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Mary River Project 2016 Core Receiving Environment Monitoring Program Report

Report Prepared For:
Baffinland Iron Mines Corporation
Mary River Project
Oakville, ON

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Monitoring Program Report

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EXECUTIVE SUMMARY

The Mary River Project is a high-grade iron ore mining operation located in the Qikiqtani Region of northern Baffin Island, Nunavut. Construction of mine infrastructure for the initial mining stages at the Mary River Project, which is owned and operated by Baffinland Iron Mines Corporation (Baffinland), occurred from mid-2013 through 2014. Surface mining commenced in mid-September 2014, and has since included pit bench development, ore haulage and stockpiling, and the crushing and screening of high-grade iron ore at the mine site. Crushed/screened ore is transported by truck to Milne Port, located approximately 100 km north of the mine site, where it is stockpiled before being loaded onto bulk carrier ships for transport to European markets during the summer ice-free period. Because no tailings are produced during the processing of the ore, the only mine waste management facility at the Mary River Project is a waste rock pad and disposal area, which has been established to the east of the current pit bench/mining operation. In addition to periodic discharge of treated effluent from the mine waste rock disposal area 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 from quarry operations to the Camp Lake catchment, deposition of fugitive dust generated by mine activities, and general mine site runoff.

Under terms and conditions of a Type A water licence issued by the Nunavut Water Board, Baffinland was required to develop and implement an Aquatic Effects Monitoring Program (AEMP) at the Mary River Project. In order to meet the AEMP objectives for the Mary River Project, Baffinland developed a Core Receiving Environment Monitoring Program (CREMP) to provide a basis for the evaluation of potential mine-related influences on water quality, sediment quality and/or biota (including phytoplankton, benthic invertebrates and/or fish) within aquatic environments near the mine (Baffinland 2014; KP 2014a; NSC 2014). This report presents the results of the 2016 CREMP, including the evaluation of potential mine-related influences on chemical and biological conditions at mine-exposed water bodies following the first full year of mine operation.

The 2016 Mary River Project CREMP included water quality monitoring, sediment quality monitoring, phytoplankton (chlorophyll a) monitoring, benthic invertebrate community assessment and an Arctic charr (*Salvelinus alpinus*) fish population survey. The 2016 CREMP used an effects-based approach that incorporated standard environmental effects monitoring techniques as the basis for the evaluation of potential mine-related effects within the mine aquatic receivers. Additional evaluation of sedimentation-related effects was conducted as part of the 2016 CREMP in consideration of an Environment and Climate Change Canada *Fisheries Act* Direction (FAD) and an Indigenous and Northern Affairs Canada Letter of Non-Compliance (LNC) related to unauthorized sediment releases in 2016. 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 evaluation of potential mine-related effects within these systems was based on comparisons of data collected in 2016 to applicable reference data and to available baseline data. The principal conclusions of the 2016 CREMP for each of these aquatic systems are discussed separately below.

Camp Lake System

Within the Camp Lake system, mine-related effects on water quality were apparent mainly within the main stem channel of Camp Lake Tributary 1 (CLT1) and at Camp Lake. Conductivity and concentrations of mine parameters including chloride, nitrate, sulphate and certain metals (e.g., iron, manganese, molybdenum, sodium, strontium and uranium) were the primary constituents reflecting a mine-related influence within CLT1 and Camp Lake in 2016 based on elevation relative to reference conditions and/or to the baseline (2005 – 2013) period. Of these parameters, only iron and uranium concentrations were above applicable water quality guideline (WQG) and/or AEMP benchmarks, but only at the upper-most monitoring station on the CLT1 main stem. Active quarrying at the QMR2 pit in 2016 likely served as the key source for these parameters at CLT1. Water chemistry at Camp Lake Tributary 2 (CLT2) was similar to applicable reference stations and to baseline water quality, with all parameters consistently observed at concentrations below applicable WQG and AEMP benchmarks. Overall, mine-related effects to water quality of the Camp Lake system were evident at the upper main stem of CLT1 and Camp Lake, with minimal effects suggested at CLT2, following the second year of mine operation. Sediment arsenic and manganese concentrations were slightly elevated at Camp Lake littoral stations compared to mean reference lake concentrations in 2016, and together with molybdenum, were also elevated compared to concentrations during the baseline period, suggesting a mine-related influence on sediment quality of Camp Lake. No metals were elevated in sediment of the profundal stations compared to the reference lake in 2016. Phosphorus was the only parameter observed at concentrations above sediment quality guidelines (SQG) in littoral and profundal sediment of Camp Lake that was not also above applicable SQG at the reference lake in 2016.

Chlorophyll a concentrations were elevated at the upper main stem of CLT1 and within Camp Lake compared to respective reference areas and to baseline data, suggesting slight enrichment possibly related to higher aqueous nitrate and/or micro-nutrient concentrations from Mary River Project mine activities. However, chlorophyll a concentrations at CLT1 north branch and lower main stem areas, and at CLT2 in 2016, were comparable to applicable reference and baseline concentrations. In addition, chlorophyll a concentrations were consistently well below the AEMP benchmark at all Camp Lake system receivers in 2016 indicating no adverse mine influence to phytoplankton. No adverse mine-related influences on the benthic invertebrate community of the Camp Lake system, including CLT1, CLT2 and Camp Lake, were indicated in 2016 based on comparisons to respective reference areas and to baseline data. Consistent with the chlorophyll a data, benthic invertebrate community data collected at the upper main stem of CLT1 suggested a slight enrichment-related influence based on higher invertebrate density, richness and proportion of Functional Feeding Group (FFG) filterers compared to an unnamed reference creek. The fish population survey suggested greater fish abundance compared to the reference lake in 2016, but similar numbers of Arctic charr in 2016 relative to the Camp Lake baseline studies. No significant, ecologically meaningful, differences in Arctic charr condition were indicated between Camp Lake and the reference lake in 2016, nor between Camp Lake Arctic charr collected in 2016 and the baseline period, for nearshore and littoral/profundal Arctic charr populations. Overall, consistent with the water chemistry and sediment chemistry generally meeting respective environmental quality guidelines and AEMP benchmarks, the phytoplankton, benthic invertebrate community and fish population survey data collectively suggested no adverse mine-related influences to the biota of the Camp Lake system in the second year of mine operation at the Mary River Project.

Sheardown Lake System

At Sheardown Lake Tributary 1 (SDLT1), aqueous concentrations of several parameters were elevated compared to average concentrations observed at the reference creek stations in 2016. However, similar to the 2015 CREMP, only nitrate and sulphate concentrations were elevated at SDLT1 in 2016 compared to the baseline period and, with the exception of copper, no parameters were present at concentrations above WQG or AEMP benchmarks in 2016. Within Sheardown Lake, aqueous total concentrations of aluminum, manganese, molybdenum and/or uranium were elevated compared to the reference lake in both 2015 and 2016, but none of these metals, or any other parameters, were elevated compared to concentrations observed during the baseline period, and none were above WQG or AEMP benchmarks. Similar to findings of the 2015 CREMP, elevated total aluminum and manganese concentrations were correlated with greater turbidity in 2016 suggesting that these metals were largely bound to/composed the suspended particulate matter and were not likely biologically available.

Sediment metal concentrations at Sheardown Lake littoral stations in 2016 were similar to those at the reference lake and compared to baseline data with the exception of slightly elevated arsenic, manganese and/or molybdenum concentrations, suggesting some mine-related influences on Sheardown Lake sediment quality. However, sediment metal concentrations at Sheardown Lake profundal stations in 2016 were similar to the reference lake and baseline data, indicating that mine-related influences on sediment quality were confined to littoral habitats. Notably, no metals were present in sediment of Sheardown Lake at concentrations above SQG or AEMP benchmarks that were not also above these criteria at the reference lake, suggesting the natural occurrence of elevated concentrations of some metals (e.g., iron, manganese) in sediment of lakes in the Mary River Project region.

Chlorophyll a concentrations at SDLT1 and Sheardown Lake were greater than concentrations observed at respective reference areas, but were similar to chlorophyll a concentrations reported during mine baseline and construction periods, respectively. In all cases, chlorophyll a concentrations were well below the AEMP benchmark at all Sheardown Lake system monitoring stations, suggesting no adverse mine-related effects to phytoplankton within the system. Consistent with higher chlorophyll a concentrations, greater relative abundance of FFG filterers and organism density at SDLT1 in 2016 compared to an unnamed reference creek and the baseline period, respectively, suggested a slight enrichment influence. However, a greater relative abundance of Habitat Preference Group (HPG) burrowers at SDLT1 and Sheardown Lake Tributary 12 (SDLT12) compared to an unnamed reference creek and to baseline data (SDLT12 only) was potentially indicative of sedimentation influences at these tributaries in 2016. No adverse mine-related influences to benthic invertebrate communities at Sheardown Lake Tributary 9 (SDLT9) and the Sheardown Lake littoral benthic invertebrate community were apparent in 2016 based on comparisons to respective reference areas and/or to baseline data. Greater Arctic charr abundance was suggested at the Sheardown Lake NW and SE basins compared to the reference lake in 2016, but similar abundance was suggested between the 2016 and baseline studies for both lake basins. The Arctic charr population exhibited different direction of significant responses in growth and condition between Sheardown Lake and the reference lake in 2016, and between Arctic charr collected at nearshore and littoral/profundal habitats for Sheardown Lake in 2016 compared to baseline studies. The differential responses in Arctic charr population endpoints suggested that the various differences between the mine-exposed and reference areas, or between studies at Sheardown Lake, reflected natural variability in the resident fish population. Overall, the chlorophyll a, benthic invertebrate community and Arctic charr fish population data all suggested no adverse mine-related influences to the biota of Sheardown Lake in the second year of mine operation at the Mary River Project.

Mary River and Mary Lake System

At Mary River, no adverse mine-related influences on water chemistry were apparent at the mine-exposed areas in 2016 based on comparisons to the Mary River upstream reference area and to baseline water chemistry taking influences of naturally high turbidity into account. At Mary Lake, aqueous total aluminum, manganese and uranium concentrations were elevated compared to the reference lake in 2016, but concentrations of these metals and all other parameters were comparable to concentrations during the baseline period, and none were above WQG or AEMP benchmarks. Similar to Sheardown Lake and Mary River, aluminum and manganese concentrations were correlated with turbidity at Mary Lake, which suggested that these metals were largely bound to/composed 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 2016 and, with the exception of slightly elevated sediment manganese concentrations at littoral stations, were similar to concentrations observed during the baseline period. Although sediment chromium, iron and manganese concentrations were above SQG at Mary Lake in 2016, with the exception of chromium, these metals were also above respective criteria at the reference lake indicating natural elevation and suggesting low potential for any adverse effects to biota associated with these metals. No metals were observed at concentrations above the sediment AEMP benchmarks at littoral and profundal stations of Mary Lake in 2016.

Chlorophyll a concentrations at Mary River and Mary Lake were, on average, similar to or slightly higher than concentrations at respective reference areas in 2016. Although relatively low chlorophyll a concentrations were observed at individual Mary River stations in 2015 and 2016 compared to the baseline period, these differences likely reflected naturally high turbidity in both 2015 and 2016, which would be expected to affect phytoplankton productivity by limiting the amount of light available for photosynthesis. In all cases, chlorophyll a concentrations were well below the AEMP benchmark, indicating no adverse mine-related influences to phytoplankton of the Mary River/Mary Lake system. The benthic invertebrate community of the Mary River exhibited few differences between mine-exposed and reference areas in 2016, and compared to respective areas during the baseline period, with the direction of the few differences in community composition between areas/studies opposite those normally reflective of an adverse mine-related effect. Benthic invertebrate community data collected at littoral habitat of Mary Lake in 2016 indicated significantly lower richness and differences in community composition compared to the reference lake that appeared to reflect natural differences in sediment physical properties between lakes. In part, this was supported by no significant differences in benthic metrics between 2016 and the baseline data for Mary Lake littoral stations. The fish population survey suggested greater fish abundance at Mary Lake compared to the reference lake in 2016. No significant or ecologically meaningful differences in growth and condition of nearshore captured Arctic charr occurred between Mary Lake and the reference lake in 2016, nor between Arctic charr collected in 2016 and the baseline period for nearshore and littoral/profundal Arctic charr populations at Mary Lake. Overall, the chlorophyll a, benthic invertebrate community and Arctic charr fish population data all suggested no adverse mine-related influences to the biota of Mary Lake in the second year of mine operation at the Mary River Project.

TABLE OF CONTENTS

LIST OF FIGURES

After Page …

LIST OF TABLES

After Page …

1.0 INTRODUCTION

1.1 Background

The Mary River Project, owned and operated by Baffinland Iron Mines Corporation (Baffinland), is a high-grade iron ore mining operation located in the Qikiqtani Region of northern Baffin Island, Nunavut (Figure 1.1). Construction of mine infrastructure for the initial mining stages at the Mary River Project, referred to as the Early Revenue Phase (ERP), commenced in mid-2013 and is currently on-going. Surface (contour strip) mining for the ERP commenced in mid-September 2014, and has since included pit bench development, ore haulage and stockpiling, and the crushing and screening of high-grade iron ore at the mine site. No milling or additional processing of the ore is conducted on-site. Baffinland has received approval to transport 3.5 million tonnes (Mt) of crushed/screened ore annually by truck to Milne Port, which is located approximately 100 km north of the mine site, for the ERP. At Milne Port, the ore is stockpiled before being loaded onto bulk carrier ships for transport to European markets during the summer ice-free period. No tailings are produced during ore processing, and therefore the only mine waste management facility at the Mary River Project is a waste rock pad and disposal area, which has been established to the east of the current pit bench/mining operation. In addition to periodic discharge of treated effluent from the mine waste rock disposal area 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 mine camp sewage effluent discharge to Mary River, runoff and explosives residue from quarry operations to the Camp Lake catchment, deposition of fugitive dust generated by mine activities, and general mine site runoff.

Under terms and conditions of a Type A water licence issued by the Nunavut Water Board (No. 2AM-MRY1325 Amendment No. 1), Baffinland developed an Aquatic Effects Monitoring Program (AEMP) for the Mary River Project. A key objective of the AEMP was to provide data and information to allow the evaluation of short- and long-term effects of the project on aquatic ecosystems. To meet this objective, Baffinland developed a Core Receiving Environment Monitoring Program (CREMP) to assess potential mine-related influences on water quality, sediment quality and biota (including phytoplankton, benthic invertebrates and fish) at aquatic environments located near the mine (Baffinland 2014; KP 2014a; NSC 2014). In 2015, the CREMP approach transitioned from a characterization-based design to an effects-based approach that incorporated standard environmental effects monitoring techniques to allow the evaluation of mine-related effects within the mine aquatic receivers. Briefly, the 2015 study suggested some effects of the Baffinland mine operations on water quality and sediment

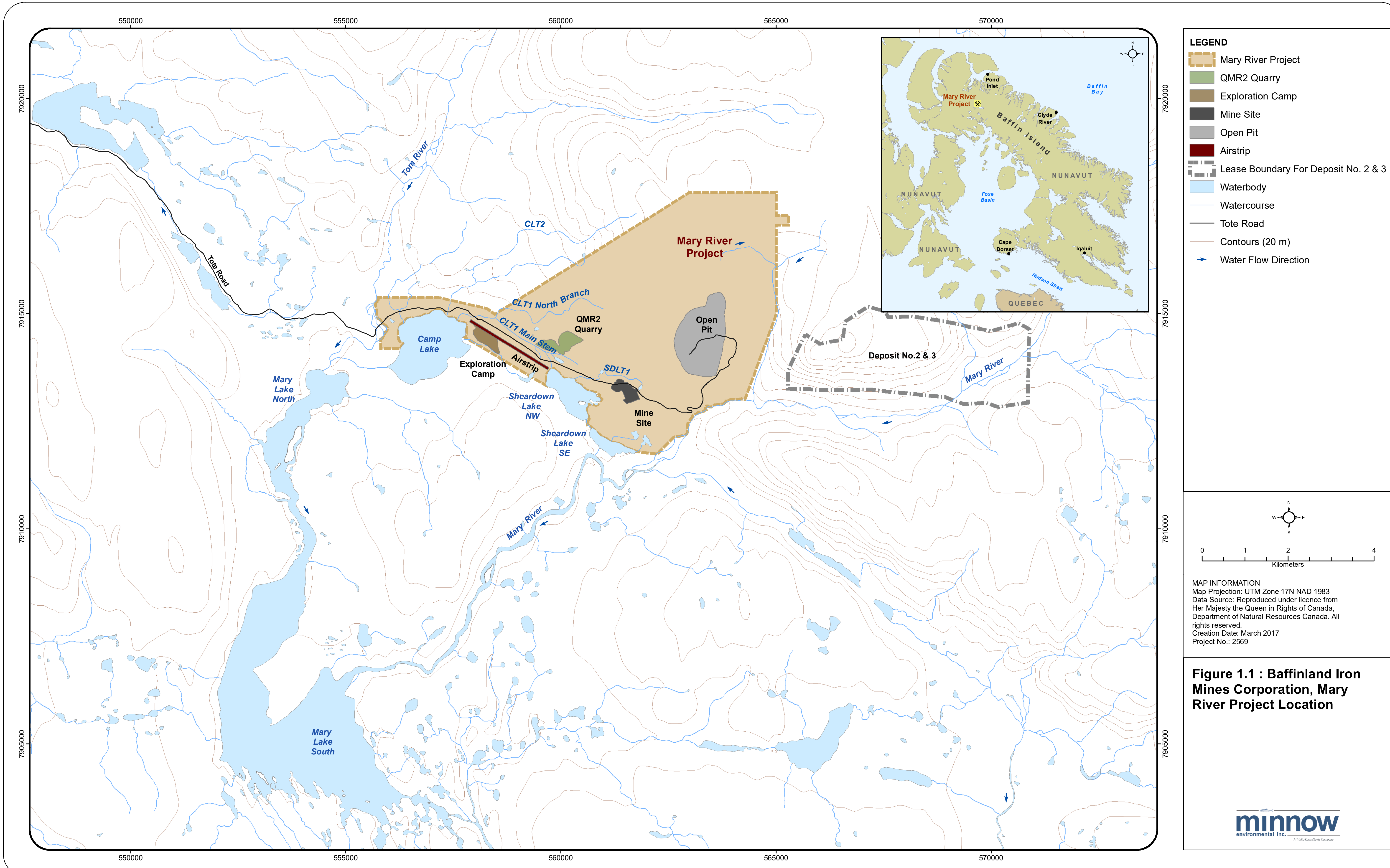


Figure 1.1 : Baffinland Iron Mines Corporation, Mary River Project Location

quality, but these effects were confined to single tributaries feeding into each of Camp and Sheardown lakes, as well as near the immediate outlets of these tributaries to each respective lake (Minnow 2016a). No adverse mine-related effects to phytoplankton, benthic invertebrate, or fish were suggested at any of the Camp, Sheardown or Mary lake systems in 2015 based on comparisons to representative reference waterbodies and to available pre-mine baseline data for each lake system (Minnow 2016a).

The CREMP was designed as an iterative series of monitoring and interpretative phases, with the results of previous studies used to inform the direction of future monitoring. Following the initial 2015 study, some minor adjustments were made to the 2016 CREMP to improve the ability of the program to meet overall objectives and provide greater efficiencies (Baffinland 2016a; Minnow 2016b). The key changes to the CREMP in 2016 included the addition of reference and mine-exposed creek benthic invertebrate community study areas and modification of the lake sediment/benthic invertebrate community survey to improve the ability of the program to assess mine-related influences. The 2016 CREMP also applied additional effort in examination of potential sedimentation-related effects during data evaluation in consideration of an Environment and Climate Change Canada (ECCC) *Fisheries Act* Direction (FAD) and an Indigenous and Northern Affairs Canada (INAC) Letter of Non-Compliance (LNC) issued to Baffinland in June 2016. The FAD and LNC were issued in response to unauthorized sediment releases, and specifically, aqueous Total Suspended Solids (TSS) concentrations above applicable discharge criteria, at several creeks on/adjacent to the mine property, mine tote road and/or mine haul road during May 2016 freshet (Baffinland 2016b).

The 2016 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. This report presents the results of the 2016 CREMP, including the evaluation of potential Mary Lake Project-related influences on chemical and biological conditions at mine-exposed waterbodies following the initial two years of mine operation.

1.2 Report Organization

The content of this report reflects the requirements outlined within the CREMP study design (Baffinland 2014; KP 2014a; NSC 2014) and adjustments to the original program in consideration of the results from the 2015 CREMP (Baffinland 2016a; Minnow 2016b). A description of the aquatic environments that serve as the focus for the CREMP, as well as detailed methods used for evaluation of water quality, sediment quality and biological components (i.e., phytoplankton, benthic invertebrate communities and fish populations) for the 2016 study are provided in Section 2.0. Because of the relatively large geographic scope and multi-component sampling approach used for the Mary River Project CREMP, study results are presented in separate sections according to lake catchment (or sub-catchment, as applicable). Accordingly, water quality, sediment quality and biological effects assessment data and analysis for the Camp Lake system, the Sheardown Lake system (including separate evaluation for the northwest and southeast segments of the lake), and the Mary River/Mary Lake waterbodies are presented in Sections 3.0, 4.0 and 5.0, respectively. The conclusions of the 2016 CREMP are presented in Section 6.0. All references cited within this document are listed in Section 7.0.

Supporting information for the 2016 CREMP is provided in seven appendices. An assessment of the quality of data used for the 2016 study is provided as a Data Quality Review in Appendix A. Natural physico-chemical and biological characteristics important to the assessment of potential mine-related effects at the aquatic mine receiving environments were identified at the study reference areas, and therefore reference conditions are described more fully in Appendix B to provide context and perspective for the CREMP. In addition to all raw water quality data, the results of supplementary baseline lake water quality power analysis conducted to evaluate suitable sample sizes for lake water quality monitoring is presented in Appendix C. Supporting sediment quality information is provided in Appendix D. Finally, supporting biological data from the phytoplankton, benthic invertebrate community and fish population surveys are provided in Appendices E, F and G, respectively.

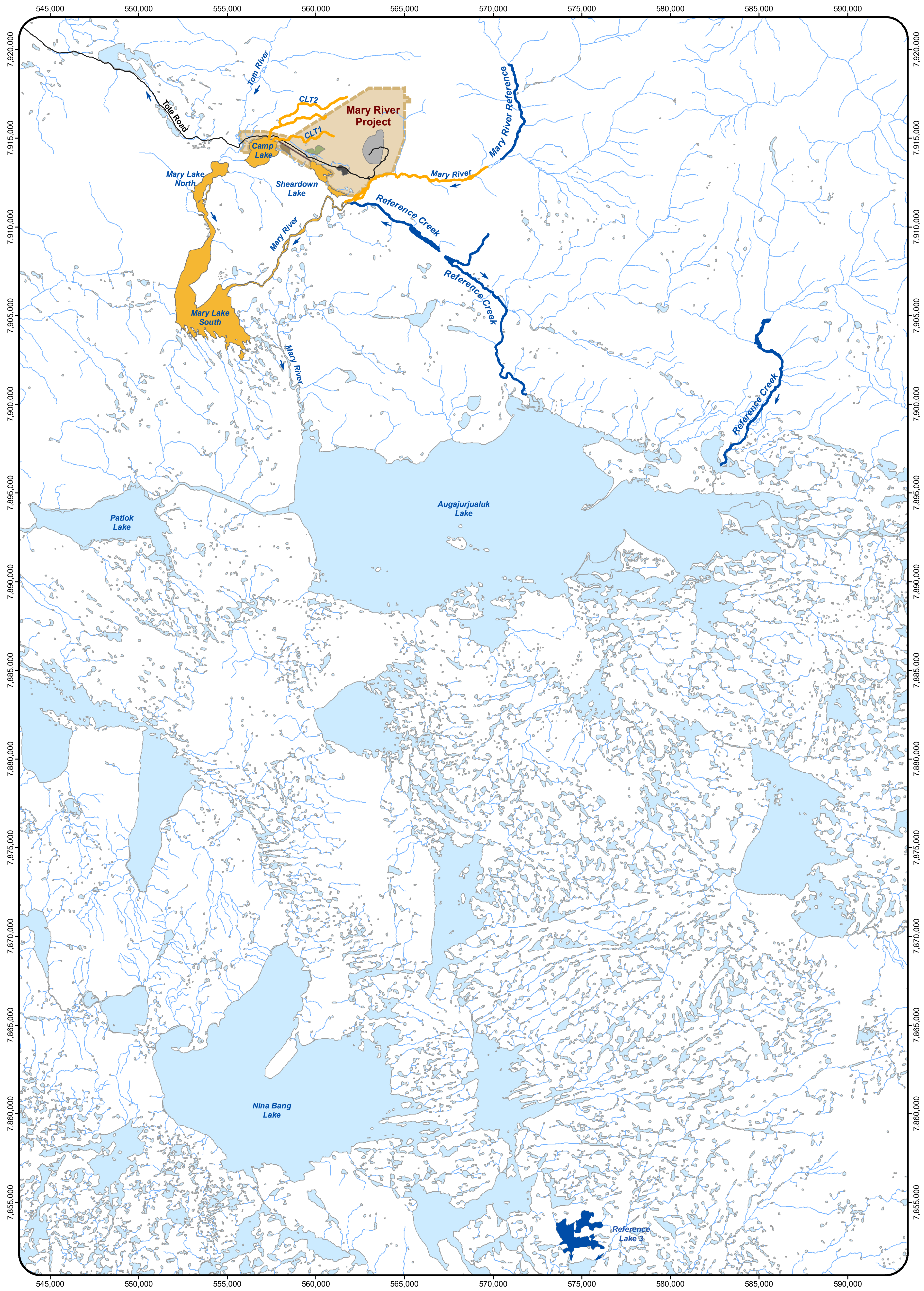
2.0 METHODS

The Mary River Project CREMP includes water quality monitoring, sediment quality monitoring, phytoplankton (chlorophyll a) monitoring, benthic invertebrate community assessment and a fish population assessment. In 2016, water quality and phytoplankton monitoring was conducted by Baffinland personnel over four separate sampling events, including an ice-cover event (April 23rd – May 7th) and open-water season events corresponding to Arctic spring (freshet), summer and autumn (June 25th – 27th, July 18th – 29th, and August 19th – 24th, respectively). Sediment quality, benthic invertebrate community and fish population sampling was conducted by Minnow Environmental Inc. (Minnow) personnel with assistance from Baffinland environment department staff from August 11th – 19th 2016, the seasonal timing of which was consistent with monitoring for previous baseline (2005 – 2013), mine construction (2014), and mine operational (2015) periods at the Mary River Project mine site. Similar to the 2015 CREMP, the 2016 program 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 2016 CREMP study areas included the same mine-exposed and reference waterbodies established in the original design documents (Baffinland 2014; KP 2014a; NSC 2014) 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 previous 2015 CREMP study, was again used as the reference lake for the 2016 study. Reference Lake 3 is located approximately 62 km south of the Mary River Project (Figure 2.1), and is well outside the area of any potential mine influence. Streams used as reference areas in the current and previous CREMP included an unnamed tributary to the Mary River and two unnamed tributaries to Angajurjuatuk Lake, all of which are located southeast of the mine (Figure 2.1). As in the previous CREMP studies, an area of Mary River located well upstream of current Baffinland mine activity (i.e., GO-09) served as a reference area for the mine-exposed portion of Mary River in the 2016 study (Figure 2.1).



LEGEND

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

N W E S

0 2.75 5.5 11
Kilometers

MAP INFORMATION
Map Projection: UTM Zone 17N NAD 1983
Data Source: Reproduced under licence from Her Majesty the Queen in Rights of Canada, Department of Natural Resources Canada. All rights reserved.
Creation Date: March 2017
Project No.: 2569

Figure 2.1: Mary River Project CREMP Study Water Bodies.

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2.1 Water Quality

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

2.1.1 In-situ Water Quality Measurement Data Collection and Analysis

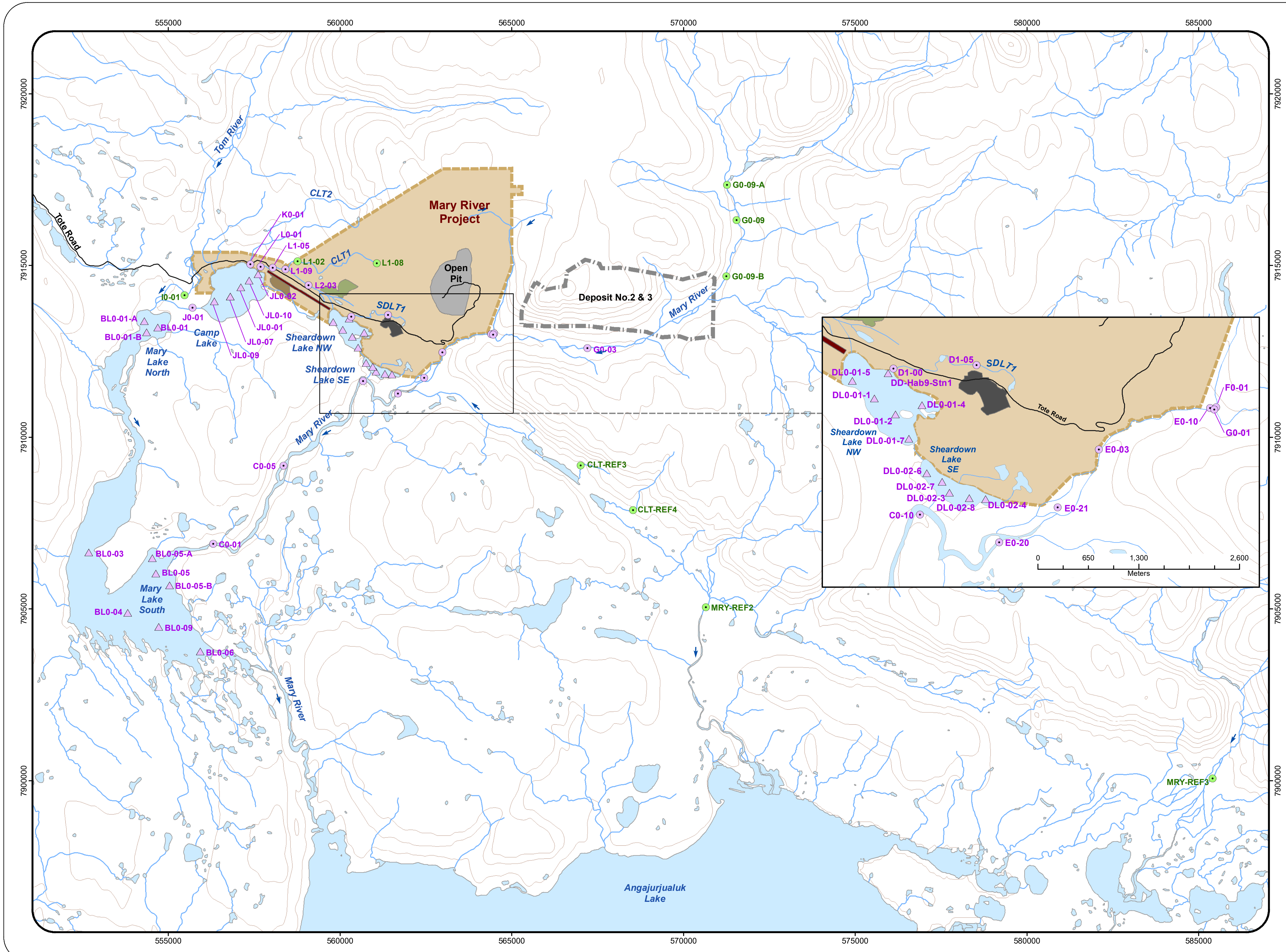
In-situ measurements of water temperature, dissolved oxygen, pH, specific conductance (i.e., temperature standardized measurement of conductivity) and turbidity were taken at the bottom of the water column at all lotic (i.e., creek, river) stations and as a vertical profile at one-meter intervals at each lentic (i.e., lake) water quality monitoring station during routine monitoring conducted by Baffinland. These *in-situ* measurements were also collected at the surface and bottom (i.e., approximately 30 cm above the water-sediment interface) at all lake benthic invertebrate community (benthic) stations during the fall biological sampling completed by Minnow, with the exception of turbidity measurements. The *in-situ* measurements were collected using YSI 556 MDS (Multiparameter Display System) or Pro DSS meters equipped with YSI 6820 or YSI 600Q sondes, respectively (YSI Inc., Yellow Springs, OH). Meter readings for pH, specific conductance and turbidity were checked against standard solutions and calibrated as necessary on the day of 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 April-May under-ice sampling event, a gas-powered, 15 centimeter (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 (i.e., the Canadian Water Quality Guidelines [WQG; CCME 1999, 2016]) and, for pH and conductivity, to baseline data. The evaluation of the *in-situ* dissolved oxygen concentration and pH data included comparisons to WQG. *In-situ* water quality data were compared spatially within each system (i.e., from upstream- to downstream-most stations) using both qualitative and statistical

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	Lotic 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		-	-	✓	✓
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	G0-09-A	571264	7917344	a	-	✓	✓	✓
		G0-09	571546	7916317		-	✓	✓	✓
		G0-09-B	571248	7914682		-	✓	✓	✓
		G0-03	567204	7912587	a,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

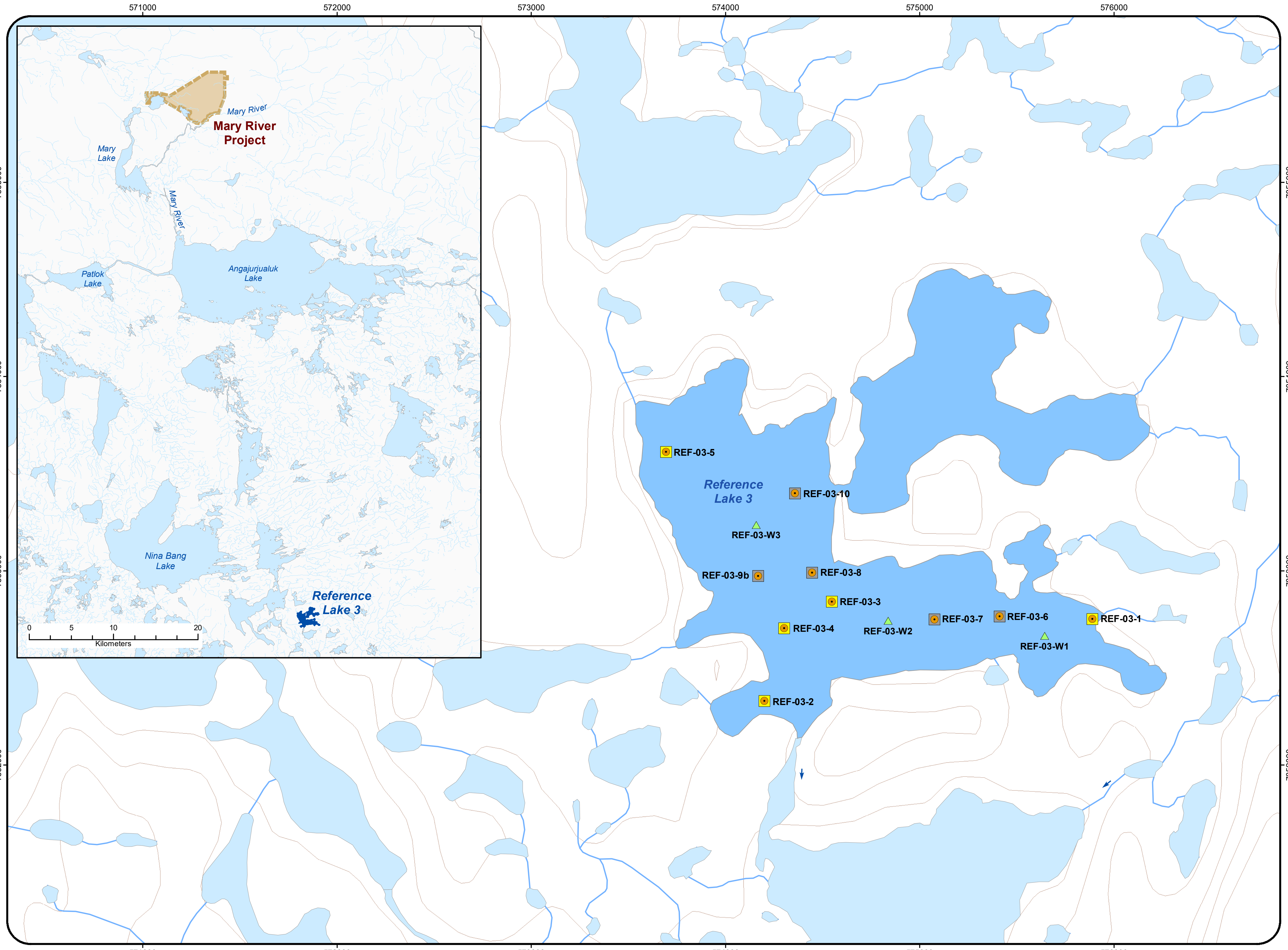
- Lake - Mine Exposed
- Stream - Mine Exposed
- Stream - Reference
- Mary River Project
- QMR2 Quarry
- Exploration Camp
- Mine Site
- Open Pit
- Airstrip
- Lease Boundary For Deposit No. 2 & 3
- Waterbody
- Watercourse
- Contours (20 m)
- Tote Road
- Water Flow Direction

0 1.5 3 6
Kilometers

MAP INFORMATION
Map Projection: UTM Zone 17N NAD 1983
Data Source: Reproduced under licence from Her Majesty the Queen in Rights of Canada, Department of Natural Resources Canada. All rights reserved.
Creation Date: March 2017
Project No.: 2569

Figure 2.2 : Mary River Project, CREMP Routine Water Quality and Phytoplankton Monitoring Station Locations

minnow environmental inc.



LEGEND

- Sediment and Benthic Monitoring Location
- Water Quality and Phytoplankton Monitoring Station
- Littoral Sampling Depth
- Profundal Sampling Depth
- Reference Lake
- Waterbody
- Watercourse
- Tote Road
- Contours (20 m)
- Water Flow Direction

N
W E
S

0 0.25 0.5 1
Kilometers

MAP INFORMATION
Map Projection: UTM Zone 17N NAD 1983
Data Source: Reproduced under licence from Her Majesty the Queen in Rights of Canada, Department of Natural Resources Canada. All rights reserved.
Creation Date: March 2017
Project No.: 2569

Figure 2.3: Mary River Project CREMP Reference Lake 3 Monitoring Station Locations

minnow environmental inc.

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 areas using Analysis-of-Variance (ANOVA). The selection of whether untransformed or log-transformed data were used for the ANOVA tests was determined based on which data best met the assumptions of ANOVA. In instances where normality could not be achieved through data transformation, non-parametric Mann-Whitney U-test and Kruskal-Wallis H-test statistics were applied using the raw data to validate the pair-wise and multiple-group ANOVA statistical results, respectively. Similarly, in instances in which variances of normal data could not be homogenized by transformation, Student's t-tests assuming unequal variance were applied using either raw or log-transformed data to validate the pair-wise ANOVA statistical results. In cases in which multiple-group comparisons were conducted, Tukey's Honestly Significant Difference (HSD) or Tamhane's pair-wise *post-hoc* tests were implemented for homogenous and non-homogenous data, respectively All statistical comparisons were conducted using SPSS Version 12.0 software (SPSS Inc., Chicago, IL).

Vertical profiles of the *in-situ* measurements taken from lake stations were plotted and visually assessed to evaluate potential thermal, dissolved oxygen or chemical (i.e., pH and/or specific conductance) stratification and the corresponding depths associated with any distinct layering. The occurrence of a thermocline was assessed as a ≥1˚C change in temperature per 1 m incremental change in depth (Wetzel 2001). The vertical profile data collected at the mine-exposed study lakes were compared to that of the reference lake for each seasonal monitoring event using profile data averaged for each incremental depth below the water surface among lake stations by season. At each study lake, spatial and seasonal differences in the vertical profile plots were evaluated to provide better understanding of natural conditions and/or mine-related influences on within-lake water quality. Additional evaluation of the *in-situ* dissolved oxygen concentration and pH data included comparisons to WQG (CCME 1999, 2016).

2.1.2 Water Chemistry Sampling and Data Analysis

Surface water chemistry samples were collected from both lotic and lentic environments (Table 2.1). At lotic stations, the water chemistry samples were collected from approximately mid-water column by hand directly into pre-labeled sample bottles which, for those requiring preservation, were pre-dosed with required chemical preservatives. At lentic stations, two water chemistry samples were collected, one approximately 1 m below the surface (or just below the ice layer for the winter sampling event) and the other from approximately 1 m above the bottom, using a non-metallic beta-bottle, vertically-oriented 2.2 L TT Silicon Kemmerer bottle (Wildco Supply Co., Yulee, FL) or, for winter sampling only, a stainless steel Kemmerer bottle. 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/Kemmerer 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 protocols (Baffinland 2014).

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

The water chemistry data were compared: i) among mine-exposed and reference areas for each study lake catchment (Table 2.1); ii) spatially and seasonally at each mine-exposed waterbody; iii) to applicable water quality guidelines/objectives 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 difference in parameter concentrations was calculated as the mine-exposed area mean concentration divided by the respective reference station/area mean concentration using the 2016 data. Similarly, for temporal comparisons, the magnitude of difference in parameter concentrations was calculated by dividing the individual mine-exposed station/area 2016 mean concentrations by the baseline (2005 - 2013) mean concentration for each parameter. The resulting magnitude of differences in 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.

Applicable water quality guidelines/objectives included CWQG (CCME 1999, 2016) 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, 2016). The water quality

Table 2.2: Water quality guidelines used for the Mary River Project 2015 and 2016 CREMP.

Parameters		Units	Water Quality Guideline (WQG)[a]	Criteria Source[a]	Supporting Information and/or Calculations Used to Derive Hardness Dependent Criteria
Conventionals	pH (lab)	pH	6.5 - 9.0	CWQG	
Nutrients and Organics	Nitrate	mg/L	13	CWQG	
	Nitrite	mg/L	0.06	CWQG	
	Total Phosphorus	mg/L	0.020	PWQO	Total phosphorus objective is 0.020 mg/L for lotic (rivers, streams) environments, and 0.030 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	
	Tin (Sn)	mg/L	-	-	
	Titanium (Ti)	mg/L	-	-	
	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 Environment Water Quality Guideline for the protection of aquatic life (CCME1999, 2016) 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; MOE 1994) or the British Columbia Water Quality Guideline (BCWQG; BCMOE 2013), as available.

Table 2.3: Categorization of magnitudes of difference used for screening parameter concentrations between mine-exposed areas and reference areas, and between 2016 and baseline data for individual mine-exposed stations/areas, Mary River Project CREMP, 2016.

Categorization	Magnitude of Difference 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 mine-exposed area versus the reference area or baseline data, as applicable.

guidelines used in this 2016 CREMP were abbreviated simply as 'WQG', 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 2016 water chemistry data were also compared to site specific water quality benchmarks developed for the Mary River Project AEMP (Intrinsik 2014). The Mary River Project AEMP water chemistry benchmarks were derived using an evaluation of background (i.e., baseline) water chemistry data together with existing generic water quality guidelines that consider aquatic toxicity thresholds. The AEMP benchmarks were developed to inform management decisions under the AEMP assessment approach and management response framework (Baffinland 2014). An elevation in parameter concentration above the respective AEMP benchmark may trigger various actions (e.g., sampling design modifications, additional statistical assessment, considerations for mitigation, etc.) to better understand and potentially mitigate effects resulting from elevated concentrations of the parameter of concern (Baffinland 2014). Water chemistry data for key parameters (i.e., parameters with concentrations that were notably higher at mine-exposed areas compared to reference areas, that were historically identified as site-specific parameters of concern, and/or that were above WQG and/or AEMP benchmarks) were plotted to evaluate changes in concentrations in 2016 compared to baseline (2005 – 2013) and previous mine construction (2014) and operational (2015) periods.

2.2 Sediment Quality

The objective of the sediment quality monitoring component of the original Mary River Project CREMP was to assess the potential effects of mine operation on sediment quality of lake environments based on a gradient design (Baffinland 2014; KP 2014a, 2015). In 2016, the lake sediment quality monitoring approach was modified to an effects-based design that included both sediment quality and benthic invertebrate community sampling at littoral stations while maintaining key profundal stations for the long-term monitoring of changes in lake sediment chemistry. Under the modified 2016 design, sediment quality sampling was conducted at five littoral stations (i.e., water depths approximately between 7 m and 12 m) and three profundal stations (i.e., water depths greater than approximately 18 m) at each study lake except Sheardown Lake SE (Table 2.4; Figure 2.4). Because the maximum depth of Sheardown Lake SE reaches approximately 14 m, only 'littoral' depth samples were collected at this lake. Although the CREMP also proposed sediment sampling within Camp Lake tributaries (three stations), Sheardown Lake tributaries (six stations) and within the Mary River (four stations), as in previous studies conducted in 2014 and 2015, these watercourses were found to contain limited depositional habitat during the 2016 field survey. The general absence of any substantial accumulation of fine sediments within these watercourses precluded any meaningful assessment of potential mine-related influences on sediment chemistry within, along and/or between watercourses, and therefore no sediment sampling was conducted at lotic environments as part of the 2016 CREMP.

2.2.1 Sample Collection and Laboratory Analysis

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

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

Table 2.4: Mary River Project CREMP lake sediment quality and benthic invertebrate community monitoring station coordinates, 2016.

Waterbody	Station Code	UTM Zone 17W, NAD83		New (2016) or Existing Station	Sampling Habitat	Sample Type	
		Easting	Northing			Sediment Sampling [a]	Benthic Invertebrate Community
Reference Lake	REF-03-1	575889	7852752	Existing	littoral	✓	✓
	REF-03-2	574200	7852330	Existing	littoral	✓	✓
	REF-03-3	574548	7852842	Existing	littoral	✓	✓
	REF-03-4	574301	7852705	Existing	littoral	✓	✓
	REF-03-5	573694	7853613	Existing	littoral	✓	✓
	REF-03-6	575411	7852766	Existing	profundal	✓	✓
	REF-03-7	575076	7852750	Existing	profundal	✓	✓
	REF-03-8	574445	7852992	Existing	profundal	✓	✓
	REF-03-9[b]	574168	7852975	Existing	profundal	✓	✓
	REF-03-10	574358	7853400	Existing	profundal	✓	✓
Camp Lake	JLO-02[b]	557619	7914753	Existing	littoral	✓	✓
	JLO-21	556926	7914911	Existing	littoral	✓	✓
	JLO-32	557590	7914174	New	littoral	✓	✓
	JLO-14	557246	7914224	Existing	profundal	✓	-
	JLO-31	557213	7913826	New	littoral	✓	✓
	JLO-07	556803	7914095	Existing	profundal	✓	-
	JLO-11	556594	7913929	Existing	profundal	✓	-
	JLO-30	556446	7913562	New	littoral	✓	✓
Sheardown Lake Northwest (NW)	DLO-01-5	559806	7913348	Existing	profundal	✓	-
	DD-HAB 9-STN2	560315	7913398	Existing	littoral	✓	✓
	DLO-01-8	560338	7913192	Existing	littoral	✓	✓
	DLO-01	560079	7913132	Existing	profundal	✓	-
	DLO-01-9	560740	7913073	Existing	littoral	✓	✓
	DLO-01-2[b]	560350	7912927	Existing	profundal	✓	-
	DLO-01-3	560478	7912827	Existing	littoral	✓	✓
	DLO-01-10	560471	7912574	New	littoral	✓	✓
Sheardown Lake Southwest (SE)	DLO-02-1	560813	7912114	Existing	littoral	✓	✓
	DLO-02-11	561680	7911809	Existing	littoral	✓	✓
	DLO-02-9	561419	7911808	Existing	littoral	✓	✓
	DLO-02-13	561245	7911947	Existing	profundal	✓	✓
	DLO-02-3	561043	7911919	Existing	profundal	✓	✓
Mary Lake	BLO-01	554690	7913194	Existing	littoral	✓	✓
	BLO-20	554382	7906326	New	littoral	✓	✓
	BLO-11	554872	7905869	Existing	littoral	✓	✓
	BLO-12	554644	7905742	Existing	profundal	✓	-
	BLO-21	554966	7905443	New	littoral	✓	✓
	BLO-10	555033	7905065	Existing	profundal	✓	-
	BLO-08	555424	7904239	Existing	profundal	✓	-
	BLO-22	555607	7904040	New	littoral	✓	✓
	BLO-06[b]	555925	7903771	Existing	littoral	✓	✓

[a] Sediment core samples analyzed for particle size, TOC and total metals. Composite of three cores, using top 3 cm of sediment.

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

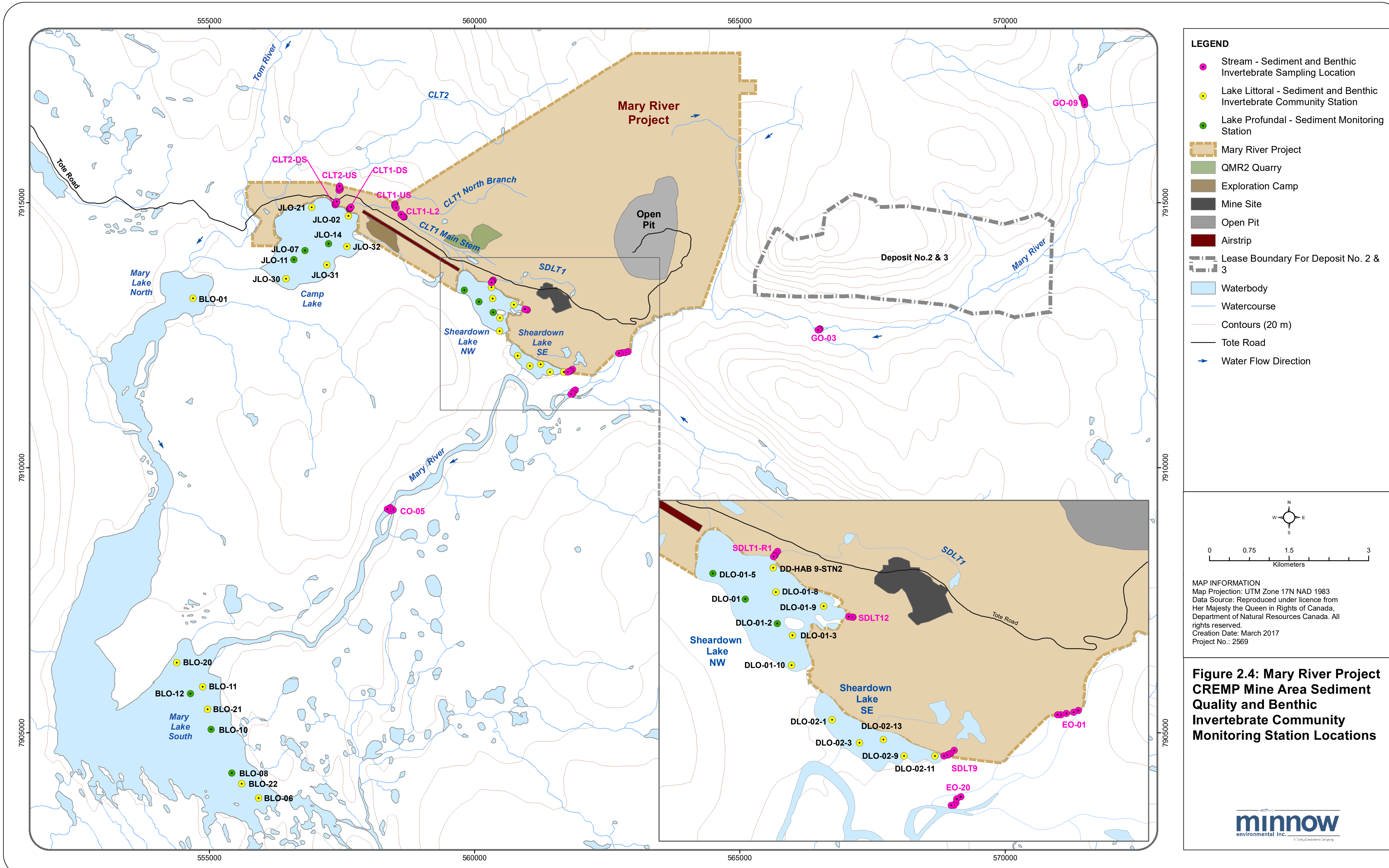


Figure 2.4: Mary River Project CREMP Mine Area Sediment Quality and Benthic Invertebrate Community Monitoring Station Locations

particle size analyses, and chemical characterization included analyses of total organic carbon (TOC) and total metals including mercury. Standard laboratory methods were used for all physical and chemical sediment analyses.

2.2.2 Data Analysis

Sediment quality data from the mine-exposed areas were compared to reference area 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 were statistically summarized based on separate calculation of mean, standard deviation, standard error, minimum and maximum for littoral and profundal habitat at each study lake. These data were compared statistically between mine-exposed and reference study areas 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 2.1.1).

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. Sediment chemistry data were then averaged by study lake and compared between mine-exposed and reference areas. For each sediment chemistry parameter, the data from each study lake were separately averaged for littoral and profundal habitat and then compared between each respective mine-exposed and reference lake based on the magnitude of difference in parameter concentrations. The magnitude of difference between the mine-exposed and reference lakes was calculated and compared as described previously (Section 2.1.2; Table 2.3).

Sediment chemistry data were compared to applicable Canadian Sediment Quality Guidelines (CSQG; CCME 1999, 2015) 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 2016 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 2016 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 2014). 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 2014).

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 2016 data, baseline (2005 – 2013) data, and previous 2015 mine operation period data. In addition, as described previously, the magnitude of difference was calculated for all parameters between 2016 and baseline data for each individual study lake using the same calculation (and categorization description) as described previously (Section 2.1.2; Table 2.3).

2.3 Biological Assessment

2.3.1 Phytoplankton

The Mary River Project CREMP uses measures of aqueous chlorophyll *a* concentrations to assess potential mine-related influences to phytoplankton. Because chlorophyll *a* is the primary pigment of phytoplankton (i.e., algae and other photosynthetic microbiota suspended in the water column), aqueous chlorophyll *a* concentrations are often used as a surrogate for evaluating the amount of photosynthetic microbiota in aquatic environments (Wetzel 2001). Chlorophyll *a* samples were collected at the same stations and same time as the collection of water chemistry samples by Baffinland environmental department staff (Table 2.1; Figures 2.2 and 2.3). Water samples for chlorophyll *a* analyses were collected using the same methods and equipment, and at the same locations, as described for water chemistry samples (Section 2.1.2). The chlorophyll *a* samples were collected into 1 L glass amber bottles and maintained in a cool and dark environment prior to submission to ALS (Mary River On-Site Laboratory, NU). On the same day of collection, the laboratory filtered the samples through a 0.45 micron cellulose acetate membrane filter assisted by 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 the ALS Waterloo, ON laboratory 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 2.1.2).

The CREMP study design also stipulates the collection of phytoplankton community samples for archiving (NSC 2014, 2015a). In the event that water quality, chlorophyll *a* and/or other biological components indicate potential mine-related effects to primary productivity at any of the mine-exposed water bodies, these phytoplankton community samples may be processed to further investigate the nature of mine-related effects to phytoplankton biomass and community structure (i.e., taxonomic composition, richness, density). To date, none of the archived phytoplankton community samples have been processed (2006 – 2015). In 2016, phytoplankton community samples were collected using the same methods described in the CREMP (NSC 2014). 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 (Section 2.1). An AEMP benchmark chlorophyll *a* concentration of 3.7 µg/L was established for the Mary River Project (NSC 2014), and therefore the 2016 chlorophyll *a* concentration data were compared to this benchmark to assist with the determination of potential mine-related enrichment effects at water bodies influenced by mine operations. A mine-related effect on the productivity of a waterbody of interest was assessed as a chlorophyll a concentration above the AEMP benchmark, the representative reference area, and/or the respective waterbody baseline condition.

2.3.2 Benthic Invertebrate Community

The Mary River Project CREMP benthic invertebrate community (benthic) survey outlines a habitat-based approach for characterizing potential mine-related effects to benthic biota of lotic (river/stream) and lentic (lake) environments (NSC 2014). Lotic areas sampled for benthic invertebrates in 2016 included Camp Lake Tributaries 1 and 2 at historically established areas located upstream and downstream of the mine tote road, Sheardown Lake Tributaries 1, 9 and 12 near their respective outlets, and the Mary River upstream (two areas) and downstream (three areas) of the mine site (Table 2.5; Figure 2.4), all of which had been sampled as part of the 2015 CREMP. In addition to these mine-exposed areas, a benthic area was established at upper Camp Lake Tributary 1 in 2016 (CLT1-L2; Table 2.5) to evaluate potential effects of elevated concentrations of mine-related parameters of concern that were shown within this portion of the tributary in the previous 2015 study (Minnow 2016). As well, a reference creek benthic study area located within at the same unnamed tributary to Angajurjualuk Lake that is used for reference water quality sampling (Stations CLT-REF4 and MRY-REF2) was added to

Table 2.5: Mary River Project CREMP stream benthic invertebrate community monitoring station coordinates for the 2016 study.

Lake System	Waterbody	Station Code	Station Type	UTM Zone 17W, NAD83	
				Easting	Northing
Angajurjualuk Lake	Unnamed Tributary	REF-CRK-B1	Reference	570069	7906132
		REF-CRK-B2	Reference	570107	7906119
		REF-CRK-B3	Reference	570135	7906103
		REF-CRK-B4	Reference	570145	7906088
		REF-CRK-B5	Reference	570148	7906078
Camp Lake	Camp Lake Tributary 1	CLT1-US-B1	Reference	558500	7914976
		CLT1-US-B2	Reference	558492	7914947
		CLT1-US-B3	Reference	558497	7914935
		CLT1-US-B4	Reference	558508	7914918
		CLT1-US-B5	Reference	558518	7914901
		CLT1-L2-B1	Mine-Exposed	558670	7914727
		CLT1-L2-B2	Mine-Exposed	558663	7914736
		CLT1-L2-B3	Mine-Exposed	558658	7914741
		CLT1-L2-B4	Mine-Exposed	558642	7914752
		CLT1-L2-B5	Mine-Exposed	558612	7914777
		CLT1-DS-B1	Mine-Exposed	557643	7914882
		CLT1-DS-B2	Mine-Exposed	557646	7914890
		CLT1-DS-B3	Mine-Exposed	557653	7914896
		CLT1-DS-B4	Mine-Exposed	557656	7914907
		CLT1-DS-B5	Mine-Exposed	557670	7914913
	Camp Lake Tributary 2	CLT2-US-B1	Reference	557444	7915234
		CLT2-US-B2	Reference	557464	7915253
		CLT2-US-B3	Reference	557454	7915278
		CLT2-US-B4	Reference	557449	7915290
		CLT2-US-B5	Reference	557453	7915313
		CLT2-DS-B1	Mine-Exposed	557372	7914958
		CLT2-DS-B2	Mine-Exposed	557374	7914970
		CLT2-DS-B3	Mine-Exposed	557381	7914990
		CLT2-DS-B4	Mine-Exposed	557395	7914999
		CLT2-DS-B5	Mine-Exposed	557402	7915018
Sheardown Lake Northwest (NW)	Sheardown Lake Tributary 1 (Reach 1)	SDLT1-R1-B1	Mine-Exposed	560352	7913537
		SDLT1-R1-B2	Mine-Exposed	560337	7913518
		SDLT1-R1-B3	Mine-Exposed	560330	7913502
		SDLT1-R1-B4	Mine-Exposed	560322	7913497
		SDLT1-R1-B5	Mine-Exposed	560318	7913493
	Sheardown Lake Tributary 12	SDLT12-B1	Mine-Exposed	560990	7912979
		SDLT12-B2	Mine-Exposed	560980	7912981
		SDLT12-B3	Mine-Exposed	560951	7912986
Sheardown Lake Southwest (SE)	Sheardown Lake Tributary 9	SDLT9-DS-B1	Mine-Exposed	561842	7911855
		SDLT9-DS-B2	Mine-Exposed	561813	7911827
		SDLT9-DS-B3	Mine-Exposed	561798	7911824
		SDLT9-DS-B4	Mine-Exposed	561785	7911816
		SDLT9-DS-B5	Mine-Exposed	561756	7911809
Mary Lake	Mary River	GO-09-B1	Reference	571450	7916984
		GO-09-B2	Reference	571468	7916966
		GO-09-B3	Reference	571491	7916924
		GO-09-B4	Reference	571499	7916889
		GO-09-B5	Reference	571502	7916847
		GO-03-B1	Mine-Exposed	566506	7912613
		GO-03-B2	Mine-Exposed	566508	7912617
		GO-03-B3	Mine-Exposed	566501	7912610
		GO-03-B4	Mine-Exposed	566490	7912603
		GO-03-B5	Mine-Exposed	566477	7912600
		EO-01-B1	Mine-Exposed	562891	7912193
		EO-01-B2	Mine-Exposed	562851	7912177
		EO-01-B3	Mine-Exposed	562791	7912169
		EO-01-B4	Mine-Exposed	562743	7912156
		EO-01-B5	Mine-Exposed	562718	7912156
		EO-20-B1	Mine-Exposed	561900	7911465
		EO-20-B2	Mine-Exposed	561866	7911446
		EO-20-B3	Mine-Exposed	561857	7911413
		EO-20-B4	Mine-Exposed	561844	7911393
		EO-20-B5	Mine-Exposed	561819	7911391
		CO-05-B1	Mine-Exposed	558466	7909205
		CO-05-B2	Mine-Exposed	558412	7909185
		CO-05-B3	Mine-Exposed	558410	7909248
		CO-05-B4	Mine-Exposed	558397	7909234
		CO-05-B5	Mine-Exposed	558357	7909220

the CREMP in 2016 (Table 2.5; Figure 2.4). This reference creek is referred to as Unnamed Reference Creek herein for the purposes of the 2016 CREMP. Consistent with the federal Environmental Effects Monitoring (EEM) program (Environment Canada 2012), five stations were sampled at each lotic study area with the exception of Sheardown Lake Tributary 12, where only three stations were sampled due to limited habitat available for sampling using conventional gear suitable for erosional habitat. As in 2015, the level of replication used for lotic benthic sampling in 2016 was greater than specified under the original CREMP design in order to provide consistency with EEM standards (Minnow 2016a). To the extent possible, previously established lotic benthic stations were incorporated into the 2016 sampling program to provide comparability to historical baseline information.

The lake benthic study approach outlined in the original Mary River Project CREMP focussed on habitat-based characterization of the community at each mine-exposed lake (Baffinland 2014; NSC 2014, 2015a). In 2016, the lake benthic monitoring approach was modified to reflect an effects-based design consistent with that recommended for mines under the national EEM program (Environment Canada 2012). In addition, the 2016 study instituted harmonized sediment quality and benthic sampling at each lake benthic station to potentially improve the ability of the study to evaluate sediment physical feature and/or metal concentration influences on the benthic invertebrate community. Under the modified 2016 design, lake benthic sampling targeted littoral habitat (i.e., water depths ranging from approximately 7 m to 12 m) with substrate composed predominantly of fine sand- to silt-sized particles at each mine-exposed and reference study lake. Analysis of benthic data collected at Reference Lake 3 in 2015 indicated that, similar to temperate lakes (Ward 1992), depth-related influences on benthic invertebrate community structure (e.g., density and richness) occurs naturally in lakes of the Baffinland region (Minnow 2016a). Additional sampling conducted at Reference Lake 3 in 2016 confirmed the occurrence of natural depth-related influences on benthic invertebrate community structure in area lakes (Appendix B). Because the occurrence of naturally lower density and richness with greater depth (i.e., profundal habitat) potentially limits the ability of the AEMP study to identify mine-related effects at area lakes, littoral habitat was preferred for CREMP lake benthic sampling. Five littoral stations were sampled at each study lake which, to the extent possible, included previously established CREMP benthic stations to provide temporal continuity (Table 2.4; Figure 2.4).

2.3.2.1 Sample Collection and Laboratory Analysis

Two types of sampling equipment and methods were employed during the 2016 CREMP benthic survey to reflect different habitat types as follows:

- at **lotic (stream/river) stations** (i.e., predominantly cobble and/or gravel substrate in flowing waters), benthic samples were collected using a Surber sampler (0.0929 m^2 sampling area) outfitted with 500-µm mesh. At each erosional station, one sample representing a composite of three Surber sampler grabs (i.e., 0.279 m^2 area) was collected to ensure that each sample was representative of habitat conditions. A concerted effort was made to ensure that water velocity and substrate characteristics were comparable among respective lotic study area stations to minimize natural influences on community variability. Once all three sub-samples were collected at each respective station, all material gathered in the Surber sampler net was transferred to a plastic sampling jar to which both external and internal station identification labels were affixed.

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

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

Benthic samples were submitted to and processed by Zeas Inc. (Nobleton, ON) using standard sorting methods. Upon arrival at the laboratory, a biological stain was added to each benthic sample to facilitate greater sorting accuracy. The samples were washed free of formalin in a

500 µm sieve and the remaining sample material was then examined under a stereomicroscope at a magnification of at least ten times by a technician. All benthic invertebrates were removed from the sample debris and placed into vials containing 70% ethanol according to major taxonomic groups (i.e., order or family levels). A senior taxonomist later enumerated and identified the benthic organisms to the lowest practical level (typically genus or species) utilizing up-to-date taxonomic keys. Quality assurance/quality control (QA/QC) conducted during the laboratory processing of benthic samples included organism recovery and sub-sampling checks on as many as 10% of the total samples collected for the 2016 CREMP (Appendix A).

2.3.2.2 Data Analysis

Benthic data were evaluated separately for lotic and lentic 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 presented in Environment Canada (2012). Additional comparisons were conducted using percent composition of dominant/indicator taxa, functional feeding groups, and habitat preference groups (calculated as the abundance of each respective group relative to the total number of organisms in the sample). Dominant/indicator taxonomic groups were defined as those groups representing, on average, greater than 5% of total organism abundance for a study area or any groups considered important indicators of environmental stress. Functional feeding groups (FFG) and habitat preference groups (HPG) were assigned based on Pennak (1989), Mandaville (2002) and/or Merritt et al. (2008) descriptions/designations for each taxon.

Statistical comparisons of all applicable benthic invertebrate community indices and community composition endpoints were conducted using the same tests, transformations[1], assumptions and software described for the *in-situ* water quality comparisons (see Section 2.1.2). 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, the magnitude of difference was calculated between study area means. Because the benthic survey was designed to have sufficient power to detect a difference (effect size) of ± two standard deviations (SD), the

[1] Rather than log-transformations like those conducted for non-normal *in-situ* water quality data, 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.

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 $\pm$ 2 SD_{REF} was used to define any 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, 2015 and 2016 data for primary benthic metrics (i.e., density, richness, Simpson's Evenness) and 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 (see Section 2.1.1). For study areas that contained data for multiple years (i.e., 3 or more), Tukey's HSD *post-hoc* tests were used in instances in which normal data showed equal variance, and Tamhane's *post-hoc* tests were used in instances in which normal data showed unequal variance. Similar to the 2016 within-year statistical analyses, the magnitude of difference was calculated for endpoints that differed significantly between years in the *post-hoc* tests and compared to the benthic survey CES_{BIC} of within two standard deviations of the baseline year mean (abbreviated as ±2 $SD_{BL\text{-}year}$).

2.3.3 Fish Population

The Mary River Project CREMP fish population survey outlines a non-lethal sampling design to evaluate potential mine-related effects to the fish population (e.g., age structure, growth, condition) at the mine-exposed lakes (NSC 2014, 2015a). The fish population survey targeted Arctic charr (*Salvelinus alpinus*) primarily because this species is the only abundant fish common to the mine's regional lakes, sufficient baseline catch and measurement data is available for this species to allow application of a before-after statistical evaluation, and because of this species importance as an Inuit subsistence food source. The approach employed for the CREMP fish population survey closely mirrored the recommended EEM approach for non-lethal sampling (Environment Canada 2012). Specifically, the 2016 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 2.1). Although the 2016 study also targeted Arctic charr from Reference Lake 3 as a basis for the evaluation of potential mine-related influences to the fish population, similar to the 2015 CREMP study, low numbers of Arctic charr were captured from the littoral/profundal zone of the reference lake in 2016. Thus, the 2016 fish population survey focussed on comparisons of fish collected at the nearshore of the mine-exposed and reference lakes, as well as on 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 ERP mine operations.

2.3.3.1 Sample Collection

Nearshore areas of the 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 one to three shoreline reaches of each study lake. The number of passes conducted at each study lake was dependent upon catch success, with more passes required in instances in which target numbers were not cumulatively attained. All fish captured during each pass were retained in buckets of aerated water. At the conclusion of each pass, total fishing effort (i.e., electrofishing seconds) was recorded to allow calculation of time-standardized catch. All captured fish were identified to species and enumerated, with any non-target species subsequently released alive at the area of capture. All captured Arctic charr were temporarily retained for processing using methods described below (Section 2.3.3.2). Additional supporting information collected for each electrofishing pass included recording the GPS coordinates at the points of commencement and completion of electrofishing activities, and a description of the sampled habitat.

Littoral/profundal areas of the study lakes were sampled for Arctic charr using experimental (gang index) gill nets. Multiple-panel, 2 m high gill nets with total lengths ranging from 61 – 91 m (200’ – 300’) and bar mesh sizes ranging from 38 – 76 mm (1.5” – 3”) were set on the bottom for short durations (approximately 0.6 – 5.7 hours per set; mean 2.5 hours) during daylight hours only. Upon retrieval of each net, all captured fish were identified to species, enumerated and processed (see below) separately for each individual gill net panel mesh size. For each gill net set, information including mesh size, duration of sampling, sampling depth range, GPS coordinates and habitat descriptions were recorded.

2.3.3.2 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) or evidence of external and/or internal parasites. All observations were recorded on field sheets, with supporting photographs taken as appropriate.

Each fish was then subject to measurement of fork and total length to the nearest millimetre using a standard measuring board. Following length measurements, fish captured using the electrofishing unit were individually weighed to the nearest milligram using an Ohaus Model 123 Scout-Pro analytical balance (Ohaus Corp., Pine Brook, NJ) with a surrounding draft shield. For Arctic charr captured in gill nets, individuals were weighed using Pesola™ spring scales (Pesola AG, Baar Switzerland) demarcated at intervals of 1-2% of the total scale range and with precision of ± 0.3%. The Pesola™ spring scale for individual weight measurement of gill-net captured fish was selected so that the fish weight was near the top of the scale's range to ensure that measurements achieved a resolution near 1%. All live Arctic charr captured by electrofishing and gill netting methods that were not selected for the collection of aging structures were released near the location of capture following these individual measurements of length and weight.

As specified for EEM non-lethal fish population surveys (see Environment Canada 2012), approximately 10% of the targeted number of Arctic charr captured using electrofishing methods were sacrificed for collection of aging structures. Arctic charr mortalities from experimental gill netting were approximately 20% of targeted catch numbers, and therefore aging structures were removed from each incidental mortality. Otoliths and pectoral fin rays were removed from all sacrificed individuals and incidental mortalities. Upon removal, these aging structures were wrapped separately in wax paper, placed inside envelopes labelled with the fish identification, and then dried for storage. For all incidental mortalities, in addition to removal of aging structures, fish were dissected to determine sex and for removal of the liver and whole gonads for weight measurement. These organs were weighed to the nearest milligram using an Ohaus Model 123 Scout-Pro balance outfitted with a surrounding draft shield. During processing, fish were also inspected for any internal abnormalities (e.g., parasites, lesions, tumours, etc.) with descriptions recorded accordingly.

Age structures (otoliths and pectoral fin rays) 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. Pectoral fin rays were cleaned, embedded in epoxy resin and, after the epoxy hardened, sectioned transversely using a Buehler Isomet (Lake Bluff, IL) low-speed diamond saw. The prepared otolith and pectoral fin ray samples were later mounted on a glass slide using a mounting medium and examined under a compound microscope using transmitted light to determine fish age. For each structure, the age and edge condition was recorded along with a confidence rating for the age determination.

2.3.3.3 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, and gill netting CPUE was calculated as the number of fish captured per 100 meter·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 the 2016 year of mine operation.

Arctic charr population health was assessed separately for electrofishing and experimental gill netting data sets. Initial data analysis for the non-lethal survey included the plotting of length frequency distributions as described by Bonar (2002) and Gray et al. (2002), so that, together with appropriate aging data, YOY individuals could be distinguished from the juvenile/adult life stages (electrofishing data set), or various size/age classes could be distinguished from one another (gill netting data set). Where relevant, the YOY age class was assessed separately from the juvenile/adult age classes for fish survey endpoints between the 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 by Environment Canada (2012) for environmental effects monitoring. Length-frequency distribution was compared between mine-exposed and reference areas, for data collected in 2016, and for before-after analysis using data collected in 2016 and during the combined baseline period, using a non-parametric two-sample Kolmogorov-Smirnov (KS) test. Mean fork length and body weight were compared between mine-exposed and reference study areas in 2016, and between 2016 and the mine baseline period, using ANOVA, with data inspected for normality and homogeneity of variance before applying parametric statistical procedures. In cases where data did not meet the assumptions of ANOVA despite log-transformation, a non-parametric Mann-Whitney U-test was also performed to test for/validate significant differences between study areas or study periods, as appropriate, indicated by the ANOVA test.

Body weight at fork length (condition) was compared using Analysis-of-Covariance (ANCOVA). Prior to conducting the ANCOVA tests, scatter plots of all variable and covariate combinations were examined to identify outliers, leverage values or other unusual data. The scatter plots were also examined to ensure there was adequate overlap between the 2016 mine-exposed

Table 2.6: Fish population survey endpoints examined for the Mary River Project CREMP, August 2016.

Response Category	Endpoint	Statistical Procedure[c,d,e]	Critical Effect Size
Survival	Length-frequency distribution[a]	K-S Test	not applicable
	Age[a,f]	ANOVA	not applicable
Energy Use (size)	Size (fresh body weight)[b]	ANOVA	25%
	Size (fork length)[b]	ANOVA	25%
Energy Use (growth)	Size-at-age (body weight against age)[a,f]	ANCOVA	25%
	Size-at-age (fork length against age)[b,f]	ANCOVA	25%
Energy Use (reproduction)	Relative abundance of YOY (% composition)[b]	None	not applicable
Energy Storage	Condition (body weight against length)[a]	ANCOVA	10%

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

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

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

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

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

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

and reference/mine-exposed baseline data sets, and that there was a linear relationship between the variable and the covariate. In order to verify the existence of a linear relationship, each 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 2016 mine-exposed and/or reference/ mine-exposed baseline data sets, then the ANCOVA was not performed. Once it was determined that ANCOVA could be used for statistical analysis of the data, the first step in the ANCOVA analysis was to test whether the slopes of the regression lines for the 2016 mine-exposed and reference/baseline data sets were equal. This was accomplished by including an interaction term (dependent × covariate) in the ANCOVA model and evaluating if the interaction term was significantly different, in which case the regression slopes would not be equal between data sets and the resulting ANCOVA would provide spurious results. In such cases, two methodologies were employed to assess whether a full ANCOVA could proceed. In order of preference these were: 1) removal of influential points using Cook's distance and re-assessment of equality of slopes; and, 2) Coefficients of Determination that considered slopes equal regardless of an interaction effect (Environment Canada 2012). For the Coefficients of Determination, the full ANCOVA was completed to test for main effects, and if the r^2 value of both the parallel regression model (interaction term) and full regression model were greater than 0.8 and within 0.02 units in value, the full ANCOVA model was considered valid (Environment Canada 2012). If both methods proved unacceptable, the magnitude of effect was estimated at both the minimum and maximum overlap of covariate variables between areas (Environment Canada 2012). This results in a statistically significant interaction effect (slopes are not equal), but the calculation of the magnitude of difference at the minimum and maximum values of covariate overlap is not assigned statistical difference as it would for a full ANCOVA model. If the interaction term was not significant (i.e., homogeneous slopes between the two populations), then the full ANCOVA model was run without the interaction term to test for differences in adjusted means between the two data sets. The adjusted mean was then used as an estimate of the population mean based on the value of the covariate in the ANCOVA model.

For endpoints showing significant data set differences, the magnitude of difference between 2016 mine-exposed and reference data or the baseline data was calculated as described by Environment Canada (2012) using mean (ANOVA), adjusted mean (ANCOVA with no significant interaction) or predicted values (ANCOVA with significant interaction). The anti-log of the mean, adjusted mean, or predicted value was used in the equations for endpoints that were log_{10}-transformed. In addition, the magnitude of difference for ANCOVA with a significant interaction was calculated for each of the minimum and maximum values of the covariate.

If there was no significant difference indicated between data sets, the minimum detectable effect size was calculated as a percent difference from the reference mean/mine-exposed baseline mean for ANOVA or adjusted reference mean/mine-exposed baseline mean for ANCOVA at alpha = beta = 0.10 using the square root of the mean square error (generated during either the ANOVA or ANCOVA procedures) as a measure of variability in the sample population based on 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.

3.0 CAMP LAKE SYSTEM

3.1 Camp Lake Tributaries (CLT)

3.1.1 Water Quality

3.1.1.1 Camp Lake Tributary 1

Camp Lake Tributary 1 (CLT1) dissolved oxygen (DO) concentrations were consistently at or above saturation at all north branch and main stem stations during all spring, summer and fall monitoring events (Appendix Tables C.1 – C.3). Dissolved oxygen concentrations and percent saturation at the CLT1 north branch and upper and lower main stem stations (downstream of QMR2 Quarry and mine-tote road, respectively) differed significantly among each other and compared to the reference creek at the time of biological sampling in August 2016 (Figure 3.1; Appendix Table C.13). However, DO saturation was well above the WQG minimum limit for cold-water biota (i.e., 54%) at all stations (Figure 3.1), suggesting that these differences were not likely to be ecologically meaningful, and that mine activity had not adversely affected DO concentrations at CLT1. No consistent spatial patterns in *in-situ* pH were shown with distance from the mine during all spring, summer and fall monitoring events within the CLT1 system (Appendix Tables C.1 – C.3). Although pH was significantly higher at all CLT1 stations compared to Unnamed Reference Creek, no significant differences in pH were indicated among the north branch and main stem study areas in August 2016 (Figure 3.1). In addition, pH at CLT1 was similar to other lotic reference stations and was consistently within WQG limits, suggesting that pH differences at CLT1 compared to Unnamed Reference Creek reflected natural variation in pH among regional creeks, and that mine activity had not adversely affected pH within the CLT1 system.

Water chemistry of the CLT1 north branch was similar to the reference creek stations with the exception of a slightly higher (i.e., 3- to 5-fold) nitrate concentration during the summer sampling event in 2016 (Table 3.1; Appendix Table C.14). *In-situ* specific conductance was significantly higher at the CLT1 stations compared to Unnamed Reference Creek, and differed significantly among the north branch and upper and lower main stem study areas during the August 2016 sampling event (Figure 3.1) suggesting a mine-related influence on water quality of the CLT1 system. In addition to conductivity and nitrate concentrations, hardness, alkalinity and concentrations of total dissolved solids (TDS), ammonia, total Kjeldahl nitrogen (TKN), organic carbon, chloride, sulphate and several metals, including cobalt, iron, manganese, molybdenum, potassium, sodium, strontium and uranium, were slightly to highly elevated (i.e., 3-fold to ≥10-fold higher, respectively) at the upstream-most CLT1 main stem station (L2-03)

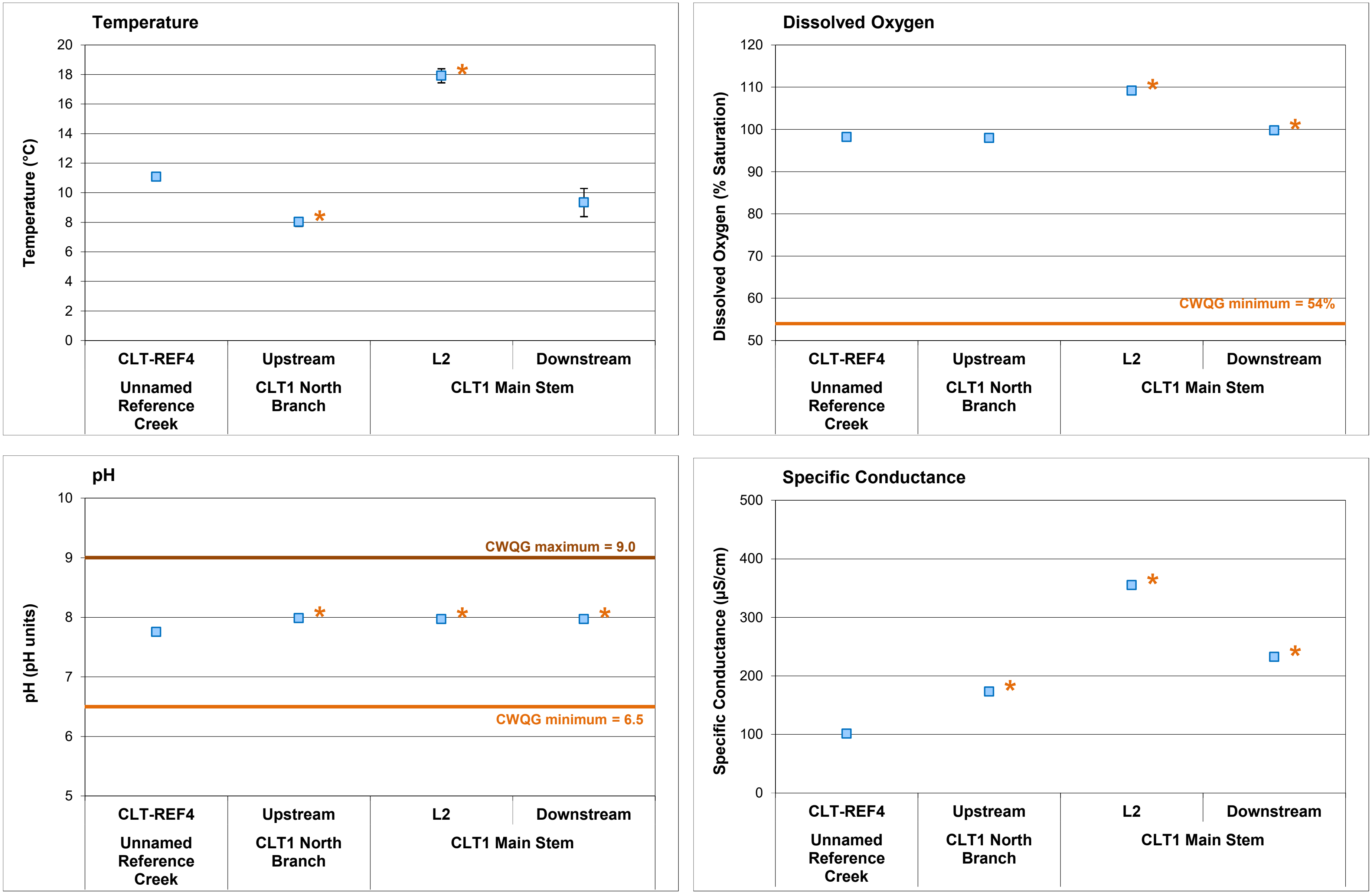


Figure 3.1: Comparison of *in-situ* water quality variables (mean ± SD; n = 5) measured at Camp Lake Tributary 1 benthic invertebrate community stations, Mary River Project CREMP, August 2016. An asterisk (*) next to data point indicates mean value differs significantly from the Unnamed Reference Creek mean.

Table 3.1: Water chemistry at Camp Lake Tributary (CLT) monitoring stations during fall (August) sampling, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Reference Creek Average (n=4)	North Branch CLT1		Main Stem CLT1				CLT-2
						L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01
					Fall 2016	20-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	125	147	209	431	293	298	296	255
	pH (lab)	pH	6.5 - 9.0	-	7.99	7.97	8.21	7.99	8.16	8.11	8.17	8.27
	Hardness (as $CaCO_3$)	mg/L	-	-	57.75	72	105	176	136	138	138	130
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	65	77	94	230	156	159	143	123
	Turbidity	NTU	-	-	1.10	0.34	0.26	2.88	0.97	0.93	0.95	0.29
	Alkalinity (as $CaCO_3$)	mg/L	-	-	57	72	104	140	119	116	116	125
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	0.237	0.048	0.047	0.042	0.031
	Nitrate	mg/L	13	13	0.021	0.079	<0.020	1.67	0.353	0.411	0.380	0.048
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	0.0203	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	0.56	0.20	0.24	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.3	1.8	2.4	4.6	3.0	3.0	2.9	3.0
	Total Organic Carbon	mg/L	-	-	1.5	1.9	2.6	4.6	3.2	3.4	3.1	3.2
	Total Phosphorus	mg/L	0.020[α]	-	0.0059	0.0087	<0.0030	0.0096	0.0033	0.0059	0.0031	0.0108
	Phenols	mg/L	0.004[α]	-	0.0055	0.0070	0.0067	0.0076	0.0041	0.0038	0.0025	0.0067
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.4975	1.91	2.13	36.7	18.4	18.9	17.2	5.11
	Sulphate (SO_4)	mg/L	218[β]	218	4.39	2.98	4.83	18.4	7.84	8.25	7.70	5.29
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0578	0.0137	0.0071	0.031	0.0098	0.0110	0.0154	0.0080
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	0.00014	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00779	0.0109	0.0128	0.0168	0.0163	0.0155	0.0157	0.0142
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00040	<0.00050	<0.00050	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.0003875	<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	0.020	<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
	Calcium (Ca)	mg/L	-	-	12.3	14.2	20.3	34.3	28.3	27.9	28.8	25.2
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	0.00034	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.0010	***0.00228***	***0.00226***	0.0013	0.00194	0.00191	0.00183	0.00156
	Iron (Fe)	mg/L	0.30	0.326	0.051	<0.030	<0.030	***0.459***	0.120	0.112	0.094	<0.030
	Lead (Pb)	mg/L	0.001	0.001	0.000096	<0.000050	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0013	0.0031	0.0037	0.0036	0.0034	0.0016
	Magnesium (Mg)	mg/L	-	-	6.77	8.69	12.9	21.0	15.7	15.9	15.8	15.7
	Manganese (Mn)	mg/L	0.935[β]	-	0.00086	0.000651	0.000694	0.0511	0.0108	0.00822	0.00535	0.00104
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000380	0.000851	0.000647	0.00353	0.00120	0.00115	0.000988	0.000436
	Nickel (Ni)	mg/L	0.025	0.025	0.00056	<0.00050	0.00071	0.00146	0.00103	0.00102	0.00101	0.00066
	Potassium (K)	mg/L	-	-	0.84	2.15	2.05	3.30	2.41	2.35	2.28	1.79
	Selenium (Se)	mg/L	0.001	-	<0.0007625	<0.0010	<0.0010	0.000118	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.95	0.83	1.10	1.22	1.21	1.26	1.30	1.05
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000020	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.830	0.584	1.55	16.3	5.32	5.37	5.10	2.80
	Strontium (Sr)	mg/L	-	-	0.01240	0.00826	0.0106	0.0415	0.0487	0.0460	0.0401	0.0151
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.0000775	<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
	Titanium (Ti)	mg/L	-	-	0.00799	<0.010	<0.010	0.00115	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.00366	0.00399	0.00277	0.0172	0.00580	0.00571	0.00501	0.00236
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.000875	<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	0.0082

[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 tributary system.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

compared to average reference creek station water chemistry at the time of the August 2016 sampling event (Table 3.1; Appendix Tables C.14 and C.16). However, on average, only concentrations of nitrate, chloride, manganese and strontium were elevated at the CLT1 lower main stem (i.e., stations L1-09, L1-05 and L0-01) compared to respective reference creek station average concentrations during the fall sampling event (Appendix Table C.14), reflecting natural dilution of the main stem from the north branch. Similar to the 2015 data, the spatial patterns in the 2016 water quality data suggested a mine-related influence within the CLT1 main stem, whereas at the north branch, only a slight mine-related influence on water quality was evident. Despite evidence of continued mine-related influence on water quality of the CLT1 system, concentrations of all parameters were below applicable WQG and watercourse-specific AEMP benchmarks at CLT1 with the exception of copper concentrations at the north branch, and iron and uranium concentrations at upstream-most Station L2-03 of the main stem[2] (Table 3.1).

Temporal comparisons of the CLT1 north branch water chemistry data indicated that parameter concentrations in fall 2016 were generally within the range of those measured during the mine baseline (2005 – 2013) period with the exception of higher copper concentrations in both 2015 and 2016 (Figure 3.2; Appendix Figure C.2). Temporal comparisons of CLT1 main stem water chemistry data indicated that, of the parameters shown to have elevated concentrations relative to the reference creek stations, hardness and concentrations of TDS, chloride and strontium in 2016 were comparable to or only slightly higher than concentrations during the mine baseline period (Figure 3.2; Appendix Figure C.2). However, conductivity, nitrate, sulphate, iron, manganese, molybdenum, sodium and uranium showed progressively higher concentrations from mine baseline, to construction, to 2015 and/or 2016 mine operational years at all four CLT1 main stem stations (Figure 3.2; Appendix Figure C.2). Higher concentrations of these parameters at the main stem CLT1 stations over time likely reflected greater blasting/excavating activity (including associated dust generation) at mine quarry QMR2, and potentially greater fugitive dust generation from increased truck usage on the mine tote road during mine activities from 2014 - 2016 compared to the baseline period. The QMR2 quarry is used to provide material for mine infrastructure projects (e.g., road construction).

[2] Although phenol concentrations were above WQG at the CLT1 tributaries, all mine lakes (including Camp, Sheardown NW, Sheardown SE and Mary) and Mary River, phenol concentrations were also above WQG at the reference creek stations, Mary River reference stations (i.e., GO-09 series stations) and Reference Lake 3, indicating natural elevation of phenol concentrations in regional water bodies unrelated to mine operations (see Appendix B for additional discussion). Because elevated aqueous phenol concentrations appeared to be a natural phenomenon, no discussion of phenol concentrations was included in comparisons to WQG for the mine-exposed waterbodies in the 2016 CREMP.

Figure 3.2: Temporal comparison of water chemistry at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods during fall. Values represent mean ± SD. Reference creek 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 2.3 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Camp Lake Tributaries.

3.1.1.2 Camp Lake Tributary 2 (CLT2)

Camp Lake Tributary 2 (CLT2) dissolved oxygen saturation levels were consistently high at Station KO-01 in 2016, and were similar to mean DO saturation observed among the reference creek stations (Appendix Tables C.1 – C.3). However, *in-situ* DO concentrations/saturation and pH at CLT2 differed significantly upstream and downstream of the mine tote road, and compared to Unnamed Reference Creek, at the time of biological sampling in August 2016 (Figure 3.3; Appendix Tables C.17). Despite these differences, DO saturation was well above the WQG minimum limit for cold-water biota (i.e., 54%) and pH was consistently within WQG limits at all CLT2 stations during all 2016 sampling events (Figure 3.3; Appendix Tables C.1 to C.3). Therefore, the differences in DO concentrations/saturation and pH between areas within the CLT2 system and at CLT2 compared to Unnamed Reference Creek were not likely to be ecologically meaningful, nor indicate an adverse mine-related influence.

Water chemistry at CLT2 (Station KO-01) was similar to the reference creek stations with the exceptions of slightly higher (i.e., 3- to 5-fold) sulphate and zinc concentrations during the spring and/or summer sampling events in 2016 (Table 3.1; Appendix Table C.14). *In-situ* specific conductance was significantly higher at CLT2 compared to the reference creek, but did not differ significantly upstream and downstream of the mine tote road during the August 2016 sampling event (Figure 3.3). However, aqueous concentrations of all parameters were consistently well below established WQG and AEMP benchmarks at the CLT2 monitoring station in 2016[3] (Table 3.1; Appendix Table C.14). Temporal comparisons of CLT2 water chemistry data indicated that parameter concentrations in fall 2016 were generally within the range of those measured during the mine baseline (2005 – 2013) period and not unlike those observed during the 2014 mine construction and 2015 mine operation periods (Figure 3.2; Appendix Figure C.2). Collectively, the 2016 water chemistry data suggested only minor mine influence on aqueous conductivity, sulphate and/or zinc concentrations within the CLT2 system in 2016.

3.1.2 Phytoplankton

3.1.2.1 Camp Lake Tributary 1 (CLT1)

Camp Lake Tributary 1 (CLT1) north branch chlorophyll a concentrations were lower than the average concentration among reference creek stations for spring, summer and fall seasons in 2016, but were within the overall range of reference creek chlorophyll a concentrations suggesting no marked differences in phytoplankton productivity between the CLT1 north

[3] Refer to Footnote 2 (page 23) and Appendix B regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA waterbodies.

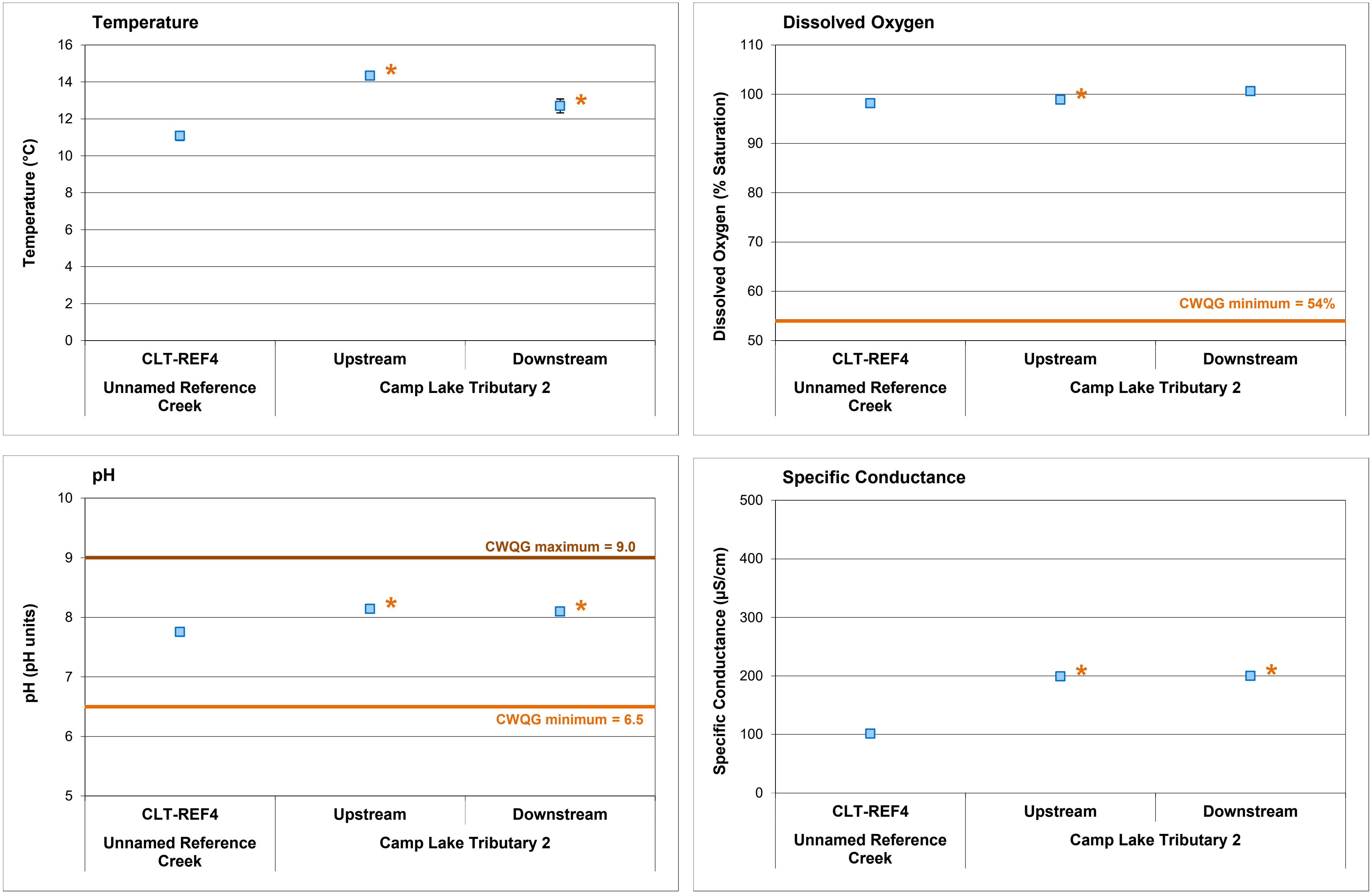


Figure 3.3: Comparison of *in-situ* water quality variables (mean ± SD; n = 5) measured at Camp Lake Tributary 2 benthic invertebrate community stations, Mary River Project CREMP, August 2016. An asterisk (*) next to data point indicates mean value differs significantly from the Unnamed Reference Creek mean.

branch and the reference creek stations (Figure 3.4). Within the CLT1 main stem, chlorophyll a concentrations were consistently highest at upstream-most Station L2-03, with concentrations at this station also consistently greater than at the reference creek stations in 2016. Downstream of the north branch confluence, beginning at Station L1-09, chlorophyll a concentrations were comparable to, or slightly greater than, those at the reference creek stations (Figure 3.4). 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 2016 (Figure 3.4). Similar to the reference creek stations, chlorophyll a concentrations observed at all CLT1 stations in 2016 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 for CLT1 based on mean aqueous total phosphorus concentrations less than 10 µg/L during all spring, summer and fall sampling events (Table 3.1; Appendix Table C.14).

Temporal comparisons of the CLT1 chlorophyll a data indicated that concentrations at the north branch in 2015 and 2016 mine operation years were similar to, or lower than, those observed during the baseline (2005 – 2013) period (Figure 3.5). However, at the CLT1 main stem, chlorophyll a concentrations were generally higher in 2015/2016 than during the mine baseline period with the exception of at the CLT1 mouth (Station L0-01; Figure 3.5). The spatial and temporal analyses of chlorophyll a concentrations at CLT1 suggested that mine operation may have contributed to slightly higher phytoplankton productivity within the upper main stem (i.e., Station L2-03), but not at the north branch or at the lower main stem stations. As described in the 2015 CREMP, higher phytoplankton productivity within the CLT1 upper main stem was consistent with the occurrence of elevated aqueous nutrient (e.g., ammonia, nitrate) concentrations in the 2015/2016 (see Section 3.1.1). This suggested that slightly greater phytoplankton productivity at Station L2-03 in 2016 was the result of current mine operations and specifically, the introduction of nutrients to the CLT1 system as a result of active quarrying at the QMR2 pit.

3.1.2.2 Camp Lake Tributary 2 (CLT2)

Camp Lake Tributary 2 (CLT2; Station KO-01) chlorophyll a concentrations were consistently low, but within the range observed among the reference creek stations during individual spring, summer and fall seasonal sampling events in 2016 (Figure 3.4). The CLT2 chlorophyll a concentrations also met the AEMP benchmark of less than 3.7 µg/L for all 2016 sampling events. Low phytoplankton productivity, indicative of oligotrophic conditions, was suggested at CLT2 based on comparison of chlorophyll a concentrations to Dodds et al (1998) trophic

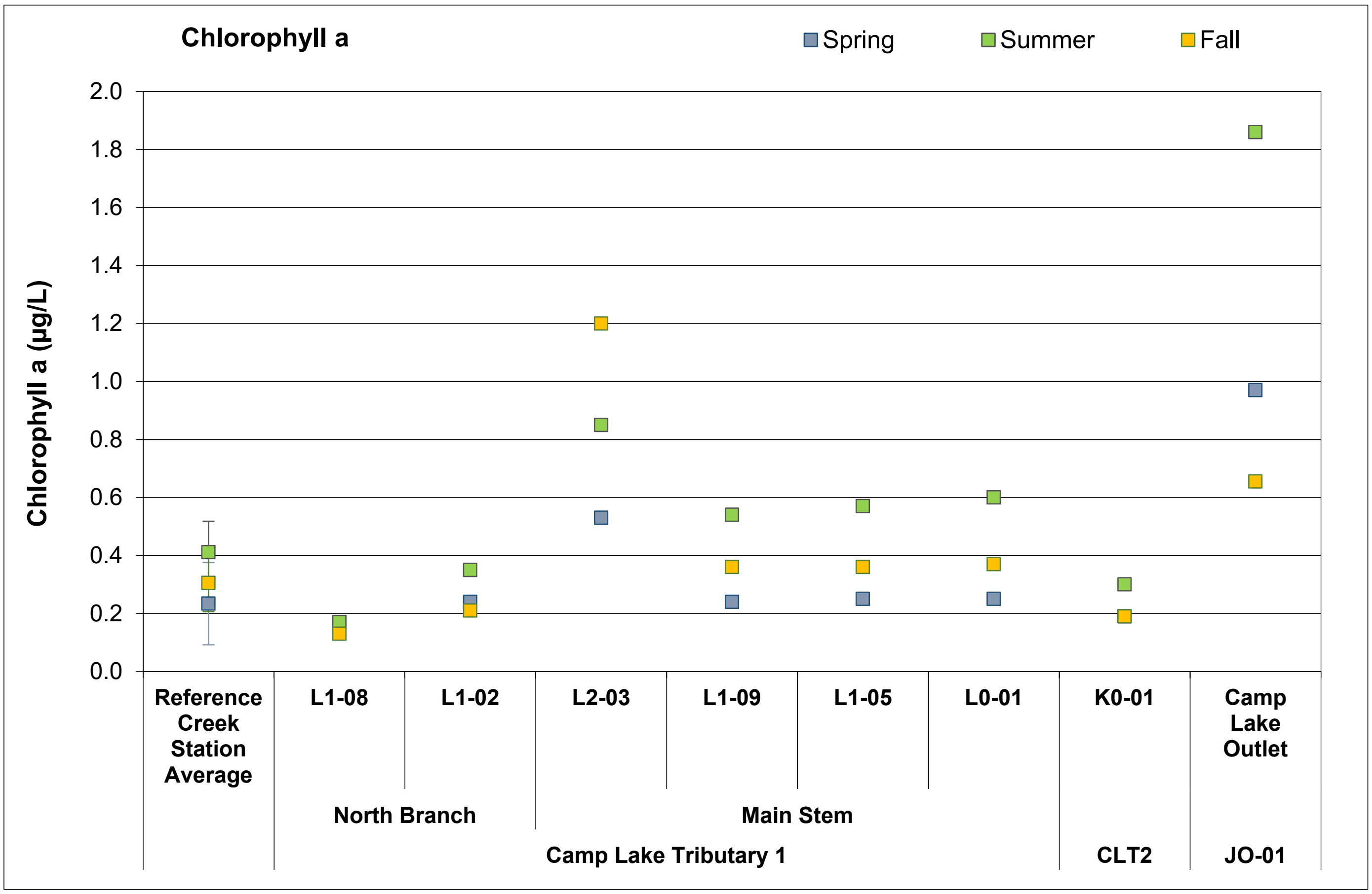


Figure 3.4: Chlorophyll a concentrations at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) phytoplankton monitoring stations, Mary River Project CREMP, 2016. Reference creek stations include the CLT-REF and MRY-REF series (mean ± SD; n = 4).

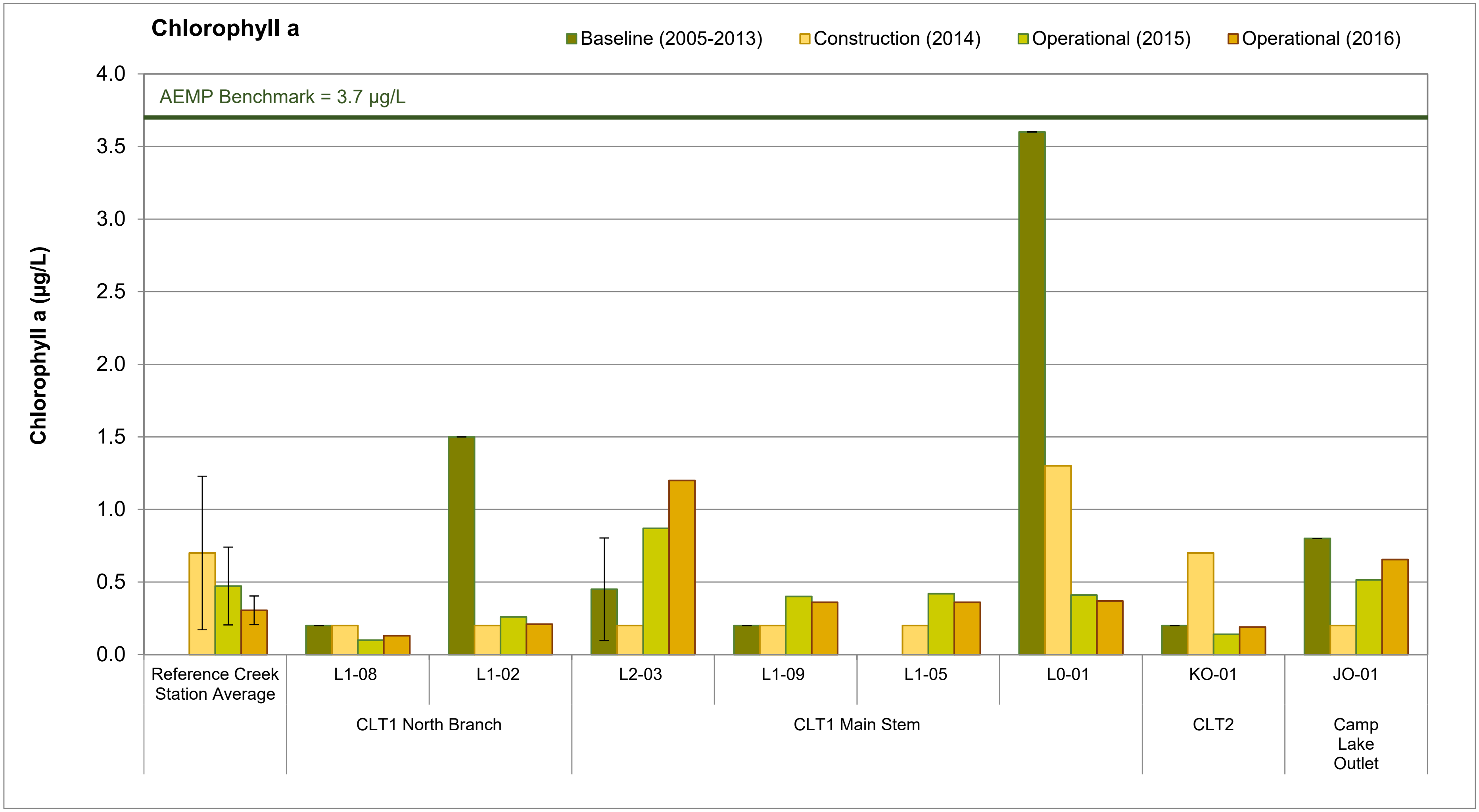


Figure 3.5: Temporal comparison of chlorophyll a concentrations at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods during fall, Mary River Project CREMP. The reference creek stations include the CLT-REF and MRY-REF series (mean ± SD; n = 4).

status classification for creek environments. This productivity classification was supported by a WQG categorization of ultra-oligotrophic to oligotrophic based on mean aqueous 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 of the CLT2 chlorophyll a data indicated that the 2015 and 2016 chlorophyll a concentrations were similar to those during the mine baseline period (Figure 3.5). Overall, no mine-related influences to phytoplankton density at CLT2 were suggested by the 2016 chlorophyll a concentration data.

3.1.3 Benthic Invertebrate Community

3.1.3.1 Camp Lake Tributary 1 (CLT1)

North Branch (CLT1 US)

Benthic invertebrate density and Simpson's Evenness did not differ significantly between the CLT1 north branch and Unnamed Reference Creek (Table 3.2). However, in addition to significantly lower richness at the CLT1 north branch compared to Unnamed Reference Creek, differences in community assemblage were suggested between watercourses based on significant differences in Bray-Curtis Index (Table 3.2). Notably, the relative abundance of metal-sensitive chironomids did not differ significantly between the CLT1 north branch and Unnamed Reference Creek, suggesting that the community composition differences between watercourses was unrelated to metal concentrations. Rather, a significantly higher proportion of the shredder functional feeding group (FFG) at the CLT1 north branch suggested the presence of greater amounts of living and/or decomposing large leafy/woody vegetation compared to Unnamed Reference Creek, which was consistent with field observations of bryophyte abundance between watercourses in 2016 (Appendix Tables F.1 and F.7). Temporal comparisons of the CLT1 north branch benthic invertebrate community data indicated that density, richness, Simpson's Evenness and relative abundance of key dominant groups and FFG in 2016 did not show any consistent type and/or direction of significant differences compared to baseline data collected in 2007 and 2011 (Figure 3.6; Appendix Table F.8). Overall, no adverse mine-related influences on benthic invertebrate community features were indicated at the CLT1 north branch in 2016 based on comparisons to 2016 reference creek data and to historical 2007 and 2011 baseline data.

Upper Main Stem (CLT1 L2)

The benthic invertebrate community of upper main stem of Camp Lake Tributary (CLT1 L2), which is located near the QMR2 mine quarry, showed significantly higher benthic invertebrate density and significant differences in community composition (as indicated by Bray-Curtis

Table 3.2: Benthic invertebrate community statistical comparison results among Camp Lake Tributary 1 and Unnamed Reference Creek study areas, Mary River Project CREMP, August 2016.

Metric	Overall four-group ANOVA[a]			ANOVA Comparison to Reference				
	Significant Difference Among Areas?	p-value	Statistical Test	CLT1 Study Area	Significantly Different from Reference?	p-value	Magnitude of Difference (no. of SD)[b]	*Post-hoc* Statistical Test
Density (No. organisms/ m^2)	YES	0.0000	α , δ	Upstream (North Branch)	NO	1.0000	-	Tamhane's
				L2 (Upper Main Stem)	YES	0.0025	9.8	
				Downstream (Lower Main Stem)	NO	0.7027	-	
Richness (Number of Taxa)	YES	0.0005	α , δ	Upstream (North Branch)	YES	0.0045	-5.1	Tukey's HSD
				L2 (Upper Main Stem)	NO	0.6133	-	
				Downstream (Lower Main Stem)	NO	0.5090	-	
Simpson's Evenness	NO	0.6326	α , δ	Upstream (North Branch)	NO	0.8334	-	Tukey's HSD
				L2 (Upper Main Stem)	NO	0.9819	-	
				Downstream (Lower Main Stem)	NO	0.9962	-	
Bray-Curtis Index	YES	0.0000	α , δ	Upstream (North Branch)	YES	0.0000	2.6	Tukey's HSD
				L2 (Upper Main Stem)	YES	0.0000	4.6	
				Downstream (Lower Main Stem)	YES	0.0000	3.6	
Oligochaeta (% of Community)	YES	0.0001	β , δ	Upstream (North Branch)	NO	0.1554	-	Tamhane's
				L2 (Upper Main Stem)	NO	0.1762	-	
				Downstream (Lower Main Stem)	YES	0.0099	14.0	
Hydracarina (% of Community)	YES	0.0000	β , δ	Upstream (North Branch)	NO	0.7896	-	Tukey's HSD
				L2 (Upper Main Stem)	YES	0.0114	3.2	
				Downstream (Lower Main Stem)	***YES***	***0.0027***	***-1.9***	
Chironomidae (% of Community)	NO	0.3439	β , δ	Upstream (North Branch)	NO	0.9884	-	Tukey's HSD
				L2 (Upper Main Stem)	NO	0.5414	-	
				Downstream (Lower Main Stem)	NO	0.9665	-	
Metal-Sensitive Chironomidae (%)	YES	0.0011	β , δ	Upstream (North Branch)	NO	0.9572	-	Tukey's HSD
				L2 (Upper Main Stem)	YES	0.0322	3.6	
				Downstream (Lower Main Stem)	NO	0.2631	-	
Tipulidae (% of Community)	YES	0.0002	β , δ	Upstream (North Branch)	NO	0.2555	-	Tukey's HSD
				L2 (Upper Main Stem)	***YES***	***0.0053***	***-1.5***	
				Downstream (Lower Main Stem)	NO	0.9621	-	

[a] Data analysis included: α - data untransformed; β - data logit transformed; ε - data log transformed; δ - single factor ANOVA test; γ - ANOVA test validated using Kruskal-Wallis H- or Mann Whitney U-test.

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

(grey box) Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10 that were also outside of a CES of ±2 SD, suggesting an ecologically meaningful difference.

BOLD Bold text values indicate significant differences between study areas based on ANOVA p-value less than 0.10, but a Critical Effect Size within ±2 SD, suggesting the difference is not ecologically meaningful.

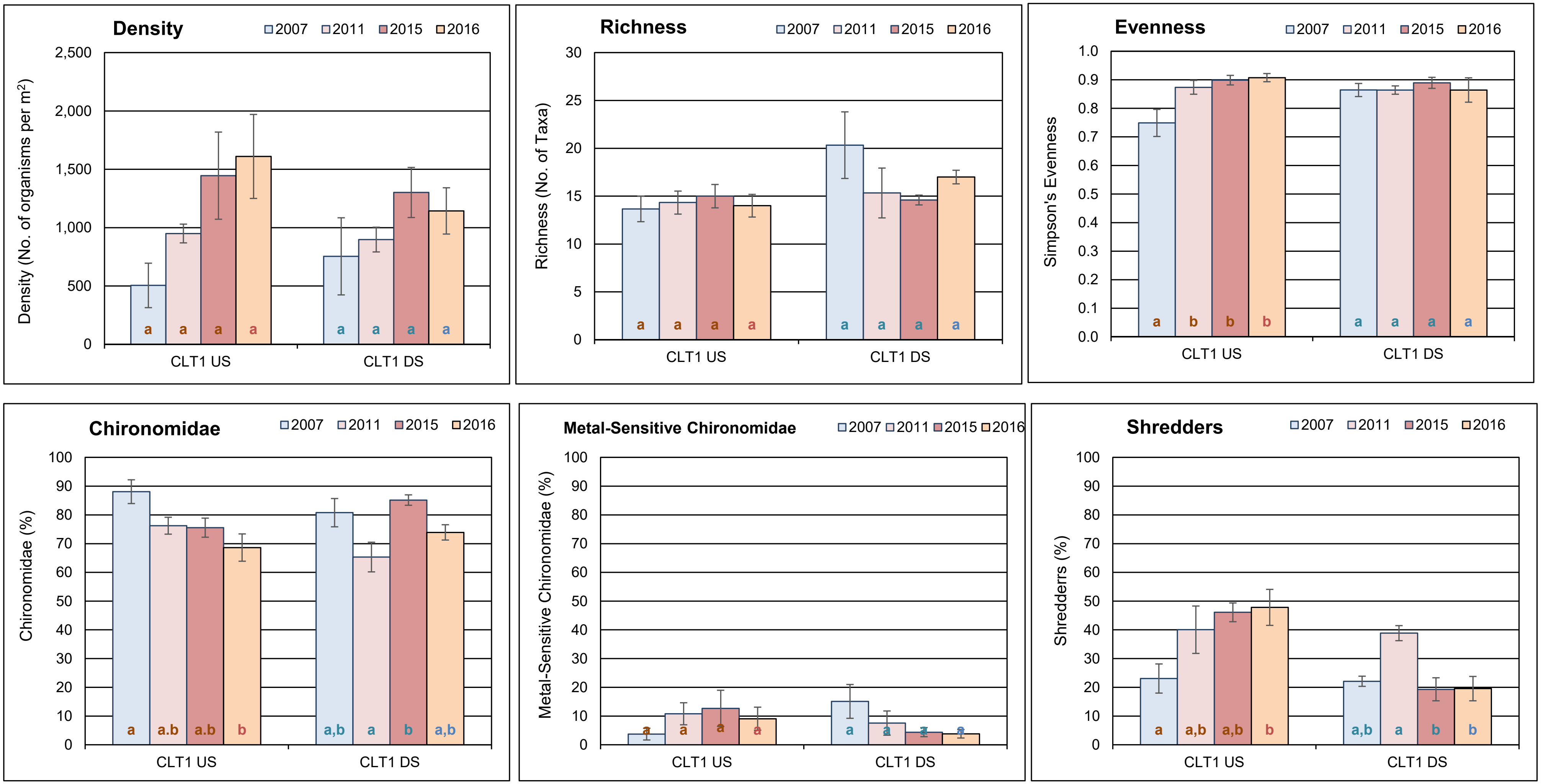


Figure 3.6: Comparison of key benthic invertebrate metrics (mean ± SE) at Camp Lake Tributary 1 stations among mine baseline (2007, 2011) and operational (2015, 2016) periods, Mary River Project CREMP, 2016. The same like-coloured letter inside bars indicate no significant difference between study years.

Index) compared to Unnnamed Reference Creek in 2016 (Table 3.2; Appendix Table F.7). Compositionally, the relative abundances of Hydracarina (water mites) and metal-sensitive chironomids were significantly higher at the CLT1 upper main stem than at Unnamed Reference Creek (Table 3.2; Appendix Table F.7). High relative abundance of metal-sensitive chironomids at the CLT1 upper main stem area, despite highest aqueous concentrations of metals within the Camp Lake system (Figure 3.2; Appendix Figure C.2), was consistent with concentrations of most metals below WQG at this area (see Appendix Table C.14). In addition, high relative abundance of metal-sensitive chironomids at the CLT1 upper main stem suggested that iron and uranium, which were observed at concentrations above WQG at this area (see Appendix Table C.14), were in forms that were not highly bioavailable. Other notable community compositional differences, including significantly higher and lower relative abundance of filterer and shredder FFG, respectively, at the CLT1 upper main stem compared to Unnamed Reference Creek (Appendix Table F.7), suggested a shift in dominant food resource at the CLT1 upper main stem. Specifically, a relatively high abundance of filterers at the CLT1 upper main stem suggested a greater reliance upon food resources suspended in the water column, including phytoplankton and fine particulate organic matter, than at Unnamed Reference Creek. These results were consistent with occurrence of relatively high chlorophyll a concentrations at the CLT1 upper main stem compared to the other CLT1 stations and the reference creeks (see Section 3.1.1.1). Collectively, the combination of relatively high benthic invertebrate density, richness (compared to the CLT1 north branch; Table 3.2; Appendix Table F.7) and proportion of the filterer FFG, together with relatively high chlorophyll a and aqueous nitrate concentrations, was consistent with a slight, mine-related enrichment effect on the benthic invertebrate community at the CLT1 upper main stem in 2016.

Despite suggestion of a mine-related enrichment influence at the CLT1 upper main stem, temporal comparisons did not indicate significant differences in benthic invertebrate density, richness, Simpson's Evenness and relative abundance of key dominant groups and FFG in 2016 compared to baseline data collected in 2007 (Figure 3.6; Appendix Table F.9). In turn, this suggested that benthic invertebrate community features at the CLT1 upper main stem in 2016 had not changed appreciably from the pre-mine operation period, and that differences in community composition relative to reference conditions may reflect natural phenomena.

Lower Main Stem (CLT1 DS)

The benthic invertebrate community at the lower main stem of Camp Lake Tributary (CLT1 DS), just downstream of the mine tote road, showed no significant, ecologically meaningful, differences in density, richness and Simpson's Evenness compared to Unnamed Reference Creek (Table 3.2; Appendix Table F.7). Nevertheless, the benthic invertebrate community assemblage at the CLT1 lower main stem differed from the reference areas based on significant differences in Bray-Curtis Index and composition of dominant invertebrate groups, FFG and habit preference groups (HPG; Table 3.2). Because no significant difference in the relative abundance of metal-sensitive chironomids was indicated between the CLT1 lower main stem and reference area (Table 3.2), the community composition differences between the mine-exposed and reference areas appeared to be unrelated to metal concentrations. Rather, the key differences in benthic invertebrate composition between areas, which included a significantly lower proportion of the collector-gatherer FFG and the clinger HPG at the CLT1 lower main stem, may have reflected greater reliance on interstitially deposited particulate organic matter food resources compared to a heavier reliance on in-stream vegetation as a food source at the reference area. Because substrate with significantly smaller diameter was sampled at the CLT1 lower main stem compared to Unnamed Reference Creek (Appendix Tables F.3 and F.4), differences in habitat may have also contributed to the indicated differences in benthic invertebrate community compositional features between areas.

Temporal comparison of the CLT1 lower main stem data indicated no significant differences in benthic invertebrate density, richness, Simpson's Evenness or the proportion of metal-sensitive chironomids between individual years of mine operation (2015, 2016) and the mine baseline (2007, 2011 data) period (Figure 3.6; Appendix Table F.10). In addition, no consistent types and/or direction of differences in the relative abundance of dominant groups or FFG were indicated between 2016 and years in which baseline data were collected at the CLT1 lower main stem (Figure 3.6; Appendix Table F.10). Overall, these results suggested no substantial changes in benthic invertebrate community features between the mine operational and mine baseline periods at the CLT1 lower main stem.

3.1.3.2 Camp Lake Tributary 2

At Camp Lake Tributary 2 (CLT2), sampling was conducted upstream and downstream of the mine tote road (areas CLT2 US and CLT2 DS, respectively) to assess for potential mine-related influences to the benthic invertebrate community. Benthic invertebrate density was significantly lower at both CLT2 study areas compared to Unnamed Reference Creek (Table 3.3). In addition, differences in community composition were indicated by significantly higher Bray-Curtis Index at both CLT2 study areas compared to the Unnamed Reference Creek. A significantly lower relative abundance of Hydracarina (water mites) and HPG clingers occurred at both CLT2 study areas compared to Unnamed Reference Creek (Table 3.3). Significantly lower relative abundance of chironomids and significantly higher relative abundance of FFG collector-gatherers and HPG sprawlers was also indicated at the CLT2 downstream area compared to Unnamed Reference Creek (Table 3.3; Appendix Table F.14).

Table 3.3: Benthic invertebrate community statistical comparison results among Camp Lake Tributary 2 and Unnamed Reference Creek study areas, Mary River Project CREMP, August 2016.

Season	Overall 3-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]					
	Significant Difference Among Areas?	p-value	Statistical Test[b]	Area	Mean Value	(I) Area	(J) Area	Significant Difference Between Areas?	p-value	Magnitude of Difference	Statistical Test
Density (No. organisms/ m^2)	YES	0.00008	α	Reference	1,645	Reference	CLT2 US	YES	0.0311	-2.0	Tamhane's (α)
				CLT2 Upstream	412	Reference	CLT2 DS	YES	0.0188	-2.3	
				CLT2 Downstream	205	CLT2 US	CLT2 DS	YES	0.0187	-2.1	
Richness (Number of Taxa)	NO	0.10651	α , γ	Reference	18.6	Reference	CLT2 US	NO	0.7365	-	Tamhane's (α)
				CLT2 Upstream	17.2	Reference	CLT2 DS	NO	0.1708	-	
				CLT2 Downstream	14.0	CLT2 US	CLT2 DS	NO	0.4707	-	
Simpson's Evenness	NO	0.35742	α	Reference	0.873	Reference	CLT2 US	NO	0.8111	-	Tukey's (α)
				CLT2 Upstream	0.898	Reference	CLT2 DS	NO	0.6688	-	
				CLT2 Downstream	0.838	CLT2 US	CLT2 DS	NO	0.3291	-	
Bray-Curtis Index	YES	0.00000	α	Reference	0.237	Reference	CLT2 US	YES	0.0000	3.8	Tukey's (α)
				CLT2 Upstream	0.726	Reference	CLT2 DS	YES	0.0000	4.7	
				CLT2 Downstream	0.844	CLT2 US	CLT2 DS	NO	0.1376	-	
Oligochaeta (% of Community)	YES	0.08905	β	Reference	2.5%	Reference	CLT2 US	NO	0.6686	-	Tamhane's (β)
				CLT2 Upstream	4.9%	Reference	CLT2 DS	NO	0.4703	-	
				CLT2 Downstream	1.9%	CLT2 US	CLT2 DS	NO	0.2621	-	
Hydracarina (% of Community)	YES	0.00630	β	Reference	11.7%	Reference	CLT2 US	***YES***	***0.0220***	***-1.7***	Tukey's (β)
				CLT2 Upstream	5.5%	Reference	CLT2 DS	***YES***	***0.0078***	***-1.9***	
				CLT2 Downstream	4.5%	CLT2 US	CLT2 DS	NO	0.8324	-	
Chironomidae (% of Community)	YES	0.09836	β	Reference	70.8%	Reference	CLT2 US	NO	0.2460	-	Tukey's (β)
				CLT2 Upstream	79.5%	Reference	CLT2 DS	***YES***	***0.0955***	***1.3***	
				CLT2 Downstream	82.4%	CLT2 US	CLT2 DS	NO	0.8252	-	
Metal-Sensitive Chironomidae (%)	NO	0.30569	β	Reference	8.9%	Reference	CLT2 US	NO	0.2847	-	Tukey's (β)
				CLT2 Upstream	5.3%	Reference	CLT2 DS	NO	0.5718	-	
				CLT2 Downstream	5.4%	CLT2 US	CLT2 DS	NO	0.8413	-	
Tipulidae (% of Community)	NO	0.20459	β	Reference	4.3%	Reference	CLT2 US	NO	0.9992	-	Tukey's (β)
				CLT2 Upstream	4.0%	Reference	CLT2 DS	NO	0.2706	-	
				CLT2 Downstream	2.2%	CLT2 US	CLT2 DS	NO	0.2564	-	

[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 logit transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

(grey box) Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10 that were also outside of a CES of ±2 SD, suggesting an ecologically meaningful difference.

BOLD Bold text values indicate significant differences between study areas based on ANOVA p-value less than 0.10, but a Critical Effect Size within ±2 SD, suggesting the difference is not ecologically meaningful.

In addition to a greater number of differences, the magnitude of these differences (compared to Unnamed Reference Creek) was greater at the CLT2 downstream area than at the upstream area, potentially indicating that the mine tote road had a greater influence on benthic invertebrates within CLT2 (Table 3.3; Appendix Table F.14). However, differences in habitat features that included significantly greater water velocity and less in-stream vegetation (Appendix Tables F.1, F.3 and F.4) potentially accounted for lower benthic invertebrate density and relative abundance of water mites and other HPG clinger taxa at the CLT2 study areas compared to the Unnamed Reference Creek. In part, this was supported by the lack of significant differences in richness, Simpson's Evenness, and relative abundance of all dominant invertebrate groups, FFG and HPG between the CLT2 upstream and downstream areas (Table 3.3; Appendix Table F.14).

Temporal comparisons indicated no significant differences in any benthic invertebrate community endpoints, including the relative abundance of all dominant invertebrate groups and FFG, at both CLT2 study areas in 2016 compared to 2007 baseline data with the exception of Simpson's Evenness (Figure 3.7; Appendix Tables F.15 and F.16.). Because high Simpson's Evenness is normally associated with a diverse, healthy benthic invertebrate community, the occurrence of significantly higher Simpson's Evenness at CLT2 in 2016 compared to 2007 was not consistent with an adverse influence related to recent mine operations. These results suggested that differences in benthic invertebrate community features between CLT2 and Unnamed Reference Creek in 2016 were most likely related to natural differences in habitat between watercourses, and that no appreciable changes to the benthic invertebrate community of CLT2 have occurred since commercial mine operations commenced in 2014.

3.2 Camp Lake (JLO)

3.2.1 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 2016[4] (Appendix Figures C.3 - C.6). Camp Lake water temperature profiles in 2016 suggested no thermal stratification during the winter and summer sampling events, but weak stratification during fall sampling that mirrored the fall temperature profile pattern at Reference Lake 3 (Figure 3.8). On average, water temperature near the bottom of the water column at

[4] The summer 2016 data suggested considerable variation among Camp Lake stations, but review of field collection notes suggested that this variation likely reflected meter calibration-related differences between sampling dates.

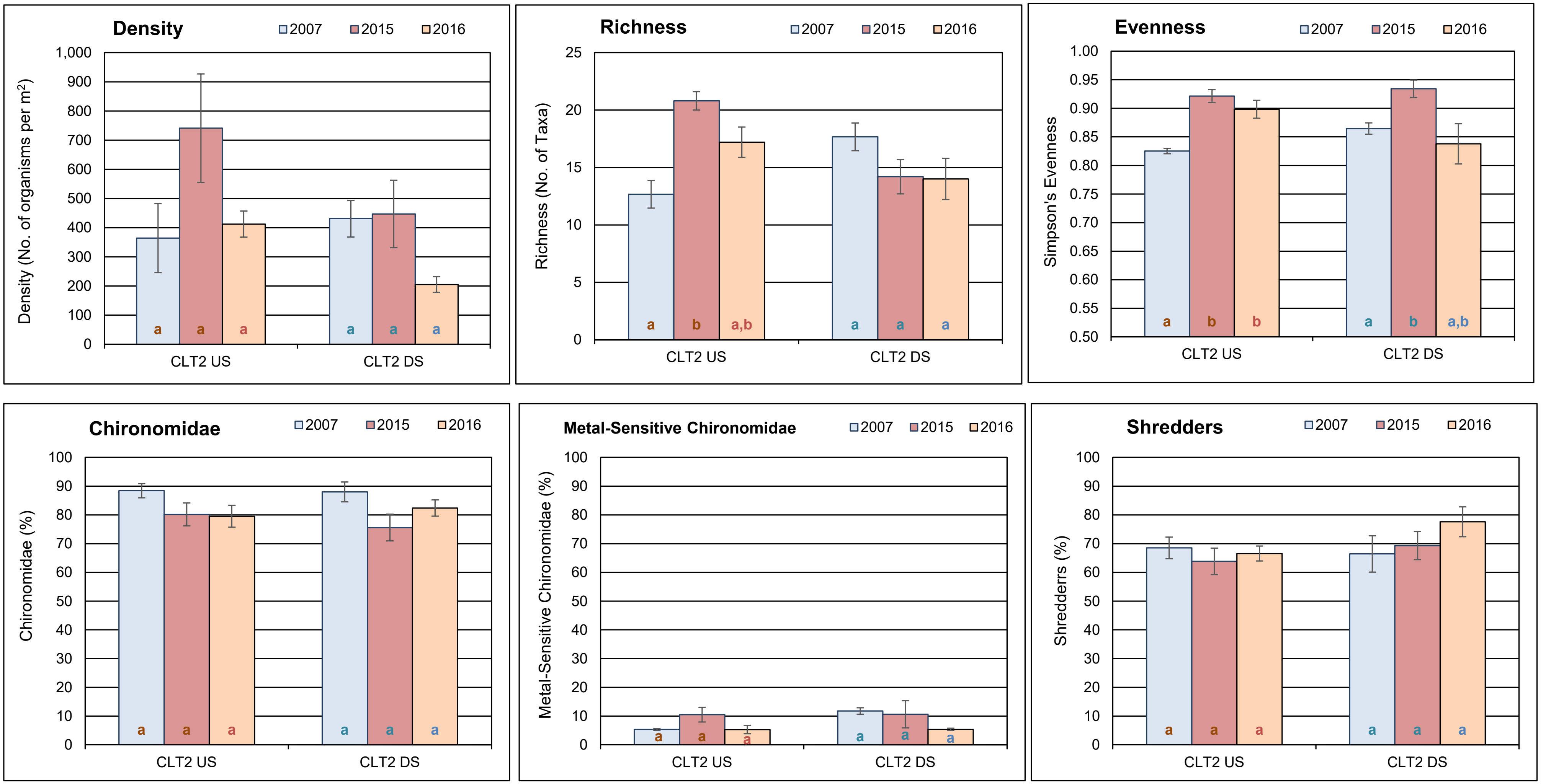
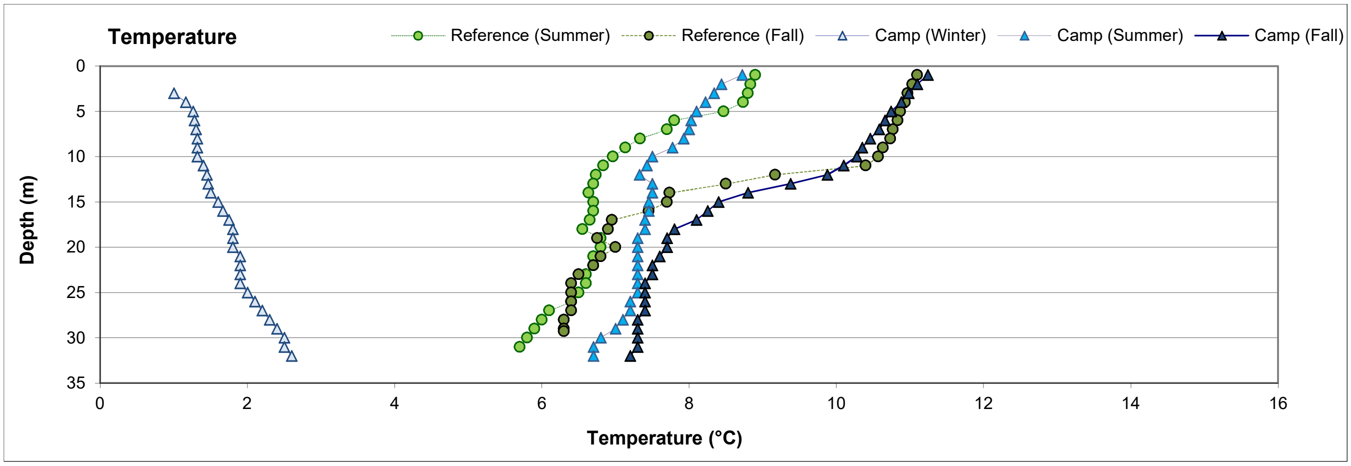
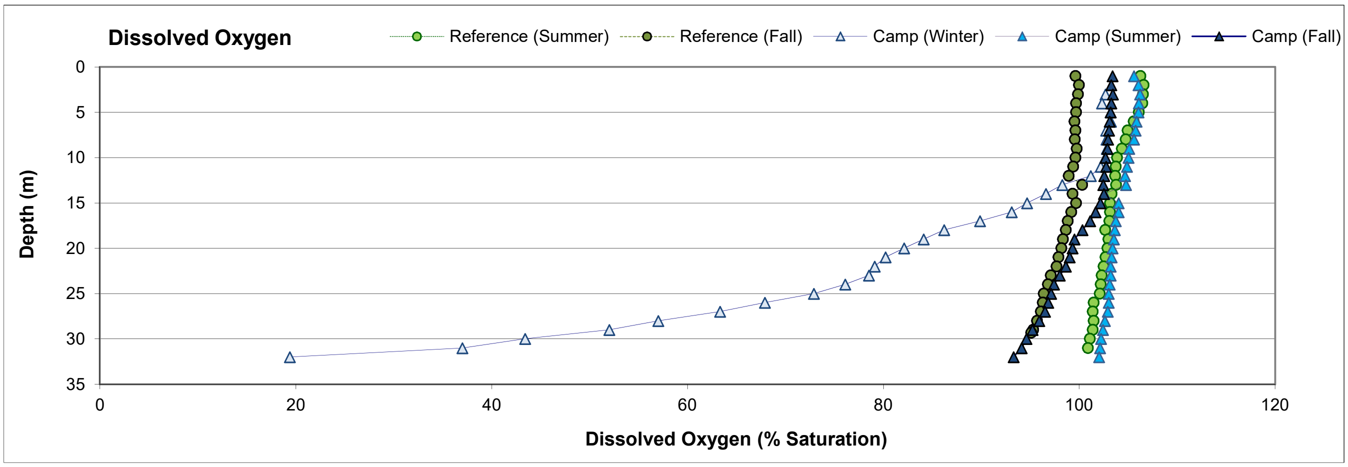
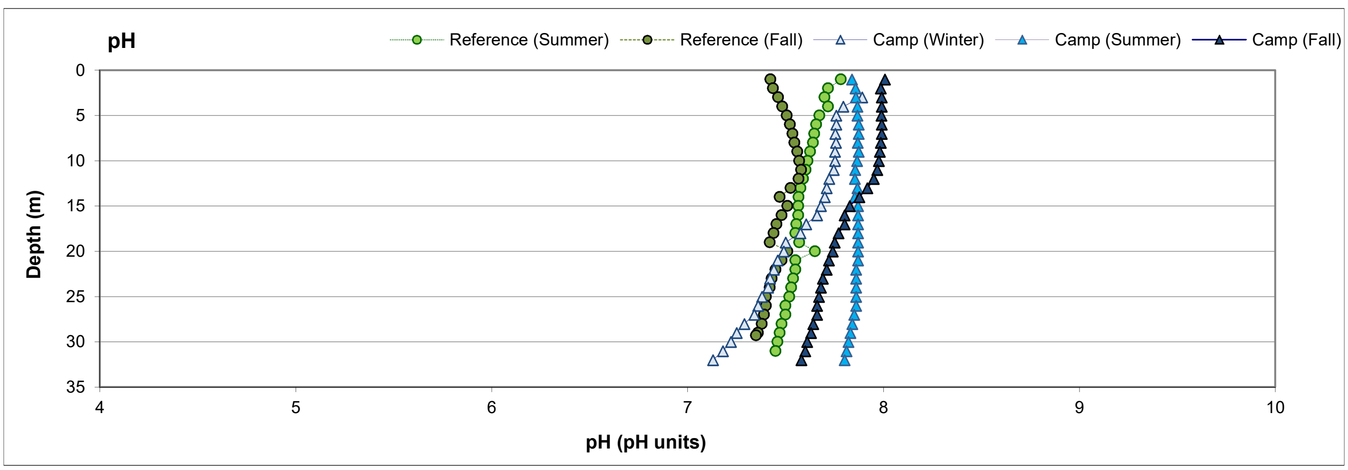


Figure 3.7: Comparison of key benthic invertebrate metrics (mean ± SE) at Camp Lake Tributary 2 stations among mine baseline (2007, 2011) and operational (2015, 2016) periods, Mary River Project CREMP, 2016. The same like-coloured letter inside bars indicate no significant difference between study years.







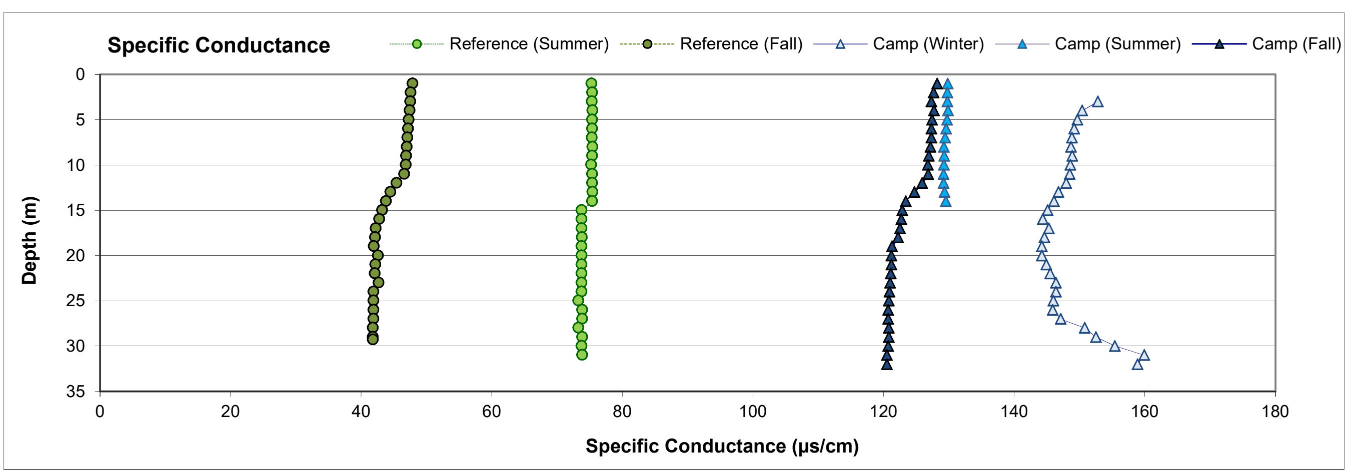


Figure 3.8: Average *in-situ* water quality with depth from surface at Camp Lake (mine-exposed area) compared to Reference Lake 3 during winter, summer, and fall sampling events, Mary River Project CREMP, 2016.

littoral stations of Camp Lake was significantly cooler than at Reference Lake 3 (Figure 3.9; Appendix Tables C.22 – C.23). Although cooler bottom water temperatures at Camp Lake littoral stations may have reflected greater station depth compared to the reference lake, the small incremental difference in water temperature (i.e., 0.7˚C) was unlikely to result in meaningful ecological differences between lakes. Dissolved oxygen profiles conducted at Camp Lake in 2016 showed declining saturation levels with increased depth beginning at approximately 12 m below surface in the winter, but otherwise showed no appreciable changes from surface to bottom during summer or fall 2016, mirroring the dissolved oxygen profiles at Reference Lake 3 (Figure 3.8) and observations from Camp Lake in 2015. Dissolved oxygen conditions near the bottom of the water column at littoral sampling depths of Camp Lake were fully saturated, and significantly higher than at Reference Lake 3 during fall sampling in 2016 (Figure 3.9; Appendix Table C.23). In addition, dissolved oxygen saturation at Camp Lake was typically well above the WQG minimum for the protection of cold water biota (i.e., 54%) during all seasonal sampling events in 2016 except at water depths greater than approximately 30 m in winter (Figures 3.8 and 3.9). This suggested that dissolved oxygen concentrations were not likely to be limiting to biota at Camp Lake for the entire lake volume for the majority of the year.

In-situ profiles of pH and specific conductance showed no substantial change from the surface to bottom of the Camp Lake water column, indicating the absence of any chemical stratification (Figure 3.8). Although the bottom pH at littoral stations of Camp Lake was significantly higher than at the reference lake during the fall sampling event (Appendix Tables C.22 – C.23), the mean incremental difference between lakes was very small (i.e., 0.3 pH units) and all pH values were consistently within WQG limits (Figure 3.9), suggesting that the pH difference between lakes was not ecologically meaningful. Specific conductance was significantly higher at Camp Lake compared to the reference lake during fall sampling in 2016 (Figure 3.9). However, because mean specific conductance at Camp Lake was intermediate to that of the reference creek and river stations, the occurrence of higher specific conductance at Camp Lake compared to the reference lake likely reflected natural phenomena. Secchi depth readings, which served as a proxy for water clarity, were significantly lower (i.e., shallower) at Camp Lake compared to Reference Lake 3 during the 2016 fall sampling event (Appendix Tables C.22 – C.23). No spatial gradient in Secchi depth readings was apparent with progression from the CLT inlet to the lake outlet stations in fall 2016 at Camp Lake (Appendix Table C.21).

Water chemistry data collected at Camp Lake in 2016 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 in 2016 (Table 3.4; Appendix Table C.24), suggesting that the lake waters

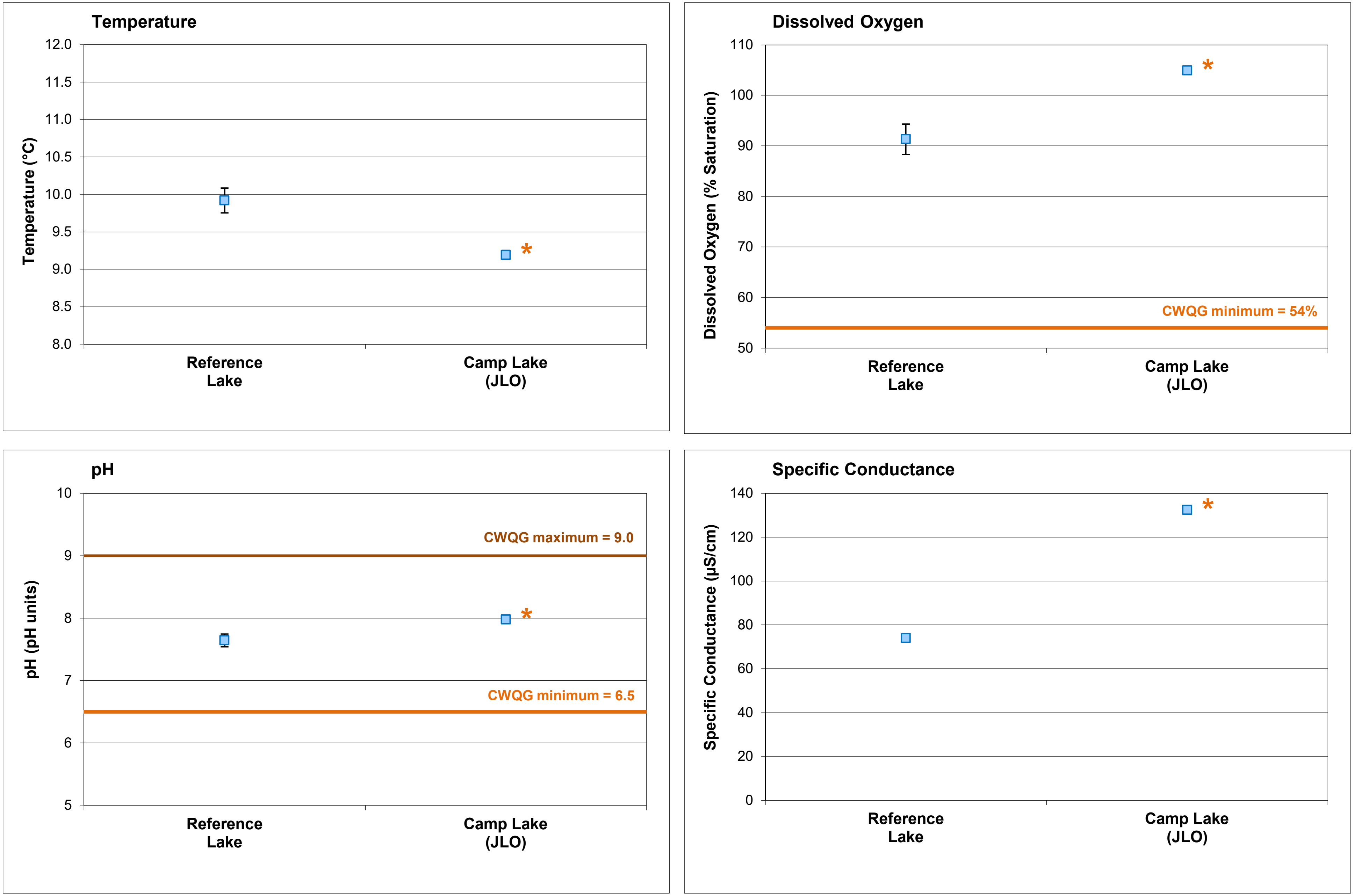


Figure 3.9: Comparison of in-situ water quality variables (mean ± SD; n = 5) measured near the bottom of the water column at Camp Lake (JLO) and Reference Lake 3 (REF3) littoral benthic invertebrate community stations, Mary River Project CREMP, August 2016. An asterisk (*) next to the Camp Lake data point indicates a significant difference compared to the reference lake measure.

Table 3.4: Water chemistry at Camp Lake (JLO) and Reference Lake 3 (REF3) monitoring stations, Mary River Project CREMP, August 2016. Values are averages of samples taken from the surface and the bottom of the water column at each station.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Reference Lake 3 Average (n = 3) Fall 2016	Camp Lake Stations JL0-02 22-Aug-16	JL0-10 22-Aug-16	JL0-01 22-Aug-16	JL0-07 22-Aug-16	JL0-09 22-Aug-16	J0-01 Camp Lake Outlet 20-Aug-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	84	139	139	135	136	136	137
	pH (lab)	pH	6.5 - 9.0	-	7.68	8.11	8.11	8.04	8.00	8.07	8.01
	Hardness (as $CaCO_3$)	mg/L	-	-	35	65	67	64	65	66	67
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	2.45	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	39	76	73	64	71	74	67
	Turbidity	NTU	-	-	0.33	0.47	0.43	0.72	0.47	0.47	0.40
	Alkalinity (as $CaCO_3$)	mg/L	-	-	33	65	61	65	65	67	64
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.040	<0.020	<0.020	0.042	0.030	<0.020	<0.020
	Nitrate	mg/L	13	13	<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
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.7	1.7	1.65	1.55	1.8	1.7	1.7
	Total Organic Carbon	mg/L	-	-	2.8	2.4	1.8	1.725	2.1	2.4	2.0
	Total Phosphorus	mg/L	0.020[α]	-	0.0099	0.0037	0.0059	0.0036	0.0045	0.0069	0.0039
	Phenols	mg/L	0.004[α]	-	0.0031	0.0015	0.0011	0.0017	0.0012	0.0061	0.0038
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	1.27	3.63	3.49	3.39	3.50	3.42	3.47
	Sulphate (SO_4)	mg/L	218[β]	218	4.1	2.3	2.2	2.1	2.1	2.1	2.2
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0042	0.0062	0.0050	0.0042	0.0052	0.0050	0.0047
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00653	0.00678	0.00644	0.00616	0.00657	0.00634	0.00663
	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	<0.010	<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
	Calcium (Ca)	mg/L	-	-	7.0	13.7	13.5	13.3	13.2	13.2	13.3
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.00082	0.00101	0.00084	0.00080	0.00093	0.00084	0.00082
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.094
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	0.0014	0.0013	0.0013	0.0013	0.0012	0.0011
	Magnesium (Mg)	mg/L	-	-	4.3	8.2	8.0	7.6	7.8	8.0	8.2
	Manganese (Mn)	mg/L	0.935[β]	-	0.00062	0.00146	0.00138	0.00153	0.00171	0.00154	0.00277
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00014	0.00026	0.00026	0.00025	0.00025	0.00026	0.00027
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00059	0.00061	0.00058	0.00060	0.00060	0.00073
	Potassium (K)	mg/L	-	-	0.9	1.1	1.1	1.0	1.1	1.1	1.0
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.42	0.36	0.34	0.35	0.41	0.36	0.38
	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	-	-	0.84	1.44	1.36	1.33	1.45	1.40	1.36
	Strontium (Sr)	mg/L	-	-	0.0081	0.0106	0.0103	0.0100	0.0100	0.0100	0.0098
	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	-	0.000270	0.0008175	0.0007745	0.00073275	0.000711	0.00075	0.000782
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

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

BOLD Indicates parameter concentration above the applicable AEMP benchmark.

were well mixed laterally. Only a slight elevation (i.e., 3- to 5-fold higher) in manganese concentrations was evident at Camp Lake compared to the reference lake during the summer 2016 sampling event (Table 3.4; Appendix Table C.26). Concentrations of manganese, together with aluminum, showed a significant positive correlation with turbidity at Camp Lake using all 2016 data ($r = 0.52$ and 0.65, respectively), suggesting that these metals were largely associated with suspended particulate material in Camp Lake and thus were unlikely to be bioavailable. Notably, concentrations of all parameters were well below established WQG and AEMP benchmarks at Camp Lake during all sampling events in 2016[5] (Table 3.4; Appendix Table C.24), further indicating that parameter concentrations at Camp Lake were unlikely to adversely affect biota.

Temporal comparisons of Camp Lake water chemistry data indicated that, of the parameters shown to be elevated at CLT1 in 2016, only conductivity and concentrations of chloride, molybdenum, sodium, strontium and uranium showed continuous increases over the mine baseline, construction and operational periods (Figure 3.10; Appendix Figure C.7). Other parameters, including hardness, iron, manganese, nitrate and sulphate, showed no consistent direction of change between the mine baseline and operational periods. Notably, parameter concentrations were consistently well below WQG and AEMP benchmarks through all years of mine construction and operation at Camp Lake (e.g., Appendix Table C.24) and thus, no adverse mine-related influences on lake water quality were suggested at Camp Lake since commercial mine operations commenced in 2014.

3.2.2 Sediment Quality

Surficial sediment (i.e., top 2 cm) collected at the Camp Lake coring stations was composed mainly of silty loam and sandy loam with low total organic carbon (TOC) content, except at the outlet littoral station (JLO-30) where sand constituted the predominant substrate material (Figure 3.11). 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 – D.7). However, similar substrate was observed at Reference Lake 3 (Appendix Tables D.1 – D.3), suggesting the natural occurrence of iron (oxy)hydroxides in the sediment of lakes within the mine LSA. Substrates of Camp Lake exhibited minor, sporadic blackening at sediment depths greater than 2 cm at some stations, suggesting occasional incidence of reducing conditions within substrates of the lake. However, no strongly defined redox boundaries were identified visually, and no noticeable sulphidic odours potentially associated with reducing sediment conditions were

[5] Refer to footnote 2 (page 23) and Appendix B regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA waterbodies.

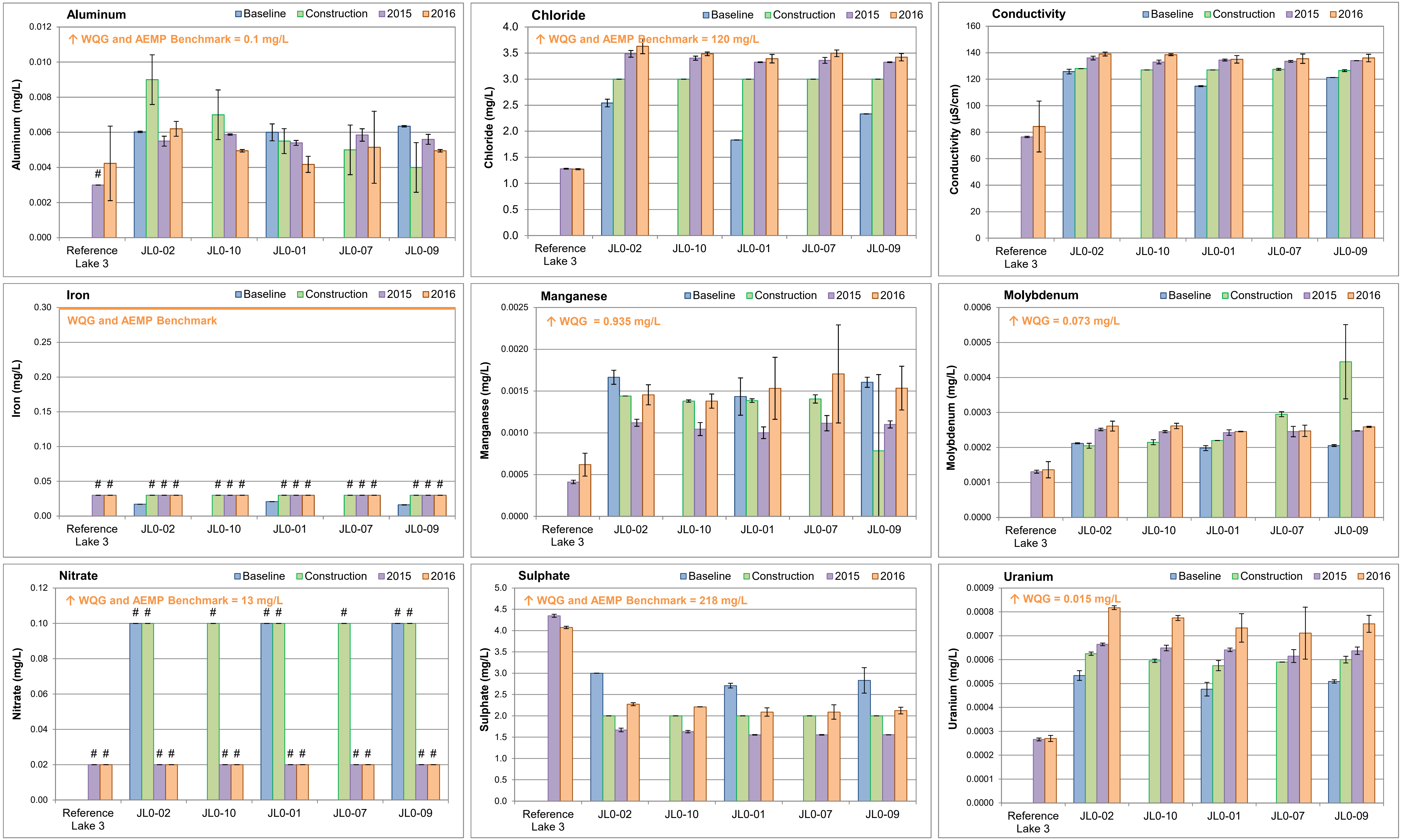


Figure 3.10: Temporal comparison of water chemistry at Camp Lake (JLO) for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods during fall. Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.3 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Camp Lake.

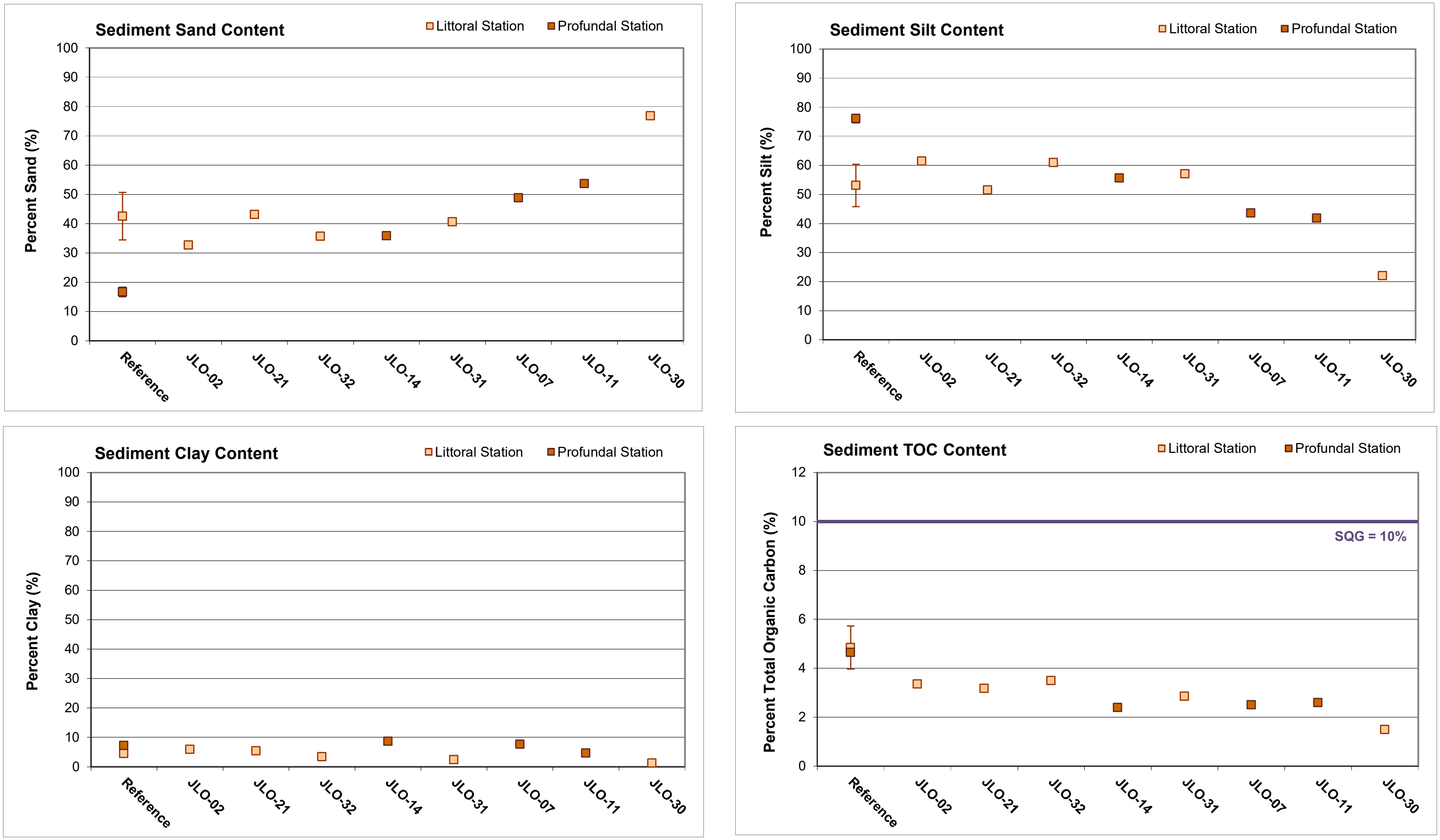


Figure 3.11: Sediment particle size and total organic carbon (TOC) content comparisons among Camp Lake (JLO) sediment monitoring stations and to Reference Lake 3 averages (mean ± SE), Mary River Project CREMP, August 2016.

detected at Camp Lake littoral and profundal stations to sediment depths as great as approximately 20 cm during the 2016 fall sampling event (Appendix Tables D.5 – D.7). Qualitative observations suggestive of reducing sediment conditions were similar between Camp Lake and Reference Lake 3 in 2016 (Appendix Tables D.1 – D.3 and D.5 – D.7), 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 lake outlet of Camp Lake in 2016 (Appendix Table D.9). Sediment metal concentrations were generally lower at littoral stations than at profundal stations of Camp Lake (Table 3.5; Appendix Table D.9), mirroring similar patterns at the reference lake. On average, sediment arsenic and manganese concentrations were slightly elevated (i.e., 2- to 5-fold higher) at Camp Lake littoral stations compared to sediment at Reference Lake 3 littoral stations (Table 3.5; Appendix Table D.10). However, metal concentrations in the profundal sediment of Camp Lake were comparable to those of the reference lake in 2016 (Table 3.5; Appendix Table D.10). Although mean iron, manganese and phosphorus concentrations were above respective SQG at Camp Lake littoral and/or profundal stations, mean concentrations of iron and manganese were also above SQG in the Reference Lake 3 profundal sediments in 2016 (Table 3.5). Similarly, although mean arsenic concentrations in littoral and profundal sediments, and mean iron and phosphorus concentrations in profundal sediments, were above respective AEMP benchmarks at Camp Lake, mean arsenic and iron concentrations were also above AEMP benchmarks in profundal sediment of Reference Lake 3 (Table 3.5). These data suggested natural elevation of arsenic, iron and manganese in sediments of LSA lakes relative to applicable SQG and/or AEMP benchmarks.

Temporal comparisons of the sediment chemistry data indicated slightly higher (2- to 5-fold greater) arsenic, manganese and molybdenum concentrations in littoral and/or profundal sediment of Camp Lake in 2016 compared to the baseline period[6] (Figure 3.12; Appendix Table D.10). Of these metals, only manganese showed progressively higher concentrations over baseline, mine construction and 2015 and 2016 mine operation periods at littoral stations of Camp Lake (Figure 3.12). Similarly, arsenic and other metals including barium, iron, magnesium and phosphorus, showed continuously higher concentrations between mine baseline and 2016 periods at profundal stations of Camp Lake (Figure 3.12; Appendix

[6] Reported sediment boron concentrations in 2015 and 2016 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 particle size, total organic carbon, and metal concentrations at Camp Lake (JLO) and Reference Lake 3 (REF3) sediment monitoring stations, Mary River Project CREMP, August 2016.

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Littoral Stations		Profundal Stations	
					Reference Lake (n = 5)	Camp Lake (n = 5)	Reference Lake (n = 5)	Camp Lake (n = 3)
					Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error
Non-metals	Sand	%	-	-	42.5 ± 8.1	45.8 ± 8.0	16.7 ± 1.5	46.1 ± 5.3
	Silt	%	-	-	53.1 ± 7.3	50.6 ± 7.4	76.1 ± 1.4	47.0 ± 4.3
	Clay	%	-	-	4.4 ± 1.0	3.7 ± 0.9	7.2 ± 0.4	6.9 ± 1.2
	Moisture	%	-	-	89.7 ± 6.0	73.5 ± 4.2	83.5 ± 5.4	68.8 ± 4.0
	Total Organic Carbon	%	10^{α}	-	4.85 ± 0.88	2.87 ± 0.36	4.64 ± 0.13	2.49 ± 0.06
Metals	Aluminum (Al)	mg/kg	-	-	16,480 ± 397	13,460 ± 1,760	25,150 ± 1,418	18,900 ± 702
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	<0.11 ± 0.006	0.12 ± 0.02	<0.10 ± 0
	Arsenic (As)	mg/kg	17	5.9	3.71 ± 0.26	***8.70*** ± 1.96	***6.47*** ± 0.27	***8.94*** ± 2.41
	Barium (Ba)	mg/kg	-	-	112 ± 11	128 ± 28	162 ± 8	126 ± 33
	Beryllium (Be)	mg/kg	-	-	0.67 ± 0.02	0.77 ± 0.10	1.02 ± 0.05	1.04 ± 0.04
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0	0.30 ± 0.04	0.21 ± 0.00	0.32 ± 0.02
	Boron (B)	mg/kg	-	-	13.0 ± 0.9	20.9 ± 2.6	19.2 ± 1.0	27.9 ± 1.5
	Cadmium (Cd)	mg/kg	3.5	1.5	0.146 ± 0.035	0.201 ± 0.044	0.180 ± 0.010	0.176 ± 0.027
	Calcium (Ca)	mg/kg	-	-	5,128 ± 470	4,404 ± 611	6,111 ± 156	4,540 ± 87
	Chromium (Cr)	mg/kg	90	98	55.0 ± 1.2	57.5 ± 6.9	80.0 ± 4.1	76.2 ± 2.0
	Cobalt (Co)	mg/kg	-	-	10.15 ± 0.57	17.00 ± 2.44	18.15 ± 0.75	20.30 ± 2.21
	Copper (Cu)	mg/kg	110^{α}	50	***66.5*** ± 7.4	38.2 ± 6.1	***101*** ± 5.6	49.8 ± 0.5
	Iron (Fe)	mg/kg	$40,000^{\alpha}$	52,400	29,840 ± 3,488	48,150 ± 8,692	***53,580*** ± 2,174	***61,633*** ± 8,732
	Lead (Pb)	mg/kg	91	35	***46.0*** ± 17.4	20.0 ± 1.8	29.5 ± 5.0	24.1 ± 1.0
	Lithium (Li)	mg/kg	-	-	27.3 ± 0.4	25.5 ± 3.3	41.7 ± 2.1	34.6 ± 1.7
	Magnesium (Mg)	mg/kg	-	-	10,852 ± 274	10,792 ± 1,375	16,160 ± 814	13,567 ± 240
	Manganese (Mn)	mg/kg	$1,100^{\alpha,\beta}$	4,370	496 ± 99	2,583 ± 758	1,866 ± 449	2,307 ± 1,583
	Mercury (Hg)	mg/kg	0.486	0.17	0.0355 ± 0.0063	0.0368 ± 0.0064	0.0699 ± 0.0019	0.0555 ± 0.0032
	Molybdenum (Mo)	mg/kg	-	-	2.19 ± 0.49	2.64 ± 0.83	3.27 ± 0.34	1.78 ± 0.62
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	72	38.6 ± 1.6	64.7 ± 9.0	56.3 ± 2.6	69.7 ± 2.8
	Phosphorus (P)	mg/kg	$2,000^{\alpha}$	1,580	840 ± 47	1,521 ± 256	1,121 ± 57	***2,137*** ± 428
	Potassium (K)	mg/kg	-	-	3,894 ± 172	3,383 ± 428	5,891 ± 281	4,773 ± 205
	Selenium (Se)	mg/kg	-	-	0.49 ± 0.06	0.39 ± 0.05	0.85 ± 0.06	0.54 ± 0.04
	Silver (Ag)	mg/kg	-	-	0.12 ± 0.01	0.11 ± 0.00	0.27 ± 0.01	0.15 ± 0.01
	Sodium (Na)	mg/kg	-	-	296 ± 29	152 ± 19	455 ± 24	274 ± 23
	Strontium (Sr)	mg/kg	-	-	11.4 ± 0.5	8.9 ± 1.0	15.8 ± 0.6	15.4 ± 2.3
	Sulphur (S)	mg/kg	-	-	<5,000 ± 0	<5,000 ± 0	<5,000 ± 0	<5,000 ± 0
	Thallium (Tl)	mg/kg	-	-	0.388 ± 0.021	0.475 ± 0.075	0.801 ± 0.035	0.504 ± 0.069
	Tin (Sn)	mg/kg	-	-	56.3 ± 28.9	5.7 ± 1.4	16.3 ± 7.8	3.3 ± 0.9
	Titanium (Ti)	mg/kg	-	-	1,072 ± 36	733 ± 89	1,331 ± 69	877 ± 53
	Uranium (U)	mg/kg	-	-	11.9 ± 1.5	5.05 ± 1.0	27.3 ± 1.5	7.20 ± 0.1
	Vanadium (V)	mg/kg	-	-	50.0 ± 1.3	47.9 ± 6.1	72.0 ± 3.6	62.6 ± 1.0
	Zinc (Zn)	mg/kg	315	135	73.7 ± 2.7	47.4 ± 6.3	105 ± 5.1	61.9 ± 1.8
	Zirconium (Zr)	mg/kg	-	-	4.3 ± 0.6	4.1 ± 1.0	4.0 ± 0.2	5.2 ± 0.8

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2016) 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 2016)).

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

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

BOLD Indicates parameter concentration above the AEMP Benchmark.

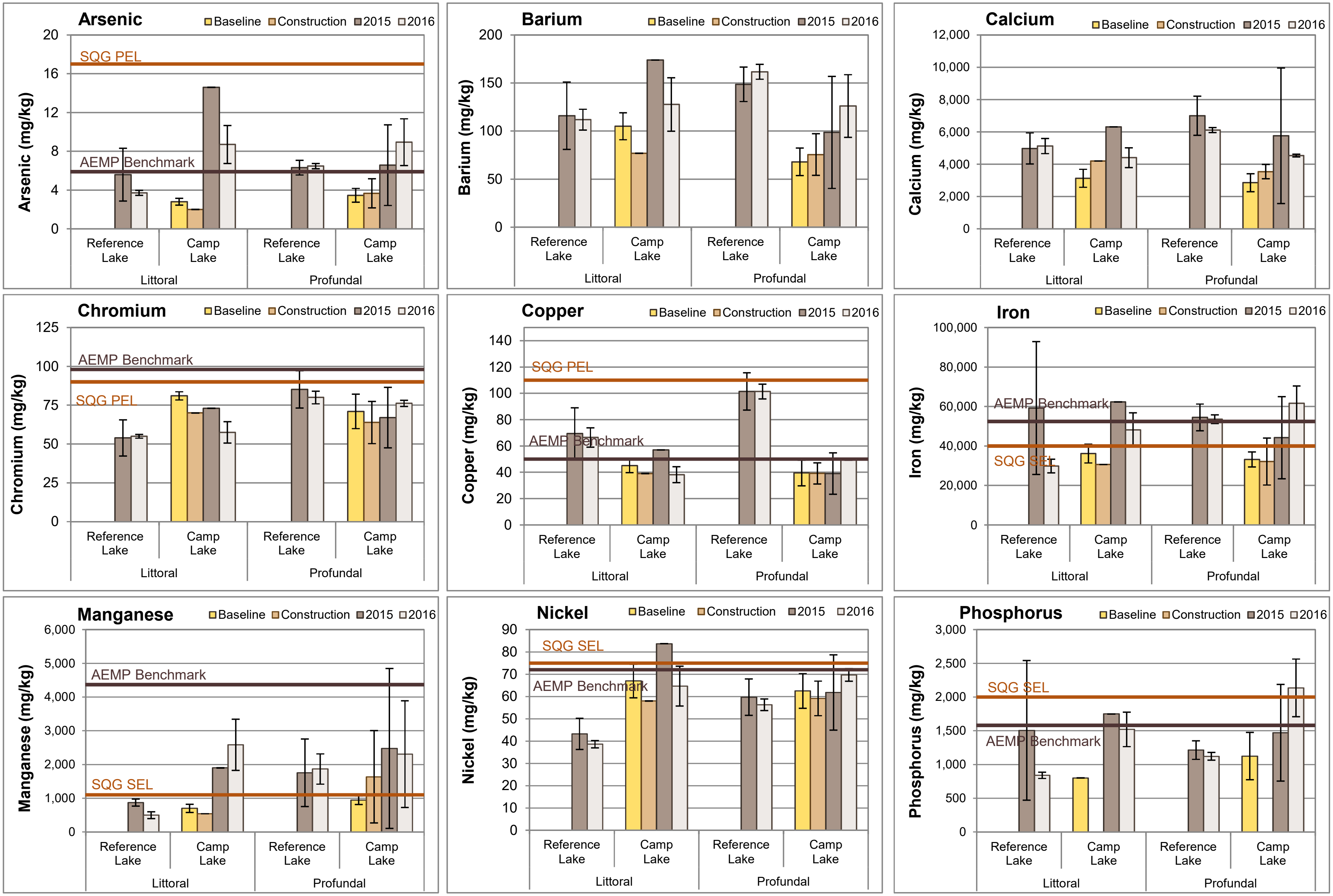


Figure 3.12: Temporal comparison of sediment metal concentrations (mean ± SD) at littoral and profundal stations of Camp Lake and Reference Lake 3 for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods, Mary River Project CREMP.

Table D.10). In part, the changes in sediment metal concentrations may have reflected changes in the number and/or location of littoral and profundal sediment quality monitoring stations at Camp Lake among studies. For instance, Station JLO-2 represented the only littoral station in Camp Lake during the baseline, 2014 and 2015 studies, and only the three deepest profundal stations were maintained in the 2016 study compared to previous studies that included up to nine profundal stations. The occurrence of Camp Lake sediment metal concentrations more closely reflecting those of the reference lake during mine operation (i.e., 2015, 2016) than during the mine baseline period was consistent with changes that may be expected from increased/decreased sampling replication at Camp Lake. Notwithstanding uncertainty related to changes in station replication among studies at Camp Lake, and taking reference lake sediment metal concentrations into account, higher concentrations of arsenic and manganese in littoral sediments of Camp Lake since the baseline period potentially reflected recent mine construction and/or operation influences to the lake shallows. In contrast, metals in Camp Lake profundal sediments showed no definitive changes in concentrations since the mine baseline period.

3.2.3 Phytoplankton

Camp Lake chlorophyll a concentrations showed no distinct gradients with distance from the CLT inlet to the lake outlet stations during any of the winter, summer or fall sampling events in 2016, although concentrations were somewhat lower at stations near the lake outlet during the summer and winter sampling events (Figure 3.13). Chlorophyll a concentrations differed significantly among all seasons at Camp Lake in 2016, with highest and lowest concentrations observed in summer and winter, respectively (Appendix Table E.4), and mirroring seasonal differences observed at the reference lake (Appendix Table B.8). On average, chlorophyll a concentrations at Camp Lake were significantly higher than at Reference Lake 3 during the summer and fall sampling events (Appendix Tables E.5 and E.6), suggesting greater phytoplankton density at Camp Lake. However, chlorophyll a concentrations were well below the AEMP benchmark of 3.7 µg/L during all winter, summer and fall sampling events in 2016 (Figure 3.13). Camp Lake mean chlorophyll a concentrations in 2016 suggested low phytoplankton productivity and an ‘oligotrophic’ trophic status based on Wetzel (2001) lake classification. 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 2016 lake sampling events (Table 3.4; Appendix Table C.24).

Temporal comparisons of the Camp Lake chlorophyll a data did not indicate any consistent significant differences among the mine construction (2014) and operational (2015, 2016) years

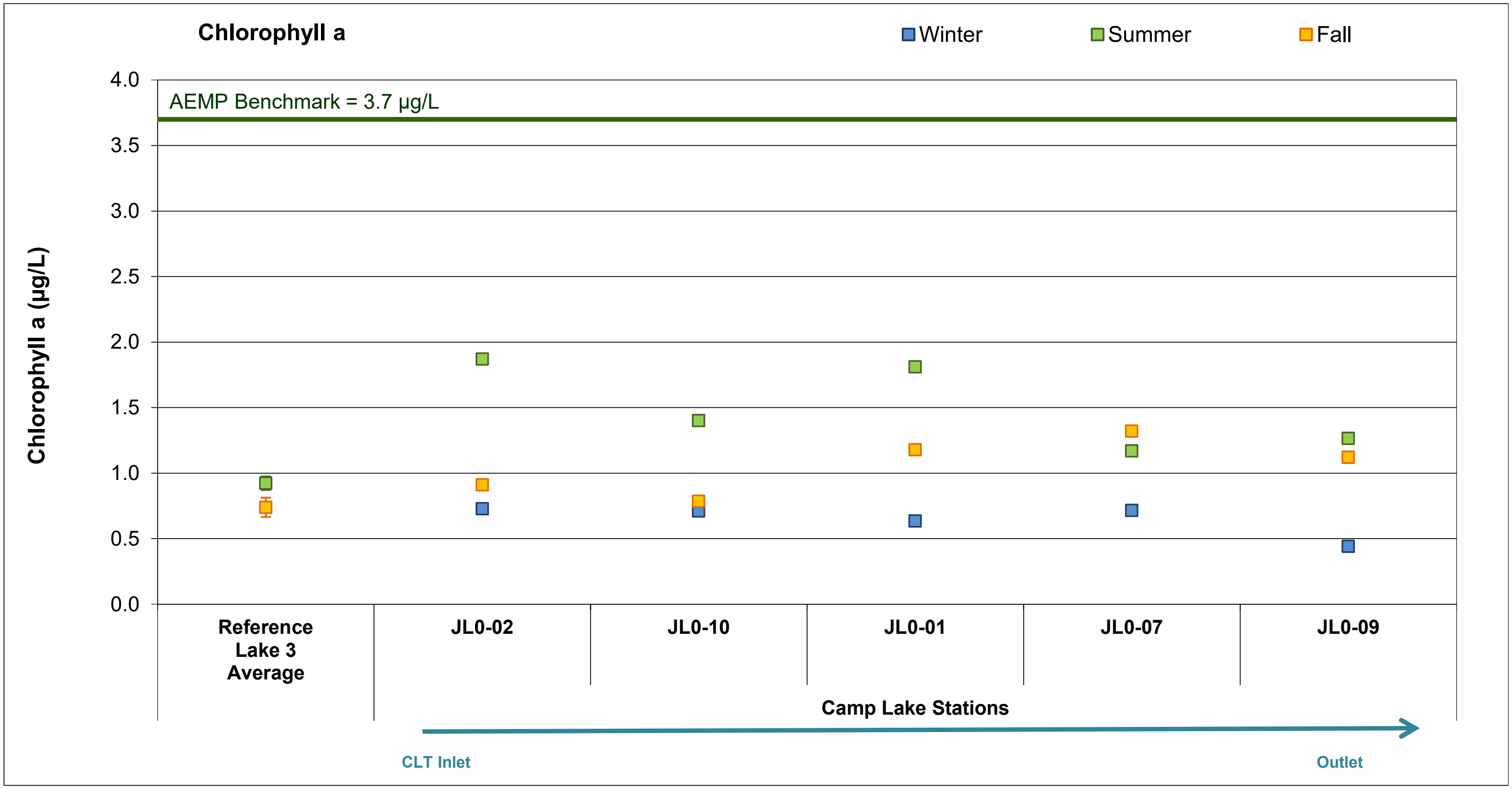


Figure 3.13: Chlorophyll a concentrations at Camp Lake (JLO) phytoplankton monitoring stations, Mary River Project CREMP, 2016. Values are averages of samples taken from the surface and the bottom of the water column at each station. Reference values represent mean ± standard deviation (n = 3). Reference Lake 3 was not sampled in winter 2016.

for seasonal data collected in winter, summer and fall (Figure 3.14). In addition, annual average chlorophyll a concentrations did not differ significantly among the most recent three years (Appendix Table E.7), suggesting no changes in the trophic status of Camp Lake since mine operations commenced at the Mary River Project. No chlorophyll a baseline (2005 – 2013) data are available for Camp Lake, precluding comparisons to conditions prior to the mine construction period.

3.2.4 Benthic Invertebrate Community

Benthic invertebrate community density and richness at littoral habitat of Camp Lake did not differ significantly from Reference Lake 3 in 2016 (Table 3.6). Simpson's Evenness was significantly higher at Camp Lake than at the reference lake in 2016, indicating that organism numbers were more uniformly distributed across a diversity of taxa at Camp Lake. Although a high Simpson's Evenness is generally indicative of healthy benthic invertebrate community conditions, the magnitude of difference in Simpson's Evenness between lakes was within a critical effect size (CES_{BIC}) of ±2 reference area standard deviations (SD_{REF}), suggesting that this difference was not ecologically meaningful. Benthic invertebrate community composition differences were evident between Camp Lake and Reference Lake 3 littoral habitat based on significantly higher Bray-Curtis Index at Camp Lake, and by significant differences in the relative abundance of dominant taxonomic groups and HPG between lakes (Table 3.6). The key differences in community structure included significantly lower relative abundance of Ostracoda (seed shrimp) and significantly higher relative abundance of Chironomidae (non-biting midges) at Camp Lake compared to the reference lake. However, because the relative abundance of metal-sensitive Chironomidae did not differ significantly between Camp Lake and Reference Lake 3 (Table 3.6), the difference in benthic invertebrate community structure between lakes was not suggestive of adverse metal-related influences at Camp Lake. This was supported by water quality monitoring data that showed aqueous metal concentrations were below WQG and AEMP benchmarks at Camp Lake, and by sediment quality monitoring data that showed sediment metal concentrations were below SQG at Camp Lake with the exception of iron and manganese, which were also above SQG at Reference Lake 3.

Benthic invertebrate community compositional differences between the Camp Lake and Reference Lake 3 littoral stations did not appear to reflect differing food resources between lakes given an absence of significant differences in FFG (Table 3.6). Although the relative abundance of benthic invertebrate HPG differed significantly between Camp Lake and the reference lake, the magnitude of these differences were within a CES_{BIC} of ±2 SD_{REF} (Table 3.6) suggesting that the dissimilarity in the benthic invertebrate HPG proportions between lakes was within natural ranges of ecological variability. Notably, sediment particle

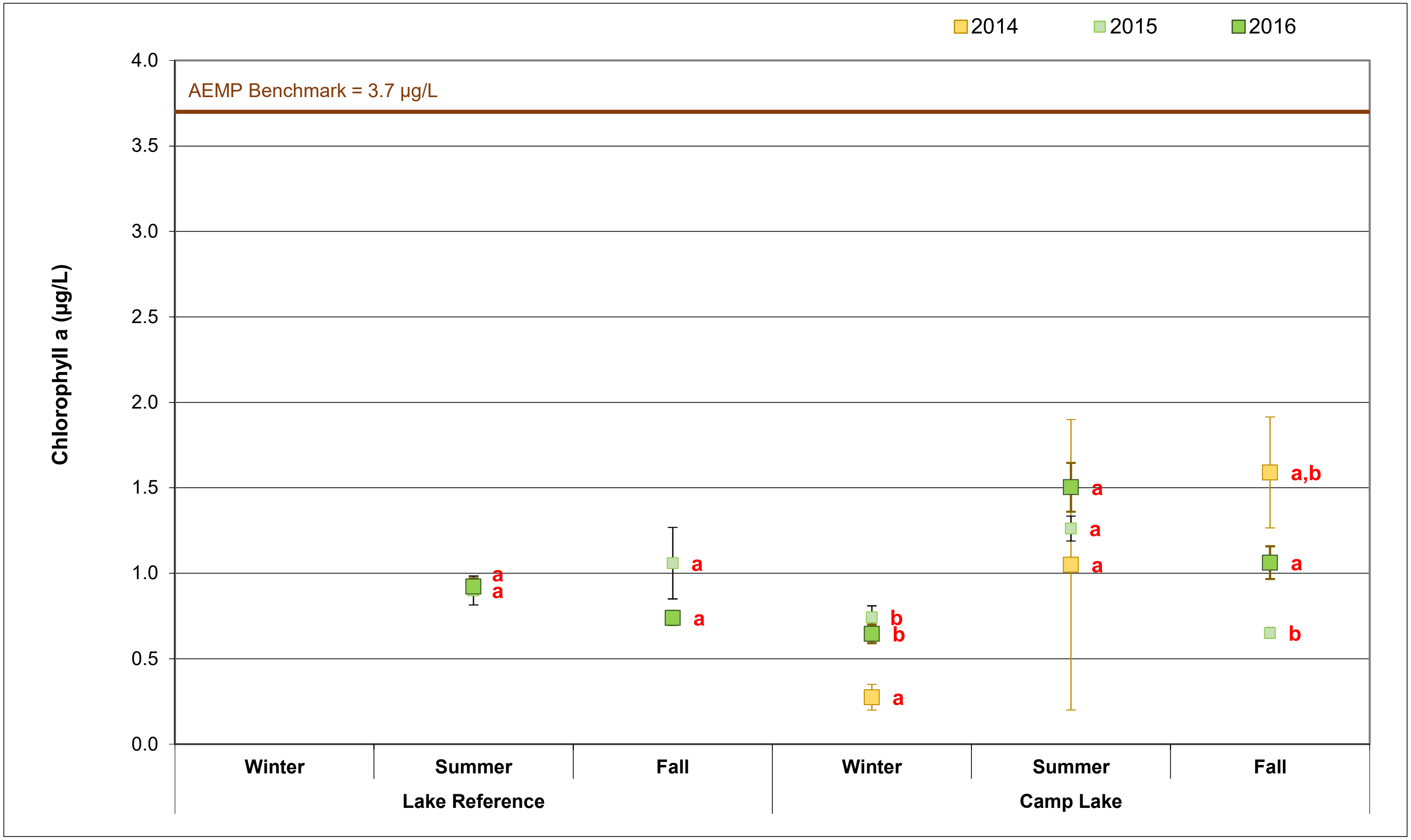


Figure 3.14: Chlorophyll a concentration seasonal comparison among 2014, 2015 and 2016 years (mean ± SE) at Camp Lake phytoplankton monitoring stations, Mary River Project CREMP. Data points with the same letter on the right do not differ significantly between years for the applicable season.

Table 3.6: Benthic invertebrate community statistical comparison results between Camp Lake (JLO) and Reference Lake 3 littoral stations, Mary River Project CREMP, August 2016.

Metric	Statistical Test Results					Summary Statistics					
	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Power	Magnitude of Difference [b] (No. of SD)	Area	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	No	0.728	α, δ, γ	-	-	Reference Lake 3	2,390	1,396	624	897	4,240
						Camp Lake Littoral	2,639	668	299	1,825	3,343
Richness (Number of Taxa)	No	0.151	γ	-	-	Reference Lake 3	12.2	1.1	0.5	11.0	14.0
						Camp Lake Littoral	15.8	3.3	1.5	10.0	18.0
Simpson's Evenness (E)	**Yes**	**0.008**	γ	**-**	**0.8**	Reference Lake 3	0.758	0.189	0.084	0.420	0.849
						Camp Lake Littoral	0.917	0.034	0.015	0.869	0.951
Bray-Curtis Index	Yes	0.001	α, δ, γ	1.000	2.8	Reference Lake 3	0.334	0.122	0.054	0.245	0.527
						Camp Lake Littoral	0.677	0.069	0.031	0.576	0.744
Nemata (%)	No	0.436	β, δ, γ	-	-	Reference Lake 3	4.0%	5.6%	2.5%	0.0%	13.5%
						Camp Lake Littoral	4.4%	4.8%	2.2%	1.0%	11.9%
Hydracarina (%)	No	0.182	β, ε	-	-	Reference Lake 3	3.6%	2.0%	0.9%	1.8%	6.7%
						Camp Lake Littoral	2.4%	3.1%	1.4%	0.0%	7.1%
Ostracoda (%)	Yes	0.008	γ	-	-2.6	Reference Lake 3	46.9%	17.5%	7.8%	37.8%	78.0%
						Camp Lake Littoral	1.8%	1.1%	0.5%	0.0%	2.8%
Chironomidae (%)	Yes	0.002	β, δ, γ	0.993	2.2	Reference Lake 3	45.4%	18.8%	8.4%	15.4%	59.2%
						Camp Lake Littoral	87.4%	7.0%	3.1%	78.6%	95.9%
Metal-Sensitive Chironomidae (%)	No	0.149	β, δ, γ	-	-	Reference Lake 3	19.3%	8.3%	3.7%	7.7%	28.1%
						Camp Lake Littoral	29.7%	11.8%	5.3%	16.2%	46.8%
Collector-Gatherers (%)	No	0.155	β, δ, γ	-	-	Reference Lake 3	75.0%	11.4%	5.1%	61.1%	89.7%
						Camp Lake Littoral	65.7%	7.8%	3.5%	52.4%	71.5%
Filterers (%)	No	0.103	β, δ, γ	-	-	Reference Lake 3	16.1%	8.4%	3.8%	7.0%	26.4%
						Camp Lake Littoral	25.0%	7.5%	3.3%	16.2%	36.5%
Clingers (%)	**Yes**	**0.093**	β, δ	**0.539**	**1.6**	Reference Lake 3	19.2%	7.6%	3.4%	8.8%	28.3%
						Camp Lake Littoral	31.5%	12.2%	5.4%	17.5%	45.3%
Sprawlers (%)	**Yes**	**0.026**	β, δ, γ	**0.803**	**-1.9**	Reference Lake 3	65.7%	12.1%	5.4%	57.2%	85.7%
						Camp Lake Littoral	42.7%	12.5%	5.6%	23.1%	54.8%
Burrowers (%)	**Yes**	**0.053**	β, δ, γ	**0.667**	**1.7**	Reference Lake 3	15.1%	6.2%	2.8%	5.5%	22.2%
						Camp Lake Littoral	25.6%	7.2%	3.2%	19.1%	35.1%

[a] Data analysis included: α - data untransformed; β - data logit transformed; ι - $\log_{10}$ transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Mann Whitney U-test.

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

[c] Estimated minimum effect size detectable (±) calculated using variance as square root of MSE from ANOVA and alpha = beta = 0.10.

(grey box) Highlighted values indicate significant differences between study areas based on ANOVA p-value less than 0.10 that were also outside of a Critical Effect Size of ±2 SD, suggesting an ecologically meaningful difference.

BOLD Bold text values indicate significant differences between study areas based on ANOVA p-value less than 0.10, but a Critical Effect Size within ±2 SD, suggesting the difference is not ecologically meaningful.

size did not differ significantly between the Camp Lake and reference lake littoral stations (Appendix Table D.8), suggesting that the differences in benthic invertebrate HPG between lakes were also not related to differing substrate texture as an artifact of the sampling program. Collectively, the lack of significant differences in FFG and ecologically meaningful differences in HPG suggested that benthic invertebrate community structural differences between Camp Lake and Reference Lake 3 littoral stations may have simply reflected natural variability between these lakes.

Temporal comparisons of the Camp Lake littoral habitat benthic invertebrate community indicated no significant differences in density, richness, dominant taxonomic group composition or FFG composition between the mine baseline (2013) and operational (2015, 2016) periods (Figure 3.15; Appendix Table F.19). Although Simpson's Evenness was significantly lower at Camp Lake littoral stations in 2015 than during either of the 2013 and 2016 studies (Figure 3.15), high Simpson's Evenness in 2016 and the absence of differences in any of the remaining key indices suggested that low evenness in 2015 did not reflect a mine-related influence. Thus, the study-to-study differences in Simpson's Evenness most likely reflected natural year-to-year variability in benthic invertebrate community features at Camp Lake. No consistent differences in benthic invertebrate community density, richness, Simpson's Evenness, FFG or HPG were indicated between Camp Lake and Reference Lake 3 littoral stations over the 2015 and 2016 studies (Figure 3.15; Appendix Table F.19). This supported the baseline data analyses in suggesting that the indicated differences for select metrics in 2015 and 2016 between the Camp Lake and reference lake benthic invertebrate communities were related to natural ecological variability rather than a mine-related influence.

3.2.5 Fish Population

3.2.5.1 Camp Lake Fish Community

The Camp Lake fish community included Arctic charr (*Salvelinus alpinus*) and ninespine stickleback (*Pungitius pungitius*), which mirrored the fish species composition observed at Reference Lake 3 in 2016 (Table 3.7). 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 in 2016 (Table 3.7). In turn, this suggested higher fish productivity at Camp Lake compared to Reference Lake 3, corroborating the chlorophyll a results which indicated higher phytoplankton productivity at Camp Lake. Notably, although ninespine stickleback have been presumed to reside in low abundance at most lakes within the mine LSA (NSC 2014), the occurrence of ninespine stickleback at Camp Lake in 2016

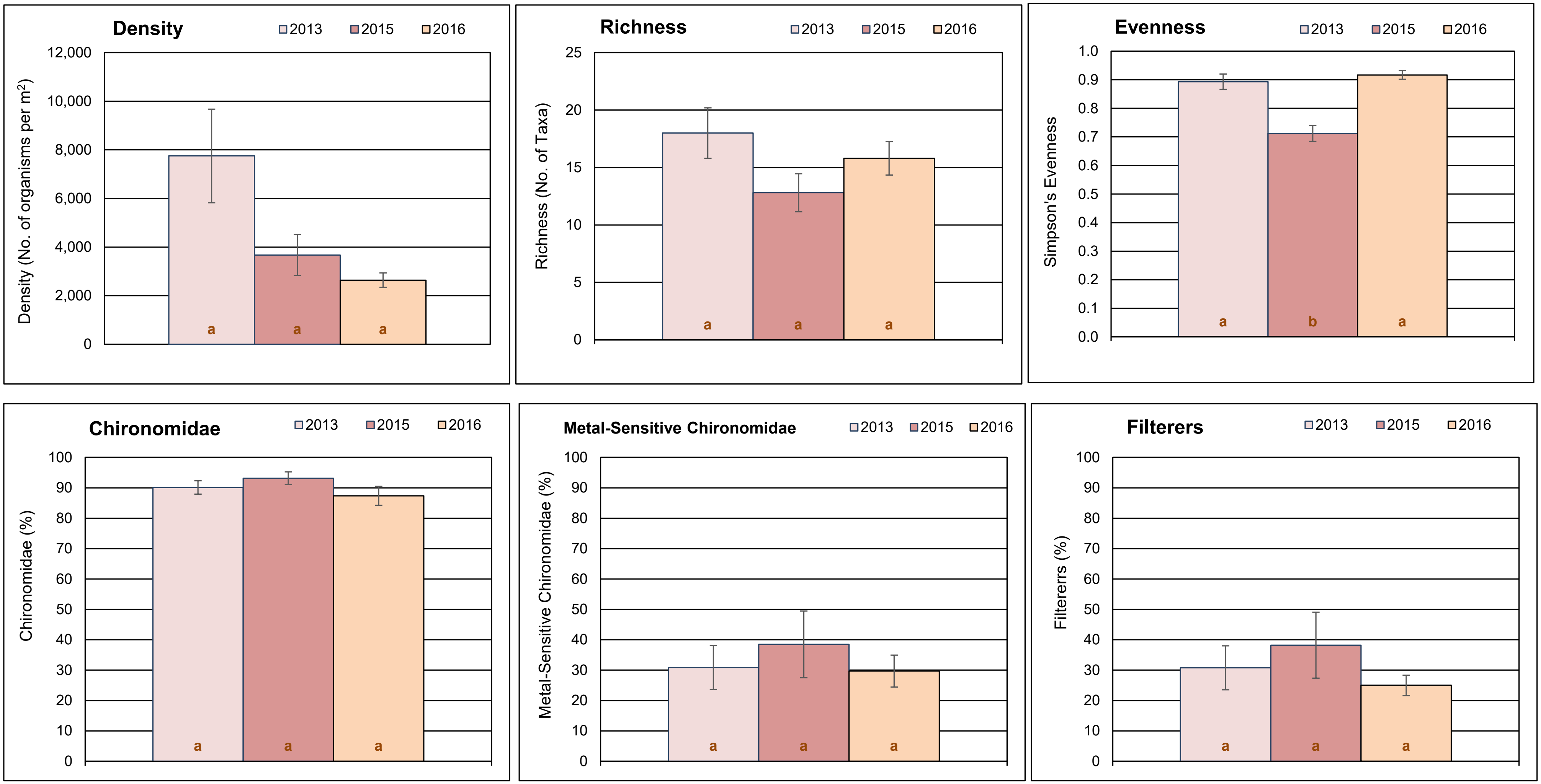


Figure 3.15: Comparison of key benthic invertebrate metrics (mean ± SE) at Camp Lake littoral stations between mine baseline (2007, 2013) and operational (2015, 2016) periods, Mary River Project CREMP, 2016. The same like-coloured letter inside bars indicate no significant difference between areas.

Table 3.7: 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 2016.

Lake	Method [a]		Arctic Charr	Nine-spine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	101	28	129	2
		CPUE	0.48	0.16	0.64	
	Gill netting	No. Caught	14	0	14	
		CPUE	0.15	0	0.15	
Camp Lake	Electrofishing	No. Caught	98	2	100	2
		CPUE	6.24	0.13	6.37	
	Gill netting	No. Caught	89	0	89	
		CPUE	5.43	0	5.43	

[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.

marks the first record of this species in the lake since the implementation of the Mary River Project AEMP studies. Similar abundance of ninespine stickleback along rocky nearshore habitat was suggested at both lakes based on comparable electrofishing CPUE for this species in 2016 (Table 3.7).

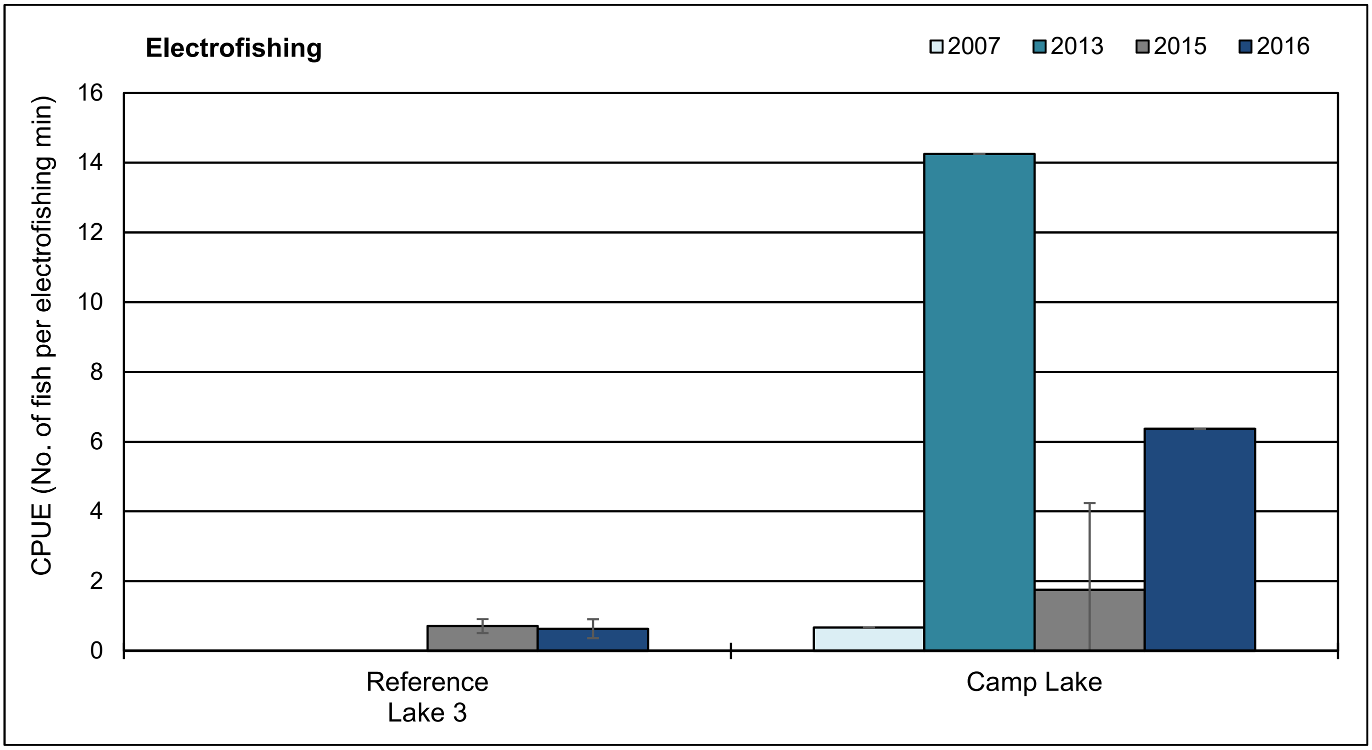
The Camp Lake 2016 electrofishing CPUE for Arctic charr was within the range of that observed during baseline (2005 - 2013) studies (Figure 3.16). This suggested that the abundance of Arctic charr at nearshore habitat of Camp Lake in 2016 was comparable to abundance observed prior to mine start-up. The Arctic charr CPUE for gill net collections was markedly higher in the 2016 study than in all previous baseline (2006 – 2008), mine construction (2014) and mine operational (2015) studies (Figure 3.16). Higher Arctic charr CPUE in 2016 may have reflected a combination of greater sampling efficiency due to experience gained from previous studies (e.g., selection of netting locations), changes in sampling gear dimensions relative to previous studies (i.e., focus on most efficient net mesh sizes as per Minnow 2016b), differences in the amount of gill netting effort applied during each study (see Minnow 2016a) and/or natural factors (e.g., weather conditions). Nevertheless, CPUE comparisons among studies suggested that the relative abundance of Arctic charr in Camp Lake had not likely changed substantially, and was not lower, in 2016 compared to the baseline and mine-construction periods.

3.2.5.2 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 2016 data from Camp Lake and Reference Lake 3, as well as a before-after analysis using Camp Lake 2016 and baseline (2013) data. A total of 98 and 100 Arctic charr were captured at nearshore habitat of Camp Lake and Reference Lake 3, respectively, in August 2016, 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 3.9 and 5.1 cm for the Camp Lake and Reference Lake 3 data sets, respectively, based on the evaluation of length-frequency distributions coupled with supporting age determinations (Figure 3.17). Due to a low number of Arctic charr YOY captured at Camp Lake (i.e., 4), fish population comparisons were conducted using only non-YOY individuals, where applicable, to limit confounding influences of naturally differing weight-at-length relationships between YOY and non-YOY individuals on data interpretation.

The length-frequency distribution for the nearshore Arctic charr differed significantly between Camp Lake and Reference Lake 3 (Table 3.8), reflecting the occurrence of very few YOY and



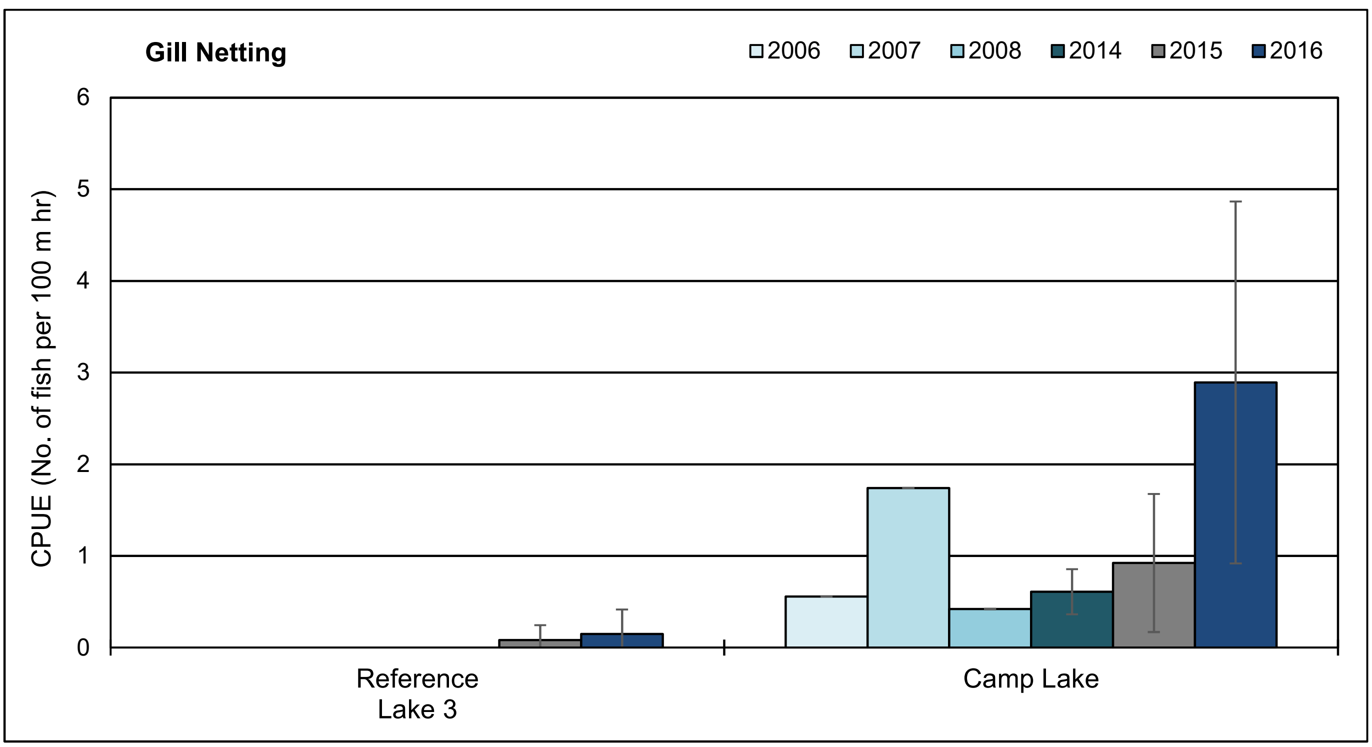


Figure 3.16: Catch-per-unit-effort (CPUE; mean ± SD) of Arctic charr captured by backpack electrofishing and gill netting at Camp Lake (JLO) for baseline (2006, 2007, 2008, 2013), mine construction (2014) and operational (2015, 2016) periods during fall, Mary River Project CREMP.

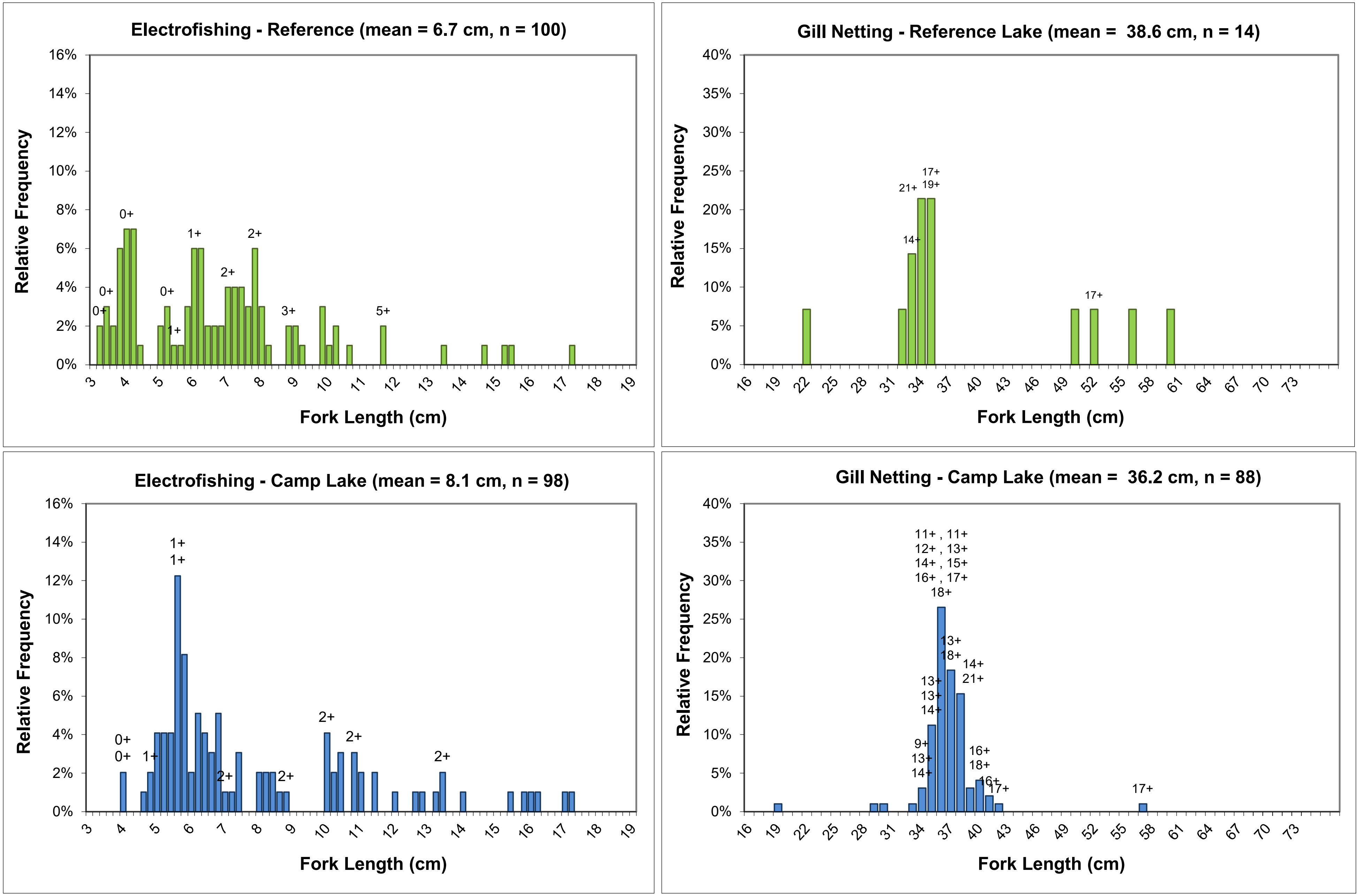


Figure 3.17: Length-frequency distributions for Arctic charr captured by backpack electrofishing and gill netting at Camp Lake (JLO) and Reference Lake 3 (REF3), August 2016, Mary River Project CREMP. Fish ages are shown above the bars, where available.

Table 3.8: Summary of statistical results for Arctic charr population comparisons between Camp Lake and Reference Lake 3 for the mine operational period (2015, 2016) and between Camp Lake mine-operational and baseline period data for fish captured by electrofishing and gill netting methods, Mary River Project CREMP, August 2016. Values in parentheses indicate direction and magnitude of any significant differences.

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed?			
			versus Reference Lake 3		versus Camp Lake baseline period data [b]	
			2015	2016	2015	2016
Nearshore Electrofishing	Survival	Length-Frequency Distribution	**Yes**	**Yes**	**Yes**	**Yes**
		Age	No	No	-	-
	Energy Use	Size (mean weight)	**Yes (+176%)**	No	**Yes (-42%)**	**Yes (-71%)**
		Size (mean fork length)	**Yes (+41%)**	No	**Yes (-15%)**	**Yes (-32%)**
		Growth (weight-at-age)	**Yes (+154%)**	No	-	-
		Growth (fork length-at-age)	**Yes (+36%)**	**Yes (+18%)**	-	-
	Energy Storage	Condition (body weight-at-fork length)	No	**Yes (-6%)**	**Yes (-6%)**	**Yes (-10%)**
Littoral/Profundal Gill Netting [a]	Survival	Length Frequency Distribution	-	-	**Yes**	**Yes**
		Age	-	-	**Yes (+48%)**	**Yes (+58%)**
	Energy Use	Size (mean weight)	-	-	No	No
		Size (mean fork length)	-	-	**Yes (+6%)**	No
		Growth (weight-at-age)	-	-	No	**Yes (nc)**
		Growth (fork length-at-age)	-	-	No	**Yes (nc)**
	Energy Storage	Condition (body weight-at-fork length)	-	-	No	**Yes (-3%)**

[a] Due to low catches of Arctic charr at Reference Lake 3 in 2015 and 2016, no comparison of fish health was possible for gill netted fish.
[b] Baseline period data included 2013 nearshore electrofishing data and 2006, 2008 and 2013 littoral/profundal gill netting data. nc = non-calculable magnitude.

greater numbers of larger individuals captured at Camp Lake. Mean fresh body weight and fork length of non-YOY Arctic charr captured at the Camp Lake nearshore did not differ significantly from those captured at the reference lake nearshore (Table 3.8; Appendix Table G.11). Non-YOY Arctic charr captured at the Camp Lake nearshore exhibited significantly faster length-based growth (i.e., length-at-age) compared to non-YOY captured at Reference Lake 3 (Table 3.8; Figure 3.17; Appendix Table G.11). However, the magnitude of difference in growth was within an ecologically meaningful Critical Effect Size (CES) of ±25% (referred to herein as CES_G; Table 3.8), suggesting that the differences in non-YOY Arctic charr energy use between lakes was within the range of variability expected to occur naturally between waterbodies uninfluenced by human activity. Notably, sample sizes used for growth comparisons were small (i.e., ten for each study area; Appendix Table G.11), resulting in some uncertainty regarding the strength of the indicated growth relationships. Non-YOY Arctic charr condition (i.e., weight-at-length relationship) was significantly lower at Camp Lake than at the reference lake (Table 3.8; Appendix Table G.11). Similar to the growth analysis, the magnitude of difference in condition of non-YOY Arctic charr between lakes was within a CES of ±10% (referred to herein as CES_C; Table 3.8), suggesting that the difference in non-YOY Arctic charr energy storage between lakes was not ecologically meaningful. Collectively, the 2016 fish health assessment results suggested only minor differences in nearshore Arctic charr energy use and storage between Camp Lake and Reference Lake 3 populations, the implications of which were not likely to be ecologically meaningful.

Temporal comparisons of the Camp Lake nearshore Arctic charr data indicated significantly different length-frequency distribution between the 2016 mine operational study and the 2013 baseline study (Table 3.8). In addition, Arctic charr captured at the nearshore of Camp Lake in 2016 were significantly lighter, shorter and of lower condition than those captured during the 2013 baseline study (Table 3.8; Appendix Table G.12). Similar differences in nearshore Arctic charr size and condition were demonstrated between the 2015 mine operational study and the 2013 baseline data (Table 3.8). However, the magnitude of difference in condition between the individual mine operational studies (i.e., 2015 and 2016) and the 2013 baseline data was within a CES_C of ±10% (Table 3.8; Appendix Table G.12), suggesting that the differences were within the natural range of variability expected between lakes uninfluenced by human activity.

Littoral/Profundal Arctic Charr

Mine-related influences on the Camp Lake littoral/profundal Arctic charr population (i.e., fish captured by gill netting) was assessed using a before-after analysis of Camp Lake 2016 versus baseline (combined 2006, 2007, 2008 and 2013) data. Similar to the 2015 CREMP, despite a total of 87 Arctic charr captured at littoral/profundal areas of Camp Lake and application of similar fishing effort, the Arctic charr sample size was small (i.e., 14) at Reference Lake 3 in August 2016, precluding a control-impact analysis for the determination of mine-related effects. Biological information collected from Arctic charr mortalities encountered during the 2016 Camp Lake littoral/profundal sampling suggested that 67% of the population was represented by non-spawners of reproductive age (referred to simply as non-spawners herein; Appendix Table G.15). The average age, length and weight of non-spawners was comparable to that of female spawners (Appendix Table G.15) indicating that, typical of high Arctic systems, individual Arctic charr do not spawn yearly at Camp Lake. Liver somatic index (LSI) was significantly lower in non-spawners than female spawners (ANOVA; $p = 0.004$), suggesting that lower energy was available for gamete development in the non-spawners. Internal body cavity parasites were present in almost all of the Arctic charr incidental mortalities (Appendix Table G.15), potentially contributing to biennial or longer frequency between spawning events for Arctic charr in the mine LSA lakes as a result of lower energy applied towards gamete production stemming from the parasitic infection. High incidence rates of internal parasites in Arctic charr of the Mary River Project mine area lakes was noted in baseline studies (NSC 2014, 2015a) and the 2015 CREMP (Minnow 2016a).

Temporal comparisons of Arctic charr data collected from Camp Lake littoral/profundal areas indicated significantly different length-frequency distribution of Arctic charr in 2016 compared to the combined baseline data set (i.e., 2006, 2007, 2008 and 2013 studies; Table 3.8). The differences in length-frequency distributions were consistent with the capture of significantly older Arctic charr at Camp Lake in 2016 compared to the baseline period (Table 3.8; Appendix Table G.16). No significant differences in Arctic charr fresh body weight or fork length were demonstrated between the 2016 and the baseline period. Arctic charr of spawning size showed significant differences in growth between 2016 and the baseline period, although the magnitude and direction of difference was non-calculable due to a significant interaction result (Table 3.8). Finally, significantly lower condition was indicated for Arctic charr of spawning size at Camp Lake between 2016 and the baseline period, but the magnitude of this difference was very small and within the CES_C of ±10% (Table 3.8; Appendix Table G.16), suggesting that this difference was not ecologically meaningful. Although length frequency distribution and average age of Arctic charr captured at Camp Lake in 2015 and 2016 consistently differed from those of the baseline period, no consistent differences in size, growth or condition were demonstrated between individual mine operational years and the baseline period.

3.3 Synthesis of Mine-Related Influences within the Camp Lake System

3.3.1 Camp Lake Tributaries

3.3.1.1 Camp Lake Tributary 1

Mine-related effects on water quality of the CLT1 north branch in 2016 included slightly elevated nitrate and copper concentrations compared to 2016 reference creek data and to 2005 - 2013 baseline data. Despite copper concentrations above WQG, chlorophyll a concentrations (a surrogate for phytoplankton abundance) at the CLT1 north branch were comparable to those of the reference creek stations in 2016, and to those during the baseline period, all of which were well below the AEMP benchmark and suggested oligotrophic conditions typical of Arctic watercourses. In addition, despite some differences in benthic invertebrate community composition between the CLT1 north branch and the reference creek in 2016, these differences appeared to be related to naturally differing amounts of in-stream vegetation between watercourses. This was supported by the absence of differences in relative abundance of metal-sensitive taxa between the CLT1 north branch and Unnamed Reference Creek in 2016, and for CLT1 north branch data collected in 2016 compared to 2005 - 2013 baseline data. Moreover, temporal comparisons that indicated no consistent differences in primary benthic invertebrate community endpoints (i.e., density, richness, Simpson's Evenness) or relative abundance of dominant invertebrate groups and FFG in 2016 compared to baseline data. Therefore, similar to the findings of the 2015 CREMP, no adverse effects to biota of the CLT1 north branch were suggested by the 2016 study.

At the CLT1 upper main stem (Station L2-03), mine-related influences on water quality were evident as elevated conductivity, hardness and concentrations of nitrate, sulphate and several metals including iron, manganese, molybdenum, sodium, strontium and uranium in 2016 compared to 2016 reference creek station data and to 2005 - 2013 baseline data. As identified during the 2015 CREMP, quarrying activity at the QMR2 pit was likely a key source for parameters elevated at the CLT1 main stem stations in 2016. Despite evidence of continued mine-related influence on water quality of the CLT1 upper main stem in 2016, parameter concentrations were below applicable WQG and site-specific AEMP benchmarks with the exception of iron and uranium at the upper main stem. However, elevated chlorophyll a concentrations and significantly higher benthic invertebrate density, richness and relative abundance of metal-sensitive taxa at the CLT1 upper main stem compared to Unnamed Reference Creek in 2016 suggested that concentrations of iron, uranium and other metals were not highly bioavailable at the CLT1 upper main stem. In fact, biological data collected at the CLT1 upper main stem in 2016 suggested a biological enrichment effect related to elevated nutrient concentrations. Temporal comparisons suggested that chlorophyll a concentrations at the CLT1 upper main stem were higher following commencement of mine operations than during the baseline period, but no significant differences in benthic invertebrate community primary endpoints, key dominant invertebrate groups, or FFG were evident between 2016 and baseline data collected in 2007. In turn, this suggested that mine-related enrichment effects at the CLT1 upper main stem, if any, were relatively minor.

At the CLT1 lower main stem (i.e., stations L1-01, L1-05 and L1-09), natural dilution of the main stem from the north branch resulted in only conductivity and aqueous concentrations of nitrate, chloride, manganese and strontium being elevated compared to concentrations observed at reference creek stations in 2016. Concentrations of all parameters were below applicable WQG and AEMP benchmarks at the CLT1 lower main stem in 2016. However, temporal comparisons suggested increased conductivity, hardness and concentrations of nitrate, sulphate and metals including iron, manganese, molybdenum, sodium, strontium and uranium during the 2015/2016 mine operation period compared to the 2005 - 2013 baseline period. Chlorophyll a concentrations at the CLT1 lower main stem in 2016 were comparable to those of the reference creek stations in 2016, and those observed during the baseline period. In all cases, chlorophyll a concentrations were well below the AEMP benchmark and suggested oligotrophic conditions typical of Arctic watercourses. No significant, ecologically meaningful, differences in benthic invertebrate community primary endpoints or relative abundance of metal-sensitive taxa were indicated at the CLT1 lower main stem between mine operation (2015, 2016) and baseline (2007, 2011) studies. Although benthic invertebrate community composition differed significantly between the CLT1 lower main stem and Unnamed Reference Creek communities in 2016, similar to the results of the 2015 CREMP, this appeared to be related to natural differences in dominant food source between the mine-exposed and reference study areas. No consistent types and/or direction of differences in the relative abundance of dominant groups or FFG were indicated between 2016 and the baseline data at the CLT1 lower main stem. Overall, no adverse mine-related effects to biota of the CLT1 lower main stem were suggested in 2016 based on comparison to Unnamed Reference Creek and baseline data.

3.3.1.2 Camp Lake Tributary 2

Mine-related effects on water quality of CLT2 in 2016 potentially included slightly elevated conductivity, sulphate and zinc concentrations based on comparisons to 2016 reference creek station data. However, water chemistry at CLT2 in 2016 was comparable to the 2005 - 2013 baseline data, suggesting that natural regional variability in water chemistry among lotic environments may have accounted for seemingly elevated concentrations of the aforementioned parameters at CLT2 in 2016 compared to the reference creek stations. Aqueous concentrations of all parameters were consistently well below established WQG and AEMP benchmarks at CLT2 during the 2015 and 2016 mine operation period. Chlorophyll a concentrations at CLT2 were consistently within the range observed among the reference creek stations in 2016 and, in addition to being well below the AEMP benchmark, were also within the range observed at CLT2 during baseline studies. Although the benthic invertebrate community of CLT2 exhibited significantly lower density and significantly different composition than Unnamed Reference Creek in 2016, these differences appeared to be related to natural habitat differences between watercourses. This was supported by no significant differences in richness, Simpson’s Evenness and relative abundance of dominant invertebrate groups, FFG and HPG between areas located upstream and downstream of the mine tote road. In addition, no significant differences in benthic invertebrate community endpoints occurred between 2016 and the 2007 baseline data at either CLT2 study area with the exception of Simpson’s Evenness, which was higher in 2016 and thus not consistent with a typical adverse mine-related response. Similar to the findings of the 2015 CREMP, the occurrence of few significant differences in benthic invertebrate community endpoints upstream and downstream of the mine tote road in 2016, and between the 2016 mine operational and 2007 baseline data, suggested no adverse mine-related influences to the benthic invertebrate community of CLT2.

3.3.2 Camp Lake

Mine-related influences on water quality of Camp Lake in 2016 included slightly elevated manganese concentrations compared to the reference lake, as well as slightly higher conductivity and concentrations of chloride, molybdenum, sodium, strontium and uranium compared to 2005 - 2013 baseline data. However, in all cases, parameter concentrations at Camp Lake were consistently well below WQG and AEMP benchmarks in 2015 and 2016. Sediment arsenic and manganese concentrations were elevated at Camp Lake littoral stations compared to the reference lake in 2016 and, together with molybdenum, were also elevated compared to concentrations during the baseline period. However, no metals were elevated in sediment at Camp Lake profundal stations compared to the reference lake in 2016. Although some changes in average sediment metal concentrations were suggested between 2016 and the baseline period at profundal stations, these changes may have reflected changes to the number of profundal sediment quality monitoring stations sampled between 2016 and the previous studies (i.e., three versus nine, respectively). Phosphorus was the only parameter observed at concentrations above SQG in littoral and profundal sediment of Camp Lake that was not also above applicable SQG at the reference lake. Overall, recent mine operations appeared to contribute to higher manganese and molybdenum concentrations in water and littoral sediment of Camp Lake, as well as higher chloride, sodium, strontium and uranium in water and potentially higher arsenic in littoral sediment, but concentrations of these parameters remained below applicable guidelines and AEMP benchmarks. In turn, this suggested a low potential for adverse effects to biota of Camp Lake.

Camp Lake chlorophyll a concentrations were significantly higher than at the reference lake in 2016 suggesting greater primary production at Camp Lake. However, Camp Lake chlorophyll a concentrations remained well below the AEMP benchmark during all seasonal sampling events in 2016, and suggested oligotrophic conditions typical of Arctic waterbodies. No significant differences in chlorophyll a concentrations were indicated among the mine construction (2014) and operational (2015, 2016) periods, suggesting no changes in the trophic status of Camp Lake since mine operations commenced at the Mary River Project. Benthic invertebrate community data collected at littoral habitat of Camp Lake in 2016 indicated significantly greater evenness and similar density, richness and relative abundance of metal sensitive taxa, FFG and HPG compared to the reference lake. In addition, no significant differences in benthic invertebrate community primary and FFG metrics were observed between 2016 and the 2013 baseline data for Camp Lake littoral stations. Analysis of Camp Lake Arctic charr populations suggested greater fish abundance compared to the reference lake in 2016, but similar numbers of Arctic charr in 2016 relative to the Camp Lake baseline studies. No significant, ecologically meaningful, differences in Arctic charr condition were indicated between Camp Lake and the reference lake in 2016, nor between Camp Lake Arctic charr collected in 2016 compared to the baseline period, for nearshore and littoral/profundal Arctic charr populations. Collectively, 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 in the second year of mine operation at the Mary River Project.

4.0 SHEARDOWN LAKE SYSTEM

4.1 Sheardown Lake Tributaries (SDLT1, 9 and 12)

4.1.1 Water Quality

Sheardown Lake Tributary 1 (SDLT1) dissolved oxygen (DO) concentrations were consistently at or above saturation in spring, summer and fall monitoring events in 2016, and did not differ significantly from Unnamed Reference Creek at the time of biological sampling in August 2016 (Figure 4.1; Appendix Tables C.1 – C.3). Although DO saturation was slightly lower at Sheardown Lake Tributary 9 and 12 (SDLT9 and SDLT12, respectively) than at SDLT1 and Unnamed Reference Creek during August 2016 sampling, DO saturation at all of the Sheardown Lake tributaries was well above the WQG minimum limit for cold-water biota (i.e., 54%) during all seasonal sampling events (Figure 4.1; Appendix Tables C.1 – C.3). *In-situ* pH was significantly higher at SDLT1 compared to Unnamed Reference Creek, whereas pH at SDLT9 and SDLT12 did not differ significantly from reference conditions during the fall sampling event in 2016. Despite minor differences in pH among the Sheardown Lake tributaries, pH was consistently within WQG limits at each mine-exposed tributary and thus slight dissimilarity in pH among areas was unlikely to be ecologically meaningful. Conductivity at each of the Sheardown Lake tributaries was significantly higher than at Unnamed Reference Creek during the August 2016 biological sampling (Figure 4.1; Appendix Table C.29). Because conductivity often serves as an indication of mine-associated influences on water quality (e.g., Environment Canada 2012), these observations suggested a mine-related influence on water quality of the SDLT1, SDLT9 and SDLT12 watercourses.

Sheardown Lake Tributary 1 is the only tributary of the Sheardown Lake system at which routine water quality monitoring is conducted, with one monitoring station established in each of the upper and lower reaches of the tributary (i.e., Stations D1-05 and D1-00, respectively; Figure 2.2). Nitrate, sulphate and molybdenum concentrations were moderately to highly elevated (i.e., 5- to 10-fold, and ≥10-fold, respectively) at both SDLT1 stations compared to reference creek station mean concentrations at the time of fall sampling (Table 4.1). In addition, slightly elevated (i.e., 3- to 5-fold higher) concentrations of cadmium and copper were observed at upper SDLT1, and slightly elevated concentrations of chloride and manganese were observed at lower SDLT1, compared to reference creek stations at the time of fall sampling in 2016 (Table 4.1). Along with the aforementioned parameters, hardness, alkalinity and concentrations of TDS, potassium, sodium, strontium and uranium were generally elevated (i.e., ≥3-fold higher) in spring and/or summer at one or both SDLT1 monitoring stations compared to reference creek station mean values for each respective seasonal

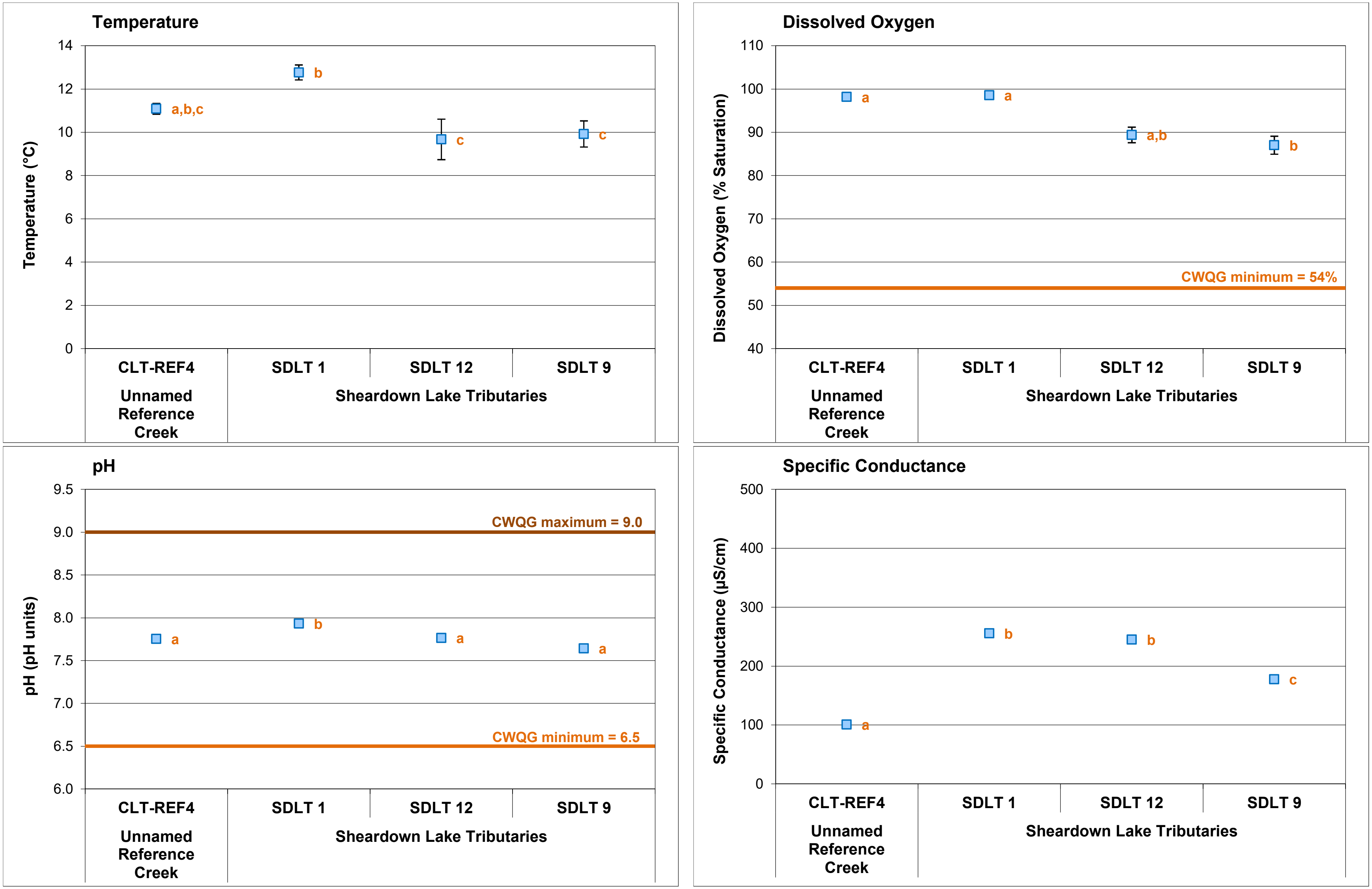


Figure 4.1: Comparison of *in-situ* water quality variables (mean ± SE; n = 5 except for SDLT 12, where n = 3) measured at the Sheardown Lake Tributaries (SDLT) and creek reference stations, Mary River Project CREMP, August 2016. The same letters next to data points indicate study area values do not differ significantly.

Table 4.1: Water chemistry at Sheardown Lake Tributary 1 (SDLT1) monitoring stations, Mary River Project CREMP, August 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Lotic Reference Average (n = 4) Fall 2016	Sheardown Lake Tributary 1	
						D1-05 (Upper) 19-Aug-2016	D1-00 (Lower) 19-Aug-2016
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	125	232	308
	pH (lab)	pH	6.5 - 9.0	-	7.99	7.85	8.08
	Hardness (as $CaCO_3$)	mg/L	-	-	57.75	108	144
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	65	118	166
	Turbidity	NTU	-	-	1.10	0.27	0.65
	Alkalinity (as $CaCO_3$)	mg/L	-	-	57	83	114
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	0.030	<0.020
	Nitrate	mg/L	13	13	0.021	0.733	0.946
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.3	2.7	3.1
	Total Organic Carbon	mg/L	-	-	1.5	2.8	3.2
	Total Phosphorus	mg/L	0.020^{α}	-	0.0059	0.0110	0.0032
	Phenols	mg/L	0.004^{α}	-	0.0055	0.0110	0.0042
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.4975	6.41	9.47
	Sulphate (SO_4)	mg/L	218^{β}	218	4.39	22.6	26.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0578	0.0082	0.0138
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00779	0.0115	0.0170
	Beryllium (Be)	mg/L	0.011^{α}	-	<0.00040	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.0003875	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	0.012	0.012
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	0.000037	0.000011
	Calcium (Ca)	mg/L	-	-	12.3	19.5	27.9
	Chromium (Cr)	mg/L	0.0089	0.00856	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	0.00011
	Copper (Cu)	mg/L	0.002	0.0022	0.0010	***0.00310***	***0.00222***
	Iron (Fe)	mg/L	0.30	0.326	0.051	<0.030	0.098
	Lead (Pb)	mg/L	0.001	0.001	0.000096	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	0.0013	0.0018
	Magnesium (Mg)	mg/L	-	-	6.77	14.1	18.9
	Manganese (Mn)	mg/L	0.935^{β}	-	0.00086	0.000436	0.00559
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000380	0.00325	0.00243
	Nickel (Ni)	mg/L	0.025	0.025	0.00056	0.00114	0.00146
	Potassium (K)	mg/L	-	-	0.84	2.33	2.41
	Selenium (Se)	mg/L	0.001	-	<0.0007625	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.95	1.36	1.59
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000020	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.830	2.98	3.88
	Strontium (Sr)	mg/L	-	-	0.01240	0.0130	0.0169
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.0000775	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.00799	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.00366	0.00654	0.00532
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.000875	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030

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

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

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

BOLD Indicates parameter concentration above the AEMP benchmark.

sampling event (Appendix Table C.32). Despite elevation of these 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 2016[7] (Table 4.1; Appendix Table C.30).

Temporal comparisons of SDLT1 water chemistry data indicated that, of the parameters shown to be elevated above average reference conditions, only nitrate and sulphate concentrations were slightly elevated (i.e., 3- to 5-fold higher) at upper and lower SDLT1 in 2016 compared to respective baseline period conditions (Figure 4.2; Appendix Table C.32 and Figure C.9). The SDLT1 concentrations of these parameters, and uranium, were elevated compared to baseline conditions in 2015 as well, suggesting a mine-related source of these metals since the initiation of mine operations at the Mary River Project.

4.1.2 Phytoplankton

Phytoplankton (chlorophyll a) monitoring is conducted only at SDLT1 within the Sheardown Lake system as part of the Mary River Project CREMP. Chlorophyll a concentrations at SDLT1 were lower at upstream-most Station D1-05 compared to near the creek mouth (Station D1- 00), during the spring and summer 2016 sampling events, but not during the fall (Figure 4.3). With the exception of markedly higher chlorophyll a concentrations near the SDLT1 creek mouth compared to reference conditions in summer, chlorophyll a concentrations were generally within the range shown among the reference creek stations and were well below the AEMP benchmark of 3.7 µg/L during all 2016 seasonal sampling events. Higher chlorophyll a concentrations observed near the mouth of SDLT1 may have reflected the occurrence of elevated nutrient concentrations, and aqueous nitrate concentrations specifically, shown at SDLT1 in 2016 (Section 4.1.1). Similar to the reference creek stations and Camp Lake tributary systems, chlorophyll a concentrations at SDLT1 were suggestive of 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). Relatively low chlorophyll a concentrations at SDLT1 stations in 2016 were consistent with an oligotrophic WQG categorization based on aqueous phosphorus concentrations near or below 10 µg/L (Table 4.1; Appendix Table C.30).

Temporal comparisons indicated that chlorophyll a concentrations at SDLT1 stations in 2016 were comparable to concentrations measured during the baseline period (Figure 4.4). In addition, no consistent directional changes in chlorophyll a concentrations were shown at the

[7] Refer to footnote 2 (page 23) and Appendix B regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA waterbodies.

Figure 4.2: Temporal comparison of water chemistry at Sheardown Lake Tributaries (SDLT) for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods during fall. Values represent mean ± SD. Creek 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 2.3 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are adopted from the Camp Lake Tributaries.

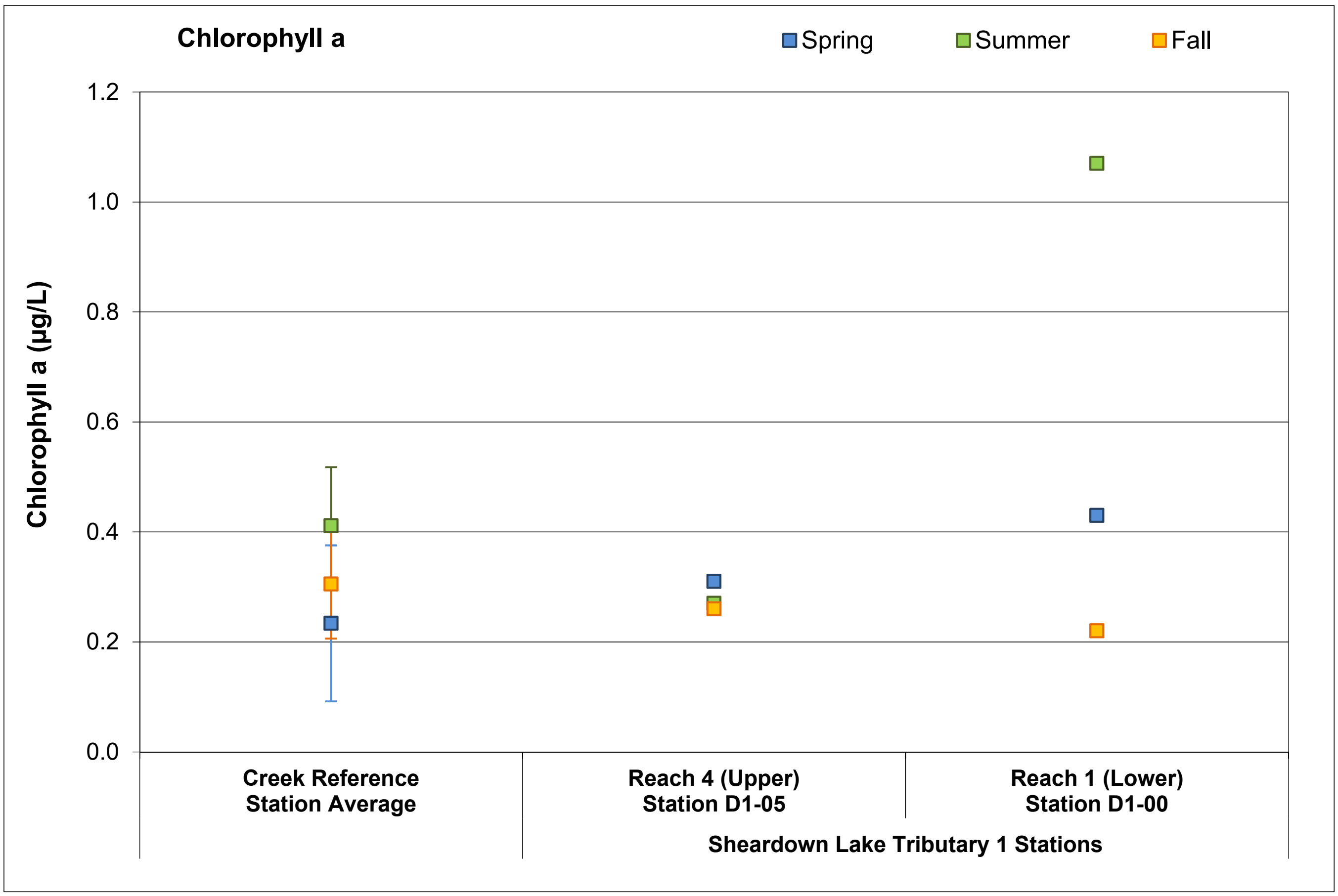


Figure 4.3: Chlorophyll a concentrations at Sheardown Lake Tributary 1 phytoplankton monitoring stations, Mary River Project CREMP, 2016. Creek reference includes the CLT-REF and MRY-REF series stations (mean ± SD; n = 4).

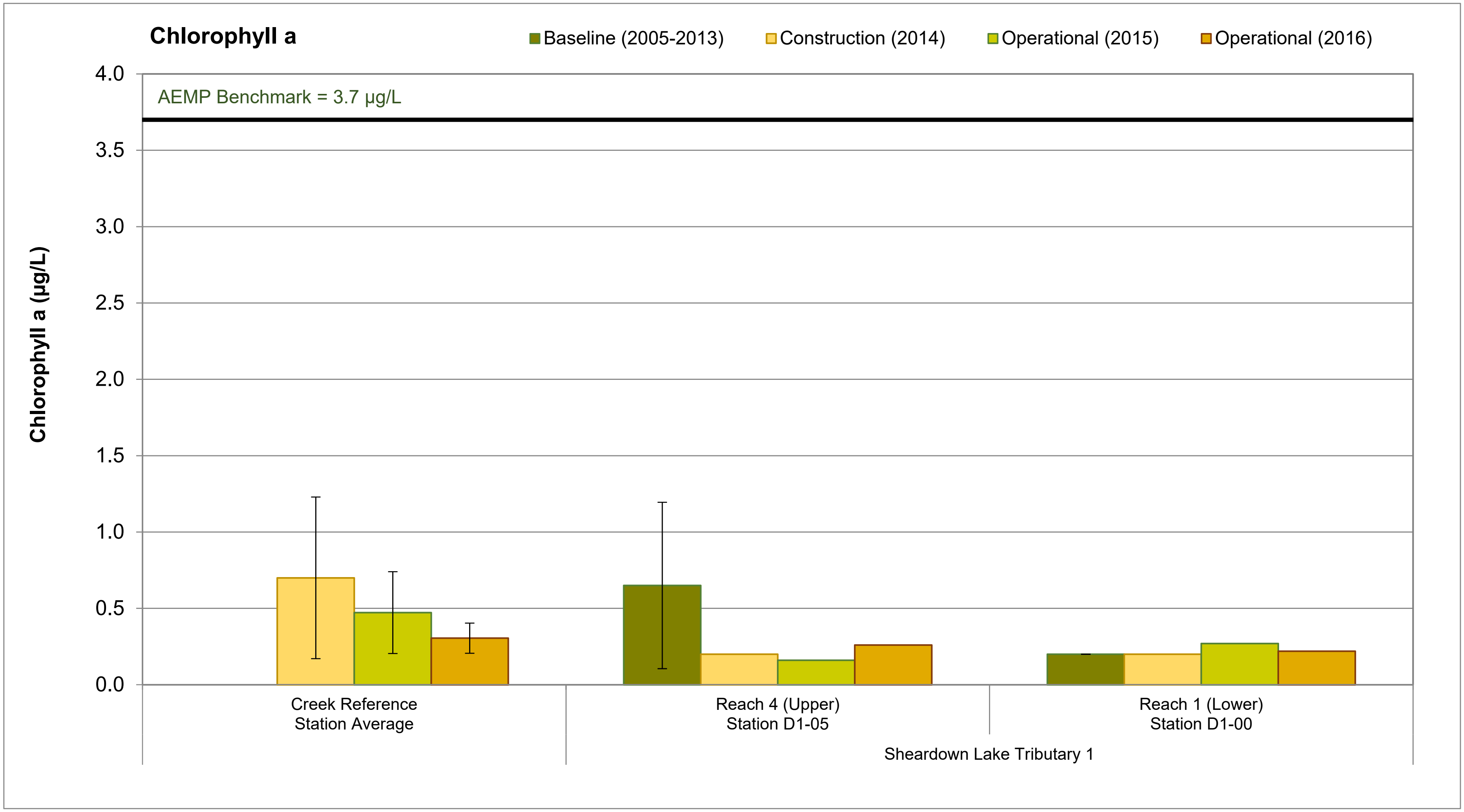


Figure 4.4: Temporal comparison of chlorophyll a concentrations at Sheardown Lake Tributary 1 for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods in the fall, Mary River Project CREMP. The creek reference includes the CLT-REF and MRY-REF series stations (mean ± SD; n = 4).

SDLT1 stations over the mine baseline (2005 – 2013), construction (2014), and operational (2015, 2016) periods (Figure 4.4). These data suggested no adverse mine-related influences to phytoplankton productivity at SDLT1 over the initial two years of mine operation.

4.1.3 Benthic Invertebrate Community

Sheardown Lake Tributary 1 (SDLT1)

The benthic invertebrate community at the lower reach of Sheardown Lake Tributary 1 (SDLT1 R1), near the outlet to Sheardown Lake NW, exhibited significantly lower richness and significant differences in composition (as indicated by Bray-Curtis Index) compared to Unnnamed Reference Creek in 2016 (Figure 4.5; Appendix Table F.25). Although the relative abundances of Hydracarina (water mites) and metal-sensitive chironomids were significantly lower and higher, respectively, at lower SDLT1 than at Unnamed Reference Creek, the magnitude of these differences was within a CES_{BIC} of ± 2 SD_{REF} (Figure 4.5; Appendix Table F.25), suggesting that these differences were not ecologically meaningful. A higher relative abundance of metal-sensitive chironomids at lower SDLT1 also suggested that the differences in community composition compared to Unnamed Reference Creek were unrelated to metal concentrations, which was consistent with concentrations of most metals below WQG at SDLT1 in 2016 (see Appendix Table C.30). A significantly higher relative abundance of FFG filterers (Appendix Table F.25), which were represented predominantly by metal-sensitive chironomids, suggested that higher nitrate (i.e., nutrient) concentrations contributed to higher abundance of phytoplankton (i.e., chlorophyll a) and a consequent shift in benthic food resources at SDLT1 compared to reference conditions. Notably, the occurrence of significantly higher relative abundance of HPG burrowers was consistent with significantly greater substrate embeddedness at SDLT1 than at Unnamed Reference Creek (Appendix Tables F.22 and F.25). Greater substrate embeddedness at SDLT1 may reflect a natural phenomenon, but could also be the result of mine-related sedimentation events in 2016 (Baffinland 2016b). Therefore, the slight shift towards a greater proportion of HPG burrowers in the benthic invertebrate community may have reflected a sedimentation influence at lower SDLT1 in 2016.

Temporal comparison of the lower SDLT1 benthic invertebrate community data indicated significantly higher invertebrate density in 2016 compared to baseline data collected in 2008 and 2013 (Figure 4.6; Appendix Table F.26). However, no significant differences in richness, Simpson's Evenness or any community compositional features occurred consistently between the 2016 data and both respective baseline data sets. Increased benthic invertebrate density can often occur as an outcome of slight nutrient enrichment of aquatic systems (Ward 1992; Taylor and Bailey 1997). However, temporal comparisons indicated similar chlorophyll a concentrations between 2016 and the baseline period at SDLT1 (Figure 4.4), suggesting that

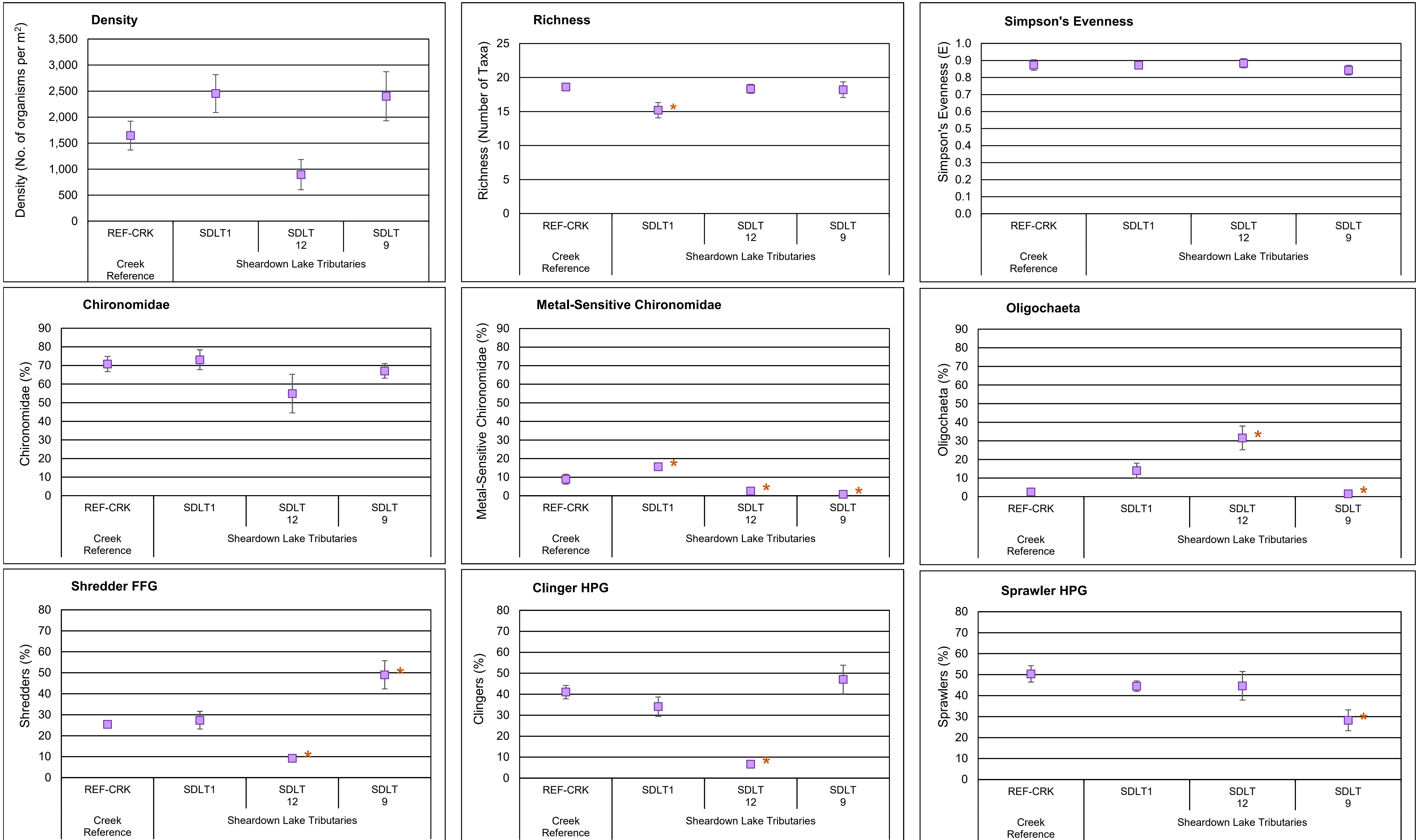


Figure 4.5: Comparison of benthic invertebrate community metrics between Sheardown Lake Tributary and creek reference study areas (mean ± SE), Mary River Project CREMP, August 2016. Asterisk (*) next to SDLT data points indicates significant difference from Unnamed Reference Creek.

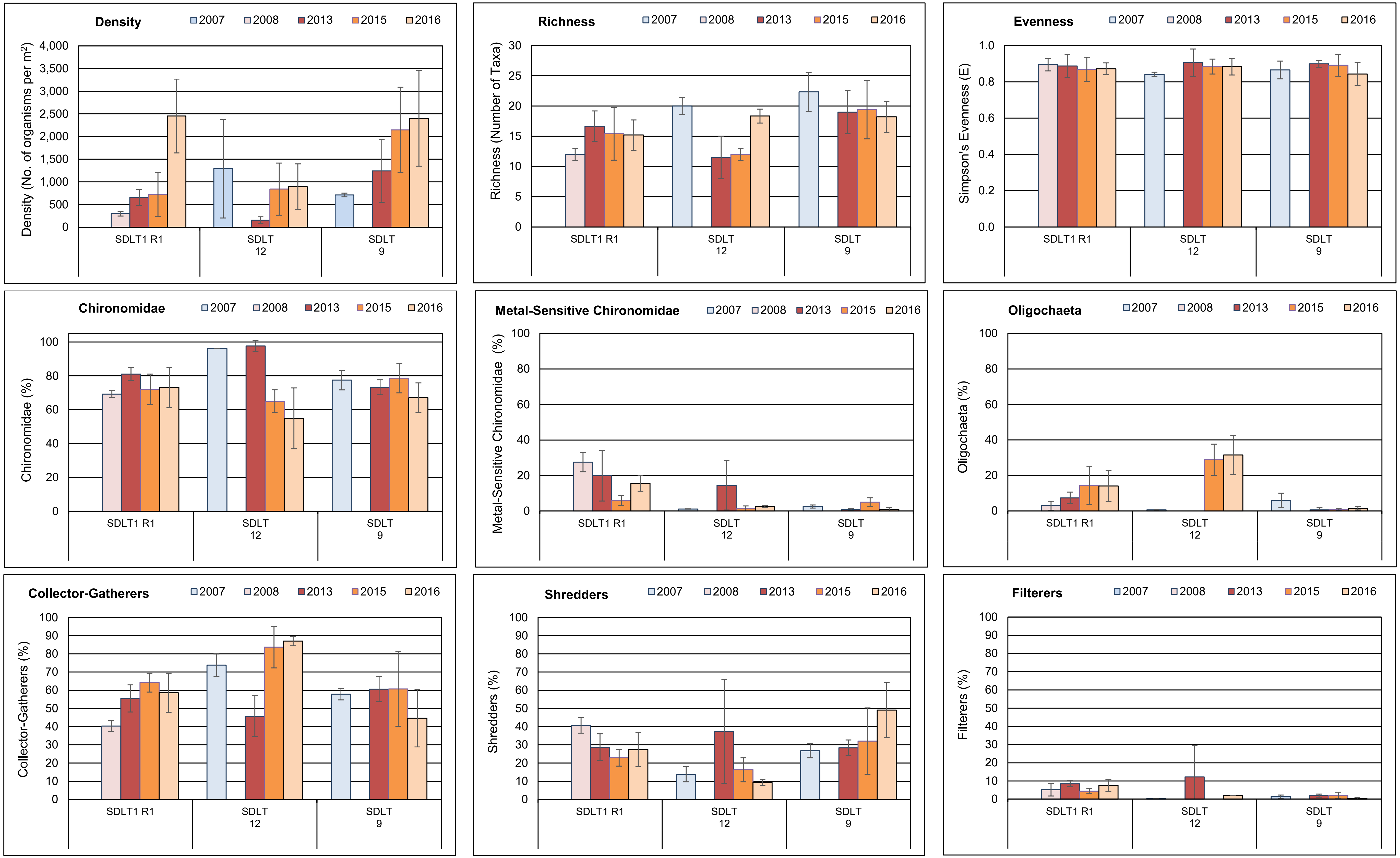


Figure 4.6: Comparison of benthic invertebrate community metrics (mean ± SD) at Sheardown Lake Tributaries 1, 12 and 9 among operational (2015, 2016) and baseline (2007, 2008, 2011, 2013) studies, Mary River Project CREMP.

higher benthic invertebrate density in 2016 was not likely related to a mine-associated change in trophic status of the SDLT1 system. Given the occurrence of few differences in benthic invertebrate community endpoints between 2016 and the baseline period, and the fact that the few differences were not consistently observed in 2015 and 2016 compared to the baseline period, higher density in 2016 potentially reflected natural year-to-year variability within the SDLT1 system. Baseline studies did not include HPG analysis precluding temporal evaluation of benthic endpoints important to assessment of sedimentation influences on in-stream biota.

Sheardown Lake Tributary 12 (SDLT12)

The benthic invertebrate community of Sheardown Lake Tributary 12 (SDLT12) did not differ significantly from Unnamed Reference Creek for primary endpoints of density, richness or Simpson's Evenness in 2016 (Figure 4.5; Appendix Table F.25). However, marked differences in community composition were indicated between these watercourses based on significant differences in Bray-Curtis Index and several key dominant invertebrate, functional feeding and habitat preference groups (Figure 4.5; Appendix Table F.25). Because the magnitude of difference in the relative abundance of metal-sensitive chironomids was within a CES_{BIC} of $\pm$ 2 SD_{REF} (Figure 4.5; Appendix Table F.25), the differences in community composition between SDLT12 and Unnamed Reference Creek were not likely related to metal concentrations. Rather, significantly higher relative abundance of HPG burrowers including Nemata (roundworms) and Oligochaeta (aquatic worms) and FFG collector-gatherer deposit feeders was consistent with the occurrence of significantly slower water velocity and greater substrate embeddedness (i.e., more depositional habitat) at SDLT12 than at Unnamed Reference Creek (Appendix Tables F.22 and F.25). Therefore, a natural difference in habitat features between SDLT12 and Unnamed Reference Creek potentially accounted for differences in benthic invertebrate community compositional features between watercourses. However, similar to SDLT1, a higher relative abundance of HPG burrowers at SDLT12 was also consistent with greater substrate embeddedness that may have resulted from sedimentation events in 2016.

Temporal comparison of the SDLT12 benthic invertebrate community data did not indicate any significant differences in density, richness and Simpson's Evenness between 2016 and baseline data collected in 2007 (Figure 4.6; Appendix Table F.27). However, significantly higher relative abundance of burrowing invertebrates including aquatic worms and Tipulidae (crane flies) together with significantly greater relative abundance of FFG collector-gatherers in both 2015 and 2016 compared to the 2007 baseline study suggested changes in habitat conditions at SDLT12 with the commencement of mine operations. Although such temporal changes potentially reflected slight differences in sampling location between the mine operational and baseline periods, field observations from the 2016 study included the occurrence of silt deposits on in-stream substrate of SDLT12. Therefore, a mine-related reduction in flow and/or increased particle loadings (e.g., through dust and/or erosional deposition) over time may have accounted for subtle temporal changes in the benthic invertebrate community between the 2015/2016 mine operational and 2007 baseline studies. Overall, it was uncertain as to whether changes in benthic invertebrate compositional features over time at SDLT12 reflected natural variability in habitat or a mine-related influence that potentially included greater sedimentation in 2016.

Sheardown Lake Tributary 9 (SDLT9)

The benthic invertebrate community of Sheardown Lake Tributary 9 (SDLT9) did not differ significantly from Unnamed Reference Creek for primary endpoints of density, richness or Simpson's Evenness in 2016 (Figure 4.5; Appendix Table F.25). However, similar to SDLT12, marked differences in community composition were indicated between SDLT9 and Unnamed Reference Creek based on significant differences in Bray-Curtis Index and several groups of dominant taxa, FFG and HPG (Figure 4.5; Appendix Table F.25). Notably, the magnitude of difference in the relative abundance of metal-sensitive chironomids between SDLT9 and the reference creek was within a CES_{BIC} of ± 2 SD_{REF} (Figure 4.5; Appendix Table F.25), suggesting that differences in community composition between watercourses were not likely related to metal concentrations. Rather, a significantly higher relative abundance of HPG burrowers including nemata (roundworms) and Tipulidae (crane flies) combined with a significantly greater relative abundance of FFG shredders was consistent with field observations of greater amounts of rooted in-stream vegetation at SDLT9 compared to the reference creek (Appendix Tables F.1 and F.25). Temporal comparisons indicated no significant differences in benthic invertebrate density, richness, Simpson's Evenness or any dominant invertebrate groups, FFG and HPG at SDLT9 between mine operational period data collected in 2015/2016 and baseline period data collected in 2007 and 2013 (Figure 4.6; Appendix Table F.28). In turn, this suggested that the differences in benthic invertebrate community composition (and amount of in-stream vegetation) between SDLT9 and Unnamed Reference Creek in 2016 likely reflected a natural difference in habitat features between watercourses.

4.2 Sheardown Lake NW (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 2016 showed no substantial station-to-station differences during any of the winter, summer or fall sampling events (Appendix Figures C.10 – C.13). On average, water temperature profiles suggested weak stratification during the summer sampling event, but more strongly established stratification during the fall sampling event at Sheardown Lake NW in 2016 (Figure 4.7). In both seasons, the greatest change in temperature occurred between lake depths of approximately 10 and 15 m, which was comparable to the thermocline depth range observed at Reference Lake 3 (Figure 4.7). Average water temperature at the bottom of the water column at Sheardown Lake NW littoral stations was slightly warmer than at Reference Lake 3 at the time of fall sampling in 2016, the difference of which was statistically significant (Figure 4.8). However, the incremental difference in average bottom water temperature between lakes was small (i.e., 0.6˚C) and thus was unlikely to be ecologically meaningful. Dissolved oxygen profiles at Sheardown Lake NW showed an oxycline at depths greater than approximately 16 m and 10 m during the winter and fall, respectively, but no appreciable change in dissolved oxygen saturation from surface to bottom in the summer of 2016 (Figure 4.7; Appendix Figure C.11). No oxycline was observed at Reference Lake 3 in 2016 during the summer or fall sampling events (Appendix Figure B.3). Dissolved oxygen saturation levels at the bottom of the water column at littoral stations (i.e., approximately 10 m deep) of Sheardown Lake NW were significantly higher than those at Reference Lake 3 during fall 2016 sampling (Figure 4.8; Appendix Table C.37). In addition, dissolved oxygen saturation levels were well above the WQG of 54% at all littoral stations of Sheardown Lake NW in fall 2016 (Figure 4.8) and, with the exception of depths greater than approximately 22 m in winter, through the majority of the water column during winter, summer and fall sampling events (Figure 4.7). This suggested that dissolved oxygen was not limiting for pelagic or bottom-dwelling biota within Sheardown Lake NW for the majority of the year in 2016.

In-situ profiles of pH and specific conductance showed no substantial change from the surface to bottom of the Sheardown Lake NW water column, indicating no chemical stratification (Figure 4.7). Mean pH at the bottom of the water column at littoral stations of Sheardown Lake NW did not differ significantly from that of Reference Lake 3 during fall sampling in 2016 (Figure 4.8; Appendix Table C.37). In addition, pH values were consistently within WQG limits of 6.5 – 9.0 through the entire water column during all 2016 sampling events conducted at Sheardown Lake NW (Appendix Tables C.33 – C.36). Specific conductance was significantly higher at Sheardown Lake NW compared to the reference lake during fall sampling (Figure 4.8; Appendix Table C.37). However, similar to observations at Camp Lake (Section 4.2.1), specific conductance at Sheardown Lake NW was intermediate to that of reference creek and river stations in fall 2016, and therefore it was unclear whether higher specific conductance at Sheardown Lake NW than at Reference Lake 3 was related to natural regional variability in

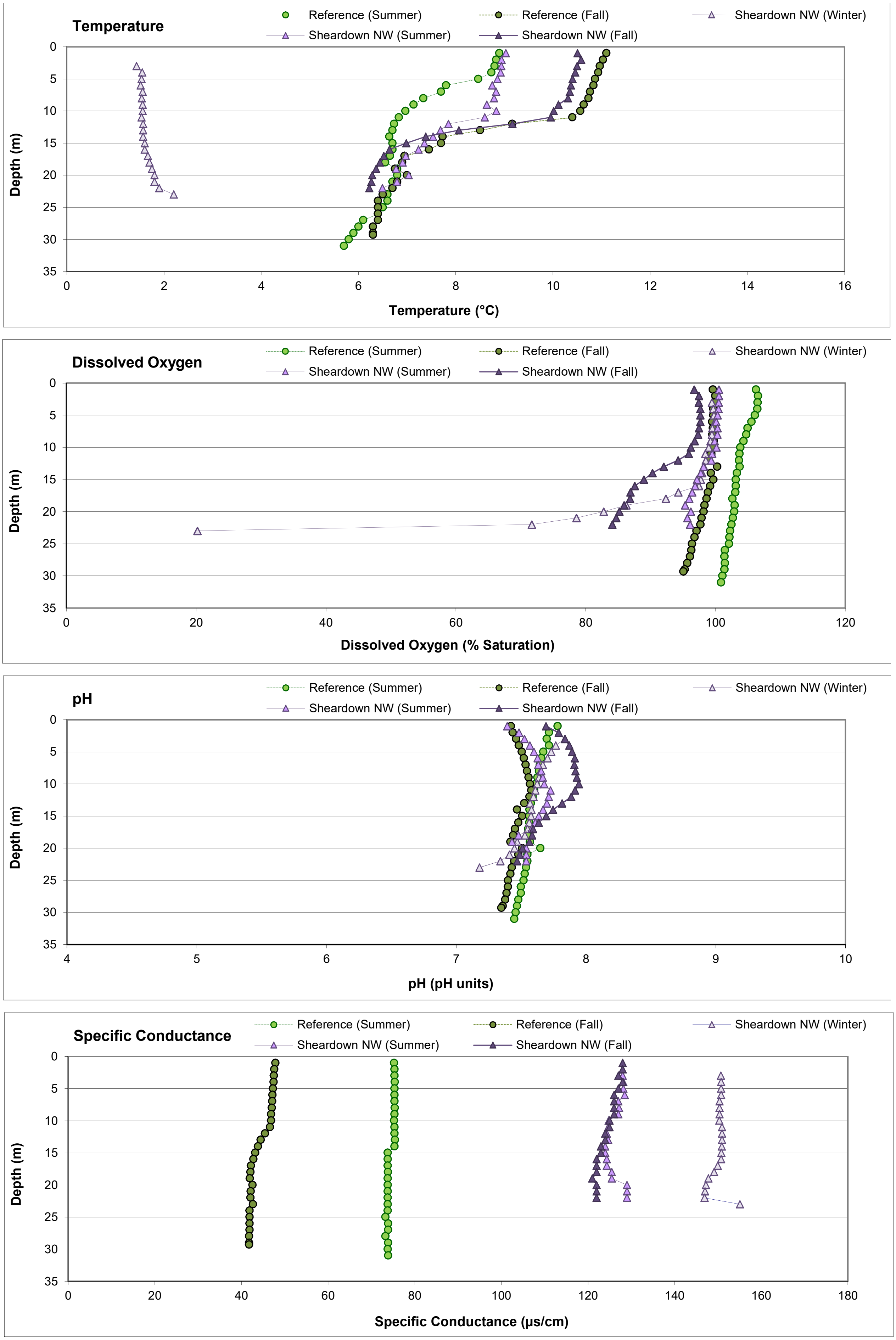


Figure 4.7: Average *in-situ* water quality with depth from surface at Sheardown Lake NW (mine-exposed area) compared to Reference Lake 3 during winter, summer, and fall sampling events, Mary River Project CREMP, 2016.

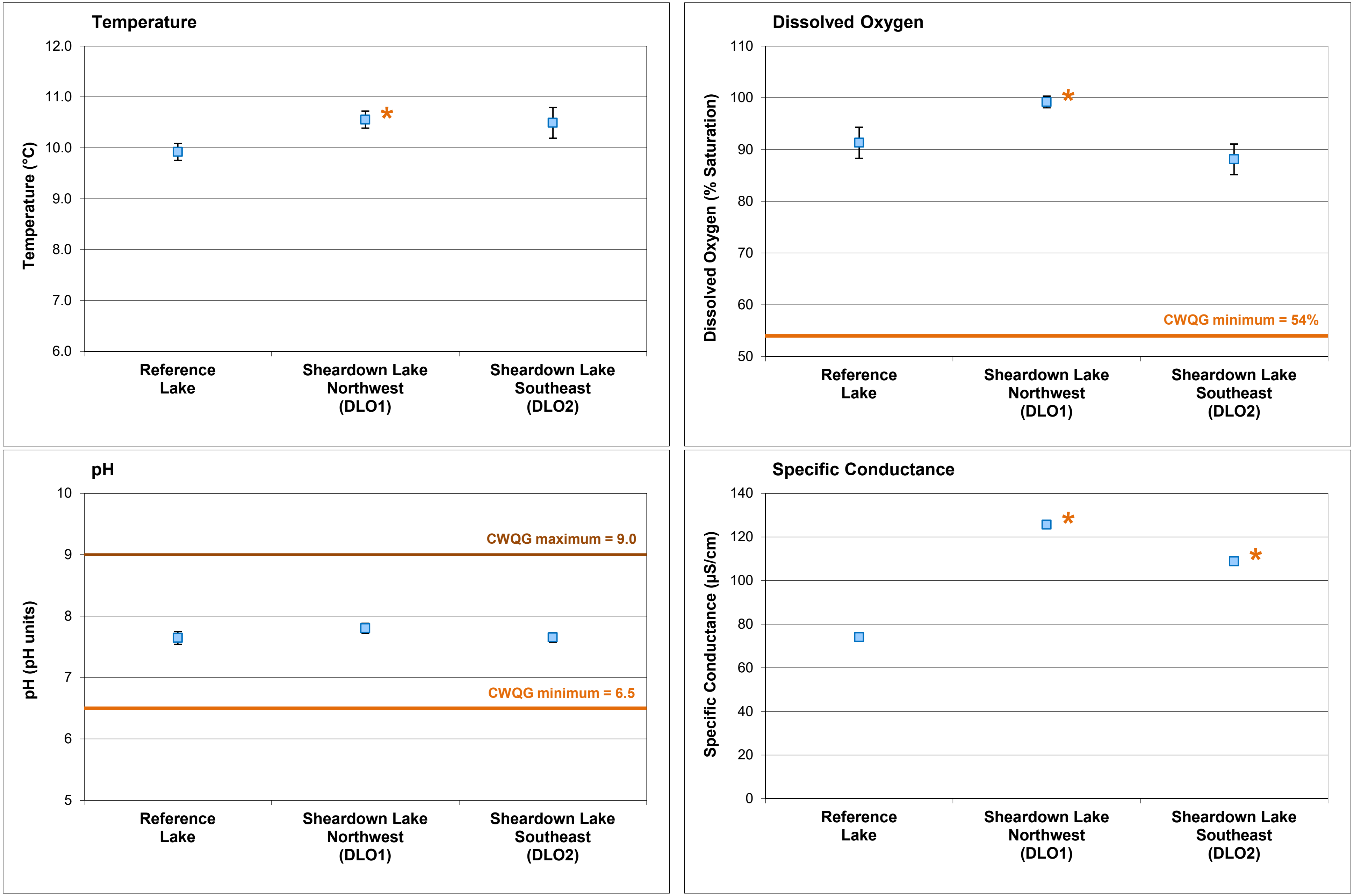


Figure 4.8: Comparison of in-situ water quality (mean ± SD; n = 5) measured near the bottom of the water column at the Sheardown Lake basins and Reference Lake 3 (REF3) littoral benthic invertebrate community stations, Mary River Project CREMP, August 2016. An asterisk (*) next to the Sheardown Lake data point indicates a significant difference compared to the reference lake measure.

surface waters or a mine-related influence. Water clarity, as determined through evaluation of Secchi depth, was significantly lower at Sheardown Lake NW than at Reference Lake 3 during the 2016 fall sampling event (Appendix Tables C.36 – C.37). Secchi depth readings showed relatively low variability among stations at Sheardown Lake NW in the fall of 2016, suggesting no spatial differences in water clarity throughout the lake (Appendix Table C.36).

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 2016 (Table 4.2; Appendix Table C.38), suggesting that the lake waters were continually well mixed both laterally and vertically. Turbidity and total concentrations of aluminum, manganese, molybdenum and uranium were slightly (3- to 5-fold higher) to moderately (5- to 10-fold higher) elevated at Sheardown Lake NW compared to Reference Lake 3 during the summer and/or fall sampling events (Table 4.2; Appendix Table C.38). Similar to the 2015 study, total aluminum and manganese concentrations showed a significant positive correlation with turbidity at Sheardown Lake NW in 2016 ($r = 0.54$ and 0.49, respectively). This suggested that elevated total aluminum and manganese concentrations at Sheardown Lake NW reflected influences associated with surface runoff or backflow received from Mary River that contained naturally high concentrations of aluminum-based, manganese bearing, particulate minerals. This was supported through comparisons of dissolved metal concentrations, which indicated that only dissolved molybdenum and uranium concentrations (and not aluminum or manganese) were elevated at Sheardown Lake NW compared to Reference Lake 3 (Appendix Table C.39). In addition, the ratio of dissolved to total concentrations of aluminum and manganese indicated that the majority (i.e., >65%) of each of these metals was in the dissolved fraction at Sheardown Lake NW based on the 2016 data. Although total molybdenum and uranium concentrations were not correlated with turbidity, similar concentrations of these metals were observed between Sheardown lake NW and the reference creek and river stations during summer and fall 2016 monitoring. In turn, this suggested that higher molybdenum and uranium concentrations at Sheardown Lake NW compared to Reference Lake 3 may have also reflected natural geochemical differences between these lakes. Despite elevation of total aluminum, manganese, molybdenum and uranium metals at Sheardown Lake NW compared to Reference Lake 3, concentrations of all parameters were well below established WQG and AEMP benchmarks at Sheardown Lake NW during all sampling events in 2016[8] (Table 4.2; Appendix Table C.38).

[8] Refer to footnote 2 (page 23) and Appendix B regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA waterbodies.

Table 4.2: Water chemistry at Sheardown Lake NW (DLO-01) and Reference Lake 3 (REF3) monitoring stations, Mary River Project CREMP, August 2016. Values presented are averages of samples taken from the surface and the bottom of the water column at each station. * Copper data confounded by sampling equipment.

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	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 2016	21-Aug-2016	21-Aug-2016	21-Aug-2016	22-Aug-2016	22-Aug-2016	22-Aug-2016
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	84	134	130	130	133	129	133
	pH (lab)	pH	6.5 - 9.0	-	7.68	8.14	7.89	7.98	8.12	7.93	8.12
	Hardness (as $CaCO_3$)	mg/L	-	-	35	64	63	63	63	62	62
	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	-	-	39	65	62	67	67	59	63
	Turbidity	NTU	-	-	0.33	0.91	0.81	0.82	0.84	0.88	0.79
	Alkalinity (as $CaCO_3$)	mg/L	-	-	33	61	61	59	60	59	59
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.040	0.027	0.026	0.040	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	0.028	0.023	0.022	0.027	0.025	0.023
	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	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.7	1.6	1.8	1.9	1.8	1.7	1.7
	Total Organic Carbon	mg/L	-	-	2.8	2.0	1.9	2.0	1.9	1.8	1.8
	Total Phosphorus	mg/L	0.020[α]	-	0.010	0.005	0.015	0.007	0.004	0.006	0.010
	Phenols	mg/L	0.004[α]	-	0.003	0.002	0.016	0.009	0.004	0.002	0.004
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.3	3.0	3.0	3.0	3.1	3.0	3.1
	Sulphate (SO_4)	mg/L	218[β]	218	4.1	4.3	3.6	3.8	4.2	3.8	4.1
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.004	0.013	0.011	0.013	0.017	0.011	0.017
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00653	0.00618	0.00607	0.00615	0.00617	0.00601	0.00643
	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	<0.010	<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	-	-	7.0	12.2	12.3	12.7	12.6	12.2	12.8
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0008	0.0010	0.0009	0.0009	*	*	*
	Iron (Fe)	mg/L	0.30	0.300	<0.030	0.03	0.03	0.03	0.03	0.03	0.03
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
	Lithium (Li)	mg/L	-	-	<0.0010	0.001	0.001	0.001	0.0012	0.0011	0.0013
	Magnesium (Mg)	mg/L	-	-	4.3	7.9	7.5	7.6	7.8	7.6	7.9
	Manganese (Mn)	mg/L	0.935[β]	-	0.00062	0.00201	0.00240	0.00207	0.00201	0.00214	0.00217
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00014	0.00075	0.00076	0.00077	0.00076	0.00072	0.00077
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00065	0.00061	0.00064	0.00061	0.00063	0.00065
	Potassium (K)	mg/L	-	-	0.89	1.09	1.07	1.06	1.08	1.06	1.10
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.42	0.46	0.51	0.48	0.48	0.51	0.48
	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	-	-	0.84	1.40	1.35	1.33	1.40	1.35	1.39
	Strontium (Sr)	mg/L	-	-	0.0081	0.0082	0.0083	0.0085	0.0084	0.0081	0.0084
	Thallium (Tl)	mg/L	0.0008	0.0008	<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	-	0.00027	0.00103	0.00094	0.00094	0.00102	0.00094	0.00098
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Temporal comparisons of the Sheardown Lake NW water chemistry data suggested that average (total) concentrations of the majority of parameters in 2016 were within the range of baseline concentrations (2005 – 2013; Figure 4.9; Appendix Figure C.18). Only phenol concentrations showed moderate elevation (i.e., 5- to 10-fold higher) in 2016 compared to the baseline data based on fall sampling results (Appendix Table C.40). A number of parameters, including conductivity, molybdenum, sodium and strontium, showed successively higher concentrations over years of mine-construction (2014), initial mine operation (2015) and 2016 (Figure 4.9; Appendix Figure C.18; Appendix Table C.40). Although the magnitude of these changes were relatively minor and, because concentrations in 2016 remained well below WQG, were unlikely to be ecologically meaningful, 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 collected at the Sheardown Lake NW coring stations was characterized by silt to sandy loam material with low TOC content (Figure 4.10). Although littoral station co-dominant sand and silt sediment particle sizes did not differ significantly between Sheardown Lake NW and the reference lake, sediment TOC content was significantly lower at Sheardown Lake NW (Appendix Table D.14). 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.11 – D.13). In Sheardown Lake NW, this material occasionally occurred as a thin, distinct layer that was likely composed principally of iron (oxy)hydroxide precipitate. No visible evidence of excessive sedimentation was observed at Sheardown Lake NW in 2016 (Appendix Tables D.11 – D.13). Below the surficial layer, substrates at some Sheardown Lake NW littoral and profundal stations exhibited blackening and/or darkening and possessed a slight sulphidic odour suggesting the occurrence of reducing conditions and, in some cases, a distinct redox boundary was observed in sediments of the lake (Appendix Tables D.11 to D.13). The occurrence of reducing sediment conditions in 2016 appeared to be more pronounced at Sheardown Lake NW than at the reference lake, where reducing sediment conditions occurred sporadically within the sediment (Appendix Tables D.1 – D.3 and D.11 – D.13).

Sediment metal concentrations at Sheardown Lake NW showed no spatial differences among stations in 2016 with the possible exception of at the littoral station located nearest the SDLT1 lake inlet (i.e., Station DD-HAB9-Stn2; Appendix Table D.15). At this station, sediment barium, iron, manganese, molybdenum and phosphorus concentrations were noticeably higher than at other littoral stations, and compared to profundal stations, suggesting that these metals originated from the SDLT1 watercourse. Erosion events that resulted in elevated total

Figure 4.9: Temporal comparison of water chemistry at Sheardown Lake Northwest (DLO-01) and Sheardown Lake Southeast (DLO-02) for mine baseline (2005 - 2013), construction (2014), and operational (2015, 2016) periods during fall. Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.3 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Sheardown Lake (northwest and southeast).

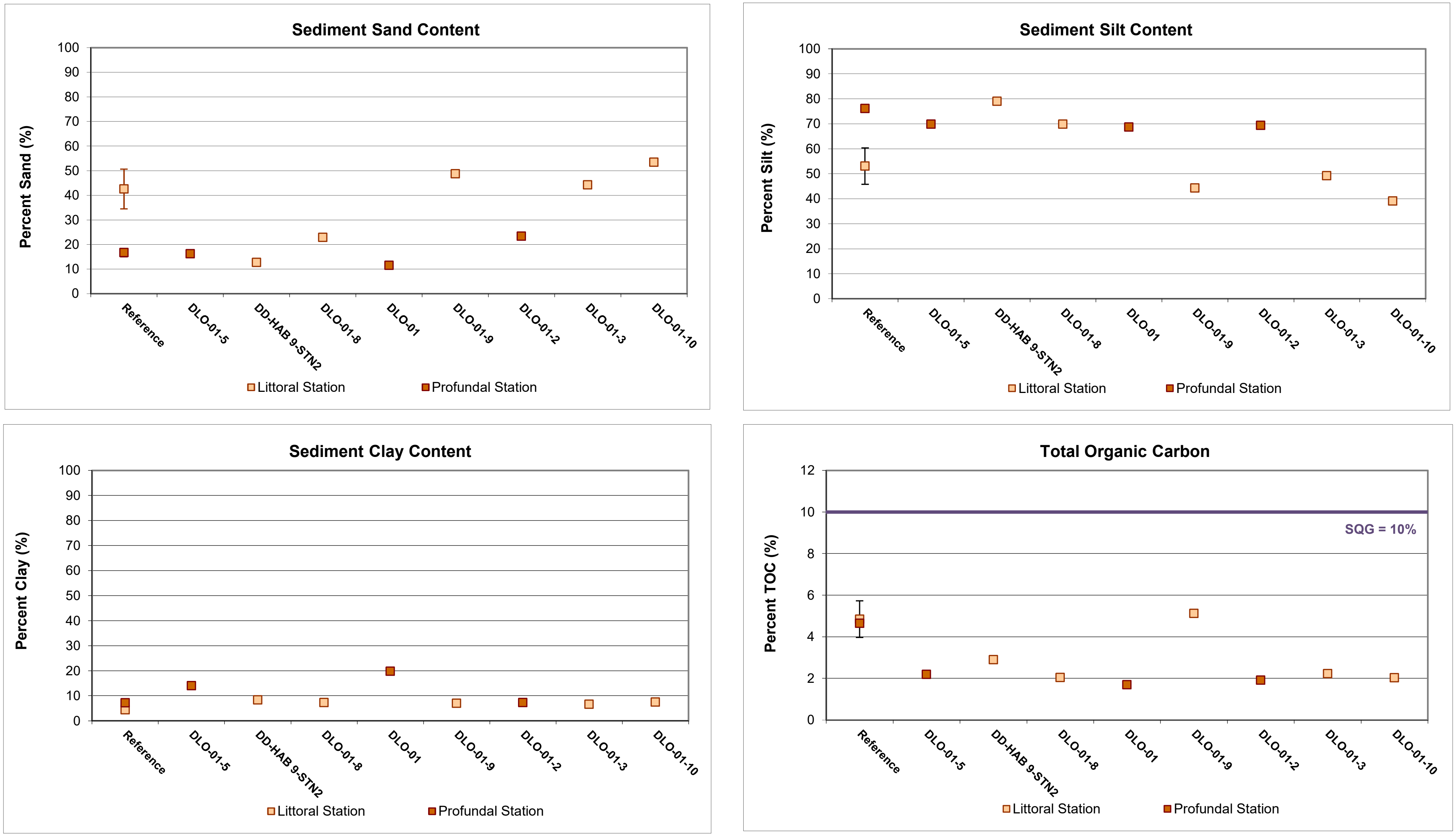


Figure 4.10: Sediment particle size and total organic carbon (TOC) content comparisons among Sheardown Lake NW (DLO-01) sediment monitoring stations and Reference Lake 3 averages (mean ± SE), Mary River Project CREMP, August 2016.

suspended solids (TSS) concentrations at SDLT1 during spring freshet potentially contributed to higher concentrations of these metals in lake sediments near the watercourse outlet to Sheardown Lake NW in 2016 (see Baffinland 2016). On average, concentrations of arsenic, manganese and molybdendum were slightly elevated (i.e., 2- to 5-fold higher) in sediment at littoral stations of Sheardown Lake NW compared to the reference lake littoral stations (Table 4.3). However, average metal concentrations in sediment at profundal stations were similar between lakes (Table 4.3). Although mean iron and manganese concentrations were above applicable SQG at littoral and profundal stations of Sheardown Lake NW, mean concentrations of these metals were also above SQG at profundal stations of Reference Lake 3 (Table 4.3). Similarly, despite mean arsenic and iron concentrations above respective AEMP benchmarks in sediment at profundal stations of Sheardown Lake NW, mean concentrations of these metals, together with chromium and copper, were above applicable AEMP benchmarks in sediment at profundal stations of Reference Lake 3 (Table 4.3). This suggested that, in part, elevated arsenic, iron, manganese concentrations at Sheardown Lake NW compared to sediment quality guidelines/benchmarks reflected at natural phenomenon. Lastly, sediment nickel and phosphorus concentrations were above SQG and the AEMP benchmark at individual stations in Sheardown Lake NW, but on average, were below the applicable guidelines/benchmarks (Table 4.3; Appendix Table D.15).

Temporal comparisons of the sediment metals data indicated slightly elevated (i.e., 2- to 5-fold higher) average concentrations of arsenic, barium, iron, manganese and molybdenum at littoral stations of Sheardown Lake NW in 2016 compared to the baseline (2005 – 2013) period[9] (Figure 4.11). No substantial changes in metal concentrations occurred at profundal stations between 2016 and the baseline period (Figure 4.11; Appendix Table D.16). The parameters listed above showed progressively higher mean concentrations from baseline, to mine construction, to 2015 and 2016 mine operational years in sediment at littoral stations of Sheardown Lake NW. However, variability in parameter concentrations was high, and none of the above listed parameters exhibited concentrations greater than at the reference lake littoral and profundal stations (Figure 4.11; Appendix Table D.16). Similar to the analysis of Camp Lake sediment quality data, this suggested that changes in station replication and location among studies likely contributed to the appearance of greater mean concentrations of select parameters in sediment over time at the Sheardown Lake NW littoral stations. Nevertheless, because arsenic, barium, iron, manganese and molybdenum have shown progressively higher mean concentrations in littoral and/or profundal sediment of both

[9] Refer to footnote 6 (page 32) regarding temporal differences in sediment boron concentrations at Mary River Project LSA waterbodies.

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 2016.

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b] (NW ; SE)	Littoral			Profundal	
					Reference Lake (n = 5)	Sheardown Lake NW (n=5)	Sheardown Lake SE (n=5)	Reference Lake (n = 5)	Sheardown Lake NW (n=3)
					Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error
Non-metals	Sand	%	-	-	42.5 ± 8.1	36.4 ± 7.9	12.0 ± 2.5	16.7 ± 1.5	17.0 ± 3.5
	Silt	%	-	-	53.1 ± 7.3	56.3 ± 7.7	73.0 ± 1.8	76.1 ± 1.4	69.3 ± 0.3
	Clay	%	-	-	4.4 ± 1.0	7.3 ± 0.3	14.9 ± 1.8	7.2 ± 0.4	13.7 ± 3.6
	Moisture	%	-	-	89.7 ± 6.0	70.4 ± 5.0	41.4 ± 3.3	83.5 ± 5.4	58.4 ± 2.7
	Total Organic Carbon	%	10^{α}	-	4.85 ± 0.88	2.86 ± 0.59	1.30 ± 0.19	4.64 ± 0.13	1.94 ± 0.14
Metals	Aluminum (Al)	mg/kg	-	-	16,480 ± 397	15,620 ± 1,329	16,440 ± 1,127	25,150 ± 1,418	21,217 ± 1,516
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0	0.12 ± 0.02	<0.10 ± 0
	Arsenic (As)	mg/kg	17	6.2 ; 5.9	3.71 ± 0.26	***7.95 ± 1.88***	4.40 ± 0.69	***6.47 ± 0.27***	4.30 ± 0.35
	Barium (Ba)	mg/kg	-	-	112 ± 11	196 ± 107	92 ± 17	162 ± 8	101 ± 5
	Beryllium (Be)	mg/kg	-	-	0.67 ± 0.02	0.82 ± 0.07	0.76 ± 0.05	1.02 ± 0.05	1.11 ± 0.09
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0.0	0.23 ± 0.02	0.29 ± 0.10	0.21 ± 0.004	0.27 ± 0.03
	Boron (B)	mg/kg	-	-	13.0 ± 0.9	24.0 ± 2.6	21.5 ± 1.7	19.2 ± 1.0	30.7 ± 2.0
	Cadmium (Cd)	mg/kg	3.5	1.5	0.146 ± 0.035	0.267 ± 0.059	0.103 ± 0.008	0.180 ± 0.010	0.257 ± 0.009
	Calcium (Ca)	mg/kg	-	-	5,128 ± 470	4,494 ± 429	5,112 ± 627	6,111 ± 156	4,402 ± 146
	Chromium (Cr)	mg/kg	90	97 ; 79	55.0 ± 1.2	61.9 ± 4.6	70.7 ± 3.7	***80.0 ± 4.1***	78.1 ± 3.9
	Cobalt (Co)	mg/kg	-	-	10.15 ± 0.57	12.70 ± 0.83	13.08 ± 0.77	18.15 ± 0.75	15.83 ± 0.70
	Copper (Cu)	mg/kg	110	58 ; 56	***66.5 ± 7.4***	42.9 ± 7.2	25.8 ± 1.5	***101.4 ± 5.6***	46.7 ± 3.3
	Iron (Fe)	mg/kg	$40{,}000^{\alpha}$	52,200 ; 34,400	29,840 ± 3,488	***58,740 ± 9,478***	***40,340 ± 3,922***	***53,580 ± 2,174***	40,333 ± 2,067
	Lead (Pb)	mg/kg	91.3	35	***46.0 ± 17.4***	19.8 ± 1.6	21.7 ± 4.3	29.5 ± 5.0	31.0 ± 3.6
	Lithium (Li)	mg/kg	-	-	27.3 ± 0.4	27.5 ± 2.4	30.4 ± 2.3	41.7 ± 2.1	39.1 ± 2.5
	Magnesium (Mg)	mg/kg	-	-	10,852 ± 274	10,896 ± 780	12,720 ± 357	16,160 ± 814	13,517 ± 738
	Manganese (Mn)	mg/kg	$1{,}100^{\alpha,\beta}$	4,530 ; 657	496 ± 99	2,503 ± 1,952	***1,596 ± 911***	***1,866 ± 449***	1,435 ± 720
	Mercury (Hg)	mg/kg	0.486	0.17	0.0355 ± 0.0063	0.0385 ± 0.0057	0.0252 ± 0.0028	0.0699 ± 0.0019	0.0432 ± 0.0078
	Molybdenum (Mo)	mg/kg	-	-	2.19 ± 0.49	8.80 ± 2.94	1.65 ± 0.45	3.27 ± 0.34	2.99 ± 1.39
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	77 ; 66	38.6 ± 1.6	65.8 ± 6.5	55.8 ± 3.2	56.3 ± 2.6	67.8 ± 0.9
	Phosphorus (P)	mg/kg	$2{,}000^{\alpha}$	1,958 ; 1,278	840 ± 47	1,410 ± 292	1,026 ± 56	1,121 ± 57	891 ± 29
	Potassium (K)	mg/kg	-	-	3,894 ± 172	3,806 ± 311	3,908 ± 319	5,891 ± 281	5,255 ± 328
	Selenium (Se)	mg/kg	-	-	0.49 ± 0.06	0.42 ± 0.07	0.20 ± 0	0.85 ± 0.06	0.40 ± 0.05
	Silver (Ag)	mg/kg	-	-	0.12 ± 0.01	0.12 ± 0.01	0.11 ± 0.01	0.27 ± 0.01	0.18 ± 0.03
	Sodium (Na)	mg/kg	-	-	296 ± 29	231 ± 20	267 ± 22	455 ± 24	301 ± 15
	Strontium (Sr)	mg/kg	-	-	11.4 ± 0.5	10.0 ± 0.5	10.5 ± 0.4	15.8 ± 0.6	12.2 ± 0.6
	Thallium (Tl)	mg/kg	-	-	0.388 ± 0.021	0.448 ± 0.045	0.377 ± 0.027	0.801 ± 0.035	0.583 ± 0.026
	Tin (Sn)	mg/kg	-	-	56.3 ± 28.9	4.6 ± 1.3	10.6 ± 6.3	16.3 ± 7.8	13.1 ± 7.0
	Titanium (Ti)	mg/kg	-	-	1,072 ± 36	968 ± 67	1,188 ± 42	1,331 ± 69	1,257 ± 62
	Uranium (U)	mg/kg	-	-	11.9 ± 1.5	8.16 ± 1.8	5.17 ± 0.5	27.3 ± 1.5	8.29 ± 1.0
	Vanadium (V)	mg/kg	-	-	50.0 ± 1.3	46.5 ± 3.9	47.6 ± 2.5	72.0 ± 3.6	59.6 ± 3.2
	Zinc (Zn)	mg/kg	315	135	73.7 ± 2.7	56.6 ± 4.7	51.5 ± 2.7	105 ± 5.1	73.0 ± 4.1
	Zirconium (Zr)	mg/kg	-	-	4.3 ± 0.6	9.7 ± 2.8	15.2 ± 1.5	4.0 ± 0.2	9.4 ± 2.9

[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, baseline sediment quality data, and method detection limits. The indicated values are specific to each respective Sheardown Lake basins.

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

BOLD Indicates parameter concentration above the AEMP Benchmark.

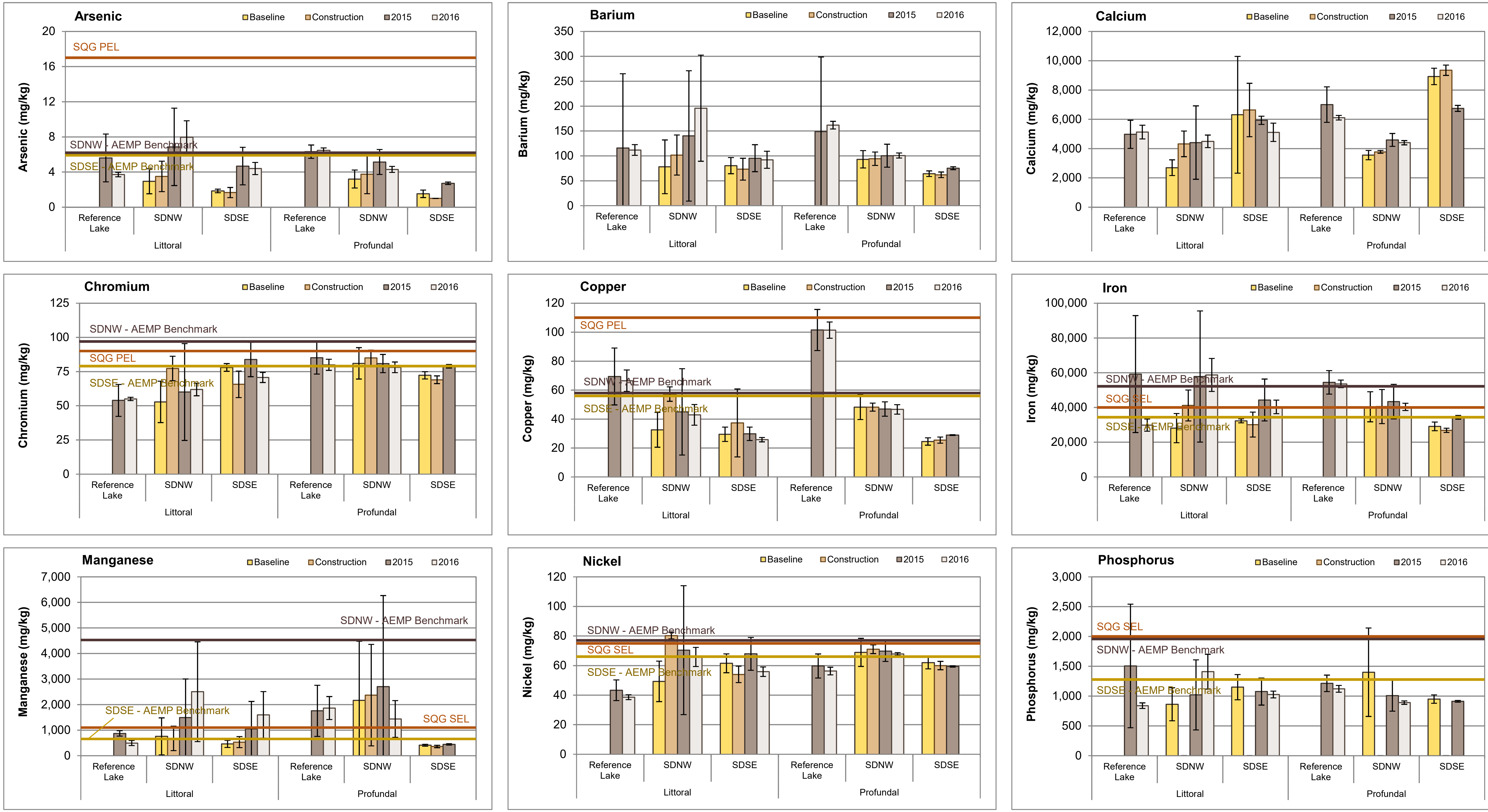


Figure 4.11: Temporal comparison of sediment metal concentrations (mean ± SD) at littoral and profundal stations of Sheardown Lake NW (SDNW), Sheardown Lake SE (SDSE), and Reference Lake 3 for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods during fall, Mary River Project CREMP, 2016.

Sheardown Lake NW and Camp Lake, these parameters also reflect a potential mine-related influence on sediment quality at these mine-exposed lakes.

4.2.3 Phytoplankton

Chlorophyll a concentrations at Sheardown Lake NW showed no distinct spatial gradients among stations during the winter and fall sampling events, but higher concentrations were apparent with closer proximity to the lake outlet during the summer sampling event in 2016 (Figure 4.12). Chlorophyll a concentrations differed significantly among seasons at Sheardown Lake NW in 2016, with highest and lowest concentrations observed in summer and winter, respectively (Appendix Table E.9), reflecting similar seasonal differences in chlorophyll a concentrations at the reference lake (Appendix Table B.8). Although chlorophyll a concentrations were significantly higher at Sheardown Lake NW compared to Reference Lake 3 for both the summer and fall sampling events in 2016 (Appendix Tables E.5 – E.6), chlorophyll a concentrations during each of the winter, summer and fall sampling events were well below the AEMP benchmark of 3.7 µg/L (Figure 4.12). Chlorophyll a concentrations at Sheardown Lake NW were suggestive of an 'oligotrophic' status using Wetzel (2001) lake trophic status classifications. This trophic status classification was consistent with a CWQG oligotrophic categorization of Sheardown Lake NW based on mean aqueous total phosphorus concentrations below 10 µg/L during all sampling events (Table 4.2; Appendix Table C.38).

Temporally, the 2016 Sheardown Lake NW chlorophyll a concentrations did not differ significantly from concentrations during the mine construction (2014) and 2015 early-operational periods in any consistent direction among the winter, summer or fall seasons (Figure 4.13). In addition, annual average chlorophyll a concentrations did not differ significantly among 2014, 2015 and 2016 (Appendix Table E.9), suggesting no ecologically meaningful changes in the trophic status of Sheardown Lake NW since the onset of mine operations at the Mary River Project. No chlorophyll a data are available for the baseline (2005 – 2013) period for Sheardown Lake NW, precluding comparisons of chlorophyll a data to the period prior to mine construction.

4.2.4 Benthic Invertebrate Community

The benthic invertebrate community at Sheardown Lake NW littoral stations exhibited significantly higher richness, but no significant differences in density or Simpson's Evenness, compared to Reference Lake 3 littoral stations in 2016 (Table 4.4). The occurrence of a higher taxonomic richness at Sheardown Lake NW was not consistent with effects that would be expected as a result of exposure to elevated metal concentrations. Moderate Simpson's Evenness at Sheardown Lake NW indicated that the distribution of benthic invertebrates in the

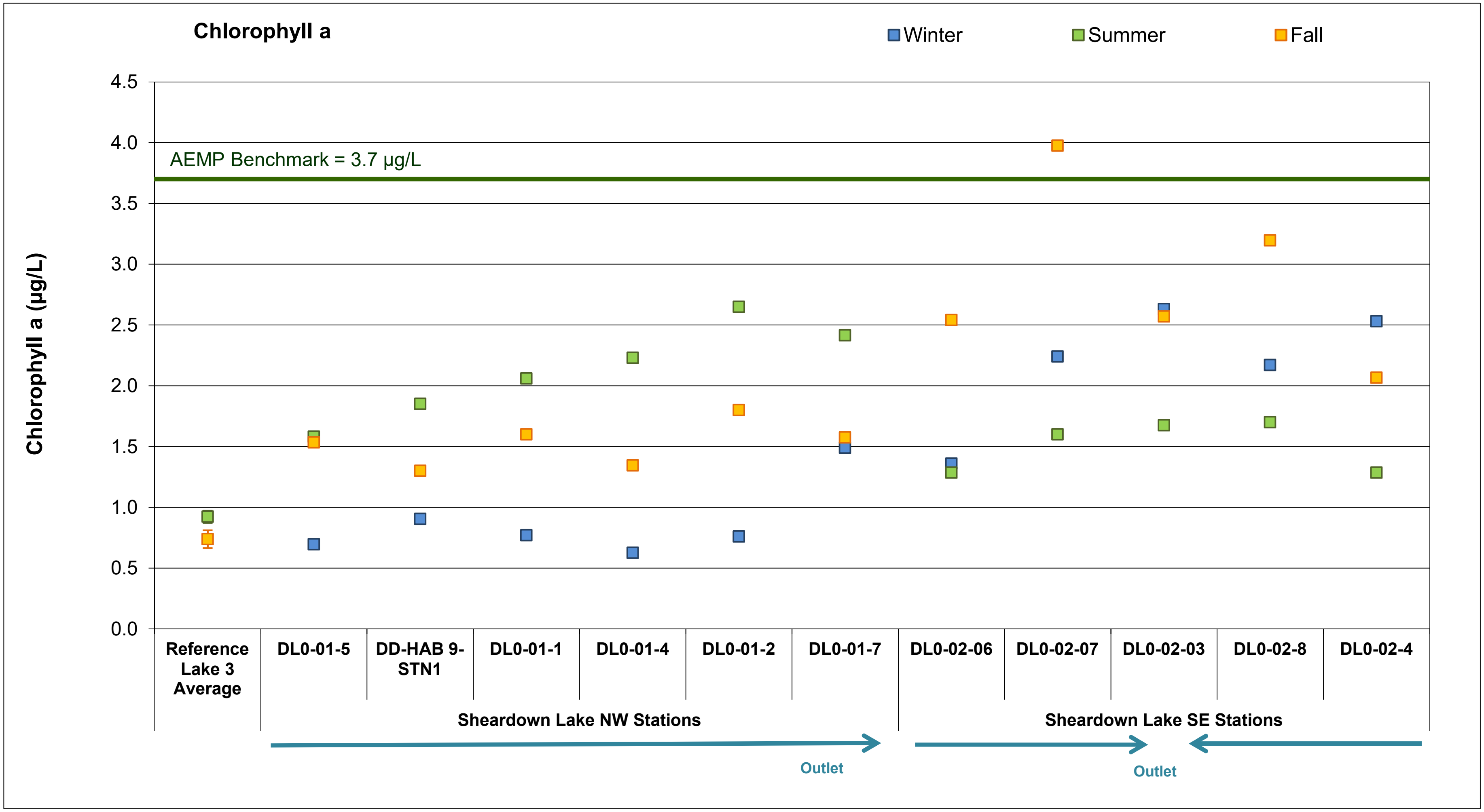


Figure 4.12: **Chlorophyll a concentrations at Sheardown Lake NW (DLO-1) and Sheardown Lake SE (DLO-2) phytoplankton monitoring stations, Mary River Project CREMP, 2016. Values are averages of samples taken from the surface and the bottom of the water column at each station. Reference values are expressed as mean ± standard deviation (n = 3). Reference Lake 3 was not sampled in winter 2016.**

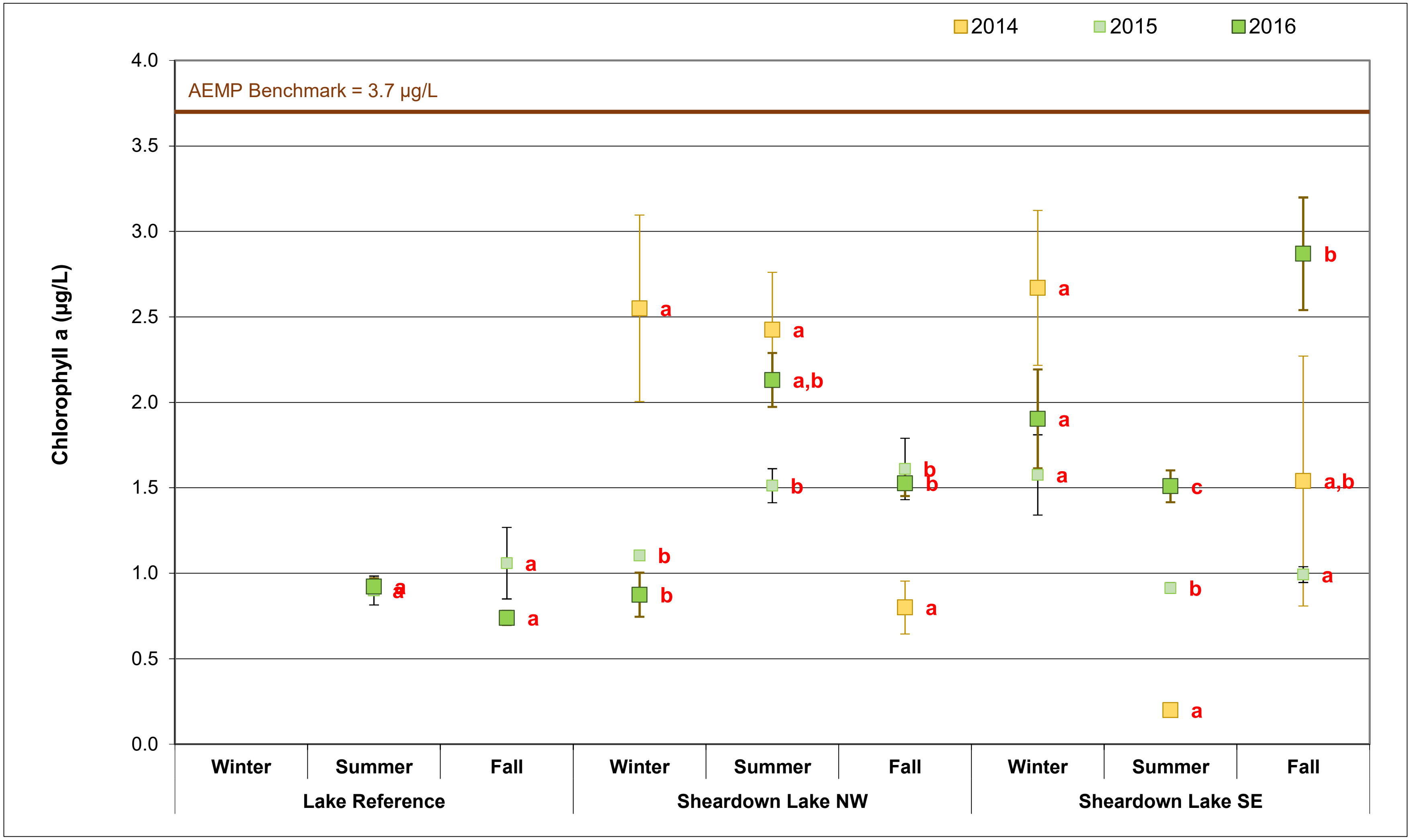


Figure 4.13: Chlorophyll a concentration seasonal comparison among 2014, 2015 and 2016 years (mean ± SE) at Sheardown Lake phytoplankton monitoring stations, Mary River Project CREMP. Data points with the same letter on the right do not differ significantly between years for the applicable season.

Table 4.4: Benthic invertebrate community statistical comparison results between the Sheardown Lake Nowrthwest basin (DLO1) and Reference Lake 3 littoral stations, Mary River Project CREMP, August 2016.

Metric	Statistical Test Results					Summary Statistics					
	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Power	Magnitude of Difference[b] (No. of SD)	Area	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	No	0.236	ι, δ, γ	-	-	Reference Lake 3	2,390	1,396	624	897	4,240
						SDNW Lake Littoral	5,503	4,184	1,871	1,415	10,484
Richness (Number of Taxa)	Yes	0.077	α, δ, γ	0.583	2.2	Reference Lake 3	12.2	1.1	0.5	11.0	14.0
						SDNW Lake Littoral	14.6	2.4	1.1	12.0	18.0
Simpson's (E) Krebs	No	0.008	γ	-	-	Reference Lake 3	0.758	0.189	0.084	0.420	0.849
						SDNW Lake Littoral	0.893	0.024	0.011	0.860	0.918
Bray-Curtis Index	Yes	0.002	α, ε, γ	1.000	2.8	Reference Lake 3	0.334	0.122	0.054	0.245	0.527
						SDNW Lake Littoral	0.669	0.037	0.016	0.628	0.711
Nemata (%)	No	1.000	γ	-	-	Reference Lake 3	4.0%	5.6%	2.5%	0.0%	13.5%
						SDNW Lake Littoral	1.1%	0.7%	0.3%	0.0%	2.0%
Hydracarina (%)	No	0.345	β, δ, γ	-	-	Reference Lake 3	3.6%	2.0%	0.9%	1.8%	6.7%
						SDNW Lake Littoral	4.2%	5.1%	2.3%	0.0%	11.3%
Ostracoda (%)	Yes	0.001	β, δ, γ	0.998	-2.2	Reference Lake 3	46.9%	17.5%	7.8%	37.8%	78.0%
						SDNW Lake Littoral	9.2%	6.1%	2.7%	3.7%	19.1%
Chironomidae (%)	Yes	0.002	β, δ, γ	0.992	2.1	Reference Lake 3	45.4%	18.8%	8.4%	15.4%	59.2%
						SDNW Lake Littoral	85.0%	6.6%	2.9%	76.3%	92.7%
Metal-Sensitive Chironomidae (%)	No	0.713	β, δ, γ	-	-	Reference Lake 3	19.3%	8.3%	3.7%	7.7%	28.1%
						SDNW Lake Littoral	24.6%	15.2%	6.8%	6.6%	41.0%
Scrapers (%)	No	0.571	β, δ, γ	-	-	Reference Lake 3	0.2%	0.4%	0.2%	0.0%	0.8%
						SDNW Lake Littoral	0.1%	0.3%	0.1%	0.0%	0.7%
Collector-Gatherers (%)	**Yes**	**0.025**	**β, δ, γ**	**0.805**	**-1.6**	Reference Lake 3	75.0%	11.4%	5.1%	61.1%	89.7%
						SDNW Lake Littoral	56.8%	7.7%	3.4%	47.6%	66.9%
Filterers (%)	No	0.803	β, ε, γ	-	-	Reference Lake 3	16.1%	8.4%	3.8%	7.0%	26.4%
						SDNW Lake Littoral	23.0%	17.3%	7.7%	3.7%	41.0%
Clingers (%)	No	0.922	β, δ, γ	-	-	Reference Lake 3	19.2%	7.6%	3.4%	8.8%	28.3%
						SDNW Lake Littoral	19.2%	5.8%	2.6%	11.0%	26.4%
Sprawlers (%)	No	0.095	γ	-	-	Reference Lake 3	65.7%	12.1%	5.4%	57.2%	85.7%
						SDNW Lake Littoral	53.0%	13.3%	6.0%	44.6%	75.6%
Burrowers (%)	No	0.156	β, δ	-	-	Reference Lake 3	15.1%	6.2%	2.8%	5.5%	22.2%
						SDNW Lake Littoral	27.8%	13.5%	6.0%	7.7%	44.2%

[a] Data analysis included: α - data untransformed; β - data logit transformed; ι - log_{10} transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Mann Whitney U-test.

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

Highlighted values indicate significant differences between study areas based on ANOVA p-value less than 0.10 that were also outside of a Critical Effect Size of ±2 SD, suggesting an ecologically meaningful difference.

BOLD Bold text values indicate significant differences between study areas based on ANOVA p-value less than 0.10, but a Critical Effect Size within ±2 SD, suggesting the difference is not ecologically meaningful.

community was not unusually skewed towards relatively few taxa and thus, was not adversely altered.

Benthic invertebrate community structural differences were suggested between Sheardown Lake NW and Reference Lake 3 littoral habitats based on significantly higher Bray-Curtis Index at Sheardown Lake NW, and by significant differences in the relative abundance of dominant taxonomic groups and FFG between lakes (Table 4.4). Similar to Camp Lake, a significantly lower and higher relative abundance of Ostracoda (seed shrimp) and Chironomidae (non-biting midges) occurred, respectively, at Sheardown Lake NW compared to the reference lake. However, the relative abundance of metal-sensitive Chironomidae did not differ significantly between Sheardown Lake NW and Reference Lake 3 (Table 4.4), and therefore the difference in benthic invertebrate community structure between lakes did not appear to be associated with an ecological response to aqueous and/or sediment metals exposure. Rather, a significantly lower relative abundance of FFG collector-gatherers (which include seed shrimp) at Sheardown Lake NW compared to the reference lake (Table 4.4) suggested that the difference in benthic invertebrate community structure between lakes was related to differences in food resources. Because collector-gatherers are deposit feeders of coarse organic matter, the occurrence of significantly lower proportion of FFG collector-gatherers was consistent with significantly lower sediment TOC content at littoral stations of Sheardown Lake NW compared to Reference Lake 3 (Table 4.4). Benthic invertebrate community structural differences between Sheardown Lake NW and Reference Lake 3 did not appear to reflect different habitat conditions between littoral areas of these lakes given the lack of significant differences in HPG (Table 4.4). This was supported by sediment particle size analysis, which indicated that the proportion of dominant sand and silt particle sizes in sediment did not differ significantly between lakes (Appendix Table D.14).

Temporal comparisons of the Sheardown Lake NW benthic invertebrate community data indicated no significant differences in density, richness or Simpson's Evenness in 2016 compared to the 2007 and 2013 baseline studies (Figure 4.14; Appendix Table F.30). In addition, among the three dominant taxonomic groups and two FFG examined, only the relative abundance of Chironomidae differed significantly between the mine-operational and baseline periods at Sheardown Lake NW (Figure 4.14). However, this difference only occurred for data collected between 2015 and the baseline studies, and because there was no significant difference in the relative abundance of metal-sensitive Chironomidae in 2016 versus the baseline studies (Figure 4.14; Appendix Table F.30), no adverse mine-related response was suggested. Moreover, no consistent differences in benthic invertebrate community density, richness, Simpson's Evenness, FFG or HPG were indicated between Sheardown Lake NW

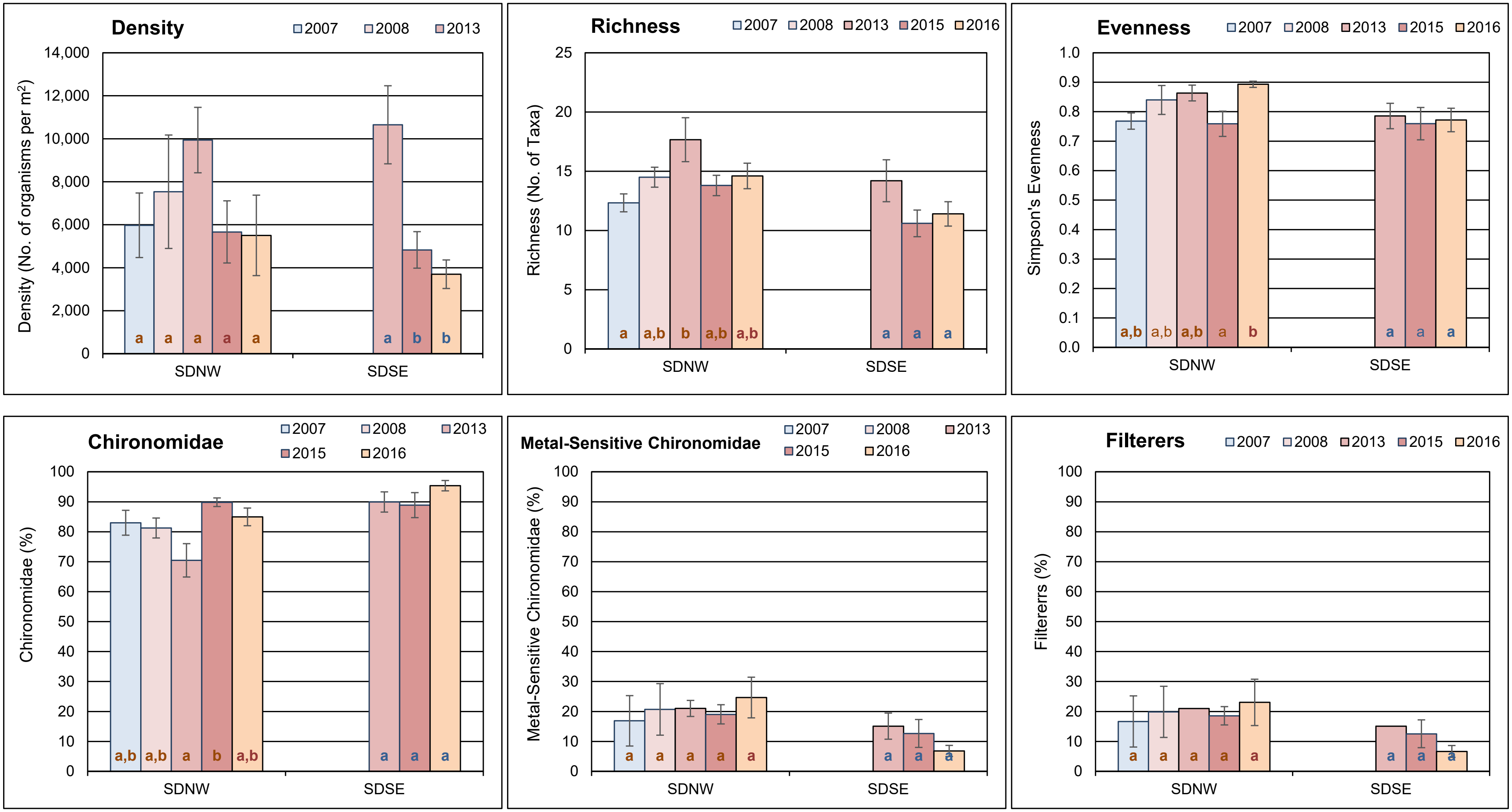


Figure 4.14: Comparison of key benthic invertebrate metrics (mean ± SE) at Sheardown Lake northwest (SDNW) and southeast (SDSE) basin littoral stations between mine baseline (2007, 2008 and 2013) and operational (2015, 2016) periods, Mary River Project CREMP, 2016. The same like-coloured letter inside bars indicate no significant difference among study years for respective lake basins.

and Reference Lake 3 littoral stations in both the 2015 and 2016 studies (Figure 4.14; Appendix Table F.30). Collectively, these results suggested no clear changes in benthic invertebrate community features in 2015/2016 compared to the baseline period, and specifically, no adverse influences associated with the recent initiation of mine operations at the Mary River Project.

4.2.5 Fish Population

4.2.5.1 Sheardown Lake NW Fish Community

Arctic charr was the only fish species captured at the northwest basin of Sheardown Lake in 2016, which differed slightly from that of Reference Lake 3 where low numbers of nine-spine stickleback were captured in nearshore rocky areas in addition to Arctic charr (Table 4.5). Total fish CPUE was much higher at Sheardown Lake NW than at the reference lake for nearshore electrofishing and for littoral/profundal gill net sampling (Table 4.5), suggesting higher densities and/or productivity of Arctic charr at Sheardown Lake. Greater numbers 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 similar Arctic charr CPUE over the mine baseline (2006-2013), construction (2014) and operational (2015, 2016) periods at nearshore rocky habitat of the lake (Figure 4.15). In addition, the 2016 Arctic charr CPUE for gill net sampling was within the range shown during the baseline period (Figure 4.15). These results suggested that the relative abundance of Arctic charr at the nearshore and littoral/profundal areas of Sheardown Lake NW remained similar between the 2016 mine operational and baseline studies, which in turn, suggested no mine-related influences to Arctic charr numbers in the lake.

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 using a control-impact analysis using data collected from Sheardown Lake NW and Reference Lake 3 in 2016, as well as a before-after analysis using data collected from Sheardown Lake NW in 2016 and during 2013 baseline characterization. A total of 100 Arctic charr were captured at nearshore habitat of each of Sheardown Lake NW and Reference Lake 3 in August 2016 for the control-impact analysis. Distinction of Arctic charr YOY from the older, non-YOY age class was possible using a fork length cut-off of 5.0 and 5.1 cm based on evaluation of length-frequency distributions coupled with supporting age determinations for the

Table 4.5: 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 2016.

Lake	Method [a]		Arctic Charr	Nine-spine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	101	28	129	2
		CPUE	0.48	0.16	0.64	
	Gill netting	No. Caught	14	0	14	
		CPUE	0.15	0	0.15	
Sheardown Lake Northwest	Electrofishing	No. Caught	106	0	106	1
		CPUE	5.26	0	5.26	
	Gill netting	No. Caught	93	0	93	
		CPUE	1.71	0	1.71	
Sheardown Lake Southeast	Electrofishing	No. Caught	109	19	128	2
		CPUE	2.69	0.47	3.16	
	Gill netting	No. Caught	83	0	83	
		CPUE	8.06	0	8.06	

[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.

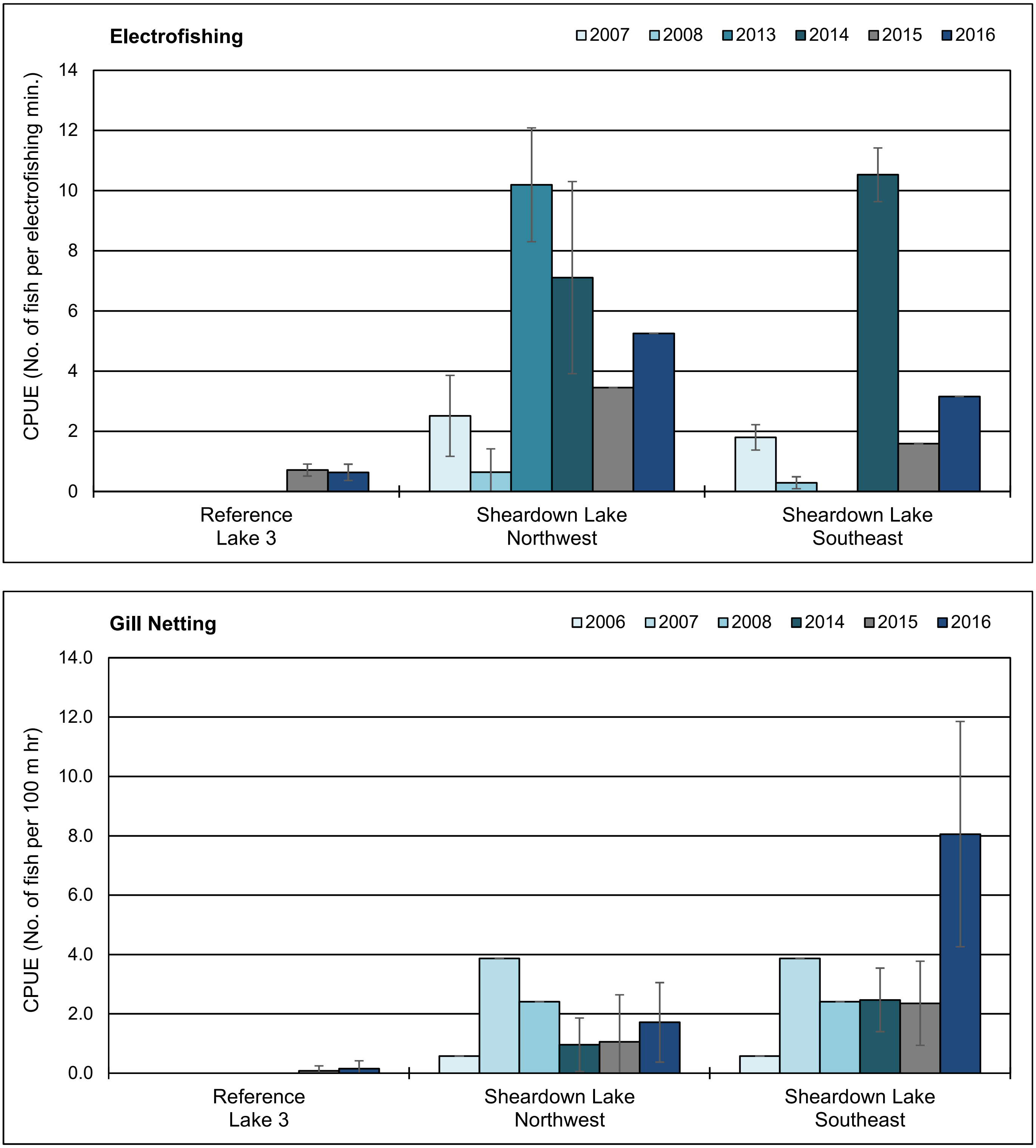


Figure 4.15: Catch-per-unit-effort (CPUE; mean ± SD) of Arctic charr captured by backpack electrofishing and gill netting at Sheardown Lake NW (DLO-01) and Sheardown Lake SE (DLO-02) for baseline (2006, 2007, 2008, 2013), mine construction (2014) and operational (2015, 2016) periods in the fall, Mary River Project CREMP. Lake basins (i.e., NW or SE) were not differentiated historically for baseline gill netting catches.

Sheardown Lake NW and Reference Lake 3 data sets, respectively (Figure 4.16). The nearshore Arctic charr health comparisons involved separate assessment of the YOY and non-YOY data sets to account for naturally differing weight-at-length relationships that occur between these life stages.

Length-frequency distributions for the nearshore Arctic charr differed significantly between Sheardown Lake NW and Reference Lake 3 (Table 4.6), potentially reflecting a lower proportion of YOY and larger mean size of individuals captured at Sheardown Lake NW. Arctic charr YOY and non-YOY were significantly heavier and longer at the Sheardown Lake NW nearshore than at the reference lake nearshore (Table 4.6; Appendix Tables G.18 and G.19). In addition, Arctic charr captured at the Sheardown Lake NW nearshore grew significantly faster than those collected from the reference lake nearshore (Table 4.6; Appendix Tables G.18 and G.19). The magnitude of the differences in weight-based size and growth were outside of the ±25% CES_G, suggesting an ecologically meaningful difference in energy use between nearshore Arctic charr populations of Sheardown Lake NW and Reference Lake 3 for both the YOY and non-YOY size categories. However, no significant differences in condition (i.e., weight-at-length relationship) were indicated between nearshore Arctic charr populations of Sheardown Lake NW and Reference Lake 3 for both the YOY and non-YOY size categories in 2016 (Table 4.6; Appendix Tables G.18 and G.19). Overall, Arctic charr of the Sheardown Lake NW nearshore were significantly larger and grew significantly faster, but exhibited similar condition, compared to those of the reference lake. Similar to the fish population results at Camp Lake, the occurrence of significantly faster growing Arctic charr with similar condition at Sheardown Lake NW compared to the reference area suggested no adverse mine-related influences on Arctic charr health for juveniles residing within Sheardown Lake NW in 2016.

Temporal comparisons of the Sheardown Lake NW nearshore Arctic charr data indicated significantly different length-frequency distribution between the 2016 mine operational study and 2007/2013 baseline study data (Table 4.6; Appendix Table G.20). In addition, Arctic charr captured at the nearshore of Sheardown Lake NW in 2016 were significantly lighter and of significantly lower condition than those captured during mine baseline characterization (Table 4.6). For each of the significantly differing nearshore Arctic charr endpoints between 2016 and the baseline data, the magnitude of difference was outside of respective CES, suggesting that the differences were ecologically meaningful (Table 4.6; Appendix Table G.20). Although no differences in size were indicated, similar differences in nearshore Arctic charr condition were demonstrated between the previous 2015 mine operational study and the 2013 baseline study data (Table 4.6). Because a similar direction and magnitude of difference in juvenile Arctic charr condition was observed temporally at both Camp and

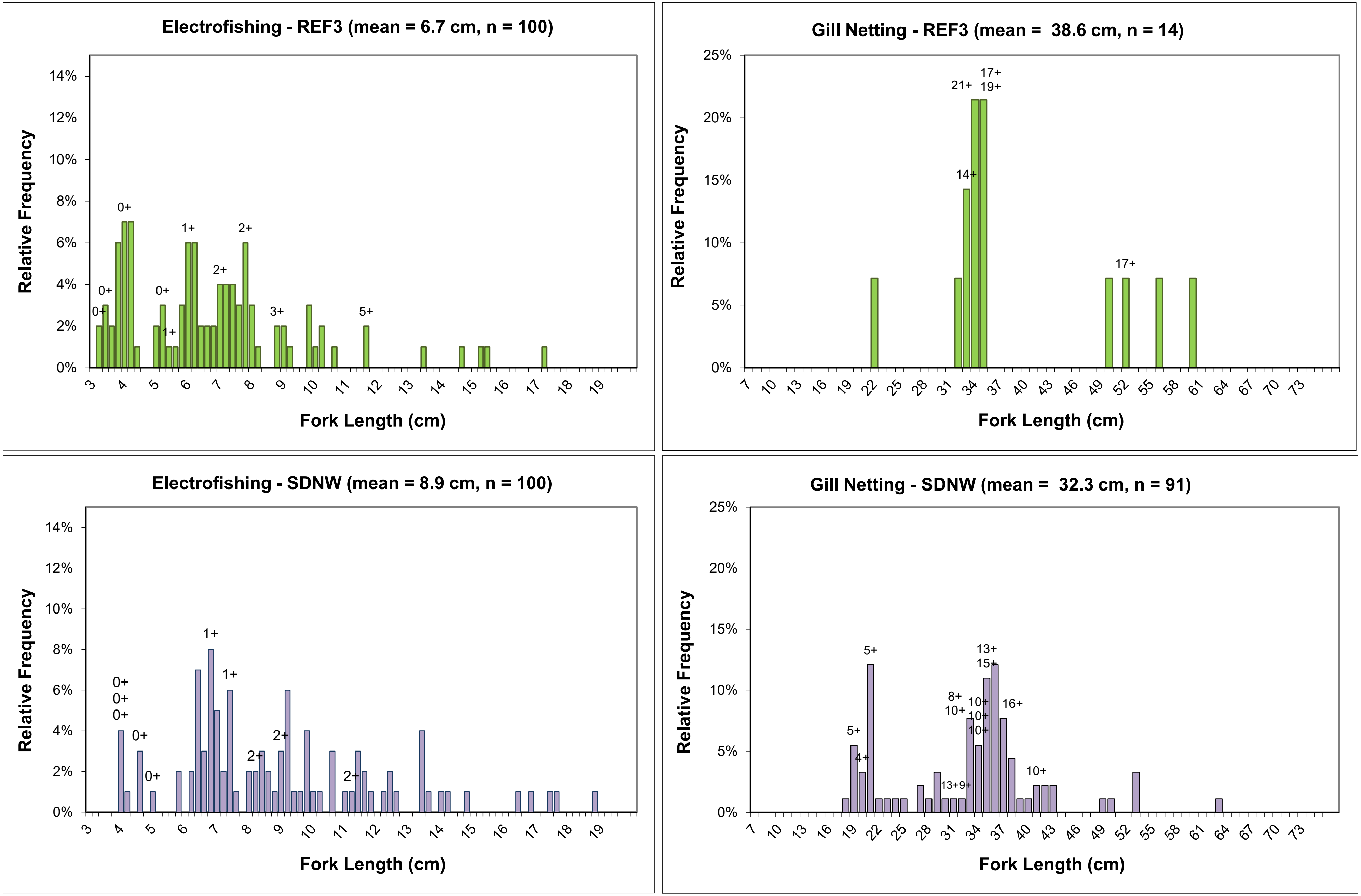


Figure 4.16: Length-frequency distributions for Arctic charr captured by backpack electrofishing and gill netting at Sheardown Lake NW (SDNW) and Reference Lake 3 (REF3), August 2016, Mary River Project CREMP. Fish ages are shown above the bars, where available.

Table 4.6: Summary of statistical results for Arctic charr population comparisons between Sheardown Lake NW and Reference Lake 3 for the mine operational period (2015, 2016) and between Sheardown Lake NW mine-operational and baseline period data for fish captured by electrofishing and gill netting methods, Mary River Project CREMP, August 2016. Values in parentheses indicate direction and magnitude of any significant differences.

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed?			
			versus Reference Lake 3		versus Sheardown Lake NW baseline period data [b]	
			2015	2016	2015	2016
Nearshore Electrofishing	Survival	Length-Frequency Distribution	**Yes**	**Yes**	**Yes**	**Yes**
		Age	No	No	No	-
	Energy Use	Size (mean weight)	**Yes (+121%)**	**Yes (+60%)**	No	**Yes (-29%)**
		Size (mean fork length)	**Yes (+29%)**	**Yes (+17%)**	No	No
		Growth (weight-at-age)	**Yes (+156%)**	**Yes (+66%)**	No	-
		Growth (fork length-at-age)	**Yes (+38%)**	**Yes (+24%)**	No	-
	Energy Storage	Condition (body weight-at-fork length)	**Yes (+3%)**	No	**Yes (-13%)**	**Yes (-12%)**
Littoral/Profundal Gill Netting [a]	Survival	Length Frequency Distribution	-	-	**Yes**	**Yes**
		Age	-	-	**Yes (-35%)**	**Yes (-28%)**
	Energy Use	Size (mean weight)	-	-	**Yes (-47%)**	**Yes (-31%)**
		Size (mean fork length)	-	-	**Yes (-21%)**	**Yes (-14%)**
		Growth (weight-at-age)	-	-	No	No
		Growth (fork length-at-age)	-	-	No	No
	Energy Storage	Condition (body weight-at-fork length)	-	-	**Yes (+8%)**	**Yes (+11%)**

[a] Due to low catches of Arctic charr at Reference Lake 3 in 2015 and 2016, no comparison of fish health was possible for gill netted fish.

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

Sheardown Lake NW, this suggested that differences in condition between 2016 and the mine baseline periods likely reflected natural temporal variability.

Littoral/Profundal Arctic Charr

Mine-related influences on the Sheardown Lake NW littoral/profundal Arctic charr population were assessed using a before-after analysis between data collected in 2016 and the baseline characterization (combined 2006, 2007, 2008 and 2013) studies. Similar to the 2015 CREMP, a small sample size from Reference Lake 3 (i.e., n = 14) precluded meaningful control-impact statistical analysis using data collected in 2016. Biological information collected from Arctic charr mortalities indicated that non-spawners of reproductive age accounted for approximately 92% of the Sheardown Lake NW Arctic charr population at the time of sampling in August 2016 (Appendix Table G.23). The incidence rate for body cavity parasites was very high in the incidental Arctic charr mortalities (i.e., 86%), with sparse to very abundant occurrence of encysted worms and/or tapeworms observed in affected individuals (Appendix Table G.23). High incidence rates of internal parasites in Arctic charr were noted at Camp Lake in 2016, at all mine-exposed lakes in 2015 (Minnow 2016a), and at the various Mary River Project mine area lakes in baseline studies (NSC 2014, 2015a). One Arctic charr that had been tagged and released previously at Sheardown Lake NW was re-captured in 2016. This fish showed a 9.8 mm/year mean annual incremental increase in fork length over the approximately three years since being tagged (Table 4.7).

Table 4.7: Fork length and weight measurement data for tagged Arctic charr captured at Sheardown Lake NW in August 2016, Mary River Project CREMP.

Fish Tag Number	Capture Information			Re-Capture Information			Growth Rate
	Date of Capture	Length (mm)	Weight (g)	Date of Capture	Length (mm)	Weight (g)	Δ Length (mm/yr)
77647	30-Aug-2013	330	400	12-Aug-2016	359	470	9.8

The length-frequency distribution for Arctic charr captured at littoral/profundal areas of Sheardown Lake NW in 2016 differed significantly from those captured during baseline monitoring (Table 4.6; Figure 4.16). In part, the differences in length-frequency distribution may have reflected significantly younger and smaller individuals captured in 2016 compared to the baseline period (Table 4.6). Arctic charr growth did not differ significantly between 2016 and the baseline period at Sheardown Lake NW (Table 4.6; Appendix Table G.24). However, Arctic charr captured at littoral/profundal areas of Sheardown Lake NW exhibited significantly greater condition in 2016 than during baseline monitoring, at a magnitude of the difference slightly outside of the ecologically relevant CES_C of ±10% (Table 4.6; Appendix Table G.24). Notably, the same type and direction of differences in length-frequency distribution, age, mean size and condition for Arctic charr captured at littoral/profundal areas of Sheardown Lake NW were consistently demonstrated in 2015 and 2016 relative to the mine baseline data (Table 4.6). Overall, the lack of significant differences in growth combined with significantly greater condition of Arctic charr captured at littoral/profundal areas of Sheardown Lake NW in 2016 versus 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.

4.3 Sheardown Lake SE (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 2016 (Appendix Figures C.14 to C.17). No thermal stratification was evident at the Sheardown Lake SE basin during any of the winter, summer or fall sampling events, and although gradually cooler water was observed with increased depth during summer and fall, no distinct layers had developed (Figure 4.17). The summer and fall water temperature profiles at Sheardown Lake SE were similar to those from the reference lake, with highest gradients in temperature with depth occurring between 5 - 10 m in summer and 10 – 17 m in fall (Figure 4.17). Mean water temperature near the bottom of the water column at littoral stations in fall 2016 did not differ significantly between Sheardown Lake SE and Reference Lake 3 (Figure 4.8; Appendix Table C.45). Notably, Sheardown Lake SE is a much smaller and shallower waterbody than Reference Lake 3 (see Figure 2.1; Appendix Table B.1), and therefore heat distribution patterns (i.e., thermal profiles) may be expected to differ naturally between these lakes.

Dissolved oxygen profiles conducted at Sheardown Lake SE in 2016 showed no change in dissolved oxygen saturation with depth during summer, but oxycline development characterized by decreasing saturation levels with increasing depth occurring at depths greater than 10 m during the winter and fall sampling events (Figure 4.17). No oxycline had developed in summer and fall at Reference Lake 3 in 2016 (Figure 4.17). Despite the differences in dissolved oxygen profiles, saturation levels at the bottom of the water column at littoral stations (i.e., approximately 10 m depth) did not differ significantly between the Sheardown Lake southeast basin and Reference Lake 3 during fall 2016 sampling (Figure 4.8; Appendix Tables C.44 – C.45). Dissolved oxygen saturation levels were generally well above the WQG of 54% at Sheardown Lake SE at all depths during the summer and fall sampling events in 2016

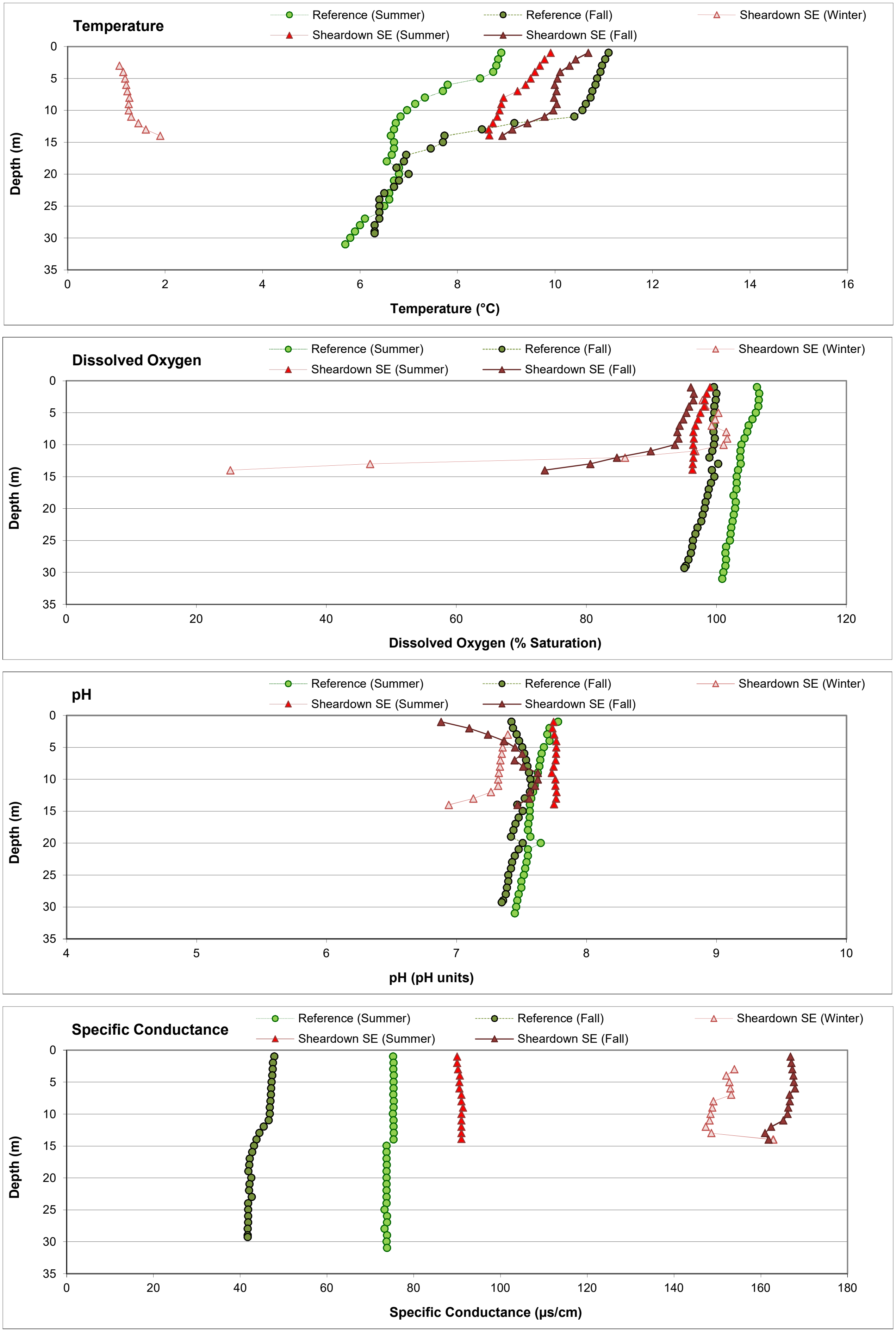


Figure 4.17: Average *in-situ* water quality with depth from surface at Sheardown Lake SE (mine-exposed area) compared to Reference Lake 3 during winter, summer, and fall sampling events, Mary River Project CREMP, 2016.

(Figure 4.8), indicating that dissolved oxygen was not likely to be limiting to pelagic or bottom-dwelling biota within the lake. However, dissolved oxygen saturation levels below 54% were observed at depths greater than 13 m during the winter at Sheardown Lake SE, the cause of which may be related to natural (e.g., sediment TOC content) or mine-related (e.g., current/ historical STP inputs) influences to lake dissolved oxygen levels.

In-situ profiles of pH and specific conductance showed no substantial change from the surface to the bottom of the Sheardown Lake SE water column, indicating no chemical stratification (Figure 4.17). Similar to the northwest basin, no significant differences in bottom pH at littoral stations were indicated between Sheardown Lake SE and Reference Lake 3 during the 2016 fall sampling, with pH at the southeast basin of Sheardown Lake also consistently within WQG limits in 2016 (Figure 4.8; Appendix Tables C.44; Figure 4.17). Specific conductance was significantly higher at Sheardown Lake SE compared to the reference lake during 2016 fall sampling (Figure 4.8). However, specific conductance at Sheardown Lake SE was intermediate to that of the reference creek and river areas (i.e., mean of 101 and 133 µS/cm, respectively) in fall 2016, and therefore the extent to which higher specific conductance at Sheardown Lake SE was related to natural regional variability or a mine-related influence was unclear. Water clarity at the southeast basin of Sheardown Lake was the lowest among the mine-exposed lakes. Secchi depth readings from Sheardown Lake SE were significantly lower (shallower) than at Reference Lake 3 during the 2016 fall sampling event, but were relatively consistent among stations, suggesting no spatial differences in water clarity of the lake (Appendix Tables C.44 – C.45).

Water chemistry at Sheardown Lake SE showed no consistent spatial differences in parameter concentrations among the five sampling stations during any of the winter, summer or fall sampling events in 2016 (Table 4.8; Appendix Table C.46), suggesting that the lake waters were generally well mixed both laterally and vertically. Total aluminum concentrations were highly elevated (i.e., ≥10-fold), turbidity and concentrations of total manganese moderately elevated (i.e., 5- to 10-fold), and concentrations of phenols and total molybdenum slightly elevated (i.e., 3- to 5-fold), at Sheardown Lake SE compared to Reference Lake 3 during the 2016 summer and fall sampling events (Table 4.8; Appendix Tables C.40 and C.46). Similar to the northwest basin, aluminum and manganese concentrations showed strong and modest positive correlations with turbidity, respectively, for the Sheardown Lake SE combined data set (i.e., winter, summer and fall data; $r^2 = 0.90$ and 0.60, respectively), suggesting that much of the aqueous aluminum and manganese was associated with suspended particles. This was corroborated by comparison of total and dissolved fractions for these metals, which indicated that most (i.e., ≥75%) was in particulate form at Sheardown Lake SE (compare Appendix

Table 4.8: Water chemistry at Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3) monitoring stations, Mary River Project CREMP, August 2016. Values presented are averages of samples taken from the surface and the bottom of the water column at each station.

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	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 2016	21-Aug-16	21-Aug-16	21-Aug-16	21-Aug-16	21-Aug-16
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	84.3	118	116	116	115	113
	pH (lab)	pH	6.5 - 9.0	-	7.68	8.10	8.10	8.01	8.05	7.91
	Hardness (as $CaCO_3$)	mg/L	-	-	35	56	55	54	54	54
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	2.7	2.1	2.2	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	39	57	60	62	62	63
	Turbidity	NTU	-	-	0.33	2.05	2.21	2.45	2.40	2.62
	Alkalinity (as $CaCO_3$)	mg/L	-	-	33	52	52	52	53	52
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.040	<0.020	0.025	<0.020	0.032	0.036
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	0.022
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	0.16
	Dissolved Organic Carbon	mg/L	-	-	2.68	1.45	1.50	1.70	1.55	1.30
	Total Organic Carbon	mg/L	-	-	2.78	1.90	1.78	1.55	1.65	1.55
	Total Phosphorus	mg/L	0.020[α]	-	0.0099	0.0064	0.0115	0.0060	0.0119	0.0138
	Phenols	mg/L	0.004[α]	-	0.0031	0.0022	0.0025	0.0020	0.0299	0.0151
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.27	2.29	2.27	2.23	2.22	2.25
	Sulphate (SO_4)	mg/L	218[β]	218	4.07	2.71	2.65	2.59	2.62	2.57
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.0042	0.052	0.051	0.070	0.052	0.059
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00653	0.00618	0.00637	0.00659	0.00630	0.00622
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	6.99	11.05	11.15	10.95	11.1	10.65
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00082	0.001	0.00115	0.00105	0.0011	0.001
	Iron (Fe)	mg/L	0.30	0.300	<0.030	0.0575	0.0525	0.0765	0.0565	0.066
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.00010	<0.00010	<0.00010	<0.00010	0.000105
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.26	6.45	6.39	6.31	6.34	6.11
	Manganese (Mn)	mg/L	0.935[β]	-	0.00062	0.00373	0.00365	0.00451	0.00386	0.00561
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000136	0.000497	0.00050625	0.0004925	0.0004955	0.000459
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.000665	0.0007	0.000705	0.0007	0.00069
	Potassium (K)	mg/L	-	-	0.89	0.93	0.92	0.93	0.92	0.90
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	0.420	0.687	0.615	0.667	0.617	0.685
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	0.836	1.140	1.135	1.120	1.125	1.110
	Strontium (Sr)	mg/L	-	-	0.0081	0.0083	0.0085	0.0084	0.0085	0.0082
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<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
	Titanium (Ti)	mg/L	-	-	<0.010	0.00234	0.00204	0.00327	0.00220	0.00275
	Uranium (U)	mg/L	0.015	-	0.000270	0.000798	0.000811	0.0007975	0.0007975	0.000748
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	-	-		<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

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

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

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Tables C.46 and C.47). 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 to aluminum and manganese, molybdenum concentrations at Sheardown Lake SE were not associated with greater turbidity, suggesting that slight elevation molybdenum compared to Reference Lake 3 was related to mine operation and/or natural geochemical differences between these lakes. Despite elevation of these metals at Sheardown Lake SE, concentrations of most parameters were well below established WQG and AEMP benchmarks during the winter, summer and fall sampling events in 2016[10] (Table 4.8; Appendix Table C.46), suggesting no adverse influences of water quality on biota of Sheardown Lake SE in 2016.

Temporal comparisons of the Sheardown Lake SE water chemistry data indicated no appreciable changes in average concentrations of parameters between the 2016 study and mine baseline (2005 – 2013) period (Figure 4.9; Appendix Figure C.18). This suggested that the differences in water chemistry between Sheardown Lake SE and Reference Lake 3 in 2016 likely reflected natural differences in mineralogy/geochemical conditions between lakes. Nevertheless, conductivity, hardness and concentrations of chloride, manganese, nickel, sodium, strontium, sulphate and uranium were consistently greater at all Sheardown Lake SE stations in 2016 compared to the previous years of mine construction (2014) and initial operation (2015; Figure 4.9; Appendix Figure C.18). Higher concentrations of these parameters in 2016 may have reflected natural temporal variability in water chemistry, but may also indicate a more recent, slight mine-related influence on water quality of Sheardown Lake SE.

4.3.2 Sediment Quality

Surficial sediment at Sheardown Lake SE littoral stations was uniformly composed of compact silty loam material with low TOC content (Figure 4.18). Substrate at littoral stations of Sheardown Lake SE contained significantly lower sand and TOC content, but significantly greater silt and clay content, than at Reference Lake 3 (Appendix Table D.19). The high proportion of fines in substrate of Sheardown Lake SE potentially reflects the receipt of Mary River backflow during high flow periods, which can be expected to result in the deposition of high quantities of naturally suspended, fine-grained material. Similar to observations at the other mine-exposed lakes and 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

[10] Refer to footnote 2 (page 23) and Appendix B regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA waterbodies.

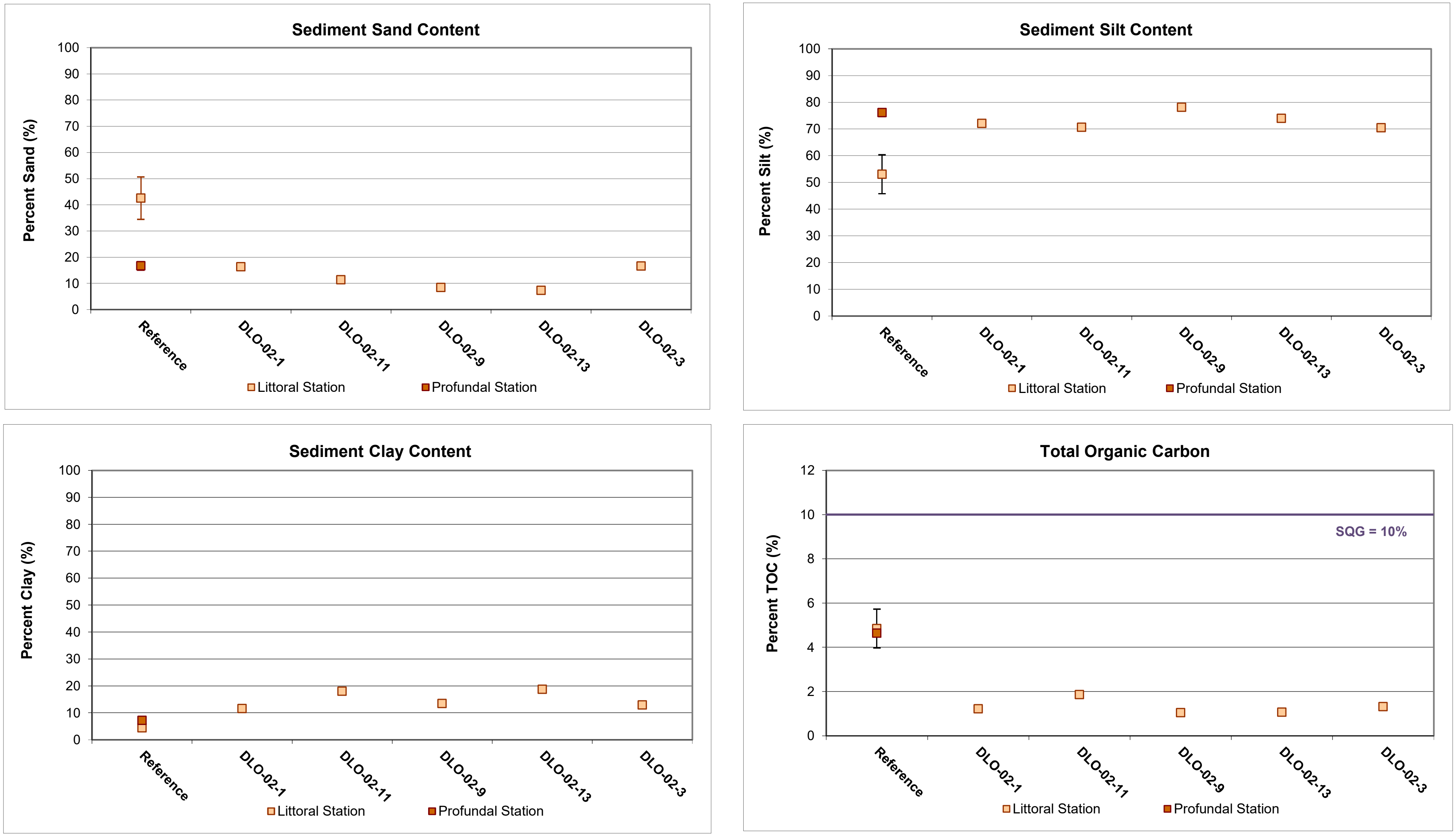


Figure 4.18: Sediment particle size and total organic carbon (TOC) content comparisons among Sheardown Lake SE (DLO-02) sediment monitoring stations and Reference Lake 3 averages (mean ± SE), Mary River Project CREMP, August 2016.

thin, distinct layer (Appendix Tables D.17 – D.18). Below the surficial layer, substrates at Sheardown Lake SE littoral stations exhibited some sporadic blackening and, at one station, had a slight sulphidic odour, suggesting development of reducing conditions. However, no distinct redox boundary was observed in the littoral station sediments (Appendix Tables D.17 - D.18). Observations regarding reducing sediment conditions at Sheardown Lake SE were similar to those made at Reference Lake 3 in 2016 (Appendix Tables D.1 – D.3 and D.17 – D.18), suggesting that factors leading to reduced sediment conditions were comparable between lakes.

Sediment metal concentrations at Sheardown Lake SE showed no spatial gradients with progression towards the lake outlet in 2016, suggesting no clear point sources of metals to the lake (Appendix Table D.20). With the exception of slightly elevated manganese concentrations, sediment metal concentrations at littoral stations of Sheardown Lake SE were, on average, similar to those observed at the reference lake littoral stations (Table 4.3; Appendix Tables D.20 – D.21). Mean iron and manganese concentrations were above respective SQG and AEMP benchmarks at the Sheardown Lake SE littoral stations, although concentrations of these metals were above SQG at only two of the five stations sampled (Table 4.3; Appendix Table D.20). As indicated previously, average concentrations of iron and manganese were also above respective SQG at profundal stations of Reference Lake 3 (Table 4.3). These results suggested that the elevation of iron and manganese concentrations in sediment of Sheardown Lake SE relative to SQG potentially reflected a natural phenomenon at lakes in the mine LSA.

Temporal comparisons of the sediment metals data suggested slightly elevated (i.e., 2- to 5-fold higher) average concentrations of arsenic and manganese at littoral stations of Sheardown Lake SE in 2016 compared to the baseline (2005 – 2013) period[11] (Figure 4.11; Appendix Table D.21). Arsenic and manganese showed progressively higher mean concentrations in 2015 and 2016 compared to the baseline/mine construction periods at littoral stations of Sheardown Lake SE (Figure 4.11). However, as at the other mine-exposed lakes, variability in parameter concentrations was high and neither parameter occurred at concentrations greater than at the reference lake littoral and/or profundal stations (Figure 4.11). This suggested that, similar to the other mine-exposed lakes, slight variation in station locations and/or data treatment among studies likely contributed to the appearance of higher mean concentrations of arsenic and manganese in sediment at the Sheardown Lake SE littoral stations in 2015 and 2016 compared to the baseline period. Nevertheless, because arsenic

[11] Refer to footnote 6 (page 32) regarding temporal differences in sediment boron concentrations at Mary River Project LSA waterbodies.

and/or manganese showed progressively higher mean concentrations in sediment at all the other mine-exposed lakes, and despite similarity to the reference lake sediment metal concentrations, greater concentrations of these parameters in sediment at the Sheardown Lake SE littoral stations over time potentially reflected a mine-related influence.

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 2016 (Figure 4.12). Chlorophyll a concentrations were significantly higher in the fall than during the either the winter or summer seasons in 2016, with comparable concentrations shown between the latter (Appendix Table E.10). Similar to Camp Lake and Sheardown Lake NW, chlorophyll a concentrations at the Sheardown Lake SE were significantly higher than at the reference lake for both the summer and fall sampling events in 2016 (Appendix Table E.5 and E.6). Moreover, chlorophyll a concentrations were well below the AEMP benchmark of 3.7 µg/L at all but one of the Sheardown Lake SE stations during the winter, summer and fall sampling events in 2016 (Figure 4.12). On average, chlorophyll a concentrations at Sheardown Lake SE fell within an 'oligotrophic' trophic status as defined by Wetzel (2001), although chlorophyll a concentrations at individual stations fell near the maxima for this designation during the fall 2016 sampling event. Mean aqueous total phosphorus concentrations at Sheardown Lake SE were also near the oligotrophic-mesotrophic boundary designation of 10 µg/L during the 2016 summer and fall sampling events (Table 4.8; Appendix Table C.46).

Chlorophyll a concentrations were significantly higher in the summer and fall of 2016 than during the same seasons in 2014 and/or 2015 at Sheardown Lake SE, but no significant differences in chlorophyll a concentrations were shown among years for data collected in the winter (Appendix Table E.11). Annual average chlorophyll a concentrations were significantly higher in 2016 than 2015, and although concentrations did not differ significantly between 2014 and 2016, higher absolute concentrations in 2016 were suggestive of slightly increased primary productivity over time at Sheardown Lake SE, particularly during the ice-free period. This suggested that the trophic status may have increased at Sheardown Lake SE since the mine-construction period, potentially representing a mine-related influence to the lake. No chlorophyll a baseline (2005 – 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, richness and Simpson's Evenness at littoral stations did not differ significantly between Sheardown Lake SE and Reference Lake 3 in 2016 (Table 4.9).

Table 4.9: Benthic invertebrate community statistical comparison results between Southeast Sheardown Lake (DLO2) and Reference Lake 3 littoral stations, Mary River Project CREMP, August 2016.

Metric	Statistical Test Results					Summary Statistics					
	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Power	Magnitude of Difference [b] (No. of SD)	Area	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	No	0.189	α, δ, γ	-	-	Reference Lake 3	2,390	1,396	624	897	4,240
						SDSE Lake Littoral	3,700	1,485	664	2,343	6,225
Richness (Number of Taxa)	No	0.510	α, ε, γ	-	-	Reference Lake 3	12.2	1.1	0.5	11.0	14.0
						SDSE Lake Littoral	11.4	2.3	1.0	9.0	14.0
Simpson's (E) Krebs	No	0.548	γ	-	-	Reference Lake 3	0.758	0.189	0.084	0.420	0.849
						SDSE Lake Littoral	0.772	0.089	0.040	0.696	0.900
Bray-Curtis Index	Yes	<0.001	α, δ, γ	1.000	3.5	Reference Lake 3	0.334	0.122	0.054	0.245	0.527
						SDSE Lake Littoral	0.761	0.082	0.037	0.669	0.886
Nemata (%)	No	0.445	β, δ, γ	-	-	Reference Lake 3	4.0%	5.6%	2.5%	0.0%	13.5%
						SDSE Lake Littoral	1.1%	1.3%	0.6%	0.0%	2.9%
Ostracoda (%)	Yes	0.001	β, δ, γ	0.997	-2.6	Reference Lake 3	46.9%	17.5%	7.8%	37.8%	78.0%
						SDSE Lake Littoral	1.7%	2.5%	1.1%	0.0%	5.9%
Chironomidae (%)	Yes	0.000	β, δ, γ	1.000	2.7	Reference Lake 3	45.4%	18.8%	8.4%	15.4%	59.2%
						SDSE Lake Littoral	95.4%	3.9%	1.7%	89.7%	98.9%
Metal-Sensitive Chironomidae (%)	**Yes**	**0.020**	**β, δ, γ**	**0.838**	**-1.5**	Reference Lake 3	19.3%	8.3%	3.7%	7.7%	28.1%
						SDSE Lake Littoral	6.8%	4.2%	1.9%	1.9%	12.2%
Collector-Gatherers (%)	**Yes**	**0.045**	**β, δ, γ**	**0.697**	**-1.6**	Reference Lake 3	75.0%	11.4%	5.1%	61.1%	89.7%
						SDSE Lake Littoral	56.5%	12.8%	5.7%	42.6%	71.0%
Filterers (%)	**Yes**	**0.063**	**β, δ, γ**	**0.627**	**-1.1**	Reference Lake 3	16.1%	8.4%	3.8%	7.0%	26.4%
						SDSE Lake Littoral	6.7%	4.4%	2.0%	1.1%	12.2%
Clingers (%)	**Yes**	**0.056**	**γ**	**-**	**-1.5**	Reference Lake 3	19.2%	7.6%	3.4%	8.8%	28.3%
						SDSE Lake Littoral	8.1%	3.9%	1.8%	1.7%	12.0%
Sprawlers (%)	**Yes**	**0.054**	**β, δ, γ**	**0.661**	**-1.6**	Reference Lake 3	65.7%	12.1%	5.4%	57.2%	85.7%
						SDSE Lake Littoral	46.2%	14.0%	6.3%	28.0%	63.1%
Burrowers (%)	Yes	0.002	β, δ, γ	0.994	4.9	Reference Lake 3	15.1%	6.2%	2.8%	5.5%	22.2%
						SDSE Lake Littoral	45.6%	12.5%	5.6%	33.3%	64.6%

[a] Data analysis included: α - data untransformed; β - data logit transformed; ι - $\log_{10}$ transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Mann Whitney U-test.

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

(grey box) Highlighted values indicate significant differences between study areas based on ANOVA p-value less than 0.10 that were also outside of a Critical Effect Size of ±2 SD, suggesting an ecologically meaningful difference.

BOLD Bold text values indicate significant differences between study areas based on ANOVA p-value less than 0.10, but a Critical Effect Size within ±2 SD, suggesting the difference is not ecologically meaningful.

However, benthic invertebrate community structural differences were indicated between Sheardown Lake SE and reference lake littoral habitats based on significantly differing Bray-Curtis Index and by significant differences in the relative abundance of dominant taxonomic groups, FFG and HPG between lakes (Table 4.9). Similar to the northwest basin of Sheardown Lake, significant differences in the relative abundance of dominant taxonomic groups (i.e., seed shrimp and chironomids) and FFG between the Sheardown Lake SE and reference lake littoral stations were potentially linked to differing food resources between lakes. Specifically, a significantly lower sediment TOC content potentially accounted for lower relative abundance of seed shrimp and the collector-gatherer FFG at Sheardown Lake SE than at the reference lake. The analysis of HPG suggested that differences in habitat also could have accounted for benthic invertebrate community structural differences between Sheardown Lake SE and Reference Lake 3 littoral areas. For instance, a significantly higher relative abundance of burrowing benthic invertebrates was consistent with the occurrence of significantly higher proportion of fines (i.e., silt and clay) in substrate of Sheardown Lake SE compared to the reference lake (Appendix Table D.19). Finer substrate composition at Sheardown Lake SE would presumably provide more suitable habitat quality for burrowing invertebrates, thus accounting for some of the differences in community structure between Sheardown Lake SE and Reference Lake 3. Lower sediment TOC and differences in sediment particle size largely reflect natural differences in habitat features between Sheardown Lake SE and the reference lake, including potential influences of backflow from the Mary River to Sheardown Lake SE during periods of high flow that would result in the deposition of fines to the lake.

Temporal comparisons of the Sheardown Lake SE benthic invertebrate community data indicated significantly lower density in 2015 and 2016 mine operational years compared to 2013 baseline period data, but no significant differences in density between 2015 and 2016 (Figure 4.14; Appendix Table F.31). In addition, richness, Simpson's Evenness, and the relative abundance of dominant taxonomic groups and FFG did not differ significantly among the mine operational and mine baseline studies (Figure 4.14; Appendix Table F.31). Because density was the only benthic invertebrate community metric that differed among periods, natural variability in density among studies most likely accounted for this difference. This was supported by the facts that no significant difference in the proportion of metal-sensitive taxa was indicated among years (Figure 4.14) and parameter concentrations in water and sediment were below applicable WQG/SQG and AEMP benchmarks at Sheardown Lake SE in 2016[12]. Consistent differences in benthic invertebrate community dominant taxonomic groups, FFG

[12] Although sediment iron and manganese concentrations were above SQG at littoral stations of Sheardown Lake SE in 2016, concentrations of these metals were also above SQG at profundal stations of Reference Lake 3, suggesting iron concentrations were naturally high within the mine LSA lakes.

and HPG were indicated between Sheardown Lake SE and Reference Lake 3 littoral stations in both the 2015 and 2016 studies, in addition to an overall greater number of significantly differing endpoints in 2016 compared to 2015 (Table 4.9; Appendix Table F.31). This suggested that factors contributing to differences in benthic invertebrate community structure between Sheardown Lake SE and Reference Lake 3 in both 2015 and 2016 had remained relatively unchanged between years.

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, reflecting the same fish species composition as the reference lake in 2016 (Table 4.6). However, total fish CPUE was much higher at Sheardown Lake SE than at Reference Lake 3 for both electrofishing and gill netting collection methods, suggesting higher densities and/or productivity of both Arctic charr and ninespine stickleback at Sheardown Lake SE (Table 4.6). Consistent with the other mine lakes, greater numbers of Arctic charr, together with greater density of benthic invertebrates, suggested that productivity was higher at Sheardown Lake SE than at Reference Lake 3.

Temporal comparison of the Sheardown Lake SE electrofishing catch data indicated that fish CPUE was highly variable among the mine baseline (2007 - 2008), construction (2014) and operational (2015, 2016) studies (Figure 4.15). Nevertheless, the abundance of Arctic charr at nearshore habitat of Sheardown Lake SE following the initial two years of mine operation (i.e., 2015 – 2016) was within the range observed prior to mine start-up. Arctic charr CPUE for gill net collections was markedly higher in 2016 compared to all previous baseline (2006 – 2008), mine construction (2014) and mine operational (2015) studies (Figure 4.15). However, similar to 2016 results at Camp Lake, the higher CPUE at Sheardown Lake SE in 2016 likely reflected improvements in sampling efficiency from experienced gained through previous studies (see Minnow 2016b) rather than higher fish densities/productivity at the lake in 2016. Nevertheless, CPUE comparisons between studies suggested that the relative abundance of Arctic charr in Sheardown Lake SE had not been reduced in 2016 compared to baseline conditions or to the previous mine construction and mine operation years.

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 with a control-impact analysis using data collected from Sheardown Lake SE and

Reference Lake 3 in 2016. Although before-after analysis of data collected from Sheardown Lake SE in 2016 (mine operation) and 2007 (baseline) was conducted, poor accuracy in fresh body weight measures during the 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 of each of Sheardown Lake SE and Reference Lake 3 in August 2016 for the control-impact analysis. Distinction of Arctic charr YOY from the older, non-YOY age category was possible using a fork length cut-off of 5.0 and 5.1 cm based on evaluation of length-frequency distributions coupled with supporting age determinations for the Sheardown Lake SE and Reference Lake 3 data sets, respectively (Figure 4.19). Nearshore Arctic charr health comparisons were conducted separately for the YOY and non-YOY data sets to account for naturally differing weight-at-length relationships that occur between these age categories.

Length-frequency distributions for the nearshore Arctic charr differed significantly between Sheardown Lake SE and Reference Lake 3 (Table 4.10), potentially reflecting a greater prevalence of YOY and smaller mean size of individuals captured at Sheardown Lake SE (Figure 4.19). Although Arctic charr YOY were significantly heavier and longer at the Sheardown Lake SE nearshore than at the reference lake nearshore, the size of non-YOY did not differ significantly between lakes in 2016 (Table 4.10; Appendix Tables G.26 – G.27). Similar to the northwest basin, Arctic charr captured at the Sheardown Lake SE nearshore grew significantly faster than those collected from the reference lake nearshore (Table 4.10). The magnitude of the differences in weight- and length-based growth were well outside of the ecologically meaningful CES_G of ±25% between Sheardown Lake SE and the reference lake (Table 4.10). However, as at the northwest basin, no significant differences in condition of nearshore Arctic charr were indicated between Sheardown Lake SE and the reference lake for YOY and non-YOY individuals in 2016 (Appendix Tables G.26 – G.27). Similar to the other mine-exposed lakes, the occurrence of faster growing Arctic charr with similar condition to those of the reference lake suggested no adverse mine-related influences on fish energy use and storage at Sheardown Lake SE in 2016.

Littoral/Profundal Arctic Charr

Mine-related influences on the Sheardown Lake SE littoral/profundal Arctic charr population was assessed using a before-after analysis between data collected in 2016 and the baseline characterization (combined 2007/2008) studies. Similar to the 2015 CREMP, a small sample size from Reference Lake 3 (i.e., n = 14) precluded meaningful control-impact statistical analysis using data collected in 2016. Biological information collected from Arctic charr mortalities indicated that non-spawners of reproductive age constituted approximately 57% of

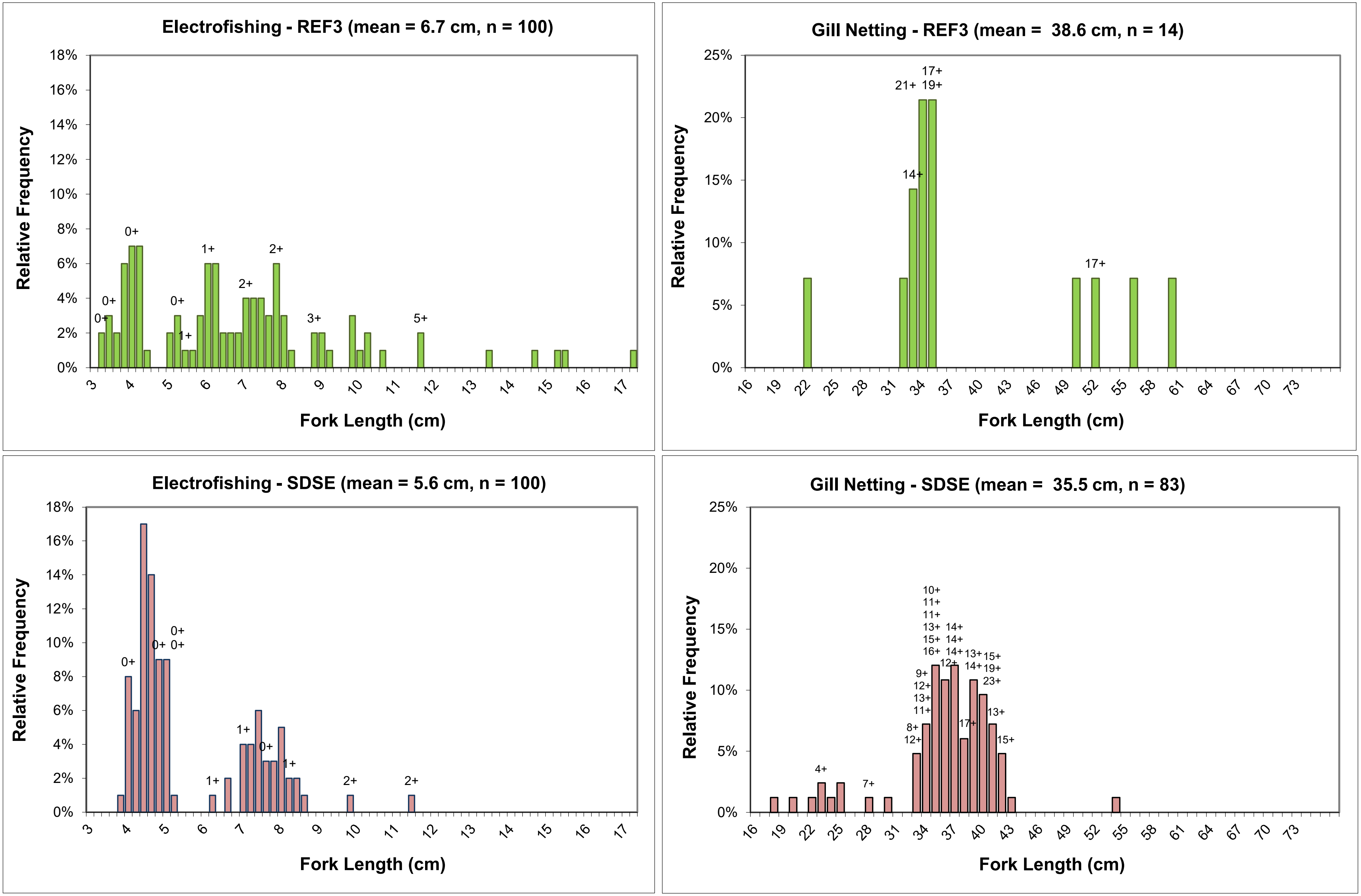


Figure 4.19: Length-frequency distributions for Arctic charr captured by backpack electrofishing and gill netting at Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2016. Fish ages are shown above the bars, where available.

Table 4.10: Summary of statistical results for Arctic charr population comparisons between Sheardown Lake SE and Reference Lake 3 for the mine operational period (2015, 2016) and between Sheardown Lake SE mine-operational and baseline period data for fish captured by electrofishing and gill netting methods, Mary River Project CREMP, August 2016. Values in parentheses indicate direction and magnitude of any significant differences.

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed?			
			versus Reference Lake 3		versus Sheardown Lake SE baseline period data [b]	
			2015	2016	2015	2016
Nearshore Electrofishing	Survival	Length-Frequency Distribution	No	**Yes**	**Yes**	**Yes**
		Age	No	No	**Yes (+273%)**	-
	Energy Use	Size (mean weight)	No	No	No	**Yes (-43%)**
		Size (mean fork length)	No	No	**Yes (+7%)**	**Yes (-15%)**
		Growth (weight-at-age)	**Yes (+85%)**	**Yes (+120%)**	No	-
		Growth (fork length-at-age)	**Yes (+21%)**	**Yes (+34%)**	No	-
	Energy Storage	Condition (body weight-at-fork length)	**Yes (+4%)**	No	**Yes (-14%)**	**Yes (-16%)**
Littoral/Profundal Gill Netting [a]	Survival	Length Frequency Distribution	-	-	**Yes**	**Yes**
		Age	-	-	**Yes (-13%)**	No
	Energy Use	Size (mean weight)	-	-	**Yes (-26%)**	**Yes (-20%)**
		Size (mean fork length)	-	-	**Yes (-9%)**	**Yes (-7%)**
		Growth (weight-at-age)	-	-	**Yes (+18%)**	**Yes (+24%)**
		Growth (fork length-at-age)	-	-	No	No
	Energy Storage	Condition (body weight-at-fork length)	-	-	No	No

[a] Due to low catches of Arctic charr at Reference Lake 3 in 2015 and 2016, no comparison of fish health was possible for gill netted fish.

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

the Sheardown Lake SE Arctic charr population during the August 2016 field study (Appendix Table G.32). On average, Arctic charr non-spawners were younger and were slightly smaller, but showed no significant difference in LSI compared to those fish with developing gonads (Appendix Table G.32; ANOVA p = 0.464). A high proportion of individuals (i.e., 96%) contained body cavity parasites (Appendix Table G.32), the incidence rate of which was comparable to that observed at other mine-exposed lakes in 2015 and 2016, as well as during baseline studies.

Length-frequency distributions of Arctic charr captured at littoral/profundal areas of Sheardown Lake SE in 2016 differed significantly from those captured during the baseline period (Table 4.10). In part, the differences in length-frequency distribution may have reflected significantly smaller size (i.e., weight and length) of individuals captured in 2016 compared to the baseline period (Table 4.10; Appendix Table G.31). Significantly greater weight-related growth was indicated in 2016 compared to the baseline period for Arctic charr captured at littoral/profundal areas of Sheardown Lake SE, but the difference was within the ecologically meaningful CES_G of ±25% (Table 4.10; Appendix Table G.31). However, condition of Arctic charr from littoral/profundal areas of Sheardown Lake SE did not differ significantly between 2016 and the baseline period (Table 4.10). The Arctic charr data collected from littoral/profundal areas of Sheardown Lake SE between 2016 and the baseline periods generally showed the same type, direction and magnitude of differences that were shown during the 2015 CREMP (Table 4.10), suggesting no substantial changes in conditions between 2015 and 2016. Overall, the absence of any ecologically significant differences in growth and condition for Arctic charr captured at littoral/profundal areas of Sheardown Lake SE in 2016 compared to the baseline period suggested no adverse influences on adult Arctic charr following the initial two years of mine operation.

4.4 Synthesis of Mine-Related Influences within the Sheardown Lake System

4.4.1 Sheardown Lake Tributaries

At Sheardown Lake Tributary 1 (SDLT1), aqueous concentrations of several parameters were elevated compared to average concentrations observed at the reference creek stations in 2016. However, similar to the 2015 CREMP, only nitrate and sulphate concentrations were elevated at SDLT1 in 2016 compared to the baseline period and, with the exception of copper, no parameters were present at concentrations above WQG or AEMP benchmarks in 2016. Chlorophyll a concentrations were elevated at lower SDLT1 compared to reference creek stations in 2016, suggesting that elevated nitrate concentrations may have contributed to biological enrichment at SDLT1. However, similar chlorophyll a concentrations between 2016 and the baseline period indicated that SDLT1 may naturally exhibit greater phytoplankton growth than at the reference creek stations. The key differences in benthic invertebrate community metrics between SDLT1 and Unnamed Reference Creek in 2016 included lower richness and greater relative abundance of filterer FFG and burrower HPG at SDLT1. Because a higher proportion of filterers may signify greater reliance upon phytoplankton as a food source within the benthic invertebrate community, these results were consistent with greater phytoplankton abundance (as indicated by chlorophyll a concentrations) at SDLT1 in 2016, and potentially indicated a slight enrichment influence at SDLT1 due to elevated nitrate concentrations. The occurrence of significantly greater relative abundance of HPG burrowers at SDLT1 compared to Unnamed Reference Creek was consistent with influences due to sedimentation, but may have also reflected naturally greater substrate embeddedness at lower SDLT1. Comparisons to baseline indicated significantly higher density at SDLT1 in 2016, which was consistent with a slight mine-related enrichment influence at SDLT1 and similar to findings of the 2015 CREMP. No other differences in benthic endpoints were observed between 2016 and baseline studies, suggesting that any enrichment influences were minor.

At Sheardown Lake Tributary 12 (SDLT12), a significantly higher relative abundance of benthic invertebrate collector-gatherers and burrowers occurred relative to Unnamed Reference Creek in 2016, as well as during the 2015/2016 mine-operational period compared to 2007 baseline data. The temporal changes in benthic invertebrate community composition at SDLT12 are hypothesized to reflect a mine-related reduction in flow and/or increased particle loadings (e.g., through dust and/or erosional deposition) over time. At Sheardown Lake Tributary 9 (SLDT9), the relative abundance of benthic invertebrate HPG burrowers and FFG shredders was significantly higher than at Unnamed Reference Creek in 2016. However, because similar differences in composition were not indicated at SDLT9 between 2016 and baseline studies conducted in 2007 and 2013, the differences in community composition between SDLT9 and Unnamed Reference Creek in 2016 potentially reflected naturally greater amounts of in-stream vegetation at SDLT9. Notably, primary benthic invertebrate community endpoints of density, richness and Simpson’s Evenness, as well as the relative abundance of metal-sensitive chironomids, showed no significant, ecologically meaningful, differences at SDLT12 or SDLT9 compared to Unnamed Reference Creek in 2016, nor compared to baseline data. This suggested that benthic invertebrate community differences at these tributaries compared to Unnamed Reference Creek in 2016 and to the baseline studies were subtle.

4.4.2 Sheardown Lake (NW and SE Basins)

At the Sheardown Lake NW and SE basins, aqueous concentrations of aluminum, manganese, molybdenum and/or uranium were elevated compared to the reference lake in both 2015 and 2016, but none of these metals, or any other parameters, were elevated compared to concentrations observed during the baseline period, and none were above WQG or AEMP benchmarks. Similar to findings of the 2015 CREMP, total aluminum and manganese concentrations showed strong positive correlations with turbidity in 2016 that, in turn, suggested that these metals were largely bound to/composed suspended particulate matter and were not likely biologically available. High turbidity in Sheardown Lake is hypothesized to reflect natural sources of suspended particulates originating from Mary River, upstream of the mine. Sediment metal concentrations at littoral stations of the Sheardown Lake basins in 2016 were similar to those at the reference lake and compared to baseline data with the exception of slightly elevated arsenic, manganese and/or molybdenum concentrations at littoral stations, suggesting some mine-related influence on sediment quality of the shallow lake zone in Sheardown Lake. However, sediment metal concentrations at profundal stations of the Sheardown Lake basins in 2016 were similar to the reference lake and baseline data, indicating that mine-related influences on sediment quality were confined to littoral habitats. Notably, no metals were present in sediment of Sheardown Lake at concentrations above SQG or AEMP benchmarks that were not also above these criteria at the reference lake, suggesting the natural occurrence of elevated concentrations of some metals (e.g., iron, manganese) in sediment of lakes in the Mary River Project LSA.

Chlorophyll a concentrations at both of the Sheardown Lake basins were significantly higher than at the reference lake in 2016 suggesting greater primary production within the Sheardown Lake system. However, chlorophyll a concentrations within the Sheardown Lake basins remained well below the AEMP benchmark during all seasonal sampling events in 2016, and were consistent with oligotrophic conditions typical of Arctic waterbodies. No significant differences in annual average chlorophyll a concentrations were indicated among the mine construction (2014) and operational (2015, 2016) periods, suggesting no changes in the trophic status of either Sheardown Lake basin since mine operations commenced at the Mary River Project. Benthic invertebrate community data collected at littoral habitat of the Sheardown Lake basins in 2016 indicated no adverse significant differences in primary endpoints (density, richness and Simpson’s Evenness) compared to the reference lake. Although significant differences in relative abundance of dominant invertebrate groups, FFG and HPG were observed between the Sheardown Lake basins and the reference lake in 2016, these differences appeared to reflect naturally differing sediment TOC and/or particle size between the mine-exposed and reference lakes. No consistent types and/or direction of differences in benthic invertebrate community endpoints were observed between 2016 and 2007/2013 baseline data for littoral stations of either Sheardown Lake basin, suggesting no adverse influences to benthic invertebrates associated with the Mary River Project mine operations.

Analysis of Arctic charr populations at the Sheardown Lake basins suggested greater fish abundance compared to the reference lake in 2016, but similar numbers of Arctic charr in 2016 compared to Sheardown Lake baseline studies. Arctic charr captured at nearshore habitat of the Sheardown Lake basins were significantly larger and grew significantly faster, but exhibited similar condition, than those captured at the reference lake in 2016. Arctic charr captured at nearshore habitat of Sheardown Lake NW in 2016 exhibited significantly lower condition than those captured during the baseline period. However, no significant, ecologically meaningful differences in growth and significantly greater condition was indicated for Arctic charr captured at littoral/profundal habitat in 2016 compared to the baseline period. The differential responses in Arctic charr endpoints between Sheardown Lake and the reference lake in 2016, and between Arctic charr collected at nearshore and littoral/profundal habitats for Sheardown Lake studies in 2016 compared to baseline, were not consistent with an adverse mine-related effect on Arctic charr populations at Sheardown Lake. Collectively, the chlorophyll a, benthic invertebrate community and Arctic charr fish population data all suggested no adverse mine-related influences to the biota of Sheardown Lake in the second year of mine operation at the Mary River Project.

5.0 MARY RIVER AND MARY LAKE SYSTEM

5.1 Mary River

5.1.1 Water Quality

Dissolved oxygen (DO) concentrations at Mary River stations were consistently at or above saturation during all spring, summer and fall monitoring events, and were comparable to DO saturation levels observed among the GO-09 series reference river stations for each respective seasonal sampling event (Figure 5.1; Appendix Tables C.1 - C.3). Although DO saturation levels differed significantly among the Mary River benthic study areas, no gradient in DO saturation levels was shown from upstream to downstream of the mine at the time of biological sampling in August 2016 and DO saturation was consistently well above the WQG minimum limit for cold-water biota (i.e., 54%) at all times (Figure 5.1; Appendix Figure C.19 and Table C.50). This suggested that slight differences in DO concentrations/saturation among Mary River study areas were not ecologically meaningful and were unrelated to potential mine influences.

In-situ pH at all Mary River stations was similar to pH at the GO-09 series river reference stations for each respective seasonal sampling event (Appendix Table C.1 – C.3 and Figure C.19). Although pH at Mary River Station CO-05, well downstream of the mine, was significantly lower than at all other Mary River study areas, including the GO-09 river reference area, during the 2016 fall sampling event, 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.50). Aqueous conductivity at Mary River stations showed no distinct spatial changes with progression from upstream to downstream of the mine during the spring, summer or fall sampling events, suggesting no mine-related influences on Mary River conductivity (Appendix Figure C.19). Notably, conductivity varied considerably among spring, summer and fall at all stations, reflecting natural seasonal differences in conductivity of surface runoff related to dilution sources (e.g., spring snowmelt). Similar to comparisons of pH, conductivity differed significantly among Mary River benthic study areas during fall biological monitoring in 2016. However, the incremental differences in conductivity among reference and mine-exposed areas of the Mary River were small and unlikely to be ecologically meaningful. Moreover, rather than being indicative of potential mine-related influences, the differences in conductivity among Mary River study areas likely reflected the natural proportion of flow contributed by various tributaries to the river, as well as differences in the geology of base material between Mary River and these tributaries.

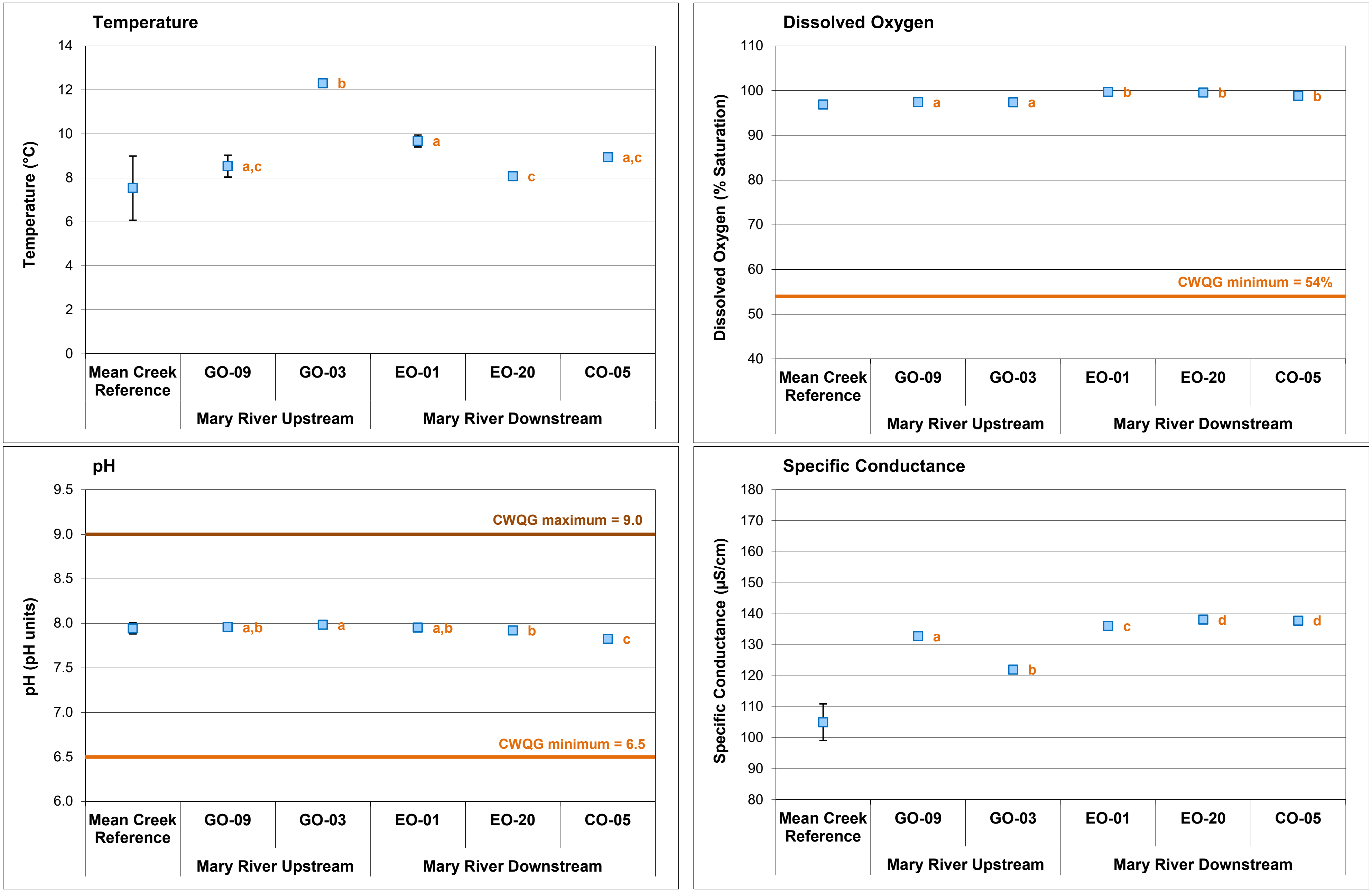


Figure 5.1: Comparison of *in-situ* water quality variables (mean ± SE) measured at the Mary River benthic invertebrate community stations (n = 5) and lotic reference stations (n = 4), Mary River Project CREMP, August 2016. The same letters next to Mary River study area data points indicate no significant difference between study areas.

Water chemistry within Mary River showed no distinct and/or consistent spatial differences with progression downstream from the GO-09 series river reference stations during any of the winter, summer or fall sampling events in 2016 (Table 5.1; Appendix Table C.51). In general, parameter concentrations at Mary River stations located adjacent to or downstream of the mine (EO and CO series stations) were similar to, and often lower than, concentrations observed at the upstream river reference stations (GO-09 series stations) during each respective spring and summer sampling event, as well as at EO series stations during the fall sampling event (Table 5.1; Appendix Table C.51). Total concentrations of several metals, including phosphorus, aluminum, chromium, iron and lead, were slightly elevated (i.e., 3- to 5-fold) at CO stations located immediately downstream of the mine compared to the GO-09 reference stations during the fall monitoring event (Table 5.1). Relatively high total concentrations of these metals at the Mary River CO stations appeared to be associated with elevated turbidity at the time of the fall sampling event (Table 5.1). Despite elevation of total concentrations of these metals, dissolved metal concentrations were consistently similar among Mary River reference and mine-exposed stations for each of the spring, summer and fall sampling events (Appendix Table C.52).

Total aluminum concentrations were above WQG and AEMP benchmarks at all Mary River mine-exposed stations during the summer and fall monitoring events, and total iron concentrations were also above WQG and/or AEMP benchmarks at all Mary River mine-exposed stations during the fall monitoring event, in 2016 (Table 5.1; Appendix Table C.51). However, concentrations of both of these metals were elevated above applicable WQG at one or more of the Mary River GO series reference stations during the spring, summer and fall monitoring events, suggesting naturally high concentrations of aluminum and iron in the Mary River system. Total phosphorus, copper and lead concentrations were also above WQG and/or AEMP benchmarks at one or more Mary River CO stations during fall monitoring in 2016 which, as discussed above, appeared to be associated with elevated turbidity at the time of sampling (Appendix Table C.51). Notably, a very high proportion (i.e., ≥80%) of aluminum, iron, lead and other metals (e.g., manganese, silicon) were in the ‘total’ concentration form, suggesting that these metals were largely associated with suspended particulate matter and were unlikely to be bioavailable. High turbidity was observed at reference (i.e., GO series) stations indicating that elevated turbidity in the Mary River was a natural phenomenon unrelated to the Mary River Project operations. Dissolved metal concentrations at all Mary River stations were well below WQG and AEMP benchmarks.

Temporal evaluation of Mary River water chemistry data suggested higher total concentrations of several metals, including aluminum, copper, iron, lead, manganese and nickel, at one or

Table 5.1: Water chemistry at Mary River monitoring stations, Mary River Project CREMP, August 2016.

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Reference Creek Average (n = 4)	Mary River Reference Station			Mary River Upstream		Tributary	Mary River Downstream of Mine					
						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
					Fall 2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	125	191	189	188	169	174	261	186	174	173	172	170	171
	pH (lab)	pH	6.5 - 9.0	-	7.99	8.23	8.24	8.21	8.14	8.14	8.28	8.14	8.12	8.16	8.17	8.13	8.15
	Hardness (as $CaCO_3$)	mg/L	-	-	58	80	84	82	76	79	131	84	80	79	80	79	79
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	5.4	2.9	2.9	2.95	2.5	3.0	2.9	<2.0	3.5	3.4	5.6	6.9
	Total Dissolved Solids (TDS)	mg/L	-	-	65	107	98	98	95	69	141	102	90	90	86	94	99
	Turbidity	NTU	-	-	1.1	16.3	9.7	11.0	12.3	16.1	11.0	16.5	12.9	14.6	16.0	32.7	41.5
	Alkalinity (as $CaCO_3$)	mg/L	-	-	57	73	79	79	74	75	118	82	70	72	68	76	76
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	<0.020	0.032	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.039	0.026	0.065	0.022
	Nitrate	mg/L	13	13	0.021	0.023	<0.020	<0.020	<0.020	<0.020	0.096	<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	0.16	0.25	<0.15	0.15	0.21	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.3	1.2	1.3	1.1	1.3	1.3	1.2	1.2	1.2	1.2	1.8	1.6	1.9
	Total Organic Carbon	mg/L	-	-	1.5	1.5	1.4	1.4	1.5	1.5	1.4	2.3	1.3	1.4	1.5	1.6	1.8
	Total Phosphorus	mg/L	0.020[α]	-	0.0059	0.0125	0.0090	0.0107	0.0089	0.0098	0.0112	0.0117	0.0097	0.0097	0.0157	0.0358	0.0206
	Phenols	mg/L	0.004[α]	-	0.0055	0.0056	0.0063	0.0086	0.0048	0.0037	0.0057	0.0058	0.0039	0.0042	0.0160	0.0552	0.0039
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.5	11.5	9.0	9.3	7.0	6.9	5.6	6.7	6.6	6.6	6.1	6.1	6.1
	Sulphate (SO_4)	mg/L	218[β]	218	4.4	5.6	4.5	4.6	3.8	4.6	14.3	5.0	4.4	4.4	4.2	5.0	5.2
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.058	0.395	0.217	0.258	0.291	0.484	0.251	0.418	0.301	0.382	0.431	**1.040**	**1.390**
	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	0.00013	<0.00010	<0.00010	0.00011	0.00013	0.00015	0.00014	0.00012	0.00012	0.00014	0.00020	0.00026
	Barium (Ba)	mg/L	-	-	0.0078	0.0147	0.0130	0.0131	0.0126	0.0142	0.0148	0.0143	0.0133	0.0133	0.0143	0.0174	0.0196
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00040	<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	-	-	<0.0003875	<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	<0.010	<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	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	12.3	17.0	17.8	18.0	15.7	16.9	27.0	17.5	17.1	16.7	16.9	16.5	16.5
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	0.00096	0.00060	0.00065	0.00073	0.00110	0.00108	0.00112	0.00076	0.00096	0.00108	0.00237	0.00319
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	0.00020	0.00012	0.00014	0.00015	0.00023	0.00024	0.00022	0.00016	0.00018	0.00022	0.00048	0.00065
	Copper (Cu)	mg/L	0.002	0.0024	0.0010	0.0017	0.0017	0.0015	0.00150	0.0016	0.0019	0.0016	0.0016	0.0015	0.0016	0.0024	**0.0027**
	Iron (Fe)	mg/L	0.30	0.874	0.051	0.410	0.227	0.278	0.298	0.471	0.325	0.437	0.308	0.383	0.442	**1.07**	**1.42**
	Lead (Pb)	mg/L	0.001	0.001	0.000096	0.00036	0.00025	0.00024	0.00029	0.00041	0.00042	0.00040	0.00031	0.00034	0.00039	0.00083	**0.00108**
	Lithium (Li)	mg/L	-	-	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	0.0017	0.0024
	Magnesium (Mg)	mg/L	-	-	6.77	9.32	9.46	9.21	8.86	9.18	15.9	10.2	9.58	9.18	9.40	9.66	9.72
	Manganese (Mn)	mg/L	0.935[β]	-	0.00086	0.00562	0.00297	0.00359	0.00365	0.00547	0.00498	0.00531	0.00400	0.00471	0.00541	0.0121	0.0167
	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	-	0.000380	0.000628	0.000510	0.000529	0.000426	0.000457	0.000337	0.000425	0.000515	0.000532	0.000534	0.000533	0.000566
	Nickel (Ni)	mg/L	0.025	0.025	0.00056	0.00079	0.00067	0.00059	0.00073	0.00102	0.00148	0.00111	0.00092	0.00103	0.00117	0.00241	0.00259
	Potassium (K)	mg/L	-	-	0.84	1.68	1.45	1.45	1.34	1.42	1.46	1.44	1.43	1.41	1.40	1.70	1.88
	Selenium (Se)	mg/L	0.001	-	<0.0007625	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000052	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	0.95	1.55	1.27	1.34	1.33	1.73	1.25	1.56	1.35	1.50	1.66	2.74	3.62
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000020	<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	-	-	1.830	5.67	4.57	4.56	3.71	3.69	2.20	3.54	3.59	3.46	3.35	3.42	3.40
	Strontium (Sr)	mg/L	-	-	0.01240	0.0234	0.0211	0.0216	0.0179	0.0184	0.0197	0.0188	0.0184	0.0182	0.0179	0.0187	0.0188
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.0000775	0.000014	0.000011	0.000012	0.0000105	0.000014	0.000013	0.000015	0.000011	0.000014	0.000015	0.000027	0.000036
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.00799	0.0233	0.0124	0.0156	0.01615	0.0271	0.0156	0.0245	0.0164	0.0212	0.0248	0.0611	0.0822
	Uranium (U)	mg/L	0.015	-	0.00366	0.00657	0.00577	0.00580	0.004605	0.00468	0.00353	0.00430	0.00453	0.00441	0.00406	0.00406	0.00407
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.000875	0.00099	0.00063	0.00074	0.000735	0.00104	0.00078	0.00101	0.00075	0.00092	0.00098	0.00208	0.00274
	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	0.0031	0.0050

[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.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

more Mary River mine-exposed stations in 2016 compared to mine baseline period (2005-2013; Figure 5.2; Appendix Figure C.20). However, as in 2015, higher total concentrations of these metals in 2016 almost certainly reflected much greater amounts of suspended matter during the fall sampling event than during the baseline period (e.g., on average, Mary River turbidity was 4.6 times higher in 2016 than during the baseline sampling in fall; Appendix Figure C.20). Turbidity of the Mary River was generally similar among reference and mine-exposed stations, suggesting naturally high suspended matter in the river that were unrelated to mine activity (Appendix Figure C.20). Comparisons of more conservative parameters commonly used as indicators of anthropogenic influences in aquatic environments (e.g., chloride, conductivity, nitrate, sulphate, hardness) indicated no substantial changes in concentrations between 2016 and the baseline period at the Mary River mine-exposed stations during fall sampling events (Figure 5.2; Appendix Figure C.20). In addition, no substantial changes in concentrations of any parameters were observed between 2016 and the mine baseline period for sampling conducted during spring and summer at the Mary River mine-exposed stations. Overall, these results suggested that mine-related influences to water quality of the Mary River, if any, were minor in 2016 based on comparisons to reference conditions and to mine baseline data.

5.1.2 Phytoplankton

Mary River chlorophyll a concentrations at stations downstream of the mine were generally within the range of the GO series river reference stations and/or stream reference stations during the 2016 spring, summer and fall sampling events (Figure 5.3). No significant differences in annual average chlorophyll a concentrations were indicated among the ten Mary River monitoring stations in 2016 (Appendix Table E.13). Chlorophyll a concentrations were well below the AEMP benchmark of 3.7 µg/L during all winter, summer and fall sampling events in 2016 at all Mary River sampling stations, and were suggestive of low (i.e., oligotrophic) phytoplankton productivity based on Dodds et al (1998) trophic status classification for stream environments (Figure 5.3). These results suggested no adverse mine-related influences on phytoplankton density at Mary River in 2016. Low to moderate phytoplankton productivity was predicted for the Mary River given 'oligotrophic' to 'mesotrophic' CWQG categorization derived from evaluation of total phosphorus concentrations of up to 36 µg/L in 2016 (Table 5.1; Appendix Table C.51). Notably, total phosphorus concentrations were not significantly correlated with chlorophyll a concentrations, and strong correlations between turbidity and total phosphorus suggested that phosphorus was bound to suspended particulates. As such, the availability of phosphorus for phytoplankton productivity at Mary River stations may be more

Figure 5.2: Temporal comparison of water chemistry at Mary River stations for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods during fall. Values represent mean ± SD. Creek reference includes 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 Mary River.

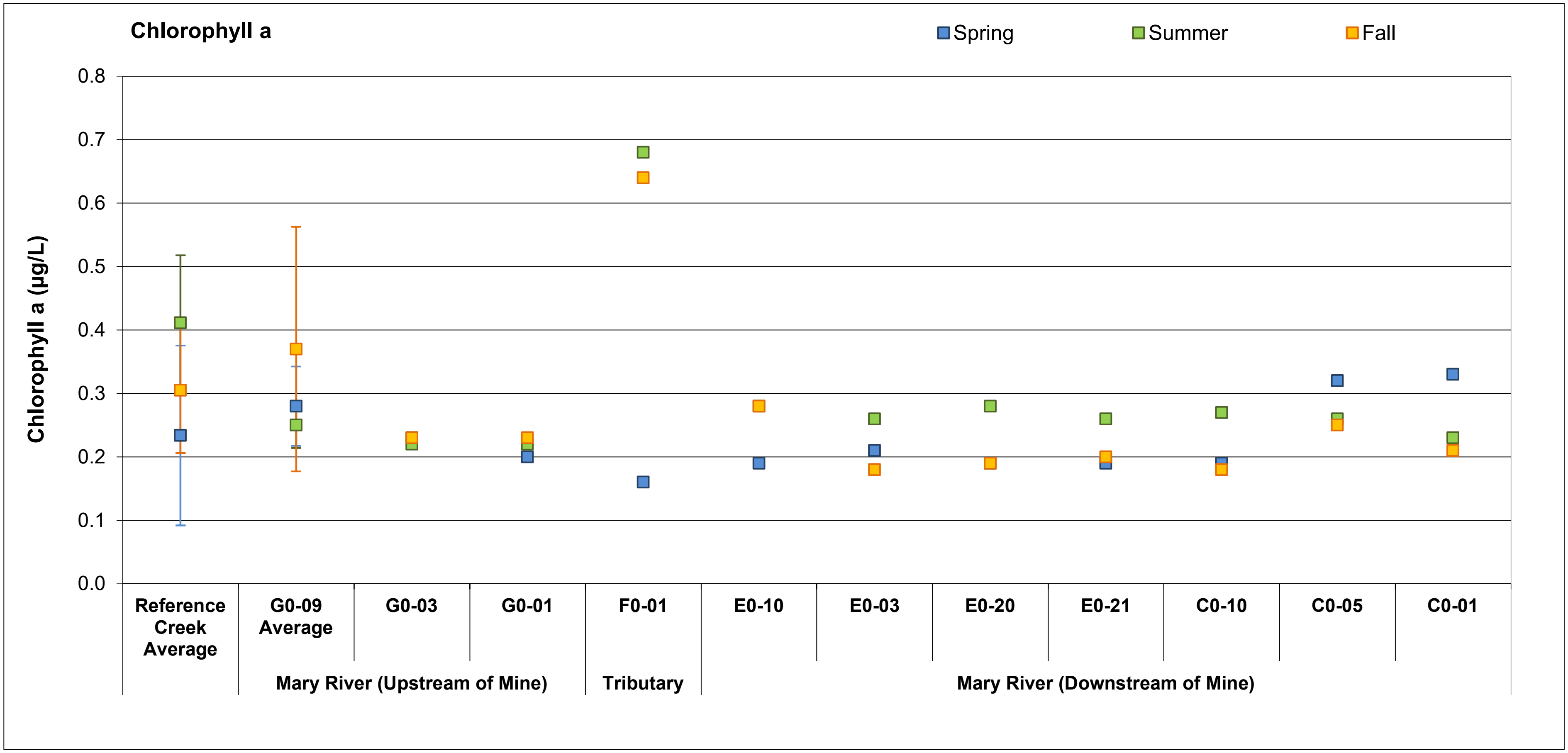


Figure 5.3: Chlorophyll a concentrations at Mary River phytoplankton monitoring stations located upstream and downstream of the mine, Mary River Project CREMP, 2016. Creek reference includes the CLT-REF and MRY-REF series stations (mean ± SD; n = 4).

limited than that suggested by the trophic categorization for the watercourse based on CWQG definitions.

Temporal comparisons of the Mary River chlorophyll a data suggested that concentrations were generally lower at stations downstream of the mine sewage treatment plant outfall (i.e., Station EO-21, -20 and CO series stations) in 2015 and 2016 compared to the baseline period (Figure 5.4). Notably, baseline period chlorophyll a concentrations at these stations were considerably higher than at reference and mine-exposed stations located upstream (Figure 5.4). Chlorophyll a concentrations at EO and CO stations located downstream of the mine sewage treatment plant outfall in 2015/2016 were comparable to concentrations at reference stations (GO) and EO stations located upstream of the mine sewage treatment plant discharge (i.e., Stations EO-10 and -03) during the baseline period (Figure 5.4). Similar to the water chemistry data for Mary River CREMP stations, variability in chlorophyll a concentrations at the Mary River stations among mine periods may have reflected natural differences in turbidity affecting the amount of light energy available to phytoplankton as opposed to adverse response to metals, nutrient enrichment or other potential mine-related influences on phytoplankton productivity. Accordingly, lower chlorophyll a concentrations in 2015 and 2016 at Mary River stations downstream of the mine sewage treatment plant discharge may have been due to naturally higher turbidity (i.e., originating from sources upstream of the mine) rather than an adverse response to mine operations.

5.1.3 Benthic Invertebrate Community

The Mary River benthic invertebrate community assessment included a spatial statistical analysis of key benthic endpoints among upstream reference areas (GO-09, GO-03), near-field mine-exposed areas located adjacent to the mine (EO-01, EO-20) and a far-field, cumulative effects mine-exposed area located downstream of the mine (CO-05; see Table 2.6, Figure 2.4). Benthic invertebrate density did not differ significantly at the three mine-exposed Mary River study areas from the GO-09 reference area in 2016 (Figure 5.5; Appendix Table F.37). Among Mary River mine-exposed areas, richness differed significantly from reference conditions only at the lower CO-05 (cumulative effects) study area. However, the occurrence of significantly higher richness downstream of the mine at CO-05 was not consistent with an adverse mine-related influence (Figure 5.5). Simpson's Evenness at Mary River mine-exposed areas EO-20 and CO-05 was significantly lower than at the GO-09 reference area in 2016 (Figure 5.5; Appendix Table F.37). Lower Simpson's Evenness at these two mine-exposed areas reflected dominance of the benthic invertebrate community by relatively few taxa, of which *Tokungaia* midges were the most numerous (Appendix Table F.35).

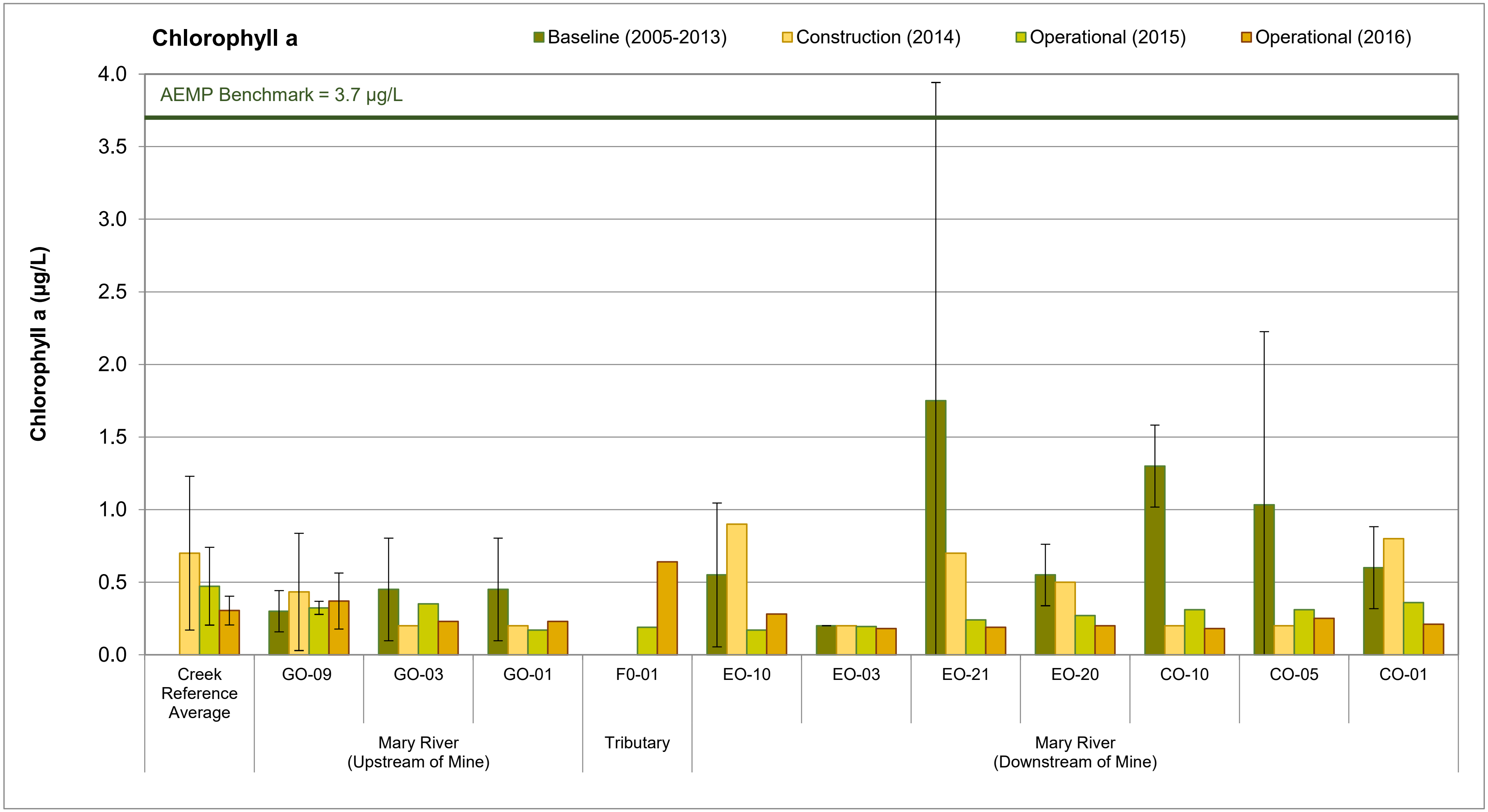


Figure 5.4: Temporal comparison of chlorophyll a concentrations at Mary River stations for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods during the fall, Mary River Project CREMP. The creek reference stations include the CLT-REF and MRY-REF series (mean ± SD; n = 4).

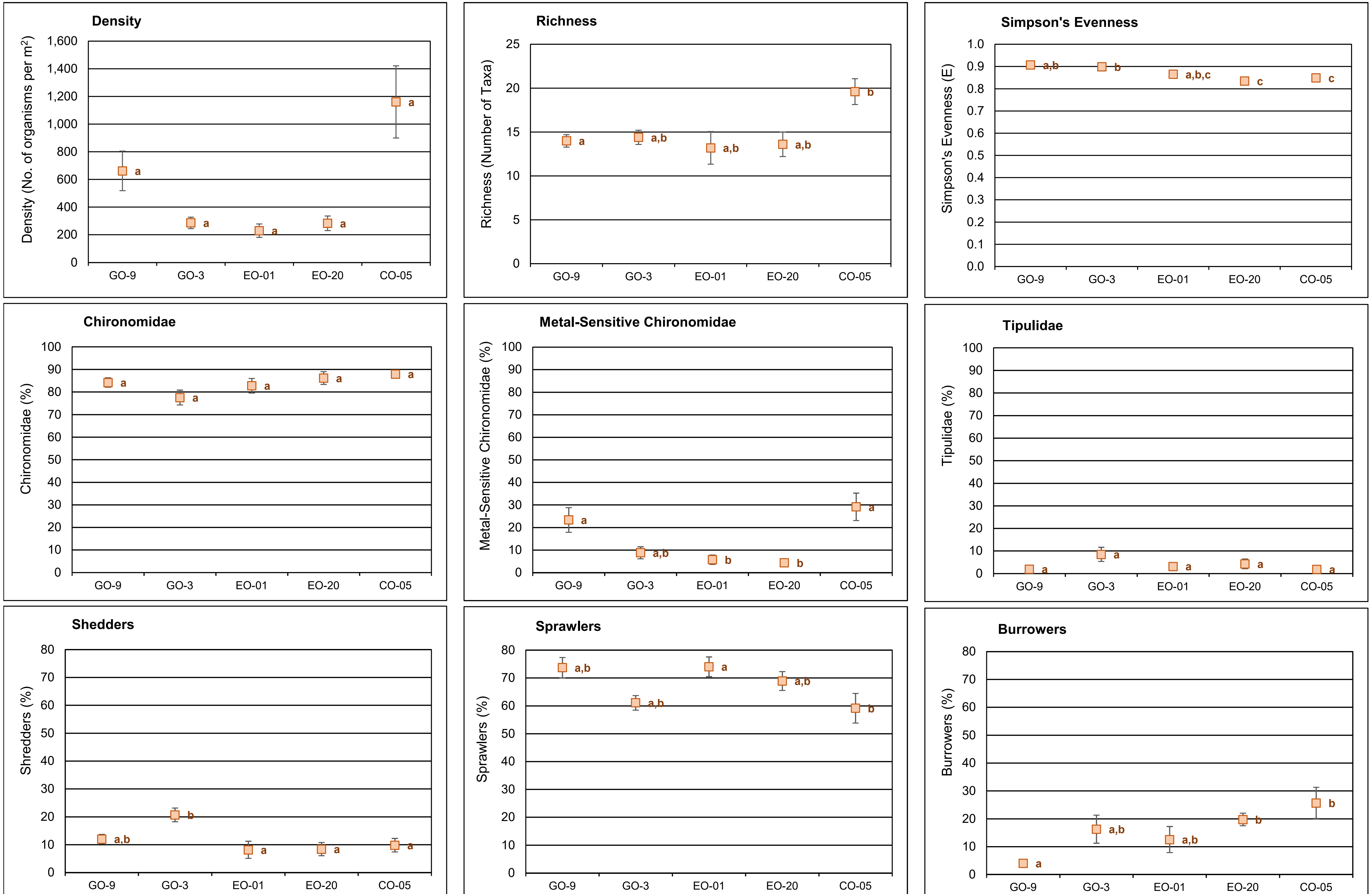


Figure 5.5: Comparison of benthic invertebrate community metrics among Mary River areas (mean ± SE), Mary River Project CREMP, August 2016. The same letters next to data points indicates no significant difference between/among study areas.

Some differences in benthic invertebrate community composition were suggested between the mine-exposed and reference areas of Mary River based on significant differences in Bray-Curtis Index (Figure 5.5; Appendix Table F.37). However, the relative abundance of dominant invertebrate groups did not differ significantly among the Mary River mine-exposed and reference areas (Figure 5.5). Despite the occurrence of significantly lower relative abundance of metal-sensitive chironomids at near-field mine-exposed areas EO-01 and EO-20 compared to the reference area, the magnitude of these differences was within a CES_{BIC} of ± 2 SD_{REF} (Figure 5.5; Appendix Table F.37). This suggested that lower relative abundance of metal-sensitive chironomids at the Mary River near-field mine-exposed areas compared to the reference area was not ecologically meaningful. No significant, ecologically meaningful, differences in the relative abundance of major FFG were shown among the Mary River study areas (Figure 5.5), suggesting no mine-related influences on food resources available for benthic invertebrates in the Mary River. A significantly higher relative abundance of HPG burrowers at Mary River mine-exposed areas EO-20 and CO-05 compared to the GO-09 reference area (Appendix Table F.37) suggested that natural differences in habitat accounted for the differences in Bray-Curtis Index between the mine-exposed and reference areas. Substrate embeddedness was significantly higher at mine-exposed CO-05 than at the reference area, which could partially explain mine-exposed and reference area differences in Bray-Curtis Index (Appendix Table F.34). Higher substrate embeddedness potentially contributed to relatively high abundance of *Tokungaia* midges at the EO-20 and CO-05 mine-exposed areas given that this genus of midges prefers more stable, depositional zones of cold water lotic environments (Oliver and Dillon 1997; Lods-Crozet et al 2012). Therefore, the differences in benthic invertebrate community composition between mine-exposed and reference areas of the Mary River suggested by significantly differing Bray Curtis Index likely reflected natural habitat factors such as substrate embeddedness.

Temporal comparison of the Mary River benthic invertebrate community data indicated no consistent significant differences in density or richness between mine operational (2015, 2016) and baseline (2006 – 2011 data) periods at any of the mine-exposed study areas (i.e., EO-01, EO-20 or CO-05; Figure 5.6; Appendix Tables F.40 – F.42). Simpson's Evenness and chironomid relative abundance was generally significantly higher and lower, respectively, at the mine-exposed areas at the time of mine operational studies compared to the mine baseline studies. However, the same type and direction of significant differences were observed at Mary River areas located upstream of the mine (Appendix Tables F.38 – F.42), suggesting that the differences in these metrics at all Mary River areas over time reflected natural temporal variability and/or represented sampling artifacts of the CREMP (e.g., changes in sampling location, personnel). Although the relative abundance of FFG collector-gatherers was

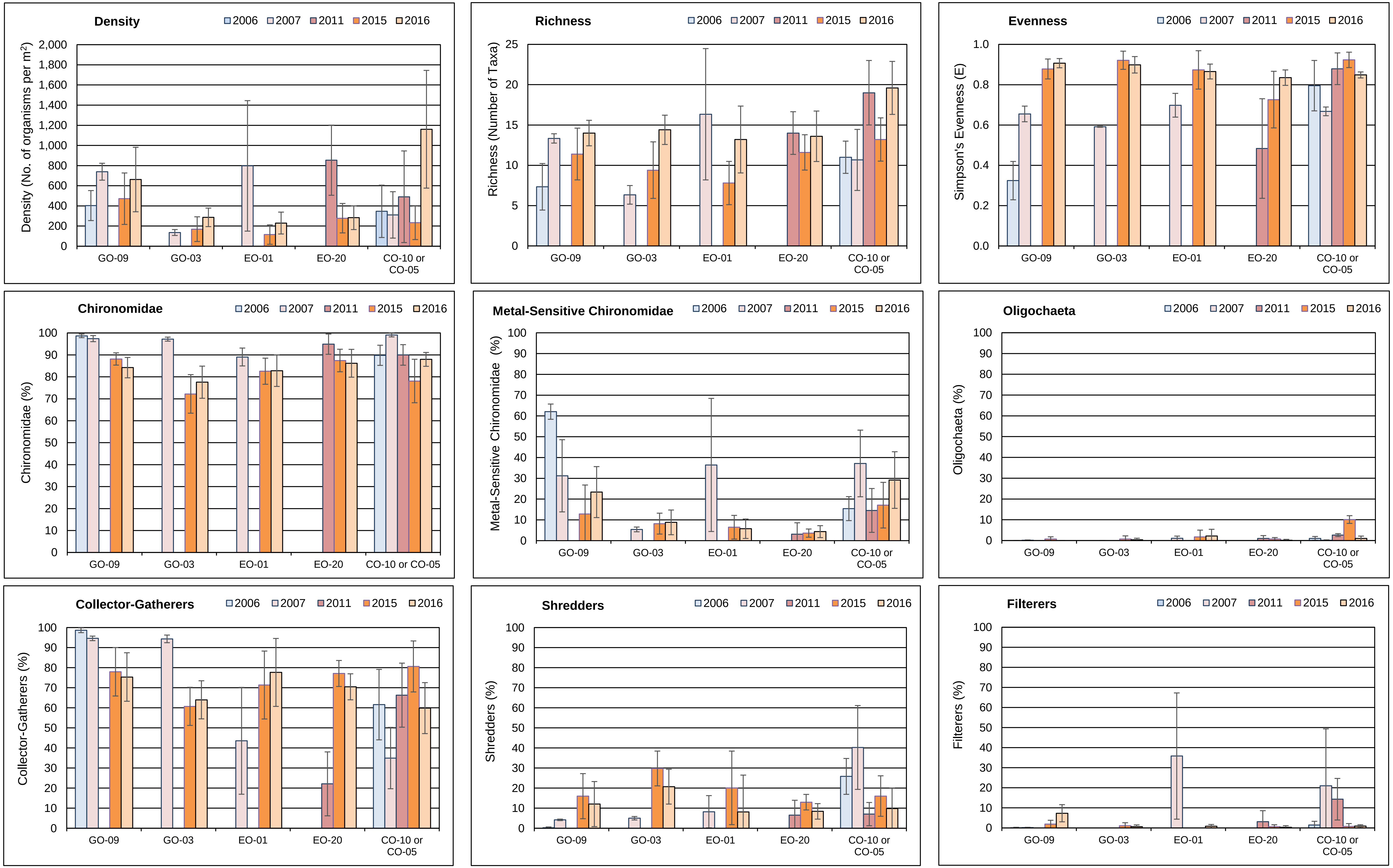


Figure 5.6: Comparison of benthic invertebrate community metrics (mean ± SD) at Mary River stations among baseline (2006, 2007), construction (2014) and operational (2015, 2016) years, Mary River Project CREMP.

significantly higher at upper mine-exposed area EO-20 following initiation of mine-operation than during the baseline period, the proportion of collector-gatherers at this area became more similar to the reference condition in the mine operational period, suggesting that the temporal changes were not mine-related (Appendix Tables F.38 and F.41). Notably, the types, direction, and magnitude of difference for endpoints that differed significantly between the mine operational and baseline periods at the Mary River mine-exposed areas were similar between the 2015 and 2016 CREMP studies (Figure 5.6), suggesting no cumulative temporal influences on benthic invertebrates of the Mary River since mine operations commenced.

5.2 Mary Lake (BLO)

5.2.1 Water Quality

Water quality profiles conducted at Mary Lake in 2016 showed similar *in-situ* water temperature, dissolved oxygen saturation and pH values, but consistently higher specific conductance, at the north basin compared to the south basin throughout the year (Figures 5.7 and 5.8). Water temperatures typically showed a gradient from surface to bottom during the winter, summer and fall at the Mary Lake north and south basins. However, the temperature profile suggested only weak thermal stratification at the south basin water column during the summer and fall sampling events in 2016, with the greatest change in temperature occurring between lake depths of approximately 10 and 20 m in both seasons (Figures 5.7 and 5.8). Weak to more strongly established thermal stratification occurred at Reference Lake 3 during the summer and fall sampling events, respectively (Figures 5.7 and 5.8). The mean water temperature at the bottom of water column at Mary Lake littoral stations did not differ significantly from that of Reference Lake 3 littoral stations in fall 2016 (Figure 5.9; Appendix Tables C.22 and C.57).

Dissolved oxygen profiles conducted at Mary Lake in 2016 indicated the development of a strong oxycline at the north basin in winter beginning at a depth of approximately 5 m, and a weak oxycline at the south basin in winter, summer and fall at depths greater than approximately 10 m (Figures 5.7 and 5.8). This differed from Reference Lake 3, where no oxycline development was apparent in the summer or fall of 2016. Nevertheless, dissolved oxygen saturation levels at Mary Lake remained above the WQG of 54% through the entire water column at the south basin in all seasons, and at the north basin in summer and fall seasons (Figures 5.7 and 5.8). Dissolved oxygen saturation levels below the WQG of 54% occurred at depths greater than approximately 11.5 m at the Mary Lake north basin in the winter (Figure 5.7). Dissolved oxygen saturation levels at Mary Lake littoral stations were well above the respective WQG at the bottom of the water column, and did not differ significantly

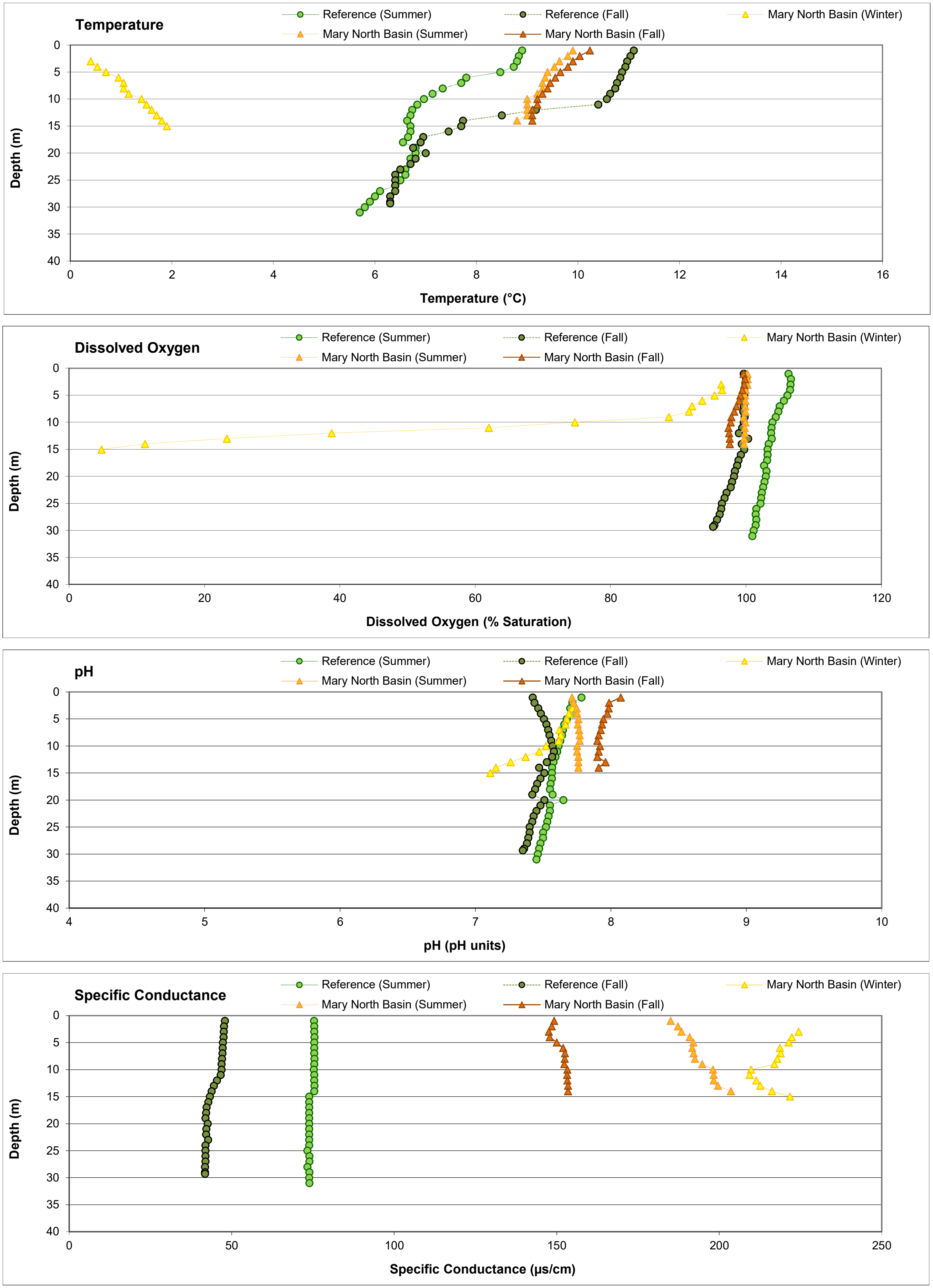


Figure 5.7: Average *in-situ* water quality with depth from surface at the Mary Lake (mine-exposed area) north basin compared to Reference Lake 3 during winter, summer, and fall sampling events, Mary River Project CREMP, 2016.

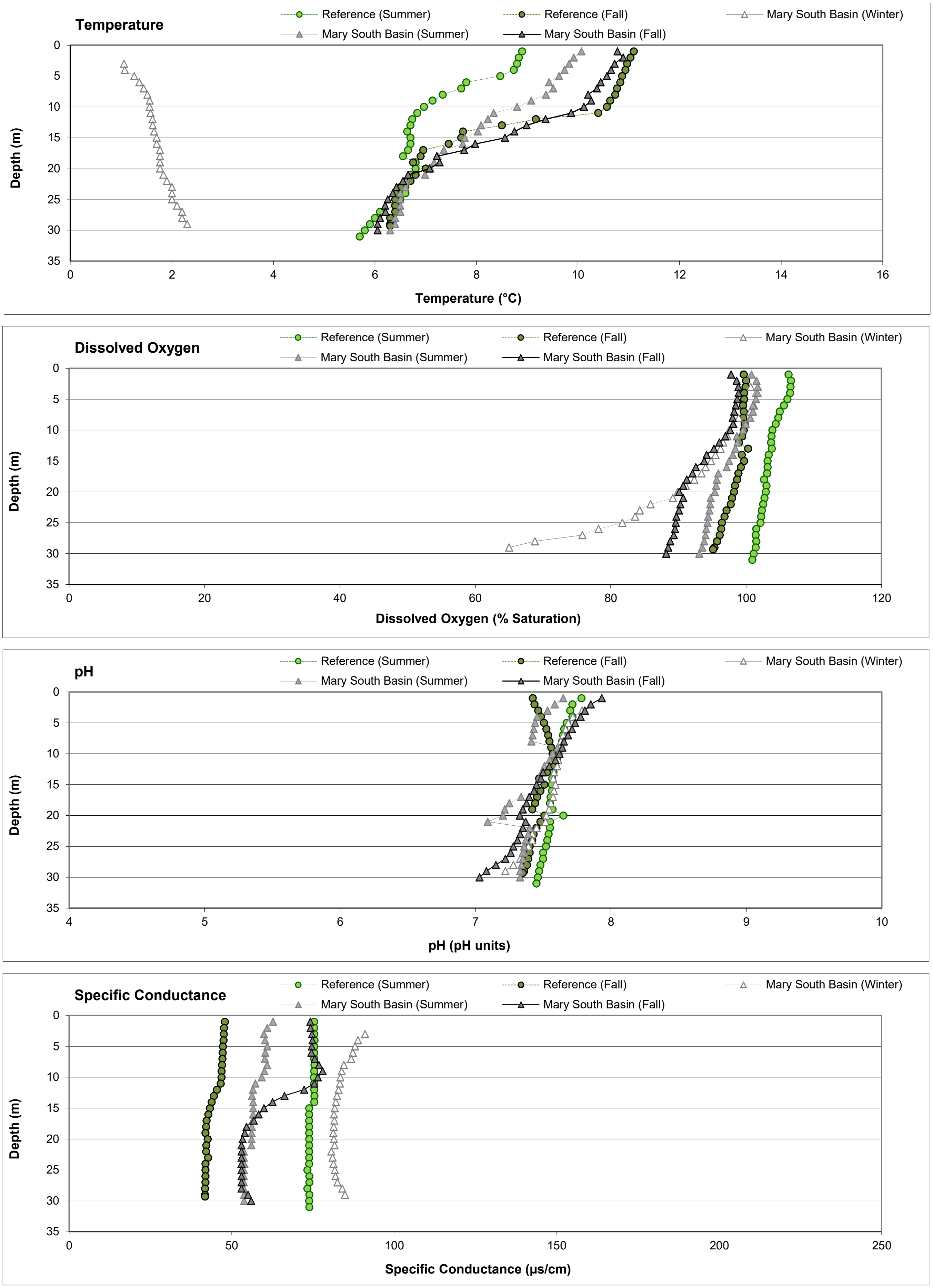


Figure 5.8: Average *in-situ* water quality with depth from surface at the Mary Lake (mine-exposed area) south basin compared to Reference Lake 3 during winter, summer, and fall sampling events, Mary River Project CREMP, 2016.

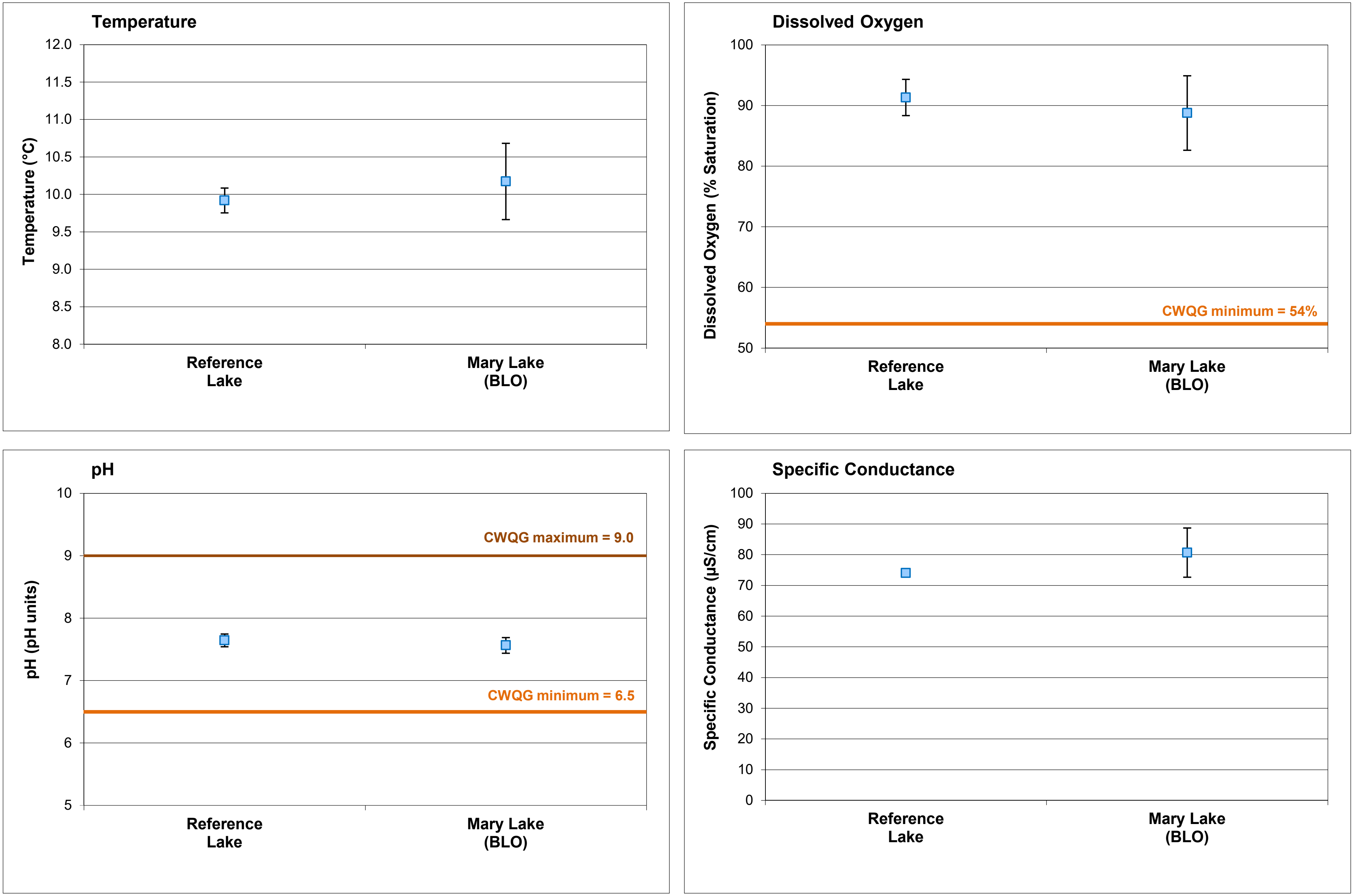


Figure 5.9: Comparison of in-situ water quality variables (mean ± SD; n = 5) measured near the bottom of the water column at Mary Lake (BLO) and Reference Lake 3 (REF3) littoral benthic invertebrate community stations, Mary River Project CREMP, August 2016. An asterisk (*) next to the Mary Lake data point indicates a significant difference compared to the reference lake measure.

from those at Reference Lake 3, during the 2016 fall sampling event (Figure 5.9; Appendix Tables C.22 and C.57).

In-situ profiles of pH showed no substantial change from the surface to bottom of the water column at either the north or south basins of Mary Lake during winter, summer or fall sampling in 2016, and were also comparable to pH profiles at Reference Lake 3 (Figures 5.7 and 5.8). No significant differences in bottom pH were indicated between Mary Lake and Reference Lake 3 at littoral stations sampled in fall 2016 (Figure 5.9; Appendix Table F.57). In addition, pH values at Mary Lake water quality and benthic littoral stations were consistently within WQG limits (Figure 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.25). 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 of the Mary Lake north basin was higher than at Reference Lake 3, but comparable to that of the reference creek stations. However, specific conductance measured at the water column bottom did not differ significantly between Mary Lake and Reference Lake 3 at littoral stations (Figure 5.9; Appendix Table C.57), reflecting the fact that specific conductance at the south basin of Mary Lake was comparable to that of Reference Lake 3 (Figures 5.7 and 5.8). Only minor changes in specific conductance were observed with depth (i.e., ≤20 μS/cm) during the winter, summer and fall sampling events in 2016 at the Mary Lake north and south basins (Figures 5.7 and 5.8). Water clarity, as determined using Secchi depth readings, was significantly lower at Mary Lake compared to Reference Lake 3 in fall 2016 (Appendix Table C.22 and C.57). 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.56).

Water chemistry of the Mary Lake north basin showed slightly (i.e., 3- to 5-fold higher) to moderately elevated (i.e., 5- to 10-fold higher) turbidity and concentrations of total aluminum, total manganese and/or total uranium compared to Reference Lake 3 at the time of summer and fall sampling in 2016 (Table 5.2; Appendix Tables C.58 and C.62). However, of these parameters, only manganese was moderately elevated at the Mary Lake north basin compared to respective mean values for the lotic reference stations, and only during the fall sampling event. In addition, no parameters were above WQG and AEMP benchmarks at the Mary Lake north basin during any of the winter, summer or fall monitoring events in 2016 (Table 5.2; Appendix Table C.58). Furthermore, despite continuously higher concentrations since mine construction (2014) and initial mine operation (2015) periods, average concentrations of the

Table 5.2: Water chemistry at Mary Lake north basin (BLO-01) and south basin (BLO) monitoring stations, Mary River Project CREMP, 2016. Values presented are averages of samples taken from the surface and the bottom of the water column at each station. * Copper data confounded by field sampling equipment.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Reference Lake 3 Average (n = 3)	Tom River I0-01	North Basin (Mine-exposed)			South Basin (Mine-exposed)						
							BL0-01-A	BL0-01	BL0-01-B	BL0-05-A	BL0-05	BL0-05-B	BL0-03	BL0-04	BL0-09	BL0-06
					Fall 2016	19-Aug-2016	21-Aug-2016	21-Aug-2016	21-Aug-2016	23-Aug-2016	23-Aug-2016	23-Aug-2016	24-Aug-2016	23-Aug-2016	23-Aug-2016	23-Aug-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	84	194	162	162	158	86	68	80	70	79	65	77
	pH (lab)	pH	6.5 - 9.0	-	7.68	8.24	8.15	8.13	8.16	7.82	7.77	7.71	7.78	7.85	7.72	7.83
	Hardness (as $CaCO_3$)	mg/L	-	-	35	95	79	78	75	40	32	37	33	36	31	36
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	2.25	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	39	98	90	84	81	45	33	40	39	42	31	38
	Turbidity	NTU	-	-	0.3	0.4	1.3	1.2	1.5	1.7	1.6	1.8	0.7	2.4	1.3	2.0
	Alkalinity (as $CaCO_3$)	mg/L	-	-	33	94	78	80	79	38	29	38	33	35	28	34
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	0.0398	<0.020	0.021	0.057	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.7	1.7	1.8	1.8	1.9	1.2	1.2	1.2	1.3	1.2	1.2	1.2
	Total Organic Carbon	mg/L	-	-	2.8	1.8	2.0	1.8	1.9	1.4	1.3	1.3	1.4	1.5	1.3	1.4
	Total Phosphorus	mg/L	0.020[α]	-	0.010	<0.0030	0.003	0.004	0.003	0.007	0.007	0.010	0.006	0.006	0.008	0.005
	Phenols	mg/L	0.004[α]	-	0.003	0.004	0.003	0.002	0.002	0.011	0.004	0.008	0.003	0.006	0.009	0.008
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	1.27	5.51	3.47	3.39	3.14	1.91	1.42	1.60	1.29	1.61	1.36	1.50
	Sulphate (SO_4)	mg/L	218[β]	218	4.07	1.95	1.43	1.42	1.35	1.33	0.90	1.12	0.84	1.19	0.81	1.11
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.004	0.010	0.026	0.030	0.026	0.078	0.058	0.065	0.023	0.056	0.050	0.059
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	0.00015	<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	-	-	0.0065	0.0098	0.0079	0.0078	0.0082	0.0056	0.0045	0.0053	0.0038	0.0049	0.0040	0.0048
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<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	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	6.99	18.90	15.55	15.40	15.45	8.24	6.48	7.63	6.68	7.52	6.26	7.26
	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	0.00082	0.00099	0.001	0.0011	0.0011	0.00068	0.00064	0.00071	0.00053	*	*	*
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.050	<0.050	<0.050	0.056	0.048	0.052	<0.030	0.050	0.039	0.052
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.00010	<0.00010	<0.00010	0.000067	0.000060	0.000062	<0.000050	0.000067	0.0000555	0.000068
	Lithium (Li)	mg/L	-	-	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.3	11.4	8.7	8.7	8.5	4.8	3.8	4.4	4.0	4.4	3.7	4.3
	Manganese (Mn)	mg/L	0.935[β]	-	0.00062	0.00032	0.00507	0.00520	0.00476	0.00158	0.00286	0.00140	0.00115	0.00163	0.00139	0.00155
	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	-	0.00014	0.00024	0.00022	0.00022	0.00021	0.00016	0.00012	0.00014	0.00009	0.00014	0.00011	0.00013
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	0.00052	0.00054	0.00055	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.89	1.04	0.88	0.88	0.87	0.68	0.57	0.63	0.51	0.63	0.54	0.62
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.000050	<0.000050	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.42	0.86	0.81	0.81	0.84	0.68	0.57	0.64	0.54	0.63	0.53	0.62
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.84	3.20	2.03	2.00	1.94	1.24	0.96	1.11	0.89	1.09	0.90	1.05
	Strontium (Sr)	mg/L	-	-	0.0081	0.0130	0.0111	0.0111	0.0110	0.0071	0.0054	0.0064	0.0050	0.0063	0.0051	0.0061
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.000010	<0.000010	<0.000010	<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	0.0009	0.0011	0.0009	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.00027	0.00253	0.00163	0.00157	0.00151	0.00085	0.00050	0.00069	0.00043	0.00068	0.00044	0.00063
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

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

BOLD Indicates parameter concentration above the AEMP benchmark.

majority of parameters at the Mary Lake north basin in 2016 were comparable to, and often lower than, concentrations observed during the mine baseline (2005 – 2013) period (Figure 5.10; Appendix Table C.62 and Figure C.26). This suggested that, similar to Mary River, elevated aluminum, manganese and uranium concentrations at the Mary Lake north basin compared to Reference Lake 3 most likely reflected naturally high turbidity and specifically, particulate-bound metals, as opposed to potential mine-related influences on water chemistry.

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 2016 (Table 5.2; Appendix Table C.59), suggesting that the south basin waters were generally well mixed both laterally and vertically. On average, turbidity was moderately elevated (i.e., 5- to 10-fold higher), and aluminum, copper and manganese concentrations moderately to highly elevated (i.e., ≥10-fold higher), at the Mary Lake south basin compared to Reference Lake 3 during the 2016 summer and/or fall sampling events (Table 5.2; Appendix Tables C.59 and C.62). Similar to water chemistry of the Mary River and Sheardown Lake SE water bodies, aluminum, manganese and iron concentrations showed a strong positive correlation with turbidity for the Mary Lake south basin combined data set (i.e., winter, summer and fall data; $r^2 \geq 0.70$), suggesting that much of the aqueous aluminum and manganese was associated with suspended particles (e.g., aluminosilicates). As indicated previously, high turbidity in the Mary River originated from natural sources upstream of the mine and accordingly, relatively high turbidity at Mary Lake was therefore not associated with the mine operations. Despite elevation of these metals at the south basin of Mary Lake relative to Reference Lake 3, concentrations of all parameters were generally well below established WQG and AEMP benchmarks during all 2016 sampling events[13] at the time of the fall sampling event (Table 5.2; Appendix Table C.59).

Temporal comparisons of the Mary Lake south basin water chemistry data suggested no changes in average concentrations of mine-related parameters in 2016 compared to the baseline (2005 – 2013) period except for aluminum and turbidity (Figure 5.10; Appendix Figure C.26). Although higher turbidity and concentrations of aluminum were observed at stations most distant to the Tom and Mary rivers inlets to Mary Lake in 2016 compared to baseline conditions, parameter levels closer to these river inlets (i.e., BLO-01 and BLO-05/-03, respectively) were comparable between 2016 and the baseline period (Figure 5.10; Appendix Figure C.26). Therefore, the source of turbidity and aluminum to the Mary Lake south basin in

[13] Refer to footnote 2 (page 23) and Appendix B regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA waterbodies.

Figure 5.10: Temporal comparison of water chemistry at Mary Lake (BLO) for mine baseline (2005 - 2013), construction (2014), and operational (2015, 2016) periods during fall. 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.

fall 2016 was unclear, but did not appear to be related to discharge from the Tom or Mary rivers. Parameter concentrations at the Mary River south basin in 2016 were similar to those in years of mine construction (2014) and initial mine operation (2015; Figure 5.10; Appendix Figure C.26). The general lack of temporal differences in water quality of the Mary Lake south basin over time provided additional support that elevated aluminum concentrations at the south basin relative to Reference Lake 3 were related to naturally higher turbidity at Mary Lake rather than a mine influence on lake water quality.

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, sediment of the littoral and profundal stations was characterized by silt loam and silty clay loam material with low TOC content (Figure 5.11). Silt was the predominant particle size among littoral stations of both Mary Lake and Reference Lake 3, with no significant difference in silt content indicated between lakes (Appendix Table D.25). However, sediment sand and TOC content was significantly lower at littoral stations of Mary Lake compared to the reference lake. Substrate containing visible iron (oxy)hydroxide material was not observed at the Mary Lake north or south basins in 2016 (Appendix Tables D.22 – D.24), which contrasted with that of 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 often contained sub-surface blackening/dark colouration which occasionally occurred as bands/layers indicating the presence of reduced sediment demarcated by distinct redox boundaries in some cases (Appendix Tables D.22 – D.24). Similar sub-surface reducing conditions were observed in sediment of the reference lake, though no distinct redox boundaries were visible (Appendix Tables D.22 – D.24).

Sediment metal concentrations at the Mary Lake north basin were similar to those observed at littoral stations of Reference Lake 3, with only manganese showing slight elevation in concentration at the Mary Lake north basin station (Table 5.3; Appendix Table D.26). Sediment metal concentrations at the Mary Lake south basin showed no spatial gradients with progression from the Mary River inlet to the lake outlet for either the littoral or profundal stations, suggesting that the Mary River was not contributing disproportionate concentrations of metals (Appendix Table D.26). Sediment metal concentrations at the Mary Lake south basin littoral and profundal sediment monitoring stations were comparable to average metal concentrations at like-depth stations of the reference lake (Table 5.3; Appendix Table D.27). Of those metals with established SQG, only manganese was above the applicable guidelines at the north basin littoral station, and on average, at the south basin littoral stations of Mary

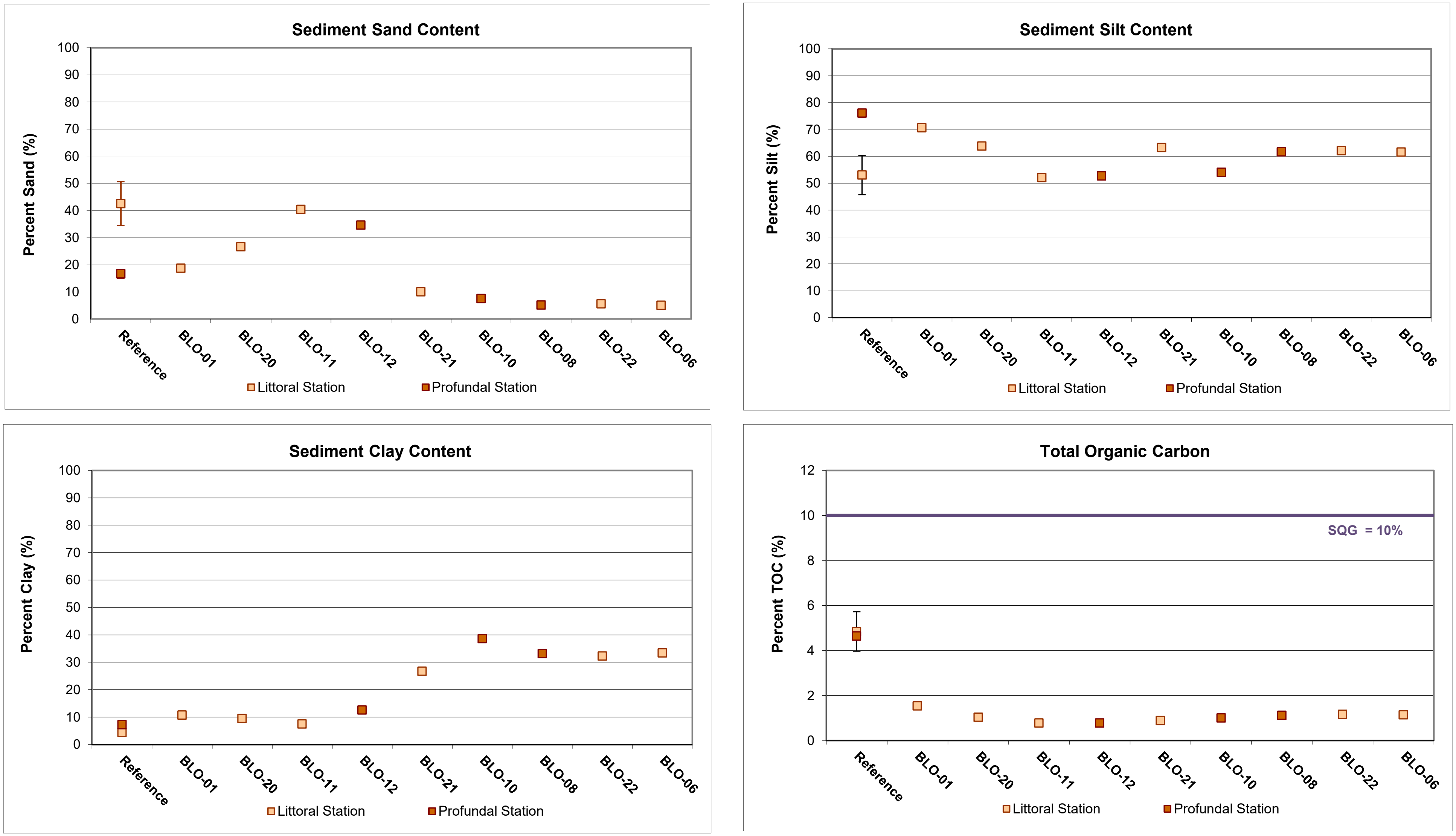


Figure 5.11: Sediment particle size and total organic carbon (TOC) content comparisons among Mary Lake (BLO) north and south basin sediment monitoring stations and to Reference Lake 3 averages (mean ± SE), Mary River Project CREMP, August 2016.

Table 5.3: Sediment particle size, total organic carbon, and metal concentrations at Mary Lake north basin (BLO-01), Mary Lake south basin (BLO), and Reference Lake 3 (REF3) sediment monitoring stations, Mary River Project CREMP, August 2016.

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Littoral			Profundal	
					Reference Lake (n = 5)	Mary Lake (North Basin) (n = 1)	Mary Lake (South Basin) (n = 5)	Reference Lake (n = 5)	Mary Lake (South Basin) (n = 3)
					Average ± Std. Error	Average	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error
Non-metals	Sand	%	-	-	42.5 ± 8.1	18.7	17.5 ± 6.3	16.7 ± 1.5	15.7 ± 9.5
	Silt	%	-	-	53.1 ± 7.3	70.6	60.6 ± 2.0	76.1 ± 1.4	56.1 ± 2.8
	Clay	%	-	-	4.4 ± 1.0	10.7	21.9 ± 5.1	7.2 ± 0.4	28.1 ± 7.9
	Moisture	%	-	-	89.7 ± 6.0	55.9	50.0 ± 3.4	83.5 ± 5.4	54.3 ± 7.7
	Total Organic Carbon	%	10^{α}	-	4.85 ± 0.88	1.54	1.00 ± 0.07	4.64 ± 0.13	0.97 ± 0.10
Metals	Aluminum (Al)	mg/kg	-	-	16,480 ± 397	14,700	20,260 ± 2,189	25,150 ± 1,418	21,533 ± 3,481
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	<0.10	<0.10 ± 0	0.12 ± 0.02	<0.10 ± 0
	Arsenic (As)	mg/kg	17	5.9	3.71 ± 0.26	5.54	3.37 ± 0.34	***6.47* ± 0.27**	3.49 ± 0.40
	Barium (Ba)	mg/kg	-	-	112 ± 11	87	88 ± 11	162 ± 8	89 ± 16
	Beryllium (Be)	mg/kg	-	-	0.67 ± 0.02	0.76	1.02 ± 0.13	1.02 ± 0.05	1.07 ± 0.19
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0	<0.20	0.23 ± 0.01	0.21 ± 0.004	0.24 ± 0.02
	Boron (B)	mg/kg	-	-	13.0 ± 0.9	21.6	27.9 ± 3.2	19.2 ± 1.0	29.5 ± 5.4
	Cadmium (Cd)	mg/kg	3.5	1.5	0.146 ± 0.035	0.100	0.120 ± 0.017	0.180 ± 0.010	0.128 ± 0.023
	Calcium (Ca)	mg/kg	-	-	5,128 ± 470	9,700	5,176 ± 593	6,111 ± 156	4,603 ± 173
	Chromium (Cr)	mg/kg	90	98	55.0 ± 1.2	61.7	76.2 ± 5.3	80.0 ± 4.1	80.7 ± 10.1
	Cobalt (Co)	mg/kg	-	-	10.15 ± 0.57	13.90	14.76 ± 1.32	18.15 ± 0.75	15.33 ± 1.93
	Copper (Cu)	mg/kg	110	50	***66.5* ± 7.4**	27.5	28.5 ± 2.7	***101.4* ± 5.6**	30.0 ± 4.7
	Iron (Fe)	mg/kg	$40,000^{\alpha}$	52,400	29,840 ± 3,488	34,400	35,750 ± 2,763	***53,580* ± 2,174**	36,400 ± 4,339
	Lead (Pb)	mg/kg	91.3	35	***46.0* ± 17.4**	16.3	23.1 ± 3.6	29.5 ± 5.0	24.7 ± 3.7
	Lithium (Li)	mg/kg	-	-	27.3 ± 0.4	29.9	39.2 ± 4.5	41.7 ± 2.1	39.6 ± 6.2
	Magnesium (Mg)	mg/kg	-	-	10,852 ± 274	14,600	14,500 ± 1,000	16,160 ± 814	14,633 ± 1,822
	Manganese (Mn)	mg/kg	$1,100^{\alpha,\beta}$	4,370	496 ± 99	1,790	1,670 ± 845	1,866 ± 449	1,047 ± 158
	Mercury (Hg)	mg/kg	0.486	0.17	0.0355 ± 0.0063	0.0275	0.0403 ± 0.0071	0.0699 ± 0.0019	0.0516 ± 0.0126
	Molybdenum (Mo)	mg/kg	-	-	2.19 ± 0.49	0.58	0.87 ± 0.16	3.27 ± 0.34	0.94 ± 0.11
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	72	38.6 ± 1.6	53.2	55.5 ± 3.2	56.3 ± 2.6	59.9 ± 5.4
	Phosphorus (P)	mg/kg	$2,000^{\alpha}$	1,580	840 ± 47	1,110	881 ± 38	1,121 ± 57	865 ± 51
	Potassium (K)	mg/kg	-	-	3,894 ± 172	3,400	4,921 ± 607	5,891 ± 281	5,210 ± 924
	Selenium (Se)	mg/kg	-	-	0.49 ± 0.06	<0.20	0.21 ± 0.01	0.85 ± 0.06	0.23 ± 0.01
	Silver (Ag)	mg/kg	-	-	0.12 ± 0.01	<0.10	0.12 ± 0.01	0.27 ± 0.01	0.13 ± 0.02
	Sodium (Na)	mg/kg	-	-	296 ± 29	239	310 ± 33	455 ± 24	331 ± 53
	Strontium (Sr)	mg/kg	-	-	11.4 ± 0.5	13.8	13.0 ± 1.0	15.8 ± 0.6	13.5 ± 1.8
	Sulphur (S)	mg/kg	-	-	<5,000 ± 0	<5,000	<5,000 ± 0	<5,000 ± 0	<5,000 ± 0
	Thallium (Tl)	mg/kg	-	-	0.388 ± 0.021	0.331	0.491 ± 0.063	0.801 ± 0.035	0.504 ± 0.088
	Tin (Sn)	mg/kg	-	-	56.3 ± 28.9	4.1	6.9 ± 3.1	16.3 ± 7.8	8.3 ± 1.1
	Titanium (Ti)	mg/kg	-	-	1072 ± 36	965	1414 ± 94	1331 ± 69	1407 ± 159
	Uranium (U)	mg/kg	-	-	11.9 ± 1.52	3.78	7.63 ± 1.00	27.3 ± 1.52	8.58 ± 1.77
	Vanadium (V)	mg/kg	-	-	50.0 ± 1.3	46.8	57.0 ± 5.3	72.0 ± 3.6	58.8 ± 8.3
	Zinc (Zn)	mg/kg	315	135	73.7 ± 2.7	49.8	68.6 ± 7.0	105 ± 5.1	70.0 ± 10.6
	Zirconium (Zr)	mg/kg	-	-	4.3 ± 0.6	9.3	19.4 ± 1.9	4.0 ± 0.2	20.2 ± 3.2

[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.

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

BOLD Indicates parameter concentration above the AEMP Benchmark.

Lake in 2016 (Table 5.3; Appendix Table D.26). Although sediment chromium and iron concentrations were above respective SQG at some individual littoral and profundal stations of the Mary Lake south basin, average concentrations of these metals were below the applicable guidelines (Table 5.3; Appendix Table D.26). Notably, concentrations of manganese (and iron) were elevated above SQG in sediment at the reference lake profundal stations, suggesting that concentrations of manganese above guidelines at Mary Lake may reflect natural conditions un-related to mine activity. No metals were observed at concentrations above the sediment AEMP benchmarks at littoral and profundal stations of the Mary Lake north or south basins (Table 5.3; Appendix Table D.26).

Temporal comparisons of the sediment metals data suggested only a slight elevation (i.e., 2- to 5-fold higher) in manganese concentrations at Mary Lake littoral stations, but similar metal concentrations at Mary Lake profundal stations, between 2016 and the baseline period[14] (Figure 5.12; Appendix Table D.27). With the exception of sediment manganese concentrations at littoral stations of Mary Lake, no metals showed progressively higher concentrations from mine baseline, to mine construction, to 2015 and 2016 mine operational years in sediment of Mary Lake littoral or profundal stations (Figure 5.12). Similar to the other mine-exposed lakes, slight variation in station locations and/or data treatment among studies likely contributed to the appearance of higher average manganese concentrations in sediment at the Mary Lake littoral stations in 2015 and 2016 compared to the mine baseline/construction periods. In addition, concentrations of all metals at Mary Lake sediment stations, including manganese, were comparable to those of the reference lake littoral and/or profundal sediment stations (Figure 5.12), suggesting no mine influence on sediment metal chemistry of Mary Lake since the onset of Mary River Project mine operations.

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 2016 (Figure 5.13). Similar to the other mine-exposed lakes, chlorophyll a concentrations generally showed significant differences among winter, summer and fall sampling events at both the north and south basins of Mary Lake in 2016 (Appendix Table E.4). Highest and lowest concentrations of chlorophyll a were observed in summer and winter, respectively, at both Mary Lake basins (Appendix Table E.14), and mirrored the summer and fall seasonal differences observed at the reference lake (Appendix Table B.8). Although chlorophyll a concentrations at the Mary Lake north basin were

[14] Refer to footnote 6 (page 32) regarding temporal differences in sediment boron concentrations at Mary River Project LSA waterbodies.

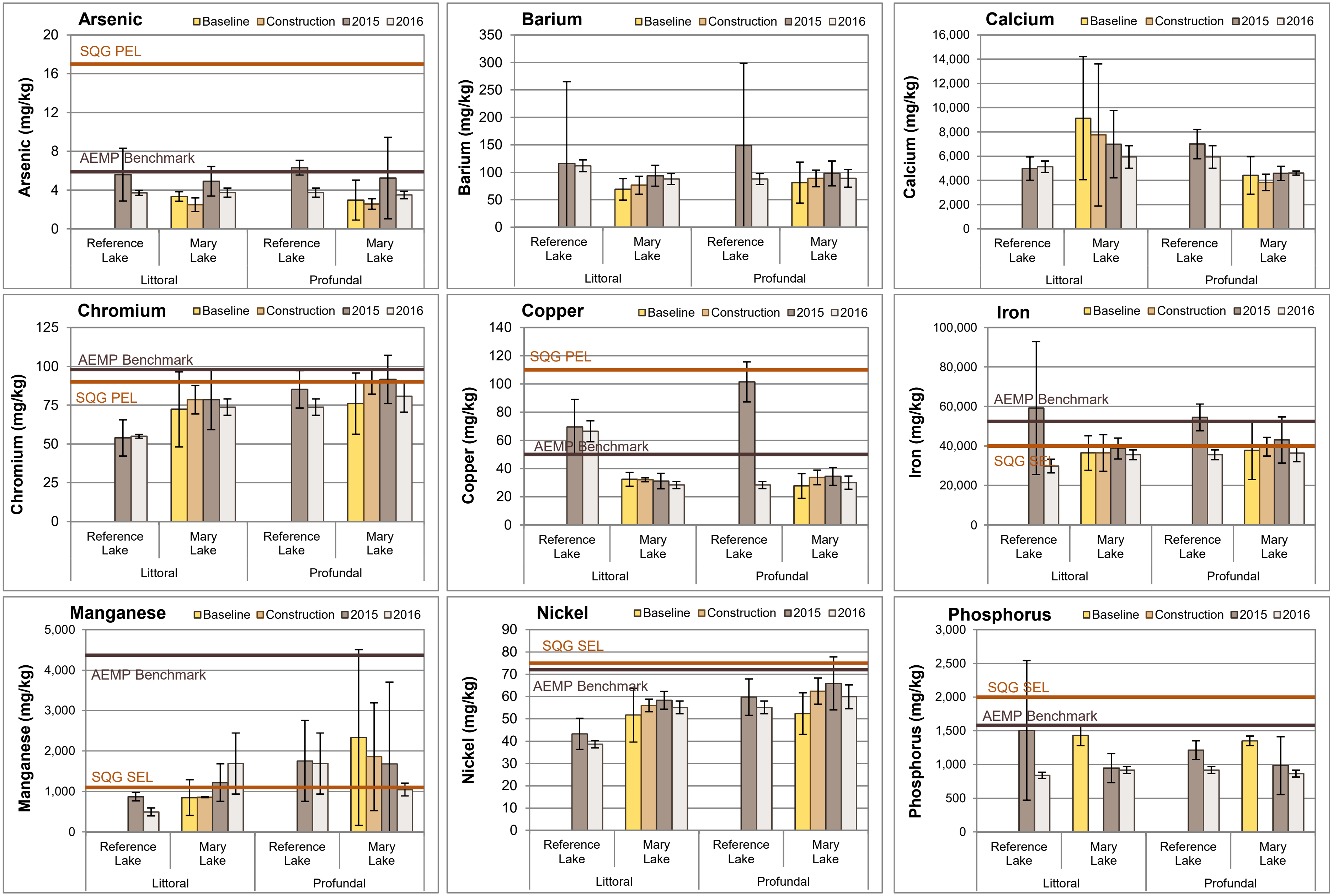


Figure 5.12: Temporal comparison of sediment metal concentrations (mean ± SD) at littoral and profundal stations of Mary Lake and Reference Lake 3 for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods, Mary River Project CREMP.

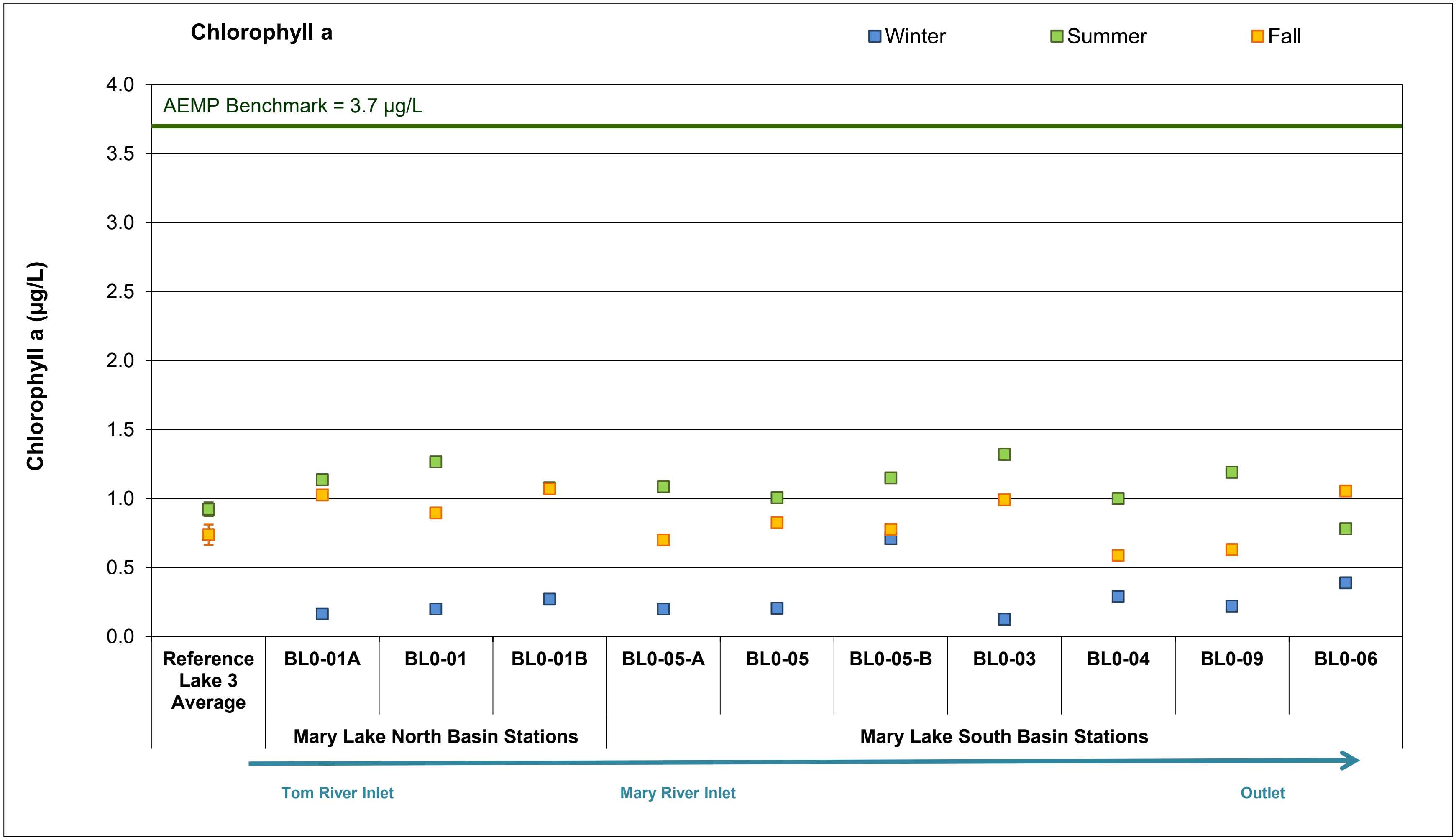


Figure 5.13: Chlorophyll a concentrations at Mary Lake (BLO) phytoplankton monitoring stations, Mary River Project CREMP, 2016. Values presented are averages of samples taken from the surface and the bottom of the water column at each station. Reference values represent mean ± standard deviation (n = 3). Reference Lake 3 was not sampled in winter 2016.

significantly higher than at the reference lake, concentrations did not differ significantly between the Mary Lake south basin and Reference Lake 3 for both the summer and fall sampling events in 2016 (Appendix Tables E.5 and E.6). The Mary Lake chlorophyll a concentrations were well below the AEMP benchmark of 3.7 µg/L during all winter, summer and fall sampling events in 2016 (Figure 5.13). Chlorophyll a concentrations at Mary Lake reflected an 'oligotrophic' primary productivity categorization (sensu Wetzel 2001), which agreed closely with an 'oligotrophic' CWQG categorization based on mean aqueous total phosphorus concentrations between 4 – 10 µg/L for the Mary Lake winter, summer and fall sampling events in 2016 (Table 5.2; Appendix Tables C.58 – C.59).

Temporal comparisons of the Mary Lake chlorophyll a data did not indicate any significant differences among the mine construction (2014) and operational (2015, 2016) yearly data that were consistent over the winter, summer or fall seasons with the exception of significantly higher concentrations in fall 2016 than in fall 2014 (Figure 5.14; Appendix Tables E.14 and E.15). In addition, annual average chlorophyll a concentrations did not differ significantly among 2014, 2015 and 2016 (Appendix Tables E.15 and E.16), suggesting no changes in the trophic status of Mary Lake since mine operations commenced at the Mary River Project. No chlorophyll a baseline (2005 – 2013) data are available for Mary Lake, precluding comparisons to conditions prior to the mine construction period.

5.2.4 Benthic Invertebrate Community

Benthic invertebrate community richness was significantly lower at Mary Lake compared to Reference Lake 3, but density and Simpson's Evenness did not differ significantly between lakes for littoral station samples collected in 2016 (Table 5.4). Although differences in benthic invertebrate community structure were indicated between Mary Lake and Reference Lake 3 based on significantly differing Bray-Curtis Index, only the relative abundance of dominant taxonomic groups differed significantly between lakes and not the proportion of key FFG and HPG (Table 5.4). Similar to the other mine-exposed lakes, significantly lower and higher relative abundance of seed shrimp and chironomids, respectively, at Mary Lake compared to the reference lake potentially reflected lower sediment TOC content, higher proportion of fine-grained sediments and/or more compact sediment (i.e., lower moisture content) at the Mary Lake littoral stations (Appendix Table D.25). Because the relative abundance of metal-sensitive Chironomidae did not differ significantly between Mary Lake and Reference Lake 3 (Table 5.4), the difference in benthic invertebrate community structure between lakes did not appear to be associated with an ecological response to aqueous and/or sediment metal concentrations.

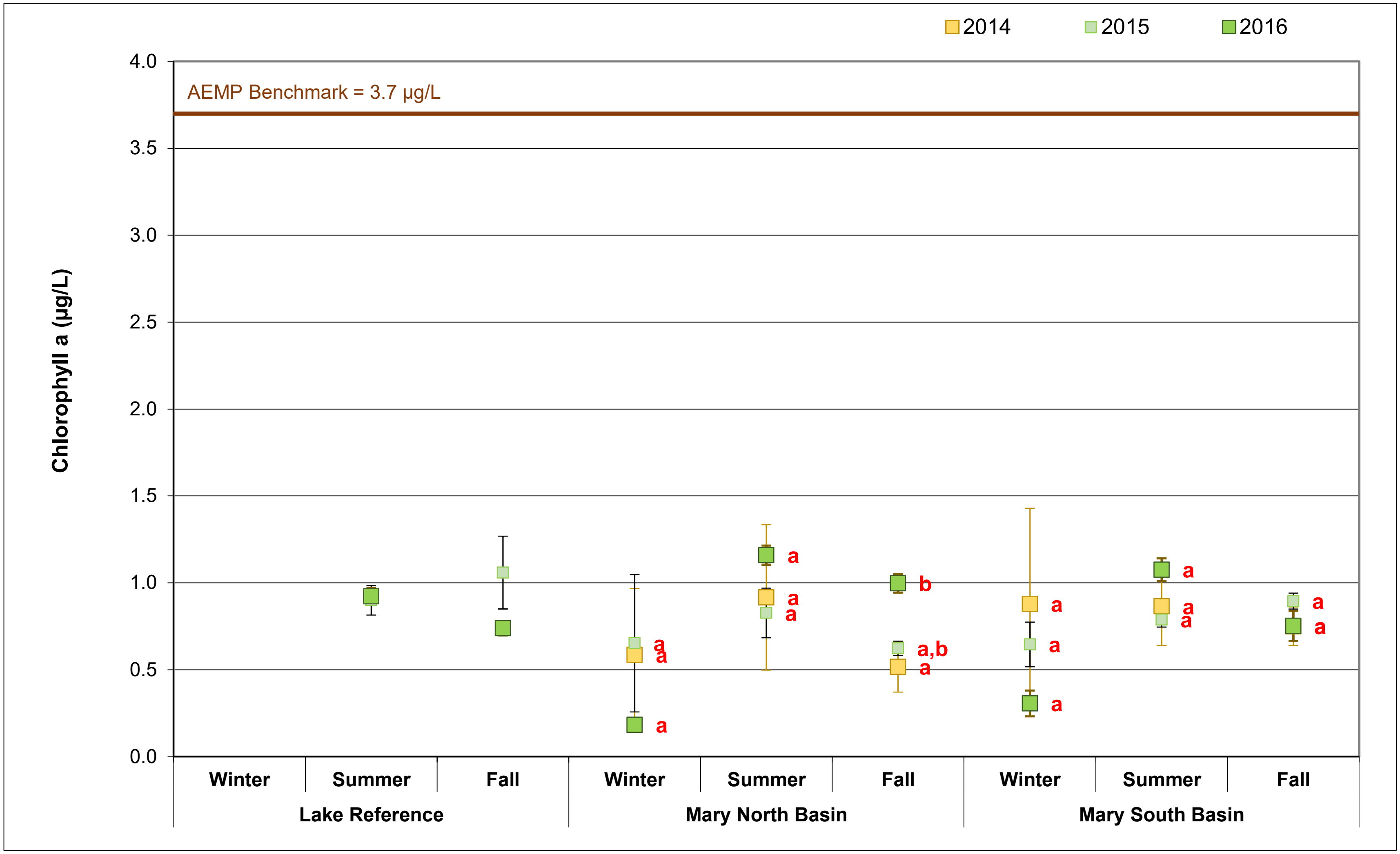


Figure 5.14: Chlorophyll a concentration seasonal comparison among 2014, 2015 and 2016 years (mean ± SE) at Mary Lake phytoplankton monitoring stations, Mary River Project CREMP. Data points with the same letter on the right do not differ significantly between years for the applicable season.

Table 5.4: Benthic invertebrate community statistical comparison results between Mary Lake (BLO) and Reference Lake 3 littoral stations, Mary River Project CREMP, August 2016.

Metric	Statistical Test Results					Summary Statistics					
	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Power	Magnitude of Difference [b] (No. of SD)	Area	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	No	0.483	ι, δ, γ	-	-	Reference Lake 3	2,390	1,396	624	897	4,240
						Mary Lake Littoral	1,947	1,591	649	457	4,036
Richness (Number of Taxa)	Yes	<0.001	ι, δ, γ	1.000	-3.2	Reference Lake 3	12.2	1.1	0.5	11.0	14.0
						Mary Lake Littoral	8.7	0.5	0.2	8.0	9.0
Simpson's (E) Krebs	No	0.249	γ	-	-	Reference Lake 3	0.758	0.189	0.084	0.420	0.849
						Mary Lake Littoral	0.574	0.299	0.122	0.249	0.958
Bray-Curtis Index	Yes	0.000	α, δ, γ	1.000	4.0	Reference Lake 3	0.334	0.122	0.054	0.245	0.527
						Mary Lake Littoral	0.820	0.093	0.038	0.642	0.902
Nemata (%)	No	0.670	β, δ, γ	-	-	Reference Lake 3	4.0%	5.6%	2.5%	0.0%	13.5%
						Mary Lake Littoral	3.6%	7.5%	3.1%	0.0%	18.8%
Hydracarina (%)	No	0.382	β, δ, γ	-	-	Reference Lake 3	3.6%	2.0%	0.9%	1.8%	6.7%
						Mary Lake Littoral	3.3%	4.2%	1.7%	0.7%	11.4%
Ostracoda (%)	Yes	0.004	β, ε, γ	0.982	-2.6	Reference Lake 3	46.9%	17.5%	7.8%	37.8%	78.0%
						Mary Lake Littoral	2.3%	2.2%	0.9%	0.0%	5.0%
Chironomidae (%)	Yes	0.002	β, δ, γ	0.992	2.4	Reference Lake 3	45.4%	18.8%	8.4%	15.4%	59.2%
						Mary Lake Littoral	90.6%	12.2%	5.0%	66.1%	99.1%
Metal-Sensitive Chironomidae (%)	No	1.000	γ	-	-	Reference Lake 3	19.3%	8.3%	3.7%	7.7%	28.1%
						Mary Lake Littoral	19.2%	13.3%	5.4%	1.7%	33.9%
Collector-Gatherers (%)	No	0.865	β, δ, γ	-	-	Reference Lake 3	75.0%	11.4%	5.1%	61.1%	89.7%
						Mary Lake Littoral	73.5%	24.7%	10.1%	28.2%	94.9%
Filterers (%)	No	0.246	β, ε, γ	-	-	Reference Lake 3	16.1%	8.4%	3.8%	7.0%	26.4%
						Mary Lake Littoral	12.4%	13.2%	5.4%	0.0%	31.6%
Clingers (%)	No	0.457	β, δ, γ	-	-	Reference Lake 3	19.2%	7.6%	3.4%	8.8%	28.3%
						Mary Lake Littoral	16.5%	13.1%	5.3%	1.7%	37.4%
Sprawlers (%)	No	0.855	β, δ, γ	-	-	Reference Lake 3	65.7%	12.1%	5.4%	57.2%	85.7%
						Mary Lake Littoral	64.8%	32.9%	13.4%	8.0%	97.4%
Burrowers (%)	No	0.581	β, δ, γ	-	-	Reference Lake 3	15.1%	6.2%	2.8%	5.5%	22.2%
						Mary Lake Littoral	18.7%	21.4%	8.7%	0.9%	54.6%

[a] Data analysis included: α - data untransformed; β - data logit transformed; ι - $\log_{10}$ transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Mann Whitney U-test.

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

[shaded box] Highlighted values indicate significant differences between study areas based on ANOVA p-value less than 0.10 that were also outside of a Critical Effect Size of ±2 SD, suggesting an ecologically meaningful difference.

BOLD Bold text values indicate significant differences between study areas based on ANOVA p-value less than 0.10, but a Critical Effect Size within ±2 SD, suggesting the difference is not ecologically meaningful.

Temporal comparisons of the Mary Lake benthic invertebrate community data did not indicate any significant differences in density, richness, Simpson's Evenness and the relative abundance of dominant taxonomic groups and FFG among data collected in 2015 and 2016 mine operational years and in 2007 prior to mine operation (i.e., baseline; Figure 5.15; Appendix Table F.44). The close similarity in benthic invertebrate community endpoints among years was consistent with the relatively minor changes in water and sediment chemistry observed at Mary Lake between the mine operational and baseline periods (Sections 5.2.1 and 5.2.2). Moreover, no mine-related influence on lotic benthic invertebrate communities was apparent within the Mary River downstream of the mine, suggesting a low potential for mine-related effects to biota of Mary Lake. The benthic invertebrate community at littoral stations of Mary Lake showed consistently lower and higher relative abundance of seed shrimp and chironomids, respectively, compared to the reference lake in both 2015 and 2016, but no consistent differences in richness and Simpson's Evenness, and no differences entirely for density, FFG and HPG endpoints (Appendix Table F.44). This suggested that factors contributing to differences in benthic invertebrate community structure between Mary Lake and Reference Lake 3 remained relatively unchanged over the 2015 to 2016 studies.

5.2.5 Fish Population

5.2.5.1 Mary Lake (South) Fish Community

Arctic charr and ninespine stickleback comprised the fish community of Mary Lake, mirroring the fish species composition observed at Reference Lake 3 (Table 5.5). Similar to the other mine-exposed lakes, Arctic charr CPUE was much higher at Mary Lake than at the reference lake for electrofishing and gill netting collection methods, 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 secondary productivity was higher at Mary Lake than at Reference Lake 3.

Temporal comparison of the Mary Lake electrofishing catch data indicated that Arctic charr CPUE was much higher in 2016 and other years of mine construction/operation than during baseline monitoring conducted in 2008 (Figure 5.16). Similar to other mine-exposed lakes, Arctic charr CPUE for gill net collections was markedly higher in 2016 compared to all previous baseline (2007 – 2008), mine construction (2014) and mine operational (2015) studies (Figure 5.15), reflecting efficiencies in sampling relative to previous studies. Overall, the CPUE data were not indicative of temporal changes in the relative abundance of Arctic charr at the nearshore or littoral/profundal areas of Mary Lake.

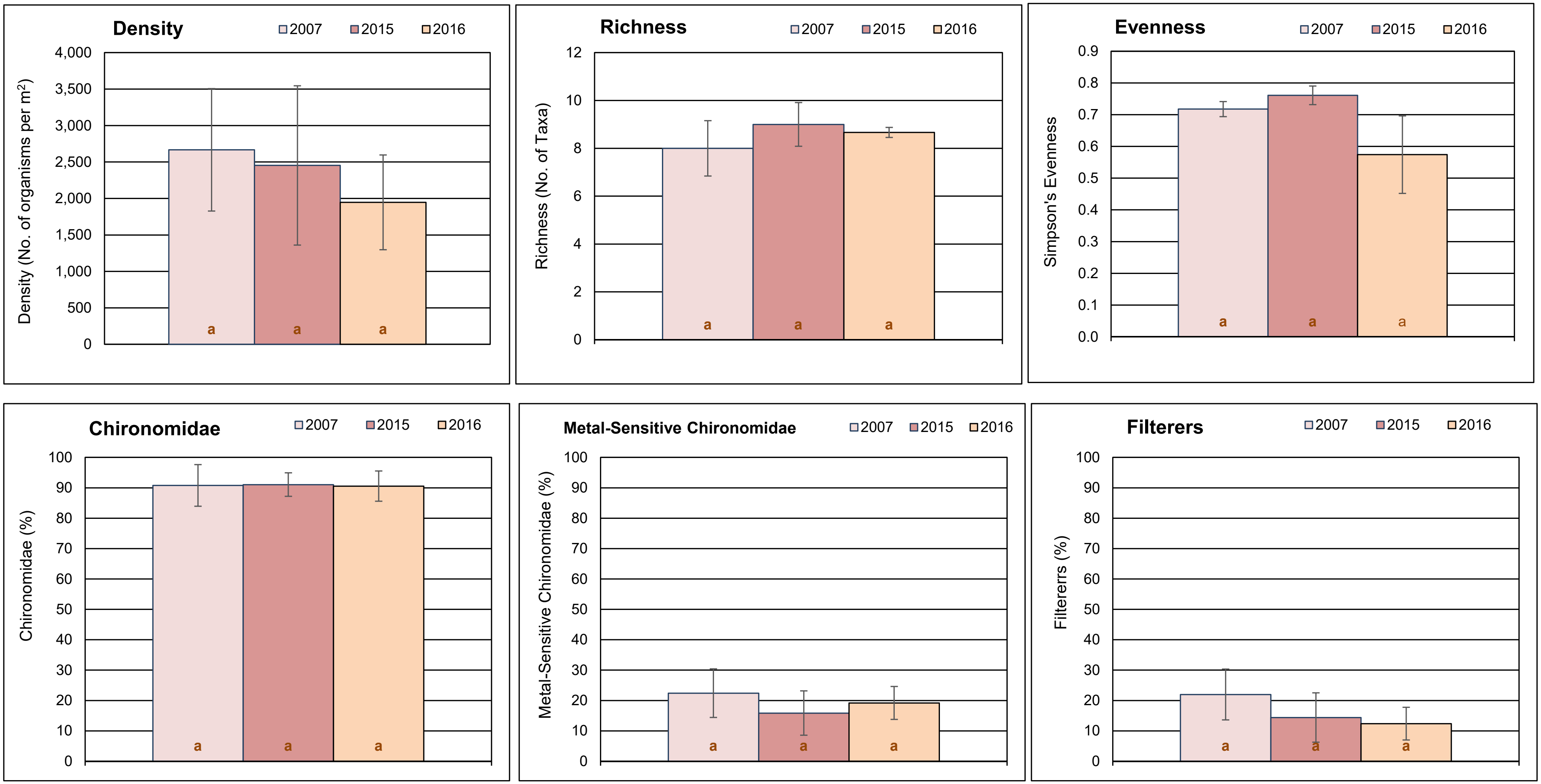
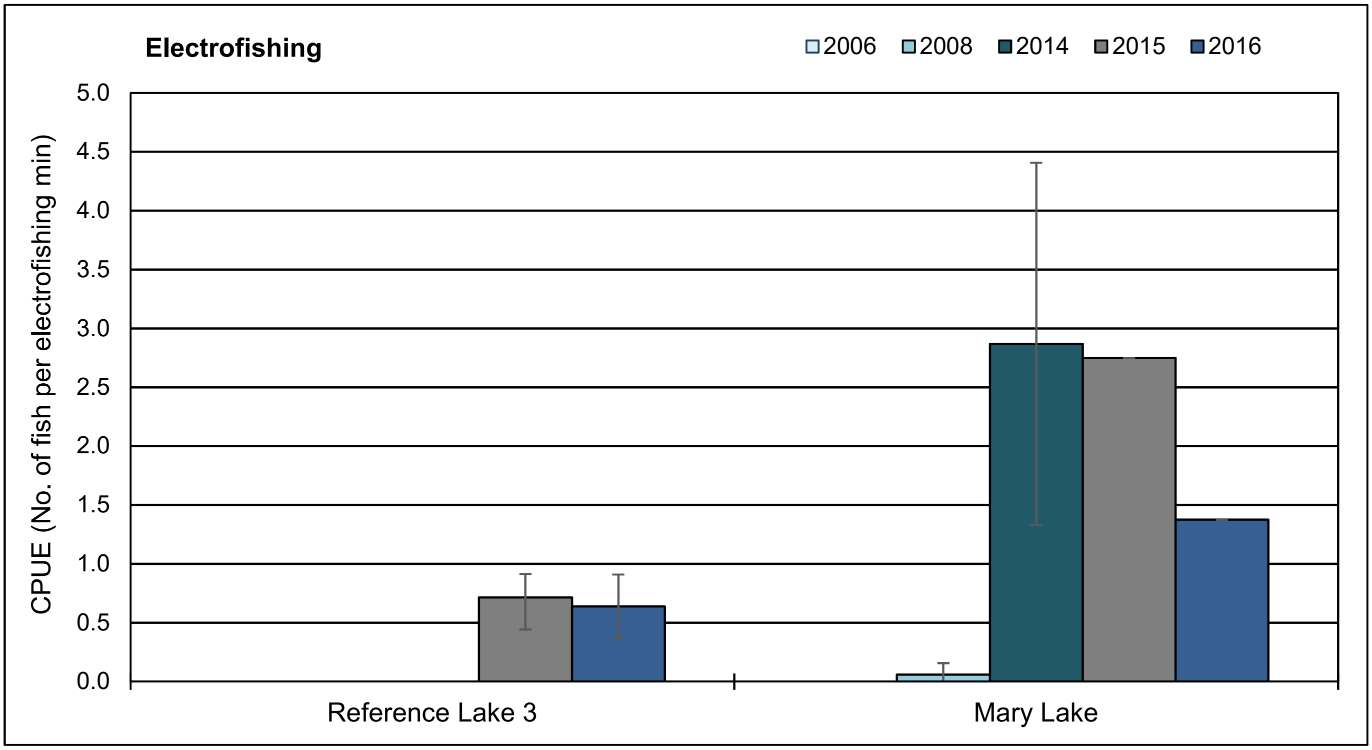


Figure 5.15: Comparison of key benthic invertebrate metrics (mean ± SE) at Mary Lake littoral stations between mine baseline (2007) and operational (2015, 2016) periods, Mary River Project CREMP, 2016. The same like-coloured letter inside bars indicate no significant difference between areas.

Table 5.5: 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 2016.

Lake	Method [a]		Arctic Charr	Nine-spine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	101	28	129	2
		CPUE	0.48	0.16	0.64	
	Gill netting	No. Caught	14	0	14	
		CPUE	0.15	0	0.15	
Mary Lake	Electrofishing	No. Caught	107	1	108	2
		CPUE	1.36	0.01	1.38	
	Gill netting	No. Caught	97	0	97	
		CPUE	5.31	0	5.31	

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



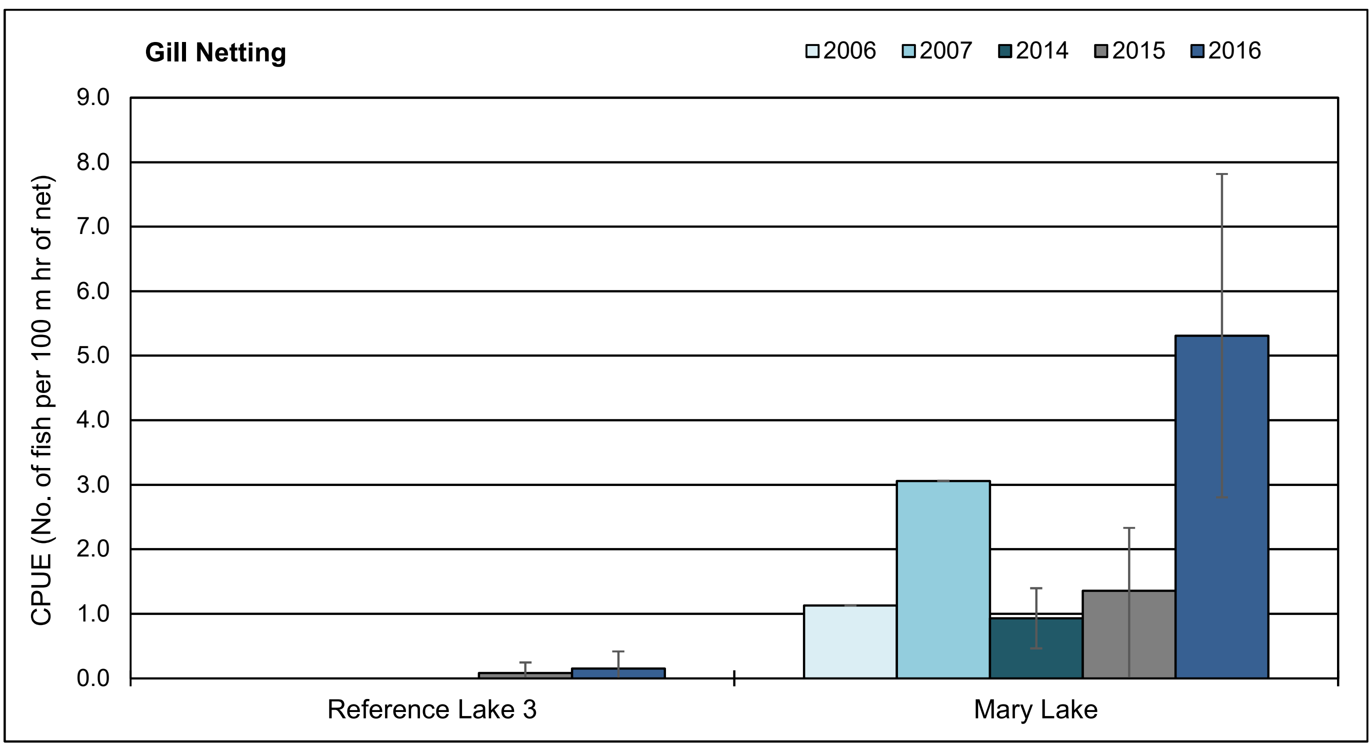


Figure 5.16: Catch-per-unit-effort (CPUE; mean ± SD) of Arctic charr captured by backpack electrofishing and gill netting at Mary Lake (BLO) for baseline (2006, 2007, 2008), mine construction (2014) and operational (2015, 2016) periods during the fall, Mary River Project CREMP.

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 with a control-impact analysis using data collected from Mary Lake and Reference Lake 3 in 2016. 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 captured at nearshore habitat at each of Mary Lake and Reference Lake 3 in August 2016 were used for the control-impact analysis. Distinction of Arctic charr YOY from the older, non-YOY age class was possible using a fork length cut-off of 4.9 and 5.1 cm based on the evaluation of length-frequency distributions coupled with supporting age determinations for the Mary Lake and Reference Lake 3 data sets, respectively (Figure 5.17). Due to a low number of Arctic charr YOY captured at the Mary Lake nearshore (i.e., 5), fish health comparisons were conducted using only non-YOY individuals, where applicable, to limit confounding influences of naturally differing weight-at-length relationships between YOY and non-YOY individuals on the data interpretation.

Nearshore Arctic charr length-frequency distributions differed significantly between Mary Lake and Reference Lake 3, reflecting the occurrence of very few YOY and greater numbers of larger individuals at Mary Lake (Table 5.6; Figure 5.17; Appendix Table G.34). However, nearshore Arctic charr non-YOY size, growth and condition did not differ significantly between Mary Lake and Reference Lake 3 in 2016 (Table 5.6; Appendix Table G.34). Fewer significant differences between nearshore Arctic charr populations of Mary Lake and Reference Lake 3 were evident in 2016 than in 2015 (Table 5.6). The dissimilarity in endpoints that differed between studies may have reflected small samples sizes of approximately ten individuals used for the age and growth endpoint comparisons during each study. Nevertheless, similar to the other mine-exposed lakes, no adverse mine-related influences on nearshore Arctic charr energy use and storage were suggested at Mary Lake for either of the 2015 and 2016 studies.

Littoral/Profundal Arctic Charr

Mine-related influences on the Mary Lake littoral/profundal Arctic charr population were assessed with a before-after analysis using data collected from Mary Lake in 2016 and during 2006-2007 baseline monitoring. Similar to the 2015 CREMP, a small sample size from Reference Lake 3 (i.e., n = 14) precluded meaningful control-impact statistical analysis using data collected in 2016. Biological information collected from Arctic charr mortalities indicated that non-spawners of reproductive age constituted approximately 63% of the Mary Lake Arctic charr population during the August 2016 field study (Appendix Table G.38). On average, Arctic charr non-spawners exhibited similar age, size (length and weight) and LSI than females with

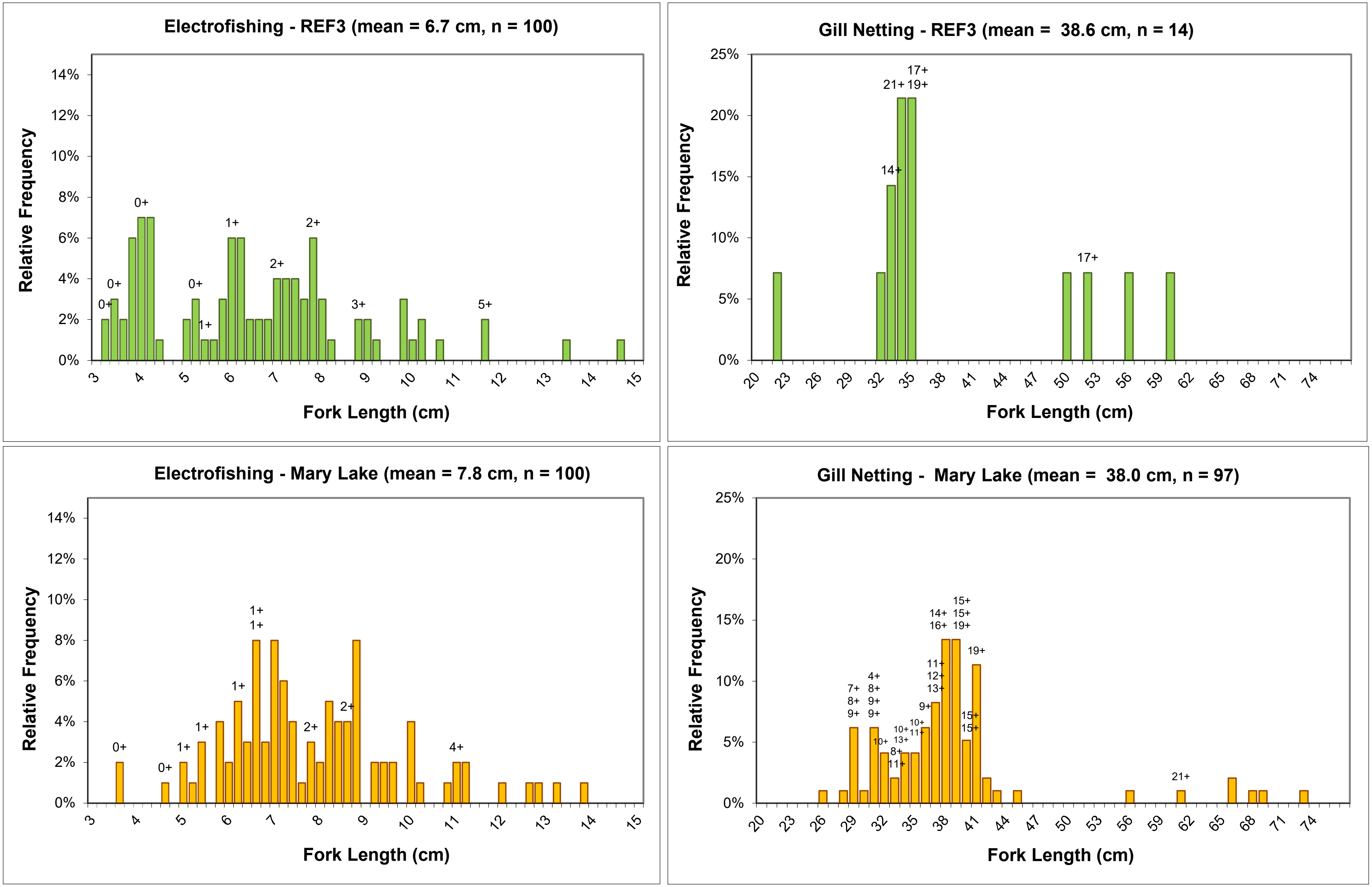


Figure 5.17: Length-frequency distributions for Arctic charr captured by backpack electrofishing and gill netting at Mary Lake and Reference Lake 3 (REF3), August 2016, Mary River Project CREMP. Fish ages are shown above the bars, where available.

Table 5.6: Summary of statistical results for Arctic charr population comparisons between Mary Lake and Reference Lake 3 for the mine operational period (2015, 2016) and between Mary Lake mine-operational and baseline period data for fish captured by electrofishing and gill netting methods, Mary River Project CREMP, August 2016. Values in parentheses indicate direction and magnitude of any signficant differences.

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed?			
			versus Reference Lake 3		versus Mary Lake baseline period data [b]	
			2015	2016	2015	2016
Electrofishing Samples	Survival	Length-Frequency Distribution	No	**Yes**	-	-
		Age	**Yes (-43%)**	No	-	-
	Energy Use	Size (mean weight)	No	No	-	-
		Size (mean fork length)	No	No	-	-
		Growth (weight-at-age)	**Yes (+99%)**	No	-	-
		Growth (fork length-at-age)	**Yes (+23%)**	No	-	-
	Energy Storage	Condition (body weight-at-fork length)	**Yes (+3%)**	No	-	-
Gill Netting Samples [a]	Survival	Length Frequency Distribution	-	-	**Yes**	**Yes**
		Age	-	-	No	**Yes (-14%)**
	Energy Use	Size (mean weight)	-	-	**Yes (+19%)**	No
		Size (mean fork length)	-	-	**Yes (+6%)**	No
		Growth (weight-at-age)	-	-	No	**Yes (nc)**
		Growth (fork length-at-age)	-	-	No	**Yes (nc)**
	Energy Storage	Condition (body weight-at-fork length)	-	-	No	**Yes (+3%)**

[a] Due to low catches of Arctic charr at Reference Lake 3 in 2015 and 2016, no comparison of fish health was possilbe for gill netted fish.

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

developing gonads (Appendix Table G.38). A high proportion of individuals (i.e., 85%) also contained body cavity parasites (Appendix Table G.38), the incidence rate of which was comparable to that observed at other mine-exposed lakes and during historical studies at mine LSA lakes. One Arctic charr that had been tagged and released previously at Mary Lake was re-captured in 2016, and showed a 26.3 mm/yr average increase in fork length over the past 9 years (Table 5.7). This growth rate showed close agreement with the incremental change in growth rate for a recaptured tagged individual from Mary Lake in 2015 (Table 5.7), as well as resident populations in other Arctic lakes available in published literature. Growth of tagged Arctic charr appeared to be considerably higher at Mary Lake than at the northwest and southeast basins of Sheardown Lake, where tagged Arctic charr showed a mean annual incremental increase in fork length of 7.5 mm/yr (Tables 4.7 and 5.7; Minnow 2016a). The tagging information suggested that Arctic charr may reside in a same lake for a prolonged period, and that faster growth rates in Arctic charr may be associated with larger lake size.

Table 5.7: Length and weight measurement data for tagged Arctic charr captured at the Mary Lake south basin in August 2015 and 2016, Mary River Project CREMP.

Fish Tag Number	Capture Information			Re-Capture Information			Growth Rate
	Date of Capture	Length (mm)	Weight (g)	Date of Capture	Length (mm)	Weight (g)	Δ Length (mm/yr)
83214	30-Jul-2007	392	500	19-Aug-2015	587	2,250	24.4
85533	29-Jul-2007	422	725	19-Aug-2016	660	>2,500	24.4

Length-frequency distributions of Arctic charr captured at littoral/profundal areas of Mary Lake in 2016 differed significantly from those captured during the baseline period (Table 5.6; Appendix Table G.37). On average, Arctic charr captured at littoral/profundal areas of Mary Lake in 2016 were significantly younger than those captured during the baseline period, but no significant differences in mean size were shown between these mine periods (Table 5.6). No definitive differences in adult Arctic charr growth were indicated between 2016 and the baseline data at Mary Lake based on considerable overlap of data (Appendix Figure G.23). Similarly, although adult Arctic charr condition differed significantly between 2016 and the baseline period, the magnitude of this difference was within ±10% CES_C (Table 5.6) suggesting that this difference was not ecologically meaningful. The responses of Arctic charr captured at littoral/profundal areas of Mary Lake in 2016 were generally not consistent with those documented in 2015 for comparisons to baseline, which potentially reflected natural sampling variability between years.

5.3 Synthesis of Mine-Related Influences at the Mary River and Mary Lake System

5.3.1 Mary River

No mine-related influences on water quality were apparent at Mary River in 2016. Although total concentrations of a number of metals, including aluminum, chromium, copper, iron, lead, manganese, nickel and phosphorus, were elevated at one or more mine-exposed areas of the Mary River in 2016 compared to reference and baseline data, naturally high turbidity in 2016 likely accounted for these spatial and temporal differences. This was supported by the occurrence of similar dissolved metal concentrations in 2016 compared to Mary River reference and baseline data, by significant positive correlations between total concentrations of key metals (e.g., aluminum, manganese) and turbidity, and by observations of high ratios of total to dissolved metal concentrations for the Mary River water quality data. Notably, turbidity within Mary River was consistently highest upstream of the mine (i.e., the GO series stations) during all mine baseline (2005 – 2013), construction (2014) and operational (2015, 2016) periods, indicating that the dominant source of turbidity at mine-exposed areas of the Mary River reflected natural (runoff) inputs unrelated to the mine operation. Although total aluminum, copper, iron, lead and phosphorus concentrations were above WQG and/or AEMP benchmarks at one or more Mary River mine-exposed stations in 2016, as discussed above, the elevation in these metals compared to water quality criteria appeared to be associated with naturally high turbidity.

Chlorophyll a concentrations were similar among the ten Mary River phytoplankton monitoring stations, with no significant differences in annual chlorophyll a concentrations indicated between Mary River mine-exposed and reference stations. Although lower chlorophyll a concentrations were indicated at individual Mary River stations in 2016 compared to the baseline period, these differences likely reflected higher natural turbidity in 2016, which would be expected to affect phytoplankton productivity by limiting the amount of light available for photosynthesis. No adverse or ecologically meaningful significant differences in benthic invertebrate density, richness or relative abundance of metal-sensitive taxa were shown between Mary River mine-exposed areas compared to an upstream reference area (i.e., GO- 09) in 2016. Although some differences in community composition were indicated between the Mary River mine-exposed and reference areas in 2016, these differences appeared to be related to naturally greater substrate embeddedness at the mine-exposed areas rather than a mine-related influence. Temporal comparisons indicated significantly higher Simpson's Evenness and significantly lower relative abundance of chironomid midges at Mary River mine-exposed areas compared to the reference area between the 2016 and baseline studies. However, because the direction of these responses was opposite to those typically related to adverse mine-related effects, natural temporal variability and/or sampling artifacts of the CREMP likely accounted for the temporal differences in these endpoints.

5.3.2 Mary Lake

At Mary Lake, turbidity and aqueous concentrations of total aluminum, manganese and uranium were elevated (i.e., ≥3-fold higher) compared to the reference lake in 2016, but none of these metals, or any other parameters, were consistently elevated compared to concentrations observed during the baseline period, and none were above WQG or AEMP benchmarks. Similar to Sheardown Lake, turbidity at Mary Lake was naturally higher than 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 consistently 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 2016 and, with the exception of slightly elevated sediment manganese concentrations at littoral stations, were similar to concentrations observed during the baseline period. Although sediment chromium, iron and manganese concentrations were above SQG at Mary Lake in 2016, with the exception of chromium, these metals were also above SQG at the reference lake suggesting low potential for any adverse effects to biota associated with these metals. No metals were observed at concentrations above the sediment AEMP benchmarks at littoral and profundal stations of Mary Lake in 2016.

Mary Lake chlorophyll a concentrations were significantly higher than at the reference lake in 2016, but only at the north basin. However, Mary Lake chlorophyll a concentrations were continuously well below the AEMP benchmark during all seasonal sampling events in 2016, and were indicative of oligotrophic conditions normally encountered in Arctic waterbodies. No significant differences in annual chlorophyll a concentrations were indicated among the mine construction (2014) and operational (2015, 2016) periods, suggesting no changes in the trophic status of Mary Lake since commencement of mine operations. Benthic invertebrate community data collected at littoral habitat of Mary Lake in 2016 indicated significantly lower richness and relative abundance of ostracods, and significantly higher relative abundance of chironomids, but no differences in density, evenness and relative abundance of metal sensitive taxa, FFG and HPG compared to the reference lake. Similar to Sheardown Lake, the differences in community composition appeared to reflect naturally differing sediment TOC and/or particle size between Mary Lake and the reference lake in 2016. No significant differences in any primary and FFG benthic metrics were indicated between 2016 and 2007 baseline data for Mary Lake littoral habitat. Analysis of Mary Lake Arctic charr populations suggested greater fish abundance compared to the reference lake in 2016, but no definitive changes in numbers of Arctic charr in 2016 relative to baseline data. No significant or ecologically meaningful differences in growth and condition of nearshore captured Arctic charr occurred between Mary Lake and the reference lake in 2016, nor between Arctic charr collected in 2016 compared to the baseline period for nearshore and littoral/profundal Arctic charr populations at Mary Lake. Collectively, the chlorophyll a, benthic invertebrate community and Arctic charr fish population data all suggested no adverse mine-related influences to the biota of Mary Lake in the second year of mine operation at the Mary River Project.

6.0 CONCLUSIONS

The objective of the 2016 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 second full year of ERP mine operation. Additional attention towards the evaluation of sedimentation-related effects was conducted as part of the 2016 CREMP assessment in consideration of an Environment and Climate Change Canada FAD and an Indigenous and Northern Affairs Canada LNC related to unauthorized sediment releases in 2016. The 2016 CREMP utilized an effects-based approach that included standard environmental effects monitoring techniques to provide rigorous analysis of potential mine-related effects at key receiving water bodies. 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 on comparisons of the 2016 data to applicable reference data and to available baseline data. Potential mine-related effects identified in the 2016 CREMP are provided separately below for the Camp, Sheardown and Mary River/Lake systems.

6.1 Camp Lake System

Within the Camp Lake system, mine-related effects on water quality were apparent mainly within the main stem channel of Camp Lake Tributary 1 (CLT1) and at Camp Lake. Conductivity and concentrations of mine parameters including chloride, nitrate, sulphate and metals including iron, manganese, molybdenum, sodium, strontium and uranium were the primary constituents reflecting a mine-related influence within CLT1 and Camp Lake in 2016 based on elevation (i.e., ≥3-fold higher) relative to reference conditions and/or to the baseline (2005 – 2013) period. Of these parameters, only iron and uranium concentrations were above applicable water quality guideline (WQG) and/or AEMP benchmarks, but only at the upper-most monitoring station on the CLT1 main stem. Active quarrying at the QMR2 pit in 2016 likely served as the key source for these parameters at CLT1. Water chemistry at Camp Lake Tributary 2 (CLT2) was similar to applicable reference stations and to baseline water quality, with all parameters consistently observed at concentrations below applicable WQG and AEMP benchmarks. Overall, mine-related effects to water quality of the Camp Lake system were evident at the upper main stem of CLT1 and Camp Lake, with minimal effects suggested at CLT2, following the second year of mine operation. Sediment arsenic and manganese concentrations were slightly elevated (i.e., 2- to 5-fold higher) at Camp Lake littoral stations compared to mean reference lake concentrations in 2016, and together with molybdenum, were also elevated compared to concentrations during the baseline period, suggesting a mine-related influence on sediment quality of Camp Lake. No metals were elevated in sediment of the profundal stations compared to the reference lake in 2016. Phosphorus was the only parameter observed at concentrations above SQG in littoral and profundal sediment of Camp Lake that was not also above applicable SQG at the reference lake in 2016.

Chlorophyll a concentrations were elevated at the upper main stem of CLT1 (Station L2-03) and within Camp Lake compared to respective reference areas and to baseline data, suggesting slight enrichment possibly related to higher aqueous nitrate and/or micro-nutrient concentrations from Mary River Project mine activities. However, chlorophyll a concentrations at CLT1 north branch and lower main stem areas, and at CLT2 in 2016, were comparable to applicable reference and baseline concentrations. In addition, chlorophyll a concentrations were consistently well below the AEMP benchmark at all Camp Lake system receivers in 2016 indicating no adverse mine influence to phytoplankton. No adverse mine-related influences on the benthic invertebrate community of the Camp Lake system, including CLT1, CLT2 and Camp Lake, were indicated in 2015 based on comparisons to respective reference areas and to baseline studies. In fact, consistent with the chlorophyll a data, benthic data collected at the upper main stem of CLT1 suggested a slight enrichment-related influence based on higher invertebrate density, richness and proportion of FFG filter feeders compared to Unnamed Reference Creek. The fish population survey suggested greater fish abundance compared to the reference lake in 2016, but similar numbers of Arctic charr in 2016 relative to the Camp Lake baseline studies. No significant, ecologically meaningful, differences in Arctic charr condition were indicated between Camp Lake and the reference lake in 2016, nor between Camp Lake Arctic charr collected in 2016 compared to the baseline period, for nearshore and littoral/profundal Arctic charr populations. Overall, consistent with the water chemistry and sediment chemistry generally meeting respective environmental quality guidelines and AEMP benchmarks, the phytoplankton, benthic invertebrate community and fish population survey data collectively suggested no adverse mine-related influences to the biota of the Camp Lake system in the second year of mine operation at the Mary River Project.

6.2 Sheardown Lake System

At Sheardown Lake Tributary 1 (SDLT1), aqueous concentrations of several parameters were elevated compared to average concentrations observed at the reference creek stations in 2016. However, similar to the 2015 CREMP, only nitrate and sulphate concentrations were elevated at SDLT1 in 2016 compared to the baseline period and, with the exception of copper, no parameters were present at concentrations above WQG or AEMP benchmarks in 2016. Within Sheardown Lake, aqueous total concentrations of aluminum, manganese, molybdenum and/or uranium were elevated compared to the reference lake in both 2015 and 2016, but none of these metals, or any other parameters, were elevated compared to concentrations observed during the baseline period, and none were above WQG or AEMP benchmarks. Similar to findings of the 2015 CREMP, elevated total aluminum and manganese concentrations were correlated with greater turbidity in 2016 suggesting that these metals were largely bound to/composed the suspended particulate matter and were not likely biologically available. Sediment metal concentrations at Sheardown Lake littoral stations in 2016 were similar to those at the reference lake and comparable to baseline with the exception of slightly elevated arsenic, manganese and/or molybdenum concentrations, suggesting some mine-related influences on Sheardown Lake sediment quality. However, sediment metal concentrations at Sheardown Lake profundal stations in 2016 were similar to the reference lake and baseline data, indicating that mine-related influences on sediment quality were confined to littoral habitats. Notably, no metals were present in sediment of Sheardown Lake at concentrations above SQG or AEMP benchmarks that were not above these criteria at the reference lake, suggesting the natural occurrence of elevated concentrations of some metals (e.g., iron, manganese) in sediment of lakes in the Mary River Project LSA.

Chlorophyll a concentrations at SDLT1 and Sheardown Lake were greater than concentrations observed at respective reference areas, but were similar to chlorophyll a concentrations reported during mine baseline and construction periods, respectively. In all cases, chlorophyll a concentrations were well below the AEMP benchmark at all Sheardown Lake system monitoring stations, suggesting no adverse mine-related effects to phytoplankton within the system. Consistent with higher chlorophyll a concentrations, greater relative abundance of FFG filterers and organism density at SDLT1 in 2016 compared to Unnamed Reference Creek and the baseline period, respectively, suggested a slight enrichment influence. However, a greater relative abundance of HPG burrowers at SDLT1 and SDLT12 compared to the Unnamed Reference Creek and to baseline data (SDLT12 only) was potentially indicative of sedimentation influences at these tributaries in 2016. No adverse mine-related influences to benthic invertebrate communities of SDLT9 and the Sheardown Lake littoral benthic invertebrate community were apparent in 2016 based on comparisons to respective reference areas and/or to baseline data. Greater Arctic charr abundance was suggested at the Sheardown Lake NW and SE basins compared to the reference lake in 2016, but similar relative numbers of Arctic charr were indicated between 2016 and baseline studies for both basins. The Arctic charr population exhibited different direction of significant responses in growth and condition between Sheardown Lake and the reference lake in 2016, and between Arctic charr collected at nearshore and littoral/profundal habitats for Sheardown Lake in 2016 compared to baseline studies. The differential responses in Arctic charr population endpoints suggested that the various differences between the mine-exposed and reference areas, or between studies at Sheardown Lake, reflected natural variability in the resident fish population. Overall, the chlorophyll a, benthic invertebrate community and Arctic charr fish population data all suggested no adverse mine-related influences to the biota of Sheardown Lake in the second year of mine operation at the Mary River Project.

6.3 Mary River and Mary Lake System

At Mary River, no adverse mine-related influences on water chemistry were apparent at the mine-exposed areas in 2016 based on comparisons to the Mary River upstream reference area and to baseline period water chemistry taking influences of naturally high turbidity into account. At Mary Lake, aqueous total aluminum, manganese and uranium concentrations were elevated compared to the reference lake in 2016, but concentrations of these metals and all other parameters were comparable to concentrations during the baseline period, and none were above WQG or AEMP benchmarks. Similar to Sheardown Lake and Mary River, aluminum and manganese concentrations were correlated with turbidity at Mary Lake, which suggested that these metals were largely bound to/composed 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 2016 and, with the exception of slightly elevated sediment manganese concentrations at littoral stations, were similar to concentrations observed during the baseline period. Although sediment chromium, iron and manganese concentrations were above SQG at Mary Lake in 2016, with the exception of chromium, these metals were also above respective criteria at the reference lake suggesting low potential for any adverse effects to biota associated with these metals. No metals were observed at concentrations above the sediment AEMP benchmarks at littoral and profundal stations of Mary Lake in 2016.

Chlorophyll a concentrations at Mary River and Mary Lake were generally similar to, or slightly higher than, respective reference areas in 2016. Although lower chlorophyll a concentrations were indicated at individual Mary River stations in 2015 and 2016 compared to the baseline period, these differences likely reflected naturally turbidity in both 2015 and 2016, which would be expected to affect phytoplankton productivity by limiting the amount of light available for photosynthesis. In all cases, chlorophyll a concentrations were well below the AEMP benchmark, indicating no adverse mine-related influences to phytoplankton of the Mary River/Mary Lake system. The benthic invertebrate community of the Mary River exhibited few differences between mine-exposed and reference areas in 2016, and compared to respective areas during the baseline period, with the direction of the few indicated differences in community composition between areas/studies opposite those responses normally reflective of an adverse mine-related effect. Benthic invertebrate community data collected at littoral habitat of Mary Lake in 2016 indicated significantly lower richness and differences in community composition compared to the reference lake that appeared to reflect natural differences in sediment physical properties between lakes. In part, this was supported by no significant differences in benthic metrics between 2016 and 2007 baseline data for Mary Lake littoral stations. The fish population survey suggested greater fish abundance at Mary Lake compared to the reference lake in 2016. No significant or ecologically meaningful differences in growth and condition of nearshore captured Arctic charr occurred between Mary Lake and the reference lake in 2016, nor between Arctic charr collected in 2016 compared to the baseline period for nearshore and littoral/profundal Arctic charr populations at Mary Lake. Overall, the chlorophyll a, benthic invertebrate community and Arctic charr fish population data all suggested no adverse mine-related influences to the biota of Mary Lake in the second year of mine operation at the Mary River Project.

7.0 REFERENCES

Baffinland (Baffinland Iron Mines Corporation). 2014. Mary River Project Aquatic Effects Monitoring Plan. Document No. BAF-PH1-830-P16-0039. Rev 0. June 27, 2014.

Baffinland (Baffinland Iron Mines Corporation). 2016a. Mary River Project Aquatic Effects Monitoring Plan. Document No. BAF-PH1-830-P16-0039. Rev 2. March 31, 2016.

Baffinland (Baffinland Iron Mines Corporation). 2016b. Completion Report: Environment and Climate Change Canada Fisheries Act Direction (File: 4408-2016-05-10-001) and INAC Letter of Non-Compliance (NWB Licence 2AM-MRY1325). September 2016.

BCMOE (British Columbia Ministry of the Environment). 2006. A Compendium of Working Water Quality Guidelines for British Columbia. Environmental Protection Division, Victoria, British Columbia.

BCMOE (British Columbia Ministry of Environment). 2016. British Columbia Approved Water Quality Guidelines. http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines. Accessed December 2016.

Bonar, S.A. 2002. Relative Length Frequency: A Simple, Visual Technique to Evaluate Size Structure in Fish Populations. N. Am. J. Fish. Manage. 22: 1086-1094.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment. Winnipeg, MB. With Updates to 2016.

CCME (Canadian Council of Ministers of the Environment). 2016. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment. Winnipeg. http://www.ccme.ca/publications/ceqg_rcqe.html . Accessed December 2016.

Craig, P.C. and P.J. McCart. 1975. Classification of stream types in Beaufort Sea drainages between Prudhoe Bay, Alaska, and the McKenzie Delta, N.W.T., Canada. Arctic and Alpine Research. 7 : 183 – 198.

Dodds, W.K., J.R. Jones and E.B. Welch. 1998. Suggested classification of stream trophic state: distributions of temperate stream types by chlorophyll, total nitrogen, and phosphorus. Water Resources 12 : 1455 – 1462.

Environment Canada. 2012. Metal Mining Technical Guidance for Environmental Effects Monitoring. ISBN 978-1-100-20496-3.

Gray, M.A., A.R. Curry and K. Munkittrick. 2002. Non-Lethal Sampling Methods for Assessing Environmental Impacts Using a Small-Bodied Sentinel Fish Species. Water Qual. Res. J. Canada. 37(1): 195-211.

Gullestad N. and A. Klemetsen. 1997. Size, Age and Spawning Frequency of Landlock Arctic Charr *Salvelinus alpines* (L.) in Svartvatnet, Svalbard. Polar Res. 16: 85-92.

Gulseth, O.A. and K.J. Nilssen. 2001. Life-History Traits of Charr, *Salvelinus alpines*, from a High Arctic Watercourse on Svalbard. Arctic 54:1-11.

Huryn, A.D. and J.B. Wallace. 2000. Life history and production of stream insects. Annual Review of Entomology 45: 83 – 110.

Intrinsik (Intrinsik Environmental Sciences Inc.) 2014. Development of Water and Sediment Quality Benchmarks for Application in Aquatic Effects Monitoring at the Mary River Project. Report Prepared for Baffinland Iron Ore. June 26 2014.

Intrinsik (Intrinsik Environmental Sciences Inc.) 2015. Establishment of Final Sediment Quality Aquatic Effects Monitoring Program Benchmarks. Report Prepared for Baffinland Iron Ore. March 2015.

Jonsson, B., S. Skulason, S.S. Snorrason, O.T. Sandlund, H.J. Malmquist, P.M. Jonasson, R. Gydemo and T. Lindem. 1988. Life History Variation of Polymorphic Arctic Charr (*Salvelinus alpinus*) in Thingvallavatn, Iceland. Can. J. Fish Aquat. Sci. 45:1537-1547.

KP (Knight Piesold Ltd.) 2014a. Baffinland Iron Mines Corporation – Mary River Project – Water and Sediment Quality Review and CREMP Monitoring Report. KP Ref. No. NB102-181/33-1. June 25, 2014.

KP (Knight Piesold Ltd.) 2014b. Baffinland Iron Mines Corporation – Mary River Project – Detailed Review of Baseline Stream Water Quality. KP Ref. No. NB102-181/33-1C. May 30, 2014.

KP (Knight Piesold Ltd.) 2014c. Baffinland Iron Mines Corporation – Mary River Project – Detailed Review of Baseline Lake Water Quality. KP Ref. No. NB102-181/33-1B. May 30, 2014.

KP (Knight Piesold Ltd.) 2015. Baffinland Iron Mines Corporation – Mary River Project – 2014 Water and Sediment CREMP Monitoring Report. KP Ref. No. NB102-181/34-6. March 19, 2015.

Lods-Crozet, B., B. Oertli and C.T. Robinson. 2012. Long-term patters of chironomid assemblages in a high elevation stream/lake network (Switzerland): implications to global change. Proceedings of the 18th International Symposium on Chironomidae: Fauna Norvegica 31: 71 – 85.

Mandaville, S.M. 2002. Benthic Macroinvertebrates in Freshwaters – Taxa Tolerance Values, Metrics and Protocols. Project H-1. Soil and Water Conservation Society of Metro Halifax.

Merritt, R.L., K.M. Cummins and M.B. Berg. 2008. An Introduction to the Aquatic Insects of North America. 4th Ed. Kendall/Hunt Publishing, Dubuque. 1214 pp.

Michalowicz, J. and W. Duda. 2007. Phenols – sources and toxicity. Polish Journal of Environmental Studies. 16: 347 – 362.

Minnow (Minnow Environmental Inc.). 2016a. Mary River Project 2015 Core Receiving Environment Monitoring Program Report. Prepared for Baffinland Iron Mines Corp. March 2016.

Minnow (Minnow Environmental Inc.). 2016b. Mary River Project CREMP Recommendations for Future Monitoring. Letter report to Jim Millard, Baffinland Iron Mines Corp. March 17, 2016.

Munkittrick, K.R., C.J. Arens, R.B. Lowell and G.P. Kaminski. 2009. A review of potential methods of determining critical effect size for designing environmental monitoring programs. Environmental Toxicology and Chemistry 8: 1361 – 1371.

NSC (North/South Consultants Inc.). 2014. Mary River Project – Core Receiving Environment Monitoring Program: Freshwater Biota. Report prepared for Baffinland Iron Mines Corporation. June 2014.

NSC (North/South Consultants Inc.). 2015a. Mary River Project - Description of Biological Sampling Completed in the Mine Area: 2014. Report prepared for Baffinland Iron Mines Corporation. March 2015.

NSC (North/South Consultants Inc.). 2015b. Mary River Project – Candidate Reference Lakes: Results of the 2014 Field Program. Report prepared for Baffinland Iron Mines Corporation. March 2015.

Oliver, D.R. and M.E. Dillon. 1997. Chironomids (Diptera: Chironomidae) of the Yukon Artcit North Slope and Herschel Island pp. 615 - 635 *in* H.V. Danks and J.A. Downes (Eds.), Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

OMOE (Ontario Ministry of Environment). 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. August 1993, Reprinted October, 1996.

OMOEE (Ontario Ministry of Environment and Energy). 1994. Water Management: Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy. July, 1994. Reprinted February 1999.

Skulason, S., S.S. Snorrason, D.L.G. Noakes and M.M. Ferguson. 1996. Genetic Basis of Life History Variations Among Sympatric Morphs of Arctic Char, *Salvelinus alpines*. Can. J. Fish Aquat. Sci. 53:1807-1813.

Smith, B. and J.B. Wilson. 1996. A consumer's guide to evenness indices. Oikos 76: 70 – 82.

Wetzel, R.G. 2001. Limnology: Lake and River Ecosystems. Third Edition. Academic Press. San Diego, CA, USA. 1006 pp.

Wetzel, R.G. and G. E. Likens 2000. Limnological Analysis. Third Edition. Springer Science + Business Media Inc. New York, NY, USA. 429 pp.

APPENDIX A

DATA QUALITY REVIEW

APPENDIX A: DATA QUALITY REVIEW

A1.0 INTRODUCTION

A1.1 Background

Data Quality Review (DQR) was conducted on data collected as part of the Mary River Project 2016 CREMP to define the overall quality of the data collected for the program, and by extension, the confidence with which the data can be used to derive conclusions. A variety of factors can influence the physical, chemical and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Depending on the magnitude of these influences, inaccuracy or imprecision have the potential to affect the reliability of conclusions drawn from the available data. Therefore, it is important to ensure that programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize the variability that does not reflect natural spatial and temporal variability in the environment) and thus assure the quality of the data.

The Mary River Project 2016 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 be used with confidence to derive study conclusions. Using this approach, questionable data received more scrutiny to determine what effect, if any, this had on interpretation of results within the context of this project. Quality Control (QC) samples assessed for the Mary River Project CREMP included water sample trip blanks, field blanks, equipment blanks and field duplicates, sediment sample field duplicates and the verification of the accuracy of sub-sampling and organism recovery for the benthic invertebrate component, defined as follows:

- **Blanks** (water quality samples) are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed the same way as regular samples. These samples reflect any 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 method detection limit (MDL) allows for slight "noise" around the detection limit.

  - **Trip blanks** are meant to detect any widespread contamination resulting from the container (including caps) and preservative during transport and storage. A trip blank is a bottle set full of de-ionized water that is prepared prior to the field sample collections, is transported with the regular sample bottles in the field, and remains unopened throughout the trip.
  - **Field blanks** mimic the sampling and preservative process but do not come in contact with ambient water. Field blanks are exposed to the sampling environment at the sample site. Consequently, they provide information on contamination resulting from the handling technique and through exposure to the atmosphere. They are processed in the same manner as the associated field samples (i.e., they are exposed to all the same potential sources of contamination as the field sample), including handling and, in some cases, filtration and/or preservation.
  - **Equipment blanks** are samples of de-ionized water collected from the sampling equipment following decontamination (i.e., rinsing of the sampling device using de-ionized water) in the field between sampling stations and/or events. These blanks are useful in identifying cross contamination of samples in the field as a result of the sampling device.

- **Field Duplicates** (water quality and sediment quality samples) are sub-sample pairs collected from a randomly selected field station using identical collection and handling methods that are then analyzed separately in the laboratory. The duplicate samples are handled and analyzed in an identical manner in the laboratory. The data from field duplicate samples reflect natural variability, as well as the variability associated with sample collection methods, and therefore provide a measure of field precision.

- **Sub-Sampling Checks** (benthic invertebrate community samples) are used when excessive sample volume and/or organism density results in only a fraction of the original sample being analyzed. By comparing the numbers of benthic invertebrates recovered between at least two sub-samples, this measure provides an evaluation of how effective the sub-sampling method was in evenly dividing the original sample. Therefore, sub-sampling error provides a measure of analytical precision. The processing of entire samples in representative sample fractions also allows an evaluation of sub-sampling accuracy.

- **Organism Recovery Checks** (benthic invertebrate community samples) involve the re-processing of previously sorted material from a randomly selected sample to determine the number of invertebrates that were not recovered during the original sample processing. The reprocessing is conducted by an analyst not involved during the original processing to reduce any bias. This check allows the determination of accuracy through assessment of recovery efficiency.

A2.0 RESULTS

A2.1 Water Samples

A2.1.1 Sample Blanks

Trip blank samples were taken on field sampling campaigns a total of nine times during the 2016 CREMP, including during two winter lake monitoring events (April-May), one spring stream monitoring event (June), three summer lake/stream monitoring events (July), and three fall lake/stream monitoring events (August). Of the 767 total number of analyses conducted on the trip blank samples, only three (0.4%) resulted in analyte detection above the trip blank DQO of less than five-times the laboratory MDL (Appendix Table A.1). Barium and phenols were detected in trip blanks at concentrations that were above the DQO, but only during the summer sampling period. Bottle contamination or contaminated deionized source water were the most likely sources of contamination. The deionized water used to create trip blanks originated from on-site stock, and was cited as the most likely source of trip blank contamination in previous CREMP (KP 2015).

Field blanks for water samples were assessed a total of eight times during the 2016 CREMP, including on one winter lake monitoring event, one spring stream monitoring event, three summer lake/stream monitoring events, and five fall lake/stream monitoring events. Of the 683 analyses conducted, five (0.7%) resulted in analyte detection above the DQO of less than five-times the laboratory MDL (Appendix Table A.2). Similar to the trip blanks, barium and phenols were the only analytes for which concentrations above DQO were observed in the 2016 field blank samples, and only during the summer sampling period. A similar frequency of detection was observed between the trip and field blanks, which suggested that a similar source of contamination was common to both DQR sample types. These patterns suggest that laboratory water is the most likely source of contamination.

Equipment blank samples were assessed a total of 11 times during the 2016 CREMP, including on two winter lake monitoring events, five summer lake monitoring events, and four fall lake monitoring events. Of the 927 analyses conducted, 19 (2.0%) resulted in analyte detection above the DQO of less than five-times the laboratory MDL (Appendix Table A.3). Similar to the trip and/or field blanks, barium and phenols were frequently observed at concentrations above the DQO in the summer equipment blank samples. In addition to these parameters, turbidity, total aluminum, total manganese, and chlorophyll-a and phaeophytin-a were each detected above the DQO in an equipment blank sample. A greater frequency of detection was observed in the equipment blanks relative to the trip

Table A.1: Trip blank results, CREMP 2016. Highlighted values did not meet the data quality objective of ≤ five-times the laboratory method detection limit (MDL).

	Client Sample ID		Lowest MDL[1]	JL0-07	BL0-01	L1-08	REF3-01	MRY-REF3	DL0-01-4	L0-01	BL0-01A	JL0-10
	Date Sampled			25-Apr-2016	1-May-2016	27-Jun-2016	16-Jul-2016	25-Jul-2016	25-Jul-2016	19-Aug-2016	21-Aug-2016	22-Aug-2016
	ALS Sample ID			L1761257-2	L1764345-3	L1790501-30	L1806585-3	L1805146-2	L1805153-4	L1816817-3	L1817107-6	L1818109-4
Physical Tests	Conductivity	umhos/cm	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Hardness (as $CaCO_3$)	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Total Suspended Solids	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	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Turbidity	NTU	0.10	<0.10	<0.10	<0.10	<0.10	0.16	0.32	0.18	0.15	0.13
Anions and Nutrients	Alkalinity, Total (as $CaCO_3$)	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Ammonia, Total (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	0.029	<0.020	<0.020	<0.020	0.027
	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	0.50	<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	0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Nitrate (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen	mg/L	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Phosphorus, Total	mg/L	0.0030	<0.0030	<0.0030	0.0035	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Sulfate (SO4)	mg/L	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Carbon	Dissolved Organic Carbon	mg/L	1.0	<1.0	1.7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Organic Carbon	mg/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total 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
	Antimony (Sb)	mg/L	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
	Barium (Ba)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000284	0.000375	<0.000050	<0.000050	<0.000050
	Beryllium (Be)	mg/L	0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<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	<0.00050	<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
	Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	0.091	0.124	<0.050	<0.050	<0.050
	Chromium (Cr)	mg/L	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
	Copper (Cu)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	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
	Magnesium (Mg)	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Manganese (Mn)	mg/L	0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070
	Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.050	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)	mg/L	0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.050	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.050	<0.050	<0.050	<0.050	0.118	<0.050	<0.050	<0.050	<0.050	<0.050
	Strontium (Sr)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Thallium (Tl)	mg/L	0.000010	<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	0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)	mg/L	0.00050	<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	0.0031	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	0.00060	<0.0030	<0.00060	<0.0050	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	mg/L	0.000020	<0.00010	<0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.000020	<0.00010	<0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.000030 - 0.00010	0.000072	0.000033	<0.00010	0.000316	0.000294	0.000363	<0.000050	<0.000050	<0.000050
	Beryllium (Be)	mg/L	0.000010	<0.00050	<0.000010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	0.0000050	<0.00050	<0.0000050	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	0.0050	<0.010	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.0000050	<0.000010	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	0.020 - 0.050	<0.050	<0.020	<0.050	0.127	0.098	0.113	<0.050	<0.050	<0.050
	Chromium (Cr)	mg/L	0.00010	<0.00050	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0000050	<0.00010	<0.0000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00050	<0.00050	<0.00010	<0.00020	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	0.0010	<0.030	<0.0010	<0.010	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.0000090	<0.000050	<0.0000090	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.00050	<0.0010	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	0.0050	<0.050	<0.0050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Manganese (Mn)	mg/L	0.000070	<0.000070	<0.000070	<0.00050	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070
	Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)	mg/L	0.000090	<0.00050	<0.000090	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)	mg/L	0.050		<0.050	<0.050						
	Potassium (K)	mg/L	0.050	<0.20	<0.050	<0.050	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)	mg/L	0.000040	<0.0010	<0.000040	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.050	<0.10	<0.050	<0.050	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Silver (Ag)	mg/L	0.0000050	<0.000010	<0.0000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.020 - 0.50	<0.050	<0.020	<0.50	0.127	<0.050	<0.050	<0.050	<0.050	<0.050
	Strontium (Sr)	mg/L	0.000050	<0.00010	<0.000050	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Thallium (Tl)	mg/L	0.0000020	<0.00010	<0.0000020	<0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.000030	<0.00010	<0.000030	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	0.00030	<0.010	<0.00050	<0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.0000070	<0.000010	<0.0000070	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)	mg/L	0.000050	<0.0010	<0.000050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.00050	<0.0030	<0.00050	<0.0010	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	0.00010		<0.00010	<0.00030						
Other	Phenols (4AAP)	mg/L	0.0010	0.0028	0.0014	0.0037	<0.0010	0.0038	0.0070	0.0027	0.0027	0.0026
	Chlorophyll a	µg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Phaeophytin a	µg/L	0.10	<0.39	0.19	0.21	0.21	0.18	0.19	0.14	0.19	0.19

[1] For some analytes, a range of MDLs were achieved in different laboratory reports. Each blank is compared to the MDL applicable to that sample.

Table A.2: Field blank results, CREMP 2015. Highlighted values did not meet the data quality objective of ≤ five-times the laboratory method detection limit (MDL).

		Client Sample ID	Lowest MDL[1]	DL0-02-3	CLT-REF3	D1-00	JL0-09	BL0-06	C0-05	REF3-03	DL0-01-07
		Date Sampled		29-Apr-2016	27-Jun-2016	19-Jul-2016	26-Jul-2016	28-Jul-2016	19-Aug-2016	20-Aug-2016	22-Aug-2016
		ALS Sample ID		L1764338-7	L1790501-31	L1802460-2	L1806556-23	L1807078-3	L1816817-13	L1816829-7	L1818099-7
Physical Tests	Conductivity	umhos/cm	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Hardness (as CaCO3)	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10
	pH	pH units	-	6.54	6.00	6.18	7.87	6.36	6.92	6.40	6.48
	Total Suspended Solids	mg/L	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids	mg/L	10	<10	<10	<20	<10	13	<10	<10	<10
	Turbidity	NTU	0.10	0.18	<0.10	<0.10	0.44	<0.10	0.23	0.16	<0.10
Anions and Nutrients	Alkalinity, Total (as CaCO3)	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10
	Ammonia, Total (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	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	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	0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Nitrate (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen	mg/L	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.29	<0.15
	Phosphorus, Total	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Sulfate (SO4)	mg/L	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Carbo	Dissolved Organic Carbon	mg/L	1.0	1.9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Organic Carbon	mg/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Metals	Aluminum (Al)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.000050	<0.000050	<0.000050	0.000380	0.000418	0.000061	<0.000050	<0.000050	<0.000050
	Beryllium (Be)	mg/L	0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<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	<0.00050	<0.00050
	Boron (B)	mg/L	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	0.050	<0.050	<0.050	0.121	0.121	<0.050	<0.050	<0.050	<0.050
	Chromium (Cr)	mg/L	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
	Copper (Cu)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	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
	Lithium (Li)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Manganese (Mn)	mg/L	0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	0.000099	<0.000070
	Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.050	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)	mg/L	0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.050	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Strontium (Sr)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Thallium (Tl)	mg/L	0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)	mg/L	0.00050	<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
Dissolved Metals	Aluminum (Al)	mg/L	0.00060	0.00063	<0.0050	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	mg/L	0.000020	<0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.000020	<0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00003 - 0.00005	0.000043	<0.00010	0.000367	0.000325	0.000054	<0.000050	0.000054	<0.000050
	Beryllium (Be)	mg/L	0.000010	<0.000010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	0.0000050	<0.0000050	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	0.0050	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	0.020 - 0.050	<0.020	<0.050	0.128	0.124	<0.050	<0.050	<0.050	<0.050
	Chromium (Cr)	mg/L	0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0000050	<0.0000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00050	<0.00010	<0.00020	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	0.0010	<0.0010	<0.010	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.0000090	<0.0000090	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	0.0050	<0.0050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Manganese (Mn)	mg/L	0.000070	<0.000070	<0.00050	<0.000070	<0.000070	<0.000070	0.000092	0.000154	<0.000070
	Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)	mg/L	0.000090	<0.000090	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)	mg/L	0.050	<0.050	<0.050						
	Potassium (K)	mg/L	0.050	<0.050	<0.050	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)	mg/L	0.000040	<0.000040	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.050	<0.050	<0.050	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Silver (Ag)	mg/L	0.0000050	<0.0000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.020	<0.020	<0.50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Strontium (Sr)	mg/L	0.000050	<0.000050	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Thallium (Tl)	mg/L	0.0000020	<0.0000020	<0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.000030	<0.000030	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	0.00030	<0.00050	<0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.0000070	<0.0000070	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)	mg/L	0.000050	<0.000050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.00050	<0.00050	<0.0010	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	0.00010	<0.00010	<0.00030						
Other	Phenols (4AAP)	mg/L	0.0010	0.0014	0.0048	0.0080	0.0040	0.0021	0.0047	0.0016	0.0023
	Chlorophyll a	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Phaeophytin a	ug/L	0.10	<0.13	0.19	0.19	0.20	0.22	0.11	0.16	0.19

Table A.3: Equipment blank results, CREMP 2016. Highlighted values did not meet the data quality objective of ≤ five-times the laboratory method detection limit (MDL).

		Client Sample ID	Lowest MDL[1]	DL0-02-4	JL0-10	JL0-02	DD-HAB-9-STN1	DD-HAB-9-STN1	BL0-05-A	BL0-03	REF3-02	BL0-01	BL0-09	BL0-03
		Date Sampled		29-Apr-2016	7-May-2016	24-Jul-2016	24-Jul-2016	25-Jul-2016	30-Jul-2016	30-Jul-2016	19-Aug-2016	21-Aug-2016	23-Aug-2016	24-Aug-2016
		ALS Sample ID		L1764338-3	L1766948-1	L1803150-10	L1803150-3	L1805153-1	L1807075-14	L1807075-7	L1816829-1	L1817107-1	L1820246-8	L1820248-3
Physical Tests	Conductivity	umhos/cm	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Hardness (as CaCO3)	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Total Suspended Solids	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	mg/L	10	<10	<10	<20	<20	<10	<10	<10	<10	<10	<10	<10
	Turbidity	NTU	0.10	1.42	<0.10	0.33	0.11	0.40	<0.10	0.13	0.24	0.20	0.38	<0.10
Anions and Nutrients	Alkalinity, Total (as CaCO3)	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Ammonia, Total (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	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	0.50	<0.50	<0.50	<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	0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Nitrate (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen	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
	Phosphorus, Total	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0031
	Sulfate (SO4)	mg/L	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Carbon	Dissolved Organic Carbon	mg/L	1.0	1.8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Organic Carbon	mg/L	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 Metals	Aluminum (Al)-Total	mg/L	0.0030	<0.0030	<0.0030	0.00890	0.0036	<0.0030	<0.0030	0.0054	0.0212	0.0063	<0.0030	<0.0030
	Antimony (Sb)-Total	mg/L	0.00010	<0.00010	<0.00010	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)-Total	mg/L	0.000050	0.000071	0.000218	0.000534	0.000604	0.000939	0.000339	0.000373	0.000221	0.000071	<0.000050	<0.000050
	Beryllium (Be)-Total	mg/L	0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Total	mg/L	0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total	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)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)-Total	mg/L	0.050	<0.050	0.084	0.188	0.151	0.158	0.127	0.060	<0.050	<0.050	<0.050	<0.050
	Chromium (Cr)-Total	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total	mg/L	0.00050	<0.00050	<0.00050	<0.00050	0.00075	0.00088	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total	mg/L	0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)-Total	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)-Total	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)-Total	mg/L	0.050	<0.050	<0.050	0.053000	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Manganese (Mn)-Total	mg/L	0.000070	<0.000070	<0.000070	0.000228	0.000164	0.000122	0.000075	0.000082	0.000413	0.000128	<0.000070	<0.000070
	Mercury (Hg)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total	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
	Nickel (Ni)-Total	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)-Total	mg/L	0.050	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)-Total	mg/L	0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)-Total	mg/L	0.050	<0.10	<0.10	<0.10	0.12	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Silver (Ag)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total	mg/L	0.050	<0.050	<0.050	0.08100	0.15700	0.15400	<0.050	0.10400	0.073	<0.050	<0.050	0.067
	Strontium (Sr)-Total	mg/L	0.00010	<0.00010	<0.00010	0.00017	0.00020	0.00023	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
	Thallium (Tl)-Total	mg/L	0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total	mg/L	0.00010	0.00012	0.00011	0.00014	0.0002	0.00029	<0.00010	0.00014	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total	mg/L	0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)-Total	mg/L	0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Total	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)-Dissolved	mg/L	0.00060	0.00064	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)-Dissolved	mg/L	0.000020	<0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved	mg/L	0.000020	<0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)-Dissolved	mg/L	0.00003 - 0.00005	0.000169	0.000312	0.000651	0.000591	0.000896	0.00085	0.000453	0.000312	0.000128	0.000237	0.000067
	Beryllium (Be)-Dissolved	mg/L	0.000010	<0.000010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Dissolved	mg/L	0.0000050	<0.0000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved	mg/L	0.0050	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved	mg/L	0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)-Dissolved	mg/L	0.020 - 0.050	0.030	0.090	0.214	0.164	0.150	0.196	0.052	0.072	<0.050	<0.050	<0.050
	Chromium (Cr)-Dissolved	mg/L	0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Dissolved	mg/L	0.0000050	<0.0000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved	mg/L	0.00050	<0.00010	<0.00050	<0.00050	0.0007	0.00078	<0.00050	<0.00050	0.00062	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved	mg/L	0.0010	<0.0010	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)-Dissolved	mg/L	0.0000090	<0.0000090	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved	mg/L	0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved	mg/L	0.0050	0.0071	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Manganese (Mn)-Dissolved	mg/L	0.000070	<0.000070	0.000071	<0.000070	0.000082	0.000087	0.000107	<0.000070	0.000099	0.000114	<0.000070	<0.000070
	Mercury (Hg)-Dissolved	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Dissolved	mg/L	0.000090	<0.000090	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)-Dissolved	mg/L	0.050	<0.050	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)-Dissolved	mg/L	0.000040	<0.000040	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)-Dissolved	mg/L	0.050	<0.050	<0.10	<0.10	0.12	<0.10	0.16	<0.10	<0.10	<0.10	<0.10	<0.10
	Silver (Ag)-Dissolved	mg/L	0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved	mg/L	0.020 - 0.050	0.039	<0.050	0.08400	0.16100	0.15300	0.19600	0.10300	0.10900	<0.050	<0.050	0.067
	Strontium (Sr)-Dissolved	mg/L	0.000050	<0.000050	<0.00010	0.00018	0.00020	0.00022	0.00024	0.00011	0.00016	<0.00010	<0.00010	<0.00010
	Thallium (Tl)-Dissolved	mg/L	0.0000020	<0.0000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Dissolved	mg/L	0.00003 - 0.0001	<0.000030	0.00021	<0.00010	0.00019	0.00025	0.00033	0.00012	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved	mg/L	0.00030	<0.00050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved	mg/L	0.0000070	<0.0000070	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)-Dissolved	mg/L	0.000050	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved	mg/L	0.00050 - 0.0030	0.00147	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0036	<0.0030	<0.0030
Other	Phenols (4AAP)	mg/L	0.0010	<0.0010	<0.0010	0.0040	0.0014	0.0057	0.0041	0.0014	0.0023	0.0022	0.0046	0.0064
	Chlorophyll a	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.80	<0.10
	Phaeophytin a	ug/L	0.10	0.13	0.18	0.22	0.19	0.17	0.18	0.20	0.17	0.23	0.56	0.18

[1] For some analytes, a range of MDLs were achieved in different laboratory reports. Each blank is compared to the MDL applicable to that sample.

and field blanks, which suggested that field sampling techniques may occasionally be a source of contamination in samples. Overall, the trip, field and equipment blank analyses indicated that barium and phenols results should be interpreted with caution, but otherwise analyses of these blanks suggested limited sample contamination for the majority of parameters.

A2.1.2 Precision – Field Duplicates

A total of 17 field duplicates were collected over the course of the 2016 Mary River Project CREMP. These included three winter lake monitoring events, two spring stream monitoring events, six summer stream/lake monitoring events, and six fall stream/lake monitoring events. In general, close agreement in parameter concentrations was observed between duplicate samples, with 95% of field duplicate analyte pairs meeting the DQO of ≤25% Relative Percent Difference (RPD) in parameter concentrations of the 1,477 duplicate analyses conducted (Table A.4). Total ammonia, total phosphorus, phenols, total aluminum and dissolved manganese were the key parameters which most frequently did not meet DQO between the duplicate samples (Table A.4). In approximately 45% of cases in which DQO were not met, measured concentrations in one or both duplicate samples were close to the MDL (i.e., two- to three-times the MDL) such that small differences in concentrations between duplicate samples resulted in relatively high RPD. For other parameters, the relatively high RPD between duplicate samples likely reflected natural variability in actual concentrations in the field or sampling related influences. However, in the majority of cases, and for key parameters of concern, the RDP in analyte concentrations was sufficiently low as to not affect interpretation of the data.

A2.2 Sediment Samples

A2.2.1 Data Precision – Field Duplicate Samples

Field duplicate sediment samples were collected at each of Camp Lake (Station JLO-02), Sheardown Lake NW (Station DLO-01-2), Mary Lake (BLO-06) and Reference Lake 3 (REF03-9), which represented 9% of the total number of sediment quality monitoring stations sampled for the 2016 CREMP. Good agreement in parameter concentrations were observed between duplicate samples, with only twelve incidences (4.2%) in which the DQO of greater than 40% RPD between duplicate samples was not achieved (Table A.5). Relatively high RPD for arsenic, barium, lead, manganese, molybdenum and/or tin were observed between the field duplicate samples collected from Camp Lake, Sheardown Lake NW and Reference Lake 3 (Table A.5). The relatively high RPD between

Figure A.4: Water sample field duplicate results. Highlighted values did not meet the DQO of ≤ 25% RPD. Higlighted and bold values did not meet the DQO and were calculated from values that were > 10-times the MDL.

	Sample ID / Date Sampled / ALS Sample ID	Lowest Detection Limit	MRY-REF2 27-Jun-16 L1790501-26	MRY-REF201 27-Jun-16 L1790501-32	RPD	CLT-REF4 24-Jul-16 L1803155-1	CLT-REF401 24-Jul-16 L1803155-2	RPD	REF3-02-S 28-Jul-16 L1806575-1	REF3-02-S01 28-Jul-16 L1806575-3	RPD
Conventionals	Conductivity (lab)	3.0	39.5	39.7	0.5	81.4	82.4	1.2	76.6	76.2	0.5
	Hardness (as $CaCO_3$)	10	18	18	0	39	39	0	35	35	0
	Total Suspended Solids (TSS)	2.0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
	Total Dissolved Solids (TDS)	10	26	25	3.9	55	48	14	50	38	**27**
	Turbidity	0.10	0.67	0.66	1.5	2.35	2.70	14	0.25	0.25	0
	Alkalinity (as $CaCO_3$)	10	18	21	15	38	37	2.7	36	37	2.7
Nutrients and Organics	Total Ammonia	0.020	<0.020	0.028	33	<0.020	<0.020	0	<0.020	<0.020	0
	Nitrate	0.020	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0
	Nitrite	0.0050	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen (TKN)	0.15	<0.15	<0.15	0	<0.15	<0.15	0	0.15	0.20	29
	Nitrate and Nitrite (as N)	0.021	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0
	Dissolved Organic Carbon	1.0	1.1	1.1	0	<1.0	<1.0	0	2.6	2.7	3.8
	Total Organic Carbon	1.0	1.3	1.3	0	<1.0	<1.0	0	2.6	2.6	0
	Total Phosphorus	0.0030	0.0303	0.0042	151	0.0044	0.0040	9.5	0.0035	0.0040	13
	Phenols	0.0010	0.0044	0.0031	35	<0.0010	0.0015	40	0.0016	0.0026	48
Anions	Bromide (Br)	0.10	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.50	0.58	0.57	1.7	<0.50	<0.50	0	1.28	1.89	38
	Sulphate (SO_4)	0.30	0.32	0.30	6.5	0.72	0.71	1.4	4.16	5.16	21
Total Metals	Aluminum (Al)	0.0030	0.0182	0.0177	2.8	0.0996	0.0698	**35**	<0.0030	<0.0030	0
	Antimony (Sb)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.00200	0.00201	0.5	0.00395	0.00374	5.5	0.00638	0.00678	6.1
	Beryllium (Be)	0.00010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.050	3.69	3.74	1.3	8.01	8.06	0.6	6.96	7.13	2.4
	Cesium (Cs)	0.000010									
	Chromium (Cr)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	0.00057	<0.00050	13
	Cobalt (Co)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	0.00079	0.00076	3.9
	Iron (Fe)	0.030	<0.030	<0.030	0	0.045	0.032	34	<0.030	<0.030	0
	Lead (Pb)	0.000050	<0.000050	<0.000050	0	0.000058	0.000052	11	<0.000050	<0.000050	0
	Lithium (Li)	0.0010	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.050	2.07	2.16	4.3	4.54	4.48	1.3	4.55	4.37	4.0
	Manganese (Mn)	0.000070	0.000617	0.000593	4.0	0.000551	0.000499	9.9	0.000677	0.000637	6.1
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	<0.000050	<0.000050	0	0.000115	0.000106	8.1	0.000124	0.000125	0.8
	Nickel (Ni)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Phosphorus (P)	0.050									
	Potassium (K)	0.050	0.27	0.29	7.1	0.50	0.47	6.2	0.89	0.89	0
	Rubidium (Rb)	0.00020									
	Selenium (Se)	0.000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.33	0.34	3.0	0.84	0.76	10	0.43	0.45	4.5
	Silver (Ag)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.050	0.399	0.415	3.9	0.580	0.569	1.9	0.847	0.847	0
	Strontium (Sr)	0.00010	0.00283	0.00286	1.1	0.00617	0.00614	0.5	0.00780	0.00801	2.7
	Sulfur (S)	0.50									
	Tellurium (Te)	0.00020									
	Thallium (Tl)	0.000010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Thorium (Th)	0.00010									
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.00030	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Tungsten (W)	0.00010									
	Uranium (U)	0.000010	0.000189	0.000199	5.2	0.00137	0.00136	0.7	0.000247	0.000256	3.6
	Vanadium (V)	0.00050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.0030	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.00030									
Dissolved Metals	Aluminum (Al)	0.00050	0.0052	<0.00050	165	0.0117	0.0121	3.4	<0.0030	<0.0030	0
	Antimony (Sb)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000030	0.00190	0.00193	1.6	0.00352	0.00362	2.8	0.00656	0.00666	1.5
	Beryllium (Be)	0.000010	<0.00010	<0.00010	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.0000050	<0.000050	<0.000050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.0050	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.0000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.020	3.67	3.74	1.9	8.16	8.04	1.5	6.96	7.00	0.6
	Cesium (Cs)	0.000010	<0.000010	<0.000010	0						
	Chromium (Cr)	0.00010	<0.00050	0.0405	**195**	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000050	<0.00010	0.00012	18	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00020	0.00027	0.00313	168	<0.00050	<0.00050	0	0.00078	0.00076	2.6
	Iron (Fe)	0.0010	<0.010	0.891	**196**	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.0000090	<0.000050	<0.000050	0	<0.000050	<0.000050	0	0.000066	<0.00050	153
	Lithium (Li)	0.00050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.0050	2.19	2.19	0	4.55	4.64	2.0	4.34	4.37	0.7
	Manganese (Mn)	0.000070	<0.00050	0.0109	**182**	0.000125	0.000078	46	0.000223	0.000283	24
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	0.000055	0.000403	152	0.000119	0.000115	3.4	0.000127	0.000128	0.8
	Nickel (Ni)	0.000090	<0.00050	0.00162	106	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Phosphorus (P)	0.050	<0.050	<0.050	0						
	Potassium (K)	0.050	0.282	0.285	1.1	0.46	0.47	2.2	0.90	0.90	0
	Rubidium (Rb)	0.00020	0.00041	0.00043	4.8						
	Selenium (Se)	0.000040	<0.000050	<0.000050	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.311	0.323	3.8	0.63	0.65	3.1	0.43	0.43	0
	Silver (Ag)	0.0000050	<0.000050	<0.000050	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.020	<0.50	<0.50	0	0.579	0.594	2.6	0.850	0.848	0.2
	Strontium (Sr)	0.000050	0.0028	0.0028	0	0.00604	0.00610	1.0	0.00815	0.00799	2.0
	Sulfur (S)	0.50	<0.50	<0.50	0						
	Tellurium (Te)	0.00020	<0.00020	<0.00020	0						
	Thallium (Tl)	0.0000020	<0.000010	<0.000010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Thorium (Th)	0.00010	<0.00010	<0.00010	0						
	Tin (Sn)	0.000030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.00030	<0.00030	<0.00030	0	<0.010	<0.010	0	<0.010	<0.010	0
	Tungsten (W)	0.00010	<0.00010	<0.00010	0						
	Uranium (U)	0.0000070	0.000185	0.000191	3.2	0.00133	0.00130	2.3	0.000255	0.000258	1.2
	Vanadium (V)	0.000050	<0.00050	<0.00050	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.00050	<0.0010	<0.0010	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.00010	<0.00030	<0.00030	0						
Other	Chlorophyll a	0.10	0.44	0.45	2.2	0.38	0.43	12	0.95	0.94	1.1
	Phaeophytin a	0.10	0.44	0.46	4.4	0.45	0.41	9.3	0.7	0.57	20

Figure A.4: Water sample field duplicate results. Highlighted values did not meet the DQO of ≤ 25% RPD. Higlighted and bold values did not meet the DQO and were calculated from values that were > 10-times the MDL.

	Sample ID / Date Sampled / ALS Sample ID	Lowest Detection Limit	REF3-0101 / 20-Aug-16 / L1816829-4	REF3-01-S / 20-Aug-16 / L1816829-5	RPD	JL0-02 (S) / 23-Apr-16 / L1761245-1	JL0-0201 / 23-Apr-16 / L1761245-2	RPD	DL0-01-1(S) / 26-Apr-16 / L1762422-3	DL0-01-101 / 26-Apr-16 / L1762422-5	RPD
Conventionals	Conductivity (lab)	3.0	76.7	77.0	0.4	161	162	0.6	151	151	0
	Hardness (as $CaCO_3$)	10	35	35	0	81	80	1.2	73	71	2.8
	Total Suspended Solids (TSS)	2.0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
	Total Dissolved Solids (TDS)	10	39	37	5.3	107	105	1.9	87	88	1.1
	Turbidity	0.10	0.32	0.44	32	0.17	0.21	21	0.26	0.26	0
	Alkalinity (as $CaCO_3$)	10	30	32	6.5	76	75	1.3	71	69	2.9
Nutrients and Organics	Total Ammonia	0.020	<0.020	<0.020	0	<0.020	0.026	26	<0.020	0.065	106
	Nitrate	0.020	<0.020	<0.020	0	<0.020	<0.020	0	0.033	0.034	3.0
	Nitrite	0.0050	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen (TKN)	0.15	<0.15	<0.15	0	<0.15	<0.15	0	0.18	0.17	5.7
	Nitrate and Nitrite (as N)	0.021	<0.021	<0.021	0	<0.021	<0.021	0	0.033	0.034	3.0
	Dissolved Organic Carbon	1.0	2.8	2.8	0	3.1	2.8	10	2.6	2.7	3.8
	Total Organic Carbon	1.0	2.9	2.8	3.5	2.1	2.0	4.9	2.2	2.0	9.5
	Total Phosphorus	0.0030	0.0043	0.0034	23	0.0031	<0.0030	3.3	0.0031	<0.0030	3.3
	Phenols	0.0010	0.0037	0.0027	31	0.0011	0.0023	71	<0.0010	<0.0010	0
Anions	Bromide (Br)	0.10	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.50	1.27	1.27	0	4.22	4.29	1.6	3.51	3.51	0
	Sulphate (SO_4)	0.30	4.04	4.08	1.0	2.02	2.04	1.0	3.96	3.95	0.3
Total Metals	Aluminum (Al)	0.0030	0.0043	0.0035	21	0.0047	<0.0030	44	0.0100	0.0049	68
	Antimony (Sb)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.00657	0.00665	1.2	0.00732	0.00738	0.8	0.00676	0.00638	5.8
	Beryllium (Be)	0.00010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.050	7.02	7.00	0.3	16.4	16.3	0.6	14.4	14.6	1.4
	Cesium (Cs)	0.000010									
	Chromium (Cr)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	0.00085	52
	Cobalt (Co)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	0.00082	0.00083	1.2	0.00112	0.00129	14	0.00091	0.00099	8.4
	Iron (Fe)	0.030	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.000050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.0010	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	0.0010	0
	Magnesium (Mg)	0.050	4.22	4.37	3.5	9.68	9.61	0.7	8.93	8.78	1.7
	Manganese (Mn)	0.000070	0.000566	0.000570	0.7	0.000426	0.000334	24	0.00176	0.00174	1.1
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	0.000136	0.000130	4.5	0.000317	0.000327	3.1	0.000939	0.000950	1.2
	Nickel (Ni)	0.00050	<0.00050	<0.00050	0	0.00072	0.00065	10	0.00146	0.00232	46
	Phosphorus (P)	0.050									
	Potassium (K)	0.050	0.88	0.90	2.2	1.27	1.27	0	1.22	1.20	1.7
	Rubidium (Rb)	0.00020									
	Selenium (Se)	0.000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.39	0.40	2.5	0.42	0.42	0	0.64	0.66	3.1
	Silver (Ag)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.050	0.826	0.832	0.7	1.65	1.64	0.6	1.55	1.52	2.0
	Strontium (Sr)	0.00010	0.00811	0.00816	0.6	0.0115	0.0116	0.9	0.00974	0.00981	0.7
	Sulfur (S)	0.50									
	Tellurium (Te)	0.00020									
	Thallium (Tl)	0.000010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Thorium (Th)	0.00010									
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	0.00024	0.00035	37
	Titanium (Ti)	0.00030	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Tungsten (W)	0.00010									
	Uranium (U)	0.000010	0.000285	0.000282	1.1	0.000931	0.000901	3.3	0.00115	0.00114	0.9
	Vanadium (V)	0.00050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.0030	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.00030									
Dissolved Metals	Aluminum (Al)	0.00050	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Antimony (Sb)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000030	0.00656	0.00630	4.0	0.00730	0.00729	0.1	0.00677	0.00661	2.4
	Beryllium (Be)	0.000010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.0000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.0050	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.0000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.020	7.12	6.92	2.8	16.5	16.1	2.5	14.0	14.2	1.4
	Cesium (Cs)	0.000010									
	Chromium (Cr)	0.00010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000050	<0.00010	<0.00010	0	0.00012	<0.00010	18	<0.00010	<0.00010	0
	Copper (Cu)	0.00020	0.00090	0.00090	0	0.00133	0.00116	14	0.00086	0.00081	6.0
	Iron (Fe)	0.0010	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.0000090	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.00050	<0.0010	<0.0010	0	0.0010	0.0011	9.5	<0.0010	<0.0010	0
	Magnesium (Mg)	0.0050	4.27	4.38	2.5	9.64	9.67	0.3	9.13	8.67	5.2
	Manganese (Mn)	0.000070	0.000255	0.000244	4.4	0.00196	0.00274	**33**	0.000303	0.000215	34
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	0.000133	0.000133	0	0.000506	0.000467	8.0	0.000920	0.000900	2.2
	Nickel (Ni)	0.000090	<0.00050	<0.00050	0	0.0121	0.00806	**40**	0.00099	0.00087	13
	Phosphorus (P)	0.050									
	Potassium (K)	0.050	0.88	0.89	1.1	1.28	1.28	0	1.10	1.09	0.9
	Rubidium (Rb)	0.00020									
	Selenium (Se)	0.000040	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.39	0.40	2.5	0.42	0.41	2.4	0.61	0.60	1.7
	Silver (Ag)	0.0000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.020	0.827	0.840	1.6	1.88	1.91	1.6	1.50	1.42	5.5
	Strontium (Sr)	0.000050	0.00833	0.00805	3.4	0.0128	0.0124	3.2	0.00933	0.00917	1.7
	Sulfur (S)	0.50									
	Tellurium (Te)	0.00020									
	Thallium (Tl)	0.0000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Thorium (Th)	0.00010									
	Tin (Sn)	0.000030	<0.00010	<0.00010	0	0.00086	0.00113	**27**	<0.00010	<0.00010	0
	Titanium (Ti)	0.00030	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Tungsten (W)	0.00010									
	Uranium (U)	0.0000070	0.000282	0.000276	2.2	0.000916	0.000888	3.1	0.00111	0.00110	0.9
	Vanadium (V)	0.000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.00050	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.00010									
Other	Chlorophyll a	0.10	0.59	0.63	6.6	0.69	0.56	21	0.89	0.87	2.3
	Phaeophytin a	0.10	0.41	0.5	20	<0.39	<0.39	0	0.85	0.58	38

Figure A.4: Water sample field duplicate results. Highlighted values did not meet the DQO of ≤ 25% RPD. Higlighted and bold values did not meet the DQO and were calculated from values that were > 10-times the MDL.

	Sample ID / Date Sampled / ALS Sample ID	Lowest Detection Limit	BL0-09-B / 6-May-16 / L1766933-4	BL0-09-B01 / 6-May-16 / L1766933-5	RPD	C0-10 / 25-Jun-16 / L1790501-3	C0-1001 / 25-Jun-16 / L1790501-4	RPD	JL0-07-S / 26-Jul-16 / L1806556-25	JL0-07-S01 / 26-Jul-16 / L1806556-26	RPD
Conventionals	Conductivity (lab)	3.0	82.6	82.7	0.1	19.9	20.0	0.5	132	132	0
	Hardness (as $CaCO_3$)	10	43	40	7.2	<10	<10	0	64	65	1.6
	Total Suspended Solids (TSS)	2.0	<2.0	<2.0	0	2.8	2.8	0	<2.0	<2.0	0
	Total Dissolved Solids (TDS)	10	45	44	2.2	<10	<10	0	76	74	2.7
	Turbidity	0.10	0.20	0.19	5.1	3.94	3.95	0.3	0.34	0.41	19
	Alkalinity (as $CaCO_3$)	10	41	40	2.5	11	12	8.7	65	66	1.5
Nutrients and Organics	Total Ammonia	0.020	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0
	Nitrate	0.020	0.076	0.069	9.7	0.048	0.033	37	<0.020	<0.020	0
	Nitrite	0.0050	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen (TKN)	0.15	<0.15	0.16	6.5	<0.15	<0.15	0	<0.15	<0.15	0
	Nitrate and Nitrite (as N)	0.021	0.076	0.069	9.7	0.048	0.033	37	<0.021	<0.021	0
	Dissolved Organic Carbon	1.0	1.2	1.3	8.0	<1.0	<1.0	0	1.5	1.5	0
	Total Organic Carbon	1.0	1.4	1.5	6.9	1.1	<1.0	9.5	1.7	1.7	0
	Total Phosphorus	0.0030	0.0043	<0.0030	36	0.0072	0.0074	2.7	0.0035	<0.0030	15
	Phenols	0.0010	0.0014	0.0015	6.9	0.0017	0.0011	43	0.0037	0.0066	56
Anions	Bromide (Br)	0.10	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.50	2.00	1.86	7.3	0.63	0.71	12	3.34	3.33	0.3
	Sulphate (SO_4)	0.30	1.03	1.01	2.0	0.45	0.43	4.5	1.98	1.98	0
Total Metals	Aluminum (Al)	0.0030	0.0065	0.0071	8.8	0.0907	0.0826	9.3	0.0059	0.0069	16
	Antimony (Sb)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.00486	0.00481	1.0	0.00202	0.00193	4.6	0.00639	0.00639	0
	Beryllium (Be)	0.00010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.050	8.10	8.11	0.1	1.92	1.78	7.6	13.1	13.0	0.8
	Cesium (Cs)	0.000010									
	Chromium (Cr)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	0.00066	0.00066	0	<0.00050	<0.00050	0	0.00076	0.00079	3.9
	Iron (Fe)	0.030	<0.030	<0.030	0	0.094	0.073	25	<0.030	<0.030	0
	Lead (Pb)	0.000050	<0.000050	<0.000050	0	0.000116	0.000093	22	<0.000050	<0.000050	0
	Lithium (Li)	0.0010	<0.0010	<0.0010	0	<0.0010	<0.0010	0	0.0012	0.0012	0
	Magnesium (Mg)	0.050	4.75	4.77	0.4	1.13	1.05	7.3	8.06	8.14	1.0
	Manganese (Mn)	0.000070	0.000786	0.000852	8.1	0.00263	0.00221	17	0.00273	0.00279	2.2
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	0.000139	0.000147	5.6	<0.000050	<0.000050	0	0.000235	0.000241	2.5
	Nickel (Ni)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	0.00054	0.00055	1.8
	Phosphorus (P)	0.050									
	Potassium (K)	0.050	0.62	0.62	0	0.23	0.22	4.4	1.01	1.03	2.0
	Rubidium (Rb)	0.00020									
	Selenium (Se)	0.000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.69	0.64	7.5	0.36	0.34	5.7	0.37	0.37	0
	Silver (Ag)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.050	1.28	1.23	4.0	0.373	0.345	7.8	1.36	1.43	5.0
	Strontium (Sr)	0.00010	0.00650	0.00644	0.9	0.00176	0.00168	4.7	0.00933	0.00927	0.6
	Sulfur (S)	0.50									
	Tellurium (Te)	0.00020									
	Thallium (Tl)	0.000010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Thorium (Th)	0.00010									
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.00030	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Tungsten (W)	0.00010									
	Uranium (U)	0.000010	0.000485	0.000517	6.4	0.000099	0.000094	5.2	0.000626	0.000640	2.2
	Vanadium (V)	0.00050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.0030	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.00030									
Dissolved Metals	Aluminum (Al)	0.00050	<0.0030	0.0035	15	0.0113	0.0107	5.5	<0.0030	0.0089	99
	Antimony (Sb)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000030	0.00471	0.00480	1.9	0.00140	0.00147	4.9	0.00615	0.00630	2.4
	Beryllium (Be)	0.000010	<0.00050	<0.00050	0	<0.00010	<0.00010	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.0000050	<0.00050	<0.00050	0	<0.000050	<0.000050	0	<0.00050	<0.00050	0
	Boron (B)	0.0050	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.0000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.020	8.73	8.17	6.6	1.75	1.73	1.1	12.7	12.9	1.6
	Cesium (Cs)	0.000010				<0.000010	<0.000010	0			
	Chromium (Cr)	0.00010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00020	0.00077	0.00065	17	0.00027	0.00026	3.8	0.00076	0.00076	0
	Iron (Fe)	0.0010	<0.030	<0.030	0	<0.010	<0.010	0	<0.030	<0.030	0
	Lead (Pb)	0.0000090	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.00050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.0050	5.15	4.77	7.7	1.07	1.05	1.9	7.95	7.93	0.3
	Manganese (Mn)	0.000070	0.000203	0.000245	19	0.00100	0.00092	8.3	0.000553	0.000846	42
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	0.000163	0.000139	16	<0.000050	<0.000050	0	0.000247	0.000230	7.1
	Nickel (Ni)	0.000090	0.00061	<0.00050	20	<0.00050	<0.00050	0	0.00052	0.00058	11
	Phosphorus (P)	0.050				<0.050	<0.050	0			
	Potassium (K)	0.050	0.68	0.61	11	0.216	0.207	4.3	1.03	1.06	2.9
	Rubidium (Rb)	0.00020				0.00027	0.00028	3.6			
	Selenium (Se)	0.000040	<0.0010	<0.0010	0	<0.000050	<0.000050	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.35	0.62	56	0.224	0.226	0.9	0.35	0.36	2.8
	Silver (Ag)	0.0000050	<0.000010	<0.000010	0	<0.000050	<0.000050	0	<0.000010	<0.000010	0
	Sodium (Na)	0.020	1.20	1.19	0.8	<0.50	<0.50	0	1.34	1.34	0
	Strontium (Sr)	0.000050	0.00680	0.00647	5.0	0.0016	0.0016	0	0.00953	0.00956	0.3
	Sulfur (S)	0.50				<0.50	<0.50	0			
	Tellurium (Te)	0.00020				<0.00020	<0.00020	0			
	Thallium (Tl)	0.0000020	<0.00010	<0.00010	0	<0.000010	<0.000010	0	<0.00010	<0.00010	0
	Thorium (Th)	0.00010				<0.00010	<0.00010	0			
	Tin (Sn)	0.000030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.00030	<0.010	<0.010	0	<0.00030	<0.00030	0	<0.010	<0.010	0
	Tungsten (W)	0.00010				<0.00010	<0.00010	0			
	Uranium (U)	0.0000070	0.000696	0.000517	**30**	0.000069	0.000065	6.0	0.000651	0.000664	2.0
	Vanadium (V)	0.000050	<0.0010	<0.0010	0	<0.00050	<0.00050	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.00050	<0.0030	<0.0030	0	<0.0010	<0.0010	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.00010				<0.00030	<0.00030	0			
Other	Chlorophyll a	0.10	0.17	<0.10	52	0.19	0.19	0	1.12	1.16	3.5
	Phaeophytin a	0.10	0.22	0.2	9.5	0.27	0.27	0	0.74	0.66	11

Figure A.4: Water sample field duplicate results. Highlighted values did not meet the DQO of ≤ 25% RPD. Higlighted and bold values did not meet the DQO and were calculated from values that were > 10-times the MDL.

	Sample ID	Lowest	DL0-02-8-B	DL0-02-8-B01		BL0-01-B-B	BL0-01-B-B01		E0-21	E0-2101	
	Date Sampled	Detection	26-Jul-16	26-Jul-16	RPD	26-Jul-16	26-Jul-16	RPD	18-Jul-16	18-Jul-16	RPD
	ALS Sample ID	Limit	L1806556-8	L1806556-9		L1806556-17	L1806556-18		L1800873-5	L1800873-6	
Conventionals	Conductivity (lab)	3.0	88.0	87.9	0.1	92.7	93.3	0.6	61.4	61.5	0.2
	Hardness (as $CaCO_3$)	10	42	42	0	45	45	0	27	27	0
	Total Suspended Solids (TSS)	2.0	10.4	8.4	21	<2.0	<2.0	0	<2.0	<2.0	0
	Total Dissolved Solids (TDS)	10	46	56	20	48	47	2.1	30	30	0
	Turbidity	0.10	6.33	5.70	10	1.01	9.11	**160**	7.46	7.47	0.1
	Alkalinity (as $CaCO_3$)	10	43	42	2.4	48	51	6.1	41	33	22
Nutrients and Organics	Total Ammonia	0.020	<0.020	0.047	81	<0.020	<0.020	0	<0.020	<0.020	0
	Nitrate	0.020	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0
	Nitrite	0.0050	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen (TKN)	0.15	<0.15	<0.15	0	<0.15	<0.15	0	<0.15	0.55	114
	Nitrate and Nitrite (as N)	0.021	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0
	Dissolved Organic Carbon	1.0	1.1	1.3	17	<1.0	<1.0	0	<1.0	<1.0	0
	Total Organic Carbon	1.0	1.5	1.5	0	1.0	1.1	9.5	<1.0	<1.0	0
	Total Phosphorus	0.0030	0.0192	0.0156	21	0.0050	0.0059	17	0.0064	0.0060	6.5
	Phenols	0.0010	0.0020	0.0011	58	0.0031	0.0037	18	0.0012	0.0017	34
Anions	Bromide (Br)	0.10	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.50	1.69	1.71	1.2	1.22	1.18	3.3	1.03	1.03	0
	Sulphate (SO_4)	0.30	1.64	1.64	0	0.66	0.60	9.5	0.88	0.88	0
Total Metals	Aluminum (Al)	0.0030	0.146	0.152	4.0	0.0396	0.0250	**45**	0.254	0.249	2.0
	Antimony (Sb)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.00638	0.00629	1.4	0.00522	0.00535	2.5	0.00555	0.00594	6.8
	Beryllium (Be)	0.00010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.050	8.46	8.73	3.1	9.40	9.12	3.0	5.70	5.81	1.9
	Cesium (Cs)	0.000010									
	Chromium (Cr)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.00010	0.00011	<0.00010	9.5	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	0.00089	0.00089	0	0.00058	0.00059	1.7	0.00070	0.00068	2.9
	Iron (Fe)	0.030	0.173	0.175	1.1	0.035	<0.030	15	0.158	0.161	1.9
	Lead (Pb)	0.000050	0.000238	0.000238	0	<0.000050	<0.000050	0	0.000193	0.000173	11
	Lithium (Li)	0.0010	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.050	5.35	5.31	0.8	5.51	5.73	3.9	3.24	3.21	0.9
	Manganese (Mn)	0.000070	0.00659	0.00660	0.2	0.00232	0.00231	0.4	0.00168	0.00182	8.0
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	0.000207	0.000236	13	0.000102	0.000094	8.2	0.000171	0.000182	6.2
	Nickel (Ni)	0.00050	0.00051	0.00053	3.8	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Phosphorus (P)	0.050									
	Potassium (K)	0.050	0.77	0.77	0	0.57	0.57	0	0.67	0.67	0
	Rubidium (Rb)	0.00020									
	Selenium (Se)	0.000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.67	0.69	2.9	0.66	0.63	4.7	1.00	1.01	1.0
	Silver (Ag)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.050	0.953	0.954	0.1	0.954	0.973	2.0	0.884	0.874	1.1
	Strontium (Sr)	0.00010	0.00640	0.00661	3.2	0.00614	0.00596	3.0	0.00611	0.00606	0.8
	Sulfur (S)	0.50									
	Tellurium (Te)	0.00020									
	Thallium (Tl)	0.000010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Thorium (Th)	0.00010									
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.00030	<0.010	<0.010	0	<0.010	<0.010	0	0.010	<0.010	0
	Tungsten (W)	0.00010									
	Uranium (U)	0.000010	0.000680	0.000681	0.1	0.000578	0.000560	3.2	0.000437	0.000428	2.1
	Vanadium (V)	0.00050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.0030	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.00030									
Dissolved Metals	Aluminum (Al)	0.00050	0.0090	0.0090	0	0.0052	0.0049	5.9	0.0217	0.0269	21
	Antimony (Sb)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000030	0.00486	0.00479	1.5	0.00502	0.00488	2.8	0.00400	0.00431	7.5
	Beryllium (Be)	0.000010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.0000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.0050	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.0000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.020	8.48	8.37	1.3	9.03	9.10	0.8	5.68	5.74	1.1
	Cesium (Cs)	0.000010									
	Chromium (Cr)	0.00010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00020	0.00058	0.00056	3.5	0.00056	0.00055	1.8	<0.00050	<0.00050	0
	Iron (Fe)	0.0010	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.0000090	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.00050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.0050	5.06	5.08	0.4	5.36	5.43	1.3	3.14	3.14	0
	Manganese (Mn)	0.000070	0.000360	0.000390	8.0	0.00113	0.00114	0.9	0.000141	0.000148	4.8
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	0.000306	0.000316	3.2	0.000106	0.000098	7.8	0.000178	0.000185	3.9
	Nickel (Ni)	0.000090	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Phosphorus (P)	0.050									
	Potassium (K)	0.050	0.72	0.72	0	0.57	0.57	0	0.57	0.57	0
	Rubidium (Rb)	0.00020									
	Selenium (Se)	0.000040	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.46	0.45	2.2	0.57	0.57	0	0.48	0.49	2.1
	Silver (Ag)	0.0000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.020	0.951	0.960	0.9	0.967	0.971	0.4	0.865	0.858	0.8
	Strontium (Sr)	0.000050	0.00633	0.00629	0.6	0.00616	0.00589	4.5	0.00572	0.00576	0.7
	Sulfur (S)	0.50									
	Tellurium (Te)	0.00020									
	Thallium (Tl)	0.0000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Thorium (Th)	0.00010									
	Tin (Sn)	0.000030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.00030	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Tungsten (W)	0.00010									
	Uranium (U)	0.0000070	0.000583	0.000576	1.2	0.000540	0.000565	4.5	0.000373	0.000376	0.8
	Vanadium (V)	0.000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.00050	<0.0030	0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.00010									
Other	Chlorophyll a	0.10	1.63	1.5900	2.5	1.08	1.07	0.9	0.27	0.25	7.7
	Phaeophytin a	0.10	0.72	0.6700	7.2	0.7	0.74	5.6	0.41	0.41	0

Figure A.4: Water sample field duplicate results. Highlighted values did not meet the DQO of ≤ 25% RPD. Higlighted and bold values did not meet the DQO and were calculated from values that were > 10-times the MDL.

	Sample ID	Lowest Detection Limit	JL0-0101	JL0-01-B	RPD	J0-01	J0-0101	RPD	DL0-02-07-B	DL0-02-0701	RPD
	Date Sampled		22-Aug-16	22-Aug-16		20-Aug-16	20-Aug-16		21-Aug-16	21-Aug-16	
	ALS Sample ID		L1818109-1	L1818109-3		L1816817-18	L1816817-19		L1817109-8	L1817109-9	
Conventionals	Conductivity (lab)	3.0	132	134	1.5	137	137	0	116	116	0
	Hardness (as $CaCO_3$)	10	62	63	1.6	66	67	1.5	54	55	1.8
	Total Suspended Solids (TSS)	2.0	<2.0	<2.0	0	<2.0	<2.0	0	2.5	<2.0	22
	Total Dissolved Solids (TDS)	10	65	62	4.7	64	70	9.0	61	53	14
	Turbidity	0.10	0.92	0.95	3.2	0.34	0.45	28	2.15	2.16	0.5
	Alkalinity (as $CaCO_3$)	10	64	62	3.2	64	63	1.6	52	55	5.6
Nutrients and Organics	Total Ammonia	0.020	0.022	0.054	84	<0.020	<0.020	0	<0.020	0.038	62
	Nitrate	0.020	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0
	Nitrite	0.0050	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen (TKN)	0.15	<0.15	<0.15	0	<0.15	<0.15	0	<0.15	<0.15	0
	Nitrate and Nitrite (as N)	0.021	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0
	Dissolved Organic Carbon	1.0	1.5	1.5	0	1.7	1.7	0	1.5	1.5	0
	Total Organic Carbon	1.0	1.6	1.7	6.1	1.9	2.0	5.1	1.7	2.2	26
	Total Phosphorus	0.0030	0.0042	0.0043	2.4	0.0048	<0.0030	46	0.0280	0.0062	127
	Phenols	0.0010	0.0014	0.0015	6.9	0.0043	0.0033	26	0.0027	0.0022	20
Anions	Bromide (Br)	0.10	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.50	3.34	3.33	0.3	3.44	3.50	1.7	2.22	2.20	0.9
	Sulphate (SO_4)	0.30	2.01	2.03	1.0	2.18	2.20	0.9	2.65	2.62	1.1
Total Metals	Aluminum (Al)	0.0030	0.0041	0.0036	13	0.0047	0.0046	2.2	0.058	0.048	19
	Antimony (Sb)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.00598	0.00608	1.7	0.00663	0.00663	0	0.00634	0.00617	2.7
	Beryllium (Be)	0.00010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00010	<0.00010	0
	Bismuth (Bi)	0.000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.000050	<0.000050	0
	Boron (B)	0.010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.050	13.0	12.7	2.3	13.2	13.3	0.8	11.3	10.9	3.6
	Cesium (Cs)	0.000010							<0.000010	<0.000010	0
	Chromium (Cr)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	0.00077	0.00076	1.3	0.00081	0.00082	1.2	0.0016	<0.0010	46
	Iron (Fe)	0.030	<0.030	<0.030	0	0.063	0.125	66	0.056	0.050	11
	Lead (Pb)	0.000050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	0.00010	<0.00010	0
	Lithium (Li)	0.0010	0.0012	0.0012	0	0.0011	0.0011	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.050	7.53	7.54	0.1	8.21	8.23	0.2	6.47	6.22	3.9
	Manganese (Mn)	0.000070	0.00184	0.00175	5.0	0.00240	0.00314	**27**	0.00389	0.00350	11
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	0.000245	0.000247	0.8	0.000268	0.000262	2.3	0.000520	0.000491	5.7
	Nickel (Ni)	0.00050	0.00055	0.00059	7.0	0.00069	0.00076	9.7	0.00083	0.00065	24
	Phosphorus (P)	0.050							<0.050	<0.050	0
	Potassium (K)	0.050	1.02	1.02	0	1.04	1.05	1.0	0.938	0.894	4.8
	Rubidium (Rb)	0.00020							0.00222	0.00212	4.6
	Selenium (Se)	0.000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.000050	<0.000050	0
	Silicon (Si)	0.050	0.35	0.36	2.8	0.38	0.38	0	0.619	0.608	1.8
	Silver (Ag)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000050	<0.000050	0
	Sodium (Na)	0.050	1.31	1.29	1.5	1.37	1.34	2.2	1.15	1.11	3.5
	Strontium (Sr)	0.00010	0.00977	0.00956	2.2	0.00975	0.00977	0.2	0.0087	0.0083	4.7
	Sulfur (S)	0.50							1.17	1.08	8.0
	Tellurium (Te)	0.00020							<0.00020	<0.00020	0
	Thallium (Tl)	0.000010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.000010	<0.000010	0
	Thorium (Th)	0.00010							<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.00030	<0.010	<0.010	0	<0.010	<0.010	0	0.00235	0.00191	21
	Tungsten (W)	0.00010							<0.00010	<0.00010	0
	Uranium (U)	0.000010	0.000696	0.000685	1.6	0.000788	0.000776	1.5	0.000821	0.000785	4.5
	Vanadium (V)	0.00050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.00050	<0.00050	0
	Zinc (Zn)	0.0030	<0.0030	<0.0030	0	<0.0030	<0.0030	0	0.0044	<0.0030	38
	Zirconium (Zr)	0.00030							<0.00030	<0.00030	0
Dissolved Metals	Aluminum (Al)	0.00050	0.0040	<0.0030	29	<0.0030	<0.0030	0	0.0094	0.0085	10
	Antimony (Sb)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000030	0.00694	0.00619	11	0.00639	0.00681	6.4	0.00593	0.00599	1.0
	Beryllium (Be)	0.000010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.0000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.0050	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.0000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.020	12.5	12.7	1.6	13.3	13.4	0.7	11.0	11.1	0.9
	Cesium (Cs)	0.000010									
	Chromium (Cr)	0.00010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00020	0.00076	0.00070	8.2	0.00079	0.00078	1.3	0.00081	0.00078	3.8
	Iron (Fe)	0.0010	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.0000090	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.00050	0.0010	0.0011	9.5	0.0011	0.0011	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.0050	7.48	7.52	0.5	7.99	8.08	1.1	6.42	6.70	4.3
	Manganese (Mn)	0.000070	0.000172	0.000096	57	0.00114	0.00101	12	0.000427	0.000356	18
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	0.000238	0.000237	0.4	0.000277	0.000275	0.7	0.000486	0.000455	6.6
	Nickel (Ni)	0.000090	0.00055	0.00055	0	0.00064	0.00057	12	<0.00050	<0.00050	0
	Phosphorus (P)	0.050									
	Potassium (K)	0.050	1.03	1.01	2.0	1.08	1.06	1.9	0.91	0.90	1.1
	Rubidium (Rb)	0.00020									
	Selenium (Se)	0.000040	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.35	0.35	0	0.36	0.36	0	0.54	0.55	1.8
	Silver (Ag)	0.0000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.020	1.32	1.32	0	1.39	1.35	2.9	1.17	1.19	1.7
	Strontium (Sr)	0.000050	0.00942	0.00951	1.0	0.00977	0.00983	0.6	0.00815	0.00819	0.5
	Sulfur (S)	0.50									
	Tellurium (Te)	0.00020									
	Thallium (Tl)	0.0000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Thorium (Th)	0.00010									
	Tin (Sn)	0.000030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.00030	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Tungsten (W)	0.00010									
	Uranium (U)	0.0000070	0.000701	0.000681	2.9	0.000776	0.000766	1.3	0.000830	0.000810	2.4
	Vanadium (V)	0.000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.00050	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.00010									
Other	Chlorophyll a	0.10	1.67	1.72	2.9	0.71	0.6	17	3.61	3.55	1.7
	Phaeophytin a	0.10	0.84	0.85	1.2	0.39	0.36	8.0	0.92	0.87	5.6

Figure A.4: Water sample field duplicate results. Highlighted values did not meet the DQO of ≤ 25% RPD. Higlighted and bold values did not meet the DQO and were calculated from values that were > 10-times the MDL.

	Sample ID	Lowest	G0-03	G0-0301		BL0-04-S	BL0-0401	
	Date Sampled	Detection	20-Aug-16	20-Aug-16	RPD	23-Aug-16	23-Aug-16	RPD
	ALS Sample ID	Limit	L1816817-24	L1816817-32		L1820246-1	L1820246-3	
Conventionals	Conductivity (lab)	3.0	169	168	0.6	75.8	75.8	0
	Hardness (as $CaCO_3$)	10	76	75	1.3	35	35	0
	Total Suspended Solids (TSS)	2.0	3.0	2.9	3.4	<2.0	<2.0	0
	Total Dissolved Solids (TDS)	10	94	95	1.1	38	43	12
	Turbidity	0.10	12.0	12.5	4.1	1.67	1.63	2.4
	Alkalinity (as $CaCO_3$)	10	74	73	1.4	32	33	3.1
Nutrients and Organics	Total Ammonia	0.020	<0.020	<0.020	0	<0.020	<0.020	0
	Nitrate	0.020	<0.020	<0.020	0	<0.020	<0.020	0
	Nitrite	0.0050	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen (TKN)	0.15	<0.15	<0.15	0	<0.15	<0.15	0
	Nitrate and Nitrite (as N)	0.021	<0.021	<0.021	0	<0.021	<0.021	0
	Dissolved Organic Carbon	1.0	1.2	1.3	8.0	1.3	1.2	8.0
	Total Organic Carbon	1.0	1.5	1.5	0	1.4	1.2	15
	Total Phosphorus	0.0030	0.0094	0.0083	12	0.0069	0.0063	9.1
	Phenols	0.0010	0.0034	0.0062	58	0.0021	0.0047	76
Anions	Bromide (Br)	0.10	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.50	6.98	7.01	0.4	1.38	1.44	4.3
	Sulphate (SO_4)	0.30	3.78	3.76	0.5	1.01	1.01	0
Total Metals	Aluminum (Al)	0.0030	0.292	0.290	0.7	0.0489	0.0537	9.4
	Antimony (Sb)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	0.00011	0.00011	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.0127	0.0125	1.6	0.00474	0.00451	5.0
	Beryllium (Be)	0.00010	<0.00010	<0.00010	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.000050	<0.000050	<0.000050	0	<0.00050	<0.00050	0
	Boron (B)	0.010	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.050	15.6	15.8	1.3	7.30	7.19	1.5
	Cesium (Cs)	0.000010	0.000044	0.000046	4.4			
	Chromium (Cr)	0.00050	0.00074	0.00072	2.7	<0.00050	<0.00050	0
	Cobalt (Co)	0.00010	0.00015	0.00015	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	0.0015	0.0015	0	0.00165	0.00135	20
	Iron (Fe)	0.030	0.295	0.301	2.0	0.040	0.044	9.5
	Lead (Pb)	0.000050	0.00028	0.00030	6.9	0.000051	<0.000050	2.0
	Lithium (Li)	0.0010	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.050	8.90	8.81	1.0	4.32	4.33	0.2
	Manganese (Mn)	0.000070	0.00362	0.00367	1.4	0.00116	0.00110	5.3
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	0.000420	0.000431	2.6	0.000135	0.000139	2.9
	Nickel (Ni)	0.00050	0.00074	0.00072	2.7	<0.00050	<0.00050	0
	Phosphorus (P)	0.050	<0.050	<0.050	0			
	Potassium (K)	0.050	1.34	1.34	0	0.60	0.60	0
	Rubidium (Rb)	0.00020	0.00265	0.00259	2.3			
	Selenium (Se)	0.000050	<0.000050	<0.000050	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	1.34	1.32	1.5	0.58	0.62	6.7
	Silver (Ag)	0.000010	<0.000050	<0.000050	0	<0.000010	<0.000010	0
	Sodium (Na)	0.050	3.73	3.69	1.1	1.01	1.02	1.0
	Strontium (Sr)	0.00010	0.0181	0.0177	2.2	0.00596	0.00583	2.2
	Sulfur (S)	0.50	1.36	1.33	2.2			
	Tellurium (Te)	0.00020	<0.00020	<0.00020	0			
	Thallium (Tl)	0.000010	0.000011	0.000010	9.5	<0.00010	<0.00010	0
	Thorium (Th)	0.00010	0.00043	0.00043	0			
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.00030	0.0158	0.0165	4.3	<0.010	<0.010	0
	Tungsten (W)	0.00010	<0.00010	<0.00010	0			
	Uranium (U)	0.000010	0.00456	0.00465	2.0	0.000577	0.000580	0.5
	Vanadium (V)	0.00050	0.00072	0.00075	4.1	<0.0010	<0.0010	0
	Zinc (Zn)	0.0030	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.00030	0.00062	0.00063	1.6			
Dissolved Metals	Aluminum (Al)	0.00050	0.0086	0.0074	15	0.0084	0.0100	17
	Antimony (Sb)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000030	0.0106	0.0104	1.9	0.00421	0.00427	1.4
	Beryllium (Be)	0.000010	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.0000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.0050	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.0000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.020	15.8	15.8	0	7.20	7.15	0.7
	Cesium (Cs)	0.000010						
	Chromium (Cr)	0.00010	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00020	0.00088	0.00093	5.5	0.00199	0.00275	**32**
	Iron (Fe)	0.0010	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.0000090	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.00050	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.0050	8.88	8.74	1.6	4.22	4.24	0.5
	Manganese (Mn)	0.000070	0.000131	0.000131	0	0.000172	0.000205	18
	Mercury (Hg)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.000050	0.000412	0.000420	1.9	0.000135	0.000132	2.2
	Nickel (Ni)	0.000090	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Phosphorus (P)	0.050						
	Potassium (K)	0.050	1.20	1.21	0.8	0.58	0.58	0
	Rubidium (Rb)	0.00020						
	Selenium (Se)	0.000040	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.87	0.87	0	0.49	0.50	2.0
	Silver (Ag)	0.0000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.020	3.76	3.63	3.5	1.00	1.00	0
	Strontium (Sr)	0.000050	0.0167	0.0167	0	0.00591	0.00603	2.0
	Sulfur (S)	0.50						
	Tellurium (Te)	0.00020						
	Thallium (Tl)	0.0000020	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Thorium (Th)	0.00010						
	Tin (Sn)	0.000030	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.00030	<0.010	<0.010	0	<0.010	<0.010	0
	Tungsten (W)	0.00010						
	Uranium (U)	0.0000070	0.00423	0.00433	2.3	0.000564	0.000540	4.3
	Vanadium (V)	0.000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.00050	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.00010						
Other	Chlorophyll a	0.10	0.22	0.24	8.7	1.02	0.71	**36**
	Phaeophytin a	0.10	0.37	0.4	7.8	0.49	0.5	2.0

Figure A.5: Sediment sample field duplicate results. Highlighted values did not meet the data quality objective of ≤ 40% Relative Percent Difference (RPD).

Parameter	Lowest Detection Limit	Units	REF-03-9	REF-03-DUP	% RPD	JLO-02	JLO-DUP	% RPD	DLO-01-02	DLO-01-DUP	% RPD	BLO-06	BLO-DUP	% RPD
			16-Aug-2016	16-Aug-2016		11-Sep-2016	11-Sep-2016		13-Aug-2016	13-Aug-2016		15-Aug-2016	15-Aug-2016	
Total Organic Carbon	0.10	%	4.46	4.36	2	3.03	3.68	19	1.90	1.93	2	1.23	1.06	15
Aluminum (Al)	50	µg/g	22,600	21,100	7	19,800	14,200	33	19,700	17,400	12	25,700	25,300	2
Antimony (Sb)	0.10	µg/g	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	0.10	0	<0.10	<0.10	0
Arsenic (As)	0.10	µg/g	5.64	6.24	10	12.1	7.2	51	4.41	4.05	9	3.95	3.91	1
Barium (Ba)	0.50	µg/g	148	179	19	155.0	184	17	86.4	130.0	40	105.0	107.0	2
Beryllium (Be)	0.10	µg/g	0.94	0.87	8	0.87	0.91	4	1.02	0.88	15	1.38	1.33	4
Bismuth (Bi)	0.20	µg/g	<0.20	<0.20	0	0.27	0.30	11	0.23	0.23	0	0.25	0.24	4
Boron (B)	5.0	µg/g	17.0	17.3	2	20.9	24.1	14	30.0	23.9	23	39.5	33.5	16
Cadmium (Cd)	0.020	µg/g	0.161	0.194	19	0.249	0.284	13	0.215	0.267	22	0.140	0.139	1
Calcium (Ca)	50	µg/g	5,640	5,710	1	4,340	5,460	23	4,570	4,320	6	4,900	4,600	6
Chromium (Cr)	0.50	µg/g	74.6	68.1	9	80.9	63.7	24	73.7	67.7	8	89.2	85.7	4
Cobalt (Co)	0.10	µg/g	16.3	18.4	12	23.3	18.4	24	15.4	15.4	0	17.2	17.2	0
Copper (Cu)	0.50	µg/g	92.8	83.6	10	51.4	45.3	13	41.7	38.5	8	33.9	34.2	1
Iron (Fe)	50	µg/g	46,800	61,000	26	54,100	44,000	21	37,300	35,500	5	42,100	41,800	1
Lead (Pb)	0.50	µg/g	21.4	33.3	44	19.9	21.2	6	22.3	53.2	82	35.0	37.4	7
Lithium (Li)	2.0	µg/g	39.2	37.4	5	27.6	30.1	9	35.9	32.1	11	51.9	51.1	2
Magnesium (Mg)	20	µg/g	15,000	13,400	11	15,800	12,300	25	12,800	11,300	12	16,800	17,000	1
Manganese (Mn)	1.0	µg/g	1,090	6,010	139	1,530	3,550	80	1,140	4,480	119	745	693	7
Mercury (Hg)	0.0050	µg/g	0.0703	0.0770	9	0.0414	0.0501	19	0.0342	0.0341	0	0.0524	0.0513	2
Molybdenum (Mo)	0.10	µg/g	2.41	6.57	93	1.55	2.48	46	2.72	8.79	105	0.92	0.80	14
Nickel (Ni)	0.50	µg/g	51.7	50.0	3	87.8	74	18	67.4	70.6	5	60.1	60.0	0
Phosphorus (P)	50	µg/g	972	1,060	9	1,870	1,290	37	881	789	11	751	782	4
Potassium (K)	100	µg/g	5,520	4,990	10	4,380	3,730	16	4,890	4,380	11	6,490	6,240	4
Selenium (Se)	0.20	µg/g	0.82	0.92	11	0.40	0.46	14	0.36	0.33	9	0.24	0.22	9
Silver (Ag)	0.10	µg/g	0.26	0.22	17	0.11	0.11	0	0.13	0.13	0	0.14	0.13	7
Sodium (Na)	50	µg/g	430	382	12	210	169	22	294	249	17	395	384	3
Strontium (Sr)	0.50	µg/g	14.7	14.8	1	8.7	10.2	16	11.9	10.2	15	15.9	14.6	9
Sulfur (S)	5000	µg/g	<5,000	<5,000	0	<5,000	<5,000	0	<5,000	<5,000	0	<5,000	<5,000	0
Thallium (Tl)	0.050	µg/g	0.754	0.789	5	0.485	0.622	25	0.543	0.595	9	0.647	0.632	2
Tin (Sn)	2.0	µg/g	6.6	23.7	113	3	<2.0	40	3.1	49.2	176	17.7	23.1	26
Titanium (Ti)	1.0	µg/g	1,210	1,200	1	1,070	800	29	1,240	1,040	18	1,680	1,640	2
Uranium (U)	0.050	µg/g	23.0	22.6	2	6.05	7.90	27	6.47	6.10	6	10.70	9.46	12
Vanadium (V)	0.20	µg/g	65.8	60.9	8	67.8	51.7	27	57.3	51.0	12	70.2	69.3	1
Zinc (Zn)	2.0	µg/g	94.7	87.7	8	67.0	54.3	21	67.1	63.2	6	85.3	84.6	1
Zirconium (Zr)	1.0	µg/g	4.3	3.1	32	5.6	6.7	18	4.4	5.4	20	24.8	24.2	2

duplicate samples for these parameters potentially reflected a combination of naturally high spatial variability of these parameters in lake sediments and/or inadequate sediment sample homogenization in the field and/or during laboratory sample preparation. Concentrations of lead, manganese, molybdenum and tin exhibited the highest between-duplicate variability (i.e., RPD), including those collected at Reference Lake 3, and therefore results for these parameters should take this variability into account during data interpretation. For all other metals, data precision was high and considered acceptable for providing reliable interpretation of the sediment quality data.

A2.3 Benthic Invertebrate Community Samples

A2.3.1 Subsampling Accuracy

Sub-sampling of benthic invertebrate community samples was conducted on 27 of 68 stream samples (40%) and 12 of 31 lake samples (39%; total of 39%) with the sorted fraction for these samples ranging between 12.5% (1/8) to 50% (1/2) of the sample material (Table A.8). Sub-sampling error estimates indicated that, on average, precision and accuracy of the sub-sampled benthic invertebrate community samples met the DQO of ≤ 20% (Table A.6). Only one of the six paired sub-sample comparisons resulted in precision and accuracy outside of the DQO for the quartered sample (Table A.6), but on average for this sample, and all others, precision and accuracy achieved the DQO of ≤ 20%. Overall, this indicated that precision and accuracy for sub-sampling of the benthic invertebrate community samples was acceptable.

A2.3.2 Organism Recovery

Sorting efficiency (i.e., percent recovery) of benthic invertebrate samples was high, averaging 98% for each of the eight lotic and three lentic samples evaluated (Table A.7a,b). Sorting efficiency for these samples achieved the DQO of ≥ 90% recovery, and therefore the benthic invertebrate community sample recovery was considered acceptable.

Table A.6: Subsampling error for benthic macroinvertebrate samples, Mary River Project CREMP, 2016.

a) Lotic (creek and river) samples

Station	Whole Organisms	Number of Organisms in Fraction 1	Number of Organisms in Fraction 2	Number of Organisms in Fraction 3	Number of Organisms in Fraction 4	Actual Density*	Precision		Accuracy	
							% range		min	max
CLT1-US-B2	19	109	130	-	-	239	16.2	-	8.8	-
CLT1-US-B5	24	175	185	-	-	360	5.4	-	2.8	-
SDLT9-B3	-	188	189	-	-	377	0.5	-	0.3	-
REF-CRK-B5	8	88	90	-	-	178	2.2	-	1.1	-
SDLT1-B2	2	83	96	-	-	179	13.5	-	7.3	-

b) Lentic (lake) samples

Station	Whole Organisms	Number of Organisms in Fraction 1	Number of Organisms in Fraction 2	Number of Organisms in Fraction 3	Number of Organisms in Fraction 4	Actual Density*	Precision		Accuracy	
							% range		min	max
REF-03-1	0	77	96	100	104	377	3.8	26.0	1.9	18.3
DL0-02-1	0	97	100	111	112	420	0.9	13.4	4.8	7.6
DL0-02-9	0	166	168	193	195	722	1.0	14.9	6.9	8.0

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

Table A.7: Percent recovery of benthic macroinvertebrate samples, Mary River Project CREMP, 2016.

(a) Lotic (creek and river) samples

Station	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
CLT1-US-B4	314	320	98.1%
CLT2-US-B2	136	140	97.1%
REF-CRK-B2	195	200	97.5%
SDLT1-R1-B3	230	232	99.1%
SDLT9-DS-B3	383	392	97.7%
CO-05-B4	407	415	98.1%
EO-01-B5	92	93	98.9%
GO-09-B3	199	201	99.0%
		Average % Recovery	**98.2%**

b) Lentic (lake) samples

Station	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
REF-03-3	99	104	95.2%
JLO-30	124	126	98.4%
BLO-21	155	155	100.0%
		Average % Recovery	**97.9%**

Table A.8: Sample fractions sorted for benthic macroinvertebrates samples, Mary River Project CREMP, 2016. Any samples not listed were sorted in their entirety (total of 68 lotic and 31 lentic samples).

(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	CLT1-L2-B2	1/4	SDLT1-R1-B2	1/2	REF-03-2	1/ 4	DLO-02-3	1/ 4
CLT1-US-B3	1/2	CLT1-L2-B3	1/4	SDLT1-R1-B3	1/4	JLO-02	1/ 4	DLO-02-11	1/ 4
CLT1-US-B4	1/2	CLT1-L2-B4	1/8	SDLT1-R1-B4	1/2	JLO-21	1/ 4	BLO-20	1/ 2
CLT1-US-B5	1/2	CLT1-L2-B5	1/8	SDLT1-R1-B5	1/2	JLO-30	1/ 2		
CLT1-DS-B1	1/4	REF-CRK-B1	1/4	SDLT9-DS-B1	1/2	JLO-31	1/ 2		
CLT1-DS-B2	1/2	REF-CRK-B2	1/2	SDLT9-DS-B2	1/4	JLO-32	1/ 4		
CLT1-DS-B3	1/4	REF-CRK-B3	1/2	SDLT9-DS-B3	1/2	DD-Hab 9	1/ 4		
CLT1-DS-B4	1/4	REF-CRK-B4	1/2	SDLT9-DS-B4	1/2	DLO-01-3	1/ 4		
CLT1-L2-B1	1/4	SDLT1-R1-B1	1/4	SDLT9-DS-B5	1/4	DLO-01-9	1/ 8		

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.

A3.0 DATA QUALITY STATEMENT

The DQR results generally indicated that water, sediment and benthic invertebrate community data were of acceptable quality. Few water quality and sediment quality parameters did not meet acceptable DQO. In general, most parameters that did not meet respective DQO typically showed very low margins of error relative to respective criteria and/or were observed at low concentrations often near MDL which led to relatively small incremental differences in concentrations between replicates resulting in failure to meet DQO. However, key exceptions to this occurred for barium and phenols concentrations, which routinely did not meet DQO in trip, field and equipment blank analyses suggesting that the results for these parameters should be interpreted with caution. Although it was unclear as to the source of barium and phenols in the blank samples, the deionized water used to create blanks has been cited as the most likely source of blank contamination in previous CREMP (KP 2015). The benthic invertebrate community data quality was also acceptable, meeting all required precision, accuracy and percent recovery benchmarks. Overall, the data associated with the 2016 CREMP were considered defensible and acceptable for interpretation and derivation of conclusions with a reasonable level of confidence.

APPENDIX B

REFERENCE AREA DESCRIPTIVE OVERVIEW

APPENDIX B: REFERENCE AREA OVERVIEW

LIST OF FIGURES

After Page …

LIST OF TABLES

After Page …

B.0 OVERVIEW OF REFERENCE CONDITIONS

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

B.1 Reference Areas

B.1.1 Creek/Tributary Environments

Four reference creek/tributary (reference creek) stations were established among two unnamed tributaries to Angajurjualuk Lake (Stations CLT-REF4, MRY-REF2 and MRY-REF3) and one unnamed tributary to the Mary River (Station CLT-REF3) during the Mary River Project CREMP in 2014[1] (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 previous 2015 study and the current 2016 study (see Table 2.1). In 2016, 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, the mid-portion area of this tributary served as a benthic reference creek (REF-CRK) in comparisons to the various mine-exposed tributaries as part of the 2016 CREMP (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

[1] No baseline (2005 – 2013) water chemistry, phytoplankton (chlorophyll a), benthic invertebrate community, or fish population data are available for the CLT-REF and MRY-REF reference creek stations, nor for Reference Lake 3, precluding evaluation of mine-related effects at various mine-exposed lotic and lentic systems based on a before-after control-impact (BACI) approach. In addition, because no intensive physico-chemical or biological sampling was conducted at Reference Lake 3 in 2014, no statistical comparisons were able to be conducted between the mine-construction period data (2014) and the 2015 – 2016 data.

as dictated by localized topography and associated gradient. The wetted width and depth of the benthic reference tributary averaged 9.0 m and 0.13 m, respectively, during the August survey in 2016 (Appendix Table F.1). The corresponding water velocities across a representative riffle area of the benthic reference tributary ranged from 0.05 – 0.49 m/s in August 2016 (average of 0.30 m/s; Appendix Table F.1). 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 – September). The substrate at the reference tributaries is composed mainly of cobble and large pebble (i.e., 50 – 256 mm diameter), with surficial areas of sand generally limited to less than 10% of stream area (Appendix Table F.1). In-stream vegetation at the reference tributaries is sparse, and generally includes a relatively thin layer of algae/periphyton attached to surficial substrate in areas providing suitable growing conditions.

B.1.2 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 2014). 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 2014; 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 for comparison to data from areas of the Mary River that are potentially influenced by mine activity.

The Mary River reference area is a moderate gradient erosional environment characterized mainly by roughly equal proportions of riffle, run, and rapid stream morphology (Appendix Table F.1). Depending on flow conditions, average wetted width and average depth of the Mary River reference area has ranged from 33 – 55 m and 0.25 - 0.36 m, respectively, in studies conducted by Minnow during the month of August. On average, the corresponding water velocities across representative riffle areas of the GO-09 benthic study area has ranged from 0.20 – 0.47 m/s during these studies. The substrate at the GO-09 reference area is composed mainly of boulder, with cobble and large pebble comprising the surficial substrate at much of the remaining area (Appendix Table F.1). In-stream vegetation at the Mary River GO-09 reference area is sparse, and generally includes a relatively thin layer of algae/periphyton attached to surficial substrate in areas providing suitable growing conditions.

B.1.3 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 community 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 as part of the 2015 and 2016 Mary River Project CREMP studies (Table B.1).

Table B.1: Comparison of lake physical characteristics for mine-exposed lakes and Reference Lake 3 (data reproduced from NSC 2015b).

Lake Feature		Mine Exposed Lakes			Reference Lake
		Camp	Sheardown NW	Sheardown SE	Reference Lake 3
Physical Characteristics	Drainage Basin Area (km^2)	26.5	6.6	-	23.2
	Lake Area (km^2)	2.21	0.68	0.25	2.05
	Drainage Basin: Lake Area Ratio	11.98	9.66	-	11.32
	Mean Depth (m)	13.0	12.1	7.4	11.8
	Maximum Depth (m)	35.1	30.1	14.8	38.3
	Volume (1,000,000 m^3)	27.5	8.18	1.8	22.6

Reference Lake 3 is an unnamed lake located approximately 62 km south of the Mary Lake Project (see Figures 2.1 and 2.3), well outside the area of mine influence. Reference Lake 3 is a headwater lake that is characterized by a relatively complex morphology that includes three basins and connection to a separate lake by a short, shallow channel (see Figure 2.3). The three basins reach approximately 15 m, 30 m and 36 m in depth with progression from east to west, and the average depth of Reference Lake 3 is approximately 11.8 m (Appendix Table B.1). The outlet of Reference Lake 3, located off the south-central portion of the lake, drains into a large boulder field through which flow can occur largely as sub-surface drainage. Substrate along the shoreline and shallow littoral areas of Reference Lake 3 is composed mainly of large boulder and cobble which 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% 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 rocky substrates along the shoreline and shallow littoral zone of the lake.

B.2 Background Water Quality

B.2.1 Creek/Tributary Environments

Water chemistry at the reference creek stations showed occasionally elevated phenol and aluminum concentrations compared to WQG and AEMP benchmarks for lotic environments (Appendix Table B.2). Phenols can be formed naturally through the decomposition of organic matter or through synthesis in plants and fungi in the presence of hydrogen peroxide and inorganic chlorine (Michalowicz and Duda 2007). In natural waters, phenol concentrations commonly range from 0.01 to 2 µg/L, and therefore concentrations at the reference creek stations in 2016 appeared to be naturally high, but were not unlike those observed previously in 2015 (i.e., 2015 and 2016 average of 2.6 and 3.2 µg/L, respectively). Spearman's rank correlations conducted using the 2016 reference creek station data indicated a significant positive relationship between phenol concentrations and nitrate and dissolved organic carbon (DOC) concentrations ($r = 0.59$ and 0.75, respectively). This suggested that the elevated phenol concentrations at the stream reference area likely reflected influences associated with natural vegetative decomposition processes.

Total aluminum concentrations at the stream reference stations showed a significant, positive correlation with turbidity (Spearman's Rank $p = 0.017$; $r = 0.67$), suggesting that a high proportion of aluminum was likely bound to, and/or composed, the suspended particulate materials (e.g., aluminosilicate clay minerals). This was supported by examination of the ratio between dissolved and total aluminum concentrations, which indicated that a higher proportion of aluminum was associated with the total (particulate) fraction in 2016 (i.e., 75%, on average; compare Appendix Tables B.2 and C.4). Therefore, despite occasional elevation of total aluminum at the reference creek stations

Table B.2: Water chemistry at reference creek stations, Mary River Project CREMP, 2016.

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark	Spring Sampling Event				Summer Sampling Event				Fall Sampling Event			
					CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2	CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2	CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2
					27-Jun-2016	27-Jun-2016	27-Jun-2016	27-Jun-2016	24-Jul-2016	24-Jul-2016	25-Jul-2016	25-Jul-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	22.2	35.3	16.0	39.6	81.9	71.7	56.6	97.2	137	116	111	136
	pH (lab)	pH	6.5 - 9.0	-	7.22	7.38	6.80	7.41	7.90	7.75	7.33	7.78	8.15	7.95	7.78	8.09
	Hardness (as $CaCO_3$)	mg/L	-	-	10	16	<10	18	39	34	21	46	67	57	41	66
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	2.0	<2.0	<2.0	<2.0	2.4	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	18	16	20	26	52	45	32	<13	68	56	60	75
	Turbidity	NTU	-	-	0.82	0.51	3.80	0.67	2.53	1.09	9.87	1.71	0.86	0.91	0.69	1.92
	Alkalinity (as $CaCO_3$)	mg/L	-	-	<10	17	<10	20	38	35	15	44	72	55	34	67
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	0.028	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.022	0.023	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	0.022	0.023	<0.021	<0.021
	Dissolved Organic Carbon	mg/L	-	-	<1.0	1.0	<1.0	1.1	<1.0	<1.0	<1.0	<1.0	1.0	1.3	1.1	1.6
	Total Organic Carbon	mg/L	-	-	<1.0	1.2	1.1	1.3	<1.0	1.3	<1.0	1.1	1.2	1.5	1.3	1.9
	Total Phosphorus	mg/L	0.020[α]	-	0.0058	0.0044	0.0087	0.0173	0.0042	<0.0030	0.0100	0.0042	0.0031	0.0083	0.0047	0.0075
	Phenols	mg/L	0.004[α]	-	0.0034	0.0024	0.0026	0.0038	0.0013	<0.0010	<0.0010	0.0012	0.0041	0.0073	0.0038	0.0067
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	1.07	0.58	<0.50	<0.50	2.48	1.19	0.60	<0.50	7.15	1.74
	Sulphate (SO_4)	mg/L	218[β]	218	<0.30	0.36	1.25	0.31	0.72	1.06	5.27	1.46	1.69	2.64	11.1	2.14
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0250	0.0202	0.0631	0.0180	0.0847	0.0284	***0.263***	0.0649	0.0364	0.0318	0.0969	0.066
	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	-	-	0.00121	0.00224	0.00217	0.00201	0.00385	0.00457	0.00684	0.00580	0.00562	0.00647	0.0106	0.00847
	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	<0.00010
	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	<0.000050
	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
	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	-	-	2.12	3.37	1.24	3.72	8.04	6.91	4.71	9.03	14.3	11.6	9.16	14.1
	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	0.0022	<0.00050	0.00063	<0.00050	<0.00050	<0.00050	0.00096	0.00116	0.00057	0.00064	0.00115	0.00121	<0.0010
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	0.062	<0.030	0.039	0.039	0.209	0.042	<0.030	0.044	0.073	0.057
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.000079	0.000100	<0.000050	0.000055	0.000116	0.000251	<0.000050	<0.000050	0.000087	0.000148	<0.00010
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	1.18	1.93	0.632	2.12	4.51	4.08	2.44	5.37	7.91	6.75	4.49	7.91
	Manganese (Mn)	mg/L	0.935[β]	-	0.000475	0.000394	0.00239	0.000605	0.000525	0.00107	0.00257	0.000842	0.000194	0.00124	0.000886	0.00110
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	<0.000050	0.000149	0.000066	<0.000050	0.000111	0.000391	0.000205	0.000144	0.000287	0.000576	0.000382	0.000273
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00054	<0.00050	<0.00050	<0.00050	0.00074	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	<0.20	0.29	0.24	0.28	0.49	0.53	0.73	0.64	0.69	0.75	1.03	0.904
	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	<0.000050
	Silicon (Si)	mg/L	-	-	0.27	0.49	0.36	0.34	0.80	0.80	1.30	0.80	0.79	0.99	1.13	0.880
	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	<0.000050
	Sodium (Na)	mg/L	-	-	0.211	0.277	0.568	0.407	0.575	0.576	1.73	1.09	1.27	0.989	3.47	1.59
	Strontium (Sr)	mg/L	-	-	0.00165	0.00234	0.00283	0.00285	0.00616	0.00452	0.0103	0.00754	0.0109	0.00770	0.0195	0.0115
	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	<0.000010
	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
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.012	<0.010	<0.010	<0.010	<0.010	0.00196
	Tungsten (W)	mg/L	0.030[α]	-												<0.00010
	Uranium (U)	mg/L	0.015	-	0.000095	0.000212	0.000232	0.000194	0.00137	0.000646	0.000537	0.000962	0.00736	0.00312	0.00154	0.00261
	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	<0.00050
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	-	-												<0.00030

[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.

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

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

in 2016, these metals were unlikely to be biologically available. No other parameters were observed at concentrations above WQG or the AEMP benchmarks at the reference creek stations in 2016. Notably, manganese also showed a higher proportion in the total fraction compared to the dissolved fraction (i.e., 56%, on average, in the total fraction) at the reference creek stations in 2016, suggesting that a large proportion of aqueous manganese concentrations were also naturally associated with particulate matter in lotic waters near the Mary River Project.

Water chemistry at the reference creek stations showed distinct seasonal changes in concentrations for some parameters (Appendix Figure B.1; Appendix Table B.2). In general, conventional parameters, ions and total metals were observed at lowest concentrations in spring, with intermediate concentrations in the summer and highest concentrations observed during the fall sampling event in 2016 (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 water quality monitoring conducted at reference creek stations showed similar seasonal patterns (KP 2014b; Minnow 2016a). Temporal comparison of mean water chemistry for the reference creek stations showed no substantial changes in water quality from 2014 to 2016, suggesting that water chemistry at the reference creek stations was relatively consistent year-to-year taking seasonal sampling timing into account. Therefore, the reference creek stations were deemed to provide a meaningful benchmark for the evaluation of potential mine-related influences on water chemistry at mine-exposed creek/ tributary receiving environments.

B.2.2 River Environments

Water chemistry at the Mary River reference stations (GO-09 series) showed elevated phenol, aluminum, iron and total phosphorus concentrations compared to WQG and/or applicable AEMP benchmarks in at least one seasonal sampling event in 2016 (Appendix Table B.3). Similar to the reference creek stations, significant positive relationships between phenol and DOC concentrations at the Mary River GO-09 reference stations in 2016 (Spearman Rank Correlation $p = 0.01$ and $r = 0.80$) suggested that elevated phenol concentrations at the Mary River reference area were associated with influences from natural decomposition of vegetation. Mary River GO-09 reference station total aluminum and iron concentrations, as well as total concentrations of other metals including chromium, cobalt, copper, lead, nickel and titanium, showed strong positive correlations

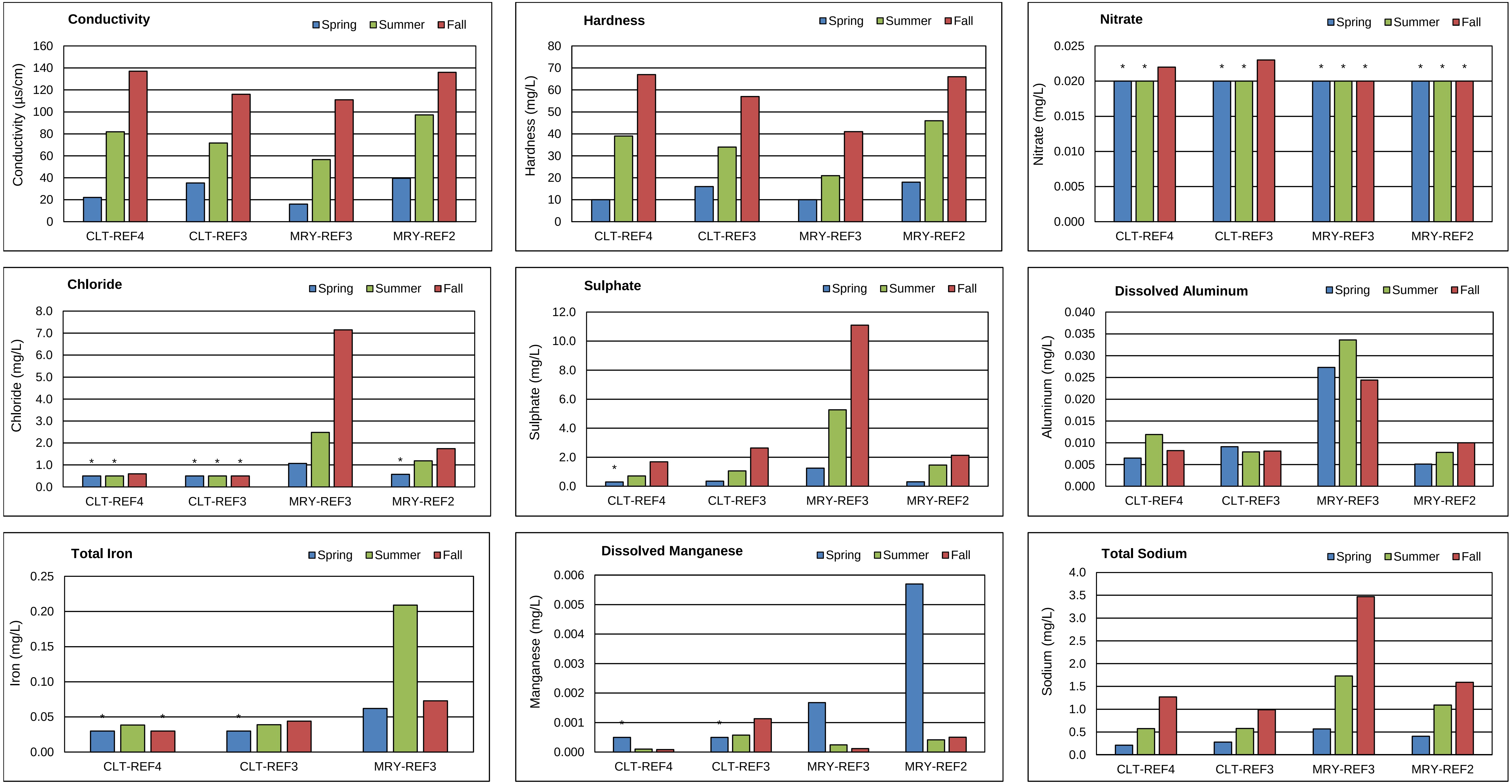


Figure B.1: Seasonal variation in water chemistry at stream/tributary reference stations, Mary River Project CREMP, 2016. Asterisk (*) indicates that the parameter concentration was below the method detection limit.

Table B.3: Water chemistry at Mary River GO-09 series reference stations, Mary River Project CREMP, 2016.

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
					29-Jun-2015	29-Jun-2015	29-Jun-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	13-Aug-2015	13-Aug-2015	13-Aug-2015
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	21.4	25.6	23.9	104	72.3	72.2	138	147	140
	pH (lab)	pH	6.5 - 9.0	-	6.86	6.94	7.06	7.97	7.905	7.94	8.03	8.01	8.01
	Hardness (as $CaCO_3$)	mg/L	-	-	<10	13	11	49	33.5	33	62	65	66
	Total Suspended Solids (TSS)	mg/L	-	-	46.4	13.6	12.8	<2.0	2.2	2.8	5.6	3.2	4.4
	Total Dissolved Solids (TDS)	mg/L	-	-	<20	<20	<20	51	59	43	70	73	73
	Turbidity	NTU	-	-	16.6	8.08	8.75	2.05	10.05	9.67	16.5	13.8	17.7
	Alkalinity (as $CaCO_3$)	mg/L	-	-	<10	11	<10	52	35.5	35	57	59	59
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.16
	Dissolved Organic Carbon	mg/L	-	-	<1.0	1.3	1.1	<1.0	<1.0	<1.0	1.3	1.4	1.4
	Total Organic Carbon	mg/L	-	-	1.1	1.5	1.1	<1.0	<1.0	<1.0	1.1	1.3	1.3
	Total Phosphorus	mg/L	0.020[α]	-	0.0862	0.0214	0.021	0.0056	0.00895	0.0134	0.0122	0.0079	0.0115
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0048	0.0040	0.0050
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	1.54	1.07	1.09	6.48	5.38	5.21
	Sulphate (SO_4)	mg/L	218[β]	218	0.33	<0.30	0.31	1.0	0.8	0.9	3.77	3.34	3.23
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	***0.374***	0.159	***0.213***	0.0815	0.135	0.119	***0.695***	***0.425***	***1.01***
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00012
	Barium (Ba)	mg/L	-	-	0.00553	0.00296	0.00368	0.0067	0.0060	0.0060	0.012	0.0111	0.0136
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<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
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	2.63	2.94	2.65	10	7	7	13.1	14.1	13.9
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00083	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00109	0.00077	0.00168
	Cobalt (Co)	mg/L	0.0009[α]	0.004	0.00031	0.00011	0.00016	<0.00010	<0.00010	<0.00010	0.00024	0.00017	0.00032
	Copper (Cu)	mg/L	0.002	0.0022	0.00119	0.00061	0.00078	0.0008	0.0008	0.0009	0.0014	0.0013	0.0019
	Iron (Fe)	mg/L	0.30	0.326	***0.512***	0.155	0.256	0.046	0.114	0.100	***0.559***	***0.367***	***0.75***
	Lead (Pb)	mg/L	0.001	0.001	0.000602	0.000278	0.000303	0.00006	0.00018	0.00016	0.00044	0.00033	0.00052
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	0.0012
	Magnesium (Mg)	mg/L	-	-	1.58	1.56	1.48	5.48	3.77	3.77	7.53	8.21	8.17
	Manganese (Mn)	mg/L	0.935[β]	-	0.0137	0.0055	0.00683	0.00065	0.00147	0.00132	0.0066	0.0046	0.0085
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	<0.000050	<0.000050	<0.000050	0.00016	0.00015	0.00015	0.00041	0.00034	0.00044
	Nickel (Ni)	mg/L	0.025	0.025	0.00068	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00083	0.0006	0.00111
	Potassium (K)	mg/L	-	-	0.44	0.34	0.39	0.86	0.78	0.76	1.4	1.27	1.5
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	0.79	0.55	0.63	0.90	0.74	0.72	1.72	1.29	2.47
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	0.334	0.217	0.328	1.610	1.130	1.120	3.38	3.24	3.24
	Strontium (Sr)	mg/L	-	-	0.00265	0.00208	0.00243	0.009	0.008	0.008	0.0166	0.0158	0.0166
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.000014	0.000011	0.000017
	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	-	-	0.028	<0.010	0.016	<0.010	<0.010	<0.010	0.0326	0.022	0.0449
	Uranium (U)	mg/L	0.015	-	0.000356	0.000135	0.00021	0.0011	0.0010	0.0009	0.00437	0.00408	0.00388
	Vanadium (V)	mg/L	0.006[α]	0.006	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00126	0.00091	0.00158
	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
	Zirconium (Zr)	mg/L	-	-				<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

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

with turbidity (Spearman Rank Correlation $p \leq 0.01$, $r \geq 0.80$). This, combined with the fact that no significant correlations were indicated between the dissolved concentrations of these metals and turbidity, suggested that total metal concentrations were largely associated with suspended particulate matter and that elevation of total metal concentrations above WQG reflected naturally turbid conditions. Comparison of the ratio between dissolved and total concentrations of aluminum and iron also indicated a high proportion of these metals was in the total (particulate) fraction in 2016 (i.e., 86% and 83%, respectively, on average; compare Appendix Tables B.3 and C.52).

Water chemistry at the Mary River reference stations showed distinct seasonal changes in concentrations of some parameters (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 2016, and in previous baseline (2005 – 2013) and 2015 water quality monitoring data collected at the Mary River GO-09 series reference stations (KP 2014b; Minnow 2016). The seasonal changes in the Mary River reference station parameter concentrations likely reflected greater dilution during the spring snowmelt period, and lower precipitation during the summer and fall periods. Temporal comparison of the Mary River GO-09 series reference station water chemistry indicated that on average, parameter concentrations in 2016 were comparable to, or in the upper range of, those observed during the baseline period and previous operating mine conditions based on fall monitoring data (Figure 5.2; Appendix Figure C.20). The occurrence of relatively high parameter concentrations in 2016 at the Mary River GO-09 reference station potentially reflected greater turbidity compared to previous studies, and suggested that water chemistry of Mary River is naturally variable as a result of the factors that affect turbidity. Nevertheless, on the whole, 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 stations and/or study areas.

B.2.3 Lake Environments (Reference Lake 3)

In-situ water temperature profiles conducted at Reference Lake 3 indicated a thermally stratified water column at the main lake basin in the summer, and throughout the lake in the fall of 2016 (Appendix Figure B.3). The thermocline was present between depths of approximately 5 and 8 m in the summer, and approximately 11 and 14 m in the fall (Appendix Figure B.3). Despite the occurrence of thermal stratification in 2016, no marked changes in dissolved oxygen concentration occurred with increased depth at any of the Reference Lake 3 basins, and dissolved oxygen saturation remained high (i.e., ≥ 95%) throughout the entire water column in both the summer and fall profiles (Appendix Figure

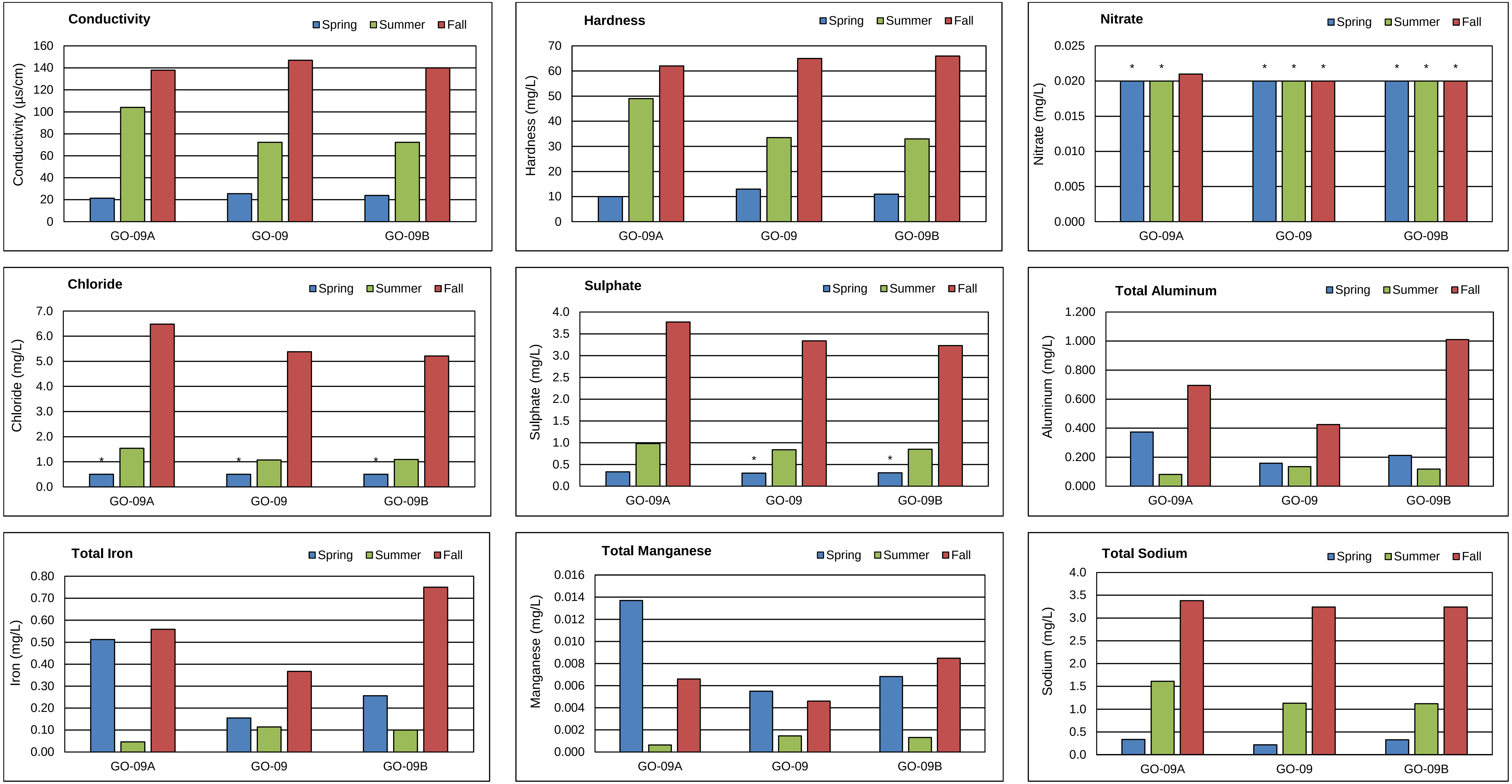


Figure B.2: Seasonal variation in water chemistry at Mary River (GO-09) reference stations, Mary River Project CREMP, 2016. Asterisk (*) indicates that the parameter concentration was below the method detection limit.

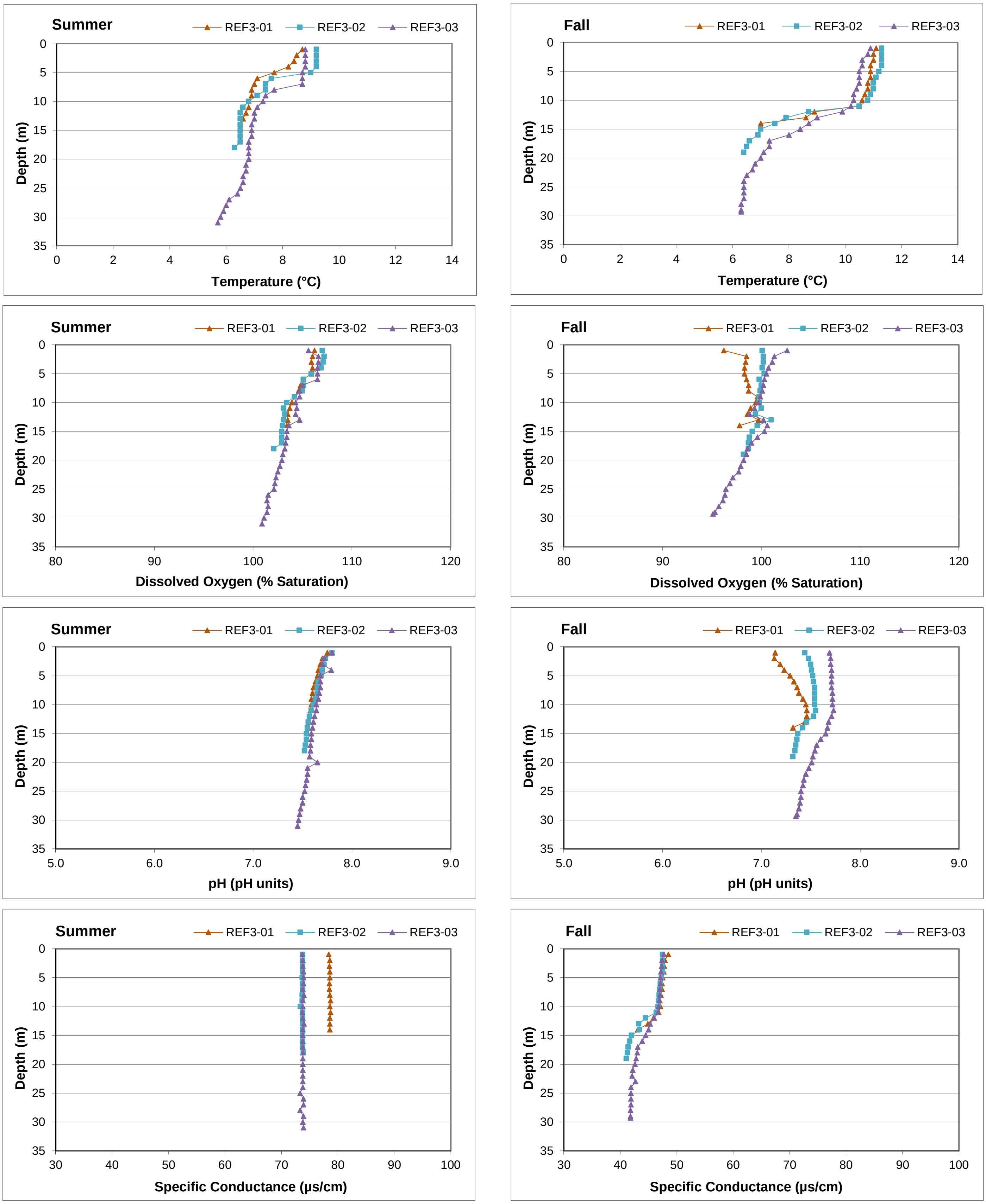


Figure B.3: ***In-situ*** **water quality with depth from surface at Reference Lake 3 during summer and fall sampling events, Mary River Project CREMP, 2016.**

B.3). The 2016 water quality profiles also showed only minor changes in pH and specific conductance among stations and with depth in each of the summer and fall sampling events (Appendix Figure B.3). Overall, the *in-situ* water quality profiles suggested relatively thorough lateral mixing within Reference Lake 3 and that, despite development of thermal stratification in 2016, no substantial influences on dissolved oxygen, pH or conductivity were associated with the changes in temperature with depth.

The evaluation of water chemistry at Reference Lake 3 showed that, consistent with observations at the lotic reference stations, aqueous phenol concentrations were occasionally elevated above WQG (Appendix Table B.4). In addition, similar to the Mary River GO-09 series reference stations, total phosphorus concentrations were elevated above WQG at Reference Lake 3, albeit in only one of six samples taken in 2016 (Appendix Table B.4). No other parameters were observed at concentrations above WQG at Reference Lake 3 in 2016. In addition, no parameters were observed at concentrations above lentic AEMP benchmarks at Reference Lake 3 (Appendix Table B.4), suggesting that these water quality benchmarks were relevant to the mine LSA lakes. No substantial differences in water chemistry were observed between the summer and fall at Reference Lake 3 in 2016, which was similar to observations among winter, summer and fall at LSA lakes during the mine baseline period and in summer and fall at Reference Lake 3 in 2015 (KP 2014a,c; Minnow 2016a).

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 (Appendix Figure B.4; Appendix Table B.4). The lack of any appreciable depth-related differences in parameter concentrations at each station likely reflected 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 at Reference Lake 3, reducing conditions conducive to metal mobilization from sediment to the overlying water are less likely to occur near the lake bottom, resulting in relative 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 LSA lakes provided no substantial gradients in dissolved oxygen saturation, pH and/or specific conductance occur within the water column.

Table B.4: Water chemistry at Reference Lake 3, Mary River Project CREMP, 20116.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event						Fall Sampling Event					
					REF3-01 surface 16-Jul-2016	REF3-01 bottom 16-Jul-2016	REF3-02 surface 28-Jul-2016	REF3-02 bottom 28-Jul-2016	REF3-03 surface 28-Jul-2016	REF3-03 bottom 28-Jul-2016	REF3-01 surface 20-Aug-2016	REF3-01 bottom 20-Aug-2016	REF3-02 surface 19-Aug-2016	REF3-02 bottom 19-Aug-2016	REF3-03 surface 20-Aug-2016	REF3-03 bottom 20-Aug-2016
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	76.5	76.4	76.4	76.3	76.6	76.0	123.5	76.2	76.7	76.4	76.5	76.6
	pH (lab)	pH	6.5 - 9.0	-	7.67	7.63	7.70	7.67	7.71	7.55	7.77	7.72	7.74	7.53	7.77	7.53
	Hardness (as $CaCO_3$)	mg/L	-	-	36	35	35	35	35	36	35	34	35	35	34	35
	Total Suspended Solids (TSS)	mg/L	-	-	3.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	43	49	44	47	46	49	37	33	39	40	41	41
	Turbidity	NTU	-	-	0.21	0.23	0.25	0.22	0.22	0.22	0.44	0.43	0.28	0.31	0.29	0.25
	Alkalinity (as $CaCO_3$)	mg/L	-	-	37	34	37	33	31	29	32	32	31	32	35	36
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.046	0.043	0.060	0.050
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.20	<0.15	0.18	<0.15	0.21	0.23	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Dissolved Organic Carbon	mg/L	-	-	2.5	2.4	2.7	2.8	2.6	2.5	2.8	2.7	2.6	2.7	2.6	2.7
	Total Organic Carbon	mg/L	-	-	2.7	2.7	2.6	2.7	2.7	2.7	2.8	2.8	2.7	2.8	2.8	2.8
	Total Phosphorus	mg/L	0.020[α]	-	0.0055	0.0044	0.0038	0.0052	0.0099	0.0037	0.0034	<0.0030	<0.0030	<0.0030	<0.0030	**0.0440**
	Phenols	mg/L	0.004[α]	-	0.0018	0.0028	0.0021	0.0023	0.0029	0.0037	0.0027	0.0017	0.0038	**0.0050**	0.0016	0.0038
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.28	1.37	1.59	1.30	1.33	1.31	1.27	1.28	1.26	1.28	1.26	1.29
	Sulphate (SO_4)	mg/L	218[β]	218	4.21	4.29	4.66	4.20	4.24	4.23	4.08	4.08	4.05	4.10	4.03	4.10
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0058	0.0031	<0.0030	0.0069	0.0034	0.0034	0.0035	<0.0030	0.0045	0.0084	<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	-	-	0.00638	0.00676	0.00658	0.00661	0.00690	0.00666	0.00665	0.00647	0.00647	0.00661	0.00649	0.00647
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	7.10	7.15	7.05	6.91	7.15	7.14	7.00	6.91	7.29	7.01	6.90	6.83
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	0.000535	<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	0.00070	0.00072	0.00078	0.00081	0.00081	0.00081	0.00083	0.00097	0.00078	0.00077	0.00073	0.00084
	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	-	-	4.16	4.36	4.46	4.28	4.51	4.62	4.37	4.34	4.11	4.32	4.29	4.14
	Manganese (Mn)	mg/L	0.935[β]	-	0.000646	0.000756	0.000657	0.000777	0.000823	0.000788	0.000570	0.000559	0.000582	0.000897	0.000535	0.000571
	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	-	0.000118	0.000115	0.000125	0.000123	0.000157	0.000120	0.000130	0.000132	0.000133	0.000182	0.000125	0.000116
	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	0.88	0.89	0.88	0.89	0.89	0.90	0.88	0.89	0.89	0.88	0.87
	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	-	-	0.43	0.45	0.44	0.45	0.44	0.47	0.40	0.40	0.39	0.46	0.39	0.48
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.790	0.846	0.847	0.839	0.855	0.847	0.832	0.840	0.841	0.836	0.831	0.835
	Strontium (Sr)	mg/L	-	-	0.00805	0.00800	0.00791	0.00780	0.00802	0.00801	0.00816	0.00802	0.00841	0.00815	0.00799	0.00798
	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	-	0.000249	0.000249	0.000252	0.000249	0.000258	0.000253	0.000282	0.000266	0.000280	0.000269	0.000275	0.000247
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	-	-												

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

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

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

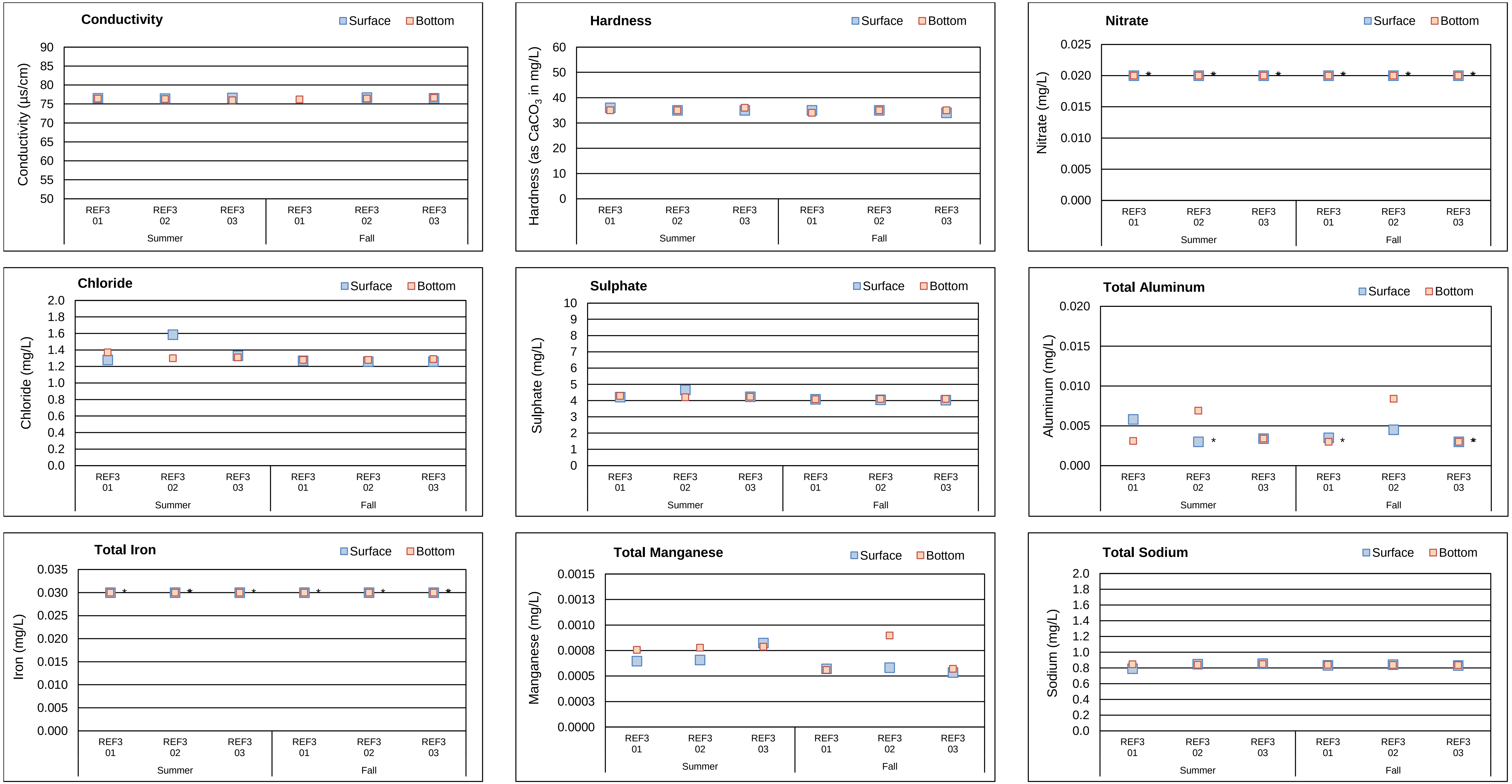


Figure B.4: Water chemistry comparison between the surface and the bottom of the water column at Reference Lake 3 routine monitoring stations during summer and fall, Mary River Project CREMP, 2016. Asterisk (*) indicates that the parameter concentration was below the laboratory method detection limit.

B.3 Background Sediment Quality Observations

B.3.1 Lotic Environments

The Mary River Project CREMP had proposed sediment chemistry sampling at lotic areas of the Camp Lake tributaries, Sheardown Lake tributaries, and the Mary River to provide qualitative information to support the lake sediment chemistry data analysis (KP 2014a, 2015). However, these watercourses were found to contain very limited depositional habitat during field studies conducted in 2014 and 2015 (KP 2015; Minnow 2016a), as well as in the current 2016 study. The general absence of any substantial accumulation of fine sediments within these watercourses precluded any meaningful assessment of potential mine-related influences on sediment chemistry within, along and/or between watercourses, and therefore no sediment chemistry sampling was conducted at lotic environments as part of the 2016 CREMP.

B.3.2 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 in 2015 and 2016 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, with a significantly higher and lower proportion of sand- and clay-sized material, respectively, present at littoral stations compared to profundal stations (Appendix Table B.5). No significant differences in sediment TOC content occurred between the littoral and profundal habitats. 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 sediments of Reference Lake 3 (Appendix Tables D.1 - D.3). 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.2 and D.3). The physical properties of sediment observed at Reference Lake 3 in 2016 were consistent with those of the 2015 study (Minnow 2016a).

Sediment metal concentrations 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.6; Appendix Figure B.5). The differences in sediment metal concentrations between the littoral and profundal station depths likely reflected a

Table B.5: Statistical comparison of substrate physical properties between littoral and profundal sediment stations of Reference Lake 3, Mary River Project CREMP, August 2016.

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	Sand (% by weight)	YES	0.009	β	Littoral	5	42.5	18.1	8.1	19.9	66.6
					Profundal	5	16.7	3.5	1.5	13.0	20.5
	Silt (% by weight)	YES	0.012	β , γ	Littoral	5	53.1	16.3	7.3	31.1	74.0
					Profundal	5	76.1	3.1	1.4	72.3	78.4
	Clay (% by weight)	YES	0.036	β , δ	Littoral	5	4.4	2.2	1.0	2.3	7.4
					Profundal	5	7.2	0.9	0.4	6.3	8.7
	TOC (%)	NO	0.824	α , δ	Littoral	5	4.8	2.0	0.9	3.3	8.0
					Profundal	5	4.6	0.3	0.1	4.3	5.0

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

Highlighted values indicate significant difference between lake depths based on ANOVA p-value less than 0.10.

Table B.6: Sediment particle size, total organic carbon, and metal concentrations at Reference Lake 3 (REF-03) sediment stations, Mary River Project CREMP, August 2016.

	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	%	-	-	66.6	32.9	39.8	53.5	19.9	42.5	8.1	20.5	13.0	15.2	13.4	20.2	16.5	1.15
	Silt	%	-	-	31.1	59.8	56.5	43.9	74.0	53.1	7.29	72.3	78.3	78.4	78.2	73.1	76.1	0.97
	Clay	%	-	-	2.30	7.4	3.70	2.70	6.10	4.4	0.99	7.2	8.7	6.3	8.4	6.7	7.5	0.33
	Moisture	%	-	-	95.4	99.0	89.8	97.7	66.6	89.7	5.99	72.9	70.5	93.2	72.5	97.6	81.3	4.10
	Total Organic Carbon	%	10$^{\alpha}$	-	5.39	8.04	3.30	4.09	3.42	4.85	0.88	4.31	4.82	5.03	4.36	4.65	4.63	0.096
Metals	Aluminum (Al)	mg/kg	-	-	15,200	17,700	16,600	16,400	16,500	16,480	397	23,700	30,300	25,500	21,100	24,400	25,000	1,068
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0.19	<0.10	<0.10	<0.10	<0.10	<0.10	0
	Arsenic (As)	mg/kg	17	5.9 - 6.2[c]	2.74	3.87	4.23	3.67	4.04	3.71	0.26	**5.96**	**7.24**	**6.98**	**6.24**	**6.25**	**6.53**	0.173
	Barium (Ba)	mg/kg	-	-	115	153	96.4	96.6	98.4	112	11	144	187	167	179	147	165	6.02
	Beryllium (Be)	mg/kg	-	-	0.61	0.70	0.70	0.69	0.67	0.67	0.02	0.96	1.20	1.04	0.87	0.99	1.01	0.039
	Bismuth (Bi)	mg/kg	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.00	<0.20	0.22	0.21	<0.20	<0.20	0.21	0.0028
	Boron (B)	mg/kg	-	-	11.4	16.4	12.1	12.4	12.9	13.0	0.9	17.8	22.4	20.3	17.3	18.1	19.2	0.68
	Cadmium (Cd)	mg/kg	3.5	1.5	0.135	0.284	0.095	0.096	0.121	0.146	0.035	0.165	0.200	0.205	0.194	0.153	0.183	0.007
	Calcium (Ca)	mg/kg	-	-	6,190	6,310	4,230	4,150	4,760	5,128	470	6,000	6,630	6,040	5,710	6,210	6,118	106.9
	Chromium (Cr)	mg/kg	90	79 - 98[c]	57.2	57.7	52.6	51.8	55.5	55.0	1.2	74.3	**93.8**	**84.2**	68.1	76.1	**79.3**	3.14
	Cobalt (Co)	mg/kg	-	-	8.87	8.86	11.6	11.2	10.2	10.1	0.6	16.9	20.9	18.6	18.4	17.0	18.4	0.51
	Copper (Cu)	mg/kg	197	50 - 58[c]	**55**	**96**	**60**	**64**	**58**	**66**	7	**94.6**	**121**	**105**	**83.6**	**98.1**	**100**	4.38
	Iron (Fe)	mg/kg	40,000$^{\alpha}$	34,400 - 52,400[c]	21,400	21,400	**34,900**	**37,400**	34,100	29,840	3,488	**49,200**	**60,700**	**55,200**	**61,000**	**48,900**	**55,000**	1,867
	Lead (Pb)	mg/kg	91.3	35	15.2	**95.9**	**79.9**	24.2	15.0	**46.0**	17.4	25.5	26.7	**48.8**	33.3	19.2	30.7	3.57
	Lithium (Li)	mg/kg	-	-	27.4	28.3	27.9	26.9	26.1	27.3	0.4	37.4	49.4	42.8	37.4	40.8	41.6	1.57
	Magnesium (Mg)	mg/kg	-	-	11,600	11,200	10,700	9,960	10,800	10,852	274	15,300	19,000	16,700	13,400	15,600	16,000	650
	Manganese (Mn)	mg/kg	1,100$^{\alpha,\beta}$	657 - 4,370	286	297	**686**	**767**	442	496	99	**1,170**	**1,420**	**2,020**	**6,010**	**1,170**	**2,358**	654.9
	Mercury (Hg)	mg/kg	0.486	0.17	0.0475	0.0515	0.0199	0.0234	0.0353	0.0355	0.0063	0.0633	0.0699	0.0738	0.0770	0.0687	0.0705	0.00165
	Molybdenum (Mo)	mg/kg	-	-	0.72	1.36	3.18	2.72	2.97	2.19	0.49	2.75	3.20	3.35	6.57	2.56	3.69	0.520
	Nickel (Ni)	mg/kg	75$^{\alpha,\beta}$	66 - 77[c]	40.1	44.4	35.8	35.7	37.1	38.6	1.6	53.3	65.1	59.1	50.0	53.0	56.1	1.90
	Phosphorus (P)	mg/kg	2,000$^{\alpha}$	1,278 - 1,958[c]	781	760	827	810	1,020	840	47	1,050	**1,320**	1,180	1,060	1,040	1,130	38.1
	Potassium (K)	mg/kg	-	-	3,280	4,260	4,170	3,820	3,940	3,894	172	5,460	6,870	6,040	4,990	5,830	5,838	221.8
	Selenium (Se)	mg/kg	-	-	0.45	0.69	0.36	0.39	0.55	0.49	0.06	0.67	0.93	1.00	0.92	0.78	0.86	0.042
	Silver (Ag)	mg/kg	-	-	0.11	0.16	<0.10	<0.10	0.11	0.12	0.01	0.24	0.32	0.28	0.22	0.26	0.26	0.012
	Sodium (Na)	mg/kg	-	-	254	403	260	250	313	296	29	412	527	491	382	437	450	18.6
	Strontium (Sr)	mg/kg	-	-	12.1	12.9	10.3	10.0	11.5	11.4	0.5	14.7	17.8	16.3	14.8	15.5	15.8	0.40
	Sulphur (S)	mg/kg	-	-	<5,000	<5,000	<5,000	<5,000	<5,000	5,000	0	<5,000	<5,000	<5,000	<5,000	<5,000	5,000	0
	Thallium (Tl)	mg/kg	-	-	0.325	0.389	0.418	0.362	0.445	0.388	0.021	0.723	0.916	0.845	0.789	0.748	0.804	0.0246
	Tin (Sn)	mg/kg	-	-	5.9	137	116	17.9	4.8	56.3	28.9	9.9	7.9	46.4	23.7	2.3	18.0	5.597
	Titanium (Ti)	mg/kg	-	-	1,050	1,060	1,010	1,030	1,210	1,072	36	1,280	1,580	1,370	1,200	1,220	1,330	48.9
	Uranium (U)	mg/kg	-	-	8.73	10.9	17.5	9.95	12.4	11.9	1.5	26.4	31.6	29.5	22.6	26.0	27.2	1.09
	Vanadium (V)	mg/kg	-	-	45.0	50.7	51.6	52.5	50.1	50.0	1.3	68.6	84.0	75.4	60.9	68.8	71.5	2.74
	Zinc (Zn)	mg/kg	315	123 - 135[c]	67.3	82.2	70.0	77.0	72.0	73.7	0.5	101	122	109	87.7	101	104.1	3.98
	Zirconium (Zr)	mg/kg	-	-	5.0	6.5	3.3	3.2	3.7	4.1	0.1	3.6	4.6	4.2	3.1	3.9	3.9	0.2

[a] Canadian Sediment Quality Guideline, probable effects level (PEL; CCME 2016) 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] Baffinland Mary River Project Aquatic Effects Monitoring Program (AEMP) sediment quality benckmarks (Baffinland 2014, 2016; Intrinsik 2014, 2015).

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

(grey box) Indicates paramter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

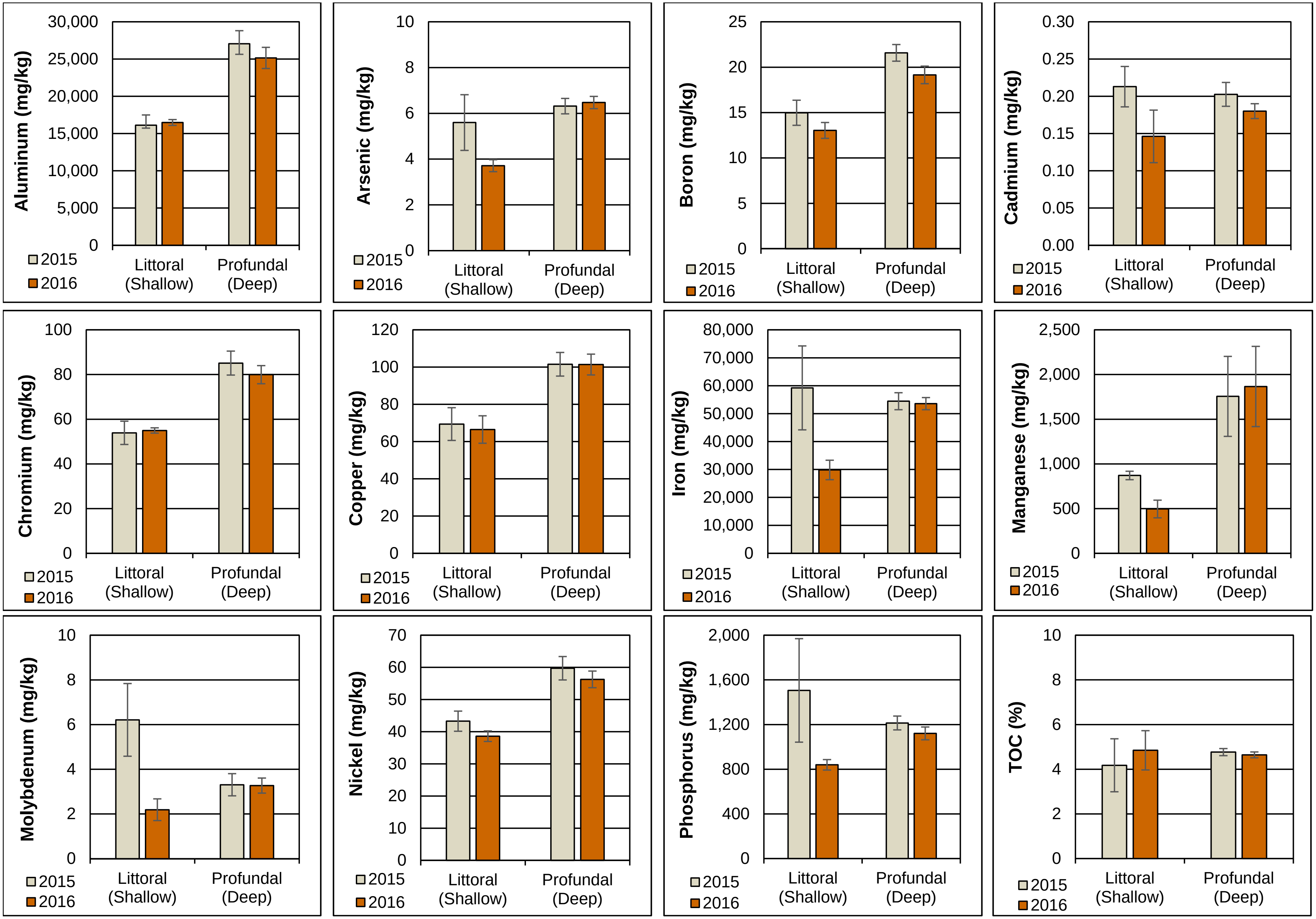


Figure B.5: Sediment metal concentrations (mean ± SE) at littoral (<12m depth) and profundal (>12m depth) monitoring stations of Reference Lake 3 (REF03), Mary River Project CREMP, August 2016.

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 and manganese were elevated above respective SQG only at profundal stations of Reference Lake 3 in 2016 (Appendix Table B.6). Sediment chromium and lead concentrations were also elevated above SQG at a single profundal and littoral station of Reference Lake 3, respectively (Appendix Table B.6). Therefore, compared to SQG, high concentrations of iron and manganese, and chromium and lead to a lesser extent, appear to occur naturally in sediments of Mary River Project LSA lakes. Mean copper and lead concentrations at littoral stations, and mean arsenic, chromium, 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.6). This suggested that the AEMP sediment benchmarks for these metals were conservative.

B.4 Phytoplankton Productivity (Chlorophyll a) Observations

B.4.1 Lotic Environments

Chlorophyll a concentrations, which were used as a surrogate for phytoplankton abundance, ranged from approximately 0.14 – 0.59 µg/L at the reference creek and river stations among spring, summer and fall sampling events in 2016 (Appendix Table B.7). 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 reference stations based on mean aqueous total phosphorus concentrations generally ranging between 4 – 10 µg/L during each respective spring, summer and fall sampling event in 2016 (Appendix Table B.2). However, a trophic status classification of ‘mesotrophic’ was suggested at the Mary River GO-09 series reference area based on an aqueous total phosphorus concentration falling between 10 – 20 µg/L for these same sampling events in 2016 (Appendix Table B.3). Seasonally, chlorophyll a concentrations did not differ significantly for the reference creek stations or the Mary River GO-09 series reference stations among the spring, summer and fall sampling events (Appendix Table B.8).

Comparisons between 2015 and 2016 chlorophyll a concentrations for like-season data indicated significantly higher concentrations in 2016 than 2015 at reference creek stations for the summer sampling event, but no differences for the spring and fall sampling events (Appendix Figure B.6). At the Mary River reference stations, significantly lower and higher

Table B.7: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at lotic reference stations, Mary River Project CREMP, 2016.

	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	27-Jun-16	27-Jun-16	27-Jun-16	27-Jun-16	26-Jun-16	26-Jun-16	26-Jun-16
	Summer	24-Jul-16	24-Jul-16	25-Jul-16	25-Jul-16	18-Jul-16	18-Jul-16	18-Jul-16
	Fall	20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16
Chlorophyll a (µg/L)	Spring	0.18	0.17	0.14	0.45	0.35	0.26	0.23
	Summer	0.41	0.31	0.56	0.37	0.29	0.24	0.22
	Fall	0.41	0.28	0.18	0.35	0.59	0.29	0.23
	Average	0.33	0.25	0.29	0.39	0.41	0.26	0.23
	Standard Deviation	0.13	0.07	0.23	0.05	0.16	0.03	0.01
	Standard Error	0.08	0.04	0.13	0.03	0.09	0.01	0.00
Phaeophytin a (µg/L)	Spring	0.28	0.29	0.28	0.45	0.39	0.35	0.31
	Summer	0.43	0.37	0.54	0.39	0.44	0.42	0.40
	Fall	0.34	0.30	0.30	0.33	0.46	0.40	0.33
	Average	0.35	0.32	0.37	0.39	0.43	0.39	0.35
	Standard Deviation	0.08	0.04	0.14	0.06	0.04	0.04	0.05
	Standard Error	0.04	0.03	0.08	0.03	0.02	0.02	0.03

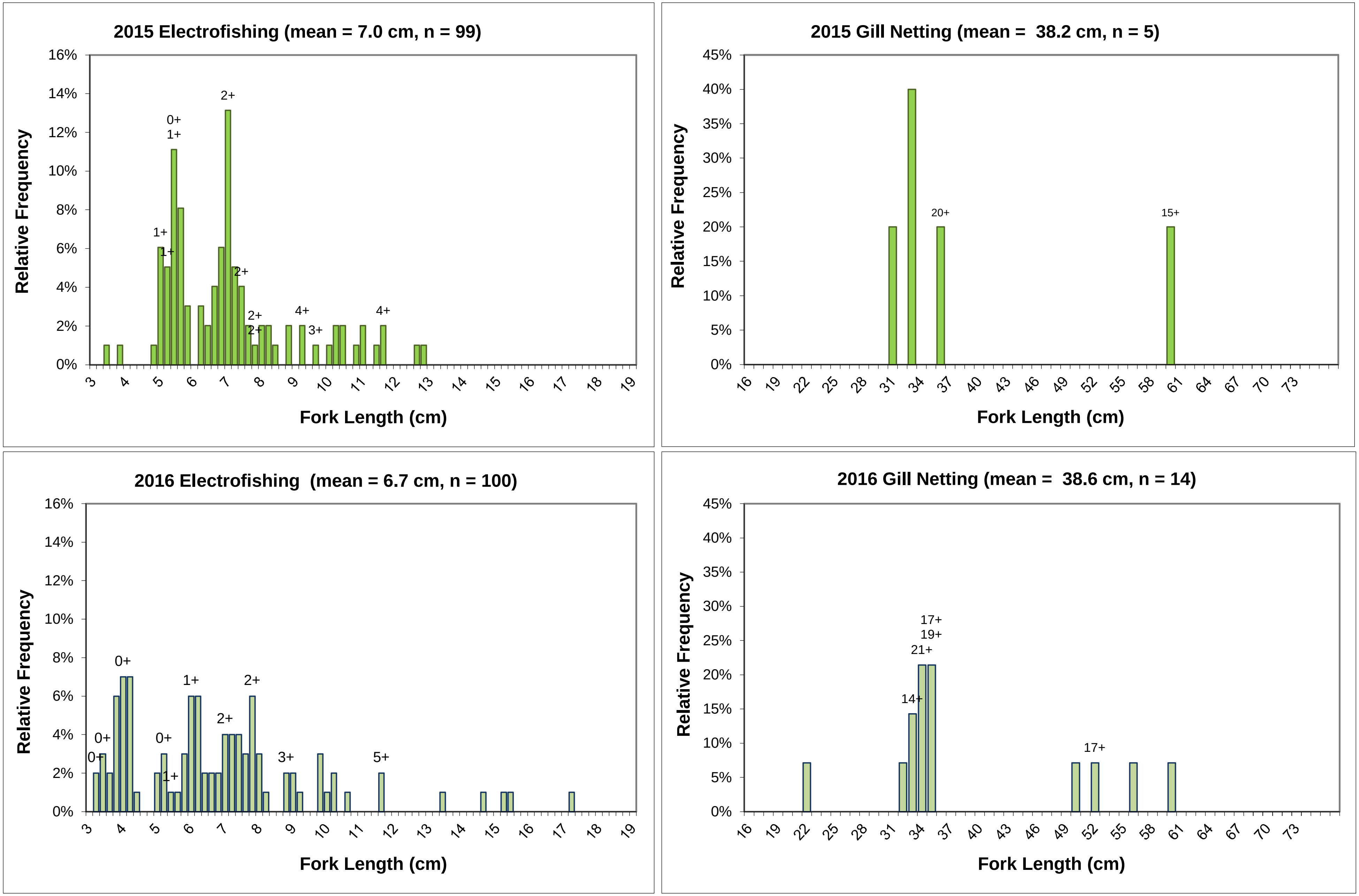


Figure B.8: Length-frequency distributions for Arctic charr captured by backpack electrofishing and gill netting at Reference Lake 3 in August 2015 and August 2016, Mary River Project CREMP. Fish ages are shown above the bars, where available.

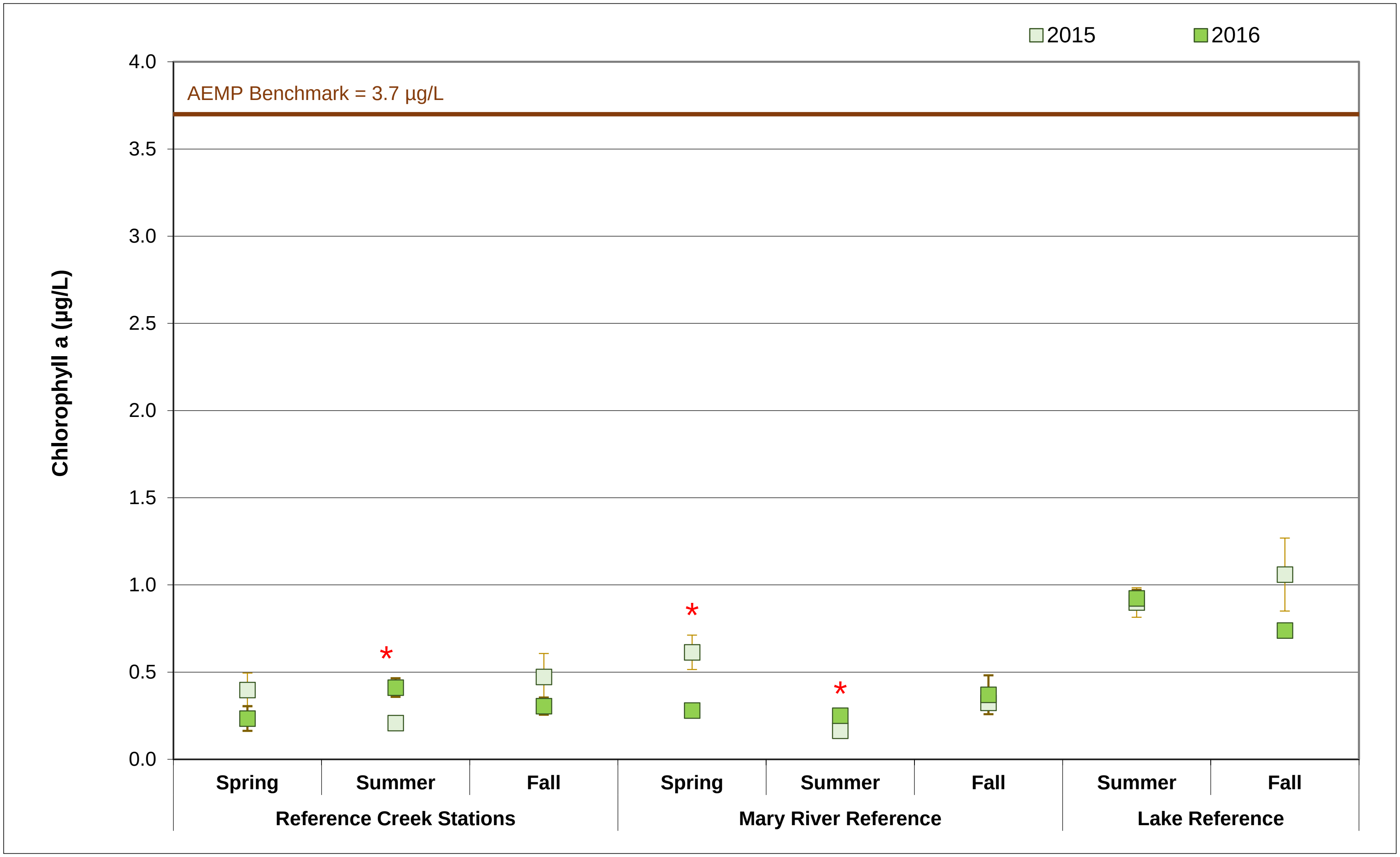


Figure B.6: Chlorophyll a concentration seasonal comparison between 2015 and 2016 at creek, river and lake reference phytoplankton monitoring stations, Mary River Project CREMP. Asterisks above data points indicate a significant difference between years for indicated season.

chlorophyll a concentrations were shown in spring and summer, respectively, during the 2016 sampling events compared to 2015 (Appendix Figure B.6). The variability in response among seasons between years at the lotic reference areas suggested that chlorophyll a concentrations exhibit naturally high spatial and temporal variability within the Mary River Project mine LSA.

B.4.2 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 2016 (Appendix Figure B.7). Chlorophyll a concentrations did not differ significantly between the surface and the bottom of the water column among Reference Lake 3 stations for either the summer or fall sampling events, suggesting similar phytoplankton abundance near the surface and bottom of the lake stations regardless of differences in depth.

Reference Lake 3 chlorophyll a concentrations averaged 0.92 µg/L in summer and 0.74 µg/L in fall 2016, and were consistently well below the AEMP benchmark of 3.7 µg/L (Appendix Figure B.7). Similar to the lotic reference stations, mean chlorophyll a concentrations observed at Reference Lake 3 in 2016 suggested low (i.e., oligotrophic) 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 2016 (Appendix Table B.4). Chlorophyll a concentrations were significantly higher in summer compared to the fall at Reference Lake 3 in 2016 (Appendix Table B.8), which differed from results of the 2015 study in which chlorophyll a concentrations were statistically comparable between the summer and fall seasons (Appendix Figure B.6). Although chlorophyll a concentrations were generally comparable between the 2015 and 2016 studies for like seasons at Reference Lake 3, the relative seasonal changes in chlorophyll a concentrations suggested naturally variable temporal patterns in phytoplankton abundance can expected at Mary River Project mine LSA lakes.

B.5 Benthic Invertebrate Community

B.5.1 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

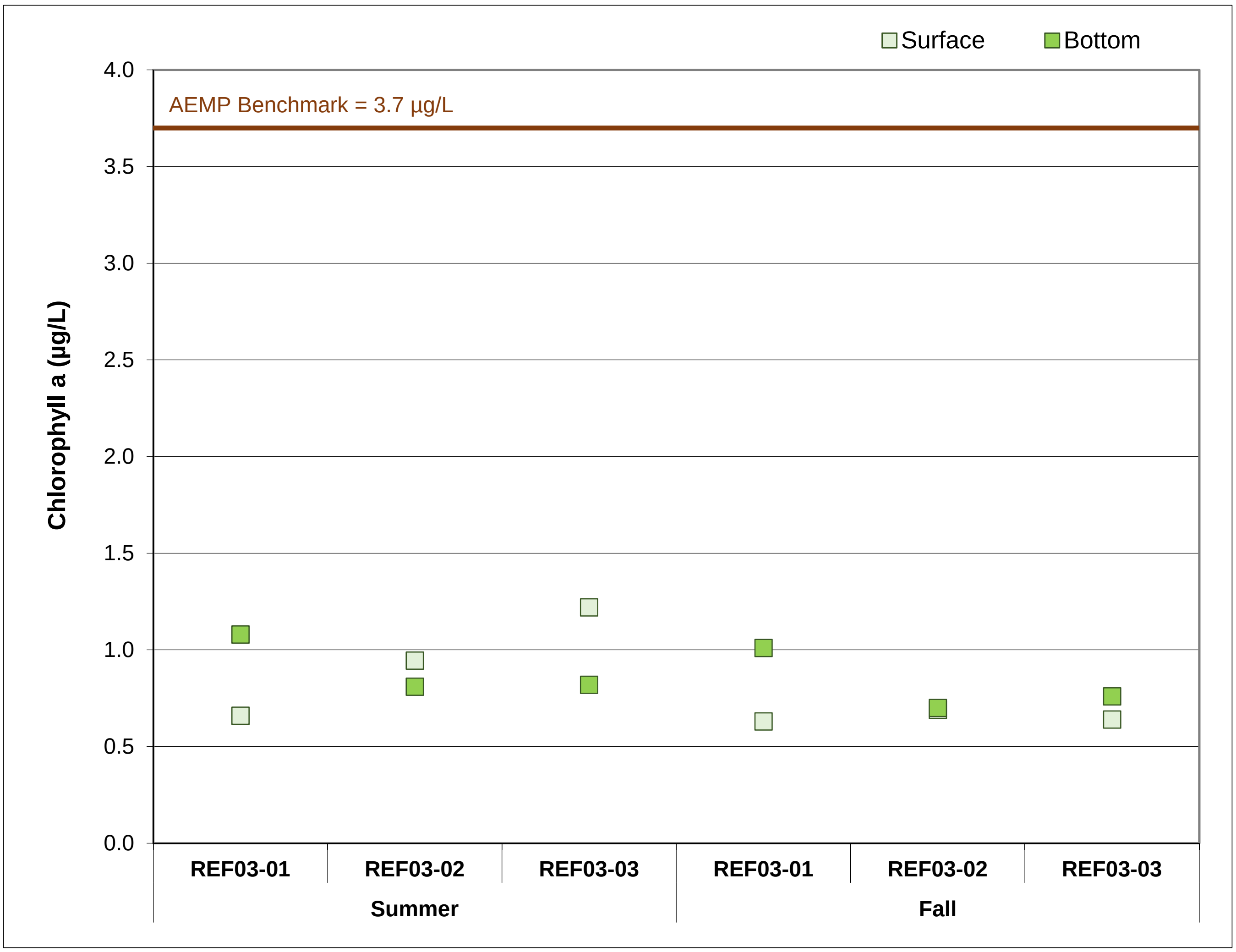


Figure B.7: Chlorophyll a concentrations at the surface and bottom of the water column at Reference Lake 3 phytoplankton monitoring stations during summer and fall sampling events, Mary River Project CREMP, 2016.

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 CREMP benthic invertebrate community study component 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 2016 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 (see Appendix Table F.1) 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 670 – 2,179 individuals/m^2, which is considered moderate to high for Arctic streams (Craig and McCart 1975). Unnamed Reference Creek also showed moderate richness and Simpson’s Evenness, which was consistent with low production in Arctic streams as a result of constraints associated with naturally low seasonal temperatures and nutrients, as well as food limitation (Huryn and Wallace 2000). Chironomidae (non-biting midges) were the dominant group observed among the Unnamed Reference Creek benthic stations, with the relative abundance of this group ranging from 57 – 81% of individuals (mean of 71%), of which 5 – 19% were represented by metal-sensitive taxa among stations (Appendix Table B.9). Collector-gatherers were the dominant benthic invertebrate functional feeding group (FFG) present at Unnamed Reference Creek (Appendix Table B.9), suggesting greatest reliance upon deposited fine particulate organic matter as a food source for benthic invertebrates. Shredders constituted a moderate proportion of the Unnamed Reference Creek benthic invertebrate community (Appendix Table B.9), suggesting that live and/or decomposing leaf material was also an important food source. In terms of benthic invertebrate habitat preference groups (HPG), clingers and sprawlers were co-dominant groups at Unnamed Reference Creek (Appendix Table B.9) suggesting that most invertebrates were associated with substrate surfaces and were not deeply embedded in the substrate (i.e., non-burrowers).

Table B.9: Benthic invertebrate community summary statistics for Unnamed Reference Creek and Mary River (GO-09) reference areas, Mary River Project CREMP, August 2016.

Metric	Area	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unnamed Reference Creek	5	1,645	619	277	876	2,414	670	2,179
	Mary River GO-09 Reference	5	662	320	143	265	1,059	334	1,162
Richness (Number of Taxa)	Unnamed Reference Creek	5	18.6	0.9	0.4	17.5	19.7	17.0	19.0
	Mary River GO-09 Reference	5	14.0	1.6	0.7	12.0	16.0	12.0	16.0
Simpson's Evenness	Unnamed Reference Creek	5	0.873	0.070	0.031	0.786	0.960	0.764	0.940
	Mary River GO-09 Reference	5	0.907	0.023	0.010	0.878	0.935	0.875	0.932
Bray-Curtis Index	Unnamed Reference Creek	5	0.237	0.130	0.058	0.076	0.398	0.092	0.437
	Mary River GO-09 Reference	5	0.277	0.097	0.043	0.156	0.397	0.142	0.385
Oligochaeta (% of community)	Unnamed Reference Creek	5	2.5%	0.5%	0.2%	1.9%	3.2%	2.0%	3.3%
	Mary River GO-09 Reference	5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Hydracarina (% of community)	Unnamed Reference Creek	5	11.7%	3.8%	1.7%	7.1%	16.4%	9.0%	18.2%
	Mary River GO-09 Reference	5	4.8%	2.1%	1.0%	2.2%	7.5%	2.5%	7.3%
Chironomidae (% of community)	Unnamed Reference Creek	5	70.8%	9.2%	4.1%	59.4%	82.2%	56.6%	81.4%
	Mary River GO-09 Reference	5	84.2%	4.6%	2.1%	78.4%	90.0%	78.2%	88.3%
Metal Sensitive Chironomidae (% of community)	Unnamed Reference Creek	5	8.9%	5.9%	2.7%	1.6%	16.3%	4.6%	19.3%
	Mary River GO-09 Reference	5	23.4%	12.3%	5.5%	8.1%	38.6%	11.5%	43.3%
Tipulidae (% of community)	Unnamed Reference Creek	5	4.3%	2.6%	1.2%	1.1%	7.6%	1.8%	8.5%
	Mary River GO-09 Reference	5	1.9%	1.6%	0.7%	0.0%	3.9%	0.0%	4.2%
Shredder FFG (% of community)	Unnamed Reference Creek	5	25.4%	3.2%	1.5%	21.4%	29.5%	20.4%	28.2%
	Mary River GO-09 Reference	5	12.0%	3.7%	1.6%	7.5%	16.6%	7.8%	15.3%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	5	53.9%	7.5%	3.4%	44.5%	63.2%	44.6%	64.6%
	Mary River GO-09 Reference	5	75.4%	9.1%	4.1%	64.0%	86.7%	61.8%	84.2%
Filterer FFG (% of community)	Unnamed Reference Creek	5	2.9%	1.1%	0.5%	1.5%	4.2%	1.0%	3.8%
	Mary River GO-09 Reference	5	7.3%	4.3%	1.9%	2.0%	12.6%	2.1%	13.4%
Clinger HPG (% of community)	Unnamed Reference Creek	5	41.0%	7.1%	3.2%	32.2%	49.8%	30.9%	47.0%
	Mary River GO-09 Reference	5	22.3%	8.7%	3.9%	11.4%	33.1%	13.3%	34.9%
Sprawler HPG (% of community)	Unnamed Reference Creek	5	50.4%	8.8%	3.9%	39.5%	61.3%	39.4%	62.9%
	Mary River GO-09 Reference	5	73.7%	8.3%	3.7%	63.4%	83.9%	61.8%	81.0%
Burrower HPG (% of community)	Unnamed Reference Creek	5	8.6%	3.6%	1.6%	4.2%	13.0%	5.9%	14.5%
	Mary River GO-09 Reference	5	4.1%	2.0%	0.9%	1.5%	6.6%	1.2%	6.3%

B.5.2 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 2014; 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 2016 CREMP (see Table 2.5; Figure 2.4).

Benthic invertebrate density at the Mary River reference area in 2016 ranged from 334 – 1,162 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 invertebrate group observed at the Mary River reference area, with the relative abundance of this group ranging from 78 – 88% of individuals (mean of 84%) and taxa considered metal-sensitive constituting 11 – 43% of the community (Appendix Table B.9). Similar to the reference creek, collector-gatherers were the dominant FFG present at the Mary River reference area (Appendix Table B.9), 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.9), 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, 2016) studies for key metrics indicated no consistent significant differences in density, richness and relative abundance of metal-sensitive chironomids between the baseline and mine-operational periods (Figure 5.6). Although Simpson's Evenness was significantly higher, and relative abundance of chironomids and FFG collector-gatherers significantly lower, for the mine-operational studies compared to the baseline studies, the direction of these differences was not consistent with an adverse change but rather suggested greater diversity and/or more even distribution of invertebrate groups and FFG for the mine-operational period (Figure 5.6). These changes in benthic invertebrate community metrics between the mine baseline and operational studies at the Mary River reference area were thus attributable to natural variability in community traits among years, and/or to artifacts associated with CREMP sampling among studies.

B.5.3 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 2016. As in the previous 2015 study, significantly higher benthic invertebrate density, richness and Simpson's Evenness was observed at littoral stations compared to profundal stations in 2016, most at Critical Effect Sizes outside of ± 2 SD (Appendix Table B.10). In addition, marked differences in benthic invertebrate community structure occurred between sampling depths as indicated by significantly differing Bray-Curtis Index and supported by lower relative abundance of Chironomidae (non-biting midges), FFG collector-gatherers, and HPG sprawlers at littoral stations compared to profundal stations (Appendix Table B.10). The considerable difference in benthic invertebrate community metrics and assemblage features between the littoral and profundal stations observed at Reference Lake 3 in both 2015 and 2016 validated changes implemented to the CREMP benthic invertebrate community survey in 2016. Specifically, the 2016 benthic invertebrate community survey focussed 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 LSA lakes.

Littoral habitat of Reference Lake 3 was largely dominated by Ostracoda (seed shrimp) and Chironomid non-biting midge larvae that exhibit collector-gathering feeding habits and inhabit the sediment surface (i.e., sprawler mode of existence) in both 2015 and 2016. Comparison of littoral habitat benthic invertebrate communities at Reference Lake 3 between the 2015 and 2016 studies for key metrics indicated no significant differences in density, richness, Simpson's Evenness, Bray-Curtis Index, relative abundance of dominant FFG and HPG, and the relative abundance of all dominant groups except Ostracoda (seed shrimp; Appendix Table B.11). Although the relative abundance of seed shrimp differed between studies, the magnitude of difference was within scientifically established Critical Effect Sizes (CES), suggesting that this difference was not ecologically meaningful. Overall, this suggested that littoral habitat benthic invertebrate community features at Reference Lake 3 were relatively consistent between the 2015 and 2016 studies.

Table B.10: Benthic invertebrate community statistical comparison results between littoral and profundal stations at Reference Lake 3 Mary River Project CREMP, August 2016.

Metric	Statistical Test Results				Summary Statistics					
	Significant Difference Between Areas?	*p*-value	Statistical Analysis[a]	Magnitude of Difference[b] (No. of SD)	Area	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	***YES***	***0.015***	**ε**	***-1.4***	Reference Lake littoral	2,390	1,396	624	897	4,240
					Reference Lake profundal	452	55	24	406	543
Richness (Number of Taxa)	YES	0.000	α	-7.3	Reference Lake littoral	12.2	1.1	0.5	11.0	14.0
					Reference Lake profundal	4.2	1.5	0.7	2.0	6.0
Simpson's Evenness (E)	YES	0.000	ζ	-2.6	Reference Lake littoral	0.758	0.189	0.084	0.420	0.849
					Reference Lake profundal	0.267	0.041	0.018	0.235	0.337
Bray-Curtis Index	YES	0.000	ε	4.8	Reference Lake littoral	0.334	0.122	0.054	0.245	0.527
					Reference Lake profundal	0.921	0.011	0.005	0.907	0.933
Nemata (%)	NO	0.126	β	-	Reference Lake littoral	4.0%	5.6%	2.5%	0.0%	13.5%
					Reference Lake profundal	0.0%	0.0%	0.0%	0.0%	0.0%
Hydracarina (%)	NO	0.177	δ	-	Reference Lake littoral	3.6%	2.0%	0.9%	1.8%	6.7%
					Reference Lake profundal	2.1%	2.1%	1.0%	0.0%	4.4%
Ostracoda (%)	YES	0.000	γ	-2.4	Reference Lake littoral	46.9%	17.5%	7.8%	37.8%	78.0%
					Reference Lake profundal	5.7%	1.8%	0.8%	3.9%	8.4%
Chironomidae (%)	YES	0.000	β	2.5	Reference Lake littoral	45.4%	18.8%	8.4%	15.4%	59.2%
					Reference Lake profundal	92.2%	3.2%	1.4%	87.2%	95.9%
Metal-Sensitive Chironomidae (%)	YES	0.005	δ	**-2.1**	Reference Lake littoral	19.3%	8.3%	3.7%	7.7%	28.1%
					Reference Lake profundal	1.7%	1.7%	0.8%	0.0%	4.1%
Shredders (%)	**YES**	***0.023***	**γ**	***-1.1***	Reference Lake littoral	4.4%	3.2%	1.4%	1.1%	9.6%
					Reference Lake profundal	0.8%	1.2%	0.5%	0.0%	2.2%
Collector-Gatherers (%)	**YES**	***0.001***	**β**	***1.9***	Reference Lake littoral	75.0%	11.4%	5.1%	61.1%	89.7%
					Reference Lake profundal	97.1%	2.4%	1.1%	93.9%	100.0%
Filterers (%)	**YES**	***0.000***	**δ**	***-1.9***	Reference Lake littoral	16.1%	8.4%	3.8%	7.0%	26.4%
					Reference Lake profundal	0.0%	0.0%	0.0%	0.0%	0.0%
Clingers (%)	YES	0.007	δ	-2.3	Reference Lake littoral	19.2%	7.6%	3.4%	8.8%	28.3%
					Reference Lake profundal	2.1%	2.1%	1.0%	0.0%	4.4%
Sprawlers (%)	YES	0.000	γ	2.6	Reference Lake littoral	65.7%	12.1%	5.4%	57.2%	85.7%
					Reference Lake profundal	97.1%	2.8%	1.2%	93.9%	100.0%
Burrowers (%)	YES	0.001	γ	-2.3	Reference Lake littoral	15.1%	6.2%	2.8%	5.5%	22.2%
					Reference Lake profundal	0.8%	1.1%	0.5%	0.0%	2.0%

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

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

[c] Minimum effect size detectable calculated based on variance as square root of MSE from ANOVA and alpha = beta = 0.10.

[shaded box] Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10 that were also outside of a Critical Effect Size of ±2 SD, suggesting an ecologically important difference.

BOLD Bold text values indicate significant difference between study areas based on ANOVA p-value less than 0.10, but a Critical Effect Size within ±2 SD, suggesting the difference is not ecologically meaningful.

Table B.11: Benthic invertebrate community statistical comparison results between 2015 and 2016 at littoral stations of Reference Lake 3, Mary River Project CREMP.

Metric	Statistical Test Results				Summary Statistics					
	Significant Difference Between Areas?	*p* -value	Statistical Analysis[a]	Magnitude of Difference [b] (No. of SD)	Year	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	NO	0.155	η	-	2015	1,278	888	397	553	2,819
					2016	2,390	1,396	624	897	4,240
Richness (Number of Taxa)	NO	0.838	ε	-	2015	12.6	4.1	1.8	9.0	18.0
					2016	12.2	1.1	0.5	11.0	14.0
Simpson's Evenness (E)	NO	0.257	ζ	-	2015	0.865	0.052	0.023	0.804	0.936
					2016	0.758	0.189	0.084	0.420	0.849
Bray-Curtis Index	NO	0.620	α	-	2015	0.382	0.170	0.076	0.219	0.662
					2016	0.334	0.122	0.054	0.245	0.527
Nemata (%)	NO	0.617	β	-	2015	8.1%	7.4%	3.3%	0.0%	17.2%
					2016	4.0%	5.6%	2.5%	0.0%	13.5%
Hydracarina (%)	NO	0.873	β	-	2015	4.2%	2.7%	1.2%	1.0%	7.5%
					2016	3.6%	2.0%	0.9%	1.8%	6.7%
Ostracoda (%)	***YES***	***0.044***	**γ**	***1.4***	2015	20.9%	18.5%	8.3%	4.1%	45.2%
					2016	46.9%	17.5%	7.8%	37.8%	78.0%
Chironomidae (%)	NO	0.110	β	-	2015	66.5%	18.9%	8.4%	40.6%	91.0%
					2016	45.4%	18.8%	8.4%	15.4%	59.2%
Metal-Sensitive Chironomidae (%)	NO	0.153	β	-	2015	11.4%	12.6%	5.6%	1.5%	32.2%
					2016	19.3%	8.3%	3.7%	7.7%	28.1%
Shredders (%)	***YES***	***0.043***	**δ**	***1.3***	2015	1.4%	2.4%	1.1%	0.0%	5.5%
					2016	4.4%	3.2%	1.4%	1.1%	9.6%
Collector-Gatherers (%)	NO	0.335	β	-	2015	81.4%	17.1%	7.7%	53.7%	95.2%
					2016	75.0%	11.4%	5.1%	61.1%	89.7%
Filterers (%)	NO	0.256	β	-	2015	11.4%	12.6%	5.6%	1.5%	32.2%
					2016	16.1%	8.4%	3.8%	7.0%	26.4%
Clingers (%)	NO	0.248	β	-	2015	13.5%	11.8%	5.3%	4.0%	33.9%
					2016	19.2%	7.6%	3.4%	8.8%	28.3%
Sprawlers (%)	NO	0.619	γ	-	2015	70.1%	14.9%	6.7%	47.1%	84.3%
					2016	65.7%	12.1%	5.4%	57.2%	85.7%
Burrowers (%)	NO	0.750	β	-	2015	16.4%	6.8%	3.0%	8.3%	25.8%
					2016	15.1%	6.2%	2.8%	5.5%	22.2%

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

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

[c] Minimum effect size detectable calculated based on variance as square root of MSE from ANOVA and alpha = beta = 0.10.

[grey box] Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10 that were also outside of a Critical Effect Size of ±2 SD, suggesting an ecologically important difference.

BOLD Bold text values indicate significant difference between study areas based on ANOVA p-value less than 0.10, but a Critical Effect Size within ±2 SD, suggesting the difference is not ecologically meaningful.

B.6 Fish Population Survey

B.6.1 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 LSA creeks/rivers for a short period each year (i.e., July – September) as a result of complete freezing/desiccation of these lotic habitats over much of the year, and because sampling of juvenile Arctic charr within a representative lotic habitat is conducted for the federal Environmental Effects Monitoring (EEM) program under the Metal Mining Effluent Regulations (Baffinland 2014; Minnow 2016c).

B.6.2 Lentic Environments (Reference Lake 3)

The Reference Lake 3 fish community was composed of Arctic charr and ninespine stickleback. As in 2015, the relative abundance of both species appeared to be low at Reference Lake 3 based on low electrofishing and gill netting catches and catch-per-unit-effort (CPUE) for each species in 2016 (Appendix Tables G.1 and G.2). Suitable numbers of Arctic charr were captured at nearshore habitat of Reference Lake 3 (i.e., 101 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 5.0 cm based on the evaluation of length-frequency distributions coupled with supporting age determinations (Appendix Figure B.8). In 2015, YOY Arctic charr captured at nearshoere habitat were not able to be distinguished from older age classes at Reference Lake 3 (Appendix Figure B.8). Therefore, population comparisons of nearshore Arctic charr captured between the mine-exposed and reference lakes in 2016 were completed separately for YOY and non-YOY data sets (2016 data), and using the full data set (to allow comparability between the 2015 and 2016 studies). Temporal comparisons of the 2015 and 2016 nearshore Arctic charr data did not indicate any significantly differing population endpoints that were not also outside of accepted CES (Appendix Table B.12). This not only indicated relatively good continuity in fish population features at Reference Lake 3 year-to-year supporting its use as a suitable reference lake for the CREMP, but also indicated that fish population CES that are generally used for EEM under the MMER are relevant, and could be suitably applied, to the Mary River Project CREMP.

Very low numbers of Arctic charr were captured at littoral/profundal areas of Reference Lake 3 in 2016 (i.e., 14 individuals; Appendix Table G.2). Due to the small sample size,

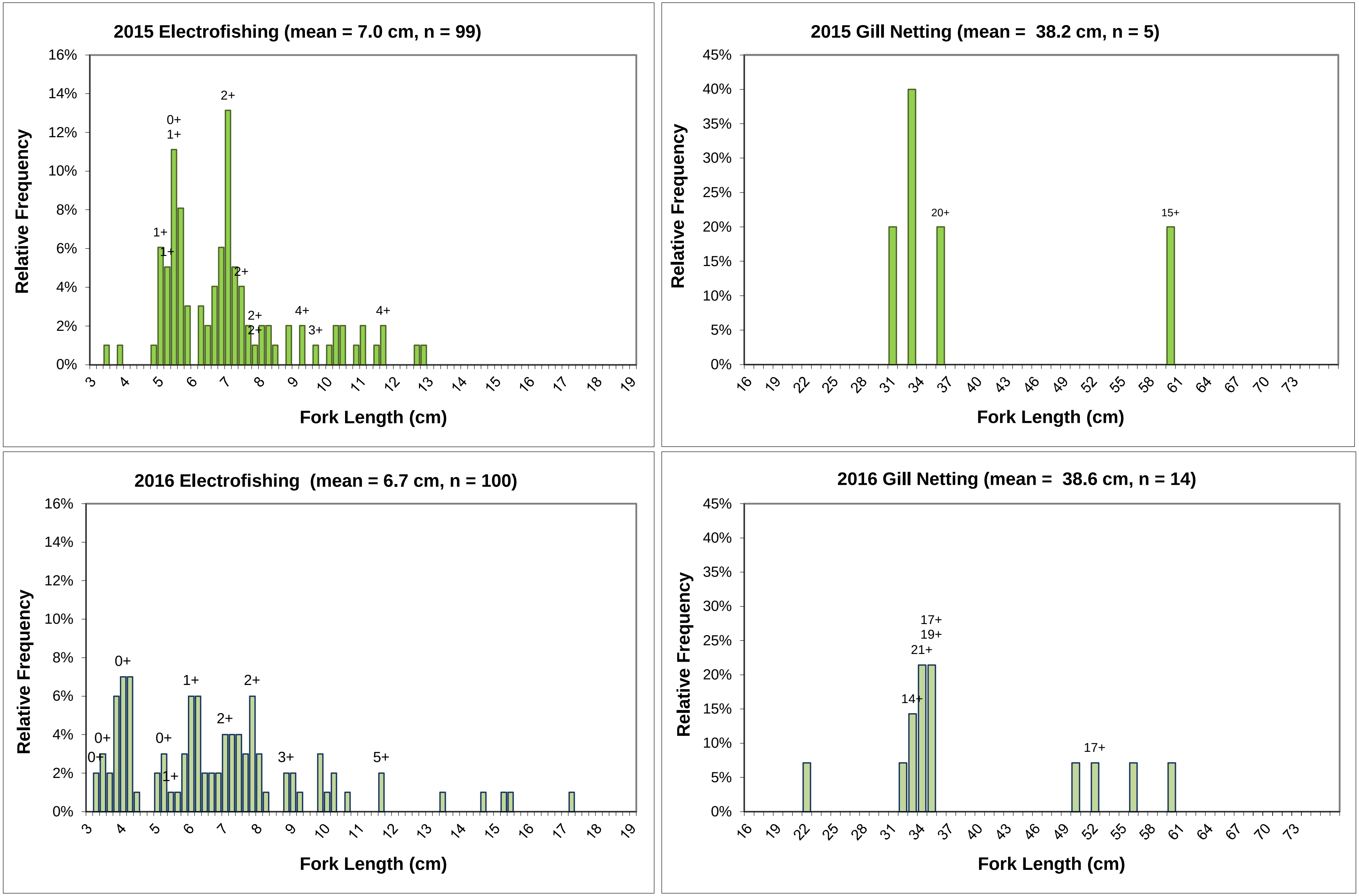


Figure B.8: Length-frequency distributions for Arctic charr captured by backpack electrofishing and gill netting at Reference Lake 3 in August 2015 and August 2016, Mary River Project CREMP. Fish ages are shown above the bars, where available.

Table B.12: Results of fish population endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured at Reference Lake 3 in August 2015 and August 2016, Mary River Project CREMP.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Areas (*p*-value)		Power
					2015		2016					
	Parameter	Covariate	2015	2016	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	99	99	-	-	-	-	K-S Test	Yes	0.002	-
	Log_{10} Age (years)	none	11	10	-	-	-	-	ANOVA	No	0.177	-
Energy Use	Log_{10} Body Weight (g)	none	99	99	-	-	-	-	ANOVA	Yes	0.075	0.555
	Log_{10} Fork Length (cm)	none	99	99	-	-	-	-	ANOVA	Yes	0.065	0.582
	Log_{10} Body Weight (g)	Log_{10} Age (years)	11	10	0.732	0.001	0.930	0.000	ANCOVA	No	0.522	-
	Log_{10} Body Weight (g)	Log_{10} Age (years)[e]	9	9	0.991	0.000	0.980	0.000	ANCOVA	Yes	0.000	-
	Log_{10} Fork Length (cm)	Log_{10} Age (years)	11	10	0.743	0.001	0.903	0.000	ANCOVA	No	0.957	-
	Log_{10} Fork Length (cm)	Log_{10} Age (years)[e,f]	8	9	0.996	0.000	0.978	0.000	ANCOVA	Yes	0.001	-
Energy Storage	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)	99	99	0.989	0.000	0.989	0.000	ANCOVA	No	0.572	-

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]		Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	2015	2016		2015	2016			Increase	Decrease
Survival	Age (years)	none	11	10	Mean	1.6	0.9	-		277.9	-73.5
Energy Use	Body Weight (g)	none	99	99	Mean	2.619	2.022	-22.8		-	-
	Fork Length (cm)	none	99	99	Mean	6.8	6.2	-8.3		-	-
	Body Weight (g)	Age (years)	11	10	Adjusted Mean	2.821	3.285	-		82.2	-45.1
	Body Weight (g)	Age (years)[e]	9	9	Predicted Values	11.953	9.479	Max overlap	-20.7	-	-
						1.004	1.722	Min overlap	71.5		
	Fork Length (cm)	Age (years)	11	10	Adjusted Mean	7.0	7.1	-		23.3	-18.9
	Fork Length (cm)	Age (years)[e,f]	8	9	Predicted Values	11.3	10.1	Max overlap	-11.3	-	-
						5.0	5.7	Min overlap	13.2		
Energy Storage	Body Weight (g)	Fork Length (cm)	99	99	Adjusted Mean	2.295	2.313	-		4.6	-4.4

[shaded] - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[e] Studentized outliers REF3-ACJ-1, REF3 ACJ-96, and REF316-ACJ-8 removed.

[f] Studentized outlier REF3-ACJ-2 removed.

meaningful evaluation of mine-related effects on the population of reproductive-aged Arctic charr was not possible using data from the mine-exposed lakes and Reference Lake 3 in 2016. 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 any differences in Arctic charr growth and condition between males and females at Mary River Project LSA lakes may be explained by naturally slow growth rates and low spawning frequency (i.e., once every 2 – 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).

B.7 Implications for the Mary River Project CREMP

This overview of reference conditions was included to provide context and perspective regarding key chemical, physical and biological features of the CREMP reference study areas. Key implications of reference area features affecting the CREMP the evaluation of potential mine-related effects at mine-exposed waterbodies that were identified through this reference area overview include the following:

- **Federal Water Quality Guidelines (WQG) 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 consistently indicated a significant, positive relationship between phenol and both nitrate and DOC concentrations, 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 CREMP.

- **Greater reliance on the use of dissolved metals concentrations for assessing mine-related influences on aqueous metal concentrations at waterbodies used for the CREMP**. Total aluminum concentrations were routinely elevated, and other metals including (total) iron and manganese periodically elevated, above WQG at creek, river and/or lake reference areas used for the CREMP in 2015, 2016, and historically as part of baseline studies. Significant positive correlations between total concentrations of these metals and turbidity were identified using the 2015 and 2016 data sets which suggested that these metals were likely bound to and/or composed suspended particulate materials in water samples. This was supported by a low ratio of dissolved to total metal concentrations for the reference water samples in 2015 and 2016. Accordingly, greater emphasis was placed on comparison of dissolved metal concentrations for assessing potential mine-related influences on water quality for the 2016 CREMP analysis.
- **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, 2015 and 2016 studies. In general, conventional parameters, ions and total metals were observed at lowest concentrations in spring, with intermediate concentrations in the summer and highest concentrations observed during the fall sampling event. 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 2016.
- **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 in 2015 or 2016. Therefore, the evaluation of water chemistry and phytoplankton productivity among stations and study areas for the 2016 Mary River Project CREMP was based on average water chemistry and chlorophyll a values, respectively, from the water column surface and bottom for each lake station.
- **Discontinue creek sediment chemistry monitoring**. Lotic habitats included in the Mary River Project CREMP contain minimal depositional habitat based on

investigations conducted during baseline (2005 – 2013), mine construction (2014) and mine-operational (2015, 2016) studies. The general lack of any substantial accumulation of fine sediments within these watercourses precludes any meaningful assessment of potential mine-related influences on sediment chemistry. Therefore, no sediment chemistry sampling was conducted at lotic environments as part of the 2016 CREMP.

- **Focus lake benthic invertebrate community survey on littoral zone**. Benthic invertebrate community data collected at Reference Lake 3 in 2015 and 2016 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 served as the focus for the lake benthic invertebrate community survey as part of the 2016 CREMP.

APPENDIX C

WATER QUALITY DATA

Table C.1: *In-situ* water quality data collected from lotic environments for the Mary River Project CREMP, spring 2016.

Study Area		Station	Sampling Date	*In-situ* Water Quality Parameter				
				Temperature (°C)	Dissolved Oxygen (% saturation)	pH	Conductivity (µS/cm)	Turbidity (NTU)
Camp Lake System	Reference Creek Stations	CLT-REF4	27-Jun-16	3.0	103.6	7.41	25.3	0.70
Camp Lake System	Reference Creek Stations	CLT-REF3	27-Jun-16	2.8	103.5	7.20	39.7	0.50
Camp Lake System	Reference Creek Stations	MRY-REF3	27-Jun-16	2.0	104.6	7.79	18.3	2.40
Camp Lake System	Reference Creek Stations	MRY-REF2	27-Jun-16	5.0	104.0	7.44	44.5	0.50
Camp Lake System	CLT-1	L1-08	27-Jun-16	2.3	102.4	7.28	44.0	1.40
Camp Lake System	CLT-1	L1-02	27-Jun-16	4.1	101.8	7.42	60.8	-
Camp Lake System	CLT-1	L2-03	27-Jun-16	5.0	96.2	7.22	246.8	2.80
Camp Lake System	CLT-1	L1-09	27-Jun-16	4.5	100.4	7.48	71.4	1.60
Camp Lake System	CLT-1	L1-05	27-Jun-16	5.0	100.2	7.27	75.2	1.20
Camp Lake System	CLT-1	L0-01	27-Jun-16	6.5	102.8	6.75	84.0	1.30
Camp Lake System	CLT-2	K0-01	25-Jun-16	8.4	98.5	7.21	77.5	1.00
Camp Lake System	Camp Lake	J0-01	26-Jun-16	4.6	103.8	7.16	127.0	0.10
Sheardown Lake System	SDL Tribs	D1-05	27-Jun-16	5.1	95.9	7.67	154.7	0.50
Sheardown Lake System	SDL Tribs	D1-00	27-Jun-16	6.1	12.3	7.55	185.3	1.70
Mary River/Lake System	Tom River	I0-01	25-Jun-16	6.8	103.8	7.07	31.5	2.40
Mary River/Lake System	Mary River	G0-09-A	26-Jun-16	1.2	98.2	7.58	20.4	8.20
Mary River/Lake System	Mary River	G0-09	26-Jun-16	1.6	99.0	7.58	21.4	5.80
Mary River/Lake System	Mary River	G0-09-B	26-Jun-16	1.4	99.5	7.82	26.1	3.70
Mary River/Lake System	Mary River	G0-03	25-Jun-16	5.2	100.6	7.07	22.0	4.50
Mary River/Lake System	Mary River	G0-01	26-Jun-16	2.6	102.7	7.51	22.4	2.90
Mary River/Lake System	Mary River	F0-01	26-Jun-16	2.2	100.5	7.34	44.0	6.10
Mary River/Lake System	Mary River	E0-10	26-Jun-16	2.7	102.4	7.10	27.7	3.70
Mary River/Lake System	Mary River	E0-03	26-Jun-16	2.2	102.3	7.54	23.6	2.80
Mary River/Lake System	Mary River	E0-20	25-Jun-16	4.7	102.5	7.22	21.9	2.60
Mary River/Lake System	Mary River	E0-21	25-Jun-16	4.8	102.0	7.20	20.7	3.30
Mary River/Lake System	Mary River	C0-10	25-Jun-16	4.3	102.7	7.40	22.7	2.36
Mary River/Lake System	Mary River	C0-05	25-Jun-16	4.3	105.4	7.54	33.3	2.60
Mary River/Lake System	Mary River	C0-01	25-Jun-16	4.6	105.4	8.15	30.8	2.80

Table C.2: *In-situ* water quality data collected from lotic environments for the Mary River Project CREMP, summer 2016.

Study Area		Station	Sampling Date	*In-situ* Water Quality Parameter				
				Temperature (^oC)	Dissolved Oxygen (% saturation)	pH	Conductivity (µS/cm)	Turbidity (NTU)
Camp Lake System	Reference Creek Stations	CLT-REF4	24-Jul-16	7.90	99.7	7.9	80.7	0.9
		CLT-REF3	24-Jul-16	6.20	100.8	7.75	72.2	-1.7
		MRY-REF3	25-Jul-16	7.70	101.0	7.33	64.6	8.2
		MRY-REF2	25-Jul-16	8.80	102.4	7.55	96.4	-1.5
	CLT-1	L1-08	20-Jul-16	5.00	100.8	7.83	84.4	1.4
		L1-02	19-Jul-16	7.70	99.2	7.96	147.2	0.3
		L2-03	19-Jul-16	8.20	96.6	7.81	371.2	2.2
		L1-09	19-Jul-16	8.20	99.0	7.95	211.3	0.7
		L1-05	20-Jul-16	10.90	100.8	8.11	210.1	0.3
		L0-01	20-Jul-16	11.10	100.7	8.14	219.2	0.3
	CLT-2	K0-01	20-Jul-16	9.70	100.1	8.02	186.5	0.9
	Camp Lake	J0-01	20-Jul-16	9.20	106.5	7.84	132.1	0.5
Sheardown Lake System	SDL Tribs	D1-05	19-Jul-16	6.40	93.2	7.64	280.4	0.3
		D1-00	19-Jul-16	9.00	-	7.66	310.5	1
Mary River/Lake System	Tom River	I0-01	20-Jul-16	9.40	103.1	7.92	88.5	1.4
	Mary River	G0-09-A	18-Jul-16	9.40	98.7	7.72	57.4	10.4
		G0-09	18-Jul-16	8.90	95.7	7.73	65.9	8.2
		G0-09-B	18-Jul-16	9.20	95.7	7.84	62.1	8.3
		G0-03	18-Jul-16	9.40	95.7	7.79	62.6	6.3
		G0-01	18-Jul-16	8.90	97.3	7.72	64.0	5.8
		F0-01	18-Jul-16	7.30	97.0	8.08	154.6	3.6
		E0-10	18-Jul-16	8.60	98.9	7.8	84.2	6.1
		E0-03	18-Jul-16	8.10	99.0	7.7	69.6	6.1
		E0-20	18-Jul-16	9.40	100.4	7.7	67.6	6.4
		E0-21	18-Jul-16	8.70	100.0	7.7	64.9	6.4
		C0-10	18-Jul-16	9.30	101.8	7.72	66.3	6.7
		C0-05	18-Jul-16	10.80	100.7	7.7	67.5	7.2
		C0-01	18-Jul-16	11.40	99.6	7.57	-	-

Table C.3: *In-situ* water quality data collected from lotic environments for the Mary River Project CREMP, fall 2016.

Study Area		Station	Sampling Date	*In-situ* Water Quality Parameter				
				Temperature (^oC)	Dissolved Oxygen (% saturation)	pH	Conductivity (µS/cm)	Turbidity (NTU)
Camp Lake System	Reference Creek Stations	CLT-REF4	20-Aug-16	4.0	96.0	7.81	98.0	-2.0
		CLT-REF3	20-Aug-16	6.9	96.2	8.11	115.0	-2.1
		MRY-REF3	20-Aug-16	11.1	98.0	7.93	115.0	-1.0
		MRY-REF2	20-Aug-16	8.2	97.3	7.92	92.0	4.6
	CLT-1	L1-08	20-Aug-16	1.5	91.6	7.62	125.0	-2.4
		L1-02	19-Aug-16	4.6	95.9	8.01	212.9	-2.7
		L2-03	19-Aug-16	6.6	95.8	7.94	441.3	0.3
		L1-09	19-Aug-16	5.8	97.1	8.04	302.4	-2.0
		L1-05	19-Aug-16	4.1	96.7	8.01	307.6	-2.0
		L0-01	19-Aug-16	4.0	96.1	8.05	305.6	-1.9
	CLT-2	K0-01	19-Aug-16	3.7	95.4	8.09	263.4	-2.8
	Camp Lake	J0-01	20-Aug-16	10.0	93.0	6.77	114.0	-2.5
Sheardown Lake System	SDL Tribs	D1-05	19-Aug-16	4.1	92.5	7.75	239.2	-2.5
		D1-00	19-Aug-16	5.2	95.8	7.94	314.5	4.9
Mary River/Lake System	Tom River	I0-01	19-Aug-16	7.8	99.9	8.10	196.7	-2.8
	Mary River	G0-09-A	20-Aug-16	8.7	95.3	8.12	160.0	18.6
		G0-09	20-Aug-16	8.8	96.4	8.15	159.0	8.6
		G0-09-B	20-Aug-16	8.6	96.2	8.11	159.0	9.2
		G0-03	20-Aug-16	5.8	95.5	7.95	142.0	11.4
		G0-01	20-Aug-16	4.5	94.4	7.52	148.0	15.9
		F0-01	20-Aug-16	5.3	95.7	8.14	225.0	10.7
		E0-10	20-Aug-16	4.8	96.4	7.98	157.0	16.5
		E0-03	19-Aug-16	7.2	96.5	8.04	176.0	13.7
		E0-20	19-Aug-16	7.2	97.5	8.08	175.1	16.3
		E0-21	19-Aug-16	6.9	97.2	8.07	175.7	14.7
		C0-10	19-Aug-16	8.9	98.8	8.15	173.3	35.9
		C0-05	19-Aug-16	8.0	101.6	8.03	172.6	51.1
		C0-01	19-Aug-16	8.4	99.5	8.07	172.5	15.1

Table C.4: Dissolved metals concentrations at reference creek monitoring stations, Mary River Project CREMP, 2016.

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
			L1790501-27	L1790501-28	27-Jun-2016	27-Jun-2016	27-Jun-2016	27-Jun-2016	24-Jul-2016	24-Jul-2016	25-Jul-2016	25-Jul-2016	20-Aug-2016	20-Aug-2016
Dissolved Metals	Aluminum (Al)	mg/L	0.0065	0.0091	0.0273	0.0051	0.0119	0.0079	0.0336	0.0078	0.0082	0.0081	0.0244	0.0100
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	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	0.00110	0.00212	0.00201	0.00192	0.00357	0.00450	0.00527	0.00538	0.00555	0.00628	0.00999	0.00816
	Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	2.11	3.35	1.30	3.71	8.10	7.02	4.69	9.32	14.3	11.8	9.20	13.6
	Cesium (Cs)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010								
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	0.0205	<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	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	<0.00020	0.00063	0.00063	0.00170	<0.00050	0.00092	0.00085	<0.00050	0.00063	0.00107	0.00100	0.00072
	Iron (Fe)	mg/L	<0.010	<0.010	0.027	0.451	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	0.000056	<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	1.23	1.97	0.657	2.19	4.60	4.03	2.36	5.43	7.67	6.63	4.46	7.78
	Manganese (Mn)	mg/L	<0.00050	<0.00050	0.00168	0.0057	0.0001	0.000574	0.000244	0.000416	0.000087	0.00113	0.000117	0.000505
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	<0.000050	0.000125	0.000064	0.000229	0.000117	0.000406	0.000236	0.000143	0.000329	0.000639	0.000429	0.000242
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	0.00106	<0.00050	0.00050	<0.00050	<0.00050	<0.00050	0.00067	<0.00050	<0.00050
	Phosphorus (P)	mg/L	<0.050	<0.050	<0.050	<0.050								
	Potassium (K)	mg/L	0.190	0.292	0.249	0.284	0.465	0.52	0.62	0.62	0.67	0.75	1.02	0.87
	Rubidium (Rb)	mg/L	0.00022	0.00065	0.00041	0.00042								
	Selenium (Se)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.231	0.481	0.290	0.317	0.64	0.76	0.84	0.69	0.73	0.92	1.03	0.80
	Silver (Ag)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	<0.50	<0.50	0.62	<0.50	0.587	0.570	1.72	1.08	1.27	0.985	3.48	1.56
	Strontium (Sr)	mg/L	0.0016	0.0023	0.0028	0.0028	0.00607	0.00458	0.0100	0.00761	0.0109	0.00795	0.0191	0.0108
	Sulfur (S)	mg/L	<0.50	<0.50	<0.50	<0.50								
	Tellurium (Te)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020								
	Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Thorium (Th)	mg/L	<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	<0.00030	<0.00030	0.00058	<0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Tungsten (W)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010								
	Uranium (U)	mg/L	0.000088	0.000201	0.000194	0.000188	0.001315	0.000625	0.000382	0.000932	0.00755	0.00311	0.00145	0.00230
	Vanadium (V)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0010	<0.0010	0.0032	<0.0010	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	<0.00030	<0.00030	<0.00030	<0.00030								

Table C.5: *In-situ* water quality profile data collected at Reference Lake 3 water quality monitoring stations in summer[a], Mary River Project CREMP, 2016.

Depth (m)	Temperature (°C)			Dissolved Oxygen (% Saturation)			pH (pH units)			Specific Conductance (µS/cm)		
	REF3-01[b]	REF3-02[b]	REF3-03[b]	REF3-01	REF3-02	REF3-03	REF3-01	REF3-02	REF3-03	REF3-01	REF3-02	REF3-03
1.0	8.7	9.2	8.8	106.2	107.0	105.6	7.75	7.80	7.80	78.4	73.8	73.7
2.0	8.5	9.2	8.8	106.0	107.2	106.6	7.70	7.73	7.72	78.6	73.8	73.8
3.0	8.4	9.2	8.8	105.9	107.1	106.6	7.68	7.72	7.70	78.5	73.8	73.8
4.0	8.2	9.2	8.8	106.0	106.9	106.5	7.66	7.70	7.79	78.6	73.8	73.9
5.0	7.7	9.0	8.7	105.9	105.9	106.5	7.65	7.69	7.68	78.6	73.7	73.9
6.0	7.1	7.6	8.7	105.1	105.1	106.5	7.63	7.66	7.68	76.5	73.8	73.9
7.0	7.0	7.4	8.7	104.8	105.1	105.0	7.61	7.65	7.68	78.5	73.8	73.8
8.0	6.9	7.4	7.7	104.6	105.0	104.7	7.60	7.65	7.67	78.6	73.7	74.0
9.0	6.9	7.1	7.4	104.2	104.2	104.7	7.59	7.63	7.66	78.7	73.7	73.8
10.0	6.8	6.8	7.3	103.9	103.4	104.3	7.59	7.61	7.64	78.6	73.4	73.8
11.0	6.8	6.6	7.1	103.7	103.1	104.4	7.58	7.59	7.64	78.7	73.8	73.7
12.0	6.7	6.5	7.0	103.5	103.2	104.3	7.58	7.57	7.62	78.6	73.8	73.8
13.0	6.6	6.5	7.7	103.5	103.1	104.7	7.56	7.56	7.61	78.6	73.8	74.0
14.0	6.5	6.5	6.9	103.4	103.0	103.6	7.55	7.55	7.60	78.6	73.8	73.8
15.0		6.5	6.9		102.9	103.4		7.54	7.59		73.8	73.8
16.0		6.5	6.9		102.9	103.4		7.54	7.59		73.8	73.8
17.0		6.5	6.8		102.9	103.3		7.53	7.58		73.8	73.8
18.0		6.3	6.8		102.1	103.2		7.52	7.58		73.9	73.8
19.0			6.8			103.0			7.57			73.8
20.0			6.8			102.9			7.65			73.8
21.0			6.7			102.7			7.55			73.8
22.0			6.7			102.5			7.55			73.8
23.0			6.6			102.3			7.54			73.8
24.0			6.6			102.2			7.53			73.8
25.0			6.5			102.1			7.52			73.3
26.0			6.4			101.5			7.50			73.9
27.0			6.1			101.4			7.50			73.9
28.0			6.0			101.5			7.48			73.3
29.0			5.9			101.4			7.47			73.9
30.0			5.8			101.1			7.46			73.8
31.0			5.7			100.9			7.45			73.9

[a] Sampling conducted on 16-July (REF3-01) and 28-July (REF3-02, REF3-03), 2016.

[b] Total depth at Stations REF3-01, REF3-02, and REF3-03 were 15.1, 18.6, and 31.4 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[a], Mary River Project CREMP, 2016.

Depth (m)	Temperature (°C)			Dissolved Oxygen (% Saturation)			pH (pH units)			Specific Conductance (µS/cm)		
	REF3-01[b]	REF3-02[b]	REF3-03[b]	REF3-01	REF3-02	REF3-03	REF3-01	REF3-02	REF3-03	REF3-01	REF3-02	REF3-03
1.0	11.1	11.3	10.9	96.2	100.1	102.6	7.40	7.44	7.69	48.5	47.5	47.7
2.0	11.0	11.3	10.8	98.5	100.2	101.3	7.13	7.48	7.70	47.9	47.5	47.4
3.0	11.0	11.3	10.6	98.4	100.2	101.1	7.19	7.50	7.70	47.8	47.5	47.3
4.0	10.9	11.3	10.6	98.3	100.1	100.7	7.23	7.51	7.71	47.7	47.5	47.2
5.0	10.9	11.2	10.5	98.3	100.3	100.5	7.29	7.52	7.71	47.5	47.3	47.1
6.0	10.9	11.1	10.5	98.5	99.8	100.3	7.33	7.53	7.71	47.4	47.1	47.1
7.0	10.8	11.0	10.5	98.7	100.0	100.2	7.36	7.54	7.71	37.4	47.0	47.0
8.0	10.8	11.0	10.4	98.7	99.9	100.1	7.38	7.54	7.72	47.2	46.9	47.0
9.0	10.7	10.9	10.3	99.6	99.8	99.9	7.42	7.54	7.72	47.0	46.8	46.9
10.0	10.6	10.8	10.3	99.4	99.8	99.7	7.45	7.54	7.72	47.1	46.7	46.8
11.0	10.5	10.5	10.2	98.9	100.0	99.3	7.46	7.55	7.73	46.8	46.4	46.7
12.0	8.9	8.7	9.9	98.6	99.4	98.8	7.46	7.53	7.71	45.9	44.5	46.0
13.0	8.6	7.9	9.0	99.7	101.0	100.2	7.44	7.46	7.68	44.9	43.3	45.3
14.0	7.0	7.5	8.7	97.8	99.6	100.6	7.32	7.42	7.67	43.1	43.4	45.0
15.0		7.0	8.4		99.1	100.3		7.37	7.65		42.0	44.5
16.0		6.9	8.0		98.8	99.6		7.36	7.60		41.7	43.9
17.0		6.6	7.3		98.7	99.0		7.35	7.56		41.4	43.1
18.0		6.5	7.3		98.7	98.6		7.34	7.54		41.3	43.0
19.0		6.4	7.1		98.2	98.5		7.32	7.52		41.1	42.8
20.0			7.0			98.2			7.51			42.6
21.0			6.8			97.9			7.48			42.2
22.0			6.7			97.7			7.45			42.1
23.0			6.5			97.1			7.43			42.7
24.0			6.4			96.8			7.42			41.9
25.0			6.4			96.4			7.40			41.9
26.0			6.4			96.3			7.40			41.9
27.0			6.4			96.1			7.39			41.9
28.0			6.3			95.7			7.38			41.8
29.0			6.3			95.3			7.36			41.8
29.3			6.3			95.1			7.35			41.8

[a] Sampling conducted on 19-August and 20-August, 2016.

[b] Total depth at stations REF3-01, REF3-02, and REF3-03 were 14.1, 20.7, and 30.3 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 2016.

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	16-Aug-16	9.0	9.0	clear, colourless	surface	12.9	8.77	83.5	7.88	75
					bottom	10.2	9.28	82.6	7.86	74
REF 03-2	16-Aug-16	8.1	8.1	clear, colourless	surface	11.8	10.50	97.0	7.19	74
					bottom	9.8	10.92	96.1	7.28	74
REF 03-3	16-Aug-16	10.0	10.0	clear, colourless	surface	12.3	10.61	99.2	7.71	74
					bottom	9.5	11.34	99.1	7.74	74
REF 03-4	16-Aug-16	8.8	8.8	clear, colourless	surface	12.5	10.89	100.4	7.80	75
					bottom	10.4	10.33	91.9	7.57	74
REF 03-5	16-Aug-16	10.7	8.5	clear, colourless	surface	11.6	10.81	99.6	7.83	74
					bottom	9.7	9.86	86.9	7.77	74
REF 03-6	16-Aug-16	19.5	8.3	clear, colourless	surface	12.8	10.19	96.1	7.86	75
					bottom	6.5	11.27	91.6	7.70	74
REF 03-7	16-Aug-16	22.9	8.0	clear, colourless	surface	12.7	8.80	82.9	7.90	75
					bottom	6.0	9.37	74.9	7.61	74
REF 03-8	16-Aug-16	18.6	8.0	clear, colourless	surface	12.4	10.28	96.3	7.87	74
					bottom	6.6	11.17	90.1	7.75	74
REF 03-9	16-Aug-16	21.6	7.8	clear, colourless	surface	12.2	10.59	98.6	7.87	74
					bottom	7.0	10.37	84.7	7.67	74
REF 03-10	16-Aug-16	19.8	8.1	clear, colourless	surface	12.5	9.88	94.4	7.88	75
					bottom	6.9	12.71	104.4	7.74	74

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 2016.

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)	YES	0.035	α	Littoral	5	8.9	0.7	0.3	8.1	10.0
					Profundal	5	8.0	0.2	0.1	7.8	8.3
	Temperature (˚C)	YES	0.000	α	Littoral	5	9.9	0.4	0.2	9.5	10.4
					Profundal	5	6.6	0.4	0.2	6.0	7.0
	Dissolved Oxygen (mg/L)	NO	0.368	α	Littoral	5	10.3	0.8	0.4	9.3	11.3
					Profundal	5	11.0	1.2	0.6	9.4	12.7
	Dissolved Oxygen (% saturation)	NO	0.710	α	Littoral	5	91.3	6.7	3.0	82.6	99.1
					Profundal	5	89.1	10.8	4.8	74.9	104.4
	pH (units)	NO	0.648	α,δ	Littoral	5	7.64	0.23	0.10	7.28	7.86
					Profundal	5	7.69	0.06	0.03	7.61	7.75
	Specific Conductance (umho/cm)	NO	1.000	α	Littoral	5	74.0	0.0	0.0	74.0	74.0
					Profundal	5	74.0	0.0	0.0	74.0	74.0

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

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

Table C.9: Dissolved metals concentrations at Reference Lake 3 monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Summer Sampling Event						Fall Sampling Event					
			REF3-01S1 surface 16-Jul-2016	REF3-01B1 bottom 16-Jul-2016	REF3-02S1 surface 28-Jul-2016	REF3-02B1 bottom 28-Jul-2016	REF3-03S1 surface 28-Jul-2016	REF3-03B1 bottom 28-Jul-2016	REF3-01S1 surface 20-Aug-2016	REF3-01B1 bottom 20-Aug-2016	REF3-02S1 surface 19-Aug-2016	REF3-02B1 bottom 19-Aug-2016	REF3-03-S1 surface 20-Aug-2016	REF3-03-B1 bottom 20-Aug-2016
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
	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	0.00672	0.00647	0.00661	0.00668	0.00676	0.00690	0.0063	0.0064	0.0065	0.00646	0.00649	0.00656
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	7.00	6.99	6.98	7.02	7.03	7.19	6.92	7	7.06	6.9	6.83	7.04
	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	0.00081	0.00068	0.00077	0.00075	0.00075	0.00079	0.0009	0.00081	0.00081	0.00081	0.00078	0.00093
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	0.000058	<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	4.40	4.30	4.36	4.35	4.33	4.33	4.38	4.13	4.23	4.23	4.02	4.27
	Manganese (Mn)	mg/L	0.000280	0.000208	0.000253	0.000195	0.000272	0.000233	0.000244	0.000123	0.000214	0.000121	0.0002	0.000195
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000121	0.000113	0.000128	0.000112	0.000115	0.000120	0.000133	0.000128	0.000131	0.000127	0.000126	0.00013
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.91	0.89	0.90	0.89	0.89	0.90	0.89	0.88	0.87	0.88	0.86	0.89
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.42	0.44	0.43	0.45	0.43	0.45	0.4	0.4	0.38	0.44	0.4	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
	Sodium (Na)	mg/L	0.864	0.850	0.849	0.852	0.841	0.847	0.84	0.828	0.829	0.838	0.816	0.85
	Strontium (Sr)	mg/L	0.00806	0.00814	0.00807	0.00811	0.00802	0.00816	0.00805	0.00822	0.00818	0.00805	0.0079	0.00822
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000252	0.000246	0.000257	0.000244	0.000252	0.000246	0.000276	0.000264	0.000282	0.00026	0.000267	0.00025
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.10: Average Relative Percent Difference (RPD) values between water chemistry samples taken at the top and bottom of the water column at lentic (lake) monitoring stations, Mary River Project CREMP, 2016. Gray shaded values indicate RDP >30%.

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)	0.3	16	3.9	0.5	2.4	2	0	3	2.4	0.6	1.4	1.3	4.2	3.1	7.3	7.5	14
	pH (lab)	1.0	2.2	2.7	6.6	1.4	0.6	1.2	1.9	0.9	0.7	1.3	3.9	0.5	0.4	0.8	0.9	1.4
	Hardness (as $CaCO_3$)	1.9	1.9	3.2	2.8	3.2	1.9	2.0	3.2	1.3	1.4	0.9	4.5	5.3	5.2	8.5	5.8	13
	Total Suspended Solids (TSS)	13	0	6.7	0	7.3	0	0	0	0	59	16	0	0	0	0	0	3.2
	Total Dissolved Solids (TDS)	8.7	4.7	5.2	5.0	2.8	8.5	7.3	5.3	1.8	1.6	4.4	0.4	5.2	4.2	15	16	18
	Turbidity	7.3	9.1	51	37	29	63	6.1	12	35	78	9.6	74	47	19	38	18	24
	Alkalinity (as $CaCO_3$)	8.4	2.0	2.3	3.5	4.3	3.8	7.6	2.2	40	3.7	5.9	4.1	6.8	3.4	6.1	18	16
Nutrients and Organics	Total Ammonia	0	8.3	49	26	17	33	15	32	0	23	40	52	0	18	0	25	0
	Nitrate	0	0	28	0	0	27	0	14	29	22	3.6	41	0	0	19	4.6	0.7
	Nitrite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total Kjeldahl Nitrogen (TKN)	18	0	0	0	0	6.1	24	3.0	0	2.5	1.3	0	0	0	31	0	0
	Nitrate and Nitrite (as N)	0	0	28	0	0	27	0	14	26	21	2.7	41	0	0	19	3.2	0
	Dissolved Organic Carbon	4.5	3.7	14	2.6	4.7	12	2.5	9.6	14	7.0	13	8.5	0	5.6	11	23	7.7
	Total Organic Carbon	1.3	1.2	8.9	23	21	6.4	13	11	22	8.9	9.8	4.0	1.6	5.1	17	12	14
	Total Phosphorus	49	62	22	34	27	2.8	43	58	25	42	63	17	9.7	17	17	36	28
	Phenols	26	51	22	28	45	6.8	34	74	37	71	83	16	72	1.4	25	33	94
Anions	Bromide (Br)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chloride (Cl)	9.4	1.6	18	1.2	3.2	2.8	1.2	3.8	5.3	3.3	2.8	3.6	2.0	10	7.8	7.2	10
	Sulphate (SO_4)	4.2	1.0	3.4	2.3	5.1	2.4	2.3	13	5.1	1.9	1.2	14	6.3	5.9	7.8	15	22
Total Metals	Aluminum (Al)	46	25	51	48	17	25	36	24	25	95	19	0	20	11	33	39	17
	Antimony (Sb)	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0
	Arsenic (As)	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Barium (Ba)	3.3	1.7	6.4	0.9	1.6	2.3	1.9	4.2	3.7	20	2.5	4.2	10	2.8	6.3	8.7	13
	Beryllium (Be)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bismuth (Bi)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Boron (B)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cadmium (Cd)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Calcium (Ca)	0.9	2.1	9.3	1.2	2.6	2.0	0.6	4.0	2.2	4.8	2.6	1.6	5.8	4.7	6.7	7.4	14
	Cesium (Cs)											7.0			0			
	Chromium (Cr)	2.3	0	66	0	0	40	0	0	29	0	0	18	0	0	0	0	0
	Cobalt (Co)	0	0	17	0	0	0	0	0	0	1.0	0	0	0	0	0	0	0
	Copper (Cu)	2.4	10	12	4.1	5.8	9.1	22	76	5.9	21	7.1	22	6.9	6.3	9.3	15	74
	Iron (Fe)	0	0	31	0	0	0	0	0	16	87	20	43	13	0	0	12	10
	Lead (Pb)	0	0	33	0	0	0	0	0	0	66	1.9	0	1.3	0	0	21	19
	Lithium (Li)	0	0	5.2	4.7	11	3.2	0	7.4	0	0	0	0	0	0	0	0	0
	Magnesium (Mg)	3.7	3.1	8.0	0.5	3.8	0.6	1.5	2.1	2.4	2.1	3.1	4.1	5.5	3.2	7.9	7.5	13
	Manganese (Mn)	12	17	111	18	25	34	7.4	14	40	38	23	99	6.8	15	38	21	41
	Mercury (Hg)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0
	Molybdenum (Mo)	10	13	15	6.3	4.5	4.5	2.3	5.3	12	21	5.3	19	10	5.0	8.7	16	18
	Nickel (Ni)	0	0	56	3.7	3.4	36	5.2	2.4	1.4	0.8	8.1	21	0	5.0	0	4.2	0
	Phosphorus (P)											0			0			
	Potassium (K)	2.7	1.1	4.9	0.8	2.7	1.5	1.3	1.3	4.3	4.1	2.0	6.2	5.3	2.7	9.7	6.4	9.1
	Rubidium (Rb)											3.5			3.2			
	Selenium (Se)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Silicon (Si)	4.5	12	33	0.6	5.6	9.8	6.0	9.0	16	31	13	28	5.6	1.7	13	5.1	10
	Silver (Ag)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sodium (Na)	2.9	0.7	23	1.1	4.8	0.9	1.4	2.2	2.5	4.0	2.1	5.2	2.3	5.3	7.1	5.9	12
	Strontium (Sr)	0.7	1.7	13	2.5	3.4	2.0	0.9	4.5	2.0	9.0	2.2	4.8	4.5	3.0	6.9	9.0	15
	Sulfur (S)											7.3			13			
	Tellurium (Te)											0			0			
	Thallium (Tl)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thorium (Th)											0			0			
	Tin (Sn)	0	0	96	0	0	40	0	0	0	0	0	9.1	0	0	0	0	0
	Titanium (Ti)	0	0	0	0	0	0	0	0	0	0	27	0	0	7.8	0	0	0
	Tungsten (W)											0			0			
	Uranium (U)	1.0	6.9	11	2.3	8.6	4.9	2.1	7.4	8.4	18	4.2	15	15	8.0	11	17	31
	Vanadium (V)	0	0	1.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zinc (Zn)	0	0	0	0	0	21	0	0	7.1	0	4.2	0	0	0	0.5	0	0

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 2016.

Study Area	Station	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Unnamed Reference Creek	REF-CRK B1	11.9	10.64	98.6	7.77	101
	REF-CRK B2	11.3	10.78	98.6	7.76	101
	REF-CRK B3	11.0	10.78	97.8	7.73	101
	REF-CRK B4	10.7	10.85	97.8	7.73	101
	REF-CRK B5	10.5	10.91	98.0	7.78	101
Camp Lake Tributary 1 Upstream	CLT-1 US B1	8.8	11.48	98.7	8.01	172
	CLT-1 US B2	8.6	11.50	98.4	8.03	173
	CLT-1 US B3	7.8	11.66	98.0	7.96	173
	CLT-1 US B4	7.6	11.56	96.5	7.99	173
	CLT-1 US B5	7.3	11.83	98.1	7.93	174
Camp Lake Tributary 1 L2 Mine Exposed	CLT-1 L2 B1	19.0	10.22	110.1	8.02	357
	CLT-1 L2 B2	18.6	10.25	109.7	8.00	356
	CLT-1 L2 B3	18.2	10.38	110.2	7.97	355
	CLT-1 L2 B4	17.5	10.44	109.2	7.95	354
	CLT-1 L2 B5	16.3	10.45	106.7	7.90	352
Camp Lake Tributary 1 Downstream	CLT-1 DS B1	8.2	11.82	100.1	7.98	233
	CLT-1 DS B2	8.9	11.70	100.9	7.99	233
	CLT-1 DS B3	10.0	11.37	100.2	8.02	232
	CLT-1 DS B4	7.0	12.07	99.2	7.90	234
	CLT-1 DS B5	12.6	10.45	98.3	7.95	229
Camp Lake Tributary 2 Upstream	CLT-2 US B1	14.3	10.26	100.3	8.11	198
	CLT-2 US B2	14.4	10.17	99.4	8.14	198
	CLT-2 US B3	14.8	10.11	99.5	8.16	197
	CLT-2 US B4	14.2	10.02	97.6	8.14	201
	CLT-2 US B5	14.0	10.05	97.5	8.15	201
Camp Lake Tributary 2 Downstream	CLT-2 DS B1	11.6	10.91	100.5	8.06	200
	CLT-2 DS B2	12.2	10.73	100.00	8.09	200
	CLT-2 DS B3	12.7	10.66	100.5	8.10	200
	CLT-2 DS B4	13.3	10.56	101.8	8.11	200
	CLT-2 DS B5	13.7	10.43	100.4	8.11	200

Table C.12: *In-situ* water quality summary statistics for the Camp Lake Tributary benthic stations, Mary River Project CREMP, August 2016. Five stations were sampled at each study area.

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Temperature (°C)	Unnamed Reference Creek	11.1	0.5	0.2	10.4	11.8	10.5	11.9
	CLT1-US North Branch	8.0	0.6	0.3	7.2	8.8	7.3	8.8
	CLT1-L2 Upper Main Stem	17.9	1.1	0.5	16.6	19.2	16.3	19.0
	CLT1-DS Lower Main Stem	9.3	2.1	0.9	6.7	12.0	7.0	12.6
	CLT2-US Upstream	14.3	0.3	0.1	14.0	14.7	14.0	14.8
	CLT2-DS Downstream	12.7	0.8	0.4	11.7	13.7	11.6	13.7
Dissolved Oxygen (mg/L)	Unnamed Reference Creek	10.79	0.10	0.05	10.67	10.92	10.64	10.91
	CLT1-US North Branch	11.61	0.14	0.06	11.43	11.78	11.48	11.83
	CLT1-L2 Upper Main Stem	10.35	0.11	0.05	10.22	10.48	10.22	10.45
	CLT1-DS Lower Main Stem	11.48	0.63	0.28	10.70	12.26	10.45	12.07
	CLT2-US Upstream	10.12	0.10	0.04	10.00	10.24	10.02	10.26
	CLT2-DS Downstream	10.66	0.18	0.08	10.43	10.88	10.43	10.91
Dissolved Oxygen (% Saturation)	Unnamed Reference Creek	98.2	0.4	0.2	97.7	98.7	97.8	98.6
	CLT1-US North Branch	97.9	0.9	0.4	96.9	99.0	96.5	98.7
	CLT1-L2 Upper Main Stem	109.2	1.4	0.6	107.4	111.0	106.7	110.2
	CLT1-DS Lower Main Stem	99.7	1.0	0.5	98.5	101.0	98.3	100.9
	CLT2-US Upstream	98.9	1.2	0.6	97.3	100.4	97.5	100.3
	CLT2-DS Downstream	100.6	0.7	0.3	99.8	101.5	100.0	101.8
pH (units)	Unnamed Reference Creek	7.75	0.02	0.01	7.73	7.78	7.73	7.78
	CLT1-US North Branch	7.98	0.04	0.02	7.93	8.03	7.93	8.03
	CLT1-L2 Upper Main Stem	7.97	0.05	0.02	7.91	8.03	7.90	8.02
	CLT1-DS Lower Main Stem	7.97	0.05	0.02	7.91	8.02	7.90	8.02
	CLT2-US Upstream	8.14	0.02	0.01	8.12	8.16	8.11	8.16
	CLT2-DS Downstream	8.09	0.02	0.01	8.07	8.12	8.06	8.11
Specific Conductance (µS/cm)	Unnamed Reference Creek	101.0	0.2	0.1	100.7	101.3	100.6	101.2
	CLT1-US North Branch	172.9	0.6	0.3	172.1	173.6	172.1	173.8
	CLT1-L2 Upper Main Stem	354.8	1.8	0.8	352.6	357.1	352.1	356.6
	CLT1-DS Lower Main Stem	232	2	1	230	235	229	234
	CLT2-US Upstream	199	2	1	197	201	197	201
	CLT2-DS Downstream	200	0	0	200	200	200	200

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 2016. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

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 2 Areas?	p-value	Statistical Test
Water Temperature (°C)	YES	0.0000	α	Unnamed Reference Creek	CLT1 North Branch	YES	0.0071	Tukey's HSD
				Unnamed Reference Creek	CLT1 Upper Main Stem	YES	0.0000	
				Unnamed Reference Creek	CLT1 Lower Main Stem	NO	0.1705	
				CLT1 North Branch	CLT1 Upper Main Stem	YES	0.0000	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.3778	
				CLT1 Upper Main Stem	CLT1 Lower Main Stem	YES	0.0000	
Dissolved Oxygen (% saturation)	YES	0.0000	α	Unnamed Reference Creek	CLT1 North Branch	NO	0.9849	Tukey's HSD
				Unnamed Reference Creek	CLT1 Upper Main Stem	YES	0.0000	
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0973	
				CLT1 North Branch	CLT1 Upper Main Stem	YES	0.0000	
				CLT1 North Branch	CLT1 Lower Main Stem	YES	0.0508	
				CLT1 Upper Main Stem	CLT1 Lower Main Stem	YES	0.0000	
pH (units)	YES	0.0000	α	Unnamed Reference Creek	CLT1 North Branch	YES	0.0000	Tukey's HSD
				Unnamed Reference Creek	CLT1 Upper Main Stem	YES	0.0000	
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0000	
				CLT1 North Branch	CLT1 Upper Main Stem	NO	0.9192	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.9192	
				CLT1 Upper Main Stem	CLT1 Lower Main Stem	NO	1.0000	
Specific Conductance (µS/cm)	YES	0.0000	α	Unnamed Reference Creek	CLT1 North Branch	YES	0.0000	Tukey's HSD
				Unnamed Reference Creek	CLT1 Upper Main Stem	YES	0.0000	
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0000	
				CLT1 North Branch	CLT1 Upper Main Stem	YES	0.0000	
				CLT1 North Branch	CLT1 Lower Main Stem	YES	0.0000	
				CLT1 Upper Main Stem	CLT1 Lower Main Stem	YES	0.0000	

[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; ζ - transformed, single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transform
test conducted; β - data logit transformed, single factor ANOVA test conducted;

Table C.14: Water chemistry at lotic Camp Lake Tributary (CLT) monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	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	L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01
					27-Jun-2016	27-Jun-2016	27-Jun-2016	27-Jun-2016	27-Jun-2016	27-Jun-2016	25-Jun-2016	20-Jul-2016	19-Jul-2016	19-Jul-2016	19-Jul-2016	20-Jul-2016	20-Jul-2016	20-Jul-2016	20-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	39.2	54.3	224	64	66.9	70.3	69.9	82	145	365	204	209	215	183	147	209	431	293	298	296	255
	pH (lab)	pH	6.5 - 9.0	-	7.44	7.58	7.84	7.64	7.66	7.68	7.63	7.78	8.08	8.01	8.07	8.18	8.22	8.17	7.97	8.21	7.99	8.16	8.11	8.17	8.27
	Hardness (as $CaCO_3$)	mg/L	-	-	18	25	87	29	30	32	32	40	74	156	97	99	105	93	72	105	176	136	138	138	130
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	24	36	127	42	42	47	29	40	95	195	105	205	115	87	77	94	230	156	159	143	123
	Turbidity	NTU	-	-	1.94	1.55	3.76	1.68	1.71	1.63	1.95	1.12	0.37	2.6	0.57	0.55	0.54	0.3	0.34	0.26	2.88	0.97	0.93	0.95	0.29
	Alkalinity (as $CaCO_3$)	mg/L	-	-	17	24	70	22	28	31	30	40	79	131	87	84	94	82	72	104	140	119	116	116	125
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	0.11	<0.020	<0.020	<0.020	<0.020	<0.020	0.036	0.141	0.021	<0.020	<0.020	<0.020	<0.020	<0.020	0.237	0.048	0.047	0.042	0.031
	Nitrate	mg/L	13	13	0.036	<0.020	0.579	0.03	0.036	0.028	0.039	0.120	<0.020	0.520	0.037	0.096	0.107	0.048	0.079	<0.020	1.67	0.353	0.411	0.38	0.048
	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	< 0.009	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0203	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.35	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	0.44000	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.56	0.2	0.24	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	0.036	<0.021	0.579	0.03	0.036	0.028	0.039	0.12000	<0.021	0.52870	0.03700	0.09600	0.10700	0.04800	0.079	<0.021	1.6903	0.353	0.411	0.38	0.048
	Dissolved Organic Carbon	mg/L	-	-	<1.0	<1.0	2.7	<1.0	<1.0	1.1	<1.0	1.4	1.7	4.2	2.1	2.2	2.1	1.4	1.8	2.4	4.6	3	3	2.9	3
	Total Organic Carbon	mg/L	-	-	<1.0	<1.0	3.1	1.2	1.2	1.3	1.1	1.4	2.7	5	2.7	2.3	2.4	2	1.9	2.6	4.6	3.2	3.4	3.1	3.2
	Total Phosphorus	mg/L	0.020[α]	-	0.006	0.0035	0.0075	<0.0030	<0.0030	<0.0030	0.0046	0.0057	0.0162	0.0049	<0.0030	<0.0030	0.0046	<0.0030	0.0087	<0.0030	0.0096	0.0033	0.0059	0.0031	0.0108
	Phenols	mg/L	0.004[α]	-	0.0024	0.0021	0.0034	0.0019	0.0025	0.0021	0.0024	<0.0010	0.022	0.0074	0.0023	0.0019	<0.0010	<0.0010	0.007	0.0067	0.0076	0.0041	0.0038	0.0025	0.0067
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	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	<0.50	<0.50	16.8	1.37	1.65	1.44	0.61	0.91	0.88	26.10	13.00	11.60	10.80	1.81	1.91	2.13	36.7	18.4	18.9	17.2	5.11
	Sulphate (SO_4)	mg/L	218[β]	218	0.45	1.88	13.5	2.05	2.04	2.14	5.51	1.5	2.4	24.6	4.7	5.6	5.7	8.1	2.98	4.83	18.4	7.84	8.25	7.7	5.29
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0467	0.0182	0.0577	0.0242	0.023	0.0229	0.0342	0.0191	0.0091	0.0174	0.0075	0.0106	0.0152	0.0083	0.0137	0.0071	0.031	0.0098	0.011	0.0154	0.008
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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	0.000	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00014	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00313	0.00345	0.00901	0.00388	0.00401	0.00428	0.00382	0.0068	0.0095	0.0155	0.0129	0.0121	0.0126	0.0107	0.0109	0.0128	0.0168	0.0163	0.0155	0.0157	0.0142
	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	<0.00010	<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	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	< 0.016	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.02	<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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	3.58	4.68	16.8	5.75	6.02	6.42	6.26	8	15	30	22	21	22	18	14.2	20.3	34.3	28.3	27.9	28.8	25.2
	Chromium (Cr)	mg/L	0.0089	0.000856	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00052	<0.00050	<0.00050	<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	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00023	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00034	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.00114	0.00091	0.0008	0.00095	0.00093	0.00093	0.00065	0.0018	0.0017	0.0009	0.0016	0.0016	0.0015	0.0010	***0.00228***	***0.00226***	0.0013	0.00194	0.00191	0.00183	0.00156
	Iron (Fe)	mg/L	0.30	0.326	0.055	<0.030	0.225	0.039	0.039	0.041	0.044	<0.030	<0.030	***0.440***	0.050	0.038	0.036	<0.030	<0.030	<0.030	***0.459***	0.12	0.112	0.094	<0.030
	Lead (Pb)	mg/L	0.001	0.001	0.000069	<0.000050	0.000103	<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	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0016	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00110	0.00340	0.00290	0.00260	0.00260	0.00140	<0.0010	0.0013	0.0031	0.0037	0.0036	0.0034	0.0016
	Magnesium (Mg)	mg/L	-	-	2.17	2.84	10.4	3.25	3.49	3.77	3.87	4.94	9.22	19.2	10.7	11.7	12.4	11.1	8.69	12.9	21	15.7	15.9	15.8	15.7
	Manganese (Mn)	mg/L	0.935[β]	-	0.00148	0.000486	0.0308	0.0014	0.00134	0.00128	0.00154	0.00059	0.00047	0.07920	0.00626	0.00233	0.00194	0.00044	0.000651	0.000694	0.0511	0.0108	0.00822	0.00535	0.00104
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000144	0.000135	0.00157	0.000221	0.000211	0.000208	0.000174	0.00051	0.00040	0.00161	0.00050	0.00052	0.00049	0.00031	0.000851	0.000647	0.00353	0.0012	0.00115	0.000988	0.000436
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	0.00085	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0006	0.0012	0.0008	0.0008	0.0008	<0.00050	<0.00050	0.00071	0.00146	0.00103	0.00102	0.00101	0.00066
	Potassium (K)	mg/L	-	-	0.65	0.63	2.06	0.74	0.76	0.78	0.6	1.55	1.60	3.09	1.77	1.87	1.85	1.50	2.15	2.05	3.3	2.41	2.35	2.28	1.79
	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	0.000118	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.42	0.34	0.52	0.37	0.37	0.38	0.41	0.62	0.79	0.79	0.82	0.91	0.97	0.77	0.83	1.1	1.22	1.21	1.26	1.3	1.05
	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	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.194	0.28	7.07	0.635	0.675	0.657	0.459	0.385	0.890	11.400	1.990	2.290	2.350	1.480	0.584	1.55	16.3	5.32	5.37	5.1	2.8
	Strontium (Sr)	mg/L	-	-	0.00208	0.00249	0.0211	0.00453	0.00496	0.005	0.00385	0.004	0.007	0.033	0.046	0.033	0.030	0.010	0.00826	0.0106	0.0415	0.0487	0.046	0.0401	0.0151
	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	0.00001	<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	0.00115	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.000128	0.000087	0.00638	0.000323	0.000303	0.000286	0.00015	0.0008	0.0009	0.0071	0.0015	0.0017	0.0017	0.0011	0.00399	0.00277	0.0172	0.0058	0.00571	0.00501	0.00236
	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	<0.00050	<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	0.0033	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0112	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0082

[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.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.15: Dissolved metals concentrations at Camp Lake Tributary water quality monitoring stations, Mary River Project CREMP, 2016.

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	L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01
			27-Jun-2016	27-Jun-2016	27-Jun-2016	27-Jun-2016	27-Jun-2016	27-Jun-2016	25-Jun-2016	20-Jul-2016	19-Jul-2016	19-Jul-2016	19-Jul-2016	20-Jul-2016	20-Jul-2016	20-Jul-2016	20-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016
Dissolved Metals	Aluminum (Al)	mg/L	0.0062	<0.0050	0.0053	<0.0050	<0.0050	<0.0050	<0.0050	0.0068	0.0034	0.0041	0.0041	0.0053	0.0043	0.0031	0.00630	0.00470	0.00430	0.00470	0.00560	<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	<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	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00304	0.00350	0.00837	0.00373	0.00392	0.00398	0.00375	0.00699	0.00949	0.0153	0.0127	0.0119	0.0126	0.0106	0.0108	0.0126	0.0167	0.016	0.0159	0.0154	0.0140
	Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050	<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	0.014	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.016	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.02	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	3.49	4.90	16.9	5.62	5.97	6.32	6.11	7.79	14.7	30.0	21.5	20.7	21.8	18.7	14.3	21	34.7	29	28.6	28.7	26.3
	Cesium (Cs)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010														
	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	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00023	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00031	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00101	0.00087	0.00072	0.00089	0.00093	0.00088	0.00060	0.00183	0.00164	0.00082	0.00162	0.00156	0.00150	0.00097	0.00222	0.00222	0.00112	0.00185	0.00193	0.00178	0.00168
	Iron (Fe)	mg/L	<0.010	<0.010	0.066	<0.010	<0.010	<0.010	<0.010	<0.030	<0.030	0.199	0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.158	0.06	0.051	0.037	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	0.0021	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0033	0.0029	0.0026	0.0024	0.0013	<0.0010	0.0012	0.0039	0.0035	0.0036	0.0033	0.0015
	Magnesium (Mg)	mg/L	2.22	3.09	10.8	3.57	3.75	3.90	4.06	4.94	8.97	19.8	10.6	11.4	12.3	11.1	8.76	12.7	21.7	15.5	16.2	16.2	15.6
	Manganese (Mn)	mg/L	<0.00050	<0.00050	0.0267	0.00087	0.00072	0.00052	<0.00050	0.000304	0.000359	0.0782	0.00603	0.00161	0.00109	0.000307	0.000438	0.00068	0.0498	0.0103	0.00763	0.00441	0.000802
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000142	0.000132	0.00142	0.000182	0.000198	0.000186	0.000154	0.000505	0.000420	0.00155	0.000496	0.000524	0.000504	0.000340	0.000885	0.000679	0.00318	0.00125	0.0012	0.00102	0.000460
	Nickel (Ni)	mg/L	<0.00050	<0.00050	0.00081	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00057	0.00119	0.00077	0.00077	0.00083	<0.00050	<0.00050	0.00069	0.00133	0.00093	0.00099	0.00103	0.00062
	Phosphorus (P)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050														
	Potassium (K)	mg/L	0.669	0.692	2.11	0.768	0.794	0.789	0.622	1.56	1.55	3.22	1.74	1.84	1.88	1.50	2.19	2.05	3.43	2.51	2.36	2.3	1.82
	Rubidium (Rb)	mg/L	0.00196	0.00187	0.00263	0.00182	0.00199	0.00190	0.00130														
	Selenium (Se)	mg/L	<0.000050	<0.000050	0.000060	<0.000050	<0.000050	<0.000050	<0.000050	<0.0010	<0.0010	<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	0.368	0.336	0.443	0.346	0.354	0.365	0.360	0.59	0.80	0.76	0.83	0.90	0.95	0.75	0.82	1.08	1.28	1.2	1.25	1.29	1.03
	Silver (Ag)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010	<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	<0.50	<0.50	7.55	0.68	0.72	0.69	0.50	0.389	0.867	11.7	1.97	2.24	2.37	1.49	0.595	1.56	16.4	5.47	5.54	4.96	2.85
	Strontium (Sr)	mg/L	0.0020	0.0026	0.0203	0.0044	0.0049	0.0049	0.0037	0.00436	0.00710	0.0340	0.0458	0.0339	0.0293	0.0106	0.00823	0.0108	0.0393	0.0491	0.0475	0.0415	0.0151
	Sulfur (S)	mg/L	<0.50	0.61	4.09	0.67	0.64	0.69	1.83														
	Tellurium (Te)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020														
	Thallium (Tl)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Thorium (Th)	mg/L	<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	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Tungsten (W)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010														
	Uranium (U)	mg/L	0.000096	0.000085	0.00609	0.000301	0.000284	0.000261	0.000135	0.000725	0.000935	0.00678	0.00148	0.00168	0.00169	0.00119	0.00385	0.00271	0.0166	0.00583	0.0056	0.00498	0.00232
	Vanadium (V)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0036	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0112	<0.0030	<0.0030	<0.0030	0.0038	<0.0030	<0.0030	0.0073
	Zirconium (Zr)	mg/L	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030														

Table C.16: Summary of the magnitude of difference in aqueous metal concentrations between the Camp Lake Tributaries and mean reference creek station data for spring summer, and fall sampling events, Mary River Project CREMP, 2016.

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)	1.7	7.9	2.4	2.5	1.5	4.7	2.7	2.4	1.4	3.4	2.4	2.0
Hardness (as $CaCO_3$)	1.6	6.4	2.2	2.4	1.6	4.5	2.9	2.7	1.5	3.0	2.4	2.3
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)	1.5	6.4	2.2	1.5	1.9	5.5	4.0	2.5	1.3	3.6	2.4	1.9
Turbidity	1.2	2.6	1.2	1.3	0.2	0.7	0.1	0.1	0.3	2.6	0.9	0.3
Alkalinity (as $CaCO_3$)	1.5	5.0	1.9	2.1	1.8	4.0	2.7	2.5	1.5	2.5	2.1	2.2
Total Ammonia	0.9	5.0	0.9	0.9	1.4	7.1	1.0	1.0	1.0	12	2.3	1.6
Nitrate	1.4	29	1.6	2.0	3.5	26	4.0	2.4	2.3	79	18	2.3
Nitrite	1.0	1.0	1.0	1.0	1.0	1.7	1.0	1.0	1.0	4.1	1.0	1.0
Total Kjeldahl Nitrogen (TKN)	1.0	2.3	1.0	1.0	1.0	2.9	1.0	1.0	1.0	3.7	1.3	1.0
Dissolved Organic Carbon	1.0	2.6	1.0	1.0	1.6	4.2	2.1	1.4	1.7	3.7	2.4	2.4
Total Organic Carbon	0.9	2.7	1.1	1.0	1.9	4.5	2.2	1.8	1.5	3.1	2.2	2.2
Total Phosphorus	0.5	0.8	0.3	0.5	2.0	0.9	0.7	0.6	1.0	1.6	0.7	1.8
Phenols	0.7	1.1	0.7	0.8	10	6.7	1.6	0.9	1.3	1.4	0.6	1.2
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	25	2.2	0.9	0.8	22	10	1.6	0.8	15	7.3	2.0
Sulphate (SO_4)	2.1	24	3.7	9.9	0.9	12	2.5	3.8	0.9	4.2	1.8	1.2
Aluminum (Al)	1.0	1.8	0.7	1.1	0.1	0.2	0.1	0.1	0.2	0.5	0.2	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	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.4	1.0	1.0
Barium (Ba)	1.7	4.7	2.1	2.0	1.5	2.9	2.4	2.0	1.5	2.2	2.0	1.8
Beryllium (Be)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	0.3	1.3	1.3
Bismuth (Bi)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	0.1	1.3	1.3
Boron (B)	1.0	1.2	1.0	1.0	1.0	1.6	1.0	1.0	1.0	2.0	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
Calcium (Ca)	1.6	6.4	2.3	2.4	1.6	4.2	3.0	2.5	1.4	2.8	2.3	2.1
Chromium (Cr)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cobalt (Co)	1.0	1.7	1.0	1.0	1.0	2.3	1.0	1.0	1.0	3.4	1.0	1.0
Copper (Cu)	1.9	1.5	1.8	1.2	2.2	1.1	2.0	1.3	2.3	1.3	1.9	1.6
Iron (Fe)	1.1	5.9	1.0	1.2	0.4	5.4	0.5	0.4	0.6	9.0	2.1	0.6
Lead (Pb)	0.9	1.5	0.7	0.7	0.4	0.4	0.4	0.4	0.5	1.0	0.5	0.5
Lithium (Li)	1.0	1.6	1.0	1.0	1.1	3.4	2.7	1.4	1.2	3.1	3.6	1.6
Magnesium (Mg)	1.7	7.1	2.4	2.6	1.7	4.7	2.8	2.7	1.6	3.1	2.3	2.3
Manganese (Mn)	1.0	32	1.4	1.6	0.4	63	2.8	0.3	0.8	60	9.5	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	1.0
Molybdenum (Mo)	1.8	20	2.7	2.2	2.1	7.6	2.4	1.5	2.0	9.3	2.9	1.1
Nickel (Ni)	1.0	1.7	1.0	1.0	1.1	2.4	1.5	1.0	1.1	2.6	1.8	1.2
Potassium (K)	2.5	8.2	3.0	2.4	2.6	5.2	3.1	2.5	2.5	3.9	2.8	2.1
Selenium (Se)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	0.2	1.3	1.3
Silicon (Si)	1.0	1.4	1.0	1.1	0.8	0.9	1.0	0.8	1.0	1.3	1.3	1.1
Silver (Ag)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	2.5	0.5	0.5
Sodium (Na)	0.6	19	1.8	1.3	0.6	11	2.2	1.5	0.6	8.9	2.9	1.5
Strontium (Sr)	0.9	8.7	2.0	1.6	0.8	4.7	5.1	1.5	0.8	3.3	3.6	1.2
Thallium (Tl)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	0.1	1.3	1.3
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
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	0.1	1.3	1.3
Uranium (U)	0.6	35	1.7	0.8	1.0	8.1	1.8	1.3	0.9	4.7	1.5	0.6
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	0.6	1.1	1.1
Zinc (Zn)	1.0	1.0	1.0	1.1	1.0	1.0	1.0	3.7	1.0	1.0	1.0	2.7

[purple] Denotes slight elevation (mean variable concentration 3 to 5 times higher than respective mean reference value).

[orange] Denotes moderate elevation (mean variable concentration 5 to 10 times higher than respective mean reference value).

[red] Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference value).

Table C.17: *In-situ* water quality statistical comparisons among Camp Lake Tributary 2 and Unnamed Reference Creek study areas, Mary River Project CREMP, August 2016. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	**p-value**	**Statistical Test [b]**	**(I) Area**	**(J) Area**	**Significant Difference Between 2 Areas?**	**p-value**	**Statistical Test**
Water Temperature (°C)	YES	0.0000	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0000	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0030	
				CLT2 Upstream	CLT2 Downstream	YES	0.0028	
Dissolved Oxygen (mg/L)	YES	0.0000	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0000	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	NO	0.2795	
				CLT2 Upstream	CLT2 Downstream	YES	0.0001	
Dissolved Oxygen (% saturation)	YES	0.0018	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.6388	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0009	
				CLT2 Upstream	CLT2 Downstream	YES	0.0874	
pH (units)	YES	0.0000	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0000	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0000	
				CLT2 Upstream	CLT2 Downstream	YES	0.0117	
Specific Conductance (µS/cm)	YES	0.0000	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0000	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0000	
				CLT2 Upstream	CLT2 Downstream	NO	0.7946	

[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; ζ - transformed, single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data logit transformed, single factor ANOVA test conducted;

Table C.18: *In-situ* water quality profile data collected at Camp Lake water quality monitoring stations in winter[a], Mary River Project CREMP, 2016.

Station JLO-02[b,c]					Station JLO-10[b,c]					Station JLO-01[b,c]					Station JLO-07[b,c]					Station JLO-09[b,c]				
Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)
3.15	1.0	15.1	7.8	152.5	2.85	1.1	14.9	7.9	148.2	3.20	1.1	14.5	7.8	145.7	3.10	1.3	13.9	7.9	156.4	2.90	0.5	14.2	8.1	161.3
4.15	1.3	15.1	7.7	152.1	3.85	1.2	14.7	7.8	147.3	4.20	1.2	14.5	7.8	146.3	4.10	1.3	14.1	7.6	151.8	3.90	0.8	14.1	7.9	154.5
5.15	1.3	15.1	7.8	151.5	4.85	1.3	14.7	7.8	146.8	5.20	1.2	14.6	7.8	147.0	5.10	1.3	14.2	7.6	151.7	4.90	1.2	14.3	7.8	151.4
6.15	1.3	15.0	7.8	150.1	5.85	1.3	14.6	7.8	146.7	6.20	1.2	14.7	7.8	147.3	6.10	1.3	14.1	7.6	151.1	5.90	1.3	14.2	7.8	150.7
7.15	1.3	14.9	7.8	149.8	6.85	1.3	14.6	7.8	146.3	7.20	1.3	14.7	7.8	147.0	7.10	1.3	14.3	7.6	151.6	6.90	1.3	14.1	7.8	149.4
8.15	1.3	14.9	7.8	149.9	7.85	1.3	14.5	7.8	145.7	8.20	1.3	14.6	7.8	146.6	8.10	1.3	14.4	7.6	152.4	7.90	1.4	14.0	7.8	148.7
9.15	1.3	14.9	7.8	149.9	8.85	1.3	14.7	7.8	148.1	9.20	1.3	14.6	7.8	146.5	9.10	1.3	14.3	7.6	151.9	8.90	1.4	13.9	7.8	148.1
10.15	1.3	14.9	7.8	149.9	9.85	1.3	14.8	7.8	149.3	10.20	1.3	14.5	7.8	146.0	10.10	1.3	14.1	7.6	150.1	9.90	1.4	13.8	7.8	147.7
11.15	1.4	15.0	7.8	149.6	10.85	1.3	14.9	7.8	149.6	11.20	1.4	14.4	7.8	145.8	11.10	1.4	13.8	7.6	149.1	10.90	1.5	13.7	7.7	148.3
12.15	1.4	14.9	7.7	149.1						12.20	1.4	14.4	7.8	146.0	12.10	1.5	13.7	7.6	148.3	11.90	1.5	13.7	7.7	148.3
										13.20	1.4	14.2	7.8	144.8	13.10	1.5	13.4	7.6	147.1	12.90	1.5	13.6	7.7	148.4
										14.20	1.5	13.8	7.8	142.7	14.10	1.5	13.3	7.6	146.5	13.90	1.5	13.4	7.7	149.1
										15.20	1.6	13.4	7.8	141.3	15.10	1.6	13.0	7.6	145.9	14.90	1.6	13.1	7.7	148.1
										16.20	1.7	13.2	7.7	141.0	16.10	1.7	12.8	7.6	145.4	15.90	1.6	13.0	7.7	146.7
															17.10	1.8	12.3	7.6	144.8	16.90	1.7	12.6	7.7	145.8
															18.10	1.8	11.9	7.5	144.4	17.90	1.8	12.3	7.6	144.8
															19.10	1.8	11.7	7.5	144.2					
															20.10	1.8	11.4	7.5	144.2					
															21.10	1.9	11.1	7.5	144.9					
															22.10	1.9	11.0	7.4	145.5					
															23.10	1.9	10.9	7.4	146.4					
															24.10	1.9	10.5	7.4	146.4					
															25.10	2.0	10.0	7.4	146.0					
															26.10	2.1	9.4	7.4	145.9					
															27.10	2.2	8.6	7.3	147.1					
															28.10	2.3	7.8	7.3	150.8					
															29.10	2.4	7.1	7.3	152.5					
															30.10	2.5	5.9	7.2	155.4					
															31.10	2.5	5.0	7.2	159.9					
															32.10	2.6	2.6	7.1	168.9					

[a] Sampling conducted on 23-April and 25-April, 2016.
[b] Total depth at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 were 14.15, 12, 16.8, 32.24, and 18.8 m, respectively, at the time of winter sampling.
[c] Ice thickness at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 were 2.15, 1.85, 2.23, 1.53, and 1.91 m, respectively, at the time of winter sampling.

Table C.19: *In-situ* water quality profile data collected at Camp Lake water quality monitoring stations in summer[a], Mary River Project CREMP, 2016.

Depth (m)	Temperature (°C)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	JLO-02[b]	JLO-10[b]	JLO-01[b]	JLO-07[b]	JLO-09[b]	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
1.0	8.9	8.4	8.2	9.2	8.9	106.8	106.4	105.1	104.7	104.9	7.80	7.86	7.89	7.85	7.79	131.2	129.2	129.0	227.0	275.0
2.0	8.9	8.4	8.2	8.3	8.4	106.9	106.9	106.2	104.9	105.3	7.82	7.88	7.89	7.87	7.82	131.0	129.2	129.1	275.7	275.3
3.0	8.9	8.3	8.1	8.2	8.2	107.2	106.8	106.5	105.1	105.4	7.83	7.87	7.88	7.88	7.83	131.0	129.2	129.1	275.5	275.7
4.0	8.9	8.2	8.2	7.9	7.9	107.0	106.8	106.7	104.9	105.0	7.84	7.88	7.88	7.89	7.84	131.1	129.2	129.2	274.7	274.8
5.0	8.9	8.2	8.1	7.7	7.6	107.0	106.6	106.7	105.0	104.8	7.84	7.87	7.88	7.89	7.85	130.6	129.5	129.1	274.8	274.4
6.0	8.8		8.1	7.6	7.6	107.0		106.7	104.8	104.8	7.85		7.89	7.89	7.86	130.0		129.1	274.5	274.4
7.0	8.7		8.1	7.6	7.6	106.8		106.7	104.7	104.7	7.85		7.89	7.89	7.86	129.7		129.1	274.5	274.3
8.0	8.5		8.1	7.5	7.6	106.6		106.6	104.5	104.6	7.85		7.88	7.88	7.86	129.3		129.1	274.4	274.4
9.0	8.0		8.0	7.5	7.6	105.3		106.2	104.4	104.5	7.85		7.89	7.88	7.87	129.4		129.1	274.5	274.4
10.0	7.1		7.8	7.5	7.6	105.2		106.2	104.3	104.4	7.83		7.88	7.88	7.87	129.3		129.1	274.5	274.3
11.0	6.9		7.8	7.5	7.5	104.7		106.2	104.2	104.3	7.81		7.87	7.87	7.87	129.2		129.1	274.5	274.4
12.0	6.8		7.5	7.5	7.5	104.6		105.8	104.0	104.2	7.80		7.86	7.88	7.87	129.2		129.1	274.3	274.3
13.0			7.6	7.4	7.5			106.2	103.9	104.2			7.86	7.87	7.87			129.3	274.4	274.3
14.0			7.6	7.4	7.5			99.6	103.9	104.2			7.81	7.87	7.88			129.5	274.4	274.3
15.0				7.4	7.5				103.8	104.2				7.87	7.87				274.3	274.3
16.0				7.4	7.5				103.8	104.2				7.87	7.87				274.4	274.2
17.0				7.4					103.7					7.87					274.4	
18.0				7.4					103.6					7.87					274.4	
19.0				7.3					103.5					7.87					274.3	
20.0				7.3					103.4					7.87					274.5	
21.0				7.3					103.3					7.87					274.4	
22.0				7.3					103.2					7.86					274.4	
23.0				7.3					103.2					7.86					274.4	
24.0				7.3					103.1					7.86					274.4	
25.0				7.3					103.0					7.86					274.4	
26.0				7.2					103.0					7.86					274.4	
27.0				7.2					102.9					7.85					274.5	
28.0				7.1					102.6					7.84					274.7	
29.0				7.0					102.4					7.83					274.6	
30.0				6.8					102.2					7.82					274.6	
31.0				6.7					102.1					7.81					274.6	
32.0				6.7					102.0					7.80					274.6	

[a] Sampling conducted on 24-July and 26-July, 2016.

[b] Total depth at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 were 12.26, 5.9, 15.9, 32.45, and 15.64 m, respectively, at the time of summer sampling.

Table C.20: *In-situ* water quality profile data collected at Camp Lake water quality monitoring stations in fall[a], Mary River Project CREMP, 2016.

Depth (m)	Temperature (°C)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	JLO-02[b]	JLO-10[b]	JLO-01[b]	JLO-07[b]	JLO-09[b]	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
1.0	11.3	11.0	10.8	11.8	11.3	102.6	103.3	103.1	103.9	104.0	8.09	7.95	7.95	8.03	8.01	129.4	127.6	125.3	130.0	128.7
2.0	11.1	11.0	10.8	11.5	11.1	103.1	103.1	102.9	103.4	103.7	8.00	7.97	7.95	8.01	8.00	129.1	127.3	125.2	128.5	128.1
3.0	11.0	10.9	10.8	11.1	11.1	103.2	103.3	102.9	104.0	103.7	8.00	7.98	7.96	8.01	8.00	128.3	127.0	125.0	128.5	127.8
4.0	10.9	10.8	10.7	11.0	11.0	103.2	103.1	102.7	103.6	103.7	8.00	7.98	7.96	8.01	8.00	131.1	126.6	125.2	128.4	127.3
5.0	10.7	10.8	10.6	10.7	10.9	103.2	102.9	102.6	103.5	103.7	8.00	7.98	7.96	8.00	8.00	130.3	126.4	125.0	128.4	127.0
6.0	10.6	10.7	10.5	10.6	10.9	102.9	102.9	102.7	103.5	103.5	8.00	7.99	7.96	8.00	8.00	129.7	126.6	125.1	128.4	126.7
7.0	10.5	10.5	10.5	10.6	10.8	103.1	102.8	102.6	103.3	103.3	8.00	7.99	7.96	8.00	8.00	129.5	126.9	125.3	128.3	126.6
8.0	10.4	10.4	10.4	10.4	10.7	103.0	102.9	102.5	103.4	102.9	7.99	7.99	7.96	7.99	8.00	128.5	126.9	125.5	128.1	126.8
9.0	10.3		10.3	10.4	10.4	103.0		102.5	103.2	102.8	7.98		7.95	7.99	8.00	127.6		125.3	127.8	127.0
10.0	10.2		10.3	10.3	10.3	102.7		102.3	102.9	102.7	7.98		7.94	7.99	7.99	127.3		125.2	128.2	126.4
11.0	10.1		10.1	10.2	10.0	102.8		102.4	102.8	102.9	7.97		7.93	7.99	7.98	128.6		125.7	127.3	125.6
12.0	10.0		9.8	9.9	9.8	102.8		102.4	102.1	102.9	7.96		7.91	7.97	7.96	128.0		125.2	125.3	125.1
13.0	9.6		9.4	9.0	9.5	102.5		102.6	102.4	102.3	7.94		7.88	7.92	7.93	126.6		123.8	124.1	124.4
14.0			8.8	8.7	8.9			102.4	102.6	102.5			7.84	7.89	7.90			123.2	123.7	123.2
15.0			8.4	8.5	8.3*			101.9	102.4	102.1*			7.79	7.85	7.84*			122.7	123.5	122.3*
16.0			8.1*	8.4				101.2*	102.1				7.76	7.84				122.3*	123.1	
17.0				8.1					101.1					7.80					122.5	
18.0				7.8					100.3					7.77					122.2	
19.0				7.7					99.5					7.75					121.3	
20.0				7.7					99.3					7.74					121.2	
21.0				7.6					99.0					7.72					121.2	
22.0				7.5					98.6					7.71					121.1	
23.0				7.5					98.0					7.69					121.0	
24.0				7.4					97.4					7.68					120.9	
25.0				7.4					97.1					7.67					120.8	
26.0				7.4					96.8					7.66					120.7	
27.0				7.4					96.5					7.66					120.7	
28.0				7.3					95.9					7.64					120.8	
29.0				7.3					95.2					7.63					120.8	
30.0				7.3					94.6					7.61					120.7	
31.0				7.3					94.1					7.6					120.5	
32.0				7.2					93.3					7.58					120.5	

[a] Sampling conducted on 22-August, 2016.
[b] Total depth at Stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 were 12.4, 9.3, 16.5, 32.7, and 14.9 m, respectively, at the time of fall sampling.
* The deepest *in situ* water quality reading at stations JLO-01 and JLO-09 were taken at 15.5 m and 14.5 m, respectively, at the time of fall sampling.

Table C.21: 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 2016.

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.)		
JLO-02	11-Aug-16	10.6	8.2	clear, slight blue-green colouration	surface	11.92	11.42	105.9	7.98	133
					bottom	9.23	12.01	104.5	7.88	134
JLO-21	11-Aug-16	11.1	7.8	clear, slight blue-green colouration	surface	11.88	11.39	105.5	8.04	133
					bottom	9.28	12.03	104.8	8.03	134
JLO-32	11-Aug-16	9.9	8.1	clear, slight blue-green colouration	surface	12.26	11.51	106.7	8.05	133
					bottom	9.16	12.23	106.3	8.00	132
JLO-31	11-Aug-16	11.7	8.3	clear, slight blue-green colouration	surface	12.01	11.81	109.6	8.05	132
					bottom	8.98	12.18	105.0	7.98	131
JLO-30	11-Aug-16	10.6	7.3	clear, slight blue-green colouration	surface	11.46	11.47	105.2	8.03	131
					bottom	9.31	11.94	104.1	7.99	131

Table C.22: Water depth and *in-situ* water quality summary statistics for littoral (<12 m) lake benthic stations, Mary River Project CREMP, August 2016. Five replicate littoral stations were sampled at all but Mary Lake, where six littoral stations were sampled.

Metric	Lake	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Depth (m)	Reference 3	9.32	1.03	0.46	8.04	10.60	8.10	10.70
	Camp	10.78	0.67	0.30	9.95	11.61	9.90	11.70
	Sheardown NW	9.36	1.52	0.68	7.48	11.24	7.50	11.40
	Sheardown SE	10.42	2.92	1.31	6.79	14.05	6.70	13.90
	Mary	10.69	1.05	0.43	9.58	11.79	9.10	11.60
Water Temperarture (^{o}C)	Reference 3	9.92	0.37	0.17	9.46	10.38	9.50	10.40
	Camp	9.19	0.13	0.06	9.03	9.36	8.98	9.31
	Sheardown NW	10.55	0.37	0.17	10.09	11.02	9.99	10.95
	Sheardown SE	10.49	0.67	0.30	9.65	11.33	9.91	11.36
	Mary	10.17	1.25	0.51	8.86	11.48	9.23	12.63
Dissolved Oxygen (mg/L)	Reference 3	10.35	0.82	0.37	9.33	11.36	9.28	11.34
	Camp	12.08	0.12	0.05	11.93	12.23	11.94	12.23
	Sheardown NW	10.97	0.36	0.16	10.52	11.42	10.34	11.19
	Sheardown SE	9.81	0.58	0.26	9.08	10.54	9.15	10.42
	Mary	10.11	1.61	0.66	8.42	11.79	7.79	11.69
Dissolved Oxygen (% saturation)	Reference 3	91.3	6.7	3.0	83.0	99.6	82.6	99.1
	Camp	104.9	0.8	0.4	103.9	106.0	104.1	106.3
	Sheardown NW	99.2	2.5	1.1	96.1	102.3	94.9	101.3
	Sheardown SE	88.1	6.6	3.0	79.9	96.4	80.9	95.3
	Mary	88.8	15.0	6.1	73.0	104.5	63.7	102.5
pH (pH units)	Reference 3	7.64	0.23	0.10	7.36	7.93	7.28	7.86
	Camp	7.98	0.06	0.03	7.91	8.05	7.88	8.03
	Sheardown NW	7.80	0.18	0.08	7.57	8.03	7.51	7.93
	Sheardown SE	7.65	0.17	0.07	7.44	7.86	7.45	7.82
	Mary	7.56	0.31	0.13	7.24	7.89	7.19	7.94
Specific Conductance (µS/cm)	Reference 3	74.0	0.0	0.0	74.0	74.0	74.0	74.0
	Camp	132.4	1.5	0.7	130.5	134.3	131.0	134.0
	Sheardown NW	125.6	0.5	0.2	124.9	126.3	125.0	126.0
	Sheardown SE	108.8	4.0	1.8	103.9	113.7	105.0	115.0
	Mary	80.7	19.6	8.0	60.1	101.3	69.0	120.0
Secchi Depth (m)	Reference 3	8.88	0.71	0.32	8.00	9.76	8.10	10.00
	Camp	7.94	0.43	0.19	7.41	8.47	7.28	8.31
	Sheardown NW	5.03	0.16	0.07	4.82	5.23	4.78	5.24
	Sheardown SE	2.15	0.08	0.04	2.05	2.25	2.03	2.24
	Mary	3.46	0.46	0.19	2.97	3.94	2.86	3.99

Table C.23: Statistical comparison of bottom *in-situ* water quality between littoral stations of Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2016.

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Lake	n	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	Yes	0.035	α, δ, γ	Reference	5	8.88	0.71	0.32	8.10	10.00
				Camp	5	7.94	0.43	0.19	7.28	8.31
Temperature (˚C)	Yes	0.004	α, ε, γ	Reference	5	9.92	0.37	0.17	9.50	10.40
				Camp	5	9.19	0.13	0.06	8.98	9.31
Dissolved Oxygen (mg/L)	Yes	0.002	α, ε, γ	Reference	5	10.3	0.8	0.4	9.3	11.3
				Camp	5	12.1	0.1	0.1	11.9	12.2
Dissolved Oxygen (% saturation)	Yes	0.002	α, ε, γ	Reference	5	91.3	6.7	3.0	82.6	99.1
				Camp	5	104.9	0.8	0.4	104.1	106.3
pH (units)	Yes	0.014	α, ε, γ	Reference	5	7.64	0.23	0.10	7.28	7.86
				Camp	5	7.98	0.06	0.03	7.88	8.03
Specific Conductance (umho/cm)	Yes	0.000	α, ε, γ	Reference	5	74.0	0.0	0.0	74.0	74.0
				Camp	5	132.4	1.5	0.7	131.0	134.0

[a] Data analysis included: α - data untransformed; β - data logit transformed; ι - $\log_{10}$ transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Mann Whitney U-test.

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

Table C.24: Water chemistry at Camp Lake (JLO) water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event										Summer Sampling Event					
					JL0-02 surface 23-Apr-16	JL0-02 bottom 23-Apr-16	JL0-10 surface 23-Apr-16	JL0-10 bottom 23-Apr-16	JL0-01 surface 23-Apr-16	JL0-01 bottom 23-Apr-16	JL0-07 surface 25-Apr-16	JL0-07 bottom 25-Apr-16	JL0-09 surface 25-Apr-16	JL0-09 bottom 25-Apr-16	JL0-02 surface 24-Jul-16	JL0-02 bottom 24-Jul-16	JL0-10 surface 24-Jul-16	JL0-10 bottom 24-Jul-16	JL0-01 surface 24-Jul-16	JL0-01 bottom 24-Jul-16
Conventionals	Conductivity (lab)	umho/cm	-	-	162	159	160	158	156	151	158	171	163	154	134	132	131	131	131	131
	pH (lab)	pH	6.5 - 9.0	-	7.81	7.83	7.71	7.81	7.80	7.61	7.95	7.29	7.86	7.91	8.03	7.96	7.99	8.01	8.02	7.99
	Hardness (as $CaCO_3$)	mg/L	-	-	80.5	79	80	79	76	73	78	76	80	75	63	59	60	62	61	62
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	2.8	<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	-	-	106	101	105	105	99	96	100	114	103	98	62	67	65	70	70	65
	Turbidity	NTU	-	-	0.19	0.42	0.16	0.23	0.17	0.61	0.23	0.31	0.16	0.16	0.93	0.69	0.64	0.75	0.74	0.66
	Alkalinity (as $CaCO_3$)	mg/L	-	-	76	77	74	74	75	74	73	74	77	72	65	62	57	60	61	57
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	0.023	0.025	0.026	0.022	0.064	0.027	0.041	<0.020	0.042	<0.020	0.097	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.116	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	0.116	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Dissolved Organic Carbon	mg/L	-	-	3.0	3.3	3.2	2.7	2.7	3.0	2.9	2.3	3.0	2.7	1.4	1.4	1.6	1.7	1.6	1.6
	Total Organic Carbon	mg/L	-	-	2.1	2.3	2.3	2.1	2.1	2.0	2.1	2.2	2.2	1.9	1.6	4.4	1.7	1.7	1.6	2.0
	Total Phosphorus	mg/L	0.020[α]	-	0.0031	0.0045	0.0030	<0.0030	<0.0030	0.0048	0.0032	0.0039	<0.0030	0.0032	0.0038	0.0036	0.0046	0.0038	<0.0030	0.0127
	Phenols	mg/L	0.004[α]	-	0.0017	0.0015	0.0022	0.0019	0.0019	0.0020	0.0034	0.0026	0.0033	0.0020	<0.0010	<0.0010	<0.0010	0.0012	0.0012	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	4.26	4.34	4.20	4.15	4.07	3.91	4.12	8.94	4.26	3.97	3.48	3.32	3.33	3.32	3.32	3.32
	Sulphate (SO_4)	mg/L	218[β]	218	2.03	2.03	1.99	1.97	1.95	1.86	1.96	2.04	2.02	1.88	2.13	1.98	2.01	2.00	1.99	1.99
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	0.0039	***0.115***	<0.0030	<0.0030	<0.0030	0.0060	<0.0030	<0.0030	<0.0030	<0.0030	0.0062	0.0078	0.0061	0.0110	0.0052	0.0146
	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	0.00023	<0.00010	<0.00010	<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	-	-	0.00735	0.00804	0.00735	0.00697	0.00724	0.00680	0.00719	0.00758	0.00728	0.00684	0.00638	0.00642	0.00616	0.00609	0.00604	0.00608
	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	-	-	16.4	22.3	16.5	15.7	15.7	15.0	15.9	15.7	16.0	15.2	12.7	12.6	12.2	12.3	12.2	12.1
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	0.00419	0.00077	0.00120	0.00069	0.00051	<0.00050	<0.00050	<0.00050	0.00144	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	0.00025	<0.00010	<0.00010	<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	0.00121	0.00181	0.00110	0.00106	0.00104	0.00102	0.00106	0.00095	0.00101	0.00098	0.00082	0.00080	0.00080	0.00083	0.00078	0.00085
	Iron (Fe)	mg/L	0.30	0.300	<0.030	0.249	<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	0.000523	<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	0.0013	0.0010	<0.0010	<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	-	-	9.65	12.7	9.52	9.41	9.26	8.92	9.50	9.28	9.65	9.13	7.54	7.61	7.62	7.60	7.58	7.61
	Manganese (Mn)	mg/L	0.935[β]	-	0.000380	0.0100	0.000606	0.00104	0.000626	0.00182	0.000661	0.00971	0.000721	0.00116	0.00272	0.00279	0.00285	0.00442	0.00268	0.00396
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000322	0.000477	0.000398	0.000366	0.000355	0.000308	0.000367	0.000323	0.000360	0.000353	0.000244	0.000249	0.000242	0.000229	0.000254	0.000224
	Nickel (Ni)	mg/L	0.025	0.025	0.00069	0.0114	0.00266	0.00358	0.00210	0.00190	0.00194	0.00170	0.00164	0.00272	0.00061	0.00061	0.00055	0.00061	0.00060	0.00062
	Potassium (K)	mg/L	-	-	1.27	1.32	1.26	1.22	1.21	1.15	1.26	1.18	1.26	1.19	1.02	1.04	1.02	1.02	1.02	1.02
	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	-	-	0.42	0.58	0.42	0.41	0.41	0.42	0.41	1.87	0.42	0.42	0.36	0.36	0.35	0.36	0.35	0.35
	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	1.86	1.63	1.59	1.57	1.52	1.61	4.37	1.65	1.55	1.29	1.33	1.31	1.31	1.30	1.30
	Strontium (Sr)	mg/L	-	-	0.0116	0.0156	0.0119	0.0114	0.0111	0.0108	0.0115	0.0139	0.0118	0.0110	0.00973	0.00928	0.00919	0.00914	0.00926	0.00900
	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	0.00186	0.00011	0.00027	0.00058	0.00013	0.00020	0.00011	0.00014	<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	-	0.000916	0.000913	0.000900	0.000856	0.000895	0.000829	0.000859	0.000584	0.000883	0.000839	0.000668	0.000639	0.000641	0.000654	0.000630	0.000641
	Vanadium (V)	mg/L	0.006[α]	0.006	<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	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.24: Water chemistry at Camp Lake (JLO) water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event					Fall Sampling Event										
					JL0-07 surface 26-Jul-16	JL0-07 bottom 26-Jul-16	JL0-09 surface 26-Jul-16	JL0-09 bottom 26-Jul-16	J0-01 outlet 20-Jul-16	JL0-02 surface 22-Aug-16	JL0-02 bottom 22-Aug-16	JL0-10 surface 22-Aug-16	JL0-10 bottom 22-Aug-16	JL0-01 surface 22-Aug-16	JL0-01 bottom 22-Aug-16	JL0-07 surface 22-Aug-16	JL0-07 bottom 22-Aug-16	JL0-09 surface 22-Aug-16	JL0-09 bottom 22-Aug-16	J0-01 outlet 20-Aug-16
Conventionals	Conductivity (lab)	umho/cm	-	-	132	132	132	131	130	138	140	138	139	137	133	138	133	138	134	137
	pH (lab)	pH	6.5 - 9.0	-	7.98	5.81	7.97	7.97	7.99	8.10	8.11	8.11	8.10	8.12	7.96	8.13	7.86	8.12	8.01	8.01
	Hardness (as $CaCO_3$)	mg/L	-	-	64.5	64	63	64	65	64	66	67	67	66	62.5	66	63	65	67	66.5
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.9	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	75	75	76	74	70	73	78	71	74	64	64	71	71	75	73	67
	Turbidity	NTU	-	-	0.38	<0.10	0.31	0.35	0.87	0.53	0.40	0.43	0.43	0.51	0.94	0.38	0.55	0.52	0.42	0.40
	Alkalinity (as $CaCO_3$)	mg/L	-	-	66	65	64	64	61	67	63	61	60	67	63	66	64	68	65	64
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	<0.020	<0.020	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.046	0.038	<0.020	0.039	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Dissolved Organic Carbon	mg/L	-	-	1.5	1.4	1.5	1.5	1.7	1.7	1.7	1.6	1.7	1.6	1.5	1.7	1.9	1.7	1.7	1.7
	Total Organic Carbon	mg/L	-	-	1.7	1.7	1.7	1.7	1.8	2.0	2.8	1.8	1.8	1.8	1.7	2.4	1.8	2.0	2.8	2.0
	Total Phosphorus	mg/L	0.020[α]	-	0.00325	0.0040	0.0033	0.0034	<0.0030	0.0037	0.0036	0.0063	0.0054	<0.0030	0.0043	0.0037	0.0053	0.0052	0.0086	0.0039
	Phenols	mg/L	0.001[α]	-	0.0052	0.0020	0.0033	0.0038	<0.0010	0.0014	0.0016	0.0012	0.0010	0.0019	0.0015	0.0013	0.0010	0.0018	0.0103	0.0038
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.34	3.32	3.30	3.29	3.27	3.53	3.73	3.46	3.51	3.45	3.34	3.54	3.45	3.47	3.37	3.47
	Sulphate (SO_4)	mg/L	218[β]	218	1.98	1.93	1.96	1.94	1.96	2.25	2.30	2.21	2.21	2.16	2.02	2.21	1.97	2.18	2.07	2.19
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	0.0064	0.0045	0.0037	0.0049	0.0076	0.0065	0.0059	0.0049	0.0050	0.0045	0.0039	0.0066	0.0037	0.0049	0.0050	0.00465
	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	-	-	0.00639	0.00629	0.00623	0.00627	0.00622	0.00675	0.00680	0.00640	0.00647	0.00628	0.00603	0.00661	0.00652	0.00631	0.00637	0.00663
	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	-	-	13.1	13.4	12.9	13.0	13.0	13.6	13.8	13.4	13.5	13.7	12.9	13.2	13.2	13.5	12.9	13.3
	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	0.00078	0.00075	0.00075	0.00073	0.00076	0.00108	0.00094	0.00083	0.00084	0.00084	0.00077	0.00091	0.00094	0.00083	0.00084	0.00082
	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	0.094
	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	0.0014	0.0012	0.0013	0.0012	0.0013	0.0014	0.0012	0.0013	0.0014	0.0012	0.0011	0.0014	0.0012	0.0012	0.0011
	Magnesium (Mg)	mg/L	-	-	8.10	8.06	8.03	8.00	7.84	7.98	8.34	8.12	7.95	7.75	7.54	7.98	7.52	8.14	7.83	8.22
	Manganese (Mn)	mg/L	0.935[β]	-	0.002760	0.00267	0.00276	0.00275	0.00315	0.00137	0.00154	0.00132	0.00144	0.00127	0.00180	0.00129	0.00212	0.00135	0.00172	0.00277
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000238	0.000252	0.000248	0.000262	0.000248	0.000271	0.000251	0.000256	0.000267	0.000245	0.000246	0.000259	0.000236	0.000260	0.000258	0.000265
	Nickel (Ni)	mg/L	0.025	0.025	0.00055	0.00054	0.00054	0.00052	0.00060	0.00059	0.00059	0.00060	0.00061	0.00058	0.00057	0.00063	0.00056	0.00060	0.00059	0.00073
	Potassium (K)	mg/L	-	-	1.02	1.00	1.00	1.00	1.05	1.08	1.08	1.06	1.05	1.05	1.02	1.08	1.02	1.07	1.03	1.05
	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	-	-	0.37	0.37	0.36	0.36	0.38	0.35	0.37	0.34	0.34	0.34	0.36	0.38	0.43	0.35	0.37	0.38
	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	-	-	1.40	1.39	1.36	1.33	1.33	1.41	1.46	1.36	1.36	1.36	1.30	1.39	1.50	1.46	1.34	1.36
	Strontium (Sr)	mg/L	-	-	0.0093	0.00959	0.00945	0.00957	0.00929	0.0104	0.0108	0.0102	0.0103	0.0104	0.00967	0.0100	0.00993	0.0102	0.00979	0.0098
	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	-	0.000633	0.000635	0.000642	0.000623	0.000681	0.000812	0.000823	0.000767	0.000782	0.000775	0.000691	0.000788	0.000634	0.000775	0.000725	0.000782
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.25: Dissolved metal concentrations at Camp Lake water quality monitoring stations, Mary River Project CREMP, 2016.

	Parameters	Units	Winter Sampling Event										Spring Sampling	Summer Sampling Event					
			JL0-02 surface 23-Apr-16	JL0-02 bottom 23-Apr-16	JL0-10 surface 23-Apr-16	JL0-10 bottom 23-Apr-16	JL0-01 surface 23-Apr-16	JL0-01 bottom 23-Apr-16	JL0-07 surface 25-Apr-16	JL0-07 bottom 25-Apr-16	JL0-09 surface 25-Apr-16	JL0-09 bottom 25-Apr-16	J0-01 outlet 26-Jun-16	JL0-02 surface 24-Jul-16	JL0-02 bottom 24-Jul-16	JL0-10 surface 24-Jul-16	JL0-10 bottom 24-Jul-16	JL0-01 surface 24-Jul-16	JL0-01 bottom 24-Jul-16
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	<0.0050	0.0037	0.0114	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00730	0.00717	0.00708	0.00719	0.00681	0.00684	0.00721	0.00748	0.00713	0.00693	0.00511	0.00635	0.00616	0.00613	0.00616	0.00611	0.00607
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<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	<0.000050	<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	16.3	15.8	16.4	16.1	15.5	14.8	15.5	15.2	16.3	15.1	10.6	12.5	11.8	12.1	12.3	12.0	12.4
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00125	0.00106	0.00095	0.00093	0.00091	0.00089	0.00097	0.00086	0.00098	0.00093	0.00065	0.00079	0.00110	0.00077	0.00077	0.00076	0.00075
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.010	<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	0.0011	<0.0010	0.0011	0.0013	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	0.0019	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	9.66	9.53	9.54	9.38	9.20	8.84	9.57	9.35	9.51	8.94	6.83	7.64	7.18	7.36	7.49	7.62	7.58
	Manganese (Mn)	mg/L	0.00235	0.00147	0.000589	0.000807	0.000199	0.000622	0.000579	0.000706	0.000323	0.000301	0.00124	0.000997	0.00117	0.000756	0.000747	0.000711	0.000520
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000487	0.000406	0.000362	0.000390	0.000334	0.000353	0.000462	0.000328	0.000383	0.000355	0.000210	0.000247	0.000222	0.000233	0.000239	0.000226	0.000249
	Nickel (Ni)	mg/L	0.01008	0.00423	0.00171	0.00199	0.00102	0.00156	0.00201	0.00165	0.00109	0.00108	0.00054	0.00061	0.00071	0.00054	0.00054	0.00056	0.00055
	Potassium (K)	mg/L	1.28	1.23	1.25	1.23	1.20	1.17	1.26	1.18	1.25	1.16	0.910	1.02	0.99	0.98	1.00	1.03	1.02
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.42	0.40	0.41	0.41	0.40	0.40	0.40	1.86	0.41	0.43	0.333	0.35	0.32	0.34	0.34	0.35	0.33
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.90	1.67	1.65	1.68	1.57	1.52	1.63	4.37	1.63	1.53	1.15	1.32	1.25	1.26	1.29	1.31	1.31
	Strontium (Sr)	mg/L	0.0126	0.0115	0.0119	0.0115	0.0111	0.0109	0.0114	0.0137	0.0115	0.0113	0.0081	0.00946	0.00879	0.00912	0.00933	0.00918	0.00914
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.00100	0.00024	<0.00010	<0.00010	<0.00010	<0.00010	0.00035	0.00013	0.00010	0.00011	<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	<0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000902	0.000875	0.000909	0.000915	0.000867	0.000807	0.000854	0.000544	0.000915	0.000813	0.000560	0.000674	0.000612	0.000629	0.000637	0.000602	0.000646
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<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	<0.0010	<0.0030	0.0068	0.0032	0.0050	<0.0030	<0.0030

Table C.25: Dissolved metal concentrations at Camp Lake water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Summer Sampling Event					Fall Sampling Event										
			JL0-07-S1 surface 26/Jul/2016	JL0-07-B1 bottom 26/Jul/2016	JL0-09-S1 surface 26/Jul/2016	JL0-09-B1 bottom 26/Jul/2016	J0-01 outlet 20/Jul/2016	JL0-02-S1 surface 22/Aug/2016	JL0-02-B1 bottom 22/Aug/2016	JL0-10-S1 surface 22/Aug/2016	JL0-10-B1 bottom 22/Aug/2016	JL0-01-S1 surface 22/Aug/2016	JL0-01-B1 bottom 22/Aug/2016	JL0-07-S1 surface 22/Aug/2016	JL0-07-B1 bottom 22/Aug/2016	JL0-09-S1 surface 22/Aug/2016	JL0-09-B1 bottom 22/Aug/2016	J0-01 outlet 20/Aug/2016
Dissolved Metals	Aluminum (Al)	mg/L	0.0089	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0033	<0.0030	0.0035	<0.0030	<0.0030	0.0034	<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
	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	0.00623	0.00611	0.00615	0.00610	0.00639	0.00636	0.00644	0.00657	0.00630	0.00627	0.00657	0.00649	0.00604	0.00647	0.00654	0.00660
	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	12.8	12.6	12.5	12.7	12.9	13.1	13.3	13.2	13.7	13.4	12.6	13.4	13.0	13.3	13.6	13.4
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00076	0.00073	0.00081	0.00142	0.00073	0.00078	0.00076	0.00089	0.00078	0.00080	0.00073	0.00078	0.00067	0.00081	0.00081	0.00079
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	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	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0012	0.0013	0.0011	0.0013	0.0012	0.0011	0.0012	0.0013	0.0011	0.0013	0.0011
	Magnesium (Mg)	mg/L	7.94	7.93	7.79	7.84	7.91	7.72	7.95	8.13	7.92	7.77	7.50	7.81	7.54	7.82	8.06	8.04
	Manganese (Mn)	mg/L	0.000700	0.000226	0.000552	0.000385	0.00136	<0.000070	<0.000070	0.000226	0.000133	0.000247	0.000134	0.000296	0.000094	0.000313	<0.000070	0.00108
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000239	0.000233	0.000237	0.000222	0.000240	0.000254	0.000272	0.000269	0.000264	0.000270	0.000238	0.000275	0.000260	0.000266	0.000284	0.000276
	Nickel (Ni)	mg/L	0.00055	0.00053	0.00058	0.00057	0.00059	0.00058	0.00057	0.00058	0.00058	0.00057	0.00055	0.00058	0.00052	0.00059	0.00057	0.00061
	Potassium (K)	mg/L	1.05	1.03	1.02	1.02	1.04	1.04	1.06	1.05	1.04	1.04	1.02	1.06	1.01	1.06	1.06	1.07
	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	0.36	0.37	0.34	0.35	0.37	0.34	0.36	0.33	0.34	0.32	0.35	0.34	0.42	0.34	0.34	0.36
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.34	1.36	1.32	1.33	1.32	1.38	1.40	1.40	1.37	1.35	1.32	1.37	1.38	1.39	1.40	1.37
	Strontium (Sr)	mg/L	0.0095	0.00940	0.00951	0.00936	0.00919	0.00980	0.0105	0.0100	0.0103	0.0102	0.00947	0.0101	0.00966	0.0101	0.0104	0.00980
	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	0.000658	0.000633	0.000644	0.000626	0.000672	0.000728	0.000824	0.000763	0.000785	0.000775	0.000691	0.000780	0.000674	0.000789	0.000801	0.000771
	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.26: Magnitude of difference in aqueous metal concentrations between Camp Lake and Reference Lake 3 in 2016, and between Camp Lake 2016 and baseline (2005 - 2013) period data for winter, summer and fall sampling events, Mary River Project CREMP. No reference lake data were collected in winter 2016.

Variable	Camp Lake vs Reference Lake 3 in 2016		Camp Lake 2016 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	1.7	1.6	1.3	1.1	1.1
Hardness (as $CaCO_3$)	1.8	1.9	1.2	1.1	1.1
Total Suspended Solids (TSS)	0.9	1.0	1.0	1.0	1.0
Total Dissolved Solids (TDS)	1.5	1.8	1.3	0.9	0.9
Turbidity	2.5	1.5	1.4	1.1	1.7
Alkalinity (as $CaCO_3$)	1.9	1.9	1.1	1.1	1.1
Total Ammonia	1.4	0.6	0.6	0.4	1.0
Nitrate	1.0	1.0	0.3	0.2	0.2
Nitrite	1.0	1.0	1.9	0.2	1.0
Total Kjeldahl Nitrogen (TKN)	0.8	1.0	0.8	0.7	0.5
Dissolved Organic Carbon	0.6	0.6	1.5	0.8	0.9
Total Organic Carbon	0.7	0.7	1.1	1.0	1.1
Total Phosphorus	0.8	0.5	0.6	1.0	1.0
Phenols	0.8	0.8	2.3	1.5	2.3
Bromide (Br)	1.0	1.0	1.1	0.4	0.4
Chloride (Cl)	2.4	2.7	3.3	1.7	1.6
Sulphate (SO_4)	0.5	0.5	1.4	1.4	0.8
Aluminum (Al)	1.7	1.2	9.0	0.6	0.8
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.1	1.0	1.0
Barium (Ba)	0.9	1.0	1.3	1.2	1.1
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)	1.8	1.9	1.3	1.1	1.1
Chromium (Cr)	1.0	1.0	8.9	1.0	1.0
Cobalt (Co)	1.0	1.0	1.2	1.0	0.9
Copper (Cu)	1.0	1.1	1.1	0.3	1.0
Iron (Fe)	1.0	1.2	1.9	1.1	1.7
Lead (Pb)	1.0	1.0	1.3	0.6	1.0
Lithium (Li)	1.1	1.3	0.2	0.2	
Magnesium (Mg)	1.8	1.9	1.3	1.1	1.1
Manganese (Mn)	4.1	2.6	3.2	1.5	1.0
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	1.9	1.9	1.8	1.3	1.2
Nickel (Ni)	1.1	1.2	4.5	0.8	1.0
Potassium (K)	1.2	1.2		1.2	1.2
Selenium (Se)	1.0	1.0			
Silicon (Si)	0.8	0.9	1.2	0.8	0.9
Silver (Ag)	1.0	1.0	1.1	1.6	2.7
Sodium (Na)	1.6	1.7		1.5	1.4
Strontium (Sr)	1.2	1.2	1.7	1.3	1.3
Thallium (Tl)	1.0	1.0	1.1	1.3	3.2
Tin (Sn)	1.0	1.0	0.3	0.2	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0
Uranium (U)	2.5	2.8	1.9	1.4	1.5
Vanadium (V)	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	2.4	1.3	1.3

Denotes slight elevation (mean variable concentration 3 to 5 times higher than respective mean reference or baseline period value).

Denotes moderate elevation (mean variable concentration 5 to 10 times higher than respective mean reference or baseline period value).

Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference or baseline period value).

Table C.27: *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 2016.

Study Area	Station	Temperature (^oC)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Unnnamed Reference Creek	REF CRK B1	11.9	10.64	98.6	7.77	101
	REF CRK B2	11.3	10.78	98.6	7.76	101
	REF CRK B3	11.0	10.78	97.8	7.73	101
	REF CRK B4	10.7	10.85	97.8	7.73	101
	REF CRK B5	10.5	10.91	98.0	7.78	101
Sheardown Lake Tributary 1 Reach 1	SDLT-1-R1 B1	13.7	10.19	98.4	7.92	246
	SDLT-1-R1 B2	13.4	10.34	99.1	7.94	251
	SDLT-1-R1 B3	12.6	10.40	98.0	7.97	257
	SDLT-1-R1 B4	12.2	10.56	98.6	7.92	262
	SDLT-1-R1 B5	11.9	10.65	98.6	7.91	261
Sheardown Lake Tributary 12 Downstream	SDLT-12-DS B1	10.7	10.10	91.0	7.74	246
	SDLT-12-DS B2	10.5	10.18	91.3	7.78	244
	SDLT-12-DS B3	7.8	10.25	85.8	7.77	244
Sheardown Lake Tributary 9 Upstream	SDLT-9-DS B1	12.2	9.58	80.3	7.81	173
	SDLT-9-DS B2	10.0	9.55	84.7	7.53	181
	SDLT-9-DS B3	9.5	10.09	88.4	7.58	179
	SDLT-9-DS B4	9.1	10.28	89.1	7.61	178
	SDLT-9-DS B5	8.8	10.74	92.4	7.68	178

Table C.28: *In-situ* water quality summary statistics for the Sheardown Lake Tributary benthic stations, Mary River Project CREMP, August 2016. Five stations were sampled at each study area except Tributary 9, where three stations were sampled.

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Temperature (°C)	Unnamed Reference Creek	11.1	0.5	0.2	10.4	11.8	10.5	11.9
	Sheardown Lake Tributary 1 (SDLT1)	12.8	0.8	0.3	11.8	13.7	11.9	13.7
	Sheardown Lake Tributary 9 (SDLT9)	9.9	1.4	0.6	8.2	11.6	8.8	12.2
	Sheardown Lake Tributary 12 (SDLT12)	9.7	1.6	0.9	5.6	13.7	7.8	10.7
Dissolved Oxygen (mg/L)	Unnamed Reference Creek	10.79	0.10	0.05	10.67	10.92	10.64	10.91
	Sheardown Lake Tributary 1 (SDLT1)	10.43	0.18	0.08	10.20	10.65	10.19	10.65
	Sheardown Lake Tributary 9 (SDLT9)	10.05	0.50	0.22	9.43	10.67	9.55	10.74
	Sheardown Lake Tributary 12 (SDLT12)	10.18	0.08	0.04	9.99	10.36	10.10	10.25
Dissolved Oxygen (% Saturation)	Unnamed Reference Creek	98.2	0.4	0.2	97.7	98.7	97.8	98.6
	Sheardown Lake Tributary 1 (SDLT1)	98.5	0.4	0.2	98.0	99.0	98.0	99.1
	Sheardown Lake Tributary 9 (SDLT9)	87.0	4.6	2.1	81.2	92.7	80.3	92.4
	Sheardown Lake Tributary 12 (SDLT12)	89.4	3.1	1.8	81.7	97.0	85.8	91.3
pH (units)	Unnamed Reference Creek	7.75	0.02	0.01	7.73	7.78	7.73	7.78
	Sheardown Lake Tributary 1 (SDLT1)	7.93	0.02	0.01	7.90	7.96	7.91	7.97
	Sheardown Lake Tributary 9 (SDLT9)	7.64	0.11	0.05	7.51	7.78	7.53	7.81
	Sheardown Lake Tributary 12 (SDLT12)	7.76	0.02	0.01	7.71	7.82	7.74	7.78
Specific Conductance (µS/cm)	Unnamed Reference Creek	101	0.2	0.1	100.7	101.3	100.6	101.2
	Sheardown Lake Tributary 1 (SDLT1)	255	7	3	247	264	246	262
	Sheardown Lake Tributary 9 (SDLT9)	178	3	1	174	182	173	181
	Sheardown Lake Tributary 12 (SDLT12)	245	1	1	242	248	244	246

Table C.29: ***In-situ*** **water quality statistical comparisons among the Sheardown Lake Tributaries and Unnamed Reference Creek study areas, Mary River Project CREMP, August 2016. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).**

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	0.0028	α	Unnamed Reference Creek	Sheardown Tributary 1	NO	0.1081	Tukey's HSD
				Unnamed Reference Creek	Sheardown Tributary 9	NO	0.3558	
				Unnamed Reference Creek	Sheardown Tributary 12	NO	0.3126	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0045	
				Sheardown Tributary 1	Sheardown Tributary 12	YES	0.0071	
				Sheardown Tributary 9	Sheardown Tributary 12	NO	0.9878	
Dissolved Oxygen (% saturation)	YES	0.0000	α	Unnamed Reference Creek	Sheardown Tributary 1	NO	0.6848	Tamhane's
				Unnamed Reference Creek	Sheardown Tributary 9	YES	0.0327	
				Unnamed Reference Creek	Sheardown Tributary 12	NO	0.2055	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0290	
				Sheardown Tributary 1	Sheardown Tributary 12	NO	0.1911	
				Sheardown Tributary 9	Sheardown Tributary 12	NO	0.9609	
pH (units)	YES	0.0000	α	Unnamed Reference Creek	Sheardown Tributary 1	YES	0.0000	Tamhane's
				Unnamed Reference Creek	Sheardown Tributary 9	NO	0.3990	
				Unnamed Reference Creek	Sheardown Tributary 12	NO	0.9947	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0191	
				Sheardown Tributary 1	Sheardown Tributary 12	YES	0.0009	
				Sheardown Tributary 9	Sheardown Tributary 12	NO	0.3340	
Specific Conductance (μS/cm)	YES	0.0000	α	Unnamed Reference Creek	Sheardown Tributary 1	YES	0.0000	Tamhane's
				Unnamed Reference Creek	Sheardown Tributary 9	YES	0.0000	
				Unnamed Reference Creek	Sheardown Tributary 12	YES	0.0001	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0000	
				Sheardown Tributary 1	Sheardown Tributary 12	NO	0.1326	
				Sheardown Tributary 9	Sheardown Tributary 12	YES	0.0000	

[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; ζ - transformed, single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data logit transformed, single factor ANOVA test conducted;

Table C.30: Water chemistry at Sheardown Lake Tributary 1 (SDLT1) water quality monitoring stations, Mary River Project CREMP, 2016.

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	D1-05	D1-00
					27-Jun-2016	27-Jun-2016	19-Jul-2016	19-Jul-2016	19-Aug-2016	19-Aug-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	139	168	274	308	232	308
	pH (lab)	pH	6.5 - 9.0	-	7.71	7.93	7.75	8.05	7.85	8.08
	Hardness (as $CaCO_3$)	mg/L	-	-	63	77	131	147	108	144
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	82	91	141	186	118	166
	Turbidity	NTU	-	-	0.43	1.32	0.41	0.98	0.27	0.65
	Alkalinity (as $CaCO_3$)	mg/L	-	-	52	70	85	114	83	114
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	<0.020	<0.020	<0.020	0.057	0.030	<0.020
	Nitrate	mg/L	13	13	0.162	0.114	0.959	0.722	0.733	0.946
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	0.22	<0.15	0.23	0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.4	2.6	2.0	2.5	2.7	3.1
	Total Organic Carbon	mg/L	-	-	3.3	2.8	2.4	2.8	2.8	3.2
	Total Phosphorus	mg/L	0.020[α]	-	0.0036	0.0062	0.0048	0.0039	0.0110	0.0032
	Phenols	mg/L	0.004[α]	-	0.0023	0.0034	0.0010	0.0064	0.0110	0.0042
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.48	3.79	6.67	9.42	6.41	9.47
	Sulphate (SO_4)	mg/L	218[β]	218	11.1	8.95	43.6	36.8	22.6	26.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0111	0.0323	0.0058	0.0115	0.0082	0.0138
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00686	0.00912	0.0136	0.0184	0.0115	0.0170
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	0.011	0.012	0.012	0.012
	Cadmium (Cd)	mg/L	0.00012	0.00008	0.000029	<0.000010	0.000041	0.000012	0.000037	0.000011
	Calcium (Ca)	mg/L	-	-	11.2	14.7	23.1	28.7	19.5	27.9
	Chromium (Cr)	mg/L	0.0089	0.00856	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	0.00011	0.00015	<0.00010	0.00011
	Copper (Cu)	mg/L	0.002	0.0022	***0.00277***	***0.00264***	***0.00266***	0.00197	***0.00310***	***0.00222***
	Iron (Fe)	mg/L	0.30	0.326	<0.030	0.088	<0.030	0.145	<0.030	0.098
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0013	0.0019	0.0013	0.0018
	Magnesium (Mg)	mg/L	-	-	7.69	9.72	17.3	20.3	14.1	18.9
	Manganese (Mn)	mg/L	0.935[β]	-	0.000348	0.00484	0.000421	0.00768	0.000436	0.00559
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00218	0.00190	0.00220	0.00182	0.00325	0.00243
	Nickel (Ni)	mg/L	0.025	0.025	0.00114	0.00136	0.00121	0.00146	0.00114	0.00146
	Potassium (K)	mg/L	-	-	1.53	1.84	2.38	2.57	2.33	2.41
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.87	0.73	1.25	1.35	1.36	1.59
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.07	1.55	2.78	3.59	2.98	3.88
	Strontium (Sr)	mg/L	-	-	0.00757	0.0107	0.0149	0.0170	0.0130	0.0169
	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	-	0.00158	0.00211	0.00511	0.00384	0.00654	0.00532
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.31: Dissolved metal concentrations at Sheardown Lake Tributary water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Spring Sampling Event		Summer Sampling Event		Fall Sampling Event	
			D1-05	D1-00	D1-05	D1-00	D1-05	D1-00
			27-Jun-2016	27-Jun-2016	19-Jul-2016	19-Jul-2016	19-Aug-2016	19-Aug-2016
Dissolved Metals	Aluminum (Al)	mg/L	0.0069	<0.0050	0.0036	0.0030	0.0048	0.0041
	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	0.00916	0.00683	0.0172	0.0137	0.0166	0.0114
	Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.000050	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	0.011	<0.010	0.012	0.011	0.012	0.011
	Cadmium (Cd)	mg/L	<0.000010	0.000031	<0.000010	0.000041	0.000014	0.000039
	Calcium (Ca)	mg/L	14.6	11.7	27.8	23.6	26.9	19.6
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	0.00013	0.00011	0.00012	<0.00010
	Copper (Cu)	mg/L	0.00256	0.00274	0.00182	0.00263	0.00220	0.00317
	Iron (Fe)	mg/L	0.044	<0.010	0.077	<0.030	0.070	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0012	<0.0010	0.0017	0.0012	0.0017	0.0012
	Magnesium (Mg)	mg/L	9.97	8.29	18.9	17.4	18.6	14.4
	Manganese (Mn)	mg/L	0.00398	<0.00050	0.00712	0.000417	0.00525	0.000420
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.00169	0.00205	0.00179	0.00224	0.00242	0.00338
	Nickel (Ni)	mg/L	0.00126	0.00115	0.00139	0.00122	0.00151	0.00117
	Potassium (K)	mg/L	1.87	1.61	2.39	2.41	2.45	2.35
	Selenium (Se)	mg/L	0.00007	0.000058	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.698	0.917	1.32	1.27	1.59	1.31
	Silver (Ag)	mg/L	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.6	1.16	3.34	2.81	3.99	3.01
	Strontium (Sr)	mg/L	0.0104	0.0078	0.0174	0.0147	0.0168	0.0131
	Thallium (Tl)	mg/L	0.000011	0.000014	<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	<0.00030	<0.00030	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.00198	0.00156	0.00373	0.00514	0.00515	0.00646
	Vanadium (V)	mg/L	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.0014	<0.0010	<0.0030	<0.0030	<0.0030	<0.0030

Table C.32: Magnitude of difference in aqueous metal concentrations between SDLT1 and reference creek stations in 2016, and at SDLT1 between 2016 and the baseline period, for spring, summer, and fall sampling events, Mary River Project CREMP.

Variable	SDLT1 Station D1-05 (Reach 4)						SDLT1 Station D1-00 (Reach 1)					
	2016 vs Reference Creek			2016 vs Baseline			2016 vs Reference Creek			2016 vs Baseline		
	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
Conductivity (lab)	4.9	3.6	1.9	2.0	1.9	1.1	5.9	4.0	2.5	2.0	1.6	1.2
Hardness (as $CaCO_3$)	4.7	3.7	1.9	1.8	1.8	1.1	5.7	4.2	2.5	1.8	1.4	1.1
Total Suspended Solids (TSS)	1.0	0.8		1.0	1.0	1.0	1.0	0.8		1.0	1.0	1.0
Total Dissolved Solids (TDS)	4.1	3.3	1.8	1.9	1.5	0.9	4.6	4.3	2.6	1.7	1.5	1.0
Turbidity	0.3	0.1	0.2	0.6	1.2	0.8	0.9	0.3	0.6	0.3	1.5	1.9
Alkalinity (as $CaCO_3$)	3.7	2.6	1.5	1.8	1.3	1.0	5.0	3.5	2.0	1.8	1.2	1.0
Total Ammonia	0.9			0.1	0.2	0.5	0.9			0.1	1.0	0.7
Nitrate	8.1		33	1.9	10	5.1	5.7		42	1.1	7.2	9.0
Nitrite	1.0			1.0		0.7	1.0			1.0		0.8
Total Kjeldahl Nitrogen (TKN)	1.0			1.1	1.3	1.4	1.5			1.0	1.3	1.2
Dissolved Organic Carbon	2.3		2.2	0.7	0.8	1.2	2.5		2.5	0.6	0.9	1.3
Total Organic Carbon	2.9	2.0	1.9	1.0	0.9	1.2	2.4	2.3	2.2	0.6	0.9	1.2
Total Phosphorus	0.4	0.8	1.9	0.3	1.0	3.7	0.7	0.6	0.5	0.6	0.8	0.5
Phenols	0.8	0.8	2.0				1.1	5.2	0.8			
Bromide (Br)	1.0			0.4			1.0			0.4		
Chloride (Cl)	3.8	3.6	2.0	0.6	2.0	0.7	5.7	5.1	3.0		2.0	1.3
Sulphate (SO_4)	20	21	5.1	14	9.5	2.4	16	17	6.1		6.7	3.1
Aluminum (Al)	0.4	0.1	0.1	0.3	0.4	0.8	1.0	0.1	0.2	0.2	0.5	1.3
Antimony (Sb)	1.0			0.5	0.7	0.7	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
Barium (Ba)	3.6	2.6	1.5	1.6	1.8	1.2	4.8	3.5	2.2	1.7	1.6	1.4
Beryllium (Be)	1.0			5.0			1.0			5.0		
Bismuth (Bi)	1.0			1.0			1.0			1.0		
Boron (B)	1.0			1.0	0.7	0.7	1.0			0.9	0.7	0.9
Cadmium (Cd)	2.9			1.0	1.2	1.0	1.0			0.7	0.7	0.8
Calcium (Ca)	4.3	3.2	1.6	1.7	1.7	1.0	5.6	4.0	2.3	1.8	1.5	1.1
Chromium (Cr)	1.0			3.0	2.4	3.8	1.0			1.0	1.7	3.3
Cobalt (Co)	1.0			0.6	0.8	0.8	1.0			0.8	1.5	1.1
Copper (Cu)	5.2	3.0	3.1	0.9	0.9	1.3	5.0	2.2	2.2	0.9	0.8	1.3
Iron (Fe)	0.8	0.4	0.5	0.5	1.2	1.2	2.3	1.8	1.7	0.5	1.4	1.9
Lead (Pb)	0.7	0.4	0.4	0.2	0.5	0.6	0.7	0.4	0.4	0.1	0.9	1.0
Lithium (Li)	1.0			2.0	1.5	1.4	1.0			2.0	1.5	1.6
Magnesium (Mg)	5.3	4.2	2.1	1.8	1.9	1.1	6.6	5.0	2.8	1.8	1.6	1.3
Manganese (Mn)	0.4	0.3	0.5	0.4	0.6	0.9	5.0	6.1	6.5	1.2	2.9	3.8
Mercury (Hg)	1.0			1.0			1.0			1.0		
Molybdenum (Mo)	28	10	8.6	2.5	0.9	1.1	24	8.6	6.4	1.5	0.9	1.3
Nickel (Ni)	2.3	2.2	1.5	0.7	1.1	1.2	2.7	2.7	2.0	0.6	1.1	1.3
Potassium (K)	6.1	4.0	2.8	1.7	1.5	1.2	7.3	4.3	2.9	1.9	1.5	1.4
Selenium (Se)	1.0						1.0					
Silicon (Si)	2.4	1.4	1.4	1.0	1.1	1.1	2.0	1.5	1.7	0.6	1.0	1.2
Silver (Ag)	1.0			0.9			1.0					
Sodium (Na)	2.9	2.8	1.6	3.6	2.9	1.4	4.2	3.6	2.1	3.1	2.9	1.8
Strontium (Sr)	3.1	2.1	1.0	2.2	1.9	1.1	4.4	2.4	1.4	2.1	1.4	1.2
Thallium (Tl)	1.0			10	7.4	7.1	1.0			10	9.1	
Tin (Sn)	1.0			1.0			1.0			1.0		
Titanium (Ti)	1.0	0.8	5.1	1.0			1.0	0.8	5.1	1.0		
Uranium (U)	8.6	5.8	1.8	2.5	2.0	0.9	12	4.4	1.5	3.4	1.5	1.2
Vanadium (V)	1.0			1.0			1.0			1.0		
Zinc (Zn)	1.0			2.2	1.2	1.4	1.0			3.0	0.7	1.1

Denotes slight elevation (mean variable concentration 3 to 5 times higher than respective mean reference or baseline period value).

Denotes moderate elevation (mean variable concentration 5 to 10 times higher than respective mean reference or baseline period value).

Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference or baseline period value).

Table C.33: ***In-situ*** **water quality profile data collected at Sheardown Lake NW water quality monitoring stations in winter[a], Mary River Project CREMP, 2016.**

Station DD-Hab 9-Stn 1[b,c]					Station DLO-01-5[b,c]					Station DLO-01-1[b,c]					Station DLO-01-4[b,c]					Station DLO-01-2[b,c]					Station DLO-01-7[b,c]				
Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (uS/cm)
2.90	1.0	101.5	7.61	146	2.90	1.3	95.9	7.83	151	3.00	1.6	98.7	8.13	152	3.15	1.7	100.2	7.92	154	3.15	1.6	98.4	7.87	151	3.20	1.4	102.0	7.7	150
3.90	1.4	101.1	7.60	150	3.90	1.5	97.2	7.79	151	4.00	1.6	99.0	7.95	151	4.15	1.7	100.5	7.83	152	4.15	1.6	98.7	7.79	151	4.20	1.5	101.4	7.6	150
4.90	1.5	100.9	7.62	150	4.90	1.5	97.9	7.74	151	5.00	1.6	99.0	7.88	151	5.15	1.6	100.6	7.77	152	5.15	1.5	99.1	7.74	151	5.20	1.5	101.2	7.6	150
5.90	1.5	100.7	7.63	149	5.90	1.5	98.2	7.70	151	6.00	1.5	99.1	7.81	151	6.15	1.6	101.1	7.74	152	6.15	1.5	99.3	7.72	151	6.20	1.5	101.0	7.6	150
6.90	1.6	100.2	7.61	149	6.90	1.5	98.3	7.66	151	7.00	1.5	99.0	7.75	151						7.15	1.6	99.3	7.69	151	7.20	1.6	100.9	7.6	150
7.90	1.6	99.9	7.62	149	7.90	1.5	98.5	7.63	151	8.00	1.5	99.2	7.69	151						8.15	1.5	99.2	7.67	151	8.20	1.6	100.5	7.6	150
8.90	1.6	99.1	7.62	149	8.90	1.5	98.3	7.61	151	9.00	1.5	99.2	7.67	151						9.15	1.6	99.2	7.66	151	9.20	1.6	100.4	7.6	150
9.90	1.6	99.1	7.6	149	9.90	1.5	97.5	7.59	151	10.00	1.5	99.1	7.64	151						10.15	1.6	99.2	7.65	151	10.20	1.6	100.0	7.6	150
					10.90	1.5	97.1	7.57	151	11.00	1.5	99.0	7.63	151						11.15	1.6	99.2	7.63	151					
					11.90	1.5	98.1	7.55	151	12.00	1.6	98.2	7.62	151						12.15	1.6	99.2	7.62	151					
					12.90	1.5	98.8	7.55	151	13.00	1.6	96.7	7.54	151						13.15	1.6	99.2	7.62	151					
					13.90	1.5	98.9	7.54	151	14.00	1.6	95.7	7.58	150						14.15	1.6	99.3	7.62	151					
					14.90	1.6	98.8	7.54	151	15.00	1.6	95.0	7.57	150						15.15	1.6	99.4	7.62	151					
					15.90	1.6	98.4	7.53	151	16.00	1.6	94.2	7.55	150						16.15	1.6	99.8	7.61	151					
					16.90	1.7	93.6	7.51	150	17.00	1.7	91.6	7.54	150						17.15	1.6	97.7	7.60	151					
					17.90	1.7	89.0	7.49	149	18.00	1.7	89.2	7.51	148						18.15	1.7	98.9	7.59	150.8					
					18.90	1.8	85.9	7.45	148	19.00	1.7	86.7	7.49	148															
					19.90	1.8	83.8	7.43	148	20.00	1.8	81.8	7.47	146.8															
					20.90	1.8	78.6	7.41	147																				
					21.90	1.9	71.7	7.34	147																				
					22.90	2.2	20.2	7.18	155																				

[a] Sampling conducted on 26-Apr and 30-Apr, 2016.
[b] Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 were 10, 23.05, 20.4, 6.4, 19.15, and 11.4, respectively, at the time of winter sampling.
[c] Ice thickness at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 were 1.98, 1.89, 2.13, 2.14, and 2.18 m, respectively, at the time of winter sampling.

Table C.34: *In-situ* water quality profile data collected at Sheardown Lake NW water quality monitoring stations in summer[a], Mary River Project CREMP, 2016.

Depth (m)	Temperature (°C)						Dissolved Oxygen (% Saturation)						pH (pH units)						Specific Conductance (µS/cm)					
	DD Hab9[b]	DLO-01-5[b]	DLO-01-1[b]	DLO-01-4[b]	DLO-01-2[b]	DLO-01-7[b]	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
1.0	10.0	9.0	9.5	8.8	9.1	7.9	102.2	99.8	101.2	99.3	101.6	99.2	6.77	7.00	7.57	7.64	7.73	7.65	122	128	122	137	122	137
2.0	10.0	9.0	9.4	8.7	9.1	7.5	102.2	99.8	101.4	99.0	101.8	99.1	7.14	7.10	7.60	7.67	7.74	7.65	122	128	122	137	122	137
3.0	10.0	8.9	9.4	8.4	9.1	7.8	102.1	99.6	101.6	98.9	101.8	99.0	7.22	7.18	7.66	7.68	7.75	7.67	122	128	122	137	122	137
4.0	10.0	8.8	9.4	8.4	9.1	7.8	102.1	99.6	101.5	98.7	101.9	99.1	7.31	7.26	7.69	7.69	7.78	7.68	122	128	123	137	122	137
5.0	10.0	8.7	9.3	8.3	9.1	7.7	102.1	99.4	101.5	98.9	101.7	98.4	7.36	7.31	7.73	7.70	7.80	7.70	122	128	123	137	122	137
6.0	10.0	8.6	9.3	8.2	9.1	7.4	101.6	99.3	101.7	98.4	101.6	98.1	7.40	7.38	7.75	7.70	7.84	7.70	123	129	123	137	122	137
7.0	10.0	8.6	9.3		9.0	7.3	101.8	99.1	101.4		101.5	97.9	7.43	7.43	7.77		7.84	7.69	124	129	123		122	137
8.0	10.0	8.5	9.3		9.0	7.2	101.8	99.2	101.3		101.4	97.7	7.48	7.47	7.79		7.85	7.69	124	129	123		123	137
9.0	10.0	8.4	9.1		8.8	6.9	101.7	99.1	101.0		100.6	97.0	7.50	7.51	7.79		7.87	7.67	123	129	123		123	137
10.0	10.0*	8.3	9.1		8.0		101.5*	98.8	100.9		99.4		7.53*	7.52	7.79		7.87		124*	129	123		123	
11.0		8.2	9.9		7.7			98.6	100.5		99.4			7.56	7.79		7.83			129	123		122	
12.0		8.1	7.8		7.7			98.8	100.7		98.6			7.57	7.76		7.81			128	123		122	
13.0		7.9	7.4		7.7			98.2	97.8		98.5			7.59	7.71		7.80			129	123		122	
14.0		7.6	7.3		7.7			97.7	97.1		98.4			7.57	7.64		7.80			128	122		122	
15.0		7.5	7.1		7.5			97.4	96.6		97.5			7.57	7.57		7.77			128	122		122	
16.0		7.3	7.1		7.3			97.2	96.3		97.1			7.57	7.50		7.76			129	122		122	
17.0		7.2	6.5		7.3			97.0	95.5		96.8			7.56	7.44		7.74			129	122		122	
18.0		7.1	6.7					96.6	95.3					7.56	7.40					129	122			
19.0		7.1	6.5					96.3	94.4					7.55	7.31					129	122			
20.0		7.0						96.2						7.54						129				
21.0		6.8						95.7						7.54						129				
22.0		6.5						96.1						7.54						129				

[a] Sampling conducted on 24-July to 26-July, 2016.
[b] Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 were 10.3, 24.1, 20.5, 6.0, 18.7, and 10.9 m, respectively, at the time of summer sampling.
* The deepest *in situ* water quality reading at station DD Hab9 was taken at 9.3 m at the time of fall sampling.

Table C.35: *In-situ* water quality profile data collected at Sheardown Lake NW water quality monitoring stations in fall[a], Mary River Project CREMP, 2016.

Depth (m)	Temperature (°C)						Dissolved Oxygen (% Saturation)						pH (pH units)						Specific Conductance (µS/cm)					
	DD Hab9[b]	DLO-01-5[b]	DLO-01-1[b]	DLO-01-4[b]	DLO-01-2[b]	DLO-01-7[b]	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
1.0	10.0	10.5	10.4	10.6	10.7	10.8	97.6	96.1	97.2	97.4	96.1	96.0	7.08	7.24	7.46	8.12	8.15	8.10	190	192	190	210	220	210
2.0	10.8	10.5	10.4	10.5	10.5	10.8	98.3	96.9	97.6	97.7	96.9	97.3	7.42	7.38	7.65	8.10	8.12	8.07	192	192	190	210	220	210
3.0	10.7	10.5	10.4	10.5	10.4	10.5	98.3	97.4	97.8	97.8	97.3	96.0	7.53	7.51	7.74	8.08	8.10	8.07	192	192	191	220	220	220
4.0	10.7	10.5	10.4	10.4	10.4	10.4	98.4	97.6	97.8	97.8	97.4	97.0	7.61	7.61	7.79	8.07	8.09	8.06	192	192	192	210	220	220
5.0	10.7	10.4	10.3	10.4	10.3	10.4	98.3	97.6	97.6	97.7	97.2	97.6	7.68	7.68	7.84	8.05	8.07	8.04	192	192	192	220	220	220
6.0	10.7	10.4	10.2	10.3	10.3	10.3	98.3	97.6	97.3	98.1	97.2	97.6	7.73	7.74	7.87	8.04	8.07	8.04	193	192	192	220	220	220
7.0	10.6	10.4	10.2		10.2	10.3	98.2	97.6	97.0		97.1	97.5	7.77	7.78	7.90		8.06	8.04	193	192	192		220	220
8.0	10.6	10.4	10.1		10.2	10.3	98.0	97.4	96.8		97.0	97.4	7.80	7.80	7.91		8.05	8.04	193	192	191		220	220
9.0	10.1	10.3	10.1		10.2	10.0	97.3	97.0	96.5		96.7	96.5	7.84	7.83	7.92		8.02	8.04	202	192	192		220	220
10.0		10.2	10.1		10.1	9.7		96.9	96.2		96.0	95.7		7.85	7.93		7.99	8.01		192	192		220	210
11.0		10.1	9.9		9.8			96.6	95.7		95.4			7.87	7.93		7.95			192	192		210	
12.0		10.1	8.6		8.9			96.4	93.1		93.2			7.89	7.87		7.90			192	186		210	
13.0		7.8	7.8		8.6			91.8	91.5		92.8			7.83	7.82		7.80			184	184		210	
14.0		6.9	7.2		8.0			89.3	90.2		91.4			7.71	7.77		7.76			183	183		210	
15.0		6.7	6.9		7.4			88.2	89.1		89.6			7.66	7.73		7.69			182	183		210	
16.0		6.5	6.6		6.8			87.4	87.9		87.4			7.61	7.69		7.61			182	182		210	
17.0		6.5	6.5		6.6			86.7	87.2		86.8			7.59	7.65		7.54			182	182		210	
18.0		6.4	6.5					86.3	87.4					7.55	7.62					182	182			
19.0		6.4	6.4					85.9	86.0					7.53	7.60					182	182			
20.0		6.3						85.2						7.51						183				
21.0		6.3						84.7						7.49						183				
22.0		6.2						84.1						7.47						183				

[a] Sampling conducted on 21-August and 22-August, 2016.

[b] Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 were 9.7, 24.4, 20.8, 6.1, 18.6, and 12.3 m, respectively, at the time of fall sampling.

Table C.36: 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 2016.

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.)		
DD HAB9 STN2	13-Aug-16	10.3	4.8	-	surface	11.88	10.71	99.2	8.09	129
					bottom	9.99	10.34	94.9	7.72	126
DLO-01-08	13-Aug-16	11.4	5.2	clear, slight blue-green colouration	surface	12.49	10.94	102.7	8.07	128
					bottom	10.40	11.19	100.1	7.91	125
DLO-01-09	13-Aug-16	7.5	5.1	clear, slight blue-green colouration	surface	12.76	10.75	101.4	8.05	130
					bottom	10.76	11.00	99.1	7.93	125
DLO-01-03	13-Aug-16	8.6	5.0	clear, slight blue-green colouration	surface	12.35	10.92	102.2	7.96	128
					bottom	10.95	11.18	101.3	7.93	126
DLO-01-10	13-Aug-16	9.0	5.1	clear, slight blue-green colouration	surface	12.28	10.79	100.7	7.74	128
					bottom	10.67	11.16	100.5	7.51	126

Table C.37: Statistical comparison of bottom *in-situ* water quality between Sheardown Lake NW and Reference Lake 3 littoral stations, Mary River Project CREMP, August 2016.

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Lake	n	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	Yes	<0.001	α, δ, γ	Reference	5	8.88	0.71	0.32	8.10	10.00
				Sheardown NW	5	5.03	0.16	0.07	4.78	5.24
Temperature (˚C)	Yes	0.032	α, δ, γ	Reference	5	9.92	0.37	0.17	9.50	10.40
				Sheardown NW	5	10.55	0.37	0.17	9.99	10.95
Dissolved Oxygen (mg/L)	No	0.156	α, δ, γ	Reference	5	10.3	0.8	0.4	9.3	11.3
				Sheardown NW	5	11.0	0.4	0.2	10.3	11.2
Dissolved Oxygen (% saturation)	Yes	0.040	α, δ, γ	Reference	5	91.3	6.7	3.0	82.6	99.1
				Sheardown NW	5	99.2	2.5	1.1	94.9	101.3
pH (units)	No	0.270	α, δ, γ	Reference	5	7.64	0.23	0.10	7.28	7.86
				Sheardown NW	5	7.80	0.18	0.08	7.51	7.93
Specific Conductance (umho/cm)	Yes	<0.001	γ	Reference	5	74.0	0.0	0.0	74.0	74.0
				Sheardown NW	5	125.6	0.5	0.2	125.0	126.0

[a] Data analysis included: α - data untransformed; β - data logit transformed; ι - $\log_{10}$ transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Mann Whitney U-test.

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

Table C.38: Water chemistry at Sheardown Lake NW (DLO-01) water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event											
					DD-HAB9-STN1-S surface 30-Apr-2016	DD-HAB9-STN1-B bottom 30-Apr-2016	DL0-01-5(S) surface 26-Apr-2016	DL0-01-5(B) bottom 26-Apr-2016	DL0-01-1 surface 26-Apr-2016	DL0-01-1(B) bottom 26-Apr-2016	DL0-01-4(S) surface 26-Apr-2016	DL0-01-4(B) bottom 26-Apr-2016	DL0-01-2(S) surface 26-Apr-2016	DL0-01-2(B) bottom 26-Apr-2016	DL0-01-7-S surface 30-Apr-2016	DL0-01-7-B bottom 30-Apr-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	153	152	150	147	151	148	157	151	154	158	154	153
	pH (lab)	pH	6.5 - 9.0	-	8.03	8.04	7.68	7.64	7.76	7.67	7.73	7.81	7.74	7.77	8.02	8.00
	Hardness (as $CaCO_3$)	mg/L	-	-	74	73	70	68	72	71	74	72	73	72	73	74
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	77	77	76	53	88	87	91	87	90	91	81	74
	Turbidity	NTU	-	-	0.13	0.49	0.38	0.33	0.26	0.24	0.17	0.31	0.22	0.58	0.47	0.17
	Alkalinity (as $CaCO_3$)	mg/L	-	-	76	76	68	65	70	68	72	69	70	70	69	77
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.029	0.021	0.020	<0.020	0.043	<0.020	0.035	0.023	0.038	0.022	<0.020	<0.020
	Nitrate	mg/L	13	13	0.032	0.033	0.033	0.103	0.0335	0.051	0.030	0.033	0.032	0.030	0.033	0.033
	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	0.20	0.16	0.175	0.16	0.16	0.16	0.18	0.17	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	3.7	3.4	2.9	2.5	2.7	3.2	3.0	2.7	2.8	3.4	3.6	3.6
	Total Organic Carbon	mg/L	-	-	2.0	2.1	2.2	1.9	2.1	2.0	2.1	2.0	2.1	2.3	2.0	2.0
	Total Phosphorus	mg/L	0.020[α]	-	<0.0030	<0.0030	0.0035	0.0031	0.0031	<0.0030	0.0033	0.0032	<0.0030	<0.0030	<0.0030	<0.0030
	Phenols	mg/L	0.004[α]	-	0.0013	0.0014	0.0021	0.0015	<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	3.52	3.50	3.59	3.50	3.51	3.46	3.88	3.52	3.54	3.51	3.54	3.49
	Sulphate (SO_4)	mg/L	218[β]	218	3.99	3.96	3.98	3.83	3.96	3.89	4.24	3.97	3.98	3.95	4.01	3.97
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	<0.0030	<0.0030	0.0052	<0.0030	0.00745	<0.0030	0.0033	<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	-	-	0.00716	0.00681	0.00650	0.00661	0.00657	0.00641	0.00658	0.00658	0.00659	0.00641	0.00695	0.00709
	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	-	-	14.9	14.1	14.5	14.0	14.5	14.4	14.9	14.6	14.6	14.6	14.5	14.5
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	0.00106	<0.00050	0.00068	<0.00050	0.00108	0.00065	0.00127	<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	0.00098	0.00086	0.00096	0.00081	0.00095	0.00089	0.00096	0.00089	0.00091	0.00090	0.00094	0.00103
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	0.0011	0.0010	0.0010	0.0011	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	9.17	9.14	8.74	8.69	8.86	8.87	8.92	8.92	8.85	9.00	9.18	9.27
	Manganese (Mn)	mg/L	0.935[β]	-	0.000821	0.00107	0.00175	0.0117	0.00175	0.00178	0.00128	0.00131	0.00141	0.00136	0.000890	0.00111
	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	-	0.000904	0.000898	0.000996	0.000867	0.000945	0.000915	0.000984	0.000932	0.000950	0.000945	0.000920	0.000888
	Nickel (Ni)	mg/L	0.025	0.025	0.00070	0.00068	0.00340	0.00137	0.00189	0.00137	0.00258	0.00201	0.00231	0.00115	0.00069	0.00073
	Potassium (K)	mg/L	-	-	1.21	1.20	1.20	1.18	1.21	1.21	1.22	1.24	1.21	1.24	1.24	1.21
	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	-	-	0.65	0.64	0.64	0.98	0.65	0.71	0.65	0.63	0.65	0.63	0.62	0.62
	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	-	-	1.55	1.54	1.52	1.51	1.54	1.51	1.54	1.52	1.52	1.53	1.55	1.56
	Strontium (Sr)	mg/L	-	-	0.00959	0.00945	0.00990	0.00948	0.0098	0.00975	0.0101	0.00979	0.00987	0.00973	0.00960	0.00946
	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	0.00012	<0.00010	0.000295	<0.00010	<0.00010	<0.00010	0.00043	<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	-	0.00114	0.00112	0.00114	0.000983	0.001145	0.00109	0.00117	0.00113	0.00115	0.00115	0.00115	0.00110
	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	0.0132	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.38: Water chemistry at Sheardown Lake NW (DLO-01) water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event											
					DD-HAB-9-STN1-S surface 24-Jul-2016	DD-HAB-9-STN1-B bottom 24-Jul-2016	DL0-01-5-S surface 26-Jul-2016	DL0-01-5-B bottom 26-Jul-2016	DL0-01-1-S surface 24-Jul-2016	DL0-01-1-B bottom 24-Jul-2016	DL0-01-4-S surface 25-Jul-2016	DL0-01-4-B bottom 25-Jul-2016	DL0-01-2-S surface 24-Jul-2016	DL0-01-2-B bottom 24-Jul-2016	DL0-01-7-S surface 25-Jul-2016	DL0-01-7-B bottom 25-Jul-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	125	125	125	124	124	124	124	124	124	124	122	122
	pH (lab)	pH	6.5 - 9.0	-	7.97	8.00	8.00	7.84	8.00	7.80	7.90	7.98	7.92	7.90	7.88	7.96
	Hardness (as $CaCO_3$)	mg/L	-	-	59	57	59	60	57	58	57	58	58	56	57	57
	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	-	-	62	57	67	67	45	52	61	62	55	50	64	58
	Turbidity	NTU	-	-	0.85	0.86	0.54	0.46	0.96	0.84	1.24	1.22	0.92	0.90	0.82	0.80
	Alkalinity (as $CaCO_3$)	mg/L	-	-	54	58	57	58	44	56	56	54	54	55	54	58
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.053	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	1.04	0.16	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.4	1.3	1.4	1.4	1.5	1.5	1.3	1.4	1.4	1.4	1.4	1.4
	Total Organic Carbon	mg/L	-	-	1.5	1.6	1.7	1.6	1.7	2.9	1.7	1.7	1.6	1.8	1.6	1.6
	Total Phosphorus	mg/L	0.020[α]	-	0.0038	0.0069	0.0037	0.0039	0.0035	0.0033	0.0047	0.0193	0.0066	0.0046	0.0055	0.0041
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	0.0020	0.0018	0.0011	<0.0010	<0.0010	0.0042	<0.0010	<0.0010	0.0022	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	2.89	2.95	2.85	2.82	2.86	2.83	2.88	2.90	2.86	2.84	2.88	2.83
	Sulphate (SO_4)	mg/L	218[β]	218	3.48	3.53	3.30	3.16	3.33	3.21	3.31	3.34	3.30	3.25	3.27	3.21
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.0079	0.0067	0.0177	0.0074	0.0067	0.0076	0.0093	0.0064	0.0067	0.0121	0.0074	0.0068
	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	-	-	0.00552	0.00549	0.00594	0.00593	0.00554	0.00549	0.00545	0.00567	0.00547	0.00569	0.00569	0.00579
	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	-	-	11.2	11.3	12.1	12.0	11.2	11.2	11.1	11.0	11.3	11.3	11.0	11.1
	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	0.00079	0.00088	0.00144	0.00086	0.00080	0.00072	0.00174	0.00135	0.00073	0.00081	0.00124	0.00098
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0011	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	7.32	7.20	7.80	7.67	7.27	7.19	7.30	7.16	7.15	7.19	7.33	7.20
	Manganese (Mn)	mg/L	0.935[β]	-	0.00362	0.00372	0.00395	0.00405	0.00378	0.00389	0.00378	0.00374	0.00384	0.00532	0.00377	0.00389
	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	-	0.000680	0.000680	0.000733	0.000705	0.000670	0.000671	0.000679	0.000662	0.000683	0.000650	0.000667	0.000652
	Nickel (Ni)	mg/L	0.025	0.025	0.00060	0.00056	0.00066	0.00060	0.00060	0.00058	0.00061	0.00059	0.00060	0.00062	0.00062	0.00059
	Potassium (K)	mg/L	-	-	1.04	1.03	1.03	1.03	1.04	1.02	1.03	1.03	1.02	1.03	1.08	1.04
	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	-	-	0.47	0.46	0.49	0.55	0.47	0.53	0.45	0.45	0.46	0.50	0.48	0.49
	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	-	-	1.26	1.25	1.33	1.34	1.27	1.24	1.26	1.24	1.25	1.24	1.29	1.26
	Strontium (Sr)	mg/L	-	-	0.00774	0.00775	0.00797	0.00787	0.00751	0.00766	0.00758	0.00758	0.00757	0.00761	0.00754	0.00765
	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	-	0.000853	0.000833	0.000834	0.000802	0.000823	0.000818	0.000833	0.000806	0.000851	0.000836	0.000807	0.000814
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.38: Water chemistry at Sheardown Lake NW (DLO-01) water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event											
					DD-HAB-9-STN-1-S surface 21-Aug-2016	DD-HAB-9-STN-1-B bottom 21-Aug-2016	DL0-01-05-S surface 21-Aug-2016	DL0-01-05-B bottom 21-Aug-2016	DL0-01-01-S surface 21-Aug-2016	DL0-01-01-B bottom 21-Aug-2016	DL0-01-4-S surface 22-Aug-2016	DL0-01-4-B bottom 22-Aug-2016	DL0-01-2-S surface 22-Aug-2016	DL0-01-2-B bottom 22-Aug-2016	DL0-01-07-S surface 22-Aug-2016	DL0-01-07-B bottom 22-Aug-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	133	135	133	126	133	127	133	132	132	126	132	133
	pH (lab)	pH	6.5 - 9.0	-	8.14	8.14	8.03	7.74	8.13	7.83	8.11	8.13	8.07	7.78	8.11	8.12
	Hardness (as $CaCO_3$)	mg/L	-	-	63	64	64	61	65	61	62	63	62	61	61	63
	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	-	-	64	66	62	62	68	65	65	68	61	57	67	59
	Turbidity	NTU	-	-	0.95	0.87	0.87	0.74	0.85	0.79	0.91	0.76	0.95	0.81	0.82	0.76
	Alkalinity (as $CaCO_3$)	mg/L	-	-	60	61	62	59	59	59	59	60	60	58	58	59
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.033	<0.020	0.031	<0.020	<0.020	0.060	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.024	0.031	0.021	0.024	0.022	0.022	0.032	0.022	0.024	0.026	0.023	0.023
	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	0.18	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.7	1.5	1.6	1.9	1.7	2.0	1.8	1.8	1.8	1.6	1.7	1.7
	Total Organic Carbon	mg/L	-	-	1.9	2.0	2.2	1.6	1.9	2.0	1.9	1.8	1.9	1.7	1.7	1.8
	Total Phosphorus	mg/L	0.020[α]	-	0.0044	0.0051	0.0236	0.0073	0.0072	0.0061	0.0045	<0.0030	0.0043	0.0079	0.0157	0.0043
	Phenols	mg/L	0.004[α]	-	0.0018	0.0024	0.0297	0.0020	0.0140	0.0047	0.0051	0.0019	0.0021	0.0024	0.0048	0.0034
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.00	3.09	3.04	2.87	3.05	2.89	3.11	3.08	3.07	2.88	3.08	3.13
	Sulphate (SO_4)	mg/L	218[β]	218	4.18	4.39	4.10	3.17	4.14	3.41	4.23	4.12	4.22	3.29	4.14	4.04
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.0122	0.0129	0.0132	0.0096	0.0152	0.0102	0.0188	0.0151	0.0116	0.0113	0.0132	0.0200
	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	-	-	0.00613	0.00623	0.00623	0.00591	0.00642	0.00587	0.00609	0.00624	0.00620	0.00581	0.00645	0.00641
	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	-	-	12.2	12.2	12.7	11.9	12.9	12.4	12.4	12.8	12.8	11.6	12.8	12.7
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	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	0.00105	0.00089	0.00084	0.00089	0.00082	**_0.0099*_**	**_0.0335*_**	**_0.00388*_**	**_0.0344*_**	**_0.00299*_**	**_0.0256*_**
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	0.0013	0.0012	<0.0010	0.0013	0.0013
	Magnesium (Mg)	mg/L	-	-	7.86	7.94	7.62	7.41	7.62	7.59	7.81	7.74	7.70	7.41	8.09	7.78
	Manganese (Mn)	mg/L	0.935[β]	-	0.00201	0.00200	0.00190	0.00289	0.00197	0.00217	0.00194	0.00207	0.00196	0.00231	0.00207	0.00226
	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	-	0.000760	0.000746	0.000799	0.000715	0.000790	0.000748	0.000748	0.000764	0.000757	0.000681	0.000765	0.000772
	Nickel (Ni)	mg/L	0.025	0.025	0.00065	0.00064	0.00062	0.00060	0.00065	0.00063	0.00060	0.00061	0.00064	0.00061	0.00065	0.00065
	Potassium (K)	mg/L	-	-	1.09	1.09	1.08	1.06	1.08	1.03	1.08	1.08	1.06	1.06	1.10	1.09
	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	-	-	0.45	0.47	0.46	0.56	0.45	0.51	0.48	0.47	0.47	0.55	0.48	0.48
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.38	1.41	1.36	1.33	1.36	1.29	1.40	1.40	1.36	1.34	1.40	1.37
	Strontium (Sr)	mg/L	-	-	0.00833	0.00813	0.00858	0.00800	0.00868	0.00835	0.00829	0.00854	0.00855	0.00773	0.00842	0.00847
	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	-	0.00102	0.00103	0.00101	0.000875	0.00100	0.000874	0.00102	0.00101	0.000994	0.000882	0.000970	0.000995
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.39: Dissolved metals concentrations at Sheardown Lake NW water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Winter Sampling Event												Summer Sampling Event					
			DD-HAB 9-STN1 surface 30-Apr-2016	DD-HAB 9-STN1 bottom 30-Apr-2016	DL0-01-5 surface 26-Apr-2016	DL0-01-5 bottom 26-Apr-2016	DL0-01-1 surface 26-Apr-2016	DL0-01-1 bottom 26-Apr-2016	DL0-01-4 surface 26-Apr-2016	DL0-01-4 bottom 26-Apr-2016	DL0-01-2 surface 26-Apr-2016	DL0-01-2 bottom 26-Apr-2016	DL0-01-7 surface 30-Apr-2016	DL0-01-7 bottom 30-Apr-2016	DD-HAB9-STN1 surface 24-Jul-2016	DD-HAB9-STN1 bottom 24-Jul-2016	DL0-01-5- surface 26-Jul-2016	DL0-01-5- bottom 26-Jul-2016	DL0-01-1- surface 24-Jul-2016	DL0-01-1- bottom 24-Jul-2016
Dissolved Metals	Aluminum (Al)	mg/L	0.00147	0.00111	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.00179	0.00106	<0.0030	<0.0030	<0.0030	<0.0030	0.0040	<0.0030
	Antimony (Sb)	mg/L	<0.000020	<0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000020	<0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.000055	0.000061	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.000059	0.000065	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00736	0.00676	0.00657	0.00654	0.00669	0.00664	0.00666	0.00661	0.00665	0.00661	0.00773	0.00722	0.00551	0.00552	0.00557	0.00579	0.00537	0.00542
	Beryllium (Be)	mg/L	<0.000010	<0.000010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000010	<0.000010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.0000050	<0.0000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0000050	<0.0000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	0.0059	0.0058	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.0059	0.0058	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	14.7	14.2	13.8	13.0	14.1	14.2	15.3	14.2	14.2	14.0	14.6	14.5	11.4	11.3	11.6	11.8	11.1	11.1
	Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0000123	0.0000113	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.0000100	0.0000135	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00088	0.00085	0.00089	0.00080	0.00084	0.00080	0.00082	0.00081	0.00086	0.00085	0.00094	0.00094	0.00162	0.00078	0.00093	0.00083	0.00074	0.00078
	Iron (Fe)	mg/L	0.0022	0.0012	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.0016	0.0017	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.0000090	<0.0000090	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.0000105	<0.0000090	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.00097	0.00093	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00088	0.00092	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	9.00	9.03	8.61	8.57	8.90	8.58	8.81	8.79	9.07	8.90	9.00	9.15	7.30	7.04	7.37	7.30	7.14	7.22
	Manganese (Mn)	mg/L	0.000388	0.000087	0.000293	0.0112	0.00026	0.000162	0.000438	0.000371	0.000293	0.000273	0.000207	0.000117	0.000417	0.000487	0.000301	0.000117	0.000336	0.000108
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000911	0.000925	0.000981	0.000894	0.000910	0.000926	0.000974	0.000925	0.000940	0.000916	0.000933	0.000891	0.000693	0.000681	0.000659	0.000683	0.000668	0.000690
	Nickel (Ni)	mg/L	0.000682	0.000682	0.00114	0.00114	0.00093	0.00098	0.00083	0.00085	0.00096	0.00089	0.000685	0.000752	0.00061	0.00053	0.00059	0.00060	0.00060	0.00058
	Potassium (K)	mg/L	1.20	1.19	1.08	1.05	1.10	1.07	1.10	1.10	1.11	1.08	1.20	1.22	1.03	1.00	1.05	1.03	1.02	1.03
	Selenium (Se)	mg/L	<0.000040	<0.000040	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000040	<0.000040	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.630	0.622	0.62	0.93	0.61	0.70	0.61	0.61	0.61	0.61	0.629	0.627	0.46	0.46	0.46	0.53	0.45	0.50
	Silver (Ag)	mg/L	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.53	1.52	1.48	1.46	1.46	1.46	1.48	1.48	1.51	1.48	1.52	1.54	1.27	1.21	1.28	1.27	1.24	1.25
	Strontium (Sr)	mg/L	0.00956	0.00934	0.00936	0.00908	0.0093	0.00940	0.00977	0.00931	0.00936	0.00935	0.00949	0.00940	0.00772	0.00764	0.00790	0.00781	0.00767	0.00787
	Thallium (Tl)	mg/L	0.0000034	0.0000031	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.0000032	0.0000035	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.000030	<0.000030	0.00013	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000030	<0.000030	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	<0.00050	<0.00050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.00050	<0.00050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.00114	0.00115	0.00111	0.000956	0.00111	0.00106	0.00111	0.00110	0.00111	0.00111	0.00118	0.00113	0.000860	0.000845	0.000834	0.000846	0.000841	0.000792
	Vanadium (V)	mg/L	<0.000050	0.000052	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.00126	0.00112	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.00075	0.00098	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.39: Dissolved metals concentrations at Sheardown Lake NW water quality monitoring stations, Mary River Project CREMP, 2016.

	Parameters	Units	Summer Sampling Event						Fall Sampling Event											
			DL0-01-4-S1 surface 25-Jul-2016	DL0-01-4-B1 bottom 25-Jul-2016	DL0-01-2-S1 surface 24-Jul-2016	DL0-01-2-B1 bottom 24-Jul-2016	DL0-01-7S1 surface 25-Jul-2016	DL0-01-7B1 bottom 25-Jul-2016	DD-HAB9-STN1-S1 surface 21-Aug-2016	DD-HAB9-STN1-B1 bottom 21-Aug-2016	DL0-01-5-S1 surface 21-Aug-2016	DL0-01-5-B1 bottom 21-Aug-2016	DL0-01-1-S1 surface 21-Aug-2016	DL0-01-1-B1 bottom 21-Aug-2016	DL0-01-4-S1 surface 22-Aug-2016	DL0-01-4-B1 bottom 22-Aug-2016	DL0-01-2-S1 surface 22-Aug-2016	DL0-01-2-B1 bottom 22-Aug-2016	DL0-01-7-S1 surface 22-Aug-2016	DL0-01-7-B1 bottom 22-Aug-2016
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0040	0.0032	<0.0030	0.0032	0.0040	0.0034	0.0044	0.0037	0.0034	<0.0030	0.0032	<0.0030
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00544	0.00575	0.00554	0.00567	0.00540	0.00581	0.00616	0.00619	0.00644	0.00584	0.00620	0.00595	0.00614	0.00614	0.00609	0.00586	0.00634	0.00624
	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	11.2	11.3	11.4	11.1	11.2	11.0	12.6	12.6	12.5	12.1	12.6	12.3	12.4	12.3	12.3	12.1	12.2	12.4
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00165	0.00145	0.00073	0.00079	0.00131	0.00098	0.00081	0.00091	0.00084	0.00082	0.00081	0.00078	0.00959	0.0310	0.00310	0.0340	0.00322	0.0242
	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0010	<0.0010	0.0011	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	7.14	7.25	7.27	6.98	7.14	7.15	7.79	7.87	7.84	7.58	8.06	7.36	7.54	7.72	7.60	7.41	7.43	7.80
	Manganese (Mn)	mg/L	0.000333	0.000299	0.000288	0.000141	0.000174	0.000143	0.000576	0.000483	0.000418	0.000152	0.000396	0.000180	0.000508	0.000454	0.000513	0.000150	0.000493	0.000409
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000656	0.000669	0.000694	0.000653	0.000670	0.000671	0.000760	0.000774	0.000728	0.000706	0.000773	0.000743	0.000747	0.000757	0.000746	0.000706	0.000748	0.000753
	Nickel (Ni)	mg/L	0.00056	0.00059	0.00058	0.00060	0.00056	0.00059	0.00062	0.00071	0.00060	0.00063	0.00061	0.00059	0.00058	0.00062	0.00062	0.00063	0.00061	0.00057
	Potassium (K)	mg/L	1.03	1.03	1.05	1.00	1.03	1.03	1.08	1.09	1.09	1.06	1.08	1.06	1.08	1.08	1.05	1.04	1.07	1.09
	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	0.45	0.44	0.45	0.46	0.47	0.49	0.43	0.45	0.43	0.54	0.44	0.49	0.43	0.45	0.43	0.52	0.44	0.43
	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	1.24	1.27	1.28	1.21	1.26	1.25	1.39	1.41	1.41	1.34	1.39	1.31	1.36	1.41	1.41	1.29	1.37	1.40
	Strontium (Sr)	mg/L	0.00756	0.00759	0.00774	0.00764	0.00765	0.00749	0.00843	0.00842	0.00841	0.00808	0.00836	0.00822	0.00834	0.00831	0.00835	0.00812	0.00824	0.00840
	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	0.000837	0.000837	0.000861	0.000828	0.000828	0.000807	0.00100	0.00104	0.000989	0.000861	0.000997	0.000891	0.00102	0.00102	0.00103	0.000882	0.000997	0.00101
	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.40: Summary of the magnitude of difference in aqueous metal concentrations between the Sheardown Lake basins and Reference Lake 3 in 2016, and at the Sheardown Lake basins between 2016 and the baseline period for winter, summer, and fall sampling events, Mary River Project CREMP. No reference lake data were collected in winter 2016.

Variable	Sheardown Lake NW					Sheardown Lake SE				
	2016 vs Reference Lake 3		2016 vs Baseline			2016 vs Reference Lake 3		2016 vs Baseline		
	Summer	Fall	Winter	Summer	Fall	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	1.6	1.6	1.1	1.1	1.1	1.2	1.4	1.0	0.9	1.0
Hardness (as $CaCO_3$)	1.6	1.8	1.1	1.0	1.0	1.2	1.6	1.0	0.9	1.0
Total Suspended Solids (TSS)	0.9	1.0	1.0	0.5	0.8	1.7	1.1	0.9	1.4	0.9
Total Dissolved Solids (TDS)	1.3	1.7	0.9	0.8	0.8	1.1	1.6	0.8	0.8	0.8
Turbidity	3.9	2.5	1.3	1.1	1.6	8.5	7.0	0.8	1.1	1.3
Alkalinity (as $CaCO_3$)	1.6	1.8	1.0	1.0	1.0	1.2	1.6	0.9	0.9	1.0
Total Ammonia	1.1	0.6	0.2	0.5	0.6	1.2	0.7	0.2	0.9	0.9
Nitrate	1.0	1.2	0.4	0.2	0.2	1.2	1.0	0.3	0.2	0.2
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)	1.2	1.0	0.7	1.4	1.0	0.8	1.0	0.7	1.1	0.7
Dissolved Organic Carbon	0.5	0.6	1.7	0.8	1.0	0.4	0.6	1.9	0.7	1.0
Total Organic Carbon	0.7	0.7	1.1	0.9	1.0	0.5	0.6	1.1	0.9	1.0
Total Phosphorus	1.1	0.8	0.8	0.9	1.5	1.7	1.0	1.0	1.3	1.8
Phenols	0.6	2.0	1.2	1.5	6.2	1.6	3.3	1.3	4.3	10
Bromide (Br)	1.0	1.0	0.6	0.4	0.4	1.0	1.0	0.7	0.4	0.4
Chloride (Cl)	2.1	2.4	1.1	1.2	1.1	1.3	1.8	1.0	0.7	0.7
Sulphate (SO_4)	0.8	1.0	1.2	1.2	1.3	0.4	0.6	1.0	0.8	1.1
Aluminum (Al)	2.0	3.2	1.2	0.6	0.7	14	13	0.6	0.8	0.8
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	0.8	0.9	1.1	1.1	1.2	0.8	1.0	1.1	0.9	1.1
Beryllium (Be)	1.0	1.0	2.0	1.4	1.5	1.0	0.2	1.5	1.2	0.3
Cadmium (Cd)	1.0	1.0	0.8	0.9	0.9	1.0	1.0	0.8	0.8	0.8
Calcium (Ca)	1.6	1.8	1.0	1.0	1.0	1.2	1.6	1.0	0.9	1.0
Chromium (Cr)	1.0	1.0				1.0	1.0			
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9	1.0	1.0	1.0	0.9	0.9
Copper (Cu)	1.3	1.1	0.9	1.0	0.7	0.9	1.3	0.8	0.6	1.1
Iron (Fe)	1.0	1.0	1.2	1.1	0.8	2.2	2.1	0.6	0.6	0.8
Lead (Pb)	1.0	1.0	0.9	0.9	0.1	1.8	2.0	0.5	0.8	1.2
Lithium (Li)	1.0	1.1	0.4	0.3	0.0	1.0	1.0	0.3	0.2	0.3
Magnesium (Mg)	1.7	1.8	1.0	1.0	1.1	1.2	1.5	1.0	1.0	1.0
Manganese (Mn)	5.3	3.4	3.4	2.2	1.0	5.8	6.9	0.3	0.8	1.3
Mercury (Hg)	1.0	1.0	1.0	0.9	0.3	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	5.4	5.5	1.1	1.0	1.1	2.6	3.6	1.1	1.0	1.1
Nickel (Ni)	1.2	1.3	2.0	0.9	0.9	1.0	1.4	0.9	0.8	1.1
Potassium (K)	1.2	1.2	1.2	1.3	1.3	0.8	1.0	1.1	1.2	1.2
Selenium (Se)	1.0	1.0				1.0	0.1			0.6
Silicon (Si)	1.1	1.2	0.8	0.8	0.8	1.1	1.6	0.7	0.7	0.9
Silver (Ag)	1.0	1.0	2.5	1.0	1.3	1.0	5.0	1.6	1.4	
Sodium (Na)	1.5	1.6	1.1	1.1	1.2	1.1	1.3	1.1	1.4	1.2
Strontium (Sr)	1.0	1.0	1.0	1.0	1.1	0.7	1.0	0.8	0.7	0.9
Thallium (Tl)	1.0	1.0	2.3	1.6	0.4	1.0	0.1	1.6	1.2	0.1
Tin (Sn)	1.0	1.0	0.2	0.2	0.2	1.0	1.0	0.1	0.1	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	0.3	1.0	0.9	0.2
Uranium (U)	3.3	3.6	1.2	1.1	1.2	2.1	2.9	1.0	1.0	1.1
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	0.5	1.0	1.0	0.5
Zinc (Zn)	1.0	1.0	1.5	1.5	1.2	1.0	1.0	1.0	1.8	1.9

Denotes slight elevation (mean variable concentration 3 to 5 times higher than respective mean reference or baseline period value).

Denotes moderate elevation (mean variable concentration 5 to 10 times higher than respective mean reference or baseline period value).

Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference or baseline period value).

Table C.41: *In-situ* water quality profile data collected at Sheardown Lake SE water quality monitoring stations in winter[a], Mary River Project CREMP, 2016.

Station DLO-02-6[b,c]					Station DLO-02-7[b,c]					Station DLO-02-4[b,c]					Station DLO-02-8[b,c]					Station DLO-02-3[b,c]				
Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)
2.80	0.9	90.1	7.48	166	2.90	1.0	99.4	7.32	153	3.40	1.2	98.6	7.34	148	2.80	1.1	99.2	7.46	180	2.90	1.1	102.0	7.37	149
3.80	0.9	90.4	7.42	164	3.50	1.1	99.7	7.32	151	4.40	1.3	99.3	7.34	148	3.80	1.2	100.1	7.38	149	3.90	1.2	101.9	7.35	149
4.80	1.0	98.7	7.39	166						5.40	1.3	100.2	7.34	148	4.80	1.2	100.5	7.34	148	4.90	1.2	101.8	7.35	149
5.80	1.0	86.5	7.37	166						6.40	1.3	100.6	7.34	149	5.80	1.2	100.7	7.33	149	5.90	1.3	101.4	7.35	148
6.80	1.1	84.0	7.35	167						7.40	1.3	101.0	7.34	149	6.80	1.2	101.0	7.32	149	6.90	1.3	101.0	7.34	149
										8.40	1.3	101.6	7.34	149	7.80	1.2	101.9	7.32	149	7.90	1.3	101.0	7.34	149
															8.80	1.2	102.0	7.32	149	8.90	1.3	101.3	7.33	149
															9.80	1.2	101.7	7.31	149	9.90	1.3	100.5	7.33	148
															10.80	1.2	100.9	7.31	149	10.90	1.4	92.6	7.33	148
															11.80	1.4	96.5	7.29	147	11.90	1.5	75.4	7.24	148
																				12.90	1.6	46.7	7.13	149
																				13.90	1.9	25.2	6.94	163

[a] Sampling conducted 29 - 30-April 2016.
[b] Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 were 6.90, 3.90, 9.10, 13.10, and 14.70 m, respectively, at the time of winter sampling.
[c] Ice thickness at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 were 1.80, 1.97, 2.40, 1.83, and 1.93 m, respectively, at the time of winter sampling

Table C.42: ***In-situ*** **water quality profile data collected at Sheardown Lake SE water quality monitoring stations in summer[a], Mary River Project CREMP, 2016.**

Depth (m)	Temperature (°C)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	DLO-02-6[b]	DLO-02-7[b]	DLO-02-4[b]	DLO-02-8[b]	DLO-02-3[b]	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
1.0	9.9	10.3	9.7	9.9	9.8	98.6	99.1	100.2	98.4	98.8	7.78	7.88	7.57	7.79	7.71	91.0	90.0	89.0	90.0	90.0
2.0	9.8	10.0	9.6	9.8	9.7	98.3	98.5	99.0	98.3	98.3	7.76	7.83	7.64	7.78	7.68	91.0	90.0	89.0	90.0	90.0
3.0	9.7	9.8	9.6	9.7	9.7	98.3	98.2	98.3	98.0	98.1	7.77	7.82	7.67	7.80	7.70	92.0	90.0	89.0	90.0	90.0
4.0	9.7	9.5	9.6	9.5	9.6	98.5	98.5	98.1	97.6	97.8	7.79	7.84	7.68	7.81	7.72	92.0	91.0	90.0	90.0	90.0
5.0	9.6		9.5	9.4	9.5	98.0		97.6	97.3	97.2	7.83		7.69	7.81	7.74	92.0		90.0	90.0	90.0
6.0	9.5		9.4	9.2	9.4	97.4		97.1	97.6	96.6	7.81		7.71	7.81	7.73	92.0		90.0	90.0	90.0
7.0	9.5*		9.2	9.1	9.2	97.2*		96.6	96.6	96.6	7.81*		7.71	7.79	7.74	92.0*		91.0	91.0	90.0
8.0			8.8	9.0	9.1			96.0	96.6	96.7			7.72	7.80	7.72			92.0	91.0	90.0
9.0			8.7*	9.0	9.0			96.3*	96.5	96.7			7.70*	7.79	7.71			92.0*	91.0	91.0
10.0				8.8	8.9				96.3	96.5				7.79	7.73				91.0	91.0
11.0				8.7	8.9				96.4	96.6				7.79	7.73				91.0	91.0
12.0				8.6	8.8				96.4	96.5				7.80	7.74				91.0	91.0
13.0				8.6*	8.7				96.4*	96.3				7.79*	7.74				91.0*	91.0
13.9					8.7					96.3					7.75					91.0

[a] Sampling conducted on 26-July, 2016.

[b] Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 were 7.1, 5, 9.3, 13.8, and 14.9 m, respectively, at the time of summer sampling.

* The deepest *in situ* water quality reading at stations DLO-02-6, DLO-02-4, and DLO-02-8 were taken at 6.1, 8.3, and 12.8 m at the time of summer sampling.

Table C.43: *In-situ* water quality profile data collected at Sheardown Lake SE water quality monitoring stations in fall[a], Mary River Project CREMP, 2016.

Depth (m)	Temperature (°C)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	DLO-02-6[b]	DLO-02-7[b]	DLO-02-4[b]	DLO-02-8[b]	DLO-02-3[b]	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
1.0	10.8	10.7	10.1	11.4	10.5	97.7	96.8	93.5	95.7	96.6	7.02	6.90	6.60	6.96	6.93	169	167	166	166	166
2.0	10.6	10.7	10.1	10.3	10.4	98.4	97.4	94.0	96.0	96.8	7.38	7.08	6.76	7.14	7.13	169	167	166	167	167
3.0	10.4	10.5	10.0	10.2	10.4	98.7	97.2	94.2	95.4	96.7	7.49	7.24	6.96	7.28	7.24	169	167	166	166	167
4.0	10.0		10.0	10.2	10.3	97.1		94.0	95.2	96.8	7.62		7.08	7.37	7.40	171		166	166	167
5.0	9.9		10.0	10.1	10.2	96.3		93.8	94.9	96.5	7.67		7.17	7.44	7.52	171		167	166	167
6.0	9.7		10.0	10.1	10.2	95.5		93.3	94.7	96.0	7.70		7.27	7.47	7.58	172		167	166	167
7.0			9.9	10.1	10.1			93.4	94.4	95.2			7.31	7.51	7.52			167	166	167
8.0			9.8	10.0	10.1			93.2	94.0	94.7			7.35	7.54	7.65			167	166	166
9.0				10.0	10.0				93.8	94.5				7.59	7.66				166	166
10.0				10.0	10.0				92.6	94.6				7.59	7.66				166	166
11.0				9.7	9.9				88.5	91.3				7.57	7.64				NA[c]	165
12.0				9.2	9.6				81.2	88.2				7.53	7.60				161	164
13.0					9.1					80.6					7.56					161
14.0					8.9					73.6					7.47					162

[a] Sampling conducted on 21-August, 2016.

[b] Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 were 6.8, 3.9, 8.9, 13.2, and 14.4 m, respectively, at the time of fall sampling.

[c] Not Available

Table C.44: 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 2016.

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.)		
DLO-02-1	14-Aug-16	11.3	2.0	slightly turbid, beige-green colouration	surface	12.22	10.43	97.3	7.72	111
					bottom	10.02	9.34	83.1	7.51	115
DLO-02-11	14-Aug-16	6.7	2.2	slightly turbid, beige-green colouration	surface	12.62	10.59	99.7	7.95	111
					bottom	11.36	10.39	95.3	7.82	110
DLO-02-9	14-Aug-16	8.2	2.1	slightly turbid, beige-green colouration	surface	12.53	10.56	99.3	7.94	111
					bottom	11.08	10.42	94.8	7.80	108
DLO-02-13	14-Aug-16	12.0	2.2	slightly turbid, beige-green colouration	surface	12.57	10.55	99.1	7.92	113
					bottom	10.09	9.75	86.5	7.68	105
DLO-02-3	14-Aug-16	13.9	2.2	slightly turbid, beige-green colouration	surface	12.25	10.53	92.8	7.87	110
					bottom	9.91	9.15	80.9	7.45	106

Table C.45: Statistical comparison of bottom *in-situ* water quality between littoral stations of Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2016.

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Lake	n	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	Yes	0.000	η, δ, γ	Reference	5	8.88	0.71	0.32	8.10	10.00
				Sheardown SE	5	2.15	0.08	0.04	2.03	2.24
Temperature (˚C)	No	0.144	η, δ, γ	Reference	5	9.92	0.37	0.17	9.50	10.40
				Sheardown SE	5	10.49	0.67	0.30	9.91	11.36
Dissolved Oxygen (mg/L)	No	0.268	α, δ, γ	Reference	5	10.3	0.8	0.4	9.3	11.3
				Sheardown SE	5	9.8	0.6	0.3	9.2	10.4
Dissolved Oxygen (% saturation)	No	0.470	α, δ, γ	Reference	5	91.3	6.7	3.0	82.6	99.1
				Sheardown SE	5	88.1	6.6	3.0	80.9	95.3
pH (units)	No	0.951	α, δ, γ	Reference	5	7.64	0.23	0.10	7.28	7.86
				Sheardown SE	5	7.65	0.17	0.07	7.45	7.82
Specific Conductance (umho/cm)	Yes	0.008	γ	Reference	5	74.0	0.0	0.0	74.0	74.0
				Sheardown SE	5	108.8	4.0	1.8	105.0	115.0

[a] Data analysis included: α - data untransformed; β - data logit transformed; η - $\log_{10}$ transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Mann Whitney U-test.

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

Table C.46: Water chemistry at Sheardown Lake SE (DLO-02) water quality monitoring stations, Mary River Project CREMP, 2016.

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event								
					DL0-02-6-S surface 30-Apr-16	DL0-02-6-B bottom 30-Apr-16	DL0-02-7 surface 29-Apr-16	DL0-02-4-S surface 29-Apr-16	DL0-02-4-B bottom 29-Apr-16	DL0-02-8-S surface 29-Apr-16	DL0-02-8-B bottom 29-Apr-16	DL0-02-3-S surface 29-Apr-16	DL0-02-3-B bottom 29-Apr-16
Conventionals	Conductivity (lab)	umho/cm	-	-	171	167	157	154	150	152	151	156	150
	pH (lab)	pH	6.5 - 9.0	-	7.87	7.84	7.95	7.97	7.98	7.92	7.98	8.00	7.81
	Hardness (as $CaCO_3$)	mg/L	-	-	81	82	77	74	73	75	74	75	74
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	85	85	89	83	81	76	76	79	83
	Turbidity	NTU	-	-	0.30	0.50	0.21	0.24	0.30	0.25	0.49	0.31	0.32
	Alkalinity (as $CaCO_3$)	mg/L	-	-	80	76	76	81	71	14	74	74	70
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.056	0.059	0.028	0.022	<0.020	<0.020	0.021	<0.020	0.057
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	3.3	3.6	3.4	3.5	3.9	3.9	3.3	3.6	2.9
	Total Organic Carbon	mg/L	-	-	3.4	2.1	2.2	2.1	1.8	2.0	1.9	2.1	1.7
	Total Phosphorus	mg/L	0.020[α]	-	0.0034	0.0042	0.0044	0.0037	0.0040	0.0047	0.0049	0.0045	0.0092
	Phenols	mg/L	0.004[α]	-	0.0022	0.0011	<0.0010	0.0019	<0.0010	<0.0010	0.0012	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.43	3.40	3.14	3.11	3.59	3.09	3.02	3.06	3.17
	Sulphate (SO_4)	mg/L	218[β]	218	3.07	3.01	2.80	2.78	2.72	2.74	2.67	2.74	2.39
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	<0.0030	0.0033	<0.0030	0.0066	<0.0030	<0.0030	<0.0030	<0.0030	0.0035
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00812	0.00840	0.00754	0.00748	0.00705	0.00712	0.00721	0.00721	0.00690
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	16.3	16.4	15.0	14.7	14.5	14.7	14.5	14.9	14.1
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00183
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00087	0.00081	0.00084	0.00091	0.00086	0.00087	0.00080	0.00078	0.00080
	Iron (Fe)	mg/L	0.30	0.300	0.032	0.045	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.040
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	9.96	10.3	9.19	9.24	8.86	9.04	8.95	9.05	8.96
	Manganese (Mn)	mg/L	0.935[β]	-	0.00412	0.00591	0.00211	0.00179	0.00165	0.00166	0.00177	0.00143	0.00482
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000656	0.000588	0.000592	0.000589	0.000595	0.000604	0.000600	0.000621	0.000438
	Nickel (Ni)	mg/L	0.025	0.025	0.00077	0.00079	0.00068	0.00067	0.00068	0.00064	0.00064	0.00061	0.00062
	Potassium (K)	mg/L	-	-	1.27	1.31	1.18	1.19	1.13	1.15	1.14	1.17	1.08
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.73	0.73	0.61	0.56	0.53	0.57	0.56	0.56	0.99
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.58	1.62	1.48	1.50	1.41	1.44	1.43	1.45	1.46
	Strontium (Sr)	mg/L	-	-	0.0109	0.0109	0.00982	0.00996	0.00964	0.00974	0.00963	0.00986	0.00952
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.000953	0.000929	0.000887	0.000875	0.000893	0.000877	0.000880	0.000888	0.000665
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	0.0040	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.46: Water chemistry at Sheardown Lake SE (DLO-02) water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event									
					DL0-02-6-S surface 26-Jul-16	DL0-02-6-B bottom 26-Jul-16	DL0-02-7-S surface 26-Jul-16	DL0-02-7-B bottom 26-Jul-16	DL0-02-4-S surface 26-Jul-16	DL0-02-4-B bottom 26-Jul-16	DL0-02-8-S surface 26-Jul-16	DL0-02-8-B bottom 26-Jul-16	DL0-02-3-S surface 26-Jul-16	DL0-02-3-B bottom 26-Jul-16
Conventionals	Conductivity (lab)	umho/cm	-	-	89.3	89.3	87.4	87.9	87.9	88.7	87.1	88	88.0	88.5
	pH (lab)	pH	6.5 - 9.0	-	7.90	7.85	7.87	7.81	7.89	7.81	7.87	7.82	7.87	7.83
	Hardness (as $CaCO_3$)	mg/L	-	-	41	42	42	42	41	41	41	42	42	41
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	2.8	<2.0	9.4	<2.0	9.6
	Total Dissolved Solids (TDS)	mg/L	-	-	56	56	54	54	51	50	49	51	45	46
	Turbidity	NTU	-	-	1.13	1.31	1.08	0.88	0.81	1.74	0.89	6.02	0.91	4.46
	Alkalinity (as $CaCO_3$)	mg/L	-	-	40	40	42	39	41	40	40	43	40	41
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.034	0.040	<0.020
	Nitrate	mg/L	13	13	0.067	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.17	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.1	1.2	1.1	1.1	1.2	1.1	1.1	1.2	1.2	1.1
	Total Organic Carbon	mg/L	-	-	1.4	1.3	1.4	1.2	1.3	1.4	1.3	1.5	1.4	1.4
	Total Phosphorus	mg/L	0.020[α]	-	0.0053	0.0052	0.0049	0.0082	0.0051	0.0081	0.0049	0.0174	0.0164	0.0165
	Phenols	mg/L	0.001[α]	-	0.0018	0.0051	0.0034	0.0022	0.0034	0.0024	0.0017	0.0016	0.0197	0.0013
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	1.83	1.83	1.79	1.80	1.81	1.75	1.81	1.70	1.79	1.68
	Sulphate (SO_4)	mg/L	218[β]	218	1.81	1.79	1.70	1.69	1.70	1.70	1.72	1.64	1.69	1.64
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.0461	0.0255	0.0312	0.0514	0.0268	0.0503	0.0173	0.149	0.0245	0.169
	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	-	-	0.00466	0.00484	0.00443	0.00502	0.00458	0.00515	0.00437	0.00634	0.00446	0.00632
	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	-	-	8.07	8.46	8.23	8.55	8.10	8.49	8.06	8.6	8.23	8.59
	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	0.00011	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00069	0.00064	0.00060	0.00064	0.00081	0.00068	0.00063	0.00089	0.00063	0.00093
	Iron (Fe)	mg/L	0.30	0.300	0.040	0.030	<0.030	0.054	0.031	0.060	<0.030	0.174	<0.030	0.180
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	0.000067	<0.000050	0.000080	<0.000050	0.000238	<0.000050	0.000218
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	5.47	5.27	5.18	5.40	5.23	5.18	5.25	5.33	5.22	5.22
	Manganese (Mn)	mg/L	0.935[β]	-	0.00363	0.00346	0.00321	0.00414	0.00382	0.00509	0.00328	0.006595	0.00335	0.00644
	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	-	0.000334	0.000356	0.000372	0.000340	0.000356	0.000347	0.000363	0.000222	0.000359	0.000238
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00052	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.74	0.72	0.72	0.73	0.73	0.72	0.71	0.77	0.72	0.77
	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	-	-	0.45	0.40	0.41	0.50	0.40	0.46	0.38	0.68	0.40	0.70
	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	-	-	0.922	0.909	0.888	0.921	0.893	0.892	0.871	0.95	0.891	0.943
	Strontium (Sr)	mg/L	-	-	0.00577	0.00597	0.00574	0.00609	0.00562	0.00609	0.00557	0.0065	0.00576	0.00649
	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	-	0.000514	0.000514	0.000478	0.000531	0.000459	0.000526	0.000477	0.000681	0.000473	0.000656
	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

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

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

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.46: Water chemistry at Sheardown Lake SE (DLO-02) water quality monitoring stations, Mary River Project CREMP, 2016.

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	DL0-02-06-S surface 21-Aug-16	DL0-02-06-B bottom 21-Aug-16	DL0-02-07-S surface 21-Aug-16	DL0-02-07 bottom 21-Aug-16	DL0-02-04-S surface 21-Aug-16	DL0-02-04-B bottom 21-Aug-16	DL0-02-08-S surface 21-Aug-16	DL0-02-08-B bottom 21-Aug-16	DL0-02-03-S surface 21-Aug-16	DL0-02-03-B bottom 21-Aug-16
					Fall Sampling Event									
Conventionals	Conductivity (lab)	umho/cm	-	-	117	119	116	116	117	115	115	115	115	111
	pH (lab)	pH	6.5 - 9.0	-	8.11	8.09	8.08	8.12	8.03	7.99	8.07	8.02	8.09	7.73
	Hardness (as $CaCO_3$)	mg/L	-	-	55	56	55	54.5	54	54	54	54	54	53
	Total Suspended Solids (TSS)	mg/L	-	-	3.4	<2.0	<2.0	2.3	2.4	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	58	55	62	57	63	60	61	62	63	62
	Turbidity	NTU	-	-	2.03	2.07	2.27	2.16	2.33	2.56	2.47	2.33	2.28	2.95
	Alkalinity (as $CaCO_3$)	mg/L	-	-	52	52	51	54	50	54	56	50	50	53
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	0.029	<0.020	<0.020	0.044	<0.020	<0.020	0.051
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.024
	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	0.16	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.4	1.5	1.5	1.5	1.5	1.9	1.8	1.3	1.3	1.3
	Total Organic Carbon	mg/L	-	-	2.0	1.8	1.6	2.0	1.6	1.5	1.6	1.7	1.6	1.5
	Total Phosphorus	mg/L	0.020[α]	-	0.0062	0.0065	0.0058	0.0171	0.0060	0.0060	0.0179	0.0059	0.0062	0.0214
	Phenols	mg/L	0.001[α]	-	0.0019	0.0024	0.0026	0.0025	0.0018	0.0021	0.0574	0.0023	<0.0010	0.0291
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	2.23	2.35	2.32	2.21	2.22	2.24	2.24	2.20	2.26	2.23
	Sulphate (SO_4)	mg/L	218[β]	218	2.67	2.75	2.67	2.64	2.59	2.59	2.63	2.61	2.58	2.56
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.052	0.052	0.049	0.053	0.078	0.061	0.046	0.057	0.047	0.071
	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	-	-	0.00609	0.00627	0.00649	0.00626	0.00671	0.00647	0.00625	0.00634	0.00624	0.00619
	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
	Bismuth (Bi)	mg/L	-	-	<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	<0.010	<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	-	-	10.8	11.3	11.2	11.1	11.1	10.8	11.1	11.1	10.9	10.4
	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	<0.0010	0.0010	<0.0010	0.0013	0.0010	0.0011	0.0011	0.0011	0.0010	<0.0010
	Iron (Fe)	mg/L	0.30	0.300	0.055	0.060	0.052	0.053	0.085	0.068	<0.050	0.063	0.051	0.081
	Lead (Pb)	mg/L	0.001	0.001	<0.00010	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	6.30	6.59	6.43	6.35	6.41	6.20	6.35	6.32	6.29	5.92
	Manganese (Mn)	mg/L	0.935[β]	-	0.00339	0.00406	0.00360	0.00370	0.00473	0.00429	0.00363	0.00408	0.00350	0.00772
	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	-	0.000479	0.000515	0.000507	0.000506	0.000500	0.000485	0.000501	0.000490	0.000490	0.000428
	Nickel (Ni)	mg/L	0.025	0.025	0.00065	0.00068	0.00066	0.00074	0.00068	0.00073	0.00070	0.00070	0.00075	0.00063
	Potassium (K)	mg/L	-	-	0.919	0.944	0.918	0.92	0.952	0.903	0.917	0.914	0.906	0.891
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	0.596	0.777	0.616	0.61	0.697	0.636	0.592	0.641	0.608	0.761
	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
	Sodium (Na)	mg/L	-	-	1.12	1.16	1.14	1.13	1.14	1.10	1.12	1.13	1.12	1.10
	Strontium (Sr)	mg/L	-	-	0.0081	0.0085	0.0084	0.0085	0.0085	0.0083	0.0084	0.0085	0.0081	0.0082
	Thallium (Tl)	mg/L	0.0008	0.0008	<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
	Titanium (Ti)	mg/L	-	-	0.00195	0.00273	0.00195	0.00213	0.00395	0.00258	0.00202	0.00237	0.00224	0.00326
	Uranium (U)	mg/L	0.015	-	0.000784	0.000812	0.000819	0.000803	0.000806	0.000789	0.000795	0.000800	0.000796	0.000700
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	0.0037	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.47: Dissolved metals concentrations at Sheardown Lake SE water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Winter Sampling Event									Summer Sampling Event					
			DL0-02-6-S surface 30-Apr-16	DL0-02-6-B bottom 30-Apr-16	DL0-02-7 surface 29-Apr-16	DL0-02-4-S surface 29-Apr-16	DL0-02-4-B bottom 29-Apr-16	DL0-02-8-S surface 29-Apr-16	DL0-02-8-B bottom 29-Apr-16	DL0-02-3-S surface 29-Apr-16	DL0-02-3-B bottom 29-Apr-16	DL0-02-6-S surface 26-Jul-16	DL0-02-6-B bottom 26-Jul-16	DL0-02-7-S surface 26-Jul-16	DL0-02-7-B bottom 26-Jul-16	DL0-02-4-S surface 26-Jul-16	DL0-02-4-B bottom 26-Jul-16
Dissolved Metals	Aluminum (Al)	mg/L	0.00109	0.00142	0.00111	0.00121	0.00106	0.00097	0.00127	0.00118	0.00108	0.0058	0.0046	0.0051	0.0061	0.0042	0.0059
	Antimony (Sb)	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.000073	0.000068	0.000059	0.000096	0.000070	0.000057	0.000061	0.000073	0.000064	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00813	0.00791	0.00733	0.00711	0.00698	0.00723	0.00711	0.00724	0.00697	0.00431	0.00463	0.00418	0.00455	0.00416	0.00455
	Beryllium (Be)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	0.0059	0.0058	0.0056	0.0055	0.0053	0.0054	0.0054	0.0055	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	16.2	16.0	15.3	14.9	14.5	14.9	14.7	14.7	14.5	8.25	8.33	8.23	8.32	8.02	8.08
	Chromium (Cr)	mg/L	<0.00010	<0.00010	0.00041	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0000122	0.0000110	0.0000099	0.0000139	0.0000095	0.0000120	0.0000086	0.0000091	0.0000091	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00086	0.00090	0.00084	0.00090	0.00081	0.00084	0.00080	0.00080	0.00078	0.00063	0.00059	0.00057	0.00056	0.00059	0.00064
	Iron (Fe)	mg/L	0.0061	0.0068	0.0061	0.0030	0.0024	0.0025	0.0025	0.0023	0.0034	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.0000090	<0.0000090	<0.0000090	<0.0000090	<0.0000090	<0.0000090	<0.0000090	<0.0000090	<0.0000090	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.00105	0.00091	0.00106	0.00078	0.00095	0.00086	0.00100	0.00099	0.00093	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	9.96	10.1	9.45	9.00	8.98	9.21	9.12	9.41	9.08	5.07	5.13	5.1	5.16	5.11	4.99
	Manganese (Mn)	mg/L	0.00115	0.000712	0.000480	0.000390	0.000201	0.000390	0.000296	0.000333	0.00234	0.000347	0.000217	0.000298	0.000254	0.000206	0.000503
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000649	0.000608	0.000623	0.000616	0.000594	0.000600	0.000615	0.000617	0.000459	0.000447	0.000347	0.000348	0.000347	0.000365	0.000334
	Nickel (Ni)	mg/L	0.000749	0.000749	0.000657	0.000660	0.000598	0.000648	0.000633	0.000652	0.000551	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	1.28	1.29	1.20	1.14	1.13	1.17	1.16	1.18	1.10	0.72	0.73	0.72	0.74	0.73	0.72
	Selenium (Se)	mg/L	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.746	0.725	0.579	0.560	0.548	0.566	0.552	0.565	0.986	0.36	0.36	0.37	0.39	0.35	0.39
	Silver (Ag)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.58	1.61	1.48	1.43	1.42	1.47	1.45	1.49	1.49	0.917	0.929	0.91	0.941	0.904	0.915
	Strontium (Sr)	mg/L	0.0107	0.0107	0.0100	0.00985	0.00966	0.00964	0.00964	0.00973	0.00950	0.0058	0.00594	0.0058	0.00613	0.00583	0.00604
	Thallium (Tl)	mg/L	0.0000023	0.0000027	<0.0000020	0.0000028	0.0000028	0.0000026	0.0000024	<0.0000020	<0.0000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000952	0.000919	0.000899	0.000900	0.000856	0.000911	0.000887	0.000891	0.000710	0.000516	0.000502	0.000467	0.000504	0.000453	0.000468
	Vanadium (V)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.00050	0.00088	0.00069	0.00107	0.00132	0.00084	0.00099	0.00117	0.00096	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.003

Table C.47: Dissolved metals concentrations at Sheardown Lake SE water quality monitoring stations, Mary River Project CREMP, 2016.

	Parameters	Units	Summer Sampling Event				Fall Sampling Event									
			DL0-02-8-S surface	DL0-02-8-B bottom	DL0-02-3-S surface	DL0-02-3-B bottom	DL0-02-06-S surface	DL0-02-06-B bottom	DL0-02-07-S surface	DL0-02-07 bottom	DL0-02-04-S surface	DL0-02-04-B bottom	DL0-02-08-S surface	DL0-02-08-B bottom	DL0-02-03-S surface	DL0-02-03-B bottom
			26/Jul/2016	26/Jul/2016	26/Jul/2016	26/Jul/2016	21/Aug/2016	21/Aug/2016	21/Aug/2016	21/Aug/2016	21/Aug/2016	21/Aug/2016	21/Aug/2016	21/Aug/2016	21/Aug/2016	21/Aug/2016
Dissolved Metals	Aluminum (Al)	mg/L	0.0052	0.009	0.0046	0.0064	0.0093	0.0170	0.0081	0.0090	0.0091	0.0077	0.0072	0.0082	0.0081	0.0079
	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	0.00426	0.004825	0.0042	0.00467	0.00597	0.00643	0.00601	0.00596	0.00600	0.00601	0.00595	0.00607	0.00593	0.00596
	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	8.22	8.425	8.23	8.24	11.0	11.7	11.2	11.1	11.1	10.9	11.0	10.9	10.8	10.8
	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.0006	0.00057	0.00058	0.00058	0.00076	0.00105	0.00094	0.00080	0.00069	0.00081	0.00084	0.00081	0.00076	0.00079
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000072	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	5.01	5.07	5.15	5.02	6.76	6.42	6.49	6.56	6.33	6.42	6.51	6.45	6.62	6.44
	Manganese (Mn)	mg/L	0.000286	0.000375	0.000196	0.000411	0.000561	0.00115	0.000440	0.00039	0.000283	0.000272	0.000414	0.000188	0.000376	0.000392
	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	0.000354	0.000311	0.00037	0.000326	0.000489	0.000507	0.000511	0.000471	0.000492	0.000480	0.000473	0.000489	0.000465	0.000447
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00071	<0.00050	<0.00050	0.00051	0.00051	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.73	0.72	0.74	0.7	0.90	0.92	0.91	0.91	0.90	0.89	0.89	0.89	0.90	0.89
	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	0.36	0.455	0.36	0.44	0.56	0.54	0.56	0.55	0.55	0.55	0.56	0.55	0.55	0.63
	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	0.9	0.9555	0.915	0.938	1.23	1.24	1.19	1.18	1.20	1.19	1.16	1.14	1.20	1.22
	Strontium (Sr)	mg/L	0.00574	0.00631	0.00574	0.00621	0.00807	0.00864	0.00835	0.00817	0.00833	0.00824	0.00812	0.00814	0.00807	0.00812
	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	0.000493	0.0005795	0.000487	0.00056	0.000836	0.000810	0.000821	0.000820	0.000801	0.000810	0.000819	0.000814	0.000821	0.000765
	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	0.003	<0.0030	<0.0030	<0.0030	0.0057	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.48: *In-situ* water quality measurements collected at Mary River benthic invertebrate community stations, Mary River Project CREMP, August 2016.

Study Area	Station	Temperature (^oC)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Mary River Upstream (GO-09)	GO-09 B1	9.9	10.98	97.0	7.98	134
	GO-09 B2	9.2	11.25	97.8	7.97	133
	GO-09 B3	8.6	11.36	97.3	7.99	132
	GO-09 B4	8.0	11.55	97.6	7.94	132
	GO-09 B5	7.0	11.81	97.4	7.90	132
Mary River Upstream (GO-03)	GO-03 B1	12.7	10.22	96.5	8.00	122
	GO-03 B2	12.6	10.36	97.4	7.99	122
	GO-03 B3	12.3	10.44	97.7	7.99	122
	GO-03 B4	12.1	10.52	97.8	7.97	122
	GO-03 B5	11.8	10.55	97.5	7.97	121
Mary River Downstream (EO-01)	EO-01 B1	10.6	11.13	99.8	7.98	135
	EO-01 B2	9.9	11.27	99.6	7.96	136
	EO-01 B3	9.6	11.33	99.4	7.93	136
	EO-01 B4	9.3	11.49	100.3	7.95	137
	EO-01 B5	9.0	11.50	99.5	7.94	137
Mary River Downstream (EO-20)	EO-20 B1	8.6	11.70	100.2	7.94	138
	EO-20 B2	8.4	11.63	99.1	7.94	138
	EO-20 B3	8.0	11.87	100.3	7.93	138
	EO-20 B4	7.7	11.84	99.3	7.94	138
	EO-20 B5	7.7	11.79	98.9	7.85	139
Mary River Downstream (CO-05)	CO-05 B1	8.7	11.33	97.3	7.79	138
	CO-05 B2	8.9	11.41	98.4	7.81	138
	CO-05 B3	8.9	11.45	98.6	7.83	138
	CO-05 B4	9.0	11.50	99.4	7.83	138
	CO-05 B5	9.2	11.54	100.4	7.86	138

Table C.49: ***In-situ*** **water quality summary for Mary River benthic invertebrate community study areas, Mary River Project CREMP, August 2016.**

Metric	Station	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Temperature (˚C)	GO-09	5	8.54	1.11	0.50	7.16	9.92	7.00	9.90
	GO-03	5	12.30	0.37	0.16	11.84	12.76	11.80	12.70
	EO-01	5	9.68	0.61	0.27	8.92	10.44	9.00	10.60
	EO-20	5	8.08	0.41	0.18	7.57	8.59	7.70	8.60
	CO-05	5	8.94	0.18	0.08	8.71	9.17	8.70	9.20
Dissolved Oxygen (mg/L)	GO-09	5	11.4	0.3	0.1	11.0	11.8	11.0	11.8
	GO-03	5	10.4	0.1	0.1	10.3	10.6	10.2	10.6
	EO-01	5	11.3	0.2	0.1	11.2	11.5	11.1	11.5
	EO-20	5	11.8	0.1	0.0	11.6	11.9	11.6	11.9
	CO-05	5	11.4	0.1	0.0	11.3	11.5	11.3	11.5
Dissolved Oxygen (% saturation)	GO-09	5	97.4	0.3	0.1	97.0	97.8	97.0	97.8
	GO-03	5	97.4	0.5	0.2	96.7	98.0	96.5	97.8
	EO-01	5	99.7	0.4	0.2	99.3	100.2	99.4	100.3
	EO-20	5	99.6	0.6	0.3	98.8	100.4	98.9	100.3
	CO-05	5	98.8	1.2	0.5	97.4	100.3	97.3	100.4
pH (pH units)	GO-09	5	7.96	0.04	0.02	7.91	8.00	7.90	7.99
	GO-03	5	7.98	0.01	0.01	7.97	8.00	7.97	8.00
	EO-01	5	7.95	0.02	0.01	7.93	7.98	7.93	7.98
	EO-20	5	7.92	0.04	0.02	7.87	7.97	7.85	7.94
	CO-05	5	7.82	0.03	0.01	7.79	7.86	7.79	7.86
Specific Conductance (uS/cm)	GO-09	5	132.7	1.0	0.5	131.4	134.0	131.7	134.2
	GO-03	5	122.0	0.5	0.2	121.3	122.6	121.3	122.4
	EO-01	5	136.0	0.5	0.2	135.4	136.6	135.4	136.5
	EO-20	5	138.1	0.3	0.1	137.7	138.4	137.8	138.5
	CO-05	5	137.8	0.2	0.1	137.5	138.0	137.5	138.1

Table C.50: Statistical comparison of *in-situ* water quality variables among Mary River benthic invertebrate community study areas, Mary River Project CREMP, August 2016.

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 2 Areas?	p-value	Statistical Test
Temperature (˚C)	YES	0.00000	α , δ	GO-09	GO-3	YES	0.0092	Tamhane's
				GO-09	EO-01	NO	0.6103	
				GO-09	EO-20	NO	0.9960	
				GO-09	CO-05	NO	0.9982	
				GO-03	EO-01	YES	0.0011	
				GO-03	EO-20	YES	0.0000	
				GO-03	CO-05	YES	0.0000	
				EO-01	EO-20	YES	0.0187	
				EO-01	CO-05	NO	0.4152	
				EO-20	CO-05	YES	0.0599	
Dissolved Oxygen (% Saturation)	YES	0.00001	α , δ	GO-09	GO-3	NO	1.0000	Tukey's HSD
				GO-09	EO-01	YES	0.0002	
				GO-09	EO-20	YES	0.0005	
				GO-09	CO-05	YES	0.0261	
				GO-03	EO-01	YES	0.0002	
				GO-03	EO-20	YES	0.0004	
				GO-03	CO-05	YES	0.0213	
				EO-01	EO-20	NO	0.9953	
				EO-01	CO-05	NO	0.2492	
				EO-20	CO-05	NO	0.4304	
pH (pH units)	YES	0.00000	α , δ	GO-09	GO-3	NO	0.5485	Tukey's HSD
				GO-09	EO-01	NO	0.9994	
				GO-09	EO-20	NO	0.3092	
				GO-09	CO-05	YES	0.0000	
				GO-03	EO-01	NO	0.4209	
				GO-03	EO-20	YES	0.0161	
				GO-03	CO-05	YES	0.0000	
				EO-01	EO-20	NO	0.4209	
				EO-01	CO-05	YES	0.0000	
				EO-20	CO-05	YES	0.0003	
Specific Conductance (umho/cm)	YES	0.00000	α , δ	GO-09	GO-3	YES	0.0000	Tamhane's
				GO-09	EO-01	YES	0.0086	
				GO-09	EO-20	YES	0.0018	
				GO-09	CO-05	YES	0.0029	
				GO-03	EO-01	YES	0.0000	
				GO-03	EO-20	YES	0.0000	
				GO-03	CO-05	YES	0.0000	
				EO-01	EO-20	YES	0.0016	
				EO-01	CO-05	YES	0.0057	
				EO-20	CO-05	NO	0.5632	

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

[b] Data analysis included: α - data untransformed; β - data logit transformed; η - log_{10} transformed; δ - single factor ANOVA test conducted; γ - ANOVA test validated using Kruskal Wallis H-test or Mann Whitney U-test, as appropriate

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

Table C.51: Water chemistry at Mary River water quality monitoring stations, Mary River Project CREMP, 2016.

	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	E0-03	E0-20	E0-21	C0-10	C0-05	C0-01
					26-Jun-2016	26-Jun-2016	26-Jun-2016	25-Jun-2016	26-Jun-2016	26-Jun-2016	25-Jun-2016	25-Jun-2016	25-Jun-2016	25-Jun-2016	25-Jun-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	18.2	19	23	19.7	19.8	20.8	19.5	18.4	19.95	28.9	26.9
	pH (lab)	pH	6.5 - 9.0	-	7.08	7.09	7.17	7.22	7.15	7.18	7.2	7.08	7.21	7.31	7.33
	Hardness (as $CaCO_3$)	mg/L	-	-	<10	<10	10	<10	<10	<10	<10	<10	<10	13	12
	Total Suspended Solids (TSS)	mg/L	-	-	15.6	8.8	6.4	5.2	4	4.8	4.4	8.8	2.8	2.8	6.9
	Total Dissolved Solids (TDS)	mg/L	-	-	<10	13	13	<10	<10	10	<10	<10	<10	<10	<10
	Turbidity	NTU	-	-	12	8.82	5.54	5.57	4.33	4.07	4.67	5.27	3.945	4.34	4.85
	Alkalinity (as $CaCO_3$)	mg/L	-	-	<10	11	13	<10	<10	13	10	<10	11.5	18	14
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.031	0.024	<0.020	<0.020	<0.020	<0.020	0.021	<0.020	0.0405	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<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	-	-	<1.0	1	1.1	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Organic Carbon	mg/L	-	-	<1.0	1	1.2	1.2	1.1	1.3	1.1	1.1	1.05	1.2	1.5
	Total Phosphorus	mg/L	0.020[α]	-	0.0192	0.0146	0.0097	0.009	0.0078	0.0114	0.0065	0.0119	0.0073	0.0077	0.0088
	Phenols	mg/L	0.004[α]	-	0.0024	0.0033	0.0029	0.0025	0.0031	0.0026	0.0015	0.0014	0.0014	0.002	0.0018
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	0.76	0.66	0.7	0.58	0.59	0.58	0.59	0.59	0.67	0.77	0.71
	Sulphate (SO_4)	mg/L	218[β]	218	0.32	<0.30	0.31	<0.30	<0.30	<0.30	0.37	0.35	0.44	0.54	0.44
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.250	0.185	0.158	0.113	0.080	0.079	0.088	0.095	0.087	0.070	0.090
	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	-	-	0.00372	0.00284	0.00291	0.00248	0.00209	0.00201	0.00208	0.00216	0.001975	0.00233	0.00247
	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
	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	-	-	1.9	1.8	2.14	1.92	1.8	1.93	1.77	1.36	1.85	2.67	2.47
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00057	<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	0.00018	<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	0.00076	0.00059	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	0.30	0.874	0.322	0.142	0.117	0.124	0.073	0.069	0.085	0.091	0.0835	0.062	0.087
	Lead (Pb)	mg/L	0.001	0.001	0.000359	0.000207	0.000145	0.000135	0.000096	0.000102	0.000119	0.000109	0.0001045	0.000094	0.000131
	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
	Magnesium (Mg)	mg/L	-	-	1.15	1.03	1.24	1.12	1.01	1.13	0.998	0.952	1.09	1.59	1.49
	Manganese (Mn)	mg/L	0.935[β]	-	0.00763	0.00399	0.00301	0.00334	0.002	0.00228	0.00266	0.00297	0.00242	0.00275	0.00328
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000071	0.000061
	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	-	-	0.32	0.29	0.32	0.25	0.24	0.25	0.23	0.22	0.225	0.29	0.28
	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	-	-	0.68	0.54	0.6	0.43	0.37	0.34	0.34	0.34	0.35	0.31	0.36
	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	-	-	0.425	0.377	0.463	0.353	0.349	0.341	0.333	0.315	0.359	0.418	0.401
	Strontium (Sr)	mg/L	-	-	0.00219	0.00204	0.00243	0.00176	0.0018	0.00185	0.00172	0.00131	0.00172	0.00222	0.00215
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.018	<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	-	0.000197	0.000146	0.000149	0.000115	0.00011	0.000103	0.000099	0.000087	0.0000965	0.000152	0.000139
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] 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.

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.51: Water chemistry at Mary River water quality monitoring stations, Mary River Project CREMP, 2016.

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	E0-20	E0-21	C0-10	C0-05	C0-01
					18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	54.2	62.3	58.7	59.1	60.7	149	76.3	61.6	63.9	61.45	66.5	62.5	68.3
	pH (lab)	pH	6.5 - 9.0	-	7.75	7.82	7.79	7.81	7.84	8.13	7.88	7.79	7.76	7.775	7.62	7.82	7.89
	Hardness (as $CaCO_3$)	mg/L	-	-	23	27	26	26	27	71	34	27	28	27	27	28	30
	Total Suspended Solids (TSS)	mg/L	-	-	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	30	33	30	31	32	83	40	26	33	30	35	38	38
	Turbidity	NTU	-	-	12.1	9.24	9.47	7.35	6.93	3.96	6.51	7.43	7.3	7.465	7.95	8.42	5.26
	Alkalinity (as $CaCO_3$)	mg/L	-	-	29	38	36	36	31	75	42	34	32	37	35	34	35
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	0.077	<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	0.35000	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	<1.0	<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 Organic Carbon	mg/L	-	-	<1.0	<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 Phosphorus	mg/L	0.020[α]	-	0.0086	0.0063	0.0067	0.0048	0.007	0.0046	0.012	0.0079	0.0055	0.0062	0.0059	0.0066	0.0043
	Phenols	mg/L	0.004[α]	-	0.0013	0.0016	0.0017	0.0018	0.0017	0.0014	0.0015	0.0019	<0.0010	0.00145	0.0011	0.0015	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.23	1.25	1.19	1.08	1.07	1.39	1.13	1.05	1.04	1.03	1.04	1.08	1.10
	Sulphate (SO_4)	mg/L	218[β]	218	0.8	0.8	0.8	0.7	0.8	5.1	1.5	0.9	0.9	0.9	0.9	1.0	1.0
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.3030	0.230	0.178	0.171	0.245	0.1010	0.213	0.234	0.249	0.252	0.239	0.228	0.224
	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	-	-	0.0056	0.0054	0.0051	0.0051	0.0054	0.0076	0.0058	0.0056	0.0058	0.0057	0.0055	0.0055	0.0058
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	5	6	5	6	6	15	7	6	6	6	6	6	6
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0008	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007
	Iron (Fe)	mg/L	0.30	0.874	0.208	0.158	0.127	0.115	0.147	0.069	0.128	0.145	0.152	0.160	0.152	0.148	0.127
	Lead (Pb)	mg/L	0.001	0.001	0.00025	0.00019	0.00017	0.00013	0.00016	0.00010	0.00015	0.00017	0.00017	0.00018	0.00018	0.00018	0.00013
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	2.72	3.18	3	3.07	3.16	8.3	4.1	3.13	3.39	3.225	3.29	3.28	3.63
	Manganese (Mn)	mg/L	0.935[β]	-	0.00244	0.00181	0.00170	0.00131	0.00158	0.00102	0.00140	0.00159	0.00170	0.00175	0.00177	0.00213	0.00179
	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	-	0.00015	0.00014	0.00012	0.00014	0.00015	0.00019	0.00015	0.00017	0.00018	0.00018	0.00017	0.00017	0.00019
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.68	0.68	0.64	0.63	0.66	0.83	0.69	0.64	0.69	0.67	0.67	0.67	0.72
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	1.07	0.99	0.79	0.80	0.99	0.79	0.93	0.99	0.95	1.01	0.98	0.89	0.95
	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	-	-	0.948	1.010	0.973	0.928	0.929	0.828	0.902	0.861	0.914	0.879	0.906	0.877	0.976
	Strontium (Sr)	mg/L	-	-	0.006	0.006	0.006	0.006	0.006	0.009	0.007	0.006	0.006	0.006	0.006	0.006	0.006
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	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	-	-	0.0120	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.0100	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0006	0.0006	0.0006	0.0005	0.0005	0.0013	0.0006	0.0005	0.0004	0.0004	0.0004	0.0004	0.0005
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.51: Water chemistry at Mary River water quality monitoring stations, Mary River Project CREMP, 2016.

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall 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	CO-01
					20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	191	189	188	168.5	174	261	186	174	172	173	170	171	170
	pH (lab)	pH	6.5 - 9.0	-	8.23	8.24	8.21	8.135	8.14	8.28	8.14	8.12	8.17	8.16	8.13	8.15	8.15
	Hardness (as $CaCO_3$)	mg/L	-	-	80	84	82	75.5	79	131	84	80	80	79	79	79	79
	Total Suspended Solids (TSS)	mg/L	-	-	5.4	2.9	2.9	2.95	2.5	3	2.9	<2.0	3.4	3.5	5.6	6.9	2.5
	Total Dissolved Solids (TDS)	mg/L	-	-	107	98	98	94.5	69	141	102	90	86	90	94	99	89
	Turbidity	NTU	-	-	16.3	9.7	11	12.25	16.1	11	16.5	12.9	16	14.6	32.7	41.5	15.5
	Alkalinity (as $CaCO_3$)	mg/L	-	-	73	79	79	73.5	75	118	82	70	68	72	76	76	72
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.032	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.026	0.039	0.065	0.022	0.022
	Nitrate	mg/L	13	13	0.023	<0.020	<0.020	<0.020	<0.020	0.096	<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	0.16	0.25	0.15	<0.15	0.21	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.2	1.3	1.1	1.25	1.3	1.2	1.2	1.2	1.8	1.2	1.6	1.9	1.5
	Total Organic Carbon	mg/L	-	-	1.5	1.4	1.4	1.5	1.5	1.4	2.3	1.3	1.5	1.4	1.6	1.8	1.6
	Total Phosphorus	mg/L	0.020[α]	-	0.0125	0.009	0.0107	0.00885	0.0098	0.0112	0.0117	0.0097	0.0157	0.0097	0.0358	0.0206	0.0102
	Phenols	mg/L	0.004[α]	-	0.0056	0.0063	0.0086	0.0048	0.0037	0.0057	0.0058	0.0039	0.016	0.0042	0.0552	0.0039	0.004
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	11.5	9	9.29	6.995	6.92	5.57	6.74	6.56	6.08	6.55	6.09	6.08	6.1
	Sulphate (SO_4)	mg/L	218[β]	218	5.58	4.52	4.64	3.77	4.59	14.3	5.01	4.38	4.19	4.36	5.03	5.15	4.03
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.395	0.217	0.258	0.291	0.484	0.251	0.418	0.301	0.431	0.382	***1.04***	***1.39***	0.32
	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	<0.00010	0.00011	0.00013	0.00015	0.00014	0.00012	0.00014	0.00012	0.0002	0.00026	0.00013
	Barium (Ba)	mg/L	-	-	0.0147	0.013	0.0131	0.0126	0.0142	0.0148	0.0143	0.0133	0.0143	0.0133	0.0174	0.0196	0.0129
	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
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	0.000011	<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	-	-	17	17.8	18	15.7	16.9	27	17.5	17.1	16.9	16.7	16.5	16.5	15.8
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00096	0.0006	0.00065	0.00073	0.0011	0.00108	0.00112	0.00076	0.00108	0.00096	0.00237	0.00319	0.00086
	Cobalt (Co)	mg/L	0.0009[α]	0.004	0.0002	0.00012	0.00014	0.00015	0.00023	0.00024	0.00022	0.00016	0.00022	0.00018	0.00048	0.00065	0.00018
	Copper (Cu)	mg/L	0.002	0.0024	0.0017	0.0017	0.0015	0.0015	0.0016	0.0019	0.0016	0.0016	0.0016	0.0015	0.0024	***0.0027***	0.0017
	Iron (Fe)	mg/L	0.30	0.874	0.41	0.227	0.278	0.298	0.471	0.325	0.437	0.308	0.442	0.383	***1.07***	***1.42***	0.356
	Lead (Pb)	mg/L	0.001	0.001	0.00036	0.00025	0.00024	0.00029	0.00041	0.00042	0.0004	0.00031	0.00039	0.00034	0.00083	***0.00108***	0.00033
	Lithium (Li)	mg/L	-	-	0.001	<0.0010	<0.0010	<0.0010	0.0011	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	0.0017	0.0024	<0.0010
	Magnesium (Mg)	mg/L	-	-	9.32	9.46	9.21	8.855	9.18	15.9	10.2	9.58	9.4	9.18	9.66	9.72	9.17
	Manganese (Mn)	mg/L	0.935[β]	-	0.0056	0.0030	0.0036	0.0036	0.0055	0.0050	0.0053	0.0040	0.0054	0.0047	0.0121	0.0167	0.0053
	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	-	0.00063	0.00051	0.00053	0.00043	0.00046	0.00034	0.00043	0.00052	0.00053	0.00053	0.00053	0.00057	0.00046
	Nickel (Ni)	mg/L	0.025	0.025	0.00079	0.00067	0.00059	0.00073	0.00102	0.00148	0.00111	0.00092	0.00117	0.00103	0.00241	0.00259	0.00114
	Potassium (K)	mg/L	-	-	1.68	1.45	1.45	1.34	1.42	1.46	1.44	1.43	1.4	1.41	1.7	1.88	1.38
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000052	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	1.55	1.27	1.34	1.33	1.73	1.25	1.56	1.35	1.66	1.5	2.74	3.62	1.41
	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	-	-	5.67	4.57	4.56	3.71	3.69	2.2	3.54	3.59	3.35	3.46	3.42	3.4	3.33
	Strontium (Sr)	mg/L	-	-	0.0234	0.0211	0.0216	0.0179	0.0184	0.0197	0.0188	0.0184	0.0179	0.0182	0.0187	0.0188	0.0165
	Thallium (Tl)	mg/L	0.0008	0.0008	0.000014	0.000011	0.000012	0.0000105	0.000014	0.000013	0.000015	0.000011	0.000015	0.000014	0.000027	0.000036	0.000013
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.0233	0.0124	0.0156	0.01615	0.0271	0.0156	0.0245	0.0164	0.0248	0.0212	0.0611	0.0822	0.0185
	Uranium (U)	mg/L	0.015	-	0.00657	0.00577	0.0058	0.004605	0.00468	0.00353	0.0043	0.00453	0.00406	0.00441	0.00406	0.00407	0.00364
	Vanadium (V)	mg/L	0.006[α]	0.006	0.00099	0.00063	0.00074	0.000735	0.00104	0.00078	0.00101	0.00075	0.00098	0.00092	0.00208	0.00274	0.00082
	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	0.0031	0.005	<0.0030

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

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

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.52: Dissolved metal concentrations at Mary River water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Spring Sampling Event													Summer Sampling Event						
			G0-09A	G0-09	G0-09B	G0-03	G0-01	F0-01	E0-10	E0-03	E0-20	E0-21	C0-10	C0-05	C0-01	GO-09-A	GO-09	GO-09-B	GO-03	GO-01	FO-01	EO-10
			26-Jun-2016	26-Jun-2016	26-Jun-2016	25-Jun-2016	26-Jun-2016	26-Jun-2016	26-Jun-2016	26-Jun-2016	25-Jun-2016	25-Jun-2016	25-Jun-2016	25-Jun-2016	25-Jun-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016
Dissolved Metals	Aluminum (Al)	mg/L	0.0215	0.0214	0.0159	0.0118	0.0126	0.0082	0.0096	0.0099	0.0092	0.0111	0.011	0.0106	0.0122	0.0380	0.0271	0.0308	0.0223	0.0246	0.0045	0.0193
	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	0.00139	0.00142	0.00182	0.00149	0.00149	0.00166	0.00153	0.00146	0.00141	0.00132	0.00144	0.00177	0.00174	0.00358	0.00390	0.00383	0.00391	0.00402	0.00683	0.00446
	Beryllium (Be)	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	1.44	1.64	2.09	1.74	1.77	3.55	2.30	1.87	1.76	1.59	1.7	2.63	2.34	4.89	5.80	5.37	5.49	5.65	14.6	7.11
	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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00031	0.00034	0.00031	0.00033	0.00032	0.00021	0.00070	0.00031	0.00028	0.00029	0.00027	0.00035	0.00033	<0.00050	<0.00050	0.00052	<0.00050	<0.00050	0.00051	0.00051
	Iron (Fe)	mg/L	0.013	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	0.011	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	0.896	1.01	1.25	1.04	1.03	2.28	1.35	1.11	1.01	0.975	1.06	1.62	1.45	2.66	3.12	2.96	3.03	3.16	8.46	3.95
	Manganese (Mn)	mg/L	0.00164	0.00134	0.00108	0.00125	0.00085	0.00057	0.00080	0.00082	0.00097	0.00103	0.00096	0.00142	0.00132	0.000219	0.000181	0.000174	0.000140	0.000151	0.000094	0.000128
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000075	0.000065	0.000186	0.000162	0.000156	0.000161	0.000157	0.000183	0.000162
	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	<0.00050
	Potassium (K)	mg/L	0.224	0.237	0.279	0.219	0.219	0.238	0.221	0.224	0.196	0.206	0.21	0.284	0.263	0.57	0.59	0.58	0.57	0.58	0.80	0.60
	Selenium (Se)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.250	0.270	0.308	0.261	0.253	0.213	0.238	0.246	0.217	0.205	0.23	0.242	0.246	0.50	0.52	0.51	0.49	0.50	0.58	0.51
	Silver (Ag)	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.942	0.995	0.979	0.913	0.920	0.839	0.881
	Strontium (Sr)	mg/L	0.0016	0.0017	0.0022	0.0016	0.0017	0.0021	0.0018	0.0017	0.0015	0.0015	0.0016	0.0022	0.0020	0.00587	0.00618	0.00590	0.00561	0.00573	0.00919	0.00634
	Thallium (Tl)	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	<0.00010	<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
	Titanium (Ti)	mg/L	0.00060	0.00062	0.00049	<0.00030	0.00042	<0.00030	<0.00030	<0.00030	<0.00030	0.00034	<0.00030	<0.00030	0.00034	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000085	0.000079	0.000102	0.000070	0.000079	0.000064	0.000077	0.000073	0.000072	0.000066	0.000067	0.000116	0.000102	0.000507	0.000564	0.000525	0.000439	0.000446	0.00125	0.000559
	Vanadium (V)	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	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	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	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.52: Dissolved metal concentrations at Mary River water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units							Fall Sampling Event												
			EO-03	E0-20	E0-21	C0-10	C0-05	C0-01	G0-09-A	G0-09	G0-09-B	G0-03	G0-01	F0-01	E0-10	E0-03	E0-20	E0-21	C010	C0-05	C0-01
			18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	18-Jul-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016	19-Aug-2016
Dissolved Metals	Aluminum (Al)	mg/L	0.0242	0.0232	0.0243	0.0222	0.0227	0.0195	0.0116	0.0079	0.0092	0.0080	0.0093	0.0037	0.0085	0.0071	0.0091	0.0097	0.0088	0.0096	0.0085
	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	0.00407	0.00421	0.00416	0.00417	0.00428	0.00450	0.0119	0.0113	0.0112	0.0105	0.0112	0.0132	0.0112	0.0107	0.0107	0.0108	0.0108	0.0110	0.0110
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	5.69	5.87	5.7	5.74	5.78	6.35	16.9	17.6	17.6	15.8	16.4	26.6	17.6	16.8	16.5	16.6	16.4	16.3	16.4
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00050	0.00052	0.00103	0.00091	0.00096	0.00091	0.00086	0.00079	0.00086	0.00088	0.00093	0.00089	0.00092	0.00095	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	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	3.15	3.32	3.14	3.19	3.21	3.50	9.21	9.79	9.28	8.81	9.34	15.6	9.80	9.20	9.30	9.02	9.28	9.29	9.32
	Manganese (Mn)	mg/L	0.000121	0.000155	0.00014	0.000241	0.000723	0.000430	0.000372	0.000193	0.000226	0.00013	0.000137	0.000417	0.000159	0.000162	0.000360	0.000139	0.000310	0.00109	0.000726
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000180	0.000192	0.000182	0.000184	0.000187	0.000197	0.000620	0.000489	0.000516	0.000416	0.000427	0.000342	0.000419	0.000505	0.000506	0.000534	0.000528	0.000529	0.000502
	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	0.00051	0.00057	0.00057
	Potassium (K)	mg/L	0.57	0.58	0.57	0.57	0.60	0.61	1.51	1.35	1.35	1.21	1.23	1.33	1.25	1.27	1.24	1.23	1.24	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	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.48	0.49	0.49	0.49	0.48	0.50	0.89	0.90	0.91	0.87	0.89	0.81	0.86	0.90	0.91	0.89	0.90	0.94	0.93
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.874	0.893	0.86	0.872	0.874	0.947	5.69	4.82	4.77	3.70	3.75	2.21	3.55	3.61	3.43	3.43	3.36	3.34	3.46
	Strontium (Sr)	mg/L	0.00576	0.00576	0.0057	0.00560	0.00574	0.00622	0.0213	0.0198	0.0211	0.0167	0.0170	0.0186	0.0171	0.0173	0.0166	0.0173	0.0166	0.0162	0.0162
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000375	0.000375	0.000375	0.000349	0.000337	0.000417	0.00631	0.00559	0.00564	0.004280	0.00417	0.00318	0.00407	0.00390	0.00355	0.00394	0.00349	0.00332	0.00341
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.53: *In-situ* water quality profile data collected at Mary Lake water quality monitoring stations in winter[a], Mary River Project CREMP, 2016.

Station BLO-01-A (North Basin)[b,c]					Station BLO-01 (North Basin)[b,c]					Station BLO-01-B (North Basin)[b,c]					Station BLO-05-A (South Basin)[b,c]					Station BLO-05 (South Basin)[b,c]				
Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)
3.15	0.5	96.2	7.8	216.5	2.90	0.4	97.4	7.7	231.3	3.00	0.3	95.3	7.7	225.5	2.50	0.6	100.3	7.7	89.3	2.30	1.0	100.6	7.8	90.1
4.15	0.7	96.1	7.8	215.0	3.90	0.5	97.4	7.7	228.1	4.00	0.4	95.8	7.6	223.9	3.50	0.8	101.5	7.7	88.0	3.30	1.0	101.8	7.8	87.7
5.15	0.8	95.5	7.7	213.3	4.90	0.7	97.3	7.7	227.3	5.00	0.6	93.2	7.6	223.5	4.50	1.2	101.5	7.7	87.2	4.30	1.2	101.7	7.7	86.8
6.15	1.1	90.0	7.7	212.0	5.90	0.8	97.0	7.7	225.4						5.50	1.3	101.4	7.7	87.0	5.30	1.3	101.1	7.7	86.4
7.15	1.2	87.1	7.6	212.7	6.90	0.9	96.9	7.7	225.2						6.50	1.4	100.4	7.7	86.0	6.30	1.4	100.2	7.7	85.0
8.15	1.1	87.0	7.6	212.0	7.90	1.0	96.1	7.7	223.7						7.50	1.5	100.1	7.7	85.6	7.30	1.5	99.2	7.7	84.1
9.15	1.2	83.1	7.6	211.1	8.90	1.1	94.1	7.7	222.8						8.50	1.5	99.5	7.7	85.1	8.30	1.5	98.2	7.7	83.5
10.15	1.4	74.7	7.5	209.8											9.50	1.5	99.2	7.7	84.5	9.30	1.5	97.6	7.7	83.2
11.15	1.5	62.0	7.5	209.4											10.50	1.5	98.7	7.7	84.3	10.30	1.6	97.2	7.7	83.0
12.15	1.6	38.8	7.4	211.4											11.50	1.6	97.5	7.7	84.1	11.30	1.6	96.8	7.7	82.6
13.15	1.7	23.3	7.3	212.6																12.30	1.6	96.4	7.7	82.5
14.15	1.8	11.2	7.2	216.2																13.30	1.6	96.1	7.7	82.2
16.15	1.9	4.8	7.1	221.8																14.30	1.7	95.2	7.7	81.6
																				15.30	1.7	94.8	7.7	81.7
																				16.30	1.7	94.2	7.7	82.6
																				17.30	1.7	92.1	7.6	82.1
																				18.30	1.7	91.6	7.6	81.7
																				19.30	1.7	90.4	7.6	82.2
																				20.30	1.8	89.4	7.6	82.4

[a] Sampling conducted on 25-April, 6-May and 16-May, 2016.

[b] 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 were 15.7, 10.1, 5, 12.4, 21.3, 7.3, 17.8, 21.8, 30, and 7.8 m, respectively, at the time of winter sampling.

[c] 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 were 1.65, 1.90, 1.50, 1.48, 1.33, 1.50, 1.32, 1.40, 1.46, and 1.65 m, respectively, at the time of winter sampling.

Table C.53: *In-situ* water quality profile data collected at Mary Lake water quality monitoring stations in winter[a], Mary River Project CREMP, 2016.

Station BLO-05-B (South Basin)[b,c]					Station BLO-03 (South Basin)[b,c]					Station BLO-04 (South Basin)[b,c]					Station BLO-09 (South Basin)[b,c]					Station BLO-06 (South Basin)[b,c]				
Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)	Depth (m)	Temp. (°C)	DO (% Sat.)	pH	Sp. Cond. (µS/cm)
2.50	1.0	104.0	7.8	95.6	2.65	0.8	98.9	7.7	88.4	2.50	1.1	101.5	7.7	92.5	3.00	1.1	98.7	7.8	88.0	2.60	1.8	100.8	7.9	93.0
3.50	1.2	105.6	7.7	93.4	3.65	1.2	99.7	7.6	86.7	3.50	1.2	100.5	7.7	88.3	4.00	1.1	99.1	7.8	87.2	3.60	1.0	102.1	7.8	90.8
4.50	1.2	106.1	7.7	93.1	4.65	1.3	99.9	7.6	86.4	4.50	1.3	100.1	7.6	86.2	5.00	1.4	99.1	7.7	86.0	4.60	1.2	101.9	7.8	90.0
5.50	1.3	105.9	7.7	92.7	5.65	1.4	99.7	7.6	85.7	5.50	1.4	99.7	7.6	85.4	6.00	1.4	98.8	7.7	85.0	5.60	1.4	101.5	7.7	88.7
6.50	1.3	106.0	7.7	93.9	6.65	1.5	99.2	7.6	85.1	6.50	1.5	99.1	7.6	84.6	7.00	1.5	98.3	7.7	84.4	6.60	1.5	100.8	7.7	88.3
					7.65	1.5	98.7	7.6	84.4	7.50	1.6	98.5	7.6	84.1	8.00	1.5	98.0	7.7	84.3					
					8.65	1.6	97.9	7.6	83.6	8.50	1.6	97.8	7.6	83.3	9.00	1.6	97.3	7.6	83.6					
					9.65	1.6	96.9	7.5	83.2	9.50	1.6	96.8	7.6	82.9	10.00	1.6	97.0	7.6	83.4					
					10.65	1.6	96.8	7.5	82.9	10.50	1.6	96.7	7.6	82.8	11.00	1.6	96.8	7.6	83.3					
					11.65	1.7	96.1	7.5	82.3	11.50	1.6	96.3	7.6	82.5	12.00	1.6	96.4	7.6	82.8					
					12.65	1.7	95.7	7.5	82.3	12.50	1.6	95.8	7.6	82.2	13.00	1.6	96.9	7.6	82.5					
					13.65	1.7	95.5	7.5	81.9	13.50	1.7	94.9	7.6	81.9	14.00	1.6	95.4	7.6	82.2					
										14.50	1.7	94.5	7.6	81.6	15.00	1.7	94.7	7.6	82.0					
										15.50	1.7	93.6	7.5	81.3	16.00	1.7	93.6	7.6	81.4					
										16.50	1.8	93.0	7.5	81.0	17.00	1.8	93.0	7.5	81.2					
										17.50	1.8	92.0	7.5	80.9	18.00	1.8	92.9	7.5	81.1					
										18.50	1.8	91.1	7.5	81.2	19.00	1.8	90.5	7.5	80.9					
										19.50	1.8	90.7	7.5	81.5	20.00	1.8	88.6	7.5	80.7					
										20.50	1.8	90.3	7.5	82.0	21.00	1.9	87.8	7.5	80.6					
															22.00	1.9	85.9	7.5	80.6					
															23.00	2.0	84.3	7.4	81.0					
															24.00	2.0	83.6	7.4	81.3					
															25.00	2.0	81.7	7.4	81.7					
															26.00	2.1	78.2	7.4	81.9					
															27.00	2.2	75.8	7.3	82.5					
															28.00	2.2	68.8	7.3	84.0					
															29.00	2.3	65.0	7.2	84.8					

[a] Sampling conducted on 25-April, 6-May and 16-May, 2016.
[b] 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 were 15.7, 10.1, 5, 12.4, 21.3, 7.3, 17.8, 21.8, 30, and 7.8 m, respectively, at the time of winter sampling.
[c] 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 were 1.65, 1.90, 1.50, 1.48, 1.33, 1.50, 1.32, 1.40, 1.46, and 1.65 m, respectively, at the time of winter sampling.

Table C.54: *In-situ* water quality profile data collected at Mary Lake water quality monitoring stations in summer[a], Mary River Project CREMP, 2016.

Depth (m)	Temperature (°C)										Dissolved Oxygen (% Saturation)									
	BLO-01-A[b]	BLO-01[b]	BLO-01-B[b]	BLO-05-A[b]	BLO-05[b]	BLO-05-B[b]	BLO-03[b]	BLO-04[b]	BLO-09[b]	BLO-06[b]	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06
1.0	9.8	10.1	9.8	10.8	11.1	9.1	10.9	10.5	10.0	8.1	100.1	100.2	100.3	99.5	100.3	98.1	102.4	103.4	102.4	99.4
2.0	9.5	10.1	9.8	10.7	10.5	8.9	10.9	10.5	9.8	8.1	100.1	100.3	100.3	101.1	100.7	99.0	104.0	103.5	102.8	99.5
3.0	9.4	10.0	9.5	10.7	10.3	8.8	10.9	10.4	9.6	8.0	99.9	100.2	100.5	101.6	101.2	99.2	104.3	103.4	102.9	99.4
4.0	9.4	9.8	9.4	10.7	10.3	8.8	10.9	9.9	9.6	8.0	99.8	99.6	100.4	101.9	101.4	99.4	104.2	102.9	102.7	99.4
5.0	9.3	9.6	9.3	10.7	10.1	8.7	10.9	9.8	9.2	8.0	99.7	99.7	100.1	102.1	101.1	99.2	104.2	102.7	101.6	99.1
6.0	9.1	9.6		10.6	9.8	8.6	10.9	9.8	8.8	7.5	100.0	99.8		102.1	100.2	99.1	104.2	102.5	101.0	98.0
7.0	9.1	9.5		10.0	9.3	8.6	10.9	9.6	8.7		100.0	99.7		100.8	99.7	99.1	104.1	101.6	100.7	
8.0	9.1	9.5		9.6	9.0	8.6*	10.9	9.4	8.7		100.1	99.7		99.8	99.2	98.7*	103.9	101.5	100.5	
9.0	9.1	9.3		9.4	9.0		9.2	9.2	8.6		100.0	99.3		99.5	99.2		101.0	100.0	99.9	
10.0	9.0			9.2	9.0		8.8	8.6	8.4		99.9			99.1	99.3		100.3	99.4	99.6	
11.0	9.0			8.2	8.0		8.8	8.3	8.4		99.8			97.3	97.1		100.4	99.0	99.4	
12.0	9.0				7.8		8.7	8.1	8.3		99.8				96.8		100.2	98.7	99.2	
13.0	9.0				7.6		8.6	8.0	8.2		99.7				96.2		100.0	98.4	99.0	
14.0	8.8				7.5		8.6	7.9	8.1		99.7				96.0		99.6	98.0	98.5	
15.0	8.7				7.3		8.4	7.5	7.9		99.8				95.5		99.3	97.0	98.1	
16.0					7.1		8.4	7.5	7.9						95.1		99.2	96.5	97.7	
17.0					7.1			7.4	7.6						94.6			96.1	97.0	
18.0					7.0			7.3	7.4						94.4			95.9	96.7	
19.0					7.0			7.2	7.3						94.3			96.0	96.4	
20.0					7.0			7.2	7.1						94.2			95.8	96.1	
21.0					6.9*				7.1						93.5*				96.0	
22.0									6.6										94.7	
23.0									6.6										94.6	
24.0									6.5										94.4	
25.0									6.5										94.3	
26.0									6.5										94.1	
27.0									6.5										94.0	
28.0									6.4										93.8	
29.0									6.4										93.5	
30.0									6.3										93.1	

[a] Sampling conducted on 26-July, 29-July and 30-July, 2016.
[b] 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 were 16.9, 9.95, 5.14, 11, 21.7, 8.5, 19.9, 21, 30.5, 8.2 m, respectively, at the time of summer sampling.
* The deepest *in situ* water quality reading at stations BL0-05 and BL0-05-B were taken at 21.7 m and 7.5 m, respectively, at the time of summer sampling.

Table C.54: *In-situ* water quality profile data collected at Mary Lake water quality monitoring stations in summer[a], Mary River Project CREMP, 2016.

Depth (m)	pH (pH units)										Specific Conductance (µS/cm)									
	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
1.0	7.63	7.83	7.68	7.71	7.63	7.27	7.65	7.75	7.82	7.70	185.5	180.1	189.5	69.0	82.0	57.0	57.2	61.3	57.9	54.3
2.0	7.66	7.80	7.72	7.76	7.60	7.03	7.64	7.71	7.77	7.59	191.0	179.8	191.2	69.0	69.0	58.0	57.2	61.1	57.9	54.4
3.0	7.69	7.81	7.74	7.68	7.59	6.86	7.65	7.69	7.71	7.54	191.7	182.2	191.2	70.0	64.0	58.0	57.2	58.0	57.8	54.4
4.0	7.69	7.80	7.76	7.68	7.58	6.41	7.64	7.67	7.71	7.50	192.7	187.6	192.3	70.0	66.0	59.0	57.3	57.4	57.4	54.5
5.0	7.71	7.80	7.77	7.70	7.57	6.38	7.65	7.63	7.67	7.48	195.1	187.8	193.2	70.0	72.0	59.0	57.3	57.4	56.4	54.5
6.0	7.71	7.80		7.70	7.57	6.38	7.65	7.62	7.64	7.46	195.4	188.0		71.0	67.0	59.0	57.3	57.4	56.2	54.2
7.0	7.72	7.81		7.69	7.57	6.39	7.66	7.61	7.61		195.6	188.7		69.0	62.0	59.0	57.3	57.7	56.2	
8.0	7.73	7.81		7.67	7.56	6.40*	7.66	7.59	7.60		195.9	189.2		73.0	62.0	59.0*	57.3	57.5	56.2	
9.0	7.74	7.80		7.66	7.54		7.66	7.58	7.59		196.8	192.7		70.0	61.0		56.2	57.4	55.8	
10.0	7.75			7.63	7.51		7.60	7.54	7.57		198.1			66.0	62.0		56.1	56.4	55.7	
11.0	7.75			7.61	7.50		7.56	7.51	7.55		198.3			60.0	58.0		56.0	56.5	55.7	
12.0	7.76				7.45		7.54	7.50	7.55		198.3				58.0		56.0	56.5	55.5	
13.0	7.76				7.41		7.53	7.49	7.53		199.6				57.0		56.0	56.6	55.4	
14.0	7.76				7.38		7.51	7.48	7.51		203.6				58.0		56.0	56.7	55.6	
15.0	7.76				7.36		7.51	7.44	7.50		205.3				57.0		56.1	57.9	55.4	
16.0					7.32		7.51	7.42	7.48						57.0		56.1	58.3	54.9	
17.0					7.12			7.42	7.47						57.0			57.5	54.7	
18.0					6.89			7.41	7.45						57.0			57.0	54.6	
19.0					6.83			7.39	7.43						57.0			56.9	54.4	
20.0					6.80			7.39	7.42						57.0			57.2	54.2	
21.0					6.77*				7.41						58.0*				54.1	
22.0									7.40										53.7	
23.0									7.39										53.7	
24.0									7.37										53.9	
25.0									7.36										53.7	
26.0									7.35										53.7	
27.0									7.35										53.7	
28.0									7.34										53.7	
29.0									7.33										53.8	
30.0									7.33										53.8	

[a] Sampling conducted on 26-July, 29-July and 30-July, 2016.

[b] 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 were 16.9, 9.95, 5.14, 11, 21.7, 8.5, 19.9, 21, 30.5, 8.2 m, respectively, at the time of summer sampling.

* The deepest *in situ* water quality reading at stations BL0-05 and BL0-05-B were taken at 21.7 m and 7.5 m, respectively, at the time of summer sampling.

Table C.55: *In-situ* water quality profile data collected at Mary Lake water quality monitoring stations in fall[a], Mary River Project CREMP, 2016.

Depth (m)	Temperature (°C)									
	BLO-01-A[b]	BLO-01[b]	BLO-01-B[b]	BLO-05-A[b]	BLO-05[b]	BLO-05-B[b]	BLO-03[b]	BLO-04[b]	BLO-09[b]	BLO-06[b]
1.0	10.4	10.1	10.2	11.1	11.3	11.2	11.0	10.5	10.5	9.9
2.0	10.0	10.0	10.1	11.1	11.3	11.2	10.9	10.5	10.5	10.8
3.0	9.9	9.9	9.9	11.1	11.2	11.2	10.9	10.4	10.5	9.7
4.0	9.7	9.9	9.8	11.0	11.1	11.1	10.9	10.4	10.3	9.7
5.0	9.5	9.8		11.0	11.0	11.0	10.7	10.4	10.2	9.6
6.0	9.4	9.7		10.9	10.8	10.7	10.6	10.4	10.2	9.6
7.0	9.3	9.6		10.9	10.7	10.6	10.6	10.2	10.1	9.5
8.0	9.3	9.5		10.9	10.5		10.5	9.9	10.1	9.4
9.0	9.2	9.4*		10.9	10.5		10.4	9.5	10.0	
10.0	9.2			10.7	10.2		10.4	9.3	10.0	
11.0	9.2			10.3*	9.6		10.3	9.1	10.0	
12.0	9.1				9.3		10.0	9.1	9.1	
13.0	9.1				9.2		8.8	9.0	8.9	
14.0	9.1				8.4		8.8	8.8	9.0	
15.0					7.9		8.7	8.7	8.9	
16.0					7.5		8.5	8.2	7.7	
17.0					7.4		8.4	7.7	7.5	
18.0					7.3			7.1	7.3	
19.0					7.2			7.4	7.2	
20.0					7.2			7.0	7.0	
21.0									6.7	
22.0									6.6	
23.0									6.4	
24.0									6.4	
25.0									6.3	
26.0									6.2	
27.0									6.2	
28.0									6.1	
29.0									6.1	
30.0									6.1	

Depth (m)	Dissolved Oxygen (% Saturation)									
	BLO-01-A[b]	BLO-01[b]	BLO-01-B[b]	BLO-05-A[b]	BLO-05[b]	BLO-05-B[b]	BLO-03[b]	BLO-04[b]	BLO-09[b]	BLO-06[b]
1.0	99.8	98.9	100.1	98.1	99.0	98.5	99.3	97.1	98.9	93.5
2.0	100.1	99.6	99.8	98.8	99.2	99.3	99.8	98.0	99.2	95.8
3.0	99.7	99.6	99.8	98.9	99.2	99.5	99.8	98.7	99.2	96.7
4.0	99.4	99.5	99.4	98.9	99.1	99.4	99.7	99.0	99.1	97.0
5.0	99.0	99.3		98.7	98.8	98.8	99.4	99.2	98.8	97.1
6.0	98.8	99.1		98.6	98.3	98.5	99.0	99.1	98.7	97.1
7.0	98.5	98.6		98.6	97.8	98.3	98.9	98.8	98.6	96.7
8.0	98.4	98.1		98.5	98.0		98.7	98.1	98.4	96.3
9.0	97.8	97.8*		98.5	97.8		98.5	97.1	98.4	
10.0	97.7			97.9	97.0		98.5	96.6	98.3	
11.0	97.4			96.7*	95.8		97.8	96.1	98.2	
12.0	97.5				95.1		97.0	96.0	96.1	
13.0	97.6				93.7		95.4	96.0	95.8	
14.0	97.6				91.5		94.3	95.1	95.8	
15.0					90.1		94.2	94.9	96.0	
16.0					89.5		93.9	93.5	93.4	
17.0					89.7		93.6	92.2	92.8	
18.0					89.5			91.9	92.3	
19.0					89.0			91.1	92.0	
20.0					88.5			90.3	91.6	
21.0									90.7	
22.0									90.3	
23.0									90.1	
24.0									89.7	
25.0									89.6	
26.0									89.5	
27.0									89.3	
28.0									88.8	
29.0									88.5	
30.0									88.2	

[a] Sampling conducted on 21-August to 24-August, 2016.

[b] 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 were 14.9, 9.2, 4.7, 11.5, 20.6, 7.6, 19.5, 21.1, 30.2, and 9.7 m, respectively, at the time of fall sampling.

* The deepest *in situ* water quality reading at stations BLO-1 and BLO-05A were taken at 8.2 and 10.5 m, respectively, at the time of fall sampling.

Table C.55: *In-situ* water quality profile data collected at Mary Lake water quality monitoring stations in fall[a], Mary River Project CREMP, 2016.

Depth (m)	pH (pH units)										Specific Conductance (µS/cm)									
	BLO-01-A[b]	BLO-01[b]	BLO-01-B[b]	BLO-05-A[b]	BLO-05[b]	BLO-05-B[b]	BLO-03[b]	BLO-04[b]	BLO-09[b]	BLO-06[b]	BLO-01-A[b]	BLO-01[b]	BLO-01-B[b]	BLO-05-A[b]	BLO-05[b]	BLO-05-B[b]	BLO-03[b]	BLO-04[b]	BLO-09[b]	BLO-06[b]
1.0	8.11	8.06	8.05	8.08	8.00	8.04	7.72	7.90	7.78	8.01	149	150	149	78	73	75	72		73	
2.0	8.01	7.96	7.99	7.95	7.93	7.92	7.70	7.83	7.74	7.89	149	149	148	78	75	75	71		73	
3.0	8.00	7.95	8.00	7.91	7.88	7.87	7.69	7.76	7.73	7.81	149	148	146	79	76	75	71		73	
4.0	7.98	7.94	8.00	7.87	7.88	7.84	7.68	7.72	7.70	7.75	150	148	146	80	77	74	71		73	
5.0	7.96	7.93		7.84	7.82	7.80	7.66	7.68	7.68	7.67	153	147		80	76	74	71		73	
6.0	7.95	7.92		7.81	7.79	7.77	7.65	7.64	7.67	7.66	154	150		81	75	74	71		73	
7.0	7.94	7.91		7.77	7.75	7.74	7.63	7.60	7.66	7.64	154	151		81	81	73	70		72	
8.0	7.92	7.90		7.77	7.71		7.63	7.56	7.64	7.61	154	151		81	84		70		72	
9.0	7.91	7.89*		7.76	7.70		7.62	7.50	7.63		154	151		81	88		70		73	
10.0	7.92			7.73	7.70		7.60	7.45	7.62		153			81	85		69		71	
11.0	7.91			7.70*	7.67		7.58	7.38	7.62		153			80	81		69		72	
12.0	7.90				7.63		7.57	7.36	7.62		153				79		67		71	
13.0	7.96				7.62		7.45	7.35	7.58		154				69		63		67	
14.0	7.91				7.60		7.44	7.35	7.54		154				61		62		65	
15.0					7.54		7.42	7.32	7.52						57		61		62	
16.0					7.50		7.40	7.33	7.50						55		60		60	
17.0					7.45		7.38	7.30	7.46						54		60		57	
18.0					7.43			7.26	7.44						53				56	
19.0					7.41			7.23	7.41						53				55	
20.0					7.39			7.20	7.39						53				54	
21.0									7.37										53	
22.0									7.35										53	
23.0									7.33										53	
24.0									7.31										53	
25.0									7.28										53	
26.0									7.26										53	
27.0									7.22										53	
28.0									7.15										53	
29.0									7.08										55	
30.0									7.03										56	

[a] Sampling conducted on 21-August to 24-August, 2016.

[b] 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 were 14.9, 9.2, 4.7, 11.5, 20.6, 7.6, 19.5, 21.1, 30.2, and 9.7 m, respectively, at the time of fall sampling.

* The deepest *in situ* water quality reading at stations BLO-1 and BLO-05A were taken at 8.2 and 10.5 m, respectively, at the time of fall sampling.

Table C.56: 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 2016.

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.)		
BLO-01	15-Aug-16	9.6	3.99	-	surface	12.07	10.75	99.9	8.13	132
					bottom	9.82	10.63	93.8	7.94	120
BLO-20	15-Aug-16	11.3	2.86	slight blue-green colouration	surface	12.32	11.18	104.4	7.72	73
					bottom	10.07	11.02	97.8	7.72	73
BLO-11	15-Aug-16	11.6	3.06	-	surface	12.64	11.76	108.4	7.86	73
					bottom	9.94	11.69	102.5	7.82	80
BLO-21	15-Aug-16	11.2	3.26	slight blue-green colouration	surface	13.42	10.31	98.7	7.50	74
					bottom	9.23	7.79	63.7	7.27	71
BLO-22	15-Aug-16	11.3	3.72	slight blue-green colouration	surface	12.92	10.65	100.8	6.87	75
					bottom	9.35	11.11	97.4	7.19	69
BLO-06	15-Aug-16	9.1	3.85	slight blue-green colouration	surface	13.23	10.95	104.3	7.77	71
					bottom	12.63	8.39	77.4	7.44	71

Table C.57: Statistical comparison of bottom *in-situ* water quality between littoral stations of Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2016.

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Areas?	*p* -value	Statistical Analysis[a]	Lake	N	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	Yes	0.001	α, δ, γ	Reference	5	8.88	0.71	0.32	8.10	10.00
				Mary	6	3.46	0.46	0.19	2.86	3.99
Temperature (˚C)	No	0.931	γ	Reference	5	9.92	0.37	0.17	9.50	10.40
				Mary	6	10.17	1.25	0.51	9.23	12.63
Dissolved Oxygen (mg/L)	No	0.769	α, δ, γ	Reference	5	10.3	0.8	0.4	9.3	11.3
				Mary	6	10.1	1.6	0.7	7.8	11.7
Dissolved Oxygen (% saturation)	No	0.734	α, δ, γ	Reference	5	91.3	6.7	3.0	82.6	99.1
				Mary	6	88.8	15.0	6.1	63.7	102.5
pH (units)	No	0.640	α, δ, γ	Reference	5	7.64	0.23	0.10	7.28	7.86
				Mary	6	7.56	0.31	0.13	7.19	7.94
Specific Conductance (umho/cm)	No	0.429	γ	Reference	5	74.0	0.0	0.0	74.0	74.0
				Mary	6	80.7	19.6	8.0	69.0	120.0

[a] Data analysis included: α - data untransformed; β - data logit transformed; η - log_{10} transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Kruskal Wallis H-test or Mann Whitney U-test, as appropriate.

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

Table C.58: Water chemistry at Mary Lake north basin (BLO-01) water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event					Spring	Summer Sampling Event							Fall Sampling Event						
					BL0-01-A(S) surface 25-Apr-2016	BL0-01-A(B) bottom 25-Apr-2016	BL0-01 (S) surface 1-May-2016	BL0-01 (B) bottom 1-May-2016	BL0-01-B surface 25-Apr-2016	I0-01 river 25-Jun-2016	I0-01 river 20-Jul-2016	BL0-01-A-S surface 26-Jul-2016	BL0-01-A-B bottom 26-Jul-2016	BL0-01-S surface 26-Jul-2016	BL0-01-B bottom 26-Jul-2016	BL0-01-B-S surface 26-Jul-2016	BL0-01-B-B bottom 26-Jul-2016	I0-01 river 19-Aug-2016	BL0-01A-S surface 21-Aug-2016	BL0-01A-B bottom 21-Aug-2016	BL0-01-S surface 21-Aug-2016	BL0-01-B bottom 21-Aug-2016	BL0-01B-S surface 21-Aug-2016	BL0-01B-B bottom 21-Aug-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	222	220	231	227	231	27.9	85.4	90.4	96.2	86.9	90.7	91.0	93	194	158	166	160	164	159	156
	pH (lab)	pH	6.5 - 9.0	-	7.85	7.31	8.08	8.13	7.86	7.45	7.86	7.89	7.93	7.88	7.91	7.94	7.89	8.24	8.17	8.12	8.12	8.13	8.14	8.17
	Hardness (as $CaCO_3$)	mg/L	-	-	110	107	116	109	113	13	43	43	46	41	44	44	45	95	76	81	76	79	77	73
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	2.8	<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	-	-	147	147	130	131	152	13	47700	49	52	45	49	47	48	98	86	93	85	83	82	80
	Turbidity	NTU	-	-	0.22	0.81	0.48	0.34	0.27	3.88	1.70	0.94	0.94	0.99	1.00	0.88	5.06	0.44	1.48	1.12	1.24	1.19	1.31	1.71
	Alkalinity (as $CaCO_3$)	mg/L	-	-	112	109	112	106	110	12	42	46	46	45	49	44	50	94	77	79	77	82	79	78
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.064	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	<0.020	0.043	0.071	<0.020	<0.020
	Nitrate	mg/L	13	13	0.071	0.164	0.070	0.068	0.068	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<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	<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	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	3.7	3.2	4.1	4.0	4.0	1.0	1.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.7	1.8	1.7	1.8	1.7	1.8	1.9
	Total Organic Carbon	mg/L	-	-	2.5	2.4	2.6	2.5	2.6	1.1	1.5	1.0	<1.0	<1.0	1.0	1.0	1.1	1.8	2.1	1.9	1.8	1.8	1.9	1.8
	Total Phosphorus	mg/L	0.020[α]	-	0.0039	0.0050	0.0033	<0.0030	0.0041	0.0062	<0.0030	0.0061	0.0050	0.0046	0.0044	0.0052	0.0055	<0.0030	<0.0030	0.0035	0.0035	0.0041	0.0030	0.0037
	Phenols	mg/L	0.004[α]	-	0.0013	<0.0010	0.0018	0.0019	0.0018	0.0027	0.0016	0.0010	0.0044 (shaded)	0.0019	0.0023	0.0016	0.0034	0.0041 (shaded)	0.0028	0.0028	0.0018	0.0018	0.0023	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	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	5.84	5.61	5.97	5.78	5.93	0.69	1.08	1.17	1.13	1.16	1.16	1.17	1.20	5.51	3.18	3.76	3.24	3.54	3.21	3.06
	Sulphate (SO_4)	mg/L	218[β]	218	2.74	2.14	2.82	2.71	2.77	<0.30	0.52	0.55	0.59	0.54	0.56	0.58	0.63	1.95	1.36	1.50	1.39	1.45	1.37	1.32
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.0036	0.0036	<0.0030	<0.0030	0.0041	0.0923	0.0629	0.0321	0.0395	0.0330	0.0403	0.0387	0.0323	0.0104	0.028	0.024	0.030	0.029	0.024	0.028
	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	0.00020	<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	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0103	0.00990	0.0113	0.0108	0.0107	0.00240	0.00487	0.00475	0.00530	0.00462	0.00522	0.00493	0.00529	0.00976	0.00764	0.00811	0.00774	0.00791	0.00817	0.00816
	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	<0.00010	<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	<0.00050	<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	<0.010	<0.010	<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	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	21.4	21.5	22.8	22.2	23.0	2.71	8.62	9.05	9.59	8.24	9.19	9.19	9.3	18.9	15.1	16.0	15.3	15.5	16.0	14.9
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00072	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00126	0.00082	0.00118	0.00117	0.00118	<0.00050	0.00053	0.00060	0.00063	0.00056	0.00065	0.00058	0.00059	0.00099	<0.0010	<0.0010	0.0011	0.0010	0.0011	0.0010
	Iron (Fe)	mg/L	0.30	0.326	<0.030	0.076	<0.030	<0.030	<0.030	0.096	0.038	0.030	0.041	0.032	0.033	0.031	0.033	<0.030	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000130	<0.000050	<0.000050	0.000052	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0012	0.0012	0.0011	<0.0010	<0.0010	<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
	Magnesium (Mg)	mg/L	-	-	13.4	12.8	13.7	13.2	13.8	1.61	5.15	5.38	6.00	5.13	5.38	5.66	5.62	11.4	8.51	8.92	8.57	8.73	8.66	8.39
	Manganese (Mn)	mg/L	0.935[β]	-	0.00134	0.0293	0.00187	0.00219	0.00223	0.00363	0.000636	0.00306	0.00264	0.00260	0.00263	0.00242	0.002315	0.000319	0.00452	0.00561	0.00465	0.00574	0.00482	0.00470
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000345	0.000250	0.000329	0.000309	0.000344	<0.000050	0.000091	0.000097	0.000098	0.000088	0.000109	0.000107	0.000098	0.000238	0.000219	0.000217	0.000209	0.000227	0.000217	0.000205
	Nickel (Ni)	mg/L	0.025	0.025	0.00204	0.00139	0.00064	0.00061	0.00153	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00053	<0.00050	0.00052	0.00055	0.00056	0.00054
	Potassium (K)	mg/L	-	-	1.25	1.16	1.27	1.21	1.30	0.29	0.55	0.56	0.58	0.54	0.59	0.59	0.57	1.04	0.862	0.898	0.882	0.886	0.887	0.857
	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	1.01	1.80	1.13	1.13	1.09	0.42	0.74	0.62	0.66	0.59	0.64	0.63	0.65	0.86	0.812	0.805	0.822	0.800	0.843	0.831
	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	3.26	3.05	3.26	3.14	3.30	0.405	0.933	0.954	0.962	0.921	0.970	0.973	0.96	3.20	1.93	2.12	1.97	2.03	1.97	1.90
	Strontium (Sr)	mg/L	-	-	0.0149	0.0141	0.0152	0.0146	0.0156	0.00200	0.00559	0.00595	0.00623	0.00552	0.00603	0.00604	0.0061	0.0130	0.0109	0.0112	0.0109	0.0112	0.0112	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	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	-	-	<0.00010	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	<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	0.00095	0.00088	0.00118	0.00109	0.00087	0.00094
	Uranium (U)	mg/L	0.015	-	0.00252	0.00189	0.00262	0.00258	0.00268	0.000086	0.000508	0.000496	0.000645	0.000472	0.000552	0.000549	0.000569	0.00253	0.00152	0.00174	0.00153	0.00160	0.00155	0.00146
	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	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	0.0030	<0.0030

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

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

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.59: Water chemistry at Mary Lake south basin (BLO) water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event													
					BL0-05-A-S surface 1-May-2016	BL0-05-A-B bottom 1-May-2016	BL0-05-S surface 1-May-2016	BL0-05-B bottom 1-May-2016	BL0-05-B-S surface 1-May-2016	BL0-05-B-B bottom 1-May-2016	BL0-03-S surface 6-May-2016	BL0-03-B bottom 6-May-2016	BL0-04-S surface 6-May-2016	BL0-04-B bottom 6-May-2016	BL0-09-S surface 6-May-2016	BL0-09-B bottom 6-May-2016	BL0-06-S surface 6-May-2016	BL0-06-B bottom 6-May-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	91.4	84.8	91.0	83.6	97.8	95.1	88.0	83.0	94.8	80.7	89.3	83	90.8	88.2
	pH (lab)	pH	6.5 - 9.0	-	7.78	7.89	7.87	7.85	7.93	7.91	7.60	7.62	7.58	7.55	7.53	7.28	7.61	7.61
	Hardness (as $CaCO_3$)	mg/L	-	-	44	41	44	40	47	46	45	39	47	40	44	41.5	45	43
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	53	51	45	45	50	47	48	52	49	39	42	45	26	49
	Turbidity	NTU	-	-	0.26	0.12	0.12	0.27	0.27	0.41	<0.10	0.10	<0.10	0.11	0.11	0.20	0.11	<0.10
	Alkalinity (as $CaCO_3$)	mg/L	-	-	44	40	42	40	45	43	37	37	41	35	44	41	44	44
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.029	0.027	0.030	0.037	0.033	0.026	0.028	0.028	0.030	0.031	0.032	0.0725	0.029	0.030
	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	0.18	0.16	0.16	<0.15
	Dissolved Organic Carbon	mg/L	-	-	3.1	3.3	3.3	2.7	3.1	3.2	1.5	1.4	1.5	1.4	1.5	1.3	1.7	1.5
	Total Organic Carbon	mg/L	-	-	1.5	1.6	1.7	2.1	2.7	1.6	1.7	1.5	1.7	1.6	1.7	1.5	1.7	1.6
	Total Phosphorus	mg/L	0.020[α]	-	<0.0030	0.0045	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0037	0.0054	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	0.0019	<0.0010	0.0019	<0.0010	<0.0010	0.0011	0.0015	0.0014	<0.0010	0.0015	<0.0010	0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.87	1.72	1.87	1.67	2.03	1.91	1.79	1.63	1.93	1.66	1.87	1.93	1.87	1.85
	Sulphate (SO_4)	mg/L	218[β]	218	1.13	1.05	1.13	1.03	1.21	1.17	1.05	0.97	1.16	1.01	1.15	1.02	1.15	1.16
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	<0.0030	0.0039	0.0049	0.0054	0.0060	0.0047	<0.0030	0.0031	<0.0030	0.0041	0.0035	0.0068	0.0068	0.0031
	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	-	-	0.00486	0.00480	0.00517	0.00482	0.00555	0.00544	0.00482	0.00444	0.00530	0.00462	0.00499	0.00484	0.00535	0.00491
	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	-	-	8.65	8.41	9.04	8.19	9.37	9.26	8.70	8.07	9.45	8.21	8.95	8.1	8.98	8.82
	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	0.00061	0.00064	0.00075	0.00066	0.00084	0.00074	0.00071	0.00062	0.00072	0.00072	0.00068	0.00066	0.00077	0.00064
	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	4.85	5.26	4.81	5.65	5.45	5.13	4.76	5.55	4.79	5.31	4.76	5.29	5.17
	Manganese (Mn)	mg/L	0.935[β]	-	0.000336	0.000429	0.000376	0.000699	0.000474	0.000669	0.000455	0.000404	0.000364	0.000522	0.000355	0.000819	0.000469	0.000392
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000022	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000171	0.000158	0.000169	0.000156	0.000176	0.000174	0.000150	0.000141	0.000179	0.000146	0.000166	0.000143	0.000167	0.000171
	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	0.62	0.67	0.60	0.74	0.70	0.69	0.62	0.74	0.63	0.70	0.62	0.70	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	-	-	0.36	0.34	0.37	0.39	0.38	0.38	0.37	0.35	0.38	0.34	0.36	0.67	0.36	0.35
	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	-	-	1.22	1.15	1.25	1.12	1.35	1.28	1.23	1.14	1.34	1.17	1.29	1.26	1.29	1.24
	Strontium (Sr)	mg/L	-	-	0.00680	0.00659	0.00709	0.00650	0.00735	0.00713	0.00683	0.00626	0.00743	0.00647	0.00711	0.0065	0.00715	0.00705
	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	-	0.000714	0.000687	0.000726	0.000615	0.000748	0.000733	0.000635	0.000596	0.000732	0.000635	0.000703	0.000501	0.000699	0.000702
	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	0.0031	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.59: Water chemistry at Mary Lake south basin (BLO) water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event													
					BL0-05-A-S surface 30-Jul-2016	BL0-05-A-B bottom 30-Jul-2016	BL0-05-S surface 30-Jul-2016	BL0-05-B bottom 30-Jul-2016	BL0-05-B-S surface 30-Jul-2016	BL0-05-B-B bottom 30-Jul-2016	BL0-03-S surface 30-Jul-2016	BL0-03-B bottom 30-Jul-2016	BL0-04-S surface 30-Jul-2016	BL0-04-B bottom 30-Jul-2016	BL0-09-S surface 30-Jul-2016	BL0-09-B bottom 30-Jul-2016	BL0-06-S surface 29-Jul-2016	BL0-06-B bottom 29-Jul-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	68.1	55.8	61.8	56.5	55.9	55.3	55.4	54.1	60.5	55.1	56.1	51.5	53.5	52.4
	pH (lab)	pH	6.5 - 9.0	-	7.82	7.75	7.74	7.58	7.71	7.73	7.74	7.70	7.69	7.68	7.74	7.64	7.80	7.73
	Hardness (as $CaCO_3$)	mg/L	-	-	31	27	29	25	26	26	25	25	27	25	25	24	24	24
	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	-	-	41	35	44	34	40	37	32	33	40	29	37	37	49	37
	Turbidity	NTU	-	-	2.09	2.01	1.30	1.55	1.32	1.22	0.94	0.97	1.33	2.07	1.12	1.76	1.86	1.78
	Alkalinity (as $CaCO_3$)	mg/L	-	-	29	22	25	23	18	24	23	26	28	24	24	22	20	25
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	0.033	<0.020	<0.020	0.034	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.044	0.021
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	0.024	<0.020	<0.020	0.023	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.1	1.7	1.8	1.9	1.8	1.7	1.9	1.8	1.1	1.1	1.0	1.9	1.2	1.8
	Total Organic Carbon	mg/L	-	-	2.4	1.5	1.5	1.5	1.5	1.6	1.6	1.6	1.9	1.5	1.4	1.5	1.2	1.2
	Total Phosphorus	mg/L	0.020[α]	-	0.0060	0.0055	0.0045	0.0056	0.0257	0.0082	0.0079	0.0044	0.0064	0.0059	0.0118	0.0068	0.0056	0.0055
	Phenols	mg/L	0.004[α]	-	0.0015	0.0017	0.0020	0.0026	0.0050	0.0032	0.0012	0.0016	0.0013	0.0013	0.0062	0.0018	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	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.35	1.18	1.26	1.20	1.19	1.19	1.11	1.35	1.24	1.19	1.22	1.26	1.25	1.19
	Sulphate (SO_4)	mg/L	218[β]	218	0.95	0.66	0.79	0.64	0.67	0.65	0.50	0.58	0.75	0.66	0.67	0.60	0.67	0.63
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.0482	0.0531	0.0369	0.0468	0.0390	0.0521	0.0123	***0.149***	0.0388	0.0533	0.0413	0.0417	0.0419	0.0387
	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	-	-	0.00444	0.00379	0.00401	0.00366	0.00356	0.00377	0.00306	0.00348	0.00374	0.00397	0.00345	0.00350	0.00327	0.00362
	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	-	-	6.48	5.47	6.01	5.24	5.31	5.40	5.34	5.45	5.73	5.23	5.40	4.97	4.98	5.00
	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	0.00067	0.00069	0.00063	0.00058	0.00052	0.00061	<0.00050	0.00097	0.00057	0.00054	0.00052	0.00051	0.00051	0.00053
	Iron (Fe)	mg/L	0.30	0.326	0.044	0.046	0.037	0.046	0.041	0.043	<0.030	<0.030	0.038	0.058	0.040	0.044	0.042	0.043
	Lead (Pb)	mg/L	0.001	0.001	0.000066	0.000060	0.000052	0.000067	0.000052	0.000054	<0.000050	0.000070	0.000051	0.000077	0.000051	0.000060	0.000054	0.000065
	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	-	-	3.81	3.09	3.42	2.90	3.03	3.02	3.08	2.99	3.25	3.09	3.05	2.87	2.88	2.90
	Manganese (Mn)	mg/L	0.935[β]	-	0.00230	0.00277	0.00222	0.00266	0.00228	0.00239	0.00195	0.00283	0.00224	0.00308	0.00214	0.00306	0.00258	0.00267
	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	-	0.000123	0.000096	0.000113	0.000081	0.000094	0.000093	0.000077	0.000086	0.000098	0.000082	0.000093	0.000079	0.000090	0.000081
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00067	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.60	0.49	0.53	0.45	0.48	0.47	0.44	0.44	0.50	0.49	0.47	0.45	0.46	0.46
	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	-	-	0.51	0.44	0.45	0.45	0.44	0.42	0.33	0.38	0.47	0.47	0.43	0.44	0.40	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	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.954	0.800	0.861	0.747	0.778	0.776	0.728	0.763	0.810	0.786	0.770	0.764	0.747	0.753
	Strontium (Sr)	mg/L	-	-	0.00565	0.00462	0.00497	0.00427	0.00439	0.00428	0.00401	0.00413	0.00475	0.00427	0.00440	0.00402	0.00409	0.00398
	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	-	0.000557	0.000368	0.000444	0.000313	0.000341	0.000337	0.000270	0.000284	0.000390	0.000330	0.000338	0.000285	0.000292	0.000287
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.59: Water chemistry at Mary Lake south basin (BLO) water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event													
					BL0-05-A-S surface 23-Aug-2016	BL0-05-A-B bottom 23-Aug-2016	BL0-05-S surface 23-Aug-2016	BL0-05-B bottom 23-Aug-2016	BL0-05-B-S surface 23-Aug-2016	BL0-05-B-B bottom 23-Aug-2016	BL0-03-S surface 24-Aug-2016	BL0-03-B bottom 24-Aug-2016	BL0-04 surface 23-Aug-2016	BL0-04-B bottom 23-Aug-2016	BL0-09-S surface 23-Aug-2016	BL0-09-B bottom 23-Aug-2016	BL0-06-S surface 23-Aug-2016	BL0-06-B bottom 23-Aug-2016
Conventionals	Conductivity (lab)	umho/cm	-	-	84.0	87.2	79.6	56.4	81.7	78.3	76.4	64.1	76	82.7	75.8	54.8	77.1	76.7
	pH (lab)	pH	6.5 - 9.0	-	7.79	7.85	7.85	7.68	7.65	7.77	7.83	7.72	7.87	7.84	7.84	7.60	7.83	7.82
	Hardness (as $CaCO_3$)	mg/L	-	-	39	41	37	26	37	37	36	30	35	37	35	26	36	36
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	2.5	<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	-	-	46	43	41	25	41	39	42	35	41	43	36	25	39	36
	Turbidity	NTU	-	-	1.69	1.80	1.55	1.67	1.71	1.88	0.79	0.52	1.65	3.12	1.41	1.23	1.70	2.27
	Alkalinity (as $CaCO_3$)	mg/L	-	-	38	38	33	24	39	37	32	34	33	37	35	21	33	35
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	<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	-	-	1.2	1.2	1.3	<1.0	1.2	1.2	1.4	1.2	1.3	1.2	1.2	1.1	1.2	1.2
	Total Organic Carbon	mg/L	-	-	1.3	1.4	1.4	1.1	1.3	1.3	1.5	1.2	1.3	1.6	1.4	1.2	1.4	1.3
	Total Phosphorus	mg/L	0.020[α]	-	0.0062	0.0072	0.0067	0.0080	0.0155	0.0054	0.0063	0.0065	0.0066	0.0061	0.0092	0.0061	0.0049	0.0059
	Phenols	mg/L	0.004[α]	-	0.0030	0.0187	0.0036	0.0038	0.0089	0.0075	0.0045	0.0014	0.0034	0.0088	0.0165	0.0021	0.0134	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	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.85	1.97	1.58	1.25	1.61	1.58	1.30	1.27	1.41	1.80	1.42	1.29	1.48	1.52
	Sulphate (SO_4)	mg/L	218[β]	218	1.29	1.37	1.12	0.68	1.12	1.12	0.94	0.74	1.01	1.37	0.96	0.66	1.08	1.14
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.0763	0.0801	0.0663	0.0496	0.0670	0.0621	0.0264	0.0200	0.0513	0.0599	0.0552	0.0440	0.0627	0.0560
	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	-	-	0.00571	0.00553	0.00499	0.00395	0.00525	0.00540	0.00416	0.00342	0.00463	0.00527	0.00448	0.00353	0.00473	0.00483
	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	-	-	8.17	8.31	7.58	5.37	7.70	7.56	7.29	6.07	7.2	7.79	7.27	5.25	7.34	7.18
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<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	0.00067	0.00069	0.00075	0.00053	0.00065	0.00076	0.00056	<0.00050	0.00150	**0.0438***	**0.00398***	**0.0271***	**0.00284***	**0.0115***
	Iron (Fe)	mg/L	0.30	0.326	0.053	0.058	0.049	0.047	0.048	0.055	<0.030	<0.030	0.042	0.058	0.039	0.039	0.048	0.055
	Lead (Pb)	mg/L	0.001	0.001	0.000068	0.000066	0.000053	0.000067	0.000057	0.000067	<0.000050	<0.000050	0.000051	0.000084	<0.000050	0.000061	0.000060	0.000075
	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	-	-	4.73	4.89	4.52	3.17	4.49	4.40	4.26	3.64	4.33	4.51	4.30	3.08	4.31	4.35
	Manganese (Mn)	mg/L	0.935[β]	-	0.00158	0.00157	0.00126	0.00445	0.00125	0.00155	0.00105	0.00125	0.00113	0.00213	0.00110	0.00167	0.00129	0.00180
	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	-	0.000164	0.000165	0.000137	0.000093	0.000137	0.000141	0.000104	0.000083	0.000137	0.000148	0.000131	0.000087	0.000141	0.000126
	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	-	-	0.67	0.68	0.64	0.50	0.63	0.63	0.53	0.49	0.60	0.66	0.59	0.49	0.61	0.62
	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	-	-	0.67	0.68	0.62	0.52	0.64	0.63	0.61	0.47	0.60	0.65	0.57	0.48	0.61	0.62
	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	-	-	1.21	1.27	1.11	0.819	1.09	1.13	0.927	0.844	1.02	1.17	0.999	0.806	1.03	1.07
	Strontium (Sr)	mg/L	-	-	0.00697	0.00721	0.00644	0.00442	0.00640	0.00632	0.00545	0.00456	0.0059	0.00676	0.00587	0.00436	0.00612	0.00609
	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	-	0.000815	0.000882	0.000695	0.000305	0.000699	0.000674	0.000505	0.000357	0.000579	0.000783	0.000570	0.000315	0.000608	0.000657
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

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

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.60: Dissolved metal concentrations at Mary Lake north basin water quality monitoring stations, Mary River Project CREMP, 2016.

	Parameters	Units	Winter Sampling Event					Spring Sampling	Summer Sampling Event							Fall Sampling Event						
			BL0-01-A (S) surface	BL0-01-A (B) bottom	BL0-01 (S) surface	BL0-01 (B) bottom	BL0-01-B surface	I0-01 river	I0-01 river	BL0-01-A-S surface	BL0-01-A-B bottom	BL0-01-S surface	BL0-01-B bottom	BL0-01-B-S surface	BL0-01-B-B bottom	I0-01 river	BL0-01A-S surface	BL0-01A-B bottom	BL0-01-S surface	BL0-01-B bottom	BL0-01B-S surface	BL0-01B-B bottom
			25-Apr-2016	25-Apr-2016	1-May-2016	1-May-2016	25-Apr-2016	25-Jun-2016	20-Jul-2016	26-Jul-2016	26-Jul-2016	26-Jul-2016	26-Jul-2016	26-Jul-2016	26-Jul-2016	19-Aug-2016	21-Aug-2016	21-Aug-2016	21-Aug-2016	21-Aug-2016	21-Aug-2016	21-Aug-2016
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	0.00218	0.00208	<0.0030	0.0075	0.0068	0.0045	0.0054	0.0055	0.0053	0.0046	0.00505	0.0035	0.0048	0.0047	0.0045	0.0047	0.0052	0.0055
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.000020	<0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<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	0.000080	0.000071	<0.00010	<0.00010	<0.00010	<0.00010	<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	0.0103	0.00947	0.0119	0.0109	0.0105	0.00166	0.00459	0.00454	0.00495	0.00434	0.00473	0.00462	0.00495	0.00976	0.00785	0.00809	0.00801	0.00824	0.00833	0.00803
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.000010	<0.000010	<0.00050	<0.00010	<0.00050	<0.00050	<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	<0.0000050	<0.0000050	<0.00050	<0.000050	<0.00050	<0.00050	<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	<0.0050	<0.0050	<0.010	<0.010	<0.010	<0.010	<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	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<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	22.2	21.7	23.1	21.9	22.7	2.54	8.66	8.73	9.42	8.39	8.88	8.99	9.1	19.7	15.4	16.9	15.4	16.3	15.6	14.7
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<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	0.0000156	0.0000129	<0.00010	<0.00010	<0.00010	<0.00010	<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	0.00122	0.00081	0.00118	0.00079	0.00116	0.00043	<0.00050	0.00056	0.00055	0.00053	0.00057	0.00057	0.00056	0.00097	0.00090	0.00091	0.00102	0.00100	0.00090	0.00097
	Iron (Fe)	mg/L	<0.030	<0.030	0.0083	0.0067	<0.030	<0.010	<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	<0.0000090	<0.0000090	<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	<0.0010	0.00108	0.00103	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0013	0.0011	0.0011	0.0011	<0.0010
	Magnesium (Mg)	mg/L	13.2	12.8	14.1	13.3	13.6	1.55	5.08	5.26	5.49	4.99	5.28	5.34	5.40	11.2	9.13	9.50	9.13	9.30	9.16	8.78
	Manganese (Mn)	mg/L	0.000765	0.000630	0.00114	0.00119	0.00143	0.00092	0.000201	0.00120	0.00109	0.00110	0.00112	0.00112	0.00114	0.000394	0.00223	0.00300	0.00228	0.00255	0.00254	0.00233
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000395	0.000254	0.000314	0.000306	0.000345	<0.000050	0.000090	0.000101	0.000094	0.000099	0.000100	0.000100	0.000102	0.000241	0.000195	0.000215	0.000200	0.000202	0.000202	0.000201
	Nickel (Ni)	mg/L	0.00125	0.00110	0.000716	0.000604	0.00106	<0.00050	<0.00050	<0.00050	<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	1.23	1.14	1.30	1.22	1.28	0.24	0.51	0.58	0.56	0.56	0.57	0.57	0.57	1.04	0.90	0.92	0.89	0.91	0.90	0.88
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.000040	<0.000040	<0.0010	<0.000050	<0.0010	<0.0010	<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	1.03	1.79	1.12	1.10	1.10	0.233	0.62	0.55	0.59	0.52	0.57	0.56	0.57	0.86	0.85	0.86	0.86	0.85	0.87	0.83
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.000010	<0.000050	<0.000010	<0.000010	<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	3.23	3.06	3.41	3.18	3.26	<0.50	0.921	0.963	0.939	0.930	0.952	0.960	0.97	3.02	2.16	2.27	2.07	2.24	2.09	2.09
	Strontium (Sr)	mg/L	0.0150	0.0142	0.0155	0.0148	0.0155	0.0017	0.00552	0.00577	0.00627	0.00573	0.00601	0.00597	0.0060	0.0130	0.0108	0.0117	0.0109	0.0112	0.0109	0.0104
	Thallium (Tl)	mg/L	<0.00010	<0.00010	0.0000038	0.0000034	<0.00010	<0.000010	<0.00010	<0.00010	<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	0.00012	<0.00010	<0.000030	<0.000030	<0.00010	<0.00010	<0.00010	<0.00010	<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	<0.00050	<0.00050	<0.010	<0.00030	<0.010	<0.010	<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	0.00267	0.00192	0.00268	0.00258	0.00265	0.000056	0.000499	0.000500	0.000623	0.000433	0.000512	0.000543	0.000553	0.00245	0.00157	0.00176	0.00156	0.00169	0.00153	0.00154
	Vanadium (V)	mg/L	<0.0010	<0.0010	0.000095	0.000086	<0.0010	<0.00050	<0.0010	<0.0010	<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	0.00112	0.00198	<0.0030	<0.0010	<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.61: Dissolved metal concentrations at Mary Lake south basin water quality monitoring stations, Mary River Project CREMP, 2016.

Parameters		Units	Winter Sampling Event														Summer Sampling Event						
			BL0-05-A-S surface 1-May-2016	BL0-05-A-B bottom 1-May-2016	BL0-05-S surface 1-May-2016	BL0-05-B bottom 1-May-2016	BL0-05-B-S surface 1-May-2016	BL0-05-B-B bottom 1-May-2016	BL0-03-S surface 6-May-2016	BL0-03-B bottom 6-May-2016	BL0-04-S surface 6-May-2016	BL0-04-B bottom 6-May-2016	BL0-09-S surface 6-May-2016	BL0-09-B bottom 6-May-2016	BL0-06-S surface 6-May-2016	BL0-06-B bottom 6-May-2016	BL0-05-A-S surface 30-Jul-2016	BL0-05-A-B bottom 30-Jul-2016	BL0-05-S surface 30-Jul-2016	BL0-05-B bottom 30-Jul-2016	BL0-05-B-S surface 30-Jul-2016	BL0-05-B-B bottom 30-Jul-2016	BL0-03-S surface 30-Jul-2016
Dissolved Metals	Aluminum (Al)	mg/L	0.00243	0.00197	0.00216	0.00230	0.00276	0.00241	<0.0030	<0.0030	0.0119	<0.0030	<0.0030	0.0033	<0.0030	0.0032	0.0081	0.0070	0.0086	0.0064	0.0066	0.0064	0.0051
	Antimony (Sb)	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.00010	<0.00010	<0.00010	<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	0.000045	0.000039	0.000043	0.000047	0.000051	0.000045	<0.00010	<0.00010	<0.00010	<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	0.00493	0.00452	0.00509	0.00499	0.00552	0.00541	0.00494	0.00412	0.00543	0.00450	0.00495	0.00476	0.00510	0.00498	0.00408	0.00371	0.00372	0.00341	0.00322	0.00350	0.00294
	Beryllium (Be)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00050	<0.00050	<0.00050	<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	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050	<0.00050	<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	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.010	<0.010	<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	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.000010	0.000014	<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	8.77	8.34	9.05	8.11	9.56	9.36	9.30	8.00	10.2	8.18	8.99	8.5	9.19	8.88	6.30	5.64	5.95	5.17	5.31	5.27	5.27
	Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<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	<0.0000050	0.0000055	0.0000065	0.0000085	0.0000072	0.0000064	<0.00010	<0.00010	<0.00010	<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	0.00068	0.00067	0.00084	0.00066	0.00075	0.00087	0.00054	0.00202	0.00065	0.00067	0.00071	0.00069	0.00066	0.00058	0.00053	0.00060	<0.00050	0.00051	<0.00050	<0.00050
	Iron (Fe)	mg/L	0.0028	0.0022	0.0025	0.0029	0.0038	0.0038	<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	<0.0000090	<0.0000090	<0.0000090	0.0000135	<0.0000090	0.0000090	<0.000050	<0.000050	0.000063	<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	0.00061	0.00059	0.00057	<0.00050	0.00056	0.00058	<0.0010	<0.0010	<0.0010	<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	5.29	4.92	5.29	4.80	5.65	5.47	5.23	4.73	5.24	4.75	5.28	4.96	5.47	5.13	3.71	3.08	3.41	2.90	3.01	3.00	2.99
	Manganese (Mn)	mg/L	0.000216	0.000169	0.000207	0.000364	0.000294	0.000481	0.000355	0.000187	0.00125	0.000190	0.000189	0.00022	0.000247	0.000214	0.000478	0.000551	0.000480	0.000809	0.000524	0.000489	0.000333
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000173	0.000167	0.000163	0.000151	0.000188	0.000179	0.000154	0.000137	0.000195	0.000145	0.000159	0.000151	0.000175	0.000160	0.000147	0.000114	0.000123	0.000094	0.000106	0.000097	0.000081
	Nickel (Ni)	mg/L	0.000372	0.000382	0.000397	0.000368	0.000424	0.000591	<0.00050	<0.00050	0.00067	<0.00050	<0.00050	0.00056	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.691	0.623	0.680	0.608	0.731	0.702	0.69	0.61	0.76	0.63	0.69	0.65	0.72	0.67	0.56	0.47	0.52	0.44	0.46	0.44	0.42
	Selenium (Se)	mg/L	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.0010	<0.0010	<0.0010	<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	0.360	0.345	0.344	0.383	0.394	0.373	0.37	0.35	0.36	0.34	0.36	0.49	0.37	0.35	0.44	0.36	0.40	0.36	0.36	0.36	0.31
	Silver (Ag)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<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	1.25	1.14	1.26	1.15	1.34	1.29	1.24	1.09	1.47	1.13	1.23	1.20	1.27	1.21	0.949	0.802	0.886	0.758	0.775	0.766	0.710
	Strontium (Sr)	mg/L	0.00698	0.00653	0.00718	0.00641	0.00758	0.00718	0.00706	0.00618	0.00784	0.00644	0.00706	0.0066	0.00732	0.00699	0.00552	0.00447	0.00495	0.00424	0.00433	0.00432	0.00388
	Thallium (Tl)	mg/L	0.0000023	<0.0000020	0.0000023	<0.0000020	0.0000021	0.0000024	<0.00010	<0.00010	<0.00010	<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	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.00010	<0.00010	0.00035	<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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.010	<0.010	<0.010	<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	0.000731	0.000699	0.000743	0.000612	0.000768	0.000742	0.000647	0.000612	0.000677	0.000610	0.000707	0.000607	0.000716	0.000690	0.000541	0.000359	0.000428	0.000287	0.000321	0.000315	0.000273
	Vanadium (V)	mg/L	0.000080	0.000074	0.000062	0.000064	0.000088	0.000077	<0.0010	<0.0010	<0.0010	<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	0.00055	0.00064	0.00098	0.00091	0.00101	0.00095	<0.0030	<0.0030	0.0081	<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.61: Dissolved metal concentrations at Mary Lake south basin water quality monitoring stations, Mary River Project CREMP, 2016.

	Parameters	Units	Summer Sampling Event							Fall Sampling Event													
			BL0-03-B	BL0-04-S	BL0-04-B	BL0-09-S	BL0-09-B	BL0-06-S	BL0-06-B	BL0-05-A-S	BL0-05-A-B	BL0-05-S	BL0-05-B	BL0-05-B-S	BL0-05-B-B	BL0-03-S	BL0-03-B	BL0-04	BL0-04-B	BL0-09-S	BL0-09-B	BL0-06-S	BL0-06-B
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom
			30-Jul-2016	30-Jul-2016	30-Jul-2016	30-Jul-2016	30-Jul-2016	29-Jul-2016	29-Jul-2016	23-Aug-2016	23-Aug-2016	23-Aug-2016	23-Aug-2016	23-Aug-2016	23-Aug-2016	24-Aug-2016	24-Aug-2016	23-Aug-2016	23-Aug-2016	23-Aug-2016	23-Aug-2016	23-Aug-2016	23-Aug-2016
Dissolved Metals	Aluminum (Al)	mg/L	0.0056	0.0083	0.0084	0.0081	0.0065	0.0062	0.0057	0.0763	0.0801	0.0663	0.0496	0.0670	0.0621	0.0264	0.0200	0.0513	0.0599	0.0552	0.0440	0.0627	0.0560
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00322	0.00341	0.00376	0.00323	0.00313	0.00329	0.00337	0.00571	0.00553	0.00499	0.00395	0.00525	0.00540	0.00416	0.00342	0.00463	0.00527	0.00448	0.00353	0.00473	0.00483
	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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	5.11	5.53	5.21	5.12	4.94	4.98	5.01	8.17	8.31	7.58	5.37	7.70	7.56	7.29	6.07	7.2	7.79	7.27	5.25	7.34	7.18
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	<0.00050	<0.00050	0.00084	<0.00050	<0.00050	<0.00050	<0.00050	0.00067	0.00069	0.00075	0.00053	0.00065	0.00076	0.00056	<0.00050	0.00150	0.0438	0.00398	0.0271	0.00284	0.0115
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.053	0.058	0.049	0.047	0.048	0.055	<0.030	<0.030	0.042	0.058	0.039	0.039	0.048	0.055
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000068	0.000066	0.000053	0.000067	0.000057	0.000067	<0.000050	<0.000050	0.000051	0.000084	<0.000050	0.000061	0.000060	0.000075
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	2.94	3.20	2.88	3.00	2.82	2.83	2.81	4.73	4.89	4.52	3.17	4.49	4.40	4.26	3.64	4.33	4.51	4.30	3.08	4.31	4.35
	Manganese (Mn)	mg/L	0.000507	0.000420	0.00117	0.000480	0.000938	0.000738	0.000743	0.00158	0.00157	0.00126	0.00445	0.00125	0.00155	0.00105	0.00125	0.00113	0.00213	0.00110	0.00167	0.00129	0.00180
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000078	0.000091	0.000103	0.000100	0.000080	0.000087	0.000087	0.000164	0.000165	0.000137	0.000093	0.000137	0.000141	0.000104	0.000083	0.000137	0.000148	0.000131	0.000087	0.000141	0.000126
	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	<0.00050	<0.00050
	Potassium (K)	mg/L	0.42	0.48	0.46	0.46	0.43	0.43	0.43	0.67	0.68	0.64	0.50	0.63	0.63	0.53	0.49	0.60	0.66	0.59	0.49	0.61	0.62
	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	0.34	0.39	0.37	0.36	0.35	0.34	0.34	0.67	0.68	0.62	0.52	0.64	0.63	0.61	0.47	0.60	0.65	0.57	0.48	0.61	0.62
	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	0.758	0.804	0.763	0.770	0.762	0.741	0.728	1.21	1.27	1.11	0.819	1.09	1.13	0.927	0.844	1.02	1.17	0.999	0.806	1.03	1.07
	Strontium (Sr)	mg/L	0.00382	0.00469	0.00424	0.00427	0.00400	0.00408	0.00398	0.00697	0.00721	0.00644	0.00442	0.00640	0.00632	0.00545	0.00456	0.0059	0.00676	0.00587	0.00436	0.00612	0.00609
	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	0.000271	0.000345	0.000294	0.000320	0.000257	0.000272	0.000272	0.000815	0.000882	0.000695	0.000305	0.000699	0.000674	0.000505	0.000357	0.000579	0.000783	0.000570	0.000315	0.000608	0.000657
	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	0.0040	<0.0030	0.0053	<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.62: Summary of the magnitude of difference in aqueous metal concentrations between Mary Lake and Reference Lake 3 in 2016, and at Mary Lake between 2016 and the baseline period for winter, summer, and fall sampling events, Mary River Project CREMP. No reference lake data were collected in winter 2016.

Variable	Mary Lake North Basin					Mary Lake South Basin				
	2016 vs Reference Lake 3		2016 vs Baseline			2016 vs Reference Lake 3		2016 vs Baseline		
	Summer	Fall	Winter	Summer	Fall	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	1.2	1.9	0.9	0.9	1.0	0.7	0.9	0.9	0.8	0.9
Hardness (as $CaCO_3$)	1.2	2.2	0.9	0.8	0.9	0.7	1.0	1.0	0.8	0.9
Total Suspended Solids (TSS)	0.9	1.0	1.0	1.0	1.0	0.9	1.0	1.0	0.6	1.0
Total Dissolved Solids (TDS)	1.0	2.2	0.9	0.7	0.8	0.8	1.0	0.7	0.9	0.7
Turbidity	7.3	4.0	2.0	0.6	1.6	6.8	4.9	0.3	0.8	1.4
Alkalinity (as $CaCO_3$)	1.4	2.4	1.0	0.9	1.0	0.7	1.0	0.9	0.7	0.9
Total Ammonia	1.0	0.8	0.3	0.2	0.2	1.2	0.5	0.2	0.3	0.3
Nitrate	1.0	1.0	0.8	0.2	0.2	1.0	1.0	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)	0.8	1.0	0.7	0.5	0.6	0.8	1.0	1.1	0.9	0.9
Dissolved Organic Carbon	0.4	0.7	1.8	0.7	1.0	0.6	0.4	1.4	1.1	0.9
Total Organic Carbon	0.4	0.7	1.2	0.6	1.1	0.6	0.5	1.1	1.0	0.9
Total Phosphorus	0.9	0.4	0.5	0.6	0.5	1.5	0.7	1.0	1.4	1.2
Phenols	0.9	0.7	1.6	2.4	2.3	0.9	2.3	1.2	2.3	7.0
Bromide (Br)	1.0	1.0	0.5	0.5	0.7	1.0	1.0	0.9	0.4	0.4
Chloride (Cl)	0.9	2.6	0.7	0.7	0.8	0.9	1.2	0.6	0.5	0.5
Sulphate (SO_4)	0.1	0.3	0.5	0.3	0.3	0.2	0.3	0.6	0.3	0.4
Aluminum (Al)	8.4	6.4	0.6	0.5	0.3	12	13	0.4	0.7	1.7
Antimony (Sb)	1.0	1.2	1.0	1.0	1.2	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)	0.8	1.2	0.9	0.7	0.9	0.6	0.7	1.0	0.8	0.9
Beryllium (Be)	1.0	0.2	1.5	1.5	0.2	1.0	1.0	1.1	1.5	2.0
Bismuth (Bi)	1.0	0.1	1.0	1.0	0.1	1.0	1.0	1.0	1.0	1.0
Boron (B)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cadmium (Cd)	1.0	1.0	0.8	0.9	0.7	1.0	1.0	0.2	0.9	0.8
Calcium (Ca)	1.3	2.2	0.9	0.8	0.9	0.8	1.0	0.9	0.8	0.9
Chromium (Cr)	1.0	1.0	1.6	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)	0.8	1.3	0.9	0.6	0.4	0.8	0.9	0.9	0.7	0.9
Iron (Fe)	1.1	1.7	1.4	0.3	0.5	1.4	1.6	1.0	0.6	1.0
Lead (Pb)	1.0	2.0	0.9	0.7	1.4	1.2	1.2	0.9	0.7	1.1
Lithium (Li)	1.0	1.0	0.4	0.3	0.2	1.0	1.0	0.2	0.3	0.4
Magnesium (Mg)	1.3	2.0	0.9	0.9	0.9	0.7	1.0	1.0	0.8	1.0
Manganese (Mn)	3.5	8.1	1.2	0.7	0.5	3.4	2.7	0.5	1.2	1.4
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0
Molybdenum (Mo)	0.8	1.6	1.0	0.7	0.9	0.7	0.9	1.1	0.9	0.9
Nickel (Ni)	1.0	1.1	1.5	0.9	0.9	1.0	1.0	1.0	1.0	1.0
Potassium (K)	0.7	1.0	1.0	1.0	1.1	0.5	0.7	1.0	1.0	1.2
Selenium (Se)	1.0	0.1	2.8	2.4	0.1	1.0	1.0	1.2	1.4	1.9
Silicon (Si)	1.4	1.9	1.0	0.9	0.9	1.0	1.4	0.8	0.8	1.3
Silver (Ag)	1.0	5.0	1.6	1.8		1.0	1.0	1.2	1.9	2.3
Sodium (Na)	1.1	2.4	0.7	1.1	0.9	0.9	1.2	0.9	1.0	1.0
Strontium (Sr)	0.7	1.4	0.9	0.8	0.9	0.6	0.7	0.7	0.7	0.8
Thallium (Tl)	1.0	0.1	1.6	1.5	0.1	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	0.1	1.0	1.0	0.1	1.0	1.0	1.0	1.0	1.0
Uranium (U)	2.2	5.8	0.8	0.7	0.7	1.4	2.2	0.9	0.7	0.9
Vanadium (V)	1.0	0.5	1.0	1.0	0.3	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.6	1.6	3.0	1.0	1.0	1.7	1.4	1.4

Denotes slight elevation (mean variable concentration 3 to 5 times higher than respective mean reference ot baseline period value).

Denotes moderate elevation (mean variable concentration 5 to 10 times higher than respective mean reference or baseline period value).

Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference or baseline period value).

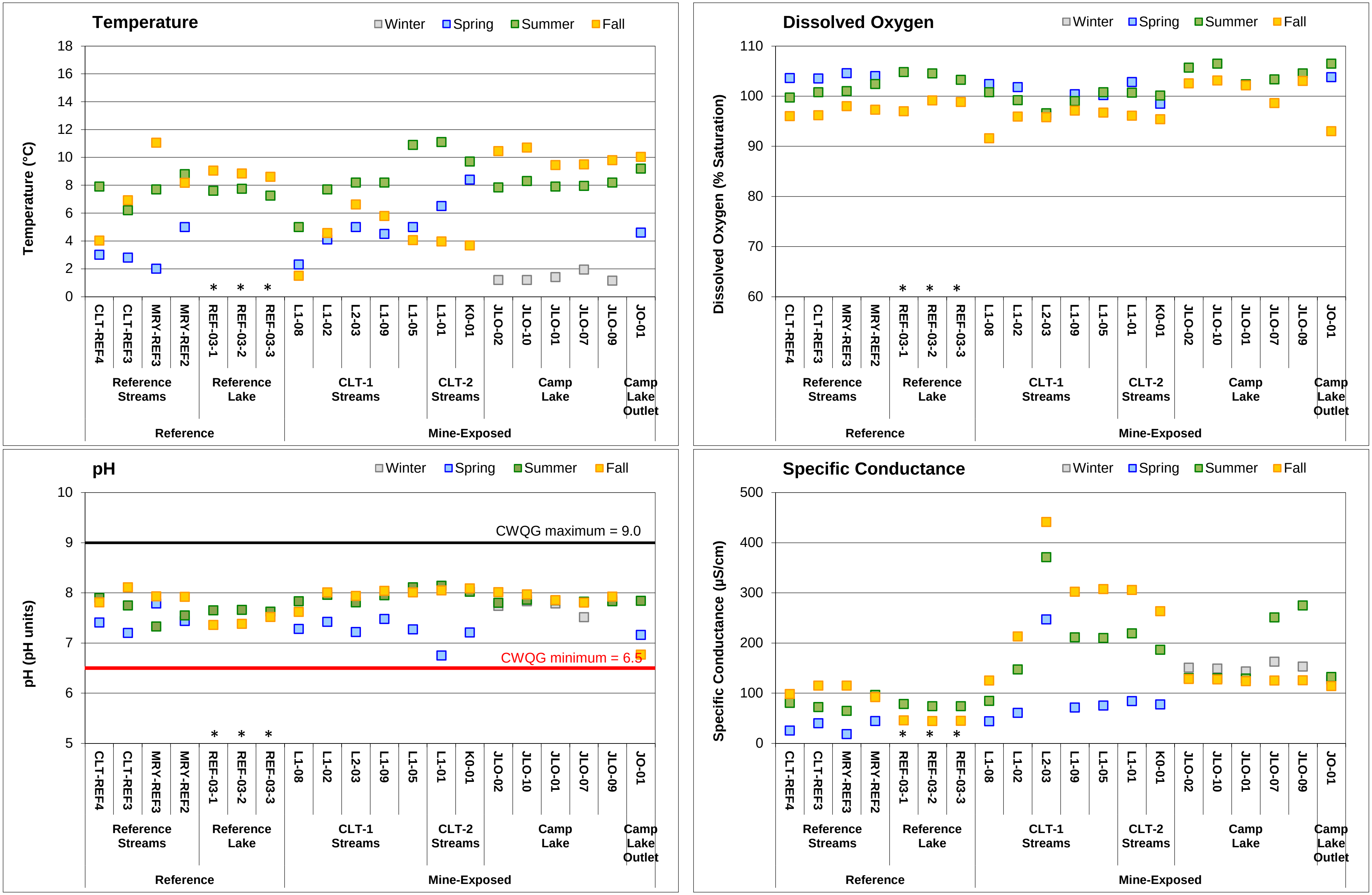


Figure C.1: Comparison of *in-situ* water quality variables measured at Camp Lake system water quality monitoring stations in winter, spring, summer, and fall 2016, Mary River Project CREMP. Lake values represent mean of surface and bottom *in-situ* water quality measurements. * Reference Lake 3 (REF-03) was not sampled in winter.

Figure C.2: Temporal comparison of water chemistry at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods in the fall. 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 Camp Lake Tributaries.

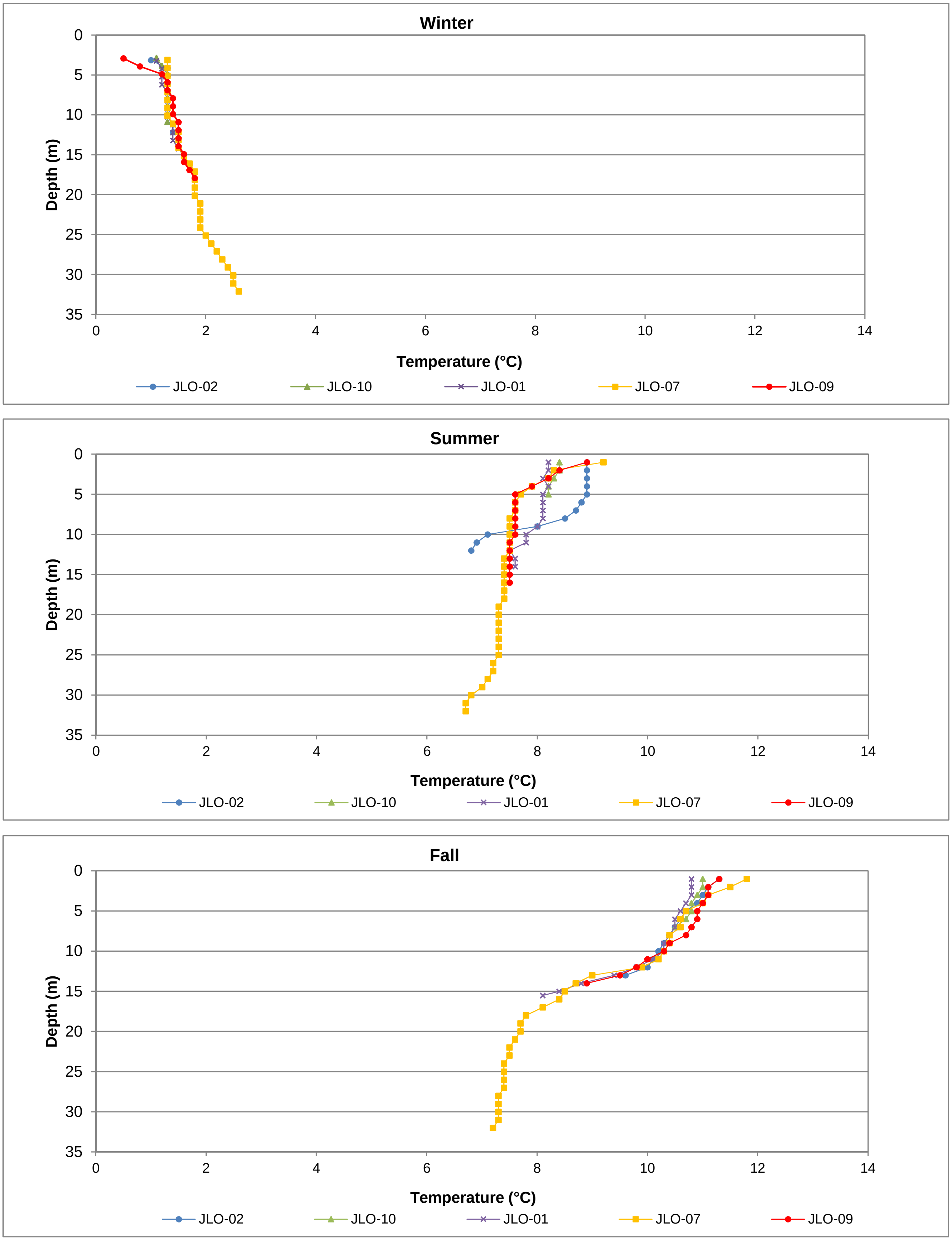


Figure C.3: Vertical profiles of temperature measured at Camp Lake in winter, summer and fall, 2016.

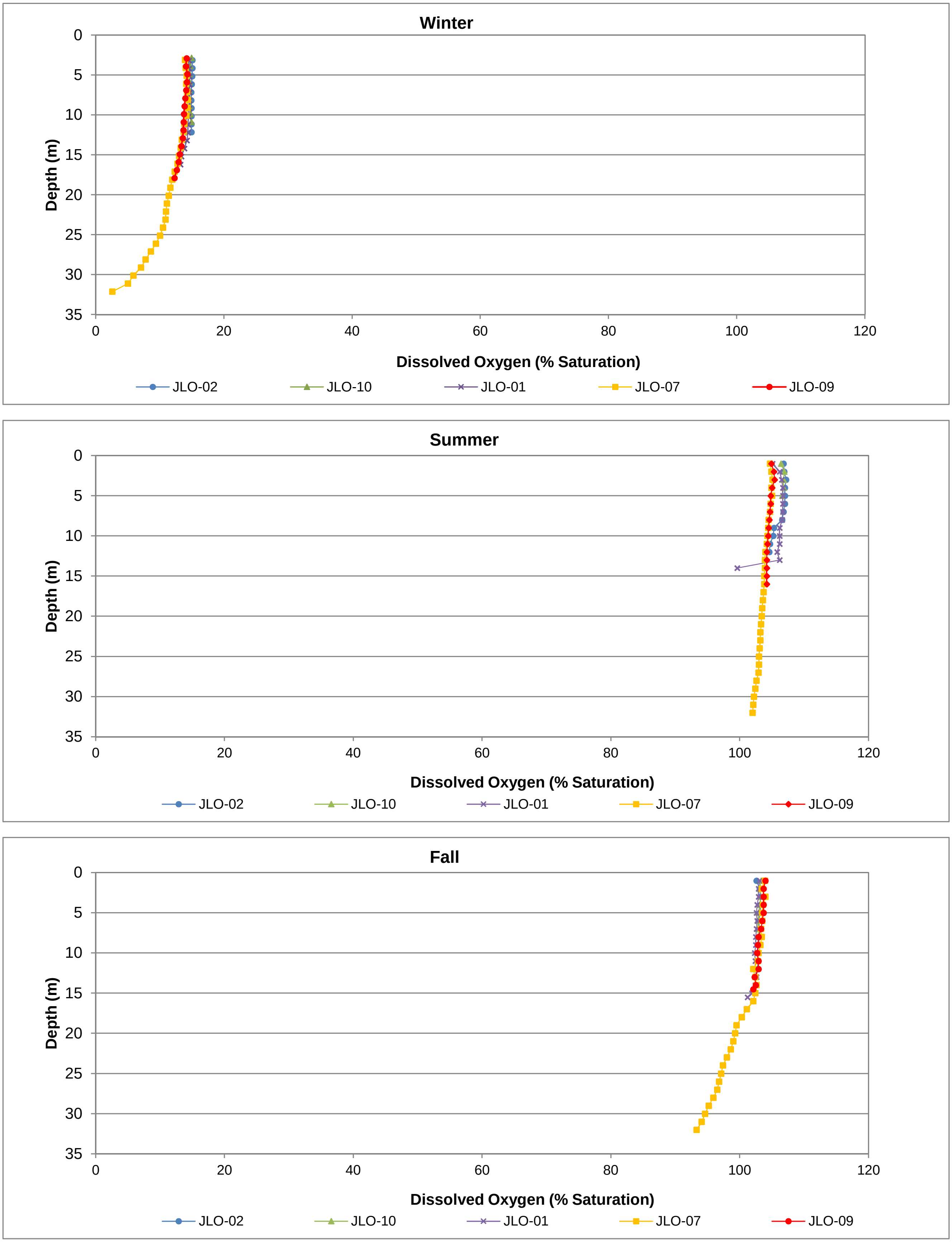


Figure C.4: Vertical profiles of dissolved oxygen measured at Camp Lake in winter, summer, and fall, 2016.

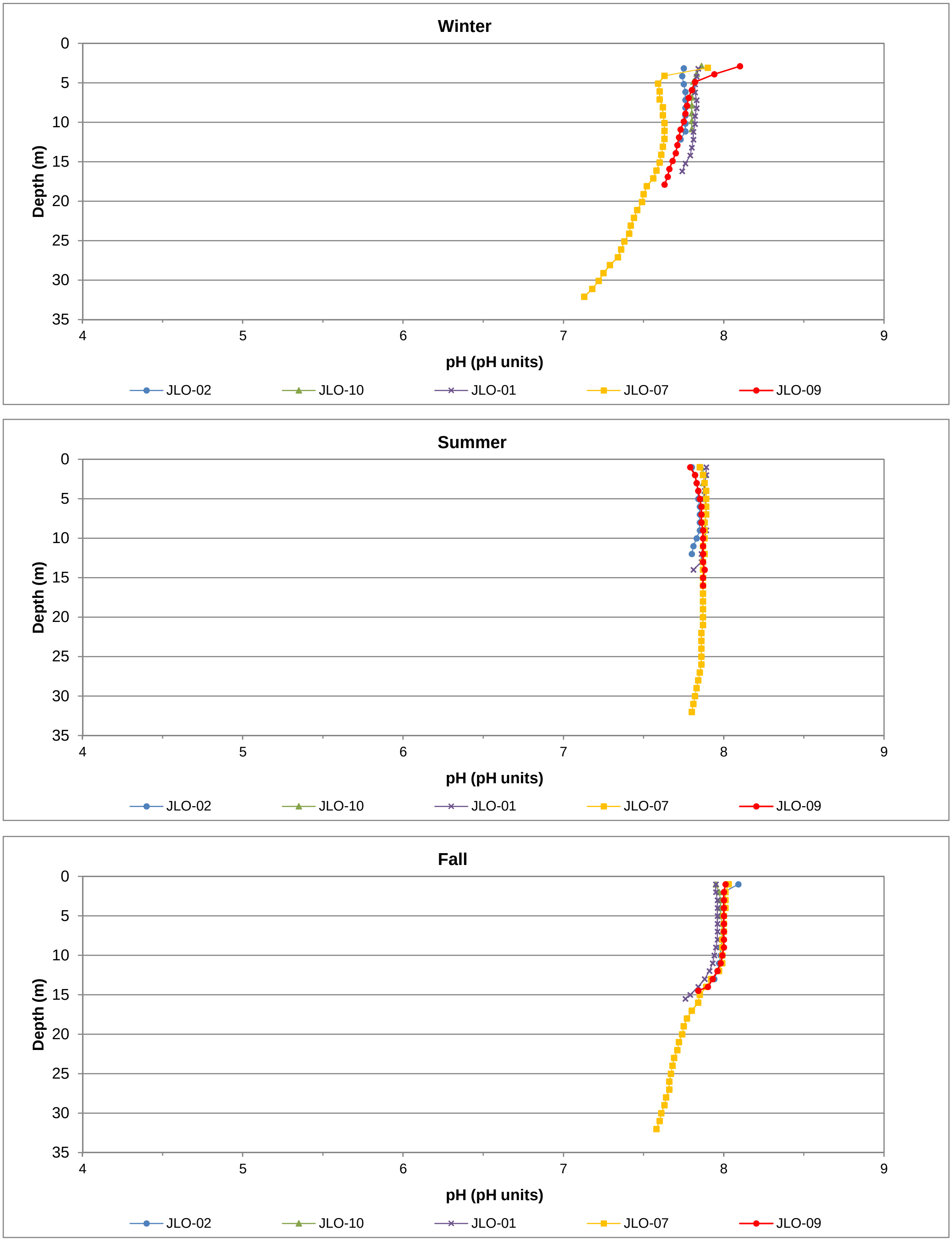


Figure C.5: Vertical profiles of pH measured at Camp Lake in winter, summer and fall, 2016.

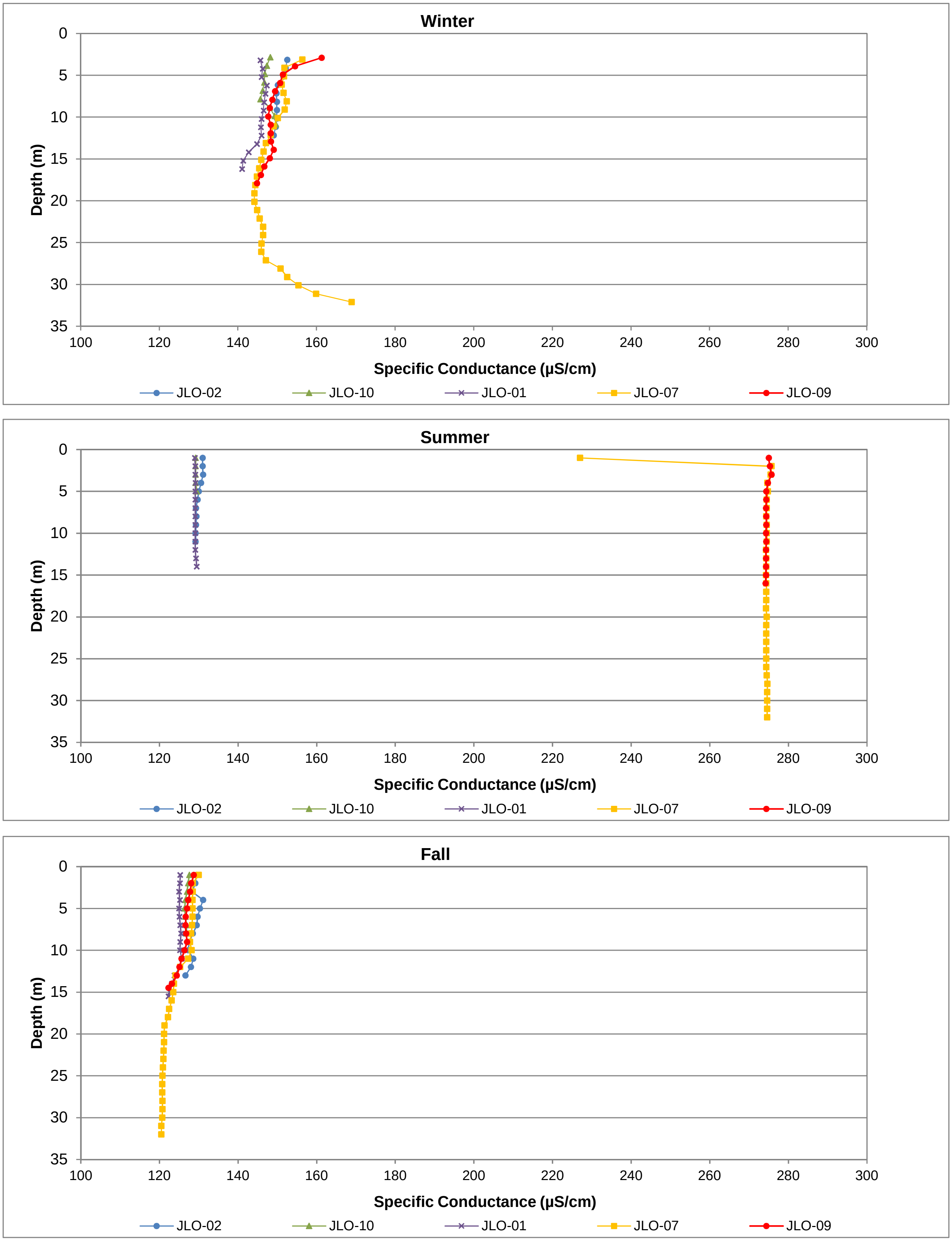


Figure C.6: Vertical profiles of conductivity measured at Camp Lake in winter, summer, and fall, 2016.

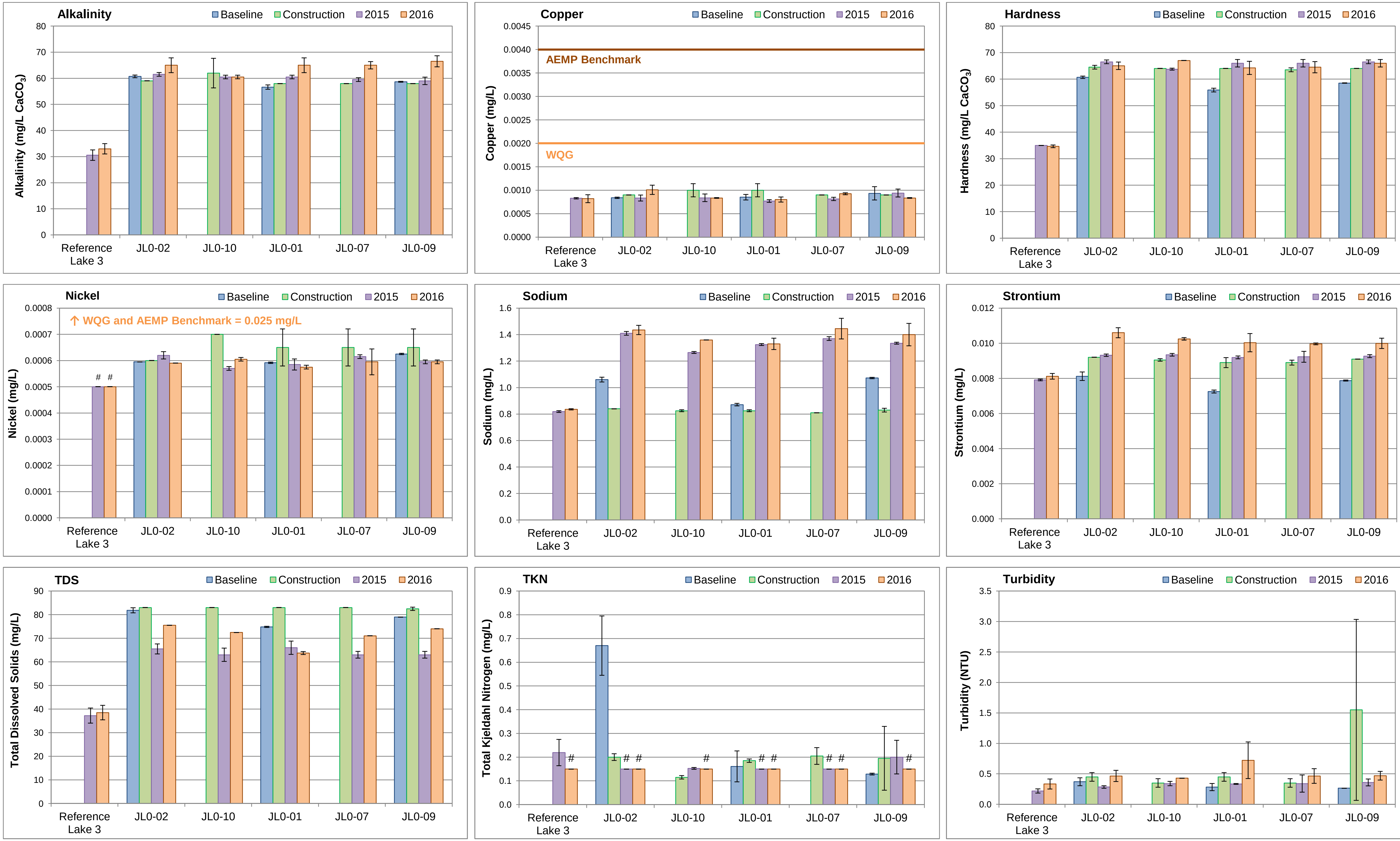


Figure C.7: Temporal comparison of water chemistry at Camp Lake (JLO) for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods during fall. Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Camp Lake.

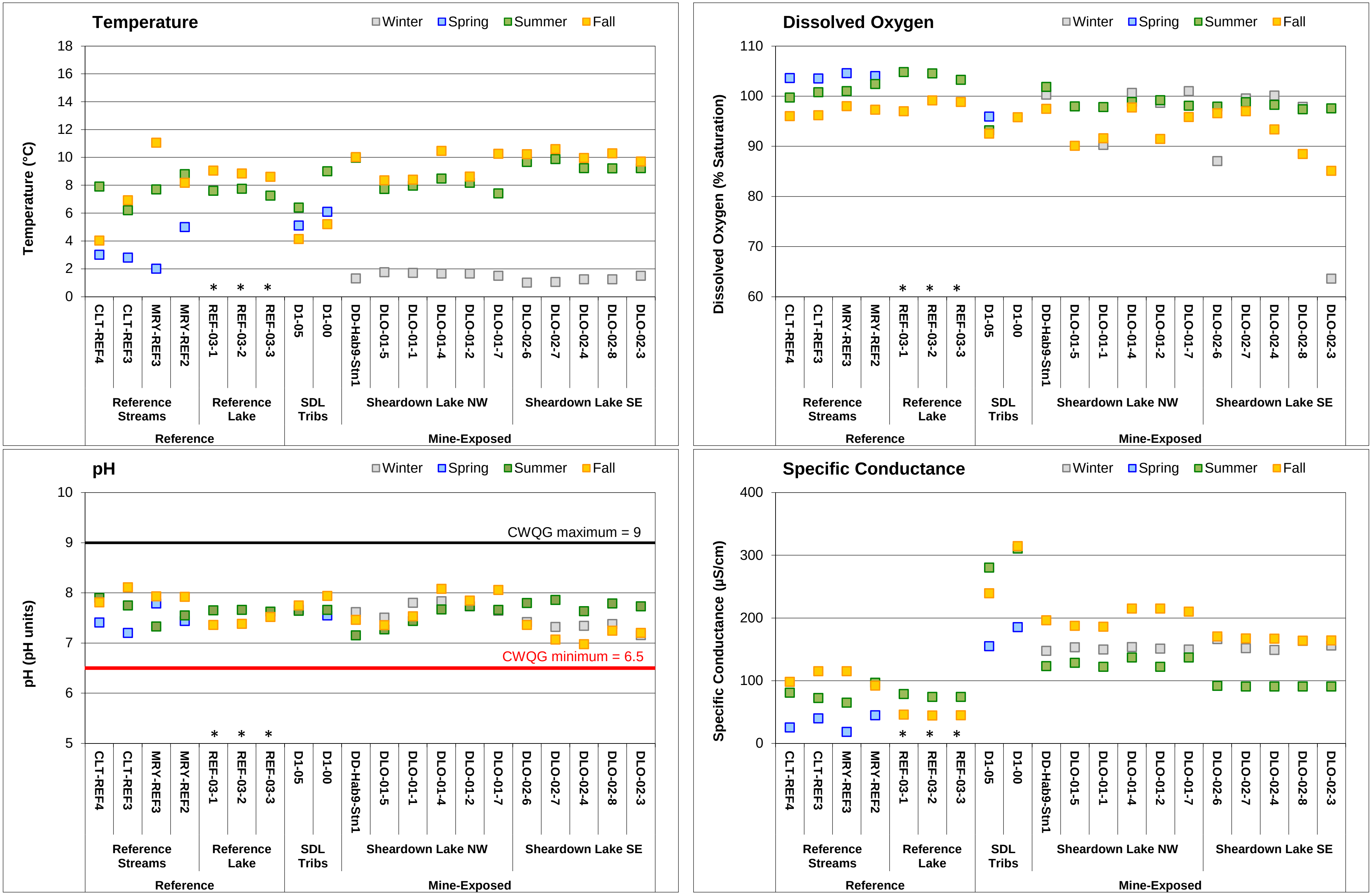


Figure C.8: Comparison of *in-situ* water quality variables measured at Sheardown Lake system water quality monitoring stations in winter, spring, summer, and fall 2016, Mary River Project CREMP. Lake values represent mean of surface and bottom *in-situ* water quality measurements. * Reference Lake 3 (REF-03) was not sampled in winter.

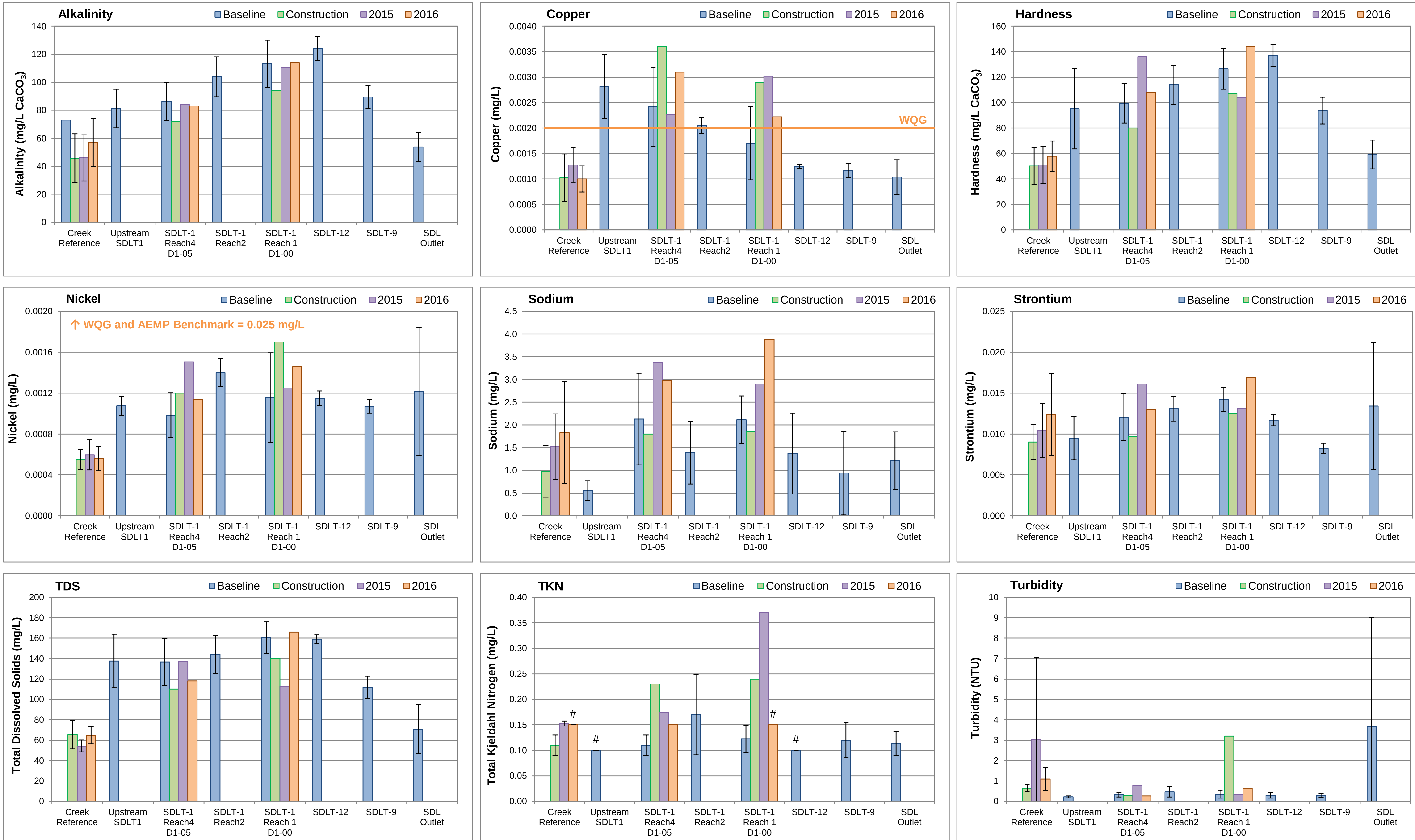


Figure C.9: Temporal comparison of water chemistry at Sheardown Lake Tributaries (SDLT) for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods during fall. Values represent mean ± SD. Creek reference includes the CLT-REF and MRY-REF series stations (mean ± SD; n = 4). 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.

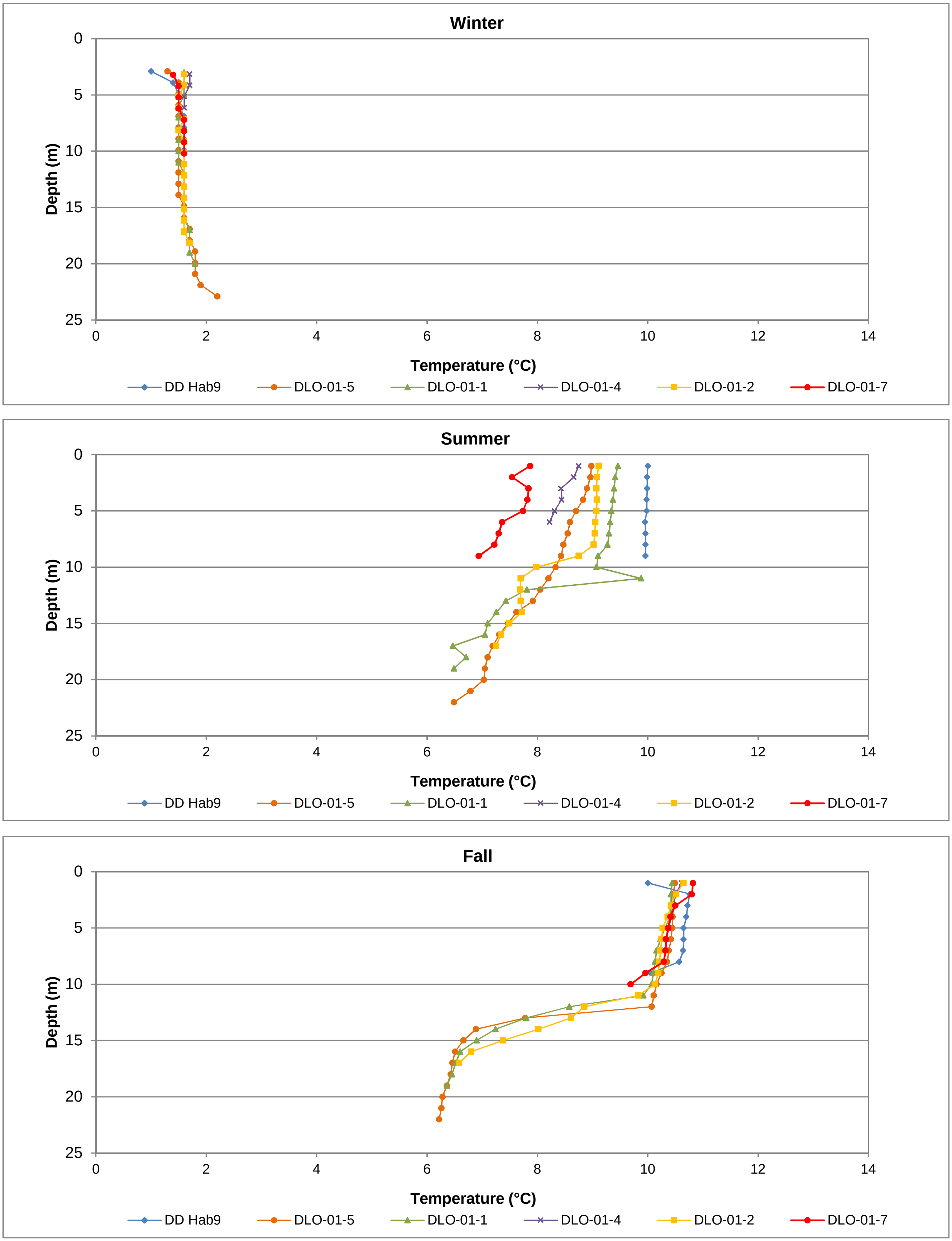
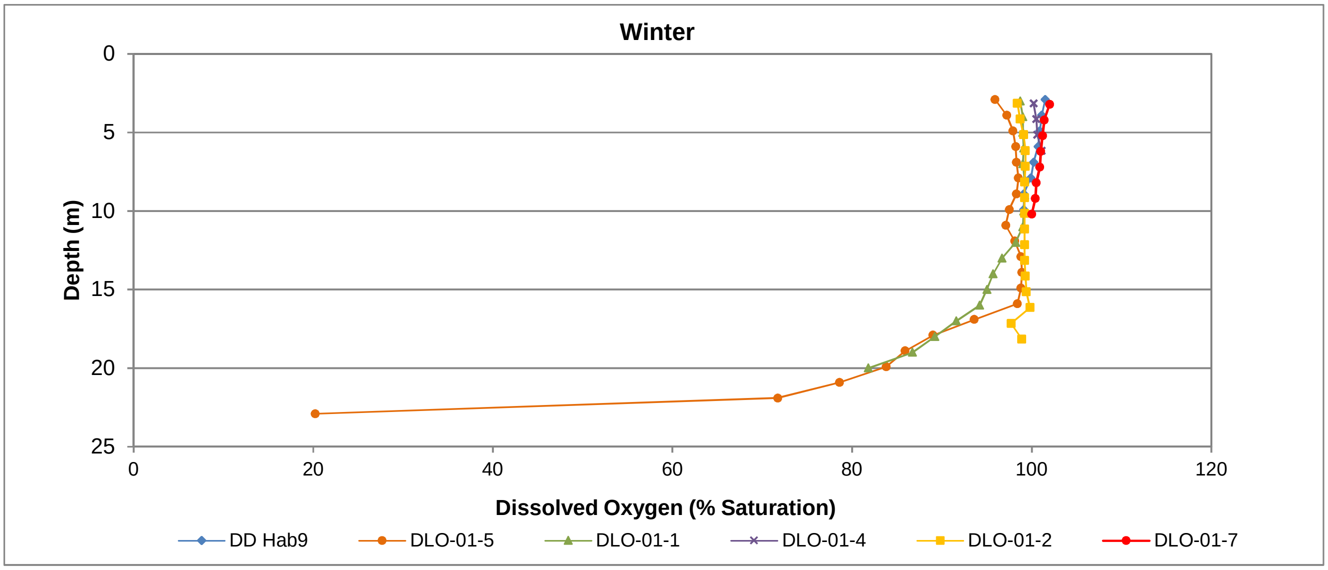
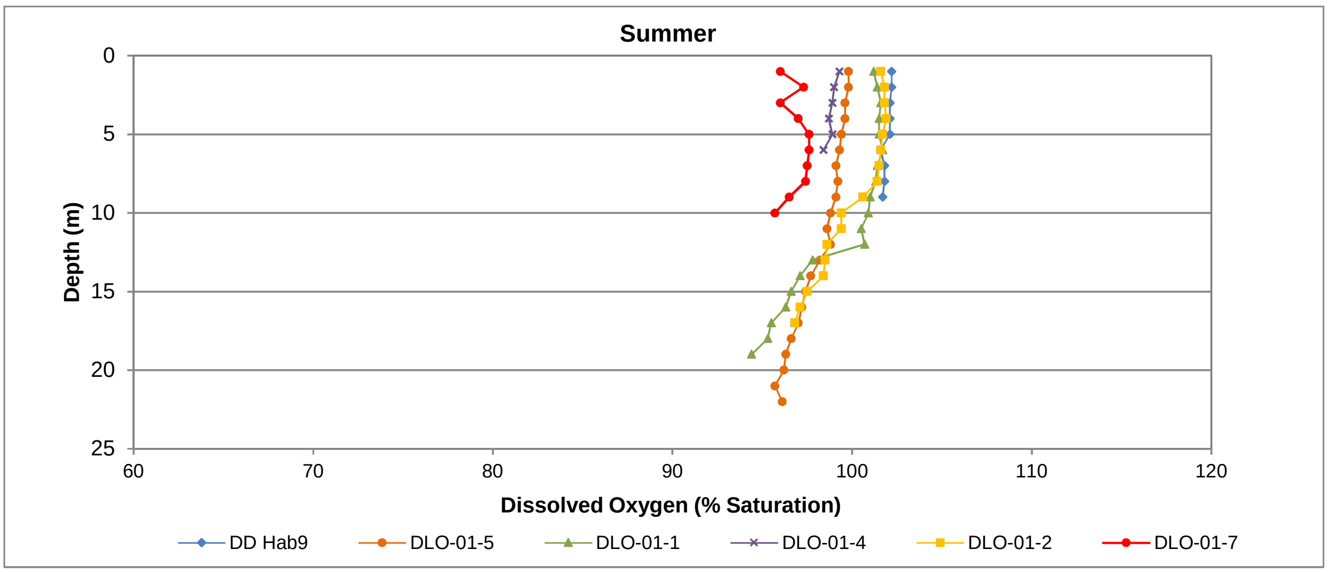


Figure C.10: Vertical profiles of temperature measured at Sheardown Lake NW in winter, summer, and fall, 2016.





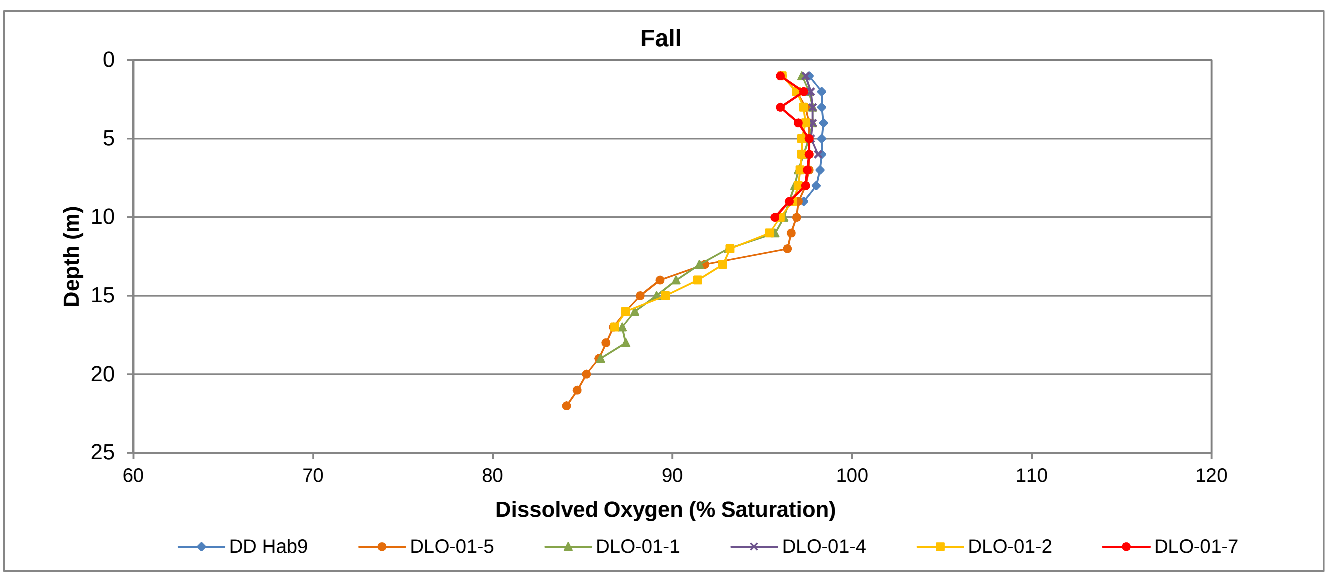


Figure C.11: Vertical profiles of dissolved oxygen measured at Sheardown Lake NW in winter, summer, and fall, 2016.

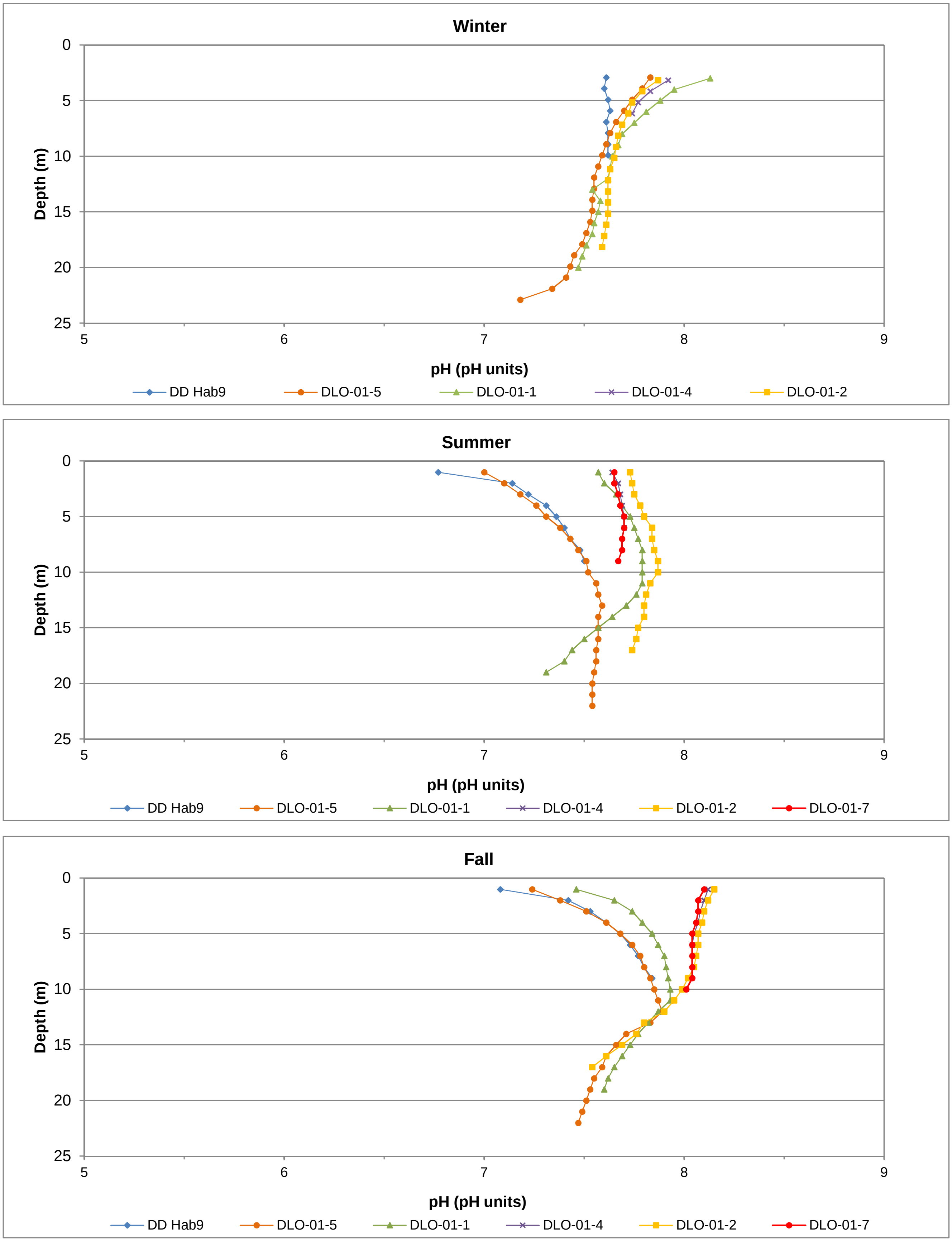


Figure C.12: Vertical profiles of pH measured at Sheardown Lake NW in winter, summer, and fall, 2016.

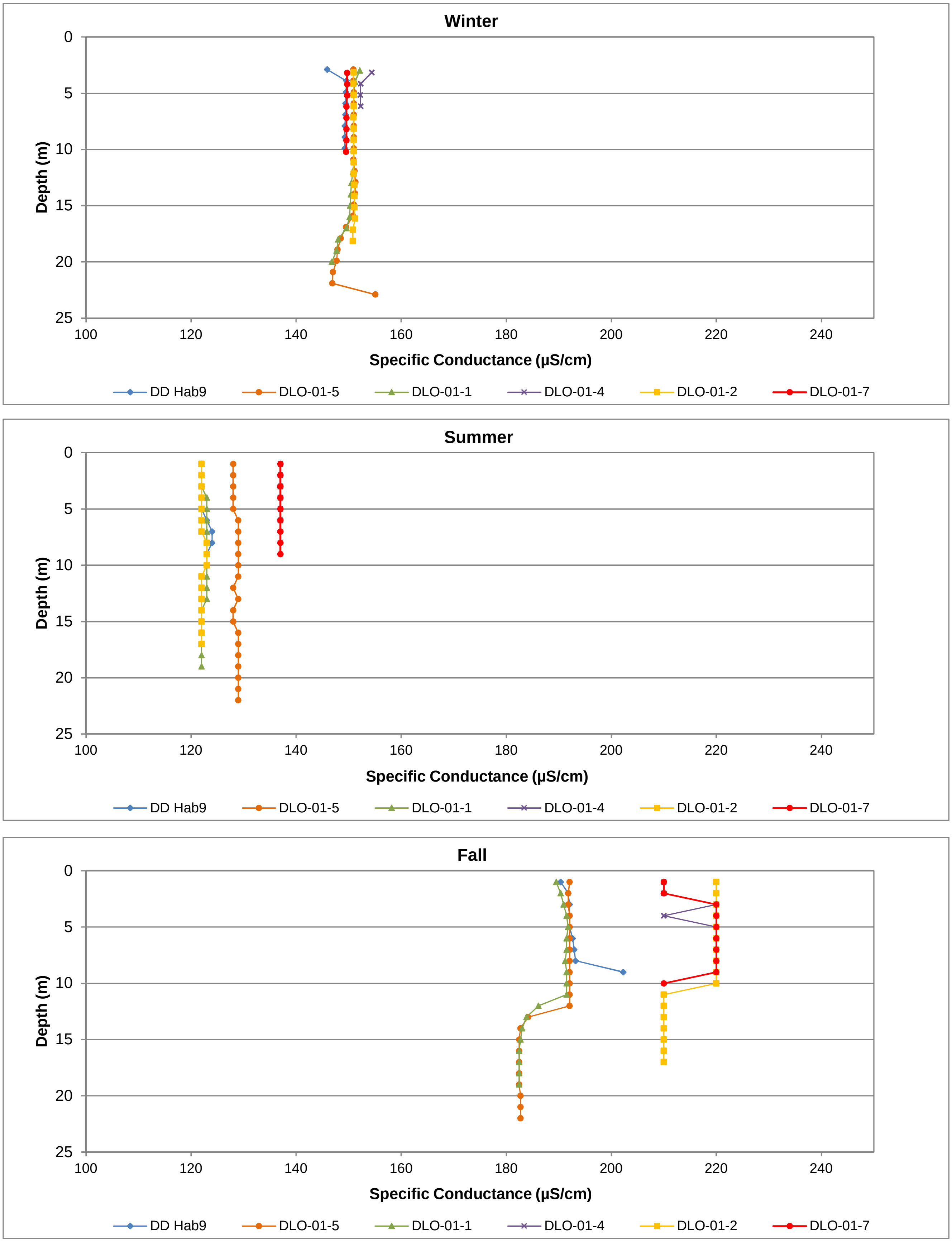


Figure C.13: Vertical profiles of conductivity measured at Sheardown Lake NW in winter, summer, and fall, 2016.

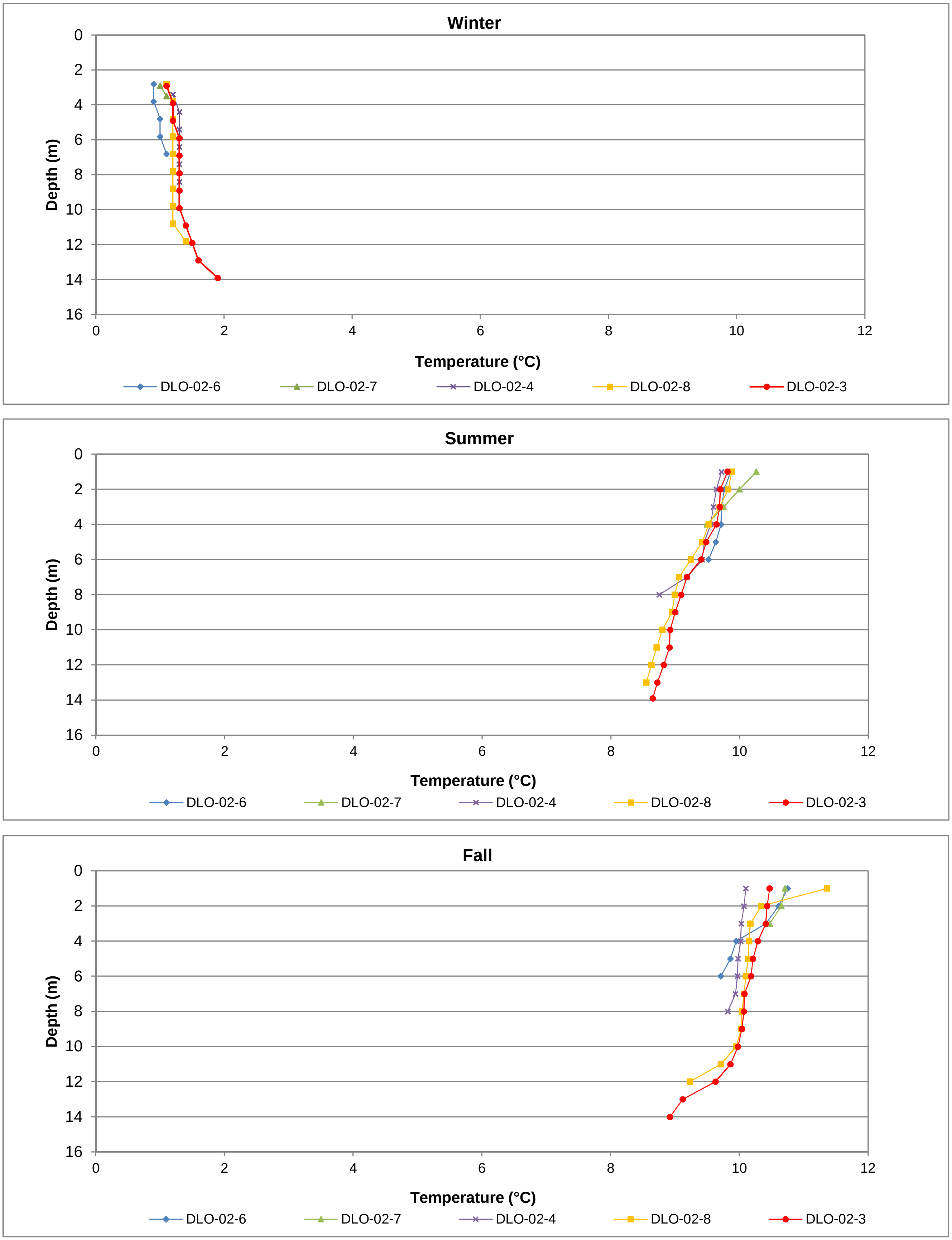
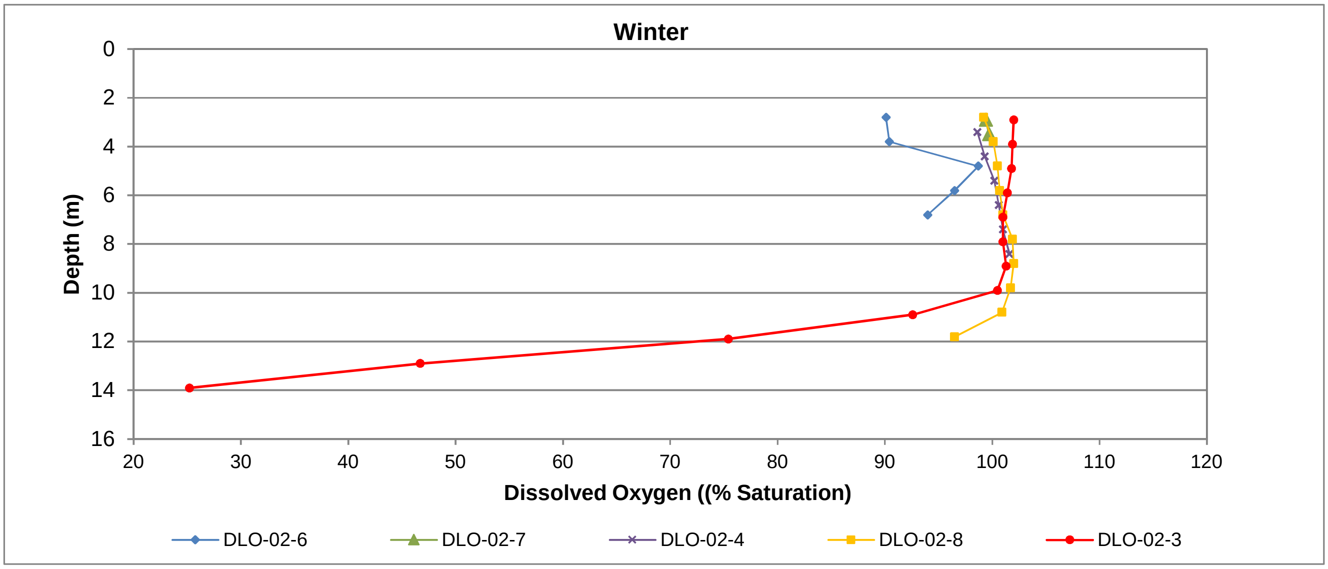
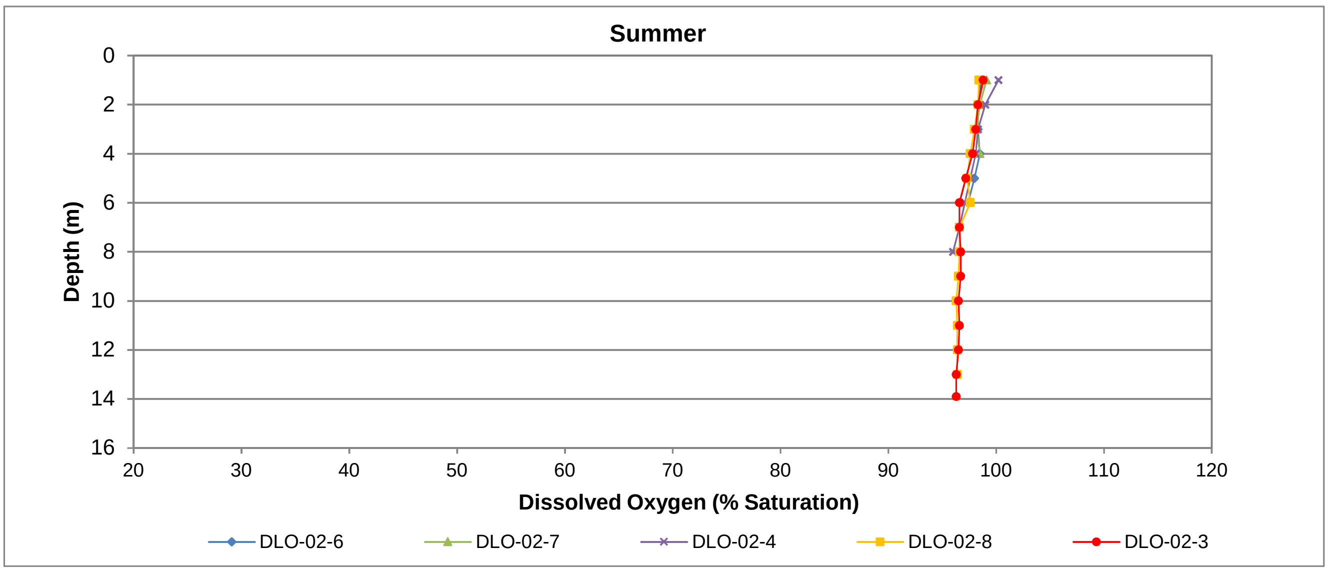


Figure C.14: Vertical profiles of temperature measured at Sheardown Lake SE in winter, summer, and fall, 2016.





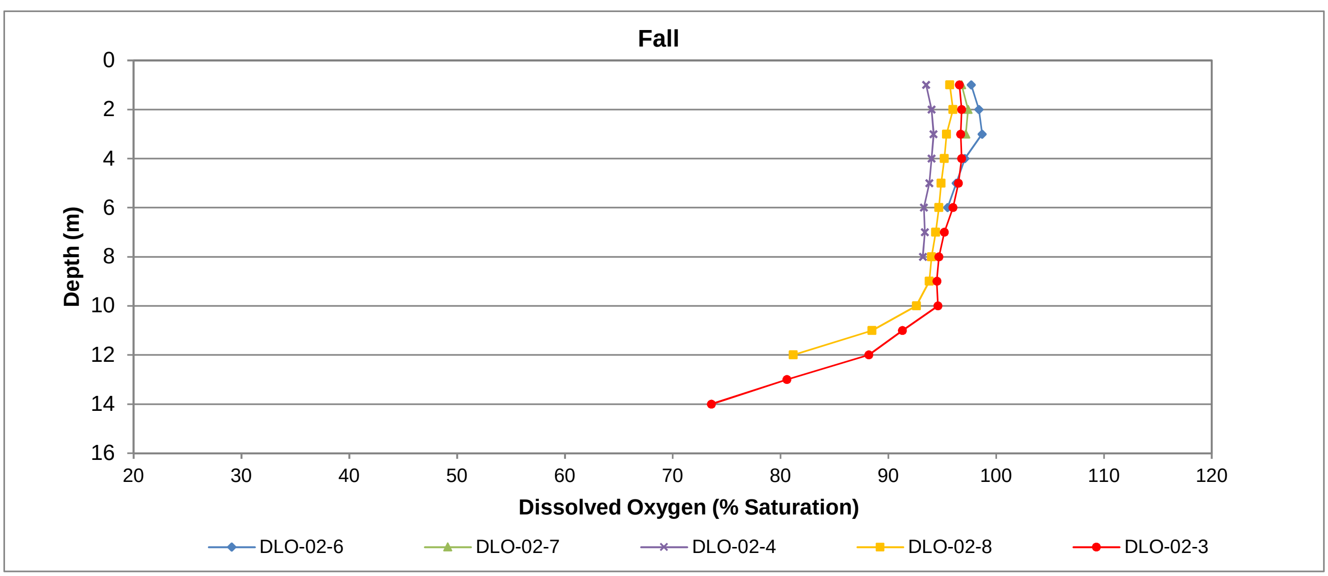


Figure C.15: Vertical profiles of dissolved oxygen measured at Sheardown Lake SE in winter, summer, and fall, 2016.

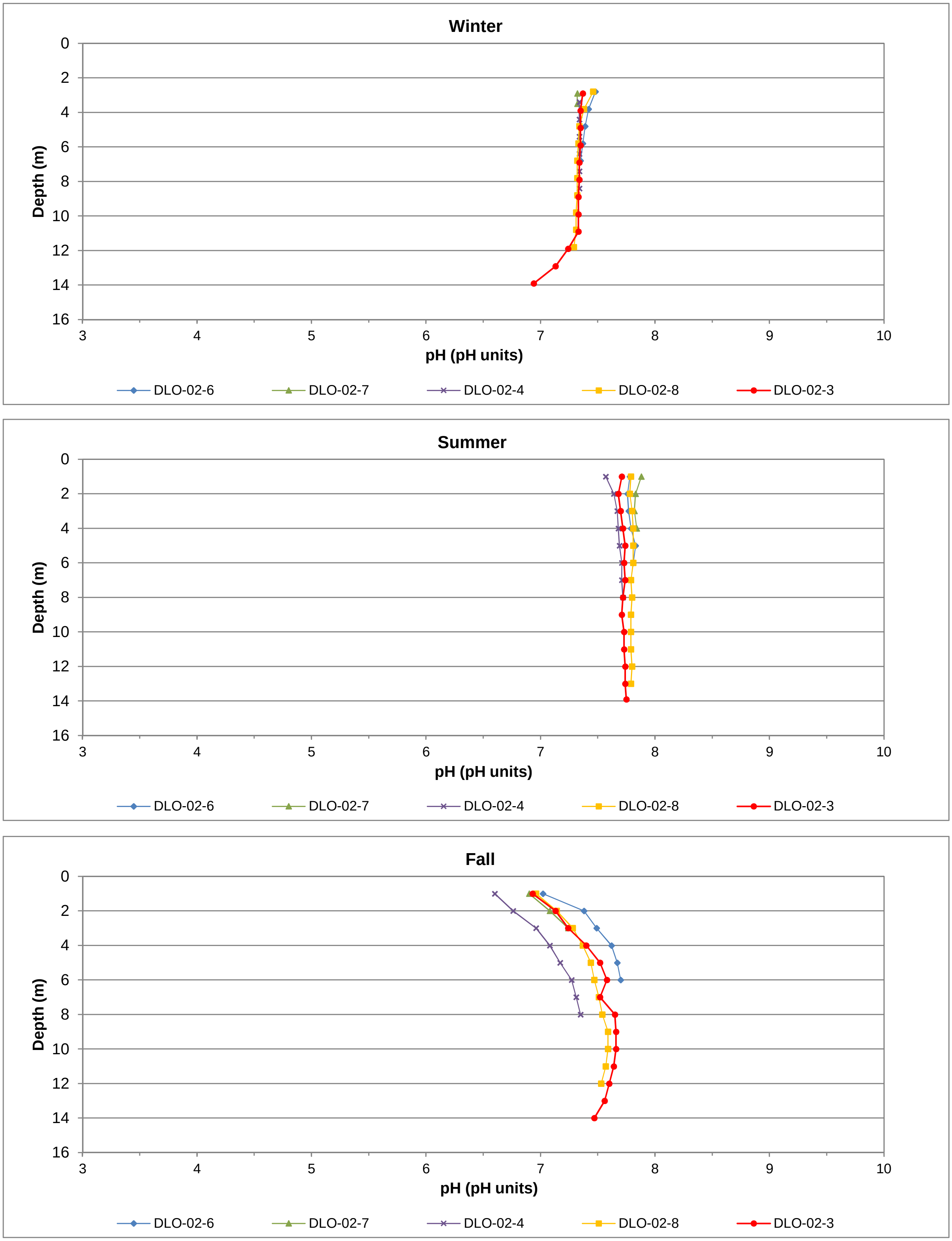


Figure C.16: Vertical profiles of pH measured at Sheardown Lake SE in winter, summer, and fall, 2016.

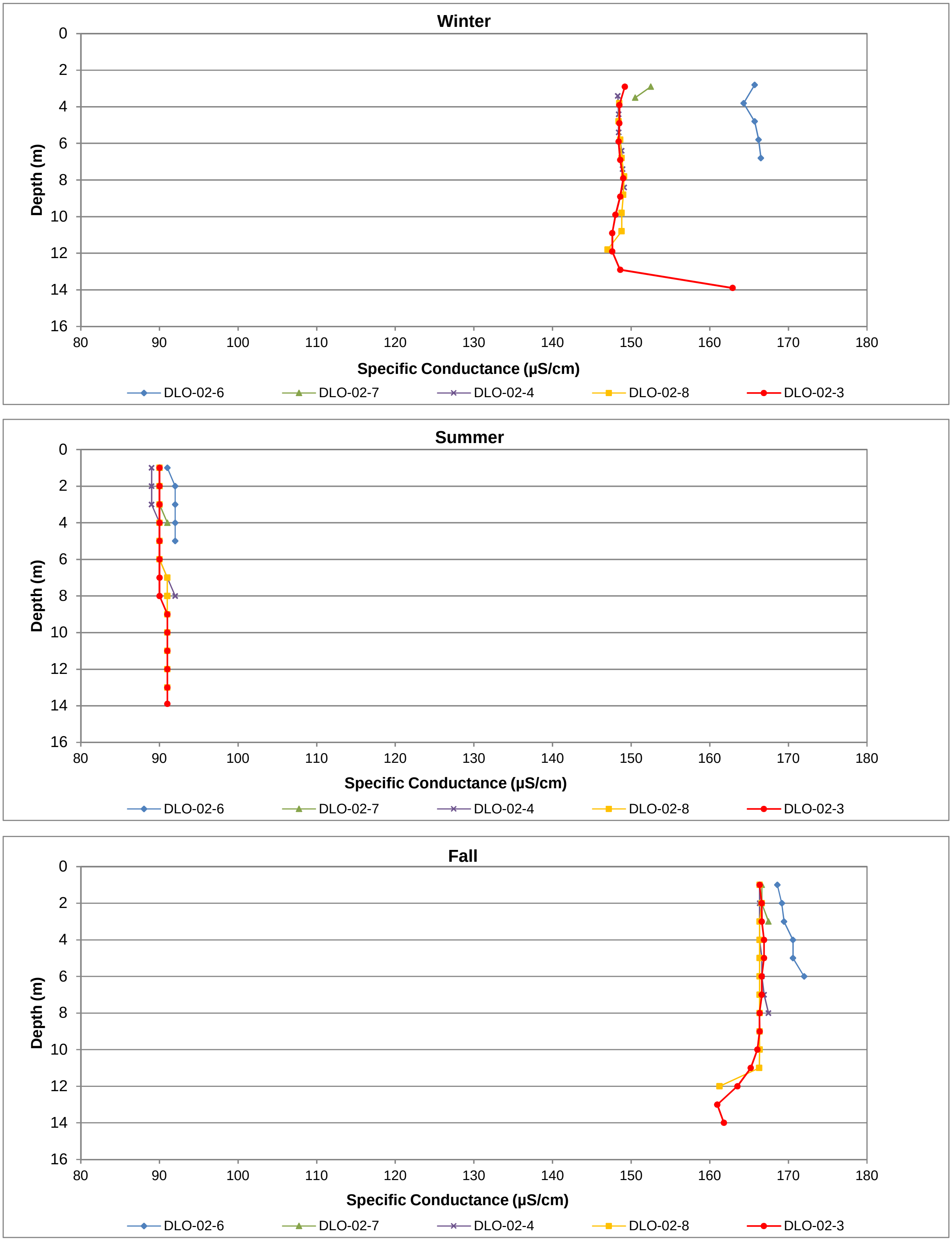


Figure C.17: Vertical profiles of conductivity measured at Sheardown Lake SE in winter, summer, and fall, 2016.

Figure C.18: Temporal comparison of water chemistry at Sheardown Lake Northwest (DLO-01) and Sheardown Lake Southeast (DLO-02) for mine baseline (2005 - 2013), construction (2014), and operational (2015, 2016) periods during fall. 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).

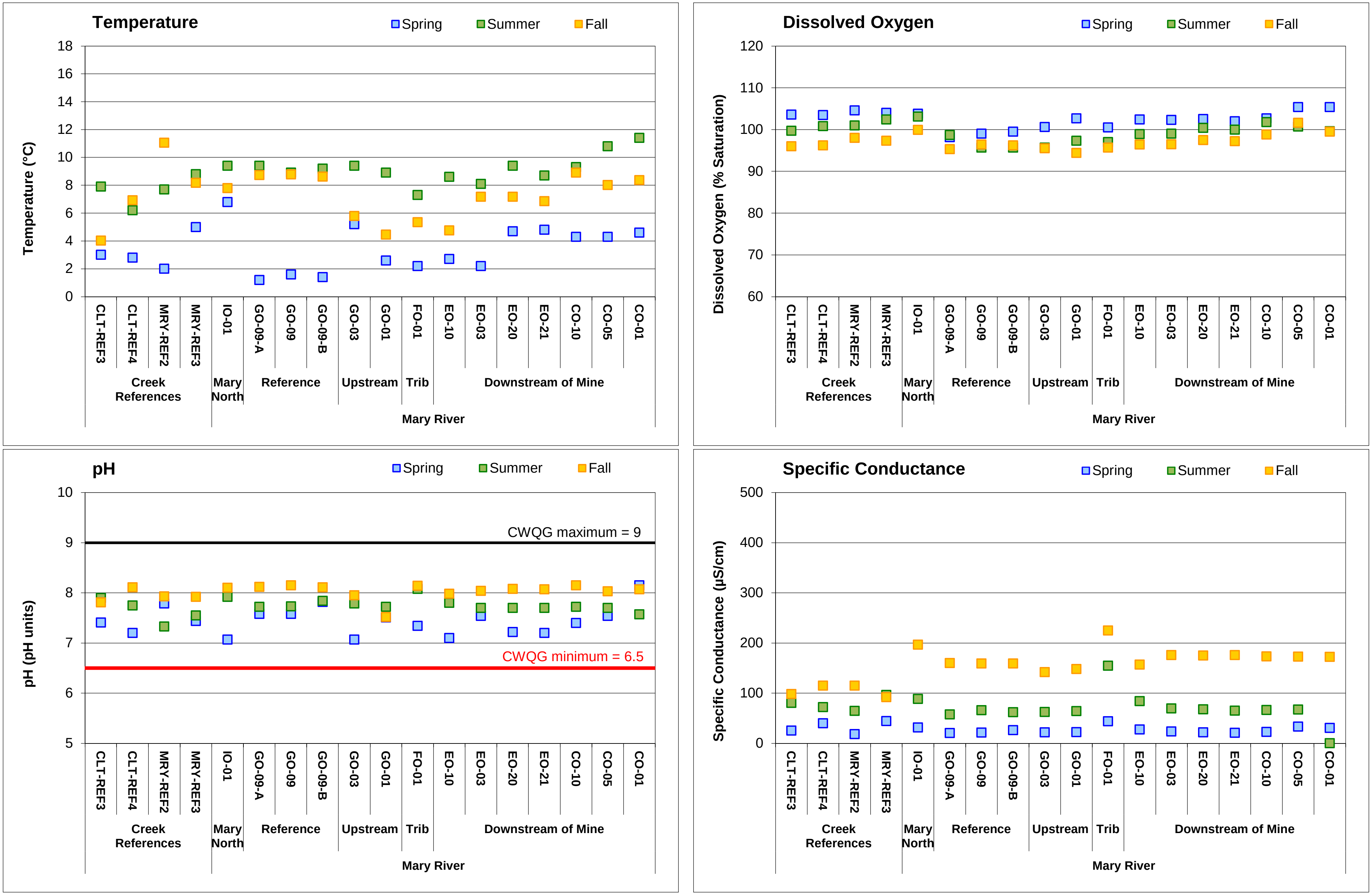


Figure C.19: Comparison of in-situ water quality variables measured at Mary River water quality monitoring stations in spring, summer, and fall 2016, Mary River Project CREMP.

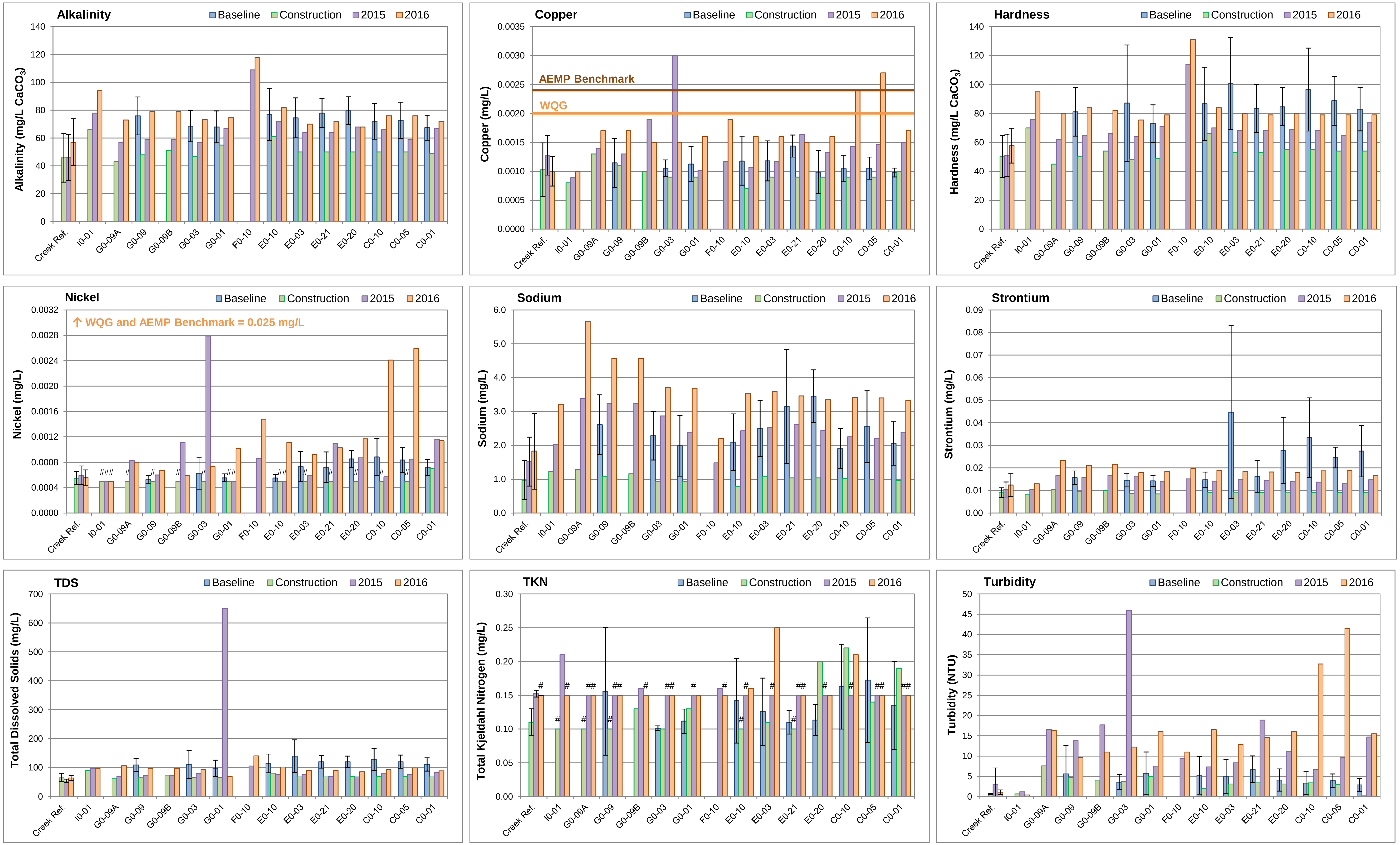


Figure C.20: Temporal comparison of water chemistry at Mary River stations for mine baseline (2005 - 2013), construction (2014) and operational (2015, 2016) periods in the fall. Values represent mean ± SD. Creek reference includes the CLT-REF and MRY-REF series stations (mean ± SD; n = 4). Pound symbol (#) 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.

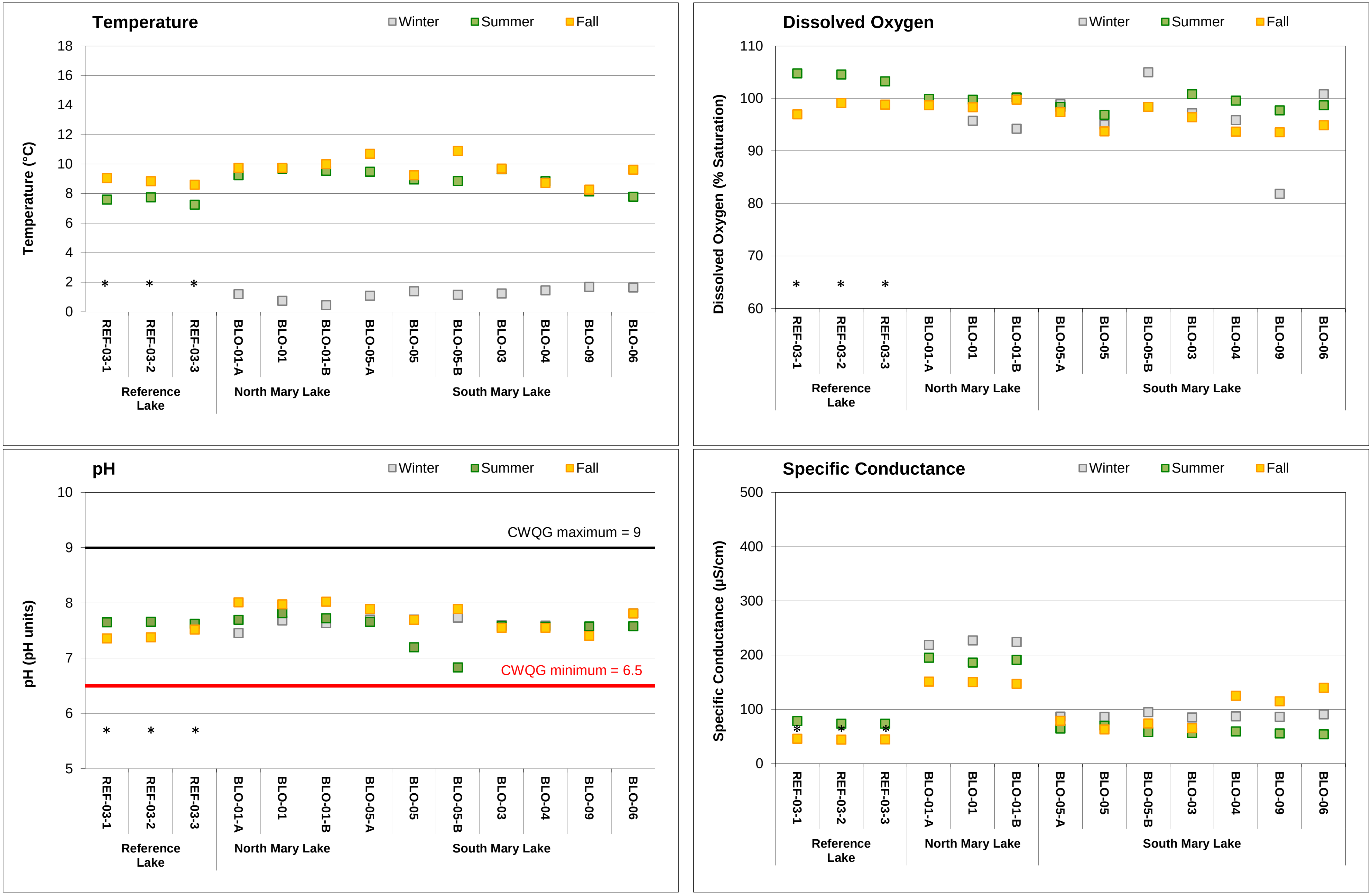


Figure C.21: Comparison of *in-situ* water quality variables measured at Mary Lake water quality monitoring stations in winter, summer, and fall 2016, Mary River Project CREMP. Lake values represent mean of surface and bottom *in-situ* water quality measurements. *Reference Lake 3 (REF-03) was not sampled in winter.

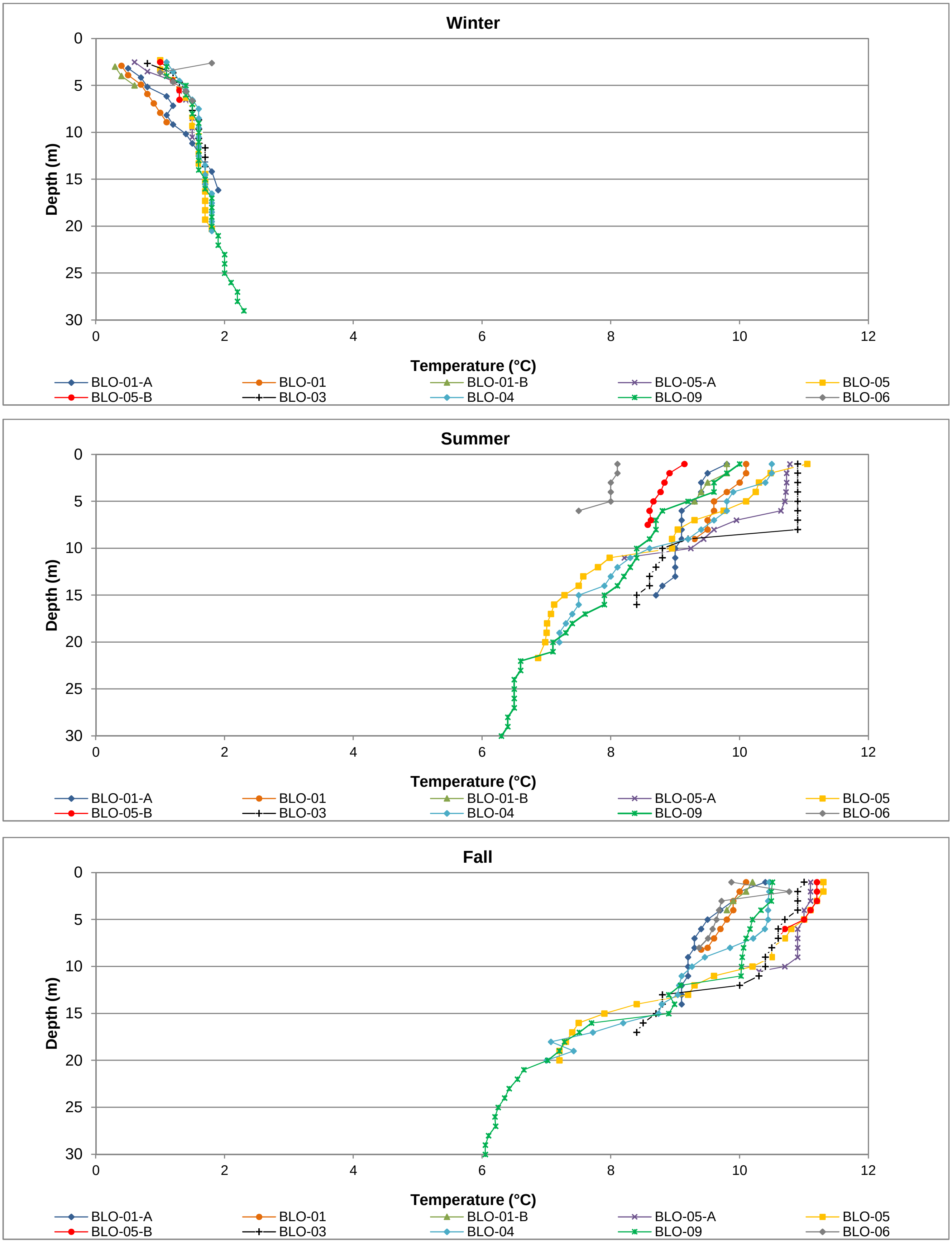


Figure C.22: Vertical profiles of temperature measured at Mary Lake in winter, summer, and fall, 2016.

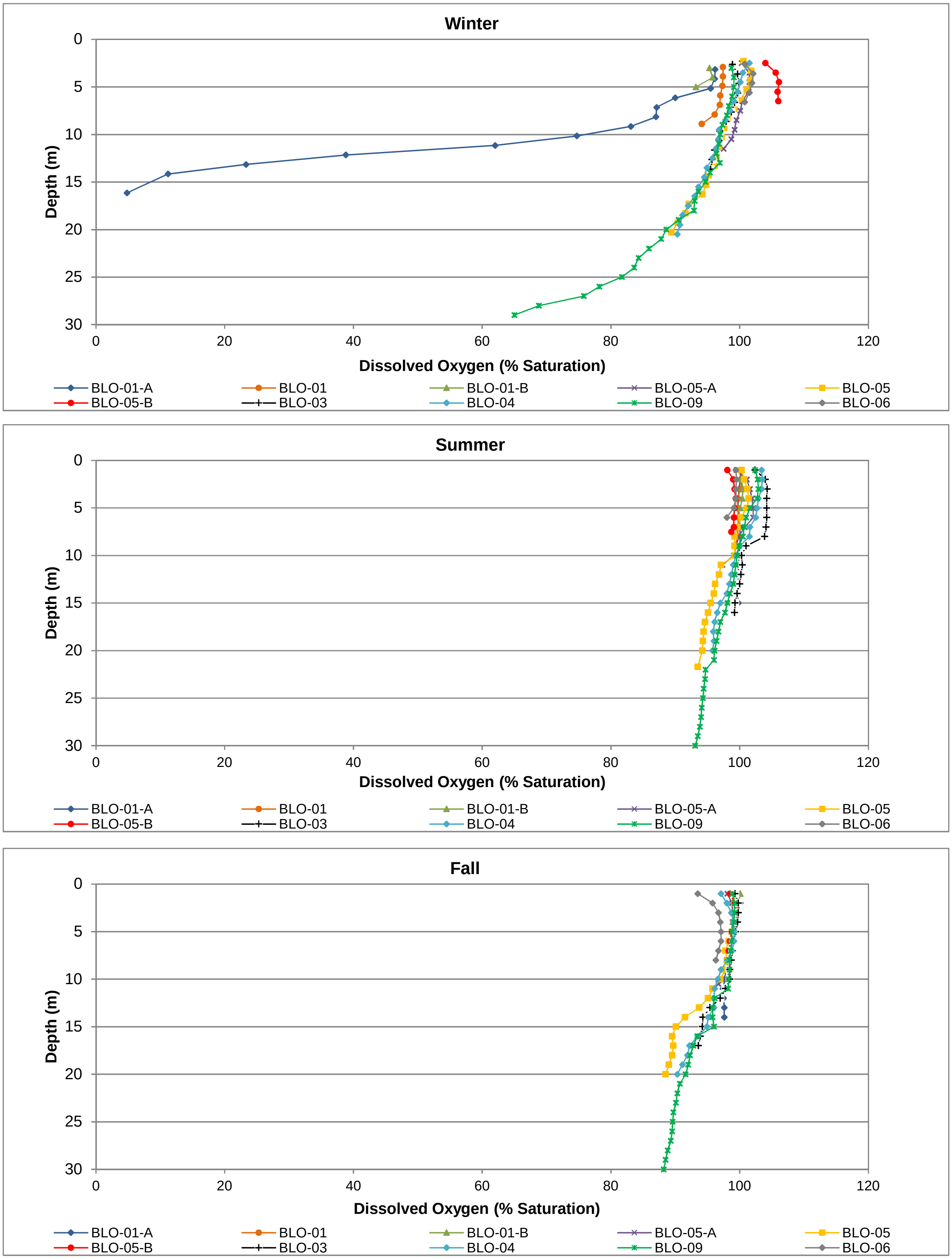


Figure C.23: Vertical profiles of dissolved oxygen measured at Mary Lake in winter, summer, and fall, 2016.

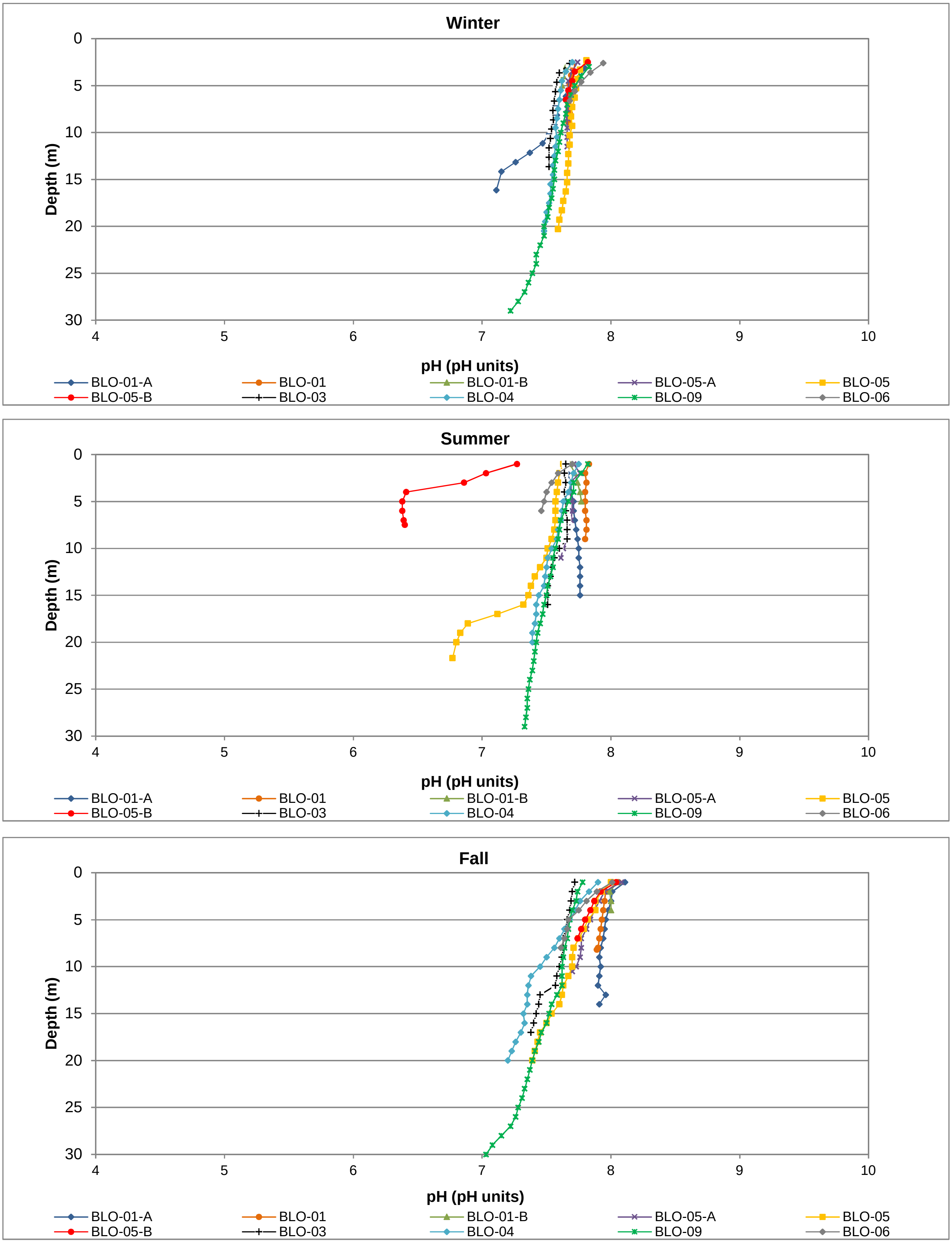


Figure C.24: Vertical profiles of pH measured at Mary Lake in winter, summer, and fall, 2016.

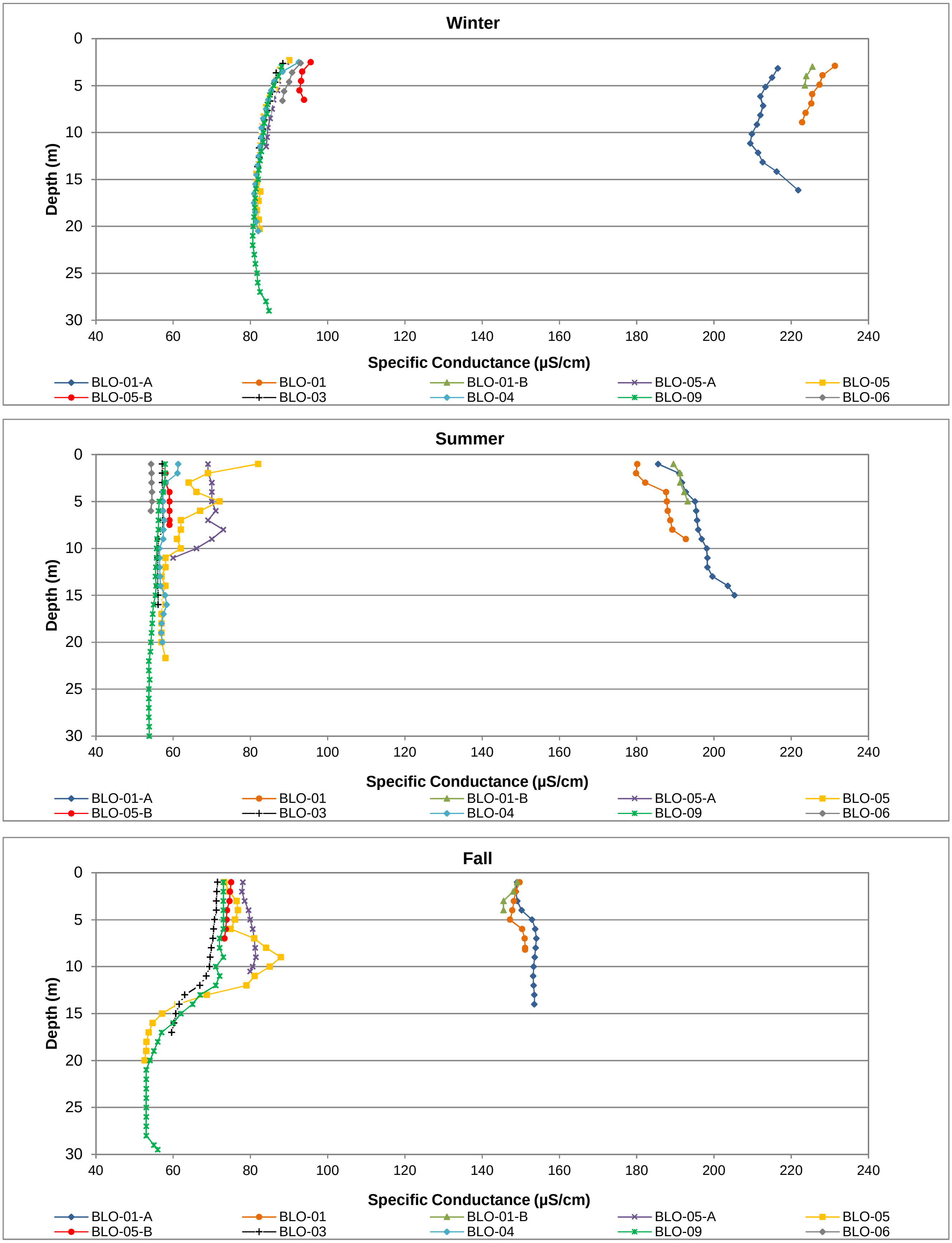


Figure C.25: Vertical profiles of conductivity measured at Mary Lake in winter, summer, and fall, 2016.

Figure C.26: Temporal comparison of water chemistry at Mary Lake (BLO) for mine baseline (2005 - 2013), construction (2014), and operational (2015, 2016) periods during fall. 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.

APPENDIX D

SEDIMENT QUALITY DATA

Table D.1: Field observations at Reference Lake 3 (REF-03) benthic invertebrate community stations[a], Mary River Project CREMP, August 2016.

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
REF-03-1	9.0	gray brown silt with some fine sand; no precipitate layer observed	none detected	sparse moss growth
REF-03-2	8.1	thin orange-brown precipitate layer over brown-gray silt	none detected	sparse moss growth
REF-03-3	10.0	thin orange-brown precipitate layer over medium red-brown sandy-silt	none detected	none observed
REF-03-4	8.8	medium brown coloured silt over gray-brown silt; no precipitate layer	none detected	none observed
REF-03-5	10.7	thin iron oxide precipitate layer over gray-brown silt	none detected	sparse moss growth
REF-03-6	19.5	medium orange-brown coloured silt; no precipitate layer observed	none detected	none observed
REF-03-7	22.9	medium orange-brown coloured silt; no precipitate layer observed	none detected	none observed
REF-03-8	18.6	orange-brown coloured silt with some fine sand, no precipitate layer observed	none detected	none observed
REF-03-9	21.6	thin orange-brown precipitate layer over medium brown silt	none detected	none observed
REF-03-10	19.8	red-brown silt; no precipitate layer observed	none detected	none observed

[a] Sediment particle size and benthic invertebrate community samples were collected by petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.2: Sediment core observations from cores collected at littoral stations of Reference Lake 3 (REF-03), Mary River Project CREMP, August 2016.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
REF-03-1	9.0	1	25.0	0 to 10	brown grey silt
				10 to 25	medium grey silt, some black streaking
		2	29.0	0 to 8	brown grey silt
				8 to 29	medium grey silt, some black streaking
		3	28.5	0 to 10	brown grey silt
				10 to 28.5	medium grey silt, some black streaking
REF-03-2	8.1	1	48.5	0 to 1	orange brown floc-like silt
				1 to 43	beige silt, sparse organics
				43 to 48.5	medium to dark brown-grey silt
		2	18.0	0 to 1	orange brown floc-like silt
				1 to 18	beige silt, sparse organics
		3	38.0	0 to 2	orange brown floc-like silt
				2 to 38	beige silt, sparse organics
REF-03-3	10.0	1	13.0	0 to 5	medium beige silt
				5 to 13	light beige silt
		2	10.0	0 to 4	medium beige silt
				4 to 10	light beige silt
		3	18.0	0 to 3	orange brown floc-like silt
				3 to 4	medium beige silt
				5 to 18	light beige silt
REF-03-4	8.8	1	18.5	0 to 8	orange brown floc-like silt
				8 to 18.5	grey beige silt, some black streaking
		2	19.0	0 to 7	orange brown floc-like silt
				7 to 19	grey beige silt, some black streaking
		3	12.0	0 to 8	orange brown floc-like silt
				8 to 12	grey beige silt, some black streaking
REF-03-5	10.7	1	12.5	0 to 1	orange brown silt
				1 to 12.5	medium grey fines with some black streaking
		2	26.0	0 to 3	orange brown silt
				3 to 18	medium grey fines with some black streaking
				18 to 26	medium-dark grey fines with some black streaking
		3	29.0	0 to 2	orange brown silt
				2 to 19	medium grey fines with some black streaking
				19 to 29	medium-dark grey fines with some black streaking

Table D.3: Sediment core observations from cores collected at profundal stations of Reference Lake 3 (REF-03), Mary River Project CREMP, August 2016.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
REF-03-6	19.5	1	30.0	0 to 27	orange brown silt
				27 to 30	medium grey silt, some black streaking
		2	30.5	0 to 27	orange brown silt
				27 to 30.5	medium grey silt, some black streaking
		3	28.0	0 to 20	orange brown silt
				20 to 24	medium grey silt, some black streaking
				24 to 28	medium-dark grey silt, some black streaking
REF-03-7	22.9	1	16.0	0 to 4	medium orange brown, floc-like silt
				4 to 14	light orange brown silt
				14 to 16	light grey brown silt
		2	25.0	0 to 4	medium orange brown, floc-like silt
				4 to 20	light orange brown silt
				20 to 25	light grey brown silt
		3	21.0	0 to 5	medium orange brown floc-like silt
				5 to 15	light orange brown silt
				15 to 21	light grey brown silt
REF-03-8	18.6	1	8.0	0 to 8	orange brown silt, black layer on top mm
		2	13.0	0 to 15	orange brown silt, black layer on top mm
		3	16.5	0 to 7	orange brown silt, black layer on top mm
				7 to 16	medium grey brown silt with black streaking
REF-03-9	21.6	1	30.0	0 to 20	orange brown silt
				20 to 30	medium grey brown silt
		2	20.0	0 to 18	orange brown silt
				18 to 20	medium grey brown silt
		3	27.0	0 to 24	orange brown silt
				24 to 27	medium grey brown silt
REF-03-DUP (Duplicate of REF-03-9)	21.6	1	19.0	0 to 10	orange brown silt, some black streaking
				10 to 19	grey brown silt, some black streaking
		2	27.0	0 to 10	orange brown silt, some black streaking
				10 to 27	grey brown silt, some black streaking
		3	26.0	0 to 14	orange brown silt, some black streaking
				14 to 26	grey brown silt, some black streaking
REF-03-10	19.8	1	22.0	0 to 8	light brown to orange brown silt
				8 to 18.5	orange brown silt (with black layer at ~ 8mm and very orange below for ~ 1mm)
				18 to 22	grey brown silt
		2	15.0	0 to 12	light brown to orange brown silt
				12 to 15	orange brown silt
		3	21.5	0 to 7	light brown to orange brown silt
				7 to 11	orange brown silt
				11 to 21	grey brown silt

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 2016.

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	Reference Lake 3 Stations										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	%	-	66.6	20.5	32.9	13.0	39.8	15.2	53.5	14.5	19.9	20.2	29.6	18.4	5.81
	Silt	%	-	31.1	72.3	59.8	78.3	56.5	78.4	43.9	78.3	74.0	73.1	64.6	16.42	5.19
	Clay	%	-	2.30	7.2	7.4	8.7	3.70	6.3	2.70	7.3	6.10	6.7	5.8	2.17	0.69
	Moisture	%	-	95.4	72.9	99.0	70.5	89.8	93.2	97.7	83.3	66.6	97.6	87	12.42	3.93
	Total Organic Carbon	%	10^{α}	5.39	4.31	8.04	4.82	3.30	5.03	4.09	4.41	3.42	4.65	4.75	1.33	0.421
Metals	Aluminum (Al)	mg/kg	-	15,200	23,700	17,700	30,300	16,600	25,500	16,400	21,850	16,500	24,400	20,815	5,069	1,603
	Antimony (Sb)	mg/kg	-	<0.10	0.19	<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	2.74	5.96	3.87	7.24	4.23	6.98	3.67	5.94	4.04	6.25	5.09	1.56	0.493
	Barium (Ba)	mg/kg	-	115	144	153	187	96.4	167	96.6	164	98.4	147	137	32.9	10.41
	Beryllium (Be)	mg/kg	-	0.61	0.96	0.70	1.20	0.70	1.04	0.69	0.91	0.67	0.99	0.85	0.20	0.063
	Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	0.22	<0.20	0.21	<0.20	<0.20	<0.20	<0.20	0.20	0.0067	0.0021
	Boron (B)	mg/kg	-	11.4	17.8	16.4	22.4	12.1	20.3	12.4	17.2	12.9	18.1	16.1	3.76	1.19
	Cadmium (Cd)	mg/kg	3.5	0.135	0.165	0.284	0.200	0.095	0.205	0.096	0.178	0.121	0.153	0.16	0.057	0.018
	Calcium (Ca)	mg/kg	-	6,190	6,000	6,310	6,630	4,230	6,040	4,150	5,675	4,760	6,210	5,620	902	285.3
	Chromium (Cr)	mg/kg	90	57.2	74.3	57.7	93.8	52.6	84.2	51.8	71.4	55.5	76.1	67.5	14.6	4.62
	Cobalt (Co)	mg/kg	-	8.87	16.9	8.86	20.9	11.6	18.6	11.2	17.4	10.2	17.0	14.1	4.45	1.41
	Copper (Cu)	mg/kg	197	55.3	94.6	95.5	121	60.3	105	63.6	88.2	57.7	98.1	83.9	23.0	7.28
	Iron (Fe)	mg/kg	$40{,}000^{\alpha}$	21,400	49,200	21,400	60,700	34,900	55,200	37,400	53,900	34,100	48,900	41,710	13,932	4,406
	Lead (Pb)	mg/kg	91.3	15.2	25.5	95.9	26.7	79.9	48.8	24.2	27.4	15.0	19.2	37.8	28.31	8.95
	Lithium (Li)	mg/kg	-	27.4	37.4	28.3	49.4	27.9	42.8	26.9	38.3	26.1	40.8	34.5	8.26	2.61
	Magnesium (Mg)	mg/kg	-	11,600	15,300	11,200	19,000	10,700	16,700	9,960	14,200	10,800	15,600	13,506	3,077	973
	Manganese (Mn)	mg/kg	$1{,}100^{\alpha,\beta}$	286	1,170	297	1,420	686	2,020	767	3,550	442	1,170	1,181	995.5	314.8
	Mercury (Hg)	mg/kg	0.486	0.0475	0.0633	0.0515	0.0699	0.0199	0.0738	0.0234	0.0737	0.0353	0.0687	0.0527	0.0206	0.00651
	Molybdenum (Mo)	mg/kg	-	0.72	2.75	1.36	3.20	3.18	3.35	2.72	4.49	2.97	2.56	2.73	1.05	0.332
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	40.1	53.3	44.4	65.1	35.8	59.1	35.7	50.9	37.1	53.0	47.4	10.37	3.28
	Phosphorus (P)	mg/kg	$2{,}000^{\alpha}$	781	1,050	760	1,320	827	1,180	810	1,016	1,020	1,040	980	184.8	58.4
	Potassium (K)	mg/kg	-	3,280	5,460	4,260	6,870	4,170	6,040	3,820	5,255	3,940	5,830	4,893	1,161	367.3
	Selenium (Se)	mg/kg	-	0.45	0.67	0.69	0.93	0.36	1.00	0.39	0.87	0.55	0.78	0.67	0.23	0.072
	Silver (Ag)	mg/kg	-	0.11	0.24	0.16	0.32	<0.10	0.28	<0.10	0.24	0.11	0.26	0.19	0.085	0.027
	Sodium (Na)	mg/kg	-	254	412	403	527	260	491	250	406	313	437	375	100	31.8
	Strontium (Sr)	mg/kg	-	12.1	14.7	12.9	17.8	10.3	16.3	10.0	14.8	11.5	15.5	13.6	2.63	0.83
	Sulphur (S)	mg/kg	-	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	0	0
	Thallium (Tl)	mg/kg	-	0.325	0.723	0.389	0.916	0.418	0.845	0.362	0.772	0.445	0.748	0.594	0.226	0.0715
	Tin (Sn)	mg/kg	-	5.9	9.9	137	7.9	116	46.4	17.9	15.2	4.8	2.3	36.3	49.39	15.619
	Titanium (Ti)	mg/kg	-	1,050	1,280	1,060	1,580	1,010	1,370	1,030	1,205	1,210	1,220	1,202	179	56.5
	Uranium (U)	mg/kg	-	8.73	26.4	10.9	31.6	17.5	29.5	9.95	22.8	12.4	26.0	19.6	8.71	2.75
	Vanadium (V)	mg/kg	-	45.0	68.6	50.7	84.0	51.6	75.4	52.5	63.4	50.1	68.8	61.0	12.9	4.09
	Zinc (Zn)	mg/kg	315	67.3	101	82.2	122	70.0	109	77.0	91.2	72.0	101	89	18.5	5.86
	Zirconium (Zr)	mg/kg	-	5.0	3.6	6.5	4.6	3.3	4.2	3.2	3.7	3.7	3.9	4.2	1.0	0.3

[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)).

(grey box) Indicates paramter concentration above Sediment Quality Guideline (SQG).

Table D.5: Field observations at Camp Lake (JLO) benthic invertebrate community stations[a], Mary River Project CREMP, August 2016.

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
JLO-2	10.6	medium to light brown silt, some reddish ozidized material to ~ 0.5cm surficial depth	none detected	root-like organics (sparse), globular algae (sparse)
JLO-21	11.1	medium brown grey silt with some fine sand; 0.5cm layer of red oxidized material at surface	none detected	globular algae (common)
JLO-32	9.9	loose' medium brown silt with thin layer of oxidized material at surface	none detected	(dead) moss leaves; globular algae (common)
JLO-31	11.7	medium brown silt; 0.5cm layer of red oxidized material at surface	none detected	globular algae (common)
JLO-30	10.6	light brown grey silt / fine sand mix; 0.5cm layer of red oxidized material at surface	none detected	globular algae (sparse)

[a] Sediment particle size and benthic invertebrate community samples were collected by petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.6: Sediment core observations from cores collected at littoral stations of Camp Lake (JLO), Mary Rive Project CREMP, August 2016.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
JLO-02	10.6	1	14.0	0 to 2	orange to black coloured organic silt
				2 to 6	dark orangish-brown silt with black streaking
				6 to 14	medium brown silt
		2	12.0	0 to 2	orange black organic silt
				2 to 6	dark orangish-brown silt with black streaking
				6 to 12	medium brown silt
		3	15.5	0 to 2.5	orange black organic silt
				2.5 to 5	dark orangish-brown silt with black streaking
				5 to 15.5	medium brown silt
JLO-30	10.6	1	8.0	0 to 1.5	orange-coloured (iron oxide) sand
				1.5 to 8	light brown grey sand
		2	5.0	0 to 0.5	orange-coloured (iron oxide) sand
				0.5 to 5	light brown grey sand; evidence of anoxia at 2 cm
		3	4.5	0 to 0.5	orange-coloured (iron oxide) sand
				0.5 to 4.5	light brown grey sand
JLO-31	11.7	1	21.0	0 to 2	orange-coloured (iron oxide) organic silt
				2 to 13	light brown grey silt
				13 to 21	medium brown grey silt
		2	13.5	0 to 1.5	orange coloured (iron oxide) organic silt
				1.5 to 13.5	medium brown grey silt
		3	11.0	0 to 2	orange coloured (iron oxide) organic silt
				2 to 11	medium brown grey silt
JLO-32	9.9	1	19.0	0 to 2	orangish-coloured (iron oxide) silt
				2 to 4	bright orange (iron oxide) smear
				4 to 11	medium light brown grey silt
				11 to 19	medium brown grey silt
		2	18.0	0 to 3	silty organics, globular algae
				3 to 7	olive brown organic silt
				7 to 18	medium light brown silt / sand
		3	13.5	0 to 3	orangish-coloured (iron oxide) silt
				3 to 13.5	medium light brown grey silt
JLO-21	11.1	1	13.5	0 to 1.5	orangish-coloured (iron oxide) silt
				1.5 to 13.5	light brown silt
		2	16.5	0 to 1.5	orangish-coloured (iron oxide) silt
				1.5 to 16.5	light brown silt
		3	11.5	0 to 2	orangish-coloured (iron oxide) silt
				2 to 11.5	light brown silt

Table D.7: Sediment core observations from cores collected at profundal stations of Camp Lake (JLO), Mary River Project CREMP, August 2016.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
JLO-14	26.5	1	12.5	0 to 3	reddish brown oxidized silt
				3 to 10	light brown grey silt
				10 to 12.5	medium brown grey silt
		2	13.0	0 to 3	reddish brown oxidized silt
				3 to 8	light brown grey silt
				8 to 13	medium brown grey silt; possible anoxia
		3	22.5	0 to 4	reddish brown oxidized silt
				4 to 9.5	light brown grey silt
				9.5 to 22	medium brown grey silt; possible anoxia
JLO-07	33.2	1	19.5	0 to 2	reddish-orange oxidized silt
				2 to 10	light brown grey; reduced streaks
				10 to 19.5	medium brown grey
		2	7.5	0 to 4	reddish-orange oxidized silt
				4 to 7.5	light brown grey
		3	10.0	0 to 2	reddish-orange oxidized silt
				2 to 7	light brown grey; reduced streaks
				7 to 10	medium brown grey
JLO-11	28.8	1	14.5	0 to 1.5	reddish-orange oxidized silt
				1.5 to 7	light brown grey silt
				7	redox boundary (band of anoxia)
				7 to 14.5	medium light brown grey silt
		2	17.5	0 to 1.5	reddish-orange oxidized silt
				1 to 6.5	light brown grey silt
				6.5	redox boundary (band of anoxia)
				6.5 to 17.5	medium light brown grey silt
		3	21.5	0 to 2	reddish-orange oxidized silt
				2 to 13	light brown grey silt
				13 to 21.5	medium brown grey silt

Table D.8: Statistical comparison of substrate physical properties at littoral depth stations between Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2016.

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
Sand (% by weight)	No	0.783	α, δ, γ	Reference	5	42.5	18.1	8.1	19.9	66.6
				Camp	5	45.8	17.8	8.0	32.7	76.8
Silt (% by weight)	No	0.816	α, δ, γ	Reference	5	53.1	16.3	7.3	31.1	74.0
				Camp	5	50.6	16.5	7.4	22.0	61.5
Clay (% by weight)	No	0.574	α, δ, γ	Reference	5	4.4	2.2	1.0	2.3	7.4
				Camp	5	3.7	2.0	0.9	1.2	5.9
Moisture (%)	Yes	0.095	γ	Reference	5	89.7	13.4	6.0	66.6	99.0
				Camp	5	73.5	9.3	4.2	59.4	82.8
TOC (%)	Yes	0.071	α, δ, γ	Reference	5	4.8	2.0	0.9	3.3	8.0
				Camp	5	2.9	0.8	0.4	1.5	3.5

[a] Data analysis included: α - data untransformed; β - data logit transformed; η - log_{10} transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Mann Whitney U-test.

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

Table D.9: Sediment particle size, total organic carbon, and metal concentrations at Camp Lake (JLO) sediment stations, Mary River Project CREMP, August 2016.

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Camp Lake Stations								Study Area Summary Statistics		
					JLO-02 (littoral)	JLO-21 (littoral)	JLO-32 (littoral)	JLO-14 (profundal)	JLO-31 (littoral)	JLO-07 (profundal)	JLO-11 (profundal)	JLO-30 (littoral)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	32.7	43.1	35.7	35.8	40.6	48.8	53.6	76.8	46	14	5.1
	Silt	%	-	-	61.5	51.5	60.9	55.6	57.0	43.6	41.8	22.0	49	13	4.7
	Clay	%	-	-	5.9	5.4	3.4	8.6	2.4	7.6	4.6	1.2	4.9	2.5	0.9
	Moisture	%	-	-	69.3	78.9	77.2	76.6	82.8	63.6	66.3	59.4	72	8	2.93
	Total Organic Carbon	%	10^{α}	-	3.36	3.17	3.49	2.39	2.85	2.50	2.59	1.49	2.73	0.64	0.23
Metals	Aluminum (Al)	mg/kg	-	-	17,000	14,700	14,800	19,500	14,100	19,700	17,500	6,700	15,500	4,148	1,466
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	0.011	0.0038
	Arsenic (As)	mg/kg	17	5.9	***9.6***	5.82	***13.8***	***8.01***	***11.4***	5.31	***13.5***	2.86	***8.79***	3.99	1.41
	Barium (Ba)	mg/kg	-	-	170	78.7	171	190	176	83.3	105	43.3	127	55.9	19.8
	Beryllium (Be)	mg/kg	-	-	0.89	0.90	0.86	1.05	0.81	1.10	0.96	0.38	0.87	0.22	0.078
	Bismuth (Bi)	mg/kg	-	-	0.29	0.42	0.35	0.30	0.26	0.36	0.31	<0.20	0.31	0.067	0.024
	Boron (B)	mg/kg	-	-	22.5	23.8	23.9	28.5	23.9	30.1	25.1	10.5	23.5	5.87	2.08
	Cadmium (Cd)	mg/kg	3.5	1.5	0.267	0.180	0.319	0.223	0.178	0.129	0.177	0.061	0.19	0.080	0.028
	Calcium (Ca)	mg/kg	-	-	4,900	4,600	5,880	4,680	4,470	4,560	4,380	2,170	4,455	1,038	367
	Chromium (Cr)	mg/kg	90	98	72.3	61.8	63.2	77.4	58.8	78.9	72.3	31.3	64.5	15.3	5.41
	Cobalt (Co)	mg/kg	-	-	20.9	16.3	20.0	24.7	20.1	17.7	18.5	7.76	18.2	4.91	1.74
	Copper (Cu)	mg/kg	197	50	48.4	38.7	***50.4***	49.5	37.6	***50.8***	49.1	16.1	42.6	11.9	4.21
	Iron (Fe)	mg/kg	$40,000^{\alpha}$	52,400	49,050	38,700	***57,600***	***66,400***	***73,500***	44,700	***73,800***	21,900	***53,206***	18,164	6,422
	Lead (Pb)	mg/kg	91.3	35	20.6	23.8	22.4	24.0	19.7	25.8	22.4	13.4	21.5	3.81	1.35
	Lithium (Li)	mg/kg	-	-	28.9	32.2	26.9	35.5	26.7	37.0	31.4	12.9	28.9	7.48	2.64
	Magnesium (Mg)	mg/kg	-	-	14,050	11,800	11,900	13,700	10,400	13,900	13,100	5,810	11,833	2,742	969
	Manganese (Mn)	mg/kg	$1,100^{\alpha,\beta}$	4,370	2,540	526	***4,690***	***5,470***	3,770	815	635	1,390	2,480	1,952	690.2
	Mercury (Hg)	mg/kg	0.486	0.17	0.0458	0.0411	0.0470	0.0512	0.0379	0.0536	0.0618	0.0120	0.0438	0.0148	0.00525
	Molybdenum (Mo)	mg/kg	-	-	2.02	1.01	4.10	3.00	5.07	0.93	1.42	1.00	2.32	1.58	0.559
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	72	***80.7***	61.4	***80.3***	***75.3***	69.1	66.3	67.5	31.9	66.6	15.6	5.51
	Phosphorus (P)	mg/kg	$2,000^{\alpha}$	1,580	1,580	1,360	***1,690***	***2,170***	***2,280***	1,380	***2,860***	697	***1,752***	668	236
	Potassium (K)	mg/kg	-	-	4,055	3,710	3,780	4,910	3,680	5,040	4,370	1,690	3,904	1,038	367
	Selenium (Se)	mg/kg	-	-	0.43	0.44	0.48	0.53	0.41	0.47	0.62	<0.20	0.45	0.12	0.043
	Silver (Ag)	mg/kg	-	-	0.11	0.11	0.12	0.15	<0.10	0.17	0.14	<0.10	0.13	0.026	0.009
	Sodium (Na)	mg/kg	-	-	190	169	167	249	157	320	253	78	198	74	26
	Strontium (Sr)	mg/kg	-	-	9.46	9.31	10.6	14.9	10.1	19.5	11.7	5.24	11.4	4.25	1.50
	Sulphur (S)	mg/kg	-	-	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5000	0	0
	Thallium (Tl)	mg/kg	-	-	0.554	0.478	0.619	0.641	0.532	0.447	0.423	0.190	0.485	0.142	0.0503
	Tin (Sn)	mg/kg	-	-	3.0	5.9	7.1	2.8	2.2	5.1	<2.0	10.2	4.8	2.9	1.0
	Titanium (Ti)	mg/kg	-	-	935	866	743	870	705	972	789	418	787	175	61.8
	Uranium (U)	mg/kg	-	-	6.98	5.45	6.64	7.39	4.52	6.92	7.29	1.66	5.86	1.96	0.694
	Vanadium (V)	mg/kg	-	-	59.8	51.7	53.7	64.3	49.9	62.5	61.0	24.5	53.4	12.8	4.53
	Zinc (Zn)	mg/kg	315	135	60.7	49.9	54.6	64.1	48.2	63.1	58.4	23.7	52.8	13.1	4.64
	Zirconium (Zr)	mg/kg	-	-	6.2	6.5	3.9	4.0	2.7	6.7	4.8	1.3	4.5	1.9	0.68

[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 Gu probable effects level (PEL; BCMOE 2015)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013, 2014) using sediment quality guidelines, baseline sediment quality data, and method detection limits. The indicated values are specific to Camp Lake.

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

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table D.10: Magnitude of difference in sediment metal concentrations between 2016 Camp Lake and Reference Lake 3 data, at Camp Lake between 2016 and baseline, and at Camp Lake between 2016 and 2015 for littoral and profundal substrates, Mary River Project CREMP, 2016.

Variable	Camp Lake versus Reference Lake 3 2016				Camp Lake 2016 versus Baseline Period				Camp Lake 2016 versus Initial Year of Mine Operation (2015)			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Reference Lake Concentration (mg/kg)	Magnitude of Difference	Reference Lake Concentration (mg/kg)	Magnitude of Difference	Camp Lake Baseline Concentration (mg/kg)	Magnitude of Difference	Camp Lake Baseline Concentration (mg/kg)	Magnitude of Difference	Camp Lake 2015 Concentration (mg/kg)	Magnitude of Difference	Camp Lake 2015 Concentration (mg/kg)	Magnitude of Difference
Aluminum (Al)	16,480	0.8	25,150	0.8	18,267	0.7	15,175	1.2	15,900	0.8	15,430	1.2
Antimony (Sb)	<0.10	1.1	0.12	0.8	1.0	0.1	1.0	0.1	0.1	1.1	0.1	1.0
Arsenic (As)	3.7	2.3	6.5	1.4	2.8	3.1	3.5	2.6	14.6	0.6	6.6	1.4
Barium (Ba)	112	1.1	162	0.8	105	1.2	68	1.9	174	0.7	99	1.3
Beryllium (Be)	0.7	1.1	1.0	1.0	1.0	0.8	1.0	1.0	0.8	0.9	0.9	1.2
Bismuth (Bi)	<0.20	1.5	0.21	1.6	-	-	-	-	0.3	1.0	0.3	1.1
Boron (B)	13.0	1.6	19.2	1.5	1	28.5	2	15.2	24	0.9	23	1.2
Cadmium (Cd)	0.1	1.4	0.2	1.0	0.5	0.4	0.5	0.4	0.4	0.6	0.2	1.1
Calcium (Ca)	5,128	0.9	6,111	0.7	3,130	1.4	2,857	1.6	6,310	0.7	5,759	0.8
Chromium (Cr)	55	1.0	80	1.0	81	0.7	71	1.1	73	0.8	67	1.1
Cobalt (Co)	10	1.7	18	1.1	18	0.9	17	1.2	22	0.8	17	1.2
Copper (Cu)	66	0.6	101	0.5	45	0.8	40	1.3	57	0.7	39	1.3
Iron (Fe)	29,840	1.6	53,580	1.2	36,133	1.3	33,206	1.9	62,300	0.8	44,161	1.4
Lead (Pb)	46	0.4	30	0.8	18	1.1	19	1.3	21	0.9	20	1.2
Lithium (Li)	27	0.9	42	0.8	-	-	-	-	28.1	0.9	28.4	1.2
Magnesium (Mg)	10,852	1.0	16,160	0.8	13,967	0.8	10,113	1.3	13,600	0.8	12,638	1.1
Manganese (Mn)	496	5.2	1,866	1.2	699	3.7	942	2.4	1,900	1.4	2,476	0.9
Mercury (Hg)	0.0355	1.0	0.0699	0.8	0.100	0.4	0.100	0.6	0.058	0.6	0.036	1.6
Molybdenum (Mo)	2.190	1.2	3.270	0.5	1.0	2.6	1.0	1.8	2.6	1.0	1.8	1.0
Nickel (Ni)	39	1.7	56	1.2	67	1.0	63	1.1	84	0.8	62	1.1
Phosphorus (P)	840	1.8	1,121	1.9	800	1.9	1,125	1.9	1750.0	0.9	1,471	1.5
Potassium (K)	3,894	0.9	5,891	0.8	3,450	1.0	3,771	1.3	4,090	0.8	4,010	1.2
Selenium (Se)	0.5	0.8	0.9	0.6	1.0	0.4	1.0	0.5	0.6	0.7	0.4	1.5
Silver (Ag)	0.1	0.9	0.3	0.6	0.3	0.4	0.3	0.4	0.2	0.7	0.1	1.1
Sodium (Na)	296	0.5	455	0.6	279	0.5	254	1.1	184	0.8	193	1.4
Strontium (Sr)	11.4	0.8	15.8	1.0	9.3	1.0	12.0	1.3	11.1	0.8	13.4	1.1
Sulphur (S)	<5,000	1.0	<5,000	1.0	-	-	-	-	5000.0	1.0	5000.0	1.0
Thallium (Tl)	0.388	1.2	0.801	0.6	1.0	0.5	1.0	0.5	0.7	0.7	0.5	1.0
Tin (Sn)	56	0.1	16	0.2	-	-	-	-	2.0	2.8	2.0	1.7
Titanium (Ti)	1,072	0.7	1,331	0.7	-	-	-	-	893.0	0.8	759.9	1.2
Uranium (U)	12	0.4	27	0.3	-	-	-	-	9.7	0.5	5.7	1.3
Vanadium (V)	50	1.0	72	0.9	69	0.7	57	1.1	61	0.8	53	1.2
Zinc (Zn)	74	0.6	105	0.6	67	0.7	57	1.1	61	0.8	52	1.2
Zirconium (Zr)	4.3	0.9	4.0	1.3	-	-	-	-	8	0.5	5	1.0

Denotes slight elevation (mean variable concentration 2 to 5 times higher than respective mean reference, baseline period 0r 2015 value).

Denotes moderate elevation (mean variable concentration 5 to 10 times higher than respective mean reference, baseline period, or 2015 value).

Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference, baseline period or 2015 value).

Table D.11: Field observations at Sheardown Lake Northwest (DLO-01) benthic invertebrate community stations [a], Mary River Project CREMP, August 2016.

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
DD-HAB-9-STN2	10.3	thin "rust" layer at surface (~0.3cm thick) over medium brown silt	none detected	moss or *Chara* sp. (common); globular algae (sparse)
DLO-01-8	11.4	very thin oxidized layer at surface (<0.2cm thick) over medium brown silt	none detected	none observed
DLO-01-9	7.5	thin layer of oxidized material (0.25cm thick) over dark brown silt	Yes (slight sulphur odour)	globular algae (sparse)
DLO-01-3	8.6	thin layer of oxidized material (0.25cm thick) over dark brown silt	Yes (slight sulphur odour, blackened substrate)	globular algae (sparse)
DLO-01-10	9.0	reddish-orange coloured oxidized material (~0.5cm thick) over medium brown silt	none detected	none observed

[a] Sediment particle size and benthic invertebrate community samples were collected by petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.12: Sediment core observations from cores collected at littoral stations in Sheardown Lake Northwest (DLO-01), Mary River Project CREMP, August 2016.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
DD-HAB 9-STN2	10.3	1	17.0	0 to 3	dark orange-brown to black organic-silt floc mixture
				3 to 17	dark to medium brown silt
		2	19.5	0 to 2.5	dark orange brown oxidized floc
				2.5 to 9	dark orange brown to black organic silt floc mix
				9 to 19.5	dark to medium brown silt
		3	16.0	0 to 1	orange brown oxidized floc
				1 to 7	dark orange brown to black organic silt floc mix
				7 to 16	dark to medium brown silt
DLO-01-08	11.4	1	14.5	0 to 2.5	orange-brown (iron oxide) silt
				2.5 to 10	medium beige-coloured silt
				10 to 11	green coloured silt
				11 to 14.5	medium beige-coloured silt
		2	16.0	0 to 2	orange-brown (iron oxide) silt
				2 to 12	medium beige-coloured silt
				12 to 13	green coloured silt
				13 to 16	medium beige-coloured silt
		3	14.5	0 to 3	orange-brown (iron oxide) silt
				3 to 10	medium beige-coloured silt
				10 to 11	green coloured silt
				11 to 14.5	medium beige-coloured silt
DLO-01-3	7.8	1	13.5	0 to 0.5	orange brown (iron oxide) silt, moss present
				0.5 to 6	gray black reducing zone, silt
				6 to 13.5	medium brown silt
		2	16.0	0 to 0.5	orange brown (iron oxide) silt, moss present
				0.5 to 6.5	gray black reducing zone, silt
				6.5 to 16	medium brown silt
		3	14.0	0 to 2	orange brown (iron oxide) silt, moss present
				2 to 14	medium brown silt
DLO-01-9	7.5	1	21.0	0 to 2	iron oxide / macrophyte (moss) mix
				2 to 10	medium brown organic silt
				10 to 21	medium brown silt
		2	18.0	0 to 1	iron oxide / macrophyte (moss) mix
				1 to 7	medium brown organic silt
				7 to 18	medium brown silt
		3	22.0	0 to 2.5	iron oxide / macrophyte (moss) mix
				2.5 to 7	medium brown organic silt
				7 to 22	medium brown silt
DLO-01-10	9.4	1	15.0	0 to 1	orange brown oxidized silt
				1 to 4	medium brown organic silt
				4 to 15	medium brown silt
		2	15.0	0 to 2	orange brown oxidized silt
				2 to 15	medium brown silt
		3	14.5	0 to 2	orange brown oxidized silt
				2 to 14.5	medium brown silt

Table D.13: Sediment core observations from cores collected at profundal stations in Sheardown Lake Northwest (DLO-01), Mary River Project CREMP, August 2016.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
DLO-01-05	23.1	1	13.0	0 to 0.5	orange brown oxidized silt
				0.5 to 4.5	dark brown silt with black streaking
				4.5 to 13	medium brown silt
		2	13.0	0 to 0.5	orange brown oxidized silt
				0.5 to 5	dark brown silt with black streaking
				5 to 13	medium brown silt
		3	22.0	0 to 0.5	orange brown oxidized silt
				0.5 to 4.5	dark brown silt with black streaking
				4 to 22	medium brown silt
DLO-01	20.3	1	14.0	0 to 0.5	oxidized orange brown silt
				0.5 to 14	uniform orange brown silt
		2	15.0	0 to 0.5	oxidized orange brown silt
				0.5 to 15	uniform orange brown silt
		3	11.5	0 to 11.5	uniform orange brown silt, some oxidation at surface
DLO-01-2	18.6	1	18.0	0 to 18	uniform orange brown silt
		2	14.5	0 to 14.5	uniform orange brown silt
		3	13.5	0 to 13.5	uniform orange brown silt
DLO-DUP (replicate of DLO-01-2)	-	1	14.5	0 to 3	orange brown oxidized silt
				3 to 5	black to orange colouorange oxidized silt
				5 to 14.5	light brown silt
		2	14.0	0 to 14.5	orange brown oxidized silt
		3	16.5	0 to 16.5	orange brown oxidized silt

Table D.14: Statistical comparison of littoral station substrate physical properties between Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2016.

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
Sand (% by weight)	No	0.601	α, δ, γ	Reference	5	42.5	18.1	8.1	19.9	66.6
				Sheardown NW	5	36.4	17.6	7.9	12.7	53.4
Silt (% by weight)	No	0.769	α, δ, γ	Reference	5	53.1	16.3	7.3	31.1	74.0
				Sheardown NW	5	56.3	17.2	7.7	39.1	79.0
Clay (% by weight)	Yes	0.041	ε, δ, γ	Reference	5	4.4	2.2	1.0	2.3	7.4
				Sheardown NW	5	7.3	0.6	0.3	6.6	8.3
Moisture (%)	Yes	0.039	α, δ, γ	Reference	5	89.7	13.4	6.0	66.6	99.0
				Sheardown NW	5	70.4	11.3	5.0	58.1	86.6
TOC (%)	Yes	0.056	γ	Reference	5	4.8	2.0	0.9	3.3	8.0
				Sheardown NW	5	2.9	1.3	0.6	2.0	5.1

[a] Data analysis included: α - data untransformed; β - data logit transformed; η - $\log_{10}$ transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Mann Whitney U-test.

[grey box] Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table D.15: Sediment particle size, total organic carbon, metal concentrations at Sheardown Lake Northwest (DLO-01) sediment stations, Mary River Project CREMP, August 2016.

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Sheardown Lake Northwest Stations								Study Area Summary Statistics		
					DLO-01-5 (profundal)	DD-HAB 9-STN2 (littoral)	DLO-01-8 (littoral)	DLO-01 (profundal)	DLO-01-9 (littoral)	DLO-01-2 (profundal)	DLO-01-3 (littoral)	DLO-01-10 (littoral)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	16.2	12.7	22.9	11.5	48.7	23.4	44.2	53.4	29	17	6.0
	Silt	%	-	-	69.8	79.0	69.8	68.7	44.3	69.4	49.2	39.1	61	15	5.2
	Clay	%	-	-	14.0	8.3	7.3	19.8	7.0	7.3	6.6	7.5	10	4.7	1.7
	Moisture	%	-	-	56.1	69.4	86.6	55.3	75.6	63.7	58.1	62.2	66	11	3.8
	Total Organic Carbon	%	10[α]	-	2.19	2.90	2.04	1.70	5.12	1.92	2.23	2.03	2.52	1.11	0.392
Metals	Aluminum (Al)	mg/kg	-	-	21,300	13,600	18,100	23,800	19,500	18,550	12,900	14,000	17,719	3,925	1,388
	Antimony (Sb)	mg/kg	-	-	<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	6.2	3.74	***13.8***	6.13	4.93	***7.54***	4.23	2.52	***9.77***	***6.58***	3.71	1.31
	Barium (Ba)	mg/kg	-	-	91.2	621	92.6	103	110	108.2	61.8	93.6	160	186.8	66.0
	Beryllium (Be)	mg/kg	-	-	1.14	0.72	0.97	1.24	1.03	0.95	0.67	0.73	0.931	0.208	0.074
	Bismuth (Bi)	mg/kg	-	-	0.32	0.27	0.21	0.27	0.28	0.23	<0.20	<0.20	0.25	0.044	0.016
	Boron (B)	mg/kg	-	-	31.2	20.2	28.4	33.9	31.9	27.0	19.5	20.2	26.5	5.83	2.06
	Cadmium (Cd)	mg/kg	3.5	1.5	0.259	0.306	0.172	0.271	0.481	0.241	0.208	0.166	0.263	0.100	0.0355
	Calcium (Ca)	mg/kg	-	-	4,130	4,360	3,960	4,630	6,180	4,445	3,920	4,050	4,459	738	261.0
	Chromium (Cr)	mg/kg	90	97	79.8	52.4	67.3	83.8	77.2	70.7	54.4	58.2	68.0	12.0	4.24
	Cobalt (Co)	mg/kg	-	-	14.9	12.6	14.3	17.2	14.5	15.4	9.90	12.2	13.9	2.24	0.79
	Copper (Cu)	mg/kg	197	58	49.8	38.6	38.9	50.1	***71.0***	40.1	34.9	31.1	44.3	12.64	4.47
	Iron (Fe)	mg/kg	40,000[α]	52,200	43,400	***83,000***	***60,700***	41,200	***65,400***	36,400	24,700	***59,900***	51,838	18,738	6,625
	Lead (Pb)	mg/kg	91.3	35	25.3	20.2	24.0	29.8	22.5	***37.8***	16.0	16.2	24.0	7.23	2.56
	Lithium (Li)	mg/kg	-	-	41.9	22.8	30.1	41.3	35.8	34.0	23.9	25.1	31.9	7.6	2.69
	Magnesium (Mg)	mg/kg	-	-	14,100	9,480	11,200	14,400	13,800	12,050	10,100	9,900	11,879	2,011	711
	Manganese (Mn)	mg/kg	1,100[α,β]	4,530	376	***10,300***	873	1,120	437	2,810	244	663	2,103	3,411	1,206
	Mercury (Hg)	mg/kg	0.486	0.17	0.0587	0.0418	0.0315	0.0367	0.0592	0.0342	0.0277	0.0322	0.0402	0.0123	0.00433
	Molybdenum (Mo)	mg/kg	-	-	1.40	19.7	8.87	1.82	7.49	5.76	2.29	5.67	6.62	5.95	2.10
	Nickel (Ni)	mg/kg	75[α,β]	77	66.0	66.3	60.6	68.5	***90.5***	69.0	55.5	56.3	66.6	11.0	3.89
	Phosphorus (P)	mg/kg	2,000[α]	1,958	909	***2,310***	1,050	929	1,030	835	780	1,880	1,215	562	199
	Potassium (K)	mg/kg	-	-	5,380	3,340	4,380	5,750	4,720	4,635	3,170	3,420	4,349	965	341
	Selenium (Se)	mg/kg	-	-	0.50	0.41	0.39	0.34	0.68	0.35	0.27	0.35	0.41	0.13	0.045
	Silver (Ag)	mg/kg	-	-	0.22	0.12	0.12	0.19	0.18	0.13	<0.10	<0.10	0.15	0.045	0.016
	Sodium (Na)	mg/kg	-	-	316	186	250	316	297	272	224	196	257	51.6	18.3
	Strontium (Sr)	mg/kg	-	-	12.3	9.17	10.1	13.2	12.1	11.1	9.43	9.24	10.8	1.57	0.55
	Sulphur (S)	mg/kg	-	-	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	5000	0	0
	Thallium (Tl)	mg/kg	-	-	0.546	0.446	0.456	0.633	0.610	0.569	0.375	0.351	0.498	0.106	0.0376
	Tin (Sn)	mg/kg	-	-	2.4	4.7	9.3	10.8	2.1	26.2	3.5	3.2	7.8	8.1	2.9
	Titanium (Ti)	mg/kg	-	-	1,280	773	1,050	1,350	1,160	1,140	973	884	1,076	196	69
	Uranium (U)	mg/kg	-	-	9.35	7.88	5.29	9.23	15.0	6.29	6.82	5.82	8.21	3.13	1.11
	Vanadium (V)	mg/kg	-	-	59.2	39.8	52.3	65.3	59.0	54.2	39.2	42.4	51.4	9.9	3.50
	Zinc (Zn)	mg/kg	315	123	75.1	51.8	61.8	78.8	72.7	65.2	47.2	49.4	62.7	12.3	4.34
	Zirconium (Zr)	mg/kg	-	-	14.9	5.9	6.7	8.3	20.7	4.9	8.7	6.4	9.6	5.45	1.93

[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, 2014) using sediment quality guidelines, baseline sediment quality data, and method detection limits. The indicated values are specific to Sheardown Lake Northwest.

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

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table D.16: Magnitude of difference in sediment metal concentrations between Sheardown Lake NW and Reference Lake 3 in 2016, at Sheardown Lake NW between 2016 and the baseline period, and at Sheardown Lake NW between 2015 and 2016 mine operation years for littoral and profundal stations, Mary River Project CREMP, 2016

Variable	Sheardown Lake NW versus Reference Lake 3 in 2016				Sheardown Lake NW 2016 versus Baseline Period				Sheardown Lake NW 2016 versus Initial Year of Mine Operation (2015)			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Reference Lake Concentration (mg/kg)	Magnitude of Difference	Reference Lake Concentration (mg/kg)	Magnitude of Difference	Sheardown Lake NW Baseline Concentration (mg/kg)	Magnitude of Difference	Sheardown Lake NW Baseline Concentration (mg/kg)	Magnitude of Difference	Sheardown Lake NW 2015 Concentration (mg/kg)	Magnitude of Difference	Sheardown Lake NW 2015 Concentration (mg/kg)	Magnitude of Difference
Aluminum (Al)	16,480	0.9	25,150	0.8	11,792	1.3	17,745	1.2	15,205	1.0	21,000	1.0
Antimony (Sb)	<0.10	1.0	0.12	0.8	1.0	0.1	1.0	0.1	0.1	1.0	0.1	1.0
Arsenic (As)	3.7	2.1	6.5	0.7	3.0	2.7	3.2	1.3	6.9	1.2	5.1	0.8
Barium (Ba)	112	1.8	162	0.6	78	2.5	93	1.1	140	1.4	100	1.0
Beryllium (Be)	0.7	1.2	1.0	1.1	1.0	0.8	1.0	1.1	0.8	1.0	1.1	1.0
Bismuth (Bi)	<0.20	1.2	0.21	1.3	-	-	-	-	0.3	-	0.3	-
Boron (B)	13.0	1.8	19.2	1.6	3	8.4	3	9.9	25	0.9	32	1.0
Cadmium (Cd)	0.1	1.8	0.2	1.4	0.5	0.5	0.5	0.5	0.4	0.8	0.3	1.0
Calcium (Ca)	5,128	0.9	6,111	0.7	2,697	1.7	3,558	1.2	4,411	1.0	4,595	1.0
Chromium (Cr)	55	1.1	80	1.0	53	1.2	81	1.0	60	1.0	81	1.0
Cobalt (Co)	10	1.3	18	0.9	10	1.2	15	1.0	14	0.9	17	0.9
Copper (Cu)	66	0.6	101	0.5	33	1.3	48	1.0	45	1.0	47	1.0
Iron (Fe)	29,840	2.0	53,580	0.8	28,120	2.1	40,382	1.0	57,810	1.0	43,375	0.9
Lead (Pb)	46	0.4	30	1.0	13	1.6	20	1.5	19	1.1	24	1.3
Lithium (Li)	27	1.0	42	0.9	-	-	-	-	26.6	-	36.2	-
Magnesium (Mg)	10,852	1.0	16,160	0.8	7,448	1.5	11,498	1.2	10,250	1.1	13,750	1.0
Manganese (Mn)	496	5.1	1,866	0.8	756	3.3	2,164	0.7	1,496	1.7	2,707	0.5
Mercury (Hg)	0.0355	1.1	0.0699	0.6	0.100	0.4	0.100	0.4	0.039	1.0	0.041	1.1
Molybdenum (Mo)	2.190	4.0	3.270	0.9	3.4	2.6	3.5	0.8	9.6	0.9	3.8	0.8
Nickel (Ni)	39	1.7	56	1.2	49	1.3	69	1.0	70	0.9	70	1.0
Phosphorus (P)	840	1.7	1,121	0.8	863	1.6	1,400	0.6	1020.3	-	1006.8	-
Potassium (K)	3,894	1.0	5,891	0.9	2,681	1.4	4,612	1.1	3,889	1.0	5,458	1.0
Selenium (Se)	0.5	0.9	0.9	0.5	1.0	0.4	1.0	0.4	0.5	0.8	0.4	1.0
Silver (Ag)	0.1	1.1	0.3	0.7	0.3	0.5	0.3	0.6	0.2	0.7	0.2	0.9
Sodium (Na)	296	0.8	455	0.7	249	0.9	342	0.9	233	1.0	306	1.0
Strontium (Sr)	11.4	0.9	15.8	0.8	7.2	1.4	11.4	1.1	10.7	0.9	13.0	0.9
Sulphur (S)	<5,000	1.0	<5,000	1.0	-	-	-	-	5000.0	-	5000.0	-
Thallium (Tl)	0.388	1.2	0.801	0.7	1.0	0.4	1.0	0.6	0.5	0.8	0.7	0.9
Tin (Sn)	56	0.1	16	0.8	-	-	-	-	2.0	-	2.0	-
Titanium (Ti)	1,072	0.9	1,331	0.9	-	-	-	-	889.3	-	1235.0	-
Uranium (U)	12	0.7	27	0.3	-	-	-	-	8.9	-	9.2	-
Vanadium (V)	50	0.9	72	0.8	37	1.2	58	1.0	47	1.0	61	1.0
Zinc (Zn)	74	0.8	105	0.7	51	1.1	76	1.0	59	1.0	76	1.0
Zirconium (Zr)	4.3	2.2	4.0	2.3	-	-	-	-	10.9875	-	9.675	-

Denotes slight elevation (mean variable concentration 2 to 5 times higher than respective mean reference, baseline, or 2015 value).

Denotes moderate elevation (mean variable concentration 5 to 10 times higher than respective mean reference, baseline period, or 2015 value).

Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference, baseline period or 2015 value).

Table D.17: Field observations at Sheardown Lake Southeast (DLO-02) benthic invertebrate community stations[a], Mary River Project CREMP, August 2016.

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
DLO-02-1	11.3	dark brown silt (compact)	none detected	globular algae (sparse)
DLO-02-11	6.7	moderately loose silt / organic silt, dark browk to black, some iron oxide flecking on surface	Yes (slight sulphur/chemical odour)	moss (very sparse), globular algae (common)
DLO-02-9	8.2	dark to medium brown compact silt, possible 0.1cm oxidized layer (reddish 6mm)	none detected	moss (sparse), globular algae (sparse)
DLO-02-13	12.0	dark brown compact to semi-compact silt	none detected	none observed
DLO-02-3	13.9	dark brown, compact silt	none detected	moss (sparse)

[a] Sediment particle size and benthic invertebrate community samples were collected by petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.18: Sediment core observations from cores collected in Sheardown Lake Southeast basin (DLO-02), Mary River Project CREMP, August 2016.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
DLO-02-1	11.3	1	26.0	0 to 2	orange brown oxidized silt
				2 to 7	medium brown silt
				7 to 22	medium brown-coloured silt sand mix
				22 to 26	medium brown silt
		2	9.5	0 to 1.5	orange brown oxidized silt
				1.5 to 9.5	medium brown silt
		3	7.0	0 to 2	orange brown oxidized silt
				2 to 7	medium brown silt
DLO-02-11	6.7	1	10.0	0 to 1	orange brown oxidized material over silt
				1 to 10	medium brown silt, some black streaking
		2	9.5	0 to 1	orange brown oxidized material over silt
				1 to 3	green, black, and/or brown organic silt floc-like material, possibly anoxic
				3 to 10	medium brown silt with some black streaking
		3	11.0	0 to 1	orange brown oxidized material over silt
				1 to 11	medium brown silt, some black streaking
DLO-02-9	8.2	1	10.5	0 to 1	orange brown oxidized material
				1 to 10.5	dark brown silt with black streaking
		2	8.0	0 to 2	orange brown oxidized material
				2 to 8	dark brown silt with black streaking
		3	9.5	0 to 1.5	orange brown oxidized material
				1.5 to 9.5	dark brown silt with black streaking
DLO-02-13	12	1	10.0	0 to 1.5	orange brown silt
				1.5 to 10	medium brown silt, some black streaking
		2	12.0	0 to 2	orange brown silt
				2 to 12	medium brown silt, some black streaking
		3	14.0	0 to 2	orange brown silt
				2 to 14	medium brown silt, some black streaking
DLO-02-3	13.9	1	15.5	0 to 2	orange brown silt
				2 to 15.5	medium brown silt with black streaking throughout
		2	12.5	0 to 2	orange brown silt
				2 to 12.4	medium brown silt with black streaking throughout
		3	7.0	0 to 7	orange brown and medium brown silt, some black streaking

Table D.19: Statistical comparison of substrate physical properties between littoral depth stations at Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2016.

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
Sand (% by weight)	Yes	0.003	β, δ, γ	Reference	5	42.5	18.1	8.1	19.9	66.6
				Sheardown SE	5	12.0	4.3	1.9	7.3	16.6
Silt (% by weight)	Yes	0.051	α, ε, γ	Reference	5	53.1	16.3	7.3	31.1	74.0
				Sheardown SE	5	73.0	3.2	1.4	70.4	78.1
Clay (% by weight)	Yes	0.000	α, δ, γ	Reference	5	4.4	2.2	1.0	2.3	7.4
				Sheardown SE	5	14.9	3.2	1.4	11.6	18.7
Moisture (%)	Yes	0.008	γ	Reference	5	89.7	13.4	6.0	66.6	99.0
				Sheardown SE	5	41.4	5.7	2.5	36.9	51.2
TOC (%)	Yes	0.015	α, ε, γ	Reference	5	4.8	2.0	0.9	3.3	8.0
				Sheardown SE	5	1.3	0.3	0.1	1.1	1.9

[a] Data analysis included: α - data untransformed; β - data logit transformed; η - $\log_{10}$ transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Mann Whitney U-test.

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

Table D.20: Sediment particle size, total organic carbon, and metal concentrations at Sheardown Lake Southeast (DLO-02) sediment stations, Mary River Project CREMP, August 2016.

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Sheardown Lake Southeast Stations: DLO-02-1 (littoral)	DLO-02-11 (littoral)	DLO-02-9 (littoral)	DLO-02-13 (littoral)	DLO-02-3 (littoral)	Study Area Summary Statistics: Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	16.3	11.4	8.4	7.3	16.6	12	4.3	1.9
	Silt	%	-	-	72.1	70.6	78.1	74.0	70.4	73	3.2	1.4
	Clay	%	-	-	11.6	18.0	13.5	18.7	12.9	15	3.2	1.4
	Moisture	%	-	-	36.9	51.2	41.3	38.6	39.0	41	5.7	2.5
	Total Organic Carbon	%	10^{α}	-	1.22	1.86	1.05	1.07	1.32	1.30	0.33	0.15
Metals	Aluminum (Al)	mg/kg	-	-	14,300	18,200	15,300	18,800	15,600	16,440	1,953	873
	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	2.86	5.14	4.49	5.89	3.63	4.40	1.20	0.54
	Barium (Ba)	mg/kg	-	-	66.2	85.4	90.2	143	76.4	92.2	29.8	13.34
	Beryllium (Be)	mg/kg	-	-	0.70	0.85	0.68	0.86	0.70	0.76	0.09	0.04
	Bismuth (Bi)	mg/kg	-	-	0.60	0.23	0.21	0.21	<0.20	0.29	0.17	0.08
	Boron (B)	mg/kg	-	-	17.4	23.6	20.2	24.8	21.3	21.5	2.91	1.30
	Cadmium (Cd)	mg/kg	3.5	1.5	0.092	0.114	0.098	0.121	0.091	0.103	0.0136	0.0061
	Calcium (Ca)	mg/kg	-	-	5,770	3,800	6,480	4,290	5,220	5,112	1,085	485.4
	Chromium (Cr)	mg/kg	90	79	63.7	76.1	74.8	75.1	63.7	70.7	6.4	2.9
	Cobalt (Co)	mg/kg	-	-	12.3	12.8	12.8	15.4	12.1	13.1	1.33	0.60
	Copper (Cu)	mg/kg	110	56	24.2	29.0	24.1	28.1	23.4	25.8	2.59	1.16
	Iron (Fe)	mg/kg	$40,000^{\alpha}$	34,400	33,100	***49,100***	***38,500***	***45,600***	***35,400***	***40,340***	6,794	3,038
	Lead (Pb)	mg/kg	91.3	35	16.6	34.6	18.3	20.9	18.1	21.7	7.4	3.3
	Lithium (Li)	mg/kg	-	-	26.5	34.8	28.4	34.6	27.8	30.4	4.0	1.8
	Magnesium (Mg)	mg/kg	-	-	12,100	12,800	13,500	13,100	12,100	12,720	618	276
	Manganese (Mn)	mg/kg	$1,100^{\alpha,\beta}$	657	527	435	***1,830***	***4,240***	***949***	***1,596***	1,578	706
	Mercury (Hg)	mg/kg	0.486	0.17	0.0240	0.0296	0.0188	0.0305	0.0233	0.0252	0.0048	0.0022
	Molybdenum (Mo)	mg/kg	-	-	0.80	2.40	1.23	2.57	1.27	1.65	0.78	0.350
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	66	52.0	57.0	61.6	60.2	48.4	55.8	5.6	2.5
	Phosphorus (P)	mg/kg	$2,000^{\alpha}$	1,278	914	1020	1060	1170	966	1,026	98	44
	Potassium (K)	mg/kg	-	-	3,340	4,450	3,570	4,550	3,630	3,908	552	247
	Selenium (Se)	mg/kg	-	-	<0.20	0.20	<0.20	<0.20	<0.20	0.20	0	0
	Silver (Ag)	mg/kg	-	-	<0.10	0.13	<0.10	0.12	0.10	0.11	0.01	0.01
	Sodium (Na)	mg/kg	-	-	219	303	250	310	255	267	38.3	17.1
	Strontium (Sr)	mg/kg	-	-	9.62	10.3	10.5	11.6	10.3	10.5	0.7	0.3
	Sulphur (S)	mg/kg	-	-	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	0	0
	Thallium (Tl)	mg/kg	-	-	0.332	0.412	0.366	0.440	0.337	0.377	0.047	0.021
	Tin (Sn)	mg/kg	-	-	4.4	30.0	5.8	5.8	6.8	10.6	10.9	4.9
	Titanium (Ti)	mg/kg	-	-	1,120	1,270	1,110	1,250	1,190	1,188	73	33
	Uranium (U)	mg/kg	-	-	4.62	6.18	4.21	5.88	4.96	5.17	0.84	0.37
	Vanadium (V)	mg/kg	-	-	43.5	52.3	44.9	52.2	45.1	47.6	4.3	1.9
	Zinc (Zn)	mg/kg	315	135	51.3	55.2	45.5	56.9	48.4	51.5	4.7	2.1
	Zirconium (Zr)	mg/kg	-	-	17.3	18.5	12.1	13.5	14.5	15.2	2.7	1.2

[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, baseline sediment quality data, and method detection limits. The indicated values are specific to Sheardown Lake Southeast.

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

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table D.21: Magnitude of difference in sediment metal concentrations between Sheardown Lake SE and Reference Lake 3 in 2016, at Sheardown Lake SE between 2016 and the baseline period, and at Sheardown Lake SE between 2016 and 2015 mine operational years for littoral and profundal stations, Mary River Project CREMP, 2016

Variable	Sheardown Lake SE versus Reference Lake 3 in 2016		Sheardown Lake SE 2016 versus Baseline Period		Sheardown Lake SE 2016 versus Initial Year of Mine Operation (2015)	
	Reference Lake Concentration (mg/kg)	Magnitude of Difference	Sheardown Lake SE Baseline Concentration (mg/kg)	Magnitude of Difference	Sheardown Lake SE 2015 Concentration (mg/kg)	Magnitude of Difference
Aluminum (Al)	16,480	1.0	14,950	1.1	18,467	0.9
Antimony (Sb)	<0.10	1.0	1.0	0.1	0.1	1.0
Arsenic (As)	3.7	1.2	1.9	2.4	4.7	0.9
Barium (Ba)	112	0.8	81	1.1	95	1.0
Beryllium (Be)	0.7	1.1	1.0	0.8	0.9	0.9
Boron (B)	13.0	1.6	3	8.6	27	0.8
Cadmium (Cd)	0.1	0.7	0.5	0.2	0.1	0.9
Calcium (Ca)	5,128	1.0	6,310	0.8	5,933	0.9
Chromium (Cr)	55	1.3	78	0.9	84	0.8
Cobalt (Co)	10	1.3	13	1.0	15	0.9
Copper (Cu)	66	0.4	30	0.9	30	0.9
Iron (Fe)	29,840	1.4	32,284	1.2	44,300	0.9
Lead (Pb)	46	0.5	17	1.3	19	1.1
Lithium (Li)	27	1.1	-	-	32.7	0.9
Magnesium (Mg)	10,852	1.2	12,634	1.0	14,233	0.9
Manganese (Mn)	496	3.2	462	3.5	1,048	1.5
Mercury (Hg)	0.0355	0.7	0.100	0.3	0.025	1.0
Molybdenum (Mo)	2.190	0.8	1.5	1.1	1.7	1.0
Nickel (Ni)	39	1.4	62	0.9	68	0.8
Phosphorus (P)	840	1.2	1,150	0.9	1,076	1.0
Potassium (K)	3,894	1.0	3,947	1.0	4,647	0.8
Selenium (Se)	0.5	0.4	1.0	0.2	0.2	0.9
Silver (Ag)	0.1	0.9	0.4	0.3	0.1	0.8
Sodium (Na)	296	0.9	353	0.8	299	0.9
Strontium (Sr)	11.4	0.9	16.0	0.7	13.1	0.8
Thallium (Tl)	0.388	1.0	1.0	0.4	0.5	0.8
Tin (Sn)	56	0.2	-	-	2.0	5.3
Titanium (Ti)	1,072	1.1	-	-	1,380	0.9
Uranium (U)	12	0.4	-	-	6.3	0.8
Vanadium (V)	50	1.0	52	0.9	55	0.9
Zinc (Zn)	74	0.7	51	1.0	62	0.8

Denotes slight elevation (mean variable concentration 2 to 4 times higher than respective mean reference, baseline period or 2015 value).

Denotes moderate elevation (mean variable concentration 4 to 10 times higher than respective mean reference, baseline period or 2015 value).

Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference, baseline period or 2015 value).

Table D.22: Field observations at Mary Lake (BLO) benthic invertebrate community stations[a], Mary River Project CREMP, August 2016.

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
BLO-01	9.6	medium brown clay silt	none detected	none observed
BLO-20	11.3	brown grey fine silt with some sand	none detected	none observed
BLO-11	11.6	medium brown silt with some sand	none detected	none observed
BLO-21	11.2	medium brown silt	none detected	none observed
BLO-22	11.3	medium brown silt	none detected	none observed
BLO-06	9.1	medium brown silt	none detected	none observed

[a] Sediment particle size and benthic invertebrate community samples were collected by petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.23: Sediment observations from cores collected at littoral stations of Mary Lake (BLO), Mary River Project CREMP, August 2016.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
BLO-01	9.6	1	17.0	0 to 2	orange brown silt
				2 to 11	medium beige silt with black streaking
				11 to 17	medium to dark brown silt
		2	27.5	0 to 2	orange brown silt
				2 to 27.5	gradient from medium beige with black streaking to dark brown silt
		3	19.0	0 to 2	orange brown silt
				2 to 19	gradient from medium beige with black streaking to dark brown silt
BLO-20	11.5	1	13.0	0 to 2	medium orange brown silt
				2 to 13	medium dark brown silt with some black streaking
		2	10.0	0 to 4	medium orange brown silt
				4 to 10	medium dark brown silt with some black streaking
		3	11.0	0 to 3	medium orange brown silt
				3 to 11	medium dark brown silt with some black streaking
BLO-11	10.9	1	15.0	0 to 1.5	orange brown silt
				1.5 to 15	orange brown silt with fine sand
		2	7.5	0 to 3	orange brown silt
				3 to 7.5	orange brown silt with fine sand
		3	13.5	0 to 2	orange brown silt
				2 to 7	orange brown silt with fine sand
				7 to 13.5	medium to dark brown silt
BLO-21	10.9	1	10.5	0 to 4	light beige silt
				4 to 10.5	medium brown silt with black streaking/band at top of layer
		2	10.5	0 to 4.5	light beige silt
				4.5 to 10.5	medium brown silt with black streaking/band at top of layer
		3	10.5	0 to 5	light beige silt
				5 to 10.5	medium brown silt with black streaking/band at top of layer
BLO-22	11.4	1	19.0	0 to 1.5	light orange brown silt
				1.5 to 8	medium beige brown silt
				8 to 19	dark brown silt with some minor black streaking
		2	20.0	0 to 2	light orange brown silt
				2 to 6	medium beige brown silt
				6 to 20	dark brown silt with some minor black streaking
		3	20.0	0 to 2	light orange brown silt
				2 to 7	medium beige brown silt
				7 to 20	dark brown silt with some minor black streaking
BLO-06	9.1	1	9.0	0 to 6	medium brown silt
				6 to 9	medium brown silt with dark brown pockets
		2	9.0	0 to 6	medium brown silt
				6 to 9	medium brown silt with dark brown pockets
		3	10.5	0 to 6.5	medium brown silt
				6.5 to 10.5	medium brown silt with dark brown pockets

Table D.24: Sediment observations from cores collected at profundal stations of Mary Lake (BLO), Mary River Project CREMP, August 2016.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
BLO-12	20.0	1	7.0	0 to 7	medium brown silt
		2	14.5	0 to 2.5	medium brown silt wth some fine sand
				2.5 to 7.5	medium dark brown silt wth some fine sand
				7.5 to 14.5	compact medium to dark brown silt wth some fine sand
		3	25.0	0 to 7	medium brown silt
				7 to 25	compact medium to dark brown silt wth some fine sand
BLO-10	17.7	1	13.0	0 to 3.5	light brown silt
				3.5 to 7	medium brown silt, some black banding/streaking
				7 to 13.5	medium to dark brown silt
		2	10.0	0 to 3	light brown silt
				3 to 9	medium brown silt, some black banding/streaking
				9 to 10	medium dark brown silt
		3	8.0	0 to 3.5	light brown silt
				3.5 to 8	medium brown silt, some black banding/streaking
BLO-08	26.3	1	18.0	0 to 3	orange brown silt
				3 to 9	medium brown silt, top of layer marked by redox band ~0.5cm thick
				9 to 18	dark brown silt
		2	17.0	0 to 3	orange brown silt
				3 to 9	medium brown silt, top of layer marked by redox band ~0.5cm thick
				9 to 17	dark brown silt
		3	12.5	0 to 3	orange brown silt
				3 to 7.5	medium brown silt, top of layer marked by redox band ~0.5cm thick
				7 to 12.5	dark brown silt

Table D.25: Statistical comparison of littoral station substrate physical properties between Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2016.

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
Sand (% by weight)	Yes	0.030	α, δ, γ	Reference	5	42.5	18.1	8.1	19.9	66.6
				Mary	6	17.7	13.9	5.7	5.1	40.4
Silt (% by weight)	No	0.228	α, δ, γ	Reference	5	53.1	16.3	7.3	31.1	74.0
				Mary	6	62.3	5.9	2.4	52.1	70.6
Clay (% by weight)	Yes	0.024	α, ε, γ	Reference	5	4.4	2.2	1.0	2.3	7.4
				Mary	6	20.0	12.1	4.9	7.5	33.4
Moisture (%)	Yes	0.001	γ	Reference	5	89.7	13.4	6.0	66.6	99.0
				Mary	6	51.0	7.8	3.2	42.0	59.7
TOC (%)	Yes	0.012	γ	Reference	5	4.8	2.0	0.9	3.3	8.0
				Mary	6	1.1	0.3	0.1	0.8	1.5

[a] Data analysis included: α - data untransformed; β - data logit transformed; η - $\log_{10}$ transformed; δ - single factor ANOVA test conducted; ε - t-test assuming unequal variance; γ - ANOVA test validated using Mann Whitney U-test.

(grey box) Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table D.26: Sediment particle size, total organic carbon, and metal concentrations at Mary Lake (BLO) sediment stations, Mary River Project CREMP, August 2016.

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Mary Lake Stations									Study Area Summary Statistics		
					BLO-01 (littoral)	BLO-11 (littoral)	BLO-12 (profundal)	BLO-08 (profundal)	BLO-10 (profundal)	BLO-20 (littoral)	BLO-21 (littoral)	BLO-22 (littoral)	BLO-06 (littoral)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	18.7	40.4	34.6	5.1	7.5	26.6	10.0	5.6	5.1	17	14	4.6
	Silt	%	-	-	70.6	52.1	52.7	61.7	54.0	63.8	63.3	62.1	61.6	60	6	2.0
	Clay	%	-	-	10.7	7.5	12.6	33.1	38.6	9.5	26.7	32.3	33.4	23	12	4.1
	Moisture	%	-	-	55.9	42.0	41.1	67.8	53.9	43.0	47.5	57.9	59.7	52	9.2	3.1
	Total Organic Carbon	%	10^{α}	-	1.54	0.78	0.78	1.12	1.00	1.03	0.88	1.16	1.15	1.05	0.24	0.079
Metals	Aluminum (Al)	mg/kg	-	-	14,700	14,800	14,700	26,100	23,800	14,300	22,100	24,600	25,500	20,067	5,281	1,760
	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	0
	Arsenic (As)	mg/kg	17	5.9	5.54	2.72	2.71	4.00	3.76	2.35	3.54	4.32	3.93	3.65	0.98	0.33
	Barium (Ba)	mg/kg	-	-	87.2	60.1	57.0	103	107	60.1	94.5	119	106	88.2	23.5	7.85
	Beryllium (Be)	mg/kg	-	-	0.76	0.70	0.69	1.27	1.24	0.70	1.10	1.26	1.36	1.01	0.289	0.0963
	Bismuth (Bi)	mg/kg	-	-	<0.20	<0.20	<0.20	0.27	0.25	<0.20	0.22	0.26	0.25	0.23	0.029	0.010
	Boron (B)	mg/kg	-	-	21.6	20.1	18.7	35.4	34.5	19.8	29.3	34.0	36.5	27.8	7.61	2.54
	Cadmium (Cd)	mg/kg	3.5	1.5	0.100	0.082	0.082	0.157	0.146	0.077	0.124	0.175	0.140	0.120	0.0364	0.01213
	Calcium (Ca)	mg/kg	-	-	9,700	4,280	4,300	4,900	4,610	7,750	4,380	4,720	4,750	5,488	1,911	636.9
	Chromium (Cr)	mg/kg	90	98	61.7	63.0	60.8	93.9	87.4	61.7	81.2	87.5	87.5	76.1	13.9	4.64
	Cobalt (Co)	mg/kg	-	-	13.9	11.6	11.5	17.7	16.8	11.1	15.8	18.1	17.2	14.9	2.86	0.955
	Copper (Cu)	mg/kg	110	50	27.5	21.5	20.7	35.7	33.5	21.1	31.4	34.3	34.1	28.9	6.27	2.09
	Iron (Fe)	mg/kg	$40,000^{\alpha}$	52,400	34,400	28,600	27,800	41,700	39,700	28,600	37,600	42,000	41,950	35,817	6,115	2,038
	Lead (Pb)	mg/kg	91.3	35	16.3	15.5	17.3	27.6	29.1	14.5	24.5	25.0	***36.2***	22.9	7.46	2.49
	Lithium (Li)	mg/kg	-	-	29.9	27.7	27.2	45.7	45.9	27.3	43.2	46.3	51.5	38.3	10.0	3.34
	Magnesium (Mg)	mg/kg	-	-	14,600	11,100	11,000	16,700	16,200	12,900	15,200	16,400	16,900	14,556	2,344	781
	Manganese (Mn)	mg/kg	$1,100^{\alpha,\beta}$	4,370	1,790	1,190	1,190	1,220	731	469	632	***5,340***	719	1,476	1,505	502
	Mercury (Hg)	mg/kg	0.486	0.17	0.0275	0.0264	0.0266	0.0665	0.0617	0.0185	0.0450	0.0598	0.0519	0.0427	0.0182	0.00607
	Molybdenum (Mo)	mg/kg	-	-	0.58	0.63	1.16	0.88	0.79	0.61	0.69	1.57	0.86	0.86	0.32	0.11
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	72	53.2	47.7	49.5	67.4	62.7	47.7	56.5	65.6	60.1	56.7	7.6	2.55
	Phosphorus (P)	mg/kg	$2,000^{\alpha}$	1,580	1,110	989	958	854	784	896	806	945	767	901	112	37
	Potassium (K)	mg/kg	-	-	3,400	3,430	3,400	6,440	5,790	3,270	5,350	6,190	6,365	4,848	1,435	478
	Selenium (Se)	mg/kg	-	-	<0.20	<0.20	<0.20	0.24	0.24	<0.20	<0.20	0.23	0.23	0.22	0.019	0.006
	Silver (Ag)	mg/kg	-	-	<0.10	<0.10	<0.10	0.15	0.15	<0.10	0.12	0.14	0.14	0.12	0.022	0.007
	Sodium (Na)	mg/kg	-	-	239	227	225	395	372	218	348	366	390	309	78.7	26.2
	Strontium (Sr)	mg/kg	-	-	13.8	10.3	10.0	16.1	14.5	10.9	13.4	15.2	15.3	13.3	2.31	0.769
	Sulphur (S)	mg/kg	-	-	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	0	0
	Thallium (Tl)	mg/kg	-	-	0.331	0.331	0.328	0.605	0.579	0.322	0.541	0.621	0.640	0.478	0.144	0.0481
	Tin (Sn)	mg/kg	-	-	4.1	4.1	7.3	7.1	10.6	3.1	5.0	2.0	20.4	7.1	5.630	1.877
	Titanium (Ti)	mg/kg	-	-	965	1,190	1,090	1,580	1,550	1,150	1,550	1,520	1,660	1,362	259	86
	Uranium (U)	mg/kg	-	-	3.78	5.02	5.05	10.4	10.3	5.04	8.36	9.64	10.1	7.52	2.74	0.915
	Vanadium (V)	mg/kg	-	-	46.8	44.0	42.3	68.7	65.5	42.1	63.3	66.0	69.8	56.5	12.3	4.08
	Zinc (Zn)	mg/kg	315	135	49.8	51.4	49.0	82.3	78.7	49.0	76.1	81.3	85.0	67.0	16.5	5.49
	Zirconium (Zr)	mg/kg	-	-	9.3	12.8	13.7	23.7	23.1	16.8	22.9	19.9	24.5	18.5	5.57	1.86

[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, baseline sediment quality data, and method detection limits. The indicated values are specific to Mary Lake.

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

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table D.27: Magnitude of difference in sediment metal concentrations between Mary Lake and Reference Lake 3 in 2016, at Mary Lake between 2016 and the baseline period, and at Mary Lake between 2015 and 2016 for littoral and profundal stations, Mary River Project CREMP, 2016.

Variable	Mary Lake versus Reference Lake 3 in 2016				Mary Lake 2016 versus Baseline Period				Mary Lake 2016 versus Initital Year of Mine Operation (2015)			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Reference Lake Concentration (mg/kg)	Magnitude of Difference	Reference Lake Concentration (mg/kg)	Magnitude of Difference	Mary Lake Baseline Concentration (mg/kg)	Magnitude of Difference	Mary Lake Baseline Concentration (mg/kg)	Magnitude of Difference	Mary Lake 2015 Concentration (mg/kg)	Magnitude of Difference	Mary Lake 2015 Concentration (mg/kg)	Magnitude of Difference
Aluminum (Al)	16,480	1.2	25,150	0.9	18,267	1.1	17,000	1.3	21,300	0.9	24,913	0.9
Antimony (Sb)	<0.10	1.0	0.12	0.8	1.0	0.1	1.0	0.1	0.1	1.0	0.1	1.0
Arsenic (As)	3.7	1.0	6.5	0.5	2.8	1.3	3.7	0.9	4.9	0.8	5.2	0.7
Barium (Ba)	112	0.8	162	0.6	105	0.8	76	1.2	94	0.9	98	0.9
Beryllium (Be)	0.7	1.5	1.0	1.0	1.0	1.0	1.0	1.1	1.1	0.9	1.2	0.9
Bismuth (Bi)	<0.20	1.1	0.21	1.2	-	-	-	-	0.2	0.9	0.3	0.8
Boron (B)	13.0	2.1	19.2	1.5	1	36.7	2	14.1	33	0.8	36	0.8
Cadmium (Cd)	0.1	0.8	0.2	0.7	0.5	0.2	0.5	0.3	0.1	1.0	0.1	0.9
Calcium (Ca)	5,128	1.2	6,111	0.8	3,130	1.9	2,934	1.6	6,995	0.8	4,583	1.0
Chromium (Cr)	55	1.3	80	1.0	81	0.9	76	1.1	79	0.9	92	0.9
Cobalt (Co)	10	1.4	18	0.8	18	0.8	18	0.9	16	0.9	18	0.9
Copper (Cu)	66	0.4	101	0.3	45	0.6	44	0.7	31	0.9	34	0.9
Iron (Fe)	29,840	1.2	53,580	0.7	36,133	1.0	35,654	1.0	38,750	0.9	43,019	0.8
Lead (Pb)	46	0.5	30	0.8	18	1.2	21	1.2	22	1.0	25	1.0
Lithium (Li)	27	1.4	42	0.9	-	-	-	-	42.3	0.9	47.0	0.8
Magnesium (Mg)	10,852	1.3	16,160	0.9	13,967	1.0	10,903	1.3	15,750	0.9	16,063	0.9
Manganese (Mn)	496	3.4	1,866	0.6	699	2.4	991	1.1	1,222	1.4	1,681	0.6
Mercury (Hg)	0.0355	1.1	0.0699	0.7	0.100	0.4	0.100	0.5	0.035	1.1	0.050	1.0
Molybdenum (Mo)	2.190	0.4	3.270	0.3	1.0	0.8	1.0	0.9	0.8	1.1	1.0	0.9
Nickel (Ni)	39	1.4	56	1.1	67	0.8	65	0.9	58	0.9	66	0.9
Phosphorus (P)	840	1.1	1,121	0.8	800	1.1	1,325	0.7	946.5	1.0	983.5	0.9
Potassium (K)	3,894	1.2	5,891	0.9	3,450	1.4	4,287	1.2	5,400	0.9	6,237	0.8
Selenium (Se)	0.5	0.4	0.9	0.3	1.0	0.2	1.0	0.2	0.2	0.9	0.2	1.0
Silver (Ag)	0.1	1.0	0.3	0.5	0.3	0.4	0.4	0.4	0.1	0.9	0.2	0.8
Sodium (Na)	296	1.0	455	0.7	279	1.1	284	1.2	331	0.9	382	0.9
Strontium (Sr)	11.4	1.2	15.8	0.9	9.3	1.4	13.3	1.0	15.3	0.9	16.4	0.8
Sulphur (S)	<5,000	1.0	<5,000	1.0	-	-	-	-	5,000	1.0	5,000	1.0
Thallium (Tl)	0.388	1.2	0.801	0.6	1.0	0.5	1.0	0.5	0.5	0.9	0.6	0.8
Tin (Sn)	56	0.1	16	0.5	-	-	-	-	2.0	3.2	2.0	4.1
Titanium (Ti)	1,072	1.2	1,331	1.1	-	-	-	-	1,401	1.0	1,565	0.9
Uranium (U)	12	0.6	27	0.3	-	-	-	-	7.4	0.9	9.7	0.9
Vanadium (V)	50	1.1	72	0.8	69	0.8	63	0.9	61	0.9	68	0.9
Zinc (Zn)	74	0.9	105	0.7	67	1.0	64	1.1	71	0.9	82	0.9
Zirconium (Zr)	4.3	4.1	4.0	5.0	-	-	-	-	18	1.0	23	0.9

Denotes slight elevation (mean variable concentration 2 to 5 times higher than respective mean reference, baseline period or 2015 value).
Denotes moderate elevation (mean variable concentration 5 to 10 times higher than respective mean reference, baseline period, or 2015 value).
Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference, baseline period, or 2015 value).

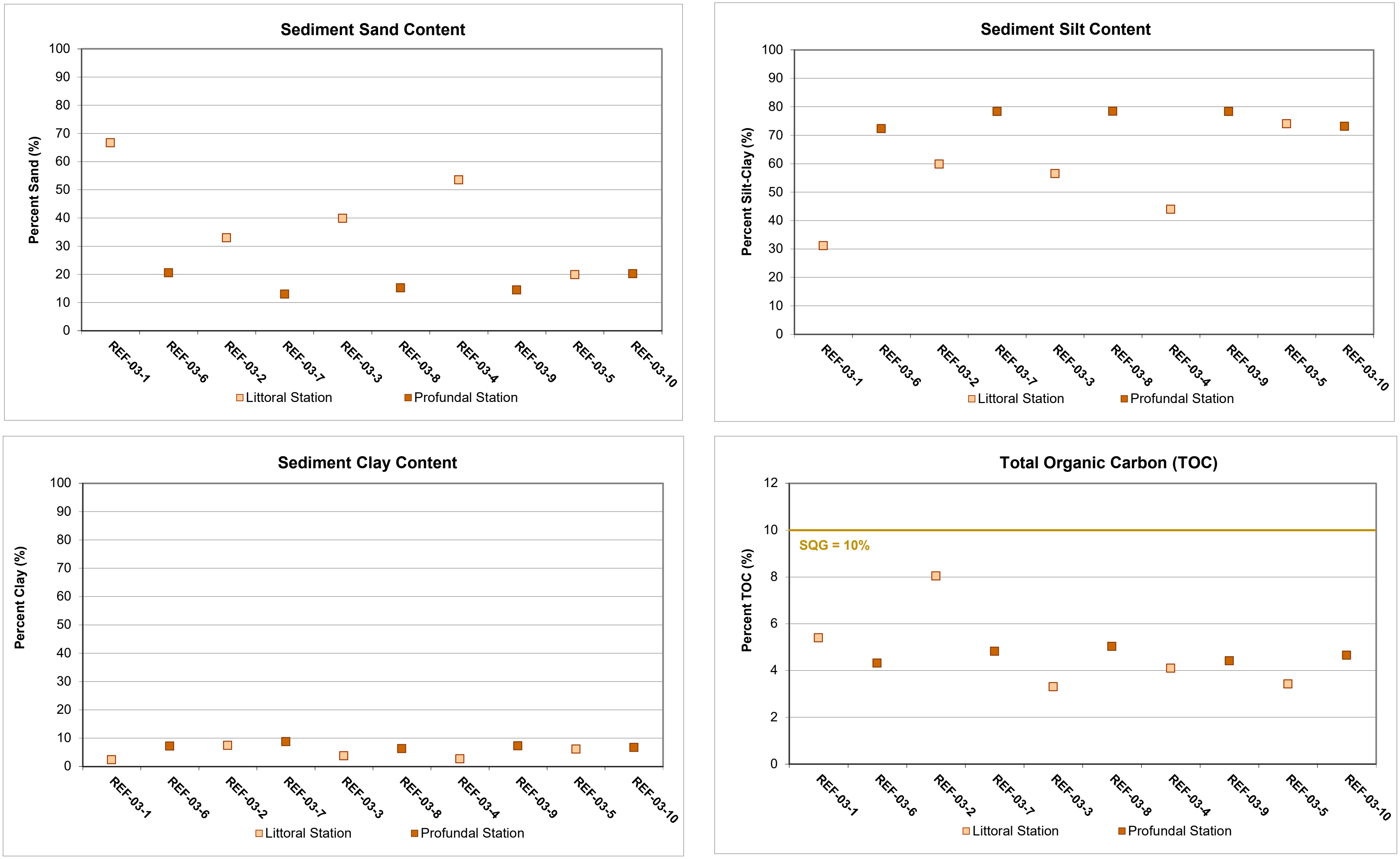


Figure D.1: Reference Lake 3 (REF-03) physical-chemical sediment quality at littoral and profundal sampling depths, Mary River Project CREMP, August 2016.

APPENDIX E

PHYTOPLANKTON DATA

Table E.1: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at lotic reference stations, the Camp Lake tributaries, Sheardown Lake Tributary 1 and the Tom River, Mary River Project CREMP, 2016.

	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	27-Jun-16	27-Jun-16	27-Jun-16	27-Jun-16	27-Jun-16	27-Jun-16	27-Jun-16	27-Jun-16	27-Jun-16	27-Jun-16	25-Jun-16	26-Jun-16	27-Jun-16	27-Jun-16	25-Jun-16
	Summer	24-Jul-16	24-Jul-16	25-Jul-16	25-Jul-16	20-Jul-16	19-Jul-16	19-Jul-16	19-Jul-16	20-Jul-16	20-Jul-16	20-Jul-16	20-Jul-16	19-Jul-16	19-Jul-16	20-Jul-16
	Fall	20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16	19-Aug-16	19-Aug-16	19-Aug-16	19-Aug-16	19-Aug-16	19-Aug-16	20-Aug-16	19-Aug-16	19-Aug-16	19-Aug-16
Chlorophyll a (µg/L)	Spring	0.18	0.17	0.14	0.45	0.13	0.24	0.53	0.24	0.25	0.25	0.19	0.97	0.31	0.43	0.21
	Summer	0.41	0.31	0.56	0.37	0.17	0.35	0.85	0.54	0.57	0.60	0.30	1.86	0.27	1.07	0.26
	Fall	0.41	0.28	0.18	0.35	0.13	0.21	1.20	0.36	0.36	0.37	0.19	0.66	0.26	0.22	0.19
	Average	0.33	0.25	0.29	0.39	0.14	0.27	0.86	0.38	0.39	0.41	0.23	1.16	0.28	0.57	0.22
	Standard Deviation	0.13	0.07	0.23	0.05	0.02	0.07	0.34	0.15	0.16	0.18	0.06	0.62	0.03	0.44	0.04
	Standard Error	0.08	0.04	0.13	0.03	0.01	0.04	0.19	0.09	0.09	0.10	0.04	0.36	0.02	0.26	0.02
Phaeophytin a (µg/L)	Spring	0.28	0.29	0.28	0.45	0.26	0.28	0.45	0.35	0.33	0.38	0.27	0.65	0.43	0.44	0.29
	Summer	0.43	0.37	0.54	0.39	0.29	0.39	0.59	0.48	0.46	0.44	0.30	0.79	0.32	0.60	0.32
	Fall	0.34	0.30	0.30	0.33	0.22	0.28	0.48	0.32	0.34	0.33	0.24	0.38	0.25	0.29	0.23
	Average	0.35	0.32	0.37	0.39	0.26	0.32	0.51	0.38	0.38	0.38	0.27	0.61	0.33	0.44	0.28
	Standard Deviation	0.08	0.04	0.14	0.06	0.04	0.06	0.07	0.09	0.07	0.06	0.03	0.21	0.09	0.16	0.05
	Standard Error	0.04	0.03	0.08	0.03	0.02	0.04	0.04	0.05	0.04	0.03	0.02	0.12	0.05	0.09	0.03

Table E.2: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at Reference Lake 3 (REF-03), Mary River Project CREMP, 2016.

	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	16-Jul-16	28-Jul-16	28-Jul-16	-	-	-	16-Jul-16	28-Jul-16	28-Jul-16	-	-	-
	Fall	20-Aug-16	19-Aug-16	20-Aug-16	-	-	-	20-Aug-16	19-Aug-16	20-Aug-16	-	-	-
Summer	Surface	0.66	0.945	1.22	0.94	0.28	0.16	0.75	0.635	0.64	0.68	0.07	0.04
	Bottom	1.08	0.81	0.82	0.90	0.15	0.09	0.74	0.69	0.65	0.69	0.05	0.03
	Average	0.87	0.88	1.02	0.92	0.08	0.05	0.75	0.66	0.65	0.68	0.05	0.03
Fall	Surface	0.63	0.69	0.64	0.65	0.03	0.02	0.5	0.43	0.45	0.46	0.04	0.02
	Bottom	1.01	0.7	0.76	0.82	0.16	0.09	0.6	0.48	0.6	0.56	0.07	0.04
	Average	0.82	0.70	0.70	0.74	0.07	0.04	0.55	0.46	0.53	0.51	0.05	0.03

Table E.3: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at Camp Lake (JLO), Mary River Project CREMP, 2016.

	Analyte	Chlorophyll a (µg/L)								Phaeophytin a (µg/L)							
	Station	JL0-02	JL0-10	JL0-01	JL0-07	JL0-09	Average	Standard Deviation	Standard Error	JL0-02	JL0-10	JL0-01	JL0-07	JL0-09	Average	Standard Deviation	Standard Error
Sample Collection Date	Winter	23-Apr-16	23-Apr-16	23-Apr-16	25-Apr-16	25-Apr-16	-	-	-	23-Apr-16	23-Apr-16	23-Apr-16	25-Apr-16	25-Apr-16	-	-	-
	Summer	24-Jul-16	24-Jul-16	24-Jul-16	26-Jul-16	26-Jul-16	-	-	-	24-Jul-16	24-Jul-16	24-Jul-16	26-Jul-16	26-Jul-16	-	-	-
	Fall	22-Aug-16	22-Aug-16	22-Aug-16	22-Aug-16	22-Aug-16	-	-	-	22-Aug-16	22-Aug-16	22-Aug-16	22-Aug-16	22-Aug-16	-	-	-
Winter	Surface	0.63	0.56	1.01	1.21	0.55	0.79	0.30	0.13	<0.39	<0.39	<0.39	0.45	<0.39	0.40	0.03	0.01
	Bottom	0.83	0.86	0.26	0.22	0.33	0.50	0.32	0.14	<0.39	<0.39	<0.39	<0.39	<0.39	0.39	0	0
	Average	0.73	0.71	0.64	0.72	0.44	0.65	0.12	0.05	0.39	0.39	0.39	0.42	0.39	0.40	0.01	0.01
Summer	Surface	1.42	1.28	1.46	1.14	1.21	1.30	0.14	0.06	0.61	0.58	0.56	0.70	0.59	0.61	0.05	0.02
	Bottom	2.32	1.52	2.16	1.20	1.32	1.70	0.51	0.23	0.62	0.61	0.69	0.80	0.87	0.72	0.11	0.05
	Average	1.87	1.40	1.81	1.17	1.27	1.50	0.32	0.14	0.62	0.60	0.63	0.75	0.73	0.66	0.07	0.03
Fall	Surface	0.67	0.68	0.66	0.63	0.70	0.67	0.03	0.01	0.48	0.42	0.41	0.44	0.46	0.44	0.03	0.01
	Bottom	1.15	0.89	1.70	2.01	1.54	1.46	0.44	0.20	0.71	0.56	0.85	0.76	0.77	0.73	0.11	0.05
	Average	0.91	0.79	1.18	1.32	1.12	1.06	0.21	0.10	0.60	0.49	0.63	0.60	0.62	0.59	0.05	0.02

Table E.4: 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, 2016.

Study Lake	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Seasons?	p-value	Statistical Test[b]	(I) Area	(J) Area	Significant Difference Between 2 Seasons?	p-value	Statistical Test
Reference Creek Stations	NO	0.11231	ANOVA[c]	Spring	Summer	NO	0.0958	Tukey's[c]
				Spring	Fall	NO	0.4767	
				Summer	Fall	NO	0.5030	
Mary River GO-09 Reference Stations	NO	0.51119	ANOVA[c]	Spring	Summer	NO	0.9173	Tukey's[c]
				Spring	Fall	NO	0.7138	
				Summer	Fall	NO	0.4935	
Reference Lake 3	-	-	-	Winter	Summer	not applicable	-	ANOVA[c]
				Winter	Fall	not applicable	-	
				Summer	Fall	YES	0.0406	
Camp Lake	YES	0.00014	ANOVA[d,e]	Winter	Summer	YES	0.0001	Tukey's[f]
				Winter	Fall	YES	0.0074	
				Summer	Fall	YES	0.0571	
Sheardown Lake NW	YES	0.00001	ANOVA[c]	Winter	Summer	YES	0.0000	Tukey's[c]
				Winter	Fall	YES	0.0008	
				Summer	Fall	YES	0.0524	
Sheardown Lake SE	YES	0.00576	ANOVA[c]	Winter	Summer	NO	0.4522	Tukey's[c]
				Winter	Fall	YES	0.0464	
				Summer	Fall	YES	0.0050	
Mary Lake North Basin	YES	0.00001	ANOVA[c]	Winter	Summer	YES	0.0000	Tukey's[c]
				Winter	Fall	YES	0.0000	
				Summer	Fall	NO	0.2408	
Mary Lake South Basin	YES	0.00001	ANOVA	Winter	Summer	YES	0.0000	Tukey's
				Winter	Fall	YES	0.0017	
				Summer	Fall	YES	0.0195	

[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] Logged data normally distributed.

[d] Logged data non-normally distributed.

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

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

Table E.5: Summary data and statistical comparison of chlorophyll a concentrations (mg/L) between individual mine-exposed lakes and Reference Lake 3 for summer sampling, Mary River Project CREMP, July 2016.

Study Lake	Comparison to Reference				Number of Stations (n)	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	p-value	Statistical Test	Magnitude of Difference					Lower Bound	Upper Bound		
Reference Lake 03	-	-	-	-	3	0.92	0.08	0.05	0.71	1.13	0.87	1.02
Camp Lake	YES	0.0115	β	6.9	5	1.50	0.32	0.14	1.11	1.90	1.17	1.87
Sheardown Lake NW	YES	0.0002	β	14.3	6	2.13	0.39	0.16	1.73	2.54	1.58	2.65
Sheardown Lake SE	YES	0.0019	β	6.9	5	1.51	0.21	0.09	1.25	1.77	1.29	1.70
Mary Lake North	YES	0.0028	β	22.9	3	2.86	0.99	0.57	0.39	5.33	2.07	3.98
Mary Lake South	NO	0.2051	β	-	7	1.08	0.17	0.06	0.92	1.23	0.78	1.32

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Mann-Whitney U-test; δ - data exhibit unequal variance; test results validated using t-test assuming unequal variance

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

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

Table E.6: Summary data and statistical comparison of chlorophyll a concentrations (mg/L) between individual mine-exposed lakes and Reference Lake 3 for fall sampling, Mary River Project CREMP, August 2016.

Study Lake	Comparison to Reference				Number of Stations (n)	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	p-value	Statistical Test	Magnitude of Difference					Lower Bound	Upper Bound		
Reference Lake 03	-	-	-	-	3	0.74	0.07	0.04	0.56	0.91	0.70	0.82
Camp Lake	YES	0.0367	β	4.6	5	1.06	0.21	0.10	0.80	1.33	0.79	1.32
Sheardown Lake NW	YES	0.0000	β	11.1	6	1.53	0.18	0.07	1.33	1.72	1.30	1.80
Sheardown Lake SE	YES	0.0001	β	30.1	5	2.87	0.74	0.33	1.95	3.78	2.07	3.98
Mary Lake North	YES	0.0170	β	3.7	3	1.00	0.09	0.05	0.77	1.22	0.90	1.07
Mary Lake South	NO	0.9080	β	-	7	0.75	0.23	0.09	0.54	0.97	0.40	1.06

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Mann-Whitney U-test; δ - data exhibit unequal variance; test results validated using t-test assuming unequal variance

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

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

Table E.7: Statistical comparisons of chlorophyll a concentrations among years of mine construction (2014) and operation (2015, 2016) at mine-exposed Camp Lake for the Mary River Project CREMP.

Season	Overall 3-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test
Winter	YES	0.00061	β , γ	2014	0.28	2014	2015	YES	0.0012	Tukey's (β , γ)
				2015	0.74	2014	2016	YES	0.0061	
				2016	0.65	2015	2016	NO	0.5455	
Summer	NO	0.21920	β , γ	2014	1.05	2014	2015	NO	0.9540	Tamhane's (β , γ)
				2015	1.26	2014	2016	NO	0.9257	
				2016	1.50	2015	2016	NO	0.4502	
Fall	YES	0.01762	α , γ	2014	1.59	2014	2015	NO	0.1262	Tamhane's (β)
				2015	0.65	2014	2016	NO	0.4558	
				2016	1.06	2015	2016	YES	0.0299	
Annual	NO	0.25654	β , γ	2014	1.01	2014	2015	NO	0.8452	Tamhane's (β , γ)
				2015	0.88	2014	2016	NO	0.5511	
				2016	1.07	2015	2016	NO	0.5364	

[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, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

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

Table E.8: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at Sheardown Lake Northwest (DLO-01), Mary River Project CREMP, 2016.

	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	30-Apr-16	26-Apr-16	26-Apr-16	26-Apr-16	26-Apr-16	30-Apr-16	-	-	-
	Summer	24-Jul-16	26-Jul-16	24-Jul-16	25-Jul-16	24-Jul-16	25-Jul-16	-	-	-
	Fall	21-Aug-16	21-Aug-16	21-Aug-16	22-Aug-16	22-Aug-16	22-Aug-16	-	-	-
Winter	Surface	0.73	0.76	0.88	0.53	0.51	1.66	0.85	0.42	0.17
	Bottom	1.08	0.63	0.66	0.72	1.01	1.32	0.90	0.28	0.11
	Average	0.91	0.70	0.77	0.63	0.76	1.49	0.87	0.32	0.13
Summer	Surface	1.99	1.68	2.28	1.99	2.28	2.37	2.10	0.26	0.11
	Bottom	1.71	1.48	1.84	2.47	3.02	2.46	2.16	0.58	0.24
	Average	1.85	1.58	2.06	2.23	2.65	2.42	2.13	0.39	0.16
Fall	Surface	1.26	1.72	1.10	1.56	1.63	1.81	1.51	0.28	0.11
	Bottom	1.34	1.35	2.10	1.13	1.97	1.34	1.54	0.40	0.16
	Average	1.30	1.54	1.60	1.35	1.80	1.58	1.53	0.18	0.07

	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	30-Apr-16	26-Apr-16	26-Apr-16	26-Apr-16	26-Apr-16	30-Apr-16	-	-	-
	Summer	24-Jul-16	26-Jul-16	24-Jul-16	25-Jul-16	24-Jul-16	25-Jul-16	-	-	-
	Fall	21-Aug-16	21-Aug-16	21-Aug-16	22-Aug-16	22-Aug-16	22-Aug-16	-	-	-
Winter	Surface	0.43	0.58	0.72	0.37	0.44	0.65	0.53	0.14	0.06
	Bottom	0.57	0.39	0.48	0.38	0.56	0.64	0.50	0.10	0.04
	Average	0.50	0.49	0.60	0.38	0.50	0.65	0.52	0.09	0.04
Summer	Surface	0.59	0.77	0.65	1.09	0.61	1.01	0.79	0.21	0.09
	Bottom	0.57	1.02	0.67	0.94	0.67	0.92	0.80	0.18	0.08
	Average	0.58	0.90	0.66	1.02	0.64	0.97	0.79	0.19	0.08
Fall	Surface	0.52	0.54	0.65	0.52	0.52	0.49	0.54	0.06	0.02
	Bottom	0.52	1.06	0.88	0.49	0.84	0.48	0.71	0.25	0.10
	Average	0.52	0.80	0.77	0.51	0.68	0.49	0.63	0.14	0.06

Table E.9: Statistical comparisons of chlorophyll a concentrations among years of mine construction (2014) and operation (2015, 2016) at mine-exposed Sheardown Lake NW for the Mary River Project CREMP.

Season	Overall 3-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test
Winter	YES	0.01755	β	2014	2.55	2014	2015	YES	0.0982	Tukey's (β)
				2015	1.10	2014	2016	YES	0.0158	
				2016	0.87	2015	2016	NO	0.6123	
Summer	YES	0.04169	β	2014	2.43	2014	2015	YES	0.0449	Tukey's (β)
				2015	1.51	2014	2016	NO	0.8630	
				2016	2.13	2015	2016	NO	0.1163	
Fall	YES	0.00554	β	2014	0.80	2014	2015	YES	0.0100	Tukey's (β)
				2015	1.61	2014	2016	YES	0.0132	
				2016	1.53	2015	2016	NO	0.9889	
Annual	NO	0.88904	β	2014	1.93	2014	2015	NO	0.9694	Tamhane's (β)
				2015	1.41	2014	2016	NO	0.9834	
				2016	1.51	2015	2016	NO	0.9997	

[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, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

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

Table E.10: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at Sheardown Lake Southeast (DLO-02), Mary River Project CREMP, 2016.

	Analyte	Chlorophyll a (µg/L)								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**	**DL0-02-06**	**DL0-02-07**	**DL0-02-4**	**DL0-02-8**	**DL0-02-03**	**Average**	**Standard Deviation**	**Standard Error**
Sample Collection Date	Winter	30-Apr-16	29-Apr-16	29-Apr-16	29-Apr-16	29-Apr-16	-	-	-	30-Apr-16	29-Apr-16	29-Apr-16	29-Apr-16	29-Apr-16	-	-	-
	Summer	26-Jul-16	26-Jul-16	26-Jul-16	26-Jul-16	26-Jul-16	-	-	-	26-Jul-16	26-Jul-16	26-Jul-16	26-Jul-16	26-Jul-16	-	-	-
	Fall	21-Aug-16	21-Aug-16	21-Aug-16	21-Aug-16	21-Aug-16	-	-	-	21-Aug-16	21-Aug-16	21-Aug-16	21-Aug-16	21-Aug-16	-	-	-
Winter	Surface	1.67	3.13	-	2.39	2.43	2.41	0.60	0.30	0.60	1.11	0.50	0.76	0.67	0.73	0.23	0.10
	Bottom	1.05	2.67	1.35	1.91	1.08	1.61	0.68	0.31	0.64	0.87	-	0.72	0.55	0.70	0.14	0.07
	Average	1.36	2.90	1.35	2.15	1.76	1.90	0.65	0.29	0.62	0.99	0.50	0.74	0.61	0.69	0.19	0.08
Summer	Surface	1.27	1.27	1.17	1.79	1.49	1.40	0.25	0.11	0.77	0.63	0.91	0.84	0.85	0.80	0.11	0.05
	Bottom	1.30	1.93	1.40	1.61	1.86	1.62	0.28	0.12	0.77	0.73	0.78	0.70	0.89	0.77	0.07	0.03
	Average	1.29	1.60	1.29	1.70	1.68	1.51	0.21	0.09	0.77	0.68	0.85	0.77	0.87	0.79	0.07	0.03
Fall	Surface	3.19	4.37	2.01	4.10	4.18	3.57	0.98	0.44	0.84	1.24	0.89	0.98	0.70	0.93	0.20	0.09
	Bottom	1.89	3.58	2.12	2.29	0.96	2.17	0.94	0.42	0.83	0.90	0.74	0.96	0.82	0.85	0.08	0.04
	Average	2.54	3.98	2.07	3.20	2.57	2.87	0.74	0.33	0.84	1.07	0.82	0.97	0.76	0.89	0.13	0.06

Table E.11: Statistical comparisons of chlorophyll a concentrations among years of mine construction (2014) and operation (2015, 2016) at mine-exposed Sheardown Lake SE for the Mary River Project CREMP.

Season	Overall 3-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test
Winter	NO	0.11765	β	2014	2.67	2014	2015	NO	0.1040	Tukey's (β)
				2015	1.58	2014	2016	NO	0.3642	
				2016	1.90	2015	2016	NO	0.6942	
Summer	YES	0.00000	α	2014	0.20	2014	2015	YES	0.0001	Tamhane's (α)
				2015	0.91	2014	2016	YES	0.0004	
				2016	1.51	2015	2016	YES	0.0056	
Fall	YES	0.03835	α	2014	1.54	2014	2015	NO	0.8717	Tamhane's (α)
				2015	0.99	2014	2016	NO	0.3911	
				2016	2.87	2015	2016	YES	0.0130	
Annual	YES	0.00666	ε	2014	1.47	2014	2015	NO	0.6827	ε
				2015	1.16	2014	2016	NO	0.1261	
				2016	2.09	2015	2016	YES	0.0000	

[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, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate; ε - transformed data non-normal, Kruskal-Wallis H-test (multiple group comparisons) or Mann-Whitney U-test (pair-wise comparisons) conducted, as appropriate.

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

Table E.12: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at the Mary River, Mary River Project CREMP, 2016.

	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	26-Jun-16	26-Jun-16	26-Jun-16	25-Jun-16	26-Jun-16	26-Jun-16	26-Jun-16	26-Jun-16	25-Jun-16	25-Jun-16	25-Jun-16	25-Jun-16	25-Jun-16
	Summer	18-Jul-16	18-Jul-16	18-Jul-16	18-Jul-16	18-Jul-16	18-Jul-16	18-Jul-16	18-Jul-16	18-Jul-16	18-Jul-16	18-Jul-16	18-Jul-16	18-Jul-16
	Fall	20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16	19-Aug-16	19-Aug-16	19-Aug-16	19-Aug-16	19-Aug-16	19-Aug-16
Chlorophyll a (µg/L)	Spring	0.35	0.26	0.23	0.23	0.20	0.16	0.19	0.21	0.19	0.19	0.19	0.32	0.33
	Summer	0.29	0.24	0.22	0.22	0.22	0.68	0.28	0.26	0.28	0.26	0.27	0.26	0.23
	Fall	0.59	0.29	0.23	0.23	0.23	0.64	0.28	0.18	0.20	0.19	0.18	0.25	0.21
	Average	0.41	0.26	0.23	0.23	0.22	0.49	0.25	0.22	0.22	0.21	0.21	0.28	0.26
	Standard Deviation	0.16	0.03	0.01	0.01	0.02	0.29	0.05	0.04	0.05	0.04	0.05	0.04	0.06
	Standard Error	0.09	0.01	0.00	0.00	0.009	0.17	0.03	0.02	0.03	0.02	0.03	0.02	0.04
Phaeophytin a (µg/L)	Spring	0.39	0.35	0.31	0.30	0.29	0.27	0.27	0.30	0.28	0.28	0.27	0.30	0.29
	Summer	0.44	0.42	0.40	0.39	0.39	0.37	0.37	0.41	0.49	0.41	0.40	0.43	0.36
	Fall	0.46	0.40	0.33	0.39	0.44	0.36	0.36	0.34	0.36	0.38	0.35	0.38	0.29
	Average	0.43	0.39	0.35	0.36	0.37	0.33	0.33	0.35	0.38	0.36	0.34	0.37	0.31
	Standard Deviation	0.04	0.04	0.05	0.05	0.08	0.06	0.06	0.06	0.11	0.07	0.07	0.07	0.04
	Standard Error	0.02	0.02	0.03	0.03	0.04	0.03	0.03	0.032	0.06	0.04	0.04	0.04	0.02

Table E.13: Statistical comparisons of annual average chlorophyll a concentrations among Mary River phytoplankton monitoring stations, 2016.

Overall 10-group Comparison			Pair-wise, post-hoc comparisons[a]				
Significant Difference Among Years?	p-value	Statistical Test[b]	(I) Area	(J) Area	Significant Difference Between 2 Years?	p-value	Statistical Test
NO	0.36058	β	GO-09 Ref	GO-03	NO	0.8716	Tukey's (β)
				GO-01	NO	0.7130	
				EO-10	NO	0.9910	
				EO-03	NO	0.6740	
				EO-20	NO	0.7761	
				EO-21	NO	0.6108	
				CO-10	NO	0.5881	
				CO-05	NO	1.0000	
				CO-01	NO	0.9973	
			GO-03	GO-01	NO	1.0000	
				EO-10	NO	1.0000	
				EO-03	NO	1.0000	
				EO-20	NO	1.0000	
				EO-21	NO	1.0000	
				CO-10	NO	1.0000	
				CO-05	NO	0.9864	
				CO-01	NO	0.9999	
			GO-01	EO-10	NO	0.9993	
				EO-03	NO	1.0000	
				EO-20	NO	1.0000	
				EO-21	NO	1.0000	
				CO-10	NO	1.0000	
				CO-05	NO	0.9470	
				CO-01	NO	0.9977	
			EO-10	EO-03	NO	0.9988	
				EO-20	NO	0.9998	
				EO-21	NO	0.9974	
				CO-10	NO	0.9966	
				CO-05	NO	0.9998	
				CO-01	NO	1.0000	
			EO-03	EO-20	NO	1.0000	
				EO-21	NO	1.0000	
				CO-10	NO	1.0000	
				CO-05	NO	0.9335	
				CO-01	NO	0.9963	
			EO-20	EO-21	NO	1.0000	
				CO-10	NO	1.0000	
				CO-05	NO	0.9656	
				CO-01	NO	0.9991	
			EO-21	CO-10	NO	1.0000	
				CO-05	NO	0.9079	
				CO-01	NO	0.9928	
			CO-10	CO-05	NO	0.8975	
				CO-01	NO	0.9911	
			CO-05	CO-01	NO	1.0000	

[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, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate; ε - transformed data non-normal, Kruskal-Wallis H-test (multiple group comparisons) or Mann-Whitney U-test (pair-wise comparisons) conducted, as appropriate.

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

Table E.14: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at Mary Lake (north and south basins; BLO), Mary River Project CREMP, 2016.

	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	25-Apr-16	1-May-16	25-Apr-16	1-May-16	1-May-16	1-May-16	6-May-16	6-May-16	6-May-16	6-May-16	-	-	-
	Summer	26-Jul-16	26-Jul-16	26-Jul-16	30-Jul-16	30-Jul-16	30-Jul-16	30-Jul-16	30-Jul-16	30-Jul-16	29-Jul-16	-	-	-
	Fall	21-Aug-16	21-Aug-16	21-Aug-16	23-Aug-16	23-Aug-16	23-Aug-16	24-Aug-16	23-Aug-16	23-Aug-16	23-Aug-16	-	-	-
Winter	Surface	0.23	0.30	0.27	0.30	0.31	0.87	0.15	0.48	0.27	0.59	0.38	0.21	0.07
	Bottom	<0.10	<0.10	-	<0.10	<0.10	0.55	<0.10	<0.10	0.17	0.19	0.17	0.15	0.05
	Average	0.17	0.20	-	0.20	0.21	0.71	0.13	0.29	0.22	0.39	0.28	0.18	0.06
Summer	Surface	1.35	1.43	1.08	1.31	1.56	1.09	1.84	1.50	1.61	0.77	1.35	0.31	0.10
	Bottom	0.92	1.10	1.08	0.86	0.45	1.21	0.80	0.50	0.77	0.79	0.85	0.25	0.08
	Average	1.14	1.27	1.08	1.09	1.01	1.15	1.32	1.00	1.19	0.78	1.10	0.15	0.05
Fall	Surface	1.20	1.03	1.03	0.70	0.87	0.71	1.28	0.87	0.81	1.46	1.00	0.25	0.08
	Bottom	0.85	0.76	1.11	<0.10	0.78	0.84	0.70	0.31	0.45	0.65	0.66	0.29	0.09
	Average	1.03	0.90	1.07	0.40	0.83	0.78	0.99	0.59	0.63	1.06	0.83	0.23	0.07

	Analyte	Phaeophytin 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	25-Apr-16	1-May-16	25-Apr-16	1-May-16	1-May-16	1-May-16	6-May-16	6-May-16	6-May-16	6-May-16			
	Summer	26-Jul-16	26-Jul-16	26-Jul-16	30-Jul-16	30-Jul-16	30-Jul-16	30-Jul-16	30-Jul-16	30-Jul-16	29-Jul-16			
	Fall	21-Aug-16	21-Aug-16	21-Aug-16	23-Aug-16	23-Aug-16	23-Aug-16	24-Aug-16	23-Aug-16	23-Aug-16	23-Aug-16			
Winter	Surface	<0.39	0.35	<0.39	0.36	0.34	0.57	0.28	0.44	0.32	0.59	0.40	0.10	0.03
	Bottom	<0.39	0.24	-	0.26	0.25	0.47	0.24	0.23	0.21	0.28	0.29	0.09	0.03
	Average	0.39	0.30	-	0.31	0.30	0.52	0.26	0.34	0.27	0.44	0.35	0.09	0.03
Summer	Surface	0.60	0.72	0.67	0.77	0.96	0.71	0.98	0.79	0.91	0.64	0.78	0.13	0.04
	Bottom	0.58	0.71	0.72	0.74	0.42	0.77	0.70	0.51	0.72	0.65	0.65	0.11	0.04
	Average	0.59	0.72	0.70	0.76	0.69	0.74	0.84	0.65	0.82	0.65	0.71	0.08	0.02
Fall	Surface	0.56	0.61	0.47	0.50	0.54	0.52	0.54	0.50	0.54	0.74	0.55	0.08	0.02
	Bottom	0.50	0.52	0.52	0.19	0.67	0.50	0.53	0.40	0.56	0.49	0.49	0.12	0.04
	Average	0.53	0.57	0.50	0.35	0.61	0.51	0.54	0.45	0.55	0.62	0.52	0.08	0.02

Table E.15: Statistical comparisons of chlorophyll a concentrations among years of mine construction (2014) and operation (2015, 2016) at the Mary Lake north basin, Mary River Project CREMP.

Season	Overall 3-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test
Winter	NO	0.57698	β , γ	2014	0.59	2014	2015	NO	0.9700	Tukey's (β , γ)
				2015	0.65	2014	2016	NO	0.6836	
				2016	0.18	2015	2016	NO	0.5678	
Summer	NO	0.65930	α	2014	0.92	2014	2015	NO	0.9670	Tukey's (α)
				2015	0.83	2014	2016	NO	0.7904	
				2016	1.16	2015	2016	NO	0.6521	
Fall	YES	0.02366	α	2014	0.52	2014	2015	NO	0.7072	Tukey's (α)
				2015	0.62	2014	2016	YES	0.0242	
				2016	1.00	2015	2016	NO	0.0649	
Annual	NO	0.65816	β , γ	2014	0.67	2014	2015	NO	0.8207	Tukey's (β , γ)
				2015	0.70	2014	2016	NO	0.6433	
				2016	0.85	2015	2016	NO	0.9451	

[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, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.05.

Table E.16: Statistical comparisons of chlorophyll a concentrations among years of mine construction (2014) and operation (2015, 2016) at the Mary Lake south basin, Mary River Project CREMP.

Season	Overall 3-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test
Winter	NO	0.26761	β , γ	2014	0.88	2014	2015	NO	0.6987	Tukey's (β , γ)
				2015	0.65	2014	2016	NO	0.6657	
				2016	0.31	2015	2016	NO	0.2380	
Summer	NO	0.33073	α	2014	0.86	2014	2015	NO	0.9845	Tamhane's (α)
				2015	0.79	2014	2016	NO	0.7789	
				2016	1.08	2015	2016	NO	0.0118	
Fall	NO	0.40871	α	2014	0.75	2014	2015	NO	0.4710	Tukey's (α)
				2015	0.90	2014	2016	NO	0.9999	
				2016	0.75	2015	2016	NO	0.4794	
Annual	NO	0.41963	β , γ	2014	0.83	2014	2015	NO	0.5285	Tamhane's (β , γ)
				2015	0.78	2014	2016	NO	0.9961	
				2016	0.71	2015	2016	NO	0.5288	

[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, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

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

APPENDIX F

BENTHIC INVERTEBRATE COMMUNITY DATA

Table F.1: Summary of habitat features at lotic environments evaluated as part of the 2016 Mary River Project CREMP benthic invertebrate community assessment.

Habitat Characteristic		Reference Creek	Camp Lake Tributary 1			Camp Lake Tributary 2		Sheardown Tributaries			Mary River Upstream		Mary River Downstream		
		REF-CRK	CLT-1 US	CLT-1-L2	CLT-1 DS	CLT-2 US	CLT-2 DS	SDLT-1 Reach 1	SDLT-12 DS	SDLT-9 DS	GO-09	GO-03	EO-01	EO-20	CO-05
Mean Width (m)	Wetted	9	4.7	1.9	5.7	4.3	4.8	4.2	0.5	0.9	33.0	20.0	20.0	12.5	90
	Bankfull	36	30.0	3.3	5.7	9.0	4.8	8.0	35.5	10.0	90.0	120.0	170.0	59.5	110
Mean Depth (m)	Average	0.13	0.12	0.19	0.29	0.15	0.97	0.09	0.06	0.06	0.36	0.28	-	0.34	-
Mean Velocity (m/s)	Average	0.26	0.30	0.24	0.12	0.36	0.27	0.33	0.16	0.21	0.20	0.61	-	0.52	-
Stream Morphology	% Pool	5	15	5	0	20	0	0	30	15	20	0	5	10	20
	% Rapid	15	10	0	10	30	30	40	60	5	30	70	40	40	20
	% Riffle	50	50	50	80	30	60	60	10	75	20	10	15	20	20
	% Run	30	25	45	10	20	10	0	0	10	30	20	40	30	40
Substrate (% areal coverage)		40% cobble 30% pebble 15% gravel 10% sand 5% boulder	40% cobble 30% boulder 20% pebble 5% gravel 5% sand	30% cobble 30% pebble 30% gravel 10% sand	60% cobble 20% pebble 10% gravel 5% boulder 5% sand	60% boulder 30% cobble 10% pebble	60% cobble 30% pebble 10% gravel	40% cobble 30% boulder 20% pebble 10% gravel	80% boulder 15% cobble 5% pebble	20% cobble 15% boulder 10% pebble 10% gravel 5% sand	70% boulder 20% cobble 10% pebble	60% boulder 30% cobble 10% pebble	60% boulder 25% cobble 10% pebble 5% gravel	40% boulder 30% cobble 20% pebble 10% gravel	30% cobble 20% pebble 20% gravel 20% sand 10% boulder
Aquatic Vegetation (% areal coverage)	Periphyton Coverage	25%	50%	50%	50%	25%	25%	50%	25%	50%	25%	25%	25%	25%	25%
	Periphyton Description	0.5 to 1 mm thick of attached algae/periphyton on rocks	1 to 5 mm thick of attached algae/periphyton on rocks	1 to 5 mm thick of attached algae/periphyton on rocks	1 to 5 mm thick of attached algae/periphyton on rocks	0.5 to 1 mm thick of attached algae/periphyton on rocks	0.5 to 1 mm thick of attached algae/periphyton on rocks	1 to 5 mm thick of attached algae/periphyton on rocks	0.5 to 1 mm thick of attached algae/periphyton on rocks	1 to 5 mm thick of attached algae/periphyton on rocks	0.5 to 1 mm thick of attached algae/periphyton on rocks	0.5 to 1 mm thick of attached algae/periphyton on rocks	0.5 to 1 mm thick of attached algae/periphyton on rocks	0.5 to 1 mm thick of attached algae/periphyton on rocks	0.5 to 1 mm thick of attached algae/periphyton on rocks
Functional Instream Cover (% areal coverage)		5% undercut banks 2% boulder 2% deep pool	30% boulder 10% undercut banks 5% deep pool	5% undercut banks	none	60% boulder 10% deep pool	none	30% boulder	10% boulder	5% undercut banks 5% boulder	50% boulder	30% boulder	30% boulder	30% boulder	5% boulder 5% deep pool

Table F.2: Replicate grab data for benthic invertebrate community samples collected at the Camp Lake Tributaries, Mary River Project CREMP, August 2016.

Study Area	Station	Water Depth (cm)			Water Velocity (m/s)			Substrate Size[a] (cm)			Embeddedness		
		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
Camp Lake Tributary 1 Upstream	CLT-1 US B1	12	12	14	0.38	0.34	0.32	6.4	6.1	6.8	50%	25%	25%
	CLT-1 US B2	12	12	14	0.36	0.45	0.37	7.4	7.6	6.1	50%	50%	50%
	CLT-1 US B3	10	10	14	0.37	0.44	0.40	6.5	5.5	8.6	50%	25%	50%
	CLT-1 US B4	12	14	12	0.33	0.30	0.46	8.7	6.4	7.4	25%	25%	-
	CLT-1 US B5	8	8	10	0.28	0.39	0.26	7.1	6.3	6.8	25%	25%	25%
Camp Lake Tributary 1 Downstream	CLT-1 DS B1	12	12	14	0.38	0.51	0.48	4.7	6.0	5.3	-	25%	25%
	CLT-1 DS B2	14	14	14	0.41	0.46	0.39	6.5	5.4	7.1	25%	25%	25%
	CLT-1 DS B3	14	12	12	0.28	0.40	0.44	5.3	6.8	4.8	25%	25%	50%
	CLT-1 DS B4	12	14	14	0.41	0.36	0.31	5.2	3.8	6.5	25%	25%	25%
	CLT-1 DS B5	12	10	12	0.31	0.34	0.48	5.0	6.0	5.8	25%	25%	25%
Camp Lake Tributary 1 L2 Mine Exposed	CLT-1 L2 B1	8	8	8	0.35	0.38	0.38	6.2	6.6	5.6	25%	25%	25%
	CLT-1 L2 B2	6	8	8	0.26	0.28	0.33	5.0	6.7	5.3	25%	25%	25%
	CLT-1 L2 B3	6	6	8	0.38	0.27	0.26	4.6	4.7	6.5	25%	25%	25%
	CLT-1 L2 B4	6	14	10	0.33	0.37	0.41	6.6	4.4	4.9	25%	25%	25%
	CLT-1 L2 B5	10	12	12	0.28	0.22	0.23	5.4	8.0	8.2	25%	25%	25%
Camp Lake Tributary 2 Upstream	CLT-2 US B1	14	14	10	0.51	0.30	0.44	5.4	7.3	4.5	25%	50%	25%
	CLT-2 US B2	12	12	10	0.43	0.38	0.33	7.7	5.9	6.1	25%	25%	25%
	CLT-2 US B3	16	18	12	0.41	0.39	0.33	4.0	8.1	9.7	25%	25%	25%
	CLT-2 US B4	14	14	14	0.44	0.22	0.41	9.3	6.4	7.5	50%	50%	50%
	CLT-2 US B5	12	14	8	0.28	0.47	0.32	7.4	7.1	10.5	50%	75%	50%
Camp Lake Tributary 2 Downstream	CLT-2 DS B1	10	10	12	0.43	0.51	0.36	5.2	4.8	6.9	50%	50%	50%
	CLT-2 DS B2	12	14	12	0.51	0.43	0.46	5.1	7.0	5.2	25%	50%	25%
	CLT-2 DS B3	10	12	10	0.43	0.31	0.31	5.5	4.6	7.6	25%	25%	25%
	CLT-2 DS B4	16	12	10	0.38	0..51	0.28	3.7	6.5	4.8	25%	25%	25%
	CLT-2 DS B5	12	12	10	0.55	0.48	0.53	5.1	4.9	5.5	25%	25%	25%

[a] Substrate measurements taken on the intermediate axis of each individual particle observed within the Surber sampler area as viewed from the surface prior to sampling. Sample size ranged from 5 - 14 measurements per replicate grab, with a mean of 9 for the Camp Lake tributaries as part of the 2016 stream sampling program.

Table F.3: Replicate station habitat feature summary statistics for the Camp Lake Tributary benthic stations, Mary River Project CREMP, August 2016. Five stations were sampled at each study area.

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Depth (cm)	Unnamed Reference Creek	12.5	2.3	1.0	9.7	15.4	10.7	15.3
	CLT1-US North Branch	11.6	1.7	0.8	9.4	13.8	8.7	12.7
	CLT1-L2 Upper Main Stem	8.7	1.9	0.9	6.3	11.1	6.7	11.3
	CLT1-DS Lower Main Stem	12.8	1.0	0.4	11.6	14.0	11.3	14.0
	CLT2-US Upstream	12.9	1.7	0.8	10.8	15.1	11.3	15.3
	CLT2-DS Downstream	11.6	1.0	0.5	10.3	12.9	10.7	12.7
Water Velocity (cm/s)	Unnamed Reference Creek	29.8	3.6	1.6	25.4	34.2	24.0	33.3
	CLT1-US North Branch	36.3	3.7	1.7	31.7	41.0	31.0	40.3
	CLT1-L2 Upper Main Stem	31.5	5.5	2.4	24.7	38.3	24.3	37.0
	CLT1-DS Lower Main Stem	39.7	4.0	1.8	34.8	44.7	36.0	45.7
	CLT2-US Upstream	37.7	2.5	1.1	34.7	40.8	35.7	41.7
	CLT2-DS Downstream	42.0	8.0	3.6	32.1	51.9	33.0	52.0
Substrate Size (cm diameter)	Unnamed Reference Creek	7.0	0.7	0.3	6.1	7.8	5.9	7.5
	CLT1-US North Branch	6.9	0.4	0.2	6.4	7.4	6.4	7.5
	CLT1-L2 Upper Main Stem	5.9	0.8	0.4	4.9	6.9	5.3	7.2
	CLT1-DS Lower Main Stem	5.6	0.4	0.2	5.1	6.2	5.2	6.3
	CLT2-US Upstream	7.1	1.0	0.5	5.9	8.4	5.7	8.3
	CLT2-DS Downstream	5.5	0.4	0.2	5.0	6.0	5.0	5.9
Substrate Embeddedness (%)	Unnamed Reference Creek	25	0	0	25	25	25	25
	CLT1-US North Branch	35	11	5	22	48	25	50
	CLT1-L2 Upper Main Stem	25	0	0	25	25	25	25
	CLT1-DS Lower Main Stem	27	4	2	22	31	25	33
	CLT2-US Upstream	38	15	7	20	57	25	58
	CLT2-DS Downstream	32	11	5	18	45	25	50

Table F.4: Benthic station habitat feature statistical comparisons among Camp Lake Tributary 1 and Unnamed Reference Creek study areas, Mary River Project CREMP, August 2016. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

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 2 Areas?	p-value	Statistical Test
Water Depth (cm)	YES	0.0083	α , ζ	Unnamed Reference Creek	CLT1 North Branch	NO	0.8410	Tukey's HSD
				Unnamed Reference Creek	CLT1 Upper Main Stem	YES	0.0171	
				Unnamed Reference Creek	CLT1 Lower Main Stem	NO	0.9956	
				CLT1 North Branch	CLT1 Upper Main Stem	YES	0.0847	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.7203	
				CLT1 Upper Main Stem	CLT1 Lower Main Stem	YES	0.0108	
Water Velocity (cm/s)	YES	0.0078	α	Unnamed Reference Creek	CLT1 North Branch	NO	0.1125	Tukey's HSD
				Unnamed Reference Creek	CLT1 Upper Main Stem	NO	0.9165	
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0097	
				CLT1 North Branch	CLT1 Upper Main Stem	NO	0.3180	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.5992	
				CLT1 Upper Main Stem	CLT1 Lower Main Stem	YES	0.0353	
Substrate Size (cm diameter)	YES	0.0048	α	Unnamed Reference Creek	CLT1 North Branch	NO	0.9995	Tukey's HSD
				Unnamed Reference Creek	CLT1 Upper Main Stem	YES	0.0669	
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0145	
				CLT1 North Branch	CLT1 Upper Main Stem	YES	0.0819	
				CLT1 North Branch	CLT1 Lower Main Stem	YES	0.0181	
				CLT1 Upper Main Stem	CLT1 Lower Main Stem	NO	0.8631	
Substrate Embeddedness (%)	YES	0.0409	α , ζ	Unnamed Reference Creek	CLT1 North Branch	NO	0.4987	Tamhane's
				Unnamed Reference Creek	CLT1 Upper Main Stem	NO	1.0000	
				Unnamed Reference Creek	CLT1 Lower Main Stem	NO	0.9398	
				CLT1 North Branch	CLT1 Upper Main Stem	NO	0.4987	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.6648	
				CLT1 Upper Main Stem	CLT1 Lower Main Stem	NO	0.9398	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data logit transformed, single factor ANOVA test conducted;

Table F.5: Benthic invertebrate community data for Camp Lake Tributary 1 study areas, August 2016. Densities expressed in number of organisms per square meter.

Station	Unnamed Reference Creek					Camp Lake Tributary 1 - North Branch (CLT1-US)				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	29	29	29	22	18	7	7	29	32	39
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	57	29	50	43	22	0	11	36	36	36
F. Naididae										
S.F. Tubificinae										
immatures with hair chaetae						0	0	0	0	0
F. Lumbriculidae										
Lumbriculus	0	0	0	0	0	7	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina	0	0	0	0	0	0	0	0	0	0
F. Hygrobatidae										
Hygrobates	0	0	0	0	0	0	0	0	0	0
F. Lebertiidae										
Lebertia	0	0	0	0	0	0	0	0	0	0
F. Sperchonidae										
Sperchon	258	144	179	187	122	57	104	208	158	237
HARPACTICOIDS										
O. Harpacticoida	0	0	0	0	0	0	0	0	0	0
SEED SHRIMPS										
Cl. Ostracoda	57	29	36	22	29	0	0	0	0	0
SPRINGTAILS										
Cl. Entognatha										
O. Collembola	0	0	0	0	0	0	0	0	0	0
INSECTS										
Cl. Insecta										
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
Acentrella feropagus	0	7	14	0	0	0	4	0	0	0
STONEFLIES										
O. Plecoptera										
F. Capniidae										
immature	0	0	0	0	0	7	7	0	7	0
TRUE FLIES										
O. Diptera										
BITING-MIDGE										
F. Ceratopogonidae										
Culicoides	0	0	0	0	0	0	0	0	0	0
indeterminate	0	0	0	0	0	0	0	0	0	0
MIDGES										
F. Chironomidae										
chironomid pupae	**201**	**108**	**72**	**129**	**75**	**36**	**18**	**72**	**50**	**36**
S.F. Chironominae										
Cladotanytarsus	0	0	0	0	0	0	0	0	0	0
Micropsectra	0	0	11	14	0	0	4	0	0	0
Paratanytarsus	0	0	0	0	0	0	0	0	0	0
Rheotanytarsus	43	29	0	14	14	0	0	0	0	0
Tanytarsus	0	7	0	29	0	0	4	0	0	0
S.F. Diamesinae										
Diamesa	0	0	0	0	4	0	0	0	0	14
Pseudokiefferiella	57	237	140	61	29	14	83	36	165	624

Table F.5: Benthic invertebrate community data for Camp Lake Tributary 1 study areas, August 2016. Densities expressed in number of organisms per square meter.

Station	Unnamed Reference Creek					Camp Lake Tributary 1 - North Branch (CLT1-US)				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
S.F. Orthocladiinae										
Chaetocladius	0	0	0	0	0	0	0	0	0	0
Corynoneura	0	0	11	0	0	0	0	0	0	0
Cricotopus	388	258	276	244	83	165	222	215	563	222
Cricotopus/Orthocladius	0	72	115	90	18	43	47	115	388	402
Diplocladius	14	0	0	0	0	0	0	0	0	0
Doncricotopus	0	0	0	0	0	0	0	0	0	0
Eukiefferiella	0	0	14	0	11	0	0	0	0	0
Hydrobaenus	14	0	0	14	0	0	11	14	0	0
Hydrosmittia	29	14	0	0	0	43	47	86	309	233
Krenosmittia	0	0	0	0	4	0	0	7	0	0
Limnophyes	0	29	0	14	4	14	0	22	0	14
Metriocnemus	0	0	0	0	0	0	0	0	0	0
Nanocladius	0	0	0	0	0	0	0	0	0	0
Orthocladius (Euorthocladius)	0	0	0	0	0	72	133	330	176	431
Parakiefferiella	0	7	11	0	0	0	0	0	0	0
Paraphaenocladius	14	0	25	47	4	0	0	0	0	0
Synorthocladius						0	0	0	0	0
Thienemanniella	0	0	0	0	0	0	0	0	0	0
Tokunagaia	660	179	581	954	90	43	36	57	57	97
Tvetenia	57	86	115	75	39	0	4	0	0	0
indeterminate	**14**	**14**	0	0	0	0	**18**	0	**29**	0
S.F. Tanypodinae										
Procladius	0	0	0	0	0	0	0	0	0	0
Thienemannimyia complex	0	7	7	14	4	0	0	0	0	0
F. Empididae										
Clinocera	201	93	79	43	39	0	4	36	0	50
pupae	0	0	0	0	0	0	0	0	0	**14**
F. Ephydridae	0	0	0	0	0	0	0	0	0	0
F. Muscidae	4	0	0	0	0	0	0	0	0	0
F. Simuliidae										
Gymnopais	0	0	7	0	4	0	4	0	0	0
Prosimulium	14	14	0	7	0	7	0	7	0	0
pupae	0	0	0	0	0	0	0	0	0	0
F. Tipulidae										
Tipula	68	25	97	65	57	305	161	158	237	219
Number of Organisms (No. organisms per m^2)	2,179	1,417	1,869	2,088	670	820	929	1,428	2,207	2,668
Richness (total number of taxa)[a]	17	19	19	19	19	13	18	15	11	13
Simpson's Evenness (E)	0.853	0.924	0.885	0.764	0.940	0.854	0.903	0.923	0.926	0.932
Bray-Curtis Index	0.207	0.276	0.092	0.173	0.437	0.645	0.537	0.490	0.587	0.602
Percent Composition										
% Nemata	1.3%	2.0%	1.6%	1.1%	2.7%	0.9%	0.8%	2.0%	1.4%	1.5%
% Oligochaeta	2.6%	2.0%	2.7%	2.1%	3.3%	0.9%	1.2%	2.5%	1.6%	1.3%
% Hydracarina	11.8%	10.2%	9.6%	9.0%	18.2%	7.0%	11.2%	14.6%	7.2%	8.9%
% Ostracods	2.6%	2.0%	1.9%	1.1%	4.3%	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	68.4%	73.9%	73.7%	81.4%	56.6%	52.4%	67.5%	66.8%	78.7%	77.7%
% Metal Sensitive Chironmids	4.6%	19.3%	8.1%	5.7%	7.0%	1.7%	9.8%	2.5%	7.5%	23.9%
% Tipulidae	3.1%	1.8%	5.2%	3.1%	8.5%	37.2%	17.3%	11.1%	10.7%	8.2%
Functional Feeding Group Composition										
% Shredders	24.0%	28.2%	27.2%	20.4%	27.3%	65.7%	49.0%	36.1%	56.3%	32.0%
% Collector - Gatherers	51.9%	50.7%	57.6%	64.6%	44.6%	26.5%	38.0%	46.4%	36.5%	56.7%
% Filterers	2.9%	3.8%	1.0%	3.3%	3.3%	0.9%	1.4%	0.5%	0.0%	0.0%
Habitat Preference Group Composition										
% Clingers	44.8%	47.0%	36.2%	30.9%	46.1%	35.5%	42.9%	42.6%	52.4%	35.1%
% Sprawlers	48.1%	47.1%	54.4%	62.9%	39.4%	25.6%	37.2%	41.8%	33.8%	53.9%
% Burrowers	7.1%	5.9%	9.4%	6.2%	14.5%	38.9%	19.3%	15.6%	13.8%	11.0%

[a] Bold entries excluded from taxa count

Table F.5: Benthic invertebrate community data for Camp Lake Tributary 1 study areas, August 2016. Densities expressed in number of organisms per square meter.

Station	Camp Lake Tributary 1 - Upper Main Stem (CLT1-L2)					Camp Lake Tributary 1 - Lower Main Stem (CLT1-DS)				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	29	187	86	115	86	14	22	158	100	11
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	301	1,005	1,234	2,009	201	72	36	158	172	126
F. Naididae										
S.F. Tubificinae										
immatures with hair chaetae	0	0	0	0	0	0	0	0	0	0
F. Lumbriculidae										
Lumbriculus	14	50	0	0	39	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina	0	0	0	0	0	0	0	0	0	0
F. Hygrobatidae										
Hygrobates	0	14	0	0	0	0	7	14	14	0
F. Lebertiidae										
Lebertia	0	14	0	29	57	0	0	0	0	0
F. Sperchonidae										
Sperchon	1,651	2,139	2,009	1,808	1,005	43	29	43	86	32
HARPACTICOIDS										
O. Harpacticoida	0	0	0	29	115	0	7	0	0	0
SEED SHRIMPS										
Cl. Ostracoda	14	14	14	0	57	0	0	0	0	0
SPRINGTAILS										
Cl. Entognatha										
O. Collembola	0	0	0	0	0	0	0	0	0	11
INSECTS										
Cl. Insecta										
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
Acentrella feropagus	0	0	0	0	0	0	0	0	0	0
STONEFLIES										
O. Plecoptera										
F. Capniidae										
immature	0	0	0	0	0	0	0	0	0	0
TRUE FLIES										
O. Diptera										
BITING-MIDGE										
F. Ceratopogonidae										
Culicoides	0	0	0	0	29	0	0	0	14	0
indeterminate	14	0	14	0	0	0	0	0	0	0
MIDGES										
F. Chironomidae										
chironomid pupae	**115**	**86**	**72**	**29**	0	**86**	**43**	**29**	**14**	**36**
S.F. Chironominae										
Cladotanytarsus	0	165	0	230	330	14	0	0	0	0
Micropsectra	0	0	0	0	0	0	7	14	0	0
Paratanytarsus	1668	1554	832	1722	4116	0	0	0	14	0
Rheotanytarsus	0	0	0	0	0	14	0	0	0	0
Tanytarsus	183	136	0	86	111	0	0	0	0	0
S.F. Diamesinae										
Diamesa	0	0	0	0	0	0	0	0	0	4
Pseudokiefferiella	25	380	201	201	0	0	7	14	158	18

Table F.5: Benthic invertebrate community data for Camp Lake Tributary 1 study areas, August 2016. Densities expressed in number of organisms per square meter.

Station	Camp Lake Tributary 1 - Upper Main Stem (CLT1-L2)					Camp Lake Tributary 1 - Lower Main Stem (CLT1-DS)				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
S.F. Orthocladiinae										
Chaetocladius	0	0	0	0	0	0	0	0	0	0
Corynoneura	0	0	0	0	0	0	0	0	0	0
Cricotopus	965	872	847	1,349	1,098	57	22	57	187	144
Cricotopus/Orthocladius	83	190	43	29	111	57	22	57	57	43
Diplocladius	0	0	0	0	0	0	0	0	0	0
Doncricotopus	287	438	129	144	384	0	0	0	0	0
Eukiefferiella	0	0	0	0	0	29	0	14	0	0
Hydrobaenus	0	0	0	0	0	14	7	57	29	4
Hydrosmittia	108	83	57	230	273	187	431	574	531	190
Krenosmittia	0	0	0	0	0	0	0	14	0	0
Limnophyes	129	273	115	545	165	43	14	72	115	22
Metriocnemus	0	0	0	0	0	29	0	0	0	0
Nanocladius	57	0	0	0	0	0	0	0	0	0
Orthocladius (Euorthocladius)	0	0	0	0	0	0	57	29	129	68
Parakiefferiella	57	136	115	603	603	0	0	14	14	7
Paraphaenocladius	0	0	0	0	0	0	0	0	14	0
Synorthocladius	0	0	14	57	0	0	0	0	0	0
Thienemanniella	0	0	0	0	0	0	0	0	0	0
Tokunagaia	57	0	0	0	0	72	43	43	29	25
Tvetenia	57	29	14	0	0	29	14	14	43	11
indeterminate	0	0	0	0	0	0	0	0	0	0
S.F. Tanypodinae										
Procladius	25	0	29	29	0	0	0	0	0	0
Thienemannimyia complex	183	165	129	115	273	0	0	0	0	0
F. Empididae										
Clinocera	0	29	14	0	0	0	0	14	0	18
pupae	0	0	0	0	0	0	0	0	0	0
F. Ephydridae	0	0	0	0	0	0	0	0	0	0
F. Muscidae	4	0	29	0	0	0	0	0	0	0
F. Simuliidae										
Gymnopais	0	0	0	0	0	0	0	0	0	0
Prosimulium	0	0	0	0	0	0	0	0	0	0
pupae	0	0	0	0	0	0	0	0	0	0
F. Tipulidae										
Tipula	61	29	50	0	11	54	54	32	72	97
Number of Organisms (No. organisms per m^2	6,087	7,988	6,047	9,359	9,064	814	822	1,421	1,792	867
Richness (total number of taxa)[a]	22	21	20	18	19	15	16	19	18	17
Simpson's Evenness (E)	0.851	0.894	0.846	0.901	0.798	0.943	0.710	0.835	0.914	0.920
Bray-Curtis Index	0.780	0.834	0.804	0.883	0.875	0.656	0.784	0.768	0.634	0.656
Percent Composition										
% Nemata	0.5%	2.3%	1.4%	1.2%	0.9%	1.7%	2.7%	11.1%	5.6%	1.3%
% Oligochaeta	5.2%	13.2%	20.4%	21.5%	2.6%	8.8%	4.4%	11.1%	9.6%	14.5%
% Hydracarina	27.1%	27.1%	33.2%	19.6%	11.7%	5.3%	4.4%	4.0%	5.6%	3.7%
% Ostracods	0.2%	0.2%	0.2%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	65.7%	56.4%	42.9%	57.4%	82.3%	77.5%	81.1%	70.5%	74.4%	66.0%
% Metal Sensitive Chironmids	30.8%	28.0%	17.1%	23.9%	50.3%	3.4%	1.7%	2.0%	9.6%	2.5%
% Tipulidae	1.0%	0.4%	0.8%	0.0%	0.1%	6.6%	6.6%	2.3%	4.0%	11.2%
Functional Feeding Group Composition										
% Shredders	18.7%	13.9%	16.0%	14.8%	13.5%	22.7%	12.4%	10.6%	17.8%	34.3%
% Collector - Gatherers	19.0%	32.8%	33.0%	42.1%	21.2%	68.1%	82.4%	83.4%	75.1%	60.0%
% Filterers	31.3%	23.7%	14.2%	21.9%	50.3%	3.9%	0.9%	1.0%	0.8%	0.0%
Habitat Preference Group Composition										
% Clingers	44.8%	41.0%	48.6%	34.4%	25.1%	21.4%	10.2%	13.4%	19.4%	28.8%
% Sprawlers	45.2%	39.2%	28.5%	39.5%	66.0%	53.3%	76.2%	62.1%	60.7%	42.9%
% Burrowers	6.9%	15.9%	22.9%	22.7%	4.0%	21.4%	13.6%	24.5%	20.0%	27.0%

[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 2016. Sample size equals five for all study areas.

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unnamed Reference Creek	1,645	619	277	876	2,414	670	2,179
	CLT1 North Branch	1,610	806	360	610	2,611	820	2,668
	CLT1 Upper Main Stem	7,709	1,583	708	5,743	9,675	6,047	9,359
	CLT1 Lower Main Stem	1,143	443	198	593	1,694	814	1,792
Richness (Number of Taxa)	Unnamed Reference Creek	18.6	0.9	0.4	17.5	19.7	17.0	19.0
	CLT1 North Branch	14.0	2.6	1.2	10.7	17.3	11.0	18.0
	CLT1 Upper Main Stem	20.0	1.6	0.7	18.0	22.0	18.0	22.0
	CLT1 Lower Main Stem	17.0	1.6	0.7	15.0	19.0	15.0	19.0
Simpson's Evenness	Unnamed Reference Creek	0.873	0.070	0.031	0.786	0.960	0.764	0.940
	CLT1 North Branch	0.908	0.032	0.014	0.868	0.947	0.854	0.932
	CLT1 Upper Main Stem	0.858	0.042	0.019	0.806	0.910	0.798	0.901
	CLT1 Lower Main Stem	0.864	0.095	0.043	0.746	0.982	0.710	0.943
Bray-Curtis Index	Unnamed Reference Creek	0.237	0.130	0.058	0.076	0.398	0.092	0.437
	CLT1 North Branch	0.572	0.060	0.027	0.498	0.647	0.490	0.645
	CLT1 Upper Main Stem	0.835	0.044	0.020	0.780	0.890	0.780	0.883
	CLT1 Lower Main Stem	0.700	0.071	0.032	0.612	0.787	0.634	0.784
Oligochaeta (% of community)	Unnamed Reference Creek	2.5%	0.5%	0.2%	1.9%	3.2%	2.0%	3.3%
	CLT1 North Branch	1.5%	0.6%	0.3%	0.7%	2.3%	0.9%	2.5%
	CLT1 Upper Main Stem	12.6%	8.6%	3.8%	1.9%	23.2%	2.6%	21.5%
	CLT1 Lower Main Stem	9.7%	3.7%	1.6%	5.1%	14.3%	4.4%	14.5%
Hydracarina (% of community)	Unnamed Reference Creek	11.7%	3.8%	1.7%	7.1%	16.4%	9.0%	18.2%
	CLT1 North Branch	9.8%	3.2%	1.4%	5.8%	13.7%	7.0%	14.6%
	CLT1 Upper Main Stem	23.8%	8.3%	3.7%	13.5%	34.0%	11.7%	33.2%
	CLT1 Lower Main Stem	4.6%	0.8%	0.4%	3.6%	5.6%	3.7%	5.6%
Chironomidae (% of community)	Unnamed Reference Creek	70.8%	9.2%	4.1%	59.4%	82.2%	56.6%	81.4%
	CLT1 North Branch	68.6%	10.6%	4.7%	55.5%	81.8%	52.4%	78.7%
	CLT1 Upper Main Stem	61.0%	14.5%	6.5%	43.0%	78.9%	42.9%	82.3%
	CLT1 Lower Main Stem	73.9%	5.9%	2.6%	66.6%	81.3%	66.0%	81.1%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	8.9%	5.9%	2.7%	1.6%	16.3%	4.6%	19.3%
	CLT1 North Branch	9.1%	9.0%	4.0%	-2.0%	20.2%	1.7%	23.9%
	CLT1 Upper Main Stem	30.0%	12.4%	5.6%	14.6%	45.5%	17.1%	50.3%
	CLT1 Lower Main Stem	3.8%	3.3%	1.5%	-0.2%	7.9%	1.7%	9.6%
Tipulidae (% of community)	Unnamed Reference Creek	4.3%	2.6%	1.2%	1.1%	7.6%	1.8%	8.5%
	CLT1 North Branch	16.9%	11.8%	5.3%	2.2%	31.6%	8.2%	37.2%
	CLT1 Upper Main Stem	0.5%	0.4%	0.2%	-0.1%	1.0%	0.0%	1.0%
	CLT1 Lower Main Stem	6.1%	3.4%	1.5%	1.9%	10.3%	2.3%	11.2%
Shredder FFG (% of community)	Unnamed Reference Creek	25.4%	3.2%	1.5%	21.4%	29.5%	20.4%	28.2%
	CLT1 North Branch	47.8%	14.0%	6.3%	30.5%	65.2%	32.0%	65.7%
	CLT1 Upper Main Stem	15.4%	2.1%	0.9%	12.8%	18.0%	13.5%	18.7%
	CLT1 Lower Main Stem	19.6%	9.5%	4.2%	7.8%	31.3%	10.6%	34.3%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	53.9%	7.5%	3.4%	44.5%	63.2%	44.6%	64.6%
	CLT1 North Branch	40.8%	11.4%	5.1%	26.7%	54.9%	26.5%	56.7%
	CLT1 Upper Main Stem	29.6%	9.5%	4.3%	17.8%	41.4%	19.0%	42.1%
	CLT1 Lower Main Stem	73.8%	9.9%	4.4%	61.5%	86.0%	60.0%	83.4%
Filterer FFG (% of community)	Unnamed Reference Creek	2.9%	1.1%	0.5%	1.5%	4.2%	1.0%	3.8%
	CLT1 North Branch	0.5%	0.6%	0.3%	-0.2%	1.3%	0.0%	1.4%
	CLT1 Upper Main Stem	28.3%	13.7%	6.1%	11.2%	45.3%	14.2%	50.3%
	CLT1 Lower Main Stem	1.3%	1.5%	0.7%	-0.6%	3.2%	0.0%	3.9%
Clinger HPG (% of community)	Unnamed Reference Creek	41.0%	7.1%	3.2%	32.2%	49.8%	30.9%	47.0%
	CLT1 North Branch	41.7%	7.1%	3.2%	32.9%	50.5%	35.1%	52.4%
	CLT1 Upper Main Stem	38.8%	9.3%	4.2%	27.3%	50.3%	25.1%	48.6%
	CLT1 Lower Main Stem	18.6%	7.3%	3.2%	9.6%	27.6%	10.2%	28.8%
Sprawler HPG (% of community)	Unnamed Reference Creek	50.4%	8.8%	3.9%	39.5%	61.3%	39.4%	62.9%
	CLT1 North Branch	38.5%	10.5%	4.7%	25.5%	51.5%	25.6%	53.9%
	CLT1 Upper Main Stem	43.7%	13.9%	6.2%	26.5%	60.9%	28.5%	66.0%
	CLT1 Lower Main Stem	59.0%	12.2%	5.5%	43.9%	74.2%	42.9%	76.2%
Burrower HPG (% of community)	Unnamed Reference Creek	8.6%	3.6%	1.6%	4.2%	13.0%	5.9%	14.5%
	CLT1 North Branch	19.7%	11.1%	5.0%	5.9%	33.5%	11.0%	38.9%
	CLT1 Upper Main Stem	14.5%	8.8%	3.9%	3.6%	25.4%	4.0%	22.9%
	CLT1 Lower Main Stem	21.3%	5.1%	2.3%	15.0%	27.6%	13.6%	27.0%

Table F.7: Benthic invertebrate community statistical comparison results among Camp Lake Tributary 1 and Unnamed Reference Creek study areas for Functional Feeding Groups (FFG) and Habitat Preference Groups (HPG), Mary River Project CREMP, August 2016.

Metric	Overall four-group ANOVA[a]			ANOVA Comparison to Reference[b]				
	Significant Difference Among Areas?	**p-value**	**Statistical Test**	**CLT1 Study Area**	**Significantly Different from Reference?**	**p-value**	**Magnitude of Difference (no. of SD)[c]**	***Post-hoc* Statistical Test**
Shredder FFG (% of community)	YES	0.0001	β , δ	Upstream (North Branch)	YES	0.0935	6.9	Tamhane's
				L2 (Upper Main Stem)	YES	0.0022	-3.1	
				Downstream (Lower Main Stem)	NO	0.7324	-	
Collector-Gatherer FFG (% of Community)	YES	0.0000	β , δ	Upstream (North Branch)	NO	0.2604	-	Tukey's HSD
				L2 (Upper Main Stem)	YES	0.0091	-3.2	
				Downstream (Lower Main Stem)	YES	0.0231	2.6	
Filterer FFG (% of community)	YES	0.0001	β , γ	Upstream (North Branch)	NO	0.2506	-	Tamhane's
				L2 (Upper Main Stem)	YES	0.0011	23.5	
				Downstream (Lower Main Stem)	NO	0.5598	-	
Clinger HPG (% of Community)	YES	0.0003	β , δ	Upstream (North Branch)	NO	0.9992	-	Tukey's HSD
				L2 (Upper Main Stem)	NO	0.9727	-	
				Downstream (Lower Main Stem)	YES	0.0010	-3.1	
Sprawler HPG (% of Community)	YES	0.0613	β , δ	Upstream (North Branch)	NO	0.3893	-	Tukey's HSD
				L2 (Upper Main Stem)	NO	0.7998	-	
				Downstream (Lower Main Stem)	NO	0.6310	-	
Burrower HPG (% of Community)	YES	0.0448	β , δ	Upstream (North Branch)	NO	0.1113	-	Tukey's HSD
				L2 (Upper Main Stem)	NO	0.6570	-	
				Downstream (Lower Main Stem)	YES	0.0491	3.6	

[a] Data analysis included: α - data untransformed; β - data probit transformed; δ - single factor ANOVA test conducted; γ - ANOVA test validated using Kruskal-Wallis H-test.

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

[grey box] Highlighted values indicate significant differences among/between study areas based on ANOVA p-value less than 0.10 that were also outside of a Critical Effect Size of ±2 SD, suggesting an ecologically meaningful difference.

BOLD Bold text values indicate significant differences between study areas based on ANOVA p-value less than 0.10, but a CES within ±2 SD, suggesting the difference is not ecologically meaningful.

Table F.8: Statistical comparison of benthic metrics at Camp Lake Tributary 1 North Branch among years of mine operation (2015, 2016) and baseline (2007, 2011) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 4-group Comparison			Pair-wise, post-hoc comparisons [a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test
Density	NO	0.1735	α , ε	2007	2011	NO	0.8558	Tukey's HSD
				2007	2015	NO	0.2870	
				2007	2016	NO	0.1764	
				2011	2015	NO	0.7574	
				2011	2016	NO	0.5686	
				2015	2016	NO	0.9805	
Richness	NO	0.8860	α , ε	2007	2011	NO	0.9879	Tukey's HSD
				2007	2015	NO	0.8876	
				2007	2016	NO	0.9978	
				2011	2015	NO	0.9833	
				2011	2016	NO	0.9978	
				2015	2016	NO	0.9228	
Simpson's Evenness	YES	0.0029	α , ε	2007	2011	YES	0.0310	Tukey's HSD
				2007	2015	YES	0.0044	
				2007	2016	YES	0.0029	
				2011	2015	NO	0.8809	
				2011	2016	NO	0.7581	
				2015	2016	NO	0.9908	
Oligochaeta (% of community)	NO	0.8373	β , ε	2007	2011	NO	0.9972	Tamhane's
				2007	2015	NO	1.0000	
				2007	2016	NO	1.0000	
				2011	2015	NO	0.9257	
				2011	2016	NO	0.5340	
				2015	2016	NO	1.0000	
Hydracarina (% of community)	YES	0.0007	β , ε	2007	2011	NO	0.3452	Tamhane's
				2007	2015	NO	0.6633	
				2007	2016	YES	0.0113	
				2011	2015	NO	0.4038	
				2011	2016	NO	0.9238	
				2015	2016	YES	0.0209	
Chironomidae (% of community)	YES	0.0521	β , ε	2007	2011	NO	0.3448	Tukey's HSD
				2007	2015	NO	0.2189	
				2007	2016	YES	0.0330	
				2011	2015	NO	0.9994	
				2011	2016	NO	0.6045	
				2015	2016	NO	0.5691	
Metal Sensitive Taxa (% of community)	NO	0.6810	β , ε	2007	2011	NO	0.8250	Tukey's HSD
				2007	2015	NO	0.6294	
				2007	2016	NO	0.8848	
				2011	2015	NO	0.9939	
				2011	2016	NO	0.9952	
				2015	2016	NO	0.9407	
Tipulidae (% of community)	NO	0.2039	β , ε	2007	2011	NO	0.9883	Tukey's HSD
				2007	2015	NO	0.5036	
				2007	2016	NO	0.4948	
				2011	2015	NO	0.3243	
				2011	2016	NO	0.3174	
				2015	2016	NO	1.0000	

Table F.8: Statistical comparison of benthic metrics at Camp Lake Tributary 1 North Branch among years of mine operation (2015, 2016) and baseline (2007, 2011) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 4-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test[b]	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test
Collector-Gatherer FFG (% of community)	YES	0.0079	β , ε	2007	2011	YES	0.0171	Tukey's HSD
				2007	2015	YES	0.0590	
				2007	2016	YES	0.0072	
				2011	2015	NO	0.6773	
				2011	2016	NO	0.9999	
				2015	2016	NO	0.5283	
Shredder FFG (% of community)	YES	0.0528	β , ε	2007	2011	NO	0.3085	Tukey's HSD
				2007	2015	YES	0.0704	
				2007	2016	YES	0.0494	
				2011	2015	NO	0.8842	
				2011	2016	NO	0.7875	
				2015	2016	NO	0.9950	
Filterer FFG (% of community)	NO	0.1160	β , ε	2007	2011	NO	0.7043	Tamhane's
				2007	2015	NO	0.7043	
				2007	2016	NO	0.9739	
				2011	2015	NO	1.0000	
				2011	2016	NO	0.4989	
				2015	2016	NO	0.4989	

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

[b] Data analysis included: α - data untransformed; η - data log transformed; β - data logit transformed; ε - single factor ANOVA test conducted; γ - ANOVA validated using Kruskal-Wallis H-test.

Table F.9: Statistical comparison of benthic metrics at Camp Lake Tributary 1 Upper Main Stem (L2) between 2016 and baseline (2011) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Benthic Endpoint	Statistical Test Results			Summary Statistics						
	Significant Difference Between Years?	*p*-value	Statistical Analysis[a]	Year	N	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density	NO	0.238	α , δ	2011	3	12,153	7,723	4,459	3,296	17,485
				2016	5	7,709	1,583	708	6,047	9,359
Richness	NO	0.194	α	2011	3	17.7	3.1	1.8	15.0	21.0
				2016	5	20.0	1.6	0.7	18.0	22.0
Simpson's Evenness	NO	0.321	α	2011	3	0.9	0.0	0.0	0.8	0.9
				2016	5	0.9	0.0	0.0	0.8	0.9
Oligochaeta (% of Community)	NO	0.191	β	2011	3	4.4	5.0	2.9	0.0	9.8
				2016	5	12.6	8.6	3.8	2.6	21.5
Hydracarina (% of Community)	NO	0.639	β	2011	3	19.0	19.8	11.4	1.1	40.3
				2016	5	23.8	8.3	3.7	11.7	33.2
Chironomidae (% of Community)	NO	0.338	β	2011	3	73.7	20.7	12.0	54.0	95.3
				2016	5	61.0	14.5	6.5	42.9	82.3
Metal Sensitive Taxa (% of Community)	NO	0.925	β	2011	3	28.8	22.6	13.0	13.0	54.7
				2016	5	30.0	12.4	5.6	17.1	50.3
Tipulidae (% of Community)	NO	0.375	β	2011	3	0.2	0.2	0.1	0.0	0.4
				2016	5	0.5	0.4	0.2	0.0	1.0
Shredder FFG (% of Community)	NO	0.984	β , δ	2011	3	29.5	9.2	5.3	23.6	40.1
				2016	5	29.6	9.5	4.3	19.0	42.1
Collector-Gatherer FFG (% of Community)	NO	0.719	β	2011	3	13.0	14.7	8.5	2.8	29.8
				2016	5	15.4	2.1	0.9	13.5	18.7
Filterer FFG (% of Community)	NO	0.971	β	2011	3	28.7	22.7	13.1	12.7	54.7
				2016	5	28.3	13.7	6.1	14.2	50.3

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

Highlighted values indicate significant difference between lake depths based on ANOVA p-value less than 0.10.

Table F.10: Statistical comparison of benthic metrics at Camp Lake Tributary 1 Lower Main Stem among years of mine operation (2015, 2016) and baseline (2007, 2011) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 4-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test[b]	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test
Density	NO	0.3775	α , ε	2007	2011	NO	0.9786	Tukey's HSD
				2007	2015	NO	0.3811	
				2007	2016	NO	0.6465	
				2011	2015	NO	0.6217	
				2011	2016	NO	0.8760	
				2015	2016	NO	0.9433	
Richness	NO	0.1540	α , ε	2007	2011	NO	0.2900	Tukey's HSD
				2007	2015	NO	0.1302	
				2007	2016	NO	0.5257	
				2011	2015	NO	0.9895	
				2011	2016	NO	0.8962	
				2015	2016	NO	0.6619	
Simpson's Evenness	NO	0.9073	α , ε	2007	2011	NO	1.0000	Tukey's HSD
				2007	2015	NO	0.9470	
				2007	2016	NO	1.0000	
				2011	2015	NO	0.9452	
				2011	2016	NO	1.0000	
				2015	2016	NO	0.9214	
Oligochaeta (% of community)	YES	0.0594	β , ε	2007	2011	NO	0.2530	Tukey's HSD
				2007	2015	NO	0.9305	
				2007	2016	NO	0.8209	
				2011	2015	NO	0.4142	
				2011	2016	YES	0.0422	
				2015	2016	NO	0.3682	
Hydracarina (% of community)	YES	0.0000	β , ε	2007	2011	NO	0.1310	Tamhane's
				2007	2015	NO	0.9106	
				2007	2016	NO	0.6384	
				2011	2015	NO	0.1234	
				2011	2016	NO	0.1730	
				2015	2016	YES	0.0606	
Chironomidae (% of community)	YES	0.0073	β , ε	2007	2011	YES	0.0563	Tukey's HSD
				2007	2015	NO	0.7959	
				2007	2016	NO	0.4991	
				2011	2015	YES	0.0063	
				2011	2016	NO	0.3195	
				2015	2016	YES	0.0759	
Metal Sensitive Taxa (% of community)	YES	0.0877	β , ε	2007	2011	NO	0.9323	Tamhane's
				2007	2015	NO	0.7455	
				2007	2016	NO	0.7160	
				2011	2015	NO	0.9907	
				2011	2016	NO	0.9797	
				2015	2016	NO	0.9999	
Tipulidae (% of community)	YES	0.0857	β , ε	2007	2011	NO	0.8104	Tukey's HSD
				2007	2015	NO	0.3413	
				2007	2016	NO	0.9983	
				2011	2015	YES	0.0732	
				2011	2016	NO	0.6617	
				2015	2016	NO	0.3063	

Table F.10: Statistical comparison of benthic metrics at Camp Lake Tributary 1 Lower Main Stem among years of mine operation (2015, 2016) and baseline (2007, 2011) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 4-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test
Collector-Gatherer FFG (% of community)	YES	0.0032	β , ε	2007	2011	NO	0.4807	Tukey's HSD
				2007	2015	YES	0.0760	
				2007	2016	NO	0.1635	
				2011	2015	YES	0.0043	
				2011	2016	YES	0.0097	
				2015	2016	NO	0.9473	
Shredder FFG (% of community)	YES	0.0210	β , ε	2007	2011	YES	0.0920	Tukey's HSD
				2007	2015	NO	0.9610	
				2007	2016	NO	0.9696	
				2011	2015	YES	0.0234	
				2011	2016	YES	0.0252	
				2015	2016	NO	1.0000	
Filterer FFG (% of community)	NO	0.1037	β , ε	2007	2011	NO	0.9012	Tamhane's
				2007	2015	NO	0.8986	
				2007	2016	NO	0.9311	
				2011	2015	NO	0.9999	
				2011	2016	NO	0.7614	
				2015	2016	NO	0.7124	

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

[b] Data analysis included: α - data untransformed; η - data log transformed; β - data logit transformed; ε - single factor ANOVA test conducted; γ - ANOVA validated using Kruskal-Wallis H-test.

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 2016. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	**p-value**	**Statistical Test [b]**	**(I) Area**	**(J) Area**	**Significant Difference Between 2 Areas?**	**p-value**	**Statistical Test**
Water Depth (cm)	NO	0.4864	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.9873	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	NO	0.8173	
				CLT2 Upstream	CLT2 Downstream	NO	0.4596	
Water Velocity (cm/s)	YES	0.0097	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0133	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0665	
				CLT2 Upstream	CLT2 Downstream	NO	0.6665	
Substrate Size (cm diameter)	YES	0.0089	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.9328	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0235	
				CLT2 Upstream	CLT2 Downstream	YES	0.0124	
Substrate Embeddedness (%)	NO	0.1890	ζ	Unnamed Reference Creek	CLT2 Upstream	NO	0.3191	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	NO	0.5644	
				CLT2 Upstream	CLT2 Downstream	NO	0.8328	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data logit transformed, single factor ANOVA test conducted;

Table F.12: Benthic invertebrate community data for Camp Lake Tributary 2 study areas, August 2016. Densities expressed in number of organisms per square meter.

Station	Camp Lake Tributary 2 - Upstream (CLT2-US)					Camp Lake Tributary 2 - Downstream (CLT2-DS)				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	0	4	4	7	4	4	0	4	0	11
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	4	4	29	29	29	0	0	0	22	4
F. Naididae										
S.F. Tubificinae										
immatures with hair chaetae	0	4	0	0	0	0	0	0	0	0
F. Lumbriculidae										
Lumbriculus	0	0	0	0	0	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina	0	0	0	0	0	0	0	0	0	0
F. Hygrobatidae										
Hygrobates	0	0	0	0	0	0	0	0	0	0
F. Lebertiidae										
Lebertia	0	0	0	0	0	0	0	0	4	0
F. Sperchonidae										
Sperchon	7	25	22	29	29	11	11	7	7	4
HARPACTICOIDS										
O. Harpacticoida	0	0	0	0	0	0	0	0	0	0
SEED SHRIMPS										
Cl. Ostracoda	0	0	0	0	0	0	0	0	0	0
SPRINGTAILS										
Cl. Entognatha										
O. Collembola	0	0	0	0	0	0	0	0	0	4
INSECTS										
Cl. Insecta										
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
Acentrella feropagus	0	0	0	0	0	0	0	0	0	4
STONEFLIES										
O. Plecoptera										
F. Capniidae										
immature	4	18	0	14	22	0	4	4	11	0
TRUE FLIES										
O. Diptera										
BITING-MIDGE										
F. Ceratopogonidae										
Culicoides	4	0	0	4	4	0	0	0	4	4
indeterminate	0	0	0	0	0	0	0	0	0	0
MIDGES										
F. Chironomidae										
chironomid pupae	**4**	**29**	**22**	**11**	**7**	**4**	**0**	0	**7**	**4**
S.F. Chironominae										
Cladotanytarsus	0	0	0	0	0	0	0	0	0	0
Micropsectra	0	0	0	0	0	4	0	0	0	0
Paratanytarsus	0	0	0	0	0	0	0	0	0	0
Rheotanytarsus	0	0	0	0	0	0	0	0	0	0
Tanytarsus	0	0	0	0	0	0	0	0	0	0
S.F. Diamesinae										
Diamesa	14	7	14	0	14	4	7	4	7	0
Pseudokiefferiella	4	0	11	11	36	7	0	4	7	11
S.F. Orthocladiinae										

Table F.12: Benthic invertebrate community data for Camp Lake Tributary 2 study areas, August 2016. Densities expressed in number of organisms per square meter.

Station	Camp Lake Tributary 2 - Upstream (CLT2-US)					Camp Lake Tributary 2 - Downstream (CLT2-DS)				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
Chaetocladius	4	11	7	11	7	0	7	0	0	4
Corynoneura	4	0	0	0	4	0	0	0	0	0
Cricotopus	65	57	111	57	39	11	0	0	47	11
Cricotopus/Orthocladius	0	7	11	4	7	0	0	0	0	32
Diplocladius	0	0	0	0	0	0	0	0	0	0
Doncricotopus	0	0	0	0	0	0	0	0	0	0
Eukiefferiella	25	4	29	0	32	0	29	14	47	0
Hydrobaenus	0	4	0	0	4	4	0	0	0	0
Hydrosmittia	0	14	11	0	0	0	4	0	0	4
Krenosmittia	14	11	0	0	11	0	0	0	0	0
Limnophyes	4	4	4	0	7	7	4	18	11	0
Metriocnemus	0	0	0	0	0	0	0	0	0	0
Nanocladius	0	0	0	0	0	0	0	0	0	0
Orthocladius (Euorthocladius)	68	86	57	36	65	11	29	18	22	11
Parakiefferiella	0	0	0	0	0	0	0	0	0	0
Paraphaenocladius	0	0	0	0	0	4	0	0	0	0
Synorthocladius	0	0	0	0	0	0	0	0	0	0
Thienemanniella	0	0	0	0	0	4	0	0	4	0
Tokunagaia	65	179	97	75	122	122	54	79	90	54
Tvetenia	0	7	7	4	4	7	0	0	0	4
indeterminate	0	0	0	0	0	0	0	0	0	0
S.F. Tanypodinae										
Procladius	0	0	0	0	0	0	0	0	0	0
Thienemannimyia complex	0	0	0	0	0	0	0	0	4	0
F. Empididae										
Clinocera	4	4	11	0	4	14	0	0	0	4
pupae	0	0	0	0	4	0	0	0	0	**0**
F. Ephydridae	0	4	0	0	0	0	0	4	0	4
F. Muscidae	0	0	0	0	0	0	0	0	0	4
F. Simuliidae										
Gymnopais	0	0	0	0	0	0	0	0	0	0
Prosimulium	0	0	4	0	0	0	0	0	0	4
pupae	0	0	0	0	0	0	0	0	4	0
F. Tipulidae										
Tipula	7	22	11	14	32	7	0	7	4	4
Number of Organisms (No. organisms per m^2)	301	505	462	306	487	225	149	163	302	186
Richness (total number of taxa)[a]	16	20	17	13	20	15	9	11	16	19
Simpson's Evenness (E)	0.893	0.841	0.906	0.924	0.928	0.717	0.878	0.799	0.892	0.902
Bray-Curtis Index	0.830	0.685	0.673	0.751	0.694	0.785	0.921	0.880	0.799	0.836
Percent Composition										
% Nemata	0.0%	0.8%	0.9%	2.3%	0.8%	1.8%	0.0%	2.5%	0.0%	5.9%
% Oligochaeta	1.3%	1.6%	6.3%	9.5%	6.0%	0.0%	0.0%	0.0%	7.3%	2.2%
% Hydracarina	2.3%	5.0%	4.8%	9.5%	6.0%	4.9%	7.4%	4.3%	3.6%	2.2%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	90.0%	83.2%	82.5%	68.3%	73.7%	84.0%	89.9%	84.0%	81.5%	72.6%
% Metal Sensitive Chironmids	6.0%	1.4%	5.4%	3.6%	10.3%	6.7%	4.7%	4.9%	4.6%	5.9%
% Tipulidae	2.3%	4.4%	2.4%	4.6%	6.6%	3.1%	0.0%	4.3%	1.3%	2.2%
Functional Feeding Group Composition										
% Shredders	25.6%	22.4%	30.5%	30.1%	20.7%	8.0%	2.7%	9.2%	21.2%	28.0%
% Collector - Gatherers	69.4%	71.9%	61.5%	59.2%	70.8%	79.1%	89.9%	86.5%	71.2%	61.3%
% Filterers	0.0%	0.0%	0.9%	0.0%	0.0%	1.8%	0.0%	0.0%	1.3%	2.2%
Habitat Preference Group Composition										
% Clingers	25.6%	19.4%	36.1%	30.4%	17.2%	16.0%	7.4%	4.3%	21.2%	30.1%
% Sprawlers	69.4%	73.1%	54.3%	52.0%	68.6%	79.1%	92.6%	86.5%	68.9%	53.2%
% Burrowers	5.0%	7.5%	9.5%	17.6%	14.2%	4.9%	0.0%	9.2%	9.9%	14.5%

[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 2016. Sample size equals five for all study areas.

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unamed Reference Creek	1,645	619	277	876	2,414	670	2,179
	CLT2 Upstream	412	100	45	288	537	301	505
	CLT2 Downstream	205	61	27	129	281	149	302
Richness (Number of Taxa)	Unnamed Reference Creek	18.6	0.9	0.4	17.5	19.7	17.0	19.0
	CLT2 Upstream	17.2	2.9	1.3	13.5	20.9	13.0	20.0
	CLT2 Downstream	14.0	4.0	1.8	9.0	19.0	9.0	19.0
Simpson's Evenness	Unnamed Reference Creek	0.873	0.070	0.031	0.786	0.960	0.764	0.940
	CLT2 Upstream	0.898	0.035	0.016	0.855	0.942	0.841	0.928
	CLT2 Downstream	0.838	0.079	0.035	0.740	0.936	0.717	0.902
Bray-Curtis Index	Unnamed Reference Creek	0.237	0.130	0.058	0.076	0.398	0.092	0.437
	CLT2 Upstream	0.726	0.065	0.029	0.646	0.807	0.673	0.830
	CLT2 Downstream	0.844	0.056	0.025	0.774	0.914	0.785	0.921
Oligochaeta (% of community)	Unnamed Reference Creek	2.5%	0.5%	0.2%	1.9%	3.2%	2.0%	3.3%
	CLT2 Upstream	4.9%	3.5%	1.5%	0.6%	9.2%	1.3%	9.5%
	CLT2 Downstream	1.9%	3.2%	1.4%	-2.0%	5.8%	0.0%	7.3%
Hydracarina (% of community)	Unnamed Reference Creek	11.7%	3.8%	1.7%	7.1%	16.4%	9.0%	18.2%
	CLT2 Upstream	5.5%	2.6%	1.2%	2.3%	8.7%	2.3%	9.5%
	CLT2 Downstream	4.5%	1.9%	0.9%	2.1%	6.9%	2.2%	7.4%
Chironomidae (% of community)	Unnamed Reference Creek	70.8%	9.2%	4.1%	59.4%	82.2%	56.6%	81.4%
	CLT2 Upstream	79.5%	8.5%	3.8%	68.9%	90.1%	68.3%	90.0%
	CLT2 Downstream	82.4%	6.3%	2.8%	74.6%	90.2%	72.6%	89.9%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	8.9%	5.9%	2.7%	1.6%	16.3%	4.6%	19.3%
	CLT2 Upstream	5.3%	3.3%	1.5%	1.2%	9.4%	1.4%	10.3%
	CLT2 Downstream	5.4%	0.9%	0.4%	4.3%	6.5%	4.6%	6.7%
Tipulidae (% of community)	Unnamed Reference Creek	4.3%	2.6%	1.2%	1.1%	7.6%	1.8%	8.5%
	CLT2 Upstream	4.0%	1.8%	0.8%	1.8%	6.2%	2.3%	6.6%
	CLT2 Downstream	2.2%	1.6%	0.7%	0.1%	4.2%	0.0%	4.3%
Shredder FFG (% of community)	Unnamed Reference Creek	25.4%	3.2%	1.5%	21.4%	29.5%	20.4%	28.2%
	CLT2 Upstream	25.9%	4.4%	2.0%	20.4%	31.3%	20.7%	30.5%
	CLT2 Downstream	13.8%	10.4%	4.7%	0.9%	26.7%	2.7%	28.0%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	53.9%	7.5%	3.4%	44.5%	63.2%	44.6%	64.6%
	CLT2 Upstream	66.6%	5.8%	2.6%	59.3%	73.8%	59.2%	71.9%
	CLT2 Downstream	77.6%	11.6%	5.2%	63.2%	92.0%	61.3%	89.9%
Filterer FFG (% of community)	Unnamed Reference Creek	2.9%	1.1%	0.5%	1.5%	4.2%	1.0%	3.8%
	CLT2 Upstream	0.2%	0.4%	0.2%	-0.3%	0.7%	0.0%	0.9%
	CLT2 Downstream	1.1%	1.0%	0.4%	-0.2%	2.3%	0.0%	2.2%
Clinger HPG (% of community)	Unnamed Reference Creek	41.0%	7.1%	3.2%	32.2%	49.8%	30.9%	47.0%
	CLT2 Upstream	25.8%	7.8%	3.5%	16.1%	35.4%	17.2%	36.1%
	CLT2 Downstream	15.8%	10.5%	4.7%	2.8%	28.8%	4.3%	30.1%
Sprawler HPG (% of community)	Unnamed Reference Creek	50.4%	8.8%	3.9%	39.5%	61.3%	39.4%	62.9%
	CLT2 Upstream	63.5%	9.6%	4.3%	51.5%	75.4%	52.0%	73.1%
	CLT2 Downstream	76.1%	15.5%	6.9%	56.8%	95.4%	53.2%	92.6%
Burrower HPG (% of community)	Unnamed Reference Creek	8.6%	3.6%	1.6%	4.2%	13.0%	5.9%	14.5%
	CLT2 Upstream	10.8%	5.1%	2.3%	4.4%	17.1%	5.0%	17.6%
	CLT2 Downstream	7.7%	5.5%	2.5%	0.9%	14.5%	0.0%	14.5%

Table F.14: Benthic invertebrate community statistical comparison results among Camp Lake Tributary 2 and Unnamed Reference Creek study areas for Functional Feeding Groups (FFG) and Habitat Preference Groups (HPG), Mary River Project CREMP, August 2016.

Season	Overall 3-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]					
	Significant Difference Among Areas?	p-value	Statistical Test[b]	Area	Mean Value	(I) Area	(J) Area	Significant Difference Between Areas?	p-value	Magnitude of Difference	Statistical Test
Shredder FFG (% of community)	YES	0.03190	α	Reference	25.4%	Reference	CLT2 US	NO	0.9971	-	Tamhane's (β)
				CLT2 Upstream	25.9%	Reference	CLT2 DS	NO	0.2465	-	
				CLT2 Downstream	13.8%	CLT2 US	CLT2 DS	NO	0.2325	-	
Collector-Gatherer FFG (% of Community)	YES	0.00555	α	Reference	53.9%	Reference	CLT2 US	NO	0.2080	-	Tukey's (β)
				CLT2 Upstream	66.6%	Reference	CLT2 DS	YES	0.0042	3.1	
				CLT2 Downstream	77.6%	CLT2 US	CLT2 DS	NO	0.1033	-	
Filterer FFG (% of community)	YES	0.00131	α , γ	Reference	2.9%	Reference	CLT2 US	YES	0.0010	-2.5	Tukey's (β)
				CLT2 Upstream	0.2%	Reference	CLT2 DS	NO	0.1691	-	
				CLT2 Downstream	1.1%	CLT2 US	CLT2 DS	YES	0.0303	2.3	
Clinger HPG (% of Community)	YES	0.00661	α	Reference	41.0%	Reference	CLT2 US	YES	0.0465	-2.1	Tamhane's (β)
				CLT2 Upstream	25.8%	Reference	CLT2 DS	YES	0.0509	-3.5	
				CLT2 Downstream	15.8%	CLT2 US	CLT2 DS	NO	0.3474	-	
Sprawler HPG (% of Community)	YES	0.01866	α	Reference	50.4%	Reference	CLT2 US	NO	0.3763	-	Tukey's (β)
				CLT2 Upstream	63.5%	Reference	CLT2 DS	YES	0.0149	2.9	
				CLT2 Downstream	76.1%	CLT2 US	CLT2 DS	NO	0.1659	-	
Burrower HPG (% of Community)	NO	0.47998	α	Reference	8.6%	Reference	CLT2 US	NO	0.9333	-	Tukey's (β)
				CLT2 Upstream	10.8%	Reference	CLT2 DS	NO	0.6743	-	
				CLT2 Downstream	7.7%	CLT2 US	CLT2 DS	NO	0.4672	-	

[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, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

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

Table F.15: Statistical comparison of benthic metrics at Camp Lake Tributary 2 Upstream among years of mine operation (2015, 2016) and baseline (2007) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between 2 Yearss?	p-value	Statistical Test
Density	NO	0.1510	α	2007	2015	NO	0.2163	Tukey's HSD
				2007	2016	NO	0.9711	
				2015	2016	NO	0.2122	
Richness	YES	0.0029	α	2007	2015	YES	0.0022	Tukey's HSD
				2007	2016	YES	0.0613	
				2015	2016	YES	0.0870	
Simpson's Evenness	YES	0.0023	α	2007	2015	YES	0.0019	Tukey's HSD
				2007	2016	YES	0.0115	
				2015	2016	NO	0.4103	
Oligochaeta (% of Community)	NO	0.3437	β	2007	2015	NO	0.9620	Tukey's HSD
				2007	2016	NO	0.4002	
				2015	2016	NO	0.4501	
Hydracarina (% of Community)	YES	0.0128	β	2007	2015	NO	0.3621	Tukey's HSD
				2007	2016	NO	0.2205	
				2015	2016	YES	0.0100	
Chironomidae (% of Community)	NO	0.3115	β	2007	2015	NO	0.3765	Tukey's HSD
				2007	2016	NO	0.3266	
				2015	2016	NO	0.9912	
Metal Sensitive Taxa (% of Community)	NO	0.1427	β	2007	2015	NO	0.2513	Tukey's HSD
				2007	2016	NO	1.0000	
				2015	2016	NO	0.1709	
Tipulidae (% of Community)	NO	0.8072	β	2007	2015	NO	0.8402	Tukey's HSD
				2007	2016	NO	0.8125	
				2015	2016	NO	0.9979	
Collector-Gatherer FFG (% of Community)	NO	0.8945	β	2007	2015	NO	0.9249	Tukey's HSD
				2007	2016	NO	0.8908	
				2015	2016	NO	0.9949	
Shredder FFG (% of Community)	NO	0.7165	β	2007	2015	NO	0.7096	Tukey's HSD
				2007	2016	NO	0.9396	
				2015	2016	NO	0.8548	
Filterer FFG (% of Commmunity)	NO	0.2245	β	2007	2015	NO	0.3947	Tukey's HSD
				2007	2016	NO	0.9890	
				2015	2016	NO	0.2391	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data probit transformed, single factor ANOVA test conducted;

Table F.16: Statistical comparison of benthic metrics at Camp Lake Tributary 2 Downstream among years of mine operation (2015, 2016) and baseline (2007) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between 2 Yearss?	p-value	Statistical Test
Density	NO	0.1071	α	2007	2015	NO	0.9912	Tukey's HSD
				2007	2016	NO	0.2282	
				2015	2016	NO	0.1211	
Richness	NO	0.3267	α	2007	2015	NO	0.3844	Tukey's HSD
				2007	2016	NO	0.3472	
				2015	2016	NO	0.9953	
Simpson's Evenness	YES	0.0516	α	2007	2015	YES	0.0267	Tamhane's
				2007	2016	NO	0.8756	
				2015	2016	NO	0.1414	
Oligochaeta (% of Community)	NO	0.4060	β	2007	2015	NO	0.5799	Tukey's HSD
				2007	2016	NO	0.9930	
				2015	2016	NO	0.4207	
Hydracarina (% of Community)	YES	0.0023	β	2007	2015	NO	0.3316	Tukey's HSD
				2007	2016	YES	0.0555	
				2015	2016	YES	0.0018	
Chironomidae (% of Community)	NO	0.1532	β	2007	2015	NO	0.1432	Tukey's HSD
				2007	2016	NO	0.6286	
				2015	2016	NO	0.4168	
Metal Sensitive Taxa (% of Community)	NO	0.3674	β	2007	2015	NO	0.9716	Tukey's HSD
				2007	2016	NO	0.4310	
				2015	2016	NO	0.4650	
Tipulidae (% of Community)	NO	0.3488	β	2007	2015	NO	0.9809	Tukey's HSD
				2007	2016	NO	0.4251	
				2015	2016	NO	0.4324	
Collector-Gatherer FFG (% of Community)	NO	0.2260	β	2007	2015	NO	0.8397	Tukey's HSD
				2007	2016	NO	0.5767	
				2015	2016	NO	0.2053	
Shredder FFG (% of Community)	NO	0.3583	β	2007	2015	NO	0.9340	Tukey's HSD
				2007	2016	NO	0.3935	
				2015	2016	NO	0.4961	
Filterer FFG (% of Commmunity)	NO	0.1150	β	2007	2015	NO	0.1134	Tukey's HSD
				2007	2016	NO	0.1874	
				2015	2016	NO	0.9247	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data probit transformed, single factor ANOVA test conducted;

Table F.17: Benthic invertebrate community data for Reference Lake 3, August 2016. Densities expressed in number of organisms per square meter.

Station	Reference Lake 03 - Littoral Stations 2016					Reference Lake 03 - Profundal Stations 2016				
Replicate	REF-01	REF-02	REF-03	REF-04	REF-05	REF-06	REF-07	REF-08	REF-09	REF-10
ROUNDWORMS										
P. Nemata	26	0	121	112	9	0	0	0	0	0
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Lumbriculidae										
Lumbriculus	0	0	0	0	0	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
immature	**9**	**34**	0	0	0	0	0	0	0	0
F. Acalyptonotidae										
Acalyptonotus	52	0	34	17	17	9	0	9	0	9
F. Hygrobatidae										
Hygrobates	0	0	0	0	0	0	0	0	0	0
F. Lebertiidae										
Lebertia	0	138	26	26	26	9	0	9	0	0
HARPACTICOIDS										
O. Harpacticoida	0	0	0	0	0	0	0	0	0	0
SEED SHRIMPS										
Cl. Ostracoda	1,241	1,655	371	1,836	457	17	17	34	34	26
WATER SCUDS										
O. Amphipoda										
F. Hyalellidae										
Hyalella	0	0	0	0	0	0	0	0	0	0
INSECTS										
Cl. Insecta										
CADDISFLIES										
O. Trichoptera										
F. Apataniidae										
Apatania	0	34	0	0	0	0	0	0	0	0
TRUE FLIES										
O. Diptera										
MIDGES										
F. Chironomidae										
chironomid pupae	**9**	**34**	**9**	0	0	0	0	0	0	0
S.F. Chironominae										
Chironomus	0	0	0	0	0	0	0	0	0	0
Micropsectra	716	828	86	164	172	0	0	0	0	0
Parachironomus	0	0	0	0	0	0	0	0	0	0
Paratanytarsus	17	138	0	0	0	0	0	0	0	0
Sergentia	17	0	0	0	0	0	0	0	0	0
Stictochironomus	440	690	0	0	216	9	0	0	0	0
Tanytarsus	121	0	0	0	0	0	0	0	0	0
S.F. Diamesinae										
Diamesa	0	69	17	17	43	0	0	0	0	9
Pseudodiamesa	0	138	34	0	9	0	17	9	0	0
S.F. Orthocladiinae										
Abiskomyia	190	207	43	60	181	0	0	0	0	0
Cricotopus/Orthocladius	0	0	0	0	0	0	0	0	0	0
Heterotrissocladius	52	0	112	69	26	388	371	345	509	414
Paracladius	17	34	9	17	9	0	0	0	0	0
Parakiefferiella	0	0	0	0	0	0	0	0	0	0
Psectrocladius	0	0	0	0	0	0	0	0	0	0
Zalutschia	310	207	26	26	43	9	9	0	0	0
Genus *"Greenland"*	0	0	0	0	0	0	0	0	0	0

Table F.17: Benthic invertebrate community data for Reference Lake 3, August 2016. Densities expressed in number of organisms per square meter.

Station	Reference Lake 03 - Littoral Stations 2016					Reference Lake 03 - Profundal Stations 2016				
Replicate	REF-01	REF-02	REF-03	REF-04	REF-05	REF-06	REF-07	REF-08	REF-09	REF-10
S.F. Tanypodinae										
Arctopelopia	17	34	0	0	0	0	0	0	0	0
Procladius	17	0	9	9	0	0	0	0	0	0
CRANE FLIES										
F. Tipulidae										
Dicranota	0	0	0	0	0	0	0	0	0	0
Density (No. organisms per m^2)	3,251	4,240	897	2,353	1,208	441	414	406	543	458
Richness (total number of taxa)[a]	14	12	12	11	12	6	4	5	2	4
Simpson's Evenness (E)	0.831	0.842	0.848	0.420	0.849	0.267	0.257	0.337	0.235	0.239
Bray-Curtis Index	0.249	0.382	0.527	0.245	0.267	0.042	0.073	0.083	0.143	0.040
Percent Composition										
% Nemata	0.8%	0.0%	13.5%	4.8%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%
% Hydracarina	1.9%	4.1%	6.7%	1.8%	3.6%	4.1%	0.0%	4.4%	0.0%	2.0%
% Ostracods	38.2%	39.0%	41.4%	78.0%	37.8%	3.9%	4.1%	8.4%	6.3%	5.7%
% Chironomids	59.2%	56.1%	38.5%	15.4%	57.9%	92.1%	95.9%	87.2%	93.7%	92.4%
% Metal Sensitive Chironmids	26.4%	28.1%	15.6%	7.7%	18.5%	0.0%	4.1%	2.2%	0.0%	2.0%
Functional Feeding Group Composition										
% Shredders	9.6%	5.0%	3.0%	1.1%	3.6%	2.0%	2.2%	0.0%	0.0%	0.0%
% Collector - Gatherers	61.1%	66.3%	79.5%	89.7%	78.6%	93.9%	97.8%	95.6%	100.0%	98.0%
% Filterers	26.4%	23.1%	9.8%	7.0%	14.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Habitat Preference Group Composition										
% Clingers	28.3%	24.7%	16.5%	8.8%	17.8%	4.1%	0.0%	4.4%	0.0%	2.0%
% Sprawlers	57.3%	57.2%	68.1%	85.7%	60.0%	93.9%	100.0%	95.6%	100.0%	96.1%
% Burrowers	14.4%	18.2%	15.4%	5.5%	22.2%	2.0%	0.0%	0.0%	0.0%	2.0%

[a] Bold entries excluded from taxa count

Table F.18: Benthic invertebrate community data for Camp Lake, August 2016. Densities expressed in number of organisms per square meter.

Station	Camp Lake - Littoral Stations 2016				
Replicate	JLO-2	JLO-21	JLO-30	JLO-31	JLO-32
ROUNDWORMS					
P. Nemata	34	34	259	121	34
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Lumbriculidae					
Lumbriculus	34	0	0	17	103
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
immature	**0**	**0**	17	0	0
F. Acalyptonotidae					
Acalyptonotus	0	0	69	17	0
F. Hygrobatidae					
Hygrobates	0	0	17	0	34
F. Lebertiidae					
Lebertia	0	0	52	52	0
HARPACTICOIDS					
O. Harpacticoida	34	0	0	69	103
SEED SHRIMPS					
Cl. Ostracoda	69	0	34	52	69
WATER SCUDS					
O. Amphipoda					
F. Hyalellidae					
Hyalella	0	0	0	0	0
INSECTS					
Cl. Insecta					
CADDISFLIES					
O. Trichoptera					
F. Apataniidae					
Apatania	34	103	17	0	0
TRUE FLIES					
O. Diptera					
MIDGES					
F. Chironomidae					
chironomid pupae	**414**	**0**	**0**	34	0
S.F. Chironominae					
Chironomus	34	0	0	0	207
Micropsectra	138	483	707	241	552
Parachironomus	0	0	0	0	0
Paratanytarsus	207	241	34	138	103
Sergentia	345	0	0	34	690
Stictochironomus	345	1,138	138	241	517
Tanytarsus	0	0	52	52	207
S.F. Diamesinae					
Diamesa	0	0	17	17	172
Pseudodiamesa	0	0	207	86	69
S.F. Orthocladiinae					
Abiskomyia	207	276	224	224	69
Cricotopus/Orthocladius	103	0	0	17	0
Heterotrissocladius	414	862	224	310	241
Paracladius	0	0	34	0	0
Parakiefferiella	0	0	0	0	0
Psectrocladius	0	0	0	0	0
Zalutschia	0	69	52	86	69
Genus *"Greenland"*	34	34	0	0	0

Table F.18: Benthic invertebrate community data for Camp Lake, August 2016. Densities expressed in number of organisms per square meter.

Station	Camp Lake - Littoral Stations 2016				
Replicate	JLO-2	JLO-21	JLO-30	JLO-31	JLO-32
S.F. Tanypodinae					
Arctopelopia	69	103	0	17	34
Procladius	34	0	17	0	0
CRANE FLIES					
F. Tipulidae					
Dicranota	34	0	0	0	0
Density (No. organisms per m^2)	2,583	3,343	2,171	1,825	3,273
Richness (total number of taxa)[a]	17	10	17	18	17
Simpson's Evenness (E)	0.935	0.869	0.894	0.951	0.936
Bray-Curtis Index	0.679	0.737	0.649	0.576	0.744
Percent Composition					
% Nemata	1.3%	1.0%	11.9%	6.6%	1.0%
% Hydracarina	0.0%	0.0%	7.1%	3.8%	1.0%
% Ostracods	2.7%	0.0%	1.6%	2.8%	2.1%
% Chironomids	90.7%	95.9%	78.6%	82.0%	89.5%
% Metal Sensitive Chironmids	16.2%	21.7%	46.8%	29.9%	33.7%
Functional Feeding Group Composition					
% Shredders	4.8%	2.1%	2.4%	5.8%	2.1%
% Collector - Gatherers	71.5%	70.1%	52.4%	65.3%	69.5%
% Filterers	16.2%	21.7%	36.5%	24.2%	26.3%
Habitat Preference Group Composition					
% Clingers	28.9%	17.5%	42.9%	23.1%	45.3%
% Sprawlers	49.8%	47.4%	38.0%	54.8%	23.1%
% Burrowers	20.4%	35.1%	19.1%	22.0%	31.6%

[a] Bold entries excluded from taxa count

Table F.19: Statistical comparison of benthic metrics at Camp Lake littoral stations among years of mine operation (2015, 2016) and baseline (2007) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 3-group Comparison			Summary Statistics		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	Year	Mean	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	NO	0.2484	α , ζ	2007	7,752	2007	2015	NO	0.3222	Tamhane's
				2015	3,671	2007	2016	NO	0.2082	
				2016	2,639	2015	2016	NO	0.6598	
Richness	NO	0.1803	η , ζ	2007	18.0	2007	2015	NO	0.1700	Tukey's HSD
				2015	12.8	2007	2016	NO	0.7622	
				2016	15.8	2015	2016	NO	0.4148	
Simpson's Evenness	YES	0.0001	α	2007	0.893	2007	2015	YES	0.0007	Tukey's HSD
				2015	0.712	2007	2016	NO	0.7754	
				2016	0.917	2015	2016	YES	0.0002	
Nemata (% of Community)	NO	0.8148	β	2007	5.6%	2007	2015	NO	0.9371	Tukey's HSD
				2015	4.7%	2007	2016	NO	0.7984	
				2016	4.4%	2015	2016	NO	0.9454	
Ostracoda (% of Community)	NO	0.2271	β , ζ	2007	0.7%	2007	2015	NO	0.6444	Tukey's HSD
				2015	0.2%	2007	2016	NO	0.6949	
				2016	1.8%	2015	2016	NO	0.2009	
Chironomidae (% of Community)	NO	0.2847	β , ζ	2007	90.1%	2007	2015	NO	0.5210	Tukey's HSD
				2015	93.1%	2007	2016	NO	0.9096	
				2016	87.4%	2015	2016	NO	0.2738	
Metal Sensitive Taxa (% of Community)	NO	0.9555	β	2007	30.8%	2007	2015	NO	0.9706	Tukey's HSD
				2015	38.5%	2007	2016	NO	0.9995	
				2016	29.7%	2015	2016	NO	0.9579	
Collector-Gatherer FFG (% of Community)	NO	0.1875	β	2007	55.9%	2007	2015	NO	0.8245	Tukey's HSD
				2015	51.1%	2007	2016	NO	0.4576	
				2016	65.7%	2015	2016	NO	0.1724	
Filterer FFG (% of Commmunity)	NO	0.8283	β	2007	30.8%	2007	2015	NO	0.9963	Tamhane's
				2015	38.2%	2007	2016	NO	0.9400	
				2016	25.0%	2015	2016	NO	0.9327	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data probit transformed, single factor ANOVA test conducted;

Table F.20: Replicate grab data for benthic invertebrate community samples collected at the Sheardown Lake Tributaries, Mary River Project CREMP, August 2016.

Study Area	Station	Water Depth (cm)			Water Velocity (m/s)			Substrate Size[a] (cm)			Embeddedness		
		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
Reference Creek	REF CRK B1	12	10	12	0.38	0.28	0.23	8.8	6.6	6.9	25%	25%	25%
	REF CRK B2	12	16	16	0.24	0.44	0.28	6.9	9.1	6.2	25%	25%	25%
	REF CRK B3	12	10	10	0.37	0.31	0.22	7.3	7.0	8.4	25%	25%	25%
	REF CRK B4	16	18	12	0.38	0.34	0.28	6.8	6.3	6.7	25%	25%	25%
	REF CRK B5	12	12	8	0.26	0.21	0.25	5.3	6.0	6.4	25%	25%	25%
Sheardown Tributary 1 Reach 1	SDLT1 R1 B1	10	10	14	0.42	0.29	0.31	8.4	7.3	6.0	50%	50%	-
	SDLT1 R1 B2	8	10	12	0.29	0.30	0.29	6.2	6.7	8.8	50%	50%	50%
	SDLT1 R1 B3	12	12	8	0.56	0.51	0.45	6.5	10.1	7.0	75%	75%	75%
	SDLT1 R1 B4	10	8	10	0.55	0.42	0.50	7.0	8.1	9.2	50%	50%	50%
	SDLT1 R1 B5	8	8	12	0.36	0.42	0.28	6.7	8.8	6.2	25%	25%	25%
Sheardown Tributary 9	SDLT 9 DS B1	2	2	2	0.20	0.22	0.22	9.0	6.1	6.2	50%	50%	50%
	SDLT 9 DS B2	6	2	4	0.34	0.28	0.26	6.9	5.8	8.2	25%	25%	25%
	SDLT 9 DS B3	2	2	2	0.49	0.31	0.47	7.1	6.4	7.1	25%	25%	25%
	SDLT 9 DS B4	4	8	4	0.34	0.30	0.42	5.3	7.5	4.8	25%	50%	50%
	SDLT 9 DS B5	2	2	2	0.51	0.35	0.44	6.5	6.9	4.8	25%	25%	25%
Sheardown Tributary 12	SDLT 12 DS B1	3	4	4	0.12	0.10	0.14	7.6	9.5	8.6	50%	50%	50%
	SDLT 12 DS B2	1	2	4	0.27	0.08	0.11	6.0	5.9	7.2	75%	50%	75%
	SDLT 12 DS B3	2	3	3	0.11	0.22	0.17	8.1	9.2	7.6	50%	50%	50%

[a] Substrate measurements taken from the intermediate axis of each individual particle observed within the Surber sampler area as viewed from the surface prior to sampling. Sample size ranged from 7 - 16 measurements per replicate grab, with a mean of 12 for the entire 2016 stream sampling program.

Table F.21: Replicate station habitat feature summary statistics for the Sheardown Lake Tributary benthic stations, Mary River Project CREMP, August 2016. Five stations were sampled at SDLT1 and SDLT9, and three stations were sampled at SDLT9.

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Depth (cm)	Unnamed Reference Creek	12.5	2.3	1.0	9.7	15.4	10.7	15.3
	Sheardown Tributary 1 (SDLT1)	10.1	0.9	0.4	9.1	11.2	9.3	11.3
	Sheardown Tributary 12 (SDLT12)	2.9	0.7	0.4	1.2	4.6	2.3	3.7
	Sheardown Tributary 9 (SDLT9)	3.1	1.5	0.7	1.2	5.0	2.0	5.3
Water Velocity (cm/s)	Unnamed Reference Creek	29.8	3.6	1.6	25.4	34.2	24.0	33.3
	Sheardown Tributary 1 (SDLT1)	39.7	9.6	4.3	27.8	51.5	29.3	50.7
	Sheardown Tributary 12 (SDLT12)	14.7	2.4	1.4	8.7	20.6	12.0	16.7
	Sheardown Tributary 9 (SDLT9)	34.3	9.2	4.1	22.9	45.8	21.3	43.3
Substrate Size (cm diameter)	Unnamed Reference Creek	7.0	0.7	0.3	6.1	7.8	5.9	7.5
	Sheardown Tributary 1 (SDLT1)	7.5	0.4	0.2	7.0	8.0	7.2	8.1
	Sheardown Tributary 12 (SDLT12)	7.7	1.2	0.7	4.8	10.7	6.4	8.6
	Sheardown Tributary 9 (SDLT9)	6.6	0.6	0.3	5.9	7.3	5.9	7.1
Substrate Embeddedness (%)	Unnamed Reference Creek	25	0	0	25	25	25	25
	Sheardown Tributary 1 (SDLT1)	50	18	8	28	72	25	75
	Sheardown Tributary 12 (SDLT12)	56	10	6	32	79	50	67
	Sheardown Tributary 9 (SDLT9)	33	12	5	19	48	25	50

Table F.22: Benthic station habitat feature statistical comparisons between individual Sheardown Lake Tributaries and Unnamed Reference Creek, Mary River Project CREMP, August 2016. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Pair-wise comparisons[a]				
	(I) Area	(J) Area	Significant Difference Between Areas?	p-value	Statistical Test[b]
Water Depth (cm)	Unnamed Reference Creek	SDLT1	YES	0.0591	α , ε
	Unnamed Reference Creek	SDLT12	YES	0.0004	α , ε
	Unnamed Reference Creek	SDLT9	YES	0.0001	α , ζ
Water Velocity (cm/s)	Unnamed Reference Creek	SDLT1	YES	0.0627	α , ε
	Unnamed Reference Creek	SDLT12	YES	0.0007	α
	Unnamed Reference Creek	SDLT9	NO	0.3352	α
Substrate Size (cm diameter)	Unnamed Reference Creek	SDLT1	NO	0.1635	α , ζ
	Unnamed Reference Creek	SDLT12	NO	0.2748	α
	Unnamed Reference Creek	SDLT9	NO	0.3736	α
Substrate Embeddedness (%)	Unnamed Reference Creek	SDLT1	YES	0.0133	α , ζ
	Unnamed Reference Creek	SDLT12	YES	0.0003	α , ζ
	Unnamed Reference Creek	SDLT9	NO	0.1525	α , ζ

[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; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - data log transformed, single factor ANOVA test conducted; ε - single factor ANOVA test validated using t-test assuming unequal variance

Table F.23: Benthic invertebrate community data for Sheardown Lake Tributaries, August 2016. Densities expressed in number of organisms per square meter.

Station	Unnamed Reference Creek					Sheardown Lake Tributary 1 (SDLT1) - Lower Reach				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	29	29	29	22	18	129	65	86	43	93
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	57	29	50	43	22	0	244	660	273	409
F. Lumbriculidae										
Lumbriculus	0	0	0	0	0	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Trombidiformes										
F. Lebertiidae										
Lebertia	0	0	0	0	0	0	0	0	0	0
F. Sperchonidae										
Sperchon	258	144	179	187	122	115	93	144	144	115
SEED SHRIMPS										
Cl. Ostracoda	57	29	36	22	29	0	7	14	0	0
SPRINGTAILS										
Cl. Entognatha										
O. Collembola	0	0	0	0	0	0	0	0	0	0
INSECTS										
Cl. Insecta										
BEETLES										
O. Coleoptera										
F. Staphylinidae	0	0	0	0	0	0	0	0	0	0
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
Acentrella feropagus	0	7	14	0	0	0	0	0	0	0
CADDISFLIES										
O. Trichoptera										
F. Limnephilidae										
immature	0	0	0	0	0	0	0	0	0	0
TRUE FLIES										
O. Diptera										
indeterminate	0	0	0	0	0	0	0	0	0	0
MIDGES										
F. Chironomidae										
chironomid pupae	**201**	**108**	**72**	**129**	**75**	0	**14**	**29**	**22**	**7**
S.F. Chironominae										
Micropsectra	0	0	11	14	0	183	0	0	0	7
Paratanytarsus	0	0	0	0	0	90	36	0	39	43
Rheotanytarsus	43	29	0	14	14	151	43	215	161	29
Tanytarsus	0	7	0	29	0	0	0	0	0	0
S.F. Diamesinae										
Diamesa	0	0	0	0	4	0	0	0	0	0
Pseudokiefferiella	57	237	140	61	29	29	57	402	244	237
S.F. Orthocladiinae										
Chaetocladius	0	0	0	0	0	0	0	0	0	0
Corynoneura	0	0	11	0	0	0	0	0	0	0
Cricotopus	388	258	276	244	83	1216	179	632	499	344
Cricotopus/Orthocladius	0	72	115	90	18	215	22	43	14	22
Diplocladius	14	0	0	0	0	0	0	0	0	0
Doncricotopus	0	0	0	0	0	0	0	0	0	0
Eukiefferiella	0	0	14	0	11	0	0	0	14	0
Hydrobaenus	14	0	0	14	0	0	0	0	0	0
Hydrosmittia	29	14	0	0	0	1033	588	689	703	380
Krenosmittia	0	0	0	0	4	0	0	0	0	0
Limnophyes	0	29	0	14	4	0	0	0	14	0

Table F.23: Benthic invertebrate community data for Sheardown Lake Tributaries, August 2016. Densities expressed in number of organisms per square meter.

Station	Unnamed Reference Creek					Sheardown Lake Tributary 1 (SDLT1) - Lower Reach				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
Metriocnemus	0	0	0	0	0	0	0	43	0	0
Orthocladius (Euorthocladius)	0	0	0	0	0	0	0	0	14	0
Parakiefferiella	0	7	11	0	0	183	36	57	25	7
Paraphaenocladius	14	0	25	47	4	0	7	0	0	7
Thienemanniella	0	0	0	0	0	0	0	0	0	0
Tokunagaia	660	179	581	954	90	0	22	0	0	36
Tvetenia	57	86	115	75	39	0	7	0	0	14
indeterminate	**14**	**14**	0	0	0	0	0	**14**	0	0
S.F. Podonominae										
Trichotanypus	0	0	0	0	0	0	0	0	0	0
S.F. Tanypodinae										
Procladius	0	0	0	0	0	0	0	0	0	0
Thienemannimyia complex	0	7	7	14	4	0	14	29	22	22
F. Empididae										
Clinocera	201	93	79	43	39	0	7	0	7	7
pupae	0	0	0	0	0	0	0	14	0	0
F. Muscidae	4	0	0	0	0	0	0	0	0	0
F. Simuliidae										
Gymnopais	0	0	7	0	4	0	0	0	0	0
Prosimulium	14	14	0	7	0	0	0	0	0	0
Simulium baffinense	0	0	0	0	0	0	0	0	0	0
F. Tipulidae										
Dicranota	0	0	0	0	0	0	0	0	0	0
Ormosia	0	0	0	0	0	0	0	0	0	0
Tipula	68	25	97	65	57	32	68	129	54	108
Number of Organisms (No. organisms per m^2)	2,179	1,417	1,869	2,088	670	3,376	1,509	3,200	2,292	1,887
Richness (total number of taxa)[a]	17	19	19	19	19	11	17	15	16	17
Simpson's Evenness (E)	0.853	0.924	0.885	0.764	0.940	0.837	0.842	0.904	0.873	0.904
Bray-Curtis Index	0.207	0.276	0.092	0.173	0.437	0.761	0.636	0.694	0.652	0.588
Percent Composition										
% Nemata	1.3%	2.0%	1.6%	1.1%	2.7%	3.8%	4.3%	2.7%	1.9%	4.9%
% Oligochaeta	2.6%	2.0%	2.7%	2.1%	3.3%	0.0%	16.2%	20.6%	11.9%	21.7%
% Hydracarina	11.8%	10.2%	9.6%	9.0%	18.2%	3.4%	6.2%	4.5%	6.3%	6.1%
% Ostracods	2.6%	2.0%	1.9%	1.1%	4.3%	0.0%	0.5%	0.4%	0.0%	0.0%
% Chironomids	68.4%	73.9%	73.7%	81.4%	56.6%	91.8%	67.9%	67.3%	77.3%	61.2%
% Metal Sensitive Chironmids	4.6%	19.3%	8.1%	5.7%	7.0%	13.4%	9.0%	19.3%	19.4%	16.7%
% Tipulidae	3.1%	1.8%	5.2%	3.1%	8.5%	0.9%	4.5%	4.0%	2.4%	5.7%
Functional Feeding Group Composition										
% Shredders	24.0%	28.2%	27.2%	20.4%	27.3%	43.3%	18.0%	25.4%	25.0%	25.2%
% Collector - Gatherers	51.9%	50.7%	57.6%	64.6%	44.6%	40.7%	69.1%	61.9%	58.6%	63.0%
% Filterers	2.9%	3.8%	1.0%	3.3%	3.3%	12.6%	5.4%	6.8%	8.9%	4.2%
Habitat Preference Group Composition										
% Clingers	44.8%	47.0%	36.2%	30.9%	46.1%	50.3%	23.1%	33.2%	36.3%	27.5%
% Sprawlers	48.1%	47.1%	54.4%	62.9%	39.4%	45.0%	52.0%	38.2%	47.5%	40.2%
% Burrowers	7.1%	5.9%	9.4%	6.2%	14.5%	4.8%	25.0%	28.7%	16.1%	32.3%

[a] Bold entries excluded from taxa count

Table F.23: Benthic invertebrate community data for Sheardown Lake Tributaries, August 2016. Densities expressed in number of organisms per square meter.

Station	Sheardown Lake Tributary 12 (SDLT12)			Sheardown Lake Tributary 9 (SDLT9)				
Replicate	B1	B2	B3	B1	B2	B3	B4	B5
ROUNDWORMS								
P. Nemata	57	54	65	108	1,249	151	201	115
ANNELIDS								
P. Annelida								
WORMS								
Cl. Oligochaeta								
F. Enchytraeidae	226	222	287	65	43	29	7	29
F. Lumbriculidae								
Lumbriculus	4	0	0	0	0	0	0	0
ARTHROPODS								
P. Arthropoda								
MITES								
Cl. Arachnida								
O. Trombidiformes								
F. Lebertiidae								
Lebertia	0	0	0	7	0	0	0	0
F. Sperchonidae								
Sperchon	4	0	7	29	201	237	115	14
SEED SHRIMPS								
Cl. Ostracoda	4	4	0	151	57	50	136	43
SPRINGTAILS								
Cl. Entognatha								
O. Collembola	0	4	0	36	14	0	29	0
INSECTS								
Cl. Insecta								
BEETLES								
O. Coleoptera								
F. Staphylinidae	0	0	0	7	0	0	0	0
MAYFLIES								
O. Ephemeroptera								
F. Baetidae								
Acentrella feropagus	0	0	0	0	14	57	0	0
CADDISFLIES								
O. Trichoptera								
F. Limnephilidae								
immature	0	0	0	7	0	0	0	0
TRUE FLIES								
O. Diptera								
indeterminate	**14**	0	0	0	0	0	0	0
MIDGES								
F. Chironomidae								
chironomid pupae	**7**	**4**	**36**	**7**	**14**	**29**	**36**	**14**
S.F. Chironominae								
Micropsectra	0	0	7	0	0	0	0	0
Paratanytarsus	11	14	22	0	0	0	0	0
Rheotanytarsus	0	0	0	0	0	0	0	0
Tanytarsus	0	0	0	0	0	0	14	0
S.F. Diamesinae								
Diamesa	0	4	14	0	0	14	36	0
Pseudokiefferiella	0	0	0	0	14	0	0	0
S.F. Orthocladiinae								
Chaetocladius	18	39	43	0	14	18	7	0
Corynoneura	0	0	7	0	29	0	0	0
Cricotopus	11	7	0	933	574	1245	266	373
Cricotopus/Orthocladius	7	29	65	287	373	104	0	43
Diplocladius	61	72	158	122	29	0	0	14
Doncricotopus	0	0	0	11	0	0	0	0
Eukiefferiella	0	0	0	0	0	14	0	0
Hydrobaenus	0	4	14	0	0	14	0	0
Hydrosmittia	14	0	14	0	29	118	144	29
Krenosmittia	0	11	14	0	115	147	136	287
Limnophyes	36	57	115	0	57	0	0	14

Table F.23: Benthic invertebrate community data for Sheardown Lake Tributaries, August 2016. Densities expressed in number of organisms per square meter.

Station	Sheardown Lake Tributary 12 (SDLT12)			Sheardown Lake Tributary 9 (SDLT9)				
Replicate	B1	B2	B3	B1	B2	B3	B4	B5
Metriocnemus	7	22	72	47	0	0	22	72
Orthocladius (Euorthocladius)	0	0	0	0	0	0	0	14
Parakiefferiella	0	0	0	0	0	0	0	0
Paraphaenocladius	18	4	0	0	0	0	0	0
Thienemanniella	0	0	0	36	0	14	14	0
Tokunagaia	11	18	93	0	359	43	0	43
Tvetenia	0	0	0	25	29	0	7	0
indeterminate	**4**	**72**	**395**	**179**	**545**	**104**	**380**	**57**
S.F. Podonominae								
Trichotanypus	0	0	0	25	0	14	0	0
S.F. Tanypodinae								
Procladius	0	4	0	0	0	0	0	0
Thienemannimyia complex	0	0	0	29	14	0	0	0
F. Empididae								
Clinocera	0	0	0	0	0	7	0	0
pupae	4	0	0	29	0	0	7	0
F. Muscidae	0	0	0	0	0	0	0	0
F. Simuliidae								
Gymnopais	0	0	0	0	0	7	0	0
Prosimulium	0	0	0	14	0	0	0	0
Simulium baffinense	0	0	0	7	14	0	0	0
F. Tipulidae								
Dicranota	0	0	0	0	0	0	0	29
Ormosia	4	4	0	0	0	0	0	0
Tipula	36	4	43	93	215	341	154	90
Number of Organisms (No. organisms per m	558	653	1,471	2,254	4,002	2,757	1,711	1,280
Richness (total number of taxa)[a]	19	19	17	21	20	19	16	15
Simpson's Evenness (E)	0.842	0.877	0.933	0.783	0.870	0.769	0.915	0.879
Bray-Curtis Index	0.843	0.859	0.761	0.670	0.549	0.655	0.666	0.615
Percent Composition								
% Nemata	10.2%	8.3%	4.4%	4.8%	31.2%	5.5%	11.7%	9.0%
% Oligochaeta	41.2%	34.0%	19.5%	2.9%	1.1%	1.1%	0.4%	2.3%
% Hydracarina	0.7%	0.0%	0.5%	1.6%	5.0%	8.6%	6.7%	1.1%
% Ostracods	0.7%	0.6%	0.0%	6.7%	1.4%	1.8%	7.9%	3.4%
% Chironomids	36.7%	55.3%	72.7%	75.5%	54.8%	68.1%	62.1%	75.0%
% Metal Sensitive Chironmids	2.0%	2.8%	2.9%	0.0%	0.3%	0.5%	2.9%	0.0%
% Tipulidae	7.2%	1.2%	2.9%	4.1%	5.4%	12.4%	9.0%	9.3%
Functional Feeding Group Composition								
% Shredders	9.7%	7.7%	10.5%	65.5%	37.3%	65.1%	35.4%	42.2%
% Collector - Gatherers	84.4%	89.6%	86.9%	29.1%	57.0%	25.8%	56.6%	54.5%
% Filterers	2.0%	2.1%	2.0%	0.9%	0.3%	0.3%	0.9%	0.0%
Habitat Preference Group Composition								
% Clingers	4.7%	7.0%	8.1%	65.5%	37.3%	61.8%	34.4%	36.3%
% Sprawlers	33.0%	44.6%	56.6%	17.7%	24.7%	18.8%	40.6%	39.5%
% Burrowers	62.4%	47.8%	35.4%	15.3%	37.7%	19.4%	23.3%	24.3%

[a] Bold entries excluded from taxa count

Table F.24: Benthic invertebrate community summary statistics for Sheardown Lake Tributaries, Mary River Project CREMP, August 2016. Sample size equals five for SDLT1 and SDLT9, and three for SDLT12.

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unnamed Reference Creek	1,645	619	277	876	2,414	670	2,179
	Sheardown Tributary 1 (SDLT1)	2,453	814	364	1,443	3,463	1,509	3,376
	Sheardown Tributary 12 (SDLT12)	894	502	290	-353	2,141	558	1,471
	Sheardown Tributary 9 (SDLT9)	2,401	1,054	471	1,092	3,710	1,280	4,002
Richness (Number of Taxa)	Unnamed Reference Creek	18.6	0.9	0.4	17.5	19.7	17.0	19.0
	Sheardown Tributary 1 (SDLT1)	15.2	2.5	1.1	12.1	18.3	11.0	17.0
	Sheardown Tributary 12 (SDLT12)	18.3	1.2	0.7	15.5	21.2	17.0	19.0
	Sheardown Tributary 9 (SDLT9)	18.2	2.6	1.2	15.0	21.4	15.0	21.0
Simpson's Evenness	Unnamed Reference Creek	0.873	0.070	0.031	0.786	0.960	0.764	0.940
	Sheardown Tributary 1 (SDLT1)	0.872	0.032	0.014	0.832	0.912	0.837	0.904
	Sheardown Tributary 12 (SDLT12)	0.884	0.046	0.027	0.769	0.998	0.842	0.933
	Sheardown Tributary 9 (SDLT9)	0.843	0.063	0.028	0.764	0.922	0.769	0.915
Bray-Curtis Index	Unnamed Reference Creek	0.237	0.130	0.058	0.076	0.398	0.092	0.437
	Sheardown Tributary 1 (SDLT1)	0.666	0.065	0.029	0.585	0.747	0.588	0.761
	Sheardown Tributary 12 (SDLT12)	0.821	0.053	0.030	0.690	0.952	0.761	0.859
	Sheardown Tributary 9 (SDLT9)	0.631	0.051	0.023	0.568	0.694	0.549	0.670
Oligochaeta (% of community)	Unnamed Reference Creek	2.5%	0.5%	0.2%	1.9%	3.2%	2.0%	3.3%
	Sheardown Tributary 1 (SDLT1)	14.1%	8.8%	3.9%	3.2%	25.0%	0.0%	21.7%
	Sheardown Tributary 12 (SDLT12)	31.6%	11.1%	6.4%	4.1%	59.0%	19.5%	41.2%
	Sheardown Tributary 9 (SDLT9)	1.5%	1.0%	0.5%	0.3%	2.8%	0.4%	2.9%
Hydracarina (% of community)	Unnamed Reference Creek	11.7%	3.8%	1.7%	7.1%	16.4%	9.0%	18.2%
	Sheardown Tributary 1 (SDLT1)	5.3%	1.3%	0.6%	3.7%	6.9%	3.4%	6.3%
	Sheardown Tributary 12 (SDLT12)	0.4%	0.4%	0.2%	-0.5%	1.3%	0.0%	0.7%
	Sheardown Tributary 9 (SDLT9)	4.6%	3.2%	1.4%	0.6%	8.6%	1.1%	8.6%
Chironomidae (% of community)	Unnamed Reference Creek	70.8%	9.2%	4.1%	59.4%	82.2%	56.6%	81.4%
	Sheardown Tributary 1 (SDLT1)	73.1%	11.9%	5.3%	58.3%	87.9%	61.2%	91.8%
	Sheardown Tributary 12 (SDLT12)	54.9%	18.0%	10.4%	10.3%	99.5%	36.7%	72.7%
	Sheardown Tributary 9 (SDLT9)	67.1%	8.8%	3.9%	56.2%	78.0%	54.8%	75.5%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	8.9%	5.9%	2.7%	1.6%	16.3%	4.6%	19.3%
	Sheardown Tributary 1 (SDLT1)	15.6%	4.4%	2.0%	10.1%	21.0%	9.0%	19.4%
	Sheardown Tributary 12 (SDLT12)	2.6%	0.5%	0.3%	1.3%	3.8%	2.0%	2.9%
	Sheardown Tributary 9 (SDLT9)	0.8%	1.2%	0.6%	-0.8%	2.3%	0.0%	2.9%
Tipulidae (% of community)	Unnamed Reference Creek	4.3%	2.6%	1.2%	1.1%	7.6%	1.8%	8.5%
	Sheardown Tributary 1 (SDLT1)	3.5%	1.9%	0.8%	1.2%	5.8%	0.9%	5.7%
	Sheardown Tributary 12 (SDLT12)	3.8%	3.1%	1.8%	-3.8%	11.4%	1.2%	7.2%
	Sheardown Tributary 9 (SDLT9)	8.0%	3.3%	1.5%	3.9%	12.1%	4.1%	12.4%
Shredder FFG (% of community)	Unnamed Reference Creek	25.4%	3.2%	1.5%	21.4%	29.5%	20.4%	28.2%
	Sheardown Tributary 1 (SDLT1)	27.4%	9.4%	4.2%	15.7%	39.1%	18.0%	43.3%
	Sheardown Tributary 12 (SDLT12)	9.3%	1.5%	0.9%	5.6%	13.0%	7.7%	10.5%
	Sheardown Tributary 9 (SDLT9)	49.1%	15.0%	6.7%	30.4%	67.7%	35.4%	65.5%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	53.9%	7.5%	3.4%	44.5%	63.2%	44.6%	64.6%
	Sheardown Tributary 1 (SDLT1)	58.6%	10.7%	4.8%	45.3%	72.0%	40.7%	69.1%
	Sheardown Tributary 12 (SDLT12)	87.0%	2.6%	1.5%	80.5%	93.4%	84.4%	89.6%
	Sheardown Tributary 9 (SDLT9)	44.6%	15.7%	7.0%	25.1%	64.1%	25.8%	57.0%
Filterer FFG (% of community)	Unnamed Reference Creek	2.9%	1.1%	0.5%	1.5%	4.2%	1.0%	3.8%
	Sheardown Tributary 1 (SDLT1)	7.6%	3.3%	1.5%	3.5%	11.6%	4.2%	12.6%
	Sheardown Tributary 12 (SDLT12)	2.1%	0.1%	0.1%	1.8%	2.3%	2.0%	2.1%
	Sheardown Tributary 9 (SDLT9)	0.5%	0.4%	0.2%	0.0%	1.0%	0.0%	0.9%
Clinger HPG (% of community)	Unnamed Reference Creek	41.0%	7.1%	3.2%	32.2%	49.8%	30.9%	47.0%
	Sheardown Tributary 1 (SDLT1)	34.1%	10.4%	4.7%	21.2%	47.0%	23.1%	50.3%
	Sheardown Tributary 12 (SDLT12)	6.6%	1.8%	1.0%	2.2%	11.0%	4.7%	8.1%
	Sheardown Tributary 9 (SDLT9)	47.0%	15.3%	6.8%	28.1%	66.0%	34.4%	65.5%
Sprawler HPG (% of community)	Unnamed Reference Creek	50.4%	8.8%	3.9%	39.5%	61.3%	39.4%	62.9%
	Sheardown Tributary 1 (SDLT1)	44.6%	5.6%	2.5%	37.6%	51.5%	38.2%	52.0%
	Sheardown Tributary 12 (SDLT12)	44.7%	11.8%	6.8%	15.4%	74.0%	33.0%	56.6%
	Sheardown Tributary 9 (SDLT9)	28.2%	11.1%	5.0%	14.5%	42.0%	17.7%	40.6%
Burrower HPG (% of community)	Unnamed Reference Creek	8.6%	3.6%	1.6%	4.2%	13.0%	5.9%	14.5%
	Sheardown Tributary 1 (SDLT1)	21.4%	11.1%	4.9%	7.6%	35.1%	4.8%	32.3%
	Sheardown Tributary 12 (SDLT12)	48.5%	13.5%	7.8%	14.9%	82.1%	35.4%	62.4%
	Sheardown Tributary 9 (SDLT9)	24.0%	8.4%	3.8%	13.5%	34.5%	15.3%	37.7%

Table F.25: Benthic invertebrate community statistical comparisons between individual Sheardown Lake Tributaries and Unnamed Reference Creek, Mary River Project CREMP, August 2016. Shading indicates a signficant difference for respective comparison (p-value≤ 0.1).

Metric	Pair-wise comparisons[a]				
	(I) Area	(J) Area	Significant Difference Between Areas?	p-value	Statistical Test[b]
Density	Unnamed Reference Creek	SDLT1	NO	0.1151	α
	Unnamed Reference Creek	SDLT12	NO	0.1283	α
	Unnamed Reference Creek	SDLT9	NO	0.2040	α
Richness	Unnamed Reference Creek	SDLT1	YES	0.0207	α , ζ
	Unnamed Reference Creek	SDLT12	NO	0.7246	α , ζ
	Unnamed Reference Creek	SDLT9	NO	0.7524	α , ζ
Simpson's Evenness	Unnamed Reference Creek	SDLT1	NO	0.9779	α
	Unnamed Reference Creek	SDLT12	NO	0.8247	α
	Unnamed Reference Creek	SDLT9	NO	0.4996	α
Bray-Curtis Index	Unnamed Reference Creek	SDLT1	YES	0.0002	α
	Unnamed Reference Creek	SDLT12	YES	0.0003	α
	Unnamed Reference Creek	SDLT9	YES	0.0002	α
Oligochaeta (% of Community)	Unnamed Reference Creek	SDLT1	NO	0.6760	η , ζ
	Unnamed Reference Creek	SDLT12	YES	0.0000	η
	Unnamed Reference Creek	SDLT9	YES	0.0832	η
Hydracarina (% of Community)	Unnamed Reference Creek	SDLT1	YES	0.0022	η
	Unnamed Reference Creek	SDLT12	YES	0.0006	η , ε
	Unnamed Reference Creek	SDLT9	YES	0.0221	η , ε
Chironomidae (% of Community)	Unnamed Reference Creek	SDLT1	NO	0.6377	η
	Unnamed Reference Creek	SDLT12	NO	0.1427	η
	Unnamed Reference Creek	SDLT9	NO	0.5092	η
Metal Sensitive Taxa (% of Community)	Unnamed Reference Creek	SDLT1	YES	0.0534	η
	Unnamed Reference Creek	SDLT12	YES	0.0208	η
	Unnamed Reference Creek	SDLT9	YES	0.0045	η , ε
Tipulidae (% of Community)	Unnamed Reference Creek	SDLT1	NO	0.5799	η
	Unnamed Reference Creek	SDLT12	NO	0.6763	η
	Unnamed Reference Creek	SDLT9	YES	0.0755	η
Shredder FFG (% of Community)	Unnamed Reference Creek	SDLT1	NO	0.7471	η
	Unnamed Reference Creek	SDLT12	YES	0.0001	η
	Unnamed Reference Creek	SDLT9	YES	0.0066	η , ε
Collector-Gatherer FFG (% of Community)	Unnamed Reference Creek	SDLT1	NO	0.4331	η
	Unnamed Reference Creek	SDLT12	YES	0.0001	η
	Unnamed Reference Creek	SDLT9	NO	0.2569	η , ζ
Filterer FFG (% of Community)	Unnamed Reference Creek	SDLT1	YES	0.0123	η
	Unnamed Reference Creek	SDLT12	NO	0.4943	η
	Unnamed Reference Creek	SDLT9	YES	0.0094	η

Table F.25: Benthic invertebrate community statistical comparisons between individual Sheardown Lake Tributaries and Unnamed Reference Creek, Mary River Project CREMP, August 2016. Shading indicates a signficant difference for respective comparison (p-value≤ 0.1).

Metric	Pair-wise comparisons[a]				
	(I) Area	(J) Area	Significant Difference Between Areas?	p-value	Statistical Test[b]
Clinger HPG (% of Community)	Unnamed Reference Creek	SDLT1	NO	0.2368	η
	Unnamed Reference Creek	SDLT12	YES	0.0000	η
	Unnamed Reference Creek	SDLT9	NO	0.4487	η , ε
Sprawler HPG (% of Community)	Unnamed Reference Creek	SDLT1	NO	0.2433	η
	Unnamed Reference Creek	SDLT12	NO	0.4549	η
	Unnamed Reference Creek	SDLT9	YES	0.0094	η
Burrower HPG (% of Community)	Unnamed Reference Creek	SDLT1	YES	0.0691	η , ζ
	Unnamed Reference Creek	SDLT12	YES	0.0004	η , ζ
	Unnamed Reference Creek	SDLT9	YES	0.0020	η , ζ

[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; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - data log transformed, single factor ANOVA test conducted; ε - single factor ANOVA test validated using t-test assuming unequal variance

Table F.26: Statistical comparison of benthic metrics at Sheardown Lake Tributary 1 (SDLT1) among years of mine operation (2015, 2016) and baseline (2008, 2013) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 4-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	YES	0.0004	α , γ	2008	2013	NO	0.3187	Tamhane's
				2008	2015	NO	0.5462	
				2008	2016	YES	0.0235	
				2013	2015	NO	0.9999	
				2013	2016	YES	0.0374	
				2015	2016	YES	0.0320	
Richness	NO	0.3303	α , ε	2008	2013	NO	0.2991	Tukey's HSD
				2008	2015	NO	0.4639	
				2008	2016	NO	0.5128	
				2013	2015	NO	0.9417	
				2013	2016	NO	0.9136	
				2015	2016	NO	0.9996	
Simpson's Evenness	NO	0.8960	α , ε	2008	2013	NO	0.9984	Tukey's HSD
				2008	2015	NO	0.9100	
				2008	2016	NO	0.9372	
				2013	2015	NO	0.9623	
				2013	2016	NO	0.9780	
				2015	2016	NO	0.9997	
Oligochaeta (% of community)	NO	0.7778	β , γ	2008	2013	NO	0.9258	Tukey's HSD
				2008	2015	NO	0.7512	
				2008	2016	NO	0.9747	
				2013	2015	NO	0.9885	
				2013	2016	NO	0.9927	
				2015	2016	NO	0.9038	
Hydracarina (% of community)	YES	0.0224	β , ε	2008	2013	YES	0.0298	Tukey's HSD
				2008	2015	YES	0.0295	
				2008	2016	YES	0.0645	
				2013	2015	NO	0.9805	
				2013	2016	NO	0.8391	
				2015	2016	NO	0.9525	
Chironomidae (% of community)	NO	0.5300	β , ε	2008	2013	NO	0.4923	Tukey's HSD
				2008	2015	NO	0.9698	
				2008	2016	NO	0.8863	
				2013	2015	NO	0.6480	
				2013	2016	NO	0.8033	
				2015	2016	NO	0.9877	
Metal Sensitive Taxa (% of community)	YES	0.0063	β , ε	2008	2013	NO	0.9620	Tamhane's
				2008	2015	YES	0.0028	
				2008	2016	NO	0.1068	
				2013	2015	NO	0.7463	
				2013	2016	NO	1.0000	
				2015	2016	YES	0.0271	
Tipulidae (% of community)	YES	0.0383	β , γ	2008	2013	NO	0.3722	Tukey's HSD
				2008	2015	YES	0.0243	
				2008	2016	NO	0.1724	
				2013	2015	NO	0.4673	
				2013	2016	NO	0.9861	
				2015	2016	NO	0.5559	
Collector-Gatherer FFG (% of community)	YES	0.0092	β , ε	2008	2013	NO	0.1400	Tukey's HSD
				2008	2015	YES	0.0058	
				2008	2016	YES	0.0339	
				2013	2015	NO	0.4269	
				2013	2016	NO	0.9417	
				2015	2016	NO	0.6548	
Shredder FFG (% of community)	YES	0.0355	β , ε	2008	2013	NO	0.2525	Tukey's HSD
				2008	2015	YES	0.0234	
				2008	2016	NO	0.1030	
				2013	2015	NO	0.6357	
				2013	2016	NO	0.9856	
				2015	2016	NO	0.7544	
Filterer FFG (% of community)	NO	0.1817	β , γ	2008	2013	NO	0.3842	Tukey's HSD
				2008	2015	NO	0.9995	
				2008	2016	NO	0.5614	
				2013	2015	NO	0.2532	
				2013	2016	NO	0.9515	
				2015	2016	NO	0.3820	

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

[b] Data analysis included: α - data untransformed; η - data log transformed; β - data logit transformed; ε - single factor ANOVA test conducted; γ - ANOVA validated using Kruskal-Wallis H-test.

Table F.27: Statistical comparison of benthic metrics at Sheardown Lake Tributary 1 (SDLT12) among years of mine operation (2015, 2016) and baseline (2007) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	NO	0.9180	α	2007	2015	NO	0.9194	Tukey's HSD
				2007	2016	NO	0.9597	
				2015	2016	NO	0.9938	
Richness	YES	0.0006	α , ζ	2007	2015	YES	0.0006	Tukey's HSD
				2007	2016	NO	0.8253	
				2015	2016	YES	0.0024	
Simpson's Evenness	NO	0.3815	α	2007	2015	NO	0.4686	Tamhane's
				2007	2016	NO	0.4775	
				2015	2016	NO	0.9999	
Oligochaeta (% of Community)	YES	0.0000	β	2007	2015	YES	0.0001	Tukey's HSD
				2007	2016	YES	0.0001	
				2015	2016	NO	0.9787	
Hydracarina (% of Community)	YES	0.0000	β	2007	2015	NO	0.1454	Tukey's HSD
				2007	2016	NO	0.6097	
				2015	2016	NO	0.5813	
Chironomidae (% of Community)	YES	0.0148	β	2007	2015	YES	0.0540	Tukey's HSD
				2007	2016	YES	0.0193	
				2015	2016	NO	0.8058	
Metal Sensitive Taxa (% of Community)	NO	0.2440	β	2007	2015	NO	0.7289	Tamhane's
				2007	2016	NO	0.9976	
				2015	2016	NO	0.7472	
Tipulidae (% of Community)	YES	0.0084	β	2007	2015	YES	0.0172	Tukey's HSD
				2007	2016	YES	0.0192	
				2015	2016	NO	0.9973	
Collector-Gatherer FFG (% of Community)	YES	0.0143	β	2007	2015	YES	0.0363	Tukey's HSD
				2007	2016	YES	0.0240	
				2015	2016	NO	0.9648	
Shredder FFG (% of Community)	NO	0.1182	β	2007	2015	NO	0.5212	Tukey's HSD
				2007	2016	NO	0.1038	
				2015	2016	NO	0.5424	
Filterer FFG (% of Commmunity)	YES	0.0233	β	2007	2015	YES	0.0401	Tamhane's
				2007	2016	NO	0.9975	
				2015	2016	YES	0.0453	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data probit transformed, single factor ANOVA test conducted;

Table F.28: Statistical comparison of benthic metrics at Sheardown Lake Tributary 9 (SDLT9) among years of mine operation (2015, 2016) and baseline (2007, 2013) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 4-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	YES	0.0682	α , ε	2007	2013	NO	0.8757	Tukey's HSD
				2007	2015	NO	0.1587	
				2007	2016	YES	0.0822	
				2013	2015	NO	0.5010	
				2013	2016	NO	0.3025	
				2015	2016	NO	0.9654	
Richness	NO	0.5174	α , ε	2007	2013	NO	0.6988	Tukey's HSD
				2007	2015	NO	0.7089	
				2007	2016	NO	0.4571	
				2013	2015	NO	0.9988	
				2013	2016	NO	0.9907	
				2015	2016	NO	0.9553	
Simpson's Evenness	NO	0.4607	α , ε	2007	2013	NO	0.8752	Tukey's HSD
				2007	2015	NO	0.9106	
				2007	2016	NO	0.9459	
				2013	2015	NO	0.9978	
				2013	2016	NO	0.5317	
				2015	2016	NO	0.5279	
Oligochaeta (% of community)	YES	0.0159	β , ε	2007	2013	NO	0.4828	Tamhane's
				2007	2015	NO	0.1639	
				2007	2016	NO	0.3243	
				2013	2015	NO	0.9149	
				2013	2016	NO	0.8090	
				2015	2016	NO	0.8369	
Hydracarina (% of community)	NO	0.3253	β , γ	2007	2013	NO	0.3585	Tukey's HSD
				2007	2015	NO	0.9959	
				2007	2016	NO	0.9817	
				2013	2015	NO	0.3681	
				2013	2016	NO	0.4427	
				2015	2016	NO	0.9981	
Chironomidae (% of community)	NO	0.1408	β , ε	2007	2013	NO	0.8856	Tukey's HSD
				2007	2015	NO	0.9856	
				2007	2016	NO	0.3374	
				2013	2015	NO	0.6666	
				2013	2016	NO	0.7788	
				2015	2016	NO	0.1243	
Metal Sensitive Taxa (% of community)	YES	0.0110	β , ε	2007	2013	NO	0.3409	Tamhane's
				2007	2015	NO	0.4627	
				2007	2016	NO	0.2646	
				2013	2015	YES	0.0773	
				2013	2016	NO	0.7011	
				2015	2016	NO	0.1368	
Tipulidae (% of community)	NO	0.1906	β , ε	2007	2013	NO	0.9987	Tukey's HSD
				2007	2015	NO	0.7998	
				2007	2016	NO	0.6864	
				2013	2015	NO	0.8777	
				2013	2016	NO	0.5893	
				2015	2016	NO	0.1429	
Collector-Gatherer FFG (% of community)	NO	0.3397	β , γ	2007	2013	NO	0.9932	Tamhane's
				2007	2015	NO	0.9993	
				2007	2016	NO	0.5819	
				2013	2015	NO	1.0000	
				2013	2016	NO	0.4569	
				2015	2016	NO	0.7067	
Shredder FFG (% of community)	NO	0.1191	β , ε	2007	2013	NO	0.9986	Tukey's HSD
				2007	2015	NO	0.9772	
				2007	2016	NO	0.1823	
				2013	2015	NO	0.9955	
				2013	2016	NO	0.2362	
				2015	2016	NO	0.2204	
Filterer FFG (% of community)	NO	0.4149	β , ε	2007	2013	NO	0.9844	Tukey's HSD
				2007	2015	NO	0.9911	
				2007	2016	NO	0.6271	
				2013	2015	NO	0.9020	
				2013	2016	NO	0.4084	
				2015	2016	NO	0.7112	

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

[b] Data analysis included: α - data untransformed; η - data log transformed; β - data logit transformed; ε - single factor ANOVA test conducted; γ - ANOVA validated using Kruskal-Wallis H-test.

Table F.29: Benthic invertebrate community data for Sheardown Lake, August 2016. Densities expressed in number of organisms per square meter.

Station	Sheardown Lake NW (DLO-01) Littoral Stations 2016					Sheardown Lake SE (DLO-02) Littoral Stations 2016				
Replicate	DD Hab9 0	DLO1-03	DLO1-08	DLO1-09	DLO1-10	DLO2-01	DLO2-03	DLO2-09	DLO2-11	DLO2-13
ROUNDWORMS										
P. Nemata	69	0	17	207	17	0	0	112	69	17
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Lumbriculidae										
Lumbriculus	0	0	0	69	9	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
immature	0	0	**9**	0	0	0	0	0	0	0
F. Acalyptonotidae										
Acalyptonotus	0	34	52	138	69	26	34	172	34	9
F. Hygrobatidae										
Hygrobates	0	0	69	0	26	9	0	129	0	0
F. Lebertiidae										
Lebertia	0	0	34	0	17	9	0	0	0	9
HARPACTICOIDS										
O. Harpacticoida	0	0	0	69	0	0	0	0	0	0
SEED SHRIMPS										
Cl. Ostracoda	276	966	103	2,000	52	86	0	9	138	9
WATER SCUDS										
O. Amphipoda										
F. Hyalellidae										
Hyalella	0	0	0	0	0	0	0	0	0	0
INSECTS										
Cl. Insecta										
CADDISFLIES										
O. Trichoptera										
F. Apataniidae										
Apatania	34	0	0	0	0	0	0	0	0	0
TRUE FLIES										
O. Diptera										
MIDGES										
F. Chironomidae										
chironomid pupae	**34**	0	0	**69**	**9**	**26**	0	**9**	0	0
S.F. Chironominae										
Chironomus	0	190	0	69	0	1,681	1,069	0	328	0
Micropsectra	793	1,267	78	1,034	43	60	103	155	34	34
Parachironomus	0	0	0	69	0	0	0	0	0	0
Paratanytarsus	586	1,905	0	1,517	9	60	0	0	34	0
Sergentia	0	569	0	69	0	9	34	0	0	0
Stictochironomus	1,690	2,405	86	2,138	517	34	1,000	1,957	707	1,052
Tanytarsus	241	500	0	966	0	319	69	138	164	0
S.F. Diamesinae										
Diamesa	0	0	9	0	78	0	0	0	0	26
Pseudodiamesa	0	0	9	0	17	0	0	0	0	0
S.F. Orthocladiinae										
Abiskomyia	345	379	112	966	103	34	138	509	345	397
Cricotopus/Orthocladius	0	0	0	0	0	0	0	0	0	0
Heterotrissocladius	517	129	293	690	78	9	0	52	34	0
Paracladius	0	0	60	0	69	0	0	0	0	0
Parakiefferiella	0	0	0	69	0	0	34	9	0	0
Psectrocladius	0	0	0	69	0	0	0	0	0	0
Zalutschia	34	60	17	0	26	0	0	43	0	0
Genus *"Greenland"*	0	0	0	0	0	0	0	0	0	0

Table F.29: Benthic invertebrate community data for Sheardown Lake, August 2016. Densities expressed in number of organisms per square meter.

Station	Sheardown Lake NW (DLO-01) Littoral Stations 2016					Sheardown Lake SE (DLO-02) Littoral Stations 2016				
Replicate	DD Hab9 0	DLO1-03	DLO1-08	DLO1-09	DLO1-10	DLO2-01	DLO2-03	DLO2-09	DLO2-11	DLO2-13
S.F. Tanypodinae										
Arctopelopia	552	500	0	207	0	17	0	43	34	0
Procladius	34	60	500	69	276	1,241	724	2,888	422	1,552
CRANE FLIES										
F. Tipulidae	0	0	0	0	0	0	0	0	0	0
Dicranota	0	0	0	0	0	0	0	0	0	0
Density (No. organisms per m^2)	5,205	8,964	1,448	10,484	1,415	3,620	3,205	6,225	2,343	3,105
Richness (total number of taxa)[a]	12	13	14	18	16	14	9	13	12	9
Simpson's Evenness (E)	0.901	0.908	0.878	0.918	0.860	0.703	0.829	0.732	0.900	0.696
Bray-Curtis Index	0.711	0.684	0.634	0.688	0.628	0.886	0.789	0.736	0.669	0.724
Percent Composition										
% Nemata	1.3%	0.0%	1.2%	2.0%	1.2%	0.0%	0.0%	1.8%	2.9%	0.5%
% Hydracarina	0.0%	0.4%	11.3%	1.3%	7.9%	1.2%	1.1%	4.8%	1.5%	0.6%
% Ostracods	5.3%	10.8%	7.1%	19.1%	3.7%	2.4%	0.0%	0.1%	5.9%	0.3%
% Chironomids	92.7%	88.8%	80.4%	76.3%	86.6%	96.4%	98.9%	93.2%	89.7%	98.6%
% Metal Sensitive Chironmids	31.4%	41.0%	6.6%	33.8%	10.5%	12.2%	5.4%	4.7%	9.9%	1.9%
Functional Feeding Group Composition										
% Shredders	0.7%	0.7%	1.2%	0.0%	1.8%	0.0%	0.0%	0.7%	0.0%	0.0%
% Collector - Gatherers	56.0%	51.7%	47.6%	61.5%	66.9%	51.5%	71.0%	42.6%	69.2%	48.3%
% Filterers	31.4%	41.0%	5.4%	33.8%	3.7%	12.2%	5.4%	4.7%	9.9%	1.1%
Habitat Preference Group Composition										
% Clingers	20.7%	26.4%	16.7%	21.2%	11.0%	12.0%	7.5%	9.6%	9.9%	1.7%
% Sprawlers	45.2%	44.6%	75.6%	54.9%	44.7%	40.0%	28.0%	57.1%	43.0%	63.1%
% Burrowers	34.0%	28.9%	7.7%	23.9%	44.2%	47.7%	64.6%	33.3%	47.1%	35.3%

[a] Bold entries excluded from taxa count

Table F.30: Statistical comparison of benthic metrics at Sheardown Lake NW (SDNW) among years of mine operation (2015, 2016) and baseline (2007, 2008, 2013) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 5-group Comparison			Pair-wise, post-hoc comparisons [a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	NO	0.5171	η , γ	2007	2008	NO	0.9979	Tukey's HSD
				2007	2013	NO	0.7838	
				2007	2015	NO	1.0000	
				2007	2016	NO	0.9648	
				2008	2013	NO	0.9082	
				2008	2015	NO	0.9926	
				2008	2016	NO	0.8654	
				2013	2015	NO	0.7033	
				2013	2016	NO	0.4144	
				2015	2016	NO	0.9765	
Richness	NO	0.1992	η , γ	2007	2008	NO	0.1143	Mann-Whitney U-test
				2007	2013	NO	0.1143	
				2007	2015	NO	0.2857	
				2007	2016	NO	0.1905	
				2008	2013	NO	0.4000	
				2008	2015	NO	0.5556	
				2008	2016	NO	0.9048	
				2013	2015	NO	0.1429	
				2013	2016	NO	0.1429	
				2015	2016	NO	0.6905	
Simpson's Evenness	YES	0.0450	α , γ	2007	2008	NO	0.6210	Tukey's HSD
				2007	2013	NO	0.4331	
				2007	2015	NO	0.9997	
				2007	2016	NO	0.1143	
				2008	2013	NO	0.9921	
				2008	2015	NO	0.4635	
				2008	2016	NO	0.7978	
				2013	2015	NO	0.3060	
				2013	2016	NO	0.9775	
				2015	2016	YES	0.0588	
Ostracoda (% of community)	NO	0.3232	ζ	2007	2008	NO	0.9999	Tamhane's
				2007	2013	NO	0.8678	
				2007	2015	NO	1.0000	
				2007	2016	NO	1.0000	
				2008	2013	NO	0.5727	
				2008	2015	NO	1.0000	
				2008	2016	NO	1.0000	
				2013	2015	NO	0.1906	
				2013	2016	NO	0.2679	
				2015	2016	NO	1.0000	
Chironomidae (% of community)	YES	0.0361	β , ε	2007	2008	NO	0.9916	Tukey's HSD
				2007	2013	NO	0.3049	
				2007	2015	NO	0.5319	
				2007	2016	NO	0.9946	
				2008	2013	NO	0.5153	
				2008	2015	NO	0.2929	
				2008	2016	NO	0.9099	
				2013	2015	YES	0.0193	
				2013	2016	NO	0.1494	
				2015	2016	NO	0.7191	

Table F.30: Statistical comparison of benthic metrics at Sheardown Lake NW (SDNW) among years of mine operation (2015, 2016) and baseline (2007, 2008, 2013) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 5-group Comparison			Pair-wise, post-hoc comparisons [a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Metal Sensitive Taxa (% of community)	NO	0.7968	β , ε	2007	2008	NO	1.0000	Tamhane's
				2007	2013	NO	0.9919	
				2007	2015	NO	0.9988	
				2007	2016	NO	0.9946	
				2008	2013	NO	1.0000	
				2008	2015	NO	1.0000	
				2008	2016	NO	1.0000	
				2013	2015	NO	0.9997	
				2013	2016	NO	1.0000	
				2015	2016	NO	1.0000	
Collector-Gatherer FFG (% of community)	NO	0.3162	β , ε	2007	2008	NO	0.6801	Tukey's HSD
				2007	2013	NO	0.8998	
				2007	2015	NO	0.9844	
				2007	2016	NO	0.2820	
				2008	2013	NO	0.9966	
				2008	2015	NO	0.9000	
				2008	2016	NO	0.9609	
				2013	2015	NO	0.9910	
				2013	2016	NO	0.8627	
				2015	2016	NO	0.4946	
Filterer FFG (% of community)	NO	0.8744	β , ε	2007	2008	NO	1.0000	Tamhane's
				2007	2013	NO	0.9899	
				2007	2015	NO	0.9986	
				2007	2016	NO	0.9998	
				2008	2013	NO	0.9998	
				2008	2015	NO	1.0000	
				2008	2016	NO	1.0000	
				2013	2015	NO	0.9988	
				2013	2016	NO	1.0000	
				2015	2016	NO	1.0000	

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

[b] Data analysis included: α - data untransformed; η - data log transformed; β - data logit transformed; ε - single factor ANOVA test conducted; γ - ANOVA validated using Kruskal-Wallis H-test.

Table F.31: Statistical comparison of benthic metrics at Sheardown Lake SE littoral stations among years of mine operation (2015, 2016) and baseline (2013) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 3-group Comparison			Summary Statistics		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	Year	Mean	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	YES	0.0036	α	2013	10,649	2013	2015	YES	0.0848	Tamhane's
				2015	4,829	2013	2016	YES	0.0455	
				2016	3,700	2015	2016	NO	0.6951	
Richness	NO	0.1829	α	2013	14.2	2013	2015	NO	0.1847	Tukey's HSD
				2015	10.6	2013	2016	NO	0.3399	
				2016	11.4	2015	2016	NO	0.9084	
Simpson's Evenness	NO	0.9249	α	2013	0.785	2013	2015	NO	0.9176	Tukey's HSD
				2015	0.759	2013	2016	NO	0.9767	
				2016	0.772	2015	2016	NO	0.9805	
Nemata (% of Community)	NO	0.8511	β	2013	0.2%	2013	2015	NO	0.9999	Tukey's HSD
				2015	1.5%	2013	2016	NO	0.8784	
				2016	1.1%	2015	2016	NO	0.8717	
Ostracoda (% of Community)	NO	0.8953	β , ζ	2013	5.9%	2013	2015	NO	0.9383	Tukey's HSD
				2015	5.5%	2013	2016	NO	0.8937	
				2016	1.7%	2015	2016	NO	0.9930	
Chironomidae (% of Community)	NO	0.1441	β	2013	89.9%	2013	2015	NO	0.9877	Tukey's HSD
				2015	88.9%	2013	2016	NO	0.2200	
				2016	95.4%	2015	2016	NO	0.1748	
Metal Sensitive Taxa (% of Community)	NO	0.3656	β	2013	15.1%	2013	2015	NO	0.8662	Tukey's HSD
				2015	12.7%	2013	2016	NO	0.3438	
				2016	6.8%	2015	2016	NO	0.6233	
Collector-Gatherer FFG (% of Community)	NO	0.1151	β	2013	44.6%	2013	2015	NO	0.1254	Tukey's HSD
				2015	59.1%	2013	2016	NO	0.2193	
				2016	56.5%	2015	2016	NO	0.9335	
Filterer FFG (% of Commmunity)	NO	0.3224	β	2013	15.1%	2013	2015	NO	0.8751	Tukey's HSD
				2015	12.5%	2013	2016	NO	0.3056	
				2016	6.7%	2015	2016	NO	0.5608	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data probit transformed, single factor ANOVA test conducted;

Table F.32: Replicate grab data for benthic invertebrate community samples collected at the Mary River, Mary River Project CREMP, August 2016.

Study Area	Station	Water Depth (cm)			Water Velocity (m/s)			Substrate Size[a] (cm)			Embeddedness		
		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 B1	6	8	8	0.29	0.39	0.38	7.8	7.5	10.0	25%	25%	25%
	GO-09 B2	10	14	14	0.21	0.38	0.40	7.2	5.1	5.0	25%	25%	25%
	GO-09 B3	8	14	6	0.26	0.27	0.32	6.4	6.7	8.0	50%	25%	25%
	GO-09 B4	8	6	6	0.22	0.23	0.27	7.7	8.3	10.3	50%	50%	50%
	GO-09 B5	18	10	12	0.28	0.31	0.27	7.0	7.5	9.5	25%	25%	25%
Mary River Upstream	GO-03 B1	16	16	16	0.28	0.24	0.32	7.6	10.6	10.9	50%	25%	25%
	GO-03 B2	8	10	12	0.25	0.21	0.22	7.6	10.9	9.4	25%	50%	50%
	GO-03 B3	12	8	12	0.21	0.32	0.34	9.2	10.5	8.3	50%	25%	25%
	GO-03 B4	12	10	14	0.32	0.33	0.26	6.6	7.3	7.9	50%	50%	25%
	GO-03 B5	12	12	14	0.28	0.28	0.37	7.3	8.6	8.6	25%	25%	25%
Mary River	EO-01 B1	12	12	0	0.32	0.35	0.35	6.8	6.6	7.4	25%	25%	25%
	EO-01 B2	12	12	14	0.27	0.31	0.36	9.7	8.3	7.6	25%	25%	50%
	EO-01 B3	12	8	4	0.23	0.23	0.25	8.3	6.9	7.8	50%	50%	25%
	EO-01 B4	16	16	14	0.23	0.21	0.20	9.0	10.1	7.9	50%	50%	50%
	EO-01 B5	12	12	10	0.22	0.26	0.31	7.9	6.6	7.5	50%	50%	50%
Mary River	EO-20 B1	16	16	16	0.41	0.38	0.24	5.2	6.0	5.3	25%	25%	25%
	EO-20 B2	14	12	14	0.21	0.22	0.25	7.8	7.2	7.2	25%	25%	25%
	EO-20 B3	14	10	14	0.31	0.27	0.36	6.6	6.2	7.3	25%	25%	25%
	EO-20 B4	12	10	16	0.22	0.46	0.36	6.7	10.5	6.4	50%	50%	50%
	EO-20 B5	14	10	10	0.28	0.40	0.34	8.2	7.2	9.4	25%	25%	25%
Mary River Downstream	CO-05 B1	16	10	14	0.38	0.35	0.23	9.4	7.8	6.4	50%	50%	25%
	CO-05 B2	8	8	8	0.32	0.32	0.34	5.8	6.9	5.2	50%	50%	50%
	CO-05 B3	10	14	14	0.23	0.33	0.27	8.2	7.2	7.9	50%	50%	50%
	CO-05 B4	14	8	10	0.25	0.29	0.41	6.1	8.2	7.8	50%	50%	50%
	CO-05 B5	10	12	16	0.23	0.27	0.39	11.3	7.3	7.6	50%	50%	50%

[a] Substrate measurements taken from the intermediate axis of each individual particle observed within the Surber sampler area as viewed from the surface prior to sampling. Sample size ranged from 6 - 16 measurements per replicate grab, with a mean of 12 for the entire 2016 stream sampling program.

Table F.33: Replicate station habitat feature summary statistics for Mary River benthic stations, Mary River Project CREMP, August 2016. Five stations were sampled at each study area.

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Depth (cm)	GO-09 Reference Area	9.9	3.0	1.4	6.1	13.6	6.7	13.3
	GO-03 Upstream Area	12.3	2.3	1.0	9.4	15.2	10.0	16.0
	EO-01 Upper Mine-Exposed Area	11.1	3.1	1.4	7.2	15.0	8.0	15.3
	EO-20 Middle Mine-Exposed Area	13.2	1.7	0.8	11.1	15.3	11.3	16.0
	CO-05 Lower Mine-Exposed Area	11.5	2.2	1.0	8.8	14.2	8.0	13.3
Water Velocity (cm/s)	GO-09 Reference Area	29.9	4.4	2.0	24.4	35.3	24.0	35.3
	GO-03 Upstream Area	28.2	3.3	1.5	24.1	32.3	22.7	31.0
	EO-01 Upper Mine-Exposed Area	27.3	5.3	2.4	20.8	33.9	21.3	34.0
	EO-20 Middle Mine-Exposed Area	31.4	5.1	2.3	25.1	37.7	22.7	34.7
	CO-05 Lower Mine-Exposed Area	30.7	2.0	0.9	28.2	33.3	27.7	32.7
Substrate Size (cm diameter)	GO-09 Reference Area	7.6	1.2	0.5	6.1	9.1	5.8	8.8
	GO-03 Upstream Area	8.7	1.0	0.4	7.5	10.0	7.3	9.7
	EO-01 Upper Mine-Exposed Area	7.9	0.9	0.4	6.8	8.9	6.9	9.0
	EO-20 Middle Mine-Exposed Area	7.1	1.1	0.5	5.8	8.5	5.5	8.3
	CO-05 Lower Mine-Exposed Area	7.5	1.0	0.5	6.3	8.8	6.0	8.7
Substrate Embeddedness (%)	GO-09 Reference Area	32	11	5	18	45	25	50
	GO-03 Upstream Area	35	7	3	26	44	25	42
	EO-01 Upper Mine-Exposed Area	40	11	5	27	53	25	50
	EO-20 Middle Mine-Exposed Area	30	11	5	16	44	25	50
	CO-05 Lower Mine-Exposed Area	48	4	2	44	53	42	50

Table F.34: Benthic station habitat feature statistical comparisons among Mary River reference and mine-exposed study areas, Mary River Project CREMP, August 2016. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

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 Depth (cm)	NO	0.3336	α	GO-09	GO-03	NO	0.5785	Tukey's HSD
				GO-09	EO-01	NO	0.9427	
				GO-09	EO-20	NO	0.2696	
				GO-09	CO-05	NO	0.8544	
				GO-03	EO-01	NO	0.9427	
				GO-03	EO-20	NO	0.9765	
				GO-03	CO-05	NO	0.9867	
				EO-01	EO-20	NO	0.6784	
				EO-01	CO-05	NO	0.9991	
				EO-20	CO-05	NO	0.8155	
Water Velocity (cm/s)	NO	0.5353	η , ζ	GO-09	GO-03	NO	0.9773	Tukey's HSD
				GO-09	EO-01	NO	0.8534	
				GO-09	EO-20	NO	0.9869	
				GO-09	CO-05	NO	0.9954	
				GO-03	EO-01	NO	0.9928	
				GO-03	EO-20	NO	0.8196	
				GO-03	CO-05	NO	0.8733	
				EO-01	EO-20	NO	0.5787	
				EO-01	CO-05	NO	0.6504	
				EO-20	CO-05	NO	1.0000	
Substrate Size (cm diameter)	NO	0.1935	α	GO-09	GO-03	NO	0.4285	Tukey's HSD
				GO-09	EO-01	NO	0.9916	
				GO-09	EO-20	NO	0.9545	
				GO-09	CO-05	NO	1.0000	
				GO-03	EO-01	NO	0.6885	
				GO-03	EO-20	NO	0.1435	
				GO-03	CO-05	NO	0.3742	
				EO-01	EO-20	NO	0.7851	
				EO-01	CO-05	NO	0.9818	
				EO-20	CO-05	NO	0.9740	
Substrate Embeddedness (%)	YES	0.0333	β , ζ	GO-09	GO-03	NO	0.9646	Tukey's HSD
				GO-09	EO-01	NO	0.6012	
				GO-09	EO-20	NO	0.9976	
				GO-09	CO-05	YES	0.0658	
				GO-03	EO-01	NO	0.9259	
				GO-03	EO-20	NO	0.8666	
				GO-03	CO-05	NO	0.2176	
				EO-01	EO-20	NO	0.4157	
				EO-01	CO-05	NO	0.6338	
				EO-20	CO-05	YES	0.0343	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data logit transformed, single factor ANOVA test conducted;

Table F.35: Benthic invertebrate community data for Mary River, August 2016. Densities expressed in number of organisms per square meter.

Station	GO-09 Reference Area					GO-03 Upstream of Mine				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	14	7	14	0	14	7	11	7	4	7
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	0	0	0	0	0	0	0	4	0	0
F. Naididae										
S.F. Tubificinae										
immatures without hair chaetae	0	0	0	0	0	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
indeterminate	0	0	0	0	0	0	0	0	0	0
F. Sperchonidae										
Sperchon	11	14	50	47	39	32	14	36	25	22
SEED SHRIMPS										
Cl. Ostracoda	0	0	0	0	0	0	0	0	0	0
INSECTS										
Cl. Insecta										
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
Acentrella feropagus	0	0	0	0	0	0	0	0	0	0
STONEFLIES										
O. Plecoptera										
F. Capniidae										
immature	0	0	0	0	0	0	4	0	0	0
TRUE FLIES										
O. Diptera										
BITING-MIDGE										
F. Ceratopogonidae										
Culicoides	0	0	0	0	0	0	0	4	0	0
MIDGES										
F. Chironomidae										
chironomid pupae	**14**	**7**	**29**	**11**	**11**	**39**	**4**	**7**	**4**	**11**
S.F. Chironominae										
Micropsectra	0	0	0	0	0	0	0	0	0	0
Paratanytarsus	0	0	0	0	0	0	0	0	0	0
Polypedilum	0	0	0	0	0	0	0	0	0	0
Stictochironomus	0	0	0	0	0	0	0	0	0	0
Tanytarsus	0	0	0	0	0	0	0	0	0	0
S.F. Diamesinae										
Diamesa	75	47	36	14	90	14	4	4	0	0
Pseudokiefferiella	4	14	47	154	413	47	47	11	4	14
S.F. Orthocladiinae										
Chaetocladius	4	0	0	0	0	0	7	4	0	0
Cardiocladius	0	0	0	14	0	32	0	0	0	36
Corynoneura	0	0	0	0	0	0	0	7	0	0
Cricotopus	18	36	72	86	90	61	50	22	14	4
Cricotopus/Orthocladius	7	0	7	4	0	11	0	0	7	4
Diplocladius	65	4	4	0	0	7	0	0	0	4
Eukiefferiella	0	39	97	32	118	0	0	0	0	0
Hydrobaenus	0	4	7	22	7	0	7	25	0	4
Hydrosmittia	0	0	0	0	7	4	11	0	4	4
Krenosmittia	4	4	11	4	18	4	36	7	7	22
Limnophyes	0	11	11	14	0	0	7	0	7	7
Orthocladius (Euorthocladius)	65	43	65	18	50	11	0	11	14	29
Parakiefferiella	0	0	0	0	0	7	0	0	0	0
Paraphaenocladius	0	0	0	0	0	0	0	0	0	0
Thienemanniella	0	4	0	0	0	4	0	0	0	0

Table F.35: Benthic invertebrate community data for Mary River, August 2016. Densities expressed in number of organisms per square meter.

Station	GO-09 Reference Area					GO-03 Upstream of Mine				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
Tokunagaia	129	75	194	133	222	126	72	72	75	43
Tvetenia	0	4	0	0	0	4	7	0	7	0
indeterminate	0	0	0	0	0	**4**	**4**	0	**4**	0
S.F. Tanypodinae										
Thienemannimyia complex	0	0	0	0	0	0	0	0	0	0
F. Empididae										
Clinocera	0	0	0	0	0	0	0	0	0	0
F. Simuliidae										
Gymnopais	22	7	61	83	83	7	0	0	0	0
Metacnephia	0	0	0	0	0	0	0	0	0	4
Prosimulium/Helodon	0	0	0	0	0	0	0	0	0	0
indeterminate	0	0	**4**	**4**	0	0	0	0	0	0
F. Tipulidae										
Dicranota	0	0	0	0	0	0	0	0	0	0
Tipula	11	14	14	7	0	4	39	11	11	50
Number of Organisms (No. organisms per m^2)	443	334	723	647	1,162	425	324	232	187	265
Richness (total number of taxa)[a]	13	16	15	14	12	17	14	14	12	15
Simpson's Evenness (E)	0.893	0.932	0.920	0.914	0.875	0.878	0.931	0.902	0.841	0.942
Bray-Curtis Index	0.351	0.278	0.142	0.228	0.385	0.300	0.473	0.518	0.545	0.613
Percent Composition										
% Nemata	3.2%	2.1%	1.9%	0.0%	1.2%	1.6%	3.4%	3.0%	2.1%	2.6%
% Oligochaeta	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.7%	0.0%	0.0%
% Hydracarina	2.5%	4.2%	6.9%	7.3%	3.4%	7.5%	4.3%	15.5%	13.4%	8.3%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	86.9%	87.4%	80.2%	78.2%	88.3%	88.2%	79.0%	73.3%	78.6%	68.7%
% Metal Sensitive Chironmids	17.8%	18.3%	11.5%	26.0%	43.3%	14.4%	15.7%	6.5%	2.1%	5.3%
% Tipulidae	2.5%	4.2%	1.9%	1.1%	0.0%	0.9%	12.0%	4.7%	5.9%	18.9%
Functional Feeding Group Composition										
% Shredders	8.4%	15.3%	13.4%	15.3%	7.8%	20.0%	29.3%	14.7%	17.6%	21.9%
% Collector - Gatherers	84.2%	78.4%	70.7%	61.8%	81.7%	62.6%	66.4%	68.1%	69.0%	54.0%
% Filterers	5.0%	2.1%	9.0%	13.4%	7.1%	1.6%	0.0%	0.0%	0.0%	1.5%
Habitat Preference Group Composition										
% Clingers	13.3%	17.4%	27.4%	34.9%	18.3%	28.2%	21.6%	25.4%	25.1%	12.8%
% Sprawlers	81.0%	76.3%	68.7%	61.8%	80.5%	60.9%	63.0%	63.4%	66.8%	51.3%
% Burrowers	5.6%	6.3%	3.9%	3.2%	1.2%	10.8%	15.4%	11.2%	8.0%	35.8%

[a] Bold entries excluded from taxa count

Table F.35: Benthic invertebrate community data for Mary River, August 2016. Densities expressed in number of organisms per square meter.

Station	EO-01 Upper Mine-Exposed					EO-20 Middle Mine-Exposed				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	4	0	7	7	4	0	4	4	4	7
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	4	0	0	25	0	0	0	0	0	4
F. Naididae										
S.F. Tubificinae										
immatures without hair chaetae	0	0	0	0	0	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
indeterminate	0	0	0	0	0	0	0	**4**	0	0
F. Sperchonidae										
Sperchon	0	14	22	36	18	14	22	11	4	39
SEED SHRIMPS										
Cl. Ostracoda	0	0	0	0	0	0	0	0	0	0
INSECTS										
Cl. Insecta										
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
Acentrella feropagus	0	0	0	0	0	0	0	0	0	0
STONEFLIES										
O. Plecoptera										
F. Capniidae										
immature	0	0	0	0	0	0	0	0	0	0
TRUE FLIES										
O. Diptera										
BITING-MIDGE										
F. Ceratopogonidae										
Culicoides	0	0	0	14	11	4	7	0	0	0
MIDGES										
F. Chironomidae										
chironomid pupae	**11**	**7**	0	**22**	**14**	**14**	**11**	**18**	**14**	**7**
S.F. Chironominae										
Micropsectra	0	0	0	4	4	0	0	0	0	0
Paratanytarsus	0	0	0	0	0	0	0	0	0	0
Polypedilum	0	0	0	0	0	0	0	4	0	0
Stictochironomus	0	0	0	0	0	0	0	0	0	0
Tanytarsus	0	0	0	0	0	0	0	0	0	0
S.F. Diamesinae										
Diamesa	4	4	0	4	0	11	0	7	0	0
Pseudokiefferiella	7	11	0	7	7	7	7	4	4	14
S.F. Orthocladiinae										
Chaetocladius	0	0	4	7	0	0	4	4	0	11
Cardiocladius	18	0	0	0	4	36	57	14	22	39
Corynoneura	0	0	7	0	0	0	4	0	0	0
Cricotopus	0	4	0	11	22	4	18	4	0	14
Cricotopus/Orthocladius	0	0	4	7	25	0	4	0	4	4
Diplocladius	0	0	7	0	7	0	4	0	0	7
Eukiefferiella	4	0	0	0	0	0	0	0	0	0
Hydrobaenus	0	11	0	11	0	0	0	0	0	4
Hydrosmittia	0	0	0	7	0	0	0	0	0	0
Krenosmittia	4	25	43	22	0	14	18	7	14	14
Limnophyes	0	0	4	4	11	4	7	0	7	11
Orthocladius (Euorthocladius)	14	0	25	0	29	25	25	0	47	39
Parakiefferiella	0	0	0	0	4	0	0	0	0	0
Paraphaenocladius	0	0	0	0	0	0	0	0	0	0
Thienemanniella	0	0	0	0	0	0	0	0	0	0

Table F.35: Benthic invertebrate community data for Mary River, August 2016. Densities expressed in number of organisms per square meter.

Station	EO-01 Upper Mine-Exposed					EO-20 Middle Mine-Exposed				
Replicate	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
Tokunagaia	39	43	75	136	136	79	118	61	93	172
Tvetenia	0	14	7	4	18	11	7	4	0	4
indeterminate	0	0	0	**4**	0	0	**7**	**14**	**4**	**7**
S.F. Tanypodinae										
Thienemannimyia complex	0	0	0	0	0	0	0	0	0	0
F. Empididae										
Clinocera	0	0	4	4	4	0	4	0	0	4
F. Simuliidae										
Gymnopais	0	0	4	0	0	0	0	0	4	0
Metacnephia	0	0	0	0	0	0	0	0	0	0
Prosimulium/Helodon	0	0	0	0	0	0	0	0	0	0
indeterminate	0	0	0	0	0	0	0	0	0	0
F. Tipulidae										
Dicranota	0	0	0	0	0	0	0	0	0	0
Tipula	4	0	11	7	18	4	14	0	7	57
Number of Organisms (No. organisms per m	113	133	224	343	336	227	342	160	228	458
Richness (total number of taxa)[a]	10	8	14	18	16	12	17	11	11	17
Simpson's Evenness (E)	0.871	0.913	0.884	0.820	0.839	0.873	0.862	0.789	0.799	0.852
Bray-Curtis Index	0.736	0.738	0.592	0.493	0.440	0.591	0.477	0.664	0.511	0.431
Percent Composition										
% Nemata	3.5%	0.0%	3.1%	2.0%	1.2%	0.0%	1.2%	2.5%	1.8%	1.5%
% Oligochaeta	3.5%	0.0%	0.0%	7.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%
% Hydracarina	0.0%	10.5%	9.8%	10.5%	5.4%	6.2%	6.4%	9.4%	1.8%	8.5%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	89.4%	89.5%	78.6%	72.9%	83.6%	90.3%	85.1%	88.1%	91.7%	75.8%
% Metal Sensitive Chironmids	9.7%	11.3%	0.0%	4.4%	3.3%	7.9%	2.0%	6.9%	1.8%	3.1%
% Tipulidae	3.5%	0.0%	4.9%	2.0%	5.4%	1.8%	4.1%	0.0%	3.1%	12.4%
Functional Feeding Group Composition										
% Shredders	3.5%	3.0%	6.7%	7.6%	19.9%	3.5%	10.8%	6.3%	4.8%	16.6%
% Collector - Gatherers	78.8%	86.5%	79.9%	75.2%	67.9%	71.4%	61.7%	73.1%	81.1%	65.1%
% Filterers	0.0%	0.0%	1.8%	1.5%	1.2%	0.0%	0.0%	0.0%	1.8%	0.0%
Habitat Preference Group Composition										
% Clingers	0.0%	13.5%	15.2%	17.2%	21.1%	7.9%	14.3%	15.6%	5.3%	13.5%
% Sprawlers	71.7%	86.5%	76.8%	67.3%	67.9%	71.4%	60.5%	70.6%	79.4%	62.7%
% Burrowers	28.3%	0.0%	8.0%	15.5%	11.0%	20.7%	25.1%	13.8%	15.4%	23.8%

[a] Bold entries excluded from taxa count

Table F.35: Benthic invertebrate community data for Mary River, August 2016. Densities expressed in number of organisms per square meter.

Station	CO-05 Lower Mine-Exposed				
Replicate	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	18	7	4	39	22
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	0	7	22	4	18
F. Naididae					
S.F. Tubificinae					
immatures without hair chaetae	0	0	0	0	4
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
indeterminate	0	0	0	0	0
F. Sperchonidae					
Sperchon	32	54	68	104	68
SEED SHRIMPS					
Cl. Ostracoda	4	0	7	4	0
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
Acentrella feropagus	0	0	0	25	0
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature	0	0	0	0	0
TRUE FLIES					
O. Diptera					
BITING-MIDGE					
F. Ceratopogonidae					
Culicoides	0	0	0	0	0
MIDGES					
F. Chironomidae					
chironomid pupae	**7**	**14**	**7**	**29**	**47**
S.F. Chironominae					
Micropsectra	0	0	0	4	0
Paratanytarsus	0	0	0	11	4
Polypedilum	0	0	0	0	0
Stictochironomus	4	0	0	0	4
Tanytarsus	0	4	0	0	0
S.F. Diamesinae					
Diamesa	0	0	0	0	0
Pseudokiefferiella	280	190	50	574	750
S.F. Orthocladiinae					
Chaetocladius	4	0	0	0	0
Cardiocladius	187	187	283	122	201
Corynoneura	0	0	0	0	0
Cricotopus	29	36	39	111	305
Cricotopus/Orthocladius	0	4	14	0	25
Diplocladius	0	0	0	0	47
Eukiefferiella	0	0	0	0	0
Hydrobaenus	0	11	108	50	4
Hydrosmittia	54	47	47	108	118
Krenosmittia	0	0	0	11	11
Limnophyes	14	0	7	14	11
Orthocladius (Euorthocladius)	0	0	0	36	11
Parakiefferiella	11	4	14	0	0
Paraphaenocladius	0	7	7	4	18
Thienemanniella	0	0	14	0	0

Table F.35: Benthic invertebrate community data for Mary River, August 2016. Densities expressed in number of organisms per square meter.

Station	CO-05 Lower Mine-Exposed				
Replicate	B1	B2	B3	B4	B5
Tokunagaia	97	129	43	136	233
Tvetenia	4	11	4	14	36
indeterminate	0	0	**4**	0	0
S.F. Tanypodinae					
Thienemannimyia complex	7	4	7	50	36
F. Empididae					
Clinocera	0	4	0	0	14
F. Simuliidae					
Gymnopais	0	0	0	0	4
Metacnephia	4	0	0	0	0
Prosimulium/Helodon	0	0	0	4	0
indeterminate	**7**	**7**	0	0	0
F. Tipulidae					
Dicranota	0	0	0	11	4
Tipula	7	7	22	25	43
Number of Organisms (No. organisms per m	770	734	771	1,490	2,038
Richness (total number of taxa)[a]	16	18	18	22	24
Simpson's Evenness (E)	0.831	0.865	0.862	0.847	0.838
Bray-Curtis Index	0.636	0.563	0.692	0.624	0.716
Percent Composition					
% Nemata	2.3%	1.0%	0.5%	2.6%	1.1%
% Oligochaeta	0.0%	1.0%	2.9%	0.3%	1.1%
% Hydracarina	4.7%	7.4%	9.7%	7.2%	3.3%
% Ostracods	0.5%	0.0%	0.9%	0.3%	0.0%
% Chironomids	90.6%	88.3%	84.0%	85.5%	91.3%
% Metal Sensitive Chironmids	36.4%	26.4%	6.5%	39.5%	37.0%
% Tipulidae	0.9%	1.0%	2.9%	2.4%	2.3%
Functional Feeding Group Composition					
% Shredders	4.7%	6.5%	9.9%	9.3%	18.7%
% Collector - Gatherers	64.3%	57.5%	42.9%	69.9%	64.7%
% Filterers	1.4%	1.5%	0.0%	1.3%	0.4%
Habitat Preference Group Composition					
% Clingers	9.4%	15.0%	15.8%	14.9%	20.9%
% Sprawlers	62.3%	56.1%	40.5%	72.1%	64.6%
% Burrowers	28.3%	28.9%	43.7%	13.0%	14.6%

[a] Bold entries excluded from taxa count

Table F.36: Benthic invertebrate community summary statistics for Mary River, Mary River Project CREMP, August 2016. Sample size equals five for all study areas.

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	GO-09 Reference Area	662	320	143	265	1,059	334	1,162
	GO-03 Upstream Area	287	92	41	172	401	187	425
	EO-01 Upper Mine-Exposed Area	230	109	49	95	365	113	343
	EO-20 Middle Mine-Exposed Area	283	118	53	137	429	160	458
	CO-05 Lower Mine-Exposed Area	1,161	584	261	435	1,886	734	2,038
Richness (Number of Taxa)	GO-09 Reference Area	14.0	1.6	0.7	12.0	16.0	12.0	16.0
	GO-03 Upstream Area	14.4	1.8	0.8	12.1	16.7	12.0	17.0
	EO-01 Upper Mine-Exposed Area	13.2	4.1	1.9	8.1	18.3	8.0	18.0
	EO-20 Middle Mine-Exposed Area	13.6	3.1	1.4	9.7	17.5	11.0	17.0
	CO-05 Lower Mine-Exposed Area	19.6	3.3	1.5	15.5	23.7	16.0	24.0
Simpson's Evenness	GO-09 Reference Area	0.907	0.023	0.010	0.878	0.935	0.875	0.932
	GO-03 Upstream Area	0.899	0.041	0.018	0.848	0.949	0.841	0.942
	EO-01 Upper Mine-Exposed Area	0.865	0.037	0.016	0.820	0.911	0.820	0.913
	EO-20 Middle Mine-Exposed Area	0.835	0.038	0.017	0.787	0.882	0.789	0.873
	CO-05 Lower Mine-Exposed Area	0.848	0.015	0.007	0.830	0.867	0.831	0.865
Bray-Curtis Index	GO-09 Reference Area	0.277	0.097	0.043	0.156	0.397	0.142	0.385
	GO-03 Upstream Area	0.490	0.117	0.053	0.344	0.636	0.300	0.613
	EO-01 Upper Mine-Exposed Area	0.600	0.136	0.061	0.431	0.769	0.440	0.738
	EO-20 Middle Mine-Exposed Area	0.535	0.093	0.042	0.419	0.651	0.431	0.664
	CO-05 Lower Mine-Exposed Area	0.646	0.060	0.027	0.571	0.721	0.563	0.716
Hydracarina (% of community)	GO-09 Reference Area	4.8%	2.1%	1.0%	2.2%	7.5%	2.5%	7.3%
	GO-03 Upstream Area	9.8%	4.6%	2.0%	4.2%	15.5%	4.3%	15.5%
	EO-01 Upper Mine-Exposed Area	7.2%	4.6%	2.0%	1.5%	12.9%	0.0%	10.5%
	EO-20 Middle Mine-Exposed Area	6.4%	3.0%	1.3%	2.8%	10.1%	1.8%	9.4%
	CO-05 Lower Mine-Exposed Area	6.5%	2.5%	1.1%	3.4%	9.6%	3.3%	9.7%
Chironomidae (% of community)	GO-09 Reference Area	84.2%	4.6%	2.1%	78.4%	90.0%	78.2%	88.3%
	GO-03 Upstream Area	77.6%	7.3%	3.3%	68.5%	86.7%	68.7%	88.2%
	EO-01 Upper Mine-Exposed Area	82.8%	7.2%	3.2%	73.9%	91.7%	72.9%	89.5%
	EO-20 Middle Mine-Exposed Area	86.2%	6.3%	2.8%	78.3%	94.1%	75.8%	91.7%
	CO-05 Lower Mine-Exposed Area	88.0%	3.2%	1.4%	84.0%	91.9%	84.0%	91.3%
Metal-Sensitive Chironomidae (% of community)	GO-09 Reference Area	23.4%	12.3%	5.5%	8.1%	38.6%	11.5%	43.3%
	GO-03 Upstream Area	8.8%	5.9%	2.7%	1.4%	16.2%	2.1%	15.7%
	EO-01 Upper Mine-Exposed Area	5.7%	4.7%	2.1%	-0.1%	11.5%	0.0%	11.3%
	EO-20 Middle Mine-Exposed Area	4.3%	2.9%	1.3%	0.8%	7.9%	1.8%	7.9%
	CO-05 Lower Mine-Exposed Area	29.2%	13.6%	6.1%	12.2%	46.1%	6.5%	39.5%
Tipulidae (% of community)	GO-09 Reference Area	1.9%	1.6%	0.7%	0.0%	3.9%	0.0%	4.2%
	GO-03 Upstream Area	8.5%	7.0%	3.1%	-0.2%	17.2%	0.9%	18.9%
	EO-01 Upper Mine-Exposed Area	3.2%	2.2%	1.0%	0.4%	5.9%	0.0%	5.4%
	EO-20 Middle Mine-Exposed Area	4.3%	4.8%	2.2%	-1.7%	10.3%	0.0%	12.4%
	CO-05 Lower Mine-Exposed Area	1.9%	0.9%	0.4%	0.8%	3.0%	0.9%	2.9%
Shredder FFG (% of community)	GO-09 Reference Area	12.0%	3.7%	1.6%	7.5%	16.6%	7.8%	15.3%
	GO-03 Upstream Area	20.7%	5.5%	2.5%	13.8%	27.6%	14.7%	29.3%
	EO-01 Upper Mine-Exposed Area	8.2%	6.9%	3.1%	-0.4%	16.7%	3.0%	19.9%
	EO-20 Middle Mine-Exposed Area	8.4%	5.3%	2.4%	1.8%	15.0%	3.5%	16.6%
	CO-05 Lower Mine-Exposed Area	9.8%	5.4%	2.4%	3.1%	16.5%	4.7%	18.7%
Collector-Gatherer FFG (% of community)	GO-09 Reference Area	75.4%	9.1%	4.1%	64.0%	86.7%	61.8%	84.2%
	GO-03 Upstream Area	64.0%	6.1%	2.7%	56.4%	71.6%	54.0%	69.0%
	EO-01 Upper Mine-Exposed Area	77.6%	6.8%	3.0%	69.2%	86.1%	67.9%	86.5%
	EO-20 Middle Mine-Exposed Area	70.5%	7.5%	3.4%	61.1%	79.9%	61.7%	81.1%
	CO-05 Lower Mine-Exposed Area	59.9%	10.4%	4.7%	46.9%	72.8%	42.9%	69.9%
Filterer FFG (% of community)	GO-09 Reference Area	7.3%	4.3%	1.9%	2.0%	12.6%	2.1%	13.4%
	GO-03 Upstream Area	0.6%	0.9%	0.4%	-0.4%	1.7%	0.0%	1.6%
	EO-01 Upper Mine-Exposed Area	0.9%	0.8%	0.4%	-0.2%	1.9%	0.0%	1.8%
	EO-20 Middle Mine-Exposed Area	0.4%	0.8%	0.4%	-0.6%	1.3%	0.0%	1.8%
	CO-05 Lower Mine-Exposed Area	0.9%	0.7%	0.3%	0.1%	1.8%	0.0%	1.5%
Clinger HPG (% of community)	GO-09 Reference Area	22.3%	8.7%	3.9%	11.4%	33.1%	13.3%	34.9%
	GO-03 Upstream Area	22.6%	6.0%	2.7%	15.2%	30.1%	12.8%	28.2%
	EO-01 Upper Mine-Exposed Area	13.4%	8.0%	3.6%	3.5%	23.4%	0.0%	21.1%
	EO-20 Middle Mine-Exposed Area	11.3%	4.5%	2.0%	5.8%	16.9%	5.3%	15.6%
	CO-05 Lower Mine-Exposed Area	15.2%	4.1%	1.8%	10.1%	20.3%	9.4%	20.9%
Sprawler HPG (% of community)	GO-09 Reference Area	73.7%	8.3%	3.7%	63.4%	83.9%	61.8%	81.0%
	GO-03 Upstream Area	61.1%	5.9%	2.6%	53.8%	68.4%	51.3%	66.8%
	EO-01 Upper Mine-Exposed Area	74.0%	7.9%	3.5%	64.2%	83.9%	67.3%	86.5%
	EO-20 Middle Mine-Exposed Area	68.9%	7.6%	3.4%	59.5%	78.3%	60.5%	79.4%
	CO-05 Lower Mine-Exposed Area	59.1%	11.9%	5.3%	44.4%	73.9%	40.5%	72.1%
Burrower HPG (% of community)	GO-09 Reference Area	4.1%	2.0%	0.9%	1.5%	6.6%	1.2%	6.3%
	GO-03 Upstream Area	16.3%	11.3%	5.0%	2.3%	30.3%	8.0%	35.8%
	EO-01 Upper Mine-Exposed Area	12.6%	10.5%	4.7%	-0.4%	25.5%	0.0%	28.3%
	EO-20 Middle Mine-Exposed Area	19.8%	5.0%	2.3%	13.5%	26.0%	13.8%	25.1%
	CO-05 Lower Mine-Exposed Area	25.7%	12.5%	5.6%	10.1%	41.2%	13.0%	43.7%

Table F.37: Benthic invertebrate community statistical comparisons between individual Mary River reference (GO-09), upstream (GO-03) and mine-exposed (EO-01, EO-20, CO-05) study areas, Mary River Project CREMP, August 2016. Shading indicates a signficant difference for respective comparison (p-value ≤ 0.1).

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	Magnitude of Difference	Statistical Test
Density	YES	0.0004	α , ε	GO-09	GO-03	NO	0.4423	-	Tamhane's
				GO-09	EO-01	NO	0.3084	-	
				GO-09	EO-20	NO	0.4316	-	
				GO-09	CO-05	NO	0.7873	-	
				GO-03	EO-01	NO	0.9939	-	
				GO-03	EO-20	NO	1.0000	-	
				GO-03	CO-05	NO	0.2450	-	
				EO-01	EO-20	NO	0.9985	-	
				EO-01	CO-05	NO	0.2016	-	
				EO-20	CO-05	NO	0.2381	-	
Richness	YES	0.0359	η , γ	GO-09	GO-03	NO	1.0000	-	Tamhane's
				GO-09	EO-01	NO	0.9998	-	
				GO-09	EO-20	NO	1.0000	-	
				GO-09	CO-05	YES	0.0740	3.5	
				GO-03	EO-01	NO	0.9984	-	
				GO-03	EO-20	NO	0.9997	-	
				GO-03	CO-05	NO	0.1191	-	
				EO-01	EO-20	NO	1.0000	-	
				EO-01	CO-05	NO	0.3687	-	
				EO-20	CO-05	NO	0.1734	-	
Simpson's Evenness	YES	0.0081	α , ε	GO-09	GO-03	NO	0.9944	-	Tukey's HSD
				GO-09	EO-01	NO	0.2905	-	
				GO-09	EO-20	YES	0.0166	-3.1	
				GO-09	CO-05	YES	0.0664	-2.6	
				GO-03	EO-01	NO	0.4967	-	
				GO-03	EO-20	YES	0.0386	-1.6	
				GO-03	CO-05	NO	0.1411	-	
				EO-01	EO-20	NO	0.5816	-	
				EO-01	CO-05	NO	0.9192	-	
				EO-20	CO-05	NO	0.9625	-	
Bray Curtis Index	YES	0.0002	α , ε	GO-09	GO-03	YES	0.0298	2.2	Tukey's HSD
				GO-09	EO-01	YES	0.0007	3.3	
				GO-09	EO-20	YES	0.0067	2.7	
				GO-09	CO-05	YES	0.0001	3.8	
				GO-03	EO-01	NO	0.4727	-	
				GO-03	EO-20	NO	0.9579	-	
				GO-03	CO-05	NO	0.1634	-	
				EO-01	EO-20	NO	0.8575	-	
				EO-01	CO-05	NO	0.9533	-	
				EO-20	CO-05	NO	0.4609	-	
Hydracarina (% of community)	NO	0.6360	β , γ	GO-09	GO-03	NO	0.5849	-	Tukey's HSD
				GO-09	EO-01	NO	0.9996	-	
				GO-09	EO-20	NO	0.9821	-	
				GO-09	CO-05	NO	0.9718	-	
				GO-03	EO-01	NO	0.7078	-	
				GO-03	EO-20	NO	0.8763	-	
				GO-03	CO-05	NO	0.9038	-	
				EO-01	EO-20	NO	0.9971	-	
				EO-01	CO-05	NO	0.9939	-	
				EO-20	CO-05	NO	1.0000	-	

Table F.37: Benthic invertebrate community statistical comparisons between individual Mary River reference (GO-09), upstream (GO-03) and mine-exposed (EO-01, EO-20, CO-05) study areas, Mary River Project CREMP, August 2016. Shading indicates a signficant difference for respective comparison (p-value ≤ 0.1).

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	Magnitude of Difference	Statistical Test
Chironomidae (% of community)	NO	0.1351	β , ε	GO-09	GO-03	NO	0.5923	-	Tukey's HSD
				GO-09	EO-01	NO	0.9999	-	
				GO-09	EO-20	NO	0.9298	-	
				GO-09	CO-05	NO	0.8097	-	
				GO-03	EO-01	NO	0.6706	-	
				GO-03	EO-20	NO	0.1982	-	
				GO-03	CO-05	NO	0.1168	-	
				EO-01	EO-20	NO	0.8848	-	
				EO-01	CO-05	NO	0.7404	-	
				EO-20	CO-05	NO	0.9982	-	
Metal Sensitive Taxa (% of community)	YES	0.0035	β , γ	GO-09	GO-03	NO	0.3268	-	Tukey's HSD
				GO-09	EO-01	YES	0.0321	-1.4	
				GO-09	EO-20	YES	0.0469	-1.6	
				GO-09	CO-05	NO	0.9960	-	
				GO-03	EO-01	NO	0.7174	-	
				GO-03	EO-20	NO	0.8157	-	
				GO-03	CO-05	NO	0.1836	-	
				EO-01	EO-20	NO	0.9997	-	
				EO-01	CO-05	YES	0.0147	5.0	
				EO-20	CO-05	YES	0.0219	8.7	
Tipulidae (% of community)	NO	0.2858	β , ε	GO-09	GO-03	NO	0.2031	-	Tukey's HSD
				GO-09	EO-01	NO	0.8043	-	
				GO-09	EO-20	NO	0.7770	-	
				GO-09	CO-05	NO	0.9632	-	
				GO-03	EO-01	NO	0.7798	-	
				GO-03	EO-20	NO	0.8069	-	
				GO-03	CO-05	NO	0.5197	-	
				EO-01	EO-20	NO	1.0000	-	
				EO-01	CO-05	NO	0.9914	-	
				EO-20	CO-05	NO	0.9869	-	
Shredder FFG (% of community)	YES	0.0167	β , ε	GO-09	GO-03	NO	0.3690	-	Tukey's HSD
				GO-09	EO-01	NO	0.5100	-	
				GO-09	EO-20	NO	0.6618	-	
				GO-09	CO-05	NO	0.9182	-	
				GO-03	EO-01	YES	0.0183	-2.3	
				GO-03	EO-20	YES	0.0314	-2.2	
				GO-03	CO-05	YES	0.0911	-2.0	
				EO-01	EO-20	NO	0.9990	-	
				EO-01	CO-05	NO	0.9342	-	
				EO-20	CO-05	NO	0.9837	-	
Collector-Gatherer FFG (% of community)	YES	0.0108	β , ε	GO-09	GO-03	NO	0.2018	-	Tukey's HSD
				GO-09	EO-01	NO	0.9817	-	
				GO-09	EO-20	NO	0.8440	-	
				GO-09	CO-05	YES	0.0533	-1.7	
				GO-03	EO-01	YES	0.0745	2.2	
				GO-03	EO-20	NO	0.7325	-	
				GO-03	CO-05	NO	0.9519	-	
				EO-01	EO-20	NO	0.5380	-	
				EO-01	CO-05	YES	0.0169	-2.6	
				EO-20	CO-05	NO	0.3282	-	

Table F.37: Benthic invertebrate community statistical comparisons between individual Mary River reference (GO-09), upstream (GO-03) and mine-exposed (EO-01, EO-20, CO-05) study areas, Mary River Project CREMP, August 2016. Shading indicates a signficant difference for respective comparison (p-value ≤ 0.1).

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	Magnitude of Difference	Statistical Test
Filterer FFG (% of community)	YES	0.0017	β , ε	GO-09	GO-03	YES	0.0072	-1.6	Tukey's HSD
				GO-09	EO-01	YES	0.0586	-1.5	
				GO-09	EO-20	YES	0.0013	-1.6	
				GO-09	CO-05	YES	0.0150	-1.5	
				GO-03	EO-01	NO	0.8616	-	
				GO-03	EO-20	NO	0.9431	-	
				GO-03	CO-05	NO	0.9970	-	
				EO-01	EO-20	NO	0.4429	-	
				EO-01	CO-05	NO	0.9659	-	
				EO-20	CO-05	NO	0.8146	-	
Clinger HPG (% of community)	NO	0.2101	β , γ	GO-09	GO-03	NO	1.0000	-	Tamhane's
				GO-09	EO-01	NO	0.9402	-	
				GO-09	EO-20	NO	0.2910	-	
				GO-09	CO-05	NO	0.7735	-	
				GO-03	EO-01	NO	0.9210	-	
				GO-03	EO-20	NO	0.1630	-	
				GO-03	CO-05	NO	0.4643	-	
				EO-01	EO-20	NO	1.0000	-	
				EO-01	CO-05	NO	0.9984	-	
				EO-20	CO-05	NO	0.9200	-	
Sprawler HPG (% of community)	YES	0.0316	β , ε	GO-09	GO-03	NO	0.1881	-	Tukey's HSD
				GO-09	EO-01	NO	0.9997	-	
				GO-09	EO-20	NO	0.8930	-	
				GO-09	CO-05	NO	0.1073	-	
				GO-03	EO-01	NO	0.1360	-	
				GO-03	EO-20	NO	0.6396	-	
				GO-03	CO-05	NO	0.9978	-	
				EO-01	EO-20	NO	0.8119	-	
				EO-01	CO-05	YES	0.0753	-1.9	
				EO-20	CO-05	NO	0.4541	-	
Burrower HPG (% of community)	YES	0.0151	β , ε	GO-09	GO-03	NO	0.1384	-	Tukey's HSD
				GO-09	EO-01	NO	0.7398	-	
				GO-09	EO-20	YES	0.0460	7.8	
				GO-09	CO-05	YES	0.0186	10.7	
				GO-03	EO-01	NO	0.7251	-	
				GO-03	EO-20	NO	0.9786	-	
				GO-03	CO-05	NO	0.8551	-	
				EO-01	EO-20	NO	0.3944	-	
				EO-01	CO-05	NO	0.2057	-	
				EO-20	CO-05	NO	0.9924	-	

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

[b] Data analysis included: α - data untransformed; η - data log transformed; β - data logit transformed; ε - single factor ANOVA test conducted; γ - ANOVA validated using Kruskal-Wallis

Table F.38: Statistical comparison of benthic metrics at the Mary River reference area (GO-09) among years of mine operation (2015, 2016) and baseline (2006, 2007) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 4-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	NO	0.2834	α , ε	2006	2007	NO	0.3796	Tukey's HSD
				2006	2015	NO	0.9805	
				2006	2016	NO	0.5022	
				2007	2015	NO	0.4738	
				2007	2016	NO	0.9720	
				2015	2016	NO	0.6264	
Richness	YES	0.0156	η , γ	2006	2007	NO	0.5742	Tamhane's
				2006	2015	NO	0.7611	
				2006	2016	NO	0.5216	
				2007	2015	NO	0.7554	
				2007	2016	NO	0.9768	
				2015	2016	NO	0.6023	
Simpson's Evenness	YES	0.0000	α , γ	2006	2007	YES	0.0000	Tukey's HSD
				2006	2015	YES	0.0000	
				2006	2016	YES	0.0000	
				2007	2015	YES	0.0004	
				2007	2016	YES	0.0001	
				2015	2016	NO	0.8210	
Hydracarina (% of community)	YES	0.0023	β , ε	2006	2007	NO	1.0000	Tamhane's
				2006	2015	NO	0.4449	
				2006	2016	NO	0.4083	
				2007	2015	NO	0.3299	
				2007	2016	NO	0.3082	
				2015	2016	NO	0.9855	
Chironomidae (% of community)	YES	0.0000	β , ε	2006	2007	YES	0.0967	Tukey's HSD
				2006	2015	YES	0.0000	
				2006	2016	YES	0.0000	
				2007	2015	YES	0.0006	
				2007	2016	YES	0.0001	
				2015	2016	NO	0.6145	
Metal Sensitive Taxa (% of community)	YES	0.0043	β , γ	2006	2007	NO	0.1759	Tamhane's
				2006	2015	YES	0.0025	
				2006	2016	YES	0.0411	
				2007	2015	NO	0.1676	
				2007	2016	NO	0.9262	
				2015	2016	NO	0.2865	
Tipulidae (% of community)	YES	0.0942	β , γ	2006	2007	NO	0.5893	Tukey's HSD
				2006	2015	YES	0.0676	
				2006	2016	NO	0.5203	
				2007	2015	NO	0.5467	
				2007	2016	NO	1.0000	
				2015	2016	NO	0.4124	
Shredder FFG (% of community)	YES	0.0006	β , ε	2006	2007	YES	0.0183	Tukey's HSD
				2006	2015	YES	0.0008	
				2006	2016	YES	0.0007	
				2007	2015	NO	0.4824	
				2007	2016	NO	0.4368	
				2015	2016	NO	0.9996	
Collector-Gatherer FFG (% of community)	YES	0.0001	β , ε	2006	2007	YES	0.0502	Tukey's HSD
				2006	2015	YES	0.0003	
				2006	2016	YES	0.0001	
				2007	2015	YES	0.0691	
				2007	2016	YES	0.0299	
				2015	2016	NO	0.9419	
Filterer FFG (% of community)	YES	0.0005	β , ε	2006	2007	NO	0.9988	Tukey's HSD
				2006	2015	NO	0.1018	
				2006	2016	YES	0.0014	
				2007	2015	YES	0.0773	
				2007	2016	YES	0.0011	
				2015	2016	YES	0.0583	

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

[b] Data analysis included: α - data untransformed; η - data log transformed; β - data logit transformed; ε - single factor ANOVA test conducted; γ - ANOVA validated using Kruskal-Wallis H-test.

Table F.39: Statistical comparison of benthic metrics at Mary River GO-03 upstream study area among years of mine operation (2015, 2016) and baseline (2007) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	NO	0.1071	α	2007	2015	NO	0.9194	Tukey's HSD
				2007	2016	NO	0.9597	
				2015	2016	NO	0.9938	
Richness	YES	0.0137	η , ζ	2007	2015	YES	0.0006	Tukey's HSD
				2007	2016	NO	0.8253	
				2015	2016	YES	0.0024	
Simpson's Evenness	YES	0.0000	α , ζ	2007	2015	NO	0.4686	Tamhane's
				2007	2016	NO	0.4775	
				2015	2016	NO	0.9999	
Hydracarina (% of Community)	YES	0.0007	β	2007	2015	NO	0.1454	Tukey's HSD
				2007	2016	NO	0.6097	
				2015	2016	NO	0.5813	
Chironomidae (% of Community)	YES	0.0000	β	2007	2015	YES	0.0540	Tukey's HSD
				2007	2016	YES	0.0193	
				2015	2016	NO	0.8058	
Metal Sensitive Taxa (% of Community)	NO	0.9176	β , ζ	2007	2015	NO	0.7289	Tamhane's
				2007	2016	NO	0.9976	
				2015	2016	NO	0.7472	
Tipulidae (% of Community)	YES	0.0145	β	2007	2015	YES	0.0172	Tukey's HSD
				2007	2016	YES	0.0192	
				2015	2016	NO	0.9973	
Shredder FFG (% of Community)	YES	0.0000	β	2007	2015	YES	0.0363	Tukey's HSD
				2007	2016	YES	0.0240	
				2015	2016	NO	0.9648	
Collector-Gatherer FFG (% of Community)	YES	0.0000	β	2007	2015	NO	0.5212	Tukey's HSD
				2007	2016	NO	0.1038	
				2015	2016	NO	0.5424	
Filterer FFG (% of Commmunity)	NO	0.5382	β	2007	2015	YES	0.0401	Tamhane's
				2007	2016	NO	0.9975	
				2015	2016	YES	0.0453	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data probit transformed, single factor ANOVA test conducted;

Table F.40: Statistical comparison of benthic metrics at Mary River EO-01 upper mine-exposed area among years of mine operation (2015, 2016) and baseline (2007) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	YES	0.0304	α	2007	2015	NO	0.5041	Tamhane's
				2007	2016	NO	0.6066	
				2015	2016	NO	0.3123	
Richness	NO	0.0799	α	2007	2015	NO	0.4992	Tamhane's
				2007	2016	NO	0.9284	
				2015	2016	NO	0.1296	
Simpson's Evenness	YES	0.0127	α , ζ	2007	2015	YES	0.0158	Tukey's HSD
				2007	2016	YES	0.0205	
				2015	2016	NO	0.9820	
Hydracarina (% of Community)	NO	0.0996	β , ζ	2007	2015	NO	0.2801	Tukey's HSD
				2007	2016	NO	0.0847	
				2015	2016	NO	0.6443	
Chironomidae (% of Community)	NO	0.3363	β	2007	2015	NO	0.3987	Tukey's HSD
				2007	2016	NO	0.3537	
				2015	2016	NO	0.9934	
Metal Sensitive Taxa (% of Community)	NO	0.3959	β	2007	2015	NO	0.6086	Tukey's HSD
				2007	2016	NO	0.3666	
				2015	2016	NO	0.8644	
Tipulidae (% of Community)	NO	0.1503	β	2007	2015	NO	0.1830	Tukey's HSD
				2007	2016	NO	0.8940	
				2015	2016	NO	0.2542	
Shredder FFG (% of Community)	NO	0.1948	β	2007	2015	NO	0.2771	Tukey's HSD
				2007	2016	NO	0.9852	
				2015	2016	NO	0.2539	
Collector-Gatherer FFG (% of Community)	NO	0.0593	β	2007	2015	NO	0.1030	Tukey's HSD
				2007	2016	NO	0.0603	
				2015	2016	NO	0.9226	
Filterer FFG (% of Commmunity)	YES	0.0212	β	2007	2015	NO	0.4095	Tamhane's
				2007	2016	NO	0.4930	
				2015	2016	NO	0.7822	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data probit transformed, single factor ANOVA test conducted;

Table F.41: Statistical comparison of benthic metrics at Mary River EO-20 middle mine-exposed area among years of mine operation (2015, 2016) and baseline (2011) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	YES	0.0043	α	2011	2015	YES	0.0062	Tukey's HSD
				2011	2016	YES	0.0065	
				2015	2016	NO	0.9992	
Richness	NO	0.3955	η , ζ	2011	2015	NO	0.4513	Tukey's HSD
				2011	2016	NO	0.9667	
				2015	2016	NO	0.5018	
Simpson's Evenness	YES	0.0229	α	2011	2015	NO	0.1002	Tukey's HSD
				2011	2016	YES	0.0185	
				2015	2016	NO	0.4811	
Hydracarina (% of Community)	YES	0.0021	β	2011	2015	YES	0.0098	Tukey's HSD
				2011	2016	YES	0.0018	
				2015	2016	NO	0.4478	
Chironomidae (% of Community)	YES	0.0369	β	2011	2015	YES	0.0597	Tukey's HSD
				2011	2016	YES	0.0413	
				2015	2016	NO	0.9637	
Metal Sensitive Taxa (% of Community)	NO	0.0932	β	2011	2015	NO	0.1261	Tukey's HSD
				2011	2016	NO	0.1065	
				2015	2016	NO	0.9915	
Tipulidae (% of Community)	NO	0.4475	β	2011	2015	NO	0.4246	Tukey's HSD
				2011	2016	NO	0.7958	
				2015	2016	NO	0.7383	
Shredder FFG (% of Community)	NO	0.1220	β	2011	2015	NO	0.1092	Tukey's HSD
				2011	2016	NO	0.5242	
				2015	2016	NO	0.4202	
Collector-Gatherer FFG (% of Community)	YES	0.0003	β	2011	2015	YES	0.0003	Tukey's HSD
				2011	2016	YES	0.0009	
				2015	2016	NO	0.6429	
Filterer FFG (% of Commmunity)	NO	0.8918	β	2011	2015	NO	0.9807	Tukey's HSD
				2011	2016	NO	0.9718	
				2015	2016	NO	0.8818	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted;
β - data probit transformed, single factor ANOVA test conducted;

Table F.42: Statistical comparison of benthic metrics at the Mary River lower mine-exposed area (CO-05) among years of mine operation (2015, 2016) and baseline (2007, 2011) for the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 4-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	YES	0.0172	α , ε	2007	2011	NO	0.9948	Tamhane's
				2007	2015	NO	0.9981	
				2007	2016	NO	0.1653	
				2011	2015	NO	0.9670	
				2011	2016	NO	0.5569	
				2015	2016	NO	0.1213	
Richness	YES	0.0073	α , ε	2007	2011	YES	0.0420	Tukey's HSD
				2007	2015	NO	0.7284	
				2007	2016	YES	0.0145	
				2011	2015	NO	0.1324	
				2011	2016	NO	0.9944	
				2015	2016	YES	0.0440	
Simpson's Evenness	YES	0.0000	α , ε	2007	2011	NO	0.1947	Tamhane's
				2007	2015	YES	0.0001	
				2007	2016	YES	0.0046	
				2011	2015	NO	0.9694	
				2011	2016	NO	0.9937	
				2015	2016	YES	0.0521	
Hydracarina (% of community)	YES	0.0346	β , ε	2007	2011	NO	0.9999	Tukey's HSD
				2007	2015	NO	0.9452	
				2007	2016	YES	0.0748	
				2011	2015	NO	0.9239	
				2011	2016	YES	0.0663	
				2015	2016	NO	0.1063	
Chironomidae (% of community)	YES	0.0000	β , ε	2007	2011	YES	0.0003	Tukey's HSD
				2007	2015	YES	0.0000	
				2007	2016	YES	0.0000	
				2011	2015	YES	0.0542	
				2011	2016	NO	0.8000	
				2015	2016	NO	0.1470	
Metal Sensitive Taxa (% of community)	NO	0.2045	β , γ	2007	2011	NO	0.2442	Tukey's HSD
				2007	2015	NO	0.3593	
				2007	2016	NO	0.8933	
				2011	2015	NO	0.9542	
				2011	2016	NO	0.4554	
				2015	2016	NO	0.6594	
Tipulidae (% of community)	NO	0.2263	β , ε	2007	2011	NO	0.4419	Tukey's HSD
				2007	2015	NO	0.2661	
				2007	2016	NO	0.2167	
				2011	2015	NO	0.9969	
				2011	2016	NO	0.9855	
				2015	2016	NO	0.9984	
Shredder FFG (% of community)	YES	0.0353	β , ε	2007	2011	YES	0.0311	Tukey's HSD
				2007	2015	NO	0.2044	
				2007	2016	YES	0.0689	
				2011	2015	NO	0.4603	
				2011	2016	NO	0.8334	
				2015	2016	NO	0.8646	
Collector-Gatherer FFG (% of community)	YES	0.0080	β , ε	2007	2011	NO	0.1437	Tukey's HSD
				2007	2015	YES	0.0053	
				2007	2016	NO	0.2621	
				2011	2015	NO	0.3932	
				2011	2016	NO	0.9060	
				2015	2016	YES	0.0831	
Filterer FFG (% of community)	YES	0.0170	β , γ	2007	2011	NO	1.0000	Tukey's HSD
				2007	2015	YES	0.0745	
				2007	2016	YES	0.0688	
				2011	2015	YES	0.0747	
				2011	2016	YES	0.0690	
				2015	2016	NO	0.9999	

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

[b] Data analysis included: α - data untransformed; η - data log transformed; β - data probit transformed; ε - single factor ANOVA test conducted; γ - ANOVA validated using Kruskal-Wallis H-test

Table F.43: Benthic invertebrate community data for Mary Lake, August 2016. Densities expressed in number of organisms per square meter.

Station	Mary Lake - Littoral Stations 2016					
Replicate	BLO-1	BLO-6	BLO-11	BLO-20	BLO-21	BLO-22
ROUNDWORMS						
P. Nemata	9	86	0	0	26	9
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Lumbriculidae						
Lumbriculus	0	0	0	0	0	0
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
immature	0	0	**17**	0	0	0
F. Acalyptonotidae						
Acalyptonotus	52	52	17	0	9	9
F. Hygrobatidae						
Hygrobates	9	0	0	0	0	0
F. Lebertiidae						
Lebertia	0	0	9	34	0	0
HARPACTICOIDS						
O. Harpacticoida	0	0	0	0	0	0
SEED SHRIMPS						
Cl. Ostracoda	164	17	9	0	0	52
WATER SCUDS						
O. Amphipoda						
F. Hyalellidae						
Hyalella	0	0	9	0	0	0
INSECTS						
Cl. Insecta						
CADDISFLIES						
O. Trichoptera						
F. Apataniidae						
Apatania	0	0	0	0	0	0
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae	0	0	0	0	0	9
S.F. Chironominae						
Chironomus	0	0	0	302	0	0
Micropsectra	905	0	60	1,233	129	9
Parachironomus	0	0	0	0	0	0
Paratanytarsus	0	0	0	0	0	0
Sergentia	0	0	0	190	0	0
Stictochironomus	776	0	0	1,793	0	0
Tanytarsus	121	0	0	0	0	0
S.F. Diamesinae						
Diamesa	0	60	26	34	9	0
Pseudodiamesa	0	95	9	0	9	9
S.F. Orthocladiinae						
Abiskomyia	190	26	0	78	0	0
Cricotopus/Orthocladius	0	0	0	0	0	0
Heterotrissocladius	0	78	741	78	1,129	914
Paracladius	0	0	0	0	0	0
Parakiefferiella	0	0	0	0	0	0
Psectrocladius	0	0	0	0	0	0
Zalutschia	0	34	0	0	9	9
Genus *"Greenland"*	0	0	0	0	0	0

Table F.43: Benthic invertebrate community data for Mary Lake, August 2016. Densities expressed in number of organisms per square meter.

Station	Mary Lake - Littoral Stations 2016					
Replicate	BLO-1	BLO-6	BLO-11	BLO-20	BLO-21	BLO-22
S.F. Tanypodinae						
Arctopelopia	0	0	0	0	0	0
Procladius	1,810	9	9	155	17	26
CRANE FLIES						
F. Tipulidae						
Dicranota	0	0	0	0	0	0
Density (No. organisms per m^2)	4,036	457	906	3,897	1,337	1,046
Richness (total number of taxa)[a]	9	9	9	9	8	8
Simpson's Evenness (E)	0.795	0.958	0.365	0.762	0.316	0.249
Bray-Curtis Index	0.642	0.839	0.877	0.805	0.854	0.902
Percent Composition						
% Nemata	0.2%	18.8%	0.0%	0.0%	1.9%	0.9%
% Hydracarina	1.5%	11.4%	4.7%	0.9%	0.7%	0.9%
% Ostracods	4.1%	3.7%	1.0%	0.0%	0.0%	5.0%
% Chironomids	94.2%	66.1%	93.3%	99.1%	97.4%	93.3%
% Metal Sensitive Chironmids	25.4%	33.9%	10.5%	32.5%	11.0%	1.7%
Functional Feeding Group Composition						
% Shredders	0.0%	7.4%	0.0%	0.0%	0.7%	0.9%
% Collector - Gatherers	28.2%	79.2%	87.6%	63.5%	87.7%	94.9%
% Filterers	25.4%	0.0%	6.6%	31.6%	9.6%	0.9%
Habitat Preference Group Composition						
% Clingers	26.9%	11.4%	11.4%	37.4%	10.3%	1.7%
% Sprawlers	53.6%	56.7%	85.8%	8.0%	87.1%	97.4%
% Burrowers	19.4%	31.9%	2.9%	54.6%	2.6%	0.9%

[a] Bold entries excluded from taxa count

Table F.44: Statistical comparison of benthic metrics at Mary Lake littoral stations among years of mine operation (2015, 2016) and baseline (2007) as part of the Mary River Project CREMP. Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

Metric	Overall 3-group Comparison			Summary Statistics		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Test [b]	Year	Mean	(I) Year	(J) Year	Significant Difference Between Years?	p-value	Statistical Test
Density	NO	0.8238	α	2007	2,667	2007	2015	NO	0.9863	Tukey's HSD
				2015	2,453	2007	2016	NO	0.8355	
				2016	1,947	2015	2016	NO	0.8980	
Richness	NO	0.6083	η , ζ	2007	8.0	2007	2015	NO	0.8978	Tamhane's
				2015	9.0	2007	2016	NO	0.9205	
				2016	8.7	2015	2016	NO	0.9957	
Simpson's Evenness	NO	0.3927	α	2007	0.718	2007	2015	NO	0.6587	Tamhane's
				2015	0.761	2007	2016	NO	0.6530	
				2016	0.574	2015	2016	NO	0.4705	
Nemata (% of Community)	NO	0.5331	β	2007	7.3%	2007	2015	NO	0.9609	Tukey's HSD
				2015	5.6%	2007	2016	NO	0.7579	
				2016	3.6%	2015	2016	NO	0.5314	
Ostracoda (% of Community)	NO	0.5424	β	2007	0.2%	2007	2015	NO	0.6843	Tukey's HSD
				2015	1.9%	2007	2016	NO	0.5217	
				2016	2.3%	2015	2016	NO	0.9712	
Chironomidae (% of Community)	NO	0.9883	β	2007	90.8%	2007	2015	NO	0.9877	Tukey's HSD
				2015	91.1%	2007	2016	NO	0.9922	
				2016	90.6%	2015	2016	NO	0.9988	
Metal Sensitive Taxa (% of Community)	NO	0.7685	β	2007	22.4%	2007	2015	NO	0.7502	Tukey's HSD
				2015	15.8%	2007	2016	NO	0.9137	
				2016	19.2%	2015	2016	NO	0.9074	
Collector-Gatherer FFG (% of Community)	NO	0.8999	β	2007	66.0%	2007	2015	NO	0.9137	Tukey's HSD
				2015	72.8%	2007	2016	NO	0.9069	
				2016	73.5%	2015	2016	NO	0.9998	
Filterer FFG (% of Commmunity)	NO	0.5744	β	2007	22.0%	2007	2015	NO	0.6010	Tukey's HSD
				2015	14.4%	2007	2016	NO	0.6172	
				2016	12.4%	2015	2016	NO	0.9925	

[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; ζ - single factor ANOVA test validated using Kruskal-Wallis H-test; η - data log transformed, single factor ANOVA test conducted; β - data probit transformed, single factor ANOVA test conducted;

APPENDIX G

FISH POPULATION SURVEY DATA

Table G.1: Electrofishing catch records, Mary River Project CREMP, August 2016. Catch-per-unit-effort (CPUE) represents the number of fish captured per electrofishing minute.

Lake	Sample Station Identifier	Location (NAD83, UTM Zone 17W)				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	CPUE	No. Captured	CPUE	No. Captured	CPUE
Reference Lake 3	R316-EF-1	574894	7853037	575170	7853094	14-Aug-16	445	30	12	6,154	36	0.35	5	0.05	41	0.40
	R316-EF-2	574894	7853037	574774	7853057	14-Aug-16	445	30	12	2,446	25	0.61	13	0.32	38	0.93
	R316-EF-3	574774	7853057	574560	7853038	15-Aug-16	445	30	12	5,160	40	0.47	10	0.12	50	0.58
									Total	**13,760**	**101**	**0.48**	**28**	**0.16**	**129**	**0.64**
Camp Lake	CL16-EF-1	557800	7914653	557810	7914604	10-Aug-16	600	50	3	942	**98**	**6.24**	**2**	**0.13**	**100**	**6.37**
Sheardown Lake NW	SDNW16-EF-1	560285	7913485	560235	7913484	12-Aug-16	600	50	3	1,210	**106**	**5.26**	**0**	**0.00**	**106**	**5.26**
Sheardown Lake SE	SDSE16-EF-1	560744	7912333	560873	7912223	12-Aug-16	600	50	3	2,430	**109**	**2.69**	**19**	**0.47**	**128**	**3.16**
Mary Lake	ML16-EF-1	555443	7905149	555509	7904995	14-Aug-16	400	30	12	4,711	**107**	**1.36**	**1**	**0.01**	**108**	**1.38**

Table G.2: Gill netting catch records for Reference Lake 3, Mary River Project CREMP, August 2016. Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Gill Net Set ID	Net Mesh	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"		
REF316-GN-1	1½", 2", 3"	0574968	7852932	91	14-Aug-16	14-Aug-16	11:51	13:56	2.08	1.90	0	0	0	0	0.00
					14-Aug-16	14-Aug-16	14:20	15:56	1.60	1.46	0	0	0	0	0.00
REF316-GN-2	1½", 2", 3"	0576157	7852461	91	14-Aug-16	14-Aug-16	12:05	14:35	2.50	2.29	0	1	0	1	0.44
					14-Aug-16	14-Aug-16	14:40	16:17	1.62	1.48	0	0	0	0	0.00
					14-Aug-16	14-Aug-16	16:27	17:46	1.32	1.20	0	0	0	0	0.00
REF316-GN-3	1½", 2", 3"	0575883	7852569	91	14-Aug-16	14-Aug-16	12:16	14:45	2.48	2.27	0	0	0	0	0.00
					14-Aug-16	14-Aug-16	14:47	16:29	1.70	1.55	0	0	0	0	0.00
					14-Aug-16	14-Aug-16	16:40	17:55	1.25	1.14	0	0	0	0	0.00
REF316-GN-4	1½", 2", 3"	0575556	7852583	91	14-Aug-16	14-Aug-16	12:38	14:51	2.22	2.03	0	0	0	0	0.00
					14-Aug-16	14-Aug-16	14:53	16:45	1.87	1.71	0	0	0	0	0.00
REF316-GN-5	1½", 2", 3"	0574297	7852528	91	14-Aug-16	14-Aug-16	12:54	14:54	2.00	1.83	0	1	0	1	0.55
					14-Aug-16	14-Aug-16	15:00	17:00	2.00	1.83	0	0	0	0	0.00
					14-Aug-16	14-Aug-16	17:04	18:08	1.07	0.98	0	0	0	0	0.00
REF316-GN-6	1½", 2", 3"	0574043	7852885	91	14-Aug-16	14-Aug-16	13:10	15:13	2.05	1.87	0	0	1	1	0.53
					14-Aug-16	14-Aug-16	15:21	17:09	1.80	1.65	0	0	0	0	0.00
REF316-GN-7	1½", 2", 3"	0573689	7853524	91	14-Aug-16	14-Aug-16	13:20	15:30	2.17	1.98	0	1	0	1	0.50
					14-Aug-16	14-Aug-16	15:44	17:21	1.62	1.48	0	0	0	0	0.00
REF316-GN-8	1½", 2", 3"	0575562	7852825	91	14-Aug-16	14-Aug-16	16:12	17:37	1.42	1.30	0	0	0	0	0.00
REF316-GN-9	1½", 2", 3"	0575203	7853013	91	15-Aug-16	15-Aug-16	10:50	15:40	4.83	4.42	0	0	1	1	0.23
REF316-GN-10	1½", 2", 3"	0575551	7852907	91	15-Aug-16	15-Aug-16	11:00	16:00	5.00	4.57	0	0	0	0	0.00
REF316-GN-11	1½", 2", 3"	0576077	7852519	91	15-Aug-16	15-Aug-16	11:15	16:15	5.00	4.57	0	0	0	0	0.00
REF316-GN-12	1½", 2", 3"	0574389	7852268	91	15-Aug-16	15-Aug-16	11:30	16:35	5.08	4.65	0	1	0	1	0.22
REF316-GN-13	1½", 2", 3"	0573836	7852703	91	15-Aug-16	15-Aug-16	11:45	17:00	5.25	4.80	0	0	0	0	0.00
REF316-GN-14	1½", 2", 3"	0574043	7854041	91	15-Aug-16	15-Aug-16	11:55	17:15	5.33	4.88	1	2	0	3	0.62
REF316-GN-15	1½", 2", 3"	0573615	7853819	91	15-Aug-16	15-Aug-16	12:00	17:40	5.67	5.18	0	0	5	5	0.96
REF316-GN-16	1½", 2", 3"	0575215	7853056	91	15-Aug-16	15-Aug-16	16:30	18:15	1.75	1.60	0	0	0	0	0.00
REF316-GN-17	1½", 2", 3"	0573897	7852975	91	15-Aug-16	15-Aug-16	17:15	18:00	0.75	0.69	0	0	0	0	0.00
									Total	**65.30**	**1**	**6**	**7**	**14**	**0.15**

Table G.3: Gill netting catch records for Camp Lake, Mary River Project CREMP, August 2016. Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Gill Net Set ID	Net Mesh	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"		
CL16-GN-1	1½", 3"	0557751	7914760	60.96	11-Aug-16	11-Aug-16	8:10	9:10	1.00	0.61	1	-	4	5	8.2
					11-Aug-16	11-Aug-16	9:20	12:05	2.75	1.68	0	-	1	1	0.60
CL16-GN-2	1½", 2", 3"	0557745	7914625	91.44	11-Aug-16	11-Aug-16	8:20	9:45	1.42	1.30	1	1	3	5	3.86
					11-Aug-16	11-Aug-16	9:55	12:25	2.50	2.29	0	1	2	3	1.31
					12-Aug-16	12-Aug-16	8:10	10:15	2.08	1.90	0	0	1	1	0.52
CL16-GN-3	1½", 2", 3"	0557630	7914315	91.44	11-Aug-16	11-Aug-16	8:35	10:05	1.50	1.37	0	5	2	7	5.1
					11-Aug-16	11-Aug-16	10:25	12:55	2.50	2.29	2	5	1	8	3.50
					12-Aug-16	12-Aug-16	7:55	9:30	1.58	1.45	2	2	1	5	3.45
CL16-GN-4	1½", 2", 3"	0557632	7914464	91.44	11-Aug-16	11-Aug-16	8:45	10:45	2.00	1.83	2	1	2	5	2.73
					11-Aug-16	11-Aug-16	11:00	13:30	2.50	2.29	2	5	5	12	5.2
					11-Aug-16	11-Aug-16	13:50	15:45	1.92	1.75	2	1	4	7	3.99
					12-Aug-16	12-Aug-16	8:05	9:55	1.83	1.68	2	0	1	3	1.79
CL16-GN-5	1½", 2", 3"	0557284	7914847	91.44	11-Aug-16	11-Aug-16	9:00	11:20	2.33	2.13	0	4	2	6	2.81
					11-Aug-16	11-Aug-16	11:35	13:50	2.25	2.06	0	2	1	3	1.46
					12-Aug-16	12-Aug-16	8:15	10:30	2.25	2.06	0	1	0	1	0.49
CL16-GN-6	1½", 3"	0557557	7914793	60.96	10-Aug-16	10-Aug-16	12:50	14:40	1.83	1.12	1	-	4	5	4.47
CL16-GN-7	1½", 2", 3"	0557461	7914841	91.44	11-Aug-16	11-Aug-16	12:55	15:05	2.17	1.98	1	1	2	4	2.02
					12-Aug-16	12-Aug-16	8:20	10:45	2.42	2.21	2	1	1	4	1.81
CL16-GN-8	1½", 2", 3"	0557717	7914236	91.44	11-Aug-16	11-Aug-16	14:00	16:05	2.08	1.90	0	3	0	3	1.57
									Total	**33.9**	**18**	**33**	**37**	**88**	**2.89**

Table G.4: Gill netting catch records for Sheardown Lake NW, Mary River Project CREMP, August 2016. Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Gill Net Set ID	Net Mesh	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"		
SDNW16-GN-1	1½", 2", 3"	0560540	7913231	91	11-Aug-16	11-Aug-16	8:40	10:45	2.08	1.90	0	2	0	2	1.05
					11-Aug-16	11-Aug-16	11:20	15:39	4.32	3.95	0	0	2	2	0.51
					12-Aug-16	12-Aug-16	9:29	12:32	3.05	2.79	1	2	1	4	1.43
					12-Aug-16	12-Aug-16	12:41	15:26	2.75	2.51	1	3	2	6	2.39
SDNW16-GN-2	1½", 2", 3"	0560681	7913119	91	11-Aug-16	11-Aug-16	9:00	11:35	2.58	2.36	3	1	1	5	2.12
					11-Aug-16	11-Aug-16	11:58	15:45	3.78	3.46	0	0	2	2	0.58
SDNW16-GN-3	1½", 2", 3"	0559788	7913351	91	11-Aug-16	11-Aug-16	9:20	12:20	3.00	2.74	0	2	0	2	0.73
SDNW16-GN-4	1½", 2", 3"	0559853	7913527	91	11-Aug-16	11-Aug-16	9:40	12:50	3.17	2.90	3	5	2	10	3.45
					11-Aug-16	11-Aug-16	13:53	16:50	2.95	2.70	2	2	1	5	1.85
					11-Aug-16	11-Aug-16	17:07	18:16	1.15	1.05	1	0	1	2	1.90
					12-Aug-16	12-Aug-16	9:53	13:45	3.87	3.54	2	2	1	5	1.41
					12-Aug-16	12-Aug-16	13:51	16:51	3.00	2.74	0	0	1	1	0.36
SDNW16-GN-5	1½", 2", 3"	0559997	7913418	91	11-Aug-16	11-Aug-16	10:00	14:43	4.72	4.31	1	1	2	4	0.93
					12-Aug-16	12-Aug-16	14:22	17:07	2.75	2.51	1	1	0	2	0.80
SDNW16-GN-6	1½", 2", 3"	0559967	7913485	91	11-Aug-16	11-Aug-16	10:20	13:55	3.58	3.28	4	2	2	8	2.44
					11-Aug-16	11-Aug-16	15:23	17:31	2.13	1.95	2	0	3	5	2.56
					11-Aug-16	11-Aug-16	17:53	18:36	0.72	0.66	0	0	0	0	0.00
					12-Aug-16	12-Aug-16	10:03	14:39	4.60	4.21	1	4	1	6	1.43
					12-Aug-16	12-Aug-16	17:32	18:30	0.97	0.88	0	1	0	1	1.13
SDNW16-GN-7	1½", 2", 3"	0559752	7913552	91	11-Aug-16	11-Aug-16	12:30	16:24	3.90	3.57	3	1	0	4	1.12
					12-Aug-16	12-Aug-16	9:48	13:00	3.20	2.93	1	2	0	3	1.03
					12-Aug-16	12-Aug-16	13:10	16:10	3.00	2.74	1	2	1	4	1.46
					12-Aug-16	12-Aug-16	17:37	18:14	0.62	0.56	3	0	0	3	5.32
SDNW16-GN-8	1½", 2", 3"	0560444	7913294	91	12-Aug-16	12-Aug-16	9:20	10:50	1.50	1.37	0	4	3	7	5.10
									Total	**61.62**	**30**	**37**	**26**	**93**	**1.71**

Table G.5: Gill netting catch records for Sheardown Lake SE, Mary River Project CREMP, August 2016. Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Gill Net Set ID	Net Mesh	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"		
SDSE16-GN-1	1½", 2", 3"	0560781	7912251	91	13-Aug-16	13-Aug-16	9:30	10:48	1.30	1.19	5	8	2	15	12.62
SDSE16-GN-2	1½", 2", 3"	0560874	7912095	91	13-Aug-16	13-Aug-16	9:41	11:16	1.58	1.45	5	5	7	17	11.74
SDSE16-GN-3	1½", 2", 3"	0561034	7911947	91	13-Aug-16	13-Aug-16	9:51	12:51	3.00	2.74	6	3	6	15	5.47
SDSE16-GN-4	1½", 2", 3"	0561294	7911852	91	13-Aug-16	13-Aug-16	10:05	13:19	3.23	2.96	2	6	9	17	5.75
SDSE16-GN-5	1½", 2", 3"	0561425	7911888	91	13-Aug-16	13-Aug-16	10:23	14:48	4.42	4.04	2	9	8	19	4.70
									Total	**12.37**	**20**	**31**	**32**	**83**	**8.06**

Table G.6: Gill netting catch records for Mary Lake, Mary River Project CREMP, August 2016. Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Gill Net Set ID	Net Mesh	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"		
ML16-GN-1	1½", 2", 3"	0556169	7903786	91.44	13-Aug-16	13-Aug-16	9:45	11:20	1.58	1.45	1	8	6	15	10.36
	1½", 2", 3"	0556169	7903786	91.44	13-Aug-16	13-Aug-16	11:45	14:45	3.00	2.74	2	8	4	14	5.10
ML16-GN-2	1½", 2", 3"	0555906	7903971	91.44	13-Aug-16	13-Aug-16	9:55	11:50	1.92	1.75	2	6	7	15	8.56
ML16-GN-3	1½", 2", 3"	0555125	7905782	91.44	13-Aug-16	13-Aug-16	10:10	13:00	2.83	2.59	1	0	7	8	3.09
					13-Aug-16	13-Aug-16	17:20	18:10	0.83	0.76	0	2	3	5	6.56
ML16-GN-4	1½", 2", 3"	0554816	7906071	91.44	13-Aug-16	13-Aug-16	10:15	13:30	3.25	2.97	7	5	3	15	5.05
					13-Aug-16	13-Aug-16	13:50	15:45	1.92	1.75	3	4	0	7	3.99
ML16-GN-5	1½", 2", 3"	0554871	7906046	91.44	13-Aug-16	13-Aug-16	10:35	14:10	3.58	3.28	2	6	0	8	2.44
ML16-GN-6	1½", 2", 3"	0555995	7903812	91.44	13-Aug-16	13-Aug-16	14:50	16:40	1.83	1.68	0	3	3	6	3.58
ML16-GN-7	1½", 2", 3"	0555251	7905387	91.44	13-Aug-16	13-Aug-16	16:15	17:15	1.00	0.91	2	2	0	4	4.37
									Total	**19.89**	**20**	**44**	**33**	**97**	**5.31**

Table G.7: Summary of Arctic charr gill net catches by mesh size, Mary River Project CREMP, August 2016.

Waterbody	Effort (m*hrs/100 m)	Arctic Charr Catch per Mesh Size			Total Catch	CPUE[a]	Mortalities
		1½"	2"	3"			
Reference Lake 3	65.30	1	6	7	14	0.15	5
Camp Lake	33.88	18	33	37	88	2.89	24
Sheardown Lake NW	61.62	30	37	26	93	1.71	15
Sheardown Lake SE	12.37	20	31	32	83	8.06	25
Mary Lake	19.89	20	44	33	97	5.31	27
Total	**193.07**	**89**	**151**	**135**	**375**	**3.62**	**96**

[a] Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.8: Arctic charr measurements from fish captured at Reference Lake 3 by electrofishing, Mary River Project CREMP, August 2016.

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Liver Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF316-ACJ-1	5.9	6.3	1.804	0.030	1	0.878
REF316-ACJ-2	7.0	7.6	3.219	0.054	2	0.938
REF316-ACJ-3	7.8	8.5	4.377	0.076	2	0.922
REF316-ACJ-4	11.5	12.4	15.167	0.110	5	0.997
REF316-ACJ-5	3.9	4.1	0.547	0.008	0	0.922
REF316-ACJ-6	3.2	3.3	0.388	0.004	0	1.184
REF316-ACJ-7	5.4	5.7	1.491	0.011	1	0.947
REF316-ACJ-8	5.1	5.4	1.026	0.022	0	0.773
REF316-ACJ-9	8.8	9.4	6.221	0.073	3	0.913
REF316-ACJ-10	3.3	3.4	0.317	0.004	0	0.882
REF316-ACJ-11	5.7	6.1	1.608	-	-	0.868
REF316-ACJ-12	6.2	6.6	2.072	-	-	0.869
REF316-ACJ-13	14.5	15.7	25.212	-	-	0.827
REF316-ACJ-14	10.0	10.8	10.188	-	-	1.019
REF316-ACJ-15	11.4	12.3	12.304	-	-	0.830
REF316-ACJ-16	9.7	10.5	9.344	-	-	1.024
REF316-ACJ-17	13.2	14.2	24.087	-	-	1.047
REF316-ACJ-18	7.3	7.8	3.684	-	-	0.947
REF316-ACJ-19	6.6	7.0	2.420	-	-	0.842
REF316-ACJ-20	6.2	6.6	2.251	-	-	0.944
REF316-ACJ-21	6.0	6.4	1.682	-	-	0.779
REF316-ACJ-22	17.0	18.4	49.518	-	-	1.008
REF316-ACJ-23	7.8	8.4	5.606	-	-	1.181
REF316-ACJ-24	8.9	9.1	6.390	-	-	0.906
REF316-ACJ-25	10.0	11.0	9.212	-	-	0.921
REF316-ACJ-26	7.7	8.4	4.671	-	-	1.023
REF316-ACJ-27	7.1	7.6	2.950	-	-	0.824
REF316-ACJ-28	7.2	7.7	3.071	-	-	0.823
REF316-ACJ-29	7.9	8.4	4.359	-	-	0.884
REF316-ACJ-30	7.6	8.1	4.211	-	-	0.959
REF316-ACJ-31	9.7	10.4	7.606	-	-	0.833
REF316-ACJ-32	10.4	11.3	9.972	-	-	0.887
REF316-ACJ-33	6.1	6.6	1.885	-	-	0.830
REF316-ACJ-34	6.0	6.3	1.783	-	-	0.825
REF316-ACJ-35	3.8	3.9	0.419	-	-	0.764
REF316-ACJ-36	5.0	5.3	1.066	-	-	0.853
REF316-ACJ-37	3.5	3.7	0.315	-	-	0.735
REF316-ACJ-38	3.4	3.5	0.266	-	-	0.677
REF316-ACJ-39	3.8	3.9	0.387	-	-	0.705
REF316-ACJ-40	7.4	7.9	3.535	-	-	0.872
REF316-ACJ-41	5.6	5.9	1.457	-	-	0.830
REF316-ACJ-42	7.5	8.0	3.580	-	-	0.849
REF316-ACJ-43	8.0	8.6	4.242	-	-	0.829
REF316-ACJ-44	8.2	8.8	4.940	-	-	0.896
REF316-ACJ-45	6.7	7.1	3.069	-	-	1.020
REF316-ACJ-46	8.0	8.6	4.517	-	-	0.882
REF316-ACJ-47	3.2	3.3	0.271	-	-	0.827
REF316-ACJ-48	6.9	7.4	3.087	-	-	0.940
REF316-ACJ-49	7.1	7.6	3.381	-	-	0.945
REF316-ACJ-50	6.3	6.7	2.030	-	-	0.812
REF316-ACJ-51	5.7	6.0	1.696	-	-	0.916
REF316-ACJ-52	8.7	9.3	5.983	-	-	0.909
REF316-ACJ-53	6.7	7.1	2.550	-	-	0.848
REF316-ACJ-54	5.2	5.5	1.307	-	-	0.930
REF316-ACJ-55	4.0	4.3	0.596	-	-	0.931
REF316-ACJ-56	4.1	4.2	0.593	-	-	0.860
REF316-ACJ-57	4.2	4.3	0.576	-	-	0.777
REF316-ACJ-58	6.9	7.3	2.001	-	-	0.609
REF316-ACJ-59	4.1	4.3	0.598	-	-	0.868
REF316-ACJ-60	3.9	4.0	0.501	-	-	0.845
REF316-ACJ-61	4.1	4.2	0.588	-	-	0.853
REF316-ACJ-62	6.2	6.5	2.135	-	-	0.896

Table G.8: Arctic charr measurements from fish captured at Reference Lake 3 by electrofishing, Mary River Project CREMP, August 2016.

	Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Liver Weight (g)	Age (years)	Fulton's Condition Factor (K)
	REF316-ACJ-63	7.8	8.1	3.395	-	-	0.715
	REF316-ACJ-64	5.2	5.6	1.137	-	-	0.809
	REF316-ACJ-65	6.6	7.0	2.245	-	-	0.781
	REF316-ACJ-66	5.0	5.2	0.995	-	-	0.796
	REF316-ACJ-67	7.0	7.3	2.506	-	-	0.731
	REF316-ACJ-68	4.1	4.2	0.381	-	-	0.553
	REF316-ACJ-69	6.1	6.3	1.776	-	-	0.782
	REF316-ACJ-70	7.3	7.8	3.246	-	-	0.834
	REF316-ACJ-71	4.3	4.6	0.653	-	-	0.821
	REF316-ACJ-72	3.3	3.5	0.379	-	-	1.055
	REF316-ACJ-73	4.0	4.2	0.507	-	-	0.792
	REF316-ACJ-74	6.3	6.8	2.191	-	-	0.876
	REF316-ACJ-75	4.0	4.2	0.776	-	-	1.213
	REF316-ACJ-76	3.8	3.9	0.367	-	-	0.669
	REF316-ACJ-77	9.0	9.6	6.207	-	-	0.851
	REF316-ACJ-78	7.7	8.1	3.707	-	-	0.812
	REF316-ACJ-79	15.3	16.6	31.755	-	-	0.887
	REF316-ACJ-80	6.0	6.4	1.756	-	-	0.813
	REF316-ACJ-81	9.2	9.9	5.990	-	-	0.769
	REF316-ACJ-82	15.0	16.1	25.471	-	-	0.755
	REF316-ACJ-83	7.8	8.3	4.503	-	-	0.949
	REF316-ACJ-84	3.8	4.0	0.393	-	-	0.716
	REF316-ACJ-85	4.1	4.2	0.462	-	-	0.670
	REF316-ACJ-86	3.5	3.6	0.369	-	-	0.861
	REF316-ACJ-87	6.0	6.3	1.670	-	-	0.773
	REF316-ACJ-88	5.7	5.9	1.317	-	-	0.711
	REF316-ACJ-89	7.3	7.9	3.306	-	-	0.850
	REF316-ACJ-90	7.1	7.6	3.210	-	-	0.897
	REF316-ACJ-91	5.9	6.3	1.572	-	-	0.765
	REF316-ACJ-92	7.5	8.1	3.680	-	-	0.872
	REF316-ACJ-93	3.8	3.9	0.355	-	-	0.647
	REF316-ACJ-94	9.6	10.4	7.873	-	-	0.890
	REF316-ACJ-95	3.9	4.1	0.528	-	-	0.890
	REF316-ACJ-96	6.1	6.4	2.050	-	-	0.903
	REF316-ACJ-97	3.8	4.0	0.460	-	-	0.838
	REF316-ACJ-98	4.2	4.4	0.601	-	-	0.811
	REF316-ACJ-99*	9.9	10.6	9.201	-	-	0.948
	REF316-ACJ-100	3.9	4.0	0.516	-	-	0.870
Overall Catch Summary	total number	100	100	100	10	10	100
	average	6.7	7.1	4.338	0.039	1.4	0.861
	median	6.3	6.7	2.104	0.026	1	0.857
	standard deviation	2.8	3.1	7.148	0.037	1.6	0.110
	standard error	0.3	0.3	0.715	0.012	0.5	0.011
	minimum	3.2	3.3	0.266	0.004	0	0.553
	maximum	17.0	18.4	49.518	0.110	5	1.213
Young-of-the-Year Catch Summary	proportion of YOY	**31%**					
	total number	31	31	31	4	4	31
	average	3.9	4.1	0.522	0.010	0	0.828
	median	3.9	4.1	0.501	0.006	0	0.827
	standard deviation	0.5	0.5	0.207	0.009	0.0	0.140
	standard error	0.1	0.1	0.037	0.004	0.0	0.025
	minimum	3.2	3.3	0.266	0.004	0	0.553
	maximum	5.1	5.4	1.066	0.022	0	1.213

* Initial screening indicated sample was an outlier, and therefore the sample was removed from all subsequent statistical analysis data sets.

Table G.9: Arctic charr measurements from fish captured at Reference Lake 3 by gill netting, Mary River Project CREMP, August 2016.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF316-AC-01	2	34.5	37.5	370	17	0.901
REF316-AC-02	2	33.6	36.3	320	21	0.844
REF316-AC-03	3	33.4	36.2	410	-	1.100
REF316-AC-04	2	31.8	34.1	300	-	0.933
REF316-AC-05	3	32.8	35.7	295	-	0.836
REF316-AC-06	2	35.0	38.0	375	-	0.875
REF316-AC-07	3	33.2	36.2	335	-	0.915
REF316-AC-08	3	49.6	52.8	1,100	-	0.901
REF316-AC-09	3	60.0	64.5	1,930	-	0.894
REF316-AC-10	3	55.5	59.4	1,430	-	0.836
REF316-AC-11	3	51.9	56.0	1,540	17	1.102
REF316-AC-12	1.5	21.1	23.2	77	-	0.820
REF316-AC-13	2	32.8	35.3	315	14	0.893
REF316-AC-14	2	35.0	37.6	340	19	0.793
Overall Catch Summary	total number	14	14	14	5	14
	average	38.6	41.6	653	17.6	0.903
	median	34.1	36.9	355	17	0.893
	standard deviation	11.0	11.7	585	2.6	0.093
	standard error	3.0	3.1	156	1.2	0.025
	minimum	21.1	23.2	77	14	0.793
	maximum	60.0	64.5	1,930	21	1.102

Table G.10: Arctic charr measurements from fish captured at Camp Lake by electrofishing, Mary River Project CREMP, August 2016.

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Liver Weight (g)	Age (years)	Fulton's Condition Factor (K)
CL16-ACJ-1	5.7	6.1	1.534	0.045	1	0.828
CL16-ACJ-2	7.1	7.7	2.721	0.070	2	0.760
CL16-ACJ-3	13.5	14.7	19.937	0.206	2	0.810
CL16-ACJ-4	5.8	6.1	1.579	0.024	1	0.809
CL16-ACJ-5	4.2	4.5	0.686	0.071	0	0.926
CL16-ACJ-6	5.0	5.3	1.020	0.013	1	0.816
CL16-ACJ-7	10.1	10.8	7.908	0.133	2	0.768
CL16-ACJ-8	9.0	9.2	6.258	0.083	2	0.858
CL16-ACJ-9	4.2	4.4	0.572	0.011	0	0.772
CL16-ACJ-10	10.9	11.3	8.874	0.110	2	0.685
CL16-ACJ-11	5.8	6.1	1.822	-	-	0.934
CL16-ACJ-12	6.3	6.7	2.314	-	-	0.925
CL16-ACJ-13	5.8	6.0	1.515	-	-	0.776
CL16-ACJ-14	5.8	6.0	1.700	-	-	0.871
CL16-ACJ-15	5.8	6.2	1.484	-	-	0.761
CL16-ACJ-16	6.9	7.2	2.553	-	-	0.777
CL16-ACJ-17	12.0	13.0	14.205	-	-	0.822
CL16-ACJ-18	6.6	7.0	2.476	-	-	0.861
CL16-ACJ-19	10.0	10.7	7.301	-	-	0.730
CL16-ACJ-20	5.2	5.5	1.187	-	-	0.844
CL16-ACJ-21	6.9	7.3	2.869	-	-	0.873
CL16-ACJ-22	5.7	5.9	1.285	-	-	0.694
CL16-ACJ-23	13.3	14.4	21.783	-	-	0.926
CL16-ACJ-24	6.9	7.2	2.599	-	-	0.791
CL16-ACJ-25	8.3	8.9	4.792	-	-	0.838
CL16-ACJ-26	5.0	5.4	1.053	-	-	0.842
CL16-ACJ-27	12.9	14.0	17.755	-	-	0.827
CL16-ACJ-28	5.9	6.2	1.675	-	-	0.816
CL16-ACJ-29	6.0	6.4	1.855	-	-	0.859
CL16-ACJ-30	6.8	7.3	2.929	-	-	0.932
CL16-ACJ-31	5.4	5.7	1.355	-	-	0.861
CL16-ACJ-32	5.7	6.1	1.705	-	-	0.921
CL16-ACJ-33	14.1	15.4	24.696	-	-	0.881
CL16-ACJ-34	17.1	18.5	38.558	-	-	0.771
CL16-ACJ-35	10.5	11.3	11.304	-	-	0.976
CL16-ACJ-36	7.5	7.9	3.707	-	-	0.879
CL16-ACJ-37	6.0	6.5	1.997	-	-	0.925
CL16-ACJ-38	6.2	6.5	1.990	-	-	0.835
CL16-ACJ-39	10.4	11.3	10.564	-	-	0.939
CL16-ACJ-40	16.0	17.0	34.482	-	-	0.842
CL16-ACJ-41	11.5	12.5	11.240	-	-	0.739
CL16-ACJ-42	12.7	14.0	19.246	-	-	0.940
CL16-ACJ-43	6.5	6.8	2.255	-	-	0.821
CL16-ACJ-44	10.2	11.1	8.139	-	-	0.767
CL16-ACJ-45	6.9	7.4	2.638	-	-	0.803
CL16-ACJ-46	5.7	6.1	1.629	-	-	0.880
CL16-ACJ-47	7.5	7.9	3.211	-	-	0.761
CL16-ACJ-48	6.4	6.8	2.167	-	-	0.827
CL16-ACJ-49	10.1	10.9	7.576	-	-	0.735
CL16-ACJ-50	11.0	12.0	9.791	-	-	0.736
CL16-ACJ-51	10.3	11.0	8.675	-	-	0.794
CL16-ACJ-52	5.2	5.5	1.099	-	-	0.782
CL16-ACJ-53	10.4	11.2	10.162	-	-	0.903
CL16-ACJ-54	6.4	6.8	2.111	-	-	0.805
CL16-ACJ-55	6.0	6.4	1.889	-	-	0.875
CL16-ACJ-56	10.9	11.7	11.131	-	-	0.860
CL16-ACJ-57	7.5	7.8	3.300	-	-	0.782
CL16-ACJ-58	6.8	7.3	2.678	-	-	0.852
CL16-ACJ-59	5.9	6.2	1.628	-	-	0.793
CL16-ACJ-60	5.8	6.2	1.535	-	-	0.787

Table G.10: Arctic charr measurements from fish captured at Camp Lake by electrofishing, Mary River Project CREMP, August 2016.

	Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Liver Weight (g)	Age (years)	Fulton's Condition Factor (K)
	CL16-ACJ-61	6.5	6.8	2.409	-	-	0.877
	CL16-ACJ-62	7.4	7.9	2.992	-	-	0.738
	CL16-ACJ-63	5.5	5.9	1.461	-	-	0.878
	CL16-ACJ-64	8.1	8.6	4.332	-	-	0.815
	CL16-ACJ-65	10.9	11.4	8.959	-	-	0.692
	CL16-ACJ-66	8.6	9.2	4.713	-	-	0.741
	CL16-ACJ-67	7.0	7.4	2.770	-	-	0.808
	CL16-ACJ-68	8.7	9.4	5.528	-	-	0.839
	CL16-ACJ-69	6.3	6.6	2.066	-	-	0.826
	CL16-ACJ-70	5.8	6.2	1.724	-	-	0.884
	CL16-ACJ-71	5.3	5.6	1.265	-	-	0.850
	CL16-ACJ-72	15.4	16.9	33.715	-	-	0.923
	CL16-ACJ-73	5.6	5.9	1.411	-	-	0.803
	CL16-ACJ-74	5.5	5.7	1.296	-	-	0.779
	CL16-ACJ-75	6.0	6.4	1.764	-	-	0.817
	CL16-ACJ-76	5.6	5.9	1.508	-	-	0.859
	CL16-ACJ-77	15.9	17.1	34.325	-	-	0.854
	CL16-ACJ-78	13.5	14.6	19.102	-	-	0.776
	CL16-ACJ-79	5.9	6.2	1.592	-	-	0.775
	CL16-ACJ-80	8.6	9.1	4.905	-	-	0.771
	CL16-ACJ-81	6.2	6.5	2.045	-	-	0.858
	CL16-ACJ-82	10.1	10.9	7.111	-	-	0.690
	CL16-ACJ-83	5.8	6.2	1.697	-	-	0.870
	CL16-ACJ-84	6.8	7.1	2.609	-	-	0.830
	CL16-ACJ-85	5.2	5.5	1.204	-	-	0.856
	CL16-ACJ-86	6.0	6.5	1.905	-	-	0.882
	CL16-ACJ-87	16.2	17.6	36.662	-	-	0.862
	CL16-ACJ-88	8.1	8.6	4.053	-	-	0.763
	CL16-ACJ-89	6.6	7.0	2.341	-	-	0.814
	CL16-ACJ-90	11.4	12.3	10.942	-	-	0.739
	CL16-ACJ-91	11.0	11.8	9.943	-	-	0.747
	CL16-ACJ-92	5.3	5.7	1.315	-	-	0.883
	CL16-ACJ-93	6.3	6.6	2.133	-	-	0.853
	CL16-ACJ-94	5.4	5.7	1.326	-	-	0.842
	CL16-ACJ-95	4.8	5.2	1.078	-	-	0.975
	CL16-ACJ-96	17.4	18.8	42.651	-	-	0.810
	CL16-ACJ-97	5.2	5.5	1.295	-	-	0.921
	CL16-ACJ-98	8.3	8.8	4.292	-	-	0.751
Overall Catch Summary	total number	98	98	98	10	10	98
	average	8.1	8.7	6.746	0.077	1.3	0.827
	median	6.8	7.2	2.576	0.071	2	0.827
	standard deviation	3.2	3.5	9.249	0.061	0.8	0.065
	standard error	0.3	0.4	0.934	0.019	0.3	0.007
	minimum	4.2	4.4	0.572	0.011	0	0.685
	maximum	17.4	18.8	42.651	0.206	2	0.976
Young-of-the-Year Catch Summary	proportion of YOY	**3%**					
	total number	3	3	3	2	2	3
	average	4.4	4.7	0.8	0.0	0.0	0.891
	median	4.2	4.5	0.7	0.0	0.0	0.926
	standard deviation	0.3	0.4	0.3	0.0	0.0	0.106
	standard error	0.2	0.3	0.2	0.0	0.0	0.061
	minimum	4.2	4.4	0.6	0.0	0.0	0.772
	maximum	4.8	5.2	1.1	0.1	0.0	0.975

Table G.11: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured between mine-exposed Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2016.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Areas (p-value)		Power
					Reference		Exposed					
	Parameter	Covariate	Ref	Exp	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	99	98	-	-	-	-	K-S Test	Yes	0.002	-
	Log_{10} Age (years)	none	10	10	-	-	-	-	ANOVA	No	0.675	-
Energy Use (non-YOY)	Log_{10} Body Weight (g)	none	68	95	-	-	-	-	ANOVA	No	0.890	-
	Log_{10} Fork Length (cm)	none	68	95	-	-	-	-	ANOVA	No	0.813	-
	Log_{10} Body Weight (g)	Log_{10} Age (years)[1]	9	10	0.980	0.000	0.730	0.002	ANCOVA	No	0.165	-
	Log_{10} Fork Length (cm)	Log10 Age (years)[1]	9	10	0.978	0.000	0.000	0.001	ANCOVA	Yes	0.045	0.668
Energy Storage	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)[2]	68	95	0.985	0.000	0.994	0.000	ANCOVA	Yes	0.000	0.989

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]	Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Ref	Exp		Ref	Exp		Increase	Decrease
Survival	Age (years)	none	10	10	Mean	0.9	1.1	-	283.1	-73.9
Energy Use	Body Weight (g)	none	68	95	Mean	3.862	3.782	-	55	-36
	Fork Length (cm)	none	68	95	Mean	7.6	7.7	-	15.7	-13.6
	Body Weight (g)	Age (years)[1]	9	10	Adjusted Mean	1.839	2.544	-	112.8	-53.0
	Fork Length (cm)	Age (years)[1]	9	10	Adjusted Mean	5.8	6.8	17.9	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)[2]	68	95	Adjusted Mean	3.9	3.7	-5.5	-	-

(shaded) - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[1] Studentized outlier REF316-ACJ-8 removed.

[2] Slopes not equal, however r^2 of both ANCOVA models (interaction = 0.991, parallel slope = 0.991) using all data was above 0.80 and within 0.20.

Table G.12: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured at Camp Lake in 2016 and during the mine baseline period, Mary River Project CREMP.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Data Sets (p-value)		Power
					Baseline		2016					
	Parameter	Covariate	Baseline	2016	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	51	98	-	-	-	-	K-S Test	Yes	0.000	-
Energy Use	Log_{10} Body Weight (g)	none	51	98	-	-	-	-	ANOVA	Yes	0.000	1.000
	Log_{10} Fork Length (cm)	none	51	98	-	-	-	-	ANOVA	Yes	0.000	1.000
Energy Storage	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)[1]	51	98	0.988	0.000	0.994	0.000	ANCOVA	Yes	0.000	1.000

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]	Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Baseline	2016	Statistic	Baseline	2016		Increase	Decrease
Energy Use	Body Weight (g)	none	51	98	Mean	12.303	3.600	-70.7	-	-
	Fork Length (cm)	none	51	98	Mean	11.2	7.6	-32.3	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)[1]	51	98	Adjusted Mean	5.9	5.3	-9.7	-	-

[shaded box] - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[1] Slopes not equal, however r^2 of both ANCOVA models (interaction = 0.995, parallel slope = 0.994) using all data was above 0.80 and within 0.20.

Table G.13: Sample sizes required to detect differences in Arctic charr non-lethal population endpoints for nearshore and littoral/profundal populations at Camp Lake compared to Reference Lake 3 or Camp Lake baseline data, as appropriate, with power = 0.90 and alpha = 0.10 using the 2016 data. Highlighted values indicate sample sizes sufficient to meet CES used for EEM studies.

Mine Lake	Endpoint		Model[a]	Minimum Sample Size (Increase[b] / Decrease[c])							
	Parameter	Covariate		i=5%	i=10%	i=20%	i=25%	i=30%	i=40%	i=50%	i=100%
				d=4%	d=9%	d=17%	d=20	d=23%	d=29%	d=33%	d=50%
Nearshore Electrofishing: Camp Lake versus Reference Lake 3	Body Weight	none	ANOVA	9,128	2394	655	438	317	193	134	46
	Fork Length	none	ANOVA	987	260	72	48	35	22	15	6
	Body Weight	Age	ANCOVA	1,741	457	126	84	61	38	26	10
	Fork Length	Age	ANCOVA	200	53	15	11	8	5	4	2
	Body Weight	Fork Length	All - ANCOVA	83	23	7	5	4	3	2	2
	Body Weight	Fork Length	YOY Only ANCOVA	-	-	-	-	-	-	-	-
	Body Weight	Fork Length	Non-YOY Only ANCOVA	43	12	4	3	3	2	2	1
Nearshore Electrofishing: Camp Lake versus Baseline	Body Weight	none	ANOVA	7,288	1,912	523	350	253	155	107	37
	Fork Length	none	ANOVA	845	223	62	42	30	19	13	5
	Body Weight	Fork Length	ANCOVA	37	11	4	3	2	2	2	1
Littoral / Profundal Gill Netting: Camp Lake versus Baseline	Body Weight	none	ANOVA	3,071	806	221	148	107	66	46	16
	Fork Length	none	ANOVA	350	93	26	18	13	9	6	3
	Body Weight	Age	ANCOVA	1,928	506	139	93	68	42	29	11
	Fork Length	Age	ANCOVA	197	53	15	11	8	5	4	2
	Body Weight	Fork Length	ANCOVA	103	28	8	6	5	3	3	2

[a] Statistical tests include Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA), Mann-Whitney U-Test (MW U-test) and Kolmogorov-Smirnov test (K-S Test).

[b] Increase relative to reference mean using log transformed data

[c] Decrease relative to reference mean using log transformed data

Table G.14: Arctic charr measurements from fish captured at Camp Lake by gill netting, Mary River Project CREMP, August 2016.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
CL16-AC-01	3"	38.2	41.7	480	-	0.861
CL16-AC-02	3"	37.6	40.8	515	-	0.969
CL16-AC-03	3"	37.0	40.5	485	-	0.957
CL16-AC-04	3"	35.4	38.2	455	-	1.026
CL16-AC-05	1½"	41.0	44.3	590	-	0.856
CL16-AC-06	3"	35.5	38.7	440	-	0.983
CL16-AC-07	3"	37.2	40.7	485	-	0.942
CL16-AC-08	3"	35.6	39.0	450	-	0.997
CL16-AC-09	2"	34.5	37.5	415	-	1.011
CL16-AC-10	1½"	37.0	40.2	455	-	0.898
CL16-AC-11	3"	36.0	39.1	525	-	1.125
CL16-AC-12	3"	35.2	38.4	450	-	1.032
CL16-AC-13*	2"	34.7	37.7	400	14	0.957
CL16-AC-14	2"	37.2	40.3	460	-	0.894
CL16-AC-15	2"	32.6	35.2	335	-	0.967
CL16-AC-16	2"	34.4	37.5	410	13	1.007
CL16-AC-17	2"	28.9	31.4	232	-	0.961
CL16-AC-18	3"	39.1	42.2	510	-	0.853
CL16-AC-19	3"	34.9	38.0	440	-	1.035
CL16-AC-20	2"	29.4	31.7	234	-	0.921
CL16-AC-21	1½"	34.0	37.4	370	14	0.941
CL16-AC-22	1½"	35.8	38.7	415	13	0.904
CL16-AC-23	2"	37.5	41.7	495	14	0.939
CL16-AC-24	2"	36.9	39.9	425	18	0.846
CL16-AC-25	2"	35.2	38.6	430	17	0.986
CL16-AC-26	2"	35.9	39.0	420	-	0.908
CL16-AC-27	3"	36.8	40.1	460	-	0.923
CL16-AC-28	3"	38.0	41.1	480	-	0.875
CL16-AC-29	3"	37.9	41.7	520	-	0.955
CL16-AC-30	3"	36.5	39.4	460	-	0.946
CL16-AC-31	3"	35.1	37.9	450	-	1.041
CL16-AC-32	2"	35.1	38.0	425	11	0.983
CL16-AC-33	3"	36.2	39.5	460	-	0.970
CL16-AC-34	2"	39.7	43.5	500	18	0.799
CL16-AC-35	2"	38.2	41.4	435	-	0.780
CL16-AC-36	2"	37.1	40.7	425	-	0.832
CL16-AC-37	2"	34.9	37.9	405	13	0.953
CL16-AC-38	2"	39.4	42.7	525	16	0.858
CL16-AC-39	1½"	36.8	40.1	495	-	0.993
CL16-AC-40	1½"	38.8	42.2	530	-	0.907
CL16-AC-41	3"	37.2	41.2	525	-	1.020
CL16-AC-42	3"	36.2	39.5	425	-	0.896
CL16-AC-43	3"	36.8	40.2	530	-	1.063
CL16-AC-44	3"	36.1	39.1	440	-	0.935
CL16-AC-45	3"	37.6	40.9	435	21	0.818
CL16-AC-46	2"	33.1	36.1	375	9	1.034
CL16-AC-47	2"	36.0	39.2	440	11	0.943
CL16-AC-48	2"	40.4	43.5	600	16	0.910
CL16-AC-49	2"	36.3	39.7	460	-	0.962
CL16-AC-50	2"	35.4	38.6	405	-	0.913
CL16-AC-51	1½"	35.5	38.6	430	16	0.961
CL16-AC-52	1½"	35.0	38.4	420	-	0.980
CL16-AC-53	3"	36.8	39.8	435	-	0.873
CL16-AC-54	2"	34.9	38.0	365	-	0.859
CL16-AC-55	2"	37.0	40.4	480	13	0.948
CL16-AC-56	3"	35.8	39.2	450	-	0.981

Table G.14: Arctic charr measurements from fish captured at Camp Lake by gill netting, Mary River Project CREMP, August 2016.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
CL16-AC-57	3"	36.1	39.3	460	-	0.978
CL16-AC-58	3"	35.7	39.0	445	-	0.978
CL16-AC-59	3"	35.9	38.7	440	-	0.951
CL16-AC-60	1½"	36.2	39.5	390	-	0.822
CL16-AC-61	3"	36.4	39.4	475	-	0.985
CL16-AC-62	3"	37.3	40.6	515	-	0.992
CL16-AC-63	2"	35.6	38.6	425	-	0.942
CL16-AC-64	1½"	37.2	40.4	500	-	0.971
CL16-AC-65	3"	35.7	39.1	390	-	0.857
CL16-AC-66	3"	37.5	42.2	460	-	0.872
CL16-AC-67	3"	36.0	39.2	415	-	0.889
CL16-AC-68	3"	36.7	39.6	455	-	0.920
CL16-AC-69	2"	35.9	39.3	425	14	0.919
CL16-AC-70	1½"	35.5	38.7	430	-	0.961
CL16-AC-71	1½"	37.6	41.1	535	-	1.006
CL16-AC-72	2"	35.6	38.8	415	12	0.920
CL16-AC-73	2"	35.2	38.3	425	18	0.974
CL16-AC-74	2"	35.8	38.9	450	-	0.981
CL16-AC-75	3"	34.3	37.9	395	-	0.979
CL16-AC-76*	2"	41.3	44.7	335	17	0.476
CL16-AC-77	2"	35.7	38.8	435	15	0.956
CL16-AC-78	1½"	34.3	37.6	445	-	1.103
CL16-AC-79	1½"	39.8	43.2	465	-	0.738
CL16-AC-80	3"	36.4	39.5	465	-	0.964
CL16-AC-81	1½"	34.5	37.4	460	-	1.120
CL16-AC-82	1½"	35.8	39.1	460	-	1.003
CL16-AC-83	3"	56.5	61.5	1,690	17	0.937
CL16-AC-84	2"	33.1	36.2	325	13	0.896
CL16-AC-85	3"	37.1	41.0	505	-	0.989
CL16-AC-86	2"	34.7	37.1	380	-	0.909
CL16-AC-87	1½"	18.3	19.9	51.5	-	0.840
CL16-AC-88	1½"	37.3	40.8	510	-	0.983
Overall Catch Summary	total number	88	88	88	24	88
	average	36.2	39.5	455	14.7	0.938
	median	36.1	39.3	448	14	0.952
	standard deviation	3.5	3.8	152	2.8	0.086
	standard error	0.4	0.4	16	0.6	0.009
	minimum	18.3	19.9	52	9	0.476
	maximum	56.5	61.5	1,690	21	1.125

* Initial screening indicated sample was an outlier, and therefore the sample was removed from all subsequent statistical analysis data sets.

Table G.15: Additional meristics collected from adult Arctic charr incidental mortalities at Camp Lake in 2016, Mary River Project CREMP, August 2016.

Specimen ID		Age (years)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Adjusted Body Weight (g)	Fulton's Condition Factor (K)	Sex	Liver Weight (g)	Liver Somatic Index (LSI)	Gonad Weight (g)	Gonad Somatic Index (GSI)	Gill Net Mesh Size (inches)	Abnormalities[a]
CL16-AC-16		13	34.4	37.5	410	406	1.01	i	4.072	1.00	-	-	2"	ew (A)
CL16-AC-23		14	37.5	41.7	495	491	0.94	i	4.263	0.87	-	-	2"	ew (A)
CL16-AC-24		18	36.9	39.9	425	420	0.85	i	4.752	1.13	-	-	2"	ew (VA)
CL16-AC-25		17	35.2	38.6	430	426	0.99	i	3.902	0.92	-	-	2"	ew (A)
CL16-AC-34		18	39.7	43.5	500	494	0.80	i	5.842	1.18	-	-	2"	ew (A)
CL16-AC-38		16	39.4	42.7	525	519	0.86	i	5.989	1.15	-	-	2"	ew (A)
CL16-AC-45		21	37.6	40.9	435	431	0.82	i	3.884	0.90	-	-	3"	ew (A)
CL16-AC-46		9	33.1	36.1	375	371	1.03	i	4.382	1.18	-	-	2"	none observed
CL16-AC-47		11	36.0	39.2	440	436	0.94	i	4.215	0.97	-	-	2"	ew (VA) + mark on caudal fin
CL16-AC-48		16	40.4	43.5	600	596	0.91	i	4.328	0.73	-	-	2"	ew (A)
CL16-AC-51		16	35.5	38.6	430	426	0.96	i	4.112	0.97	-	-	1½"	ew (VA)
CL16-AC-55		13	37.0	40.4	480	474	0.95	i	6.084	1.28	-	-	2"	ew (VA)
CL16-AC-72		12	35.6	38.8	415	411	0.92	i	3.765	0.92	-	-	2"	ew (A)
CL16-AC-76		17	41.3	44.7	335	331	0.48	i	3.809	1.15	-	-	2"	ew (S), emaciated condition
CL16-AC-77		15	35.7	38.8	435	429	0.96	i	5.780	1.35	-	-	2"	ew (A)
CL16-AC-83		17	56.5	61.5	1,690	1,667	0.94	i	22.71	1.36	-	-	3"	ew (A)
CL16-AC-13		14	34.7	37.7	400	390	0.96	F	5.893	1.51	4.203	1.078	2"	ew (A)
CL16-AC-21		14	34.0	37.4	370	362	0.94	F	5.420	1.50	2.270	0.627	1½"	ew (A)
CL16-AC-22		13	35.8	38.7	415	409	0.90	F	4.468	1.09	1.602	0.392	1½"	ew (S)
CL16-AC-32		11	35.1	38.0	425	415	0.98	F	5.697	1.37	4.067	0.979	2"	ew (A)
CL16-AC-37		13	34.9	37.9	405	398	0.95	F	4.639	1.17	2.315	0.582	2"	ew (C)
CL16-AC-69		14	35.9	39.3	425	415	0.92	F	5.253	1.27	4.609	1.110	2"	ew (A)
CL16-AC-73		18	35.2	38.3	425	416	0.97	F	4.700	1.13	4.595	1.105	2"	ew (A)
CL16-AC-84		13	33.1	36.2	325	318	0.90	F	4.802	1.51	2.643	0.832	2"	ew (C)
Adult Non-Spawner Statistics	Average	15	38.2	41.7	526	521	0.90	-	5.743	1.07	-	-	-	-
	St. deviation	3.0	5.4	5.8	316	312	0.13	-	4.599	0.18	-	-	-	-
	Minimum	9	33.1	36.1	335	331	0.48	-	3.765	0.73	-	-	-	-
	Maximum	21	56.5	61.5	1690	1667	1.03	-	22.71	1.36	-	-	-	-
	Sample Size (N)	16	16	16	16	16	16	16	16	16	-	-	-	-
Females Statistics	Average	14	34.8	37.9	399	390	0.94	-	5.109	1.32	3.29	0.84	-	-
	St. deviation	2.0	0.9	0.9	35	35	0.03	-	0.531	0.18	1.20	0.28	-	-
	Minimum	11	33.1	36.2	325	318	0.90	-	4.468	1.09	1.60	0.39	-	-
	Maximum	18	35.9	39.3	425	416	0.98	-	5.893	1.51	4.61	1.11	-	-
	Sample Size (N)	8	8	8	8	8	8	8	8	8	8	8	-	-

[a] - Abnomalities include encysted worms (ew) in body cavity; letter in paraentheses indicates Scarce (1-5), Common (6-15), Abundant (16-50) and Very Abundant (>50) observation.

Sex - Female (F), Male (M), Indeterminate (i)

Table G.16: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Camp Lake littoral/profundal areas in 2016 and during the mine baseline period, Mary River Project CREMP.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Areas (p-value)		Power
					Baseline		2016					
	Parameter	Covariate	Baseline	2016	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	63	87	-	-	-	-	K-S Test	Yes	0.000	-
	Log_{10} Age (years)	none	30	24	-	-	-	-	ANOVA	Yes	0.000	1.000
Energy Use	Log_{10} Body Weight (g)	none	63	87	-	-	-	-	ANOVA	No	0.235	-
	Log_{10} Fork Length (cm)	none	63	87	-	-	-	-	ANOVA	No	0.125	-
	Log_{10} Body Weight (g)	Log_{10} Age (years)[1]	29	24	0.605	0.000	0.073	0.202	ANCOVA	Yes	0.008	-
	Log_{10} Fork Length (cm)	Log_{10} Age (years)[1]	30	24	0.689	0.000	0.199	0.029	ANCOVA	Yes	0.010	-
Energy Storage	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)	63	87	0.971	0.000	0.940	0.000	ANCOVA	Yes	0.080	0.543

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]		Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Baseline	2016	Statistic	Baseline	2016			Increase	Decrease
Survival	Age (years)	none	30	24	Mean	9.1	14.5	58.0		-	-
Energy Use	Body Weight (g)	none	63	87	Mean	385.4	438.5	-		37.1	-27.1
	Fork Length (cm)	none	63	87	Mean	34.0	36.0	-		11.2	-10.1
	Body Weight (g)	Age (years)[1]	29	24	Predicted Values	1,025.0	509.5	Max overlap	-50.3	-	-
						202.5	368.9	Min overlap	82.2		
	Fork Length (cm)	Age (years)[1]	30	24	Predicted Values	477.6	394.7	Max overlap	-17.4	-	-
						269.2	327.9	Min overlap	21.8		
Energy Storage	Body Weight (g)	Fork Length (cm)	63	87	Adjusted Mean	423.9	409.2	-3.5		-	-

[grey box] - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[1] Poor covariate (age) overlap.

Table G.17: Arctic charr measurements from fish captured at Sheardown Lake NW by electrofishing, Mary River Project CREMP, August 2016.

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDNW16-ACJ-01	7.4	7.9	2.95	1	0.728
SDNW16-ACJ-02	6.7	6.7	2.16	1	0.717
SDNW16-ACJ-03	4.0	4.2	0.492	0	0.769
SDNW16-ACJ-04	3.9	4.2	0.564	0	0.951
SDNW16-ACJ-05	5.0	5.3	1.17	0	0.938
SDNW16-ACJ-06	8.1	8.8	4.62	2	0.870
SDNW16-ACJ-07	9.0	9.7	6.58	2	0.903
SDNW16-ACJ-08	11.2	11.9	11.1	2	0.789
SDNW16-ACJ-09	4.0	4.2	0.564	0	0.881
SDNW16-ACJ-10	4.6	4.9	0.796	0	0.818
SDNW16-ACJ-11	7.3	7.8	3.57	-	0.917
SDNW16-ACJ-12	13.2	15.0	24.6	-	1.069
SDNW16-ACJ-13	6.3	6.7	2.10	-	0.839
SDNW16-ACJ-14	6.8	7.4	2.74	-	0.871
SDNW16-ACJ-15	13.3	15.0	23.6	-	1.002
SDNW16-ACJ-16	9.7	10.3	7.13	-	0.781
SDNW16-ACJ-17	6.4	6.8	2.31	-	0.880
SDNW16-ACJ-18	10.5	11.3	9.79	-	0.846
SDNW16-ACJ-19	11.3	12.0	12.3	-	0.856
SDNW16-ACJ-20	8.9	9.4	6.34	-	0.899
SDNW16-ACJ-21	9.1	9.7	7.11	-	0.943
SDNW16-ACJ-22	7.4	8.0	3.67	-	0.906
SDNW16-ACJ-23	9.2	10.1	6.57	-	0.843
SDNW16-ACJ-24	6.8	7.5	2.87	-	0.914
SDNW16-ACJ-25	6.6	6.9	2.26	-	0.784
SDNW16-ACJ-26	6.3	6.7	2.67	-	1.069
SDNW16-ACJ-27	6.9	7.3	2.76	-	0.839
SDNW16-ACJ-28	6.8	7.2	2.70	-	0.858
SDNW16-ACJ-29	8.4	9.1	5.10	-	0.860
SDNW16-ACJ-30	6.2	6.7	2.26	-	0.946
SDNW16-ACJ-31	8.0	8.6	4.51	-	0.880
SDNW16-ACJ-32	7.2	7.6	2.95	-	0.791
SDNW16-ACJ-33	9.2	9.9	6.66	-	0.855
SDNW16-ACJ-34	17.2	18.6	44.3	-	0.871
SDNW16-ACJ-35	11.1	11.9	10.7	-	0.784
SDNW16-ACJ-36	6.4	6.8	2.18	-	0.831
SDNW16-ACJ-37	14.6	15.7	27.6	-	0.888
SDNW16-ACJ-38	17.6	19.1	49.1	-	0.901
SDNW16-ACJ-39	13.8	15.0	26.4	-	1.005
SDNW16-ACJ-40	7.0	7.5	2.70	-	0.787
SDNW16-ACJ-41	9.2	9.8	6.80	-	0.873
SDNW16-ACJ-42	6.6	7.0	2.28	-	0.794
SDNW16-ACJ-43	16.2	17.6	38.0	-	0.895
SDNW16-ACJ-44	9.3	10.1	7.56	-	0.940
SDNW16-ACJ-45	9.9	10.6	7.99	-	0.823
SDNW16-ACJ-46	7.3	7.8	3.41	-	0.877
SDNW16-ACJ-47	8.1	8.7	4.62	-	0.869
SDNW16-ACJ-48	14.1	15.3	25.2	-	0.898
SDNW16-ACJ-49	8.6	9.2	5.00	-	0.786
SDNW16-ACJ-50	9.4	10.3	7.50	-	0.903
SDNW16-ACJ-51	10.4	11.2	10.7	-	0.950
SDNW16-ACJ-52	12.2	13.1	15.4	-	0.848
SDNW16-ACJ-53	8.4	9.2	5.82	-	0.982
SDNW16-ACJ-54	13.4	14.6	24.0	-	0.999
SDNW16-ACJ-55	8.5	9.1	5.29	-	0.861
SDNW16-ACJ-56	7.4	8.0	3.58	-	0.883
SDNW16-ACJ-57	7.3	7.7	3.22	-	0.827
SDNW16-ACJ-58	10.1	10.9	8.70	-	0.845
SDNW16-ACJ-59	9.2	9.9	7.43	-	0.954

Table G.17: Arctic charr measurements from fish captured at Sheardown Lake NW by electrofishing, Mary River Project CREMP, August 2016.

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDNW16-ACJ-60		13.3	14.4	19.7	-	0.839
SDNW16-ACJ-61		6.3	6.6	2.20	-	0.879
SDNW16-ACJ-62		8.7	9.3	5.37	-	0.816
SDNW16-ACJ-63		6.7	7.1	2.58	-	0.856
SDNW16-ACJ-64		7.2	7.7	3.26	-	0.872
SDNW16-ACJ-65		10.4	11.3	10.0	-	0.889
SDNW16-ACJ-66		9.2	9.8	6.64	-	0.852
SDNW16-ACJ-67		6.1	6.5	1.94	-	0.853
SDNW16-ACJ-68		6.9	7.3	3.18	-	0.969
SDNW16-ACJ-69		12.2	13.2	16.6	-	0.913
SDNW16-ACJ-70		18.7	20.3	45.1	-	0.690
SDNW16-ACJ-71		6.7	7.1	2.73	-	0.906
SDNW16-ACJ-72		12.1	13.1	15.0	-	0.847
SDNW16-ACJ-73		4.5	4.8	0.801	-	0.879
SDNW16-ACJ-74		5.8	6.1	1.64	-	0.842
SDNW16-ACJ-75		4.2	4.4	0.600	-	0.810
SDNW16-ACJ-76		11.6	12.5	12.4	-	0.794
SDNW16-ACJ-77		6.8	7.2	2.80	-	0.892
SDNW16-ACJ-78		8.4	9.1	5.02	-	0.846
SDNW16-ACJ-79		6.9	7.4	2.93	-	0.893
SDNW16-ACJ-80		11.4	12.3	11.9	-	0.803
SDNW16-ACJ-81		13.2	14.4	20.3	-	0.882
SDNW16-ACJ-82		11.5	12.5	12.8	-	0.844
SDNW16-ACJ-83		11.3	12.3	12.3	-	0.854
SDNW16-ACJ-84		9.0	9.7	4.80	-	0.659
SDNW16-ACJ-85		6.6	7.1	2.56	-	0.890
SDNW16-ACJ-86		9.6	10.4	8.01	-	0.905
SDNW16-ACJ-87		12.5	13.5	16.4	-	0.840
SDNW16-ACJ-88		10.9	11.8	11.3	-	0.869
SDNW16-ACJ-89		9.6	10.3	6.94	-	0.784
SDNW16-ACJ-90		6.7	7.2	2.65	-	0.882
SDNW16-ACJ-91		4.6	4.9	0.840	-	0.863
SDNW16-ACJ-92		16.7	18.2	47.0	-	1.010
SDNW16-ACJ-93		9.7	10.5	7.84	-	0.859
SDNW16-ACJ-94		4.0	4.2	0.576	-	0.900
SDNW16-ACJ-95		6.3	6.7	2.14	-	0.856
SDNW16-ACJ-96		8.0	8.6	4.68	-	0.915
SDNW16-ACJ-97		5.8	6.2	1.61	-	0.827
SDNW16-ACJ-98		6.9	7.3	2.60	-	0.791
SDNW16-ACJ-99		7.5	8.1	3.97	-	0.941
SDNW16-ACJ-100		6.4	6.7	2.20	-	0.838
Overall Catch Summary	total number	100	100	100	10	100
	average	9	10	8.77	0.8	0.868
	median	8	9	4.90	0.5	0.869
	standard deviation	3	4	10.5	0.9	0.069
	standard error	0	0	1.05	0.3	0.007
	minimum	4	4	0.492	0	0.659
	maximum	19	20	49.1	2	1.069
Young-of-the-Year Catch Summary	proportion of YOY			**9%**		
	total number	9	9	9	5	9
	average	4.3	4.6	0.712	0	0.868
	median	4.2	4.4	0.600	0	0.879
	standard deviation	0.4	0.4	0.214	0.0	0.060
	standard error	0.1	0.1	0.071	0.0	0.020
	minimum	3.9	4.2	0.492	0	0.769
	maximum	5.0	5.3	1.172	0	0.951

Table G.18: Results of health endpoint statistical comparisons for nearshore non-YOY Arctic charr captured between mine-exposed Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2016.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Areas (p-value)		Power
					Reference		Exposed					
	Parameter	Covariate	Ref	Exp	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	99	100	-	-	-	-	K-S Test	Yes	0.000	-
	Log_{10} Age (years)	none	10	10	-	-	-	-	ANOVA	No	0.477	-
Energy Use (non-YOY)	Log_{10} Body Weight (g)	none	68	91	-	-	-	-	ANOVA	Yes	0.001	0.960
	Log_{10} Fork Length (cm)	none	68	91	-	-	-	-	ANOVA	Yes	0.001	0.969
	Log_{10} Body Weight (g)	Log_{10} Age (years)[1]	9	10	0.980	0.000	0.914	0.000	ANCOVA	Yes	0.001	0.980
	Log_{10} Body Weight (g)	Log10 Age (years)[1]	9	10	0.978	0.000	0.919	0.000	ANCOVA	Yes	0.000	0.999
Energy Storage (non-YOY)	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)	68	91	0.985	0.000	0.992	0.000	ANCOVA	No	0.363	-

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]	Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Ref	Exp		Ref	Exp		Increase	Decrease
Survival	Age (years)	none	10	10	Mean	0.9	0.7	-	315.3	-75.9
Energy Use	Body Weight (g)	none	68	91	Mean	3.862	6.197	60.5	-	-
	Fork Length (cm)	none	68	91	Mean	7.6	8.9	17.3	-	-
	Body Weight (g)	Age (years)[1]	9	10	Adjusted Mean	1.839	3.050	65.8	-	-
	Fork Length (cm)	Age (years)[1]	9	10	Adjusted Mean	5.8	7.2	24.2	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	68	91	Adjusted Mean	5.1	5.0	-	4.4	-4.2

[shaded] - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[1] Studentized outlier REF316-ACJ-8 removed.

Table G.19: Results of health endpoint statistical comparisons for nearshore YOY Arctic charr captured between mine-exposed Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2016.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Areas (p-value)		Power
					Reference		Exposed					
	Parameter	Covariate	Ref	Exp	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	31	9	-	-	-	-	K-S Test	No	0.139	-
Energy Use	Log_{10} Body Weight (g)	none	31	9	-	-	-	-	ANOVA	Yes	0.013	0.820
	Log_{10} Fork Length (cm)	none	31	9	-	-	-	-	ANOVA	Yes	0.032	0.706
Energy Storage	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)	31	9	0.799	0.000	0.937	0.000	ANCOVA	No	0.205	-
	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)[1]	18	9	0.705	0.000	0.937	0.000	ANCOVA	No	0.404	-

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]	Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Ref	Exp		Ref	Exp		Increase	Decrease
Energy Use	Body Weight (g)	none	31	9	Mean	0.489	0.687	40.4	-	-
	Fork Length (cm)	none	31	9	Mean	3.9	4.3	9.8	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	31	9	Adjusted Mean	0.5	0.5	-	15.5	-13.4
	Body Weight (g)	Fork Length (cm)[1]	18	9	Adjusted Mean	0.6	0.7	-	18.1	-15.3

[shaded box] - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[1] Comparison using fish with fork length of 3.9 cm and greater to satisfy statistical assumption of covariate overlap.

Table G.20: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured at Sheardown Lake NW in 2016 and during the mine baseline period, Mary River Project CREMP.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Data Sets (p-value)		Power
					Baseline		2016					
	Parameter	Covariate	Baseline	2016	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	253	100	-	-	-	-	K-S Test	Yes	0.048	-
Energy Use	Log_{10} Body Weight (g)	none	253	100	-	-	-	-	ANOVA	Yes	0.019	0.763
	Log_{10} Fork Length (cm)	none	253	100	-	-	-	-	ANOVA	No	0.144	-
Energy Storage	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)	253	100	0.981	0.000	0.994	0.000	ANCOVA	Yes	0.000	1.000

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]	Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Baseline	2016	Statistic	Baseline	2016		Increase	Decrease
Energy Use	Body Weight (g)	none	253	100	Mean	7.151	5.084	-28.9	-	-
	Fork Length (cm)	none	253	100	Mean	9.0	8.4	-	13.6	-12.0
Energy Storage	Body Weight (g)	Fork Length (cm)	253	100	Adjusted Mean	6.741	5.923	-12.1	-	-

[shaded box] - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

Table G.21: Sample sizes required to detect differences in Arctic charr non-lethal population endpoints for nearshore and littoral/profundal populations at Sheardown Lake NW compared to Reference Lake 3 or Sheardown Lake NW baseline data, as appropriate, with power at 0.90 and alpha = 0.10 using the 2016 data. Highlighted values indicate sample sizes sufficient to meet CES used for EEM studies.

Mine Lake	Endpoint		Model[a]	Minimum Sample Size (Increase[b] / Decrease[c])							
	Parameter	Covariate		i=5%	i=10%	i=20%	i=25%	i=30%	i=40%	i=50%	i=100%
				d=4%	d=9%	d=17%	d=20	d=23%	d=29%	d=33%	d=50%
Nearshore Electrofishing: Sheardown Lake NW versus Reference Lake 3	Body Weight	none	ANOVA	9,219	2418	662	442	320	195	135	47
	Fork Length	none	ANOVA	981	258	71	48	35	22	15	6
	Body Weight	Age	ANCOVA	565	149	42	28	21	13	9	4
	Fork Length	Age	ANCOVA	65	18	6	4	3	3	2	1
	Body Weight	Fork Length	All - ANCOVA	82	22	7	5	4	3	2	2
	Body Weight	Fork Length	YOY Only ANCOVA	132	35	11	7	6	4	3	2
	Body Weight	Fork Length	Non-YOY Only ANCOVA	61	17	5	4	3	2	2	1
Nearshore Electrofishing: Sheardown Lake NW versus Baseline	Body Weight	none	ANOVA	10,722	2,812	769	514	372	227	157	54
	Fork Length	none	ANOVA	1,198	315	87	58	43	26	19	7
	Body Weight	Fork Length	ANCOVA	173	46	14	9	7	5	4	2
Littoral / Profundal Gill Netting: Sheardown Lake NW versus Baseline	Body Weight	none	ANOVA	4,687	1230	337	225	163	100	69	24
	Fork Length	none	ANOVA	499	132	37	25	18	12	8	4
	Body Weight	Age	ANCOVA	1,404	369	102	68	50	31	22	8
	Fork Length	Age	ANCOVA	148	40	12	8	6	4	3	2
	Body Weight	Fork Length	ANCOVA	100	27	8	6	5	3	3	2

[a] Statistical tests include Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA), Mann-Whitney U-Test (MW U-test) and Kolmogorov-Smirnov test (K-S Test).

[b] Increase relative to reference mean using log transformed data

[c] Decrease relative to reference mean using log transformed data

Table G.22: Arctic charr measurements from fish captured at Sheardown Lake NW by gill netting, Mary River Project CREMP, August 2016.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDNW16-AC-01	2"	26.3	28.4	161	-	0.885
SDNW16-AC-02	2"	36.1	38.8	462	16	0.982
SDNW16-AC-03	3"	37.0	40.0	480	-	0.948
SDNW16-AC-04	2"	27.4	29.6	180	-	0.875
SDNW16-AC-05	1½"	35.2	38.6	415	-	0.952
SDNW16-AC-06	1½"	18.0	19.5	52	-	0.892
SDNW16-AC-07	1½"	18.5	20.0	56.5	-	0.892
SDNW16-AC-08	2"	36.0	39.1	400	-	0.857
SDNW16-AC-09	2"	24.4	26.0	132	-	0.909
SDNW16-AC-10	3"	52.8	56.4	1,900	-	1.291
SDNW16-AC-11	2"	34.0	36.6	380	-	0.967
SDNW16-AC-12	3"	35.8	38.6	445	-	0.970
SDNW16-AC-13	2"	35.8	38.4	435	-	0.948
SDNW16-AC-14	2"	34.2	37.7	405	-	1.012
SDNW16-AC-15	2"	39.4	42.8	480	-	0.785
SDNW16-AC-16	2"	37.8	40.9	550	-	1.018
SDNW16-AC-17	1½"	20.2	22.0	80	-	0.971
SDNW16-AC-18	1½"	18.7	20.1	65	-	0.994
SDNW16-AC-19	1½"	19.5	21.0	71	4	0.958
SDNW16-AC-20	1½"	20.9	22.6	80	5	0.876
SDNW16-AC-21	1½"	20.3	21.7	72	-	0.861
SDNW16-AC-22	1½"	21.0	22.6	81	-	0.875
SDNW16-AC-23	1½"	20.5	22.0	88	-	1.021
SDNW16-AC-24	2"	36.8	38.8	410	-	0.823
SDNW16-AC-25	3"	35.5	36.1	340	-	0.760
SDNW16-AC-26	3"	33.4	35.9	380	10	1.020
SDNW16-AC-27	2"	34.6	37.5	360	13	0.869
SDNW16-AC-28	1½"	32.6	34.9	330	-	0.952
SDNW16-AC-29	3"	34.9	37.9	420	-	0.988
SDNW16-AC-30	3"	42.1	45.3	780	-	1.045
SDNW16-AC-31	2"	62.5	66.4	2,000	-	0.819
SDNW16-AC-32	3"	38.2	41.9	545	-	0.978
SDNW16-AC-33	3"	41.3	44.3	710	-	1.008
SDNW16-AC-34	1½"	20.6	22.1	80	-	0.915
SDNW16-AC-35	1½"	20.4	21.9	77	-	0.907
SDNW16-AC-36	1½"	18.4	19.9	61	-	0.979
SDNW16-AC-37	2"	33.0	35.8	365	10	1.016
SDNW16-AC-38	1½"	29.7	32.2	235	-	0.897
SDNW16-AC-39	1½"	23.5	25.2	124	-	0.955
SDNW16-AC-40	2"	37.8	41.2	515	-	0.954
SDNW16-AC-41	2"	48.8	52.1	1,150	-	0.990
SDNW16-AC-42	3"	52.2	56.1	1,900	-	1.336
SDNW16-AC-43	1½"	20.7	22.3	83	-	0.936
SDNW16-AC-44	1½"	19.2	20.6	67	-	0.947
SDNW16-AC-45	3"	34.5	37.9	420	-	1.023
SDNW16-AC-46	3"	35.6	38.1	515	-	1.141
SDNW16-AC-47	3"	50.0	53.5	1,200	-	0.960
SDNW16-AC-48	3"	32.6	35.6	370	-	1.068
SDNW16-AC-49	1½"	37.7	41.5	510	-	0.952
SDNW16-AC-50	3"	36.1	39.9	505	-	1.073
SDNW16-AC-51	3"	35.2	38.2	425	-	0.974
SDNW16-AC-52	2"	28.6	31.1	203	-	0.868
SDNW16-AC-53	3"	42.0	45.2	705	-	0.952
SDNW16-AC-54	2"	31.8	34.2	300	9	0.933
SDNW16-AC-55	2"	32.4	34.5	310	8	0.911
SDNW16-AC-56	2"	34.0	36.9	380	10	0.967

Table G.22: Arctic charr measurements from fish captured at Sheardown Lake NW by gill netting, Mary River Project CREMP, August 2016.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDNW16-AC-57	1½"	35.0	38.3	400	-	0.933
SDNW16-AC-58	2"	36.6	39.7	435	-	0.887
SDNW16-AC-59	2"	33.5	36.0	330	10	0.878
SDNW16-AC-60	3"	43.0	46.3	845	-	1.063
SDNW16-AC-61	2"	32.5	35.9	360	-	1.049
SDNW16-AC-62	1½"	52.8	56.3	1,300	-	0.883
SDNW16-AC-63	2"	40.9	43.8	650	10	0.950
SDNW16-AC-64	3"	35.6	38.8	490	-	1.086
SDNW16-AC-65	2"	33.0	35.8	380	-	1.057
SDNW16-AC-66	2"	37.7	41.0	500	-	0.933
SDNW16-AC-67	1½"	18.6	20.0	59	-	0.917
SDNW16-AC-68	1½"	18.8	20.4	66	5	0.993
SDNW16-AC-69	3"	36.8	40.3	480	-	0.963
SDNW16-AC-70	2"	33.4	36.4	365	-	0.980
SDNW16-AC-71	2"	28.3	30.5	220	-	0.971
SDNW16-AC-72	1½"	21.8	23.6	106	-	1.023
SDNW16-AC-73	2"	34.6	38.0	445	15	1.074
SDNW16-AC-74	2"	30.8	33.4	320	13	1.095
SDNW16-AC-75	3"	40.6	44.0	640	-	0.956
SDNW16-AC-76	3"	35.0	37.9	400	-	0.933
SDNW16-AC-77	2"	32.6	36.0	370	-	1.068
SDNW16-AC-78	2"	29.0	31.2	245	-	1.005
SDNW16-AC-79	2"	26.5	28.6	173	-	0.930
SDNW16-AC-80	1½"	19.8	21.1	71	-	0.915
SDNW16-AC-81	3"	35.4	39.2	465	-	1.048
SDNW16-AC-82	2"	34.3	37.5	370	-	0.917
SDNW16-AC-83	2"	35.9	39.3	470	-	1.016
SDNW16-AC-84	1½"	35.0	38.2	390	-	0.910
SDNW16-AC-85	1½"	34.9	37.9	395	-	0.929
SDNW16-AC-86	2"	36.5	39.7	470	-	0.967
SDNW16-AC-87	1½"	20.9	22.1	84	-	0.920
SDNW16-AC-88	1½"	20.6	22.3	78	-	0.892
SDNW16-AC-89	1½"	20.1	21.8	77	-	0.948
SDNW16-AC-90	1½"	22.3	23.9	98	-	0.884
SDNW16-AC-91	2"	35.4	38.0	440	-	0.992
Overall Catch Summary	total number	91	91	91	14	91
	average	32.3	34.9	409	9.9	0.963
	median	34.2	36.9	380	10	0.954
	standard deviation	9.1	9.8	375	3.6	0.088
	standard error	1.0	1.0	39.3	1.0	0.009
	minimum	18.0	19.5	52	4	0.760
	maximum	62.5	66.4	2,000	16	1.336

* Initial screening indicated sample was an outlier, and therefore the sample was removed from all subsequent statistical analysis data sets.

Table G.23: Additional meristics collected from adult Arctic charr incidental mortalities at Sheardown Lake NW in 2016, Mary River Project CREMP, August 2016.

Specimen ID		Age (years)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Adjusted Body Weight (g)	Fulton's Condition Factor (K)	Sex	Liver Weight (g)	Liver Somatic Index (LSI)	Gonad Weight (g)	Gonad Somatic Index (GSI)	Gill Net Mesh Size (inches)	Abnormalities[a]
SDNW16-AC-02		16	36.1	38.8	462	456	0.98	i	5.651	1.22	-	-	2"	ew (VA)
SDNW16-AC-19		4	19.5	21.0	71	70	0.96	i	0.714	1.01	-	-	1½"	none observed
SDNW16-AC-20		5	20.9	22.6	80	79	0.88	i	0.688	0.86	-	-	1½"	none observed
SDNW16-AC-26		10	33.4	35.9	380	376	1.02	i	4.056	1.07	-	-	3"	ew (S)
SDNW16-AC-27		13	34.6	37.5	360	357	0.87	i	3.258	0.91	-	-	2"	ew (C)
SDNW16-AC-37		10	33.0	35.8	365	361	1.02	i	3.655	1.00	-	-	2"	ew (S)
SDNW16-AC-54		9	31.8	34.2	300	298	0.93	i	2.413	0.80	-	-	2"	ew (A)
SDNW16-AC-55		8	32.4	34.5	310	307	0.91	i	2.885	0.93	-	-	2"	ew (A)
SDNW16-AC-56		10	34.0	36.9	380	377	0.97	i	3.332	0.88	-	-	2"	ew (C)
SDNW16-AC-59		10	33.5	36.0	330	327	0.88	i	3.277	0.99	-	-	2"	ew (C)
SDNW16-AC-63		10	40.9	43.8	650	642	0.95	i	7.540	1.16	-	-	2"	ew (S)
SDNW16-AC-68		5	18.8	20.4	66	65	0.99	i	0.680	1.03	-	-	1½"	tape worms (S)
SDNW16-AC-73		15	34.6	38.0	445	442	1.07	i	3.221	0.72	-	-	2"	ew (C)
SDNW16-AC-74		13	30.8	33.4	320	303	1.10	M	2.609	0.82	14.412	4.757	2"	ew (S)
Adult Non-Spawner Statistics	Average	9.6	31.0	33.5	323	320	0.96	-	3.182	0.97	-	-	-	-
	St. deviation	3.6	6.8	7.3	168	166	0.06	-	1.944	0.14	-	-	-	-
	Minimum	4	18.8	20.4	66	65	0.87	-	0.680	0.72	-	-	-	-
	Maximum	16	40.9	43.8	650	642	1.07	-	7.540	1.22	-	-	-	-
	Sample Size (N)	13	13	13	13	13	13	13	13	13	-	-	-	-

[a] - Abnomalities include encysted worms (ew) in body cavity; letter in paraentheses indicates Scarce (1-5), Common (6-15), Abundant (16-50) and Very Abundant (>50) observation.

Sex - Male (M), Indeterminate (i)

Table G.24: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Sheardown Lake NW littoral/profundal areas in 2016 and during the mine baseline period, Mary River Project CREMP.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Data Sets (p-value)		Power
					Baseline		2016					
	Parameter	Covariate	Baseline	2016	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	118	91	-	-	-	-	K-S Test	Yes	0.001	-
	Log_{10} Age (years)	none	30	14	-	-	-	-	ANOVA	Yes	0.016	0.797
Energy Use	Log_{10} Body Weight (g)	none	118	91	-	-	-	-	ANOVA	Yes	0.001	0.948
	Log_{10} Fork Length (cm)	none	118	91	-	-	-	-	ANOVA	Yes	0.000	0.995
	Log_{10} Body Weight (g)	Log_{10} Age (years)	30	14	0.680	0.000	0.790	0.000	ANCOVA	No	0.153	-
	Log_{10} Fork Length (cm)	Log_{10} Age (years)	30	14	0.717	0.000	0.756	0.000	ANCOVA	No	0.500	-
Energy Storage	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)	118	91	0.965	0.000	0.991	0.000	ANCOVA	Yes	0.000	1.000

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]	Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Baseline	2016	Statistic	Baseline	2016		Increase	Decrease
Survival	Age (years)	none	30	14	Mean	12.7	9.2	-27.7	-	-
Energy Use	Body Weight (g)	none	118	91	Mean	411.8	284.7	-30.9	-	-
	Fork Length (cm)	none	118	91	Mean	36.2	31.0	-14.5	-	-
	Body Weight (g)	Age (years)	30	14	Adjusted Mean	308.5	377.1	-	50.0	-33.3
	Fork Length (cm)	Age (years)	30	14	Adjusted Mean	330.7	338.2	-	14.0	-12.3
Energy Storage	Body Weight (g)	Fork Length (cm)	118	91	Adjusted Mean	336.1	373.3	11.1	-	-

(grey shading) - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

Table G.25: Arctic charr measurements from fish captured at Sheardown Lake SE by electrofishing, Mary River Project CREMP, August 2016.

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDSE16-ACJ-01	7.6	8.1	3.853	0	0.878
SDSE16-ACJ-02	11.3	12.1	12.118	2	0.840
SDSE16-ACJ-03*	4.7	4.9	0.556	0	0.536
SDSE16-ACJ-04	4.9	5.2	1.096	0	0.932
SDSE16-ACJ-05	3.9	4.1	0.443	0	0.747
SDSE16-ACJ-06	7.0	7.5	2.897	1	0.845
SDSE16-ACJ-07	9.6	10.1	8.764	2	0.991
SDSE16-ACJ-08	6.2	6.5	1.930	1	0.810
SDSE16-ACJ-09	8.1	8.6	4.192	1	0.789
SDSE16-ACJ-10	5.0	5.2	1.112	0	0.890
SDSE16-ACJ-11	7.9	8.3	4.473	-	0.907
SDSE16-ACJ-12	7.3	7.8	3.083	-	0.793
SDSE16-ACJ-13	7.4	7.9	3.612	-	0.891
SDSE16-ACJ-14	8.4	9.0	5.529	-	0.933
SDSE16-ACJ-15	7.9	8.6	4.682	-	0.950
SDSE16-ACJ-16	4.6	4.9	0.933	-	0.959
SDSE16-ACJ-17	4.7	5.0	0.900	-	0.867
SDSE16-ACJ-18	4.3	4.5	0.692	-	0.870
SDSE16-ACJ-19	4.6	4.9	0.832	-	0.855
SDSE16-ACJ-20	4.4	4.6	0.654	-	0.768
SDSE16-ACJ-21	4.9	5.2	1.074	-	0.913
SDSE16-ACJ-22	4.6	4.8	0.717	-	0.737
SDSE16-ACJ-23	5.1	5.4	1.059	-	0.798
SDSE16-ACJ-24	4.2	4.4	0.689	-	0.930
SDSE16-ACJ-25	8.6	9.1	5.123	-	0.805
SDSE16-ACJ-26	4.0	4.2	0.536	-	0.838
SDSE16-ACJ-27	4.6	4.8	0.963	-	0.989
SDSE16-ACJ-28	8.1	8.5	4.410	-	0.830
SDSE16-ACJ-29	4.8	5.1	0.919	-	0.831
SDSE16-ACJ-30	4.5	4.8	0.831	-	0.912
SDSE16-ACJ-31	4.4	4.6	0.747	-	0.877
SDSE16-ACJ-32	4.3	4.5	0.712	-	0.896
SDSE16-ACJ-33	5.0	5.2	1.110	-	0.888
SDSE16-ACJ-34	4.2	4.4	0.643	-	0.868
SDSE16-ACJ-35	4.2	4.4	0.593	-	0.800
SDSE16-ACJ-36	8.0	8.4	4.859	-	0.949
SDSE16-ACJ-37	7.3	7.8	3.733	-	0.960
SDSE16-ACJ-38	4.5	4.7	0.831	-	0.912
SDSE16-ACJ-39	4.4	4.6	0.734	-	0.862
SDSE16-ACJ-40	4.4	4.6	0.776	-	0.911
SDSE16-ACJ-41	4.0	4.2	0.475	-	0.742
SDSE16-ACJ-42	6.5	7.0	2.414	-	0.879
SDSE16-ACJ-43	4.3	4.5	0.660	-	0.830
SDSE16-ACJ-44	7.3	7.7	3.323	-	0.854
SDSE16-ACJ-45	7.2	7.6	3.026	-	0.811
SDSE16-ACJ-46	6.9	7.4	3.263	-	0.993
SDSE16-ACJ-47	7.2	7.7	3.744	-	1.003
SDSE16-ACJ-48	4.8	4.9	0.959	-	0.867
SDSE16-ACJ-49	7.8	8.3	4.482	-	0.944
SDSE16-ACJ-50	4.7	4.9	1.026	-	0.988
SDSE16-ACJ-51	7.9	8.4	5.024	-	1.019
SDSE16-ACJ-52	7.9	8.5	4.188	-	0.849
SDSE16-ACJ-53	7.8	8.2	4.076	-	0.859
SDSE16-ACJ-54	4.6	4.8	0.770	-	0.791
SDSE16-ACJ-55	7.3	7.8	3.810	-	0.979
SDSE16-ACJ-56	4.5	4.7	0.682	-	0.748
SDSE16-ACJ-57	5.0	5.2	1.184	-	0.947
SDSE16-ACJ-58	7.0	7.4	3.003	-	0.876
SDSE16-ACJ-59	4.5	4.7	0.871	-	0.956

Table G.25: Arctic charr measurements from fish captured at Sheardown Lake SE by electrofishing, Mary River Project CREMP, August 2016.

	Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
	SDSE16-ACJ-60	4.5	4.7	0.792	-	0.869
	SDSE16-ACJ-61	4.0	4.2	0.604	-	0.944
	SDSE16-ACJ-62	4.5	4.7	0.772	-	0.847
	SDSE16-ACJ-63	7.1	7.5	3.292	-	0.920
	SDSE16-ACJ-64	4.4	4.6	0.813	-	0.954
	SDSE16-ACJ-65	4.7	4.9	0.871	-	0.839
	SDSE16-ACJ-66	4.2	4.3	0.631	-	0.852
	SDSE16-ACJ-67	4.4	4.6	0.648	-	0.761
	SDSE16-ACJ-68	4.2	4.4	0.651	-	0.879
	SDSE16-ACJ-69	7.5	8.0	3.677	-	0.872
	SDSE16-ACJ-70	4.7	4.9	0.803	-	0.773
	SDSE16-ACJ-71	4.0	4.2	0.446	-	0.697
	SDSE16-ACJ-72	3.8	4.0	0.409	-	0.745
	SDSE16-ACJ-73	7.8	8.3	4.247	-	0.895
	SDSE16-ACJ-74	4.5	4.7	0.786	-	0.863
	SDSE16-ACJ-75	4.0	4.2	0.574	-	0.897
	SDSE16-ACJ-76	4.7	4.9	0.887	-	0.854
	SDSE16-ACJ-77	5.0	5.3	1.169	-	0.935
	SDSE16-ACJ-78	4.0	4.2	0.432	-	0.675
	SDSE16-ACJ-79	8.3	8.8	5.124	-	0.896
	SDSE16-ACJ-80	4.4	4.6	0.763	-	0.896
	SDSE16-ACJ-81	6.9	7.3	2.885	-	0.878
	SDSE16-ACJ-82	6.5	6.9	2.195	-	0.799
	SDSE16-ACJ-83	5.0	5.3	1.182	-	0.946
	SDSE16-ACJ-84	4.3	4.5	0.602	-	0.757
	SDSE16-ACJ-85	4.5	4.4	0.638	-	0.700
	SDSE16-ACJ-86	4.3	4.5	0.606	-	0.762
	SDSE16-ACJ-87	4.5	4.7	0.810	-	0.889
	SDSE16-ACJ-88	7.5	8.0	3.744	-	0.887
	SDSE16-ACJ-89	4.7	5.0	0.929	-	0.895
	SDSE16-ACJ-90	7.2	7.6	2.874	-	0.770
	SDSE16-ACJ-91	4.0	4.2	0.539	-	0.842
	SDSE16-ACJ-92	4.4	4.6	0.771	-	0.905
	SDSE16-ACJ-93	5.0	5.3	1.198	-	0.958
	SDSE16-ACJ-94	4.9	5.1	1.038	-	0.882
	SDSE16-ACJ-95	4.3	4.5	0.671	-	0.844
	SDSE16-ACJ-96	4.3	4.5	0.693	-	0.872
	SDSE16-ACJ-97	7.4	7.9	3.998	-	0.987
	SDSE16-ACJ-98	4.1	4.2	0.586	-	0.850
	SDSE16-ACJ-99	4.3	4.4	0.668	-	0.840
	SDSE16-ACJ-100	4.3	4.5	0.656	-	0.825
Overall Catch Summary	total number	100	100	100	10	100
	average	5.6	5.9	1.961	0.7	0.864
	median	4.7	4.9	0.924	1	0.871
	standard deviation	1.6	1.8	1.953	1	0.081
	standard error	0.2	0.2	0.195	0.3	0.008
	minimum	3.8	4.0	0.409	0	0.536
	maximum	11.3	12.1	12.118	2	1.019
Young-of-the-Year Catch Summary	proportion of YOY	**64%**				
	total number	64	64	64	4	64
	average	4.5	4.7	0.771	0	0.852
	median	4.5	4.6	0.755	0	0.867
	standard deviation	0.3	0.3	0.200	0.0	0.084
	standard error	0.0	0.0	0.025	0.0	0.011
	minimum	3.8	4.0	0.409	0	0.536
	maximum	5.0	5.3	1.198	0	0.989

* Initial screening indicated sample was an outlier, and therefore the sample was removed from all subsequent statistical analysis data sets.

Table G.26: Results of health endpoint statistical comparisons for nearshore (non-YOY) Arctic charr captured between mine-exposed Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2016.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Areas (p-value)		Power
					Reference		Exposed					
	Parameter	Covariate	Ref	Exp	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	99	100	-	-	-	-	K-S Test	Yes	0.000	-
	Log_{10} Age (years)	none	10	10	-	-	-	-	ANOVA	No	0.374	0.227
Energy Use (non-YOY)	Log_{10} Body Weight (g)	none	68	35	-	-	-	-	ANOVA	No	0.951	0.101
	Log_{10} Fork Length (cm)	none	68	35	-	-	-	-	ANOVA	No	0.944	0.101
	Log_{10} Body Weight (g)	Log_{10} Age (years)[1]	9	9	0.980	0.000	0.647	0.009	ANCOVA	Yes	0.003	0.960
	Log_{10} Fork Length (cm)	Log10 Age (years)[1]	9	10	0.978	0.000	0.698	0.003	ANCOVA	Yes	0.001	0.994
Energy Storage (non-YOY)	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)	68	35	0.985	0.000	0.951	0.000	ANCOVA	No	0.329	0.256

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]	Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Ref	Exp	Statistic	Ref	Exp		Increase	Decrease
Survival	Age (years)	none	10	10	Mean	0.9	0.6	-32.4	297.4	-74.8
Energy Use	Body Weight (g)	none	68	35	Mean	3.862	3.897	-	52	-34
	Fork Length (cm)	none	68	35	Mean	7.6	7.6	-	14.3	-12.5
	Body Weight (g)	Age (years)[1]	9	9	Adjusted Mean	1.839	4.045	120.0	-	-
	Fork Length (cm)	Age (years)[1]	9	10	Adjusted Mean	5.8	7.8	34.1	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	68	35	Adjusted Mean	3.8	3.9	-	5.7	-5.4

(shaded) - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[1] Studentized outlier REF316-ACJ-8 removed.

Table G.27: Results of health endpoint statistical comparisons for nearshore YOY Arctic charr captured between mine-exposed Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2016.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Areas (p-value)		Power
					Reference		Exposed					
	Parameter	Covariate	Ref	Exp	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	31	65	-	-	-	-	K-S Test	Yes	0.000	-
Energy Use	Log_{10} Body Weight (g)	none	31	64	-	-	-	-	ANOVA	Yes	0.000	1.000
	Log_{10} Fork Length (cm)	none	31	65	-	-	-	-	ANOVA	Yes	0.000	1.000
Energy Storage	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)[1]	31	64	0.799	0.000	0.905	0.000	ANCOVA	No	0.316	-
	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)[2]	24	64	0.761	0.000	0.905	0.000	ANCOVA	No	0.273	-

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]	Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Ref	Exp	Statistic	Ref	Exp		Increase	Decrease
Energy Use	Body Weight (g)	none	31	64	Mean	0.489	0.753	54.0	-	-
	Fork Length (cm)	none	31	65	Mean	3.9	4.5	14.0	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)[1]	31	64	Adjusted Mean	0.6	0.6	4.4	7.6	-7.0
	Body Weight (g)	Fork Length (cm)[2]	24	64	Adjusted Mean	0.7	0.7	4.5	7.0	-6.6

[grey box] - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[1] Slopes not equal, however r^2 of both ANCOVA models (interaction = 0.901, parallel slope = 0.893) using all data was above 0.80 and within 0.20.

Table G.28: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured at Sheardown Lake SE in 2016 and during the mine baseline period, Mary River Project CREMP.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Data Sets (p-value)		Power
	Parameter	Covariate	Baseline	2016	Baseline		2016					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	16	100	-	-	-	-	K-S Test	Yes	0.000	-
Energy Use	Log_{10} Body Weight (g)	none	16	99	-	-	-	-	ANOVA	Yes	0.010	0.832
	Log_{10} Fork Length (cm)	none	16	100	-	-	-	-	ANOVA	Yes	0.020	0.757
Energy Storage	Log_{10} Adj. Body Weight (g)	Log10 Fork Length (cm)[1]	16	99	0.811	0.000	0.990	0.000	ANCOVA	Yes	0.029	0.712
	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)[2]	14	11	0.705	0.000	0.811	0.000	ANCOVA	Yes	0.008	0.878

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]	Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Baseline	2016	Statistic	Baseline	2016		Increase	Decrease
Energy Use	Body Weight (g)	none	16	99	Mean	2.371	1.347	-43.2	-	-
	Fork Length (cm)	none	16	100	Mean	6.3	5.4	-14.8	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)[1]	16	99	Adjusted Mean	1.207	1.396	15.7	-	-
	Body Weight (g)	Fork Length (cm)[2]	14	11	Adjusted Mean	2.967	2.487	-16.2	-	-

[shaded box] - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[1] Poor overlap of covariate values between areas.

[2] Comparison using fish with fork length between 5.7 and 7.3 cm to satisfy statistical assumption of covariate overlap.

Table G.29: Sample sizes required to detect differences in Arctic charr non-lethal population endpoints for nearshore and littoral/profundal populations at Sheardown Lake SE compared to Reference Lake 3 or Sheardown Lake SE baseline data, as appropriate, with power at 0.90 and alpha = 0.10 using the 2016 data. Highlighted values indicate sample sizes sufficient to meet CES used for EEM studies.

Mine Lake	Endpoint		Model[a]	Minimum Sample Size (Increase[b] / Decrease[c])							
	Parameter	Covariate		i=5%	i=10%	i=20%	i=25%	i=30%	i=40%	i=50%	i=100%
				d=4%	d=9%	d=17%	d=20	d=23%	d=29%	d=33%	d=50%
Nearshore Electrofishing: Sheardown Lake SE versus Reference Lake 3	Body Weight	none	ANOVA	-	-	-	-	-	-	-	-
	Fork Length	none	ANOVA	-	-	-	-	-	-	-	-
	Body Weight	Age	ANCOVA	1,713	450	124	83	60	37	26	10
	Fork Length	Age	ANCOVA	167	45	13	9	7	5	4	2
	Body Weight	Fork Length	All - ANCOVA	82	22	7	5	4	3	2	2
	Body Weight	Fork Length	YOY Only ANCOVA	103	28	8	6	5	3	3	2
	Body Weight	Fork Length	Non-YOY Only ANCOVA	66	18	6	4	3	3	2	1
Nearshore Electrofishing: Sheardown Lake SE versus Baseline	Body Weight	none	ANOVA	4,599	1,207	331	221	160	98	68	24
	Fork Length	none	ANOVA	463	122	34	23	17	11	8	3
	Body Weight	Fork Length	ANCOVA	93	25	8	6	4	3	3	2
Littoral / Profundal Gill Netting: Sheardown Lake SE versus Baseline	Body Weight	none	ANOVA	1,265	333	92	62	45	28	20	7
	Fork Length	none	ANOVA	134	36	11	8	6	4	3	2
	Body Weight	Age	ANCOVA	340	90	25	17	13	8	6	3
	Fork Length	Age	ANCOVA	39	11	4	3	2	2	2	1
	Body Weight	Fork Length	ANCOVA	73	20	6	5	4	3	2	2

[a] Statistical tests include Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA), Mann-Whitney U-Test (MW U-test) and Kolmogorov-Smirnov test (K-S Test).

[b] Increase relative to reference mean using log transformed data

[c] Decrease relative to reference mean using log transformed data

Table G.30: Arctic charr measurements from fish captured at Sheardown Lake SE by gill netting, Mary River Project CREMP, August 2016.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDSE16-AC-01	3"	38.2	41.6	470	14	0.843
SDSE16-AC-02	2"	37.5	40.4	450	-	0.853
SDSE16-AC-03	2"	35.0	38.3	460	-	1.073
SDSE16-AC-04	2"	53.1	56.3	1,200	-	0.801
SDSE16-AC-05	2"	33.2	35.9	380	-	1.038
SDSE16-AC-06	2"	33.3	36.7	365	-	0.988
SDSE16-AC-07	2"	35.1	37.7	485	-	1.122
SDSE16-AC-08	1½"	38.0	40.7	550	-	1.002
SDSE16-AC-09	1½"	39.1	42.3	530	-	0.887
SDSE16-AC-10	1½"	36.2	39.6	430	-	0.906
SDSE16-AC-11	1½"	35.2	38.2	430	-	0.986
SDSE16-AC-12	1½"	35.9	39.2	460	-	0.994
SDSE16-AC-13	3"	34.5	37.7	500	13	1.218
SDSE16-AC-14	2"	34.9	37.6	430	16	1.012
SDSE16-AC-15	2"	32.7	35.2	380	12	1.087
SDSE16-AC-16	3"	38.0	41.2	540	-	0.984
SDSE16-AC-17	1½"	35.2	38.1	415	-	0.952
SDSE16-AC-18	1½"	34.5	38.2	395	-	0.962
SDSE16-AC-19	1½"	36.8	40.1	440	-	0.883
SDSE16-AC-20	1½"	40.4	44.1	665	-	1.009
SDSE16-AC-21	2"	36.1	39.2	470	-	0.999
SDSE16-AC-22	3"	36.4	39.3	530	-	1.099
SDSE16-AC-23	3"	32.9	35.4	385	-	1.081
SDSE16-AC-24	3"	35.3	38.5	430	-	0.978
SDSE16-AC-25	3"	34.0	37.1	405	-	1.030
SDSE16-AC-26	3"	37.7	40.5	530	-	0.989
SDSE16-AC-27	1½"	24.1	25.9	122	-	0.872
SDSE16-AC-28	3"	37.0	40.1	520	-	1.027
SDSE16-AC-29	1½"	24.4	26.3	134	-	0.922
SDSE16-AC-30	3"	38.5	41.2	570	-	0.999
SDSE16-AC-31	3"	40.4	44.1	660	-	1.001
SDSE16-AC-32	1½"	23.5	25.4	120	-	0.925
SDSE16-AC-33	1½"	23.0	25.0	113	-	0.929
SDSE16-AC-34	3"	39.5	42.2	605	-	0.982
SDSE16-AC-35	3"	38.2	41.3	555	-	0.996
SDSE16-AC-36	3"	42.2	45.1	745	-	0.991
SDSE16-AC-37	3"	39.1	42.2	570	-	0.954
SDSE16-AC-38	3"	38.5	41.5	650	-	1.139
SDSE16-AC-39	3"	39.1	42.2	535	-	0.895
SDSE16-AC-40	1½"	21.9	23.7	113	-	1.076
SDSE16-AC-41	1½"	19.2	20.8	67	-	0.947
SDSE16-AC-42	2"	34.9	37.7	370	15	0.870
SDSE16-AC-43	1½"	22.5	24.6	124	4	1.089
SDSE16-AC-44	2"	34.3	37.2	470	11	1.165
SDSE16-AC-45	2"	37.3	40.5	510	17	0.983
SDSE16-AC-46	1½"	36.1	39.2	545	14	1.158
SDSE16-AC-47	3"	41.7	44.5	770	-	1.062
SDSE16-AC-48	3"	39.9	43.0	645	-	1.015
SDSE16-AC-49	3"	41.1	44.5	640	-	0.922
SDSE16-AC-50	3"	35.2	38.1	460	-	1.055
SDSE16-AC-51	2"	35.0	37.6	440	-	1.026
SDSE16-AC-52	2"	29.7	31.8	262	-	1.000
SDSE16-AC-53	3"	36.4	39.7	510	-	1.057
SDSE16-AC-54	3"	32.2	34.1	272	8	0.815
SDSE16-AC-55	3"	36.1	39.2	520	-	1.105
SDSE16-AC-56	3"	35.6	38.9	490	-	1.086

Table G.30: Arctic charr measurements from fish captured at Sheardown Lake SE by gill netting, Mary River Project CREMP, August 2016.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDSE16-AC-57	3"	33.1	36.7	375	13	1.034
SDSE16-AC-58	2"	33.3	36.1	345	12	0.934
SDSE16-AC-59	2"	35.5	38.6	500	12	1.118
SDSE16-AC-60	2"	38.5	42.3	655	13	1.148
SDSE16-AC-61	3"	38.5	40.6	540	-	0.946
SDSE16-AC-62	3"	38.5	41.8	625	-	1.095
SDSE16-AC-63	3"	34.1	37.1	420	-	1.059
SDSE16-AC-64	3"	40.2	43.5	500	-	0.770
SDSE16-AC-65	3"	38.5	41.8	550	-	0.964
SDSE16-AC-66	3"	38.5	42.2	520	-	0.911
SDSE16-AC-67	2"	40.5	43.5	585	-	0.881
SDSE16-AC-68	1½"	35.3	38.5	390	-	0.887
SDSE16-AC-69	1½"	17.5	18.9	53	-	0.989
SDSE16-AC-70	2"	41.1	44.3	705	-	1.015
SDSE16-AC-71	2"	40.2	43.6	555	-	0.854
SDSE16-AC-72	2"	32.8	35.2	380	-	1.077
SDSE16-AC-73	2"	39.7	43.1	590	19	0.943
SDSE16-AC-74	2"	40.8	44.1	660	13	0.972
SDSE16-AC-75	2"	34.2	36.9	435	10	1.087
SDSE16-AC-76	2"	36.1	39.3	435	14	0.925
SDSE16-AC-77	2"	41.8	44.9	710	15	0.972
SDSE16-AC-78*	1½"	27.4	29.8	126	7	0.613
SDSE16-AC-79	3"	39.2	43.1	550	23	0.913
SDSE16-AC-80	2"	34.0	37.0	400	9	1.018
SDSE16-AC-81	2"	36.5	39.6	430	14	0.884
SDSE16-AC-82	2"	40.0	43.5	615	15	0.961
SDSE16-AC-83	2"	34.2	37.4	370	11	0.925
Overall Catch Summary	total number	83	83	83	25	83
	average	35.5	38.4	468	13.0	0.985
	median	36.1	39.2	470	13.0	0.989
	standard deviation	5.6	6.0	179	3.8	0.098
	standard error	0.6	0.7	19.66	0.8	0.011
	minimum	17.5	18.9	53	4.0	0.613
	maximum	53.1	56.3	1,200	23.0	1.218

* Initial screening indicated sample was an outlier, and therefore the sample was removed from all subsequent statistical analysis data sets.

Table G.31: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Sheardown Lake SE littoral/profundal areas in 2016 and during the mine baseline period, Mary River Project CREMP.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Data Sets (p-value)		Power
					Baseline		2016					
	Parameter	Covariate	Baseline	2016	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	89	82	-	-	-	-	K-S Test	Yes	0.000	-
	Log_{10} Age (years)	none	9	23	-	-	-	-	ANOVA	No	0.885	-
Energy Use	Log_{10} Body Weight (g)	none	89	82	-	-	-	-	ANOVA	Yes	0.001	0.964
	Log_{10} Fork Length (cm)	none	89	82	-	-	-	-	ANOVA	Yes	0.000	0.974
	Log_{10} Body Weight (g)	Log_{10} Age (years)[1]	9	22	0.418	0.060	0.317	0.006	ANCOVA	Yes	0.011	0.842
	Log_{10} Fork Length (cm)	Log_{10} Age (years)[1]	9	22	0.323	0.111	0.401	0.002	ANCOVA	No	0.218	-
Energy Storage	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)[2,3]	89	82	0.848	0.000	0.971	0.000	ANCOVA	No	0.840	-

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]	Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Baseline	2016	Statistic	Baseline	2016		Increase	Decrease
Survival	Age (years)	none	9	23	Mean	12.9	12.7	-	41.1	-29.1
Energy Use	Body Weight (g)	none	89	82	Mean	531.1	425.5	-19.9	-	-
	Fork Length (cm)	none	89	82	Mean	37.8	35.1	-7.2	-	-
	Body Weight (g)	Age (years)[1]	9	22	Adjusted Mean	371.6	463.5	24.7	-	-
	Fork Length (cm)	Age (years)[1]	9	22	Adjusted Mean	348.9	360.8	-	8.1	-7.5
Energy Storage	Body Weight (g)	Fork Length (cm)[2,3]	89	82	Adjusted Mean	472.4	477.4	-	4.6	-4.4

[grey box] - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[1] Young (small) Fish (SDSE16-AC-43) removed to satisfy statistical assumption of covariate overlap.

[2] Poor covariate (length) overlap.

[3] Slopes not equal, however r^2 of both ANCOVA models (interaction = 0.948, parallel slope = 0.947) using all data was above 0.80 and within 0.20.

Table G.32: Additional meristics collected from adult Arctic charr incidental mortalities at Sheardown Lake SE in 2016, Mary River Project CREMP, August 2016.

Specimen ID		Age (years)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Adjusted Body Weight (g)	Fulton's Condition Factor (K)	Sex	Liver Weight (g)	Liver Somatic Index (LSI)	Gonad Weight (g)	Gonad Somatic Index (GSI)	Gill Net Mesh Size (inches)	Abnormalities[a]
SDSE16-AC-42		15	34.9	37.7	370	365	0.870	i	5.375	1.45	-	-	2"	ew (A)
SDSE16-AC-43		4	22.5	24.6	124	122	1.089	i	1.639	1.32	-	-	1½"	none observed
SDSE16-AC-45		17	37.3	40.5	510	503	0.983	i	6.602	1.29	-	-	2"	ew (C)
SDSE16-AC-46		14	36.1	39.2	545	538	1.158	i	6.721	1.23	-	-	1½"	ew (C)
SDSE16-AC-54		8	32.2	34.1	272	270	0.815	i	2.082	0.77	-	-	3"	ew (S)
SDSE16-AC-57		13	33.1	36.7	375	372	1.034	i	3.257	0.87	-	-	3"	ew (C)
SDSE16-AC-58		12	33.3	36.1	345	341	0.934	i	4.099	1.19	-	-	2"	ew (C)
SDSE16-AC-60		13	38.5	42.3	655	648	1.148	i	6.832	1.04	-	-	2"	is (S)
SDSE16-AC-74		13	40.8	44.1	660	651	0.972	i	8.836	1.34	-	-	2"	ew (C)
SDSE16-AC-75		10	34.2	36.9	435	430	1.087	i	4.745	1.09	-	-	2"	ew (C)
SDSE16-AC-80		9	34.0	37.0	400	396	1.018	i	3.526	0.88	-	-	2"	ew (C)
SDSE16-AC-82		15	40.0	43.5	615	610	0.961	i	5.022	0.82	-	-	2"	ew (A)
SDSE16-AC-83		11	34.2	37.4	370	366	0.925	i	3.684	1.00	-	-	2"	ew (A)
SDSE16-AC-01		14	38.2	41.6	470	462	0.843	F	4.468	0.95	3.676	0.782	3"	ew (VA)
SDSE16-AC-13		13	34.5	37.7	500	451	1.218	F	6.763	1.35	42.34	8.468	3"	ew (C)
SDSE16-AC-14		16	34.9	37.6	430	422	1.012	F	4.453	1.04	3.273	0.761	2"	ew (A)
SDSE16-AC-15		12	32.7	35.2	380	336	1.087	F	7.718	2.03	36.747	9.670	2"	ew (C)
SDSE16-AC-59		12	35.5	38.6	500	487	1.118	F	7.729	1.55	5.038	1.008	2"	ew (C)
SDSE16-AC-76		14	36.1	39.3	435	427	0.925	F	3.833	0.88	3.707	0.852	2"	ew (A)
SDSE16-AC-79		23	39.2	43.1	550	539	0.913	F	5.882	1.07	5.229	0.951	3"	ew (C)
SDSE16-AC-81		14	36.5	39.6	430	423	0.884	F	4.437	1.03	2.226	0.518	2"	ew (VA)
SDSE16-AC-73		19	39.7	43.1	590	571	0.943	M	4.907	0.83	14.036	2.379	2"	ew (A)
SDSE16-AC-77		15	41.8	44.9	710	688	0.972	M	8.405	1.18	13.945	1.964	2"	ew (C)
Adult Non-Spawner Statistics	Average	11.8	34.7	37.7	437	432	1.00	-	4.802	1.10	-	-	-	-
	St. deviation	3.5	4.6	5.0	156	155	0.10	-	2.059	0.22	-	-	-	-
	Minimum	4	22.5	24.6	124	122	0.81	-	1.639	0.77	-	-	-	-
	Maximum	17	40.8	44.1	660	651	1.16	-	8.836	1.45	-	-	-	-
	Sample Size (N)	13	13	13	13	13	13	13	13	13	-	-	-	-
Females Statistics	Average	14.8	36.0	39.1	462	443	1.00	-	5.660	1.24	12.780	2.876	-	-
	St. deviation	3.6	2.1	2.5	54	59	0.13	-	1.581	0.39	16.614	3.839	-	-
	Minimum	12	32.7	35.2	380	336	0.84	-	3.833	0.88	2.226	0.518	-	-
	Maximum	23	39.2	43.1	550	539	1.22	-	7.729	2.03	42.340	9.670	-	-
	Sample Size (N)	8	8	8	8	8	8	8	8	8	8	8	-	-

[a] - Abnomalities include encysted worms (ew) in body cavity; letter in paraentheses indicates Scarce (1-5), Common (6-15), Abundant (16-50) and Very Abundant (>50) observation.

Sex - Female (F), Male (M), Indeterminate (i).

Table G.33: Arctic charr measurements from fish captured at Mary Lake by electrofishing, Mary River Project CREMP, August 2016.

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Liver Weight (g)	Age (years)	Fulton's Condition Factor (K)
ML16-ACJ-01	8.5	9.1	4.495	0.053	2	0.732
ML16-ACJ-02	10.9	11.9	12.989	0.182	4	1.003
ML16-ACJ-03	6.5	6.9	2.799	0.048	1	1.019
ML16-ACJ-04	6.6	7.0	2.662	0.034	1	0.926
ML16-ACJ-05	6.2	6.6	2.320	0.047	1	0.973
ML16-ACJ-06	5.0	5.3	1.085	0.014	1	0.868
ML16-ACJ-07	5.4	5.9	1.525	0.036	1	0.968
ML16-ACJ-08	3.5	3.6	0.369	0.009	0	0.861
ML16-ACJ-09	4.5	4.7	0.840	0.018	0	0.922
ML16-ACJ-10	7.7	8.3	3.967	0.052	2	0.869
ML16-ACJ-11	8.1	8.8	4.626	-	-	0.870
ML16-ACJ-12	8.3	8.8	4.254	-	-	0.744
ML16-ACJ-13	8.6	9.2	4.868	-	-	0.765
ML16-ACJ-14	8.2	8.8	4.539	-	-	0.823
ML16-ACJ-15	6.2	6.5	2.347	-	-	0.985
ML16-ACJ-16	6.0	6.4	2.109	-	-	0.976
ML16-ACJ-17	7.1	7.5	3.159	-	-	0.883
ML16-ACJ-18	11.1	12.0	15.206	-	-	1.112
ML16-ACJ-19	8.2	8.9	4.701	-	-	0.853
ML16-ACJ-20	13.6	14.7	25.937	-	-	1.031
ML16-ACJ-21	11.8	12.7	13.345	-	-	0.812
ML16-ACJ-22	9.3	10.1	8.195	-	-	1.019
ML16-ACJ-23	8.3	8.8	4.969	-	-	0.869
ML16-ACJ-24	8.8	9.4	6.157	-	-	0.903
ML16-ACJ-25	9.8	10.8	8.027	-	-	0.853
ML16-ACJ-26	8.2	8.9	4.627	-	-	0.839
ML16-ACJ-27	7.5	8.0	3.804	-	-	0.902
ML16-ACJ-28	8.8	9.6	5.642	-	-	0.828
ML16-ACJ-29	9.2	9.7	7.019	-	-	0.901
ML16-ACJ-30	9.9	10.8	8.944	-	-	0.922
ML16-ACJ-31	7.0	7.5	2.741	-	-	0.799
ML16-ACJ-32	8.6	9.3	5.454	-	-	0.857
ML16-ACJ-33	10.7	11.6	9.901	-	-	0.808
ML16-ACJ-34	12.7	13.8	19.760	-	-	0.965
ML16-ACJ-35	13.0	14.2	20.760	-	-	0.945
ML16-ACJ-36	10.8	11.8	11.388	-	-	0.904
ML16-ACJ-37	7.8	8.4	4.220	-	-	0.889
ML16-ACJ-38	8.4	9.0	5.094	-	-	0.859
ML16-ACJ-39	7.2	7.7	3.254	-	-	0.872
ML16-ACJ-40*	7.2	7.7	19.541	-	-	5.235
ML16-ACJ-41	7.0	7.5	3.187	-	-	0.929
ML16-ACJ-42	7.9	8.4	4.342	-	-	0.881
ML16-ACJ-43	9.4	10.1	7.014	-	-	0.844
ML16-ACJ-44	6.3	6.7	2.190	-	-	0.876
ML16-ACJ-45	6.6	6.9	2.425	-	-	0.843
ML16-ACJ-46	6.9	7.3	3.078	-	-	0.937
ML16-ACJ-47	7.0	7.5	2.778	-	-	0.810
ML16-ACJ-48	6.5	7.0	2.434	-	-	0.886
ML16-ACJ-49	8.8	9.5	6.155	-	-	0.903
ML16-ACJ-50	6.6	7.1	2.809	-	-	0.977
ML16-ACJ-51	9.9	10.6	7.730	-	-	0.797
ML16-ACJ-52	8.2	8.8	4.935	-	-	0.895
ML16-ACJ-53	7.0	7.5	2.938	-	-	0.857
ML16-ACJ-54	8.8	9.5	5.687	-	-	0.835
ML16-ACJ-55	6.7	7.4	3.119	-	-	1.037
ML16-ACJ-56	6.7	7.2	2.859	-	-	0.951
ML16-ACJ-57	6.7	7.2	2.501	-	-	0.832
ML16-ACJ-58	6.2	6.7	2.128	-	-	0.893
ML16-ACJ-59	6.2	6.7	2.011	-	-	0.844

Table G.33: Arctic charr measurements from fish captured at Mary Lake by electrofishing, Mary River Project CREMP, August 2016.

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Liver Weight (g)	Age (years)	Fulton's Condition Factor (K)
ML16-ACJ-60		8.8	9.5	5.009	-	-	0.735
ML16-ACJ-61		10.0	10.8	8.885	-	-	0.889
ML16-ACJ-62		7.2	7.7	3.451	-	-	0.925
ML16-ACJ-63		11.1	11.9	11.497	-	-	0.841
ML16-ACJ-64		7.1	7.6	3.213	-	-	0.898
ML16-ACJ-65		6.3	6.6	2.119	-	-	0.847
ML16-ACJ-66		9.4	10.1	7.504	-	-	0.903
ML16-ACJ-67		6.0	6.4	2.007	-	-	0.929
ML16-ACJ-68		6.6	7.0	2.615	-	-	0.910
ML16-ACJ-69		7.3	7.7	3.481	-	-	0.895
ML16-ACJ-70		7.3	7.2	3.677	-	-	0.945
ML16-ACJ-71		7.0	7.5	2.893	-	-	0.843
ML16-ACJ-72		8.0	8.5	5.392	-	-	1.053
ML16-ACJ-73		5.7	6.1	1.554	-	-	0.839
ML16-ACJ-74		5.2	5.4	1.203	-	-	0.856
ML16-ACJ-75		7.2	7.5	2.899	-	-	0.777
ML16-ACJ-76		8.8	9.4	4.500	-	-	0.660
ML16-ACJ-77		7.3	7.7	2.992	-	-	0.769
ML16-ACJ-78		8.3	8.8	4.163	-	-	0.728
ML16-ACJ-79		5.3	5.5	1.112	-	-	0.747
ML16-ACJ-80		8.5	9.2	5.807	-	-	0.946
ML16-ACJ-81		5.8	6.1	1.612	-	-	0.826
ML16-ACJ-82		9.9	10.6	8.093	-	-	0.834
ML16-ACJ-83		9.2	9.8	4.686	-	-	0.602
ML16-ACJ-84		8.8	9.4	5.393	-	-	0.791
ML16-ACJ-85		12.4	13.4	16.240	-	-	0.852
ML16-ACJ-86		7.4	7.9	3.499	-	-	0.863
ML16-ACJ-87		7.8	8.3	4.005	-	-	0.844
ML16-ACJ-88		8.7	9.6	5.601	-	-	0.851
ML16-ACJ-89		5.7	6.0	1.744	-	-	0.942
ML16-ACJ-90		6.3	6.7	2.149	-	-	0.859
ML16-ACJ-91		5.8	6.2	1.689	-	-	0.866
ML16-ACJ-92		6.9	7.2	2.856	-	-	0.869
ML16-ACJ-93		6.5	7.0	2.290	-	-	0.834
ML16-ACJ-94		6.9	7.5	3.006	-	-	0.915
ML16-ACJ-95		6.2	6.7	2.017	-	-	0.846
ML16-ACJ-96		5.3	5.8	1.732	-	-	1.163
ML16-ACJ-97		4.9	5.1	1.102	-	-	0.937
ML16-ACJ-98		3.5	3.6	0.485	-	-	1.131
ML16-ACJ-99		6.5	7.0	2.349	-	-	0.855
ML16-ACJ-100		9.3	10.1	6.984	-	-	0.868
Overall Catch Summary	total number	100	100	100	10	10	100
	average	7.8	8.3	5.115	0.049	1.3	0.925
	median	7.3	7.7	3.588	0.042	1	0.869
	standard deviation	1.9	2.2	4.579	0.049	1.2	0.444
	standard error	0.2	0.2	0.458	0.016	0.4	0.044
	minimum	3.5	3.6	0.369	0.009	0	0.602
	maximum	13.6	14.7	25.937	0.182	4	5.235
Young-of-the-Year Catch Summary	proportion of YOY	4%					
	total number	4	4	4	2	2	4
	average	4.1	4.3	0.699	0.014	0.0	0.963
	median	4.0	4.2	0.663	0.014	0	0.929
	standard deviation	0.7	0.8	0.335	0.006	0.0	0.117
	standard error	0.4	0.4	0.168	0.005	0.0	0.059
	minimum	3.5	3.6	0.369	0.009	0	0.861
	maximum	4.9	5.1	1.102	0.018	0	1.131

Table G.34: Results of health endpoint statistical comparisons for nearshore (non-YOY) Arctic charr captured between mine-exposed Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2016.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Areas (p-value)		Power
					Reference		Exposed					
	Parameter	Covariate	Ref	Exp	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	99	99	-	-	-	-	K-S Test	Yes	0.000	-
	Log_{10} Age (years)	none	10	10	-	-	-	-	ANOVA	No	0.801	-
Energy Use (non-YOY)	Log_{10} Body Weight (g)	none	68	94	-	-	-	-	ANOVA	No	0.610	-
	Log_{10} Fork Length (cm)	none	68	94	-	-	-	-	ANOVA	No	0.626	-
	Log_{10} Body Weight (g)	Log_{10} Age (years)[1]	9	10	0.980	0.000	0.875	0.000	ANCOVA	No	0.219	-
	Log_{10} Fork Length (cm)	Log10 Age (years)[1]	9	10	0.978	0.000	0.890	0.000	ANCOVA	No	0.117	-
Energy Storage (non-YOY)	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)[2]	68	94	0.985	0.000	0.977	0.000	ANCOVA	No	0.848	-

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]	Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Ref	Exp	Statistic	Ref	Exp		Increase	Decrease
Survival	Age (years)	none	10	10	Mean	0.9	1.0	-	292.6	-74.5
Energy Use (non-YOY)	Body Weight (g)	none	68	94	Mean	3.862	4.099	-	41	-29
	Fork Length (cm)	none	68	94	Mean	7.6	7.8	-	11.8	-10.5
	Body Weight (g)	Age (years)[1]	9	10	Adjusted Mean	1.839	2.187	-	57.6	-36.5
	Fork Length (cm)	Age (years)[1]	9	10	Adjusted Mean	5.8	6.2	-	15.7	-13.6
Energy Storage	Body Weight (g)	Fork Length (cm)[2]	68	94	Adjusted Mean	4.0	4.0	-	4.9	-4.6

[grey box] - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[1] Studentized outlier REF316-ACJ-8 removed.

[2] Slopes not equal, however r^2 of both ANCOVA models (interaction = 0.981, parallel slope = 0.981) using all data was above 0.80 and within 0.20.

Table G.35: Sample sizes required to detect differences in Arctic charr non-lethal population endpoints for nearshore and littoral/profundal populations at Mary Lake compared to Reference Lake 3 or Mary Lake baseline data, as appropriate, with power = 0.90 and alpha = 0.10 using the 2016 data. Highlighted values indicate sample sizes sufficient to meet CES used for EEM studies.

Mine Lake	Endpoint		Model[a]	Minimum Sample Size (Increase[b] / Decrease[c])							
	Parameter	Covariate		i=5%	i=10%	i=20%	i=25%	i=30%	i=40%	i=50%	i=100%
				d=4%	d=9%	d=17%	d=20	d=23%	d=29%	d=33%	d=50%
Nearshore Electrofishing: Mary Lake versus Reference Lake 3	Body Weight	none	ANOVA	7,202	1889	517	346	250	153	106	37
	Fork Length	none	ANOVA	770	203	56	38	28	17	12	5
	Body Weight	Age	ANCOVA	632	167	46	31	23	14	10	4
	Fork Length	Age	ANCOVA	66	18	6	4	3	3	2	1
	Body Weight	Fork Length	All - ANCOVA	68	19	6	4	3	3	2	2
	Body Weight	Fork Length	YOY Only ANCOVA	-	-	-	-	-	-	-	-
	Body Weight	Fork Length	Non-YOY Only ANCOVA	48	13	5	3	3	2	2	1
Nearshore Electrofishing: Mary Lake versus 2014 data	Body Weight	none	ANOVA	4,436	1,164	319	213	155	95	66	23
	Fork Length	none	ANOVA	489	129	36	25	18	11	8	4
	Body Weight	Fork Length	ANCOVA	117	32	9	7	5	4	3	2
Littoral / Profundal Gill Netting: Mary Lake versus Baseline	Body Weight	none	ANOVA	3,239	850	233	156	113	69	48	17
	Fork Length	none	ANOVA	382	101	28	19	14	9	7	3
	Body Weight	Age	ANCOVA	1,962	515	142	95	69	42	30	11
	Fork Length	Age	ANCOVA	183	49	14	10	7	5	4	2
	Body Weight	Fork Length	ANCOVA	120	32	10	7	5	4	3	2

[a] Statistical tests include Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA), Mann-Whitney U-Test (MW U-test) and Kolmogorov-Smirnov test (K-S Test).

[b] Increase relative to reference mean using log transformed data

[c] Decrease relative to reference mean using log transformed data

Table G.36: Arctic charr measurements from fish captured at Mary Lake by gill netting, Mary River Project CREMP, August 2016.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor
ML16-AC-01	3"	56.0	59.8	1,280	-	0.729
ML16-AC-02	3"	38.2	41.6	560	-	1.005
ML16-AC-03	3"	35.6	39.0	395	-	0.875
ML16-AC-04	3"	38.2	41.3	565	-	1.014
ML16-AC-05	3"	37.2	40.2	485	-	0.942
ML16-AC-06	3"	38.9	42.2	620	-	1.053
ML16-AC-07	2"	38.0	41.2	535	16	0.975
ML16-AC-08	2"	28.9	31.4	210	8	0.870
ML16-AC-09	2"	44.5	48.2	760	-	0.862
ML16-AC-10	2"	40.8	44.7	625	-	0.920
ML16-AC-11	2"	35.5	38.8	440	-	0.983
ML16-AC-12	2"	37.5	40.7	485	-	0.920
ML16-AC-13	2"	37.2	40.2	445	-	0.864
ML16-AC-14	2"	36.1	39.2	465	-	0.988
ML16-AC-15	1½"	38.3	41.5	485	-	0.863
ML16-AC-16	3"	73.0	77.8	> 2,500	-	> 0.64
ML16-AC-17	3"	66.0	71.4	> 2,500	-	> 0.87
ML16-AC-18	3"	33.5	36.4	355	-	0.944
ML16-AC-19	3"	67.6	72.5	> 2,500	-	> 0.81
ML16-AC-20	3"	68.1	73.0	2,440	-	0.773
ML16-AC-21	3"	41.1	44.4	700	-	1.008
ML16-AC-22	3"	36.5	39.5	460	12	0.946
ML16-AC-23	2"	35.0	37.9	315	-	0.735
ML16-AC-24	2"	25.5	27.8	151	-	0.911
ML16-AC-25	2"	38.1	41.5	560	15	1.013
ML16-AC-26	2"	38.4	41.6	460	19	0.812
ML16-AC-27	2"	35.0	38.0	435	10	1.015
ML16-AC-28	2"	37.8	41.2	565	-	1.046
ML16-AC-29	1½"	40.9	44.1	600	-	0.877
ML16-AC-30	1½"	40.5	43.4	625	-	0.941
ML16-AC-31	3"	60.2	64.3	2,040	21	0.935
ML16-AC-32	3"	38.5	41.7	495	-	0.867
ML16-AC-33	3"	37.7	41.3	535	-	0.998
ML16-AC-34	3"	38.7	35.9	450	-	0.776
ML16-AC-35	3"	34.1	37.2	435	-	1.097
ML16-AC-36	3"	38.7	42.3	510	-	0.880
ML16-AC-37	3"	40.6	44.1	590	-	0.882
ML16-AC-38	1½"	36.5	39.8	465	-	0.956
ML16-AC-39	3"	40.5	44.1	630	19	0.948
ML16-AC-40	3"	38.5	41.8	530	-	0.929
ML16-AC-41	3"	35.8	38.9	470	-	1.024
ML16-AC-42	2"	35.4	38.1	425	9	0.958
ML16-AC-43	2"	33.0	35.6	315	11	0.877
ML16-AC-44	2"	30.4	33.1	245	8	0.872
ML16-AC-45	2"	40.3	44.3	650	-	0.993
ML16-AC-46	2"	38.3	41.6	500	-	0.890
ML16-AC-47	1½"	33.6	36.6	480	10	1.265
ML16-AC-48	1½"	30.2	32.8	360	9	1.307
ML16-AC-49	1½"	30.4	33.0	280	9	0.997
ML16-AC-50	1½"	28.8	31.4	222	7	0.929
ML16-AC-51	1½"	30.6	33.3	276	4	0.963
ML16-AC-52	1½"	30.8	33.7	285	-	0.975
ML16-AC-53	1½"	35.9	39.1	445	-	0.962
ML16-AC-54	2"	39.4	42.5	530	15	0.867
ML16-AC-55	2"	31.7	34.8	294	-	0.923
ML16-AC-56	2"	29.9	32.4	262	-	0.980

Table G.36: Arctic charr measurements from fish captured at Mary Lake by gill netting, Mary River Project CREMP, August 2016.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor
ML16-AC-57	2"	38.5	42.2	520	15	0.911
ML16-AC-58	2"	33.2	36.3	405	13	1.107
ML16-AC-59	2"	31.5	34.7	295	10	0.944
ML16-AC-60	1½"	35.4	38.5	475	-	1.071
ML16-AC-61	1½"	18.0	19.5	47	-	0.806
ML16-AC-62	3"	40.3	42.9	540	-	0.825
ML16-AC-63	3"	39.9	43.0	590	-	0.929
ML16-AC-64	3"	36.2	39.0	460	-	0.970
ML16-AC-65	3"	39.6	42.7	625	-	1.006
ML16-AC-66	2"	32.6	35.6	345	8	0.996
ML16-AC-67	2"	37.9	41.3	555	14	1.019
ML16-AC-68	2"	31.4	34.0	285	-	0.921
ML16-AC-69	2"	39.2	42.5	540	15	0.896
ML16-AC-70	2"	36.1	38.8	505	13	1.073
ML16-AC-71	2"	37.1	41.0	545	-	1.067
ML16-AC-72	2"	36.1	38.9	450	-	0.957
ML16-AC-73	2"	41.1	44.4	570	-	0.821
ML16-AC-74	1½"	40.1	43.4	475	-	0.737
ML16-AC-75	1½"	36.9	40.1	475	-	0.945
ML16-AC-76	2"	36.7	40.0	490	11	0.991
ML16-AC-77	2"	35.0	38.1	485	11	1.131
ML16-AC-78	2"	28.2	30.3	180	-	0.803
ML16-AC-79	2"	28.8	31.2	204	9	0.854
ML16-AC-80	1½"	28.6	31.2	233	-	0.996
ML16-AC-81	1½"	37.5	40.5	480	-	0.910
ML16-AC-82	1½"	33.3	36.1	365	-	0.988
ML16-AC-83	3"	65.3	70.2	2,490	-	0.894
ML16-AC-84	3"	40.0	44.4	590	-	0.922
ML16-AC-85	3"	40.2	43.9	640	-	0.985
ML16-AC-86	2"	42.9	46.5	675	-	0.855
ML16-AC-87	2"	39.0	42.5	525	-	0.885
ML16-AC-88	2"	37.1	40.6	500	-	0.979
ML16-AC-89	2"	31.8	34.6	325	-	1.011
ML16-AC-90	2"	28.2	31.0	215	-	0.959
ML16-AC-91	1½"	37.1	40.1	460	-	0.901
ML16-AC-92	1½"	27.4	29.7	199	-	0.967
ML16-AC-93	3"	37.8	41.3	545	-	1.009
ML16-AC-94	3"	37.3	40.5	515	-	0.992
ML16-AC-95	3"	40.8	44.6	640	-	0.942
ML16-AC-96	2"	30.9	33.7	258	-	0.874
ML16-AC-97	2"	40.8	44.1	530	-	0.780
Overall Catch Summary	total number	97	97	94	27	97
	average	38.0	41.1	521	11.9	0.9
	median	37.2	40.5	483	11	0.9
	standard deviation	8.9	9.4	369	4.0	0.1
	standard error	0.9	1.0	38.0	0.8	0.0
	minimum	18.0	19.5	47	4	0.6
	maximum	73.0	77.8	2,490	21	1.3

Table G.37: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Mary Lake littoral/profundal areas in 2016 and during the mine baseline period, Mary River Project CREMP.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Areas (p-value)		Power
					Baseline		2015					
	Parameter	Covariate	Baseline	2015	r	p-value	r	p-value				
Survival	Fork Length Distribution	none	161	94	-	-	-	-	K-S Test	Yes	0.000	-
	Log_{10} Age (years)	none	84	27	-	-	-	-	ANOVA	Yes	0.022	0.749
Energy Use	Log_{10} Body Weight (g)	none	161	94	-	-	-	-	ANOVA	No	0.606	-
	Log_{10} Fork Length (cm)	none	161	94	-	-	-	-	ANOVA	No	0.358	-
	Log_{10} Body Weight (g)	Log_{10} Age (years)[2,3]	84	25	0.470	0.000	0.640	0.000	ANCOVA	Yes	0.007	-
	Log_{10} Fork Length (cm)	Log_{10} Age (years)[2,3]	84	25	0.499	0.000	0.774	0.000	ANCOVA	Yes	0.004	-
Energy Storage	Log_{10} Adj. Body Weight (g)	Log_{10} Fork Length (cm)	161	94	0.964	0.000	0.963	0.000	ANCOVA	Yes	0.044	0.645

b) Results expressed as anti-logged values

Response	Endpoint		Sample Size		Mean, Adjusted Mean or Predicted Value[a]			Magnitude of Difference (%)[b,c]		Minimum Detectable Effect Size (%)[d]	
	Parameter	Covariate	Baseline	2015	Statistic	Baseline	2015			Increase	Decrease
Survival	Age (years)	none	84	27	Mean	13.0	11.2	-13.7		-	-
Energy Use	Body Weight (g)	none	161	94	Mean	472.6	451.8	-		28.2	-22.0
	Fork Length (cm)	none	161	94	Mean	37.4	36.4	-		8.9	-8.2
	Body Weight (g)	Age (years)[2,3]	84	25	Predicted Values	1,082.1	651.2	Max overlap	-39.8	-	-
						158.1	284.7	Min overlap	80.1		
	Fork Length (cm)	Age (years)[2,3]	84	25	Predicted Values	495.5	409.7	Max overlap	-17.3	-	-
						247.7	305.6	Min overlap	23.4		
Energy Storage	Body Weight (g)	Fork Length (cm)	161	94	Adjusted Mean	459.1	475.0	3.5		-	-

[grey box] - indicates a significant ($p < 0.10$) difference between areas.

[a] The mean and adjusted mean is reported for ANOVAs and ANCOVAs, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., difference in slopes) occurs and cannot be resolved by removing outliers, and the r^2 for the ANCOVA models with and without the interaction term are less than 0.8 or differ by more than 0.02.

[b] ANCOVA: magnitude of difference between antilogged adjusted means for reference and exposed areas calculated as: [(exposed adjusted mean - reference adjusted mean) /reference adjusted mean] x 100.

[c] ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: [(exposed predicted value - reference predicted value) / reference predicted value] x 100.

[d] Minimum detectable effect size (see methods section of report for formula).

[1] Poor covariate (age) overlap.

[2] Young (small) Fish (ML16-AC-51) removed to satisfy statistical assumption of covariate overlap.

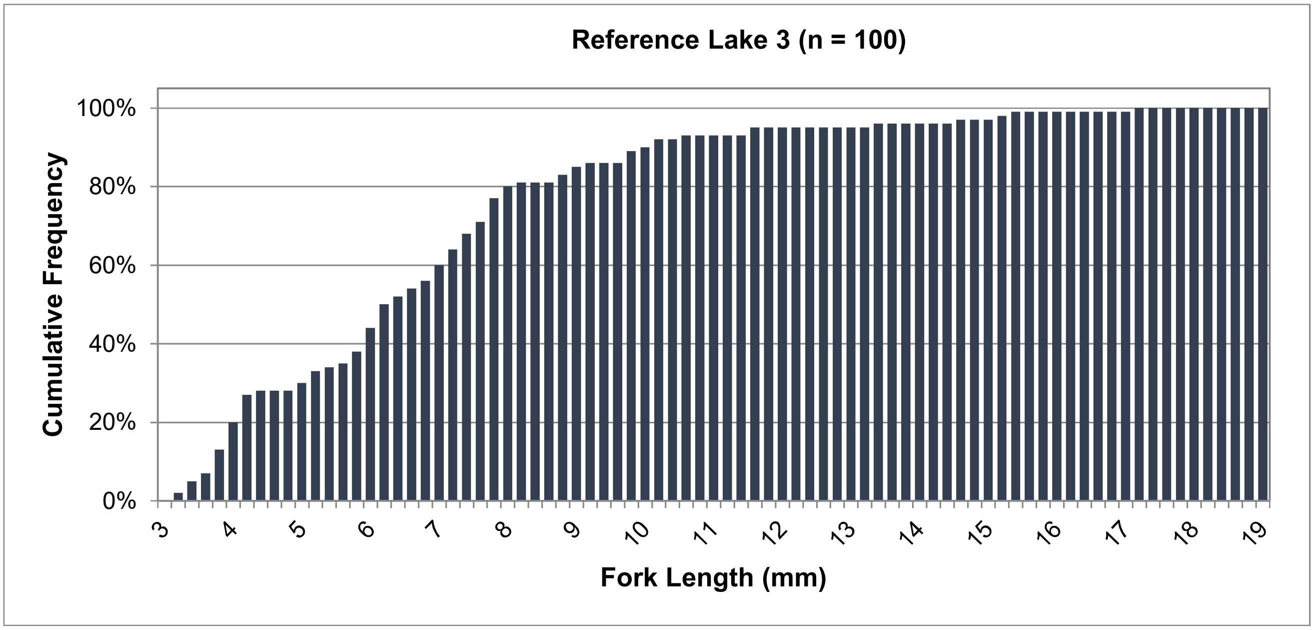
[3] Studentized outlier CL16-AC-83 removed.

Table G.38: Additional meristics collected from Arctic charr incidental mortalities at Mary Lake in 2016, Mary River Project CREMP, August 2016

Specimen ID		Age (years)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Adjusted Body Weight (g)	Fulton's Condition Factor (K)	Sex	Liver Weight (g)	Liver Somatic Index (LSI)	Gonad Weight (g)	Gonad Somatic Index (GSI)	Gill Net Mesh Size (inches)	Abnormalities[a]
ML16-AC-08		8	28.9	31.4	210	208	0.870	i	2.247	1.07	-	-	2"	ew (S)
ML16-AC-22		12	36.5	39.5	460	455	0.946	i	4.535	0.99	-	-	3"	ew (A)
ML16-AC-25		15	38.1	41.5	560	554	1.013	i	5.716	1.02	-	-	2"	ew (VA)
ML16-AC-31		21	60.2	64.3	2,040	2,019	0.935	i	21.297	1.04	-	-	3"	ew (A)
ML16-AC-39		19	40.5	44.1	630	624	0.948	i	6.382	1.01	-	-	3"	ew (C)
ML16-AC-42		9	35.4	38.1	425	420	0.958	i	4.903	1.15	-	-	2"	ew (S)
ML16-AC-43		11	33.0	35.6	315	313	0.877	i	2.274	0.72	-	-	2"	ew (C)
ML16-AC-44		8	30.4	33.1	245	243	0.872	i	2.256	0.92	-	-	2"	ew (S)
ML16-AC-47		10	33.6	36.6	480	476	1.265	i	4.158	0.87	-	-	1½"	ew (C)
ML16-AC-48		9	30.2	32.8	360	358	1.307	i	2.465	0.68	-	-	1½"	ew (S)
ML16-AC-50		7	28.8	31.4	222	220	0.929	i	2.496	1.12	-	-	1½"	ew (S)
ML16-AC-51		4	30.6	33.3	276	273	0.963	i	2.972	1.08	-	-	1½"	is (C)
ML16-AC-54		15	39.4	42.5	530	524	0.867	i	5.773	1.09	-	-	2"	ew (A)
ML16-AC-57		15	38.5	42.2	520	515	0.911	i	4.820	0.93	-	-	2"	ew (C)
ML16-AC-67		14	37.9	41.3	555	549	1.019	i	5.883	1.06	-	-	2"	ew (VA)
ML16-AC-76		11	36.7	40.0	490	485	0.991	i	5.132	1.05	-	-	2"	ew (C)
ML16-AC-79		9	28.8	31.2	204	202	0.854	i	2.014	0.99	-	-	2"	none observed
ML16-AC-07		16	38.0	41.2	535	477	0.975	F	9.677	1.81	48.548	9.074	2"	ew (C)
ML16-AC-26		19	38.4	41.6	460	452	0.812	F	4.751	1.03	3.179	0.691	2"	ew (C)
ML16-AC-27		10	35.0	38.0	435	429	1.015	F	3.049	0.70	3.124	0.718	2"	none observed
ML16-AC-49		9	30.4	33.0	280	276	0.997	F	2.722	0.97	1.012	0.361	1½"	ew (C)
ML16-AC-58		13	33.2	36.3	405	397	1.107	F	3.947	0.97	3.830	0.946	2"	ew (VA)
ML16-AC-59		10	31.5	34.7	295	291	0.944	F	2.675	0.91	1.445	0.490	2"	ew (A)
ML16-AC-66		8	32.6	35.6	345	340	0.996	F	3.908	1.13	0.852	0.247	2"	ew (C) + liver parasite
ML16-AC-69		15	39.2	42.5	540	531	0.896	F	4.506	0.83	4.505	0.834	2"	none observed
ML16-AC-70		13	36.1	38.8	505	441	1.073	F	9.082	1.80	54.793	10.850	2"	none observed
ML16-AC-77		11	35.0	38.1	485	478	1.131	F	4.181	0.86	2.546	0.525	2"	ew (VA)
Adult Non-Spawner Statistics	Average	11.6	35.7	38.8	501	496	0.972	-	5.019	0.99	-	-	-	-
	St. deviation	4.4	7.5	7.9	420	416	0.129	-	4.463	0.13	-	-	-	-
	Minimum	4	28.8	31.2	204	202	0.854	-	2.014	0.68	-	-	-	-
	Maximum	21	60.2	64.3	2,040	2019	1.307	-	21.297	1.15	-	-	-	-
	Sample Size (N)	17	17	17	17	17	17	17	17	17	-	-	-	-
Females Statistics	Average	12.4	34.9	38.0	429	411	0.995	-	4.850	1.10	12.383	2.474	-	-
	St. deviation	3.5	3.0	3.1	95	84	0.096	-	2.494	0.39	20.792	3.974	-	-
	Minimum	8	30.4	33.0	280	276	0.812	-	2.675	0.70	0.852	0.247	-	-
	Maximum	19	39.2	42.5	540	531	1.131	-	9.677	1.81	54.793	10.850	-	-
	Sample Size (N)	10	10	10	10	10	10	10	10	10	10	10	-	-

[a] - Abnomalities include encysted worms (ew) in body cavity; letter in paraentheses indicates Scarce (1-5), Common (6-15), Abundant (16-50) and Very Abundant (>50) observation.

Sex - Female (F), Indeterminate (i).



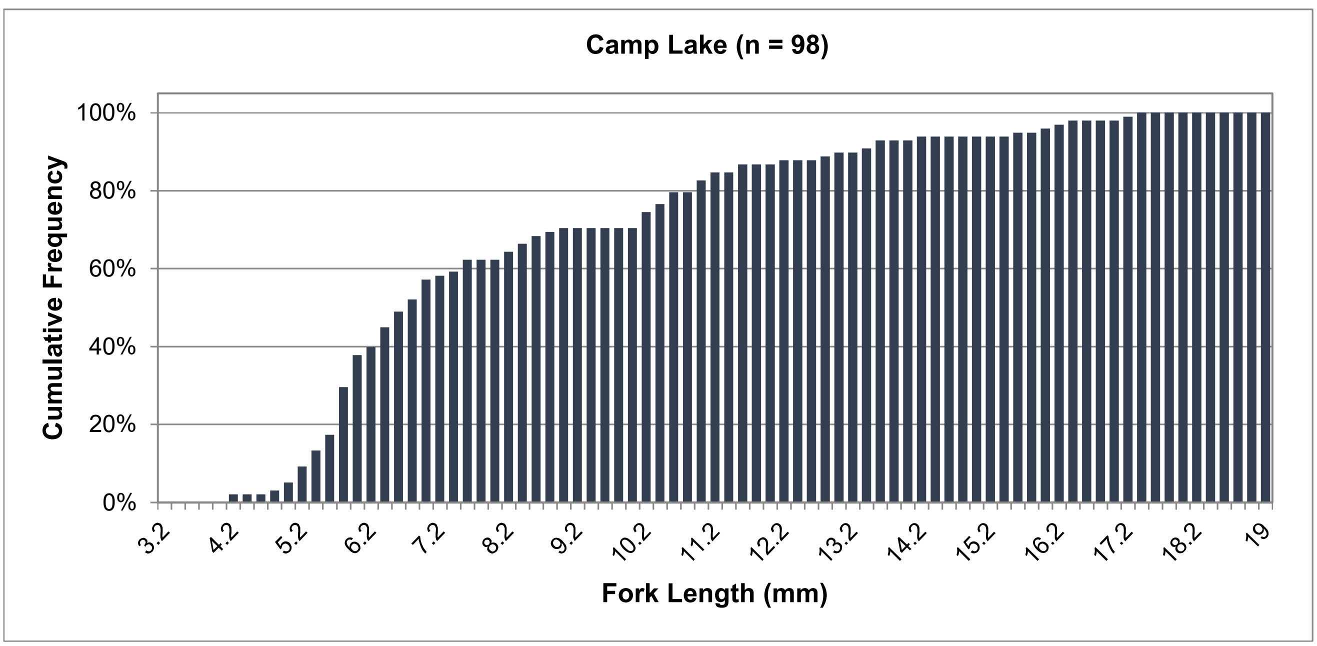


Figure G.1: Cumulative length-frequency distributions for juvenile Arctic charr captured by electrofishing at nearshore areas of Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2016.

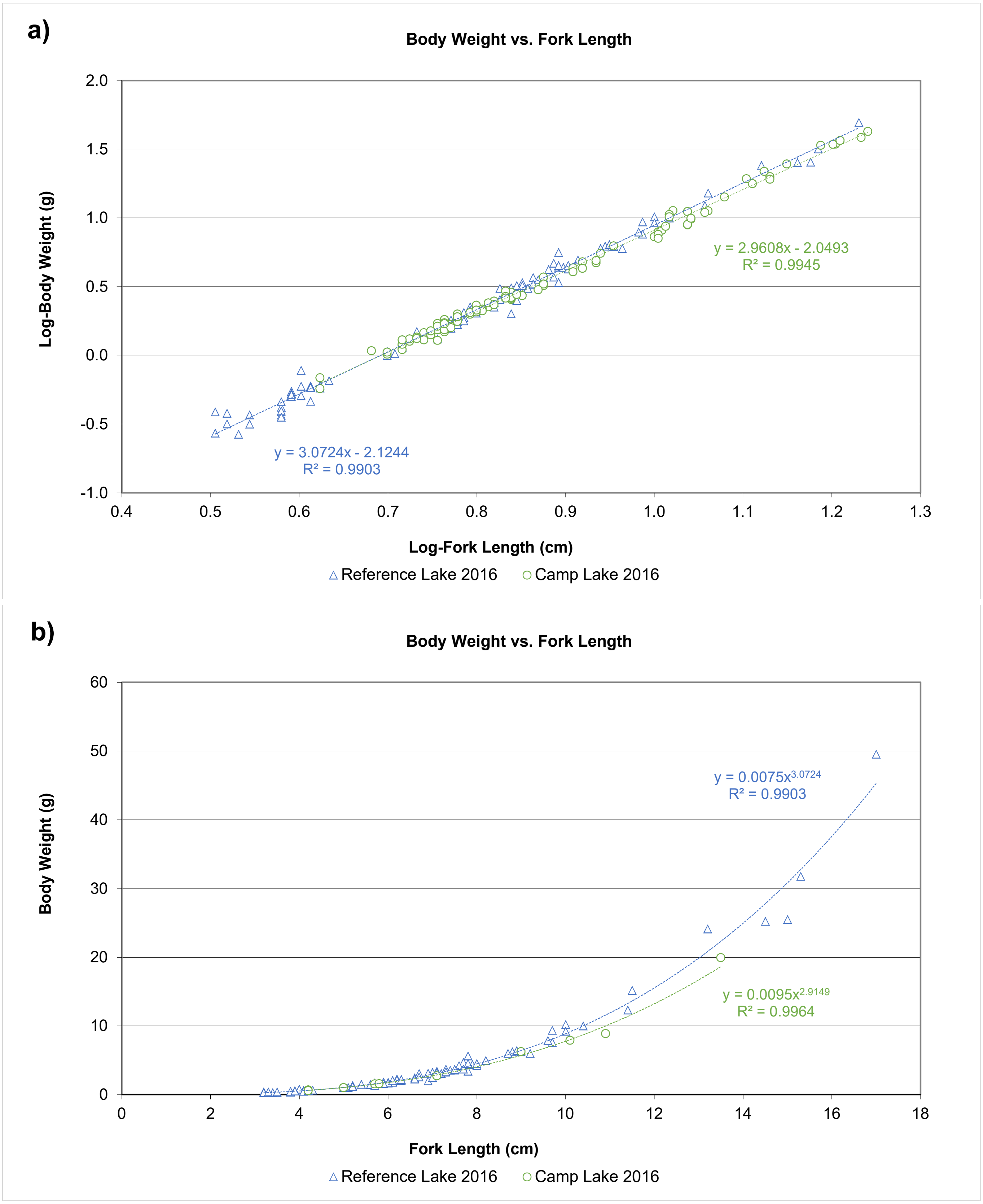
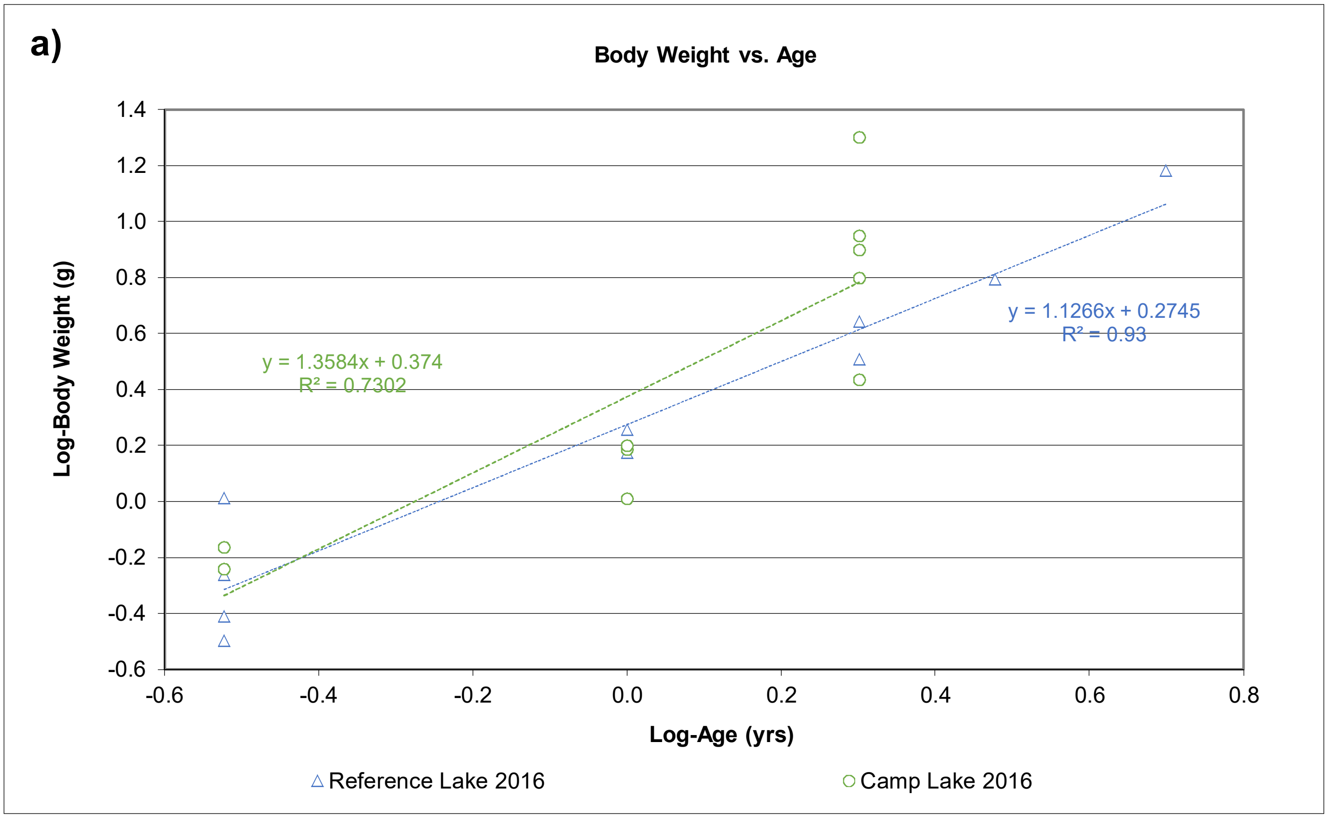


Figure G.2: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected at the nearshore area of Camp Lake and Reference Lake 3 in August 2016 using log-transformed (a) and untransformed (b) data, Mary River Project CREMP, 2016.



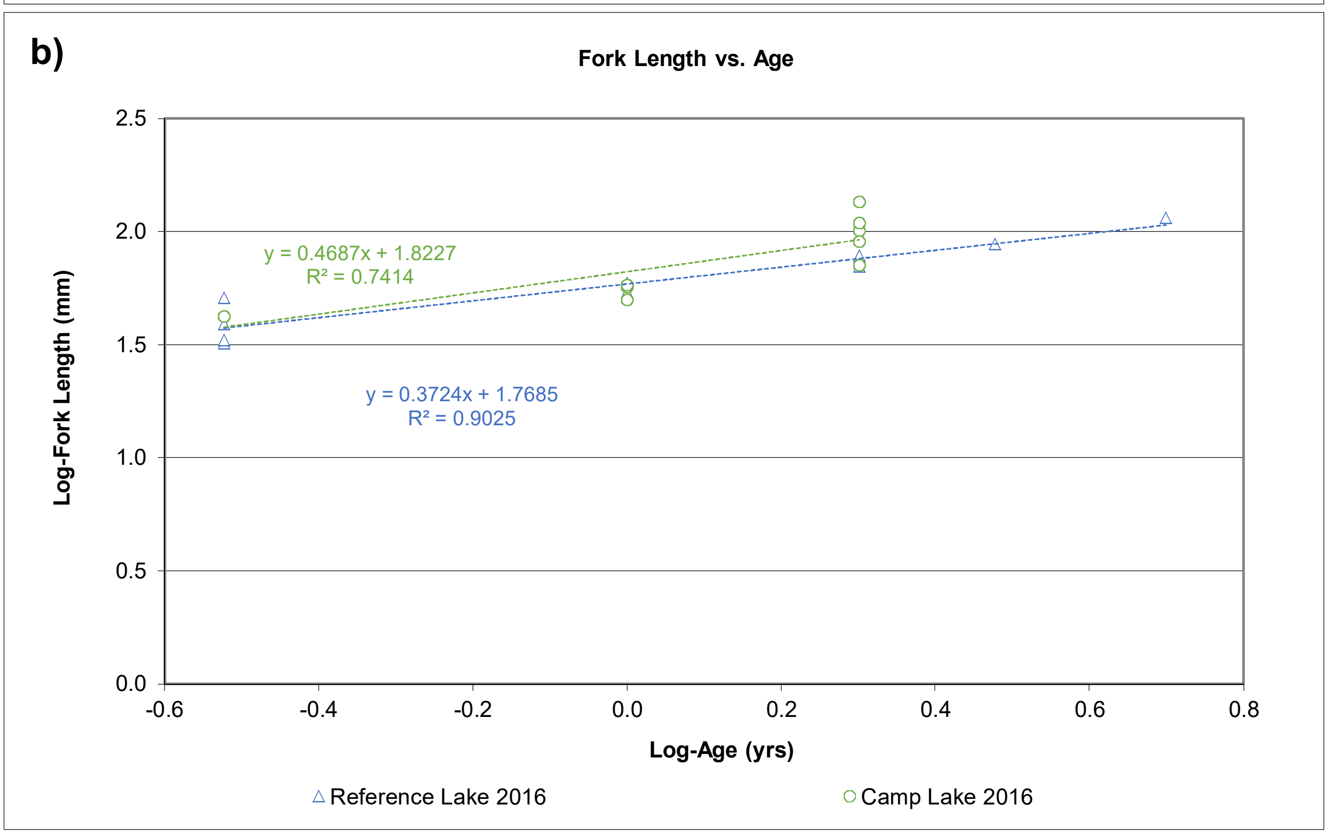
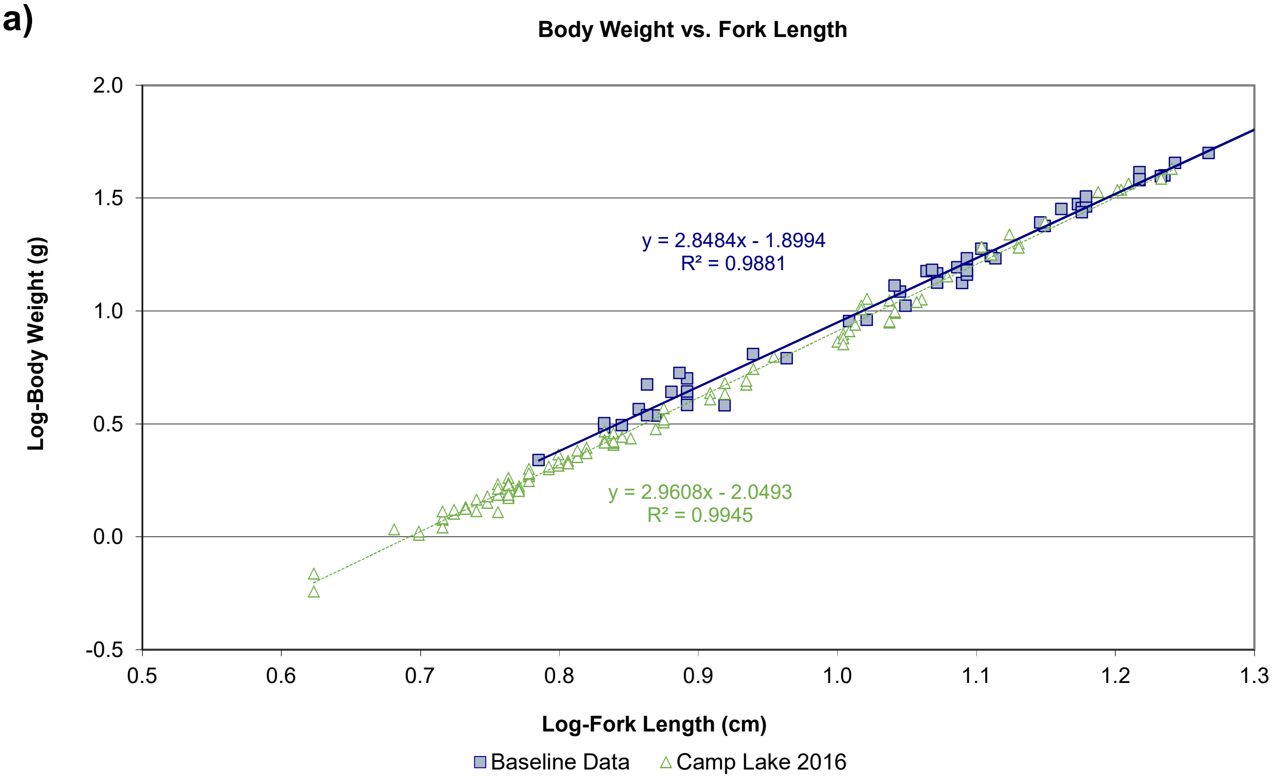


Figure G.3: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected at the nearshore area of Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2016.

a)



b)

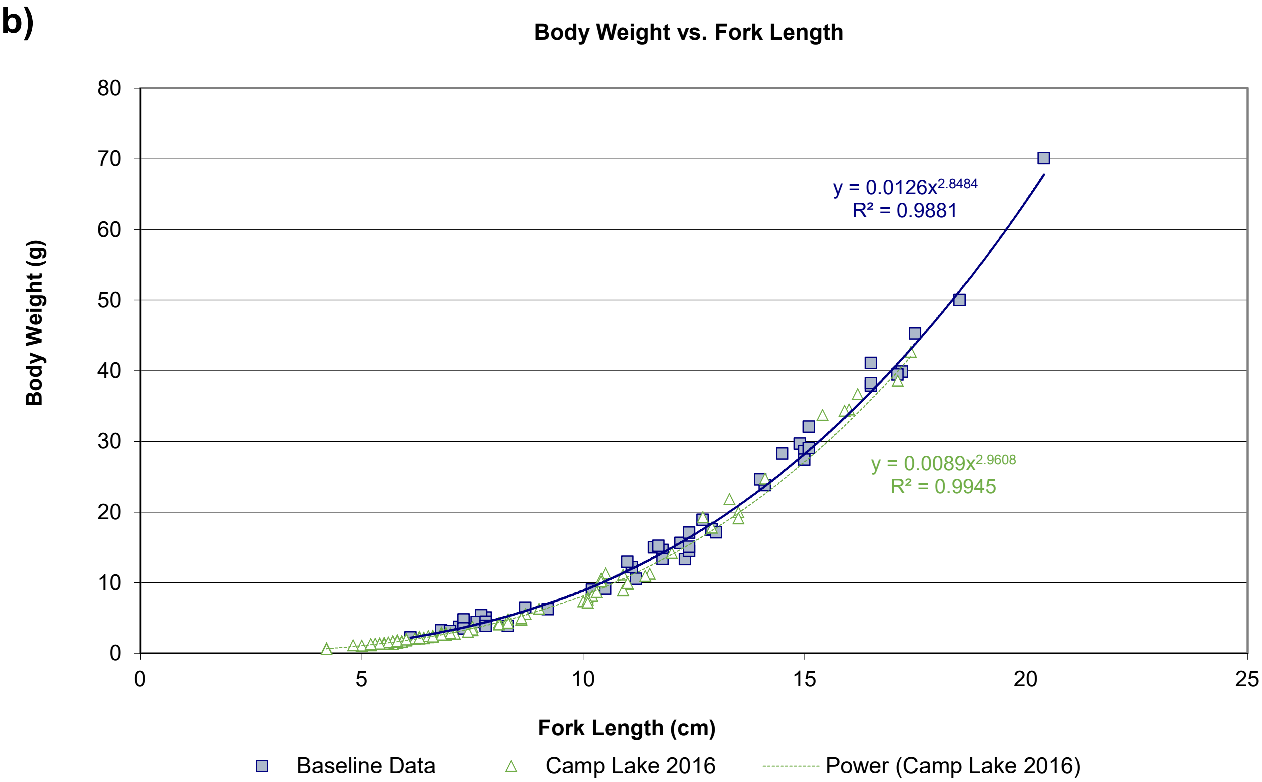


Figure G.4: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Camp Lake nearshore areas in 2016 and during the mine baseline period (2013) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

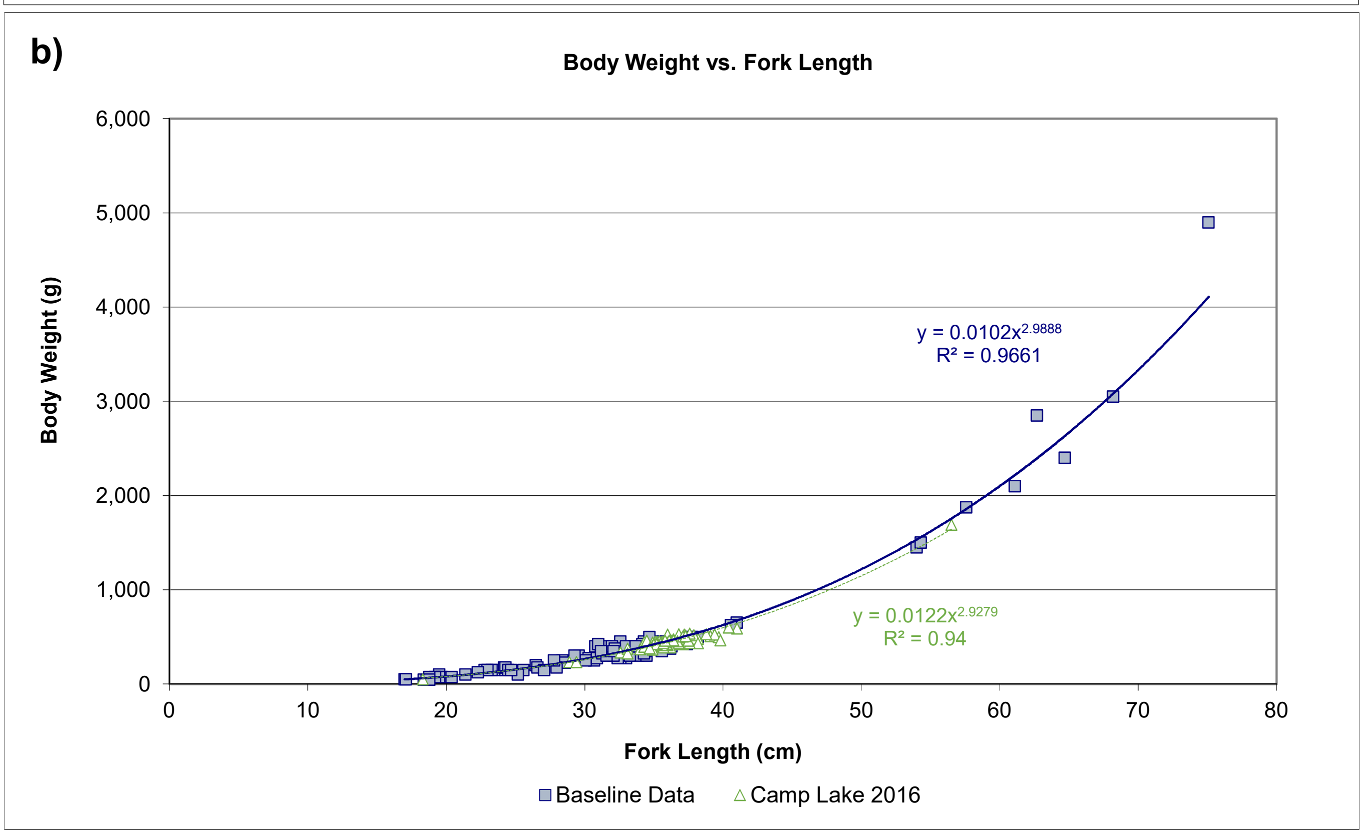


Figure G.5: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Camp Lake littoral/profundal areas in 2016 and during the mine baseline period (2006, 2007, 2008, 2013) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

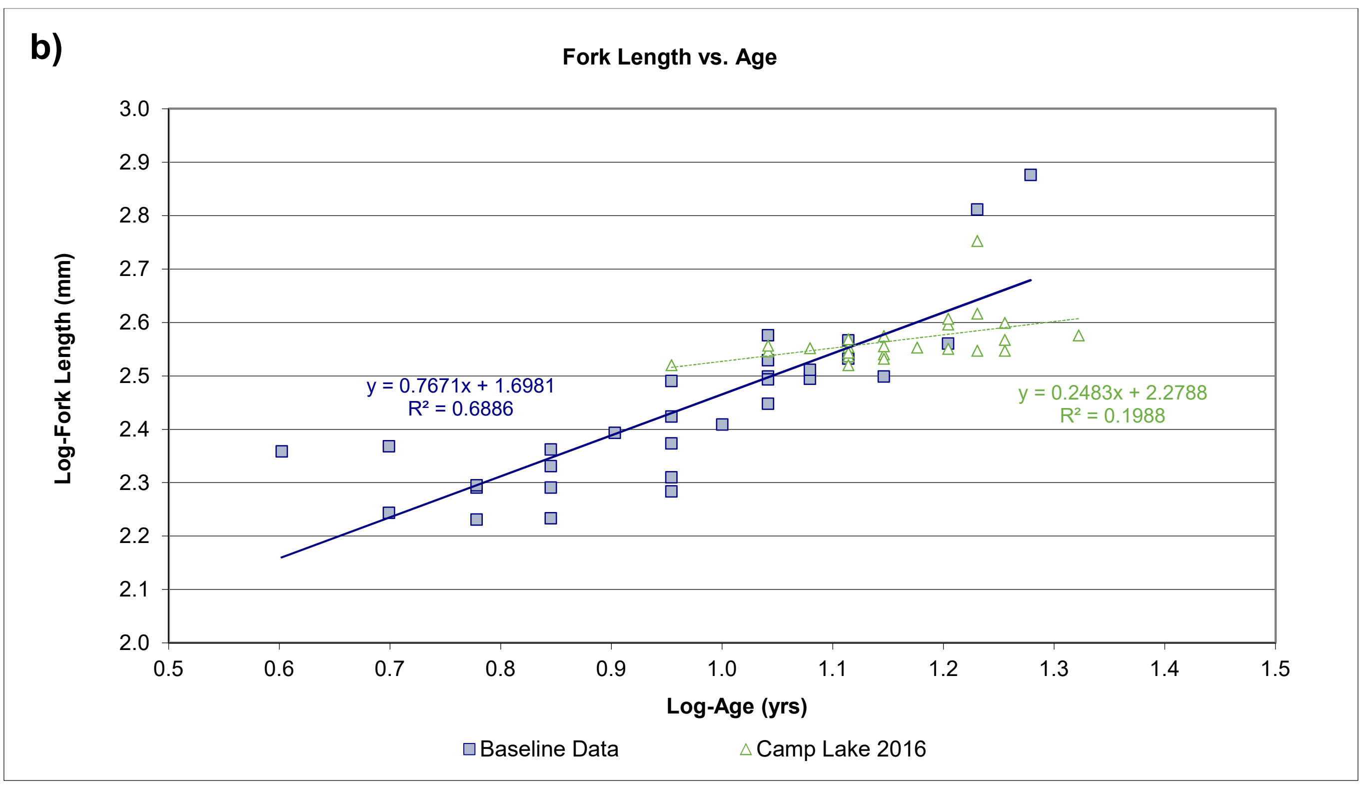
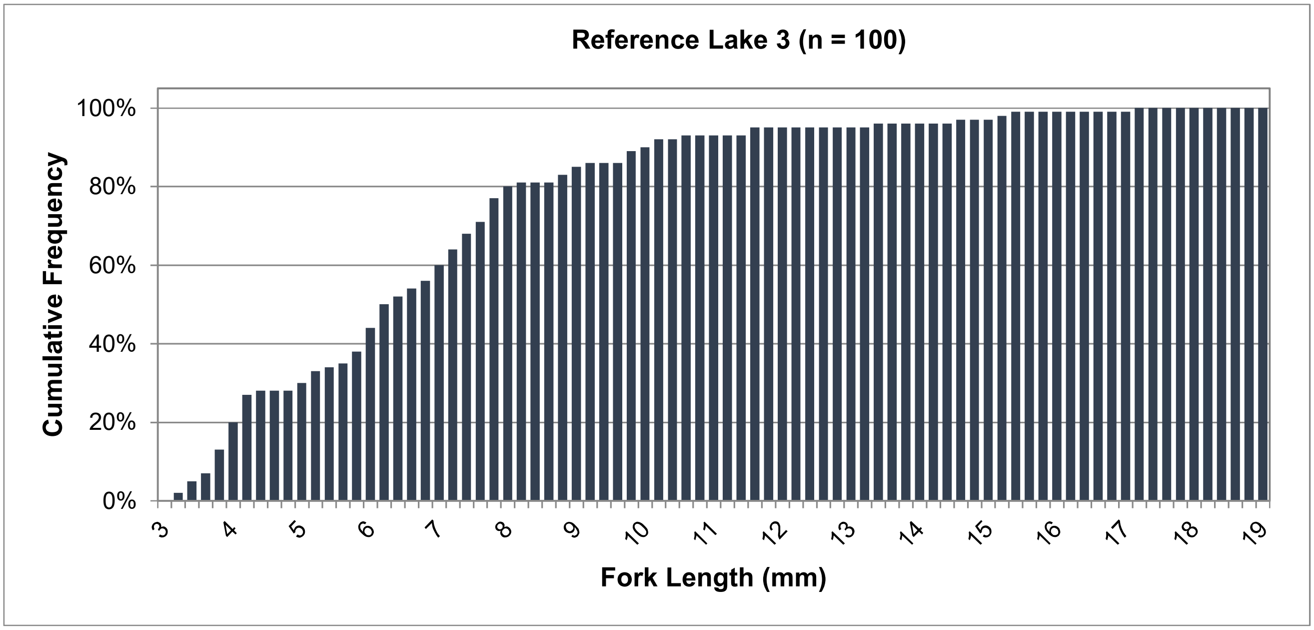


Figure G.6: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected in fall (August-September) at Camp Lake nearshore areas in 2016 and during the baseline period (2006, 2007, 2013), Mary River Project CREMP.



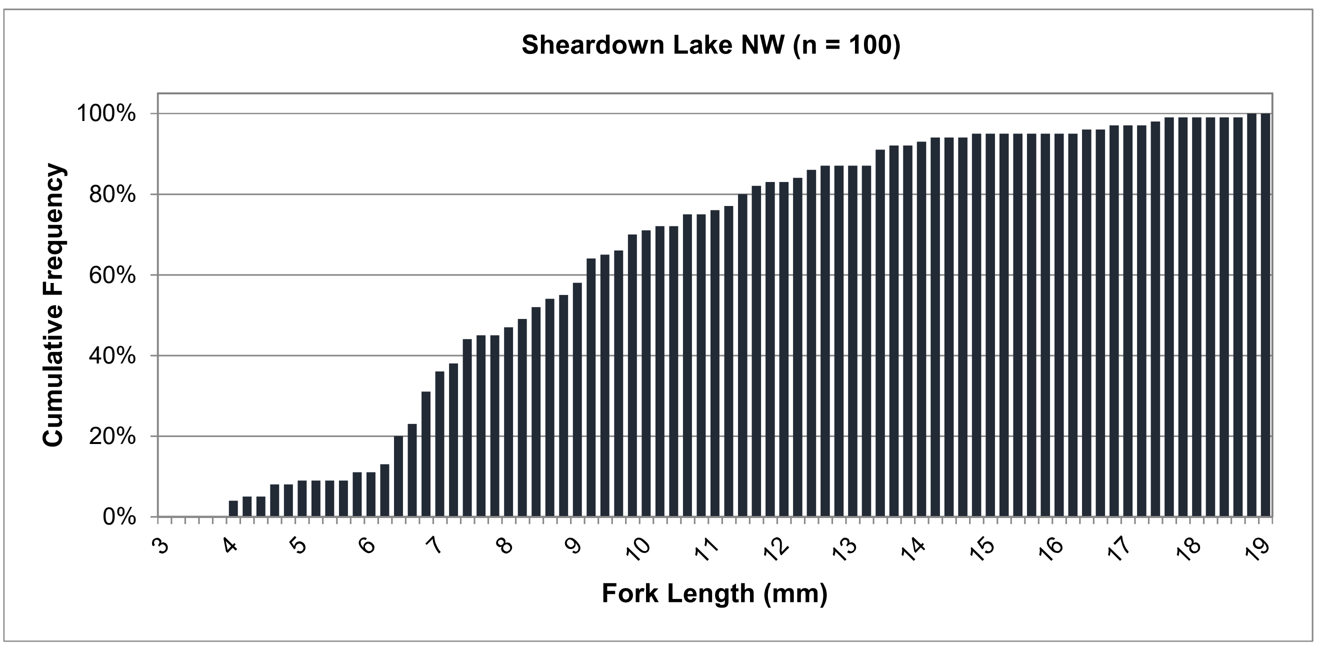
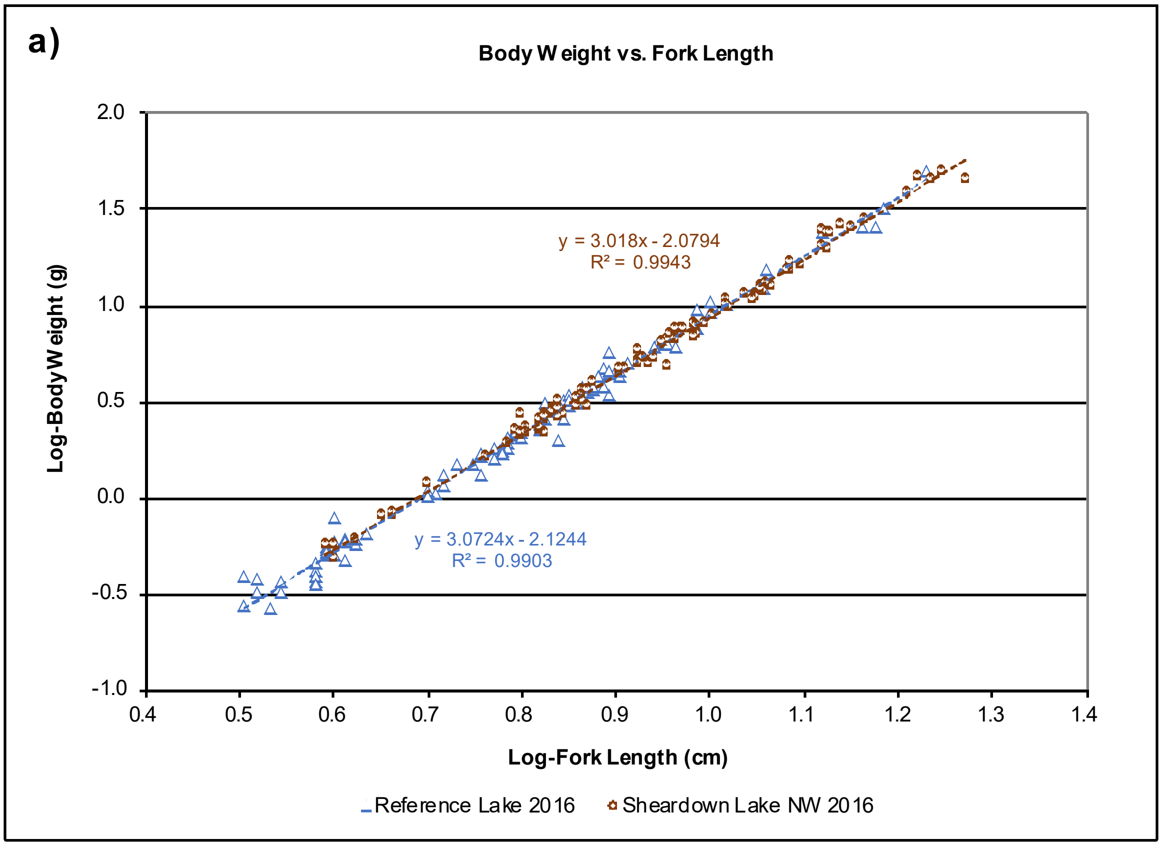


Figure G.7: Cumulative length-frequency distributions for juvenile Arctic charr captured by electrofishing at nearshore areas of Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2016.



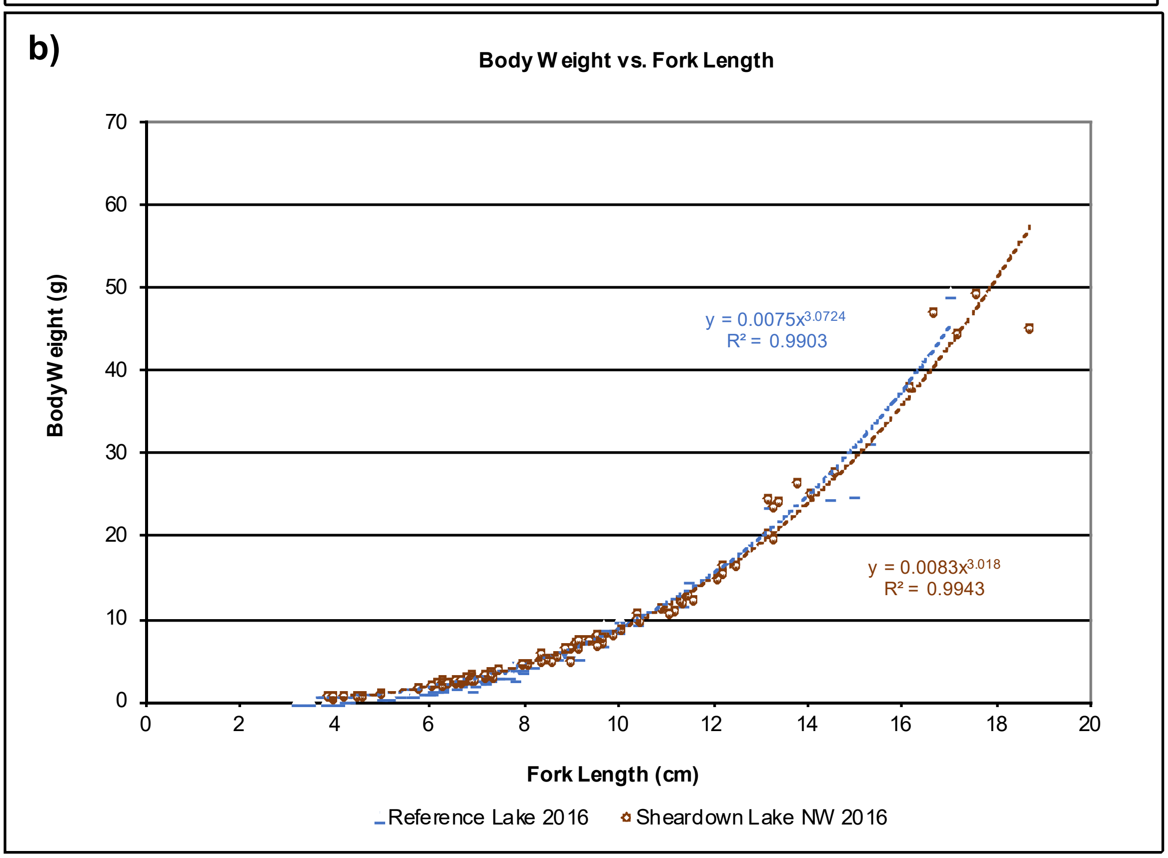
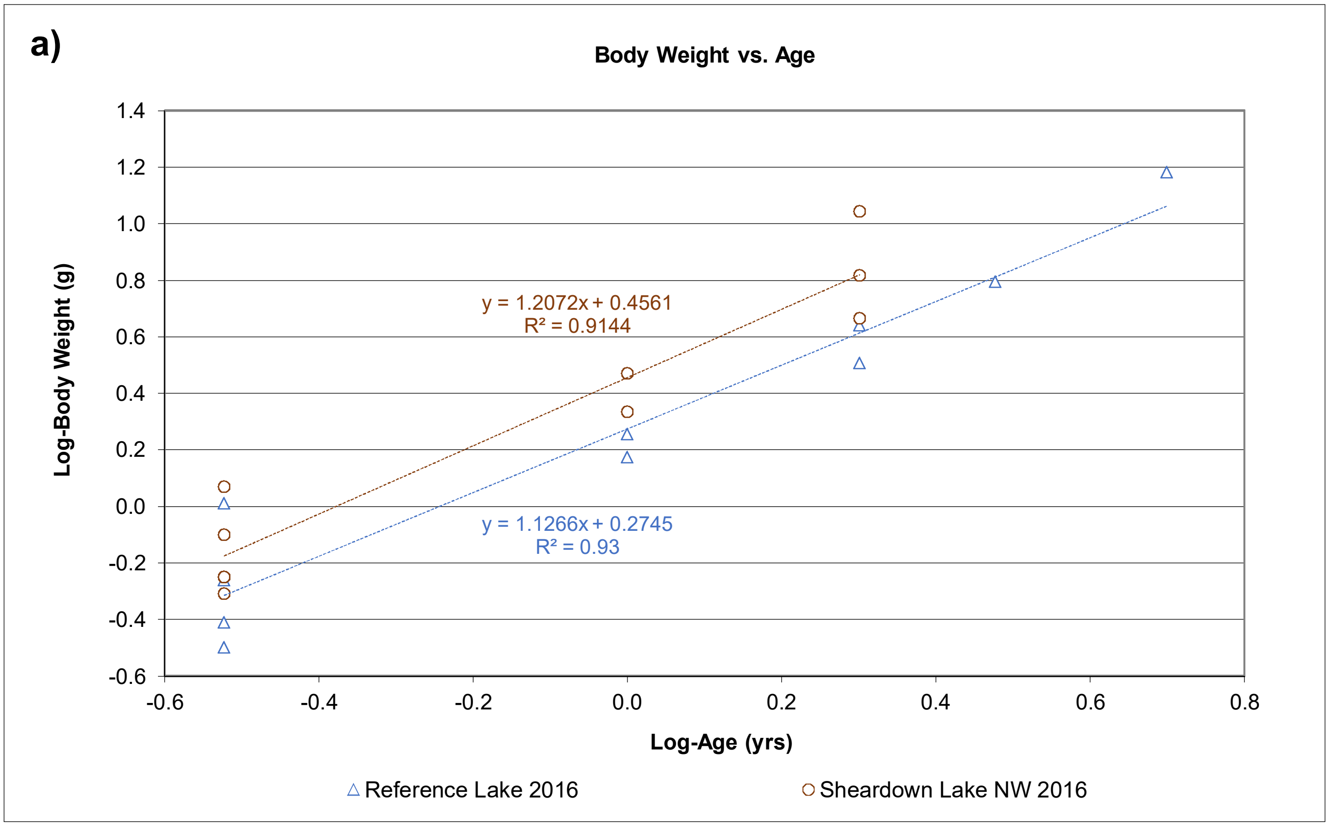


Figure G.8: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected at the nearshore area of Sheardown Lake NW and Reference Lake 3 in August 2016 using log-transformed (a) and untransformed (b) data, Mary River Project CREMP, 2016.



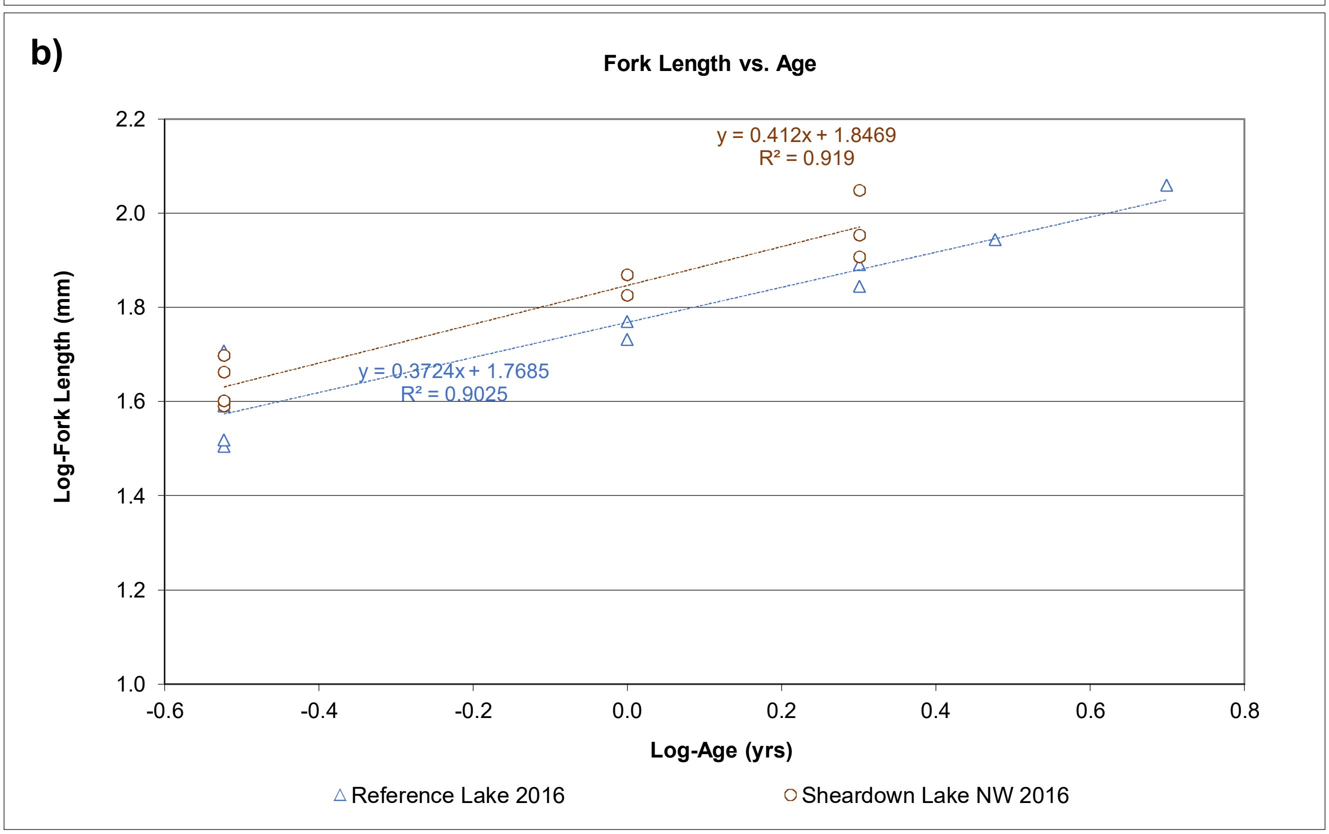


Figure G.9: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected at the nearshore area of Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2016.

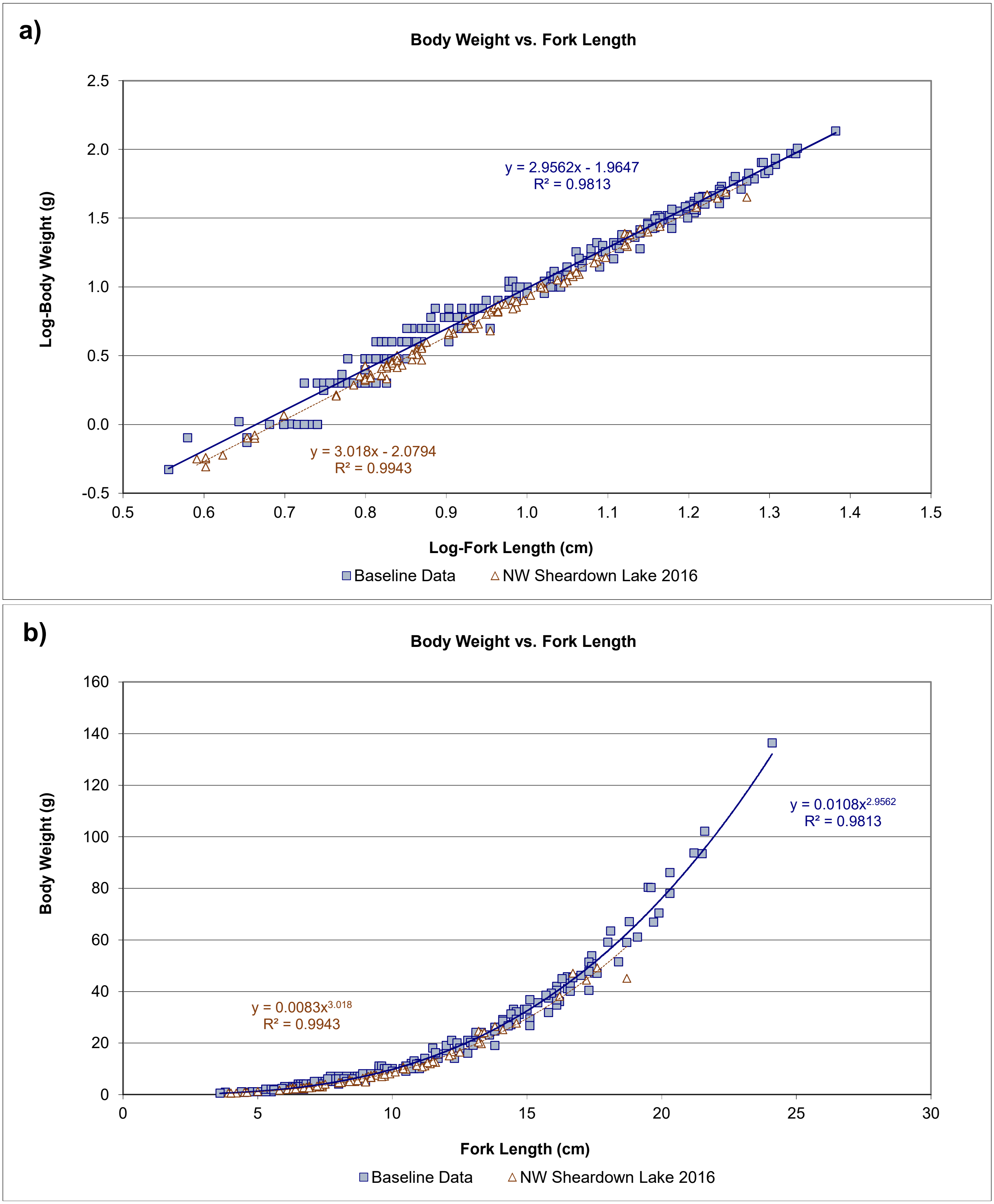
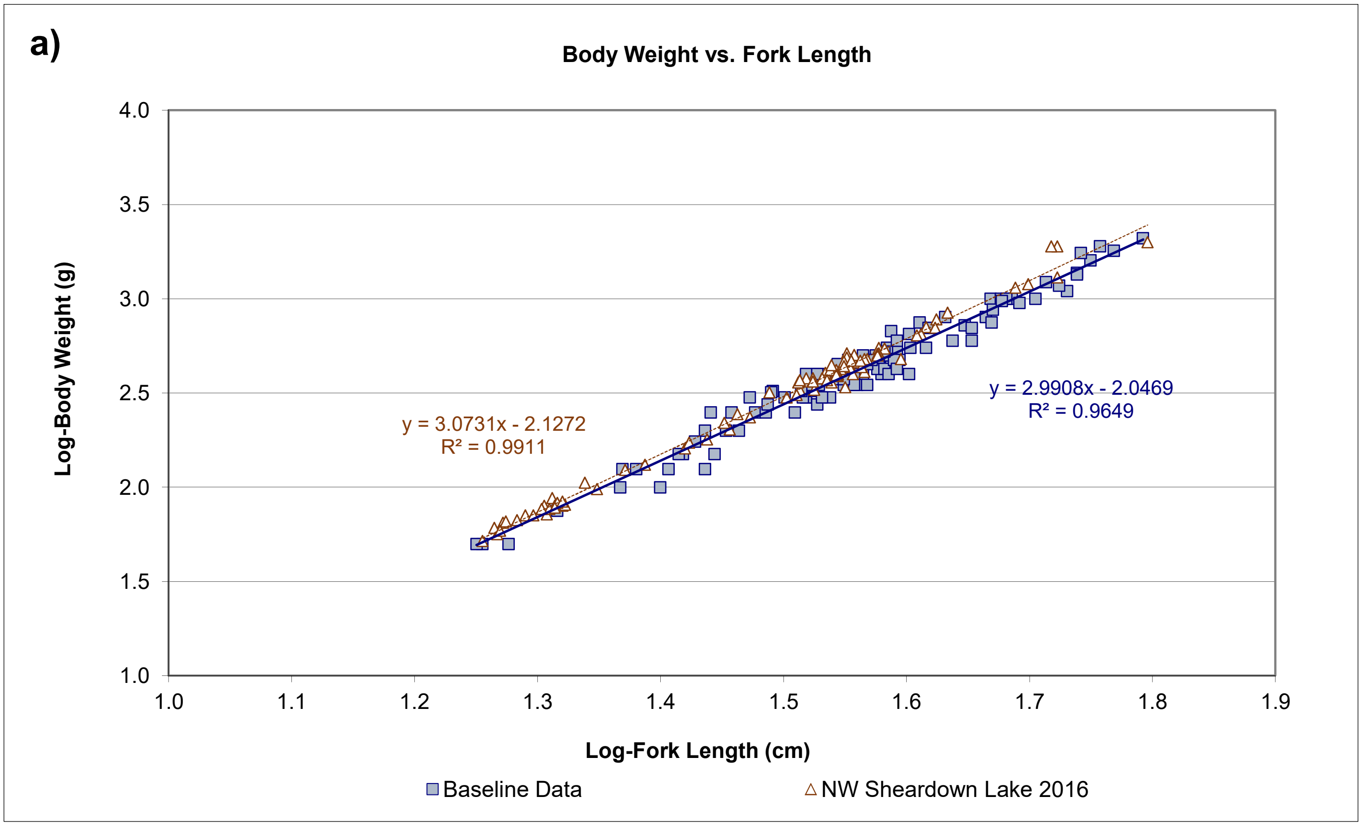


Figure G.10: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake NW nearshore areas in 2016 and during the mine baseline period (2007, 2008, 2013) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.



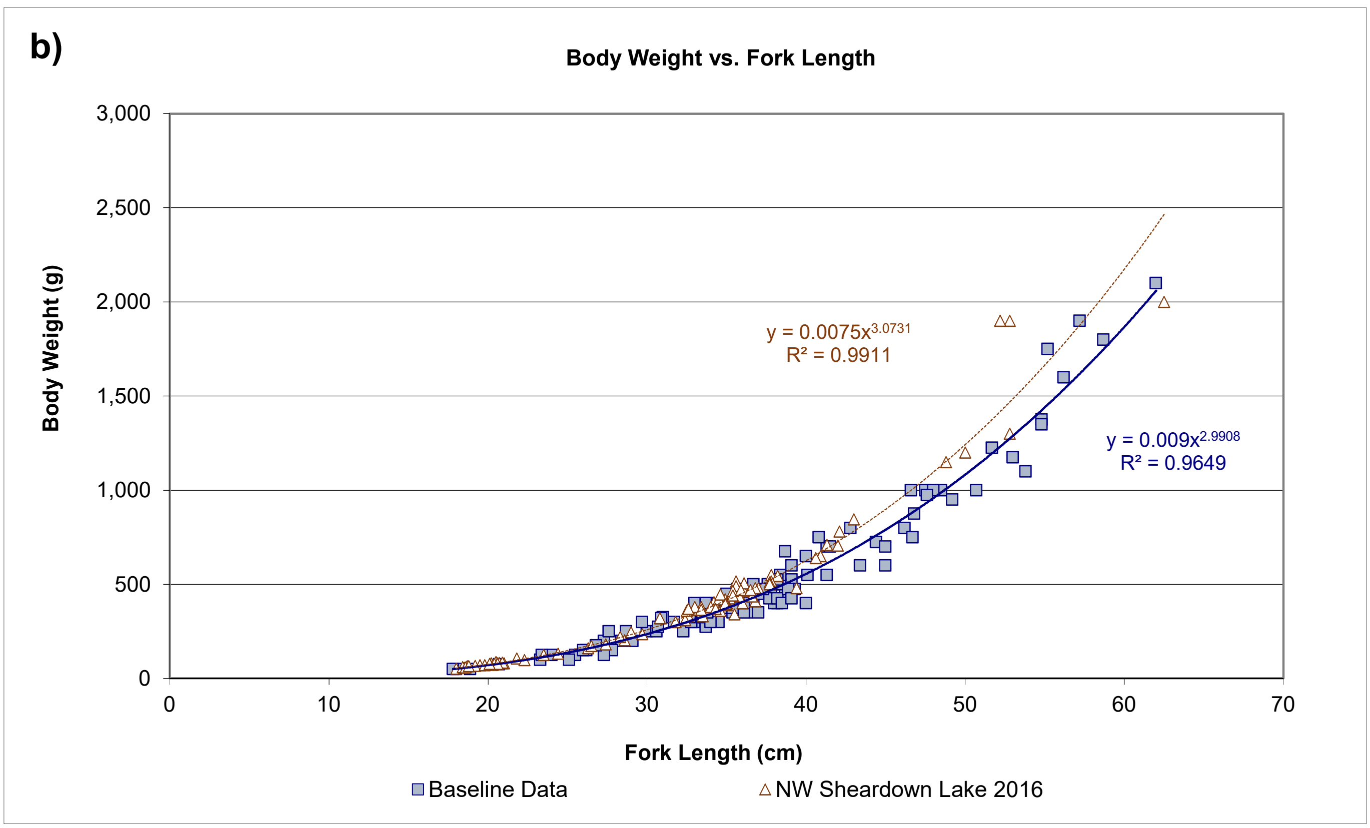


Figure G.11: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake NW nearshore areas in 2016 and during the mine baseline period (2006, 2007, 2008, 2013) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

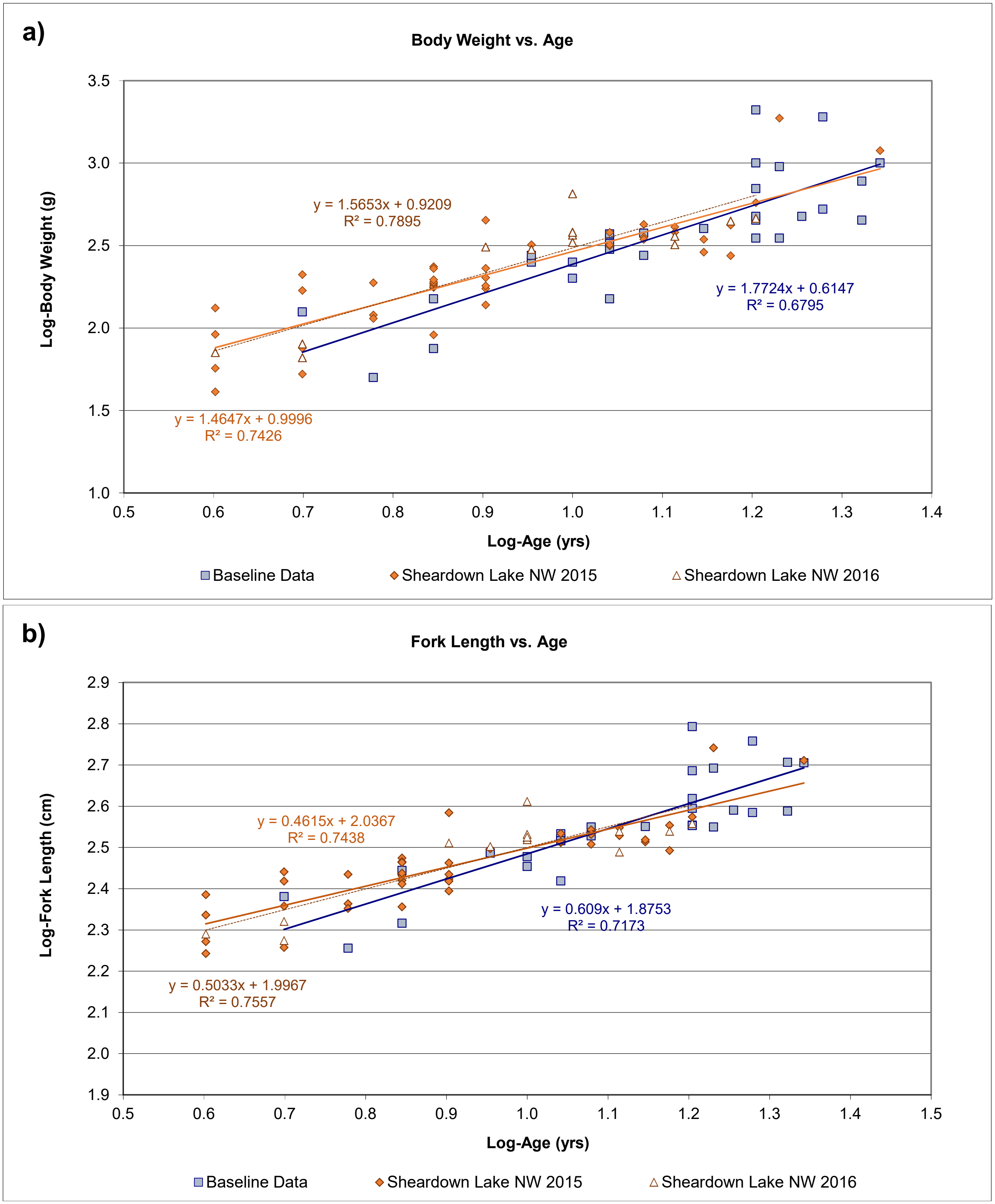


Figure G.12: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected in fall (August-September) at Sheardown Lake NW nearshore areas in 2016, 2015 and over the baseline period (2006, 2007, 2013), Mary River Project CREMP.

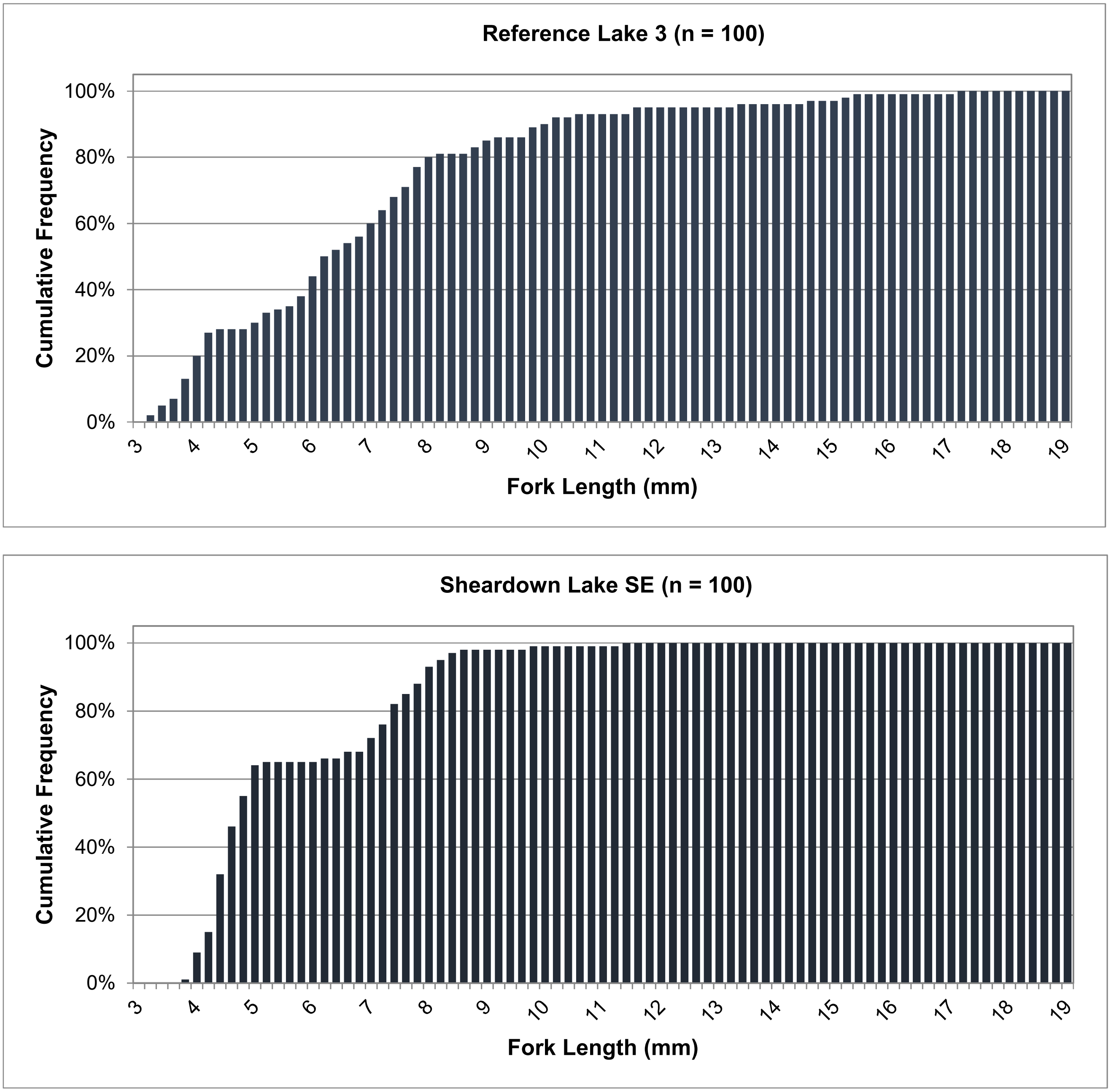


Figure G.13: Cumulative length-frequency distributions for juvenile Arctic charr captured by electrofishing at nearshore areas of Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2016.

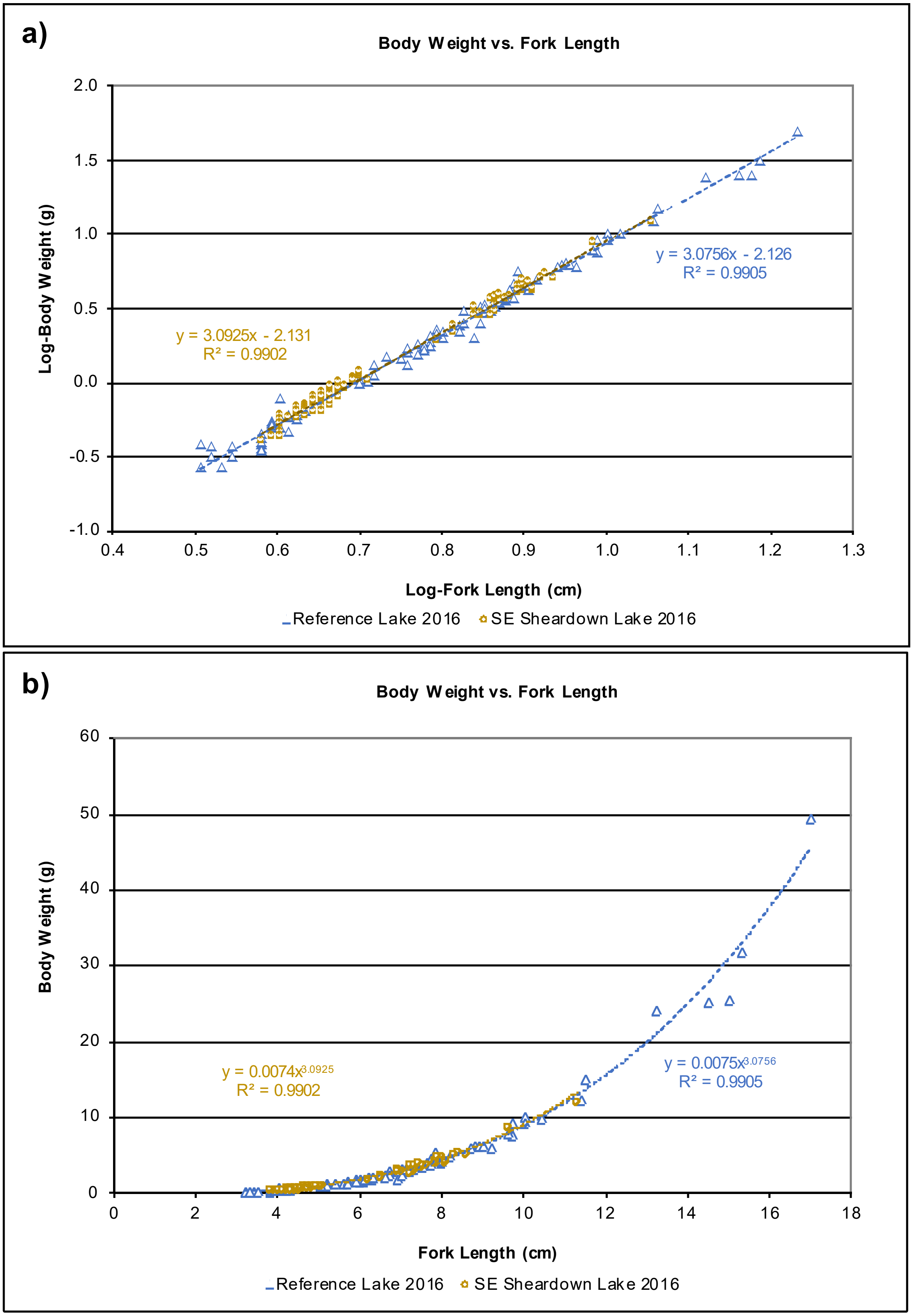


Figure G.14: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected at the nearshore area of Sheardown Lake SE and Reference Lake 3 in August 2016 using log-transformed (a) and untransformed (b) data, Mary River Project CREMP, 2016.

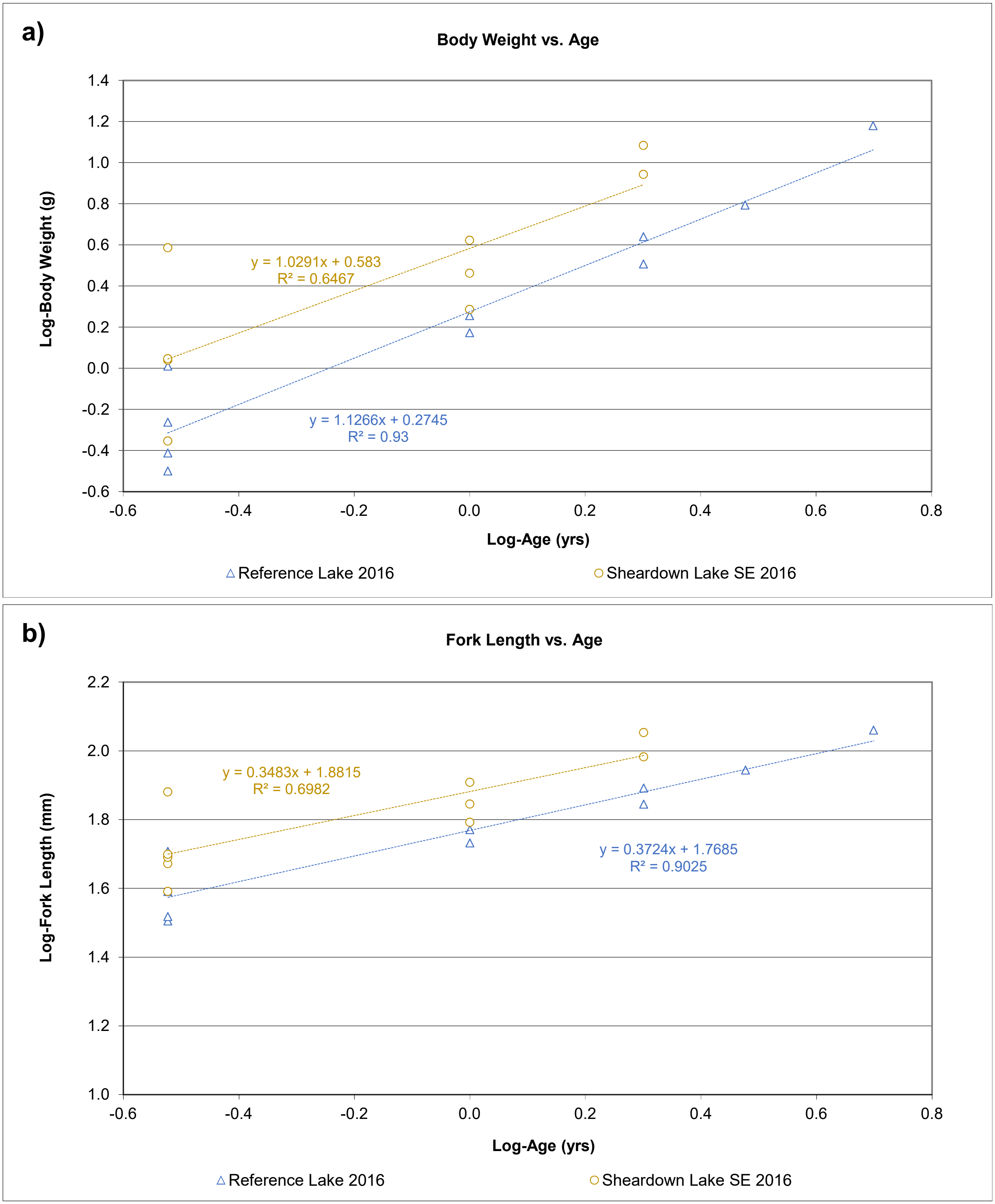
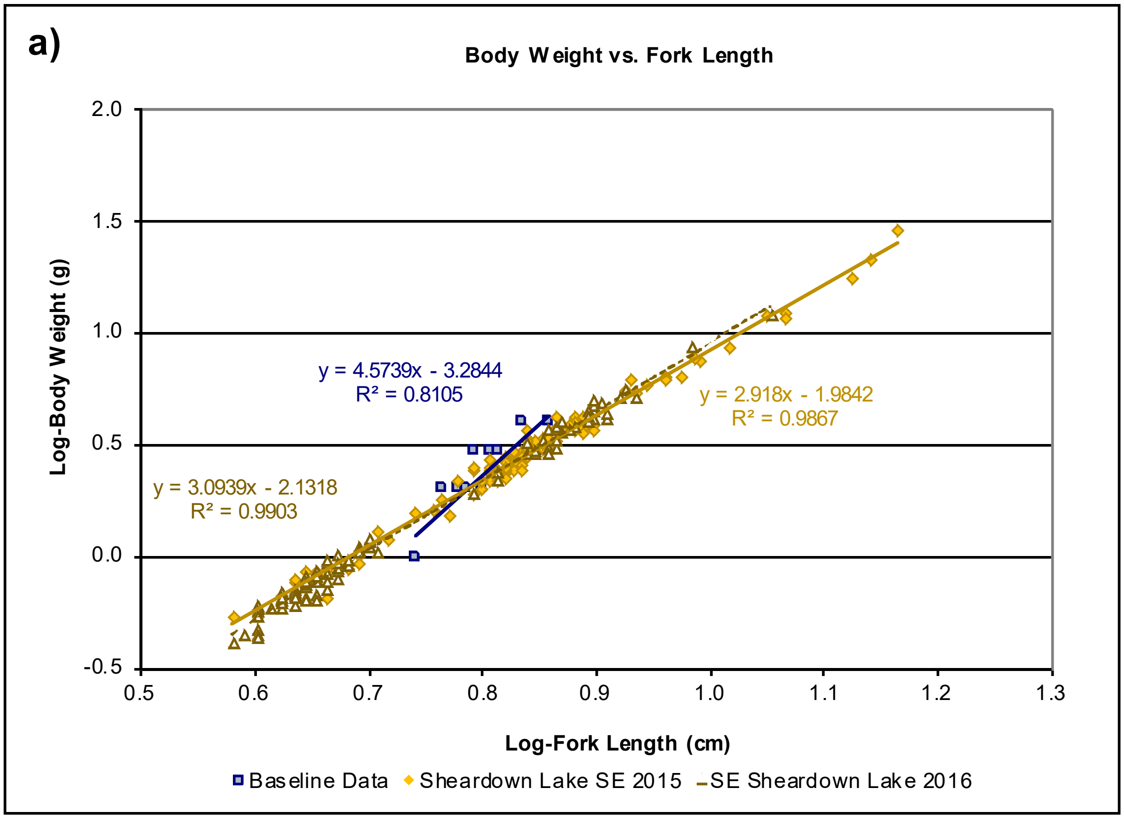


Figure G.15: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected at the nearshore area of Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2016.



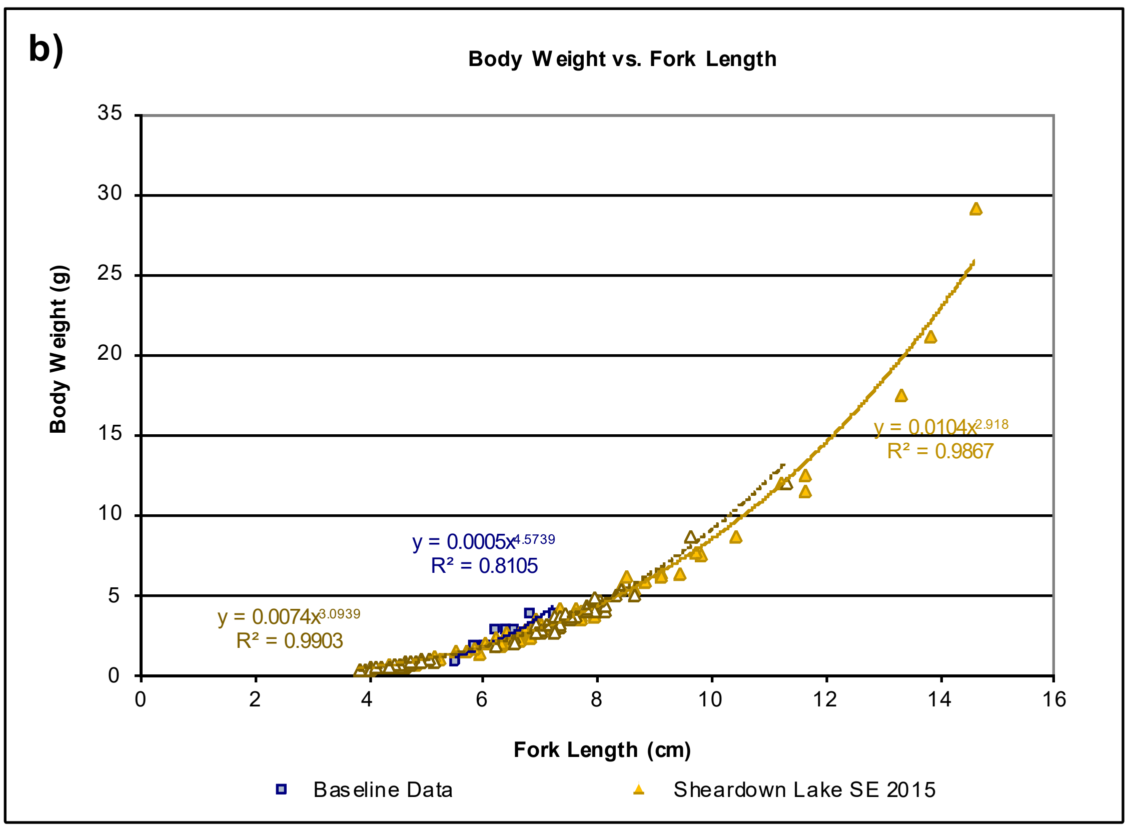
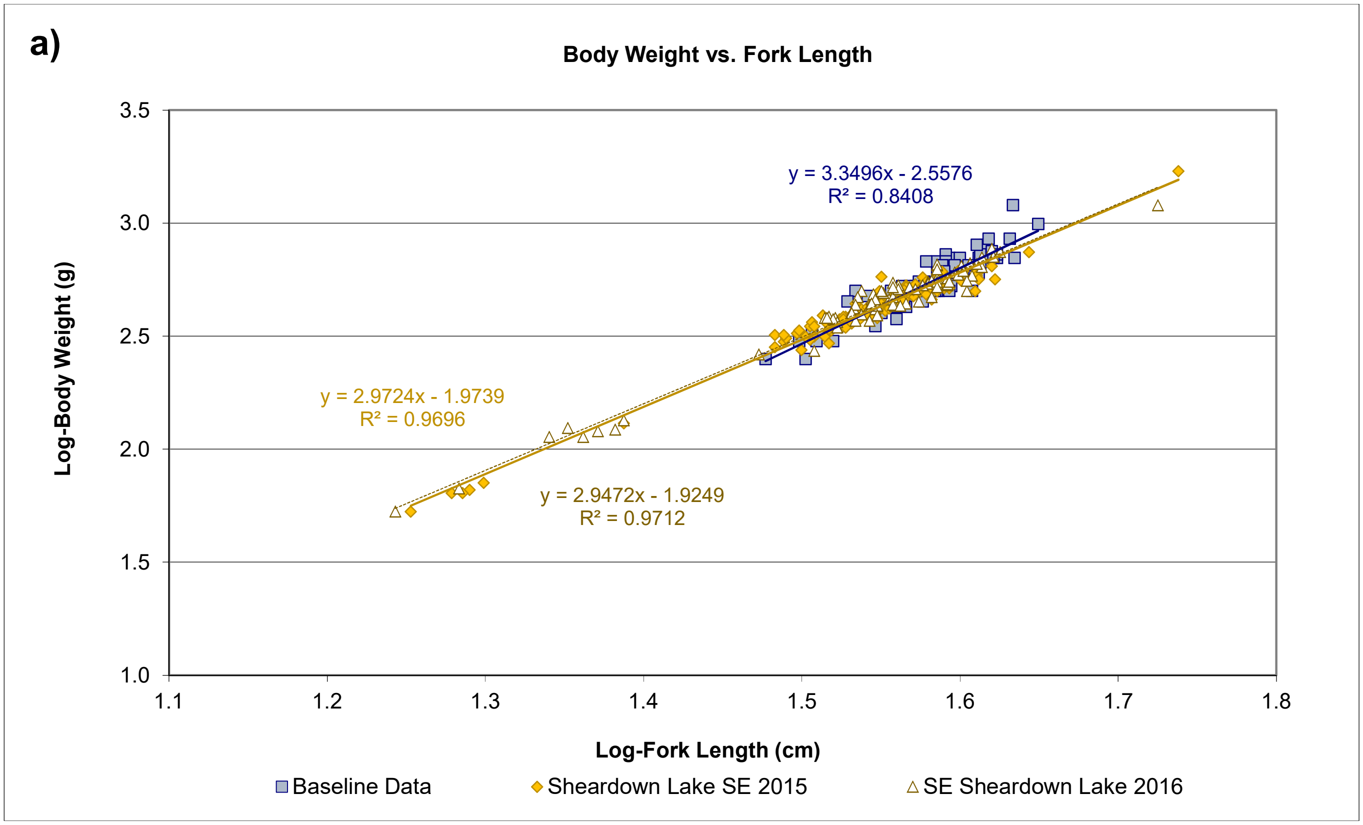


Figure G.16: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake SE nearshore areas in 2016, 2015 and over the mine baseline period (2007) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.



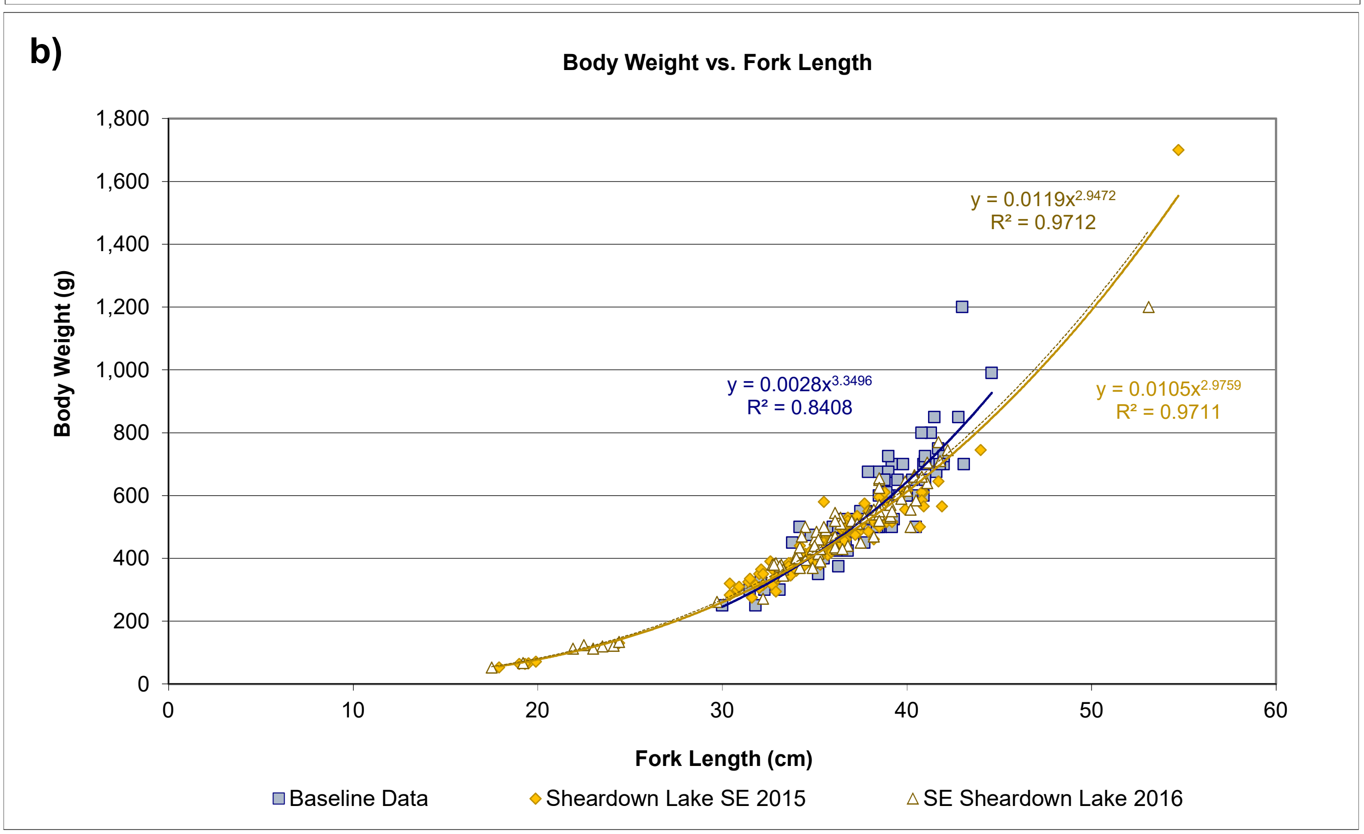
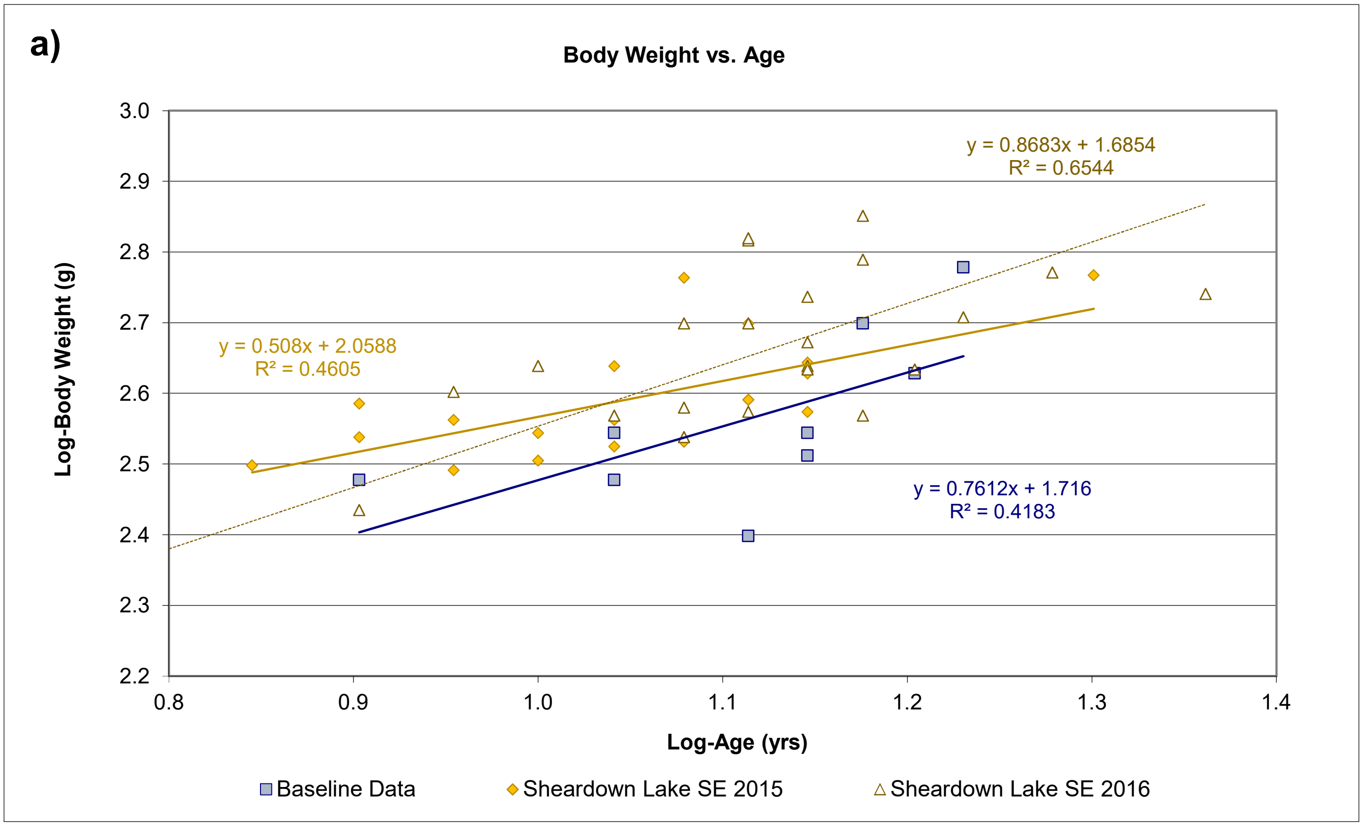


Figure G.17: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake SE nearshore areas in 2016, 2015 and during the mine baseline period (2007, 2008) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.



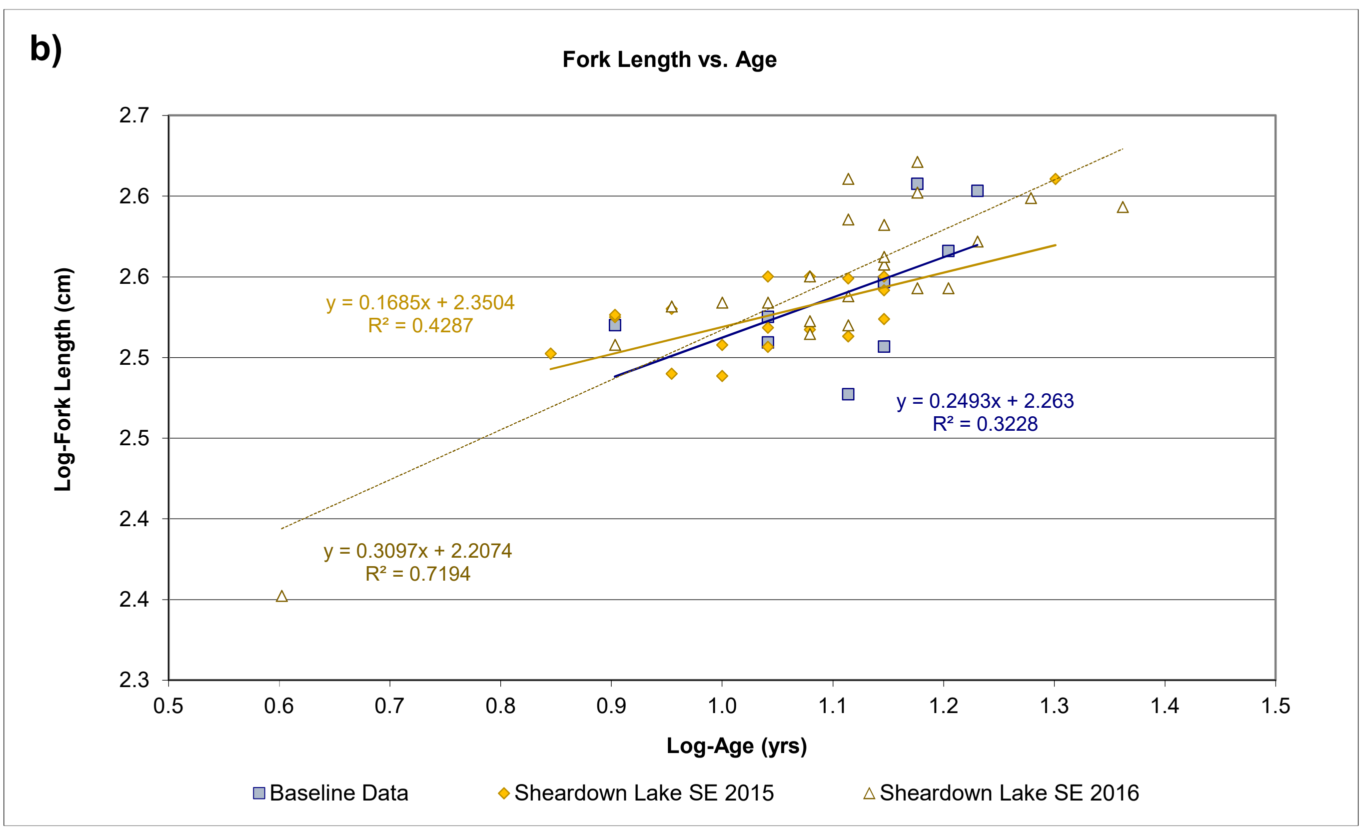
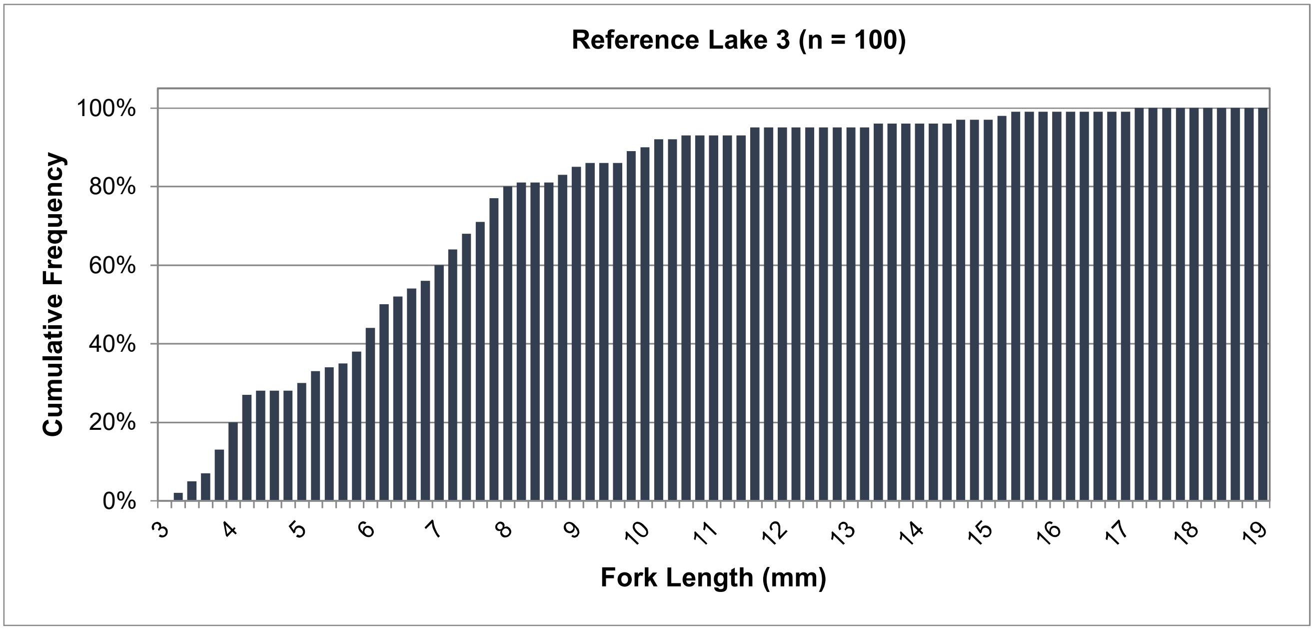


Figure G.18: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected in fall (August-September) at Sheardown Lake SE nearshore areas in 2016, 2015 and during the baseline period (2007), Mary River Project CREMP.



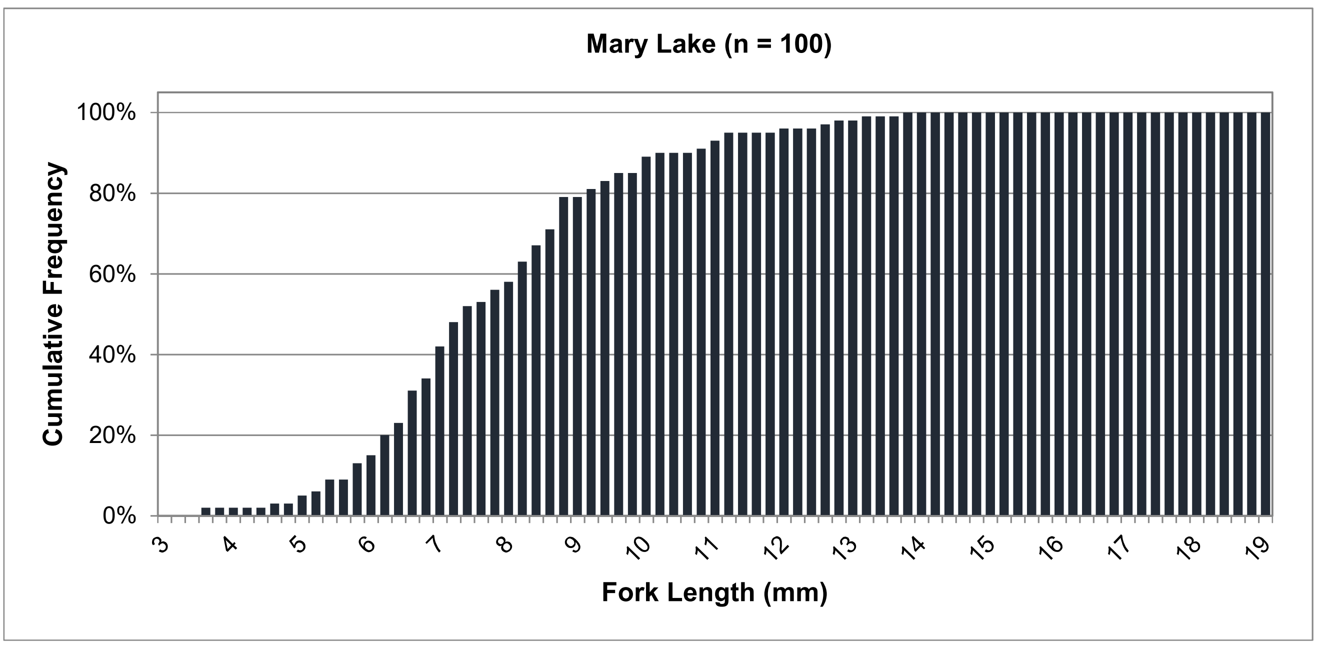


Figure G.19: Cumulative length-frequency distributions for juvenile Arctic charr captured by electrofishing at nearshore areas of Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2016.

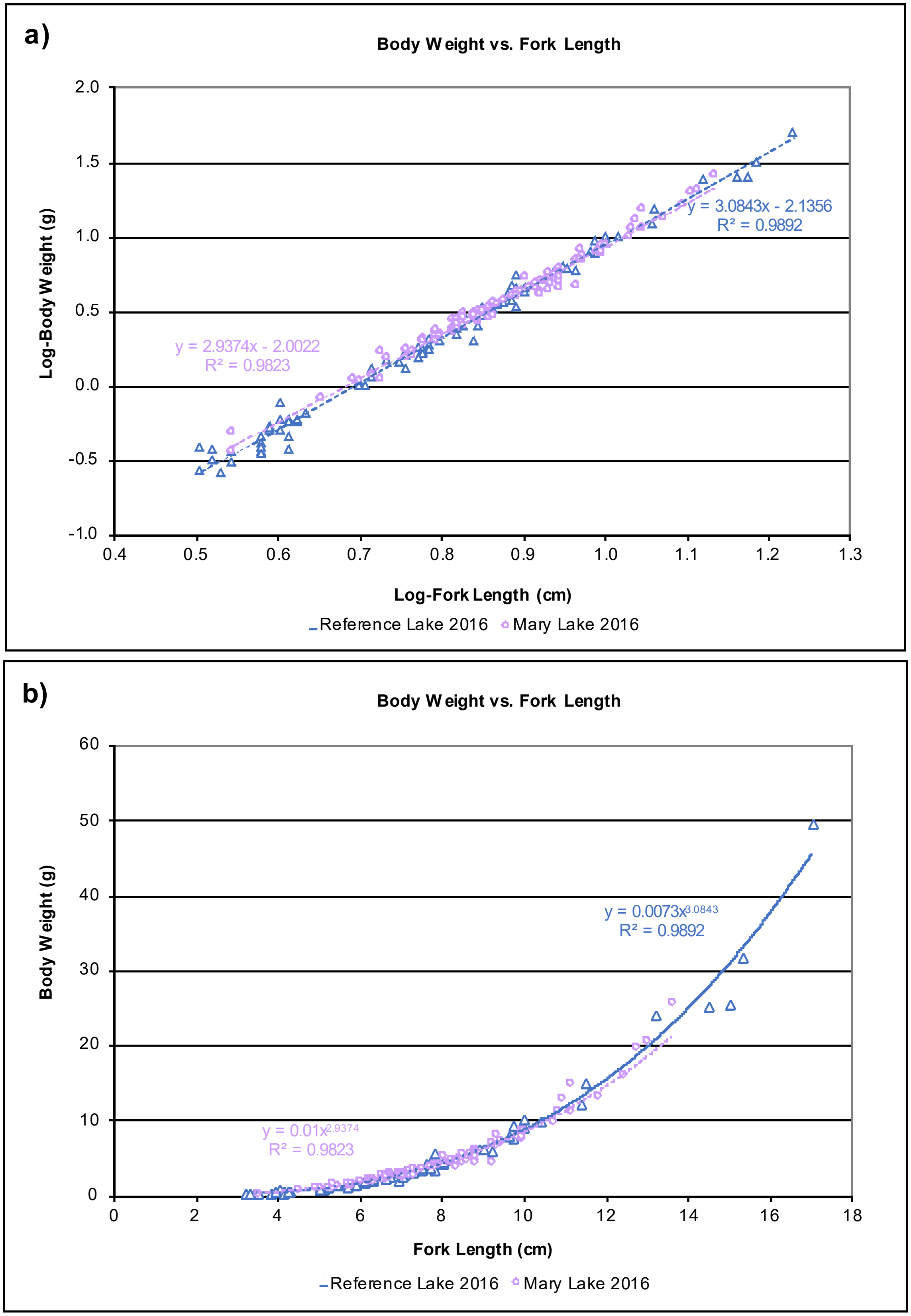
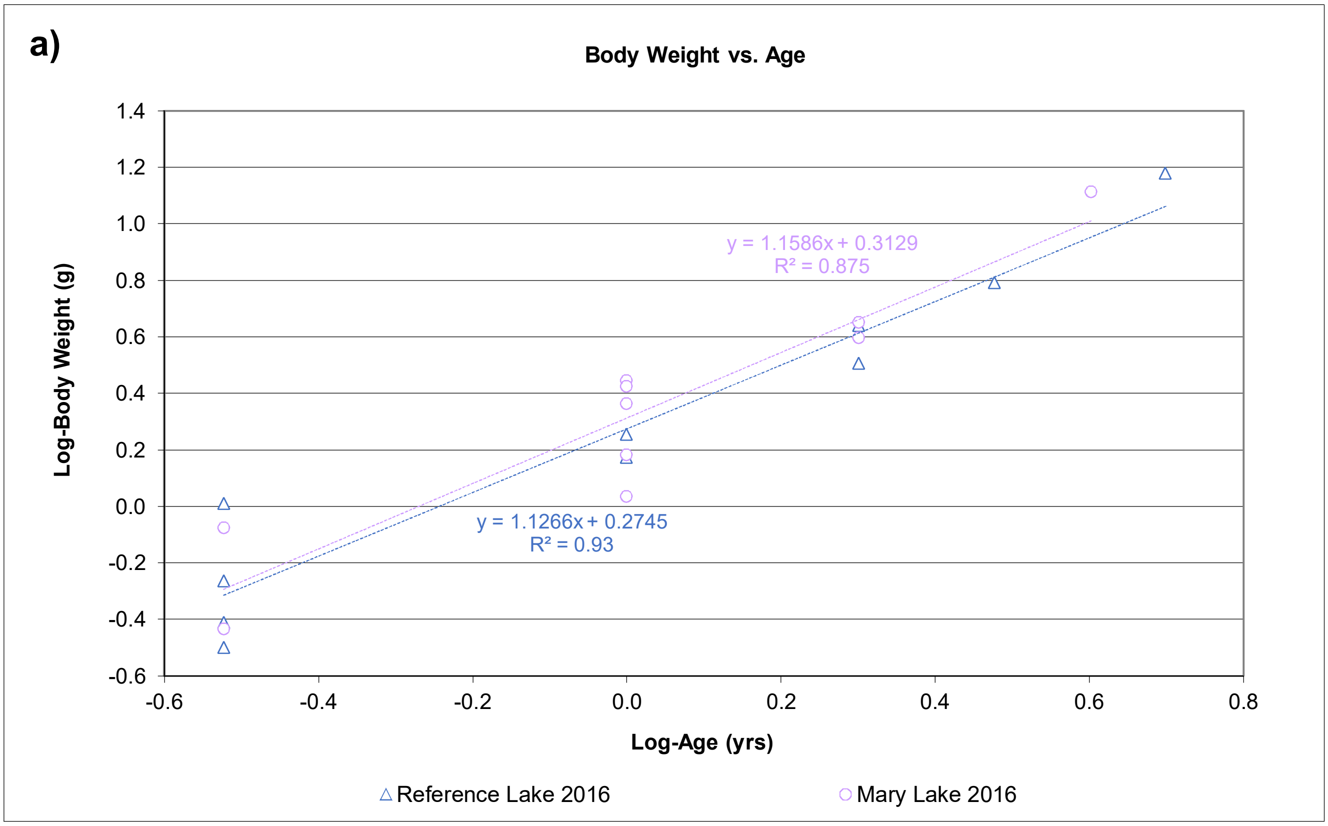


Figure G.20: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected at the nearshore area of Mary Lake and Reference Lake 3 in August 2016 using log-transformed (a) and untransformed (b) data, Mary River Project CREMP, 2016.



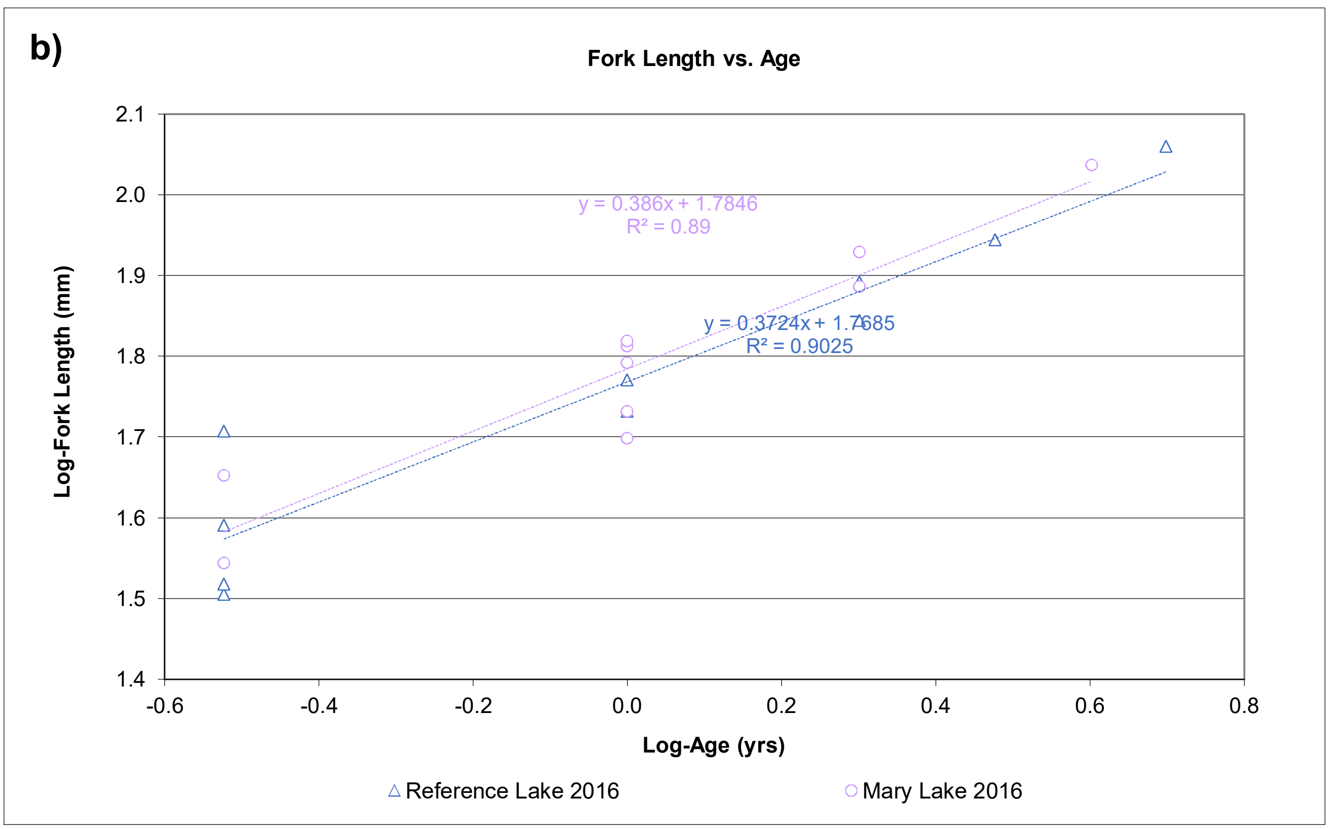
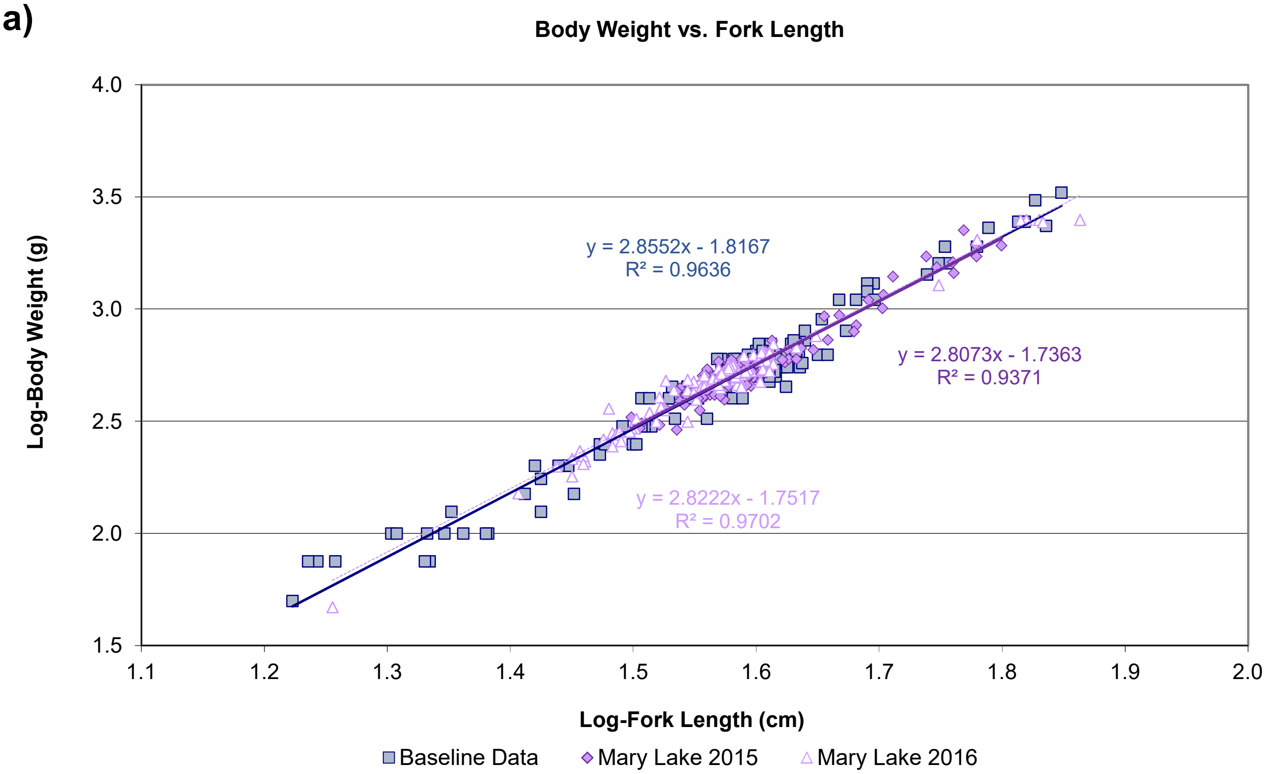


Figure G.21: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected at the nearshore area of Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2016.

a)



b)

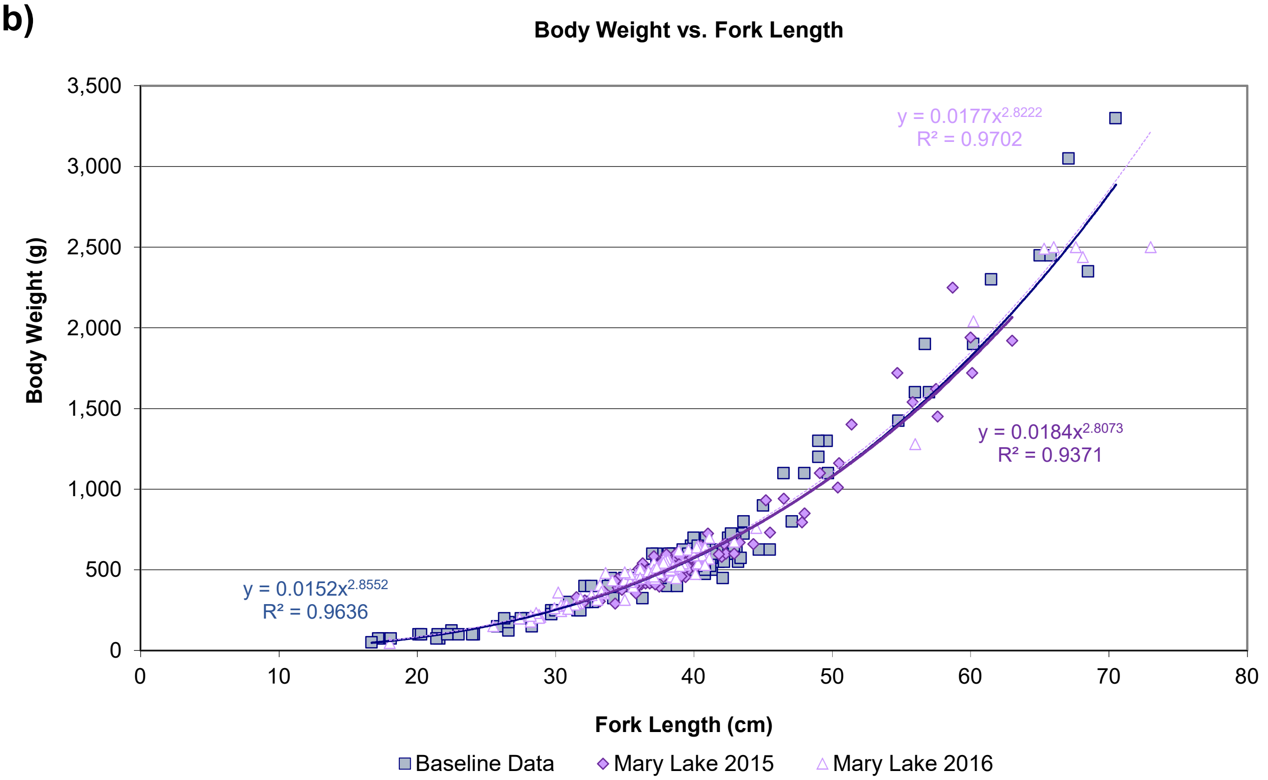
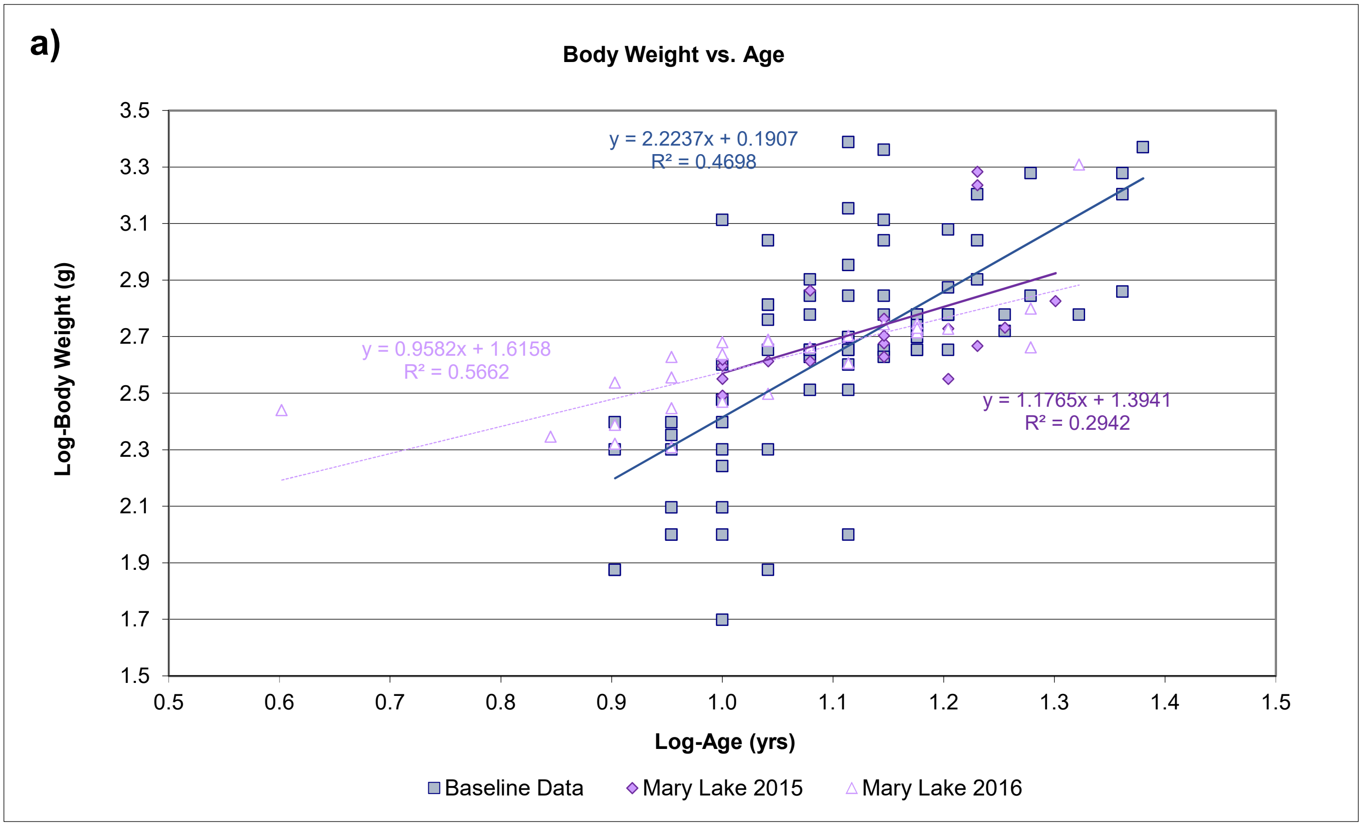


Figure G.22: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Mary Lake nearshore areas in 2016, 2015 and during the mine baseline period (2006, 2007) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.



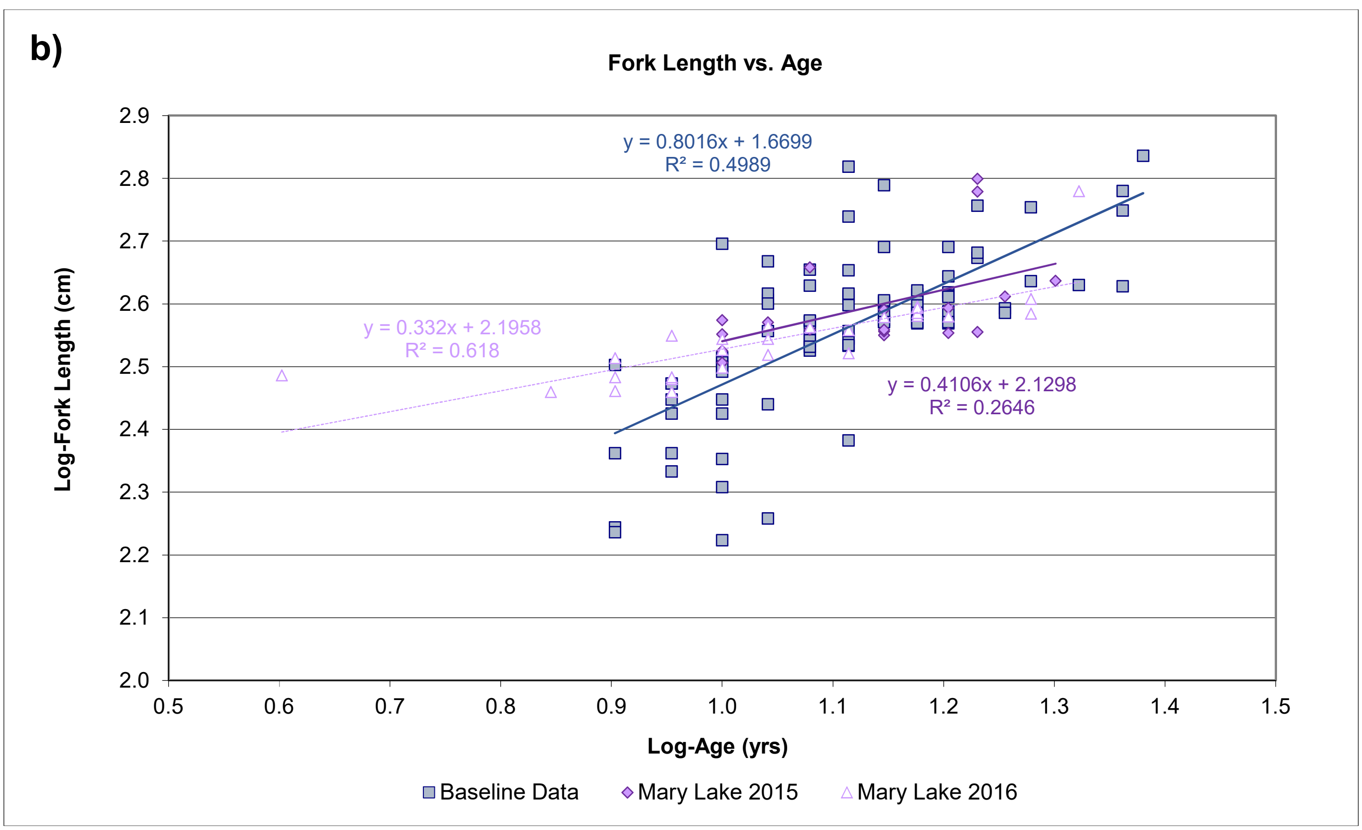


Figure G.23: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected in fall (August-September) at Mary Lake nearshore areas in 2016, 2015 and during the baseline period (2006, 2007), Mary River Project CREMP.