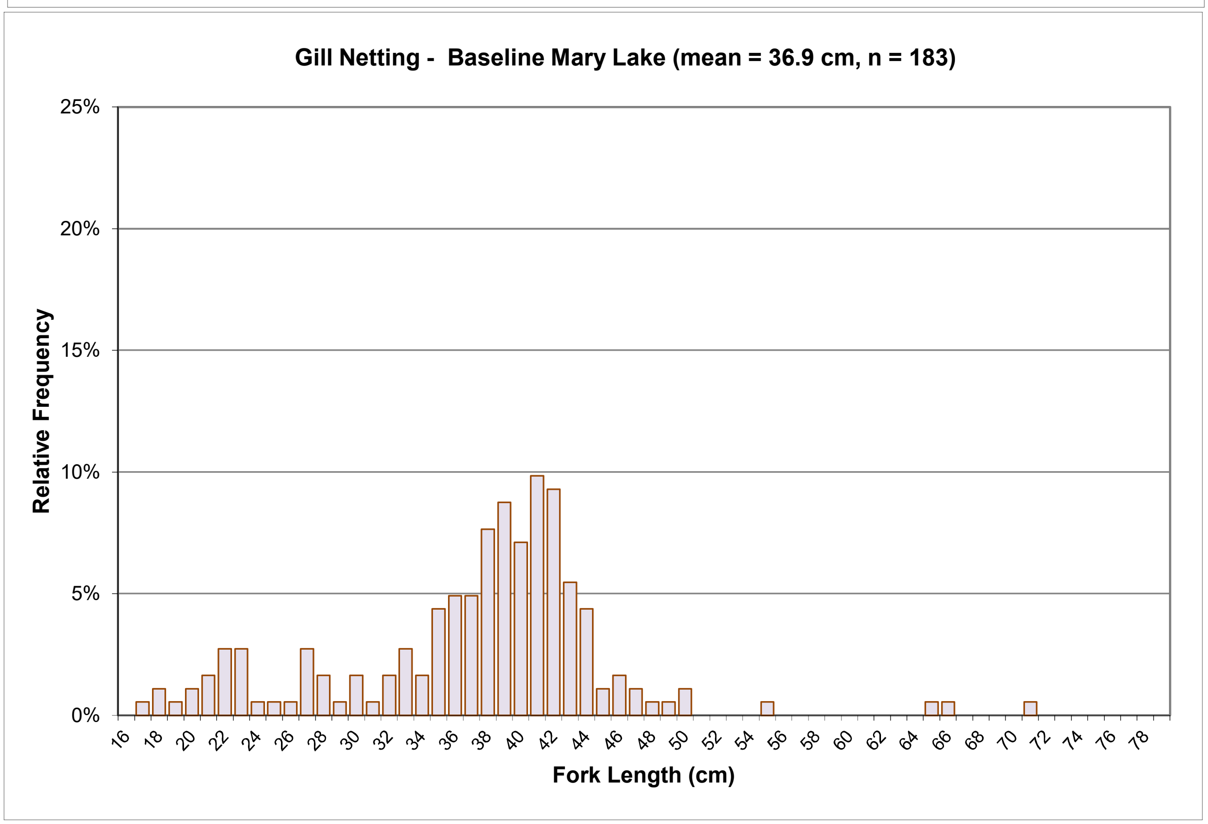
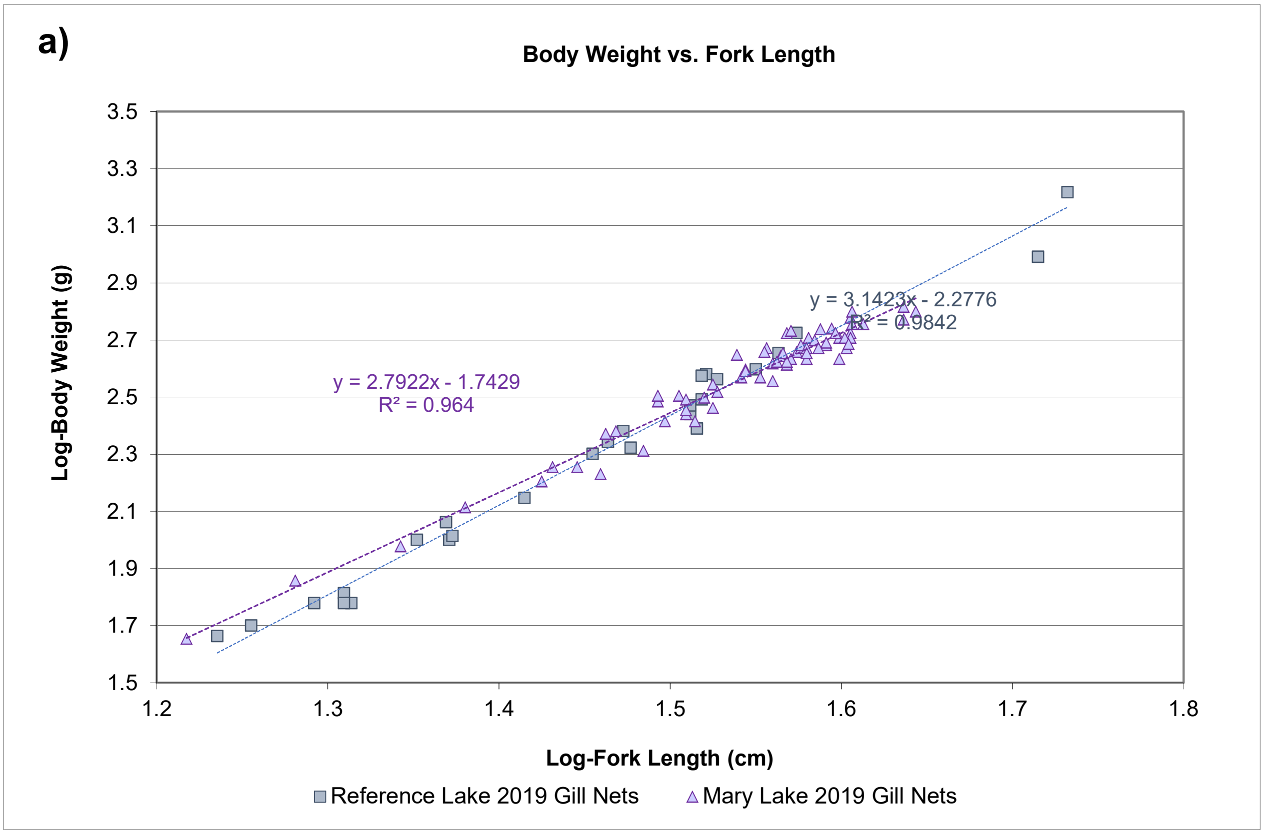


Figure G.21: Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Mary Lake (BLO) in 2019 and Baseline Studies Conducted in Fall

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



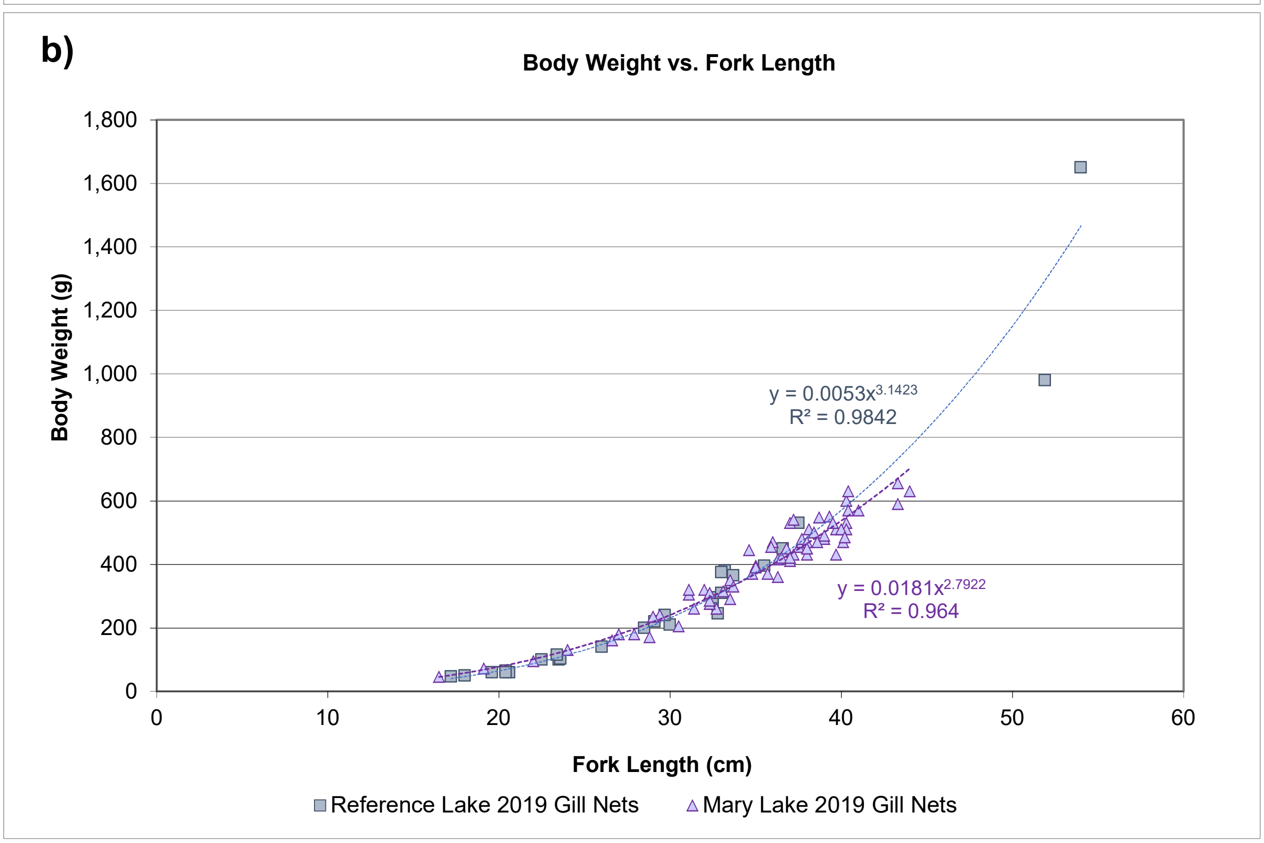
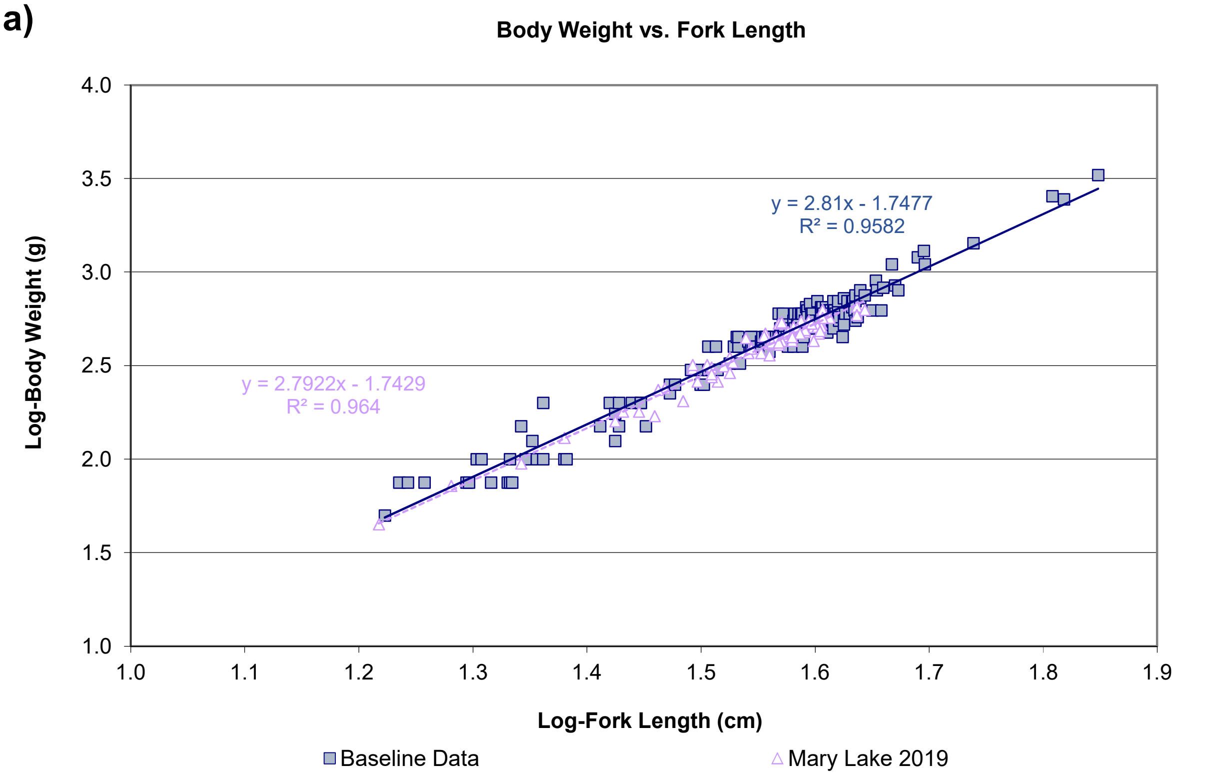


Figure G.22: Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at Littoral/Profundal Areas of Mary Lake and Reference Lake 3 in August 2019 using Log-transformed (a) and Untransformed (b) Data

a)



b)

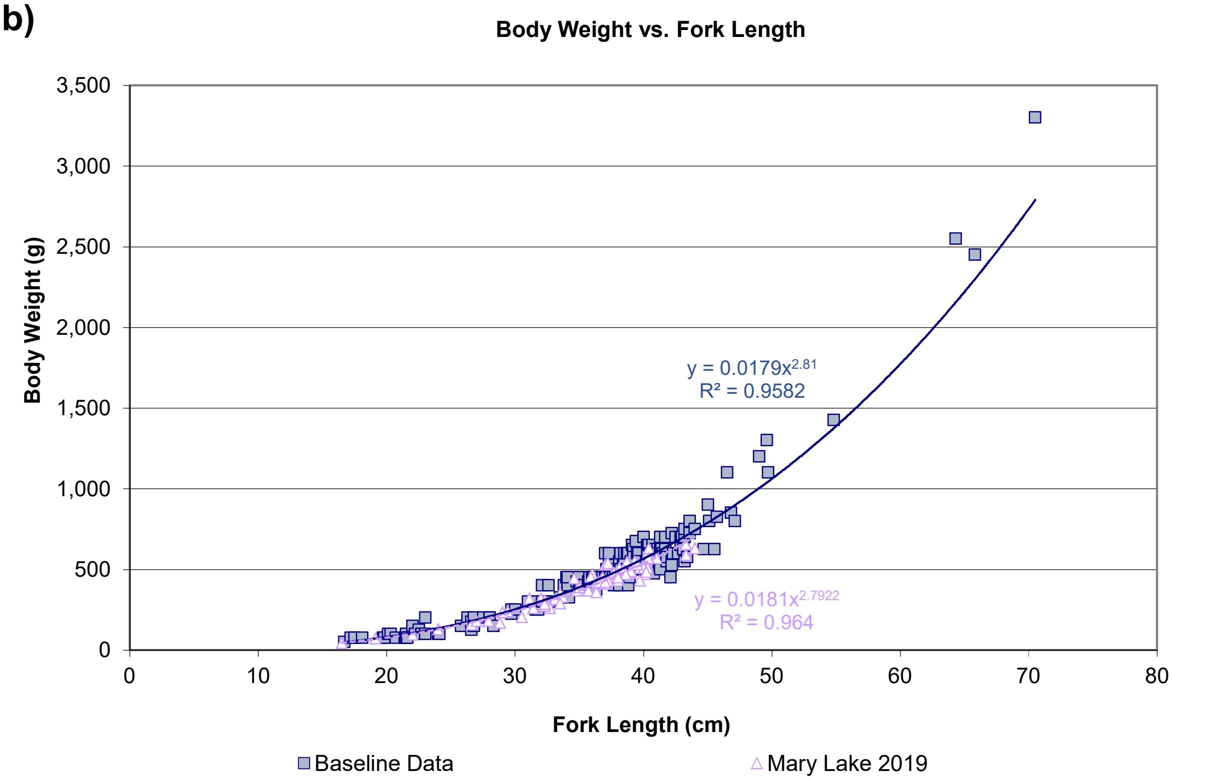


Figure G.23: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Mary Lake Nearshore Areas in 2019 and During the Mine Baseline Period (2006, 2007) using Log-transformed (a) and Untransformed (b) Data

Table G.1: Electrofishing Catch Records, Mary River Project CREMP, August 2019

Waterbody	Sample Station Identifier	Location (NAD83, UTM Zone 17W)				Fishing Date	Electrofisher Settings			Effort (seconds)	Fish Species						Total (all species)	
		Start		Finish							Arctic Charr			Nine-spine Stickleback				
		Easting	Northing	Easting	Northing		Output Voltage (volts)	Cycle Freq. (Hz)	Duty Cycle (%)		No. Captured	No. Mortalities / Retained	CPUE	No. Captured	No. Mortalities / Retained	CPUE	Total Catch	CPUE
Reference Lake 3	REF3-19-EF-1	575172	7853094	575086	7853075	22-Aug-19	600	30	12	1,468	57	4	2.33	0	0	0.00	101	2.11
	REF3-19-EF-2	575086	7853075	574947	7853021	22-Aug-19	600	30	12	1,399	44	6	1.89	0	0	0.00		
Camp Lake	JLO-19-EF-1	557805	7914662	557808	7914611	16-Aug-19	500	30	4	980	64	10	3.92	3	0	0.18	89	3.03
	JLO-19-EF-2	557808	7914611	557805	7914662	16-Aug-19	500	30	4	672	22	0	1.96	0	0	0.00		
Sheardown Lake NW	DL01-19-EF-1	559662	7913331	559707	7913283	18-Aug-19	500	30	12	643	53	0	4.95	1	0	0.09	96	4.32
	DL01-19-EF-2	560296	7913534	560232	7913541	23-Aug-19	500	30	12	700	42	10	3.60	0	0	0.00		
Sheardown Lake SE	DL02-19-EF-1	560745	7912332	560687	7912379	18-Aug-19	500	30	12	1,567	82	3	3.14	14	0	0.54	120	4.34
	DL02-19-EF-2	560745	7912332	560720	7912334	18-Aug-19	500	30	12	288	20	7	4.17	4	0	0.83		
Mary Lake	BLO-19-EF-1	555411	7905143	555486	7905056	27-Aug-19	500	30	12	1,784	60	1	2.02	0	0	0.00	104	1.61
	BLO-19-EF-2	555486	7905056	555569	7904938	27-Aug-19	500	30	12	2,201	40	9	1.09	4	0	0.11		

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 2019

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (ft)	Length (m)	Set 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"		
REF3-19-GN-01	574748	7852958	300	91.4	19-Aug-19	10:20	12:25	2.08	1.90	0	0	0	0	0
REF3-19-GN-02	574645	7852922	300	91.4	19-Aug-19	10:25	12:30	2.08	1.90	2	0	0	2	1.05
REF3-19-GN-03	574543	7852969	300	91.4	19-Aug-19	10:31	12:50	2.32	2.12	2	0	0	2	0.94
REF3-19-GN-04	574459	7853096	300	91.4	19-Aug-19	10:37	13:00	2.38	2.18	0	0	0	0	0
REF3-19-GN-05	574431	7853264	300	91.4	19-Aug-19	10:51	13:05	2.23	2.04	1	0	0	1	0.49
REF3-19-GN-06	574531	7853381	300	91.4	19-Aug-19	10:57	14:06	3.15	2.88	0	1	0	1	0.35
REF3-19-GN-07	574237	7853527	300	91.4	19-Aug-19	11:46	14:20	2.57	2.35	0	0	0	0	0
REF3-19-GN-08	574186	7853508	300	91.4	19-Aug-19	11:50	14:40	2.83	2.59	0	0	0	0	0
REF3-19-GN-09	574047	7853647	300	91.4	19-Aug-19	12:15	15:00	2.75	2.51	0	0	0	0	0
REF3-19-GN-10	574004	7853834	300	91.4	19-Aug-19	12:25	15:12	2.78	2.55	0	0	0	0	0
REF3-19-GN-11	574645	7852922	300	91.4	19-Aug-19	12:40	15:30	2.83	2.59	0	0	0	0	0
REF3-19-GN-12	574543	7852969	300	91.4	19-Aug-19	12:55	15:45	2.83	2.59	1	1	2	4	1.54
REF3-19-GN-13	573989	7852764	300	91.4	19-Aug-19	13:10	15:55	2.75	2.51	0	0	0	0	0
REF3-19-GN-14	574117	7852763	300	91.4	19-Aug-19	13:15	16:00	2.75	2.51	0	0	0	0	0
REF3-19-GN-15	574983	7852924	300	91.4	19-Aug-19	13:35	16:30	2.92	2.67	0	0	0	0	0
REF3-19-GN-16	574458	7853486	300	91.4	19-Aug-19	14:20	15:50	1.50	1.37	1	0	0	1	0.73
REF3-19-GN-17	573728	7853359	300	91.4	19-Aug-19	14:50	15:55	1.08	0.99	0	2	0	2	2.02
REF3-19-GN-18	573666	7853645	300	91.4	19-Aug-19	14:55	16:10	1.25	1.14	1	0	0	1	0.87
REF3-19-GN-19	575100	7853019	300	91.4	19-Aug-19	15:20	16:20	1.00	0.91	0	0	0	0	0
REF3-19-GN-20	575146	7853019	300	91.4	19-Aug-19	15:25	16:30	1.08	0.99	0	0	0	0	0
REF3-19-GN-21	574431	7853264	300	91.4	20-Aug-19	9:25	12:00	2.58	2.36	0	1	0	1	0.42
REF3-19-GN-22	574459	7853096	300	91.4	20-Aug-19	9:30	12:15	2.75	2.51	1	0	0	1	0.40
REF3-19-GN-23	574543	7852969	300	91.4	20-Aug-19	9:50	12:25	2.58	2.36	1	0	0	1	0.42
REF3-19-GN-24	574645	7852922	300	91.4	20-Aug-19	9:55	12:35	2.67	2.44	1	0	0	1	0.41
REF3-19-GN-25	574748	7852958	300	91.4	20-Aug-19	10:00	12:45	2.75	2.51	0	0	0	0	0
REF3-19-GN-26	575296	7853020	300	91.4	20-Aug-19	9:15	12:15	3.00	2.74	0	0	0	0	0
REF3-19-GN-27	575373	7852845	300	91.4	20-Aug-19	9:20	12:25	3.08	2.82	1	0	0	1	0.35
REF3-19-GN-28	575582	7852878	300	91.4	20-Aug-19	9:25	14:26	5.02	4.59	0	0	0	0	0
REF3-19-GN-29	575696	7852812	300	91.4	20-Aug-19	9:32	14:35	5.05	4.62	0	2	0	2	0.43
REF3-19-GN-30	575866	7852774	300	91.4	20-Aug-19	9:40	14:44	5.07	4.63	2	0	0	2	0.43
REF3-19-GN-31	574543	7852969	300	91.4	20-Aug-19	12:30	15:30	3.00	2.74	0	1	1	2	0.73
REF3-19-GN-32	574645	7852922	300	91.4	20-Aug-19	12:40	15:35	2.92	2.67	0	0	0	0	0
REF3-19-GN-33	574305	7852409	300	91.4	20-Aug-19	13:35	16:00	2.42	2.21	0	0	0	0	0
REF3-19-GN-34	574021	7852785	300	91.4	20-Aug-19	13:45	16:10	2.42	2.21	0	0	0	0	0
REF3-19-GN-35	574090	7852804	300	91.4	20-Aug-19	14:00	16:15	2.25	2.06	0	0	0	0	0
REF3-19-GN-36	575982	7852567	300	91.4	20-Aug-19	14:15	16:30	2.25	2.06	0	0	2	2	0.97
REF3-19-GN-37	575773	7852603	300	91.4	20-Aug-19	14:20	16:40	2.33	2.13	0	0	0	0	0
REF3-19-GN-38	575628	7852493	300	91.4	20-Aug-19	14:50	16:45	1.92	1.75	0	0	0	0	0
								Total	**90.74**	**14**	**8**	**5**	**27**	**0.33**

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 2019

Waterbody	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE	Mortalities
		1½"	2"	3"			
Reference Lake 3	90.7	14	8	5	27	0.33	7
Camp Lake	85.2	13	29	23	65	0.85	7
Sheardown Lake NW	101.5	15	34	31	80	0.93	14
Sheardown Lake SE	31.3	22	38	41	101	3.06	20
Mary Lake	24.8	21	29	19	69	2.81	14
Total	**333.5**	**85**	**138**	**119**	**342**	**1.60**	**62**

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 2019

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF3-19-ACJ-01	15.5	16.7	33.741	-	0.906
REF3-19-ACJ-02	6.7	7.2	2.647	-	0.880
REF3-19-ACJ-03	12.1	13.1	13.906	-	0.785
REF3-19-ACJ-04	12.3	13.4	15.199	-	0.817
REF3-19-ACJ-05	10.0	10.9	9.091	-	0.909
REF3-19-ACJ-06	9.4	10.2	7.442	-	0.896
REF3-19-ACJ-07	10.2	11.0	8.457	-	0.797
REF3-19-ACJ-08	6.6	7.1	2.169	-	0.754
REF3-19-ACJ-09	12.7	13.7	19.713	-	0.962
REF3-19-ACJ-10	12.2	13.2	16.449	-	0.906
REF3-19-ACJ-11	5.3	5.6	1.104	-	0.742
REF3-19-ACJ-12	12.8	13.9	16.937	-	0.808
REF3-19-ACJ-13	12.3	13.4	13.812	-	0.742
REF3-19-ACJ-14	13.1	14.1	19.142	-	0.851
REF3-19-ACJ-15	12.0	12.9	13.847	-	0.801
REF3-19-ACJ-16	7.6	8.1	3.313	-	0.755
REF3-19-ACJ-17	11.5	12.6	12.666	-	0.833
REF3-19-ACJ-18	9.4	10.1	6.986	-	0.841
REF3-19-ACJ-19	7.9	8.4	3.600	-	0.730
REF3-19-ACJ-20	13.8	15.0	23.729	-	0.903
REF3-19-ACJ-21	9.0	9.7	5.964	-	0.818
REF3-19-ACJ-22	6.8	7.3	2.328	2	0.740
REF3-19-ACJ-23	3.4	3.5	0.318	-	0.809
REF3-19-ACJ-24	9.5	10.4	7.684	-	0.896
REF3-19-ACJ-25	9.4	10.2	6.649	3	0.801
REF3-19-ACJ-26	5.5	5.9	1.500	1	0.902
REF3-19-ACJ-27	13.9	15.0	22.815	-	0.850
REF3-19-ACJ-28	8.4	9.0	4.463	-	0.753
REF3-19-ACJ-29	10.4	11.3	9.414	-	0.837
REF3-19-ACJ-30	6.6	7.1	2.577	-	0.896
REF3-19-ACJ-31	4.2	4.3	0.461	-	0.622
REF3-19-ACJ-32	16.5	17.9	38.185	-	0.850
REF3-19-ACJ-33	8.7	9.5	5.186	-	0.788
REF3-19-ACJ-34	7.0	7.6	2.843	-	0.829
REF3-19-ACJ-35	8.9	9.6	5.728	-	0.813
REF3-19-ACJ-36	12.0	12.9	14.334	-	0.830
REF3-19-ACJ-37	11.6	12.6	13.117	-	0.840
REF3-19-ACJ-38	3.7	3.8	0.377	0	0.744
REF3-19-ACJ-39	10.3	11.2	8.678	-	0.794
REF3-19-ACJ-40	7.3	7.9	3.924	-	1.009
REF3-19-ACJ-41	9.3	9.9	6.388	-	0.794
REF3-19-ACJ-42	12.5	13.6	18.888	-	0.967
REF3-19-ACJ-43	10.5	11.4	9.404	-	0.812
REF3-19-ACJ-44	11.2	12.1	11.850	-	0.843
REF3-19-ACJ-45	7.5	8.0	3.611	-	0.856
REF3-19-ACJ-46	9.5	10.2	7.084	-	0.826
REF3-19-ACJ-47	12.7	13.8	15.627	-	0.763
REF3-19-ACJ-48	11.0	11.8	11.251	-	0.845
REF3-19-ACJ-49	6.8	7.3	2.667	-	0.848
REF3-19-ACJ-50	7.4	8.1	3.642	-	0.899
REF3-19-ACJ-51	11.0	11.8	10.143	-	0.762
REF3-19-ACJ-52	7.4	7.9	3.127	-	0.772
REF3-19-ACJ-53	5.6	5.9	1.396	-	0.795
REF3-19-ACJ-54	8.1	8.8	4.305	-	0.810
REF3-19-ACJ-55	5.5	5.8	1.253	-	0.753
REF3-19-ACJ-56	8.4	9.0	5.311	-	0.896
REF3-19-ACJ-57	7.4	8.0	3.388	-	0.836

Table G.4: Arctic Charr Measurements from Fish Captured at Reference Lake 3 by Electrofishing, Mary River Project CREMP, August 2019

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF3-19-ACJ-58		10.5	11.3	8.695	-	0.751
REF3-19-ACJ-59		12.7	13.5	18.872	-	0.921
REF3-19-ACJ-60		14.8	16.1	28.111	-	0.867
REF3-19-ACJ-61		5.2	5.5	1.076	-	0.765
REF3-19-ACJ-62		8.8	9.4	5.009	2	0.735
REF3-19-ACJ-63		5.6	6.0	1.425	1	0.811
REF3-19-ACJ-64		8.2	8.8	4.551	3	0.825
REF3-19-ACJ-65		10.5	11.4	8.729	3	0.754
REF3-19-ACJ-66		7.4	8.0	3.557	2	0.878
REF3-19-ACJ-67		10.4	11.2	9.295	-	0.826
REF3-19-ACJ-68		13.2	14.3	19.460	-	0.846
REF3-19-ACJ-69		11.1	12.2	11.595	-	0.848
REF3-19-ACJ-70		13.0	14.2	18.909	-	0.861
REF3-19-ACJ-71		13.0	14.1	17.692	-	0.805
REF3-19-ACJ-72		5.6	6.0	1.476	-	0.840
REF3-19-ACJ-73		11.0	11.9	10.946	-	0.822
REF3-19-ACJ-74		8.9	9.6	5.695	-	0.808
REF3-19-ACJ-75		12.3	13.3	16.525	-	0.888
REF3-19-ACJ-76		13.1	14.1	21.042	-	0.936
REF3-19-ACJ-77		9.7	10.5	7.549	-	0.827
REF3-19-ACJ-78		9.1	9.7	6.020	-	0.799
REF3-19-ACJ-79		9.5	10.5	7.611	-	0.888
REF3-19-ACJ-80		15.0	16.3	31.252	-	0.926
REF3-19-ACJ-81		15.5	16.8	30.544	-	0.820
REF3-19-ACJ-82		20.3	21.9	67.641	-	0.809
REF3-19-ACJ-83		9.7	10.5	6.784	-	0.743
REF3-19-ACJ-84		11.0	11.9	10.772	-	0.809
REF3-19-ACJ-85		10.0	10.9	8.372	-	0.837
REF3-19-ACJ-86		9.4	10.2	6.960	-	0.838
REF3-19-ACJ-87		9.5	10.4	7.746	-	0.903
REF3-19-ACJ-88		12.0	13.2	15.162	-	0.877
REF3-19-ACJ-89		15.0	16.2	27.101	-	0.803
REF3-19-ACJ-90		14.3	15.5	22.521	5	0.770
REF3-19-ACJ-91		8.0	8.7	4.126	-	0.806
REF3-19-ACJ-92		8.5	9.3	4.851	-	0.790
REF3-19-ACJ-93		12.5	13.5	15.391	-	0.788
REF3-19-ACJ-94		5.0	5.3	1.037	-	0.830
REF3-19-ACJ-95		8.2	8.9	4.445	-	0.806
REF3-19-ACJ-96		14.0	15.2	25.581	-	0.932
REF3-19-ACJ-97		8.9	9.6	5.556	-	0.788
REF3-19-ACJ-98		12.7	13.8	21.084	-	1.029
REF3-19-ACJ-99		13.7	14.8	21.200	-	0.824
REF3-19-ACJ-100		13.0	14.2	20.264	-	0.922
Overall Catch Summary	Sample Size (N)	100	100	100	10	100
	Average	10.1	10.9	11.121	2.2	0.831
	Median	9.9	10.7	8.059	2.0	0.826
	Standard Deviation	3.1	3.4	10.140	1.4	0.064
	Standard Error	0.3	0.3	1.014	0.4	0.006
	Minimum	3.4	3.5	0.318	0	0.622
	Maximum	20.3	21.9	67.641	5	1.029
Young-of-the-Year Catch Summary	proportion of YOY			3%		
	Sample Size (N)	3	3	3	1	3
	Average	3.8	3.9	0.385	0	0.725
	Median	3.7	3.8	0.377	0	0.744
	Standard Deviation	0.4	0.4	0.072	-	0.095
	Standard Error	0.2	0.2	0.041	-	0.055
	Minimum	3.4	3.5	0.318	0	0.622
	Maximum	4.2	4.3	0.461	0	0.809

Table G.5: Arctic Charr Measurements from Fish Captured at Camp Lake by Electrofishing, Mary River Project CREMP, August 2019

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
JLO-19-ACJ-01	17.0	18.4	46.191	-	0.940
JLO-19-ACJ-02	14.3	15.7	22.995	3	0.786
JLO-19-ACJ-03	10.0	10.7	6.479	2	0.648
JLO-19-ACJ-04	7.5	8.2	3.374	1	0.800
JLO-19-ACJ-05	10.2	11.1	7.644	-	0.720
JLO-19-ACJ-06	10.5	11.7	8.012	-	0.692
JLO-19-ACJ-07	9.6	10.4	7.142	-	0.807
JLO-19-ACJ-08	13.8	15.0	19.299	3	0.734
JLO-19-ACJ-09	9.7	10.5	7.298	2	0.800
JLO-19-ACJ-10	10.9	12.1	10.249	-	0.791
JLO-19-ACJ-11	16.7	18.3	39.604	-	0.850
JLO-19-ACJ-12	10.9	11.8	9.897	-	0.764
JLO-19-ACJ-13	7.9	8.4	3.956	1	0.802
JLO-19-ACJ-14	6.7	7.2	2.903	-	0.965
JLO-19-ACJ-15	13.8	14.5	18.479	-	0.703
JLO-19-ACJ-16	15.3	16.6	29.478	-	0.823
JLO-19-ACJ-17	9.2	9.7	6.295	-	0.808
JLO-19-ACJ-18	5.4	5.6	1.408	-	0.894
JLO-19-ACJ-19	9.5	10.2	6.738	-	0.786
JLO-19-ACJ-20	12.2	13.1	12.510	-	0.689
JLO-19-ACJ-21	11.3	12.1	11.873	-	0.823
JLO-19-ACJ-22	11.7	12.6	11.649	-	0.727
JLO-19-ACJ-23	12.0	13.3	13.846	-	0.801
JLO-19-ACJ-24	11.7	12.7	11.385	3	0.711
JLO-19-ACJ-25	10.7	11.6	8.652	-	0.706
JLO-19-ACJ-26	14.4	15.8	24.951	-	0.836
JLO-19-ACJ-27	9.9	10.6	7.007	-	0.722
JLO-19-ACJ-28	10.4	11.3	8.551	-	0.760
JLO-19-ACJ-29	9.8	10.7	6.586	-	0.700
JLO-19-ACJ-30	14.0	15.2	22.149	-	0.807
JLO-19-ACJ-31	14.2	15.3	22.603	-	0.789
JLO-19-ACJ-32	14.5	15.7	23.133	4	0.759
JLO-19-ACJ-33	11.2	12.1	11.153	-	0.794
JLO-19-ACJ-34	11.7	12.7	11.866	-	0.741
JLO-19-ACJ-35	13.7	15.0	20.414	-	0.794
JLO-19-ACJ-36	11.0	11.9	9.667	-	0.726
JLO-19-ACJ-37	6.9	7.2	2.679	-	0.816
JLO-19-ACJ-38	12.6	13.7	17.001	-	0.850
JLO-19-ACJ-39	12.5	13.6	15.657	-	0.802
JLO-19-ACJ-40	8.3	8.7	4.581	-	0.801
JLO-19-ACJ-41	14.0	15.0	20.866	-	0.760
JLO-19-ACJ-42	5.9	6.3	1.837	-	0.894
JLO-19-ACJ-43	17.3	18.7	43.318	-	0.837
JLO-19-ACJ-44	10.9	11.8	9.971	-	0.770
JLO-19-ACJ-45	11.6	12.7	11.990	-	0.768
JLO-19-ACJ-46	10.8	11.6	10.522	-	0.835
JLO-19-ACJ-47	8.2	8.7	4.155	-	0.754
JLO-19-ACJ-48	7.9	8.5	4.102	-	0.832
JLO-19-ACJ-49	8.3	9.0	4.650	-	0.813
JLO-19-ACJ-50	17.4	18.9	41.786	-	0.793
JLO-19-ACJ-51	14.9	16.1	30.660	-	0.927
JLO-19-ACJ-52	12.4	13.6	14.740	-	0.773
JLO-19-ACJ-53	9.0	9.7	5.645	-	0.774

Table G.5: Arctic Charr Measurements from Fish Captured at Camp Lake by Electrofishing, Mary River Project CREMP, August 2019

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
JLO-19-ACJ-54		10.0	11.1	7.357	2	0.736
JLO-19-ACJ-55		10.0	11.6	7.523	-	0.752
JLO-19-ACJ-56		8.3	8.9	4.503	-	0.788
JLO-19-ACJ-57		10.9	11.9	9.769	2	0.754
JLO-19-ACJ-58		15.6	17.1	32.142	-	0.847
JLO-19-ACJ-59		9.5	10.3	6.233	-	0.727
JLO-19-ACJ-60		12.4	13.4	13.655	-	0.716
JLO-19-ACJ-61		9.7	10.5	7.322	-	0.802
JLO-19-ACJ-62		9.0	9.7	5.768	-	0.791
JLO-19-ACJ-63		13.5	14.7	19.291	-	0.784
JLO-19-ACJ-64		10.1	10.9	7.364	-	0.715
JLO-19-ACJ-65		11.0	11.8	10.482	-	0.788
JLO-19-ACJ-66		10.0	10.7	7.297	-	0.730
JLO-19-ACJ-67		10.9	11.7	10.402	-	0.803
JLO-19-ACJ-68		11.0	11.8	9.746	-	0.732
JLO-19-ACJ-69		12.3	13.2	13.626	-	0.732
JLO-19-ACJ-70		12.2	13.1	13.771	-	0.758
JLO-19-ACJ-71		9.0	9.6	5.810	-	0.797
JLO-19-ACJ-72		10.7	11.7	9.212	-	0.752
JLO-19-ACJ-73		14.9	16.3	25.444	-	0.769
JLO-19-ACJ-74		8.0	8.5	4.326	-	0.845
JLO-19-ACJ-75		11.7	12.7	11.987	-	0.748
JLO-19-ACJ-76		8.5	9.1	5.013	-	0.816
JLO-19-ACJ-77		10.0	10.9	7.341	-	0.734
JLO-19-ACJ-78		12.2	13.2	12.361	-	0.681
JLO-19-ACJ-79		13.7	14.7	23.040	-	0.896
JLO-19-ACJ-80		13.3	14.3	15.781	-	0.671
JLO-19-ACJ-81		15.6	17.0	27.103	-	0.714
JLO-19-ACJ-82		8.3	8.8	4.626	-	0.809
JLO-19-ACJ-83		10.0	10.8	7.322	-	0.732
JLO-19-ACJ-84		15.1	16.5	26.942	-	0.783
JLO-19-ACJ-85		11.5	12.6	11.710	-	0.770
JLO-19-ACJ-86		8.4	9.0	4.669	-	0.788
Overall Catch Summary	Sample Size (N)	86	86	86	10	86
	Average	11.3	12.2	13.122	2.3	0.780
	Median	10.9	11.8	10.110	2	0.785
	Standard Deviation	2.6	2.9	9.777	0.9	0.059
	Standard Error	0.3	0.3	1.054	0.3	0.006
	Minimum	5.4	5.6	1.408	1	0.648
	Maximum	17.4	18.9	46.191	4	0.965
Young-of-the-Year Catch Summary	proportion of YOY			**0%**		
	Sample Size (N)	0	0	0	0	0
	Average	0.0	0.0	0.000	0	0.000
	Median	0.0	0.0	0.000	0	0.000
	Standard Deviation	0.0	0.0	0.000	-	0.000
	Standard Error	0.0	0.0	0.000	-	0.000
	Minimum	0.0	0.0	0.000	0	0.000
	Maximum	0.0	0.0	0.000	0	0.000

Table G.6: Results of Nearshore Arctic Charr Non-Young-of-the-Year (YOY) Health Endpoint Statistical Comparisons between Camp Lake (JLO) and Reference Lake 3 (REF), Mary River Project CREMP, August 2019

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	JLO		Interaction P-value	Covariate P-value		Statistic	REF	JLO		
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	86	K-S	-	-	-	NA	-	-	0.012	-
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	97	86	K-S	-	-	-	NA	-	-	0.025	-
	Body Size	Fork Length	Fork Length (cm)	-	97	86	tequal	-	-	-	Mean	10.3	11.3	0.017	9.7
		Body Weight	Body Weight (g)	-	97	86	tequal	-	-	-	Geometric Mean	7.96	10.2	0.04	29
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	97	86	ANCOVA	0.022[e]	<0.001	10.4	Adjusted Mean	9.26	8.64	<0.001	-6.8

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.7: Results of Nearshore Arctic Charr Non-Young-of-the-Year (Non-YOY) Health Endpoint Statistical Comparisons between Samples Collected in 2019 and the Baseline Period at Individual Mine-Exposed Lakes, Mary River Project 2019 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: Interaction P-value	Parallel Slope Model: Covariate P-value	Covariate Value for Comparisons[a]	Statistic	Baseline	2018		
Camp (JLO)	Non-YOY	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	51	86	K-S	-	-	-	NA	-	-	0.100	-
		Body Size	Fork Length	Fork Length (cm)	-	51	86	tunequal	-	-	-	Mean	11.8	11.3	0.393	-4.3
			Body Weight	Body Weight (g)	-	51	86	tunequal	-	-	-	Geometric Mean	12.3	10.2	0.228	-17
		Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	51	86	ANCOVA	0.032[e]	<0.001	11.1	Adjusted Mean	11.8	10.5	<0.001	-11
Sheardown NW (DLO-01)	Non-YOY	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	244	95	K-S	-	-	-	-	-	-	0.089	-
		Body Size	Fork Length	Fork Length (cm)	-	244	95	M-W	-	-	-	Median	8.3	8.9	0.977	7
			Body Weight	Body Weight (g)	-	244	95	M-W	-	-	-	Median	6.00	5.91	0.271	-1
		Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	244	95	ANCOVA	0.439	<0.001	9.13	Adjusted Mean	7.51	6.54	<0.001	-13
Sheardown SE (DLO-02)[g]	Non-YOY	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	16	94	K-S	-	-	-	-	-	-	0.004	-
		Body Size	Fork Length	log[Fork Length (cm)]	-	16	94	M-W	-	-	-	Median	6.30	7.20	0.182	14
			Body Weight	Body Weight (g)	-	16	94	M-W	-	-	-	Median	2.50	3.00	0.282	20
		Energy Storage	Condition[e]	log[Body Weight (g)]	log[Fork Length (cm)]	16	94	ANCOVA	0.002[f]	<0.001	7.09	Adjusted Mean	3.40	2.94	0.001	-13

Grey shading: Area P-value < 0.1 or Interaction P-value < 0.05

Blue shading: 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] ANCOVA proceeded under the assumption that the slopes are practically parallel (R2 of interaction model = 0.9889 and R2 of parallel slope model = 0.9885; a difference < 0.02) following Environment Canada (2012).

[f] ANCOVA proceeded under the assumption that the slopes are practically parallel (R2 of interaction model = 0.9748 and R2 of parallel slope model = 0.9724; a difference < 0.02) following Environment Canada (2012).

[g] 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 2019 Data Relative to Reference Lake 3 Data (2019) or Camp Lake Baseline Data (2006 to 2013) with α=β=0.1, Mary River Project 2019 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% / -5%	10% / -9%	20% / -17%	25% / -20%	30% / -23%	33% / -25%	40% / -29%	50% / -33%	100% / -50%
									Response	±5%	±10%	±20%	±25%	±30%	±33%	±40%	±50%	±100%
Nearshore Arctic Charr (Electrofishing) versus Ref. Lake 3, 2019 Data	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	tequal	-	27.2	log(Response)	509	128	33	22	15	13	9	6	3
			Body Weight	Body Weight (g)	-	tequal	0.358	-	Response	4,896	1,284	352	235	170	142	104	72	25
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0318	-	log(Response)	41	12	5	4	4	4	4	3	3
Nearshore Arctic Charr (Electrofishing) 2019 versus Baseline	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	tunequal	-	26.0	log(Response)	463	117	30	20	14	12	8	6	3
			Body Weight	Body Weight (g)	-	tunequal	0.348	-	Response	4,616	1,211	332	222	161	134	98	68	24
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0377	-	log(Response)	56	16	6	5	4	4	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	0.0823	23.4	log(Response)	301	80	24	17	12	11	9	6	4
			Body Weight	Body Weight (g)	-	M-W	0.258	135	Response	2,938	771	212	142	104	86	64	44	17
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0471	-	log(Response)	87	24	8	6	5	5	4	4	3
Littoral/Profundal Arctic Charr (Gill Netting) 2018 versus Baseline	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.0926	22.1	log(Response)	380	99	26	18	13	11	9	6	4
			Body Weight	Body Weight (g)	-	M-W	0.282	91.7	Response	3,519	923	254	169	123	104	76	53	19
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0724	-	log(Response)	202	55	17	12	9	8	7	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 2019

Specimen ID	Net ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Sex	Abnormalities	Fulton's Condition Factor (K)
REF3-19-AC-01	REF3-19-GN-02	1½	51.9	54.5	980	Unknown	-	0.701
REF3-19-AC-02	REF3-19-GN-02	1½	19.6	20.9	60	Unknown	-	0.797
REF3-19-AC-03	REF3-19-GN-03	1½	20.4	23.3	65	Unknown	-	0.766
REF3-19-AC-04	REF3-19-GN-03	1½	17.2	18.4	46	Unknown	-	0.904
REF3-19-AC-05	REF3-19-GN-05	3	32.8	35.0	245	Unknown	-	0.694
REF3-19-AC-06	REF3-19-GN-12	3	37.5	40.2	530	Unknown	-	1.005
REF3-19-AC-07	REF3-19-GN-12	2	33.2	36.0	380	Unknown	-	1.038
REF3-19-AC-08	REF3-19-GN-12	2	30.0	32.5	210	Unknown	-	0.778
REF3-19-AC-09	REF3-19-GN-12	1½	22.5	24.0	100	Unknown	-	0.878
REF3-19-AC-10	REF3-19-GN-21	2	28.5	31.0	200	Unknown	-	0.864
REF3-19-AC-11	REF3-19-GN-22	1½	26.0	28.0	140	Unknown	-	0.797
REF3-19-AC-12	REF3-19-GN-23	1½	23.5	25.0	100	Unknown	-	0.771
REF3-19-AC-13	REF3-19-GN-24	1½	18.0	19.5	50	Unknown	-	0.857
REF3-19-AC-14	REF3-19-GN-31	3	54.0	57.0	1,650	Male	-	1.048
REF3-19-AC-15	REF3-19-GN-31	2	33.0	35.5	375	Unknown	-	1.043
REF3-19-AC-16	REF3-19-GN-06	2	29.1	31.5	220	Unknown	-	0.893
REF3-19-AC-17	REF3-19-GN-16	1½	20.6	22.2	60	Male	-	0.686
REF3-19-AC-18	REF3-19-GN-17	2	36.6	39.7	450	Male	-	0.918
REF3-19-AC-19	REF3-19-GN-17	2	32.5	35.6	275	Male	-	0.801
REF3-19-AC-20	REF3-19-GN-18	1½	20.4	22.0	60	Unknown	-	0.707
REF3-19-AC-21	REF3-19-GN-27	1½	23.6	25.7	103	Unknown	-	0.784
REF3-19-AC-22	REF3-19-GN-29	2	32.5	35.0	295	Unknown	-	0.859
REF3-19-AC-23	REF3-19-GN-29	2	33.0	35.6	310	Unknown	-	0.863
REF3-19-AC-24	REF3-19-GN-30	1½	33.7	36.5	365	Unknown	-	0.954
REF3-19-AC-25	REF3-19-GN-30	1½	23.4	25.6	115	Unknown	-	0.898
REF3-19-AC-26	REF3-19-GN-36	3	35.5	39.0	395	Unknown	-	0.883
REF3-19-AC-27	REF3-19-GN-36	3	29.7	32.4	240	Unknown	-	0.916
Overall Catch Summary		**Sample Size (N)**	**27**	**27**	**27**	**-**	**-**	**27**
		Average	**29.6**	**31.9**	**297**	**-**	**-**	**0.856**
		Median	**29.7**	**32.4**	**220**	**-**	**-**	**0.863**
		Standard Deviation	**9.1**	**9.5**	**337**	**-**	**-**	**0.105**
		Standard Error	**1.7**	**1.8**	**65**	**-**	**-**	**0.020**
		Minimum	**17.2**	**18.4**	**46**	**-**	**-**	**0.686**
		Maximum	**54.0**	**57.0**	**1,650**	**-**	**-**	**1.048**

Table G.10: Gill Netting Catch Records for Camp Lake, Mary River Project CREMP, August 2019

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-19-GN-01	557246	7914862	91.4	16-Aug-19	16-Aug-19	10:40	12:50	2.17	1.98	2	1	0	3	1.51
JLO-19-GN-02	557295	7914826	91.4	16-Aug-19	16-Aug-19	10:47	13:05	2.30	2.10	0	1	0	1	0.48
JLO-19-GN-03	557334	4714815	91.4	16-Aug-19	16-Aug-19	10:52	13:20	2.47	2.26	0	0	0	0	0.00
JLO-19-GN-04	557468	7914834	91.4	16-Aug-19	16-Aug-19	11:05	13:40	2.58	2.36	1	0	0	1	0.42
JLO-19-GN-05	557559	7914773	91.4	16-Aug-19	16-Aug-19	11:10	14:00	2.83	2.59	1	0	0	1	0.39
JLO-19-GN-06	557246	7914862	91.4	16-Aug-19	16-Aug-19	12:55	15:05	2.17	1.98	1	1	0	2	1.01
JLO-19-GN-07	557740	7914602	91.4	16-Aug-19	16-Aug-19	13:25	15:45	2.33	2.13	0	1	0	1	0.47
JLO-19-GN-08	557726	7914512	91.4	16-Aug-19	16-Aug-19	13:30	16:00	2.50	2.29	0	0	1	1	0.44
JLO-19-GN-09	557621	7914309	91.4	16-Aug-19	16-Aug-19	14:15	17:00	2.75	2.51	1	2	1	4	1.59
JLO-19-GN-10	557725	7914727	91.4	16-Aug-19	16-Aug-19	14:25	17:20	2.92	2.67	0	0	0	0	0.00
JLO-19-GN-11	557279	7914949	91.4	16-Aug-19	16-Aug-19	15:15	17:35	2.33	2.13	0	0	0	0	0.00
JLO-19-GN-12	557192	7915016	91.4	16-Aug-19	16-Aug-19	16:05	17:40	1.58	1.45	0	0	0	0	0.00
JLO-19-GN-13	557134	7915007	91.4	16-Aug-19	16-Aug-19	16:15	17:50	1.58	1.45	0	0	1	1	0.69
JLO-19-GN-14	79 25.406	71 19.687	91.4	17-Aug-19	17-Aug-19	8:45	11:30	2.75	2.51	0	1	1	2	0.80
JLO-19-GN-15	79 25.472	71 19.619	91.4	17-Aug-19	17-Aug-19	8:50	11:56	3.10	2.83	0	3	0	3	1.06
JLO-19-GN-16	79 25.484	71 19.551	91.4	17-Aug-19	17-Aug-19	9:00	11:50	2.83	2.59	2	2	0	4	1.54
JLO-19-GN-17	79 25.256	71 19.492	91.4	17-Aug-19	17-Aug-19	9:05	12:10	3.08	2.82	0	1	0	1	0.35
JLO-19-GN-18	79 25.260	71 19.399	91.4	17-Aug-19	17-Aug-19	9:15	12:20	3.08	2.82	0	1	1	2	0.71
JLO-19-GN-19	557080	7915020	91.4	17-Aug-19	17-Aug-19	8:50	11:30	2.67	2.44	1	1	1	3	1.23
JLO-19-GN-20	557144	7915023	91.4	17-Aug-19	17-Aug-19	9:00	11:50	2.83	2.59	0	0	2	2	0.77
JLO-19-GN-21	557196	7915025	91.4	17-Aug-19	17-Aug-19	9:10	12:05	2.92	2.67	0	0	0	0	0.00
JLO-19-GN-22	557310	7914843	61.0	17-Aug-19	17-Aug-19	9:40	12:20	2.67	1.63	0	0	1	1	0.62
JLO-19-GN-23	557266	7914904	91.4	16-Aug-19	16-Aug-19	9:45	12:40	2.92	2.67	1	0	4	5	1.87
JLO-19-GN-24	557794	7914194	91.4	17-Aug-19	17-Aug-19	12:45	15:15	2.50	2.29	0	1	1	2	0.87
JLO-19-GN-25	557800	7914174	91.4	17-Aug-19	17-Aug-19	13:00	15:30	2.50	2.29	0	0	1	1	0.44
JLO-19-GN-26	557740	7914094	91.4	17-Aug-19	17-Aug-19	13:05	15:45	2.67	2.44	0	1	1	2	0.82
JLO-19-GN-27	557606	7914028	91.4	17-Aug-19	17-Aug-19	13:15	15:50	2.58	2.36	0	0	0	0	0.00

Table G.10: Gill Netting Catch Records for Camp Lake, Mary River Project CREMP, August 2019

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-19-GN-28	557334	7914010	91.4	17-Aug-19	17-Aug-19	13:20	16:05	2.75	2.51	0	1	1	2	0.80
JLO-19-GN-29	557708	7914204	91.4	17-Aug-19	17-Aug-19	13:06	15:15	2.15	1.97	0	0	0	0	0.00
JLO-19-GN-30	557673	7914286	91.4	17-Aug-19	17-Aug-19	13:10	15:30	2.33	2.13	0	0	1	1	0.47
JLO-19-GN-31	557620	7914366	91.4	17-Aug-19	17-Aug-19	13:15	15:50	2.58	2.36	0	1	1	2	0.85
JLO-19-GN-32	557681	7914535	61.0	17-Aug-19	17-Aug-19	13:20	14:09	0.82	0.50	1	1	0	2	4.02
JLO-19-GN-33	557694	7914627	91.4	17-Aug-19	17-Aug-19	13:30	16:20	2.83	2.59	1	1	0	2	0.77
JLO-19-GN-34	556625	7913505	91.4	17-Aug-19	17-Aug-19	16:15	17:35	1.33	1.22	0	1	0	1	0.82
JLO-19-GN-35	556521	7913402	91.4	17-Aug-19	17-Aug-19	16:20	17:45	1.42	1.30	1	0	0	1	0.77
JLO-19-GN-36	556378	7913462	91.4	17-Aug-19	17-Aug-19	16:25	17:55	1.50	1.37	0	1	1	2	1.46
JLO-19-GN-37	556247	7913604	91.4	17-Aug-19	17-Aug-19	16:30	18:05	1.58	1.45	0	2	0	2	1.38
JLO-19-GN-38	556159	7913771	91.4	17-Aug-19	17-Aug-19	16:35	18:20	1.75	1.60	0	2	0	2	1.25
JLO-19-GN-39	557240	7914878	91.4	17-Aug-19	17-Aug-19	16:30	17:45	1.25	1.14	0	1	2	3	2.62
JLO-19-GN-40	557316	7914840	91.4	17-Aug-19	17-Aug-19	16:37	18:00	1.38	1.26	0	1	1	2	1.58
JLO-19-GN-41	557529	7914829	61.0	17-Aug-19	17-Aug-19	16:45	18:15	1.50	0.91	0	0	0	0	0.00
								Total	**85.17**	**13**	**29**	**23**	**65**	**0.85**

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 2019

Specimen ID	Net ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Abnormalities	Fulton's Condition Factor (K)
JLO-19-AC-01	JLO-19-GN-01	1½	33.2	35.8	380	-	1.038
JLO-19-AC-02	JLO-19-GN-01	1½	39.8	43.2	510	-	0.809
JLO-19-AC-03	JLO-19-GN-01	2	39.9	43.9	610	-	0.960
JLO-19-AC-04	JLO-19-GN-02	2	38.5	41.3	515	-	0.902
JLO-19-AC-05	JLO-19-GN-04	1½	60.9	65.1	1,900	-	0.841
JLO-19-AC-06	JLO-19-GN-05	1½	35.5	38.4	440	-	0.983
JLO-19-AC-07	JLO-19-GN-06	1½	37.3	40.8	545	-	1.050
JLO-19-AC-08	JLO-19-GN-06	2	39.0	42.0	595	-	1.003
JLO-19-AC-09	JLO-19-GN-07	2	34.1	37.2	385	-	0.971
JLO-19-AC-10	JLO-19-GN-08	3	35.8	39.0	470	-	1.024
JLO-19-AC-11	JLO-19-GN-09	3	38.5	42.2	575	-	1.008
JLO-19-AC-12	JLO-19-GN-09	2	39.0	43.1	545	-	0.919
JLO-19-AC-13	JLO-19-GN-09	2	37.0	40.4	535	-	1.056
JLO-19-AC-14	JLO-19-GN-09	1½	39.5	42.7	565	-	0.917
JLO-19-AC-15	JLO-19-GN-013	3	36.1	38.6	390	-	0.829
JLO-19-AC-16	JLO-19-GN-014	3	51.7	55.6	1,300	-	0.941
JLO-19-AC-17	JLO-19-GN-014	2	40.2	44.5	495	-	0.762
JLO-19-AC-18	JLO-19-GN-015	2	35.5	38.5	440	-	0.983
JLO-19-AC-19	JLO-19-GN-015	2	37.9	41.6	490	-	0.900
JLO-19-AC-20	JLO-19-GN-015	2	40.6	44.5	550	Gill Parasites	0.822
JLO-19-AC-21	JLO-19-GN-016	1½	39.0	42.8	590	-	0.995
JLO-19-AC-22	JLO-19-GN-016	1½	59.5	62.9	2,200	-	1.044
JLO-19-AC-23	JLO-19-GN-016	2	37.8	40.9	555	-	1.028
JLO-19-AC-24	JLO-19-GN-016	2	38.9	42.2	440	-	0.747
JLO-19-AC-25	JLO-19-GN-017	2	36.0	38.9	445	-	0.954
JLO-19-AC-26	JLO-19-GN-018	2	37.2	41.2	530	-	1.030
JLO-19-AC-27	JLO-19-GN-018	3	36.4	39.4	510	-	1.057
JLO-19-AC-28	JLO-19-GN-024	2	37.5	41.3	440	-	0.834
JLO-19-AC-29	JLO-19-GN-024	3	35.1	38.2	400	-	0.925
JLO-19-AC-30	JLO-19-GN-025	3	37.1	40.3	480	-	0.940
JLO-19-AC-31	JLO-19-GN-026	3	36.7	40.4	495	-	1.001
JLO-19-AC-32	JLO-19-GN-026	2	38.6	41.5	520	-	0.904
JLO-19-AC-33	JLO-19-GN-028	2	33.8	36.6	405	-	1.049
JLO-19-AC-34	JLO-19-GN-028	3	38.8	42.7	540	-	0.924
JLO-19-AC-35	JLO-19-GN-034	2	35.5	38.8	455	-	1.017
JLO-19-AC-36	JLO-19-GN-035	1½	37.2	40.5	445	-	0.864
JLO-19-AC-37	JLO-19-GN-036	3	37.8	41.1	380	-	0.704
JLO-19-AC-38	JLO-19-GN-036	2	34.7	37.9	415	-	0.993
JLO-19-AC-39	JLO-19-GN-037	2	36.5	39.4	495	-	1.018
JLO-19-AC-40	JLO-19-GN-037	2	34.5	37.2	410	-	0.998
JLO-19-AC-41	JLO-19-GN-019	1½	39.6	43.0	520	-	0.837

Table G.11: Arctic Charr Measurements from Fish Captured at Camp Lake by Gill Netting, Mary River Project CREMP, August 2019

Specimen ID	Net ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Abnormalities	Fulton's Condition Factor (K)
JLO-19-AC-42	JLO-19-GN-019	2	36.3	39.5	485	-	1.014
JLO-19-AC-43	JLO-19-GN-019	3	39.3	43.3	530	-	0.873
JLO-19-AC-44	JLO-19-GN-020	3	38.8	44.0	550	-	0.942
JLO-19-AC-45	JLO-19-GN-020	3	39.6	42.2	530	-	0.853
JLO-19-AC-46	JLO-19-GN-022	3	38.9	42.4	600	-	1.019
JLO-19-AC-47	JLO-19-GN-023	3	44.0	47.5	760	-	0.892
JLO-19-AC-48	JLO-19-GN-023	3	38.7	42.3	500	-	0.863
JLO-19-AC-49	JLO-19-GN-023	3	41.7	44.9	630	-	0.869
JLO-19-AC-50	JLO-19-GN-023	3	39.5	42.8	525	-	0.852
JLO-19-AC-51	JLO-19-GN-023	1½	38.9	42.6	515	-	0.875
JLO-19-AC-52	JLO-19-GN-030	3	37.9	41.3	520	-	0.955
JLO-19-AC-53	JLO-19-GN-031	2	39.3	43.0	540	-	0.890
JLO-19-AC-54	JLO-19-GN-031	3	39.9	43.5	510	-	0.803
JLO-19-AC-55	JLO-19-GN-032	1½	36.0	39.3	420	-	0.900
JLO-19-AC-56	JLO-19-GN-032	2	31.9	35.9	360	-	1.109
JLO-19-AC-57	JLO-19-GN-033	1½	36.7	39.6	490	-	0.991
JLO-19-AC-58	JLO-19-GN-033	2	36.7	39.7	500	-	1.012
JLO-19-AC-59	JLO-19-GN-039	2	35.0	39.0	400	-	0.933
JLO-19-AC-60	JLO-19-GN-039	3	65.5	69.8	3,000	-	1.068
JLO-19-AC-61	JLO-19-GN-039	3	36.4	39.4	415	-	0.860
JLO-19-AC-62	JLO-19-GN-040	2	34.9	38.0	300	-	0.706
JLO-19-AC-63	JLO-19-GN-040	3	35.8	38.5	380	-	0.828
JLO-19-AC-64	JLO-19-GN-038	2	39.0	42.5	505	Gill Parasites	0.851
JLO-19-AC-65	JLO-19-GN-038	2	38.2	41.1	495	-	0.888
Overall Catch Summary	**Sample Size (N)**		**65**	**65**	**65**	**-**	**65**
	Average		**38.9**	**42.3**	**590**	**-**	**0.930**
	Median		**37.9**	**41.3**	**505**	**-**	**0.933**
	Standard Deviation		**5.8**	**6.0**	**425**	**-**	**0.092**
	Standard Error		**0.7**	**0.8**	**53**	**-**	**0.011**
	Minimum		**31.9**	**35.8**	**300**	**-**	**0.704**
	Maximum		**65.5**	**69.8**	**3,000**	**-**	**1.109**

Table G.12: Results of Littoral/Profundal Arctic Charr Health Endpoint Statistical Comparisons between 2019 Camp Lake (JLO) and 2019 Reference Lake 3 (REF) Data, and for Camp Lake between 2019 and the Mine Baseline Period (2005 to 2013), Mary River Project 2019 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 2019 or JLO Base	JLO 2019		Interaction Model: Interaction P-value	Parallel Slope Model: Covariate P-value	Covariate Value for Comparisons[a]	Statistic	REF 2019 or JLO Base	JLO 2019		
Camp Lake versus Reference Lake 3, 2019	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	27	65	K-S	-	-	-	-	-	-	<0.001	-
	Body Size	Fork Length	Fork Length (cm)	-	27	65	M-W	-	-	-	Median	29.7	37.9	<0.001	28
		Body Weight	Body Weight (g)	-	27	65	M-W	-	-	-	Median	220	505	<0.001	130
	Energy Storage	Condition[e]	log[Body Weight (g)]	log[Fork Length (cm)]	27	65	ANCOVA	0.127	<0.001	35.2	Adjusted Mean	378	401	0.052	6
Camp Lake 2019 versus Baseline	Survival	Length Frequency Distribution	Fork Length (cm)	-	130	65	K-S	-	-	-	-	-	-	<0.001	-
	Body Size	Fork Length	Fork Length (cm)	-	130	65	M-W	-	-	-	Median	32.3	37.9	<0.001	17
		Body Weight	Body Weight (g)	-	130	65	M-W	-	-	-	Median	350	505	<0.001	44
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	130	65	ANCOVA	0.990	<0.001	32.9	Adjusted Mean	344	333	0.283	-3.0

(Grey shading) Area P-value < 0.1 or Interaction P-value < 0.05

(Blue shading) 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 2019

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
DLO1-19-ACJ-01	14.0	15.3	23.245	-	0.847
DLO1-19-ACJ-02	7.3	7.8	3.412	-	0.877
DLO1-19-ACJ-03	6.7	7.2	2.477	-	0.824
DLO1-19-ACJ-04	9.5	10.5	7.108	-	0.829
DLO1-19-ACJ-05	8.9	9.6	6.360	-	0.902
DLO1-19-ACJ-06	13.9	15.2	20.634	-	0.768
DLO1-19-ACJ-07	11.0	11.9	9.904	-	0.744
DLO1-19-ACJ-08	13.8	15.2	20.771	-	0.790
DLO1-19-ACJ-09	11.3	12.2	11.787	-	0.817
DLO1-19-ACJ-10	13.0	14.2	18.287	-	0.832
DLO1-19-ACJ-11	10.5	11.3	8.978	-	0.776
DLO1-19-ACJ-12	14.5	15.8	26.713	-	0.876
DLO1-19-ACJ-13	6.4	6.9	2.226	-	0.849
DLO1-19-ACJ-14	9.1	9.8	6.702	-	0.889
DLO1-19-ACJ-15	8.9	9.6	5.913	-	0.839
DLO1-19-ACJ-16	4.8	5.0	0.688	-	0.622
DLO1-19-ACJ-17	5.2	5.5	1.397	-	0.994
DLO1-19-ACJ-18	11.4	12.3	11.919	-	0.804
DLO1-19-ACJ-19	4.7	4.9	0.831	-	0.800
DLO1-19-ACJ-20	8.4	9.1	5.124	-	0.865
DLO1-19-ACJ-21	8.9	9.6	6.102	-	0.866
DLO1-19-ACJ-22	7.8	8.4	4.421	-	0.932
DLO1-19-ACJ-23	13.3	14.4	21.686	-	0.922
DLO1-19-ACJ-24	6.4	6.9	2.258	-	0.861
DLO1-19-ACJ-25	7.2	7.7	3.195	-	0.856
DLO1-19-ACJ-26	6.5	7.0	2.305	-	0.839
DLO1-19-ACJ-27	14.4	15.8	27.336	-	0.915
DLO1-19-ACJ-28	16.0	17.4	37.689	-	0.920
DLO1-19-ACJ-29	10.4	11.1	9.022	-	0.802
DLO1-19-ACJ-30	9.3	10.0	7.072	-	0.879
DLO1-19-ACJ-31	11.9	13.0	14.213	-	0.843
DLO1-19-ACJ-32	11.2	12.1	10.515	-	0.748
DLO1-19-ACJ-33	6.7	7.1	2.419	-	0.804
DLO1-19-ACJ-34	11.4	12.3	11.385	-	0.768
DLO1-19-ACJ-35	5.5	5.8	1.523	-	0.915
DLO1-19-ACJ-36	6.7	7.3	2.623	-	0.872
DLO1-19-ACJ-37	13.5	14.7	22.212	-	0.903
DLO1-19-ACJ-38	7.6	8.1	3.748	-	0.854
DLO1-19-ACJ-39	5.5	5.9	1.497	-	0.900
DLO1-19-ACJ-40	9.7	10.5	8.634	-	0.946
DLO1-19-ACJ-41	7.9	8.5	4.416	-	0.896
DLO1-19-ACJ-42	4.9	5.2	1.114	-	0.947
DLO1-19-ACJ-43	9.1	9.7	6.905	-	0.916
DLO1-19-ACJ-44	6.4	6.8	2.440	-	0.931

Table G.13: Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Electrofishing, Mary River Project CREMP, August 2019

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
DLO1-19-ACJ-45	4.9	5.2	0.999	-	0.849
DLO1-19-ACJ-46	5.1	5.4	1.136	-	0.856
DLO1-19-ACJ-47	10.1	10.9	8.409	-	0.816
DLO1-19-ACJ-48	10.2	11.0	9.206	-	0.868
DLO1-19-ACJ-49	8.9	9.5	5.687	-	0.807
DLO1-19-ACJ-50	7.7	8.3	3.746	-	0.821
DLO1-19-ACJ-51	6.5	6.9	2.238	-	0.815
DLO1-19-ACJ-52	9.1	9.9	6.410	-	0.851
DLO1-19-ACJ-53	6.9	7.4	2.929	-	0.892
DLO1-19-ACJ-54	19.3	21.0	60.325	-	0.839
DLO1-19-ACJ-55	9.2	9.7	5.707	-	0.733
DLO1-19-ACJ-56	14.4	15.5	28.818	-	0.965
DLO1-19-ACJ-57	7.4	8.0	3.605	-	0.890
DLO1-19-ACJ-58	15.6	16.7	33.422	-	0.880
DLO1-19-ACJ-59	7.3	7.8	3.393	-	0.872
DLO1-19-ACJ-60	8.7	9.3	5.649	-	0.858
DLO1-19-ACJ-61	7.6	8.2	3.939	-	0.897
DLO1-19-ACJ-62	7.7	8.4	4.297	-	0.941
DLO1-19-ACJ-63	7.2	7.8	3.238	-	0.868
DLO1-19-ACJ-64	7.3	7.8	3.270	-	0.841
DLO1-19-ACJ-65	10.1	11.0	8.125	2	0.789
DLO1-19-ACJ-66	12.0	13.0	14.144	3	0.819
DLO1-19-ACJ-67	14.9	16.3	28.611	5	0.865
DLO1-19-ACJ-68	7.4	7.9	3.300	1	0.814
DLO1-19-ACJ-69	8.5	9.2	5.125	1	0.835
DLO1-19-ACJ-70	5.5	5.8	1.403	0	0.843
DLO1-19-ACJ-71	6.7	7.2	2.631	1	0.875
DLO1-19-ACJ-72	9.2	9.7	6.093	2	0.782
DLO1-19-ACJ-73	7.7	8.3	4.257	1	0.932
DLO1-19-ACJ-74	13.6	14.8	24.475	3	0.973
DLO1-19-ACJ-75	7.8	8.3	3.926	-	0.827
DLO1-19-ACJ-76	18.3	19.6	54.532	-	0.890
DLO1-19-ACJ-77	12.0	12.9	16.840	-	0.975
DLO1-19-ACJ-78	9.3	10.2	8.325	-	1.035
DLO1-19-ACJ-79	8.4	9.0	5.155	-	0.870
DLO1-19-ACJ-80	15.7	16.8	31.552	-	0.815
DLO1-19-ACJ-81	5.3	5.6	1.304	-	0.876
DLO1-19-ACJ-82	7.7	8.3	4.180	-	0.916
DLO1-19-ACJ-83	7.0	7.5	3.114	-	0.908
DLO1-19-ACJ-84	10.5	11.4	11.182	-	0.966
DLO1-19-ACJ-85	5.4	5.8	1.543	-	0.980
DLO1-19-ACJ-86	13.1	14.1	20.395	-	0.907
DLO1-19-ACJ-87	9.0	9.7	6.577	-	0.902
DLO1-19-ACJ-88	6.5	6.9	2.432	-	0.886
DLO1-19-ACJ-89	12.5	13.5	16.435	-	0.841
DLO1-19-ACJ-90	12.6	13.7	16.311	-	0.815

Table G.13: Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Electrofishing, Mary River Project CREMP, August 2019

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
DLO1-19-ACJ-91		12.3	13.3	14.765	-	0.793
DLO1-19-ACJ-92		6.5	7.0	2.673	-	0.973
DLO1-19-ACJ-93		8.8	9.4	5.990	-	0.879
DLO1-19-ACJ-94		11.1	11.9	11.460	-	0.838
DLO1-19-ACJ-95		6.5	6.9	2.334	-	0.850
Overall Catch Summary	Sample Size (N)	95	95	95	10	95
	Average	9.4	10	9.945	1.9	0.863
	Median	8.9	10	5.913	1.5	0.865
	Standard Deviation	3.2	4	11.007	1.4	0.064
	Standard Error	0.3	0	1.129	0.5	0.007
	Minimum	4.7	5	0.688	0.0	0.622
	Maximum	19.3	21	60.325	5.0	1.035
Young-of-the-Year Catch Summary	proportion of YOY	**0%**				
	Sample Size (N)	0	0	0	0	0
	Average	0.0	0.0	0.000	0	0.000
	Median	0.0	0.0	0.000	0	0.000
	Standard Deviation	0.0	0.0	0.000	0	0.000
	Standard Error	0.0	0.0	0.000	0	0.000
	Minimum	0.0	0.0	0.000	0	0.000
	Maximum	0.0	0.0	0.000	0	0.000

Table G.14: Results of Nearshore Arctic Charr Non-Young-of-the-Year (YOY) Health Endpoint Statistical Comparisons between Sheardown Lake NW (DLO1) and Reference Lake 3 (REF), Mary River Project CREMP, August 2019

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 / Interaction P-value	Parallel Slope Model / Covariate P-value	Covariate Value for Comparisons[a]	Statistic	REF	DLO1		
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	95		-	-	-	NA	-	-	0.027	-
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	97	95	K-S	-	-	-	NA	-	-	0.013	-
Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	97	95	tequal	-	-	-	Geometric Mean	9.86	8.9	0.027	-9.7
Non-YOY	Body Size	Body Weight	Body Weight (g)	-	97	95	tequal	-	-	-	Geometric Mean	7.96	6.07	0.052	-24
Non-YOY	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	97	94[e]	ANCOVA	0.005[f]	<0.001	9.4	Adjusted Mean	6.91	7.19	<0.001	3.9

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 was removed from the analysis (DLO1-19-ACJ-16 with a Studentized residual of -4.9).

[f] ANCOVA proceeded under the assumption that the slopes are practically parallel (R2 of interaction model = 0.9949 and R2 of parallel slope model = 0.9946; a difference < 0.02) following Environment Canada (2012).

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 2019 Data Relative to Reference Lake 3 Data (2019) or Sheardown Lake NW Baseline Data (2006 to 2013) with α=β=0.1, Mary River Project 2019 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, 2019 Data	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	tequal	0.137	-	log(Response)	721	190	53	36	26	22	16	12	5
			Body Weight	Body Weight (g)	-	tequal	0.416	-	Response	6,607	1,732	474	317	230	191	140	97	34
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0305[d]	-	log(Response)	38	12	5	4	4	4	4	3	3
Nearshore Arctic Charr (Electrofishing) 2019 versus Baseline	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.171	41.1	log(Response)	1,293	337	86	56	39	32	22	16	5
			Body Weight	Body Weight (g)	-	M-W	0.51	117	Response	10,907	2,729	683	438	305	247	172	110	29
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0663	-	log(Response)	170	46	14	10	8	7	6	5	4
Littoral/Profundal Arctic Charr (Gill Netting) versus Ref. Lake 3, 2019 Data	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.106	31.7	log(Response)	494	131	38	26	19	16	12	9	4
			Body Weight	Body Weight (g)	-	M-W	0.322	171	Response	4,588	1,204	330	222	160	134	99	69	25
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0535[d]	-	log(Response)	94	26	9	7	6	5	4	4	3
Littoral/Profundal Arctic Charr (Gill Netting) 2019 versus Baseline	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.102	24.7	log(Response)	463	123	32	21	16	13	10	7	4
			Body Weight	Body Weight (g)	-	M-W	0.306	91.8	Response	4,123	1,082	297	198	144	121	88	62	19
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0596	-	log(Response)	138	38	12	9	7	6	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.

[d] One outlier was removed from the analysis (DLO1-19-AC-61 with a Studentized residual of -4.3)

Table G.16: Gill Netting Catch Records for Sheardown Lake NW, Mary River Project CREMP, August 2019

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"		
DLO1-19-GN-01	560011	7913430	300	91.4	21-Aug-19	21-Aug-19	10:45	12:00	1.55	1.42	0	1	1	2	1.41
DLO1-19-GN-02	559864	7913611	300	91.4	21-Aug-19	21-Aug-19	10:50	12:17	1.58	1.44	0	1	2	3	2.08
DLO1-19-GN-03	559697	7913349	300	91.4	21-Aug-19	21-Aug-19	10:50	12:35	1.75	1.60	0	1	1	2	1.25
DLO1-19-GN-04	559929	7913263	300	91.4	21-Aug-19	21-Aug-19	10:59	12:40	1.95	1.78	0	0	0	0	0
DLO1-19-GN-05A	560539	7913170	300	91.4	24-Aug-19	24-Aug-19	9:10	10:50	2.13	1.95	0	0	1	1	0.51
DLO1-19-GN-05B	560539	7913170	300	91.4	24-Aug-19	24-Aug-19	10:55	13:25	2.13	1.95	0	0	0	0	0
DLO1-19-GN-06A	560401	7913284	300	91.4	24-Aug-19	24-Aug-19	9:15	11:10	2.25	2.06	0	0	0	0	0
DLO1-19-GN-06B	560401	7913284	300	91.4	24-Aug-19	24-Aug-19	11:15	13:30	2.25	2.06	0	0	0	0	0
DLO1-19-GN-07A	560064	7913433	300	91.4	24-Aug-19	24-Aug-19	9:30	11:30	1.10	1.01	0	5	3	8	7.95
DLO1-19-GN-07B	560064	7913433	300	91.4	24-Aug-19	24-Aug-19	11:45	13:55	1.10	1.01	0	0	2	2	1.99
DLO1-19-GN-07C	560064	7913433	300	91.4	24-Aug-19	24-Aug-19	14:30	16:45	1.10	1.01	0	1	0	1	0.99
DLO1-19-GN-08A	559872	7913606	200	61.0	24-Aug-19	24-Aug-19	9:35	11:50	2.17	1.32	2	0	0	2	1.51
DLO1-19-GN-08B	559872	7913606	200	61.0	24-Aug-19	24-Aug-19	11:55	14:35	2.23	1.36	0	0	0	0	0
DLO1-19-GN-08C	559872	7913606	200	61.0	24-Aug-19	24-Aug-19	14:40	17:00	2.20	1.34	0	0	1	1	0.75
DLO1-19-GN-09A	559817	7913611	300	91.4	24-Aug-19	24-Aug-19	9:40	11:55	2.08	1.90	1	0	1	2	1.05
DLO1-19-GN-09B	559817	7913611	300	91.4	24-Aug-19	24-Aug-19	12:00	14:50	2.12	1.94	1	2	0	3	1.55
DLO1-19-GN-09C	559817	7913611	300	91.4	24-Aug-19	24-Aug-19	14:55	17:15	1.87	1.71	0	2	1	3	1.75
DLO1-19-GN-10A	559753	7913371	300	91.4	24-Aug-19	24-Aug-19	9:45	12:10	1.80	1.65	0	1	2	3	1.82
DLO1-19-GN-10B	559753	7913371	300	91.4	24-Aug-19	24-Aug-19	12:15	15:00	1.92	1.76	0	2	2	4	2.28
DLO1-19-GN-10C	559753	7913371	300	91.4	24-Aug-19	24-Aug-19	15:15	17:25	1.97	1.80	0	1	0	1	0.56
DLO1-19-GN-11	560094	7913017	300	91.4	24-Aug-19	24-Aug-19	13:40	16:25	1.93	1.76	1	1	0	2	1.13
DLO1-19-GN-12	560022	7913156	300	91.4	24-Aug-19	24-Aug-19	13:45	16:30	1.87	1.71	0	1	0	1	0.58
DLO1-19-GN-13	559915	7913302	300	91.4	24-Aug-19	24-Aug-19	13:50	16:40	1.72	1.57	0	1	0	1	0.64
DLO1-19-GN-14	559694	7913453	300	91.4	24-Aug-19	24-Aug-19	15:25	16:50	1.75	1.60	2	2	2	6	3.75
DLO1-19-GN-15A	560064	7913433	300	91.4	25-Aug-19	25-Aug-19	8:20	10:30	1.52	1.39	1	0	2	3	2.16
DLO1-19-GN-15B	560064	7913433	300	91.4	25-Aug-19	25-Aug-19	10:35	13:00	1.42	1.30	0	0	1	1	0.77
DLO1-19-GN-15C	560064	7913433	300	91.4	25-Aug-19	25-Aug-19	13:10	15:10	1.32	1.21	0	0	1	1	0.83
DLO1-19-GN-15D	560064	7913433	300	91.4	25-Aug-19	25-Aug-19	15:15	17:35	2.38	2.18	2	1	0	3	1.38
DLO1-19-GN-16A	559872	7913606	200	61.0	25-Aug-19	25-Aug-19	8:25	10:40	3.35	2.04	1	0	0	1	0.49
DLO1-19-GN-16B	559872	7913606	200	61.0	25-Aug-19	25-Aug-19	10:40	13:15	3.92	2.39	0	0	1	1	0.42
DLO1-19-GN-16C	559872	7913606	200	61.0	25-Aug-19	25-Aug-19	13:20	15:15	4.05	2.47	0	0	0	0	0
DLO1-19-GN-16D	559872	7913606	200	61.0	25-Aug-19	25-Aug-19	15:20	17:30	4.13	2.52	0	0	0	0	0
DLO1-19-GN-17A	559814	7913642	300	91.4	25-Aug-19	25-Aug-19	8:30	11:00	3.38	3.09	0	0	0	0	0
DLO1-19-GN-17B	559814	7913642	300	91.4	25-Aug-19	25-Aug-19	11:05	13:25	2.28	2.08	1	0	1	2	0.96
DLO1-19-GN-17C	559814	7913642	300	91.4	25-Aug-19	25-Aug-19	13:30	15:35	2.22	2.03	0	0	0	0	0
DLO1-19-GN-17D	559814	7913642	300	91.4	25-Aug-19	25-Aug-19	15:40	17:10	1.97	1.80	0	0	0	0	0

Table G.16: Gill Netting Catch Records for Sheardown Lake NW, Mary River Project CREMP, August 2019

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"		
DLO1-19-GN-18A	559817	7913611	300	91.4	25-Aug-19	25-Aug-19	8:35	11:15	1.85	1.69	0	1	3	4	2.36
DLO1-19-GN-18B	559817	7913611	300	91.4	25-Aug-19	25-Aug-19	11:25	13:35	1.68	1.54	1	0	0	1	0.65
DLO1-19-GN-18C	559817	7913611	300	91.4	25-Aug-19	25-Aug-19	13:40	15:45	2.43	2.22	0	0	1	1	0.45
DLO1-19-GN-18D	559817	7913611	300	91.4	25-Aug-19	25-Aug-19	15:50	17:15	2.08	1.90	0	0	0	0	0
DLO1-19-GN-19A	559694	7913453	300	91.4	25-Aug-19	25-Aug-19	8:45	11:30	2.33	2.13	0	2	1	3	1.41
DLO1-19-GN-19B	559694	7913453	300	91.4	25-Aug-19	25-Aug-19	11:40	13:45	2.55	2.33	0	0	0	0	0
DLO1-19-GN-19C	559694	7913453	300	91.4	25-Aug-19	25-Aug-19	13:50	16:00	2.53	2.31	0	0	0	0	0
DLO1-19-GN-19D	559694	7913453	300	91.4	25-Aug-19	25-Aug-19	16:05	16:55	2.68	2.45	1	0	0	1	0.41
DLO1-19-GN-20A	559753	7913371	300	91.4	25-Aug-19	25-Aug-19	8:50	12:00	2.42	2.21	0	1	0	1	0.45
DLO1-19-GN-20B	559753	7913371	300	91.4	25-Aug-19	25-Aug-19	12:10	13:55	2.25	2.06	0	2	0	2	0.97
DLO1-19-GN-20C	559753	7913371	300	91.4	25-Aug-19	25-Aug-19	14:10	16:00	2.17	1.98	0	0	0	0	0
DLO1-19-GN-20D	559753	7913371	300	91.4	25-Aug-19	25-Aug-19	16:05	16:50	2.33	2.13	0	0	0	0	0
DLO1-19-GN-21A	560281	7913378	300	91.4	25-Aug-19	25-Aug-19	8:55	12:15	2.33	2.13	0	1	1	2	0.94
DLO1-19-GN-21B	560281	7913378	300	91.4	25-Aug-19	25-Aug-19	12:20	14:30	1.17	1.07	0	1	0	1	0.93
DLO1-19-GN-21C	560281	7913378	300	91.4	25-Aug-19	25-Aug-19	14:35	17:00	2.33	2.13	1	0	0	1	0.47
DLO1-19-GN-21D	560281	7913378	300	91.4	25-Aug-19	25-Aug-19	17:05	18:00	2.66	2.43	0	2	0	2	0.82
DLO1-19-GN-22	560004	7913161	300	91.4	25-Aug-19	25-Aug-19	9:00	12:10	2.58	2.36	0	0	0	0	0
DLO1-19-GN-23	560458	7913159	300	91.4	25-Aug-19	25-Aug-19	12:10	14:20	2.00	1.83	0	1	0	1	0.55
DLO1-19-GN-24	560608	7912873	300	91.4	25-Aug-19	25-Aug-19	14:25	17:50	1.50	1.37	0	0	0	0	0
									Total	**101.48**	**15**	**34**	**31**	**80**	**0.93**

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 2019

Specimen ID	Net ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Abnormalities	Fulton's Condition Factor (K)
DLO1-19-AC-01	DLO1-19-GN-01	3	37.6	41.0	490	-	0.922
DLO1-19-AC-02	DLO1-19-GN-01	2	37.0	40.0	460	-	0.908
DLO1-19-AC-03	DLO1-19-GN-02	3	38.5	41.8	565	-	0.990
DLO1-19-AC-04	DLO1-19-GN-02	3	37.6	40.9	520	-	0.978
DLO1-19-AC-05	DLO1-19-GN-02	2	36.6	39.7	410	-	0.836
DLO1-19-AC-06	DLO1-19-GN-03	2	66.2	70.2	2,750	-	0.948
DLO1-19-AC-07	DLO1-19-GN-05	3	45.0	47.9	640	-	0.702
DLO1-19-AC-08	DLO1-19-GN-07	2	35.2	37.4	310	-	0.711
DLO1-19-AC-09	DLO1-19-GN-07	2	34.3	37.6	330	-	0.818
DLO1-19-AC-10	DLO1-19-GN-07	2	23.0	24.8	94	-	0.773
DLO1-19-AC-11	DLO1-19-GN-07	2	32.0	34.8	285	-	0.870
DLO1-19-AC-12	DLO1-19-GN-07	3	34.1	37.3	380	-	0.958
DLO1-19-AC-13	DLO1-19-GN-07	3	65.3	70.5	2,300	-	0.826
DLO1-19-AC-14	DLO1-19-GN-07	3	37.1	39.8	435	-	0.852
DLO1-19-AC-15	DLO1-19-GN-07	3	39.8	42.7	455	-	0.722
DLO1-19-AC-16	DLO1-19-GN-08	1½	35.0	38.2	395	-	0.921
DLO1-19-AC-17	DLO1-19-GN-09	3	38.0	41.3	480	-	0.875
DLO1-19-AC-18	DLO1-19-GN-09	1½	41.8	45.5	590	-	0.808
DLO1-19-AC-19	DLO1-19-GN-10	3	37.8	41.1	595	-	1.102
DLO1-19-AC-20	DLO1-19-GN-10	3	38.2	41.5	495	-	0.888
DLO1-19-AC-21	DLO1-19-GN-10	2	35.6	38.6	445	-	0.986
DLO1-19-AC-22	DLO1-19-GN-07	3	36.5	40.0	475	-	0.977
DLO1-19-AC-23	DLO1-19-GN-07	3	56.4	59.9	1,340	-	0.747
DLO1-19-AC-24	DLO1-19-GN-09	2	30.0	32.6	215	-	0.796
DLO1-19-AC-25	DLO1-19-GN-09	2	33.5	36.5	330	-	0.878
DLO1-19-AC-26	DLO1-19-GN-09	3	56.5	60.9	1,440	-	0.798
DLO1-19-AC-27	DLO1-19-GN-10	3	36.1	39.5	445	-	0.946
DLO1-19-AC-28	DLO1-19-GN-10	3	36.1	39.4	390	-	0.829
DLO1-19-AC-29	DLO1-19-GN-10	2	35.5	39.0	405	-	0.905
DLO1-19-AC-30	DLO1-19-GN-10	2	36.0	39.5	445	-	0.954
DLO1-19-AC-31	DLO1-19-GN-11	1½	35.6	39.0	380	-	0.842
DLO1-19-AC-32	DLO1-19-GN-11	2	30.9	33.7	275	-	0.932
DLO1-19-AC-33	DLO1-19-GN-12	2	39.5	42.8	580	-	0.941
DLO1-19-AC-34	DLO1-19-GN-13	1½	32.7	35.8	375	-	1.072
DLO1-19-AC-35	DLO1-19-GN-07	2	35.7	38.7	420	-	0.923
DLO1-19-AC-36	DLO1-19-GN-08	3	36.1	39.5	395	-	0.840
DLO1-19-AC-37	DLO1-19-GN-09	3	35.5	39.1	490	-	1.095
DLO1-19-AC-38	DLO1-19-GN-09	2	53.1	56.0	1,420	gill parasites	0.948
DLO1-19-AC-39	DLO1-19-GN-09	2	40.7	44.4	505	-	0.749
DLO1-19-AC-40	DLO1-19-GN-10	2	67.0	71.8	2,600	-	0.864
DLO1-19-AC-41	DLO1-19-GN-14	1½	35.7	39.1	380	-	0.835
DLO1-19-AC-42	DLO1-19-GN-14	1½	33.5	36.3	360	-	0.958
DLO1-19-AC-43	DLO1-19-GN-14	2	35.0	38.2	330	-	0.770
DLO1-19-AC-44	DLO1-19-GN-14	2	45.0	48.5	595	-	0.653

Table G.17: Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Gill Netting, Mary River Project CREMP, August 2019

Specimen ID	Net ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Abnormalities	Fulton's Condition Factor (K)
DLO1-19-AC-45	DLO1-19-GN-14	3	56.7	61.2	1,900	-	1.042
DLO1-19-AC-46	DLO1-19-GN-14	3	37.8	41.1	485	-	0.898
DLO1-19-AC-47	DLO1-19-GN-15	1½	20.9	22.7	74	-	0.811
DLO1-19-AC-48	DLO1-19-GN-15	3	60.3	64.7	1,950	-	0.889
DLO1-19-AC-49	DLO1-19-GN-15	3	35.0	38.5	405	-	0.945
DLO1-19-AC-50	DLO1-19-GN-16	1½	38.0	41.0	440	-	0.802
DLO1-19-AC-51	DLO1-19-GN-18	2	35.6	38.7	420	-	0.931
DLO1-19-AC-52	DLO1-19-GN-18	3	36.5	39.5	425	-	0.874
DLO1-19-AC-53	DLO1-19-GN-18	3	39.0	42.3	540	-	0.910
DLO1-19-AC-54	DLO1-19-GN-18	3	38.5	41.1	460	-	0.806
DLO1-19-AC-55	DLO1-19-GN-19	2	36.0	38.9	405	-	0.868
DLO1-19-AC-56	DLO1-19-GN-19	2	25.1	27.1	146	-	0.923
DLO1-19-AC-57	DLO1-19-GN-19	3	34.2	37.3	375	-	0.937
DLO1-19-AC-58	DLO1-19-GN-20	2	36.0	38.8	480	-	1.029
DLO1-19-AC-59	DLO1-19-GN-21	3	38.5	41.5	470	-	0.824
DLO1-19-AC-60	DLO1-19-GN-21	2	35.3	38.5	395	-	0.898
DLO1-19-AC-61	DLO1-19-GN-15	3	54.1	57.2	840	emaciated	0.531
DLO1-19-AC-62	DLO1-19-GN-16	3	36.9	39.8	470	-	0.935
DLO1-19-AC-63	DLO1-19-GN-17	1½	36.8	39.5	400	-	0.803
DLO1-19-AC-64	DLO1-19-GN-17	3	36.5	39.6	325	-	0.668
DLO1-19-AC-65	DLO1-19-GN-18	1½	32.4	35.6	335	-	0.985
DLO1-19-AC-66	DLO1-19-GN-20	2	35.6	38.7	390	-	0.864
DLO1-19-AC-67	DLO1-19-GN-20	1½	34.4	37.3	320	-	0.786
DLO1-18-AC-68	DLO1-19-GN-23	2	35.2	38.7	330	-	0.757
DLO1-18-AC-69	DLO1-19-GN-21	2	35.2	38.3	390	-	0.894
DLO1-18-AC-70	DLO1-19-GN-15	3	35.5	38.7	410	-	0.916
DLO1-18-AC-71	DLO1-19-GN-18	3	58.5	62.1	1,750	-	0.874
DLO1-18-AC-72	DLO1-19-GN-21	1½	35.3	38.6	365	-	0.830
DLO1-18-AC-73	DLO1-19-GN-16	1½	22.5	24.4	105	-	0.922
DLO1-18-AC-74	DLO1-19-GN-15	1½	58.5	62.1	1,780	-	0.889
DLO1-18-AC-75	DLO1-19-GN-21	2	31.5	34.4	245	-	0.784
DLO1-18-AC-76	DLO1-19-GN-21	2	37.8	41.4	400	-	0.741
Overall Catch Summary	**Sample Size (N)**		**76**	**76**	**76**	**-**	**76**
	Average		**38.9**	**42.1**	**608**	**-**	**0.871**
	Median		**36.1**	**39.5**	**423**	**-**	**0.876**
	Standard Deviation		**9.5**	**9.9**	**555**	**-**	**0.102**
	Standard Error		**1.1**	**1.1**	**63.7**	**-**	**0.012**
	Minimum		**20.9**	**22.7**	**74**	**-**	**0.531**
	Maximum		**67.0**	**71.8**	**2,750**	**-**	**1.102**

Table G.18: Results of Littoral/Profundal Arctic Charr Health Endpoint Statistical Comparisons between 2019 Sheardown Lake NW (DLO1) and 2018 Reference Lake 3 (REF) Data, and for Sheardown Lake NW between 2019 and the Mine Baseline Period (2006 to 2013), Mary River Project 2019 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 2019 or DLO1 Base	DLO1 2019		Interaction Model / Interaction P-value	Parallel Slope Model / Covariate P-value	Covariate Value for Comparisons[a]	Statistic	REF 2019 or DLO1 Base	DLO1 2019		
Sheardown Lake NW versus Reference Lake 3, 2019	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	27	76	K-S	-	-	-	-	-	-	<0.001	-
	Body Size	Fork Length	Fork Length (cm)	-	27	76	M-W	-	-	-	Median	29.7	36.1	<0.001	22
		Body Weight	Body Weight (g)	-	27	76	M-W	-	-	-	Median	220	422	<0.001	92
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	27	75[e]	ANCOVA	0.092	<0.001	35	Adjusted Mean	367	372	0.653	1.3
Sheardown Lake NW 2019 versus Baseline	Survival	Length Frequency Distribution	Fork Length (cm)	-	98	76	K-S	-	-	-	-	-	-	0.032	-
	Body Size	Fork Length	Fork Length (cm)	-	98	76	M-W	-	-	-	Median	35.8	36.1	0.208	1.0
		Body Weight	Body Weight (g)	-	98	76	M-W	-	-	-	Median	400	422	0.226	5.6
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	98	76	ANCOVA	0.940	<0.001	36.6	Adjusted Mean	424	425	0.934	0.2

(Grey shading) Area P-value < 0.1 or Interaction P-value < 0.05

(Blue shading) 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 was removed from the analysis (DLO1-19-AC-61 with a Studentized residual of -4.3).

Table G.19: Arctic Charr Measurements from Fish Captured at Sheardown Lake SE by Electrofishing, Mary River Project CREMP, August 2019

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
DLO2-19-ACJ-01	5.5	5.8	1.363	0	0.819
DLO2-19-ACJ-02	6.9	7.4	2.578	1	0.785
DLO2-19-ACJ-03	5.3	5.5	1.324	-	0.889
DLO2-19-ACJ-04	7.8	8.4	4.469	-	0.942
DLO2-19-ACJ-05	4.7	4.9	0.890	-	0.857
DLO2-19-ACJ-06	7.5	8.1	3.971	-	0.941
DLO2-19-ACJ-07	11.9	12.9	13.497	-	0.801
DLO2-19-ACJ-08	5.1	5.3	1.221	-	0.920
DLO2-19-ACJ-09	4.9	5.2	1.087	-	0.924
DLO2-19-ACJ-10	5.3	5.5	1.226	-	0.823
DLO2-19-ACJ-11	4.4	4.6	0.768	-	0.902
DLO2-19-ACJ-12	6.2	6.6	2.184	-	0.916
DLO2-19-ACJ-13	15.6	16.3	30.721	-	0.809
DLO2-19-ACJ-14	5.2	5.5	1.245	-	0.885
DLO2-19-ACJ-15	5.1	5.3	1.157	-	0.872
DLO2-19-ACJ-16	4.6	4.8	0.810	-	0.832
DLO2-19-ACJ-17	5.4	5.7	1.420	-	0.902
DLO2-19-ACJ-18	4.9	5.1	1.026	-	0.872
DLO2-19-ACJ-19	5.4	5.7	1.389	-	0.882
DLO2-19-ACJ-20	5.2	5.5	1.296	-	0.922
DLO2-19-ACJ-21	4.3	4.5	0.702	-	0.883
DLO2-19-ACJ-22	5.2	5.4	1.151	-	0.819
DLO2-19-ACJ-23	11.9	12.9	14.140	-	0.839
DLO2-19-ACJ-24	7.9	8.5	4.593	-	0.932
DLO2-19-ACJ-25	4.8	5.0	0.878	-	0.794
DLO2-19-ACJ-26	10.1	10.8	8.767	-	0.851
DLO2-19-ACJ-27	5.5	5.9	1.446	-	0.869
DLO2-19-ACJ-28	5.0	5.2	0.906	-	0.725
DLO2-19-ACJ-29	8.8	9.5	6.879	-	1.009
DLO2-19-ACJ-30	7.0	7.5	3.214	-	0.937
DLO2-19-ACJ-31	11.4	12.4	11.381	-	0.768
DLO2-19-ACJ-32	4.8	5.0	1.079	-	0.976
DLO2-19-ACJ-33	4.6	4.8	0.856	-	0.879
DLO2-19-ACJ-34	6.7	7.1	2.788	-	0.927
DLO2-19-ACJ-35	5.4	5.7	1.510	-	0.959
DLO2-19-ACJ-36	5.6	5.9	1.684	-	0.959
DLO2-19-ACJ-37	12.5	13.4	18.318	-	0.938
DLO2-19-ACJ-38	9.5	10.3	7.460	-	0.870
DLO2-19-ACJ-39	4.1	4.3	0.616	-	0.894
DLO2-19-ACJ-40	4.8	5.0	1.017	-	0.920
DLO2-19-ACJ-41	8.2	8.6	4.965	-	0.900
DLO2-19-ACJ-42	7.1	7.7	3.054	-	0.853
DLO2-19-ACJ-43	4.8	5.0	1.012	-	0.915
DLO2-19-ACJ-44	6.5	7.0	2.269	-	0.826
DLO2-19-ACJ-45	8.7	9.3	5.169	-	0.785
DLO2-19-ACJ-46	9.5	10.3	7.243	-	0.845
DLO2-19-ACJ-47	4.9	5.1	0.988	-	0.840
DLO2-19-ACJ-48	8.3	8.9	5.302	-	0.927
DLO2-19-ACJ-49	17.4	19.0	47.569	-	0.903
DLO2-19-ACJ-50	8.7	9.3	6.089	-	0.925
DLO2-19-ACJ-51	7.3	7.9	3.673	-	0.944
DLO2-19-ACJ-52	7.0	7.5	3.001	1	0.875
DLO2-19-ACJ-53	7.9	8.4	4.321	-	0.876
DLO2-19-ACJ-54	8.1	8.8	4.551	-	0.856
DLO2-19-ACJ-55	7.2	7.8	3.394	-	0.909
DLO2-19-ACJ-56	12.8	13.8	17.292	-	0.825
DLO2-19-ACJ-57	6.2	6.5	2.061	-	0.865

Table G.19: Arctic Charr Measurements from Fish Captured at Sheardown Lake SE by Electrofishing, Mary River Project CREMP, August 2019

	Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
	DLO2-19-ACJ-58	5.0	5.2	1.148	-	0.918
	DLO2-19-ACJ-59	4.9	5.1	1.027	-	0.873
	DLO2-19-ACJ-60	6.9	7.4	2.895	-	0.881
	DLO2-19-ACJ-61	7.5	7.9	3.664	-	0.869
	DLO2-19-ACJ-62	7.4	8.0	3.682	-	0.909
	DLO2-19-ACJ-63	16.5	17.9	41.034	-	0.913
	DLO2-19-ACJ-64	4.9	5.2	1.030	-	0.875
	DLO2-19-ACJ-65	4.8	5.0	0.985	-	0.891
	DLO2-19-ACJ-66	9.0	9.7	5.861	-	0.804
	DLO2-19-ACJ-67	7.3	7.9	3.349	-	0.861
	DLO2-19-ACJ-68	7.0	7.5	2.983	-	0.870
	DLO2-19-ACJ-69	5.3	5.6	1.322	-	0.888
	DLO2-19-ACJ-70	12.7	13.8	18.582	-	0.907
	DLO2-19-ACJ-71	7.2	7.8	3.270	-	0.876
	DLO2-19-ACJ-72	12.0	13.0	14.302	-	0.828
	DLO2-19-ACJ-73	5.5	5.8	1.551	-	0.932
	DLO2-19-ACJ-74	7.8	8.5	4.434	-	0.934
	DLO2-19-ACJ-75	5.2	5.4	1.233	-	0.877
	DLO2-19-ACJ-76	7.7	8.3	4.604	-	1.008
	DLO2-19-ACJ-77	6.8	7.4	2.761	-	0.878
	DLO2-19-ACJ-78	11.5	12.4	11.692	-	0.769
	DLO2-19-ACJ-79	7.2	7.7	2.877	-	0.771
	DLO2-19-ACJ-80	5.3	5.5	1.347	-	0.905
	DLO2-19-ACJ-81	7.5	8.1	3.588	-	0.850
	DLO2-19-ACJ-82	10.9	11.8	11.014	-	0.850
	DLO2-19-ACJ-83	5.4	5.7	1.333	0	0.847
	DLO2-19-ACJ-84	9.3	10.0	7.360	2	0.915
	DLO2-19-ACJ-85	8.7	9.4	5.521	2	0.838
	DLO2-19-ACJ-86	7.5	8.0	3.459	1	0.820
	DLO2-19-ACJ-87	8.7	9.4	5.270	2	0.800
	DLO2-19-ACJ-88	11.5	12.4	12.123	3	0.797
	DLO2-19-ACJ-89	12.5	13.6	13.880	3	0.711
	DLO2-19-ACJ-90	5.4	5.7	1.317	-	0.836
	DLO2-19-ACJ-91	5.2	5.4	1.171	-	0.833
	DLO2-19-ACJ-92	5.3	5.5	1.312	-	0.881
	DLO2-19-ACJ-93	8.0	8.5	4.523	-	0.883
	DLO2-19-ACJ-94	9.1	9.8	6.326	-	0.839
	DLO2-18-ACJ-95	7.5	8.0	3.506	-	0.831
	DLO2-18-ACJ-96	10.9	11.7	9.943	-	0.768
	DLO2-18-ACJ-97	5.4	5.6	1.415	-	0.899
	DLO2-18-ACJ-98	8.9	9.6	6.174	-	0.876
	DLO2-18-ACJ-99	7.4	7.8	3.295	-	0.813
	DLO2-18-ACJ-100	6.8	7.3	2.533	-	0.806
Overall Catch Summary	Sample Size (N)	100	100	100	10	100
	Average	7.4	8.0	5.257	1.5	0.870
	Median	7.0	7.5	2.992	1.5	0.876
	Standard Deviation	2.8	3.1	7.471	1.1	0.056
	Standard Error	0.3	0.3	0.747	0.3	0.006
	Minimum	4.1	4.3	0.616	0.0	0.711
	Maximum	17.4	19.0	47.569	3.0	1.009
Young-of-the-Year Catch Summary	proportion of YOY			**40%**		
	Sample Size (N)	40	40	40	2	40
	Average	5.1	5.3	1.156	0	0.880
	Median	5.2	5.4	1.164	0	0.883
	Standard Deviation	0.4	0.4	0.244	0	0.048
	Standard Error	0.1	0.1	0.039	0	0.008
	Minimum	4.1	4.3	0.616	0	0.725
	Maximum	5.6	5.9	1.684	0	0.976

Table G.20: Results of Nearshore Arctic Charr Non-Young-of-the-Year (YOY) Health Endpoint Statistical Comparisons between Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF), Mary River Project CREMP, August 2019

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	DLO-02		Interaction P-value	Covariate P-value		Statistic	REF	DLO-02		
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	94	K-S	-	-	-	-	-	-	<0.001	-
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	97	94	K-S	-	-	-	-	-	-	<0.001	-
Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	97	94	M-W	-	-	-	Median	10.0	7.2	<0.001	-28
Non-YOY	Body Size	Body Weight	Body Weight (g)	-	97	94	tunequal	-	-	-	Geometric Mean	7.96	3.28	<0.001	-59
Non-YOY	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	97	94	ANCOVA	0.001[e]	<0.001	8.46	Adjusted Mean	5.04	5.26	<0.001	4

(grey) Area P-value < 0.1 or Interaction P-value < 0.05

(blue) 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] ANCOVA proceeded under the assumption that the slopes are practically parallel (R2 of interaction model = 0.9957 and R2 of parallel slope model = 0.9955; a difference < 0.02) following Environment Canada (2012).

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 2019 Data Relative to Reference Lake 3 Data (2019) or Sheardown Lake SE Baseline Data (2006 to 2013) with α=β=0.1, Mary River Project 2019 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, 2019 Data	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.135	27.7	log10(Response)	610	154	40	26	19	16	11	9	4
			Body Weight	Body Weight (g)	-	tunequal	0.406	-	Response	6,276	1,645	451	301	218	182	133	92	32
		Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0303	-	log10(Response)	37	11	5	4	4	4	3	3	3
Nearshore Arctic Charr (Electrofishing) 2019 versus Baseline	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.131	40.5	log10(Response)	763	202	56	39	28	24	18	13	5
			Body Weight	Body Weight (g)	-	M-W	0.413	278.0	Response	7,548	1,980	542	363	263	219	160	112	40
		Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0694	-	log10(Response)	186	50	15	11	9	8	6	5	4
Littoral/Profundal Arctic Charr (Gill Netting) versus Ref. Lake 3, 2019 Data	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.0774	19.4	log10(Response)	267	71	20	14	10	9	6	5	3
			Body Weight	Body Weight (g)	-	M-W	0.247	79.4	Response	2,696	708	195	130	95	79	58	41	14
		Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0441	-	log10(Response)	76	22	8	6	5	5	4	4	3
Littoral/Profundal Arctic Charr (Gill Netting) 2019 versus Baseline	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.0605	12.2	log10(Response)	120	32	10	6	5	5	4	4	3
			Body Weight	Body Weight (g)	-	M-W	0.194	37.9	Response	1,141	286	73	48	34	27	20	13	5
		Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.461[d]	-	log10(Response)	83	23	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.

[d] One outlier was removed from the analysis (SLSE-08-005.10 with a Studentized residual of 4.3).

Table G.22: Gill Netting Catch Records for Sheardown Lake SE, Mary River Project CREMP, August 2019

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"		
DLO2-19-GN-01	561380	7911816	300	91.4	21-Aug-19	21-Aug-19	9:45	12:05	2.33	2.13	2	5	2	9	4.22
DLO2-19-GN-02	561109	7911847	300	91.4	21-Aug-19	21-Aug-19	9:50	12:40	2.83	2.59	1	4	3	8	3.09
DLO2-19-GN-03	561004	7911917	300	91.4	21-Aug-19	21-Aug-19	9:55	13:00	3.08	2.82	1	1	6	8	2.84
DLO2-19-GN-04	560826	7912166	300	91.4	21-Aug-19	21-Aug-19	10:00	13:35	3.58	3.28	3	6	4	13	3.97
DLO2-19-GN-05	561380	7911816	300	91.4	21-Aug-19	21-Aug-19	12:15	15:10	2.92	2.67	4	5	7	16	6.00
DLO2-19-GN-06	561109	7911847	300	91.4	21-Aug-19	21-Aug-19	12:45	15:25	2.67	2.44	2	1	3	6	2.46
DLO2-19-GN-07	561004	7911917	300	91.4	21-Aug-19	21-Aug-19	13:15	15:40	2.42	2.21	2	0	4	6	2.72
DLO2-19-GN-08	560826	7912166	300	91.4	21-Aug-19	21-Aug-19	13:40	15:50	2.17	1.98	1	1	1	3	1.51
DLO2-19-GN-09	560943	7912068	300	91.4	21-Aug-19	21-Aug-19	13:01	14:35	1.57	1.43	1	1	1	3	2.09
DLO2-19-GN-10	561021	7912034	300	91.4	21-Aug-19	21-Aug-19	13:06	14:45	1.65	1.51	1	1	0	2	1.33
DLO2-19-GN-11	561125	7911970	300	91.4	21-Aug-19	21-Aug-19	13:11	15:10	1.98	1.81	1	2	4	7	3.86
DLO2-19-GN-12	561250	7911921	300	91.4	21-Aug-19	21-Aug-19	13:15	15:30	2.25	2.06	2	2	1	5	2.43
DLO2-19-GN-13	561174	7911927	300	91.4	21-Aug-19	21-Aug-19	13:31	16:15	2.73	2.50	1	9	3	13	5.20
DLO2-19-GN-14	561221	7911824	300	91.4	21-Aug-19	21-Aug-19	13:37	15:40	2.05	1.87	0	0	2	2	1.07
									Total	**31.30**	**22**	**38**	**41**	**101**	**3.06**

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 2019

Specimen ID	Net ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Abnormalities	Fulton's Condition Factor (K)
DLO2-19-AC-01	SDSE-19-GN-01	3	36.4	39.2	430	-	0.892
DLO2-19-AC-02	SDSE-19-GN-01	3	37.3	39.9	375	-	0.723
DLO2-19-AC-03	SDSE-19-GN-01	2	33.8	36.5	340	-	0.880
DLO2-19-AC-04	SDSE-19-GN-01	2	31.1	33.6	320	-	1.064
DLO2-19-AC-05	SDSE-19-GN-01	2	35.4	38.5	427	-	0.963
DLO2-19-AC-06	SDSE-19-GN-01	2	35.6	39.0	435	-	0.964
DLO2-19-AC-07	SDSE-19-GN-01	2	31.3	33.8	305	-	0.995
DLO2-19-AC-08	SDSE-19-GN-01	1½	20.0	21.8	70	-	0.875
DLO2-19-AC-09	SDSE-19-GN-01	1½	34.1	37.2	375	-	0.946
DLO2-19-AC-10	SDSE-19-GN-02	1½	22.8	24.5	100	-	0.844
DLO2-19-AC-11	SDSE-19-GN-02	2	27.2	28.8	180	-	0.894
DLO2-19-AC-12	SDSE-19-GN-02	2	39.0	42.8	545	-	0.919
DLO2-19-AC-13	SDSE-19-GN-02	2	31.1	33.6	308	-	1.024
DLO2-19-AC-14	SDSE-19-GN-02	2	34.5	37.5	395	-	0.962
DLO2-19-AC-15	SDSE-19-GN-02	3	38.2	40.9	480	-	0.861
DLO2-19-AC-16	SDSE-19-GN-02	3	38.5	42.5	530	-	0.929
DLO2-19-AC-17	SDSE-19-GN-02	3	34.7	37.4	470	caudal fin erosion	1.125
DLO2-19-AC-18	SDSE-19-GN-03	3	38.3	41.1	540	-	0.961
DLO2-19-AC-19	SDSE-19-GN-03	3	36.0	38.9	500	-	1.072
DLO2-19-AC-20	SDSE-19-GN-03	3	37.3	40.3	510	-	0.983
DLO2-19-AC-21	SDSE-19-GN-03	3	38.3	41.6	485	-	0.863
DLO2-19-AC-22	SDSE-19-GN-03	3	38.0	41.1	505	-	0.920
DLO2-19-AC-23	SDSE-19-GN-03	3	49.6	52.6	1,300	-	1.065
DLO2-19-AC-24	SDSE-19-GN-03	2	39.2	41.9	585	-	0.971
DLO2-19-AC-25	SDSE-19-GN-03	1½	43.0	45.9	835	-	1.050
DLO2-19-AC-26	SDSE-19-GN-04	3	38.1	41.2	410	-	0.741
DLO2-19-AC-27	SDSE-19-GN-04	3	39.8	43.0	515	-	0.817
DLO2-19-AC-28	SDSE-19-GN-04	3	36.4	39.3	495	-	1.026
DLO2-19-AC-29	SDSE-19-GN-04	3	36.5	38.9	460	-	0.946
DLO2-19-AC-30	SDSE-19-GN-04	2	36.3	39.4	410	-	0.857
DLO2-19-AC-31	SDSE-19-GN-04	2	35.4	38.3	375	-	0.845
DLO2-19-AC-32	SDSE-19-GN-04	2	32.2	34.3	290	-	0.869
DLO2-19-AC-33	SDSE-19-GN-04	2	34.1	36.9	360	-	0.908
DLO2-19-AC-34	SDSE-19-GN-04	2	31.5	34.2	305	-	0.976
DLO2-19-AC-35	SDSE-19-GN-04	2	34.5	37.6	360	-	0.877
DLO2-19-AC-36	SDSE-19-GN-04	1½	20.5	21.9	-	-	
DLO2-19-AC-37	SDSE-19-GN-04	1½	36.5	39.2	440	-	0.905
DLO2-19-AC-38	SDSE-19-GN-04	1½	38.0	41.3	451	-	0.822
DLO2-19-AC-39	SDSE-19-GN-05	3	36.9	37.8	470	-	0.935
DLO2-19-AC-40	SDSE-19-GN-05	3	39.5	42.4	530	-	0.860
DLO2-19-AC-41	SDSE-19-GN-09	1½	36.0	39.2	430	-	0.922
DLO2-19-AC-42	SDSE-19-GN-09	2	35.5	38.7	400	-	0.894
DLO2-19-AC-43	SDSE-19-GN-09	3	36.7	39.8	455	-	0.920
DLO2-19-AC-44	SDSE-19-GN-10	2	28.3	30.7	210	-	0.927
DLO2-19-AC-45	SDSE-19-GN-10	1½	37.5	40.6	465	-	0.882
DLO2-19-AC-46	SDSE-19-GN-11	1½	34.1	37.2	380	-	0.958
DLO2-19-AC-47	SDSE-19-GN-11	2	37.0	40.4	455	-	0.898
DLO2-19-AC-48	SDSE-19-GN-11	2	34.6	37.5	350	-	0.845
DLO2-19-AC-49	SDSE-19-GN-11	3	35.6	38.6	430	-	0.953
DLO2-19-AC-50	SDSE-19-GN-11	3	37.9	41.4	465	-	0.854
DLO2-19-AC-51	SDSE-19-GN-11	3	37.9	41.0	500	-	0.918
DLO2-19-AC-52	SDSE-19-GN-11	3	36.0	39.0	580	-	1.243
DLO2-19-AC-53	SDSE-19-GN-12	3	40.2	43.4	595	-	0.916
DLO2-19-AC-54	SDSE-19-GN-12	2	52.9	56.0	1,760	-	1.189
DLO2-19-AC-55	SDSE-19-GN-12	2	37.0	40.1	450	-	0.888

Table G.23: Arctic Charr Measurements from Fish Captured at Sheardown Lake SE by Gill Netting, Mary River Project CREMP, August 2019

Specimen ID	Net ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Abnormalities	Fulton's Condition Factor (K)
DLO2-19-AC-56	SDSE-19-GN-12	1½	37.2	40.4	405	-	0.787
DLO2-19-AC-57	SDSE-19-GN-12	1½	36.7	39.8	495	-	1.001
DLO2-19-AC-58	SDSE-19-GN-14	3	35.5	38.4	430	-	0.961
DLO2-19-AC-59	SDSE-19-GN-14	3	37.5	40.5	450	-	0.853
DLO2-19-AC-60	SDSE-19-GN-13	3	36.2	39.6	455	-	0.959
DLO2-19-AC-61	SDSE-19-GN-13	3	45.0	48.0	890	-	0.977
DLO2-19-AC-62	SDSE-19-GN-13	3	35.1	38.5	405	-	0.937
DLO2-19-AC-63	SDSE-19-GN-13	2	35.5	38.1	410	-	0.916
DLO2-19-AC-64	SDSE-19-GN-13	2	31.7	34.7	315	-	0.989
DLO2-19-AC-65	SDSE-19-GN-13	2	31.3	34.3	250	-	0.815
DLO2-19-AC-66	SDSE-19-GN-13	2	34.8	37.6	445	-	1.056
DLO2-19-AC-67	SDSE-19-GN-13	2	36.9	40.4	465	-	0.925
DLO2-19-AC-68	SDSE-19-GN-13	2	35.0	37.9	350	-	0.816
DLO2-19-AC-69	SDSE-19-GN-13	2	39.5	42.7	580	-	0.941
DLO2-19-AC-70	SDSE-19-GN-13	2	39.0	42.5	570	-	0.961
DLO2-19-AC-71	SDSE-19-GN-13	2	36.5	39.6	495	-	1.018
DLO2-19-AC-72	SDSE-19-GN-13	1½	35.6	38.4	445	-	0.986
DLO2-19-AC-73	SDSE-19-GN-05	3	40.1	43.2	450	-	0.698
DLO2-19-AC-74	SDSE-19-GN-05	3	39.1	42.2	510	-	0.853
DLO2-19-AC-75	SDSE-19-GN-05	3	36.5	39.2	410	-	0.843
DLO2-19-AC-76	SDSE-19-GN-05	3	37.0	41.2	420	-	0.829
DLO2-19-AC-77	SDSE-19-GN-05	3	37.5	40.6	415	-	0.787
DLO2-19-AC-78	SDSE-19-GN-05	2	36.5	39.2	422	-	0.868
DLO2-19-AC-79	SDSE-19-GN-05	2	37.3	40.5	440	-	0.848
DLO2-19-AC-80	SDSE-19-GN-05	2	25.0	27.0	120	-	0.768
DLO2-19-AC-81	SDSE-19-GN-05	2	34.6	37.2	410	-	0.990
DLO2-19-AC-82	SDSE-19-GN-05	1½	32.5	35.0	280	-	0.816
DLO2-19-AC-83	SDSE-19-GN-05	2	38.0	41.0	540	-	0.984
DLO2-19-AC-84	SDSE-19-GN-05	1½	37.6	40.1	480	-	0.903
DLO2-19-AC-85	SDSE-19-GN-05	1½	39.9	43.0	560	-	0.882
DLO2-19-AC-86	SDSE-19-GN-05	1½	22.9	25.1	90	-	0.749
DLO2-19-AC-87	SDSE-19-GN-06	1½	37.0	39.2	410	-	0.809
DLO2-19-AC-88	SDSE-19-GN-06	1½	34.5	37.2	350	-	0.852
DLO2-19-AC-89	SDSE-19-GN-06	2	38.8	42.1	510	caudal fin erosion	0.873
DLO2-19-AC-90	SDSE-19-GN-06	3	37.9	41.2	507	-	0.931
DLO2-19-AC-91	SDSE-19-GN-06	3	35.1	39.1	440	-	1.017
DLO2-19-AC-92	SDSE-19-GN-06	3	37.4	39.0	430	-	0.822
DLO2-19-AC-93	SDSE-19-GN-07	3	40.0	43.3	520	-	0.813
DLO2-19-AC-94	SDSE-19-GN-07	3	34.8	38.0	400	-	0.949
DLO2-19-AC-95	SDSE-19-GN-07	3	40.5	44.0	650	-	0.978
DLO2-19-AC-96	SDSE-19-GN-07	3	37.1	41.0	450	-	0.881
DLO2-19-AC-97	SDSE-19-GN-07	1½	38.5	41.8	540	-	0.946
DLO2-19-AC-98	SDSE-19-GN-07	1½	31.0	33.9	260	-	0.873
DLO2-19-AC-99	SDSE-19-GN-08	3	40.9	44.0	570	-	0.833
DLO2-19-AC-100	SDSE-19-GN-08	2	37.4	46.0	460	-	0.879
DLO2-19-AC-101	SDSE-19-GN-08	1½	39.4	44.0	510	-	0.834
Overall Catch Summary	**Sample Size (N)**		**101**	**101**	**100**	**-**	**100**
	Average		**36.0**	**39.0**	**456**	**-**	**0.913**
	Median		**36.5**	**39.3**	**445**	**-**	**0.912**
	Standard Deviation		**4.7**	**5.1**	**201**	**-**	**0.091**
	Standard Error		**0.5**	**0.5**	**20.09**	**-**	**0.009**
	Minimum		**20.0**	**21.8**	**70**	**-**	**0.698**
	Maximum		**52.9**	**56.0**	**1,760**	**-**	**1.243**

Table G.24: Results of Littoral/Profundal Arctic Charr Health Endpoint Statistical Comparisons between 2019 Sheardown Lake SE (DLO-02) and 2019 Reference Lake 3 (REF) Data, and for Sheardown Lake SE between 2019 and the Mine Baseline Period (2006 to 2013), Mary River Project 2019 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 2019 or DLO-02 Baseline	DLO-02 2019		Interaction Model: Interaction P-value	Parallel Slope Model: Covariate P-value	Covariate Value for Comparisons[a]	Statistic	REF 2019 or DLO-02 Baseline	DLO-02 2019		
Sheardown Lake SE versus Reference Lake 3, 2019	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	27	100	K-S	-	-	-	-	-	-	<0.001	-
	Body Size	Fork Length	Fork Length (cm)	-	27	100	M-W	-	-	-	Median	29.7	36.6	<0.001	23
		Body Weight	Body Weight (g)	-	27	100	M-W	-	-	-	Median	220	445	<0.001	102
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	27	100	ANCOVA	0.092	<0.001	35.0	Adjusted Mean	347	359	0.165	3.6
Sheardown Lake SE 2019 versus Baseline	Survival	Length Frequency Distribution	Fork Length (cm)	-	70	100	K-S	-	-	-	-	-	-	0.291	-
	Body Size	Fork Length	Fork Length (cm)	-	70	100	M-W	-	-	-	Median	37.4	36.6	0.096	-2
		Body Weight	Body Weight (g)	-	70	100	M-W	-	-	-	Median	500	445	0.001	-11
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	69[e]	100	ANCOVA	0.325	<0.001	36.0	Adjusted Mean	450	424	<0.001	-5.9

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 2019**

Specimen ID	Fork Length (cm)	Total Length (cm)	Total Weight (g)	Age (years)	Fulton's Condition Factor (K)
BLO-19-ACJ-01	5.4	5.7	1.277	-	0.811
BLO-19-ACJ-02	6.9	7.3	3.102	-	0.944
BLO-19-ACJ-03	5.4	5.7	1.210	-	0.768
BLO-19-ACJ-04	5.2	5.4	1.193	-	0.848
BLO-19-ACJ-05	7.6	8.2	3.965	-	0.903
BLO-19-ACJ-06	4.7	4.9	0.784	-	0.755
BLO-19-ACJ-07	7.1	7.5	2.874	-	0.803
BLO-19-ACJ-08	11.5	12.4	11.098	-	0.730
BLO-19-ACJ-09	8.0	8.5	4.345	-	0.849
BLO-19-ACJ-10	6.0	6.3	2.180	-	1.009
BLO-19-ACJ-11	9.4	10.0	8.402	-	1.012
BLO-19-ACJ-12	8.0	8.6	5.430	-	1.061
BLO-19-ACJ-13	10.6	11.5	9.539	-	0.801
BLO-19-ACJ-14	5.4	5.7	1.481	-	0.941
BLO-19-ACJ-15	5.3	5.5	1.241	-	0.834
BLO-19-ACJ-16	5.3	5.5	1.240	-	0.833
BLO-19-ACJ-17	4.9	5.1	1.069	-	0.909
BLO-19-ACJ-18	5.1	5.3	1.106	-	0.834
BLO-19-ACJ-19	6.4	6.8	2.327	-	0.888
BLO-19-ACJ-20	7.0	7.5	3.059	-	0.892
BLO-19-ACJ-21	7.3	7.8	3.601	-	0.926
BLO-19-ACJ-22	7.5	8.0	3.940	-	0.934
BLO-19-ACJ-23	6.8	7.2	2.653	-	0.844
BLO-19-ACJ-24	6.0	6.4	1.924	-	0.891
BLO-19-ACJ-25	7.6	8.1	3.995	-	0.910
BLO-19-ACJ-26	5.7	6.1	1.775	-	0.958
BLO-19-ACJ-27	5.0	5.3	1.002	-	0.802
BLO-19-ACJ-28	5.3	5.6	1.112	-	0.747
BLO-19-ACJ-29	6.9	7.3	2.703	-	0.823
BLO-19-ACJ-30	4.6	4.8	0.804	-	0.826
BLO-19-ACJ-31	6.1	6.4	1.931	-	0.851
BLO-19-ACJ-32	4.8	5.0	0.833	-	0.753
BLO-19-ACJ-33	10.0	10.8	10.483	-	1.048
BLO-19-ACJ-34	4.7	4.9	0.786	-	0.757
BLO-19-ACJ-35	7.6	8.0	3.879	-	0.884
BLO-19-ACJ-36	5.0	5.2	1.238	-	0.990
BLO-19-ACJ-37	8.5	9.1	5.436	-	0.885
BLO-19-ACJ-38	5.8	6.1	1.726	-	0.885
BLO-19-ACJ-39	8.3	8.9	4.950	-	0.866
BLO-19-ACJ-40	10.1	10.9	8.007	-	0.777
BLO-19-ACJ-41	6.2	6.6	1.953	-	0.819
BLO-19-ACJ-42	5.2	5.4	1.086	-	0.772
BLO-19-ACJ-43	8.6	9.2	5.233	-	0.823
BLO-19-ACJ-44	6.6	7.0	2.309	-	0.803
BLO-19-ACJ-45	8.5	9.1	5.631	-	0.917
BLO-19-ACJ-46	10.5	11.4	11.762	-	1.016
BLO-19-ACJ-47	7.7	8.2	3.758	-	0.823
BLO-19-ACJ-48	7.6	8.0	3.524	-	0.803
BLO-19-ACJ-49	5.5	5.8	1.463	-	0.879
BLO-19-ACJ-50	5.8	6.1	1.646	-	0.844
BLO-19-ACJ-51	6.3	6.7	2.114	-	0.845
BLO-19-ACJ-52	10.5	11.4	9.771	-	0.844
BLO-19-ACJ-53	5.0	5.3	1.062	-	0.850
BLO-19-ACJ-54	7.3	7.7	3.029	-	0.779
BLO-19-ACJ-55	7.9	8.4	4.125	-	0.837
BLO-19-ACJ-56	7.7	8.2	3.742	-	0.820
BLO-19-ACJ-57	6.3	6.7	2.225	-	0.890
BLO-19-ACJ-58	8.1	8.7	4.402	-	0.828

Table G.25: Arctic Charr Measurements from Fish Captured at Mary Lake by Electrofishing, Mary River Project CREMP, August 2019

Specimen ID		Fork Length (cm)	Total Length (cm)	Total Weight (g)	Age (years)	Fulton's Condition Factor (K)
BLO-19-ACJ-59		4.4	4.6	0.694	-	0.815
BLO-19-ACJ-60		7.7	8.2	3.719	1	0.815
BLO-19-ACJ-61		8.2	8.8	4.177	2	0.758
BLO-19-ACJ-62		8.2	8.8	4.756	2	0.863
BLO-19-ACJ-63		5.4	5.7	1.355	0	0.861
BLO-19-ACJ-64		10.9	11.9	11.818	4	0.913
BLO-19-ACJ-65		11.2	12.1	10.901	4	0.776
BLO-19-ACJ-66		8.3	8.9	4.337	2	0.758
BLO-19-ACJ-67		9.5	10.2	7.542	3	0.880
BLO-19-ACJ-68		5.9	6.3	1.840	1	0.896
BLO-19-ACJ-69		14.1	15.4	22.753	3	0.812
BLO-19-ACJ-70		5.3	5.6	1.290	-	0.866
BLO-19-ACJ-71		6.9	7.3	2.808	-	0.855
BLO-19-ACJ-72		6.5	6.8	2.543	-	0.926
BLO-19-ACJ-73		14.6	16.1	24.908	-	0.800
BLO-19-ACJ-74		4.8	5.0	0.914	-	0.826
BLO-19-ACJ-75		5.9	6.2	1.629	-	0.793
BLO-19-ACJ-76		6.8	7.2	2.760	-	0.878
BLO-19-ACJ-77		9.9	10.8	7.696	-	0.793
BLO-19-ACJ-78		5.3	5.5	1.138	-	0.764
BLO-19-ACJ-79		8.0	8.7	4.466	-	0.872
BLO-19-ACJ-80		7.0	7.5	2.909	-	0.848
BLO-19-ACJ-81		6.1	6.4	1.859	-	0.819
BLO-19-ACJ-82		7.3	7.8	3.204	-	0.824
BLO-19-ACJ-83		8.3	9.0	4.577	-	0.800
BLO-19-ACJ-84		9.6	10.4	7.479	-	0.845
BLO-19-ACJ-85		7.4	7.8	3.675	-	0.907
BLO-19-ACJ-86		5.0	5.2	1.031	-	0.825
BLO-19-ACJ-87		9.3	10.1	6.636	-	0.825
BLO-19-ACJ-88		10.9	11.9	11.341	-	0.876
BLO-19-ACJ-89		8.3	8.9	4.458	-	0.780
BLO-19-ACJ-90		4.4	4.5	0.679	-	0.797
BLO-19-ACJ-91		10.7	11.5	10.460	-	0.854
BLO-19-ACJ-92		7.5	8.0	3.758	-	0.891
BLO-19-ACJ-93		5.5	5.7	1.434	-	0.862
BLO-19-ACJ-94		7.7	8.3	3.672	-	0.804
BLO-19-ACJ-95		4.9	5.2	0.991	-	0.842
BLO-19-ACJ-96		9.6	10.4	7.132	-	0.806
BLO-19-ACJ-97		10.0	10.8	10.242	-	1.024
BLO-19-ACJ-98		5.0	5.3	1.153	-	0.922
BLO-19-ACJ-99		6.4	6.8	2.294	-	0.875
BLO-19-ACJ-100		7.9	8.5	4.223	-	0.857
Overall Catch Summary	Sample Size (N)	100	100	100	10	100
	Average	7.3	7.8	4.158	2.2	0.854
	Median	7.0	7.5	2.969	2.0	0.845
	Standard Deviation	2.1	2.3	4.098	1.3	0.068
	Standard Error	0.2	0.2	0.410	0.4	0.007
	Minimum	4.4	4.5	0.679	0.0	0.730
	Maximum	14.6	16.1	24.908	4.0	1.061
Young-of-the-Year Catch Summary	proportion of YOY			**5%**		
	Sample Size (N)	5	5	5	0	5
	Average	4.6	4.7	0.749	0	0.790
	Median	4.6	4.8	0.784	0	0.797
	Standard Deviation	0.2	0.2	0.058	0	0.033
	Standard Error	0.1	0.1	0.026	0	0.015
	Minimum	4.4	4.5	0.679	0	0.755
	Maximum	4.7	4.9	0.804	0	0.826

Table G.26: Results of Nearshore Arctic Charr Non-Young-of-the-Year (YOY) Health Endpoint Statistical Comparisons between Mary Lake (BLO) and Reference Lake 3 (REF), Mary River Project CREMP, August 2019

Group	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
			Response	Covariate	REF	BLO		Interaction Model: Interaction P-value	Parallel Slope Model: Covariate P-value	Covariate Value for Comparisons[a]	Statistic	REF	BLO		
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	100	K-S	-	-	-	-	-	-	<0.001	-
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	97	95	K-S	-	-	-	-	-	-	<0.001	-
	Body Size	Fork Length	Fork Length (cm)	-	97	95	tunequal	-	-	-	Geometric Mean	9.9	7.2	<0.001	-27
		Body Weight	Body Weight (g)	-	97	95	tunequal	-	-	-	Geometric Mean	7.96	3.13	<0.001	-61
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	97	95	ANCOVA	0.0202	<0.001	6.38	Adjusted Mean	4.92	5.11	0.002	4

(grey) Area P-value < 0.1 or Interaction P-value < 0.05

(blue) 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 2019 Data Relative to Reference Lake 3 Data (2019) or Mary Lake Baseline Data (2006 to 2013) with α=β=0.1, Mary River Project 2019 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, 2019 Data	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	tunequal	0.121	-	log10(Response)	564	149	41	28	21	17	13	9	4
			Body Weight	Body Weight (g)	-	tunequal	0.370	-	Response	5,222	1,369	375	251	182	151	111	77	27
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.032	-	log10(Response)	42	13	5	4	4	4	4	3	3
Littoral/Profundal Arctic Charr (Gill Netting) versus Ref. Lake 3, 2019 Data	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.0941	22.4	log10(Response)	393	102	27	18	13	11	9	6	4
			Body Weight	Body Weight (g)	-	M-W	0.283	72.2	Response	3,548	931	256	167	117	95	66	43	12
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.0478	-	log10(Response)	89	25	9	7	5	5	4	4	3
Littoral/Profundal Arctic Charr (Gill Netting) 2019 versus Baseline	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	0.100	4.93	log10(Response)	338	86	22	16	11	10	7	5	3
			Body Weight	Body Weight (g)	-	M-W	0.287	1.41	Response	3,215	805	203	130	91	75	53	34	10
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.058	-	log10(Response)	131	36	11	8	7	6	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 2019

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-19-GN-01	555120	7905422	91.44	18-Aug-19	18-Aug-19	11:20	13:35	2.25	2.06	1	1	1	3	1.46
BLO-19-GN-02	555084	7905570	91.44	18-Aug-19	18-Aug-19	11:30	13:45	2.25	2.06	1	1	0	2	0.97
BLO-19-GN-03	554871	7905897	91.44	18-Aug-19	18-Aug-19	12:02	14:10	2.13	1.95	0	2	1	3	1.54
BLO-19-GN-04	554636	7906211	91.44	18-Aug-19	18-Aug-19	12:08	14:25	2.28	2.09	5	7	4	16	7.66
BLO-19-GN-05	555083	7905748	91.44	18-Aug-19	18-Aug-19	12:10	15:05	2.92	2.67	5	2	0	7	2.62
BLO-19-GN-06	555092	7905911	91.44	18-Aug-19	18-Aug-19	12:15	15:15	3.00	2.74	1	2	5	8	2.92
BLO-19-GN-07	555147	7905336	91.44	18-Aug-19	18-Aug-19	13:55	16:10	2.25	2.06	1	2	0	3	1.46
BLO-19-GN-08	555218	7905086	91.44	18-Aug-19	18-Aug-19	14:00	16:20	2.33	2.13	0	1	0	1	0.47
BLO-19-GN-09	554636	7906211	91.44	18-Aug-19	18-Aug-19	14:50	16:40	1.83	1.68	3	4	2	9	5.37
BLO-19-GN-10	554563	7906360	91.44	18-Aug-19	18-Aug-19	15:00	17:00	2.00	1.83	3	5	5	13	7.11
BLO-19-GN-11	555092	7905911	91.44	18-Aug-19	18-Aug-19	15:25	17:15	1.83	1.68	0	0	0	0	0.00
BLO-19-GN-12	554928	7905897	91.44	18-Aug-19	18-Aug-19	15:30	17:30	2.00	1.83	1	2	1	4	2.19
Total									**24.76**	**21**	**29**	**19**	**69**	**2.81**

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 2019

Specimen ID	Net ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Abnormalities	Fulton's Condition Factor
BLO-19-AC-01	BLO-19-GN-01	1½	16.5	19.0	45	-	1.002
BLO-19-AC-02	BLO-19-GN-01	2	24.0	27.0	130	-	0.940
BLO-19-AC-03	BLO-19-GN-01	3	36.0	39.4	470	-	1.007
BLO-19-AC-04	BLO-19-GN-02	1½	26.6	28.9	160	-	0.850
BLO-19-AC-05	BLO-19-GN-02	2	29.4	31.8	240	-	0.944
BLO-19-AC-06	BLO-19-GN-03	3	35.9	39.5	455	-	0.983
BLO-19-AC-07	BLO-19-GN-03	2	27.0	29.3	180	-	0.914
BLO-19-AC-08	BLO-19-GN-03	2	31.1	33.5	305	-	1.014
BLO-19-AC-09	BLO-19-GN-04	3	38.7	42.3	547	-	0.944
BLO-19-AC-10	BLO-19-GN-04	3	34.6	37.5	445	-	1.074
BLO-19-AC-11	BLO-19-GN-04	3	37.5	40.5	455	-	0.863
BLO-19-AC-12	BLO-19-GN-04	3	36.3	39.3	415	-	0.868
BLO-19-AC-13	BLO-19-GN-04	2	35.7	39.1	370	-	0.813
BLO-19-AC-14	BLO-19-GN-04	2	38.1	41.4	510	-	0.922
BLO-19-AC-15	BLO-19-GN-04	2	33.5	36.4	350	-	0.931
BLO-19-AC-16	BLO-19-GN-04	2	35.0	38.3	395	-	0.921
BLO-19-AC-17	BLO-19-GN-04	2	38.0	41.2	450	-	0.820
BLO-19-AC-18	BLO-19-GN-04	2	37.7	40.9	470	-	0.877
BLO-19-AC-19	BLO-19-GN-04	2	33.7	36.0	330	-	0.862
BLO-19-AC-20	BLO-19-GN-04	1½	38.4	41.2	500	-	0.883
BLO-19-AC-21	BLO-19-GN-04	1½	40.3	43.4	530	-	0.810
BLO-19-AC-22	BLO-19-GN-04	1½	32.0	34.7	320	-	0.977
BLO-19-AC-23	BLO-19-GN-04	1½	31.4	34.0	260	-	0.840
BLO-19-AC-24	BLO-19-GN-04	1½	34.8	37.7	370	-	0.878
BLO-19-AC-25	BLO-19-GN-05	1½	31.1	34.0	320	-	1.064
BLO-19-AC-26	BLO-19-GN-05	1½	40.3	43.7	510	-	0.779
BLO-19-AC-27	BLO-19-GN-05	1½	36.3	39.0	360	-	0.753
BLO-19-AC-28	BLO-19-GN-05	1½	22.0	23.7	95	-	0.892
BLO-19-AC-29	BLO-19-GN-05	1½	27.9	30.3	180	-	0.829
BLO-19-AC-30	BLO-19-GN-05	2	28.8	31.3	170	-	0.712
BLO-19-AC-31	BLO-19-GN-05	2	35.0	38.7	390	-	0.910
BLO-19-AC-32	BLO-19-GN-06	3	39.3	42.6	550	-	0.906
BLO-19-AC-33	BLO-19-GN-06	3	37.0	40.2	530	-	1.046
BLO-19-AC-34	BLO-19-GN-06	3	39.7	42.7	510	-	0.815
BLO-19-AC-35	BLO-19-GN-06	3	43.3	46.1	655	-	0.807
BLO-19-AC-36	BLO-19-GN-06	3	40.0	43.7	510	-	0.797
BLO-19-AC-37	BLO-19-GN-06	2	37.7	40.4	480	-	0.896
BLO-19-AC-38	BLO-19-GN-06	2	39.0	41.8	480	-	0.809
BLO-19-AC-39	BLO-19-GN-06	1½	39.5	42.7	530	-	0.860
BLO-19-AC-40	BLO-19-GN-07	1½	19.1	20.4	72	-	1.033
BLO-19-AC-41	BLO-19-GN-07	2	40.1	44.1	470	-	0.729
BLO-19-AC-42	BLO-19-GN-07	2	33.1	36.0	315	-	0.869
BLO-19-AC-43	BLO-19-GN-08	2	32.3	35.3	310	-	0.920
BLO-19-AC-44	BLO-19-GN-09	3	40.3	43.7	600	-	0.917
BLO-19-AC-45	BLO-19-GN-09	3	40.4	43.3	630	-	0.955
BLO-19-AC-46	BLO-19-GN-09	2	36.7	39.6	440	-	0.890

Table G.29: Arctic Charr Measurements from Fish Captured at Mary Lake by Gill Netting, Mary River Project CREMP, August 2019

Specimen ID	Net ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Abnormalities	Fulton's Condition Factor
BLO-19-AC-47	BLO-19-GN-09	2	37.2	40.4	430	-	0.835
BLO-19-AC-48	BLO-19-GN-09	2	38.0	42.0	430	-	0.784
BLO-19-AC-49	BLO-19-GN-09	2	40.2	43.6	485	-	0.747
BLO-19-AC-50	BLO-19-GN-09	1½	37.0	40.7	410	-	0.809
BLO-19-AC-51	BLO-19-GN-09	1½	32.7	35.6	260	-	0.744
BLO-19-AC-52	BLO-19-GN-09	1½	36.8	39.7	450	-	0.903
BLO-19-AC-53	BLO-19-GN-10	3	39.0	42.2	490	-	0.826
BLO-19-AC-54	BLO-19-GN-10	3	44.0	47.3	630	-	0.740
BLO-19-AC-55	BLO-19-GN-10	3	37.2	40.3	540	-	1.049
BLO-19-AC-56	BLO-19-GN-10	3	43.3	47.0	590	-	0.727
BLO-19-AC-57	BLO-19-GN-10	3	41.0	44.4	570	-	0.827
BLO-19-AC-58	BLO-19-GN-10	2	38.0	41.4	470	-	0.857
BLO-19-AC-59	BLO-19-GN-10	2	32.3	35.2	275	-	0.816
BLO-19-AC-60	BLO-19-GN-10	2	38.6	41.8	470	-	0.817
BLO-19-AC-61	BLO-19-GN-10	2	40.4	43.7	570	-	0.864
BLO-19-AC-62	BLO-19-GN-10	2	30.5	33.2	205	-	0.723
BLO-19-AC-63	BLO-19-GN-10	1½	36.5	40.0	420	-	0.864
BLO-19-AC-64	BLO-19-GN-10	1½	37.0	40.5	420	-	0.829
BLO-19-AC-65	BLO-19-GN-10	1½	29.0	31.7	235	-	0.964
BLO-19-AC-66	BLO-19-GN-12	3	39.7	42.7	430	-	0.687
BLO-19-AC-67	BLO-19-GN-12	2	32.3	34.8	285	-	0.846
BLO-19-AC-68	BLO-19-GN-12	2	33.5	36.2	290	-	0.771
BLO-19-AC-69	BLO-19-GN-12	1½	38.0	41.5	450	-	0.820
Overall Catch Summary	Sample Size (N)		69	69	69	-	69
	Average		35.3	38.3	400	-	0.869
	Median		36.8	40.0	430	-	0.863
	Standard Deviation		5.4	5.8	142	-	0.091
	Standard Error		0.7	0.7	17	-	0.011
	Minimum		16.5	19.0	45	-	0.687
	Maximum		44.0	47.3	655	-	1.074

Table G.30: Results of Littoral/Profundal Arctic Charr Health Endpoint Statistical Comparisons between 2019 Mary Lake (BLO) and 2019 Reference Lake 3 (REF) Data, and for Mary Lake between 2019 and the Mine Baseline Period (2006 to 2013), Mary River Project 2019 CREMP

Comparison	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 2019 or BLO Baseline	BLO 2019		Interaction P-value	Covariate P-value		Statistic	REF 2019 or BLO Baseline	BLO 2019		
Mary Lake versus Reference Lake 3, 2019	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	27	69	K-S	-	-	-	-	-	-	<0.001	-
	Body Size	Fork Length	Fork Length (cm)	-	27	69	M-W	-	-	-	Median	29.7	36.8	<0.001	24
		Body Weight	Body Weight (g)	-	27	69	M-W	-	-	-	Median	220	430	<0.001	96
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	27	69	ANCOVA	<0.001[e]	<0.001	32.8	Adjusted Mean	299	307	0.374	2.5
Mary Lake 2019 versus Baseline	Survival	Length Frequency Distribution	Fork Length (cm)	-	183	69	K-S	-	-	-	-	-	-	0.001	-
	Body Size	Fork Length	Fork Length (cm)	-	183	69	M-W	-	-	-	Median	38.4	36.8	0.011	-4.2
		Body Weight	Body Weight (g)	-	183	69	M-W	-	-	-	Median	500	430	0.001	-14.0
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	183	69	ANCOVA	0.857	<0.001	35.5	Adjusted Mean	407	387	0.006	-5.1

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.

[e] ANCOVA proceeded under the assumption that the slopes are practically parallel (R2 of interaction model = 0.9792 and R2 of parallel slope model = 0.9764; a difference < 0.02) following Environment Canada (2012).