

APPENDIX E.10
AQUATIC EFFECTS MONITORING REPORTS

APPENDIX E.10.1

2015 CORE RECEIVING ENVIRONMENT MONITORING PLAN



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March 17, 2016

Mr. Jim Millard
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Dear Mr. Millard,

Re: Mary River Project CREMP Recommendations for Future Monitoring

In 2015, the Mary River Project CREMP was implemented to evaluate potential mine-related influences on chemical and biological conditions at aquatic environments located near the mine following the first full year of mine operation. The 2015 study was conducted with no deviations from the original CREMP study design (KP 2014; NSC 2014). The key findings of the CREMP suggested a mine-related influence to water and/or sediment quality at Camp Lake system water bodies, and to water quality at a tributary to Sheardown Lake, but no influence to water and sediment quality of Sheardown Lake, Mary River and Mary Lake. In addition, no adverse mine-related influences on phytoplankton, benthic invertebrates or fish (Arctic charr) populations were indicated at any of the Camp Lake, Sheardown Lake and Mary River/Mary Lake systems based on comparisons to reference conditions and to baseline information.

The CREMP was designed as an iterative system of monitoring and interpretation stages, with the results of previous studies used to inform the direction of future monitoring. Therefore, based on the results of the 2015 study, this letter outlines 19 recommendations for modifications of the CREMP design. The suggested modifications are not only intended to provide greater efficiencies to the program, but will also improve the ability of the program to meet the overall objectives (i.e., to evaluate short- and long-term effects of the project on aquatic ecosystems). Accordingly, the following recommendations applicable to stream water quality monitoring, lake water quality monitoring, stream sediment quality and benthic invertebrate community monitoring, lake sediment and benthic invertebrate community sampling and lake fish population monitoring are provided in separate sub-sections herein.

Stream Water Quality Monitoring

- 1) **Discontinue water quality monitoring at Station L1-09 (Camp Lake Tributary 1).** Currently, four water quality monitoring stations are located on the main stem of Camp Lake Tributary 1 (CLT1), with Stations L1-09 and L1-05 both located on the portion of the main stem between the confluence with the north branch and the mine tote road crossing. Monitoring conducted during the 2015 CREMP indicated that water chemistry at these stations was very similar, which can be expected since no sources of dilution occur between these stations. Therefore, the monitoring of two stations within this segment of the CLT1 is redundant.
- 2) **Add a water quality monitoring station to the lower Tom River.** Currently, water quality monitoring stations are located in the tributary exiting Camp Lake (Station J0-01) and on the Tom River upstream of the confluence with this tributary (Station I0-01), but not on the Tom River downstream of this confluence. Therefore, the addition of a water quality monitoring station on the Tom River downstream of the Camp Lake outlet stream confluence would provide information on potential mine-related influence on water quality of the Tom River (Figure 1).
- 3) **Add a water quality monitoring station to each of Sheardown Lake Tributary 12 and Sheardown Lake Tributary 9.** Although benthic invertebrate community sampling is conducted at both of these Sheardown Lake tributaries, no water quality monitoring is conducted on either tributary. Therefore, the addition of a water quality monitoring station on the lower segment of each of these tributaries would provide supporting information important to the interpretation of potential mine-related effects to benthic invertebrate communities of these tributaries (Figure 1).
- 4) **Discontinue water quality monitoring at Station D1-05 (Sheardown Lake Tributary 1).** Currently, two water quality monitoring stations, upstream Station D1-05 and downstream Station D1-00, are located on Sheardown Lake Tributary 1 (SDLT1). Water quality monitoring data collected at the downstream station is sufficient for evaluating mine related effects to water quality of SDLT1. Therefore, water quality monitoring at upstream station D1-05 does not provide additional information important to evaluating effects at SDLT1.
- 5) **Discontinue water quality monitoring at upstream Mary River Stations G0-09A and G0-09B.** The G0-09 series of stations, including G0-09A, G0-09 and G0-09B, are located on Mary River well upstream of the area of mine influence, and thus act as reference stations. Due to the close proximity of all three G0-09 series stations to one another, the water quality data provided from all three stations is redundant. The sampling of a single station at this upstream area is sufficient for interpreting potential effects of the Mary River Project on water quality of Mary River.

- 6) **Discontinue water quality monitoring at Station C0-01 (Mary River).** Because no substantial sources of dilution to Mary River occur between the current C0-05 and C0-01 water quality monitoring stations, Station C0-01 does not provide any additional, useful, information for the evaluation of potential mine influence on Mary River or Mary Lake.

Lake Water Quality Monitoring

- 7) **Reduce the number of water quality monitoring stations to three (3) in each of Camp, Sheardown NW and Sheardown SE lakes, and four (4) in Mary Lake.** No consistent spatial differences in water chemistry were evident in any of the mine-exposed or reference lakes in 2015, nor during any of the baseline studies. In addition, *in-situ* water quality profile data collected in 2015 indicates that all lakes are generally well mixed both laterally and vertically, and as a result, water chemistry is likely to be relatively uniform throughout these lakes during most sampling conditions. Therefore, the sampling of several water quality monitoring stations within these lakes is redundant. Accordingly, it is recommended that for each study lake, only three existing water quality monitoring stations be sampled at each lake using the locations provided in the table below and illustrated in Figure 2.

Lake	Station ID	Depth (m)	Description
Reference Lake 3	REF03-01	15.1	East end of southeast basin
	REF03-02	30.4	Centre of southeast basin
	REF03-03	37.5	Centre of northwest basin
Camp Lake	JLO-02	12.3	Littoral station near primary lake inlet (CLT1, CLT2)
	JLO-07	32.7	Deep basin, near centre of lake
	JLO-09	14.3	Near lake outlet
Sheardown Lake NW	DD-Hab9-Stn1	10.3	Near inlet from SDLT1
	DLO-01-2	17.5	Deep location, near centre of northwest basin
	DLO-01-7	11.4	Near lake outlet
Sheardown Lake SE	DLO-02-6	7.1	Near inlet from Sheardown Lake NW
	DLO-02-3	13.7	Deep location, near centre of southeast basin
	DLO-02-4	8.05	Near inlet from SDLT9
Mary Lake	BLO-1A	14.65	Deepest location at the north basin
	BLO-5	21	Near inlet from Mary River
	BLO-9	30	Deepest location at the south basin
	BLO-6	6.8	Near lake outlet

- 8) **Conduct water quality profiling at only a single station in each of Camp, Sheardown NW and Sheardown SE lakes, and two stations at Mary Lake.** No consistent spatial differences in *in-situ* water quality depth profiles were evident among stations at each mine-exposed and reference lake in 2015, nor would they be expected under typical mixing patterns driven by density gradients (Wetzel 2001). Therefore, it is recommended that water quality profiling be conducted only at the main (i.e., deepest) basin of each study lake, except at Mary Lake where water quality profiling is recommended at the north and south basins, to provide information on lake stratification. Stations recommended for the implementation of water quality profiling include:

Camp Lake Station JL0-07;
Sheardown Lake NW Station DL0-01-2;
Sheardown Lake SE Station DL0-02-3;
Mary Lake (north basin) Station BL0-1A;
Mary Lake (south basin) Station BL0-9; and,
Reference Lake 3 (northwest basin) Station REF03-3.

- 9) **Collect water samples only from mid-water column at each lake water quality monitoring station.** Currently, water chemistry and chlorophyll a samples are collected from approximately 1 m below the surface and 1 m above the bottom at each lake monitoring station (i.e., 2 samples per station). Water chemistry data collected during the 2015 CREMP, as well as during baseline studies, has generally shown only minor (i.e., <2-fold higher) differences in water chemistry and chlorophyll a concentrations between the surface and bottom at each station. Therefore, the collection of a single water sample from approximately mid-column will be sufficient for evaluating average water quality conditions at each lake water quality monitoring station unless it is determined that the lake is thermally (or otherwise) stratified, in which case the same sampling convention from previous studies will be applied (i.e., top-bottom). Interpretation of *in-situ* water quality profile data collected at the main basin of the lake will be used as the basis for determination of whether one or two water samples will be collected from each respective lake station during each winter, summer or fall sampling event.

Stream Sediment and Benthic Invertebrate Community Monitoring

- 10) **Discontinue stream sediment quality monitoring as part of the CREMP.** Stream sediment sampling was included in the Mary River Project CREMP to provide qualitative information to support the lake sediment quality data analysis (KP 2014, 2015). Streams and rivers in the Mary River Project local study area (LSA) contain very limited depositional habitat suitable for the collection of fine sediments. The general absence of any substantial accumulation of fine sediments within these watercourses precluded any meaningful assessment of potential mine-related influences on sediment quality within, along and/or between watercourses during the 2015 CREMP, as well as during baseline studies (KP

2015). Because the current sediment sampling program provides no ecologically meaningful information considered useful for the evaluation of potential mine-related effects, it is recommended that stream sediment sampling be discontinued.

11) Add a benthic invertebrate community study area to the CLT1 upper main stem.

Elevated concentrations of chloride, iron, nitrate and other parameters were observed at the upper main stem area of CLT1 (Station L2-03) in 2015 compared to reference conditions and the mine baseline period, with iron concentrations above water quality guidelines and AEMP benchmarks at this area. Mine-related influence on water quality of CLT1 was consistent with blasting/quarrying activity at the QRM2 pit. Therefore, the addition of a benthic invertebrate community study area to CLT1 near Station L2-03 is recommended to evaluate potential biological effects associated with mine activity in the upper portion of the CLT1 watershed. The benthic invertebrate community sampling will follow the same approach as that employed elsewhere for the stream program (Figure 3).

12) Discontinue benthic invertebrate community sampling at the two upper reaches of Sheardown Lake Tributary 1 (SDLT1).

Currently, three benthic invertebrate community study areas are situated on SDLT1. Similar to sampling conducted at Sheardown Lake Tributary 9 and Tributary 12, one study area is sufficient for evaluating mine related effects to the benthic invertebrate community of SDLT1. This study area should be situated at the lower creek reach (Reach 1) to provide temporal continuity with previous studies, and because water chemistry data is also collected at this location (i.e., Station D1-00).

13) Add a stream reference benthic invertebrate community study area.

No stream reference study area has been established for the stream benthic invertebrate community component of the CREMP (NSC 2014). Therefore, in order to provide a stronger basis for evaluating mine-related effects to biota residing in the mine-exposed tributaries of Camp and Sheardown lakes, it is recommended that a reference study area be incorporated into the program. The ideal reference area should share similar habitat features with the mine-exposed tributaries (e.g., similar width, water velocity, substrate size, etc.) and be outside the area of mine influence. It is recommended that one of the watercourses used as a lotic reference for water monitoring (i.e., CLT-REF4, MRY-REF2, MRY-REF3) also serve as a reference area for the stream benthic invertebrate community assessment (Figure 3). The determination of the most suitable reference watercourse, based on similarity in habitat characteristics to the mine-exposed tributaries, can be selected during the next CREMP biological field study (i.e., August 2016).

Lake Sediment and Benthic Invertebrate Community Monitoring

14) Consider updating the AEMP sediment quality benchmarks.

On average, arsenic, copper and iron concentrations were elevated above respective AEMP sediment quality benchmarks within Reference Lake 3 littoral and/or profundal station sediment during the 2015 CREMP. In turn, this suggested that the AEMP benchmarks for these metals may

be overly conservative. Because reference lake information had not been available at the time of AEMP benchmark development, it is recommended that reference sediment quality data be factored into the derivation of AEMP benchmarks for arsenic, copper and iron to improve the applicability of these benchmarks as a tool for evaluating potential mine effects for the Mary River Project CREMP.

- 15) **Focus the lake benthic invertebrate community (benthic) survey only on the littoral zone.** Benthic invertebrate density, richness and relative abundance of dominant groups, including metal-sensitive taxa, differed significantly between littoral (shallow) and profundal (deep) stations of the reference lake during the 2015 CREMP, which is consistent with general distribution patterns of benthic invertebrates with depth in lakes (Ward 1992). Thus, the sampling of benthic invertebrates at profundal depths limits the ability to evaluate the occurrence and/or magnitude, of mine-related effects on biota due to natural factors being more important drivers of community structure than mine-related contaminants of concern at these depths (e.g., naturally lower oxygen and food resources with depth). Therefore, it is recommended that benthic sampling at mine-exposed lakes focus solely on littoral sampling depth (i.e., approximately 8 – 10 m depth). Consistent with Environmental Effects Monitoring (EEM) guidance under the Metal Mining Effluent Regulations (MMER), it is recommended that five stations be sampled at each mine-exposed lake (Environment Canada 2012) at littoral sampling depths. To the extent possible, the littoral sampling stations will be established at existing benthic stations at Camp, Sheardown NW, Sheardown SE and Mary mine-exposed lakes, as well as at Reference Lake 3 (Figures 2 and 3). However, in some cases, new stations will be need to be established to ensure sufficient coverage of the lake, and to ensure that substrate properties are comparable among and within lakes. Under this recommendation, benthic sampling would be discontinued at all profundal stations, resulting in a total of 25 lake benthic stations in the CREMP rather than 50 currently (Figures 2 and 3).
- 16) **Harmonize the lake sediment quality and benthic invertebrate community monitoring stations.** Currently, sediment chemistry data is not collected at all benthic invertebrate community sampling stations, limiting the ability to establish linkages between sediment metal concentrations and potential effects on benthic invertebrates. Therefore, it is recommended that sediment samples be collected at all benthic invertebrate community stations and analyzed for particle size, total organic carbon (TOC), and total metals concentrations as part of the CREMP.
- 17) **Restructure the lake sediment quality monitoring program to reflect changes in the benthic invertebrate community survey sampling station locations.** To accommodate the recommended changes to the lake benthic invertebrate community survey, it is recommended that sediment quality monitoring station locations be re-located to the same five littoral benthic sampling depths/stations per lake discussed above (Recommendation 15). In addition, to maintain proper coverage of each study lake and

ensure temporal continuity, it is recommended that three profundal sediment sampling stations be maintained in the program for each mine-exposed lake, resulting in a total of eight sediment quality monitoring stations at all mine-exposed lakes except Sheardown Lake SE, where the majority of the lake is less than 12 m deep (i.e., representative of littoral habitat). Under this approach, the total number of sediment quality monitoring stations sampled would be reduced from 33 currently to 29. The profundal sediment quality stations recommended for inclusion in the CREMP are provided in the table below, and are shown on Figures 2 and 3.

Lake	Station ID	Depth (m)	Sediment Profundal Station Description
Camp Lake	JLO-14	26.5	Central basin – east (inlet area)
	JLO-07	32.7	Central basin – middle
	JLO-11	28.8	Central basin – west (outlet area)
Sheardown Lake NW	DLO-01-5	23.1	Central basin – north
	DLO-01	20.8	Central basin – middle
	DLO-01-2	18.6	Central basin – south
Mary Lake	BLO-12	21.7	South basin – near Mary River inlet
	BLO-10	18.7	South basin – middle
	BLO-08	26.7	South basin – near lake outlet

Lake Fish Population Monitoring

- 18) **Reduce the non-lethal adult Arctic charr sample size to 50 fish per lake.** The adult Arctic charr fish population survey currently targets 100 fish from each study lake using a ‘non-lethal’ sampling approach (KP 2014, 2015). Based on data acquired during the 2015 CREMP, power analysis indicated that total sample sizes can be reduced by half (i.e., 50 fish) while still maintaining the ability to detect changes between lakes and/or between study periods with sufficient power. Therefore, it is recommended that sample sizes for adult Arctic charr be reduced from 100 to 50 in future CREMP studies. By doing so, the number of incidental mortalities would be reduced substantially. A total of 57 adult Arctic charr incidental mortalities were encountered during the 2015 CREMP under normal sampling conditions, and therefore, by reducing the amount of effort applied, the number of incidental mortalities may be reduced to less than 25 without affecting the ability of the program to meet study objectives.
- 19) **Focus the current collection gear for optimal capture rates for adult Arctic charr.** Currently, gang index gill nets with net mesh sizes ranging from 25 – 127 mm are prescribed to capture adult Arctic charr at all study lakes under the CREMP (NSC 2014, 2015). During the 2015 CREMP, the majority of Arctic charr were captured in net mesh

sizes ranging from 38 – 64 mm, which was also similar to the most efficient mesh size used to capture adult Arctic charr during the previous baseline studies. Therefore, it is recommended that the 38 – 64 mm mesh size be adopted as the 'standard' size used to collect fish samples for the CREMP. In doing so, it is anticipated that fewer incidental mortalities will be encountered (e.g., reduced handling time) and additional sampling efficiencies will be gained.

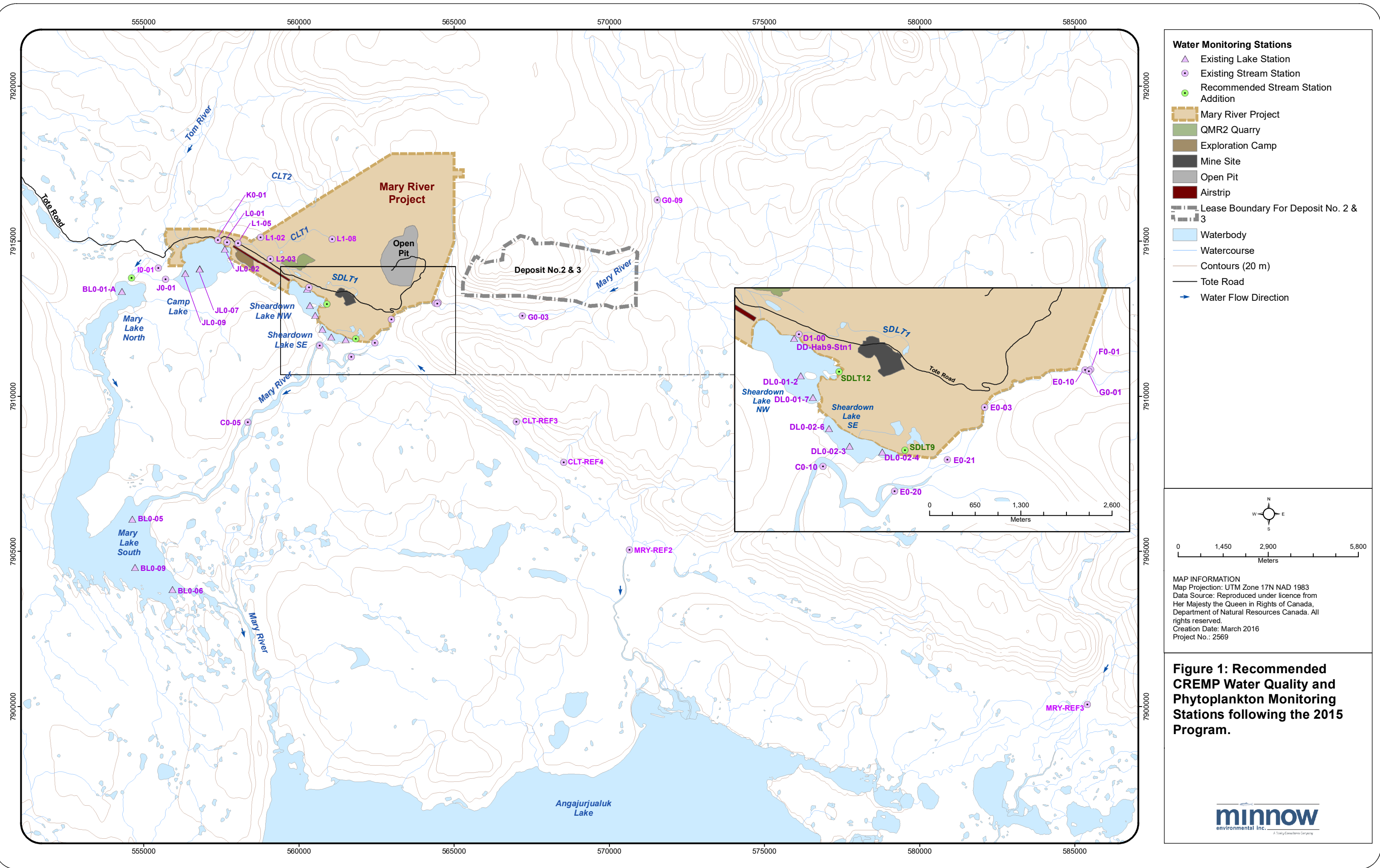
As mentioned previously, we believe the 19 suggested modifications outlined above will not only provide greater efficiencies to the CREMP, but are also scientifically defensible and will maintain and, in some cases, improve the ability of the program to meet the overall objectives set out under the AEMP. Should you have any questions, or require additional supporting information regarding these recommendations, please do not hesitate to contact me.

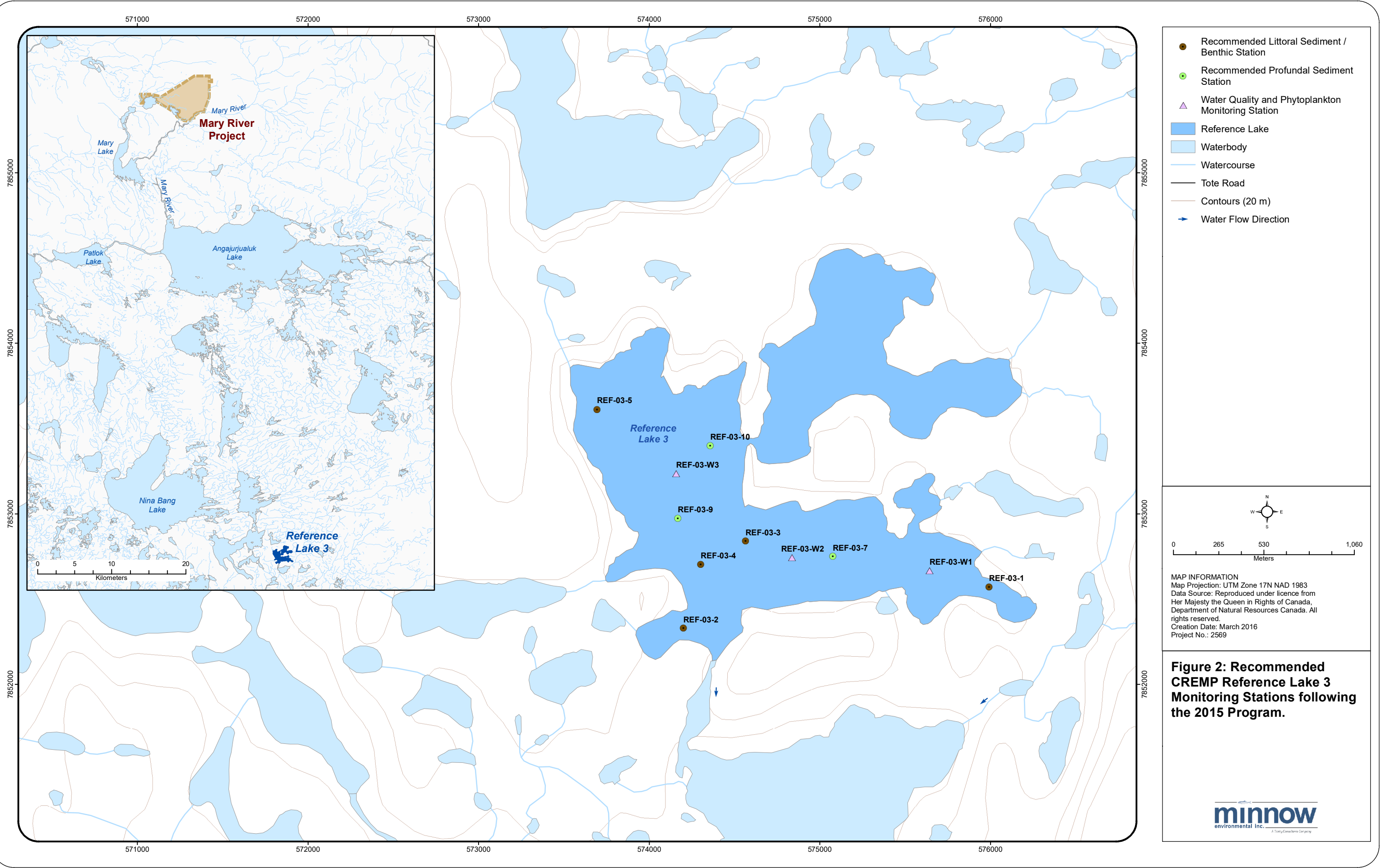
Sincere regards,

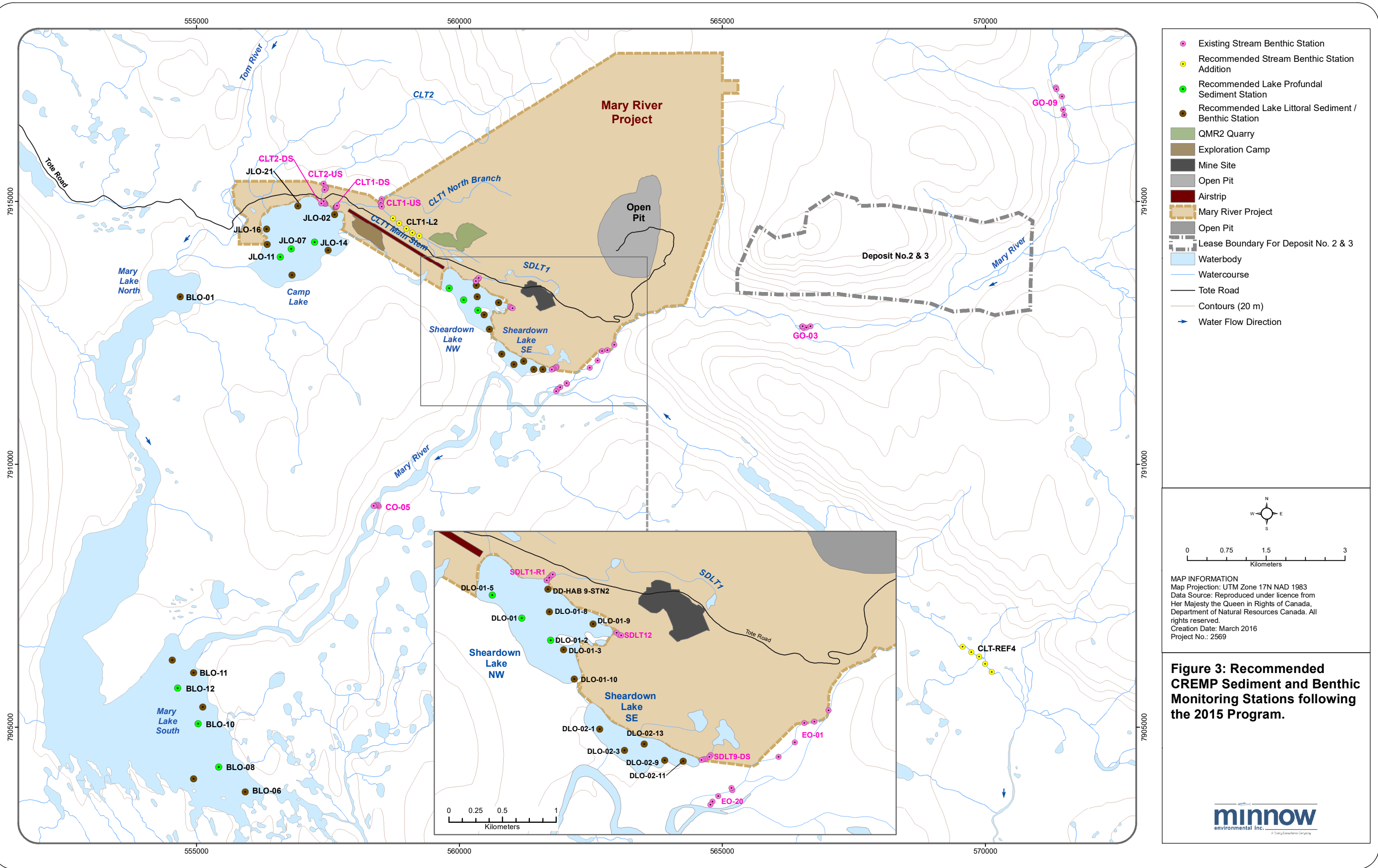
Minnow Environmental Inc.

A handwritten signature in blue ink, appearing to read 'Paul LePage', is positioned above the printed name.

Paul LePage, M.Sc.
Senior Project Manager









**Mary River Project 2015
Core Receiving Environment
Monitoring Program Report**

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

Prepared By:
Minnow Environmental Inc.
Georgetown, ON

March 2016

Mary River Project 2015 Core Receiving Environment Monitoring Program Report

Report Prepared for:

**Baffinland Iron Mines Corp.
Mary River Project**

**Report Prepared by:
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March 2016

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 (contour strip) 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. 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 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, 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 2015 CREMP study, 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 2015 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. In 2015, the CREMP approach transitioned from a characterization-based study, which was used prior to the mine becoming operational to provide a baseline for future evaluation of mine effects, to an effects-based approach that incorporated standard environmental effects monitoring techniques to provide a stronger basis for the evaluation of potential mine-related effects within the mine aquatic receivers. 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 to applicable reference data and to available baseline data. The principal conclusions of the 2015 CREMP for each of these aquatic systems are separately discussed 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). Concentrations of mine parameters including chloride, iron, nitrate and sulphate were the primary constituents reflecting a mine-related influence within CLT1 based on elevation (i.e., ≥ 3 -fold higher) relative to reference conditions and concentrations observed during the baseline (2005 – 2013) period. Of these parameters, only iron concentrations were above applicable water quality guideline (WQG) and AEMP benchmarks, but only at the upper-most monitoring station on the CLT1 main stem. Active quarrying at the QMR2 pit in 2015 likely served as the key source for these parameters at CLT1. Water chemistry at Camp Lake Tributary 2 (CLT2) and at Camp Lake was similar to reference areas 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 limited to the upper main stem of CLT1, with no effects suggested at CLT2 or Camp Lake itself, following the initial year of mine operation.

At Camp Lake, sediment arsenic and manganese concentrations were slightly elevated (i.e., 2- to 5-fold higher) at the single littoral monitoring station compared to mean reference lake concentrations, and these metals as well as calcium, molybdenum and phosphorus were also elevated compared to the baseline period. No metals were elevated in sediment of the profundal stations compared to the reference lake, and with the exception of slightly elevated calcium and manganese concentrations, sediment metal concentrations at profundal stations were similar to the baseline period. In turn, this suggested a mine-related influence to sediment quality near the CLT1 inlet to Camp Lake, but this mine influence did not extend to the profundal stations. No metals were elevated above sediment quality guidelines (SQG) and/or AEMP sediment quality benchmarks at Camp Lake that were not also elevated above these criteria at the reference lake, which suggested natural elevation of certain metals (i.e., iron and manganese). This suggested a low potential for adverse effects to biota as a result of the elevation in concentrations of these metals relative to SQG and AEMP benchmarks at Camp Lake.

Chlorophyll a concentrations within the Camp Lake system showed no consistent differences relative to reference or baseline concentrations except at the CLT1 upper main stem. Higher chlorophyll a concentrations at the CLT1 upper main stem compared to reference and baseline was consistent with a slight enrichment effect in 2015 that likely reflected increased nitrate inputs from the mine. Nevertheless, chlorophyll a concentrations remained well below the AEMP benchmark at all Camp Lake system receivers in 2015 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. The fish population survey indicated larger, faster growing juvenile Arctic charr at Camp Lake compared to the reference lake, and no ecologically meaningful differences in the health of juvenile or adult Arctic charr at Camp Lake between the 2015 and baseline periods, suggesting no mine-related effects on the resident fish population. Overall, consistent with water 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 mine-related influences to the biota of the Camp Lake system following the initial year of mine operation at the Mary River Project.

Sheardown Lake System

At Sheardown Lake Tributary 1 (SDLT1), nitrate and sulphate were the only mine parameters elevated above average concentrations from the lotic reference stations and average concentrations during the baseline period, suggesting an on-going mine-related source of these parameters. However, no parameters were elevated above WQG or the AEMP benchmarks at SDLT1, suggesting limited potential for adverse effects on aquatic biota within SDLT1. Within Sheardown Lake, aluminum was the only mine parameter observed at elevated (i.e., ≥ 3 -fold higher) concentrations compared to the reference lake, but aluminum and all other parameter concentrations were similar to respective concentrations during the baseline period, and none were elevated above WQG or AEMP benchmarks, suggesting low potential for adverse effects to biota within the lake. Total aluminum concentrations at Sheardown Lake were positively correlated with turbidity (i.e., a proxy for suspended particulate matter) introduced to the lake as a result of Mary River inflow, and therefore elevated aluminum concentrations did not reflect a mine influence on Sheardown Lake water quality. Sediment metal concentrations at Sheardown Lake were similar to the reference lake and, with the exception of slightly elevated (i.e., 2- to 3-fold higher) sediment arsenic and manganese concentrations at littoral stations, were similar to concentrations observed during the baseline period. No metals were present at concentrations above SQG or AEMP

benchmarks that were not also above these criteria at the reference lake (iron and manganese only), suggesting low potential for any adverse effects to biota associated with these metals.

Chlorophyll a concentrations at SDLT1 and Sheardown Lake were similar to, or greater than, those at respective reference areas, and were also similar to chlorophyll a concentrations reported during mine baseline/construction periods. Chlorophyll a concentrations were consistently well below the AEMP benchmark at all Sheardown Lake system monitoring stations, suggesting no adverse mine-related effects to phytoplankton within the system. No adverse mine-related influences to the benthic invertebrate community were apparent at SDLT1, although significantly higher benthic invertebrate density and relative abundance of filterers compared to the baseline period suggested a slight enrichment influence that could be associated with higher aqueous nitrate concentrations in 2015. The benthic invertebrate communities at Sheardown Lake Tributary 12 (SDLT12) and Tributary 9 (SDLT9) remained relatively unchanged between the mine baseline and operational (2015) periods, which suggested no change in biological conditions at these tributaries since the initiation of mining activities. Benthic invertebrate density, richness and relative abundance metal sensitive taxa did not differ significantly, or were significantly higher, at Sheardown Lake than at the reference lake in 2015 which, coupled with close similarity (and no ecologically meaningful differences) in most benthic invertebrate community metrics relative to the baseline period, suggested no adverse mine-related effects on the benthic invertebrate community of Sheardown Lake in 2015. Juvenile Arctic charr at Sheardown Lake grew significantly faster than at the reference lake, and no significant (ecologically meaningful) differences in juvenile growth and adult growth and condition were indicated at the Sheardown Lake basins compared to the baseline period, which suggested no adverse mine-related influences on the Arctic charr population of Sheardown Lake in 2015. Overall, consistent with water 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 mine-related influences to the biota of the Sheardown Lake system following the initial year of mine operation at the Mary River Project.

Mary River and Mary Lake System

At Mary River, no adverse mine-related influence on water chemistry was apparent based on evaluation of dissolved metals relative to the lotic reference stations, as well as on comparison of all parameters to the baseline period water chemistry. At Mary Lake, aluminum was the only mine parameter observed at elevated (i.e., ≥ 3 -fold higher) concentrations in water compared to the reference lake in 2015. However, concentrations of

aluminum and all other parameters were not consistently elevated compared to concentrations observed during the baseline period, and none were ever above WQG or AEMP benchmarks. Highly turbid water at Mary River and Mary Lake originated from sources upstream of the mine, and therefore higher turbidity, as well higher total concentrations of aluminum and other metals potentially associated with this turbidity, was not related to mine activity. Therefore, the 2015 water quality data did not suggest any mine-related influences on water quality Mary River/Mary Lake system and, based on comparison to WQG and AEMP benchmarks, there was a low potential for adverse effects to biota within this system. Sediment metal concentrations at Mary Lake were similar to those at the reference lake in 2015 and, with the exception of slightly elevated (i.e., 2- to 3-fold higher) sediment calcium concentrations at littoral stations, were similar to concentrations observed during the baseline period. Although Mary Lake average concentrations of chromium, iron and manganese were above SQG, and the average concentration of arsenic was above the applicable AEMP benchmark, with the exception of chromium, concentrations of these metals were also above respective criteria at the reference lake, suggesting low potential for any adverse effects to biota associated with these metals.

Chlorophyll a concentrations were similar between Mary River and Mary Lake compared to respective lotic and lentic reference areas and, for Mary Lake, compared to concentrations observed during the baseline period as well. Lower chlorophyll a concentrations were indicated at individual Mary River stations in 2015 compared to the baseline and mine construction periods, but these differences likely reflected higher natural turbidity in 2015. In all cases, chlorophyll a concentrations were well below the AEMP benchmark, indicating adverse mine-related influences to phytoplankton of the Mary River/Mary Lake system were unlikely. The benthic invertebrate community of the Mary River and Mary Lake was generally similar to respective lotic and lentic reference areas in 2015, and with the exception of significantly lower density and richness at Mary River mine-exposed areas, was generally similar to respective communities during the baseline period as well. The differences in benthic invertebrate community metrics between 2015 and the baseline period at Mary River were not consistent with responses normally associated with mine activity and thus, were attributed to natural temporal variability. With the exception of significantly faster growing juvenile Arctic charr, no significant and/or ecologically meaningful differences in growth and condition of juvenile or adult Arctic charr were indicated at Mary Lake in 2015 compared to the reference lake or to the baseline period. Overall, no adverse mine-related influences to biota of Mary Lake were suggested by the phytoplankton, benthic invertebrate community and fish population survey results following the first year of mine operation at the Mary River Project.

TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
1.1	Background	1
1.2	Report Organization	2
2.0	METHODS	3
2.1	Water Quality	4
2.1.1	In-situ Water Quality Measurement Data Collection and Analysis	4
2.1.2	Water Chemistry Sampling and Data Analysis	6
2.2	Sediment Quality	8
2.2.1	Sample Collection and Laboratory Analysis	8
2.2.2	Data Analysis	9
2.3	Biological Assessment	10
2.3.1	Phytoplankton	10
2.3.2	Benthic Invertebrate Community Assessment	12
2.3.3	Fish Population Survey	15
3.0	OVERVIEW OF REFERENCE CONDITIONS	20
3.1	Reference Areas	20
3.2	Background Water Quality	21
3.2.1	Lotic Environments	21
3.2.2	Lake Environments (Reference Lake 3)	22
3.3	Sediment Quality Observations	23
3.3.1	Lotic Environments	23
3.3.2	Lentic Environments (Reference Lake 3)	23
3.4	Phytoplankton Productivity (Chlorophyll a) Observations	24
3.4.1	Lotic Environments	24
3.4.2	Lentic Environments (Reference Lake 3)	24
3.5	Benthic Invertebrate Community Observations	25
3.5.1	Lotic Environments	25
3.5.2	Lentic Environments (Reference Lake 3)	26
3.6	Fish Survey Observations	26
3.6.1	Lotic Environments	26
3.6.2	Lentic Environments (Reference Lake 3)	26
4.0	CAMP LAKE SYSTEM	28
4.1	Camp Lake Tributaries (CLT)	28
4.1.1	Water Quality	28
4.1.2	Phytoplankton (Chlorophyll a)	30
4.1.3	Benthic Invertebrate Community	31
4.2	Camp Lake (JLO)	33
4.2.1	Water Quality	33
4.2.2	Sediment Quality	35
4.2.3	Phytoplankton	37
4.2.4	Benthic Invertebrate Community	37
4.2.5	Fish Population Survey	39
4.3	Synthesis of Mine-Related Influences within the Camp Lake System	42
5.0	SHEARDOWN LAKE SYSTEM	45
5.1	Sheardown Lake Tributaries (SDLT1, 9 and 12)	45
5.1.1	Water Quality	45

5.1.2	Phytoplankton	46
5.1.3	Benthic Invertebrate Community	47
5.2	Sheardown Lake NW (DLO-1)	49
5.2.1	Water Quality	49
5.2.2	Sediment Quality	51
5.2.3	Phytoplankton	52
5.2.4	Benthic Invertebrate Community	53
5.2.5	Fish Population Survey	55
5.3	Sheardown Lake SE (DLO-2)	57
5.3.1	Water Quality	57
5.3.2	Sediment Quality	59
5.3.3	Phytoplankton	60
5.3.4	Benthic Invertebrate Community	61
5.3.5	Fish Population Survey	63
5.4	Synthesis of Mine-Related Influences within the Sheardown Lake System	65
6.0	MARY RIVER AND MARY LAKE SYSTEM	68
6.1	Mary River	68
6.1.1	Water Quality	68
6.1.2	Phytoplankton	70
6.1.3	Benthic Invertebrate Community	71
6.2	Mary Lake (BLO)	72
6.2.1	Water Quality	72
6.2.2	Sediment Quality	75
6.2.3	Phytoplankton	76
6.2.4	Benthic Invertebrate Community	77
6.2.5	Fish Population Survey	78
6.3	Synthesis of Mine-Related Influences at the Mary River and Mary Lake System	81
7.0	CONCLUSIONS	84
7.1	General Findings	84
7.2	Camp Lake System	85
7.3	Sheardown Lake System	86
7.4	Mary River and Mary Lake System	88
8.0	REFERENCES	90

APPENDIX A DATA QUALITY REVIEW

APPENDIX B WATER QUALITY DATA

APPENDIX C SEDIMENT QUALITY DATA

APPENDIX D PHYTOPLANKTON DATA

APPENDIX E BENTHIC INVERTEBRATE COMMUNITY DATA

APPENDIX F FISH POPULATION SURVEY DATA

LIST OF FIGURES**After Page ...**

Figure 1.1:	Mary River Project location.....	1
Figure 2.1:	Mary River Project CREMP study water body locations.....	3
Figure 2.2:	CREMP water quality and phytoplankton sampling station locations.....	4
Figure 2.3:	CREMP reference lake monitoring station locations	4
Figure 2.4:	CREMP mine-exposed sediment and benthic station locations	8
Figure 3.1:	Water chemistry seasonal variation at lotic reference stations.....	21
Figure 3.2:	<i>In-situ</i> water quality profiles for Reference Lake 3.....	22
Figure 3.3:	Water chemistry at surface and bottom of Reference Lake 3.....	22
Figure 3.4:	Sediment metal concentrations at Reference Lake 3	24
Figure 3.5:	Chlorophyll a concentrations at Reference Lake 3 stations.....	24
Figure 3.6:	Benthic metrics for littoral and profundal stations of Reference Lake 3.....	26
Figure 3.7:	Length-frequency distribution for Reference Lake 3 juvenile Arctic charr	27
Figure 4.1:	Camp Lake tributary <i>in-situ</i> water quality comparisons, 2015	28
Figure 4.2:	Camp Lake tributary water chemistry temporal comparisons	29
Figure 4.3:	Camp Lake tributary chlorophyll a comparisons, 2015.....	30
Figure 4.4:	Camp Lake tributary chlorophyll a temporal comparisons.....	30
Figure 4.5:	Camp Lake Tributary 1 benthic community temporal comparisons.....	32
Figure 4.6:	Camp Lake Tributary 2 benthic community temporal comparisons.....	33
Figure 4.7:	Camp Lake <i>in-situ</i> water quality profiles, 2015	33
Figure 4.8:	Camp Lake <i>in-situ</i> water quality replicate station comparison, 2015.....	33
Figure 4.9:	Camp Lake water chemistry temporal comparison.....	34
Figure 4.10:	Camp Lake sediment particle size comparisons, 2015	35
Figure 4.11:	Camp Lake sediment metal concentration temporal comparisons	36
Figure 4.12:	Camp Lake chlorophyll a comparisons, 2015.....	37
Figure 4.13:	Camp Lake chlorophyll a temporal comparisons	37
Figure 4.14:	Camp Lake benthic invertebrate community temporal comparisons	39
Figure 4.15:	Camp Lake Arctic charr CPUE temporal comparison.....	39
Figure 4.16:	Camp Lake Arctic charr length-frequency distributions, 2015	40
Figure 5.1:	Sheardown Lake tributaries <i>in-situ</i> water quality comparisons, 2015.....	45
Figure 5.2:	Sheardown Lake tributaries water chemistry temporal comparisons	46
Figure 5.3:	Sheardown Lake Tributary 1 chlorophyll a comparisons, 2015	46
Figure 5.4:	Sheardown Lake Tributary 1 chlorophyll a temporal comparisons	47
Figure 5.5:	Sheardown Lake tributaries benthic community comparisons, 2015.....	47
Figure 5.6:	Sheardown Lake tributaries benthic community temporal comparisons.....	48
Figure 5.7:	Sheardown Lake NW <i>in-situ</i> water quality profiles, 2015	50

Figure 5.8:	Sheardown Lake <i>in-situ</i> water quality replicate station comparison, 2015	50
Figure 5.9:	Sheardown Lake NW and SE water chemistry temporal comparison	51
Figure 5.10:	Sheardown Lake NW sediment particle size comparisons, 2015	51
Figure 5.11:	Sheardown Lake sediment metal concentration temporal comparisons	52
Figure 5.12:	Sheardown Lake chlorophyll a comparisons, 2015	53
Figure 5.13:	Sheardown Lake chlorophyll a temporal comparisons	53
Figure 5.14:	Sheardown Lake NW benthic community temporal comparisons	54
Figure 5.15:	Sheardown Lake Arctic charr CPUE temporal comparison	55
Figure 5.16:	Sheardown Lake NW Arctic charr length-frequency distributions, 2015	55
Figure 5.17:	Sheardown Lake SE <i>in-situ</i> water quality profiles, 2015	57
Figure 5.18:	Sheardown Lake SE sediment particle size comparisons, 2015	59
Figure 5.19:	Sheardown Lake SE benthic community temporal comparisons	62
Figure 5.20:	Sheardown Lake SE Arctic charr length-frequency distributions, 2015	63
Figure 6.1:	Mary River <i>in-situ</i> water quality comparisons, 2015	68
Figure 6.2:	Mary River water chemistry temporal comparisons	69
Figure 6.3:	Mary River chlorophyll a comparisons, 2015	70
Figure 6.4:	Mary River chlorophyll a temporal comparisons	71
Figure 6.5:	Mary River benthic invertebrate community comparisons, 2015	71
Figure 6.6:	Mary River benthic community temporal comparisons	72
Figure 6.7:	Mary Lake north basin <i>in-situ</i> water quality profiles, 2015	72
Figure 6.8:	Mary Lake south basin <i>in-situ</i> water quality profiles, 2015	72
Figure 6.9:	Mary Lake <i>in-situ</i> water quality replicate station comparison, 2015	73
Figure 6.10:	Mary Lake water chemistry temporal comparison	74
Figure 6.11:	Mary Lake sediment particle size comparisons, 2015	75
Figure 6.12:	Mary Lake sediment metal concentration temporal comparisons	76
Figure 6.13:	Mary Lake chlorophyll a comparisons, 2015	76
Figure 6.14:	Mary Lake chlorophyll a temporal comparisons	77
Figure 6.15:	Mary Lake benthic invertebrate community temporal comparisons	78
Figure 6.16:	Mary Lake Arctic charr CPUE temporal comparison	78
Figure 6.17:	Mary Lake Arctic charr length-frequency distributions, 2015	79

LIST OF TABLES

After Page ...

Table 2.1:	Physical characteristics of mine lakes compared to Reference Lake 3	3
Table 2.2:	CREMP water quality and phytoplankton monitoring station coordinates	4
Table 2.3:	Water quality guidelines used for the Mary River Project	6
Table 2.4:	Magnitude of difference categorization descriptions	7

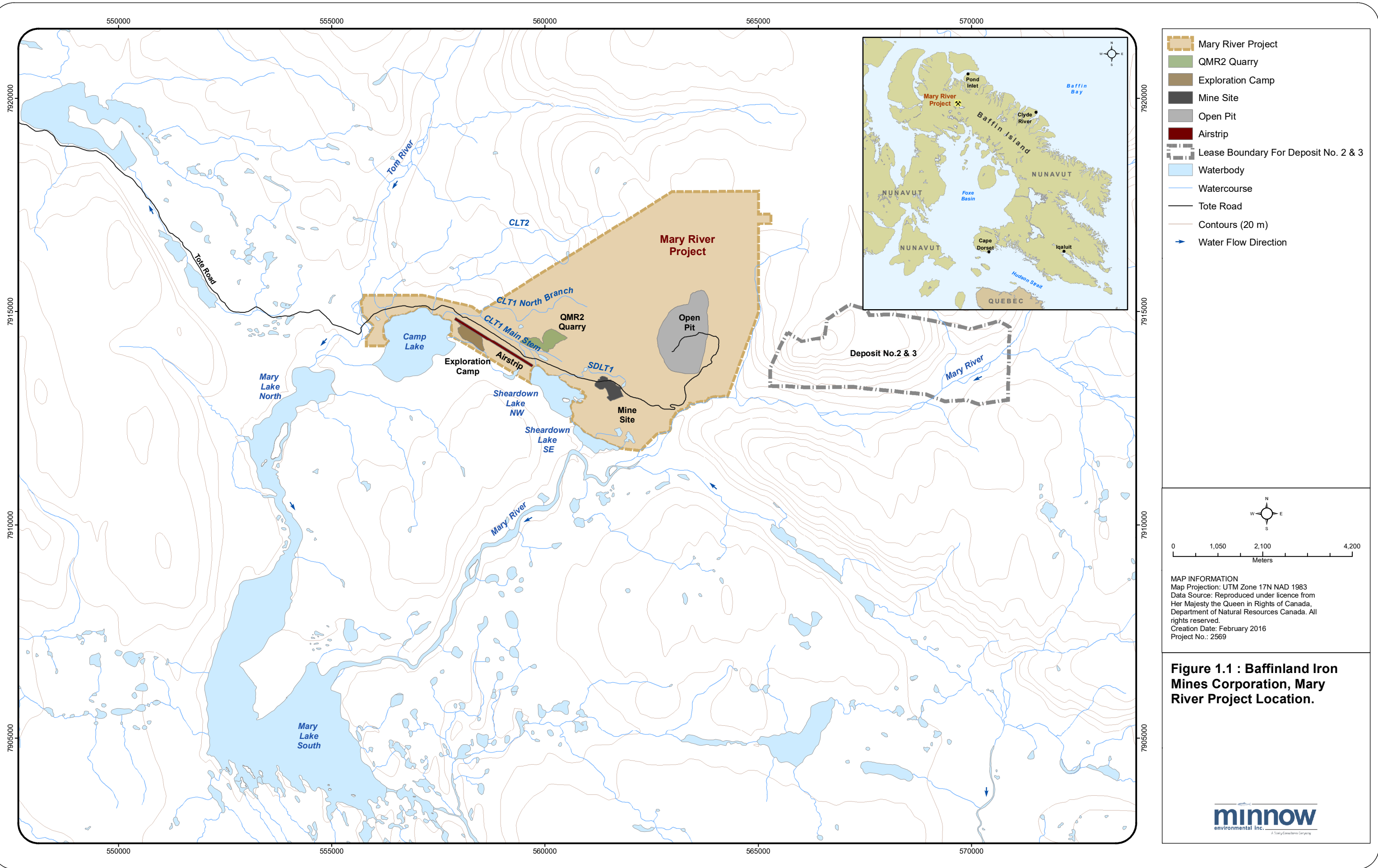
Table 2.5:	CREMP sediment quality and lake benthic station coordinates	8
Table 2.6:	CREMP stream benthic station coordinates	12
Table 2.7:	Fish population survey endpoints examined for the 2015 CREMP	18
Table 3.1:	Water chemistry at lotic reference stations, 2015	21
Table 3.2:	Water chemistry at Reference Lake 3 monitoring stations, 2015	22
Table 3.3:	Sediment quality at Reference Lake 3 monitoring stations, 2015	24
Table 4.1:	Camp Lake tributary water chemistry, fall 2015	28
Table 4.2:	Camp Lake Tributary 1 benthic community comparisons, 2015	31
Table 4.3:	Camp Lake Tributary 2 benthic community comparisons, 2015	32
Table 4.4:	Camp Lake water chemistry, fall 2015	34
Table 4.5:	Camp Lake sediment quality, 2015	35
Table 4.6:	Camp Lake littoral station benthic community comparisons, 2015	37
Table 4.7:	Camp Lake profundal station benthic community comparisons, 2015	37
Table 4.8:	Camp Lake fish catch and fish community comparisons, 2015	39
Table 4.9:	Camp Lake Arctic charr juvenile and adult health comparisons, 2015	40
Table 5.1:	Sheardown Lake Tributary 1 water chemistry, fall 2015	45
Table 5.2:	Sheardown Lake NW water chemistry, fall 2015	50
Table 5.3:	Sheardown Lake sediment quality, 2015	52
Table 5.4:	Sheardown Lake NW littoral station benthic comparisons, 2015	53
Table 5.5:	Sheardown Lake NW profundal station benthic comparisons, 2015	53
Table 5.6:	Sheardown Lake fish catch and fish community comparisons, 2015	55
Table 5.7:	Sheardown Lake NW Arctic charr health endpoint comparisons, 2015	55
Table 5.8:	Sheardown Lake SE water chemistry, fall 2015	58
Table 5.9:	Sheardown Lake SE littoral station benthic comparisons, 2015	61
Table 5.10:	Sheardown Lake SE profundal station benthic comparisons, 2015	61
Table 5.11:	Sheardown Lake SE Arctic charr health endpoint comparisons, 2015	63
Table 5.12:	Sheardown Lake SE tagged Arctic charr re-capture measurements	64
Table 6.1:	Mary River water chemistry, fall 2015	69
Table 6.2:	Mary Lake north and south basin water chemistry, fall 2015	74
Table 6.3:	Mary Lake sediment quality, 2015	75
Table 6.4:	Mary Lake littoral station benthic community comparisons, 2015	77
Table 6.5:	Mary Lake profundal station benthic community comparisons, 2015	77
Table 6.6:	Mary Lake fish catch and fish community comparisons, 2015	78
Table 6.7:	Mary Lake Arctic charr juvenile and adult health comparisons, 2015	79
Table 6.8:	Mary Lake tagged Arctic charr re-capture measurements	80

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 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. For the ERP, approximately 3.5 million tonnes (Mt) of crushed/screened ore will be transported annually by truck to Milne Port, which is located approximately 100 km north of the mine site. At Milne Port, the ore is stockpiled before being loaded onto bulk carrier ships for transport to 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 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, 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 was required to develop and implement an Aquatic Effects Monitoring Program (AEMP) for the Mary River Project. The over-arching objectives of the AEMP are to provide data and information that will: 1) allow evaluation of short- and long-term effects of the project on aquatic ecosystems; 2) allow evaluation of the accuracy of environmental impact assessment predictions; 3) assess the effectiveness of any impact mitigation measures that have been applied; and, 4) allow the identification of additional impact mitigation measures that could be used to reduce or eliminate any observed environmental effects resulting from the project. In order to meet the first of these 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 located near the mine (Baffinland 2014; KP 2014a; NSC 2014). This report presents the results of the 2015 CREMP study, which includes the evaluation of potential Mary Lake Project-related influences on chemical and biological conditions at mine-exposed water bodies following the first full year 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). 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 2015 study are provided in Section 2.0. The initial review of background (reference) data revealed a number of natural physico-chemical and biological characteristics that have a bearing on the assessment of potential mine-related effects at aquatic receiving environments, and thus Section 3.0 gives an overview of background conditions to provide context and perspective for subsequent sections. Because of the relatively large geographic scope and multi-component sampling approach used for the Mary River Project CREMP, the results of the 2015 study 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 4.0, 5.0 and 6.0, respectively. The conclusions of the 2015 CREMP are presented in Section 7.0. Finally, all references cited within this document are listed in Section 8.0.

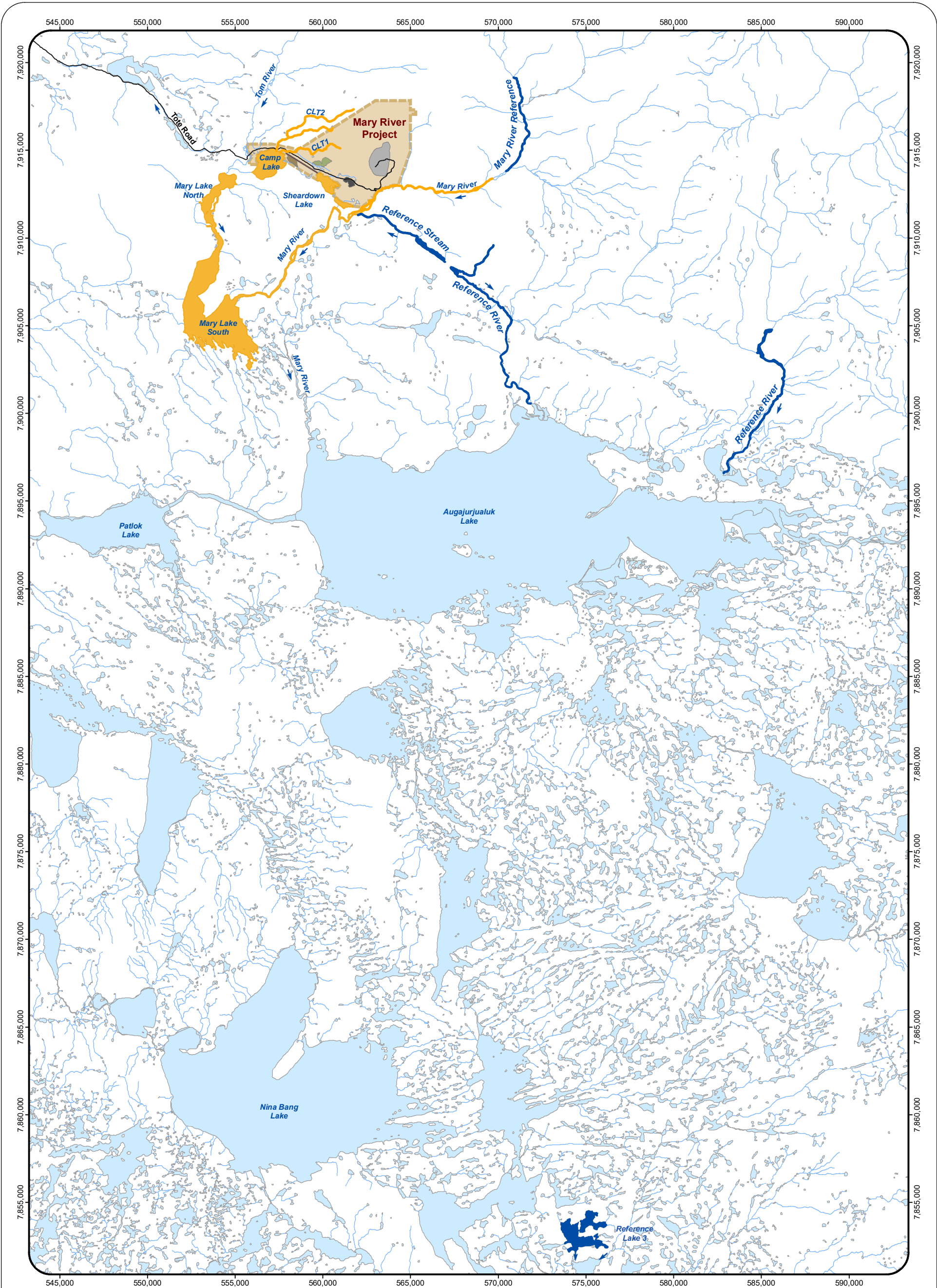
2.0 METHODS

The Mary River Project CREMP includes water quality monitoring, sediment quality monitoring, phytoplankton (chlorophyll a) monitoring, benthic invertebrate community assessment and a fish population survey. Water quality and phytoplankton monitoring was conducted by Baffinland personnel over four separate sampling periods in 2015, including an ice-cover period (April 25th – May 7th) and periods corresponding to Arctic spring (freshet), summer and autumn during the open-water season (June 23rd – 29th, July 17th – 31st, and August 13th – 24th, respectively). Sediment quality, benthic invertebrate and fish population sampling was conducted by Minnow Environmental Inc. (Minnow) personnel with assistance from Baffinland environment department staff from August 12th – 25th 2015, the timing of which was consistent with the seasonal timing of previous baseline monitoring at the Mary River Project. Field and standard laboratory quality assurance/quality control (QA/QC) was implemented for the 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).

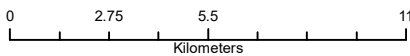
The CREMP 2015 study areas were the same mine-exposed and reference study areas and stations established previously (Figure 2.1). To simplify the discussion of results, the mine-exposed study areas were separated by lake catchment as follows:

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

In addition to these mine-exposed study areas, an unnamed reference lake (referred to as Reference Lake 3) located well outside any potential area of mine influence (i.e., approximately 62 linear km south of the Mary River Project; Figure 2.1) was added to the CREMP sampling program in summer 2015. The criterion used for the selection of a suitable reference lake was close comparability in habitat features with the mine-exposed lakes (e.g., surface area, maximum depth, substrate, etc.; Table 2.1). The addition of Reference Lake 3 to the CREMP provided a stronger basis for evaluation of potential mine-related influences to the study lakes located near the mine compared to the previous baseline studies.



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



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: February 2016
Project No.: 2569

**Figure 2.1: Mary River Project
CREMP Study Water Bodies.**

Table 2.1: 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	26.4	38.3
	Volume (1,000,000 m ³)	27.5	8.18	1.8	22.6

2.1 Water Quality

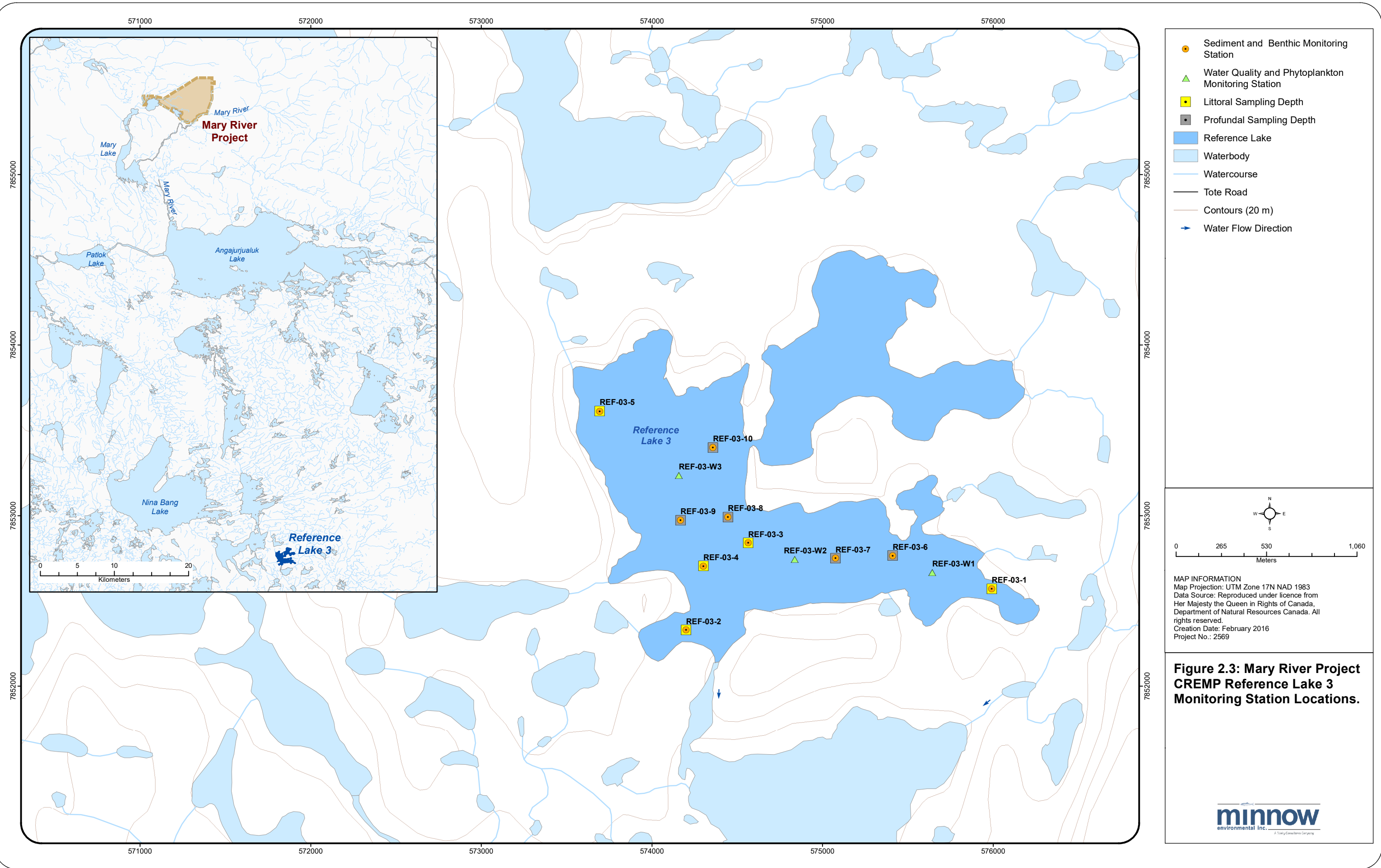
Surface water quality monitoring was conducted by Baffinland environment department personnel at the sampling locations and frequency stipulated in the Mary River Project CREMP design (Baffinland 2014; KP 2014a). The surface water sampling was conducted at as many as 57 stations per sampling period (Table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

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 stations and as a vertical profile at one-meter intervals at each lentic water quality monitoring station, with care taken to not disturb the bottom sediments, 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. The *in-situ*

Table 2.2: 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		Sampling Season			
			Easting	Northing	Winter (Apr. - May)	Spring (June)	Summer (July)	Fall (Aug. - Sept.)
Reference Areas	Lotic Reference	CLT-REF3	567004	7909174	-	✓	✓	✓
		CLT-REF4	568533	7907874	-	✓	✓	✓
		MRY-REF3	585407	7900061	-	✓	✓	✓
		MRY-REF2	570650	7905045	-	✓	✓	✓
	Reference Lake 3	REF-03-W1	575642	7852666	-	-	✓	✓
		REF-03-W2	574836	7852744	-	-	✓	✓
		REF-03-W3	574158	7853237	-	-	✓	✓
Camp Lake System	Camp Lake Tributaries	I0-01	555470	7914139	-	✓	✓	✓
		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	✓	-	✓	✓
		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	-	✓	✓	✓
		D1-05	561397	7913558	-	✓	✓	✓
	Sheardown Lake NW	DD-Hab9-Stn1	560259	7913455	✓	-	✓	✓
		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	✓	-	✓	✓
		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	-	✓	✓	✓
		G0-09	571546	7916317	-	✓	✓	✓
		G0-09-B	571248	7914682	-	✓	✓	✓
		G0-03	567204	7912587	-	✓	✓	✓
		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	✓	-	✓	✓
		BL0-01-A	554300	7913378	✓	-	✓	✓
		BL0-01-B	554369	7913058	✓	-	✓	✓
	Mary Lake (South Basin)	BL0-03	552680	7906651	✓	-	✓	✓
		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	✓	-	✓	✓



measurements were collected using YSI 556 MDS (Multiparameter Display System) or Pro DSS meters equipped 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 based on 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, 2015]), 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 approaches. For the statistical analysis, raw data and log-transformed data were assessed for normality and homogeneity of variance prior to conducting pair-wise comparisons between applicable like-habitat mine-exposed and reference study area pairings 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 statistics were applied using the raw data to confirm ANOVA statistical results. 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 confirm the ANOVA statistical results. All statistical comparisons were conducted using SPSS Version 12.0 (SPSS Inc., Chicago, IL).

Vertical profiles of the *in-situ* measurements taken from lake stations were plotted and visually assessed to evaluate any thermal, dissolved oxygen or chemical (i.e., pH and/or

specific conductance) stratification and the corresponding depths associated with any distinct layering. The vertical profile data collected at the mine-exposed study lakes were compared to that of the reference lake for each monitoring period using averaged data (from the same depth below the water surface) to evaluate any potential mine-related influences. At each study lake, spatial and seasonal differences in the vertical profile plots were also 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, 2015).

2.1.2 Water Chemistry Sampling and Data Analysis

Surface water chemistry samples were collected from both lotic (i.e., stream/river) and lentic (i.e., lake) environments (Table 2.2). At lotic stations, the water chemistry samples were collected directly into pre-labeled sample bottles which, for those requiring preservation, were pre-dosed with required chemical preservatives. The water samples were collected from approximately mid-column at each station. At lake 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, with the aid of a non-metallic beta-bottle or vertically-oriented 2.2 L TT Silicon Kemmerer bottle (Wildco Supply Co., Yulee, FL). During the winter sampling event, the water column was accessed at the same time and using the same methods as described above for the *in-situ* measurements. Lake water collected using the beta-bottle/Kemmerer bottle was transferred directly into sample bottles that had been pre-dosed with required chemical preservatives, where appropriate. Following collection, the water chemistry samples were placed into coolers 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 the collection of field duplicates, equipment blanks, field blanks and trip blanks with replication conducted on as many as 10% of the total samples collected for each CREMP sampling period (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; ii) spatially and seasonally at each mine-exposed water body; iii) to applicable water quality guidelines/objectives for the protection of aquatic life (Table 2.3);

Table 2.3: Water quality guidelines used for the Mary River Project 2015 CREMP.

Parameters		Units	Water Quality Guideline (WQG) ^a	Criteria Source ^a	Comments and 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 comparison to guideline.
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 $Cd\text{ (ug/L)} = 10^{(0.83[\log(\text{hardness}) - 2.46])}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with 75 mg/L hardness.
	Chromium (Cr)	mg/L	0.0089	CWQG	
	Cobalt (Co)	mg/L	0.001	PWQO	
	Copper (Cu)	mg/L	0.002	CWQG	Copper guideline is hardness (mg/L CaCO ₃) dependent. At hardness <82 mg/L and >180 mg/L, the copper guideline is 2 and 4 ug/L, respectively. For hardness ranging from 82 - 180 mg/L, the copper guideline (ug/L) = $0.2 * e^{(0.8545[\ln(\text{hardness}) - 1.463])}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to 75 mg/L hardness.
	Iron (Fe)	mg/L	0.30	CWQG	
	Lead (Pb)	mg/L	0.002	CWQG	Lead guideline is hardness (mg/L CaCO ₃) dependent. At hardness <60 mg/L and >180 mg/L, the lead guideline is 1 and 7 ug/L, respectively. For hardness ranging from 60 - 180 mg/L, the lead guideline (ug/L) = $e^{(1.273[\ln(\text{hardness}) - 4.705])}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to 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 $Mn\text{ (ug/L)} = 0.0044 * (\text{hardness}) + 0.605$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with hardness of 75 mg/L.
	Mercury (Hg)	mg/L	0.000026	CWQG	
	Molybdenum (Mo)	mg/L	0.073	CWQG	
	Nickel (Ni)	mg/L	0.077	CWQG	Nickel guideline is hardness (mg/L CaCO ₃) dependent. At hardness <60 mg/L and >180 mg/L, the nickel guideline is 25 and 150 ug/L, respectively. For hardness ranging from 60 - 180 mg/L, the nickel guideline (ug/L) = $e^{(0.76[\ln(\text{hardness}) + 1.06])}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to 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	
	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 (CCME1987, 1999) 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.

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 concentration divided by the respective reference stations/area concentration or, for temporal comparisons, between each individual mine-exposed station/area 2015 concentrations and the baseline (2007-2013) concentration and mine-construction (2014) concentrations, for each parameter. The magnitude of any 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 2.4.

Table 2.4: Categorization of magnitudes of difference used for screening parameter concentrations between mine-exposed areas and reference areas, and between 2015 and baseline data for individual mine-exposed stations/areas, Mary River Project CREMP, 2015.

Categorization	Magnitude of Difference Criterion
Slightly elevated	Concentration 3-fold to 5-fold higher at mine-exposed area in 2015
Moderately elevated	Concentration 5-fold to 10-fold higher at mine-exposed area in 2015
Highly elevated	Concentration $\geq$ 10-fold higher at mine-exposed area in 2015

Applicable water quality guidelines/objectives included CWQG (CCME 1999, 2015) or, for parameters with no CWQG or those parameters for which a more conservative (i.e., lower) provincial criterion is available, to established Ontario Provincial Water Quality Objectives (PWQO; OMOEE 1994) and/or British Columbia Water Quality Guidelines (BCWQG; BCMOE 2006, 2015). The water quality guidelines used in this 2015 CREMP were abbreviated simply as 'WQG', although it is recognized that in certain cases the values presented may represent 'objectives'. For those water quality criteria that are hardness dependent, the hardness of the individual sample was used to calculate the respective water quality guideline for the specific parameter according to established formulae (Table 2.3). The 2015 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. 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 any effects resulting from 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, that have been identified as site-specific parameters of concern and/or that showed concentrations above WQG and/or AEMP benchmarks) were plotted to evaluate any changes in concentrations in 2015 compared to baseline (2007 – 2013) and mine construction (2014) periods.

2.2 Sediment Quality

Sediment quality monitoring under the Mary River Project CREMP is focussed primarily on assessing potential mine-related effects to the sediment of lake environments based on a gradient design (Baffinland 2014; KP 2014a, 2015). Sediment quality sampling was conducted at five to ten stations per study lake for physical and chemical characterization as outlined under the CREMP, with additional characterization of physical sediment properties conducted at four to six stations per study lake in 2015 to support the benthic invertebrate community analysis (Table 2.5; Figure 2.4). 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), these watercourses were found to contain limited depositional habitat during the 2015 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 quality within, along and/or between watercourses, and therefore no sediment sampling was conducted at lotic environments as part of the 2015 CREMP.

2.2.1 Sample Collection and Laboratory Analysis

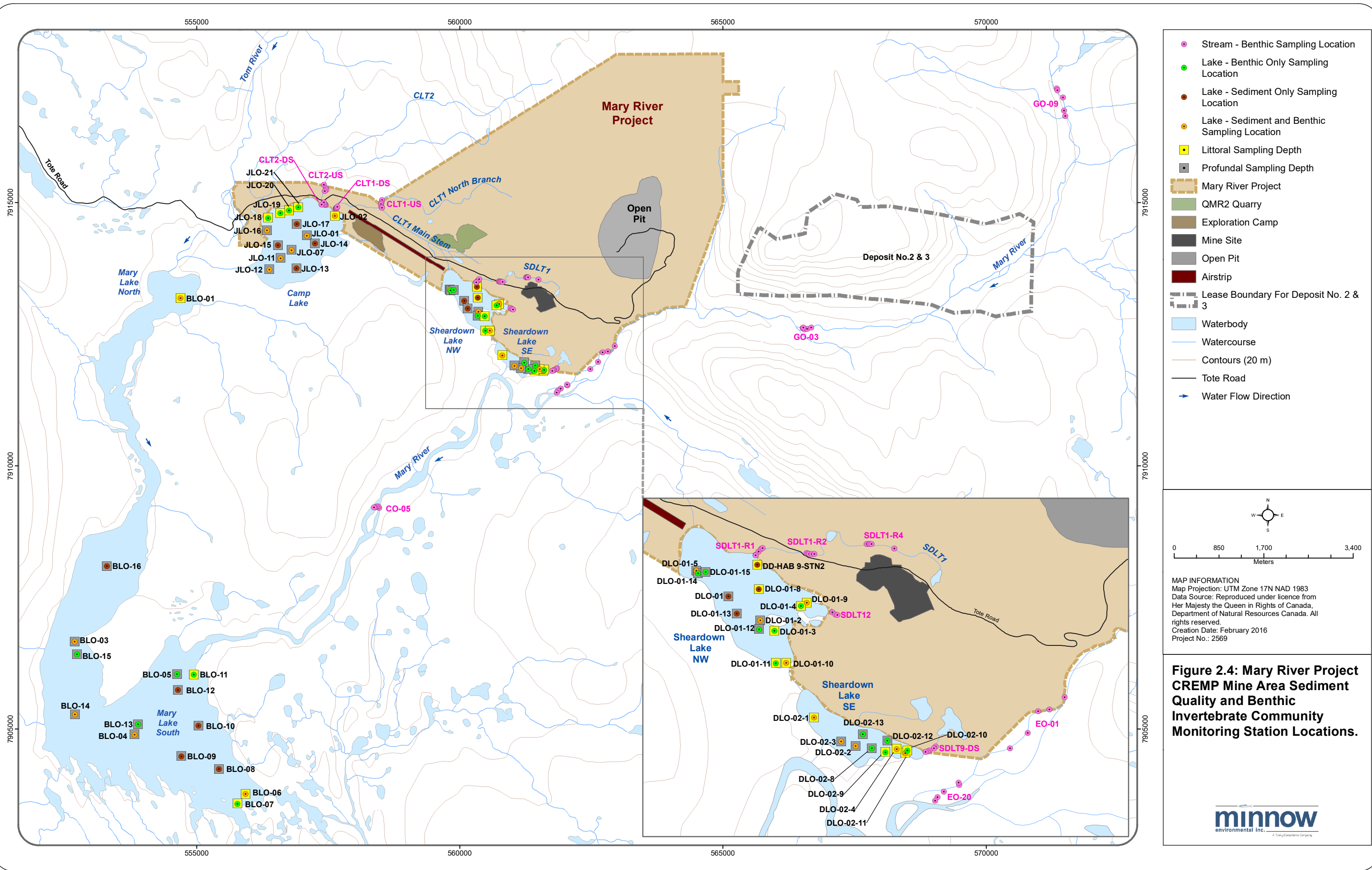
Sediment samples for physical and chemical characterization were collected at the study lakes using a gravity corer (Hoskin Scientific Ltd., Model E-777-00) outfitted with a clean 5.1 cm inside-diameter polycarbonate tube. From each retrieved core sample containing an intact, representative sediment-water 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 were taken for each core sample were also recorded. Supporting observations of sediment texture and colour for each horizon, sediment odour

Table 2.5: Mary River Project CREMP lake sediment quality and benthic invertebrate community monitoring station coordinates.

Waterbody	Station Code	UTM Zone 17W		Sampling Habitat	Sample Type		
		Easting	Northing		Sediment Core ^a	Sediment petite-Ponar ^a	Benthic Invertebrate
Reference Lake	REF-03-1	575992	7852992	littoral	✓	-	✓
	REF-03-2	574200	7852330	littoral	✓	-	✓
	REF-03-3	574564	7852840	littoral	✓	-	✓
	REF-03-4	574301	7852705	littoral	✓	-	✓
	REF-03-5	573694	7853613	littoral	✓	-	✓
	REF-03-6	575411	7852766	profundal	✓	-	✓
	REF-03-7	575076	7852750	profundal	✓	-	✓
	REF-03-8	574445	7852992	profundal	✓	-	✓
	REF-03-9	574168	7852975	profundal	✓	-	✓
	REF-03-10 ^b	574358	7853400	profundal	✓	-	✓
Camp Lake	JLO-02	557627	7914748	littoral	✓	-	✓
	JLO-01	557092	7914370	profundal	✓	-	✓
	JLO-14 ^b	557246	7914224	profundal	✓	-	-
	JLO-17	556900	7914594	profundal	✓	-	-
	JLO-21	556926	7914911	littoral	-	✓	✓
	JLO-20	556750	7914850	littoral	-	✓	✓
	JLO-19	556587	7914801	littoral	-	✓	✓
	JLO-07	556803	7914095	profundal	✓	-	✓
	JLO-18	556357	7914706	littoral	-	✓	✓
	JLO-16	556335	7914470	profundal	✓	-	✓
	JLO-15	556542	7914184	profundal	✓	-	-
	JLO-11	556594	7913946	profundal	✓	-	✓
	JLO-13	556896	7913751	profundal	✓	-	-
	JLO-12	556378	7913728	profundal	✓	-	✓
Sheardown Lake Northwest (NW)	DLO-01-5	559806	7913348	profundal	✓	-	✓
	DLO-01-14	559821	7913328	profundal	-	✓	✓
	DLO-01-15	559884	7913340	profundal	-	✓	✓
	DD-HAB 9-STN2	560325	7913400	littoral	✓	-	-
	DLO-01-8	560338	7913192	littoral	✓	-	-
	DLO-01	560079	7913132	profundal	✓	-	-
	DLO-01-13	560149	7912985	profundal	✓	-	-
	DLO-01-2	560350	7912927	profundal	✓	-	✓
	DLO-01-12	560339	7912852	profundal	-	✓	✓
	DLO-01-9 ^b	560746	7913076	littoral	✓	-	✓
	DLO-01-4	560696	7913049	littoral	-	✓	✓
	DLO-01-3	560471	7912838	littoral	-	✓	✓
Sheardown Lake Southwest (SE)	DLO-01-11	560482	7912563	littoral	-	✓	✓
	DLO-01-10	560570	7912566	littoral	✓	-	✓
	DLO-02-1	560807	7912099	littoral	✓	-	✓
	DLO-02-11	561585	7911799	littoral	✓	-	✓
	DLO-02-10	561602	7911821	littoral	-	✓	✓
	DLO-02-4	561512	7911833	littoral	✓	-	✓
	DLO-02-12	561433	7911905	profundal	-	✓	✓
	DLO-02-9	561414	7911806	littoral	-	✓	✓
	DLO-02-8	561300	7911839	profundal	-	✓	✓
	DLO-02-13	561222	7911958	profundal	-	✓	✓
Mary Lake	DLO-02-2 ^b	561161	7911858	profundal	✓	-	✓
	DLO-02-3	561039	7911898	profundal	✓	-	✓
	BLO-01	554690	7913186	littoral	✓	-	✓
	BLO-16	553289	7908092	profundal	✓	-	-
	BLO-03	552679	7906660	profundal	✓	-	✓
	BLO-15	552723	7906419	profundal	-	✓	✓
	BLO-14	552688	7905282	profundal	✓	-	✓
	BLO-05	554627	7906041	profundal	-	✓	✓
	BLO-11	554942	7906033	littoral	-	✓	✓
	BLO-12 ^b	554644	7905742	profundal	✓	-	-
	BLO-13	553886	7905089	profundal	-	✓	✓
	BLO-04	553820	7904893	profundal	✓	-	✓
	BLO-10	555033	7905065	profundal	✓	-	-
	BLO-09	554707	7904486	profundal	✓	-	-
	BLO-08	555424	7904239	profundal	✓	-	-
	BLO-07	555772	7903585	littoral	-	✓	✓
	BLO-06	555925	7903771	littoral	✓	-	✓

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

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



(e.g., hydrogen sulphide), and the presence of algae or plants on or in the sediment. For QA/QC, a field duplicate sample was collected at each study lake using the same coring methods discussed above (Table 2.5; Appendix A). Additional sediment samples were collected only for physical substrate characterization at benthic invertebrate community stations that had not been paired with sediment quality monitoring under the CREMP (Table 2.2). The additional physical substrate characterization samples were collected using a stainless steel petite-Ponar grab (15.24 cm x 15.24 cm; 0.023 m² sampling area). A composite sample was created at each of these stations by collecting the top 2 - 3 centimetres of surficial sediment from each of two acceptable petite-Ponar grabs (i.e., full to each edge of the sampler) into a plastic tub. The composite sample was homogenized before being spooned directly into a one litre sealable plastic sample bag. Supporting observations of sediment texture, colour and odour were collected for each physical substrate characterization sample, together with observations regarding the presence of algae or plants on or in the sediment. Following collection, all sediment samples were placed into a cooler, transported to the mine and stored under cool conditions until shipment to the analytical laboratory.

Upon completion of the biological monitoring field program, sediment samples were shipped to ALS (Waterloo, ON). Physical characterization of samples included percent moisture and particle size analyses, and chemical characterization included analysis of total organic carbon (TOC) and total metals including mercury. Standard laboratory methods were used for all physical and chemical 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 historical (baseline) sediment quality data. Sediment physical characteristic (i.e., moisture, particle size) and TOC data were summarized based on calculation of average, standard deviation, standard error, minimum and maximum for 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 all proportional data rather than log transformations), assumptions and software described above for the *in-situ* water quality comparisons (see Section 2.1.1). Within each mine-exposed study lake, an evaluation of any spatial differences in sediment chemistry was conducted to determine potential gradients in metal concentrations associated with mine sources. Sediment chemistry data were averaged by study lake and then compared between mine-exposed and reference areas. For each sediment chemistry parameter, the

magnitude of difference was calculated between the mine-exposed and reference area using the same calculation (and categorization description) as described previously (Section 2.1.2; Table 2.3).

The sediment chemistry data analysis included comparisons 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 in this 2015 CREMP were abbreviated simply as 'SQG', although it is recognized that in certain cases the values presented may represent either PEL or SEL guidelines. The 2015 sediment chemistry data were also compared to Mary River Project AEMP sediment quality benchmarks that were derived taking into account background (i.e., baseline) sediment chemistry data 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 respective AEMP benchmark may trigger various actions to better understand and potentially mitigate any effects resulting from 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 reference, that have been identified as site-specific parameters of concern and/or those with concentrations above SQG and/or AEMP benchmarks) were plotted to evaluate potential changes in parameter concentrations between 2015 and baseline (2007 – 2014) conditions. In addition, as described previously, the magnitude of difference was calculated for all parameters between the 2015 and baseline period 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 CREMP assessment of potential mine-related influences to phytoplankton focussed on the evaluation of aqueous chlorophyll *a* concentrations. 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 productivity of photosynthetic microbiota in aquatic environments. 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 2.2; 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 the water chemistry sampling program, 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 structure (i.e., taxonomic composition, richness, density). To date, none of the archived phytoplankton community samples have been processed (2006 – 2014). In 2015, 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 for each study lake catchment; ii) spatially and seasonally at each mine-exposed water body; 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 2015 chlorophyll *a* concentration data were compared to this benchmark to assist with the determination of potential mine-related effects at water bodies influenced by mine operations. A mine-related effect on the productivity of a water body of interest was assessed as a

chlorophyll a concentration above the AEMP benchmark, the representative reference area, and/or the respective water body baseline condition.

2.3.2 Benthic Invertebrate Community Assessment

The Mary River Project CREMP benthic invertebrate community (benthic) survey outlines a habitat-based approach focussed on assessing potential mine-related effects to benthic biota of lotic (river/stream) and lentic (lake) environments (NSC 2014). Lotic areas sampled for benthic invertebrates in 2015 included Camp Lake Tributaries 1 and 2 at areas upstream and downstream of the mine tote road, three separate reaches of Sheardown Lake Tributary 1, Sheardown Lake Tributaries 9 and 12 near their respective outlets, and the Mary River upstream (two areas) and downstream (three areas) of the mine site (Table 2.6; Figure 2.4). 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. The level of replication used for lotic benthic sampling in 2015 was greater than specified under the CREMP design in order to provide consistency with EEM standards. To the extent possible, previously established lotic benthic stations were incorporated into the 2015 sampling program to provide comparability to historical baseline information. At lentic environments, the 2015 benthic sampling was conducted at the same 40 previously established stations among the four mine-exposed study lakes (i.e., ten stations in each of Camp, Sheardown NW, Sheardown SE and Mary lakes), as well as at ten new stations from Reference Lake 3 (Table 2.5; Figures 2.3 and 2.4). The benthic stations at each mine-exposed and reference lake were categorized as littoral/euphotic zone (2-12 m depth) or profundal zone (>12 m depth) stations based on station depth (Table 2.5).

2.3.2.1 Sample Collection and Laboratory Analysis

Two types of sampling equipment and methods were employed during the 2015 CREMP benthic survey to reflect different habitat types as follows:

- at **lotic (stream/river) stations** (i.e., predominantly cobble, gravel and/or sand substrate in flowing waters), benthic invertebrate community samples were collected using a Surber sampler (0.0929 m² sampling area) equipped with 500-µm mesh. At each erosional station, one sample representing a composite of three Surber sampler grabs (i.e., 0.279 m² 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

Table 2.6: Mary River Project CREMP stream benthic invertebrate community monitoring station coordinates.

Lake System	Waterbody	Station Code	Station Type	UTM Zone 17W	
				Easting	Northing
Camp Lake	Camp Lake Tributary 1	CLT1-US-B1	Reference	558522	7915048
		CLT1-US-B2	Reference	558508	7914997
		CLT1-US-B3	Reference	558499	7914973
		CLT1-US-B4	Reference	558509	7914915
		CLT1-US-B5	Reference	558518	7914899
		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	557417	7915338
		CLT2-US-B2	Reference	-	-
		CLT2-US-B3	Reference	557456	7915265
		CLT2-US-B4	Reference	557459	7915247
		CLT2-US-B5	Reference	557435	7915219
		CLT2-DS-B1	Mine-Exposed	557449	7914956
		CLT2-DS-B2	Mine-Exposed	557438	7914964
		CLT2-DS-B3	Mine-Exposed	557426	7914980
		CLT2-DS-B4	Mine-Exposed	557418	7915001
		CLT2-DS-B5	Mine-Exposed	557374	7914967
Sheardown Lake Northwest (NW)	Sheardown Lake Tributary 1 (Reach 4)	SDLT-R4-B1	Mine-Exposed	560311	7913487
		SDLT-R4-B2	Mine-Exposed	560335	7913511
		SDLT-R4-B3	Mine-Exposed	560356	7913533
		SDLT-R4-B4	Mine-Exposed	560368	7913540
		SDLT-R4-B5	Mine-Exposed	560310	7913483
	Sheardown Lake Tributary 1 (Reach 2)	SDLT-R2-B1	Mine-Exposed	560742	7913502
		SDLT-R2-B2	Mine-Exposed	560755	7913498
		SDLT-R2-B3	Mine-Exposed	560766	7913494
		SDLT-R2-B4	Mine-Exposed	560787	7913492
		SDLT-R2-B5	Mine-Exposed	560809	7913491
	Sheardown Lake Tributary 1 (Reach 1)	SDLT1-R1-B1	Mine-Exposed	560311	7913487
		SDLT1-R1-B2	Mine-Exposed	560335	7913511
		SDLT1-R1-B3	Mine-Exposed	560356	7913533
		SDLT1-R1-B4	Mine-Exposed	560368	7913540
		SDLT1-R1-B5	Mine-Exposed	560310	7913483
	Sheardown Lake Tributary 12	SDLT12-B1	Mine-Exposed	560962	7912996
		SDLT12-B2	Mine-Exposed	560989	7912978
		SDLT12-B3	Mine-Exposed	561007	7912972
Sheardown Lake Southwest (SE)	Sheardown Lake Tributary 9	SDLT9-DS-B1	Mine-Exposed	561843	7911853
		SDLT9-DS-B2	Mine-Exposed	561828	7911837
		SDLT9-DS-B3	Mine-Exposed	561789	7911818
		SDLT9-DS-B4	Mine-Exposed	561773	7911813
		SDLT9-DS-B5	Mine-Exposed	561756	7911809
Mary Lake	Mary River	GO-09-B1	Reference	571341	7917169
		GO-09-B2	Reference	571351	7917132
		GO-09-B3	Reference	571458	7916995
		GO-09-B4	Reference	571481	7916749
		GO-09-B5	Reference	571502	7916640
		GO-03-B1	Mine-Exposed	566516	7912618
		GO-03-B2	Mine-Exposed	566547	7912591
		GO-03-B3	Mine-Exposed	566597	7912604
		GO-03-B4	Mine-Exposed	566673	7912623
		GO-03-B5	Mine-Exposed	566524	7912630
		EO-01-B1	Mine-Exposed	562942	7912274
		EO-01-B2	Mine-Exposed	562810	7912170
		EO-01-B3	Mine-Exposed	562714	7912156
		EO-01-B4	Mine-Exposed	562625	7911971
		EO-01-B5	Mine-Exposed	562476	7911841
		EO-20-B1	Mine-Exposed	562043	7911528
		EO-20-B2	Mine-Exposed	562037	7911546
		EO-20-B3	Mine-Exposed	561913	7911472
		EO-20-B4	Mine-Exposed	561858	7911423
		EO-20-B5	Mine-Exposed	561839	7911392
		CO-05-B1	Mine-Exposed	558466	7909205
		CO-05-B2	Mine-Exposed	558448	7909225
		CO-05-B3	Mine-Exposed	558416	7909231
		CO-05-B4	Mine-Exposed	558387	7909215
		CO-05-B5	Mine-Exposed	558366	7909209

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 containing both external and internal station identification labels.

- at **lentic (lake) stations** (i.e., predominantly soft silt-sand, silt and/or clay substrates with variable amounts of organics), benthic invertebrate community sampling was conducted using a petite-Ponar grab sampler. A single sample, consisting of a composite of five grabs (i.e., 0.115 m² 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 containing both external and internal station identification labels.

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, 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 invertebrate community 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 invertebrate community 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 invertebrate community 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.

2.3.2.2 Data Analysis

Benthic data were evaluated separately according to habitat type (i.e., littoral lake habitat, profundal lake habitat, erosional lotic habitat). Benthic invertebrate communities were evaluated using summary metrics of mean taxonomic richness (number of taxa, as identified to lowest practical level), mean invertebrate abundance (or “density”; average number of organisms per m²), Simpson’s Evenness Index (E) and the Bray-Curtis Index of Dissimilarity. Simpson’s E was calculated using the Krebs method (Smith and Wilson 1996) whereas the Bray-Curtis Index was calculated using the formula presented in Environment Canada (2012). Additional comparisons were conducted using percent composition of dominant/indicator taxa and functional feeding 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) were assigned based on Mandaville (2002) and Merritt et al. (2008) designations for each taxon.

Statistical comparisons of all applicable benthic invertebrate community indices and community composition endpoints were conducted using the same tests, transformations, assumptions and software described above 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 $\pm$ two standard deviations (SD), the magnitude of the difference was calculated to reflect the number of reference mean SDs using equations provided by Environment Canada (2012). A Critical Effect Size (CES) of ± 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 any anthropogenic inputs (i.e., between pristine reference areas; see Munkittrick et al. 2009, Environment Canada 2012).

Temporal comparisons included statistical evaluations between/among the 2015 and baseline data for each individual study area for key benthic metrics using uni-variate tests

(e.g., ANOVA) and, where applicable, *post-hoc* comparisons. The temporal statistical comparisons of were conducted using the same tests, transformations, assumptions and software described above for the *in-situ* water quality comparisons (see Section 2.1.2). For study areas that contained data for multiple years (i.e., 3 or more), Tukey's 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. In cases in which benthic data had been collected at the same study areas in 2015 and during baseline (i.e., prior to mine operation) at the mine-exposed area and a respective reference area, before and after comparisons were evaluated using a two-way factorial ANOVA to provide statistical validation for any observed changes over time.

2.3.3 Fish Population Survey

The Mary River Project CREMP fish population survey outlines a non-lethal sampling design to evaluate potential mine-related effects to fish population health (e.g., age structure, growth, condition) at the mine-exposed lakes. The fish population survey targeted Arctic charr (*Salvelinus alpinus*) for non-lethal sampling, mainly because this species is the only relatively abundant fish common to the mine's regional lakes and because a sufficient amount of baseline data is available for this species. The approach employed for the CREMP fish population survey closely mirrored the recommended EEM approach for non-lethal sampling (Environment Canada 2012). Accordingly, the 2015 fish population survey targeted the collection of 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 fish health conditions, namely Camp, Sheardown NW, Sheardown SE and Mary lakes (Figure 2.1). Although the 2015 study also targeted Arctic charr from Reference Lake 3 to provide a basis for the evaluation of potential mine-related influences to fish health, low numbers of Arctic charr were captured from the littoral/profundal lake zone of Reference Lake 3. Thus, the 2015 fish health survey focussed on comparisons of fish collected at the nearshore of the mine-exposed and reference lakes, as well as to comparisons of fish captured at nearshore and littoral/profundal lake 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 along two to three shoreline reaches of each study lake. 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 then 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 habitat description.

Littoral/profundal areas of 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 90 – 215 m and bar mesh sizes ranging from 13 – 127 mm were set on the bottom for short durations (approximately 1.5 – 5.5 hours per set; mean 2.8 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 (i.e., 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 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% of the total scale range and with precision of $\pm 0.3\%$. 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 fish that were not selected for the collection of aging structures were released near the location of capture following the 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 greater than 10% 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 removal of whole gonads and the liver 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 average number of fish captured per electrofishing minute, and gill netting CPUE was calculated as the average number of fish captured per 100 meter·hours⁻¹ of net used for each study lake. Temporal comparisons of fish assemblage was conducted in addition to comparisons of electrofishing and gill netting CPUE to evaluate any relative changes in fish catches at mine area lakes since the mine start-up.

Arctic charr population health was assessed separately based on fish capture method (i.e., electrofishing and experimental gill netting data sets). Initial data analysis for the non-lethal survey included the plotting of size 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 class in pair-wise comparisons of health endpoints between the mine-exposed and reference lakes. Fish health 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 endpoints were used as the basis for evaluating four response categories (survival, growth, reproduction and energy storage; Table 2.7) according to the procedures outlined for both a non-lethal and lethal assessment (Gray et al. 2002; Environment Canada 2012). Length-frequency distribution was compared between mine-exposed and reference areas using a non-parametric two-sample Kolmogorov-Smirnov (K-S) test. Mean fork length and body weight were compared between mine-exposed and reference study areas 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/confirm any significant differences between areas.

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 reference and exposure groups, 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 reference and/or exposure areas, then 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 reference and exposure areas were equal. This was accomplished by including an interaction term (dependent $\times$ 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 areas 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

Table 2.7: Fish population survey endpoints examined for the Mary River Project CREMP, August 2015.

Response Category	Endpoint	Statistical Procedure ^{c,d,e}
Survival	Length-frequency distribution ^a	K-S Test
	Age ^{a,f}	ANOVA
Energy Use (size)	Size (fresh body weight) ^b	ANOVA
	Size (fork length) ^b	ANOVA
Energy Use (growth)	Size-at-age (body weight against age) ^{a,f}	ANCOVA
	Size-at-age (fork length against age) ^{b,f}	ANCOVA
Energy Use (reproduction)	Relative abundance of YOY (% composition) ^b	None
Energy Storage	Condition (body weight against length) ^a	ANCOVA

^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-parametric 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.

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 calculation 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 populations. 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 area differences, the magnitude of difference between reference and exposure areas 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 areas, the minimum detectable effect size was calculated as a percent difference from the reference mean for ANOVA or adjusted reference 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(s) upon examination of scatter plots and residuals, then the values were removed and ANOVA or ANCOVA tests were repeated for the reduced data, with both sets of results then provided.

The data analysis approach described above was applied to Arctic charr population health data collected before (i.e., baseline data to 2014) and after (i.e., 2015) mine start-up by study lake to evaluate any early influences of the Mary River Project ERP on fish health at the mine-exposed lakes.

3.0 OVERVIEW OF REFERENCE CONDITIONS

The initial review of background (reference) data collected from lotic (i.e., streams 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 lake littoral and profundal stations. Therefore, this overview of reference conditions is included to provide context and perspective regarding reference water quality, sediment quality, phytoplankton productivity, benthic invertebrate community and fish population characteristics, as well as the implications of these features for the evaluation of potential mine-related effects at mine-exposed water bodies.

3.1 Reference Areas

Four lotic reference 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) as part of the Mary River Project CREMP in 2014¹ (Figure 2.2). Study area GO-09 (including water quality stations GO-09A, GO-09 and GO-09B), located upstream of the mine lease area on the Mary River (Figure 2.2), is only minimally influenced by Mary River Project mining activity (i.e., low amounts of dust deposition; see Baffinland 2014). Therefore, this study area was considered representative of reference conditions for comparisons of water quality, phytoplankton productivity and benthic invertebrate community metrics to mine-exposed stations/study areas situated farther downstream on the Mary River. A geographically expansive reconnaissance survey of local study area (LSA) lakes was conducted in 2014 to identify a water body that could potentially serve as a suitable reference 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 water body with similar surface area, maximum water depth, substrate features, and fish community species composition as the mine-exposed lakes, but was also uninfluenced by any current or past mining activity. Reference Lake 3, which is an unnamed lake located approximately 62 km south of the Mary Lake Project (Table 2.1; Figures 2.1 and 2.3), was selected to represent reference conditions for the mine-exposed lakes as part of the Mary River Project CREMP in 2015.

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 lotic reference 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. Because no intensive physico-chemical or biological sampling was conducted at Reference Lake 3 until the current 2015 field study, no control-impact comparisons were possible between the 2015 and mine-construction (2014) periods for the mine-exposed lakes.

3.2 Background Water Quality

3.2.1 Lotic Environments

Water chemistry at the lotic reference stations showed routinely elevated phenol concentrations and periodically elevated aluminum and iron concentrations compared to WQG and AEMP benchmarks for lotic environments (Table 3.1). 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 lotic reference stations appeared to be naturally high (i.e., 2015 average of 2.6 µg/L). Total aluminum and iron concentrations at the lotic reference stations showed a strong, positive relationship with turbidity, suggesting that a high proportion of these metals were likely bound to, and/or comprised, the suspended particulate materials (e.g., aluminosilicate clay minerals). This was supported by examination of the ratio between dissolved and total concentrations of these metals, which showed that under more highly turbid conditions, a higher proportion of the metal concentration was associated with particulates (i.e., the total fraction; compare Table 3.1 and Appendix Table B.4). Therefore, despite elevation of total aluminum and iron at the lotic reference stations, these metals were unlikely to be biologically available. No other parameters were observed at concentrations above WQG or the AEMP benchmarks at the lotic reference stations in 2015.

Water chemistry at the lotic reference stations showed distinct seasonal changes in parameter concentrations (Figure 3.1; Table 3.1). 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 2015 (Figure 3.1). 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 water quality monitoring conducted for the Mary River Project showed similar seasonal patterns in parameter concentrations at lotic environments (KP 2014b). Consequently, the water chemistry data presented herein generally focus on the results of the fall sampling event to allow the most conservative evaluation of water chemistry data to applicable WQG. Temporal comparison of the lotic reference station mean water chemistry showed no substantial changes in water quality from 2014 to 2015, suggesting that water chemistry at the lotic reference stations was relatively consistent year-to-year taking seasonal sampling timing into account. Therefore, the lotic reference stations

Table 3.1: Water chemistry at lotic reference stations, Mary River Project CREMP, 2015.

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
					26-Jun-2015	26-Jun-2015	26-Jun-2015	26-Jun-2015	21-Jul-2015	21-Jul-2015	21-Jul-2015	21-Jul-2015	13-Aug-2015	13-Aug-2015	13-Aug-2015	13-Aug-2015
Conventional ^b	Conductivity (lab)	umho/cm	-	-	30	43	32	56	79	73	54	89	120	104	74	123
	pH (lab)	pH	6.5 - 9.0	-	7.07	7.38	7.31	7.40	7.96	7.98	6.98	6.20	8.06	7.89	7.69	8.02
	Hardness (as CaCO ₃)	mg/L	-	-	14	21	12	27	38	34	20	42	60	52	30	62
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	2.4	<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	27	20	40	43	36	50	45	58	52	47	60
	Turbidity	NTU	-	-	0.6	0.3	4.8	0.6	0.6	0.3	5.9	1.4	0.6	0.7	9.0	1.8
	Alkalinity (as CaCO ₃)	mg/L	-	-	13	20	11	26	42	40	22	45	58	49	22	55
Nutrients and Organics	Total Ammonia	mg/L	0.715	0.855	<0.050	<0.050	<0.050	<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	0.036	<0.020	<0.020	0.020	0.021	0.020	0.034	<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	0.16
	Dissolved Organic Carbon	mg/L	-	-	1.3	2.2	1.7	1.7	<1.0	<1.0	<1.0	<1.0	1.3	2.0	1.4	2.2
	Total Organic Carbon	mg/L	-	-	1.6	2.6	1.8	2.0	<1.0	1.1	1.3	<1.0	1.3	2.0	1.6	2.0
	Total Phosphorus	mg/L	0.020 ^α	-	0.0043	0.0032	0.0061	0.0033	<0.0030	<0.0030	<0.0030	0.0039	<0.0030	0.0030	0.0080	<0.0030
	Phenols	mg/L	0.001 ^α	-	<0.0010	<0.0010	<0.0010	0.0015	0.0033	0.0025	0.0019	0.0027	0.0054	0.0037	0.0033	0.0044
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	1.57	0.74	<0.50	<0.50	1.89	1.15	0.75	<0.50	3.47	1.50
	Sulphate (SO ₄)	mg/L	218 ^β	218	0.4	0.8	2.9	0.6	0.6	1.3	3.9	1.2	2.0	1.8	7.0	1.9
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.029	0.020	0.111	0.025	0.031	0.013	0.134	0.066	0.028	0.050	0.494	0.082
	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	-	-	0.0017	0.0030	0.0041	0.0035	0.0036	0.0045	0.0064	0.0059	0.0048	0.0062	0.0101	0.0074
	Beryllium (Be)	mg/L	0.011 ^α	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<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	<0.000050	<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
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	3.23	4.57	2.90	5.97	8.10	7.31	4.63	8.82	12.6	10.8	6.69	12.5
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00083	<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	0.00014	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	<0.00050	0.0013	0.0012	0.0005	0.0007	0.0012	0.0012	0.0006	<0.0010	0.0014	0.0017	<0.0010
	Iron (Fe)	mg/L	0.30	0.33	<0.030	<0.030	0.104	<0.030	<0.030	<0.030	0.107	0.034	<0.050	0.069	0.341	0.084
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.000075	0.00014	<0.000050	<0.000050	<0.000050	0.00015	<0.000050	<0.00010	0.00016	0.00034	<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	-	-	1.77	2.50	1.45	3.40	4.23	3.97	2.16	4.70	7.14	6.51	3.47	7.49
	Manganese (Mn)	mg/L	0.935 ^β	-	0.000237	0.000274	0.00167	0.00124	0.000154	0.000414	0.00124	0.000469	<0.00050	0.00162	0.00375	0.000960
	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	0.000200	0.000122	0.000063	0.000170	0.000454	0.000334	0.000176	0.000283	0.000648	0.000419	0.000242
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00071	<0.00050	<0.00050	<0.00050	0.00061	<0.00050	<0.00050	<0.00050	0.00081	0.00057	<0.00050
	Potassium (K)	mg/L	-	-	0.32	0.42	0.49	0.52	0.52	0.53	0.79	0.74	0.61	0.71	1.04	0.83
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	0.37	0.67	0.80	0.49	0.62	0.69	1.00	0.69	0.60	0.94	1.80	0.80
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	0.36	0.39	1.14	0.62	0.62	0.61	1.80	1.22	1.07	0.92	2.52	1.57
	Strontium (Sr)	mg/L	-	-	0.00231	0.00282	0.00577	0.00450	0.00635	0.00479	0.01020	0.00808	0.00980	0.00670	0.0148	0.0104
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	0.00001	<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	<0.010	<0.010	0.0006	0.0016	0.0210	0.0026
	Uranium (U)	mg/L	0.015	-	0.00019	0.00039	0.00043	0.00026	0.00144	0.00069	0.00048	0.00072	0.00597	0.00232	0.00087	0.00190
	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	<0.00050	<0.00050	0.0008	<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

^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 2.3 for information regarding WQG criteria.

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD

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

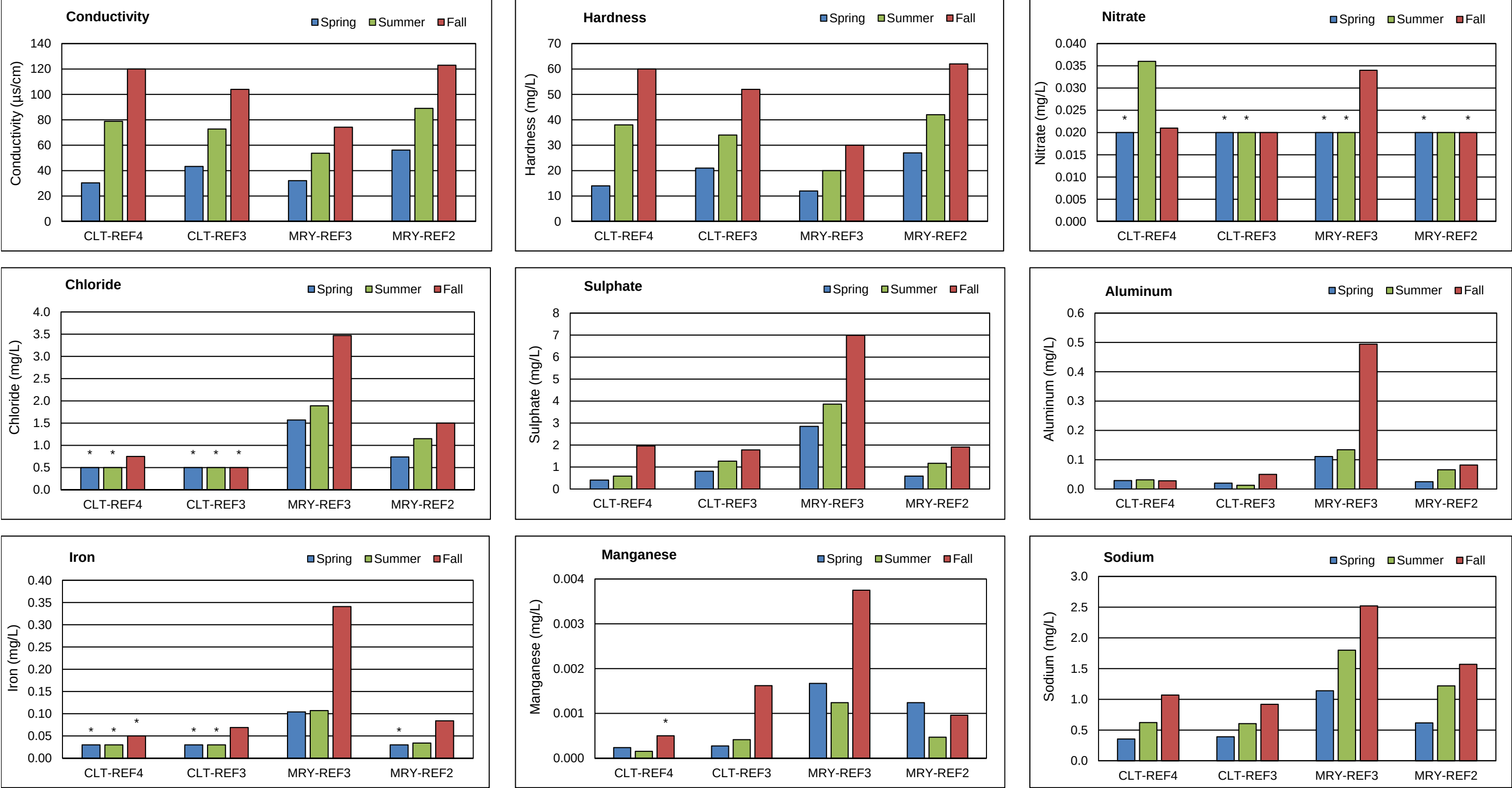


Figure 3.1: Seasonal variation in water chemistry at lotic reference stations, Mary River Project CREMP, 2015. Asterisk (*) indicates that the parameter concentration was below the method detection limit.

were deemed to provide a meaningful benchmark for the evaluation of potential mine-related influences on water chemistry at mine-exposed lotic receiving environments.

3.2.2 Lake Environments (Reference Lake 3)

In-situ water quality vertical profiles conducted at Reference Lake 3 showed no substantial differences in water temperature, dissolved oxygen, pH or specific conductance among profile stations during summer or fall sampling events in 2015 (Figure 3.2), suggesting thorough lateral mixing at LSA lakes. As a result, the evaluation of any differences in vertical water quality profiles among LSA lakes for the 2015 Mary River Project CREMP was conducted using *in-situ* water quality values averaged among respective lake stations for each vertical profile interval.

Water chemistry at Reference Lake 3 showed that, consistent with observations at the lotic reference stations, aqueous phenol concentrations were routinely elevated above WQG (Table 3.2). Accordingly, phenol concentrations in both lotic and lentic environments of the Mary River Project LSA appear to be naturally elevated above WQG as a result of sources unrelated to mine activity. No other parameters were observed at concentrations above WQG at Reference Lake 3 in 2015. In addition, no parameters were observed at concentrations above lentic AEMP benchmarks at Reference Lake 3 (Table 3.2), suggesting that these 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, which was similar to observations at LSA lakes during baseline studies, which did not show any pronounced seasonal differences in lake water chemistry among winter, summer and fall sampling events (KP 2014a,c). Although fall water chemistry data generally served as the focus for the evaluation of potential mine-related influences on water quality of the mine-exposed lakes, the 2015 CREMP data analysis also evaluated potential influences of mine operations on water quality at mine-exposed lakes during the winter and summer seasons.

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 (Figure 3.3; Table 3.2). The lack of any appreciable vertical differences in water chemistry at each station likely reflected absent to weak development of thermal stratification and, relatedly, no substantial differences in dissolved oxygen saturation and/or pH with increased depth from the surface. Because no, or relative weak, thermal stratification likely developed (or develops) in Reference Lake 3, the entire water column mixes freely under various wind conditions, resulting in similar water chemistry at the water column surface and bottom. Moreover, the development of anoxic, reducing conditions and subsequent mobilization of metals from sediment to the overlying water is less likely to occur,

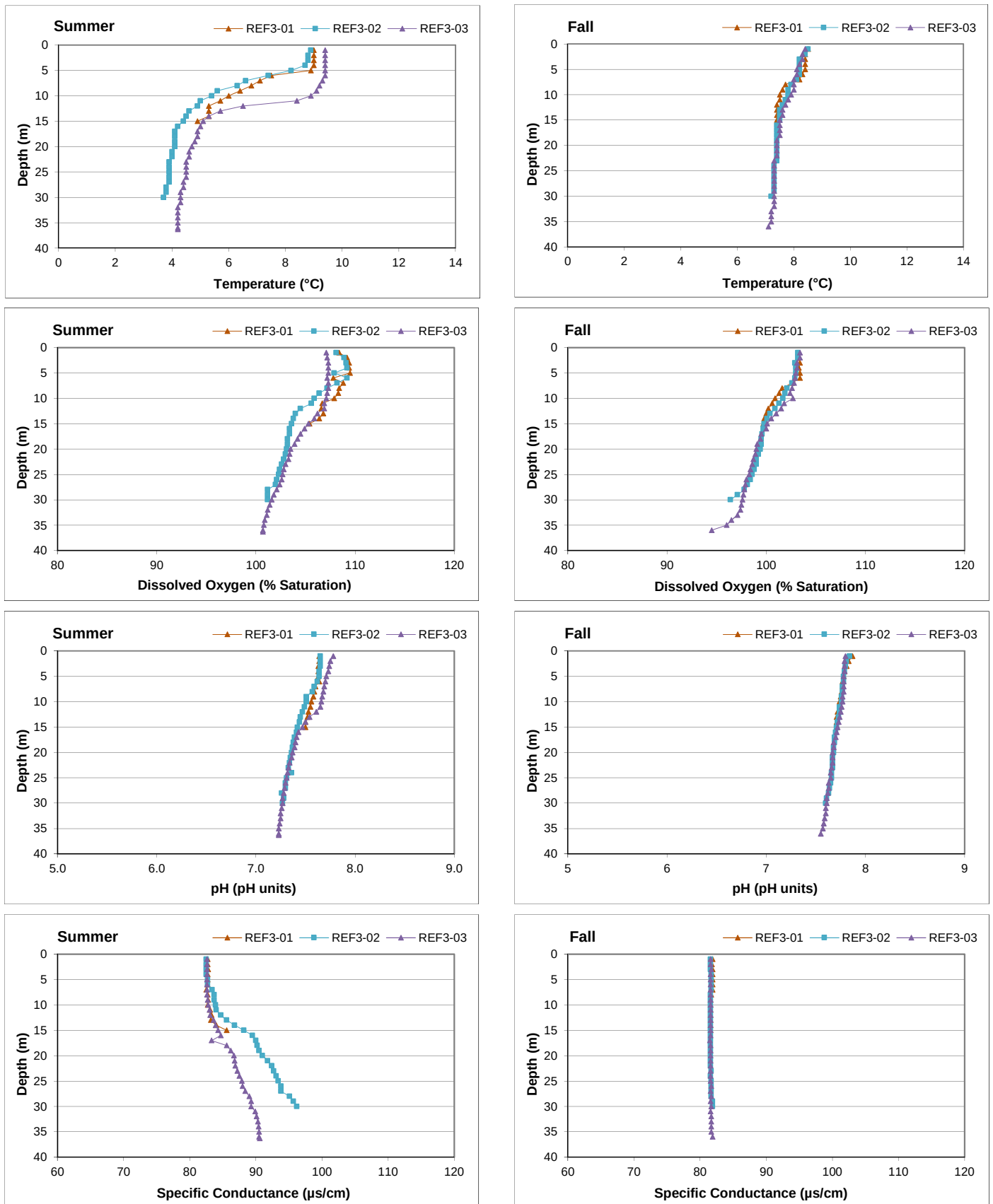


Figure 3.2: *In-situ* water quality with depth from surface at Reference Lake 3 during summer and fall sampling events, Mary River Project CREMP, 2015.

Table 3.2: Water chemistry at Reference Lake 3, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Summer Sampling Event						Fall Sampling Event					
					REF3-01 surface	REF3-01 bottom	REF3-02 surface	REF3-02 bottom	REF3-03 surface	REF3-03 bottom	REF3-01 surface	REF3-01 bottom	REF3-02 surface	REF3-02 bottom	REF3-03 surface	REF3-03 bottom
					28-Jul-2015	28-Jul-2015	28-Jul-2015	28-Jul-2015	31-Jul-2015	31-Jul-2015	22-Aug-2015	22-Aug-2015	22-Aug-2015	22-Aug-2015	24-Aug-2015	24-Aug-2015
Conventionals ^b	Conductivity (lab)	umho/cm	-	-	75.7	74.5	73.6	85.1	74.4	81.0	76.8	76.5	76.1	77.6	75.7	76.0
	pH (lab)	pH	6.5 - 9.0	-	7.59	7.62	7.65	7.49	7.89	7.82	7.55	7.55	7.65	7.59	7.61	7.59
	Hardness (as CaCO ₃)	mg/L	-	-	35	35	35	40	34	37	35	35	35	35	35	35
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	49	45	44	43	56	60	33	37	40	38	34	42
	Turbidity	NTU	-	-	0.28	0.20	0.23	0.19	0.30	0.21	0.28	0.21	0.19	0.25	0.20	0.19
	Alkalinity (as CaCO ₃)	mg/L	-	-	32	32	31	37	32	36	28	31	32	28	32	33
Nutrients and Organics	Total Ammonia	mg/L	0.715	0.855	<0.050	<0.050	<0.050	<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	<0.020	<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	-	-	0.34	0.19	0.19	0.16	<0.15	<0.15	<0.15	0.31	0.22	0.24	0.17	0.23
	Dissolved Organic Carbon	mg/L	-	-	2.4	2.4	2.3	2.7	2.2	2.6	3.1	3.1	3.1	3.2	3.0	3.1
	Total Organic Carbon	mg/L	-	-	2.6	2.5	2.5	3.0	2.5	2.6	3.2	3.3	3.4	3.4	3.2	3.1
	Total Phosphorus	mg/L	0.020 ^α	-	0.003	0.003	<0.0030	0.003	0.005	<0.0030	0.003	<0.0030	0.003	0.005	<0.0030	0.003
Anions	Phenols	mg/L	0.001 ^α	-	<0.0010	<0.0010	0.0023	<0.0010	<0.050	0.0022	0.0033	0.0038	0.00385	0.00395	<0.0010	<0.0010
	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	1.31	1.28	1.27	1.54	1.25	1.38	1.29	1.28	1.275	1.29	1.28	1.27
Anions	Sulphate (SO ₄)	mg/L	218 ^β	218	4.42	4.42	4.34	4.99	4.29	4.67	4.41	4.36	4.37	4.37	4.34	4.24
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	0.003	0.003	<0.0030	<0.0030	0.004	0.003	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	mg/L	0.020 ^α	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0067	0.0067	0.0065	0.0078	0.0064	0.0062	0.0063	0.0063	0.0063	0.0064	0.0065	0.0064
	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	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	7.05	6.94	6.89	7.95	6.90	7.29	7.20	7.19	7.05	7.00	6.99	7.15
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009 ^α	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.004	0.00092	0.00085	0.00075	0.00095	0.00096	0.00076	0.00089	0.00091	0.00081	0.00082	0.00079	0.00076
	Iron (Fe)	mg/L	0.30	0.30	<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	-	-	4.28	4.30	4.08	4.92	4.17	3.93	4.20	4.22	4.21	4.22	4.31	4.20
	Manganese (Mn)	mg/L	0.935 ^β	-	0.0005	0.0005	0.0005	0.0009	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
	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	0.00013	0.00013	0.00015	0.00014	0.00014	0.00013	0.00013	0.00013	0.00013	0.00013	0.00014
	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	-	-	0.91	0.91	0.87	1.04	0.90	0.88	0.91	0.91	0.90	0.91	0.92	0.89
	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	-	-	0.41	0.40	0.39	0.52	0.41	0.45	0.40	0.40	0.40	0.42	0.40	0.41
	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	-	-	0.82	0.83	0.78	0.97	0.79	0.76	0.82	0.82	0.82	0.83	0.82	0.81
	Strontium (Sr)	mg/L	-	-	0.008	0.008	0.008	0.009	0.008	0.009	0.008	0.008	0.008	0.008	0.008	0.008
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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	-	0.00027	0.00027	0.00027	0.00030	0.00027	0.00028	0.00027	0.00027	0.00027	0.00026	0.00026	0.00026
	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 2.3 for information regarding WQG.

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

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD

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

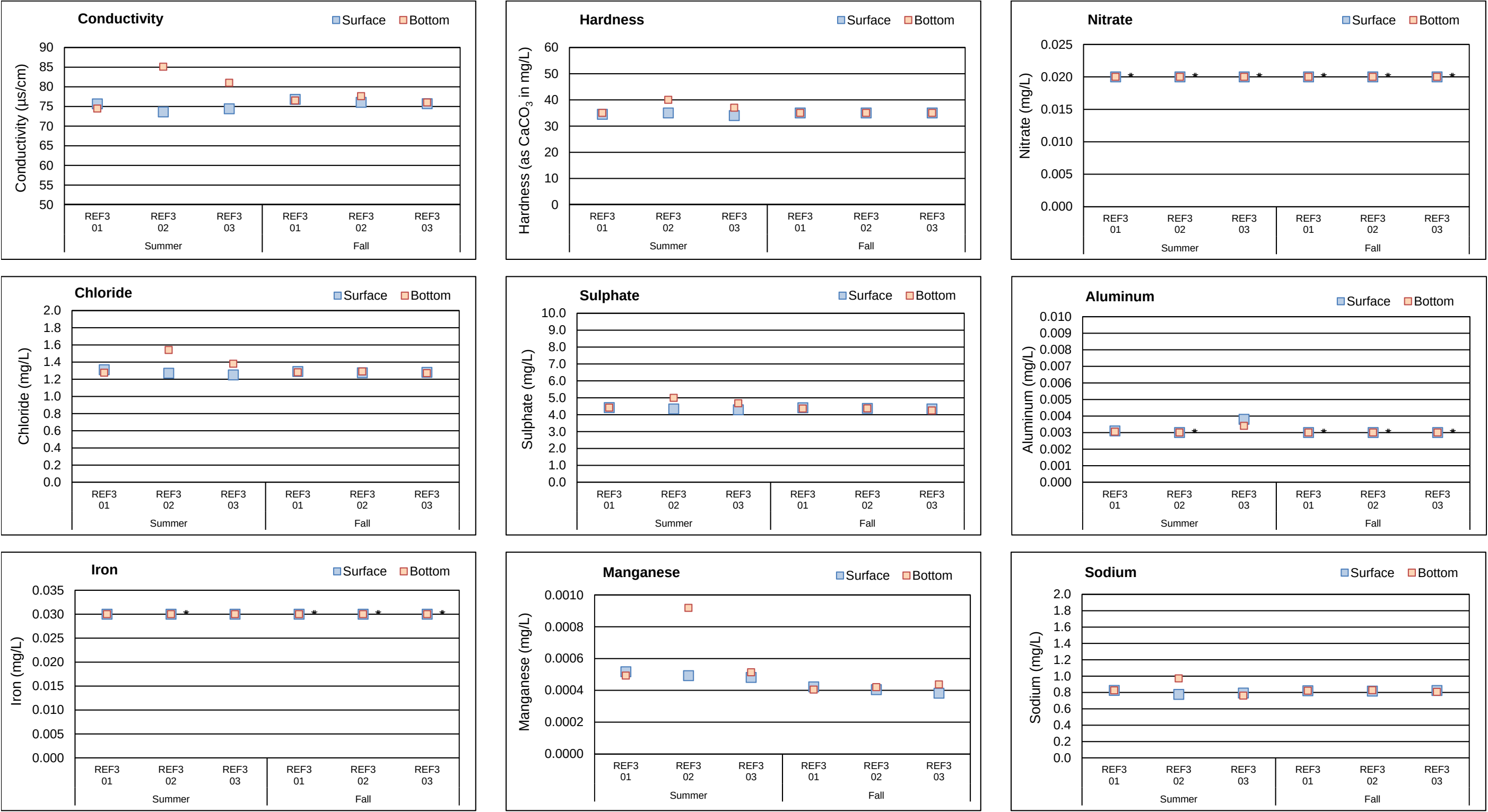


Figure 3.3: Water chemistry comparison between the surface and the bottom of the water column at Reference Lake 3 routine monitoring stations during summer and fall, Mary River Project CREMP, 2015. Asterisk (*) indicates that the parameter concentration was below the laboratory method detection limit.

or to contribute substantially to aqueous metal concentrations, under absent to weakly stratified conditions, resulting in relative uniform water chemistry between surface and bottom waters. Because no consistent differences in water chemistry were observed between the surface and bottom of the water column at Reference Lake 3 stations, the evaluation of water chemistry among stations and study areas for the 2015 Mary River Project CREMP was based on average water chemistry values from the water column surface and bottom for each lake station.

3.3 Sediment Quality Observations

3.3.1 Lotic Environments

The Mary River Project CREMP had proposed sediment sampling at lotic areas of the Camp Lake tributaries, Sheardown Lake tributaries, and the Mary River (KP 2014a, 2015). However, these watercourses were found to contain very limited depositional habitat during the 2015 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 quality within, along and/or between watercourses, and therefore no sediment sampling was conducted at lotic environments as part of the 2015 CREMP.

3.3.2 Lentic 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 for the analysis of particle size, total organic carbon (TOC) content and total metal concentrations (Table 2.5; Figure 2.3). Surficial sediment at Reference Lake 3 littoral and profundal areas was comprised of silty to sandy loam substrate 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 the littoral stations than at the profundal stations (Appendix Table C.4). No significant differences in sediment TOC content were shown between the littoral and profundal habitats. A surficial and/or sub-surface layer of oxidized material (likely iron hydroxide or oxy-hydroxides), visible as a reddish-orange to orange-brown floc or as a distinct layer, was commonly observed in sediments of Reference Lake 3 (Appendix Tables C.1 and C.2). In addition, sub-surface sediment of Reference Lake 3 occasionally contained black/dark colouration, which suggested the occurrence of reducing (i.e., anoxic) sediment conditions (Appendix Table C.2).

Sediment metal concentrations at Reference Lake 3 were generally lower at the littoral stations compared to the profundal stations, although less than a two-fold difference in concentrations was typically shown between these habitats (Table 3.3; Figure 3.4). The differences in sediment metal concentrations between the littoral and profundal stations likely reflected a naturally higher proportion of fine silt- and clay-sized particles at the latter, which is consistent with expected depositional patterns in lakes. Among metals with established SQG, average concentrations of iron were elevated above respective SQG at both littoral and profundal stations, and average concentrations of manganese were elevated above respective SQG at profundal stations, of Reference Lake 3 (Table 3.3). Sediment chromium, copper and phosphorus concentrations were also elevated above SQG at individual stations of Reference Lake 3 (Table 3.3). Therefore, high concentrations of iron and manganese, as well as chromium, copper and phosphorus (relative to SQG) could be expected to occur naturally in sediments of Mary River Project LSA lakes. Average arsenic, copper and iron concentrations, as well as chromium and phosphorus at individual stations, were above AEMP benchmarks at Reference Lake 3 (Table 3.3), which suggested that the AEMP sediment benchmarks for these metals were very conservative.

3.4 Phytoplankton Productivity (Chlorophyll a) Observations

3.4.1 Lotic Environments

Chlorophyll a concentrations, which were used as a surrogate for phytoplankton productivity, ranged from approximately 0.15 – 0.82 µg/L among the lotic reference stations (including the Station GO-09 series) over the spring, summer and fall sampling events in 2015 (Appendix Table D.1). The lotic reference station chlorophyll a concentrations were 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 also consistent with an 'oligotrophic' CWQG categorization for the lotic reference stations based on mean aqueous total phosphorus concentrations ranging between 4 – 10 µg/L at these stations during each respective spring, summer and fall sampling event in 2015 (Table 3.1). Seasonally, chlorophyll a concentrations did not differ significantly at the lotic reference stations among the spring, summer and fall sampling events (Appendix Table D.8).

3.4.2 Lentic Environments (Reference Lake 3)

Chlorophyll a concentrations at Reference Lake 3 showed no consistent and/or substantial differences between the surface and the bottom of the water column at each individual station during both the summer and fall sampling events in 2015 (Figure 3.5). Therefore,

Table 3.3: Sediment particle size, total organic carbon, and total metal concentrations at Reference Lake 3 (REF 03) sediment quality monitoring stations, Mary River Project CREMP, August 2015.

Analyte		Units	Sediment Quality Guideline (SQG) ^a	AEMP Benchmark ^b	Replicate Station										Study Area Summary Statistics		
					REF-03-1 (littoral)	REF-03-2 (littoral)	REF-03-3 (littoral)	REF-03-4 (littoral)	REF-03-5 (littoral)	REF-03-6 (profundal)	REF-03-7 (profundal)	REF-03-8 (profundal)	REF-03-9 (profundal)	REF-03-10 (profundal)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	60	49	42	64	40	40	19	40	40	47	44	12	4
	Silt	%	-	-	32	37	48	32	52	46	62	45	49	40	44	9	3
	Clay	%	-	-	8	15	10	4	8	14	19	15	11	13	12	4	1
	Moisture	%	-	-	91	91	71	81	87	88	87	88	82	85	85	6	2
	Total Organic Carbon	%	10 ^α	-	2.5	8.3	1.9	2.9	5.3	4.9	4.4	5.3	4.7	4.5	4.5	1.8	0.6
Metals	Aluminum (Al)	mg/kg	-	-	21,400	14,900	13,400	15,500	15,400	31,700	30,000	23,400	22,900	27,300	21,590	6,648	2,102
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
	Arsenic (As)	mg/kg	17	5.9	5.30	6.01	3.20	3.50	9.98	7.12	6.81	6.44	5.17	6.04	5.96	1.92	0.607
	Barium (Ba)	mg/kg	-	-	128	136	80.3	78.7	157	171	159	140	124	150	132	31.4	9.92
	Beryllium (Be)	mg/kg	-	-	0.95	0.64	0.60	0.65	0.61	1.13	1.13	0.93	0.94	1.05	0.86	0.22	0.069
	Bismuth (Bi)	mg/kg	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	0.24	0.24	0.23	<0.20	0.23	0.21	0.0180	0.0057
	Boron (B)	mg/kg	-	-	19.8	15.0	11.9	12.7	15.5	23.5	23.9	20.0	19.3	21.2	18.3	4.27	1.35
	Cadmium (Cd)	mg/kg	3.5	1.5	0.189	0.242	0.287	0.125	0.222	0.257	0.205	0.206	0.160	0.185	0.21	0.047	0.015
	Calcium (Ca)	mg/kg	-	-	5,630	6,000	3,840	4,080	5,330	6,700	6,540	6,170	9,140	6,450	5,988	1,484	469.1
	Chromium (Cr)	mg/kg	90	98	72.7	49.4	42.0	49.2	56.2	101	91.7	74.0	72.7	86.2	69.5	19.9	6.28
	Cobalt (Co)	mg/kg	-	-	14.2	11.1	12.2	11.6	14.1	22.3	20.7	17.3	15.7	18.9	15.8	3.89	1.23
	Copper (Cu)	mg/kg	110 ^α	50	98.0	79.0	48.1	56.6	65.3	119	111	90.6	84.5	102	85.5	23.4	7.40
	Iron (Fe)	mg/kg	40,000 ^α	52,400	52,100	73,400	26,900	33,700	110,000	59,600	56,200	60,900	44,300	51,250	56,835	23,016	7,278
	Lead (Pb)	mg/kg	91	35	19.3	17.0	14.3	13.9	16.2	25.1	23.9	23.3	22.4	22.4	19.8	4.17	1.32
	Lithium (Li)	mg/kg	-	-	35.3	22.2	23.2	24.4	24.4	43.6	46.4	36.6	35.9	40.5	33.3	9.04	2.86
	Magnesium (Mg)	mg/kg	-	-	13,300	9,360	8,420	9,060	10,300	20,200	18,200	14,400	14,700	17,150	13,509	4,157	1,314
	Manganese (Mn)	mg/kg	1,100 ^{α,β}	4,370	850	827	1,050	774	853	1,520	1,480	3,510	1,010	1,260	1,313	817.4	258.5
	Mercury (Hg)	mg/kg	0.486	0.17	0.0461	0.0744	0.0198	0.0231	0.0629	0.0731	0.0745	0.0838	0.127	0.0675	0.0652	0.0309	0.00978
	Molybdenum (Mo)	mg/kg	-	-	5.66	6.77	3.62	2.91	12.1	3.15	3.27	5.17	2.32	2.63	4.76	2.96	0.936
	Nickel (Ni)	mg/kg	75 ^{α,β}	72	54.1	42.0	44.7	35.1	40.5	71.1	63.5	55.0	49.8	59.2	51.5	11.23	3.55
	Phosphorus (P)	mg/kg	2,000 ^α	1,580	1,240	1,420	732	847	3,290	1,400	1,320	1,100	1,100	1,150	1,360	713.6	225.7
	Potassium (K)	mg/kg	-	-	5,030	3,690	3,550	3,670	3,860	7,420	7,250	5,630	5,600	6,555	5,226	1,508	477.0
	Selenium (Se)	mg/kg	-	-	0.76	0.91	0.33	0.38	0.92	1.05	0.88	1.13	0.85	0.86	0.81	0.26	0.082
	Silver (Ag)	mg/kg	-	-	0.19	0.18	<0.10	<0.10	0.15	0.33	0.34	0.29	0.28	0.31	0.23	0.093	0.029
	Sodium (Na)	mg/kg	-	-	354	283	232	236	311	577	530	418	436	497	387	123	38.9
	Strontium (Sr)	mg/kg	-	-	13.9	13.0	10.6	11.2	14.1	18.2	19.1	16.6	26.4	17.4	16.0	4.64	1.47
	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	-	-	0.612	0.456	0.489	0.371	0.440	1.02	0.938	0.897	0.802	0.926	0.695	0.246	0.0779
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	2.3	<2.0	<2.0	2.1	2.1	0.15	0.047
	Titanium (Ti)	mg/kg	-	-	1,070	752	1,030	914	1,070	1,710	1,550	1,090	1,240	1,365	1,179	291	92.2
	Uranium (U)	mg/kg	-	-	19.4	15.3	14.7	8.29	14.6	29.9	31.9	24.4	22.2	27.3	20.8	7.66	2.42
	Vanadium (V)	mg/kg	-	-	71.3	50.0	43.9	49.3	49.5	89.8	83.9	65.1	64.2	76.0	64.3	15.9	5.04
	Zinc (Zn)	mg/kg	315	135	106	78.4	60.4	72.4	74.9	132	123	96.3	94.6	112	95	23.4	7.41
	Zirconium (Zr)	mg/kg	-	-	3.6	3.8	3.0	2.5	3.0	3.8	3.7	3.4	3.6	4.0	3.4	0.5	0.1

^a Canadian Sediment Quality Guideline for the protection of aquatic life, probable effect level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Guideline [PSQG], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG] PEL; BCMOE 2015).

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

Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD

 Indicates parameter concentration above the AEMP Benchmark.

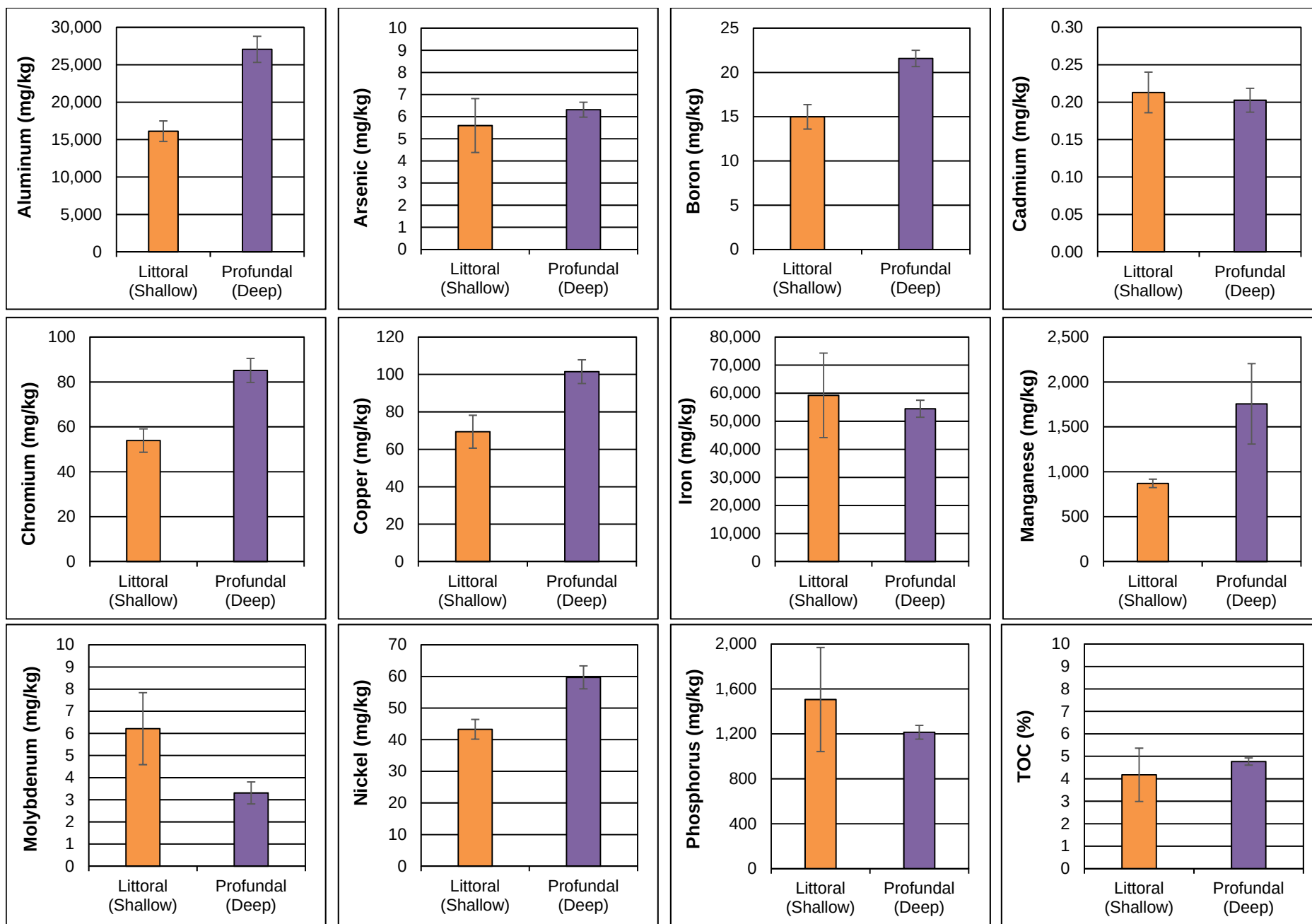


Figure 3.4: Sediment metal concentrations (mean $\pm$ SE) at littoral (<12m depth) and profundal (>12m depth) monitoring stations of Reference Lake 3 (REF03), Mary River Project CREMP, August 2015.

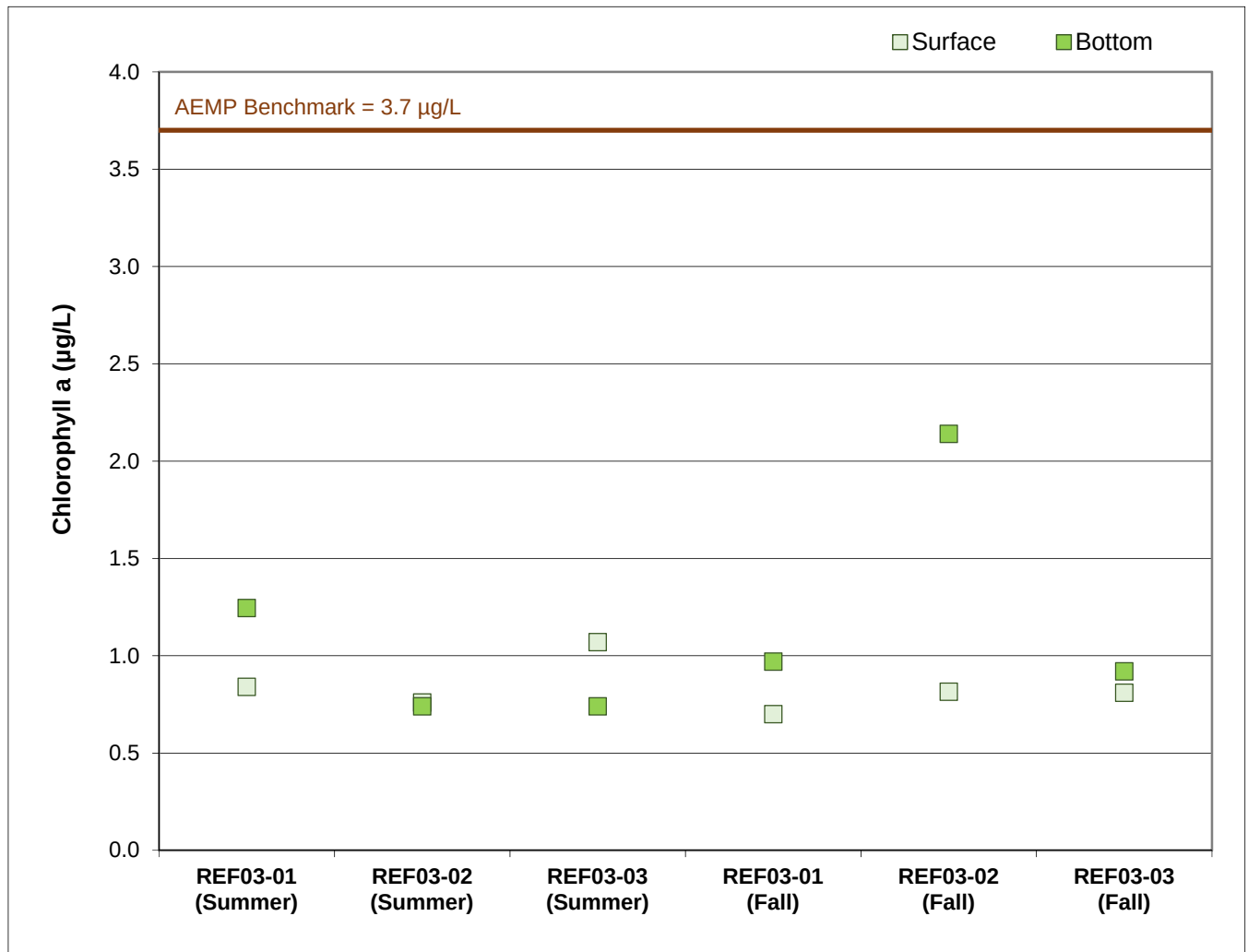


Figure 3.5: Chlorophyll a concentrations at the surface and bottom of the water column at Reference Lake 3 phytoplankton monitoring stations during summer and fall sampling events, Mary River Project CREMP, 2015.

similar to the evaluation of the water chemistry data, chlorophyll a concentrations taken from the water column surface and bottom at each station were averaged and then used as the basis for the 2015 CREMP assessment of phytoplankton productivity between the mine-exposed and reference lakes.

Chlorophyll a concentrations at Reference Lake 3 averaged 0.90 µg/L in summer and 1.1 µg/L in fall 2015, and were consistently well below the AEMP benchmark of 3.7 µg/L (Figure 3.5). Similar to the lotic reference stations, mean chlorophyll a concentrations observed at Reference Lake 3 in 2015 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 ranging between 4 and 10 µg/L during the summer and fall sampling events in 2015 (Table 3.2). There were no significant differences in chlorophyll a concentrations between the 2015 summer and fall sampling events at Reference Lake 3 (Appendix Table D.8).

3.5 Benthic Invertebrate Community Observations

3.5.1 Lotic Environments

No pristine lotic reference areas have been established for benthic invertebrate sampling as part of the Mary River Project CREMP (see NSC 2014). Rather, the CREMP was designed to assess mine-related influences on benthic invertebrate communities of mine-exposed watercourses using a before-after approach comparing the most current field data to baseline (2005 – 2013) data. Nevertheless, for the purposes of the 2015 CREMP, minimally mine-influenced areas at Camp Lake tributaries 1 and 2 (CLT1-US and CLT2-US, respectively) and at the Mary River (GO-09) were used as reference areas for the evaluation of mine-related effects on benthic invertebrate communities at areas downstream of potential mine contaminant sources in each respective watercourse. The minimally mine-influenced areas were used as reference areas only following confirmation that water chemistry at these areas had not been adversely affected by current or past mining activity, which included evaluation of water chemistry to applicable WQG and AEMP benchmarks.

Average benthic invertebrate densities at the lotic reference areas ranged from 472 – 1,446 individuals/m², which is considered moderate for Arctic streams (Craig and McCart 1975). The lotic reference areas 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 lotic reference areas, with the relative abundance of this group ranging from 76 – 88% of individuals, of which 11 – 13% were represented by metal-sensitive taxa.

3.5.2 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. Significantly higher benthic invertebrate density, richness, Simpson's Evenness, and relative abundance of the collector-gatherer functional feeding group (FFG) and the sprawler habitat preference group (HPG), as well as significantly lower relative abundance of Chironomidae, was shown at the benthic littoral area compared to the benthic profundal area of Reference Lake 3 (Figure 3.6; Appendix Table E.26). The considerable difference in benthic invertebrate community metrics and assemblage features between the littoral and profundal stations of Reference Lake 3 clearly indicated that littoral and profundal data sets should be assessed separately in comparisons between the mine-exposed lakes and Reference Lake 3.

3.6 Fish Survey Observations

3.6.1 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 streams/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 these lotic habitats is conducted for the federal Environmental Effects Monitoring (EEM) program under the Metal Mining Effluent Regulations (Baffinland 2014).

3.6.2 Lentic Environments (Reference Lake 3)

The Reference Lake 3 fish community was comprised of Arctic charr and ninespine stickleback. The relative abundance of both species appeared to be low at Reference Lake 3 based on low electrofishing and gill netting catches and CPUE for each species (Appendix Table F.1 and F.2). Suitable numbers of Arctic charr were captured at nearshore habitat of Reference Lake 3 (i.e., 99 individuals) to allow evaluation of mine-related effects on survival, growth and condition of juveniles at the mine-exposed lakes. However, very low numbers of Arctic charr were captured at littoral/profundal areas of the reference lake (i.e., 5 individuals; Appendix Tables F.7 and F.23), precluding any meaningful evaluation of mine-related effects on the health of reproductive-aged Arctic charr using data from mine-exposed lakes and Reference Lake 3. For the nearshore fish, young-of-the-year (YOY) individuals

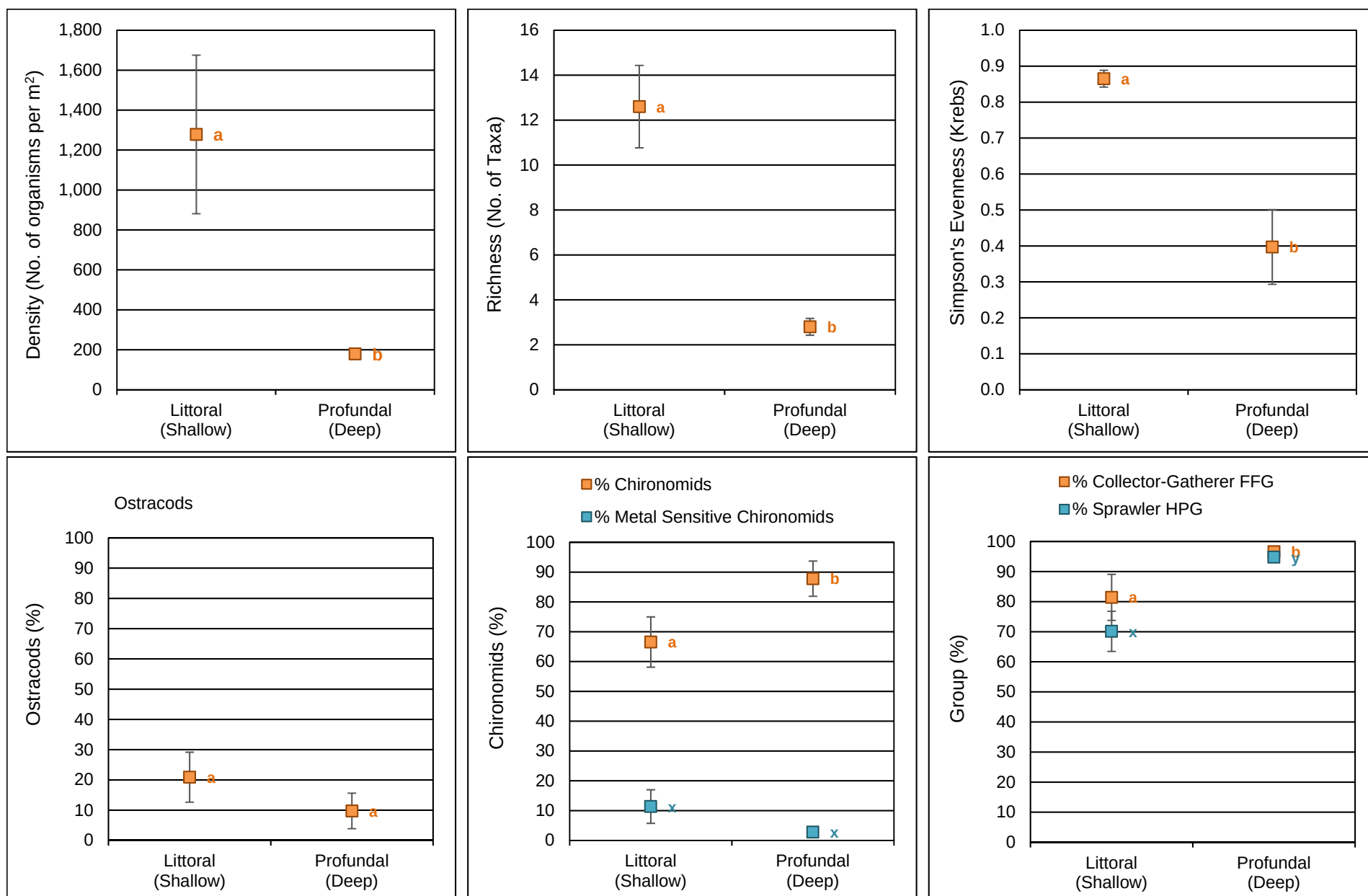


Figure 3.6: Benthic invertebrate community metrics (mean $\pm$ standard error) at littoral (<12 m deep) and profundal (>12 m deep) monitoring stations at Reference Lake 3 (REF03), Mary River Project CREMP, August 2015. The same, like-coloured letter next to data points indicates no significant difference between littoral and profundal stations.

could not be distinguished from the 1⁺ to 4⁺ age classes based on the evaluation of length-frequency distributions coupled with supporting age determinations (Figure 3.7). Therefore, health comparisons of nearshore Arctic charr captured between the mine-exposed and reference lakes were completed using the full data set.

Because Arctic charr can show differential growth rates between the sexes (females grow faster; Jonsson et al. 1999; Skúlason 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. 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).

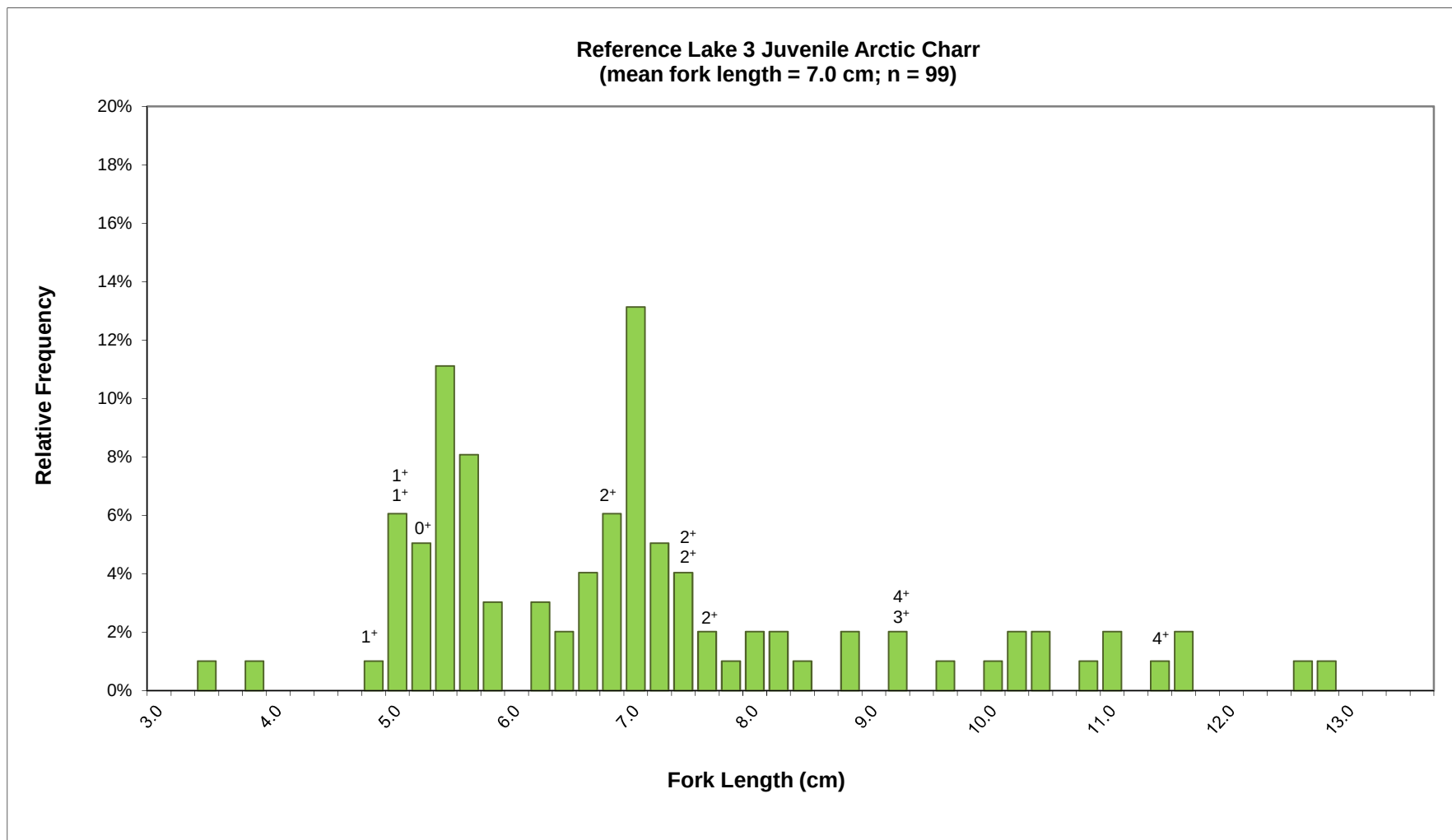


Figure 3.7: Length-frequency distribution of (nearshore) Arctic charr captured by backpack electrofishing at Reference Lake 3 (REF3), Mary River Project CREMP, August 2015. Fish age data are shown above the bars, where available.

4.0 CAMP LAKE SYSTEM

4.1 Camp Lake Tributaries (CLT)

4.1.1 Water Quality

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 B.1 – B.3). No significant differences in DO concentrations were shown between CLT1 study areas located in the north branch (upstream) and lower main stem (downstream of the mine tote road), at the time of biological sampling in August 2015 (Figure 4.1; Appendix Table B.12). In addition, DO saturation at all CLT1 monitoring stations was consistently similar to that of the lotic reference areas, and was well above the CWQG minimum limit for cold-water biota (i.e., 54%) at all stations (Figure 4.1), suggesting no mine related influences on dissolved oxygen concentrations of CLT1. Similarly, 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 B.1 – B.3), and no significant difference in pH was indicated between the north branch and lower main stem study areas in August 2015 (Figure 4.1). *In-situ* pH at CLT1 was similar to the lotic reference areas, and was consistently within the CWQG limits, suggesting no mine-related influences on pH of CLT1.

Water chemistry of the CLT1 north branch was similar to the lotic reference stations with the exception of a slightly higher (i.e., 3- to 5-fold) nitrate concentrations (Table 4.1; Appendix Table B.16). *In-situ* specific conductance was significantly higher within the CLT1 main stem compared to the north branch during the August 2015 sampling event (Figure 4.1). In addition to conductivity, hardness, alkalinity and concentrations of total dissolved solids (TDS), nitrate, chloride, sulphate, iron, manganese, molybdenum, potassium, sodium, strontium and uranium were slightly to highly elevated (i.e., 3-fold to ≥ 10 -fold higher, respectively) at the upstream-most CLT1 main stem station (L2-03) compared to average water chemistry at the lotic reference stations during the August 2015 sampling event (Table 4.1; Appendix Table B.16). However, only nitrate, chloride, manganese and sodium concentrations were elevated at the CLT1 lower main stem (i.e., stations L1-09, L1-05 and L0-01) compared to respective lotic reference station average concentrations during the fall sampling event (Appendix Table B.16), reflecting natural dilution of the main stem from the north branch. Collectively, the spatial patterns in water quality were consistent with 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. Nevertheless, concentrations of all

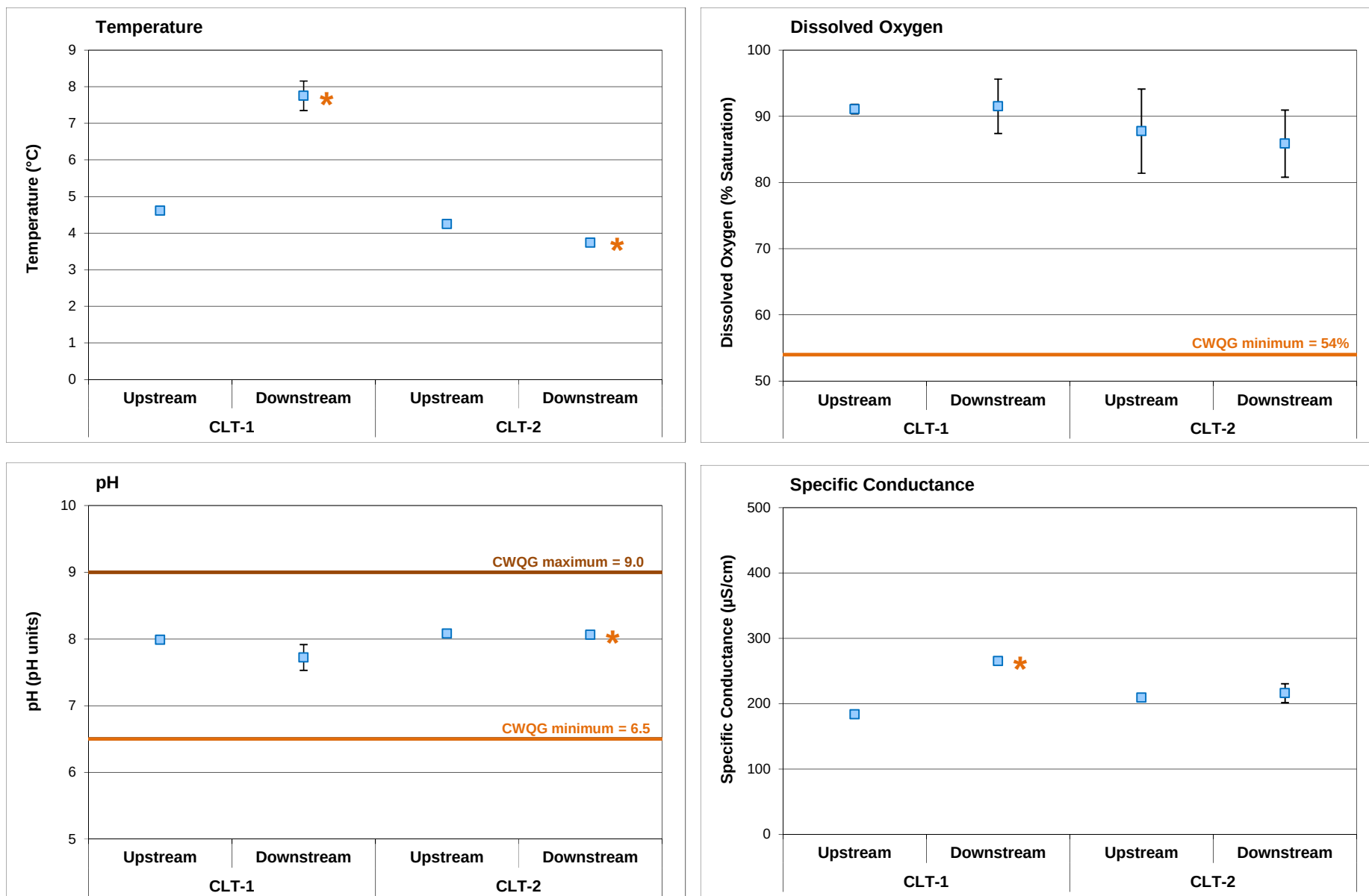


Figure 4.1: Comparison of *in-situ* water quality variables (mean $\pm$ SD; n = 5) measured at Camp Lake Tributary 1 and 2 benthic invertebrate community stations, Mary River Project CREMP, August 2015. An asterisk (*) next to the downstream data point indicates a significant difference compared to the upstream measure for the respective Camp Lake Tributary.

Table 4.1: Water chemistry at Camp Lake Tributary (CLT) monitoring stations during fall (August) sampling, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Lotic Reference Average (n=4) Fall 2015	North Branch CLT1		Main Stem CLT1				CLT-2
						L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01
						13-Aug-2015	18-Aug-2015	18-Aug-2015	18-Aug-2015	17-Aug-2015	17-Aug-2015	17-Aug-2015
Conventional ^b	Conductivity (lab)	umho/cm	-	-	105	125	199	449	262	258	256	220
	pH (lab)	pH	6.5 - 9.0	-	7.92	7.92	8.14	8.12	8.17	8.15	8.18	8.18
	Hardness (as CaCO ₃)	mg/L	-	-	51	63	104	183	126	123	124	117
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	2	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	54	66	90	241	129	140	131	115
	Turbidity	NTU	-	-	3.03	0.25	0.21	3.22	0.65	0.86	0.70	0.23
	Alkalinity (as CaCO ₃)	mg/L	-	-	46	59	97	142	111	107	113	122
Nutrients and Organics	Total Ammonia	mg/L	0.715	0.855	<0.050	<0.050	<0.050	0.144	<0.050	<0.050	<0.050	<0.050
	Nitrate	mg/L	13	13	0.024	0.079	0.038	1.01	0.20	0.26	0.23	0.033
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	0.0205	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.15	<0.15	0.17	0.59	0.24	0.19	0.29	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.7	2.6	2.6	4.8	3.4	3.7	3.4	2.7
	Total Organic Carbon	mg/L	-	-	1.7	2.2	2.8	5.1	3.6	3.4	3.5	3.6
	Total Phosphorus	mg/L	0.020 ^α	-	0.0043	0.0040	0.0167	0.0051	<0.0030	0.0039	0.0040	0.0032
	Phenols	mg/L	0.001 ^α	-	0.0042	0.0046	0.0019	0.0014	0.0014	0.0019	<0.0010	0.0019
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	1.56	1.79	1.62	48.20	13.70	14.10	12.70	2.43
	Sulphate (SO ₄)	mg/L	218 ^β	218	3.16	1.98	6.55	19.60	8.59	9.56	8.65	3.00
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.1635	0.0250	0.0066	0.0390	0.0112	0.0122	0.0150	0.0109
	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	0.00013	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00712	0.00919	0.0118	0.0163	0.0136	0.0136	0.0131	0.0119
	Beryllium (Be)	mg/L	0.011 ^α	-	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.000050	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	0.025	<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	-	-	10.6	12.8	19.4	34.2	24.2	25.0	24.6	23.3
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00058	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009 ^α	0.004	0.000110	<0.00010	<0.00010	0.000390	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.0013	0.0026	0.0022	0.00098	0.0019	0.0019	0.0018	0.0014
	Iron (Fe)	mg/L	0.30	0.326	0.14	<0.050	<0.030	0.63	0.090	0.089	0.082	<0.030
	Lead (Pb)	mg/L	0.001	0.001	0.00018	<0.00010	<0.000050	0.000085	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0012	0.0046	0.0026	0.0022	0.0021	0.0012
	Magnesium (Mg)	mg/L	-	-	6.15	8.22	12.8	24.1	15.8	15.1	14.8	14.2
	Manganese (Mn)	mg/L	0.935 ^β	-	0.00171	0.000690	0.000508	0.0741	0.00984	0.00786	0.00666	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	-	0.000398	0.000889	0.000679	0.00297	0.00105	0.00109	0.000952	0.000404
	Nickel (Ni)	mg/L	0.025	0.025	0.00060	<0.00050	0.00067	0.00148	0.00093	0.00095	0.00093	0.00057
	Potassium (K)	mg/L	-	-	0.80	1.98	1.85	3.59	2.17	2.20	2.11	1.62
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	1.03	0.833	1.00	0.94	1.05	1.04	1.10	0.99
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.52	0.570	1.34	20.1	4.88	4.74	4.36	1.90
	Strontium (Sr)	mg/L	-	-	0.0104	0.0073	0.0097	0.0368	0.0277	0.0268	0.0248	0.0132
	Thallium (Tl)	mg/L	0.0008	0.0008	0.000010	0.000013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.00644	0.00123	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.00277	0.00242	0.00208	0.0108	0.00358	0.00343	0.00321	0.00180
	Vanadium (V)	mg/L	0.006 ^α	0.006	0.00057	<0.00050	<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	0.0106

^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 2.3 for information regarding WQG criteria.

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

 Indicates parameter concentration above applicable Water Quality Guideline.

BOLD  Indicates parameter concentration above the AEMP benchmark.

parameters met (i.e., were below) applicable WQG and site-specific AEMP benchmarks at CLT1 with the exception of copper within the north branch, and iron at upstream-most Station L2-03 of the main stem² (Table 4.1).

Temporal comparisons of the CLT1 north branch water chemistry data showed no consistent directional change in parameter concentrations among mine baseline (2005 – 2013), construction (2014) and operational (2015) periods with the exception of chloride, which was observed at lower concentrations over time (Figure 4.2; Appendix Figure B.2). Lower chloride concentrations at the CLT1 north branch in 2015 were potentially related to a reduction in exploration activity in this portion of the CLT1 watershed since the baseline/mine construction periods. Temporal comparisons of CLT1 main stem water chemistry data indicated that, of the parameters shown to be elevated above average reference conditions in 2015, conductivity, hardness and concentrations of TDS, chloride and strontium were comparable to, or only slightly higher than, the mine baseline and construction periods in 2015 (Figure 4.2; Appendix Figure B.2). However, nitrate, sulphate, iron, manganese, molybdenum, sodium and uranium showed progressively higher concentrations from baseline, to mine construction, to mine operational periods at all CLT1 main stem stations (Figure 4.2; Appendix Figure B.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, in 2014-2015 compared to the baseline period. The QMR2 quarry is used to provide material for mine infrastructure projects (e.g., road construction).

Camp Lake Tributary 2 (CLT2) dissolved oxygen saturation levels were consistently high at Station KO-01 in 2015, and were similar to mean DO saturation observed at the lotic reference stations (Appendix Tables B.1 – B.3). No significant differences in dissolved oxygen saturation were indicated between CLT2 study areas located downstream and upstream of the mine tote road during the August 2015 sampling event (Figure 4.1; Appendix Table B.13). In addition, the dissolved oxygen saturation at CLT2 was consistently well above the CWQG minimum limit for cold-water biota. *In-situ* pH at CLT2 was similar to that of the lotic reference stations in 2015, and was also comparable between areas located downstream and upstream of the mine tote road during the August 2015 sampling event (Figure 4.1). *In-situ* pH at CLT2 was consistently within CWQG limits for all 2015 sampling

² Although phenol concentrations were above WQG at the CLT1 tributaries, all mine lakes (including Camp, Sheardown NW, Sheardown SE and Mary) and the Mary River, phenol concentrations were also above WQG at the lotic (stream) reference stations and at Reference Lake 3, indicating natural elevation of phenol concentrations in regional water bodies unrelated to mine operations (see Section 3.0 for additional discussion).

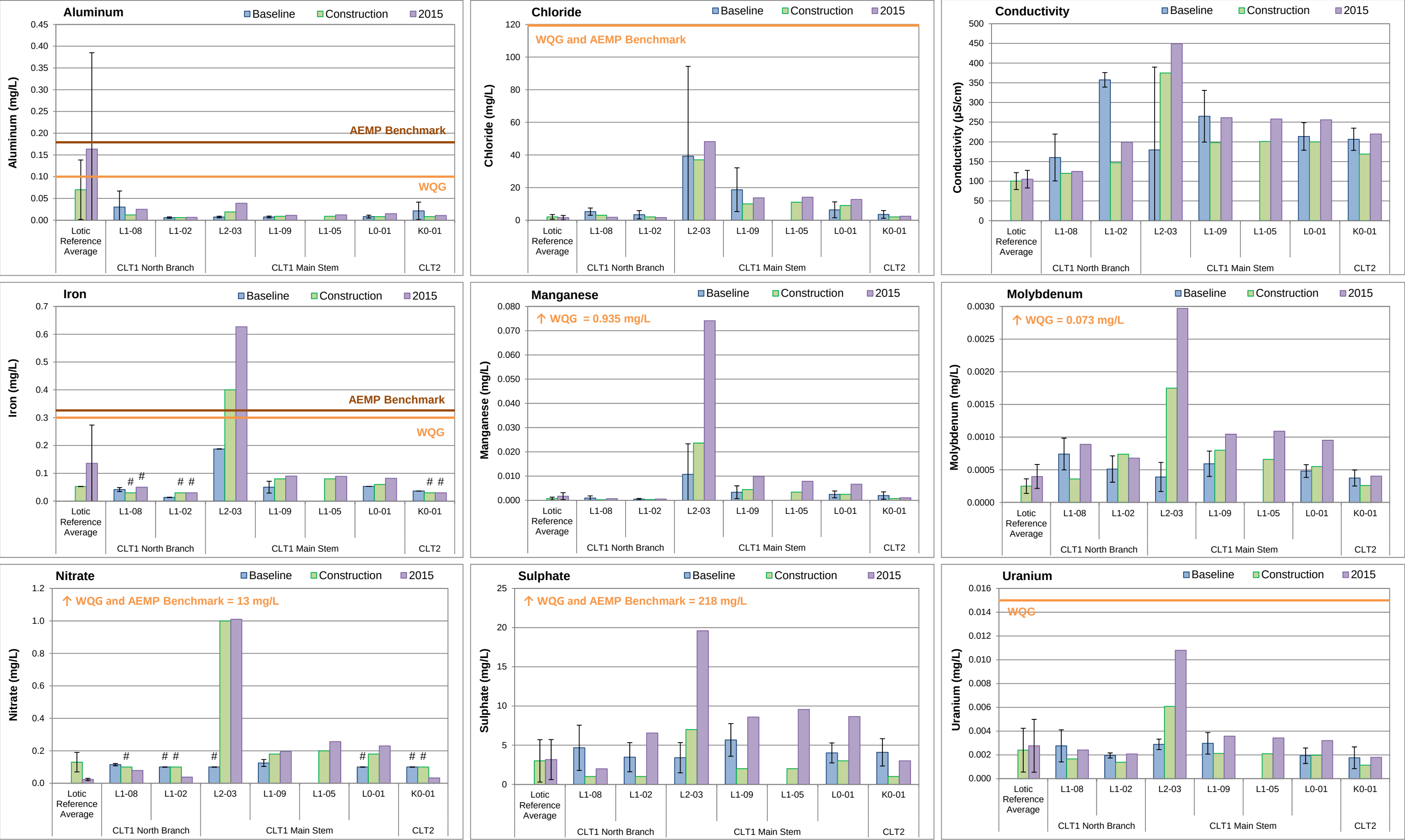


Figure 4.2: Temporal comparison of water chemistry at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods in the fall. Values represent mean ± SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.3 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Camp Lake Tributaries.

events (Figure 4.1; Appendix Tables B.1 to B.3). All conventional, nutrient, major ion and total metal concentrations were similar (i.e., <3-fold higher) between CLT2 (Station K0-01) and mean lotic reference station values in August 2015 (Table 4.1). Moreover, aqueous concentrations of all parameters were below established WQG and AEMP benchmarks at the CLT2 monitoring station in 2015³ (Table 4.1). Temporal comparisons of CLT2 water chemistry data showed no consistent directional changes in parameter concentrations over mine baseline, construction or operational periods (Figure 4.2; Appendix Figure B.2). Overall, the 2015 data suggested no mine influence on water quality of the CLT2 system.

4.1.2 Phytoplankton (Chlorophyll a)

Camp Lake Tributary 1 (CLT1) north branch chlorophyll a concentrations were lower than the lotic reference station average for each of the 2015 sampling events, but were consistently within the range of reference suggesting no marked differences in phytoplankton productivity among the CLT1 north branch and the lotic reference stations (Figure 4.3). 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 lotic reference stations. Downstream of the north branch confluence, beginning at station L1-09, chlorophyll a concentrations were comparable to that of the lotic reference stations (Figure 4.3). Chlorophyll a concentrations at all CLT1 north branch and main stem monitoring stations were well below the AEMP benchmark of 3.7 µg/L during all sampling events in 2015 (Figure 4.3). Similar to the lotic reference stations, chlorophyll a concentrations observed at CLT1 in 2015 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' CWQG categorization for CLT1 based on mean aqueous total phosphorus concentrations less than 10 µg/L during all spring, summer and fall sampling events (Table 4.1; Appendix Table B.14).

Temporal comparisons of the CLT1 data indicated that chlorophyll a concentrations at the north branch in 2015 were similar to, or lower than, those observed during the baseline (2005 – 2013) and mine construction (2014) periods (Figure 4.4). However, at the CLT1 main stem, chlorophyll a concentrations were generally higher in 2015 than during the mine construction and baseline periods, with the exception of at the CLT1 mouth (Station L0-01; Figure 4.4). Chlorophyll a concentrations at the CLT1 mouth were considerably lower in 2015 compared to both the mine construction and baseline periods. The spatial and

³ Refer to footnote 2 (page 28) and Section 3.0 regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA.

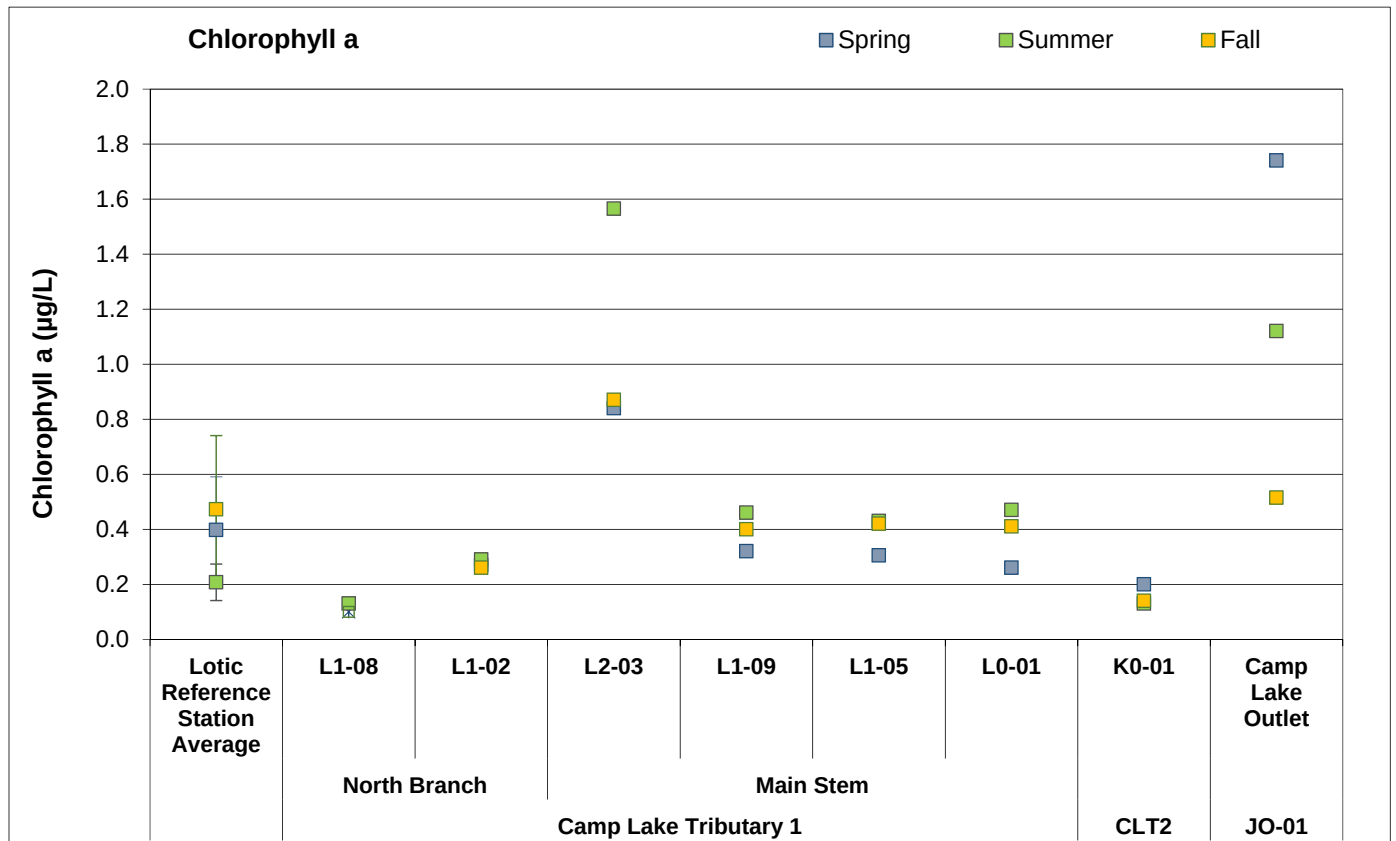


Figure 4.3: Chlorophyll a concentrations at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) phytoplankton monitoring stations, Mary River Project CREMP, 2015. Lotic reference stations include the CLT-REF and MRY-REF series (mean $\pm$ SD; n = 4).

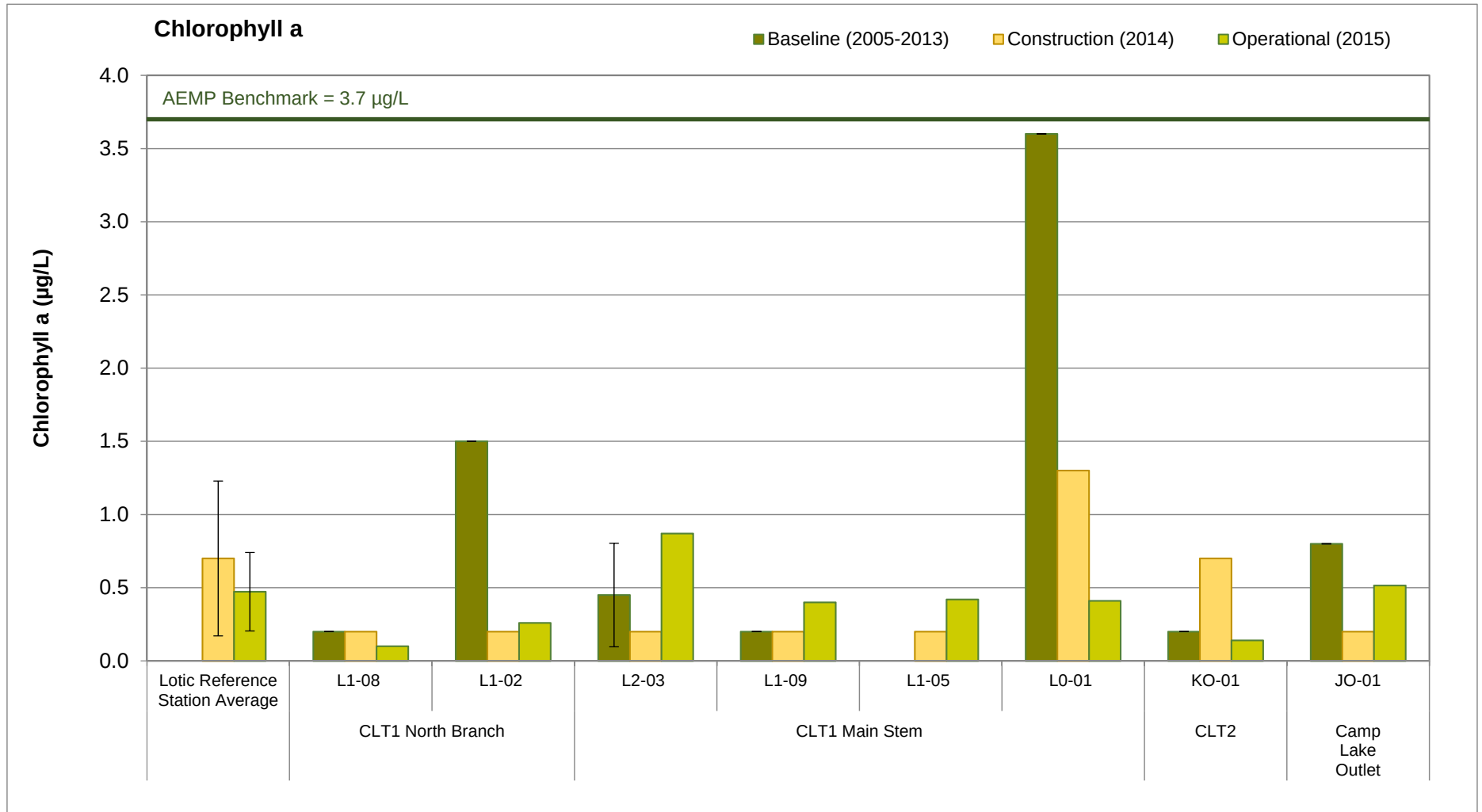


Figure 4.4: Temporal comparison of chlorophyll a concentrations at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods during fall, Mary River Project CREMP. The lotic reference stations include the CLT-REF and MRY-REF series (mean $\pm$ SD; n = 4).

temporal analyses of chlorophyll a concentrations at CLT1 suggested that current mine operations 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. Significant correlations between chlorophyll a and key nutrient concentrations from all available CLT1 and reference station data (i.e., from 2005 – 2015) suggested that higher chlorophyll a concentrations at the CLT1 upper main stem were associated with higher nitrate concentrations. Because elevated nitrate concentrations at CLT1 appeared to be related to mine operations (see Section 4.1.1), this suggested that slightly greater phytoplankton productivity at Station L2-03 in 2015 was the result of current mine operations and specifically, active quarrying at the QMR2 pit.

Camp Lake Tributary 2 (CLT2; Station KO-01) chlorophyll a concentrations were consistently low, being comparable to those of the CLT1 north branch and the average lotic reference station concentrations, during all 2015 sampling events (Figure 4.3). Moreover, chlorophyll a concentrations at CLT2 were consistently well below the AEMP benchmark of 3.7 µg/L in 2015 and suggested low (i.e., oligotrophic) phytoplankton productivity at CLT2 based on the Dodds et al (1998) trophic status classification for streams. This productivity classification was supported by a CWQG categorization of ultra-oligotrophic to oligotrophic categorization based on mean aqueous phosphorus concentrations below 10 µg/L at CLT2 during all spring, summer and fall sampling events (Table 4.1; Appendix Table B.14). Temporal comparisons of the CLT2 chlorophyll a data indicated that the 2015 chlorophyll a concentrations were similar to, or were lower than, those during baseline and mine construction periods, respectively (Figure 4.4). Overall, no mine-related influences to phytoplankton productivity of CLT2 were suggested by the chlorophyll a concentration data.

4.1.3 Benthic Invertebrate Community

At Camp Lake Tributary 1 (CLT1), the lower main stem (downstream) and north branch (upstream) areas were considered representative of “mine-exposed” and “reference” conditions, respectively, for the benthic invertebrate community survey based on the spatial and temporal evaluation of recent water chemistry data (see Section 4.1.1). No significant differences in benthic invertebrate density, richness or Simpson’s Evenness were indicated between the lower main stem mine-exposed and the north branch reference study areas of CLT1 in August 2015 (Table 4.2). Benthic invertebrate density at both CLT1 study areas were considered moderate based on the classification of Arctic streams by Craig and McCart (1975). Nevertheless, some differences in benthic invertebrate community assemblage were apparent between these study areas based on significant differences in Bray-Curtis Index and compositional features including dominant invertebrate groups, functional feeding

Table 4.2: Benthic invertebrate community statistical comparison results between Camp Lake Tributary 1 (CLT1) lower main stem (downstream) and north branch (upstream) creek study areas, Mary River Project CREMP, August 2015.

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	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m ²)	NO	0.746	α	0.060	-	CLT1 Upstream	1,446	836	374	679	2,839
						CLT1 Downstream	1,301	479	214	702	1,921
Richness (Number of Taxa)	NO	0.770	α	0.058	-	CLT1 Upstream	15.0	2.7	1.2	12.0	19.0
						CLT1 Downstream	14.6	1.1	0.5	13.0	16.0
Simpson's Evenness (E)	NO	0.722	α	0.062	-	CLT1 Upstream	0.899	0.037	0.017	0.851	0.946
						CLT1 Downstream	0.889	0.044	0.020	0.822	0.937
Bray-Curtis Index	YES	0.053	α	0.514	1.3	CLT1 Upstream	0.311	0.138	0.062	0.184	0.540
						CLT1 Downstream	0.489	0.108	0.048	0.334	0.573
Oligochaeta (%)	YES	0.055	β	0.507	3.3	CLT1 Upstream	1.4%	1.3%	0.6%	0.0%	2.5%
						CLT1 Downstream	5.6%	3.1%	1.4%	2.0%	10.6%
Chironomidae (%)	YES	0.035	δ	0.604	1.3	CLT1 Upstream	75.6%	7.5%	3.3%	65.2%	83.6%
						CLT1 Downstream	85.2%	4.0%	1.8%	78.2%	88.4%
Metal-Sensitive Chironomidae (%)	NO	0.237	β	0.204	-	CLT1 Upstream	12.7%	14.0%	6.3%	1.2%	35.9%
						CLT1 Downstream	4.4%	3.5%	1.6%	0.0%	8.1%
Tipulidae (%)	YES	0.000	γ	1.000	-3.0	CLT1 Upstream	16.8%	4.7%	2.1%	12.8%	24.3%
						CLT1 Downstream	3.1%	1.0%	0.4%	2.0%	4.5%
Shredders (%)	YES	0.001	δ	0.994	-3.7	CLT1 Upstream	46.1%	7.3%	3.3%	37.3%	54.9%
						CLT1 Downstream	19.3%	9.0%	4.0%	10.3%	32.6%
Collector-Gatherers (%)	YES	0.001	β	0.995	3.8	CLT1 Upstream	50.2%	7.3%	3.3%	39.8%	60.2%
						CLT1 Downstream	78.4%	9.5%	4.2%	63.9%	85.8%
Clingers (%)	YES	0.013	β	0.795	-3.1	CLT1 Upstream	32.7%	4.7%	2.1%	26.8%	38.8%
						CLT1 Downstream	18.2%	9.1%	4.1%	9.7%	31.5%
Sprawlers (%)	YES	0.002	β	0.973	3.3	CLT1 Upstream	46.5%	7.1%	3.2%	36.7%	56.6%
						CLT1 Downstream	70.0%	9.3%	4.2%	59.3%	79.9%
Burrowers (%)	YES	0.012	β	0.805	-2.0	CLT1 Upstream	20.5%	4.3%	1.9%	16.4%	26.4%
						CLT1 Downstream	11.8%	4.7%	2.1%	8.1%	20.0%

^a Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data logit transformed, single factor ANOVA test conducted; γ - data logit transformed, single factor ANOVA test results confirmed using Mann-Whitney U-test; and, δ - data logit transformed, single-factor ANOVA test results confirmed 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.

Highlighted values indicate a 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 meaningful difference.

BOLD text values indicate a 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 was not ecologically meaningful.

groups (FFG) and habit preference groups (HPG; Table 4.2). Because no significant difference in the relative abundance of metal-sensitive chironomids was indicated between the mine-exposed and reference areas of CLT1, the community composition differences between these 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 shredders, clingers and burrowers at the CLT1 main stem mine-exposed area (Table 4.3), may have reflected lower amounts of organic material (e.g., living and/or decomposing leaf/woody debris and coarse particulate organic material [CPOM]) than at the north branch reference area and/or natural variability between areas. No significant differences in important sampling variables (i.e., water velocity, substrate size) were shown between the CLT1 study areas (Appendix Table E.3), and thus sampling-based artifacts did not likely account for the differences in benthic assemblage features between areas. Instead, the introduction of till material containing low organic content to lower CLT1 as a result of stream bank erosion and/or due to natural channel braiding may have accounted for the differences in community composition observed between the CLT1 lower main stem and north branch study areas. During the August 2015 field survey, recent introduction of coarse till material (i.e., cobble, gravel) was apparent at the lower CLT1 study area as 'clean' substrate with very little periphyton growth on the substrate surface, supporting this hypothesis.

Temporal comparison of the CLT1 data indicated no significant change in benthic invertebrate density, richness, Simpson's Evenness or the proportion of metal-sensitive midges at the mine-exposed main stem between the mine baseline (combined 2007 and 2011 data) and operational (2015) periods taking temporal changes at the north branch reference area into account (i.e., two-factor ANOVA; Figure 4.5; Appendix Table E.6). However, the relative abundance of shredders and crane flies (Tipulidae), the latter of which were represented solely by the shredder FFG, comprised a significantly lower proportion of the benthic invertebrate community at the CLT1 main stem in 2015 compared to the 2007-2011 combined data set (Figure 4.5; Appendix Table E.6). Overall, these results suggested that natural channel erosion/braiding at lower CLT1 (near its mouth) in 2015, likely accounted for the slight changes in benthic invertebrate community composition compared to reference and baseline conditions.

At Camp Lake Tributary 2 (CLT2), sampling was conducted downstream and upstream of the mine tote road to assess potential mine-related influences to the benthic invertebrate community. There were no significant differences in benthic invertebrate density or Simpson's Evenness between the CLT2 study areas in August 2015 (Table 4.3). Although

Table 4.3: Benthic invertebrate community statistical comparison results between Camp Lake Tributary 2 (CLT2) upstream and downstream study areas, Mary River Project CREMP, August 2015.

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	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m ²)	NO	0.215	α	0.221	-	CLT2 Upstream	741	416	186	374	1,427
						CLT2 Downstream	447	258	115	106	769
Richness (Number of Taxa)	YES	0.005	α	0.924	-3.7	CLT2 Upstream	20.8	1.8	0.8	19.0	23.0
						CLT2 Downstream	14.2	3.3	1.5	9.0	17.0
Simpson's Evenness (E)	NO	0.520	α	0.092	-	CLT2 Upstream	0.922	0.025	0.011	0.892	0.960
						CLT2 Downstream	0.934	0.034	0.015	0.895	0.982
Bray-Curtis Index	YES	0.099	α	0.376	1.3	CLT2 Upstream	0.347	0.119	0.053	0.179	0.498
						CLT2 Downstream	0.496	0.133	0.060	0.354	0.712
Oligochaeta (%)	NO	0.837	δ	0.054	-	CLT2 Upstream	2.7%	2.8%	1.3%	0.9%	7.6%
						CLT2 Downstream	8.8%	12.8%	5.7%	0.0%	30.8%
Chironomidae (%)	NO	0.477	β	0.101	-	CLT2 Upstream	80.2%	8.9%	4.0%	69.5%	87.8%
						CLT2 Downstream	75.6%	10.4%	4.7%	59.8%	87.2%
Metal-Sensitive Chironomidae (%)	NO	0.568	β	0.082	-	CLT2 Upstream	10.5%	5.7%	2.5%	4.0%	18.1%
						CLT2 Downstream	10.6%	10.6%	4.7%	0.0%	27.6%
Tipulidae (%)	NO	0.874	β	0.052	-	CLT2 Upstream	4.1%	3.5%	1.5%	0.9%	9.6%
						CLT2 Downstream	5.8%	5.1%	2.3%	0.0%	13.2%
Shredders (%)	NO	0.820	β	0.055	-	CLT2 Upstream	26.2%	5.8%	2.6%	19.1%	32.9%
						CLT2 Downstream	25.7%	11.6%	5.2%	14.0%	40.8%
Collector-Gatherers (%)	NO	0.396	β	0.125	-	CLT2 Upstream	63.8%	10.3%	4.6%	50.5%	74.4%
						CLT2 Downstream	69.3%	10.9%	4.9%	54.8%	81.3%
Clingers (%)	NO	0.569	δ	0.084	-	CLT2 Upstream	23.6%	4.5%	2.0%	19.5%	30.6%
						CLT2 Downstream	21.6%	11.7%	5.2%	10.4%	37.6%
Sprawlers (%)	NO	0.770	β	0.058	-	CLT2 Upstream	58.2%	9.7%	4.3%	45.7%	70.3%
						CLT2 Downstream	56.4%	8.3%	3.7%	45.8%	66.0%
Burrowers (%)	NO	0.415	β	0.118	-	CLT2 Upstream	17.0%	9.5%	4.3%	6.0%	27.8%
						CLT2 Downstream	22.0%	10.7%	4.8%	10.2%	38.4%

^a Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data logit transformed, single factor ANOVA test conducted; γ - data logit transformed, single factor ANOVA test results confirmed using Mann-Whitney U-test; and, δ - data logit transformed, single-factor ANOVA test results confirmed 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.

Highlighted values indicate a 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 meaningful difference.

BOLD Bold text values indicate a 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 was not ecologically meaningful.

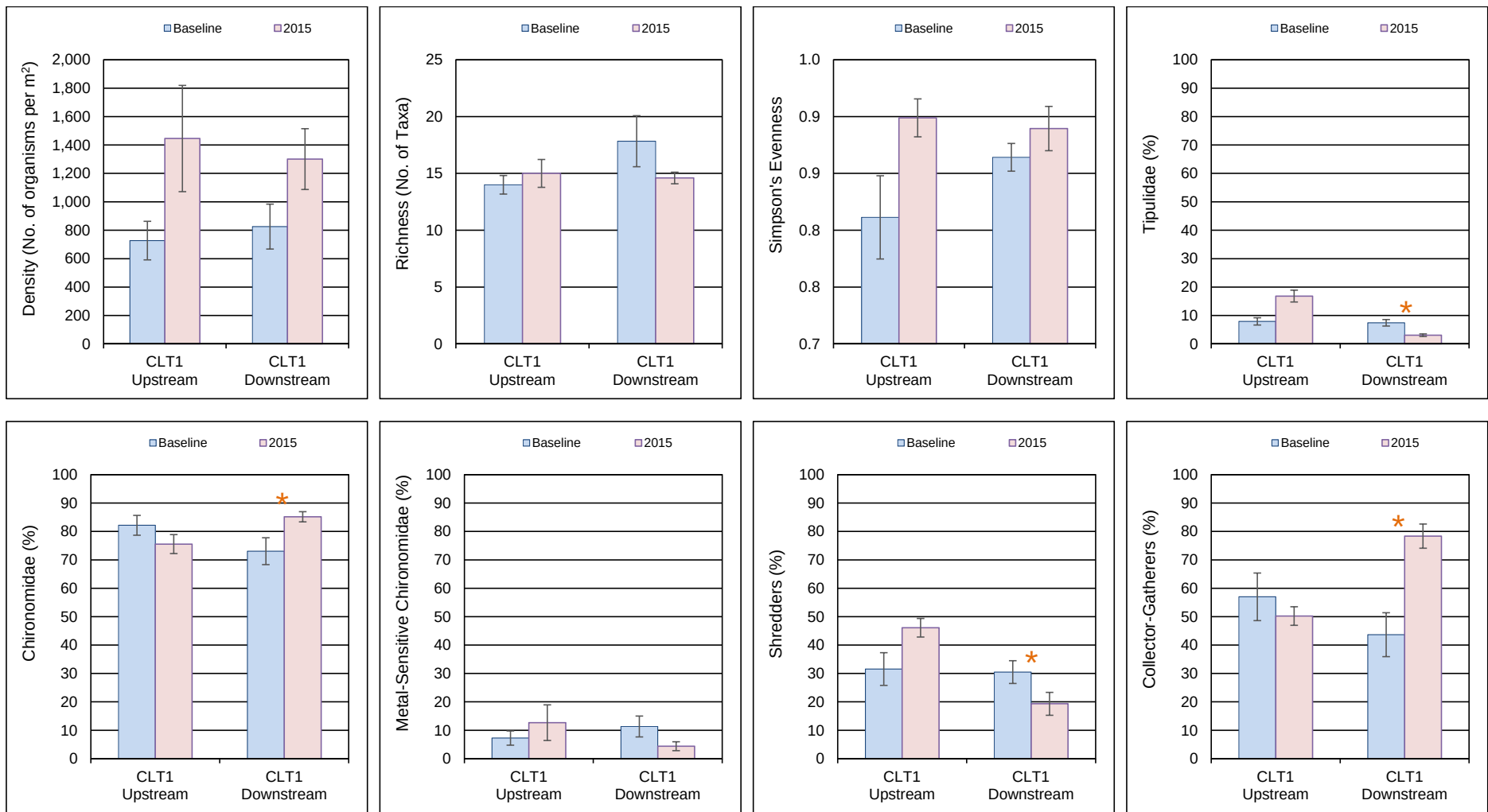


Figure 4.5: Comparison of key benthic invertebrate community metrics (mean $\pm$ SE) at Camp Lake Tributary 1 (CLT1) lower main stem (downstream) and north branch (upstream) study areas between operational (2015) and baseline (2007, 2011) periods, Mary River Project CREMP, 2015. Asterisk (*) above bars indicates that change between periods at the downstream area differed from the change between periods at the upstream area.

significantly lower benthic invertebrate richness and a significant difference in Bray Curtis Index was indicated at the CLT2 downstream area compared to the upstream area, no significant differences in the relative abundance of any dominant invertebrate groups, FFG or HPG were indicated between the CLT2 study areas (Table 4.3). Notably, a significant positive correlation was indicated between richness and Bray-Curtis Index using the 2015 data ($p = 0.012$), which suggested that the Bray-Curtis Index was largely weighted by benthic invertebrate taxa presence-absence (i.e., richness). Temporal comparison of the CLT2 data suggested no significant change in any benthic invertebrate community indices, including the relative abundance of any dominant invertebrate groups, FFG or HPG, at the CLT2 downstream area between the 2007 baseline study and 2015 study taking temporal changes at the north branch reference area into account, with the exception of richness (Figure 4.6; Appendix Table E.8). However, richness at the CLT2 downstream area in 2015 was within the range observed at the upstream study area in 2007 (Figure 4.6). This, coupled with the fact that water quality at CLT2 was comparable to reference conditions and also met (i.e., was below) WQG and AEMP benchmarks during all 2015 sampling events (Appendix Table B.14), suggested that lower richness at the CLT2 downstream area was not likely related to mine activity, but rather, likely reflected natural variability between study areas and years.

4.2 Camp Lake (JLO)

4.2.1 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 seasonal sampling events in 2015 (Appendix Figures B.3 - B.6). Camp Lake water temperature profiles suggested no thermal stratification during any of the 2015 sampling events, which contrasted with Reference Lake 3 where thermal stratification was apparent during the summer (Figure 4.7). No ecologically meaningful differences in bottom water temperature were indicated at littoral or profundal areas of Camp Lake compared to the reference area at the time of fall sampling in 2015 (Figure 4.8; Appendix Tables B.22 – B.23). Dissolved oxygen profiles conducted at Camp Lake indicated rapidly declining dissolved oxygen saturation with depth beginning at approximately 16 m below surface in the winter, but otherwise showed no appreciable changes from surface to bottom during summer or fall (Figure 4.7). Despite rapidly declining dissolved oxygen with depth in the winter at Camp Lake and the occurrence of significantly lower bottom dissolved oxygen concentrations at littoral and profundal stations compared to Reference Lake 3 during fall sampling, dissolved oxygen saturation at Camp Lake was

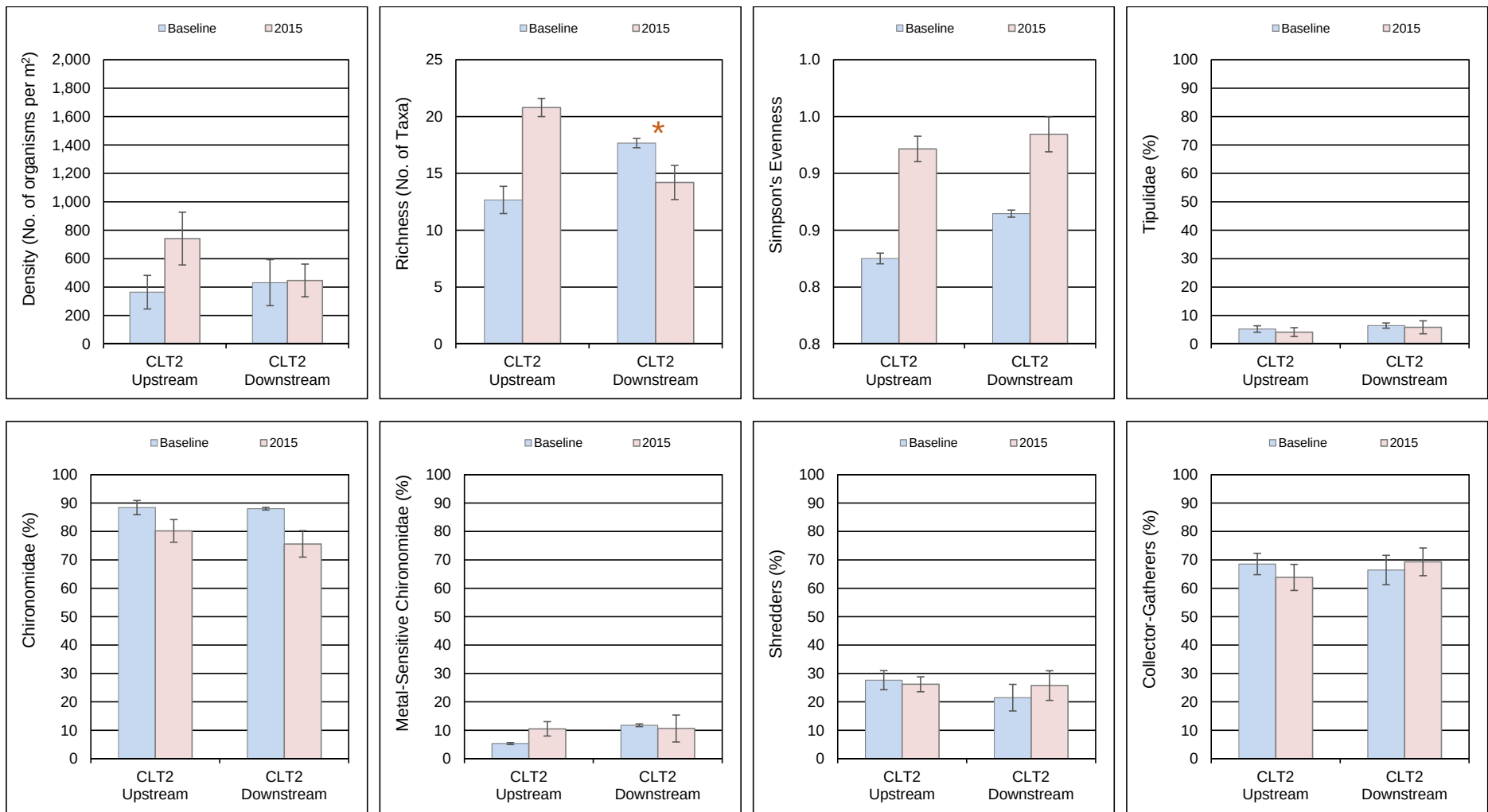


Figure 4.6: Comparison of key benthic invertebrate community metrics (mean ± SE) at Camp Lake Tributary 2 (CLT2) downstream and upstream of the mine tote road crossing between operational (2015) and baseline (2007, 2011) periods, Mary River Project CREMP, 2015. Asterisk (*) above bars indicates that change between periods at the downstream area differed from the change between periods at the upstream area.

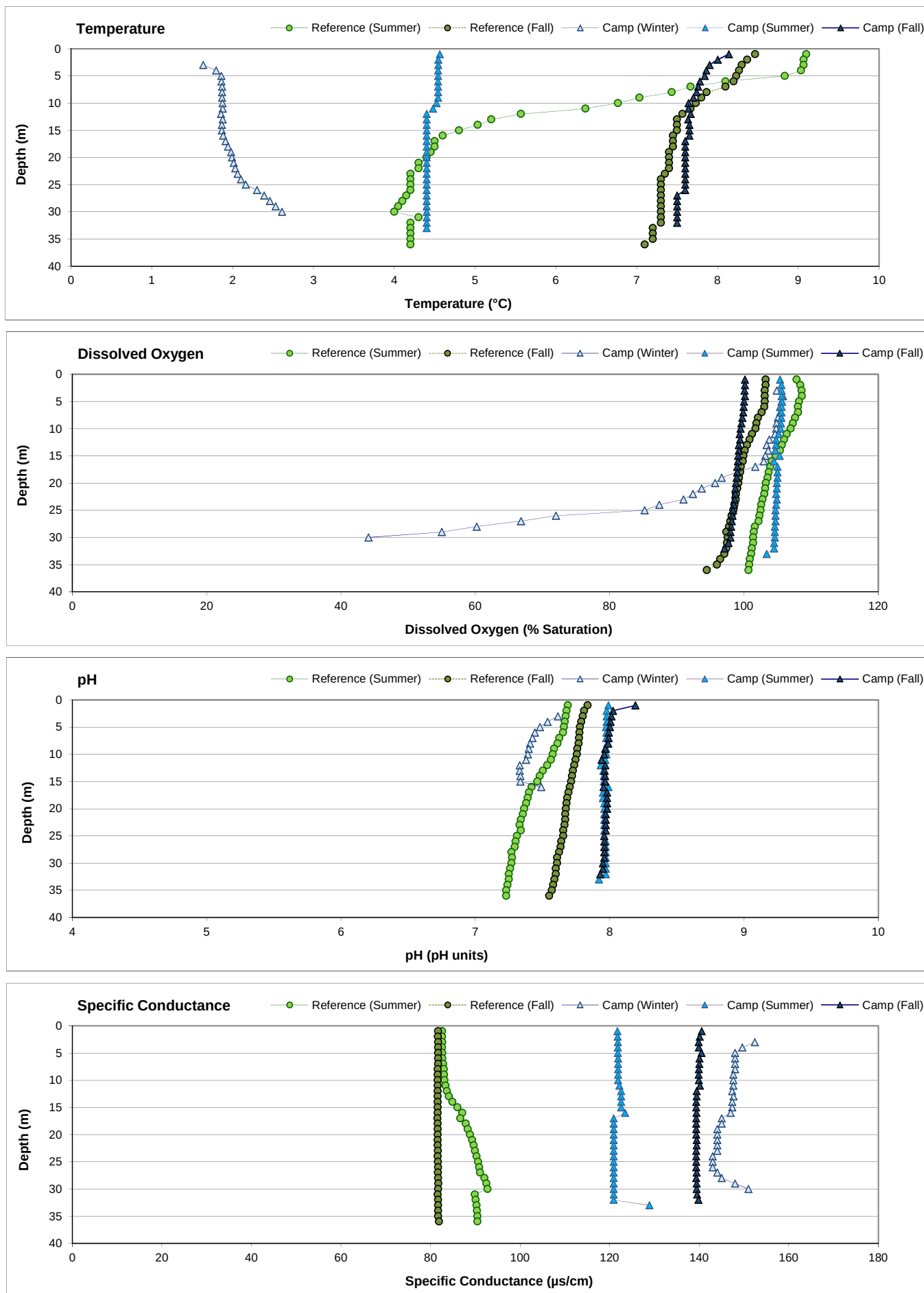


Figure 4.7: Average *in-situ* water quality with depth from surface at Camp Lake (mine-exposed area) compared to Reference Lake 3 during winter, summer, and fall sampling events, Mary River Project CREMP, 2015.

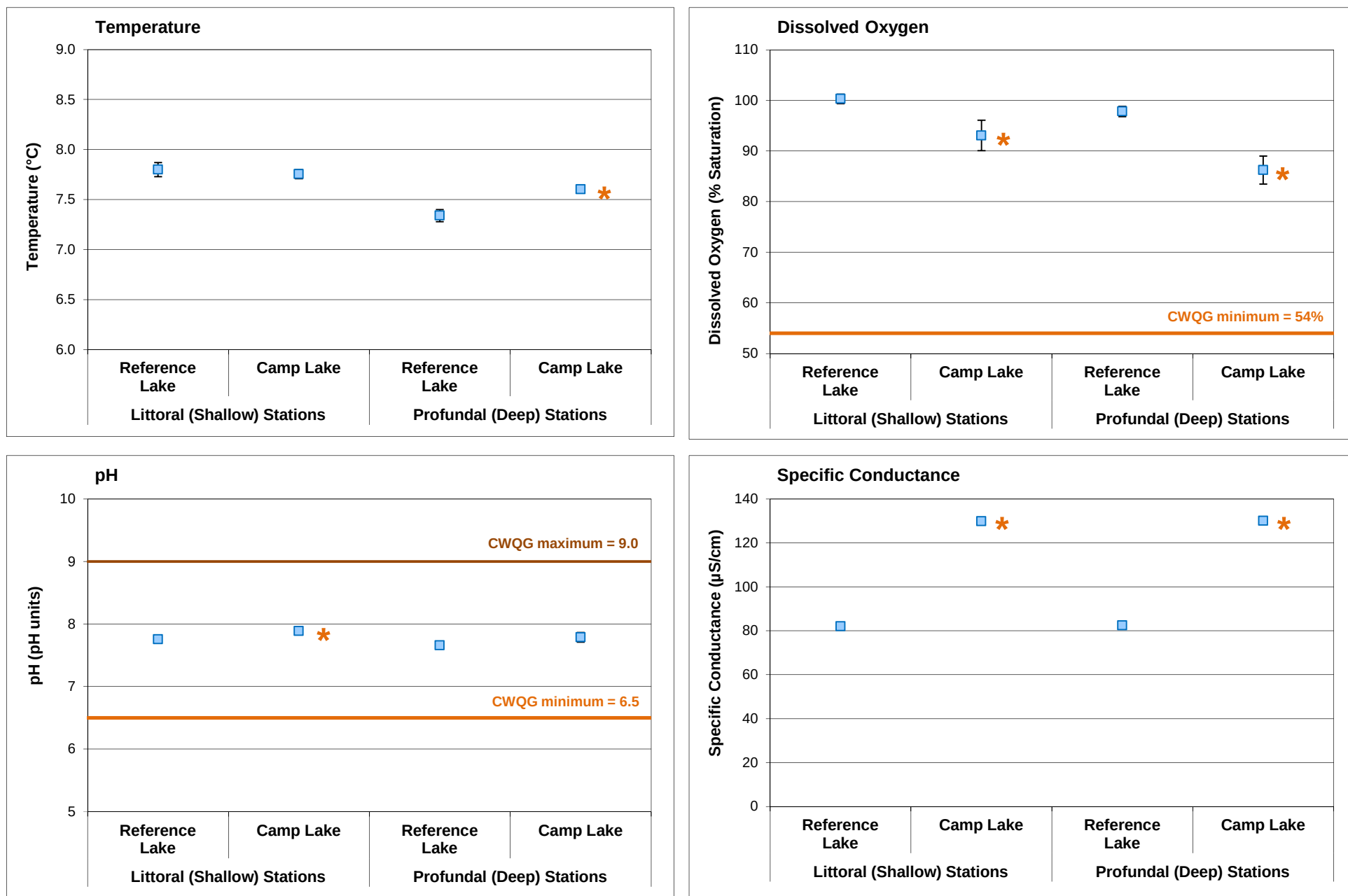


Figure 4.8: Comparison of in-situ water quality variables (mean $\pm$ SD; $n = 5$) measured at Camp Lake (JLO) and Reference Lake 3 (REF3) littoral and profundal benthic invertebrate community stations, Mary River Project CREMP, Augsut 2015. An asterisk (*) next to the Camp Lake data point indicated a significant difference compared to the reference lake measure for the respective station type.

generally above the CWQG minimum for the protection of cold water biota (i.e., 54%; Figures 4.7 and 4.8).

In-situ profiles of pH and specific conductance showed no substantial change from the surface to bottom of Camp Lake, indicating no chemical stratification of the water column (Figure 4.7). Although the bottom pH at littoral and profundal stations of Camp Lake was significantly higher than at the reference lake during the fall sampling event (Appendix Tables B.22 – B.23), the mean incremental difference between lakes was very small (i.e., 0.3 pH units) and all pH values were consistently within CWQG limits (Figure 4.8), 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 (Figure 4.8). However, because specific conductance at Camp Lake was comparable to the lotic reference area, it was unclear to what extent higher values at Camp Lake compared to the reference lake reflected a natural difference as opposed to a mine-related influence at the former. Secchi depth, which served as a proxy for water clarity, was significantly lower at Camp Lake compared to Reference Lake 3 during the 2015 fall sampling event (Appendix Tables B.22 – B.23). No spatial gradient in Secchi depth was apparent at Camp Lake with progression from the CLT1 inlet to the lake outlet stations during the August 2015 biological sampling event (Appendix Table B.20).

Water chemistry data collected at Camp Lake in 2015 showed no distinct spatial differences with progression from the CLT inlet to the lake outlet during any of the winter, summer or fall sampling events in 2015 (Table 4.4; Appendix Table B.24), suggesting that the lake waters 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 2015 sampling event (Table 4.4; Appendix Table B.26). In addition, concentrations of all parameters were well below established WQG and AEMP benchmarks at Camp Lake during all sampling events in 2015⁴ (Table 4.4; Appendix Table B.24), suggesting that parameter concentrations at Camp Lake were unlikely to adversely affect biota.

Temporal comparisons of Camp Lake water chemistry data suggested no consistent changes in parameter concentrations in 2015 compared to the mine baseline (2005-2013) or construction (2014) periods (Figure 4.9; Appendix Figure B.7 and Table B.26). Of the parameters shown to be elevated at CLT1 in 2015, only chloride, sodium, strontium and uranium showed an increasing trend in concentrations at Camp Lake over the mine baseline, construction and operational periods (Figure 4.9; Appendix Figure B.7). However, the overall

⁴ Refer to footnote 2 (page 28) and Section 3.0 regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA.

Table 4.4: Water chemistry at Camp Lake (JLO) and Reference Lake 3 (REF3) monitoring stations, Mary River Project CREMP, August 2015. 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 2015	Mine-exposed					
						JL0-02	JL0-10	JL0-01	JL0-07	JL0-09	J0-01 Camp Lake Outlet
						19-Aug-2015	20-Aug-2015	19-Aug-2015	19-Aug-2015	19-Aug-2015	16-Aug-2015
Conventional ^b	Conductivity (lab)	umho/cm	-	-	76.4	136	133	135	134	134	130
	pH (lab)	pH	6.5 - 9.0	-	7.59	7.91	8.00	7.99	7.95	7.98	7.90
	Hardness (as CaCO ₃)	mg/L	-	-	35	67	64	66	66	67	67
	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	-	-	37	66	63	66	63	63	61
	Turbidity	NTU	-	-	0.22	0.29	0.34	0.34	0.34	0.36	0.64
	Alkalinity (as CaCO ₃)	mg/L	-	-	31	62	61	61	60	59	65
Nutrients and Organics	Total Ammonia	mg/L	0.715	0.855	<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	<0.020
	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	0.20	0.23
	Dissolved Organic Carbon	mg/L	-	-	3.1	1.9	2.0	2.0	2.0	1.9	2.0
	Total Organic Carbon	mg/L	-	-	3.3	2.0	2.2	2.1	2.0	2.1	2.2
	Total Phosphorus	mg/L	0.020 ^α	-	0.0035	0.0037	0.0042	0.0035	0.0047	0.0034	0.0040
	Phenols	mg/L	0.001 ^α	-	0.0028	0.0024	0.0016	0.0019	0.0019	0.0022	0.0024
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	1.28	3.49	3.40	3.33	3.36	3.33	3.40
	Sulphate (SO ₄)	mg/L	218 ^β	218	4.35	1.67	1.63	1.56	1.56	1.56	1.57
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	<0.0030	0.0055	0.0059	0.0054	0.0059	0.0056	0.0065
	Antimony (Sb)	mg/L	0.020 ^α	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0064	0.00602	0.00582	0.00577	0.00585	0.00590	0.00613
	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	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	7.10	13.2	12.9	13.0	13.1	13.1	13.4
	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	0.004	0.00083	0.00084	0.00084	0.00077	0.00082	0.00094	0.00082
	Iron (Fe)	mg/L	0.30	0.30	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.070
	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	0.0013	0.0010	0.0014	0.0014	0.0014	0.0013
	Magnesium (Mg)	mg/L	-	-	4.23	8.54	7.62	8.15	8.29	8.33	8.09
	Manganese (Mn)	mg/L	0.935 ^β	-	0.000411	0.00112	0.00105	0.00100	0.00112	0.00110	0.00377
	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	-	0.000131	0.000252	0.000245	0.000243	0.000246	0.000248	0.000269
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00062	0.00057	0.00059	0.00062	0.00060	0.00075
	Potassium (K)	mg/L	-	-	0.906	1.02	1.01	0.985	0.990	0.985	0.940
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.403	0.39	0.36	0.36	0.39	0.37	0.43
	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	-	-	0.819	1.41	1.27	1.33	1.37	1.34	1.25
	Strontium (Sr)	mg/L	-	-	0.00791	0.00932	0.00935	0.00920	0.00923	0.00927	0.00953
	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	-	0.000266	0.000664	0.000649	0.000641	0.000615	0.000637	0.000641
	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 background water quality data. The values are specific to the Camp Lake system.

 Indicates parameter concentration above applicable Water Quality Guideline.

BOLD  Indicates parameter concentration above the AEMP benchmark.



Figure 4.9: Temporal comparison of water chemistry at Camp Lake (JLO) for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods during fall. Values represent mean $\pm$ 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.

increases in concentrations of these parameters between the mine baseline and 2015 periods was minor (i.e., <3-fold difference; Appendix Table B.26). In contrast, manganese, sulphate and TDS concentrations were slightly lower in 2015 compared to the mine baseline and/or construction periods. Other parameters that showed a mine-related elevation at the CLT1 main stem either showed no changes among mine operation, construction or baseline periods (molybdenum) at Camp Lake, or were not able to be assessed temporally due to method detection limit (MDL) differences among studies (nitrate and iron). Notably, by parameter concentrations remained well below WQG and AEMP benchmarks in 2015 (Appendix Table B.24). Overall, temporal comparison of the water chemistry data suggested no adverse mine-related influences on lake water quality at Camp Lake since mine operations commenced in 2015.

4.2.2 Sediment Quality

Surficial sediment (i.e., top 2 cm) collected at the Camp Lake coring stations was comprised mainly of silty loam and sandy loam with low total organic carbon (TOC) content, except at two stations (JLO-12 and JLO-16) where the substrate was comprised mainly of sand (Figure 4.10). 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 C.5 – C.6). However, similar substrate was observed at Reference Lake 3 (Appendix Table C.2), suggesting the natural occurrence of iron (oxy)hydroxides in the sediment of lakes within the mine LSA. Substrates of Camp Lake were not blackened (or darkly-coloured) and did not emit a noticeably sulphidic odour near or below the sediment surface, suggesting that substrates were not reducing and that no strong redox boundaries were present within the substrate (Appendix Tables C.5 – C.6), which contrasted with Reference Lake 3, where reducing sediment conditions were evident (see Section 3.3).

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 within Camp Lake (Appendix Table C.7). Arsenic, manganese and nickel concentrations were slightly elevated (i.e., 2- to 5-fold higher) in sediment at the single Camp Lake littoral station (i.e., Station JLO-2) compared to mean littoral sediment at Reference Lake 3 (Table 4.5; Appendix Table C.8). Of these, manganese and nickel were above respective SQG at the Camp Lake littoral station (Table 4.5). Although arsenic, copper, iron, nickel and phosphorus concentrations were above respective AEMP benchmarks at the Camp Lake littoral station, with the exception of nickel and phosphorus, concentrations of these metals are also above AEMP sediment benchmarks at the reference lake, suggesting that benchmarks for these

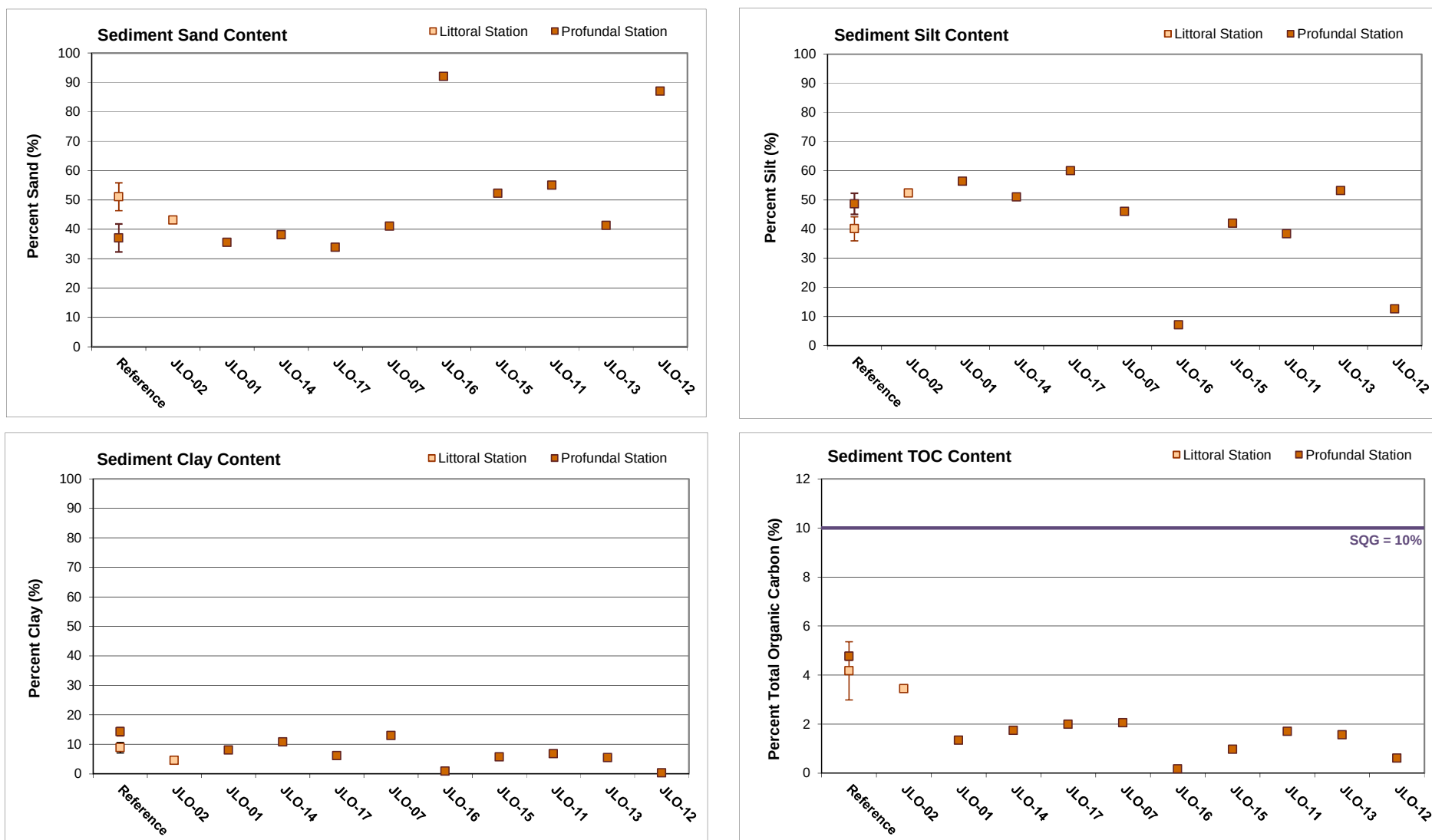


Figure 4.10: Sediment particle size and total organic carbon (TOC) content comparisons among Camp Lake (JLO) sediment monitoring stations and to Reference Lake 3 averages (mean $\pm$ SE), Mary River Project CREMP, August 2015.

Table 4.5: 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 2015.

Analyte		Units	Sediment Quality Guideline (SQG) ^a	AEMP Benchmark ^b	Littoral Stations		Profundal Stations	
					Reference Lake (n = 5)	Camp Lake (n=1)	Reference Lake (n = 5)	Camp Lake (n=9)
					Average ± Std. Error		Average ± Std. Error	Average ± Std. Error
Non-metals	Sand	%	-	-	51 ± 5	43	37 ± 5	53 ± 7
	Silt	%	-	-	40 ± 4	52	49 ± 4	41 ± 6
	Clay	%	-	-	9 ± 2	5	14 ± 1	6 ± 1
	Moisture	%	-	-	84 ± 4	81	86 ± 1	63 ± 5
	Total Organic Carbon	%	10 ^a	-	4.2 ± 1.2	3.4	4.8 ± 0.2	1.3 ± 0.2
Metals	Aluminum (Al)	mg/kg	-	-	16,120 ± 1,372	15,900	27,060 ± 1,745	15,430 ± 1,898
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	<0.10	<0.10 ± 0	<0.10 ± 0
	Arsenic (As)	mg/kg	17	5.9	5.60 ± 1.22	14.60	6.32 ± 0.34	6.57 ± 1.39
	Barium (Ba)	mg/kg	-	-	116 ± 16	174	149 ± 8	98.6 ± 19
	Beryllium (Be)	mg/kg	-	-	0.69 ± 0.07	0.84	1.04 ± 0.04	0.86 ± 0.11
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0	0.31	0.227 ± 0.00734847	0.29 ± 0.02
	Boron (B)	mg/kg	-	-	15.0 ± 1.4	23.6	21.6 ± 0.9	23.3 ± 2.7
	Cadmium (Cd)	mg/kg	3.5	1.5	0.213 ± 0.027	0.354	0.203 ± 0.016	0.154 ± 0.024
	Calcium (Ca)	mg/kg	-	-	4,976 ± 430	6,310	7,000 ± 542	5,759 ± 1,398
	Chromium (Cr)	mg/kg	90	98	53.9 ± 5.2	73	85.1 ± 5.4	67 ± 6
	Cobalt (Co)	mg/kg	-	-	12.6 ± 0.6	21.5	19.0 ± 1.2	17.4 ± 2.2
	Copper (Cu)	mg/kg	110 ^a	50	69.4 ± 8.8	57	101.5 ± 6.3	39 ± 5
	Iron (Fe)	mg/kg	40,000 ^a	52,400	59,220 ± 15,044	62,300	54,450 ± 3,037	44,161 ± 6,929
	Lead (Pb)	mg/kg	91	35	16.1 ± 1.0	21.1	23.4 ± 0.5	19.6 ± 2.6
	Lithium (Li)	mg/kg	-	-	25.9 ± 2.4	28.1	40.6 ± 2.0	28.4 ± 3.5
	Magnesium (Mg)	mg/kg	-	-	10,088 ± 858	13,600	16,930 ± 1,089	12,638 ± 943
	Manganese (Mn)	mg/kg	1,100 ^{a,β}	4,370	871 ± 47	1,900	1,756 ± 448	2,476 ± 791
	Mercury (Hg)	mg/kg	0.486	0.17	0.0453 ± 0.0107	0.0578	0.0852 ± 0.0108	0.0356 ± 0.0065
	Molybdenum (Mo)	mg/kg	-	-	6.21 ± 1.63	2.64	3.31 ± 0.50	1.83 ± 0.58
	Nickel (Ni)	mg/kg	75 ^{a,β}	72	43.3 ± 3.1	83.7	59.7 ± 3.6	61.8 ± 5.6
	Phosphorus (P)	mg/kg	2,000 ^a	1,580	1,506 ± 463	1,750	1,214 ± 62	1,471 ± 239
	Potassium (K)	mg/kg	-	-	3,960 ± 272	4,090	6,491 ± 386	4,010 ± 493
	Selenium (Se)	mg/kg	-	-	0.66 ± 0.13	0.56	0.95 ± 0.06	0.37 ± 0.05
	Silver (Ag)	mg/kg	-	-	0.14 ± 0.02	0.15	0.31 ± 0.01	0.14 ± 0.01
	Sodium (Na)	mg/kg	-	-	283 ± 23	184	492 ± 29	193 ± 31
	Strontium (Sr)	mg/kg	-	-	12.6 ± 0.7	11.1	19.5 ± 1.8	13.4 ± 1.7
	Sulphur (S)	mg/kg	-	-	<5,000 ± 0	<5,000	<5,000 ± 0	<5,000 ± 0
	Thallium (Tl)	mg/kg	-	-	0.474 ± 0.040	0.70	0.917 ± 0.035	0.48 ± 0.07
	Tin (Sn)	mg/kg	-	-	<2.0 ± 0	<2.0	2.15 ± 0.084	<2.0 ± 0
	Titanium (Ti)	mg/kg	-	-	967 ± 61	893	1,391 ± 110	760 ± 68
	Uranium (U)	mg/kg	-	-	14.5 ± 1.8	9.7	27.1 ± 1.8	5.66 ± 0.9
	Vanadium (V)	mg/kg	-	-	52.8 ± 4.8	60.8	75.8 ± 5.1	53.3 ± 6.2
	Zinc (Zn)	mg/kg	315	135	78.4 ± 7.5	61.3	111.5 ± 7.3	52.3 ± 6.3
	Zirconium (Zr)	mg/kg	-	-	3.2 ± 0.2	8.1	3.7 ± 0.1	5.0 ± 0.6

^a Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL);

OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

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

Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

metals may be overly conservative. Nevertheless, because the Camp Lake littoral station is located near the inlet from CLT1, this suggested that mine-influenced flow from this tributary potentially contributed to elevated sediment arsenic and manganese concentrations near the creek inlet to Camp Lake. On average, no metals were elevated in the profundal sediment of Camp Lake compared to those of Reference Lake 3 in 2015 (Table 4.5; Appendix Table C.8). Although mean iron and manganese concentrations at Camp Lake profundal stations were above respective SQG, mean concentrations of these metals were also above SQG within the Reference Lake 3 profundal sediments (Table 4.5), suggesting naturally high concentrations of these metals in the mine LSA. The Camp Lake profundal station sediment arsenic concentration was, on average, above the AEMP benchmark, but arsenic (in addition to copper and iron) concentrations were also above the AEMP benchmark at Reference Lake 3 (Table 4.5), indicating natural elevation of these metals in mine LSA lakes that is unrelated to mine activity (Table 4.5).

Temporal comparisons of the sediment chemistry data indicated moderately higher (i.e., 5- to 10-fold greater) arsenic concentrations and slightly higher (2- to 5-fold greater) calcium, manganese, molybdenum and phosphorus concentrations in sediment at the Camp Lake littoral station in 2015 than during the baseline and/or mine construction periods⁵ (Figure 4.11; Appendix Table C.8). Mean calcium and manganese concentrations were also slightly higher in profundal sediment of Camp Lake in 2015 compared to the baseline period, but not the mine construction period (Figure 4.11; Appendix Table C.8). Concentrations of calcium in sediment of the littoral and profundal areas, and manganese at profundal areas, showed consistently higher concentrations from baseline, to mine construction, to mine operation periods (Figure 4.11), suggesting that sources of these metals began to originate at the time of mine construction and continued through current operations. In part, higher sediment calcium concentrations at Camp Lake may reflect the use of calcium chloride at the mine airstrip as a dust suppressant, and its subsequent runoff to the lake. A noticeable step increase in average concentrations of arsenic, iron, manganese and nickel at the Camp Lake littoral station in 2015 compared to 2014 suggested that current mine operations had resulted in higher concentrations of these metals (Figure 4.11). Notably, the changes in sediment metal concentrations over time at Camp Lake appeared to have resulted in elevating iron, manganese and nickel concentrations above SQG in littoral and/or profundal lake sediments.

⁵ Reported sediment boron concentrations in 2015 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 study periods was likely related to a laboratory-based difference between studies.

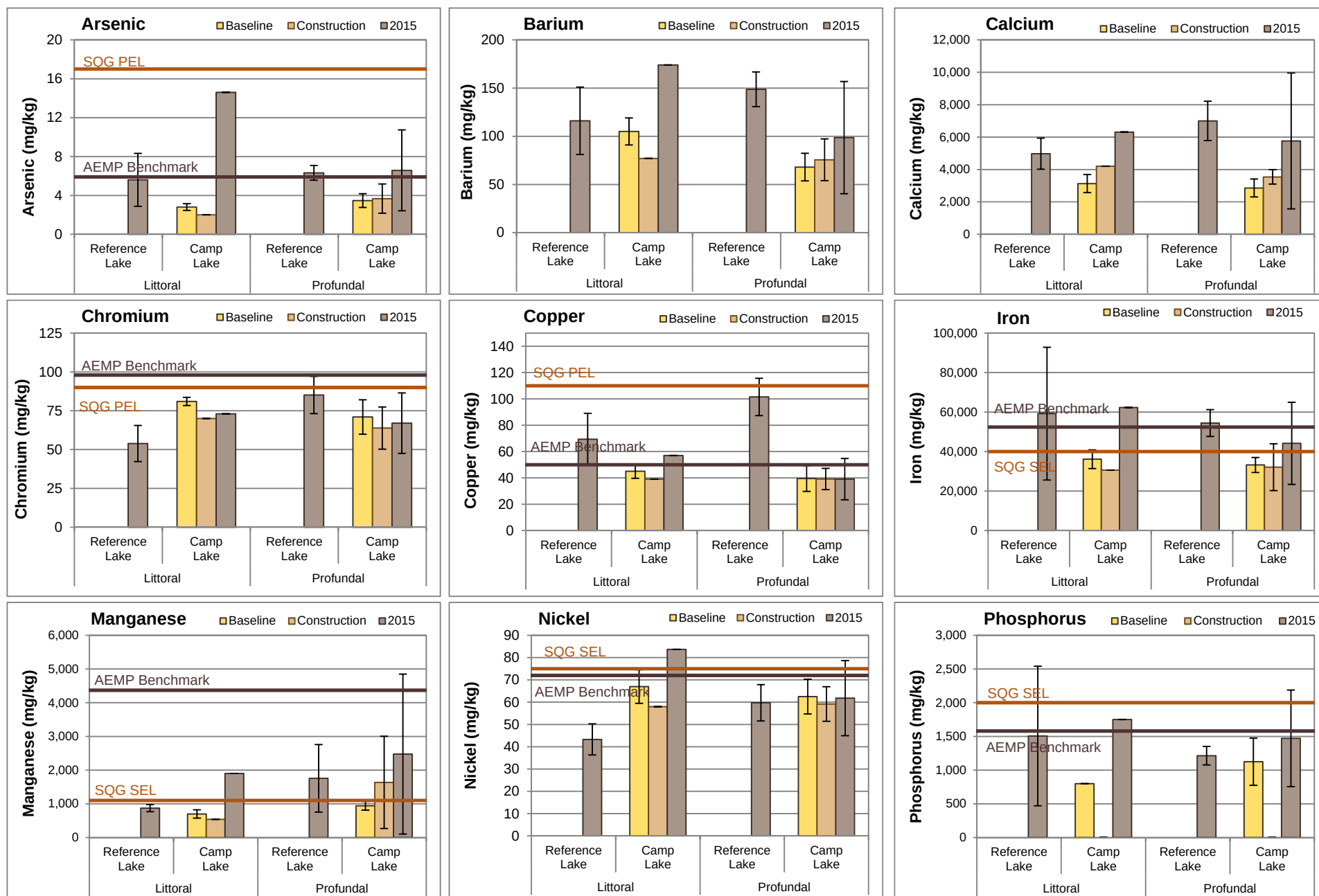


Figure 4.11: Temporal comparison of sediment metal concentrations (mean $\pm$ SD) at littoral and profundal stations of Camp Lake and Reference Lake 3 for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods, Mary River Project CREMP.

4.2.3 Phytoplankton

Camp Lake chlorophyll a concentrations showed no distinct spatial changes with progression from the CLT inlet to the lake outlet stations during any of the winter, summer or fall sampling events in 2015 (Figure 4.12). The 2015 Camp Lake chlorophyll a concentrations were significantly higher in summer than during the winter and fall sampling events (Appendix Table D.8). On average, chlorophyll a concentrations at Camp Lake were significantly higher than at Reference Lake 3 during the summer sampling event, but not during the fall sampling event (Appendix Tables D.9 – D.10). Chlorophyll a concentrations were well below the AEMP benchmark of 3.7 µg/L during all winter, summer and fall sampling events in 2015 (Figure 4.12). Mean chlorophyll a concentrations suggested low phytoplankton productivity at Camp Lake which were suggestive of oligotrophic conditions based on Wetzel (2001) lake trophic status 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 for all 2015 lake sampling events (Table 4.5; Appendix Table B.24).

Temporal comparisons of the Camp Lake chlorophyll a data indicated higher concentrations during the winter and summer sampling events in 2015 compared to the 2014 mine construction period, but lower chlorophyll a concentrations in fall 2015 than in 2014 (Figure 4.13). However, annual average chlorophyll a concentrations did not differ significantly between 2014 and 2015 (ANOVA $p = 0.848$), suggesting no changes in the trophic status of Camp Lake were associated with the early start-up phase of mine operations. No chlorophyll a baseline (2005 – 2013) data are available for Camp Lake, precluding comparisons to conditions prior to the mine construction period. The variable differences in chlorophyll a concentrations at Camp Lake relative to mean reference concentrations and previous study results likely reflected high natural within- and between-lake variability in phytoplankton growth and/or distribution.

4.2.4 Benthic Invertebrate Community

Benthic invertebrate density was significantly higher at littoral and profundal stations of Camp Lake compared to like-habitat stations at Reference Lake 3 (Tables 4.6 and 4.7). For both the littoral and profundal stations, the magnitude of difference in density was outside of the benthic invertebrate community critical effect size (CES_{BIC}) of ± 2 reference area standard deviation (SD_{REF}), suggesting that the difference was ecologically meaningful. Notably, the magnitude of this difference was much greater in the comparison of density at profundal stations than at littoral stations. Although no significant difference in richness was indicated between lakes at littoral stations, richness was significantly higher at Camp Lake compared

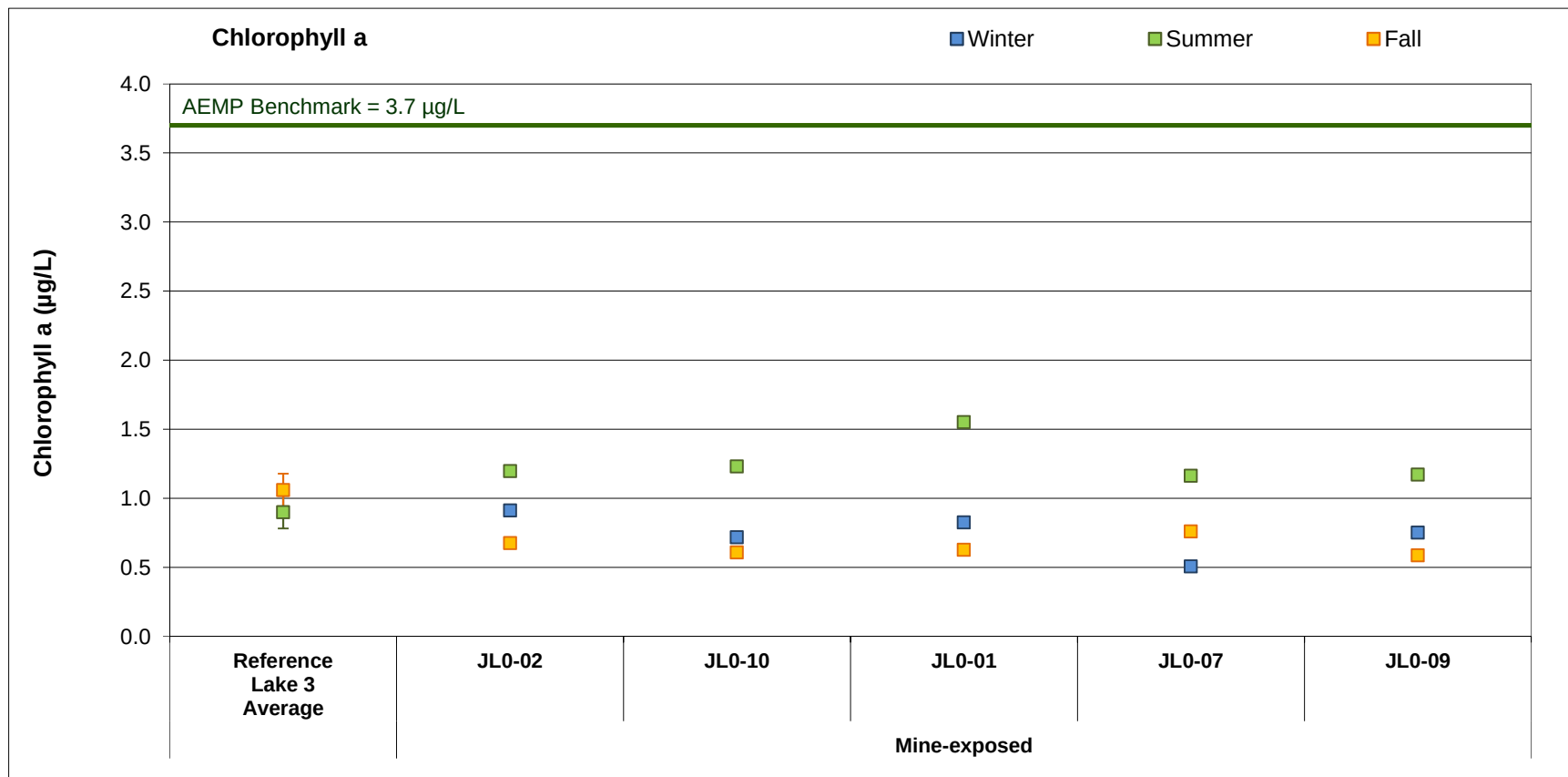


Figure 4.12: Chlorophyll a concentrations at Camp Lake (JLO) phytoplankton monitoring stations, Mary River Project CREMP, 2015. Values are averages of samples taken from the surface and the bottom of the water column at each station. Reference values represent mean $\pm$ standard deviation ($n = 3$). Reference Lake 3 was not sampled in winter 2015.

Table 4.6: Benthic invertebrate community statistical comparison results between Camp Lake (JLO) and Reference Lake 3 for littoral stations, Mary River Project CREMP, August 2015.

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)	YES	0.034	ζ	0.614	2.7	Reference Lake 3	1,278	888	397	553	2,819
						Camp Lake Littoral	3,671	1,891	846	2,205	6,344
Richness (Number of Taxa)	NO	0.937	α	0.051	-	Reference Lake 3	12.6	4.1	1.8	9.0	18.0
						Camp Lake Littoral	12.8	3.7	1.7	8.0	17.0
Simpson's Evenness (E)	YES	0.003	α	0.955	-2.9	Reference Lake 3	0.865	0.052	0.023	0.804	0.936
						Camp Lake Littoral	0.712	0.063	0.028	0.635	0.806
Bray-Curtis Index	YES	0.001	α	0.991	2.4	Reference Lake 3	0.382	0.170	0.076	0.219	0.662
						Camp Lake Littoral	0.795	0.072	0.032	0.705	0.867
Nemata (%)	NO	0.790	β	0.057	-	Reference Lake 3	8.1%	7.4%	3.3%	0.0%	17.2%
						Camp Lake Littoral	4.7%	4.6%	2.0%	1.0%	12.2%
Ostracoda (%)	YES	0.001	β	0.998	-1.1	Reference Lake 3	20.9%	18.5%	8.3%	4.1%	45.2%
						Camp Lake Littoral	0.2%	0.3%	0.1%	0.0%	0.7%
Chironomidae (%)	YES	0.010	β	0.832	1.4	Reference Lake 3	66.5%	18.9%	8.4%	40.6%	91.0%
						Camp Lake Littoral	93.1%	4.7%	2.1%	86.4%	98.5%
Metal-Sensitive Chironomidae (%)	YES	0.072	β	0.445	2.2	Reference Lake 3	11.4%	12.6%	5.6%	1.5%	32.2%
						Camp Lake Littoral	38.5%	24.5%	11.0%	4.7%	60.9%
Collector-Gatherers (%)	YES	0.016	β	0.755	-1.8	Reference Lake 3	81.4%	17.1%	7.7%	53.7%	95.2%
						Camp Lake Littoral	51.1%	14.7%	6.6%	37.6%	68.8%
Filterers (%)	YES	0.073	β	0.443	2.1	Reference Lake 3	11.4%	12.6%	5.6%	1.5%	32.2%
						Camp Lake Littoral	38.2%	24.3%	10.9%	4.7%	60.2%
Clingers (%)	YES	0.088	β	0.401	2.3	Reference Lake 3	13.5%	11.8%	5.3%	4.0%	33.9%
						Camp Lake Littoral	40.7%	23.8%	10.6%	4.7%	61.6%
Sprawlers (%)	YES	0.000	δ	0.999	-2.9	Reference Lake 3	70.1%	14.9%	6.7%	47.1%	84.3%
						Camp Lake Littoral	26.1%	4.2%	1.9%	22.1%	31.2%
Burrowers (%)	NO	0.122	δ	0.331	-	Reference Lake 3	16.4%	6.8%	3.0%	8.3%	25.8%
						Camp Lake Littoral	33.2%	21.8%	9.8%	16.3%	64.1%

^a Data analysis included: α - data untransformed, single factor ANOVA test conducted; ζ - data untransformed, single factor ANOVA test confirmed using Mann Whitney U-test; β - data logit transformed, single factor ANOVA test conducted; γ - data logit transformed, single factor ANOVA test results confirmed using Mann-Whitney U-test; and, δ - data logit transformed, single-factor ANOVA test results confirmed 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.

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 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.

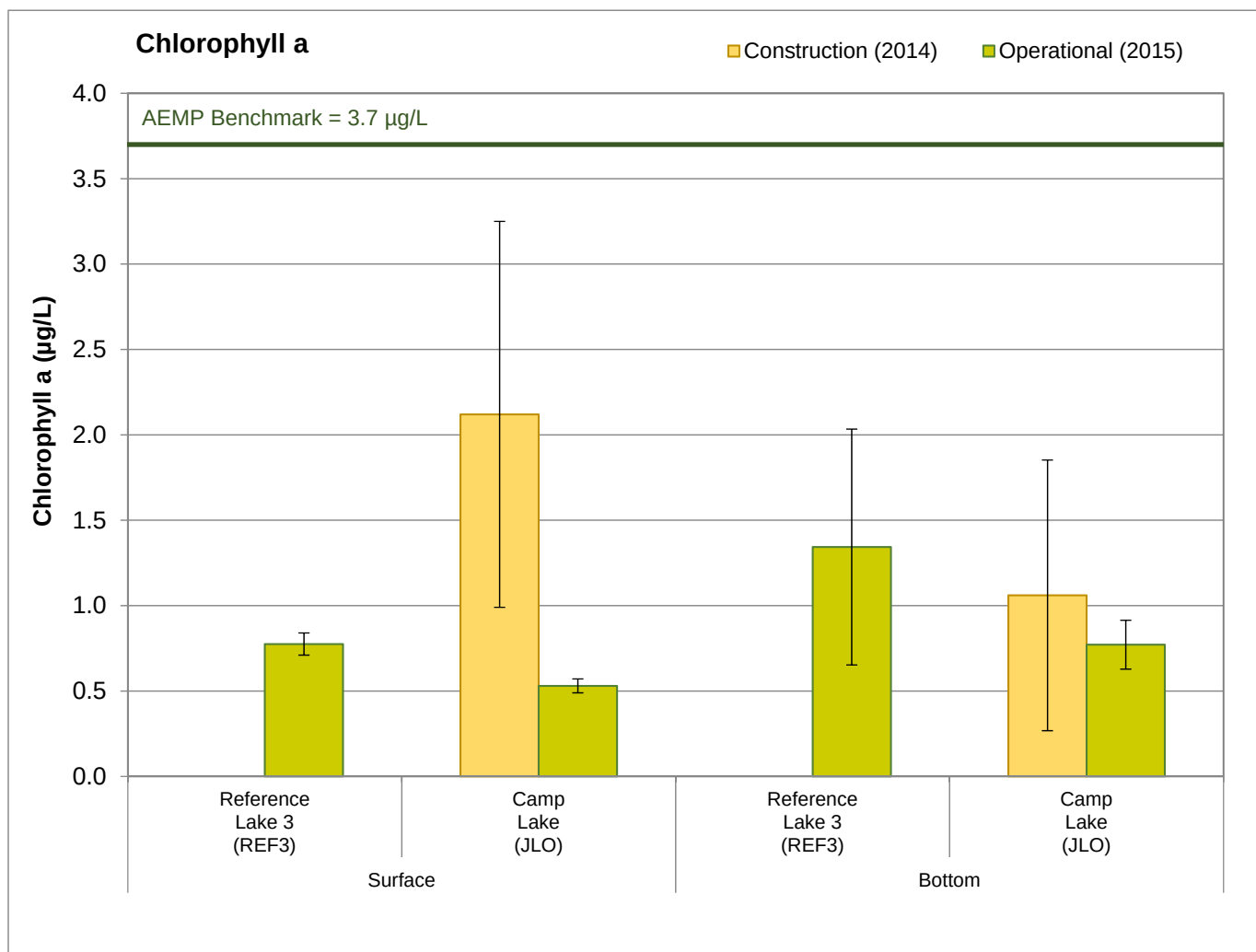


Figure 4.13: Temporal comparison of chlorophyll a concentrations at Camp Lake (JLO) and Reference Lake 3 (REF3) for mine construction (2014) and operational (2015) periods during fall, Mary River Project CREMP. Average chlorophyll a concentrations (±SD) from samples taken at the surface and bottom of Camp Lake (n = 5) and Reference Lake 3 (n = 3) are presented.

Table 4.7: Benthic invertebrate community statistical comparison results between Camp Lake (JLO) and Reference Lake 3 for profundal stations, Mary River Project CREMP, August 2015.

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)	YES	0.016	ε	0.762	34.8	Reference Lake 3	180	39	18	122	216
						Camp Lake Profundal	1,552	1,005	449	157	2,810
Richness (Number of Taxa)	YES	0.003	ε	0.953	6.5	Reference Lake 3	2.8	0.8	0.4	2.0	4.0
						Camp Lake Profundal	8.2	2.8	1.2	5.0	12.0
Simpson's Evenness (E)	NO	0.241	α	0.201	-	Reference Lake 3	0.397	0.232	0.104	0.160	0.732
						Camp Lake Profundal	0.604	0.283	0.127	0.176	0.914
Bray-Curtis Index	YES	0.000	α	1.000	6.8	Reference Lake 3	0.157	0.101	0.045	0.049	0.273
						Camp Lake Profundal	0.846	0.110	0.049	0.732	1.000
Nemata (%)	NO	0.555	γ	0.085	-	Reference Lake 3	1.0%	2.2%	1.0%	0.0%	5.0%
						Camp Lake Profundal	6.7%	10.4%	4.7%	0.0%	24.2%
Ostracoda (%)	YES	0.035	β	0.602	-0.7	Reference Lake 3	9.7%	13.1%	5.9%	0.0%	31.9%
						Camp Lake Profundal	0.3%	0.7%	0.3%	0.0%	1.5%
Chironomidae (%)	NO	0.994	β	0.050	-	Reference Lake 3	87.8%	13.2%	5.9%	68.1%	100.0%
						Camp Lake Profundal	90.4%	11.3%	5.1%	71.7%	100.0%
Metal-Sensitive Chironomidae (%)	YES	0.034	δ	0.612	3.5	Reference Lake 3	2.8%	2.6%	1.2%	0.0%	5.5%
						Camp Lake Profundal	11.7%	7.3%	3.3%	5.3%	21.0%
Collector-Gatherers (%)	YES	0.012	δ	0.810	-3.6	Reference Lake 3	96.6%	3.3%	1.5%	92.6%	100.0%
						Camp Lake Profundal	84.7%	7.3%	3.3%	74.2%	93.2%
Filterers (%)	YES	0.013	δ	0.795	3.5	Reference Lake 3	1.9%	2.7%	1.2%	0.0%	5.5%
						Camp Lake Profundal	11.4%	6.8%	3.1%	5.3%	19.4%
Clingers (%)	YES	0.038	δ	0.588	3.3	Reference Lake 3	3.4%	3.3%	1.5%	0.0%	7.4%
						Camp Lake Profundal	14.3%	8.4%	3.8%	5.7%	25.8%
Sprawlers (%)	YES	0.005	β	0.912	-36.4	Reference Lake 3	94.8%	1.3%	0.6%	92.6%	95.8%
						Camp Lake Profundal	46.6%	29.2%	13.0%	1.6%	72.7%
Burrowers (%)	YES	0.015	β	0.771	14.8	Reference Lake 3	1.8%	2.5%	1.1%	0.0%	5.0%
						Camp Lake Profundal	39.1%	36.4%	16.3%	2.4%	91.6%

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

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 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.

to the reference lake at profundal stations (Tables 4.6 and 4.7). Similarly, Simpson's Evenness differed significantly between lakes at the littoral stations, but not at the profundal stations. Simpson's Evenness was low at littoral and profundal stations of Camp Lake, indicating that few taxa dominated the benthic invertebrate community.

Marked differences in benthic invertebrate community structure were evident between Camp Lake and Reference Lake 3 based on significantly higher Bray-Curtis Index at Camp Lake, and by significant differences in the relative abundance of dominant taxonomic groups, FFG and HPG between lakes at both littoral and profundal station types. The between lake magnitude of these differences was generally much greater for profundal station comparisons than for littoral station comparisons (Tables 4.6 and 4.7). 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 littoral and profundal stations of Camp Lake compared to Reference Lake 3. However, because the relative abundance of metal-sensitive Chironomidae was significantly higher at Camp Lake than at Reference Lake 3, the difference in benthic invertebrate community structure between lakes was unlikely related to any mine-related influences associated with metal deposition. This was supported by water quality monitoring data that showed aqueous metal concentrations 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.

The differences in benthic invertebrate community structure between Camp Lake and Reference Lake 3 were consistent with differences in food resources between lakes. For instance, greater benthic invertebrate density and significantly higher relative abundance of filter-feeders suggested higher phytoplankton productivity at Camp Lake than at Reference Lake 3, which was supported by observations of significantly lower Secchi depth and higher summer chlorophyll a concentrations at Camp Lake in 2015 (Appendix Tables B.22 – B.23, D.9 – D.10). Similarly, significantly lower relative abundance of Ostracoda and collector-gatherers at Camp Lake compared to the reference lake may have been related to significantly lower sediment TOC (Appendix Figure C.2), which serves as a key food source for these groups, at Camp Lake. These general observations suggested that benthic invertebrates of Camp Lake utilize autochthonous food sources (i.e., primary producers) to a greater extent than at Reference Lake 3, and that Camp Lake was naturally more productive than Reference Lake 3.

Temporal comparisons of Camp Lake benthic invertebrate community features at littoral stations indicated no significant differences in density, richness, dominant taxonomic group composition or FFG composition between mine baseline (2013) and operational (2015) periods (Figure 4.14). Although Simpson's Evenness was significantly lower at Camp Lake littoral stations in 2015 than in 2013, the absence of differences in any of the remaining key indices suggested that this difference may have reflected natural variability in the Camp Lake system. At profundal stations, significantly lower richness was indicated at Camp Lake in 2015 compared to 2013, but not compared to the 2007 baseline data (Figure 4.14). In addition, the relative abundance of metal-sensitive Chironomidae and the filterer FFG at Camp Lake profundal stations was significantly lower in 2015 compared to both the 2013 and 2007 baseline studies (Figure 4.14). The lack of any substantial changes in water quality and only slight change (i.e., <3-fold increase) in sediment calcium and manganese concentrations at the profundal stations were not consistent with the benthic invertebrate community temporal response shown between the baseline and 2015 studies, particularly given that the relative abundance of metal-sensitive taxa was significantly higher at Camp Lake than at the reference lake in 2015. Therefore, the differences in community features at profundal stations of Camp Lake was likely the result of sampling artifacts (e.g., differences in sampling station locations and/or replication among studies) or natural temporal variability among studies unrelated to potential influences from the 2015 mine operations.

4.2.5 Fish Population Survey

4.2.5.1 Camp Lake Fish Community

Arctic charr (*Salvelinus alpinus*) was the only fish species captured at Camp Lake in 2015, contrasting slightly with Reference Lake 3, where low numbers of nine-spine stickleback (*Pungitius pungitius*) were captured in addition to Arctic charr (Table 4.8). Higher density of Arctic charr was encountered along rocky shoreline habitat and littoral/profundal areas of Camp Lake than at Reference Lake 3 based on greater electrofishing and gill netting catch-per-unit-effort (CPUE), respectively, at Camp Lake in 2015 (Table 4.8). This suggested higher fish productivity at Camp Lake compared to Reference Lake 3, corroborating the chlorophyll a and benthic invertebrate community results which also suggested higher productivity (primary and secondary, respectively) at Camp Lake.

Arctic charr CPUE in 2015 was within the range of that observed in baseline (2006-2013) and mine construction (2014) studies (Figure 4.15). Although the Arctic charr gill netting CPUE was approximately 50% higher in 2015 than in 2014, the differences in CPUE between years most likely reflected differences in the amount of gill netting effort applied

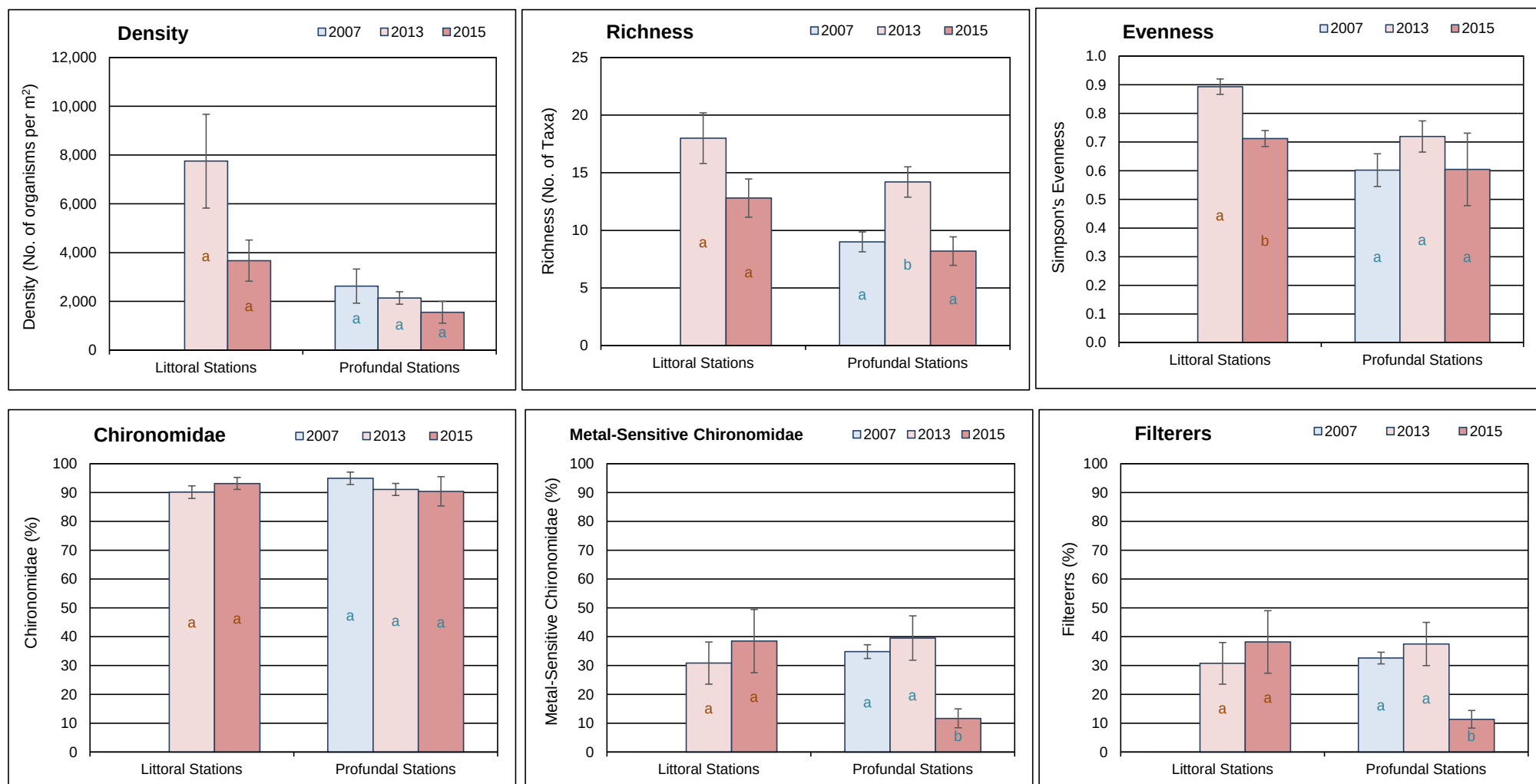


Figure 4.14: Comparison of key benthic invertebrate metrics (mean $\pm$ SE) at Camp Lake littoral and profundal stations between mine baseline (2007, 2013) and operational (2015) periods, Mary River Project CREMP, 2015. The same like-coloured letter inside bars indicate no significant difference between areas.

Table 4.8: Fish catch and community summary from backpack electrofishing and gill netting conducted at Camp Lake (JLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2015.

Lake	Method		Arctic Charr	Nine-spine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	99	8	107	2
		CPUE	0.71	0.05	0.77	
	Gill netting	No. Caught	6	0	6	
		CPUE	0.08	0	0.081	
Camp Lake	Electrofishing	No. Caught	106	0	106	1
		CPUE	1.76	0	1.76	
	Gill netting	No. Caught	103	0	103	
		CPUE	0.92	0	0.92	

CPUE - Catch-per-unit-effort. For electrofishing: number of fish captured per electrofishing minute. For gill netting: number of fish captured per 100 m hours of net.

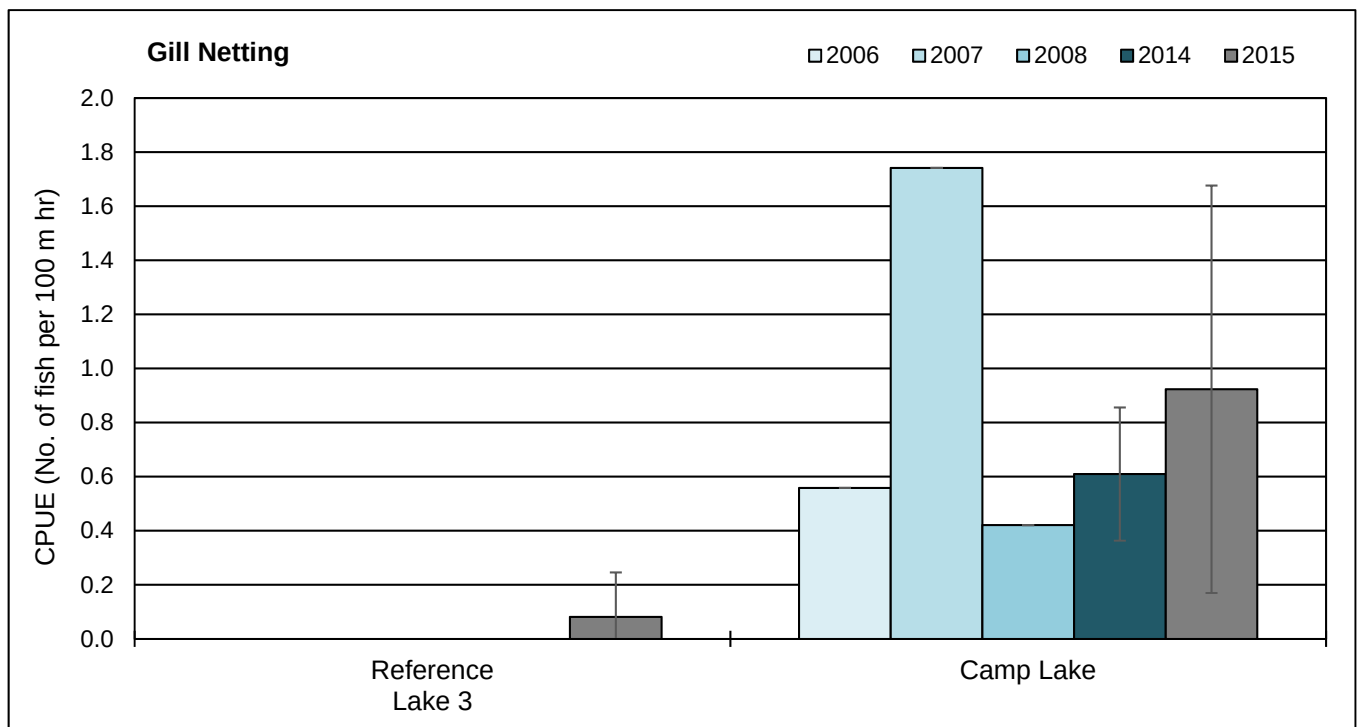
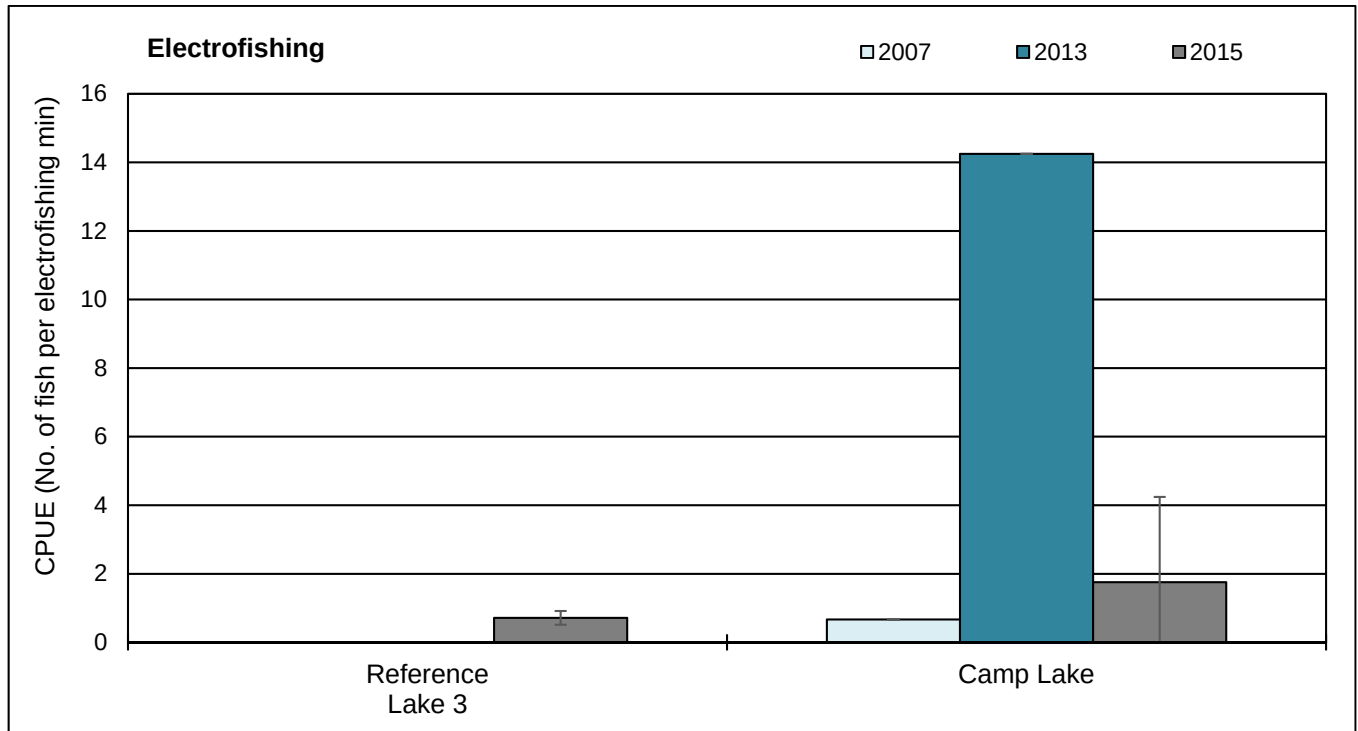


Figure 4.15: Catch-per-unit-effort (CPUE; mean $\pm$ SD) of Arctic charr captured by backpack electrofishing and gill netting at Camp Lake (JLO) for baseline (2006, 2007, 2008, 2013), mine construction (2014) and operational (2015) periods during fall, Mary River Project CREMP.

during each study (e.g., 122 versus 34 m·hrs/100m of net, respectively), netting location differences and/or natural factors (e.g., weather conditions) that can affect fish catches. Nevertheless, CPUE comparisons between studies suggested that the relative abundance of Arctic charr in Camp Lake had not likely changed substantially, and was unlikely to be lower, in 2015 compared to the baseline and mine-construction periods.

4.2.5.2 Camp Lake Fish Health Assessment

Nearshore Arctic Charr

Mine-related influences on the Camp Lake nearshore Arctic charr population (i.e., fish captured by electrofishing) was assessed with based on a control-impact analysis using 2015 data from Camp Lake and Reference Lake 3, as well as a before-after analysis using Camp Lake 2015 and baseline (2013) data. A total of 102 and 99 Arctic charr were captured at nearshore habitat of Camp Lake and Reference Lake 3, respectively, in August 2015, for the control-impact analysis. Young-of-the-year (YOY) could not be distinguished from older age classes in either Camp Lake or Reference Lake 3 based on the evaluation of length-frequency distributions coupled with supporting age determinations (Figure 4.16). The length-frequency distributions for the nearshore Arctic charr differed significantly between Camp Lake and Reference Lake 3 (Table 4.9), reflecting the occurrence of larger individuals at Camp Lake. Because the nearshore Arctic charr age distribution was similar between lakes (Figure 4.16), the differences in length-frequency distribution were not likely related to differences in survival between Camp Lake and Reference Lake 3. The nearshore Arctic charr captured at Camp Lake were significantly larger, and had grown significantly faster (i.e., greater weight- and length-at-age) than those captured at Reference Lake 3 (Table 4.9; Appendix Table F.10). Moreover, the magnitude of differences in size and growth were outside of a Critical Effect Size (CES) of $\pm 25\%$ (referred to herein as CES_{SG}; Table 4.9), suggesting an ecologically meaningful difference in energy use between Camp Lake and Reference Lake 3 nearshore Arctic charr populations. Despite the differences in nearshore Arctic charr energy use, no significant difference in condition (i.e., weight-at-length relationship) was indicated between the Camp Lake and Reference Lake 3 populations (Table 4.9; Appendix Table F.10), indicating similar energy storage between study areas. Collectively, the fish health assessment results suggested greater food abundance and/or quality were available at Camp Lake compared to Reference Lake 3 for the nearshore Arctic charr population. These findings were consistent with the benthic invertebrate community data, which showed significantly higher benthic invertebrate density at Camp Lake compared to Reference Lake 3 (see Section 4.2.4).

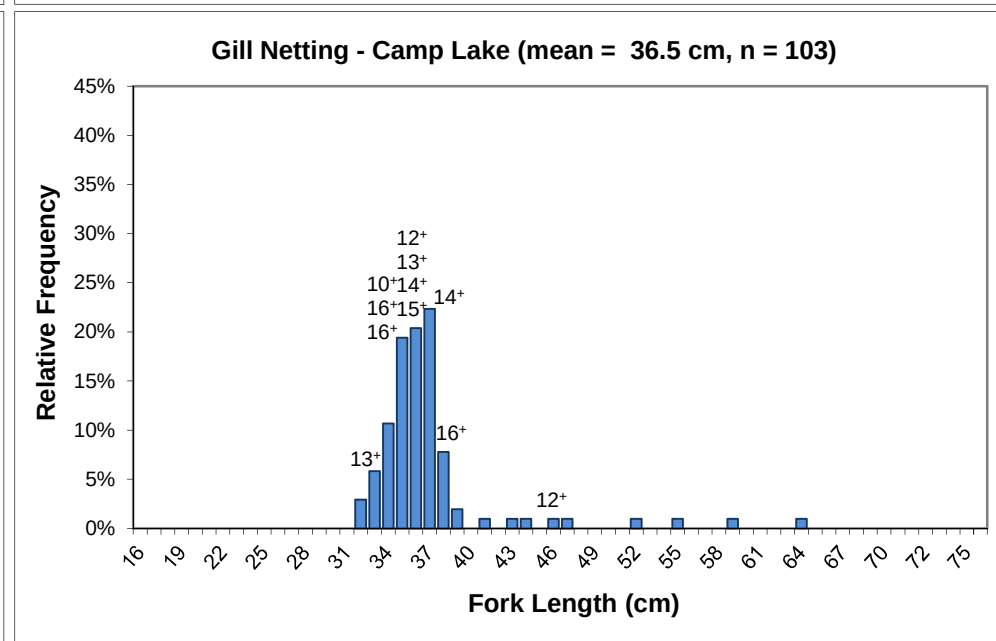
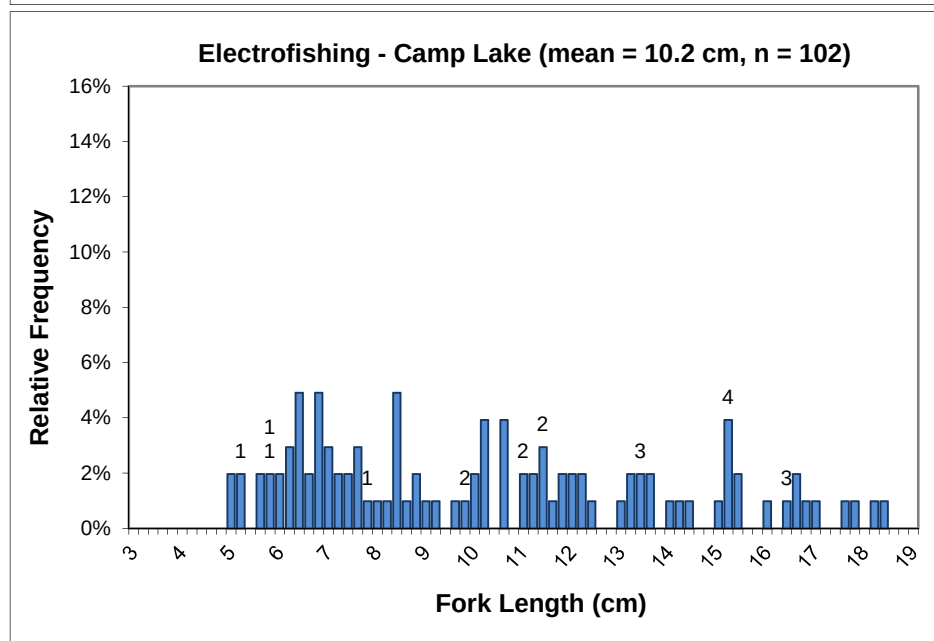
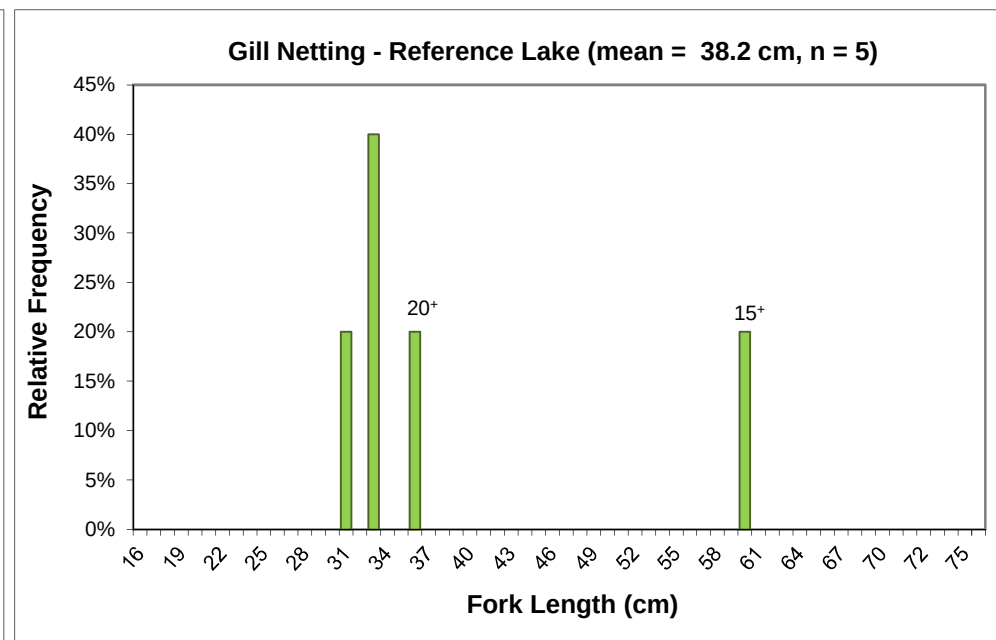
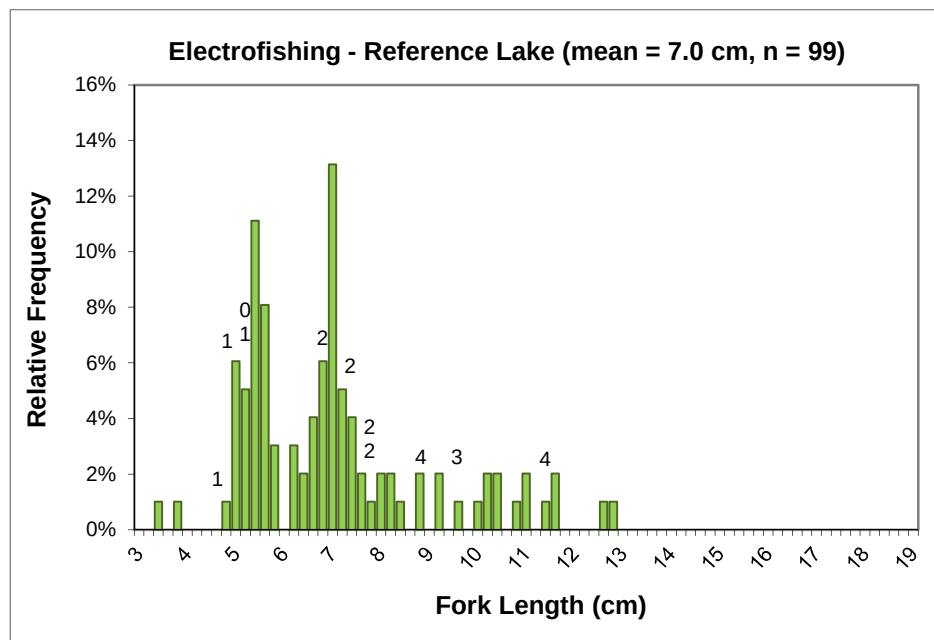


Figure 4.16: Length-frequency distributions for Arctic charr captured by backpack electrofishing and gill netting at Camp Lake (JLO) and Reference Lake 3 (REF3), August 2015, Mary River Project CREMP. Fish ages are shown above the bars, where available.

Table 4.9: Summary of statistical results for Arctic charr population comparisons between Camp Lake and Reference Lake 3 for the mine operational period (2015), between Camp Lake mine-operational and baseline (2005 - 2013) periods, and between Camp Lake mine-operational and construction (2014) periods for fish captured by electrofishing and gill netting methods, Mary River Project CREMP, August 2015. 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	versus Camp Lake Mine Construction period
			2015	2005 - 2013	2014
Electrofishing Samples	Survival	Length-Frequency Distribution	Yes	Yes	-
		Age	No	-	-
	Energy Use	Size (mean weight)	Yes (+176%)	Yes (-42%)	-
		Size (mean fork length)	Yes (+41%)	Yes (-15%)	-
		Growth (weight-at-age)	Yes (+154%)	-	-
		Growth (fork length-at-age)	Yes (+36%)	-	-
	Energy Storage	Condition (body weight-at-fork length)	No	Yes (-6.3%)	-
Gill Netting Samples*	Survival	Length Frequency Distribution	-	Yes	Yes
		Age	-	Yes (+48%)	-
	Energy Use	Size (mean weight)	-	No	Yes (+15%)
		Size (mean fork length)	-	Yes (+6.3%)	Yes (+4.4%)
		Growth (weight-at-age)	-	No	-
		Growth (fork length-at-age)	-	No	-
	Energy Storage	Condition (body weight-at-fork length)	-	No	Yes (+4.7%)

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

Comparison of the 2015 nearshore Arctic charr population to baseline (2005-2013) indicated significantly different length-frequency distributions between time periods at Camp Lake, with significantly smaller Arctic charr observed in 2015 (Table 4.9). Condition of the nearshore Arctic charr was also significantly lower in 2015 compared to the baseline period (Table 4.9; Appendix Table F.11). However, because the magnitude of difference in condition between the 2015 and baseline periods was within a CES of $\pm 10\%$ (referred to herein as CES_C; Table 4.9), this difference was not likely ecologically meaningful, and was likely associated with variability in sampling (e.g., seasonal timing of sampling, field personnel) or natural factors (e.g., annual differences in weather/lake heat, spawning/emergence timing).

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 2015 versus baseline (combined 2006, 2007, 2008 and 2013 data) and mine construction period (2014) data. Although a total of 103 Arctic charr were captured at littoral/profundal areas of Camp Lake, only five Arctic charr were similarly captured at Reference Lake 3 in August 2015, precluding a control-impact analysis for the determination of mine-related effects. Biological information collected from Arctic charr mortalities encountered during the 2015 Camp Lake littoral/profundal sampling suggested that approximately 59% of the population was represented by non-spawners of reproductive age (referred to simply as non-spawners herein; Appendix Table F25). The average age, length and weight of non-spawners was comparable to that of female spawners (Appendix Table F.25) indicating that, typical of high Arctic systems, individual Arctic charr do not spawn yearly at Camp Lake. This was supported by comparisons of Arctic charr liver somatic index (LSI), which was significantly lower in non-spawners than for female spawners (ANOVA; $p = 0.024$), suggesting that lower energy was available for gamete development in the non-spawners. Internal body cavity parasites were present in almost all Arctic charr incidental mortalities (Appendix Table F.25), which could potentially contribute to fish spawning on a biennial or otherwise longer frequency in the mine LSA as a result of parasites utilizing energy that may otherwise be used for gamete production. High incidence rates of internal parasites in Arctic charr of the Mary River Project mine area lakes has been noted in previous baseline studies (NSC 2014, 2015a).

Comparison of the 2015 littoral/profundal Arctic charr population to baseline (2005-2013) and mine construction (2014) period conditions indicated significantly different length-frequency distribution of Arctic charr in 2015 compared to both of the mine pre-operational periods at Camp Lake (Table 4.9). The differences in length-frequency distributions were consistent

with the capture of significantly older and/or larger sized Arctic charr at Camp Lake in 2015 compared to both the baseline and mine construction periods (Table 4.9; Appendix Tables F.26 – F.27). Notably, the magnitude of difference in Arctic charr size between the 2015 and mine pre-operational periods was within the $\pm 25\%$ CES_{SG} (Table 4.9), suggesting that these differences were not ecologically meaningful. No significant difference in Arctic charr growth was indicated between the 2015 and baseline periods for the Camp Lake littoral/profundal population (Table 4.9). In addition, there was no significant difference in littoral/profundal Arctic charr condition between the 2015 and baseline periods. Although significantly greater Arctic charr condition was indicated at Camp Lake between 2015 and the mine construction period, the magnitude of this difference was within the $\pm 10\%$ CES_C (Table 4.9), suggesting that it was not likely ecologically meaningful. Moreover, the direction of significant differences in Arctic charr size and condition that were indicated between the Camp Lake 2015 and mine pre-operational periods for the littoral/profundal population contrasted with that of the nearshore population, further suggesting that any differences shown between the 2015 and mine pre-operational periods were not ecologically meaningful.

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

Camp Lake Tributaries

At Camp Lake Tributary 1 (CLT1), mine-related influences on water quality were evident as elevated conductivity, hardness, alkalinity and concentrations of TDS, nitrate, chloride, sulphate, iron, manganese, molybdenum, sodium, strontium and uranium within the upper main stem compared to lotic reference stations and/or to baseline data. Quarrying activity at the QMR2 pit appeared to be the source of elevated parameter concentrations at the main stem of CLT1. With the exception of only a slight elevation in nitrate concentrations, no parameters were elevated at the CLT1 north branch compared to reference and baseline conditions. Despite elevation of several parameters at the CLT1 main stem relative to reference conditions, only iron concentrations were above established WQG, and only at the upstream-most station on the CLT1 main stem.

Chlorophyll a concentrations at the upper CLT1 main stem were slightly higher than the lotic reference station average in 2015, and also higher than baseline, suggesting slight enrichment of the system that was likely in response to mine-related elevation in nitrate concentrations. In the CLT1 lower main stem, and at the north branch, chlorophyll a concentrations were comparable to lotic reference and baseline concentrations, suggesting that any enrichment effects were limited to the upper portion of the CLT1 main stem. The benthic invertebrate community of the CLT1 lower main stem showed no significant differences in density, richness, Simpson's Evenness or the proportion of metal-sensitive

midges compared to the 2015 north branch reference area data, or to baseline data, suggesting no adverse metal-related influences on biota of the CLT1 system. Although benthic invertebrate community composition at the CLT1 lower main stem in 2015 differed significantly from the north branch and baseline conditions, these difference likely reflected natural spatial and temporal changes in channel erosion/braiding between areas and/or studies. Overall, despite slight mine-related influences on water quality of the CLT1 lower main stem, no adverse mine-related influences to phytoplankton or benthic invertebrate biota of the CLT1 lower main stem were evident in 2015.

At Camp Lake Tributary 2 (CLT2), water quality and chlorophyll a concentrations in 2015 were similar to the lotic reference stations and to baseline conditions, and also consistently met (i.e., were below) applicable WQG and AEMP benchmarks. In addition, there were no differences in benthic invertebrate density, Simpson's Evenness or relative abundance of dominant taxonomic groups, FFG or HPG between CLT2 areas located upstream and downstream of the mine tote road, or between the 2015 and baseline studies. Overall, no adverse mine-related influences to water quality, phytoplankton productivity, or the benthic invertebrate community were evident at CLT2 in 2015.

Camp Lake

At Camp Lake, aqueous manganese concentrations were slightly elevated (i.e., 3- to 5-fold higher) compared to the reference lake in 2015, but concentrations of manganese and all other parameters were similar to the baseline period, and were consistently below applicable WQG and AEMP benchmarks, suggesting no mine influence on water quality of Camp Lake. Sediment arsenic and manganese concentrations were elevated at the single Camp Lake littoral station compared to mean reference lake concentrations in 2015, and these metals as well as calcium, molybdenum and phosphorus were also elevated compared to baseline conditions. However, no metals were elevated in sediment of the Camp Lake profundal stations compared to the reference lake in 2015, and calcium and manganese were only slightly elevated at Camp Lake in 2015 compared to the baseline period. Collectively, slightly higher sediment metal concentrations at the single Camp Lake littoral station, which is located near the CLT1 inlet, was consistent with a mine influence. However, the extent of this mine influence appeared to be limited mainly to this single littoral station. With the exception of nickel, no metals were elevated above SQG and/or AEMP sediment quality benchmarks at Camp Lake that were not also elevated above these criteria at Reference Lake 3, suggesting natural elevation of certain metals (i.e., iron and manganese) at mine LSA lakes. In turn, this suggested a low potential for adverse effects to biota as a result of

the elevation in concentrations of these metals relative to SQG and AEMP benchmarks at Camp Lake.

Chlorophyll a concentrations showed no consistent differences between Camp Lake and the reference lake over summer and fall sampling events in 2015, nor between the 2015 and mine construction (2014) periods at Camp Lake, and were consistently below the AEMP benchmark. However, the benthic invertebrate and fish population data both suggested higher productivity at Camp Lake compared to the reference lake based on significantly higher benthic invertebrate density and higher Arctic charr CPUE, respectively, at Camp Lake. No adverse mine-related influences on the benthic invertebrate community of the Camp Lake were indicated in 2015 based on comparisons to the reference lake as well as to baseline studies. Analysis of Arctic charr populations indicated larger, faster growing juveniles of similar condition at Camp Lake compared to the reference lake in 2015, and no ecologically meaningful differences in the health of juvenile or adult Arctic charr at Camp Lake between the 2015 and baseline periods. Overall, the biological data collectively suggested no mine-related influences to the biota of Camp Lake following the initial year of mine operation at the Mary River Project.

5.0 SHEARDOWN LAKE SYSTEM

5.1 Sheardown Lake Tributaries (SDLT1, 9 and 12)

5.1.1 Water Quality

Sheardown Lake Tributary 1 (SDLT1) dissolved oxygen (DO) concentrations were consistently at or above saturation during all spring, summer and fall monitoring events, and were comparable to DO saturation levels observed among the lotic reference stations for each respective seasonal sampling event (Figure 5.1; Appendix Tables B.1 - B.3). Within SDLT1, DO levels were significantly higher at the middle and lower reaches compared to the upper reach at the time of biological sampling in August 2015 (Figure 5.1), which potentially reflected greater prevalence of turbulent riffle habitat at the middle and lower reaches (Appendix Table E.1). Although mean DO saturation was slightly lower at Sheardown Lake Tributary 9 and 12 (SDLT9 and SDLT12, respectively) than at SDLT1 and the lotic reference area during August 2015 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 sampling events (Figure 5.1; Appendix Tables B.1 – B.3).

In-situ pH at all of the Sheardown Lake tributaries was similar to pH measured at the lotic reference stations for each respective seasonal sampling event, and was consistently within WQG limits at each Sheardown Lake tributary (Figure 5.1; Appendix Tables B.1 – B.3). *In-situ* conductivity at SDLT1 was generally higher than at the lotic reference stations, and spatially within SDLT1, became higher with progression from the upper to lower reaches (Figure 5.1). The *in-situ* conductivity measured at SDLT9 and SDLT12 during August 2015 biological sampling was also elevated compared to the lotic reference stations. 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, chloride, 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 lotic reference station mean concentrations at the time of fall sampling (Table 5.1). These parameters, and hardness, alkalinity and concentrations of copper, manganese, potassium and uranium, were generally elevated (i.e., ≥ 3 -fold higher) during spring and/or summer at one or both SDLT1 monitoring stations compared to mean lotic

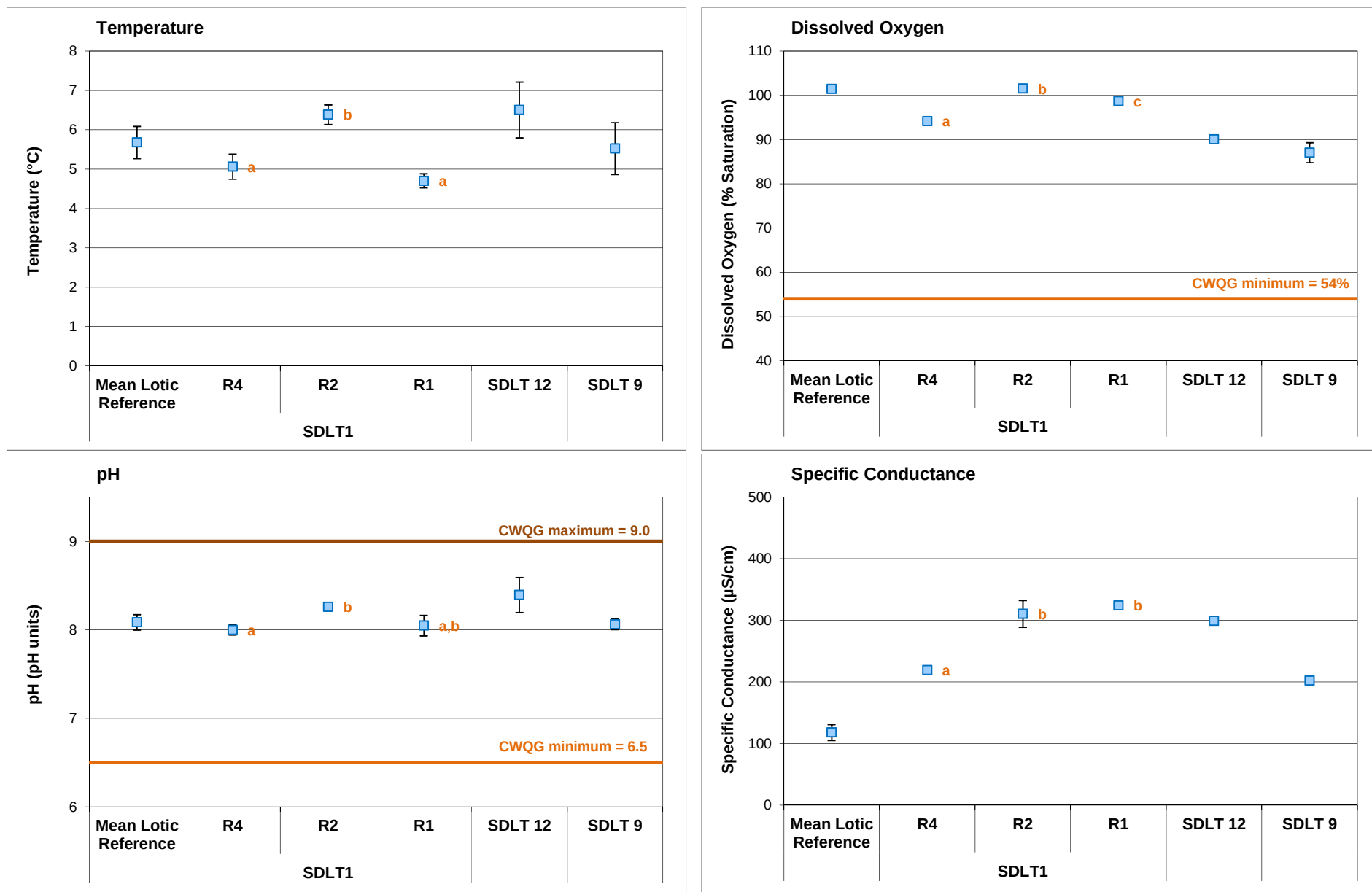


Figure 5.1: Comparison of in-situ water quality variables (mean $\pm$ SE; $n = 5, 3$, and 5 for SDLT 1, SDLT 12, and SDLT 9, respectively) measured at the Sheardown Lake Tributaries (SDLT) and lotic reference stations, Mary River Project CREMP, August 2015. The same letters next to SDLT1 data points indicate no significant differences between reaches.

**Table 5.1: Water chemistry at Sheardown Lake Tributary 1 (SDLT1) monitoring stations, Mary River
Project CREMP, August 2015.**

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Lotic Reference Average (n = 4) Fall 2015	Mine-exposed	
						D1-05 17-Aug-2015	D1-00 18-Aug-2015
Conventional ^b	Conductivity (lab)	umho/cm	-	-	105	217	274.5
	pH (lab)	pH	6.5 - 9.0	-	7.92	7.92	8.12
	Hardness (as CaCO ₃)	mg/L	-	-	51	104	136
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	54	113	137
	Turbidity	NTU	-	-	3.03	0.33	0.78
	Alkalinity (as CaCO ₃)	mg/L	-	-	46	84	111
Nutrients and Organics	Total Ammonia	mg/L	variable ^c	0.855	<0.050	<0.050	<0.050
	Nitrate	mg/L	13	13	0.024	0.40	0.57
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.15	0.37	0.18
	Dissolved Organic Carbon	mg/L	-	-	1.7	3.1	3.3
	Total Organic Carbon	mg/L	-	-	1.7	3.3	3.4
	Total Phosphorus	mg/L	0.020 ^{a,d}	-	0.0043	<0.0030	<0.0030
Anions	Phenols	mg/L	0.001 ^a	-	0.0042	0.0014	0.0021
	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.56	7.23	8.87
	Sulphate (SO ₄)	mg/L	218 ^{b,e}	218	3.16	22.3	20.9
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.164	0.0135	0.0324
	Antimony (Sb)	mg/L	0.020 ^a	-	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00712	0.0108	0.0141
	Beryllium (Be)	mg/L	0.011 ^a	-	<0.00010	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.000050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	0.011	0.011
	Cadmium (Cd)	mg/L	0.00012 ^f	-	<0.000010	0.000039	0.000015
	Calcium (Ca)	mg/L	-	-	10.6	19.6	25.1
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00058	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009 ^a	0.004	0.00011	<0.00010	0.000100
	Copper (Cu)	mg/L	0.003 ^g	-	0.0013	0.0030	0.0023
	Iron (Fe)	mg/L	0.30	-	0.14	<0.030	0.08
	Lead (Pb)	mg/L	0.001 ^h	0.001	0.00018	0.000061	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	0.0012	0.0021
	Magnesium (Mg)	mg/L	-	-	6.15	13.6	18.2
	Manganese (Mn)	mg/L	0.935 ^{b,i}	-	0.00171	0.000441	0.00389
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00040	0.00381	0.00275
	Nickel (Ni)	mg/L	0.025 ^j	0.025	0.00060	0.00125	0.00151
	Potassium (K)	mg/L	-	-	0.797	2.27	2.23
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	1.0	1.4	1.6
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000050	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.52	2.90	3.38
	Strontium (Sr)	mg/L	-	-	0.0104	0.0131	0.0161
	Thallium (Tl)	mg/L	0.0008	0.0008	0.000010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.00644	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.00277	0.00496	0.00506
	Vanadium (V)	mg/L	0.006 ^a	0.006	0.00057	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	0.0034

^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 Intrinsic (2013) using background water quality data. The values are adopted from the Camp Lake Tributaries.

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

reference station values for each respective seasonal sampling event (Appendix Table B.32). However, with the exception of copper at Station D1-05, no parameters were present at concentrations greater than respective WQG, and no parameters were above AEMP benchmarks, at either of the SDLT1 monitoring stations in 2015⁶ (Table 5.1; Appendix Table B.30).

Temporal comparisons of SDLT1 water chemistry data indicated that, of the parameters shown to be elevated above average reference conditions, only nitrate, sulphate and uranium concentrations at the upper reach (4; Station D1-05) and nitrate concentrations at the lower reach (1; Station D1-00) were slightly elevated (i.e., 3- to 5-fold higher) in 2015 compared to the baseline period (Figure 5.2; Appendix Table B.32 and Figure B.9). Despite slight elevation of nitrate, sulphate and, to a lesser extent, uranium and sodium, at SDLT1 in 2015 compared to the baseline period, concentrations of all parameters generally remained well below WQG and AEMP benchmarks in 2015 (Table 5.1; Figure 5.2; Appendix Figure B.9).

5.1.2 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 consistently lowest at upstream-most Station D1-05 compared to the lower station, near the creek mouth (Station D1-00), during all 2015 sampling events (Figure 5.3). However, chlorophyll a concentrations were consistently within the range shown among the lotic reference stations for all sampling events, suggesting no marked differences in phytoplankton productivity between SDLT1 and average reference conditions (Figure 5.3). Moreover, chlorophyll a concentrations at SDLT1 were well below the AEMP benchmark of 3.7 µg/L at the time of all 2015 seasonal sampling events. Similar to the lotic reference and Camp Lake systems, chlorophyll a concentrations observed at SDLT1 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). Relatively low chlorophyll a concentrations at SDLT1 stations in 2015 was consistent with an ultra-oligotrophic to oligotrophic CWQG categorization of SDLT1 based on aqueous phosphorus concentrations below 10 µg/L (Table 5.1; Appendix Table B.30). Interestingly, despite elevated nitrate concentrations at SDLT1 compared to average lotic reference conditions, chlorophyll a concentrations remained low in SDLT1, suggesting that phosphorus concentrations may be limiting for phytoplankton productivity at SDLT1 and/or alternatively,

⁶ Refer to footnote 2 (page 28) and Section 3.0 regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA.



Figure 5.2: Temporal comparison of water chemistry at Sheardown Lake Tributaries (SDLT) for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods in the fall. Values represent mean $\pm$ SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean $\pm$ 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 Sheardown Lake Tributaries.

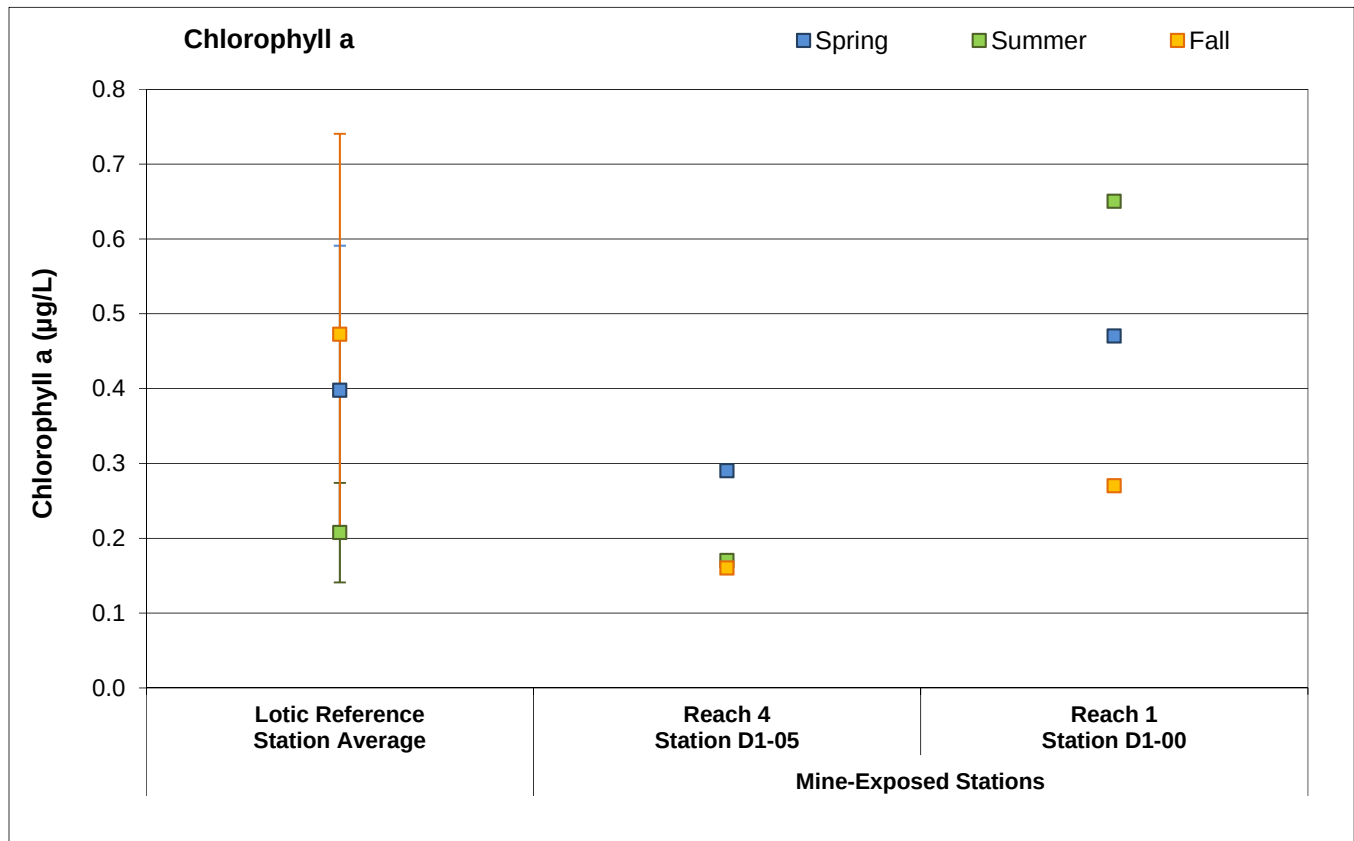


Figure 5.3: Chlorophyll a concentrations at Sheardown Lake Tributary 1 phytoplankton monitoring stations, Mary River Project CREMP, 2015. Lotic reference stations include the CLT-REF and MRY-REF series (mean $\pm$ SD; n = 4).

chlorophyll a concentrations are not a good proxy for phytoplankton abundance in stream environments.

Temporal comparisons of the SDLT1 data showed no consistent directional changes in chlorophyll a concentrations at both the upper and lower SDLT1 stations through the mine baseline (2005 – 2013), construction (2014), and operational (2015) periods (Figure 5.4). Moreover, the variability in chlorophyll a concentrations among the three mine development periods at SDLT1 was comparable to that observed at the lotic reference stations between 2014 and 2015. Accordingly, these results suggested that any changes in chlorophyll a concentrations among the mine development periods at SDLT1 were within the range of natural variability, which in turn, suggested no mine-related influences to phytoplankton productivity at SDLT1 associated with the initial year of mine operation.

5.1.3 Benthic Invertebrate Community

The benthic invertebrate community (benthic) assessment of the Sheardown Lake tributaries included a spatial statistical analysis among upper, middle and lower reaches of SDLT1, as well as a quantitative descriptive analysis among the SDLT1, SDLT9 and SDLT12 systems, to provide insight into any potential mine-related effects since the initiation of mine operations in 2015. However, temporal comparison of the Sheardown Lake tributary data between mine operation and baseline periods served as the primary tool for evaluating current (2015) effects because a suitable reference creek has not been established for comparisons to the Sheardown Lake tributary data as part of the Mary River Project CREMP.

Sheardown Lake Tributary 1 (SDLT1)

Benthic invertebrate density decreased substantially with progression from upper to middle to lower reaches of SDLT1 in 2015, but despite differing significantly between the upper and lower reaches (Figure 5.5), the magnitude of the difference was within the ± 2 SD_{REF} CES_{BIC}, suggesting that the difference in density was not ecologically meaningful (Appendix Table E.16). Benthic invertebrate richness, Simpson's Evenness and the proportion of metal-sensitive chironomids did not differ significantly among the SDLT1 reaches in 2015 (Figure 5.5). However, some differences in community assemblage were apparent among reaches as indicated by significant differences in Bray-Curtis Index⁷, dominant invertebrate groups, FFG and HPG (Figure 5.5; Appendix Table E.16). Similar to CLT1, the lack of any significant difference in richness and relative abundance of metal-sensitive chironomids among reaches within SDLT1 in 2015 suggested that community composition differences

⁷ Bray-Curtis Index was calculated using the median of the SDLT1 upper reach (Reach 4) benthic invertebrate community data as the basis for developing values for all SDLT1 reaches.

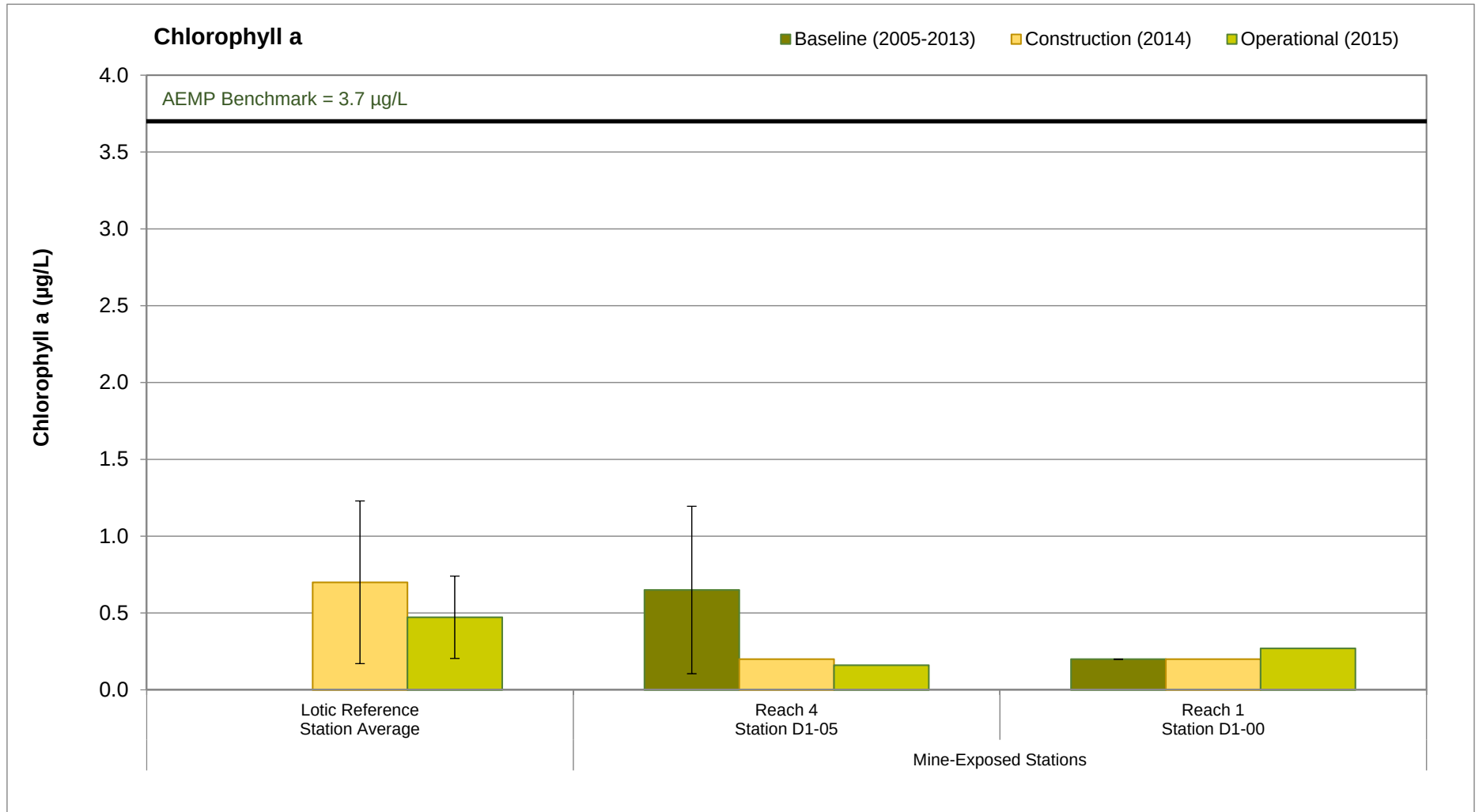


Figure 5.4: Temporal comparison of chlorophyll a concentrations at Sheardown Lake Tributary 1 for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods in the fall, Mary River Project CREMP. The lotic reference stations include the CLT-REF and MRY-REF series (mean $\pm$ SD; n = 4).

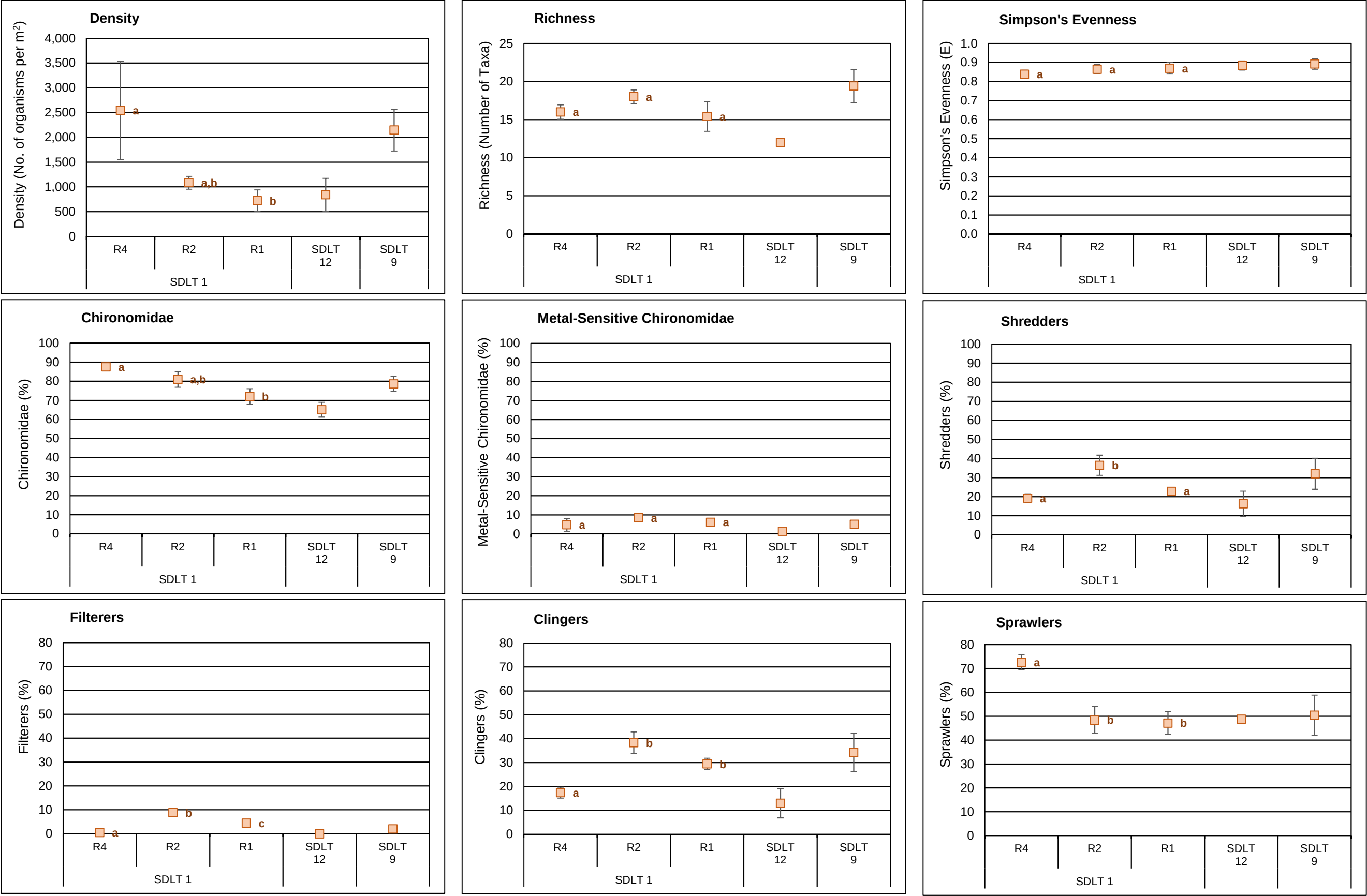


Figure 5.5: Comparison of benthic invertebrate community metrics among Sheardown Lake Tributary study areas (mean $\pm$ SE), Mary River Project CREMP, August 2015. The same letters next to SDLT1 data points indicate no significant difference between/among reaches.

between reaches were not likely related to metal concentrations. Instead, the key differences in benthic invertebrate community composition among reaches, which included a significantly higher proportion of shredders, filterers and clingers, and lower proportion of sprawlers, at the middle and/or lower reaches of SDLT1 compared to the upper reach, was consistent with differences in habitat (Figure 5.5; Appendix Table E.16). For instance, a higher proportion of riffle habitat, significantly lower substrate embeddedness and greater periphyton growth observed at the middle and lower reaches of SDLT1 in 2015 (Appendix Tables E.1 and E.11) may have accounted for the differences in community structure at the upper reach compared to the middle and lower reaches.

Temporal comparison of the SDLT1 data suggested the same general changes in benthic metrics and proportion of dominant groups with progression from upper to lower reaches in 2015 as shown during the baseline period (i.e., 2007 – 2013; Figure 5.6). For instance, benthic invertebrate density and chironomid relative abundance was consistently highest, and relative abundance of oligochaetes and filterers was consistently lowest, at the upper reach during each respective study (Figure 5.6). In addition, richness and Simpson's Evenness observed at each SDLT1 reach in 2015 was within the historical range of baseline conditions (Figure 5.6). In turn, this suggested no substantial changes in benthic invertebrate community features at the SDLT1 reaches with the commencement of mine operations in 2015. Notably, slightly higher benthic invertebrate density and relative abundance of filterers was suggested at the middle and lower reaches in concert with a lower proportion of metal-sensitive chironomids at the upper and lower reaches of SDLT1 in 2015 compared to previous studies (Figure 5.6). This suggested a potential mine-related influence on the benthic invertebrate community of SDLT1 in 2015 that was consistent with slight nutrient enrichment of the middle and lower portion of the SDLT1 system. In turn, this was supported by the water chemistry data, which indicated higher aqueous concentrations of nitrate at SDLT1 monitoring stations in 2015 compared to the baseline period.

Sheardown Lake Tributary 12 (SDLT12)

The benthic invertebrate community of Sheardown Lake Tributary 12 (SDLT12) was very similar to that of SDLT1 on the basis of benthic invertebrate community metrics of density, richness and Simpson's Evenness in 2015 (Figure 5.5). In addition, close similarity in composition of all dominant groups, FFG and HPG was demonstrated between SDLT12 and the SDLT1 lower reach in 2015 (Figure 5.5). Because aqueous specific conductance, which commonly serves as proxy for mine-related influences on water bodies, was comparable between SDLT12 and the middle to lower reaches of SDLT1, this suggested that the similarity in benthic invertebrate community features between SDLT12 and lower SDLT1

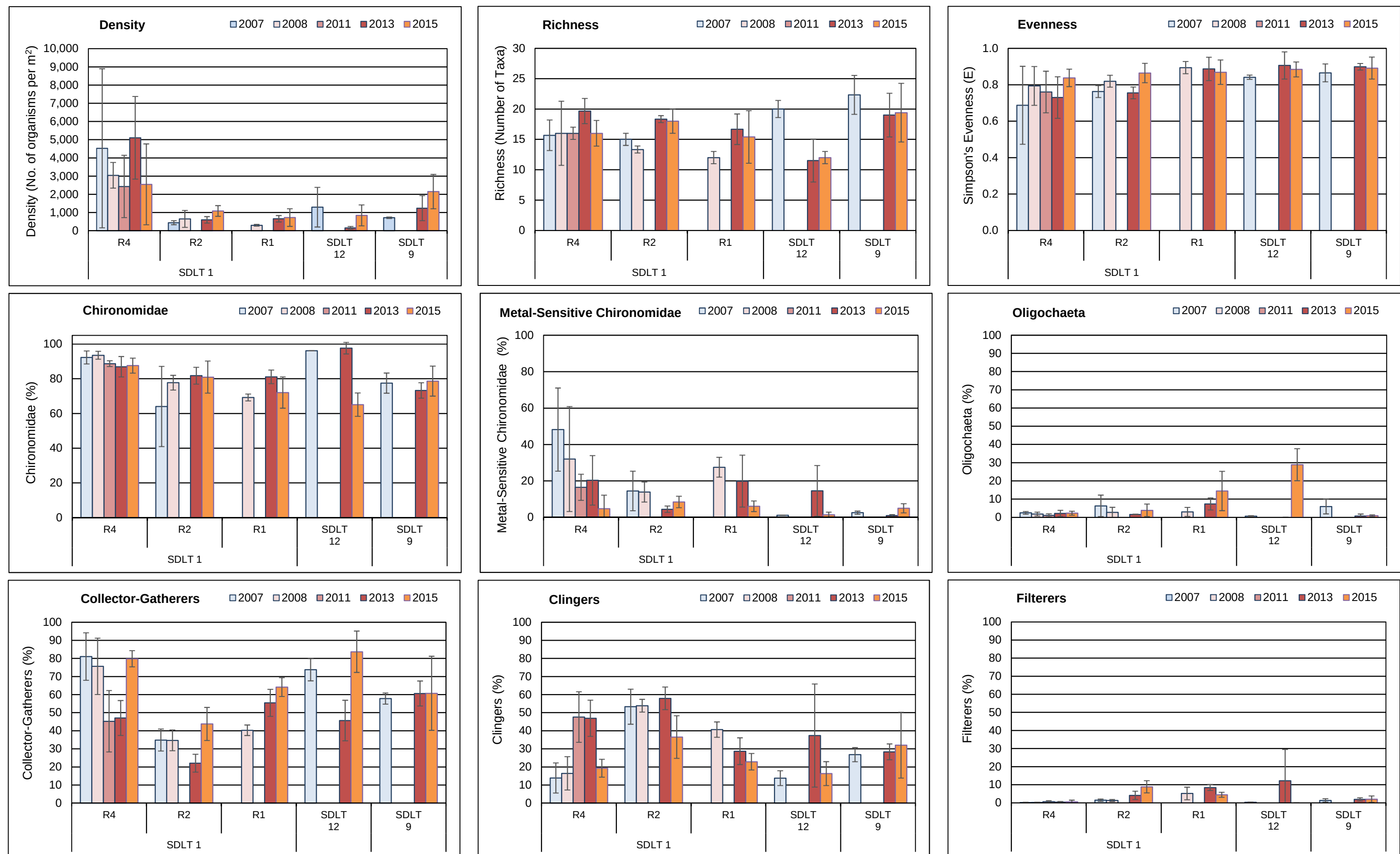


Figure 5.6: Comparison of benthic invertebrate community metrics (mean $\pm$ SD) at Sheardown Lake Tributaries 1, 12 and 9 among operational (2015) and baseline (2007, 2008, 2011, 2013) studies, Mary River Project CREMP.

reflected a similar mine-related influence. Specifically, subtle mine-related influences potentially associated with slight nutrient enrichment may have influenced the benthic invertebrate community of SDLT12 in 2015.

Temporal comparison of the SDLT12 benthic invertebrate community data indicated no clear directional changes for benthic metrics of benthic invertebrate density, richness, Simpson's Evenness, and the relative abundance of metal-sensitive chironomids, or any of the main FFG, between the baseline (2007 – 2013) the 2015 studies (Figure 5.6). Higher relative abundance of oligochaetes in 2015 at SDLT12 compared to baseline potentially reflected slight enrichment of the system (e.g., greater organic matter inputs), but may have also simply reflected slight differences in sampling location among studies. Therefore, it was uncertain as to whether any changes over time reflected a mine-related influence based on the available data.

Sheardown Lake Tributary 9 (SDLT9)

The benthic invertebrate community of Sheardown Lake Tributary 9 (SDLT9) showed, on average, similar density, richness, and Simpson's Evenness, than the upper reach of SDLT1 in 2015 (Figure 5.5). In addition, close similarity in composition of all dominant groups, FFG and HPG was demonstrated between SDLT9 and the upper reach of SDLT1 in 2015 (Figure 5.5). Within SDLT1, the upper reach might be expected to show lowest cumulative influence from the Mary River Project operation. Therefore, because benthic invertebrate community features at SDLT9 closely matched those of the SDLT1 upper reach, this suggested no to minimal mine-related influences on the benthic invertebrate community of SDLT9 were associated with mine operations in 2015.

Temporal comparison of the SDLT9 benthic invertebrate community data indicated no clear directional changes in any of the key benthic metrics, dominant taxa groups or FFG between the baseline (2007 – 2013) and 2015 studies (Figure 5.6). With the exception of higher benthic invertebrate density and relative abundance of metal-sensitive Chironomidae at SDLT9 in 2015, most benthic invertebrate community endpoints from the 2015 sampling were within the range observed during the baseline (2007 – 2013) studies. Overall, this suggested no mine-related effects to the benthic invertebrate community of SDLT9.

5.2 Sheardown Lake NW (DLO-1)

5.2.1 Water Quality

Water quality profiles of *in-situ* water temperature, dissolved oxygen, pH and specific conductance conducted at Sheardown Lake NW in 2015 showed no station-to-station

differences during any of the winter, summer or fall sampling events (Appendix Figures B.10 – B.13). No thermal stratification was apparent at the Sheardown Lake NW basin in 2015, which differed from Reference Lake 3 where stratification was apparent during the summer (Figure 5.7). On average, bottom water temperature at Sheardown Lake NW littoral and profundal areas was slightly warmer than at Reference Lake 3 at the time of fall sampling in 2015, the difference of which was statistically significant (Figure 5.8). Dissolved oxygen profiles of Sheardown Lake NW showed an oxycline at depths greater than approximately 16 m during the fall, but otherwise showed no appreciable changes from surface to bottom during winter or summer in 2015 (Figure 5.7). Dissolved oxygen saturation levels at the bottom of the water column in littoral and profundal areas of Sheardown Lake NW were lower compared to those at Reference Lake 3 during fall 2015 sampling, whereas the opposite was apparent during summer. However, in all cases, dissolved oxygen saturation levels remained well above the WQG of 54% at all littoral and profundal stations of Sheardown Lake NW in 2015 (Figures 5.7 and 5.8), indicating that dissolved oxygen was not limiting for pelagic or bottom-dwelling biota within the lake.

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 5.7). Although pH at the bottom of the water column at littoral and profundal areas of Sheardown Lake NW was slightly higher than at Reference Lake 3 during fall sampling, the mean incremental difference between lakes was small (i.e., <0.2 pH units) and all pH values were consistently within WQG limits (Figure 5.8), suggesting that the pH difference between lakes was unlikely to be ecologically meaningful. Specific conductance was significantly higher at Sheardown Lake NW compared to the reference lake during fall sampling (Figure 5.8). However, similar to observations at Camp Lake (Section 4.2.1), specific conductance at Sheardown Lake NW was comparable to the lotic reference area, and therefore the extent to which higher specific conductance at Sheardown Lake NW was related to natural regional variability or a mine-related influence was uncertain. Water clarity, as determined through evaluation of Secchi depth, was significantly lower at Sheardown Lake NW than at Reference Lake 3 during the 2015 fall sampling event (Appendix Tables B.22 – B.23). Secchi depth readings were relatively consistent among stations in Sheardown Lake NW in the fall of 2015, suggesting no spatial differences in water clarity throughout the lake (Appendix Table B.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 2015 (Table 5.2; Appendix Table B.38), suggesting that the lake

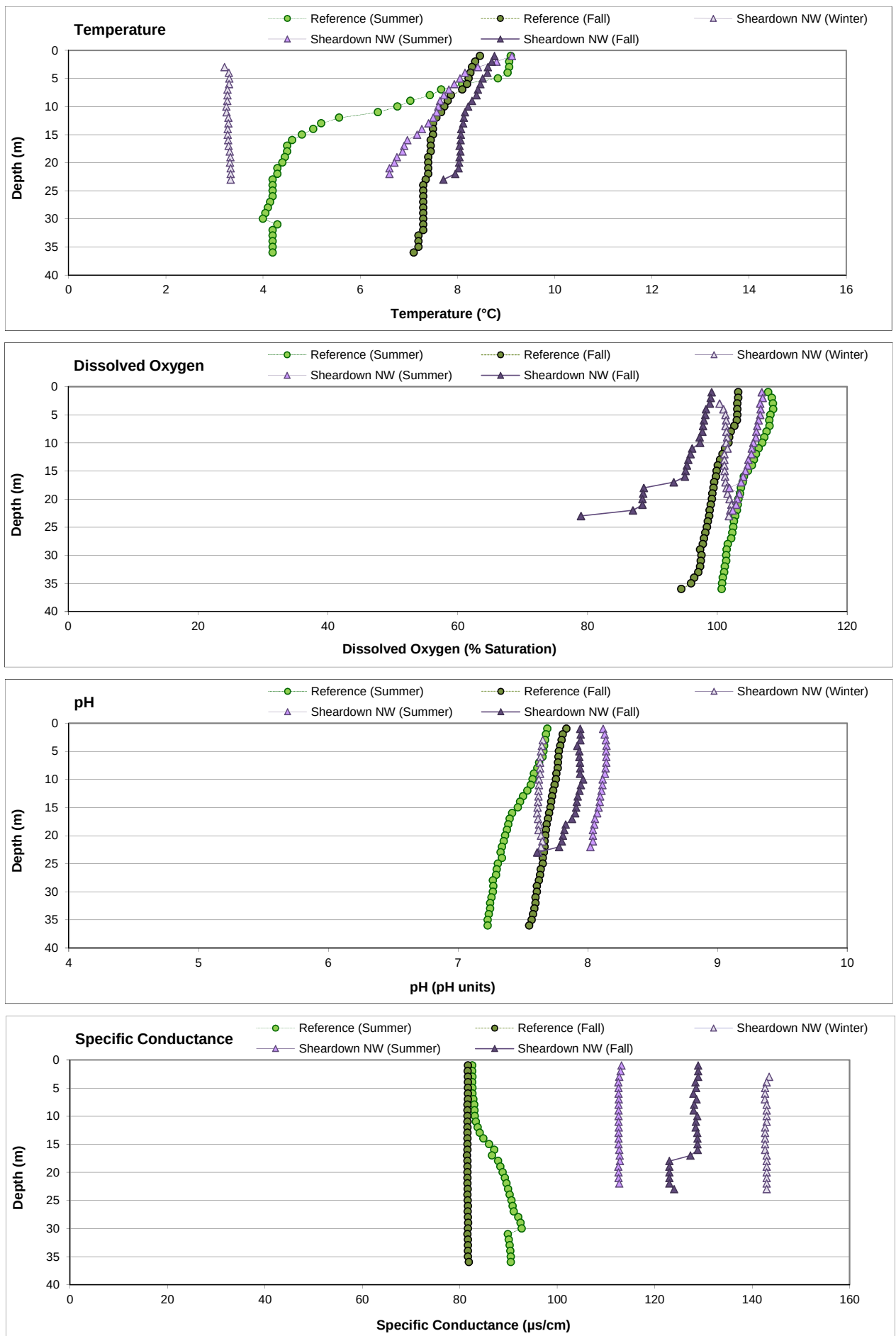


Figure 5.7: Average *in-situ* water quality with depth from surface at Sheardown Lake NW (mine-exposed area) compared to Reference Lake 3 during winter, summer, and fall sampling events, Mary River Project CREMP, 2015.

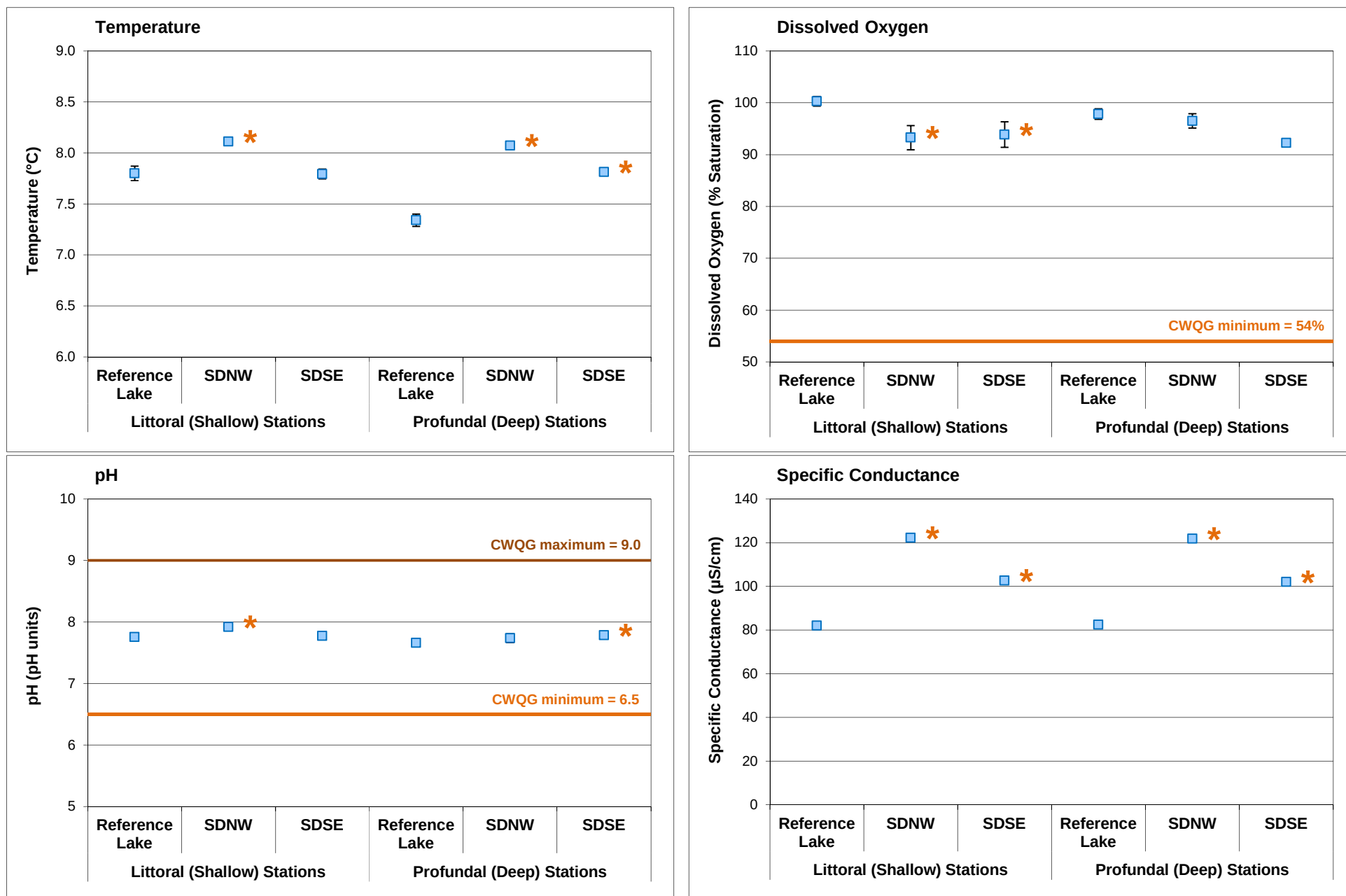


Figure 5.8: Comparison of in-situ water quality variables (mean $\pm$ SD; n = 5) measured at Sheardown Lake NW (DLO-01), Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3) littoral and profundal stations, Mary River Project CREMP, Augsut 2015. An asterisk (*) next to Sheardown Lake NW or SE data points indicates a significant difference compared to the reference lake measure for the respective station type.

Table 5.2: Water chemistry at Sheardown Lake NW (DLO-01) and Reference Lake 3 (REF3) monitoring stations, Mary River Project CREMP, August 2015. 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) Fall 2015	Mine-Exposed Station					
						DD-HAB9-STN1	DL0-01-5	DL0-01-1	DL0-01-4	DL0-01-2	DL0-01-7
						22-Aug-2015	22-Aug-2015	21-Aug-2015	21-Aug-2015	21-Aug-2015	20-Aug-2015
Conventional ^b	Conductivity (lab)	umho/cm	-	-	76.4	124	125	124	125	125	124
	pH (lab)	pH	6.5 - 9.0	-	7.59	7.97	7.95	7.91	7.98	7.97	7.95
	Hardness (as CaCO ₃)	mg/L	-	-	35	60	60	60	60	59	60
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	2.1	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	37	55	57	64	62	61	62
	Turbidity	NTU	-	-	0.22	0.54	0.64	0.96	0.55	0.59	0.54
	Alkalinity (as CaCO ₃)	mg/L	-	-	31	56	57	56	59	59	57
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
	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	0.17	0.27	<0.15	<0.15	0.20	<0.15
	Dissolved Organic Carbon	mg/L	-	-	3.1	2.0	2.0	1.9	2.0	2.0	2.0
	Total Organic Carbon	mg/L	-	-	3.3	2.1	2.1	2.0	2.1	2.0	2.1
	Total Phosphorus	mg/L	0.020 ^a	-	0.0035	0.0059	0.0036	0.0034	0.0109	0.0062	0.0035
	Phenols	mg/L	0.001 ^a	-	0.0028	0.0035	0.0036	0.0023	0.0025	0.0026	0.0015
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	1.28	2.80	2.79	2.78	2.77	2.79	2.76
	Sulphate (SO ₄)	mg/L	218 ^β	218	4.35	2.91	2.91	2.88	2.86	2.85	2.85
Total Metals	Aluminum (Al)	mg/L	0.100	0.179,0.173 ^c	<0.0030	0.0070	0.0074	0.0061	0.0068	0.0086	0.0067
	Antimony (Sb)	mg/L	0.020 ^a	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0064	0.0052	0.0053	0.0053	0.0053	0.0053	0.0052
	Beryllium (Be)	mg/L	0.011 ^a	-	<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	-	-	7.10	12.0	11.8	12.0	11.9	11.9	11.9
	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 ^a	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00083	0.00073	0.00078	0.00082	0.00077	0.00079	0.00078
	Iron (Fe)	mg/L	0.30	0.30	<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
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.23	7.35	7.18	7.30	7.32	7.32	7.06
	Manganese (Mn)	mg/L	0.935 ^β	-	0.000411	0.00120	0.00145	0.00128	0.00131	0.00145	0.00118
	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	-	0.000131	0.000711	0.000704	0.000707	0.000704	0.000693	0.000714
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00058	0.00056	0.00060	0.00058	0.00061	0.00060
	Potassium (K)	mg/L	-	-	0.906	1.02	0.985	1.01	1.01	1.01	0.965
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.40	0.46	0.48	0.46	0.46	0.45	0.46
	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	-	-	0.819	1.25	1.21	1.24	1.24	1.25	1.19
	Strontium (Sr)	mg/L	-	-	0.00791	0.00771	0.00776	0.00770	0.00774	0.00775	0.00764
	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	-	0.000266	0.000831	0.000850	0.000825	0.000817	0.000832	0.000866
	Vanadium (V)	mg/L	0.006 ^a	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 background water quality data. The values are specific to the Sheardown Lake System.

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

 Indicates parameter concentration above applicable Water Quality Guideline.

 **BOLD** Indicates parameter concentration above the AEMP benchmark.

waters were continually well mixed both laterally and vertically. Turbidity and 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 5.2; Appendix Table B.40). Because turbidity showed a significant positive correlation with aluminum and manganese concentrations ($r^2 = 0.87$ and 0.54 , respectively), elevated aluminum and manganese concentrations at Sheardown Lake NW may have reflected influences associated with surface runoff or flow received from Mary River containing naturally greater concentrations of aluminum-based, manganese bearing, particulate minerals (e.g., pennantite, edenite) compared to Reference Lake 3 (see Section 3.1). Nevertheless, molybdenum, manganese and uranium concentrations were also elevated at SDLT1 compared to the reference lake, suggesting that slight elevation in concentrations of these metals at Sheardown Lake NW may have reflected a mine influence. Despite elevation of these metals at Sheardown Lake NW, concentrations of all parameters were well below established WQG and AEMP benchmarks during all sampling events in 2015⁸ (Table 5.2; Appendix Table B.38), suggesting that any mine-related influences on water quality of Sheardown Lake NW were unlikely to adversely affect biota.

Temporal comparisons of the Sheardown Lake NW water chemistry data suggested no change in average concentrations of any parameters in 2015 compared to baseline (2005 – 2013) and mine-construction (2014) periods for sampling conducted during each respective winter, summer and fall season (Figure 5.9; Appendix Figure B.18; Appendix Table B.40).

5.2.2 Sediment Quality

Surficial sediment collected at the Sheardown Lake NW coring stations was comprised of loam to silty loam containing low (i.e., $\leq 2\%$) to moderate (i.e., $2 - 5\%$) TOC content (Figure 5.10). No significant difference in substrate particle size was indicated between littoral and profundal areas of Sheardown Lake NW (Appendix Table C.4). Similar to substrate observations at Reference Lake 3 and Camp Lake, iron (oxy)hydroxide material was visible in surficial and/or sub-surface substrate of the Sheardown Lake northwest basin, occasionally occurring as a thin, distinct layer (Appendix Tables C.9 – C.10). Substrates of Sheardown Lake NW were not blackened (or darkly-coloured) and did not have a noticeably sulphidic odour, suggesting the absence of strongly reducing conditions in the sediment and/or overlying water (Appendix Tables C.9 – C.10).

⁸ Refer to footnote 2 (page 28) and Section 3.0 regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA.



Figure 5.9: 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) periods in the fall. Values represent mean $\pm$ SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.3 for information regarding Water Quality Guideline (WQG). AEMP Benchmarks are specific to Sheardown Lake (northwest and southeast).

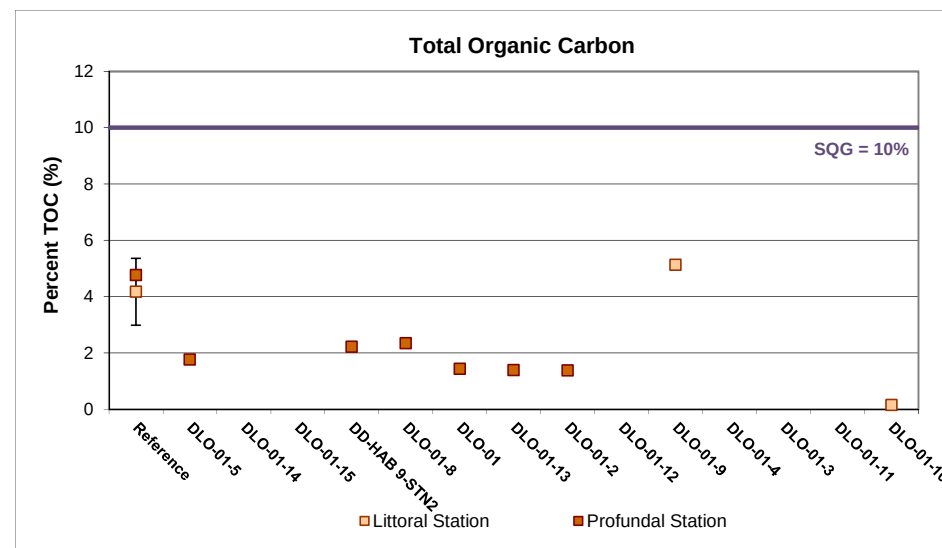
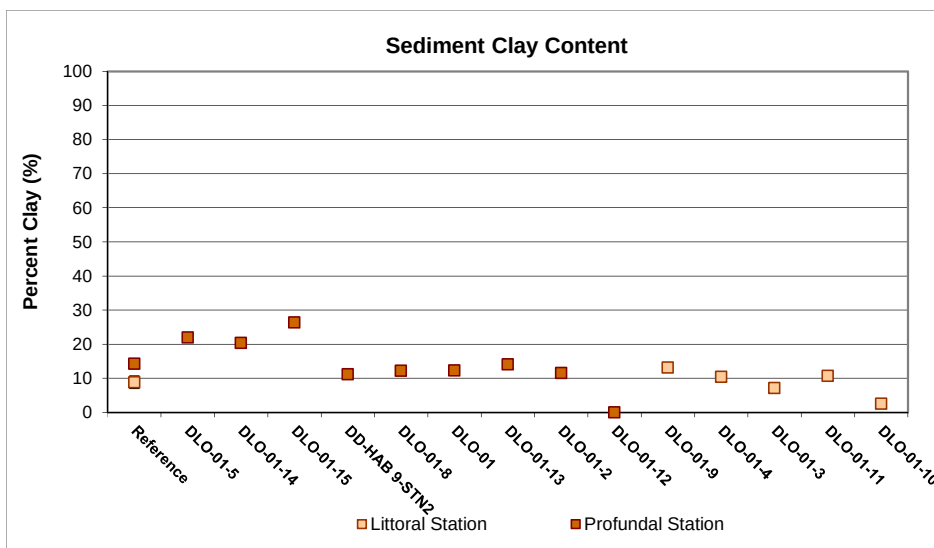
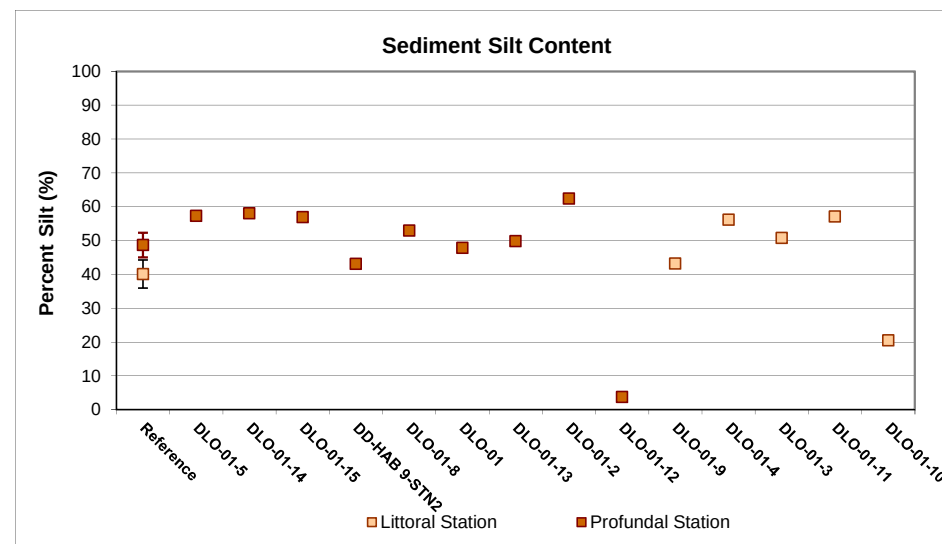
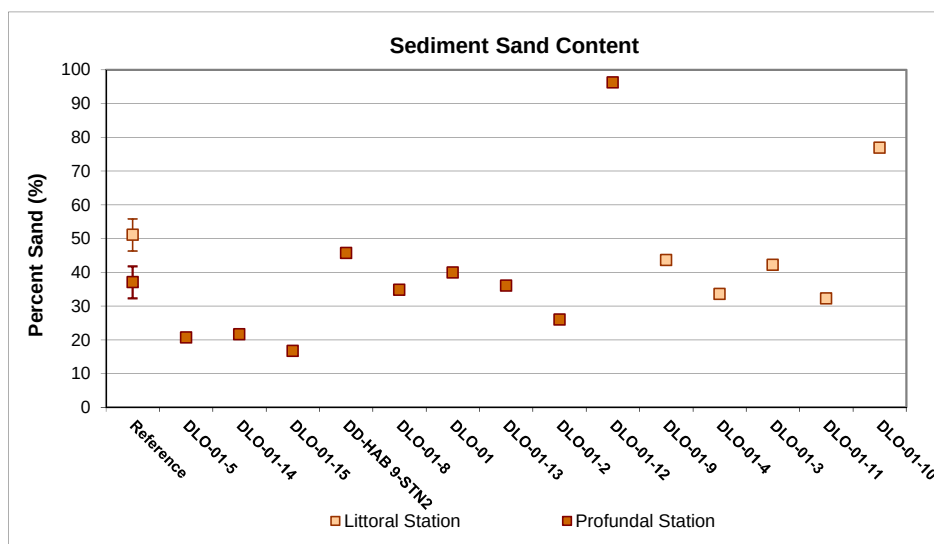


Figure 5.10: Sediment particle size and total organic carbon (TOC) content comparisons among Sheardown Lake NW (DLO-01) sediment monitoring stations and Reference Lake 3 averages (mean $\pm$ SE), Mary River Project CREMP, August 2015.

Sediment metal concentrations at Sheardown Lake NW showed no spatial differences among stations in 2015 and as such, did not suggest any point sources of metals to the lake (Appendix Table C.11). In addition, sediment metal concentrations at littoral and profundal stations of Sheardown Lake NW were very similar to those observed at the same respective station types in Reference Lake 3 (Table 5.3; Appendix Table C.12), suggesting no mine-related influences on sediment metal concentrations in Sheardown Lake NW. Although mean iron and manganese concentrations were above respective SQG at littoral and profundal areas of Sheardown Lake NW, mean concentrations of these metals were also above SQG at Reference Lake 3 (Table 5.3). Sediment nickel concentrations were also above SQG and the AEMP benchmark at individual stations in Sheardown Lake NW, but on average, were below each of these criteria (Table 5.3; Appendix Table C.11). Despite average arsenic and iron concentrations above respective AEMP benchmarks at littoral stations of Sheardown Lake NW in 2015, concentrations of these metals were also above these benchmarks at Reference Lake 3, suggesting that the AEMP benchmarks for these parameters are overly conservative. As a result, the AEMP benchmarks for arsenic and iron are not likely reflective of ecological, effect-based thresholds for biota at Sheardown Lake.

Temporal comparisons of the sediment metals data indicated slightly elevated (i.e., 2- to 5-fold higher) average concentrations of arsenic, iron and molybdenum at littoral stations of Sheardown Lake NW in 2015 compared to the baseline (2005 – 2013) period, but no differences in metal concentrations were observed over time at the profundal stations (Figure 5.11; Appendix Table C.12). Average manganese and molybdenum concentrations were also higher at Sheardown Lake NW in 2015 compared to the mine construction (2014) period, but similarly, only at littoral stations (Figure 5.11). Because concentrations of these metals were not elevated at Sheardown Lake NW compared to Reference Lake 3, the differences between 2015 and the baseline or mine construction periods at littoral stations may have reflected sampling artifacts related to differences in the number and/or locations of sampling stations among mine development periods. Moreover, temporal comparison of the water chemistry data did not suggest increased concentrations of arsenic, iron, manganese or molybdenum at Sheardown Lake NW in 2015 compared to past studies. Nevertheless, the occurrence of elevated concentrations of arsenic, iron, manganese and molybdenum in littoral sediment of Sheardown Lake NW could potentially reflect a slight mine influence associated with the 2015 mine operation.

5.2.3 Phytoplankton

Chlorophyll a concentrations at Sheardown Lake NW showed no consistent differences with progression towards the lake outlet during any of the winter, summer or fall sampling events

Table 5.3: 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 2015.

Analyte		Units	Sediment Quality Guideline (SQG) ^a	AEMP Benchmark ^b (NW, SE)	Littoral			Profundal		
					Reference Lake (n = 5)	Sheardown Lake NW (n=4)	Sheardown Lake SE (n=3)	Reference Lake (n = 5)	Sheardown Lake NW (n=4)	Sheardown Lake SE (n=2)
					Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error
Non-metals	Sand	%	-	-	51 ± 5	50 ± 9	15 ± 2	37 ± 5	31 ± 4	22 ± 2
	Silt	%	-	-	40 ± 4	40 ± 7	68 ± 2	49 ± 4	54 ± 3	62 ± 2
	Clay	%	-	-	9 ± 2	10 ± 2	17 ± 3	14 ± 1	15 ± 2	16 ± 0.5
	Moisture	%	-	-	84 ± 4	67 ± 14	53 ± 7	86 ± 1	71 ± 2	44 ± 3
	Total Organic Carbon	%	10 ^a	-	4.2 ± 1.2	2.5 ± 1.0	1.2 ± 0.2	4.8 ± 0.2	1.5 ± 0.09	0.9 ± 0.02
Metals	Aluminum (Al)	mg/kg	-	-	16,120 ± 1,372	15,205 ± 4,611	18,467 ± 1,396	27,060 ± 1,745	21,000 ± 1,119	18,600 ± 200
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0	0.10 ± 0.0025	<0.10 ± 0
	Arsenic (As)	mg/kg	17	6.2, 5.9	5.60 ± 1.22	6.87 ± 2.20	4.68 ± 1.23	6.32 ± 0.34	5.14 ± 0.71	2.72 ± 0.10
	Barium (Ba)	mg/kg	-	-	116 ± 16	140 ± 65	95 ± 16	149 ± 8.0	100 ± 12	75 ± 2.1
	Beryllium (Be)	mg/kg	-	-	0.69 ± 0.07	0.84 ± 0.25	0.89 ± 0.072	1.04 ± 0.0438	1.11 ± 0.057	0.85 ± 0.043
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0	0.27 ± 0.022	0.25 ± 0.029	0.227 ± 0.00735	0.31 ± 0.025	0.23 ± 0.0050
	Boron (B)	mg/kg	-	-	15.0 ± 1.38	25.3 ± 6.81	27.5 ± 2.61	21.6 ± 0.919	31.8 ± 1.60	26.5 ± 2.53
	Cadmium (Cd)	mg/kg	3.5	1.5, 1.5	0.213 ± 0.027	0.351 ± 0.131	0.111 ± 0.00751	0.203 ± 0.016	0.270 ± 0.016	0.102 ± 0.0012
	Calcium (Ca)	mg/kg	-	-	4,976 ± 430	4,411 ± 1,253	5,933 ± 162	7,000 ± 542	4,595 ± 219	6,745 ± 145
	Chromium (Cr)	mg/kg	90	97, 79	53.9 ± 5.2	60 ± 18	84 ± 7.3	85.1 ± 5.4	81 ± 3.3	79 ± 0.92
	Cobalt (Co)	mg/kg	-	-	12.6 ± 0.641	14.4 ± 4.53	15.0 ± 1.0	19.0 ± 1.2	16.8 ± 0.8	14.2 ± 0.025
	Copper (Cu)	mg/kg	110	58, 56	69.4 ± 8.79	45 ± 15	30 ± 2.7	101.5 ± 6.3	47 ± 2.5	29 ± 0.15
	Iron (Fe)	mg/kg	40,000 ^a	52,200, 34,400	59,220 ± 15,044	57,810 ± 18,867	44,300 ± 6,963	54,450 ± 3,037	43,375 ± 4,987	34,350 ± 750
	Lead (Pb)	mg/kg	91.3	35	16.1 ± 1.0	18.5 ± 5.34	19.3 ± 1.30	23.4 ± 0.5	24.2 ± 0.9	18.8 ± 0.475
	Lithium (Li)	mg/kg	-	-	25.9 ± 2.4	26.6 ± 7.98	32.7 ± 2.08	40.6 ± 2.0	36.2 ± 1.9	32.3 ± 1.15
	Magnesium (Mg)	mg/kg	-	-	10,088 ± 858	10,250 ± 3,055	14,233 ± 837	16,930 ± 1,089	13,750 ± 561	14,425 ± 25.0
	Manganese (Mn)	mg/kg	1,100 ^{a,β}	4,530, 657	871 ± 47	1,496 ± 753	1,048 ± 621	1,756 ± 448	2,707 ± 1,781	444 ± 19.8
	Mercury (Hg)	mg/kg	0.486	0.17	0.0453 ± 0.0107	0.0390 ± 0.0122	0.0248 ± 0.00116	0.0852 ± 0.0108	0.0407 ± 0.00512	0.0257 ± 0.0003
	Molybdenum (Mo)	mg/kg	-	-	6.21 ± 1.63	9.63 ± 3.87	1.72 ± 0.544	3.31 ± 0.50	3.77 ± 1.55	0.88 ± 0.045
	Nickel (Ni)	mg/kg	75 ^{a,β}	77, 66	43.3 ± 3.1	70.4 ± 21.8	67.9 ± 6.41	59.7 ± 3.6	69.8 ± 3.5	59.4 ± 0.275
	Phosphorus (P)	mg/kg	2,000 ^a	1,958, 1,278	1,506 ± 463	1,020 ± 294	1,076 ± 131	1,214 ± 62	1,007 ± 130	912 ± 10.0
	Potassium (K)	mg/kg	-	-	3,960 ± 272	3,889 ± 1,183	4,647 ± 445	6,491 ± 386	5,458 ± 318	4,503 ± 143
	Selenium (Se)	mg/kg	-	-	0.66 ± 0.13	0.53 ± 0.12	0.22 ± 0.020	0.95 ± 0.058	0.42 ± 0.048	0.22 ± 0.0050
	Silver (Ag)	mg/kg	-	-	0.14 ± 0.02	0.17 ± 0.028	0.14 ± 0.015	0.31 ± 0.011	0.20 ± 0.018	0.15 ± 0.0075
	Sodium (Na)	mg/kg	-	-	283 ± 23	233 ± 61	299 ± 28	492 ± 29	306 ± 15	293 ± 12.3
	Strontium (Sr)	mg/kg	-	-	12.6 ± 0.709	10.7 ± 2.34	13.1 ± 0.689	19.5 ± 1.77	13.0 ± 0.56	13.5 ± 0.450
	Sulphur (S)	mg/kg	-	-	<5,000 ± 0	<5,000 ± 0	<5,000 ± 0	<5,000 ± 0	<5,000 ± 0	<5,000 ± 0
	Thallium (Tl)	mg/kg	-	-	0.47 ± 0.040	0.55 ± 0.17	0.47 ± 0.034	0.917 ± 0.035	0.66 ± 0.04	0.44 ± 0.0020
	Tin (Sn)	mg/kg	-	-	<2.0 ± 0	<2.0 ± 0	<2.0 ± 0	2.15 ± 0.084	<2.0 ± 0	<2.0 ± 0
	Titanium (Ti)	mg/kg	-	-	967 ± 61	889 ± 252	1,380 ± 106	1,391 ± 110	1,235 ± 46.6	1,418 ± 37.5
	Uranium (U)	mg/kg	-	-	14.5 ± 1.78	8.92 ± 3.22	6.31 ± 0.493	27.1 ± 1.76	9.17 ± 0.54	6.39 ± 0.198
	Vanadium (V)	mg/kg	-	-	52.8 ± 4.76	47.1 ± 13.7	54.5 ± 4.28	75.8 ± 5.05	60.9 ± 2.42	53.9 ± 0.950
	Zinc (Zn)	mg/kg	315	135	78.4 ± 7.53	59.3 ± 17.4	62.0 ± 4.51	111.5 ± 7.31	75.5 ± 3.66	62.4 ± 0.450
	Zirconium (Zr)	mg/kg	-	-	3.2 ± 0.2	11.0 ± 4.26	21.7 ± 4.17	3.69 ± 0.093	9.68 ± 0.86	22.6 ± 1.03

^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; BC MOE 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 the Sheardown Lake basins.

Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

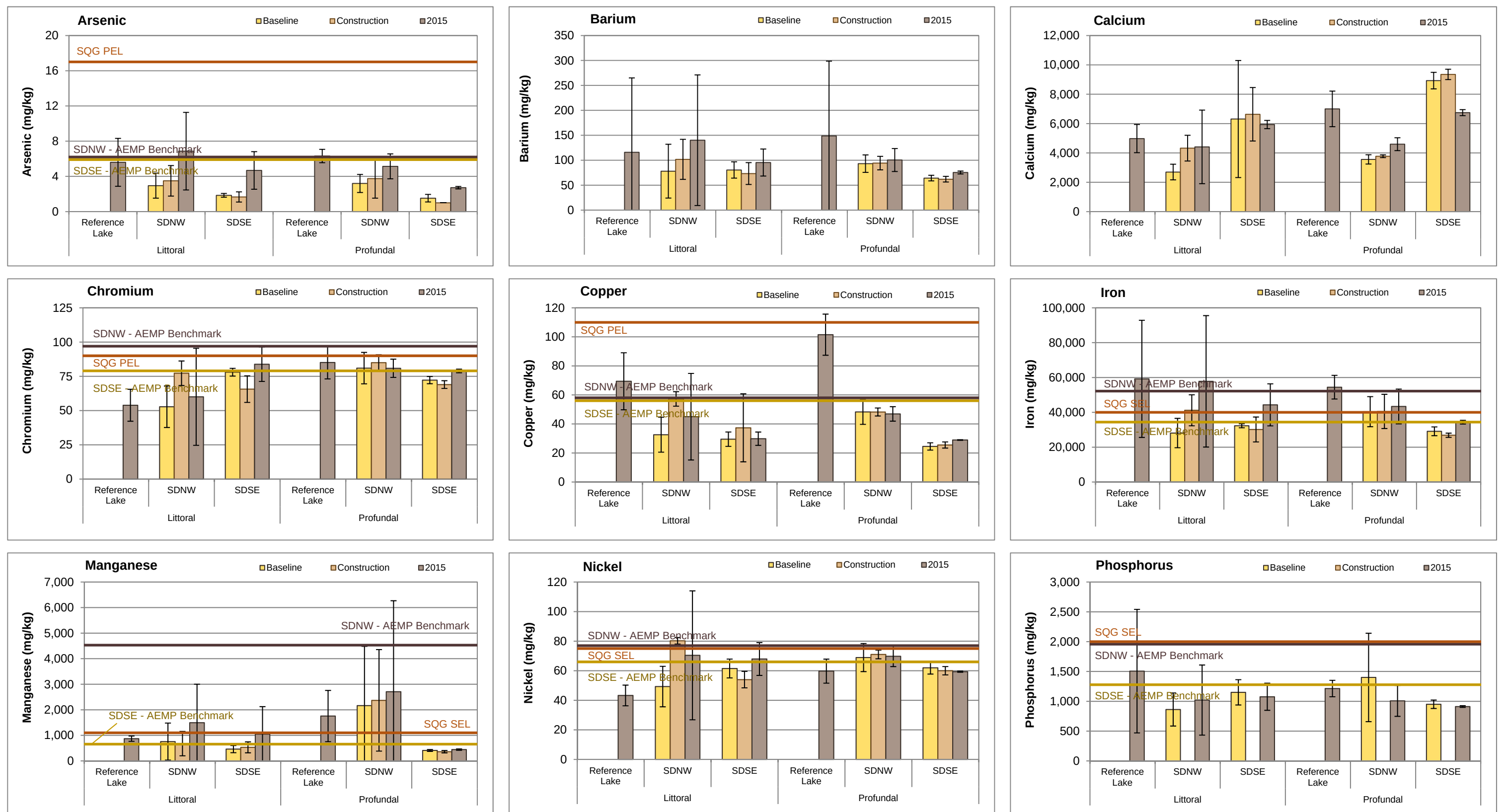


Figure 5.11: Temporal comparison of sediment metal concentrations (mean $\pm$ SD) at littoral and profundal stations of Sheardown Lake NW (SDNW), Sheardown Lake SE (SDSE), and Reference Lake 3 for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods during fall, Mary River Project CREMP, 2015.

in 2015 (Figure 5.12). Chlorophyll a concentrations were significantly lower in winter than during the summer and fall, with comparable concentrations shown between the latter (Appendix Table D.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 2015 (Appendix Tables D.9 – D.10), chlorophyll a concentrations during all winter, summer and fall sampling events were well below the AEMP benchmark of 3.7 µg/L (Figure 5.12). Low phytoplankton productivity was indicated at Sheardown Lake NW in 2015 based on Wetzel (2001) lake trophic status classifications using chlorophyll a concentrations, which suggested oligotrophic conditions. 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 5.2; Appendix Table B.38).

Temporal comparisons indicated significantly lower chlorophyll a concentrations at the time of winter and summer sampling in 2015 compared to the 2014 mine construction period, but no differences in chlorophyll a concentrations between 2015 and 2014 during fall sampling (Figure 5.13; Appendix Table D.11). Although the annual average chlorophyll a concentration at Sheardown Lake NW was lower in 2015 than in 2014, no significant difference in chlorophyll a concentrations was shown between years (ANOVA $p = 0.427$). In turn, this suggested that the trophic status of Sheardown Lake NW had not changed significantly between the period of mine construction and mine operation. No chlorophyll a baseline (2005 – 2013) data are available for Sheardown Lake NW, precluding comparisons to conditions prior to the mine construction period.

5.2.4 Benthic Invertebrate Community

Benthic invertebrate density was significantly higher at littoral and profundal stations of Sheardown Lake NW compared to like-habitat stations at Reference Lake 3 (Tables 5.4 and 5.5). Similar to Camp Lake, richness did not differ significantly between Sheardown Lake NW and the reference lake at the littoral stations, but significantly higher richness was shown at Sheardown Lake NW compared to Reference Lake 3 at the profundal stations (Table 5.4 and 5.5). In addition, Simpson's Evenness was significantly lower at Sheardown Lake NW than at Reference Lake 3 littoral stations, but evenness did not differ significantly between lakes at profundal stations. Simpson's Evenness at Sheardown Lake NW was low at littoral stations, and very low at profundal stations, indicating that very few taxa dominated the benthic invertebrate community at these sampling depths.

Some differences in benthic invertebrate community structure were suggested between Sheardown Lake NW and Reference Lake 3 based on a significant difference in Bray Curtis

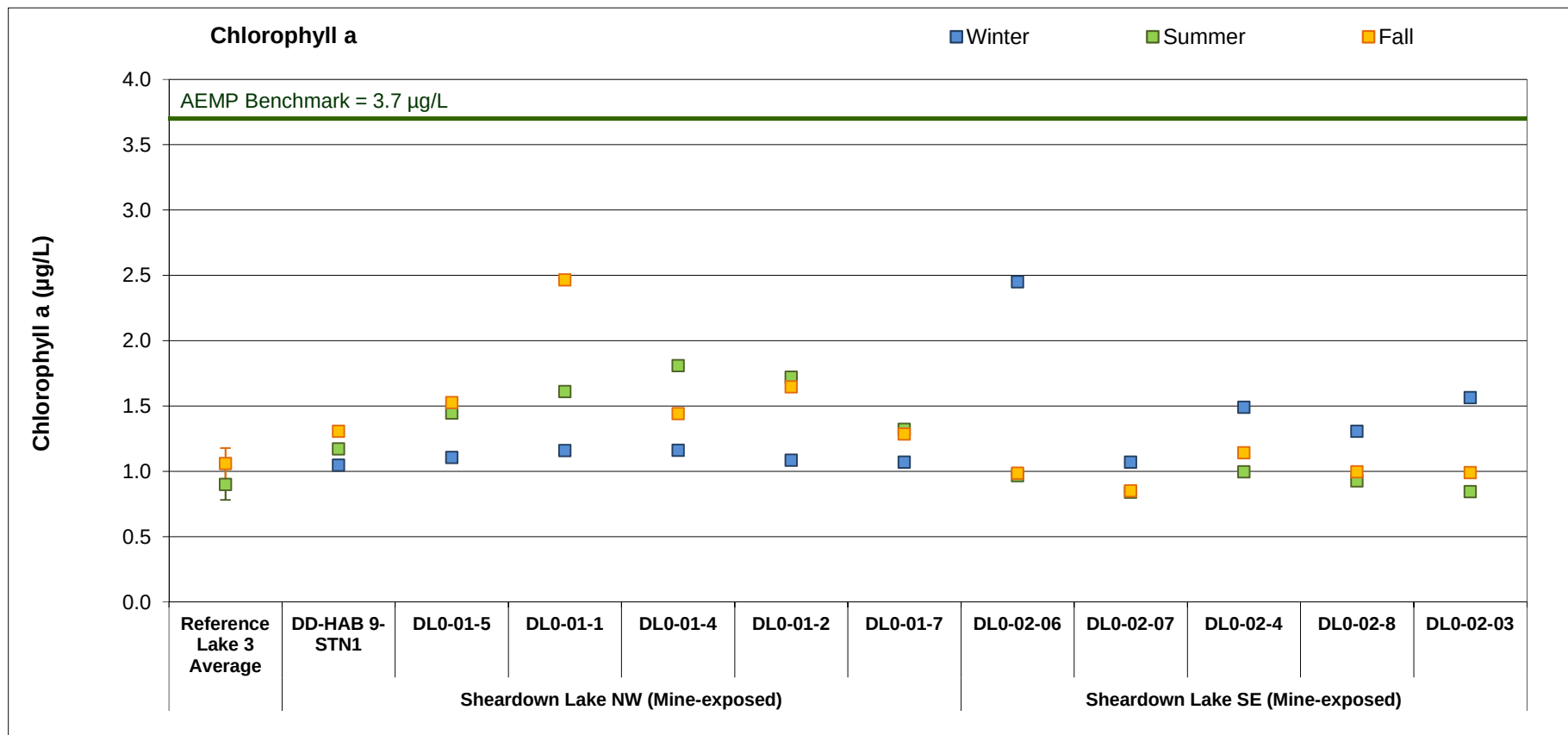


Figure 5.12: Chlorophyll a concentrations at Sheardown Lake NW (DLO-1) and Sheardown Lake SE (DLO-2) phytoplankton monitoring stations, Mary River Project CREMP, 2015. Values are averages of samples taken from the surface and the bottom of the water column at each station. Reference values are expressed as mean $\pm$ standard deviation (n = 3). Reference Lake 3 was not sampled in winter 2015.

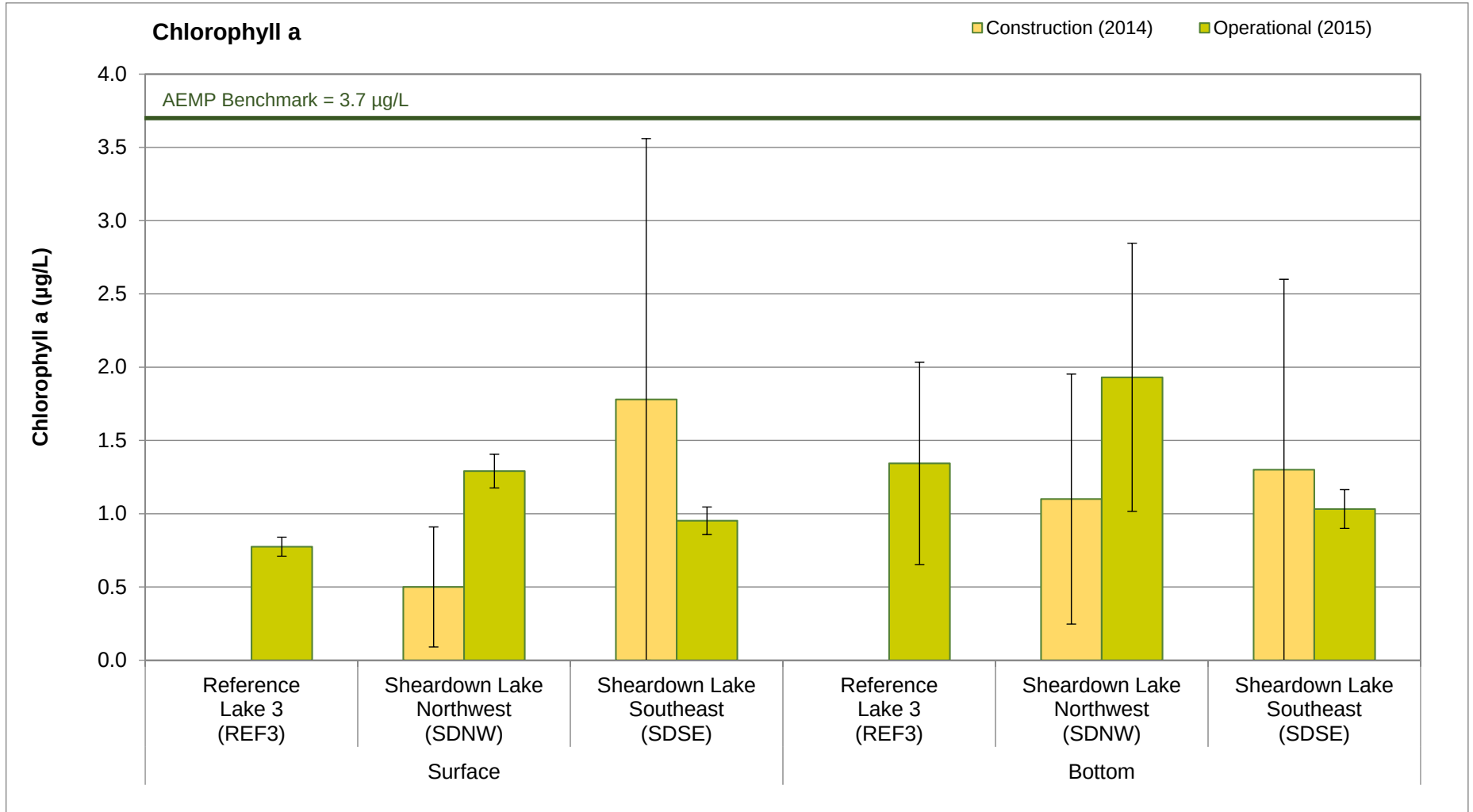


Figure 5.13: Temporal comparison of chlorophyll a concentrations (mean $\pm$ SD) at Sheardown Lake NW (SDNW; n = 6), Sheardown Lake SE (SDSE; n = 5), and Reference Lake 3 (REF3; n = 3) for mine construction (2014) and operational (2015) periods in the fall (August), Mary River Project CREMP. No chlorophyll a baseline (pre-operational) data are available. Samples were collected from the surface and the bottom of the water column at each station.

Table 5.4: Benthic invertebrate community statistical comparison results between Sheardown Lake NW (DLO-01) and Reference Lake 3 for littoral stations, Mary River Project CREMP, August 2015.

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	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m ²)	YES	0.002	η	0.975	4.9	Reference Lake 3	1,278	888	397	553	2,819
						Sheardown NW Littoral	5,665	3,230	1,444	3,135	11,292
Richness (Number of Taxa)	NO	0.570	ε	0.082	-	Reference Lake 3	12.6	4.1	1.8	9.0	18.0
						Sheardown NW Littoral	13.8	1.9	0.9	11.0	16.0
Simpson's Evenness (E)	YES	0.061	α	0.482	-2.0	Reference Lake 3	0.865	0.052	0.023	0.804	0.936
						Sheardown NW Littoral	0.759	0.096	0.043	0.616	0.868
Bray-Curtis Index	YES	0.000	ζ	0.999	2.7	Reference Lake 3	0.382	0.170	0.076	0.219	0.662
						Sheardown NW Littoral	0.842	0.049	0.022	0.801	0.927
Nemata (%)	NO	0.261	β	0.187	-	Reference Lake 3	8.1%	7.4%	3.3%	0.0%	17.2%
						Sheardown NW Littoral	0.9%	1.1%	0.5%	0.0%	2.7%
Ostracoda (%)	NO	0.197	δ	0.238	-	Reference Lake 3	20.9%	18.5%	8.3%	4.1%	45.2%
						Sheardown NW Littoral	7.8%	3.7%	1.7%	5.0%	14.3%
Chironomidae (%)	YES	0.019	β	0.724	1.2	Reference Lake 3	66.5%	18.9%	8.4%	40.6%	91.0%
						Sheardown NW Littoral	89.8%	3.2%	1.4%	84.6%	93.3%
Metal-Sensitive Chironomidae (%)	NO	0.139	δ	0.305	-	Reference Lake 3	11.4%	12.6%	5.6%	1.5%	32.2%
						Sheardown NW Littoral	19.1%	7.2%	3.2%	11.3%	25.6%
Collector-Gatherers (%)	NO	0.106	δ	0.362	-	Reference Lake 3	81.4%	17.1%	7.7%	53.7%	95.2%
						Sheardown NW Littoral	68.9%	8.0%	3.6%	61.7%	79.0%
Filterers (%)	NO	0.148	δ	0.293	-	Reference Lake 3	11.4%	12.6%	5.6%	1.5%	32.2%
						Sheardown NW Littoral	18.6%	6.8%	3.1%	10.9%	24.8%
Clingers (%)	NO	0.760	β	0.059	-	Reference Lake 3	13.5%	11.8%	5.3%	4.0%	33.9%
						Sheardown NW Littoral	13.0%	5.1%	2.3%	7.7%	20.8%
Sprawlers (%)	YES	0.004	β	0.939	-2.3	Reference Lake 3	70.1%	14.9%	6.7%	47.1%	84.3%
						Sheardown NW Littoral	35.3%	10.9%	4.9%	20.6%	49.6%
Burrowers (%)	YES	0.000	β	1.000	5.2	Reference Lake 3	16.4%	6.8%	3.0%	8.3%	25.8%
						Sheardown NW Littoral	51.7%	9.0%	4.0%	39.1%	64.4%

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

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 meaningful difference.

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 5.5: Benthic invertebrate community statistical comparison results between Sheardown Lake NW (DLO-01) and Reference Lake 3 for profundal stations, Mary River Project CREMP, August 2015

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	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m ²)	YES	0.000	α	1.000	31.6	Reference Lake 3	180	39	18	122	216
						Sheardown NW Profundal	1,425	210	94	1,182	1,742
Richness (Number of Taxa)	YES	0.004	ε	0.932	6.7	Reference Lake 3	2.8	0.8	0.4	2.0	4.0
						Sheardown NW Profundal	8.4	3.0	1.4	5.0	12.0
Simpson's Evenness (E)	NO	0.772	α	0.058	-	Reference Lake 3	0.397	0.232	0.104	0.160	0.732
						Sheardown NW Profundal	0.355	0.212	0.095	0.125	0.623
Bray-Curtis Index	YES	0.000	ζ	1.000	6.6	Reference Lake 3	0.157	0.101	0.045	0.049	0.273
						Sheardown NW Profundal	0.824	0.085	0.038	0.756	0.973
Nemata (%)	NO	0.712	γ	0.063	-	Reference Lake 3	1.0%	2.2%	1.0%	0.0%	5.0%
						Sheardown NW Profundal	0.5%	0.3%	0.1%	0.0%	0.8%
Ostracoda (%)	NO	0.287	β	0.172	-	Reference Lake 3	9.7%	13.1%	5.9%	0.0%	31.9%
						Sheardown NW Profundal	2.8%	3.7%	1.7%	0.0%	8.0%
Chironomidae (%)	NO	0.996	δ	0.050	-	Reference Lake 3	87.8%	13.2%	5.9%	68.1%	100.0%
						Sheardown NW Profundal	93.2%	6.0%	2.7%	83.8%	98.2%
Metal-Sensitive Chironomidae (%)	NO	0.918	β	0.051	-	Reference Lake 3	2.8%	2.6%	1.2%	0.0%	5.5%
						Sheardown NW Profundal	2.8%	2.8%	1.2%	0.6%	5.9%
Collector-Gatherers (%)	YES	0.054	δ	0.509	-1.8	Reference Lake 3	96.6%	3.3%	1.5%	92.6%	100.0%
						Sheardown NW Profundal	90.5%	5.3%	2.4%	84.7%	96.0%
Filterers (%)	NO	0.379	γ	0.131	-	Reference Lake 3	1.9%	2.7%	1.2%	0.0%	5.5%
						Sheardown NW Profundal	1.9%	2.6%	1.1%	0.0%	4.9%
Clingers (%)	NO	0.431	δ	0.114	-	Reference Lake 3	3.4%	3.3%	1.5%	0.0%	7.4%
						Sheardown NW Profundal	4.6%	4.0%	1.8%	1.3%	11.0%
Sprawlers (%)	NO	0.342	γ	0.145	-	Reference Lake 3	94.8%	1.3%	0.6%	92.6%	95.8%
						Sheardown NW Profundal	78.8%	34.3%	15.4%	17.9%	97.1%
Burrowers (%)	NO	0.236	γ	0.205	-	Reference Lake 3	1.8%	2.5%	1.1%	0.0%	5.0%
						Sheardown NW Profundal	16.6%	33.3%	14.9%	1.1%	76.2%

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

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 meaningful 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.

Index at both littoral and profundal stations (Tables 5.4 and 5.5). However, no ecologically meaningful differences in the relative abundance of dominant taxonomic groups was indicated between Sheardown Lake NW and Reference Lake 3 at either sampling depth (i.e., CES_{BIC} within $\pm 2 SD_{REF}$; Tables 5.4 and 5.5), suggesting that the differences in Bray Curtis Index between lakes reflected the dramatic differences in density between water bodies. No significant difference in the relative abundance of metal-sensitive Chironomidae were indicated between Sheardown Lake NW and Reference Lake 3. In addition, a higher proportion of burrowing invertebrates were present at Sheardown Lake NW (significantly so at littoral stations) than at the reference lake (Tables 5.4 and 5.5). Similar relative abundance of metal-sensitive taxa between these lakes coupled with a high proportion of burrowing taxa suggested that there were no sediment metal-related influences on the benthic invertebrate community of Sheardown Lake NW. Overall, naturally higher secondary productivity and no adverse mine-related influence to the benthic invertebrate community of Sheardown Lake NW was indicated in 2015 based on comparisons to Reference Lake 3.

Temporal comparisons of the Sheardown Lake NW benthic invertebrate community data indicated no significant differences in density and Simpson's Evenness at littoral stations among the 2015 study and 2007 – 2013 baseline studies (Figure 5.14; Appendix Table E.33). In addition, taxonomic richness at littoral habitat of Sheardown Lake NW in 2015 was within the range shown in these baseline studies (Figure 5.14). Although the relative abundance of Chironomidae was higher in 2015 compared the baseline period, there was no difference in the relative abundance of metal-sensitive Chironomidae in 2015 versus the baseline studies (Figure 5.14; Appendix Table E.33), suggesting that this difference was unrelated to metal exposure. At profundal habitat, benthic invertebrate density at Sheardown Lake NW in 2015 was within the range of baseline, and richness and the relative abundance of all dominant taxonomic groups, including metal-sensitive Chironomidae, did not differ significantly among the baseline and 2015 studies (Figure 5.14; Appendix Table E.34). Collectively, these results suggested no definitive changes in benthic invertebrate community features in 2015 compared to the baseline period, and relatedly, no adverse influences associated with the recent initiation of mine operations at the Mary River Project. Moreover, results of the temporal analysis of the Sheardown Lake NW benthic invertebrate community data were consistent with the water quality and sediment quality results, which also suggested no changes in the water chemistry and only slight differences in sediment (metal) chemistry in 2015 compared to the baseline period at Sheardown Lake NW.

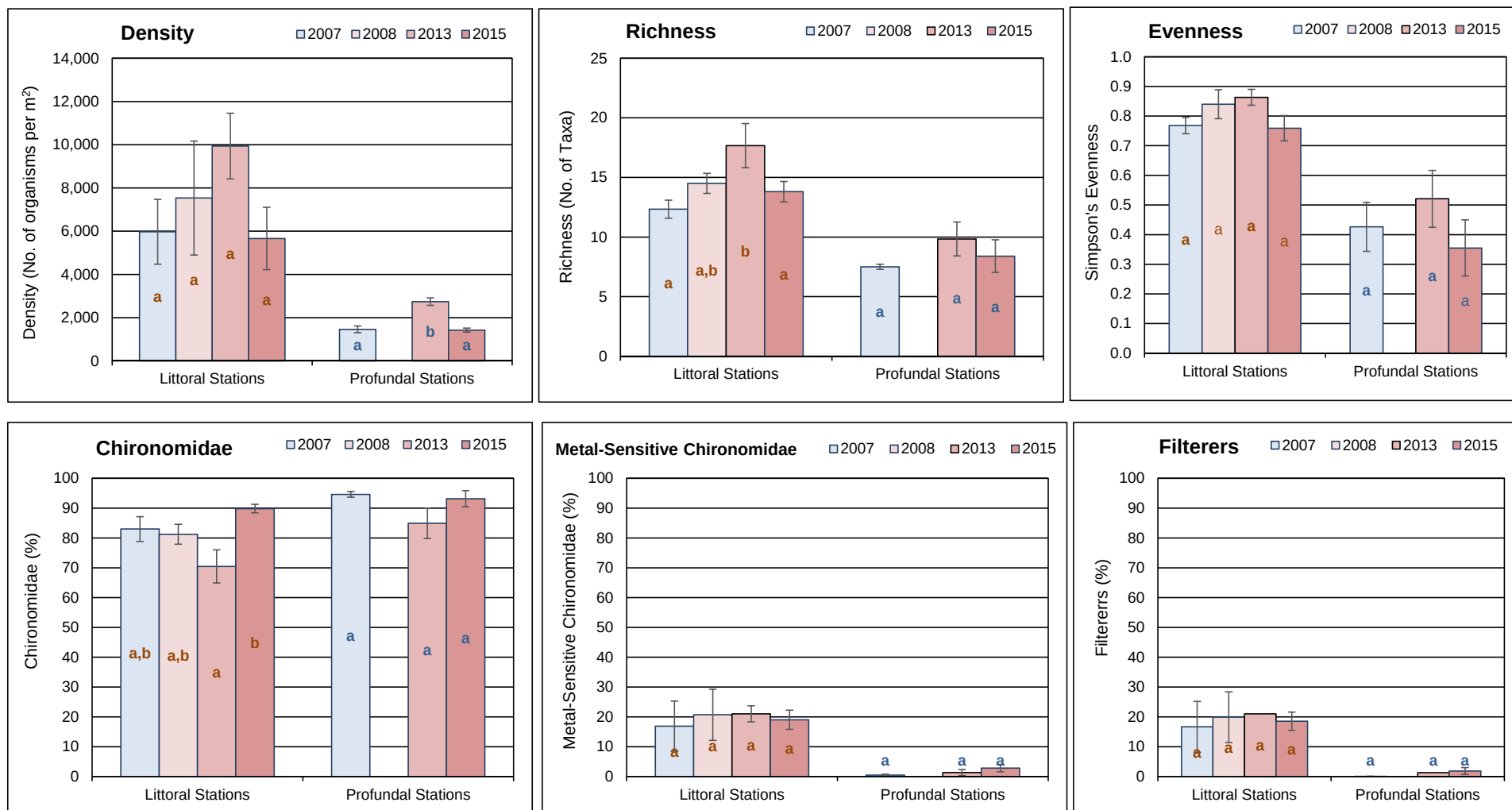


Figure 5.14: Comparison of key benthic invertebrate metrics (mean $\pm$ SE) at Sheardown Lake NW littoral and profundal stations between mine baseline (2007, 2008 and 2013) and operational (2015) periods, Mary River Project CREMP, 2015. The same like-coloured letter inside bars indicate no significant difference between study years for respective littoral and profundal station depths. No profundal stations were sampled in 2008.

5.2.5 Fish Population Survey

5.2.5.1 Sheardown Lake NW Fish Community

Arctic charr was the only fish species captured at the northwest basin of Sheardown Lake in 2015, which differed slightly from that of Reference Lake 3 where low numbers of nine-spine stickleback were captured in addition to Arctic charr (Table 5.6). Total fish CPUE was much higher at Sheardown Lake NW compared to Reference Lake 3 for both electrofishing and gill netting collection methods (Table 5.6), 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 juvenile Arctic charr CPUE over the mine baseline (2006-2013), construction (2014) and operational (2015) periods (Figure 5.15). Similarly, the 2015 gill netting CPUE for Arctic charr was within the range shown during the baseline period, and nearly identical to that observed in the mine construction period (Figure 5.15). These results suggested that the relative abundance of Arctic charr at the nearshore and littoral/profundal areas of Sheardown Lake NW in 2015 remained similar to the baseline and mine construction periods, which in turn, suggested no mine-related influences to Arctic charr numbers in the lake.

5.2.5.2 Sheardown Lake NW Fish Health Assessment

Nearshore Arctic Charr

Mine-related influences on the Sheardown Lake NW nearshore Arctic charr population were assessed following a control-impact approach using 2015 data from Sheardown Lake NW and Reference Lake 3, and a before-after approach separately comparing Sheardown Lake NW 2015 data to baseline and mine construction period data. A total of 102 and 99 Arctic charr were captured at nearshore habitat of Sheardown Lake NW and Reference Lake 3, respectively, in August 2015, for the control-impact analysis. Arctic charr YOY were distinguishable from older age classes using length-frequency distribution analysis coupled with supporting age determinations (i.e., YOY fork length ≤ 5 cm; Figure 5.16). However, because no separation of age classes was possible at Reference Lake 3, YOY were grouped with older age classes for the juvenile Arctic charr health assessment.

Nearshore Arctic charr length-frequency distributions differed significantly between lakes, potentially reflecting the occurrence and/or capture of a greater number of larger individuals at Sheardown Lake NW (Table 5.7; Figure 5.16). However, the age distribution for

Table 5.6: Fish catch and community summary from backpack electrofishing and gill netting conducted at Sheardown Lake NW (DLO-01), Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2015.

Lake	Method		Arctic Charr	Nine-spine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	99	8	107	2
		CPUE	0.71	0.05	0.77	
	Gill netting	No. Caught	6	0	6	
		CPUE	0.08	0	0.08	
Sheardown Lake Northwest	Electrofishing	No. Caught	106	0	106	1
		CPUE	3.45	0	3.45	
	Gill netting	No. Caught	96	0	96	
		CPUE	0.93	0	0.93	
Sheardown Lake Southeast	Electrofishing	No. Caught	109	0	109	1
		CPUE	1.59	0	1.59	
	Gill netting	No. Caught	119	0	119	
		CPUE	2.01	0	2.01	

CPUE - Catch-per-unit-effort. For electrofishing: number of fish captured per electrofishing minute. For gill netting: number of fish captured per 100 m hours of net.

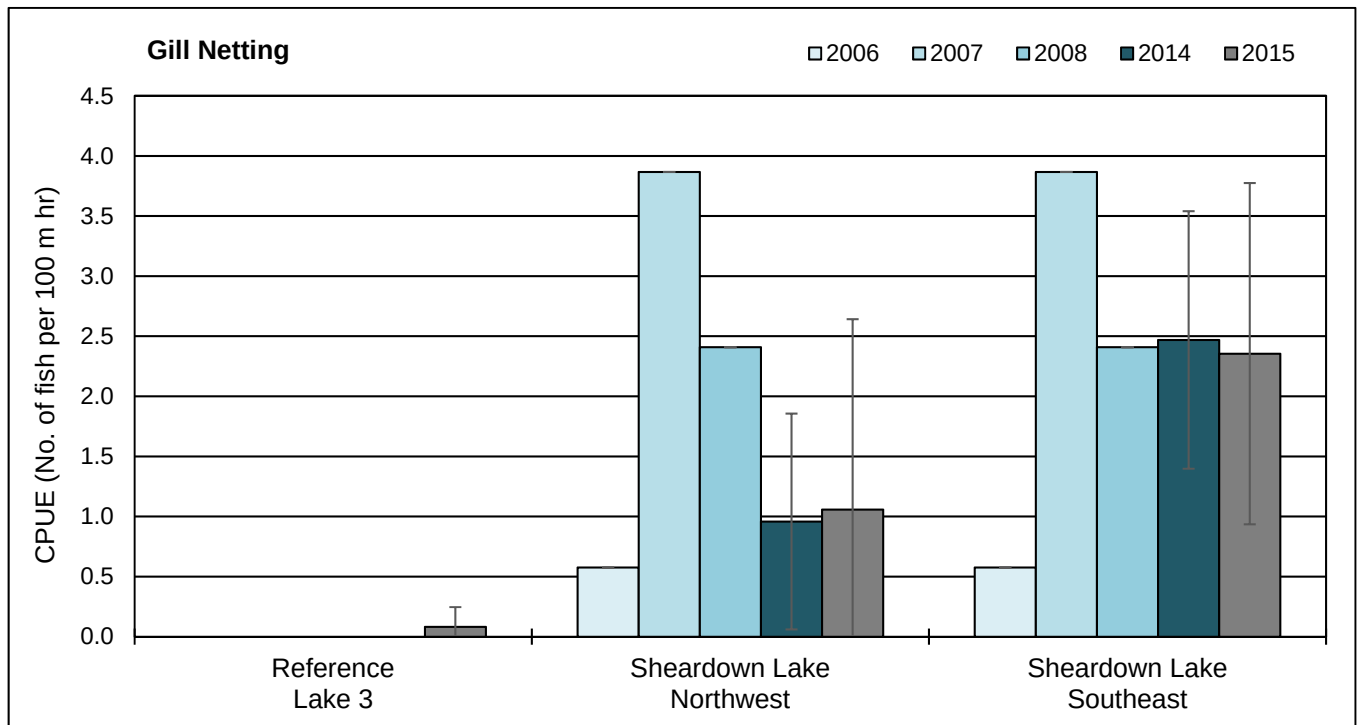
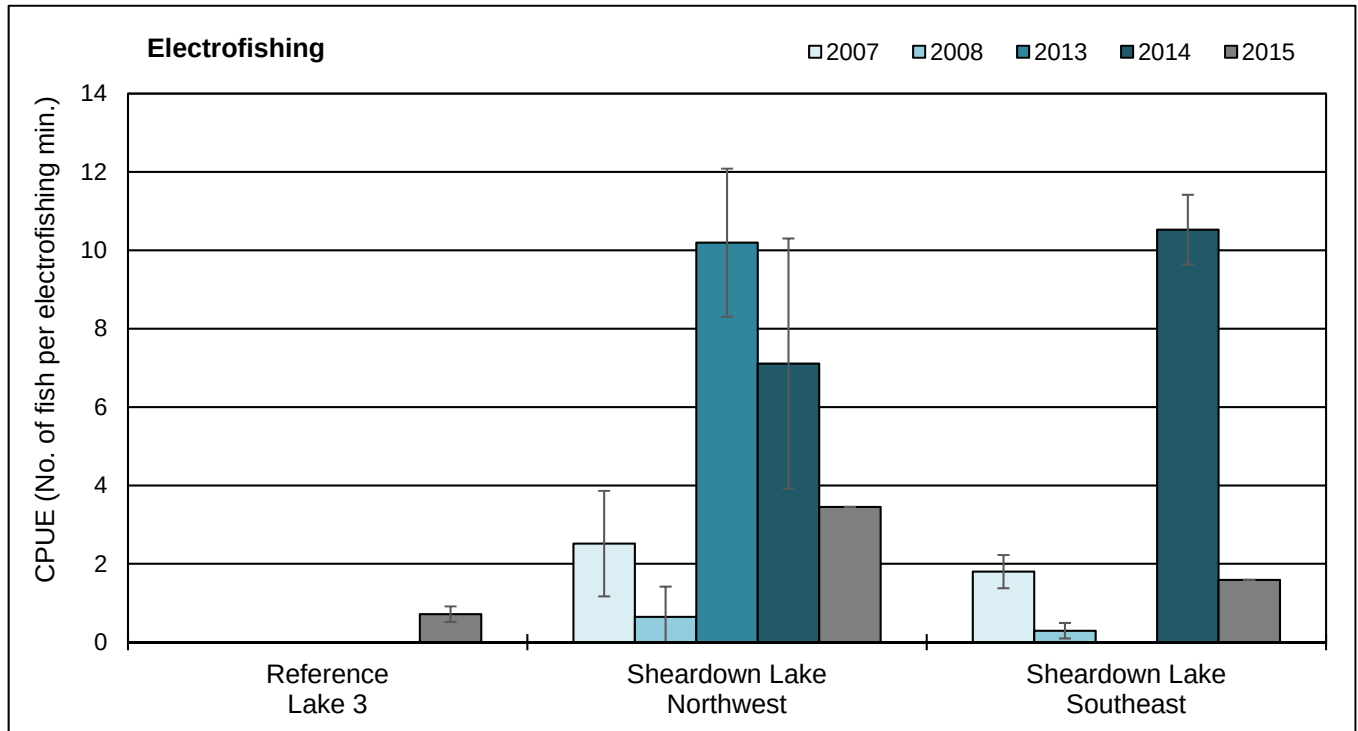


Figure 5.15: Catch-per-unit-effort (CPUE; mean $\pm$ SD) of Arctic charr captured by backpack electrofishing and gill netting at Sheardown Lake NW (DLO-01) and Sheardown Lake SE (DLO-02) for baseline (2006, 2007, 2008, 2013), mine construction (2014) and operational (2015) periods in the fall, Mary River Project CREMP. Lake basins (i.e., NW or SE) were not differentiated historically for baseline gill netting catches.

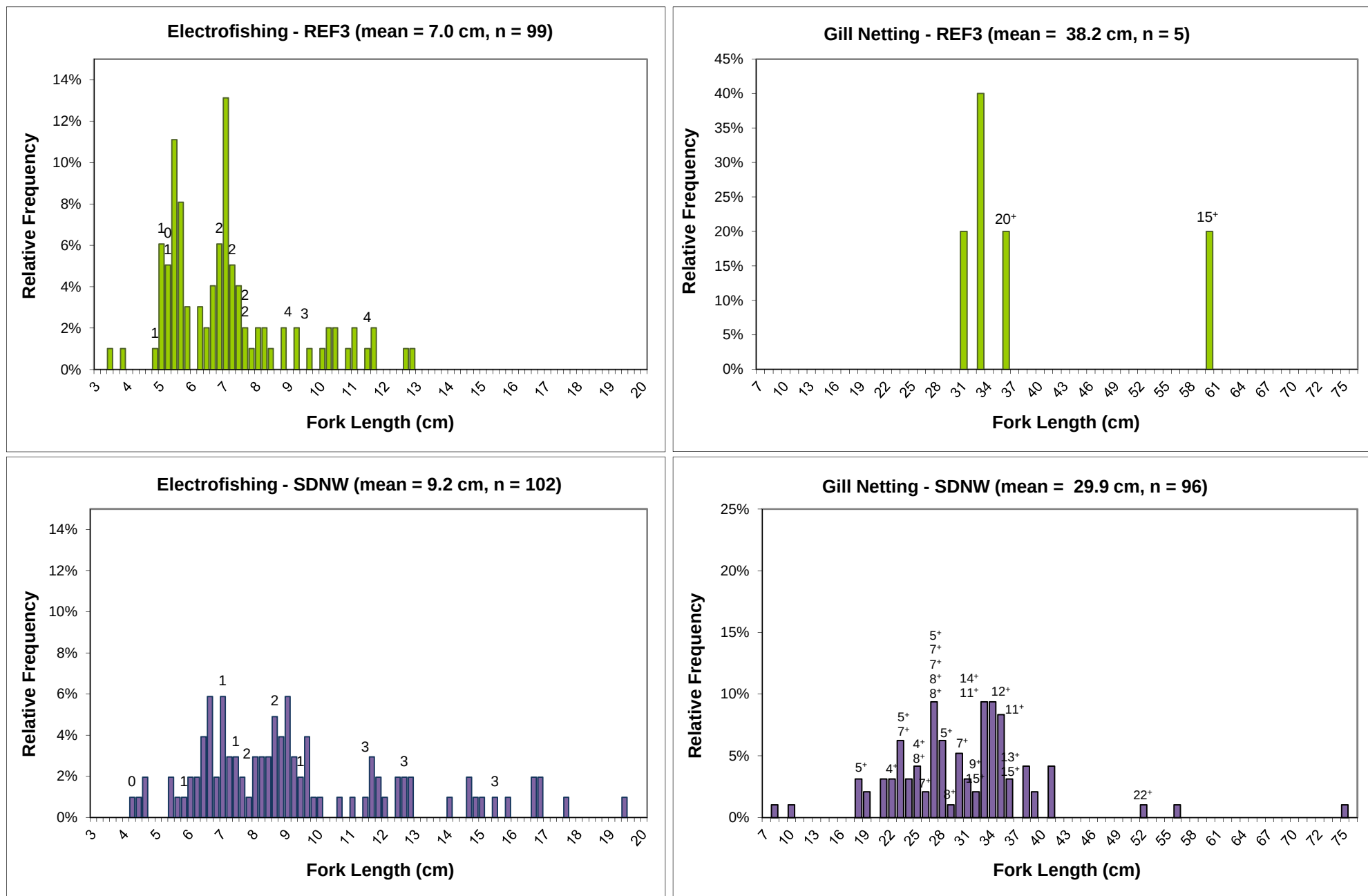


Figure 5.16: Length-frequency distributions for Arctic charr captured by backpack electrofishing and gill netting at Sheardown Lake NW (SDNW) and Reference Lake 3 (REF3), August 2015, Mary River Project CREMP. Fish ages are shown above the bars, where available.

Table 5.7: Summary of statistical results for Arctic charr population comparisons between Sheardown Lake NW and Reference Lake 3 for the mine operational period (2015), between Sheardown Lake NW mine-operational and baseline (2005 - 2013) periods, and between Sheardown Lake NW mine-operational and construction (2014) periods for fish captured by electrofishing and gill netting methods, Mary River Project CREMP, August 2015. 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	versus Sheardown Lake NW Mine Construction period
			2015	2005 - 2013	2014
Electrofishing Samples	Survival	Length-Frequency Distribution	Yes	Yes	Yes
		Age	No	No	-
	Energy Use	Size (mean weight)	Yes (+121%)	No	No
		Size (mean fork length)	Yes (+29%)	No	No
		Growth (weight-at-age)	Yes (+156%)	No	-
		Growth (fork length-at-age)	Yes (+38%)	No	-
	Energy Storage	Condition (body weight-at-fork length)	Yes (+3%)	Yes (-13%)	Yes (- 11%)
Gill Netting Samples*	Survival	Length Frequency Distribution	-	Yes	Yes
		Age	-	Yes (-35%)	-
	Energy Use	Size (mean weight)	-	Yes (- 47%)	Yes (-46%)
		Size (mean fork length)	-	Yes (-21%)	Yes (-18%)
		Growth (weight-at-age)	-	No	-
		Growth (fork length-at-age)	-	No	-
	Energy Storage	Condition (body weight-at-fork length)	-	Yes (+8%)	No

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

nearshore Arctic charr was similar between lakes, suggesting that the differences in length-frequency distribution were not likely related to differences in survival between Sheardown Lake NW and Reference Lake 3. Arctic charr captured at the northwest basin nearshore were significantly larger and grew significantly faster compared to those captured at the reference lake (Table 5.7; Appendix Table F.13). The magnitude of the differences in size and growth were outside of the $\pm 25\%$ CES_{SG} , suggesting an ecologically meaningful difference in energy use between nearshore Arctic charr populations of Sheardown Lake NW and Reference Lake 3. Nearshore Arctic charr of Sheardown Lake NW also had significantly greater condition compared to those captured at Reference Lake 3, but the magnitude of this difference was within the $\pm 10\%$ CES_C (Table 5.7; Appendix Table F.13), suggesting that this difference was not ecologically meaningful. Similar to the fish population results at Camp Lake, the occurrence of significantly faster growing Arctic charr with slightly greater condition at Sheardown Lake NW compared to the reference area suggested no mine-related influences on Arctic charr health for juveniles residing within Sheardown Lake in 2015.

Separate comparison of the 2015 nearshore Arctic charr population data to the baseline (2005-2013) and mine construction (2014) periods showed significant differences in length-frequency distributions between respective time periods at the northwest basin of Sheardown Lake (Table 5.7). Although no significant differences in age, size and/or growth of nearshore Arctic charr were indicated between juveniles collected in 2015 and those collected during either the baseline or mine construction periods, significantly lower condition was indicated in 2015 compared to the historical data (Table 5.7; Appendix Table F.14 – F.15). In both cases, the magnitude of the difference in condition was outside of the $\pm 10\%$ CES_C , suggesting ecologically meaningful, lower condition of nearshore Arctic charr in 2015 compared to time periods before mine operations commenced at the Mary River Project. Because a similar direction and magnitude of difference in juvenile Arctic charr condition was observed temporally at both Camp and Sheardown Lake NW, this suggested that differences in condition between 2015 and the mine baseline/construction periods likely reflected natural temporal variability.

Littoral/Profundal Arctic Charr

Non-spawners of reproductive age accounted for approximately 67% of the Sheardown Lake NW Arctic charr population at the time of sampling in August 2015 (Appendix Table F.29). On average, Arctic charr non-spawners were slightly younger and lighter (Appendix Table F.29), and showed significantly lower LSI (ANOVA; $p = 0.008$), than those fish that were likely to spawn in 2015. Approximately 14% of individuals contained body cavity

parasites (Appendix Table F.29), the incidence rate of which was lower than that observed at Camp Lake and other mine lakes.

Mine-related influences on the Sheardown Lake NW littoral/profundal Arctic charr population were assessed using a before-after approach only because the sample size from Reference Lake 3 (i.e., $n = 5$) was insufficient to conduct a meaningful statistical analysis. Length-frequency distributions of Arctic charr captured at littoral/profundal areas of Sheardown Lake NW in 2015 differed significantly from those captured during baseline and mine-construction periods (Table 5.7; Figure 5.16). In part, the differences in length-frequency distribution may have reflected significantly younger and smaller (i.e., weight and length) individuals captured in 2015 compared to the baseline and mine construction periods (Table 5.7). No significant differences in growth were indicated in 2015 compared to the baseline period (Table 5.7; Appendix Table F.14). In addition, although condition was significantly greater for Arctic charr captured in 2015 than those captured during the baseline period, the magnitude of the difference was within the $\pm 10\%$ CES_C (Table 5.7). Arctic charr condition was similar between the 2015 and mine construction periods for fish captured in littoral/profundal areas of Sheardown Lake NW (Table 5.7; Appendix Table F.15). Overall, the lack of significant differences in growth combined with no (ecologically meaningful) differences in condition between Arctic charr captured in 2015 and over both the baseline or mine construction periods at littoral/profundal areas of Sheardown Lake NW suggested no adverse mine-related influences on the adult Arctic charr population of the lake resulting from the first year of mine operation.

5.3 Sheardown Lake SE (DLO-2)

5.3.1 Water Quality

Vertical water quality profiles of *in-situ* water temperature, dissolved oxygen, pH and specific conductance conducted at Sheardown Lake SE showed no station-to-station differences during any of the winter, summer or fall sampling events in 2015 (Appendix Figures B.14 to B.17). No distinct thermal stratification was apparent at the Sheardown Lake SE basin during any of the winter, summer or fall sampling events, although gradually cooler water was observed with increased depth, particularly in the surficial 5 m during summer and fall, which suggested the initial stages of thermocline development (Figure 5.17). The summer water temperature profile at Sheardown Lake SE differed from that of the reference lake, where thermocline development was apparent at depths between approximately 4 and 15 m (Figure 5.17). Mean water temperature near the bottom of the water column was comparable between Sheardown Lake SE and Reference Lake 3 at littoral areas, but was significantly warmer at Sheardown Lake SE at profundal stations, during fall sampling in

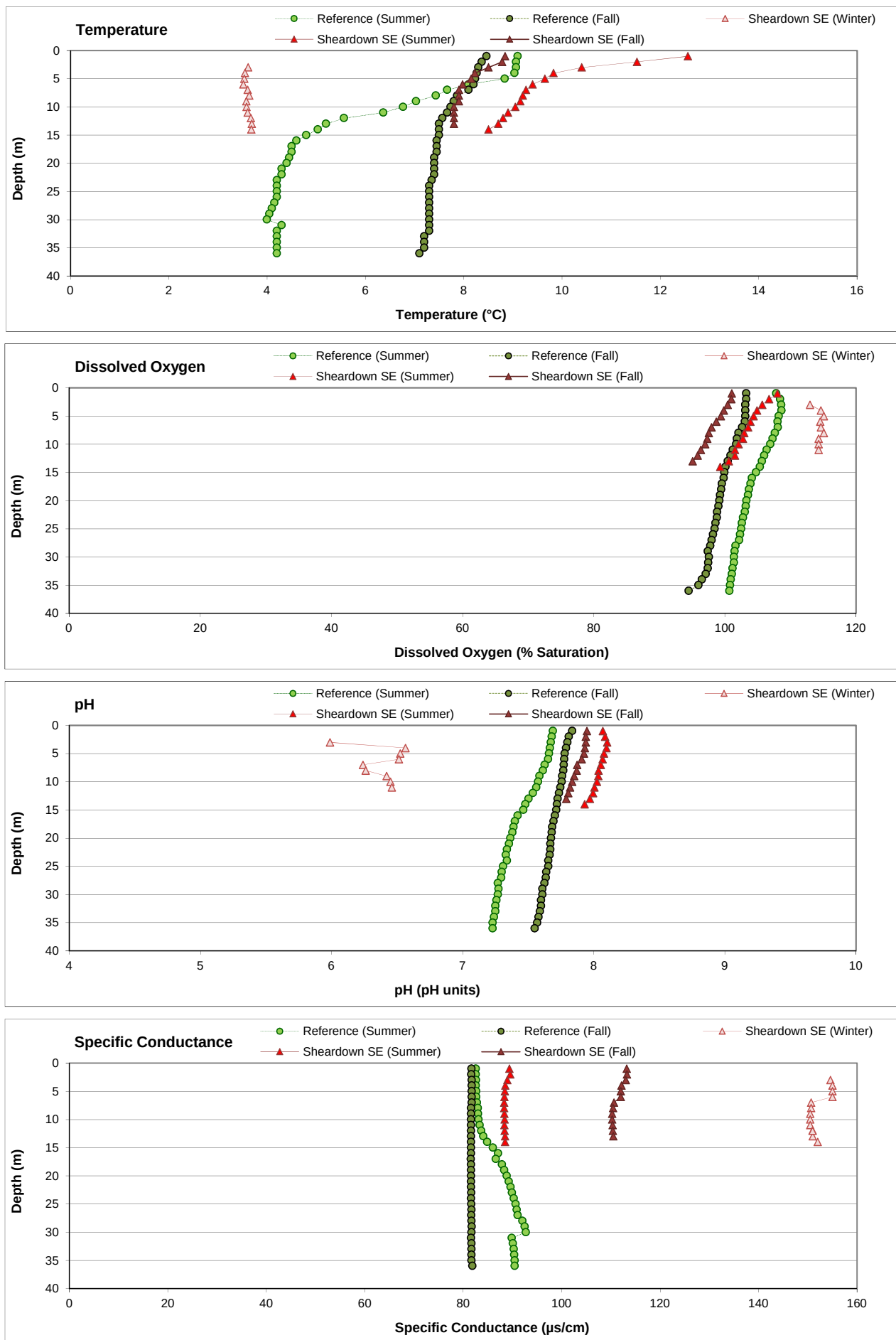


Figure 5.17: Average *in-situ* water quality with depth from surface at Sheardown Lake SE (mine-exposed area) compared to Reference Lake 3 during winter, summer, and fall sampling events, Mary River Project CREMP, 2015.

2015 (Figure 5.8). The variable differences in littoral and profundal water temperature between lakes likely reflected the fact that Sheardown Lake SE is much shallower than the reference lake, as evidenced by a difference in depth of 8.2 m between profundal stations of Sheardown Lake SE and Reference Lake 3.

Dissolved oxygen profiles conducted at Sheardown Lake SE in 2015 showed no change in dissolved oxygen saturation with depth during winter, but slight oxycline development during summer and fall characterized by decreasing saturation levels with increasing depth (Figure 5.17). Although similar oxycline development occurred at Reference Lake 3 in summer and fall, the change in dissolved oxygen saturation with depth was more pronounced at Sheardown Lake SE (Figure 5.17). Commensurately, dissolved oxygen saturation levels at the bottom of the water column in littoral and profundal areas of the Sheardown Lake southeast basin were significantly lower than at Reference Lake 3 during fall 2015 sampling (Figure 5.8; Appendix Tables B.22 – B.23). Nevertheless, dissolved oxygen saturation levels remained well above the WQG of 54% at all littoral and profundal areas of Sheardown Lake SE in 2015 (Figure 5.8), indicating that dissolved oxygen was not likely to be limiting to pelagic or bottom-dwelling biota within the lake.

In-situ profiles of pH and specific conductance showed no substantial change from the surface to bottom of the Sheardown Lake SE water column, indicating no chemical stratification (Figure 5.17). Similar to the northwest basin, no ecologically meaningful differences in bottom pH at littoral and profundal stations of Sheardown Lake SE and Reference Lake 3 were indicated during the 2015 fall sampling (i.e., mean incremental difference between lakes was less than 0.15 pH units), with pH values at the southeast basin of Sheardown Lake consistently within WQG limits during 2015 (Figure 5.8; Appendix Tables B.22 – B.23). Specific conductance was significantly higher at Sheardown Lake SE compared to the reference lake during the 2015 fall sampling (Figure 5.8). However, specific conductance at Sheardown Lake SE was similar to the lotic reference area, 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 than at Reference Lake 3 during the 2015 fall sampling event, but were relatively consistent among stations, suggesting no spatial differences in water clarity of the lake (Appendix Table B.22 – B.23).

Water chemistry of 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 2015 (Table 5.8; Appendix Table B.46), suggesting that the lake

Table 5.8: Water chemistry at Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3) monitoring stations, Mary River Project CREMP, August 2015. 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) Fall 2015	Mine-Exposed				
						DL0-02-6 20-Aug-2015	DL0-02-7 21-Aug-2015	DL0-02-4 20-Aug-2015	DL0-02-8 21-Aug-2015	DL0-02-3 21-Aug-2015
Conventional ^b	Conductivity (lab)	us/cm	-	-	76.4	110	108	105	104	105
	pH (lab)	pH	6.5 - 9.0	-	7.59	8.00	7.91	7.91	7.84	7.85
	Hardness (as CaCO ₃)	mg/L	-	-	35	53	52	50.5	50.5	50
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	37	54	51	53	45	50
	Turbidity	NTU	-	-	0.22	1.69	1.78	2.07	2.16	1.71
	Alkalinity (as CaCO ₃)	mg/L	-	-	31	48	49	49	50	48
Nutrients and Organics	Total Ammonia	mg/L	variable ^c	0.855	<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
	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	0.175	<0.15	0.34	0.2
	Dissolved Organic Carbon	mg/L	-	-	3.1	1.7	1.7	1.7	1.7	1.7
	Total Organic Carbon	mg/L	-	-	3.3	1.8	1.9	1.8	1.9	1.9
	Total Phosphorus	mg/L	0.020 ^α	-	0.0035	0.0042	0.0048	0.0049	0.0052	0.0099
	Phenols	mg/L	0.001 ^α	-	0.0028	0.0017	0.0039	0.0021	0.0037	0.0020
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.28	2.20	2.17	2.06	2.07	2.09
	Sulphate (SO ₄)	mg/L	218 ^β	218	4.35	2.05	2.01	1.88	1.89	1.90
Total Metals	Aluminum (Al)	mg/L	0.100	0.179,0.173 ^c	<0.0030	0.0556	0.0589	0.0700	0.0604	0.0614
	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	-	-	0.00637	0.00512	0.00523	0.00524	0.00529	0.00534
	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	-	-	7.10	10.5	10.3	10.1	10.0	10.1
	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	0.00083	0.00076	0.00077	0.00084	0.00080	0.00077
	Iron (Fe)	mg/L	0.30	0.30	<0.030	0.045	0.042	0.056	0.045	0.047
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.000059	0.000051	0.000083	0.000063	0.000065
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.23	6.33	6.27	5.92	6.04	6.05
	Manganese (Mn)	mg/L	0.935 ^β	-	0.000411	0.00227	0.00217	0.00268	0.00244	0.00272
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000131	0.000462	0.000456	0.000413	0.000424	0.000426
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00054	0.00053	0.00052	0.00050	0.00051
	Potassium (K)	mg/L	-	-	0.91	0.87	0.89	0.83	0.87	0.87
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.40	0.53	0.52	0.55	0.52	0.54
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.819	1.07	1.09	1.04	1.08	1.07
	Strontium (Sr)	mg/L	-	-	0.00791	0.00709	0.00718	0.00694	0.00707	0.00709
	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	-	0.000266	0.000701	0.000659	0.000676	0.000635	0.000646
	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 (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 background water quality data. The values are specific to the Sheardown Lake System.

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

 Indicates parameter concentration above applicable Water Quality Guideline.

 Indicates parameter concentration above the AEMP benchmark.

waters were generally well mixed both laterally and vertically. Turbidity and concentrations of aluminum were moderately (i.e., 5- to 10-fold) and highly (i.e., ≥ 10 -fold) elevated, respectively, and manganese and molybdenum slightly to moderately elevated, at Sheardown Lake SE compared to Reference Lake 3 during the 2015 summer and fall sampling events (Table 5.8; Appendix Tables B.40 and B.46). Similar to the northeast basin, turbidity showed a strong positive correlation with aluminum concentrations for the Sheardown Lake SE combined data set (i.e., winter, summer and fall data; $r^2 = 0.92$), suggesting that much of the aqueous aluminum was associated with suspended particles. This was corroborated by comparison of total and dissolved aluminum concentrations, which indicated that most aluminum was in particulate form at Sheardown Lake SE during turbid sampling events (compare Appendix Tables B.46 – B.47). Higher turbidity at Sheardown Lake SE, and lower water clarity (Secchi depth) associated with this turbidity, reflected flows 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, to a lesser extent), total molybdenum and uranium concentrations were not associated with particulate material, suggesting that slight elevation in concentrations of these metals at Sheardown Lake SE was related to mine operation and/or natural geochemical differences relative to the Reference Lake 3 system. Despite elevation of these metals at Sheardown Lake SE, concentrations of all parameters were well below established WQG and AEMP benchmarks during all sampling events in 2015⁹ (Table 5.8; Appendix Table B.46), suggesting that any mine-related influences on water quality of Sheardown Lake SE were unlikely to adversely affect biota.

Temporal comparisons of the Sheardown Lake SE water chemistry data suggested no changes in average concentrations of any parameters over the mine baseline (2005 – 2013), construction (2014) and operational (2015) periods for sampling conducted during each respective winter, summer and fall season (Figure 5.9; Appendix Table B.40). In turn, this suggested that the differences in water chemistry discussed above between Sheardown Lake SE and Reference Lake 3 likely reflected natural differences in mineralogy/geochemical conditions between lakes.

5.3.2 Sediment Quality

Surficial sediment of Sheardown Lake SE was comprised of silty loam with low TOC content, and showed little variability in substrate compositional features among all lake stations (Figure 5.18). No significant difference in substrate particle size distribution was indicated

⁹ Refer to footnote 2 (page 28) and Section 3.0 regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA.

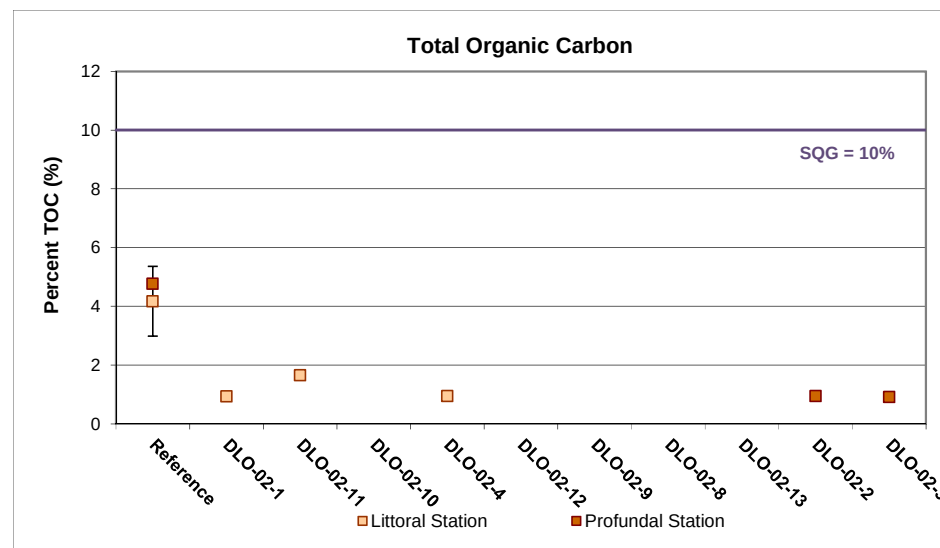
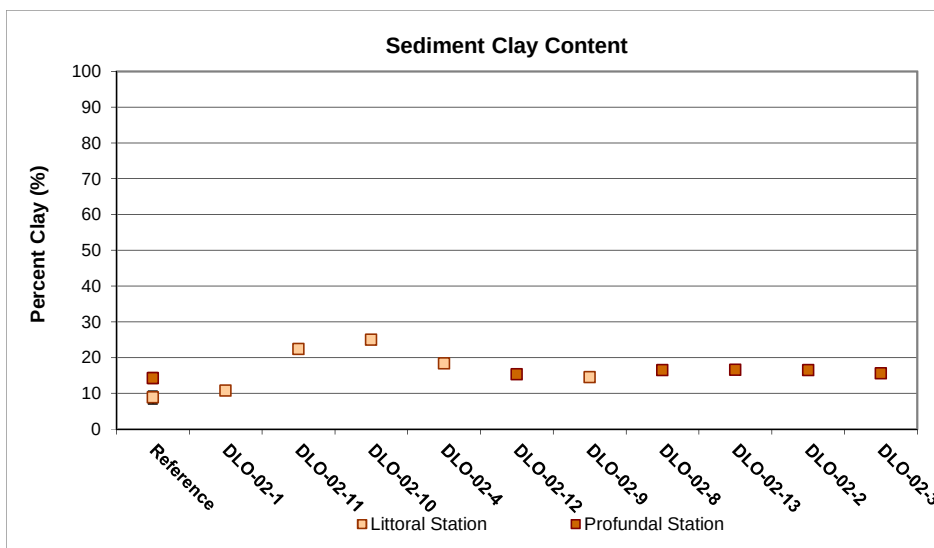
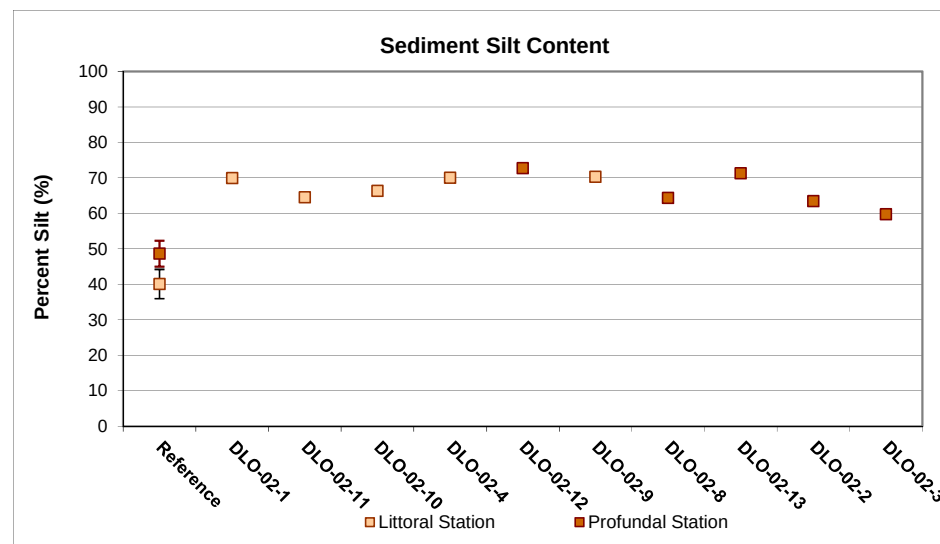
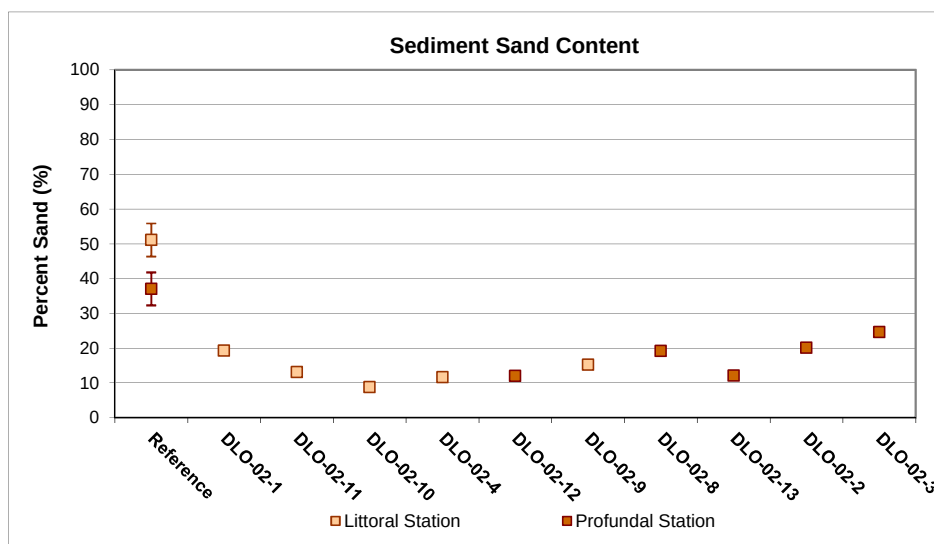


Figure 5.18: Sediment particle size and total organic carbon (TOC) content comparisons among Sheardown Lake SE (DLO-02) sediment monitoring stations and Reference Lake 3 averages (mean $\pm$ SE), Mary River Project CREMP, August 2015.

between littoral and profundal stations of the Sheardown Lake southeast basin (Appendix Table C.4). Similar to observations at Reference Lake 3 and other mine-exposed lakes, iron (oxy)hydroxide material was visible in surficial and/or sub-surface substrate of Sheardown Lake SE, occurring as a thin, distinct layer or floc at several stations (Appendix Tables C.13 – C.14). Substrates of Sheardown Lake SE were not blackened (or similarly darkly-coloured) and did not have a noticeably sulphidic odour (Appendix Tables C.13 – C.14), suggesting the absence of anoxia in sediment or the overlying water.

Sediment metal concentrations at Sheardown Lake SE in 2015 showed no spatial gradients with progression towards the lake outlet, suggesting no clear point sources of metals to the lake system (Appendix Table C.15). Sediment metal concentrations at littoral and profundal stations of Sheardown Lake SE were, on average, very similar to those observed at Reference Lake 3 (Table 5.3; Appendix Table C.16), suggesting no mine-related influences on sediment metal concentrations in Sheardown Lake SE. Although sediment chromium, iron, manganese and nickel concentrations were above respective SQG at one or more littoral stations at Sheardown Lake SE, on average, only iron was above its respective SQG (at littoral stations only), with concentrations of all other metals below respective SQG at all littoral and profundal stations (Table 5.3; Appendix Table C.15). Average chromium, iron, manganese and nickel levels were above the sediment AEMP benchmarks at Sheardown Lake SE (Table 5.3). As mentioned previously, average concentrations of iron and manganese were above respective SQG, and mean arsenic, copper and iron concentrations were also above respective AEMP benchmarks, at Reference Lake 3 (Table 5.3). These results suggested that the elevation of iron concentrations in sediment of Sheardown Lake SE relative to SQG likely reflected a natural phenomenon at lakes within the mine LSA.

Temporal comparisons of the sediment metals data suggested slightly elevated (i.e., 2- to 5-fold higher) average concentrations of arsenic at littoral and profundal stations, and manganese at littoral stations, of Sheardown Lake SE in 2015 compared to the baseline (2005 – 2013) and/or mine construction periods (Figure 5.11; Appendix Table C.16). The differences in sediment metal concentrations among study periods mirrored those observed at Sheardown Lake NW and suggested that, despite similarity to Reference Lake 3 sediment metal concentrations, slightly higher sediment arsenic and manganese concentrations at Sheardown Lake SE littoral stations in 2015 than during the baseline period potentially reflected a mine influence.

5.3.3 Phytoplankton

Chlorophyll a concentrations at Sheardown Lake SE showed no spatial differences with progression towards the lake outlet during any of the winter, summer or fall sampling events

in 2015 (Figure 5.12). Similar to the northwest basin, chlorophyll a concentrations were significantly lower in winter than during the summer and fall, with comparable concentrations shown between the latter at the southeast basin of Sheardown Lake (Appendix Table D.8). No significant difference in chlorophyll a concentration was shown between Sheardown Lake SE and Reference Lake 3 for both the summer and fall sampling events in 2015 (Appendix Tables D.9 – D.10). Moreover, chlorophyll a concentrations were well below the AEMP benchmark of 3.7 µg/L during all winter, summer and fall sampling events in 2015 at the southeast basin of Sheardown Lake (Figure 5.12). Low phytoplankton productivity was indicated at Sheardown Lake SE in 2015 based on Wetzel (2001) lake trophic status classifications using chlorophyll a concentrations, which suggested oligotrophic conditions. This trophic status classification mirrored a CWQG oligotrophic categorization for Sheardown Lake SE based on mean aqueous total phosphorus concentrations below 10 µg/L during all sampling events (Table 5.8; Appendix Table B.46).

Temporal comparisons indicated significantly lower chlorophyll a concentrations at the time of winter and summer sampling in 2015 compared to the 2014 mine construction period, but no differences in chlorophyll a concentrations between 2015 and 2014 during fall sampling at Sheardown Lake SE (Figure 5.13; Appendix Table D.11). The annual average chlorophyll a concentration at Sheardown Lake SE was slightly lower in 2015 than in 2014, but no significant difference in chlorophyll a concentrations was indicated between years (ANOVA $p = 0.699$). Similar to observations at the northwest basin, this suggested that the trophic status of the southeast basin of Sheardown Lake had not changed significantly between the period of mine construction and mine operation. No chlorophyll a baseline (2005 – 2013) data are available for Sheardown Lake SE, precluding comparisons to conditions prior to the mine construction period.

5.3.4 Benthic Invertebrate Community

Benthic invertebrate density was significantly higher at littoral and profundal stations of Sheardown Lake SE compared to like-depth stations at Reference Lake 3 (Tables 5.9 and 5.10). Similar to all the other mine-exposed lakes, no significant difference in richness was indicated between Sheardown Lake SE and the reference lake at the littoral stations, but richness was significantly higher at Sheardown Lake SE compared to Reference Lake 3 for the profundal stations (Tables 5.9 and 5.10). However, unlike the other mine-exposed lakes, Simpson's Evenness at littoral and profundal stations of Sheardown Lake SE did not differ significantly compared to Reference Lake 3 (Tables 5.9 and 5.10).

Benthic invertebrate community structure differed between Sheardown Lake SE and Reference Lake 3 as evidenced by a significant difference in Bray Curtis Index in separate

Table 5.9: Benthic invertebrate community statistical comparison results between Sheardown Lake SE (DLO-02) and Reference Lake 3 for littoral stations, Mary River Project CREMP, August 2015.

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	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m ²)	YES	0.002	η	0.971	4.0	Reference Lake 3	1,278	888	397	553	2,819
						Sheardown SE Littoral	4,829	1,898	849	2,975	6,947
Richness (Number of Taxa)	NO	0.379	α	0.130	-	Reference Lake 3	12.6	4.1	1.8	9.0	18.0
						Sheardown SE Littoral	10.6	2.5	1.1	8.0	13.0
Simpson's Evenness (E)	NO	0.114	α	0.345	-	Reference Lake 3	0.865	0.052	0.023	0.804	0.936
						Sheardown SE Littoral	0.759	0.123	0.055	0.585	0.920
Bray-Curtis Index	YES	0.000	α	1.000	2.9	Reference Lake 3	0.382	0.170	0.076	0.219	0.662
						Sheardown SE Littoral	0.878	0.027	0.012	0.840	0.906
Nemata (%)	NO	0.143	β	0.300	-	Reference Lake 3	8.1%	7.4%	3.3%	0.0%	17.2%
						Sheardown SE Littoral	1.5%	2.9%	1.3%	0.0%	6.7%
Ostracoda (%)	YES	0.043	δ	0.561	-0.8	Reference Lake 3	20.9%	18.5%	8.3%	4.1%	45.2%
						Sheardown SE Littoral	5.5%	10.0%	4.5%	0.0%	23.2%
Chironomidae (%)	YES	0.036	β	0.600	1.2	Reference Lake 3	66.5%	18.9%	8.4%	40.6%	91.0%
						Sheardown SE Littoral	88.9%	9.4%	4.2%	72.7%	95.8%
Metal-Sensitive Chironomidae (%)	NO	0.637	β	0.072	-	Reference Lake 3	11.4%	12.6%	5.6%	1.5%	32.2%
						Sheardown SE Littoral	12.7%	10.4%	4.7%	2.5%	29.0%
Collector-Gatherers (%)	YES	0.032	δ	0.623	-1.3	Reference Lake 3	81.4%	17.1%	7.7%	53.7%	95.2%
						Sheardown SE Littoral	59.1%	10.6%	4.7%	45.8%	72.2%
Filterers (%)	NO	0.644	β	0.071	-	Reference Lake 3	11.4%	12.6%	5.6%	1.5%	32.2%
						Sheardown SE Littoral	12.5%	10.4%	4.6%	2.5%	29.0%
Clingers (%)	NO	0.982	β	0.050	-	Reference Lake 3	13.5%	11.8%	5.3%	4.0%	33.9%
						Sheardown SE Littoral	11.3%	2.8%	1.3%	7.3%	14.1%
Sprawlers (%)	YES	0.019	β	0.729	-2.1	Reference Lake 3	70.1%	14.9%	6.7%	47.1%	84.3%
						Sheardown SE Littoral	39.4%	18.0%	8.1%	19.9%	67.0%
Burrowers (%)	YES	0.007	β	0.890	4.8	Reference Lake 3	16.4%	6.8%	3.0%	8.3%	25.8%
						Sheardown SE Littoral	49.3%	19.1%	8.5%	19.1%	66.0%

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

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 meaningful difference.

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 5.10: Benthic invertebrate community statistical comparison results between Sheardown Lake SE (DLO-02) and Reference Lake 3 for profundal stations, Mary River Project CREMP, August 2015

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	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m ²)	YES	0.000	α	1.000	76.2	Reference Lake 3	180	39	18	122	216
						Sheardown SE Profundal	3,185	281	125	2,742	3,518
Richness (Number of Taxa)	YES	0.000	ζ	1.000	7.2	Reference Lake 3	2.8	0.8	0.4	2.0	4.0
						Sheardown SE Profundal	8.8	1.8	0.8	6.0	10.0
Simpson's Evenness (E)	NO	0.148	ζ	0.293	-	Reference Lake 3	0.397	0.232	0.104	0.160	0.732
						Sheardown SE Profundal	0.588	0.130	0.058	0.364	0.677
Bray-Curtis Index	YES	0.000	ζ	1.000	8.3	Reference Lake 3	0.157	0.101	0.045	0.049	0.273
						Sheardown SE Profundal	0.994	0.002	0.001	0.990	0.995
Nemata (%)	NO	0.195	γ	0.239	-	Reference Lake 3	1.0%	2.2%	1.0%	0.0%	5.0%
						Sheardown SE Profundal	0.6%	1.1%	0.5%	0.0%	2.6%
Ostracoda (%)	NO	0.100	β	0.373	-	Reference Lake 3	9.7%	13.1%	5.9%	0.0%	31.9%
						Sheardown SE Profundal	0.5%	0.4%	0.2%	0.0%	0.9%
Chironomidae (%)	NO	0.412	δ	0.119	-	Reference Lake 3	87.8%	13.2%	5.9%	68.1%	100.0%
						Sheardown SE Profundal	97.0%	2.9%	1.3%	92.0%	99.5%
Metal-Sensitive Chironomidae (%)	YES	0.074	δ	0.439	2.0	Reference Lake 3	2.8%	2.6%	1.2%	0.0%	5.5%
						Sheardown SE Profundal	8.0%	4.7%	2.1%	3.0%	15.7%
Collector-Gatherers (%)	YES	0.002	β	0.970	-11.0	Reference Lake 3	96.6%	3.3%	1.5%	92.6%	100.0%
						Sheardown SE Profundal	60.2%	23.0%	10.3%	31.8%	89.1%
Filterers (%)	YES	0.028	δ	0.654	2.2	Reference Lake 3	1.9%	2.7%	1.2%	0.0%	5.5%
						Sheardown SE Profundal	7.8%	4.7%	2.1%	3.0%	15.7%
Clingers (%)	YES	0.071	δ	0.448	1.9	Reference Lake 3	3.4%	3.3%	1.5%	0.0%	7.4%
						Sheardown SE Profundal	9.7%	4.9%	2.2%	4.4%	17.2%
Sprawlers (%)	YES	0.000	δ	1.000	-46.4	Reference Lake 3	94.8%	1.3%	0.6%	92.6%	95.8%
						Sheardown SE Profundal	33.3%	23.7%	10.6%	6.1%	58.3%
Burrowers (%)	YES	0.000	β	0.999	21.9	Reference Lake 3	1.8%	2.5%	1.1%	0.0%	5.0%
						Sheardown SE Profundal	57.0%	22.8%	10.2%	30.5%	86.7%

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

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 meaningful difference.

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.

comparisons of the littoral and profundal station data (Tables 5.9 and 5.10). However, no ecologically meaningful differences in the relative abundance of dominant taxonomic groups was indicated between Sheardown Lake SE and Reference Lake 3 for either station type (i.e., CES_{BIC} within $\pm 2 SD_{REF}$; Tables 5.9 and 5.10). In addition, the relative abundance of metal-sensitive Chironomidae did not differ significantly between lakes at littoral stations, but was significantly higher at profundal stations of Sheardown Lake SE compared to Reference Lake 3 (Tables 5.9 and 5.10). These results suggested no adverse metal-related influences on the benthic invertebrate community at Sheardown Lake SE. Rather, the differences in benthic invertebrate community structure suggested by Bray Curtis Index differences between Sheardown Lake SE and Reference Lake 3 may have reflected naturally differing substrate between lakes. For instance, a significantly higher relative abundance of burrowing benthic invertebrates was observed at littoral and profundal stations of Sheardown Lake SE compared to the reference lake, which was consistent with the occurrence of significantly higher proportion of fines (i.e., silt and clay) in substrate of Sheardown Lake SE (Appendix Table E.36). Finer substrate composition at Sheardown Lake SE would presumably provide more suitable habitat quality for burrowing invertebrates, thus accounting for the differences in community structure between Sheardown Lake SE and Reference Lake 3. Overall, no adverse mine-related influences to the benthic invertebrate community of Sheardown Lake SE were indicated in 2015 based on comparisons to Reference Lake 3. In addition, as observed at the other mine-exposed lakes, higher benthic invertebrate density also suggested naturally higher secondary productivity at Sheardown Lake SE compared to reference lake conditions.

Temporal comparisons of the Sheardown Lake SE benthic invertebrate community data indicated significantly lower density at littoral and profundal habitat in 2015 compared to baseline data collected in 2007 and 2013 (Figure 5.19; Appendix Tables E.37 and E.38). However, taxonomic richness, Simpson's Evenness and relative abundance of any dominant taxonomic groups or FFG did not differ significantly in 2015 compared to the baseline studies (Figure 5.19; Appendix Tables E.37 and E.38). 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 5.19) and parameter concentrations in water and sediment were below applicable WQG/SQG and AEMP benchmarks at Sheardown Lake SE in 2015¹⁰.

¹⁰ Although sediment iron concentrations were above SQG at littoral stations of Sheardown Lake SE in 2015, iron concentrations were also above SQG at littoral and profundal stations of Reference Lake 3, suggesting iron concentrations were naturally high within the mine LSA lakes.

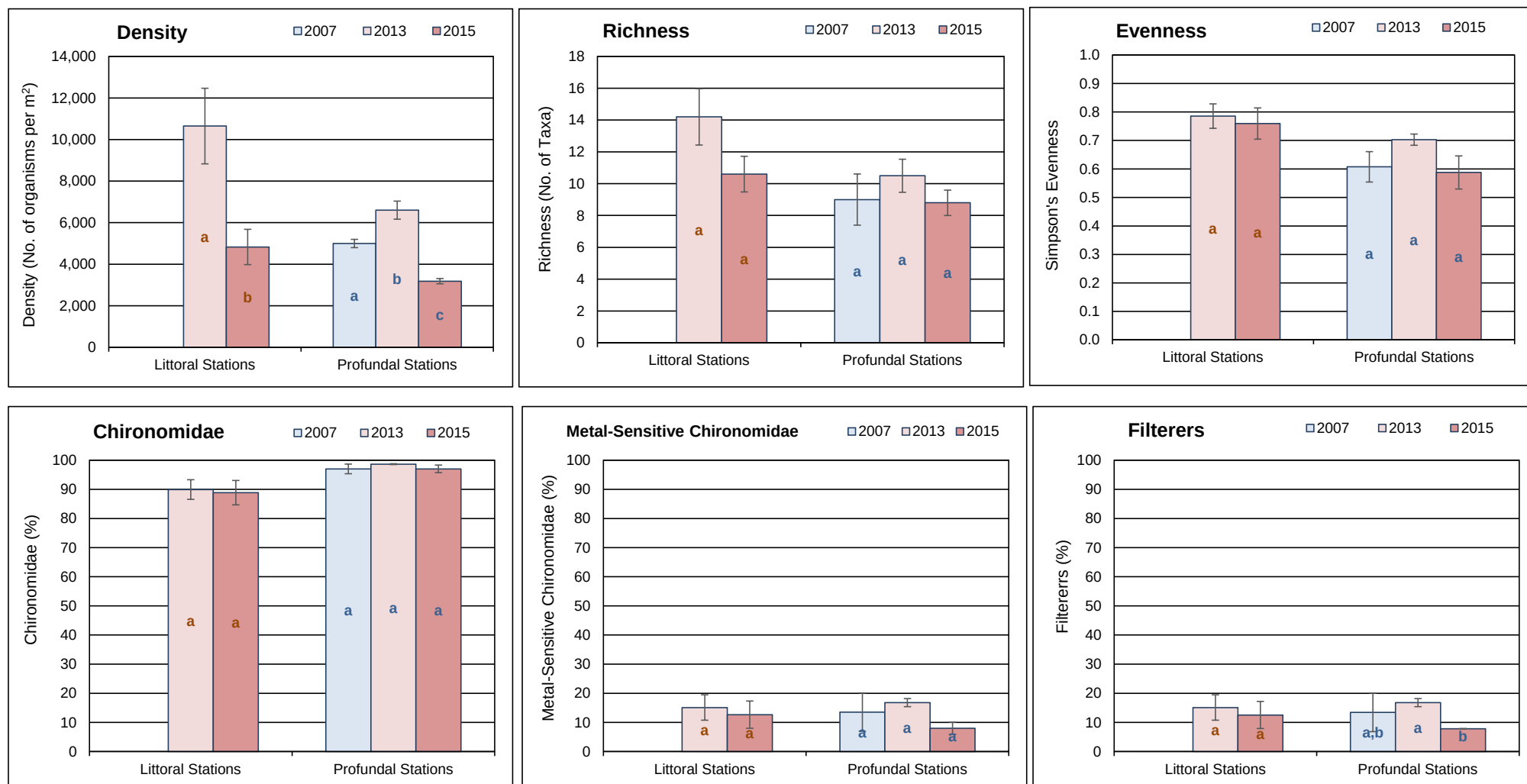


Figure 5.19: Comparison of key benthic invertebrate metrics (mean $\pm$ SE) at Sheardown Lake SE littoral and profundal stations between mine baseline (2007 and 2013) and operational (2015) periods, Mary River Project CREMP, 2015. The same like-coloured letter inside bars indicates no significant difference between study years for respective littoral and profundal station depths.

5.3.5 Fish Population Survey

5.3.5.1 Sheardown Lake SE Fish Community

Arctic charr was the only fish species captured at Sheardown Lake SE in 2015 which, as for the northwest basin, differed slightly from that of Reference Lake 3 where low numbers of nine-spine stickleback were captured in addition to Arctic charr (Table 5.6). 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 Arctic charr at the Sheardown Lake southeast basin (Table 5.6). 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 Arctic charr CPUE was similar among the mine baseline (2006-2013), construction (2014) and operational (2015) studies (Figure 5.15). Similarly, the 2015 gill netting CPUE for Arctic charr was comparable to that shown during the baseline and mine construction periods (Figure 5.15). Therefore, relative abundance of Arctic charr at the nearshore and littoral/profundal areas of Sheardown Lake SE in 2015 appeared to remain within the range shown through baseline and mine construction periods, suggesting no mine-related influences to Arctic charr numbers in the lake.

5.3.5.2 Sheardown Lake SE Fish Health Assessment

Nearshore Arctic Charr

Mine-related influence on the Sheardown Lake SE nearshore Arctic charr population was assessed following a control-impact approach using 2015 data from Sheardown Lake and Reference Lake 3, and a before-after approach separately comparing Sheardown Lake SE 2015 data to baseline and mine construction period data. A total of 102 and 99 Arctic charr were captured at nearshore habitat of Sheardown Lake SE and the reference lake, respectively, in August 2015, for the control-impact analysis. Similar to the Sheardown Lake northwest basin, Arctic charr YOY could be separated from older age classes at the southeast basin based on a fork length of approximately 5.5 cm (Figure 5.20). Because no separation of age classes was possible at Reference Lake 3, YOY were grouped with older age classes for the juvenile Arctic charr health assessment at Sheardown Lake SE.

Nearshore Arctic charr length-frequency distributions were similar between Sheardown Lake SE and the reference lake, as were age distributions between lakes (Table 5.11; Figure 5.20), suggesting no differences in survival between Sheardown Lake SE and

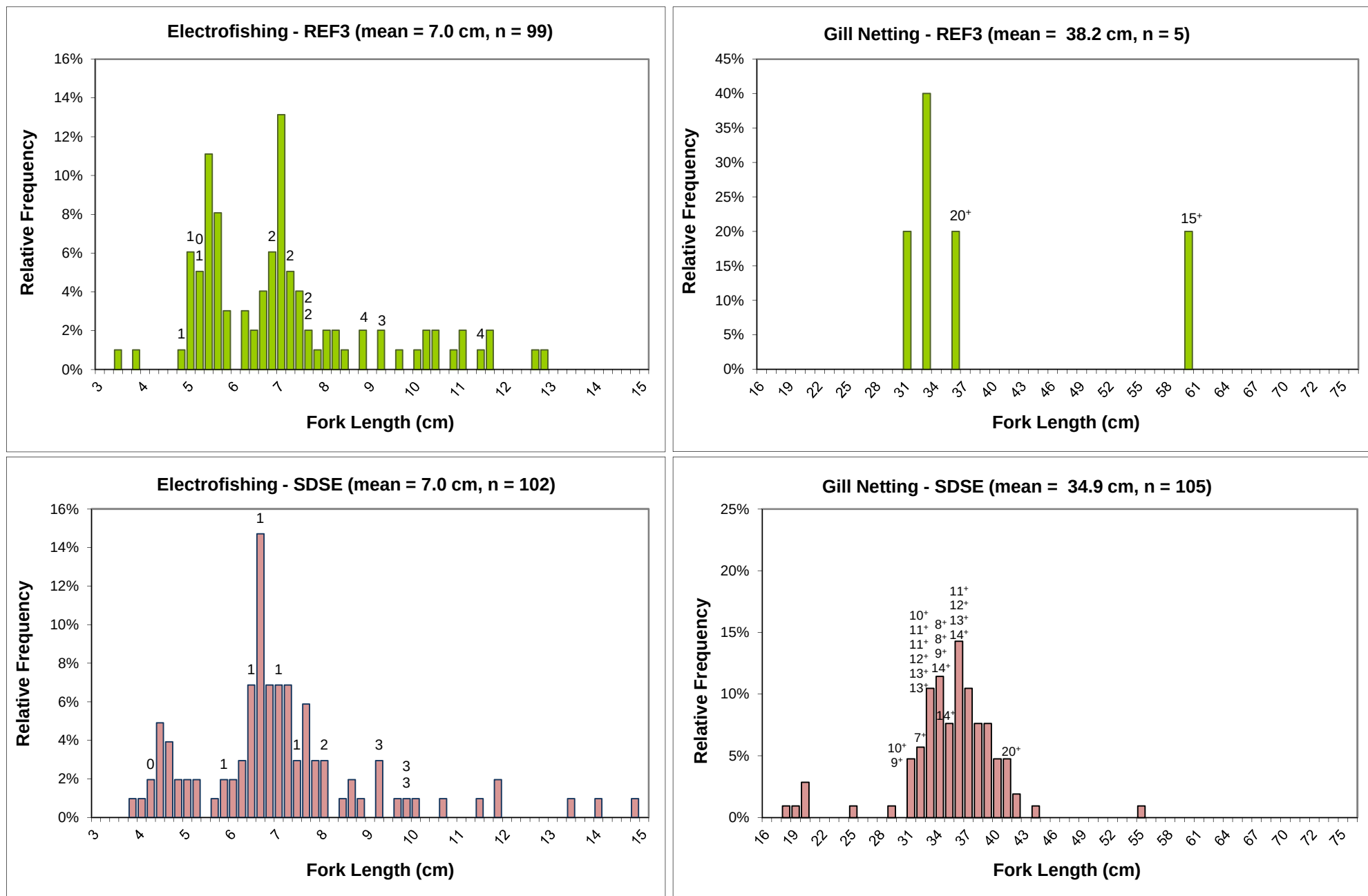


Figure 5.20: Length-frequency distributions for Arctic charr captured by backpack electrofishing and gill netting at Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2015. Fish ages are shown above the bars, where available.

Table 5.11: Summary of statistical results for Arctic charr population comparisons between Sheardown Lake SE and Reference Lake 3 for the mine operational period (2015), between Sheardown Lake SE mine-operational and baseline (2005 - 2013) periods, and between Sheardown Lake SE mine-operational and construction (2014) periods for fish captured by electrofishing and gill netting methods, Mary River Project CREMP, August 2015. 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	versus Sheardown Lake NW Mine Construction period
			2015	2005 - 2013	2014
Electrofishing Samples	Survival	Length-Frequency Distribution	No	Yes	Yes
		Age	No	Yes (+273%)	-
	Energy Use	Size (mean weight)	No	No	Yes (+150%)
		Size (mean fork length)	No	Yes (+7%)	Yes (+39%)
		Growth (weight-at-age)	Yes (+85%)	No	-
		Growth (fork length-at-age)	Yes (+21%)	No	-
	Energy Storage	Condition (body weight-at-fork length)	Yes (+4%)	Yes (-14%)	Yes (- 12%)
Gill Netting Samples*	Survival	Length Frequency Distribution	-	Yes	Yes
		Age	-	Yes (-13%)	-
	Energy Use	Size (mean weight)	-	Yes (- 26%)	Yes (-18%)
		Size (mean fork length)	-	Yes (-8.8%)	Yes (-7%)
		Growth (weight-at-age)	-	Yes (+18%)	-
		Growth (fork length-at-age)	-	No	-
	Energy Storage	Condition (body weight-at-fork length)	-	No	Yes (+4%)

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

Reference Lake 3. However, Arctic charr captured at the Sheardown Lake SE nearshore showed significantly greater growth compared to those captured at the reference lake, with the magnitude of the differences in weight-at-age growth outside of the $\pm 25\%$ CES_{SG} (Table 5.11; Appendix Table F.17), suggesting an ecologically meaningful difference in juvenile Arctic charr energy use between lakes. Although nearshore arctic charr of Sheardown Lake SE also showed a significant difference in condition compared to those captured at Reference Lake 3, the magnitude of this difference was within the $\pm 10\%$ CES_C, suggesting that this difference was not ecologically meaningful (Table 5.11; Appendix Table F.17). Similar to the other mine lakes, the occurrence of faster growing Arctic charr with slightly greater condition at Sheardown Lake SE compared to the reference lake suggested no mine-related influences on fish health at Sheardown Lake SE in 2015.

Separate comparison of the 2015 nearshore Arctic charr population data to baseline (2005-2013) and mine construction (2014) period data indicated significant differences in length-frequency distributions between respective time periods at Sheardown Lake SE (Table 5.11). Nearshore Arctic charr captured at Sheardown Lake SE in 2015 were significantly older and larger than those captured during the baseline and mine construction periods (Table 5.11). Although no significant differences in growth of nearshore Arctic charr were indicated between juveniles collected in 2015 and those collected during the baseline period, significantly lower Arctic charr condition was indicated between juveniles captured in 2015 and those captured in during both the baseline and mine construction periods (Table 5.11). In both cases, the magnitude of the difference in condition was outside of the $\pm 10\%$ CES_C, suggesting ecologically meaningful, lower condition of nearshore Arctic charr in 2015 at Sheardown Lake SE compared to periods prior to initiation of ERP mining at the Mary River Project. Similar differences in condition were also observed between the 2015 and mine baseline/ construction period studies at Sheardown Lake NW and Camp Lake.

Littoral/Profundal Arctic Charr

Non-spawners of reproductive age accounted for approximately 47% of the Sheardown Lake SE Arctic charr population during the August 2015 field study (Appendix Table F.33). On average, Arctic charr non-spawners were slightly younger and had significantly lower LSI than those fish with developing gonads (Appendix Table F.33; ANOVA $p = 0.040$). A high proportion of individuals (i.e., 89%) contained body cavity parasites (Appendix Table F.33), the incidence rate of which was comparable to that observed at Camp Lake and in historical studies for the mine LSA lakes. Interestingly, two Arctic charr that had been tagged and released previously at Sheardown Lake SE were re-captured in 2015. These fish showed a similar mean annual incremental increase in fork length (Table 5.12).

Table 5.12: Length and weight measurement data for tagged Arctic charr captured at Sheardown Lake SE in August 2015, 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)
85944	3-Aug-2007	363	375	17-Aug-2015	407	500	5.5
89525	21-Aug-2014	368	500	17-Aug-2015	375	505	7.0

Mine-related influences on the Sheardown Lake SE littoral/profundal Arctic charr population were assessed using a before-after approach to separately evaluate differences in fish health endpoints between 2015 and previous mine operation stages. Length-frequency distributions of Arctic charr captured at littoral/profundal areas of Sheardown Lake NW in 2015 differed significantly from those captured during the baseline and mine-construction periods (Table 5.11). In part, the differences in length-frequency distribution may have reflected significantly younger age and smaller size (i.e., weight and length) of individuals captured in 2015 compared to the baseline and mine construction periods (Table 5.11; Appendix Tables F.34 and F.35). Significantly greater weight-related growth was indicated in 2015 compared to the baseline period for Arctic charr captured at littoral/profundal areas of Sheardown Lake SE, but the difference was within the $\pm 25\%$ CES_{SG} (Table 5.11; Appendix Table F.34). In addition, although significantly greater condition was indicated in 2015 than in the mine construction period, the magnitude of the difference was within the $\pm 10\%$ CES_C and no similar difference was indicated relative to the baseline period (Table 5.11). Overall, the absence of any ecologically significant differences in growth and condition for Arctic charr captured in 2015 compared to either the baseline or mine construction periods at littoral/profundal areas of Sheardown Lake SE suggested no adverse influences on adult Arctic charr following the initial year of mine operation.

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

Sheardown Lake Tributaries

At Sheardown Lake Tributary 1 (SDLT1), aqueous concentrations of only nitrate, sulphate and uranium were elevated relative to the lotic reference station average and the baseline period, suggesting a mine-related source of these parameters to SDLT1. However, no parameters were elevated above WQG or the AEMP benchmarks at SDLT1, with the exception of copper concentrations above WQG at lower SDLT1, suggesting limited potential

for effects on aquatic biota within SDLT1. Chlorophyll a concentrations at SDLT1 were similar to the lotic reference station average and concentrations during the baseline period, and were consistently well below the AEMP benchmark, suggesting no effects to phytoplankton. In addition, no adverse mine-related influences to the benthic invertebrate community were apparent among the three SDLT1 reaches in 2015, with comparisons to baseline potentially indicating a slight enrichment influence at lower SDLT1 that may have been associated with higher aqueous nitrate concentrations in 2015 than during the baseline period. No meaningful changes in benthic invertebrate community features of Sheardown Lake Tributary 12 (SDLT12) or Tributary 9 (SDLT9) were apparent between the mine baseline and operational (2015) periods, which suggested that biological conditions at these tributaries likely remained relatively unchanged since the initiation of mining activities in 2015.

Sheardown Lake (NW and SE Basins)

At Sheardown Lake, aqueous concentrations of aluminum, manganese, molybdenum and uranium were elevated compared to the reference lake in 2015, 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. In addition, total aluminum and manganese concentrations showed a strong positive correlation with turbidity that in turn, suggested that these metals were largely bound to/comprised suspended particulate matter and were not likely biologically available. High turbidity in Sheardown Lake reflected natural sources of suspended particulates originating from Mary River, upstream of the mine (see Section 6.1). Sediment metal concentrations at littoral and profundal stations in Sheardown Lake were similar to those at the reference lake in 2015 and, with the exception of slightly elevated (i.e., 2- to 3-fold higher) sediment arsenic and manganese concentrations at littoral stations, were similar to concentrations observed during the baseline period. In addition, 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 limited potential for any adverse effects to biota associated with these metals.

Sheardown Lake chlorophyll a concentrations were significantly higher (northwest basin), or were similar (southeast basin), than at the reference lake in 2015, and were also similar to the mine construction (2014) period and consistently below the AEMP benchmark, suggesting no adverse effects on the lake phytoplankton community. In addition, higher benthic invertebrate density and richness, higher Arctic charr density, and significantly faster growth of juvenile Arctic charr also suggested higher biological productivity, and no adverse

mine influence on biota, at Sheardown Lake compared to the reference lake. Benthic invertebrate richness and relative abundance metal sensitive taxa did not differ significantly, or was significantly higher, at Sheardown Lake than at the reference lake in 2015 which, coupled with close similarity (and no ecologically meaningful differences) in most benthic invertebrate community metrics relative to the baseline period, suggested no adverse effects on the benthic invertebrate community of Sheardown Lake in 2015. In addition, no significant differences in growth of juvenile or adult Arctic charr, as well as no ecologically meaningful differences in condition of adult Arctic charr, were shown at Sheardown Lake in 2015 compared to the baseline period. It is noteworthy that condition of juvenile Arctic charr was significantly lower at Sheardown Lake in 2015 than during the baseline and mine construction periods. However, a similar direction and magnitude of change in condition was observed at Camp Lake (and all other mine-exposed lakes) which otherwise showed no to minimal mine-related influence on water quality, sediment quality and biota, suggesting that the difference in juvenile condition between the 2015 and mine baseline periods at all mine-exposed lakes was most likely related to sampling and/or natural variability (e.g., sampling timing, meteorological variability). Overall, the biological data not only suggested no adverse mine-related influences on biota of Sheardown Lake, but that secondary productivity and fish productivity of the lake was high relative to the reference lake.

6.0 MARY RIVER AND MARY LAKE SYSTEM

6.1 Mary River

6.1.1 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 lotic reference stations for each respective seasonal sampling event (Figure 6.1; Appendix Tables B.1 - B.3). No consistent gradient in, and no significant difference in, DO saturation was shown among the five Mary River study areas at the time of biological sampling in August 2015 (Figure 6.1; Appendix Figure F.19 and Table B.50). In addition, DO saturation at all Mary River stations was well above the WQG minimum limit for cold-water biota (i.e., 54%) during all sampling events (Figure 6.1; Appendix Tables B.1 – B.3).

In-situ pH at all Mary River stations was similar to pH at the lotic reference stations for each respective seasonal sampling event (Appendix Table B.1 – B.3 and Figure B.19), and no significant differences in pH were indicated among the Mary River study areas during the 2015 fall sampling event (Figure 6.1; Appendix Table B.50), suggesting no mine-related influences on pH of the Mary River. Moreover, pH at all Mary River stations was consistently within WQG limits during all spring, summer and fall sampling events. *In-situ* 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 B.19). On average, conductivity of the combined Mary River stations was significantly lower than at the lotic reference stations during spring, similar to the lotic reference stations during summer, and significantly higher than at the lotic reference stations during fall. These seasonal changes likely reflected natural differences in conductivity of surface runoff related to dilution sources (e.g., spring snowmelt) and proportion of flow contributed to Mary River by various tributaries, as well as differences in the geology of base material between Mary River and these tributaries. During the fall biological monitoring, specific conductance of the Mary River downstream of the outlet of Sheardown Lake SE (i.e., CO-05 study area) was significantly lower than at the immediately upstream area (Figure 6.1; Appendix Table B.50), indicating: a) no elevation in aqueous specific conductance of the Mary River related to the 2015 mine operations; and, b) the CLT-REF lotic reference stream acts as a key dilution source to the Mary River.

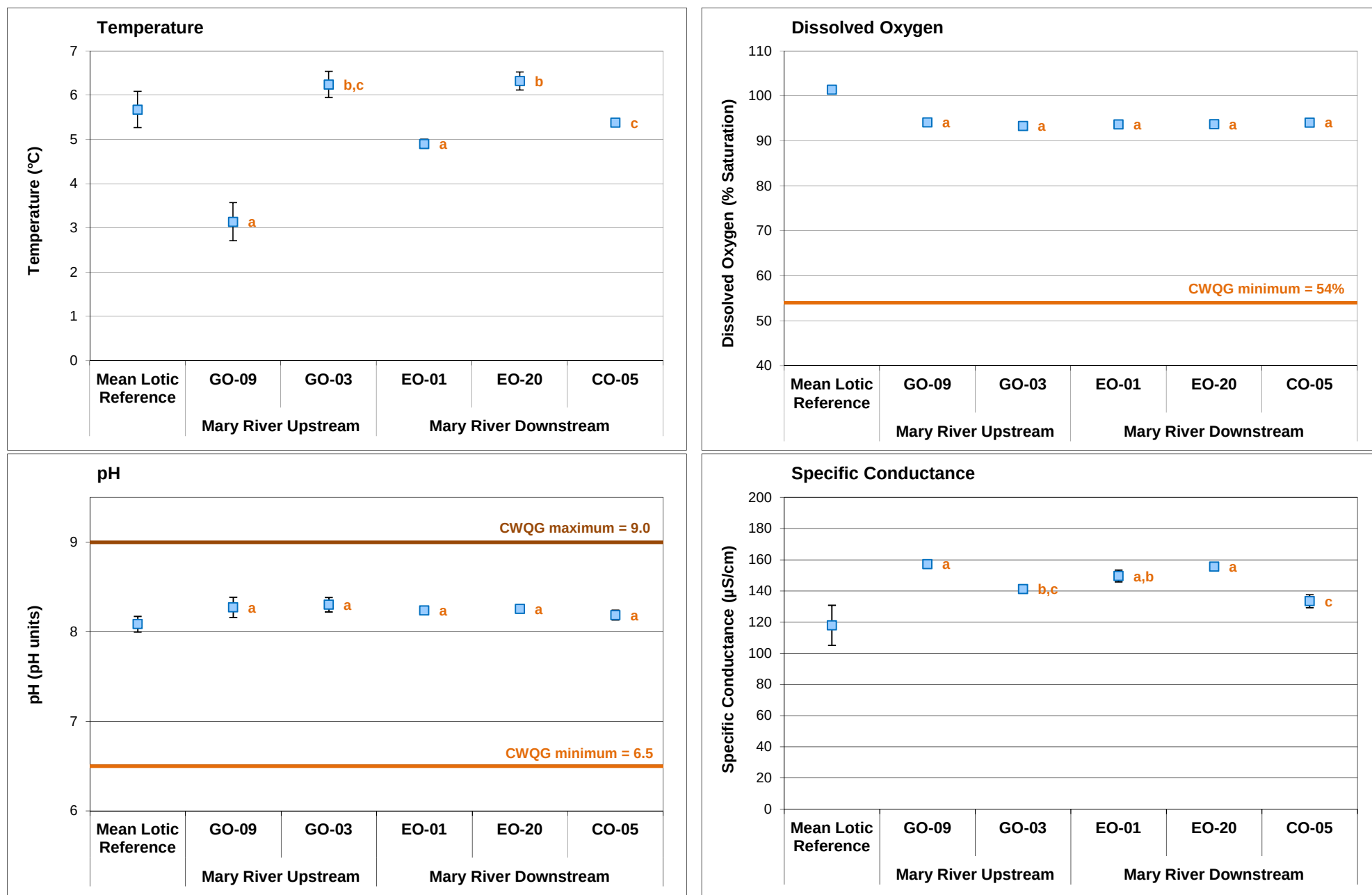


Figure 6.1: Comparison of *in-situ* water quality variables (mean $\pm$ SE) measured at the Mary River benthic invertebrate community stations (n = 5) and lotic reference stations (n = 4), Mary River Project CREMP, August 2015. The same letters next to Mary River study area data points indicate no significant difference between study areas.

Water chemistry within Mary River showed no distinct and/or consistent spatial differences with progression downstream during any of the winter, summer or fall sampling events in 2015 (Table 6.1; Appendix Table B.51). Total concentrations of several metals, including aluminum, iron, manganese and phosphorus, were elevated (i.e., ≥ 3 -fold higher) at individual stations along the Mary River compared to the lotic reference station average during each respective sampling event (Table 6.1; Appendix Table B.51). However, in all cases, total metal concentrations at downstream, mine-exposed stations (i.e., EO and CO series stations) were lower than, or similar to, those at stations located upstream of the mine (i.e., GO series; Table 6.1) suggesting natural sources of metals to Mary River that were unrelated to the mine operations. Moreover, strong correlations between total concentrations of these metals and turbidity indicated that high total metal concentrations in the Mary River were associated with suspended inorganic material (e.g., aluminum-based minerals). In contrast, no significant correlations were shown between dissolved concentrations of non-conservative metals (e.g., aluminum, iron, manganese) and turbidity using the 2015 data, further supporting the fact that these metals were associated with inorganic particles suspended in the water column. Notably, turbidity of Mary River was 3.1 – 4.8 times higher than at the lotic reference stations, on average, during the 2015 spring, summer and fall sampling events (Appendix Table B.51). Highest turbidity was observed upstream of the mine-exposed stations (i.e., GO series stations), indicating that elevated turbidity in Mary River was a natural phenomenon unrelated to the Mary River Project operations. The occurrence of naturally high suspended particulate matter in Mary River confounded meaningful comparison of total metal concentrations to WQG, which are applicable to total metals. For instance, although aluminum, copper, iron, lead and/or phosphorus were elevated above WQG at one or more Mary River stations during spring, summer and fall sampling events¹¹ (Table 6.1; Appendix Table B.51), these metals were strongly correlated with turbidity, indicating that all were likely associated with suspended particles and not biologically available. Dissolved metal concentrations at all Mary River stations were well below WQG and AEMP benchmarks.

Temporal evaluation of Mary River water chemistry data also suggested that higher total metal concentrations in 2015 compared to the baseline (2005-2013) and mine construction (2014) periods was related to the occurrence of greater turbidity in 2015 (Figure 6.2; Appendix Figure B.20). For instance, mean turbidity of the Mary River was 2.7 to 4.1 times higher in 2015 than during the baseline and mine construction periods at the time of the spring and fall sampling events (Appendix Figure B.20). Highest elevation in total

¹¹ Refer to footnote 2 (page 28) and Section 3.0 regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA..

Table 6.1: Water chemistry at Mary River monitoring stations, Mary River Project CREMP, August 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Lotic Reference Average (n = 4) Fall 2015	Mine-exposed											
						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
						13-Aug-2015	13-Aug-2015	13-Aug-2015	13-Aug-2015	17-Aug-2015	17-Aug-2015	17-Aug-2015	16-Aug-2015	16-Aug-2015	16-Aug-2015	16-Aug-2015	16-Aug-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	105	138	147	140	134	145	216	143	138	138	143	139	133
	pH (lab)	pH	6.5 - 9.0	-	7.92	8.03	8.01	8.01	7.98	8.05	8.20	8.05	8.00	8.01	7.99	7.99	7.92
	Hardness (as CaCO ₃)	mg/L	-	-	51	62	65	66	64	71	114	70	68.5	68	69	68	65
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	5.6	3.2	4.4	14.4	2.0	9.2	<2.0	3.2	12.0	5.2	2.0	3.6
	Total Dissolved Solids (TDS)	mg/L	-	-	54	70	73	73	80	650	106	76	76	70	68	79	77
	Turbidity	NTU	-	-	3.03	16.50	13.80	17.70	45.90	7.53	9.48	7.35	8.35	18.90	11.20	6.68	9.67
	Alkalinity (as CaCO ₃)	mg/L	-	-	46	57	59	59	57	67	109	72	64	64	68	66	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	<0.050	<0.050	<0.050	<0.050
	Nitrate	mg/L	13	13	0.024	0.021	<0.020	<0.020	0.021	<0.020	0.092	<0.020	<0.020	<0.020	<0.020	0.023	<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	0.16	<0.15	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.7	1.3	1.4	1.4	1.4	1.7	1.3	1.7	1.6	1.5	1.8	1.8	1.7
	Total Organic Carbon	mg/L	-	-	1.7	1.1	1.3	1.3	1.3	1.6	1.4	1.8	1.7	1.6	1.7	1.8	1.7
	Total Phosphorus	mg/L	0.020 ^a	-	0.0043	0.0122	0.0079	0.0115	0.0246	0.0079	0.0147	0.0209	0.0094	0.0195	0.0124	0.0087	0.0303
	Phenols	mg/L	0.001 ^a	-	0.0042	0.0048	0.0040	0.0050	0.0040	0.0017	0.0018	0.0019	0.0027	0.0034	0.0022	0.0012	0.0028
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	1.56	6.48	5.38	5.21	4.27	4.18	3.96	4.19	4.06	4.02	3.83	3.72	3.66
	Sulphate (SO ₄)	mg/L	218 ^ß	218	3.16	3.77	3.34	3.23	3.20	3.40	5.74	3.37	3.31	3.31	3.29	3.18	3.08
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.164	0.695	0.425	1.01	2.58	0.230	0.154	0.223	0.168	0.238	0.194	0.161	0.230
	Antimony (Sb)	mg/L	0.020 ^a	-	<0.00010	<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	0.00012	0.00021	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00712	0.0120	0.0111	0.0136	0.0220	0.0099	0.0113	0.0100	0.00956	0.0106	0.0100	0.00948	0.00918
	Beryllium (Be)	mg/L	0.011 ^a	-	<0.00010	<0.00010	<0.00010	<0.00010	0.0001	<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	<0.00050	<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	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	10.6	13.1	14.1	13.9	13.3	14.7	23.6	14.6	14.5	14.4	14.3	14.4	13.7
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00058	0.00109	0.00077	0.00168	0.00432	<0.00050	<0.00050	<0.00050	<0.00050	0.00072	0.00051	<0.00050	0.00050
	Cobalt (Co)	mg/L	0.0009 ^a	0.004	0.000110	0.000240	0.000170	0.000320	0.000850	<0.00010	0.000140	<0.00010	0.000105	0.000240	0.000140	<0.00010	0.000140
	Copper (Cu)	mg/L	0.002	0.0024	0.0013	0.0014	0.0013	0.0019	0.0030	0.0010	0.0012	0.0011	0.0012	0.0016	0.0013	0.0014	0.0015
	Iron (Fe)	mg/L	0.30	0.87	0.14	0.56	0.37	0.75	2.0	0.16	0.15	0.16	0.16	0.30	0.21	0.13	0.24
	Lead (Pb)	mg/L	0.001	0.00100	0.00018	0.00044	0.00033	0.00052	0.0014	0.00019	0.00032	0.00018	0.00022	0.00049	0.00030	0.00017	0.00028
	Lithium (Li)	mg/L	-	-	<0.0010	0.0011	<0.0010	0.0012	0.0030	<0.0010	0.0012	<0.0010	0.00115	0.0013	0.0010	<0.0010	0.0012
	Magnesium (Mg)	mg/L	-	-	6.15	7.53	8.21	8.17	8.44	8.17	13.7	8.17	7.99	8.17	8.24	7.84	7.44
	Manganese (Mn)	mg/L	0.935 ^ß	-	0.00171	0.00660	0.00460	0.00849	0.02210	0.00222	0.00574	0.00201	0.00310	0.00746	0.00451	0.00207	0.00422
	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	-	0.000398	0.000412	0.000340	0.000438	0.000426	0.000340	0.000206	0.000311	0.000383	0.000236	0.000295	0.000410	0.000391
	Nickel (Ni)	mg/L	0.025	0.025	0.00060	0.00083	0.00060	0.00111	0.00279	<0.00050	0.00086	<0.00050	0.00059	0.00110	0.00087	0.00057	0.00085
	Potassium (K)	mg/L	-	-	0.80	1.4	1.3	1.5	2.1	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0
	Selenium (Se)	mg/L	0.001	-	<0.000050	<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	-	-	1.0	1.7	1.3	2.5	5.8	1.1	1.2	1.2	1.1	1.2	1.2	1.2	1.3
	Silver (Ag)	mg/L	0.00025	0.0001	<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
	Sodium (Na)	mg/L	-	-	1.52	3.38	3.24	3.24	2.87	2.39	1.48	2.43	2.53	2.62	2.44	2.25	2.21
	Strontium (Sr)	mg/L	-	-	0.0104	0.0166	0.0158	0.0166	0.0164	0.0141	0.0151	0.0142	0.0150	0.0146	0.0141	0.0137	0.0130
	Thallium (Tl)	mg/L	0.0008	0.0008	0.000010	0.000014	0.000011	0.000017	0.000043	<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	-	-	0.00644	0.0326	0.0220	0.0449	0.133	<0.010	<0.010	<0.010	<0.010	0.0150	0.0110	<0.010	0.0130
	Uranium (U)	mg/L	0.015	-	0.00277	0.00437	0.00408	0.00388	0.00339	0.00301	0.00254	0.00304	0.00294	0.00290	0.00271	0.00253	0.00233
	Vanadium (V)	mg/L	0.006 ^a	0.006	0.00057	0.00126	0.00091	0.00158	0.00393	<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	0.0049	<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 2.3 for information regarding WQG criteria.

^b AEMP Water Quality Benchmarks developed by Intrinsik (2013) using background water quality data. The values are specific to the Mary River System.

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD

 Indicates parameter concentration above the AEMP benchmark.

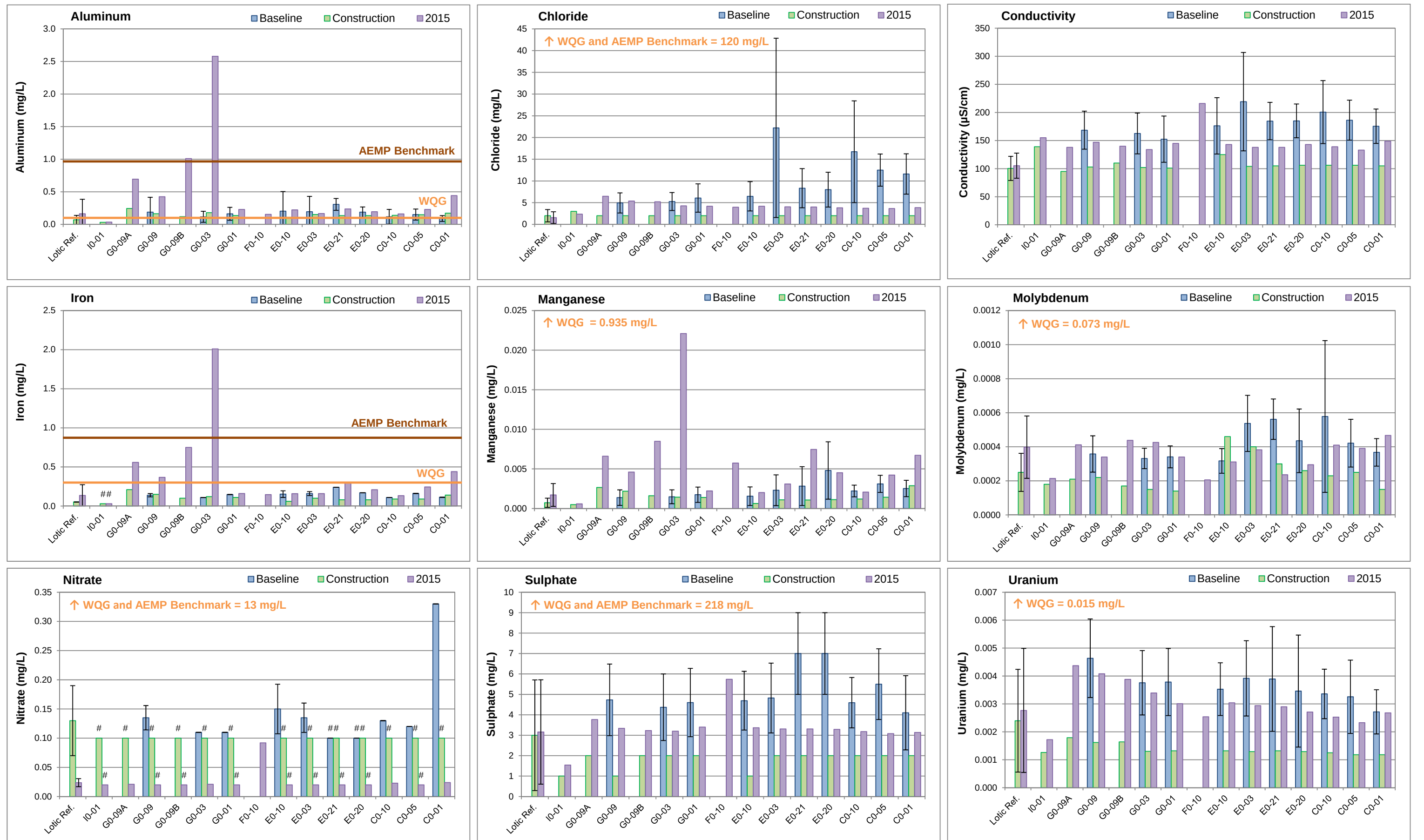


Figure 6.2: Temporal comparison of water chemistry at Mary River stations for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods during fall. Values represent mean $\pm$ SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean $\pm$ SD; n = 4). Pound symbol (#) 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.

concentrations of aluminum, copper, iron, manganese and other metals in 2015 compared to these historical periods was often observed at those stations with highest elevation in turbidity (Figure 6.2; Appendix Figure B.20), suggesting a clear link between total concentrations of non-conservative metals and turbidity. It is noteworthy that for conservative parameters (i.e., parameters that do not bind readily with inorganic or organic particulate matter) commonly used as indicators of anthropogenic influences in aquatic environments (e.g., conductivity, chloride, nitrate, sodium, sulphate), concentrations at Mary River stations in 2015 were comparable to those during the baseline and mine construction periods (Figure 6.2; Appendix Figure B.20). Notably, Mary River turbidity was consistently highest upstream of the mine (i.e., the GO series stations) during all mine baseline, construction and operational periods (Figure 6.2; Appendix Figure B.20), indicating naturally high turbidity unrelated to the mine. Overall, these results suggested no mine-related influences to water quality of the Mary River following the initial year of mining operations at the Mary River Project.

6.1.2 Phytoplankton

Mary River chlorophyll a concentrations were similar among the upstream-most (i.e., GO-9, GO-3) and downstream-most (i.e., CO series) stations during the 2015 spring, summer and fall sampling events with the exception of spring, when chlorophyll a concentrations were lower at CO stations (Figure 6.3). No significant differences in annual average chlorophyll a concentrations were indicated among the ten Mary River monitoring stations in 2015 (Appendix Table D.12). In addition, chlorophyll a concentrations at all Mary River stations were generally similar to the lotic reference stations during each respective season (Figure 6.3). These results suggested no mine-related influences on Mary River phytoplankton productivity in 2015. Chlorophyll a concentrations were well below the AEMP benchmark of 3.7 µg/L during all winter, summer and fall sampling events in 2015 at all Mary River sampling stations (Figure 6.3). Moderate phytoplankton productivity may be expected in the Mary River given a 'mesotrophic' CWQG categorization based on average total phosphorus concentrations ranging between 10 - 20 µg/L in 2015 (Table 6.1; Appendix Table B.51). However, much of this total phosphorus was bound to suspended particulates based on strong correlations with turbidity and total concentrations of aluminum, iron, lead and manganese metals (see sub-section 6.1.1 above). As such, the availability of phosphorus for phytoplankton productivity at Mary River may be more 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 in 2015 than during the baseline period at individual stations

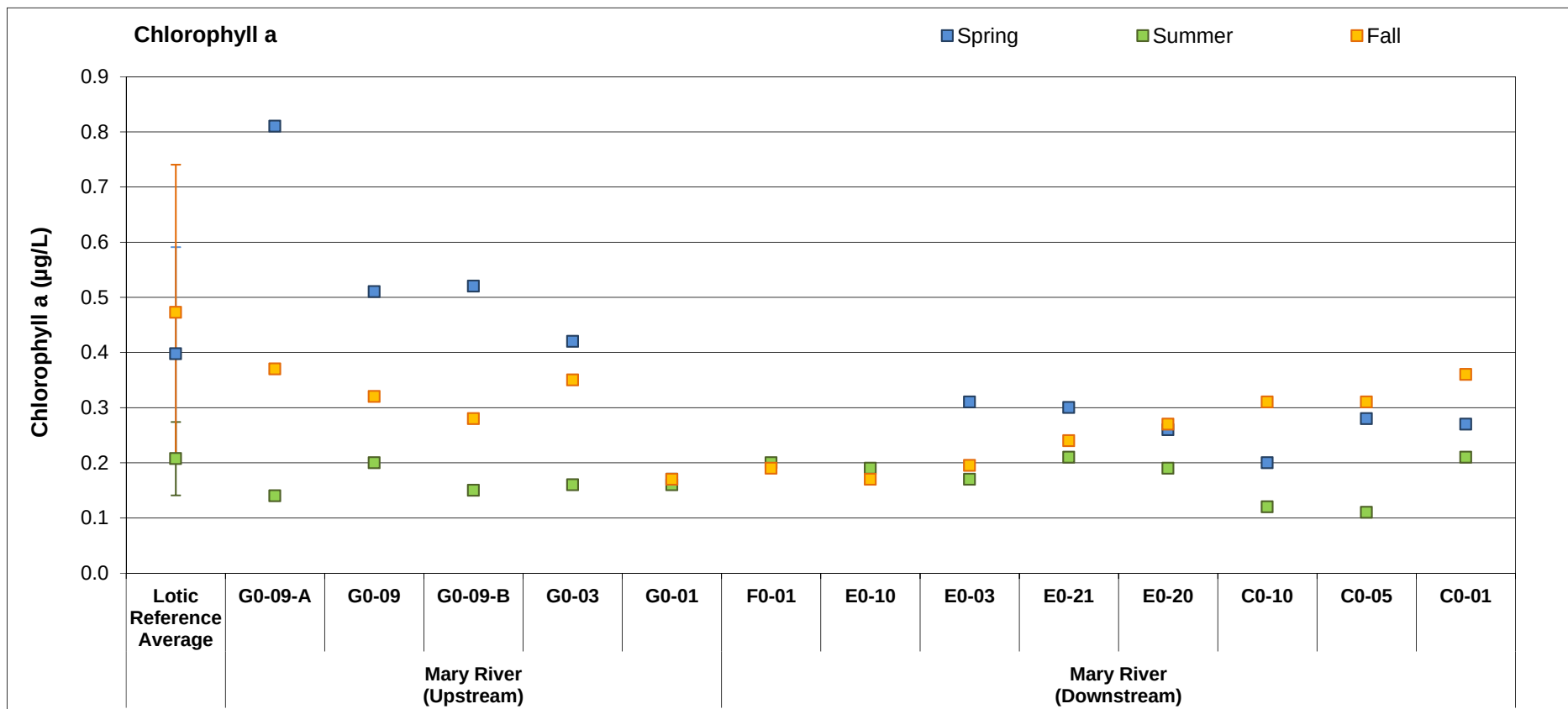


Figure 6.3: Chlorophyll a concentrations at Mary River phytoplankton monitoring stations upstream and downstream of Sheardown Lake (SDL), Mary River Project CREMP, 2015. Lotic reference stations include the CLT-REF and MRY-REF series (mean $\pm$ SD; n = 4).

(Figure 6.4). Approximately equal numbers of stations showed either similar chlorophyll a concentrations, or lower chlorophyll a concentrations, in 2015 compared to the 2014 mine construction period (Figure 6.4). 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 any toxicity, nutrient enrichment or other potential mine-related influences on phytoplankton productivity. Accordingly, lower chlorophyll a concentrations in 2015 at Mary River may have been due to naturally higher turbidity (i.e., originating from sources upstream of the mine) than during the mine construction period.

6.1.3 Benthic Invertebrate Community

The Mary River benthic invertebrate community assessment included a spatial statistical analysis of key benthic endpoints among study areas that reflected a minimally-mine influenced (GO-09) to cumulative mine-influenced (CO-05) gradient (see Table 2.6). Benthic invertebrate density at the Mary River study areas was low to moderate for Arctic streams (i.e., within a range of 100 – 1,000 individuals/m²; Craig and McCart 1975) during the August 2015 biological monitoring (Appendix Tables E.19 – E.21). However, no significant differences in benthic invertebrate density were indicated among the five Mary River study areas (Figure 6.5; Appendix Table E.23). In addition, there were no significant differences in richness between the upstream-most, minimally-mine influenced area (GO-09) and each respective mine-exposed area (Figure 6.5). Although richness differed significantly between middle (EO-01) and lower (CO-05) mine-exposed study areas (Figure 6.5; Appendix Table E.23), higher richness at the lower (cumulative effects) study area was not consistent with any adverse mine-related effects. Similarly, although lowest Simpson's Evenness occurred at EO-20, no significant differences in Evenness were shown at mine-exposed areas located upstream and downstream of this study area compared to the GO-09 minimally mine-influenced study area (Figure 6.5; Appendix Table E.23). This suggested that significantly lower Evenness at EO-20 relative to all other study areas was not associated with any adverse mine-related influences.

Differences in benthic invertebrate community composition were also indicated among the Mary River study areas that included lower and higher relative abundance of Chironomidae (non-biting midges) and Tipulidae (crane flies), respectively, at GO-03, and significantly higher relative abundance of Oligochaeta (aquatic worms) at CO-05, compared to the minimally mine-influenced GO-09 study area (Figure 6.5; Appendix Table E.23). However, the relative abundance of metal-sensitive chironomids did not differ significantly between any

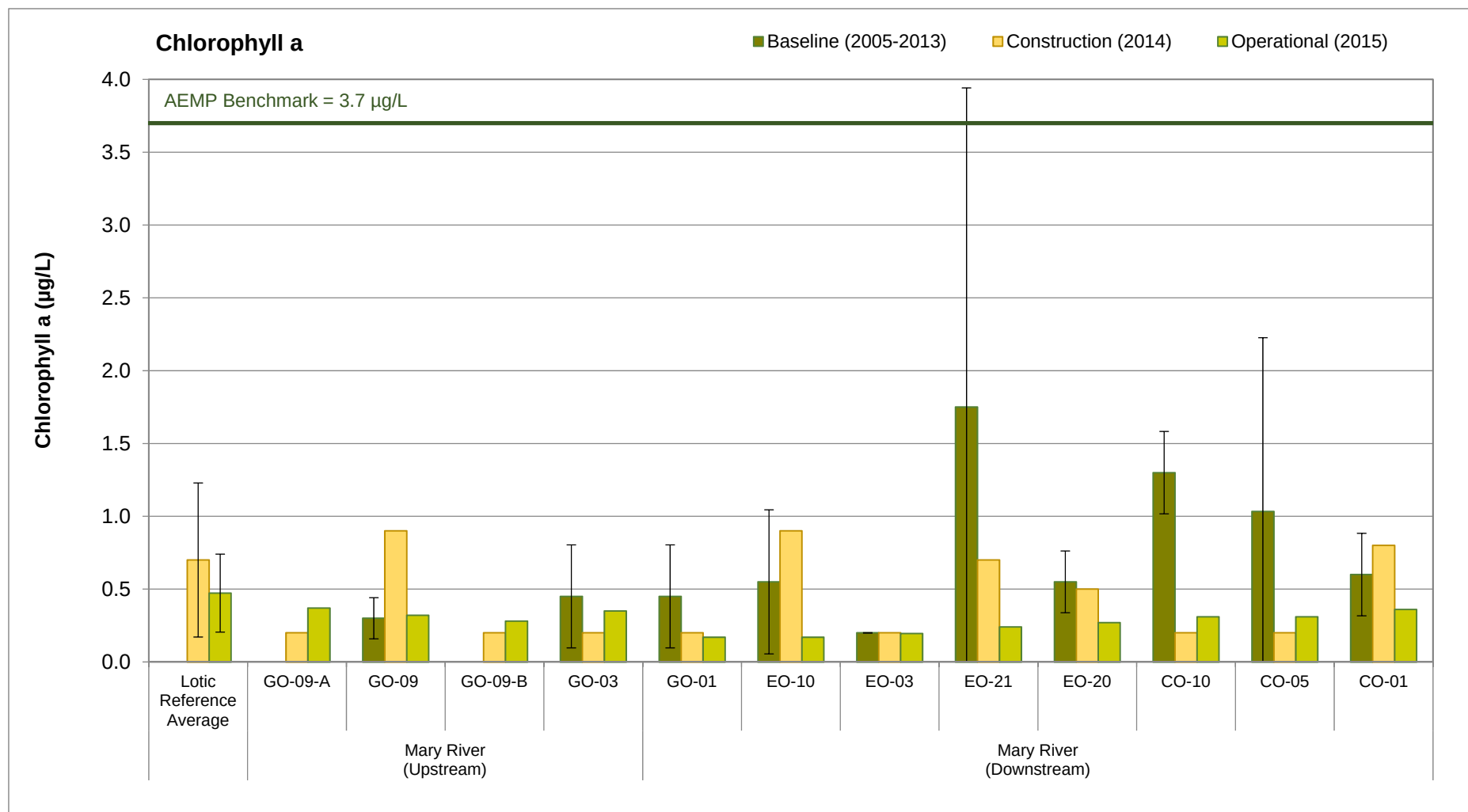


Figure 6.4: Temporal comparison of chlorophyll a concentrations at Mary River stations for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods during the fall, Mary River Project CREMP. The lotic reference stations include the CLT-REF and MRY-REF series (mean $\pm$ SD; n = 4).

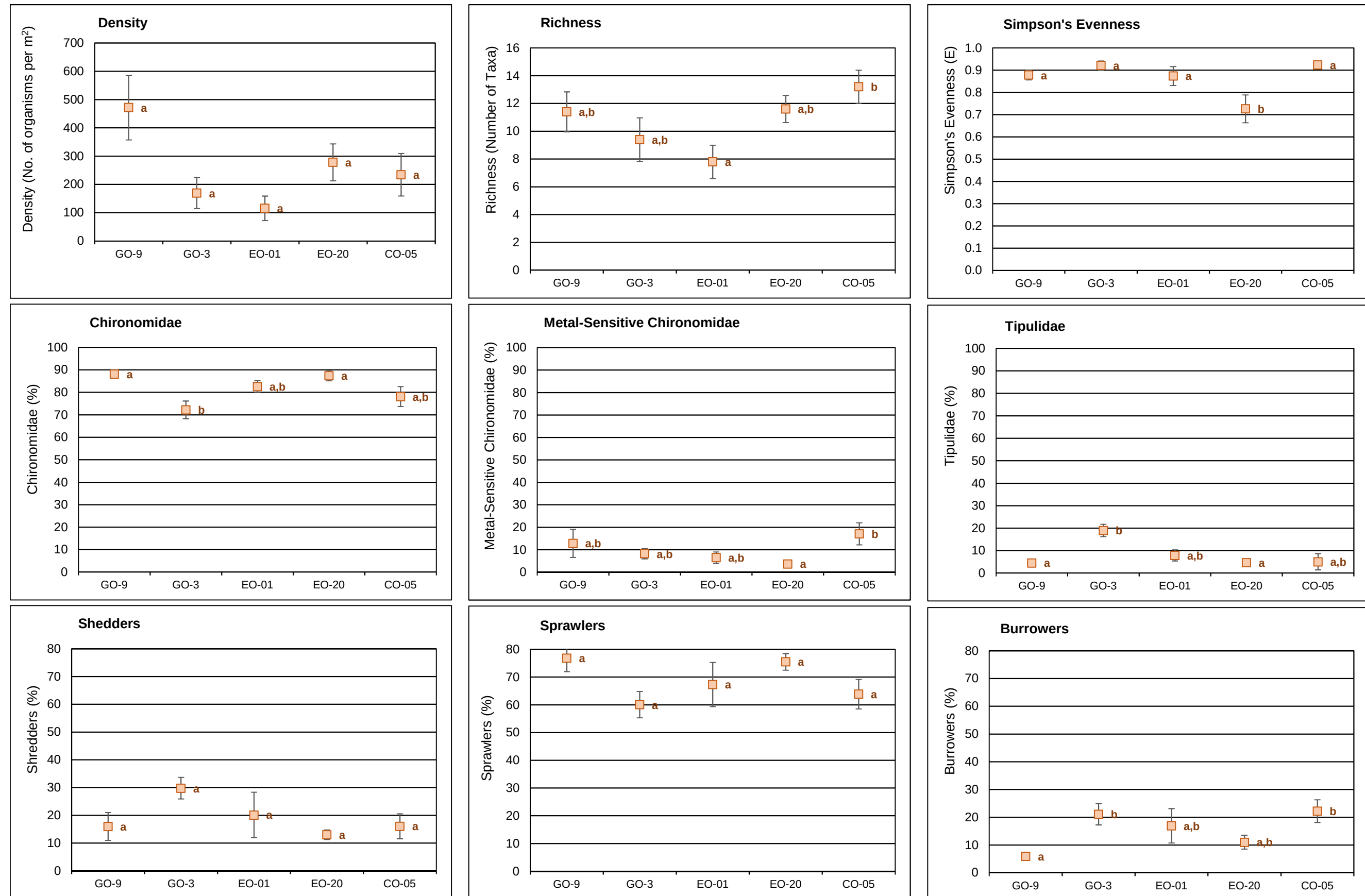


Figure 6.5: Comparison of benthic invertebrate community metrics among Mary River areas (mean $\pm$ SE), Mary River Project CREMP, August 2015. The same letters next to data points indicates no significant difference between/among study areas.

of the mine-exposed areas and the minimally mine-influenced GO-09 study area (Appendix Table E.23). In addition, no significant differences in the relative abundance of any FFG were shown among the Mary River study areas, including comparisons to the minimally mine-influenced GO-09 (Figure 6.5), suggesting no mine-related influences on food resources available for benthic invertebrates in the Mary River. Rather, a significantly higher proportion of the burrower HPG at the GO-03 and CO-05 mine-exposed study areas compared to the minimally mine-influenced GO-09 study area (Figure 6.5; Appendix Table E.23) suggested that the differences in community composition shown at GO-03 and CO-05 study areas were related to natural differences in habitat including a greater proportion of fine substrates (e.g., sand, silt) at the latter (see Appendix Table E.18).

Temporal comparison of the Mary River benthic invertebrate community data indicated lower density and richness of benthic invertebrates at EO-01, EO-20 and CO-05 mine-exposed areas in 2015 compared to the mine baseline and construction periods (Figure 6.6). The relative abundance of collector-gatherer and filterer FFG at these mine-exposed areas also changed in 2015 compared to the baseline and mine construction periods (higher and lower, respectively, in 2015; Figure 6.6). This contrasted with the 2015 data from GO-09 and GO-03 upstream study areas, where benthic invertebrate density, richness and relative abundance of filterers were similar to the baseline period, and the relative abundance of collector-gatherers was lower than during the baseline period (Figure 6.6). Because no changes in Mary River water quality were evident in 2015 compared to the baseline and mine construction periods, the temporal changes in benthic invertebrate community metrics over time may have simply reflected natural variability. For instance, higher Evenness, greater relative abundance of Tipulidae and shredders, and lower relative abundance of Chironomidae were observed at all Mary River study areas in 2015 compared to the baseline and mine construction periods (Figure 6.6), suggesting that these changes between mine baseline and operational periods reflected natural temporal variability within the system.

6.2 Mary Lake (BLO)

6.2.1 Water Quality

Water quality profiles of *in-situ* water temperature, dissolved oxygen, pH and specific conductance conducted at Mary Lake in 2015 indicated warmer water and higher specific conductance at the north basin compared to the south basin of the lake during the summer and fall sampling events (Figures 6.7 and 6.8). Although no thermal stratification was apparent at the Mary Lake north or south basins during the winter or fall sampling events in 2015, thermocline development was observed during the summer. Thermal stratification was also apparent at Reference Lake 3 during the summer (Figures 6.7 and 6.8). On average,

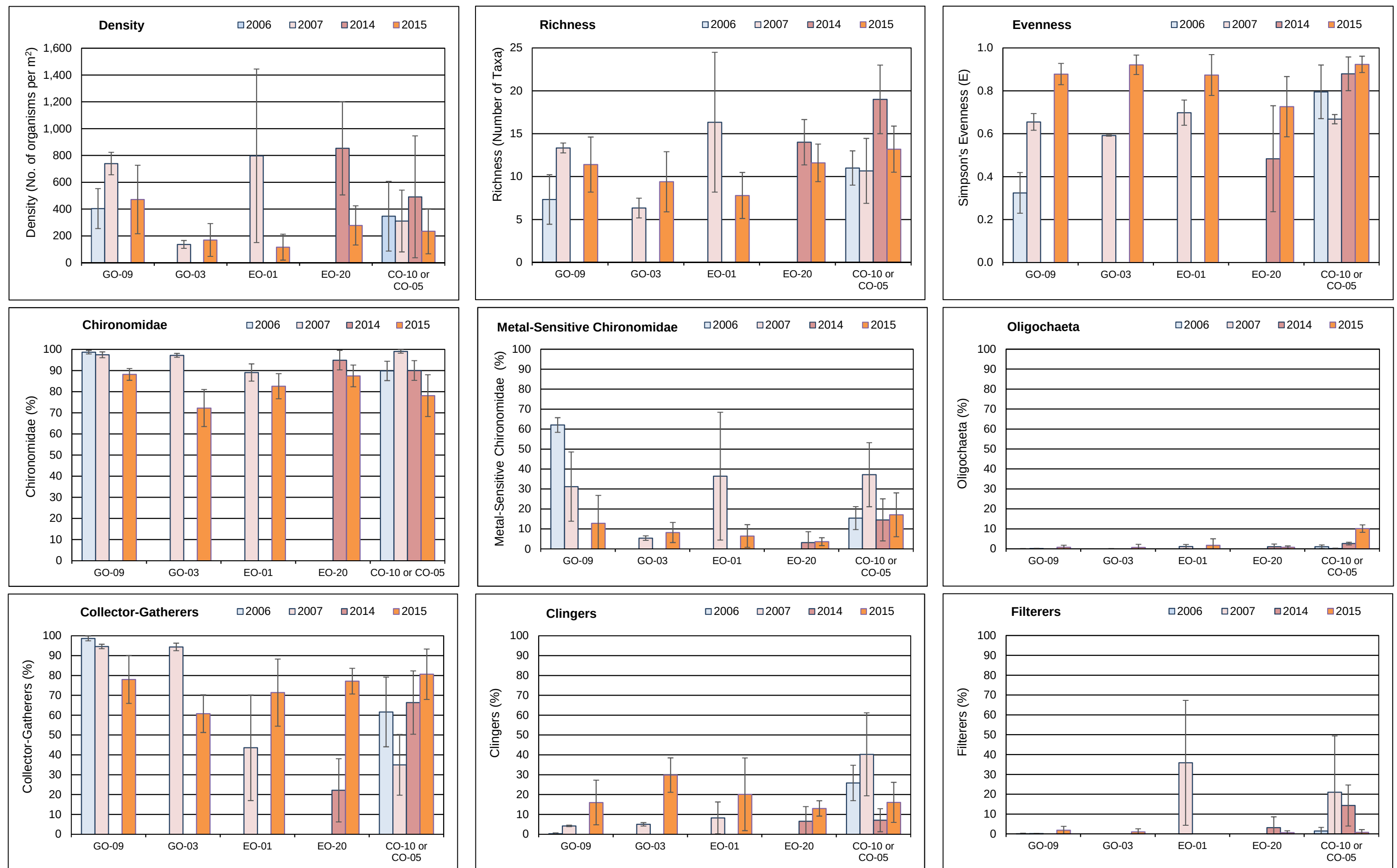


Figure 6.6: Comparison of benthic invertebrate community metrics (mean $\pm$ SD) at Mary River stations among baseline (2006, 2007), construction (2014) and operational (2015) studies, Mary River Project CREMP.

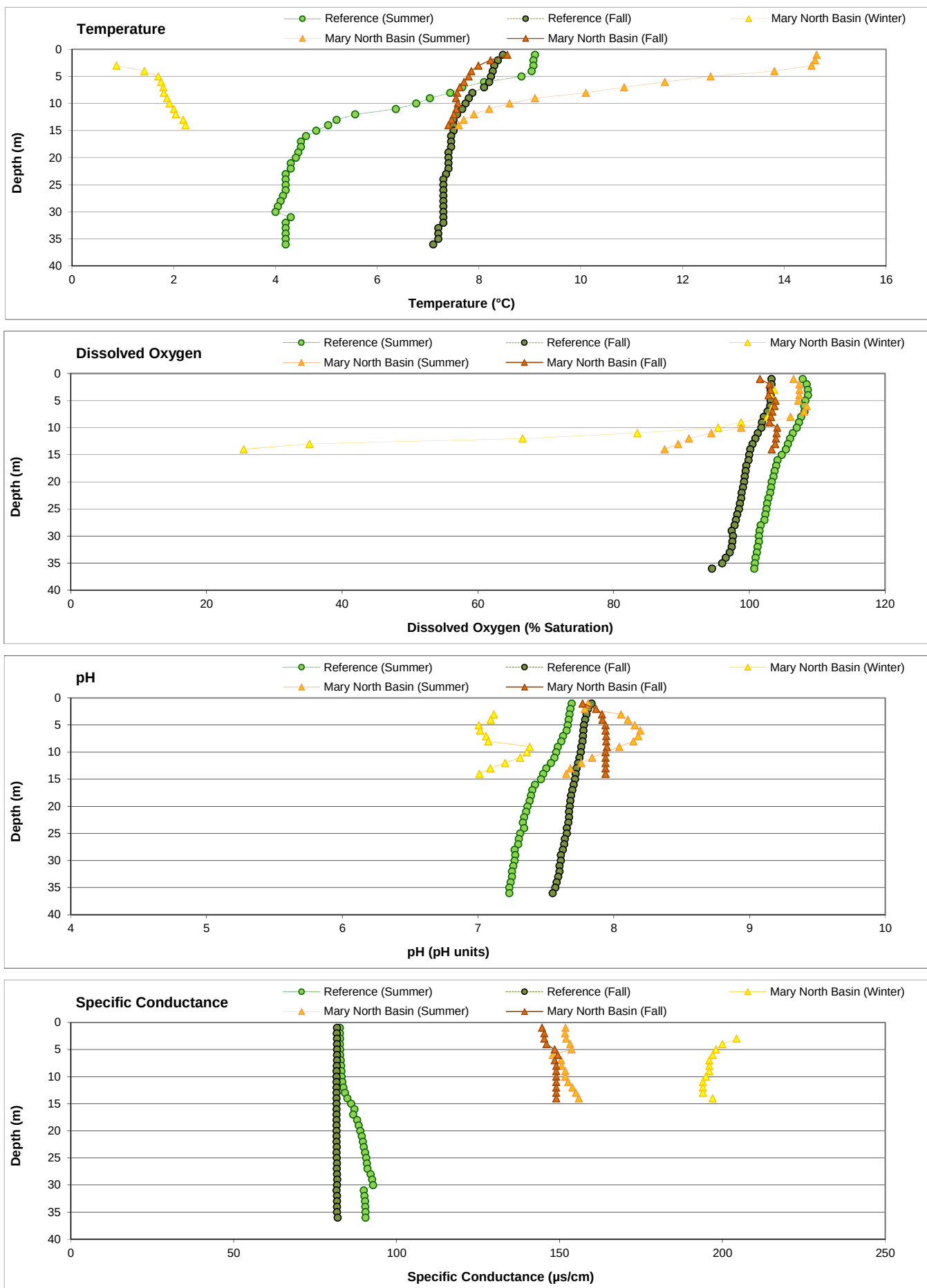


Figure 6.7: Average *in-situ* water quality with depth from surface at the Mary Lake (mine-exposed area) north basin compared to Reference Lake 3 during winter, summer, and fall sampling events, Mary River Project CREMP, 2015.

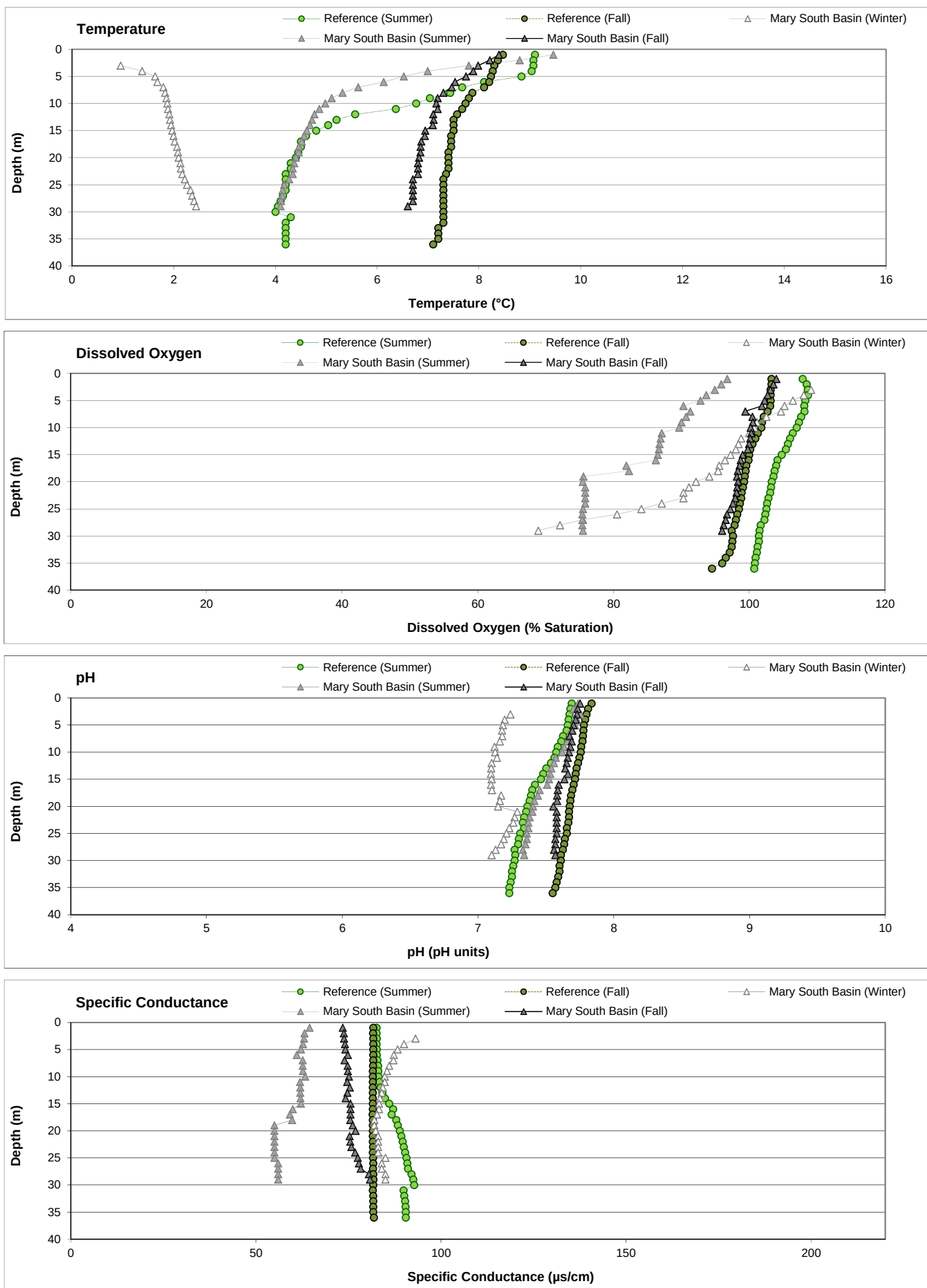


Figure 6.8: Average *in-situ* water quality with depth from surface at the Mary Lake (mine-exposed area) south basin compared to Reference Lake 3 during winter, summer, and fall sampling events, Mary River Project CREMP, 2015.

bottom water temperature at Mary Lake littoral and profundal stations was slightly cooler than at Reference Lake 3 at the time of fall sampling in 2015, although the difference was statistically significant only for the profundal stations (Figure 6.9; Appendix Table B.22 and B.23). Dissolved oxygen profiles indicated winter and summer oxycline development in 2015, beginning at approximately 7 – 9 m below the surface in the north basin and at the surface in the south basin (Figures 6.7 and 6.8). This differed from Reference Lake 3 where no oxycline was apparent in the summer. Although dissolved oxygen saturation levels remained above the WQG of 54% through the water column at the south basin in all seasons, including at littoral and profundal stations during the fall sampling event, saturation levels below this level occurred at depths greater than approximately 12.5 m at the north basin in the winter (Figure 6.7; Appendix Tables B.22 – B.23). No substantial changes in dissolved oxygen saturation levels were apparent from surface to bottom in the fall of 2015 at either the Mary Lake north or south basins, nor at Reference Lake 3 (Figures 6.7 and 6.8). Dissolved oxygen saturation levels at the bottom of the water column at littoral and profundal stations of Mary Lake were similar to those at Reference Lake 3 during the 2015 fall sampling event (Figure 6.9; Appendix Tables B.22 – B.23).

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 2015, and were also similar to pH profiles at Reference Lake 3 (Figures 6.7 and 6.8). Although pH at the bottom of the water column at littoral and profundal stations of Mary Lake was slightly lower than at the reference during fall sampling, the mean incremental difference between lakes was small (i.e., <0.2 pH units) and all pH values were consistently within WQG limits (Figure 6.9), suggesting that the pH difference between lakes was unlikely to be ecologically meaningful. Specific conductance was substantially higher at the north basin compared to the south basin of Mary Lake (Figures 6.7 and 6.8). The differences in specific conductance between lake basins likely reflected natural differences in dominant inflow sources to Mary Lake, including the Tom River inflow to the north basin and the Mary River inflow to the south basin, and natural differences in geochemistry associated with these inflows. Specific conductance profiles showed no changes in specific conductance with depth during the winter, summer and fall sampling events in 2015 at either lake basin (Figures 6.7 and 6.8). Specific conductance of the Mary Lake north basin was comparable to that of the lotic reference stations, whereas on average, bottom specific conductance at littoral and profundal stations of Mary Lake was lower than that at both the lotic reference station average and Reference Lake 3 (Figure 6.9). Accordingly, no marked influences on specific conductance of Mary Lake were suggested by the 2015 data. Water clarity was significantly lower at Mary Lake compared to Reference Lake 3 during the 2015

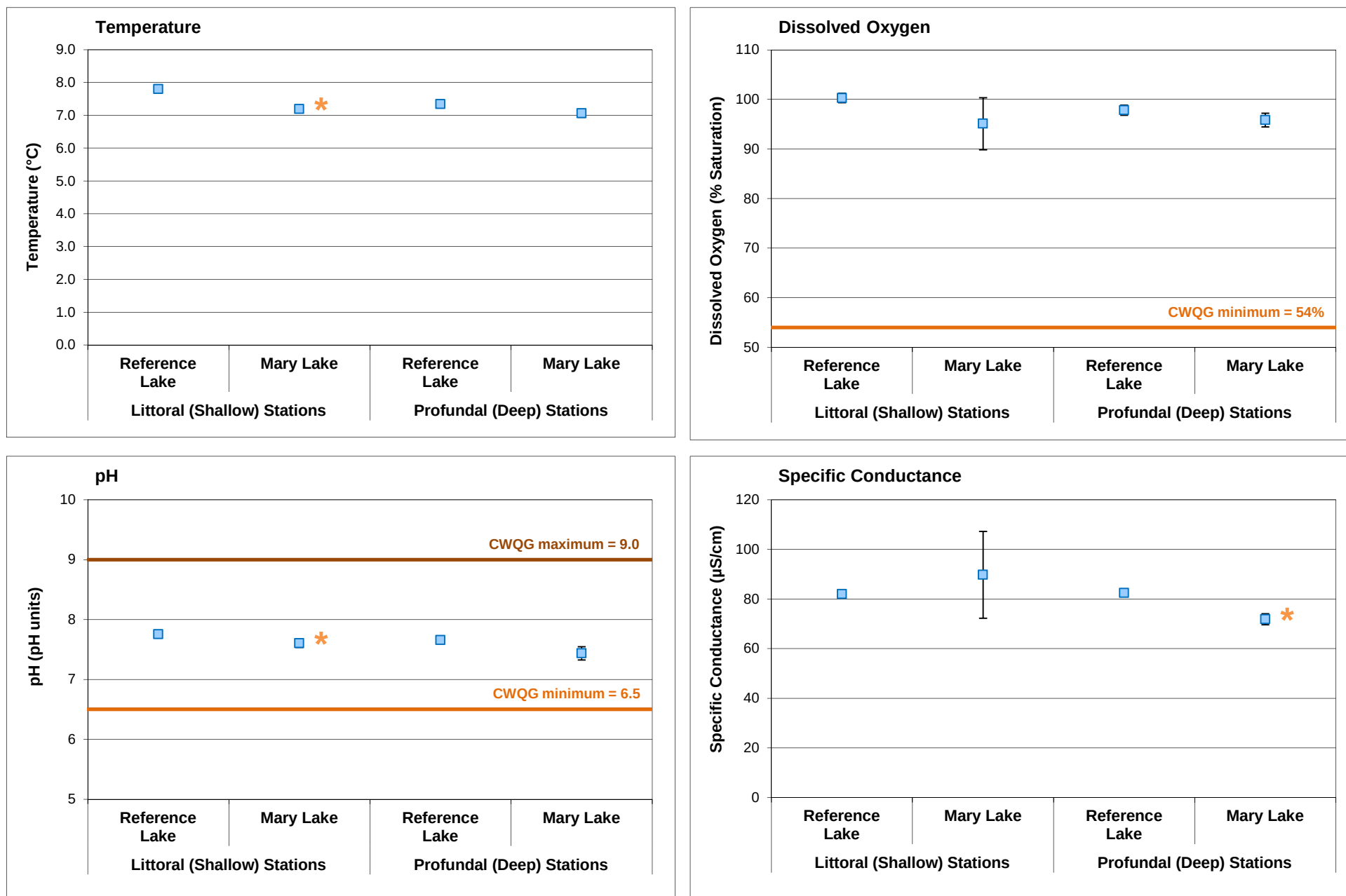


Figure 6.9: Comparison of *in-situ* water quality variables (mean $\pm$ SD; n = 5) measured at Mary Lake (BLO) and Reference Lake 3 (REF3) littoral and profundal benthic invertebrate community stations, Mary River Project CREMP, August 2015. An asterisk (*) next to the Mary Lake data point indicates a significant difference compared to the reference lake measure for the respective station type.

fall sampling event (Appendix Table B.22 – B.23). In general, Secchi depth readings were similar among the Mary Lake stations, suggesting no spatial differences in water clarity throughout the lake (Appendix Table B.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 aluminum, manganese and/or uranium compared to Reference Lake 3 at the time of summer and fall sampling in 2015 (Table 6.2; Appendix Table B.62). However, of these parameters, only manganese was only slightly elevated between the Mary Lake north basin and mean lotic reference station water quality. 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 2015¹²(Table 6.2; Appendix Table B.58). Furthermore, there were no consistent differences in average concentrations of any parameters among mine baseline (2005 – 2013), construction (2014) and operational (2015) periods over each respective winter, summer and fall season (Figure 6.10; Appendix Table B.62 and Figure B.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 of 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 2015 (Table 6.2; Appendix Table B.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 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 2015 summer and/or fall sampling events (Table 6.2; Appendix Tables B.59 and B.62). Similar to water chemistry of the Mary River and Sheardown Lake SE water bodies, turbidity showed a strong positive correlation with aluminum and manganese concentrations for the Mary Lake south basin combined data (i.e., winter, summer and fall data; $r^2 = 0.93$), suggesting that much of the aqueous aluminum and manganese was associated with suspended particles. As indicated previously, high turbidity of Mary River originated from natural sources upstream of the mine 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, concentrations of all parameters were generally well below established WQG and AEMP

Table 6.2: Water chemistry at Mary Lake north basin (BLO-01) and south basin (BLO) monitoring stations, Mary River Project CREMP, 2015. 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) Fall 2015	Tom River I0-01 16-Aug-2015	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
							24-Aug-2015	24-Aug-2015	24-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	76.4	155	147	147	148	74.2	73.8	71.7	67.5	71.7	73.0	69.3
	pH (lab)	pH	6.5 - 9.0	-	7.59	8.02	8.02	8.08	8.08	7.72	7.75	7.72	7.74	7.72	7.69	7.69
	Hardness (as CaCO ₃)	mg/L	-	-	35	76	72	72	71	35	35	33	32	34	33	33
	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	-	-	37	98	74	76	76	31	33	37	28	27	33	33
	Turbidity	NTU	-	-	0.22	1.20	0.77	0.67	0.72	2.01	1.74	1.86	0.72	1.48	1.35	1.38
	Alkalinity (as CaCO ₃)	mg/L	-	-	31	78	69	69	69	35	34	33	33	34	32	31
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	<0.050	<0.050	<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	-	-	0.15	0.21	0.53	<0.15	1.26	0.17	0.15	0.15	0.16	0.15	0.15	0.20
	Dissolved Organic Carbon	mg/L	-	-	3.1	2.4	2.0	2.0	2.0	1.6	1.7	1.6	1.6	1.6	1.6	1.5
	Total Organic Carbon	mg/L	-	-	3.3	2.0	2.0	2.0	2.0	1.6	1.6	1.6	1.6	1.7	1.6	1.7
	Total Phosphorus	mg/L	0.020 ^{a,d}	-	0.0035	0.0037	0.0038	0.0038	0.0036	0.0064	0.0102	0.0042	0.0043	0.0059	0.0049	0.0120
	Phenols	mg/L	0.001 ^a	-	0.00282	0.0021	<0.0010	<0.0010	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.28	2.36	2.58	2.57	2.58	1.61	1.59	1.57	1.36	1.54	1.57	1.45
	Sulphate (SO ₄)	mg/L	218 ^{g,e}	218	4.35	1.54	1.39	1.39	1.38	1.12	1.08	1.06	0.84	1.03	1.06	0.965
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	<0.0030	0.0352	0.0168	0.0166	0.0179	0.0641	0.0566	0.0515	0.0225	0.0463	0.1163	0.0458
	Antimony (Sb)	mg/L	0.020 ^a	-	<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	-	-	0.00637	0.00740	0.00693	0.00666	0.00694	0.00440	0.00425	0.00404	0.00367	0.00408	0.00484	0.00387
	Beryllium (Be)	mg/L	0.011 ^a	-	<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 ^f	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	-	-	7.10	16.10	14.58	14.53	14.55	7.13	7.04	6.87	6.74	6.89	7.01	6.63
	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 ^a	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00014	<0.00010
	Copper (Cu)	mg/L	0.002 ^g	0.0024	0.00083	0.00089	0.00093	0.00086	0.00091	0.00071	0.00060	0.00060	0.00055	0.00060	0.00088	0.00058
	Iron (Fe)	mg/L	0.30	0.30	<0.030	<0.030	<0.030	<0.030	<0.030	0.045	0.040	0.036	0.030	0.038	0.14	0.031
	Lead (Pb)	mg/L	0.001 ^h	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000072	0.000059	0.000054	<0.000050	0.000061	0.000270	0.000051
	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	-	-	4.23	9.58	8.50	8.50	8.52	4.35	4.36	4.17	3.99	4.20	4.21	4.12
	Manganese (Mn)	mg/L	0.935 ^{g,i}	-	0.000411	0.000583	0.00199	0.00197	0.00185	0.00240	0.00155	0.00134	0.00118	0.00146	0.01291	0.00127
	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	-	0.000131	0.000214	0.000196	0.000194	0.000192	0.000162	0.000148	0.000138	0.000115	0.000132	0.000127	0.000129
	Nickel (Ni)	mg/L	0.025 ^j	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.000635	<0.00050
	Potassium (K)	mg/L	-	-	0.91	0.79	0.83	0.83	0.83	0.58	0.56	0.55	0.51	0.55	0.57	0.54
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.40	0.90	0.69	0.69	0.69	0.53	0.50	0.46	0.38	0.48	0.55	0.46
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.819	2.03	1.82	1.82	1.82	1.00	0.988	0.943	0.852	0.937	0.938	0.912
	Strontium (Sr)	mg/L	-	-	0.00791	0.0105	0.00973	0.00973	0.00977	0.00568	0.00564	0.00538	0.00496	0.00539	0.00556	0.00520
	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	-	0.000266	0.00172	0.00146	0.00145	0.00143	0.000619	0.000607	0.000542	0.000420	0.000535	0.000660	0.000493
	Vanadium (V)	mg/L	0.006 ^a	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 2.3 for information regarding WQG criteria.

^b AEMP Water Quality Benchmarks developed by Intrinsik (2013) using background water quality data. The values are specific to the Mary Lake System.

 Indicates parameter concentration above applicable Water Quality Guideline.

 **BOLD** Indicates parameter concentration above the AEMP benchmark.



Figure 6.10: Temporal comparison of water chemistry at Mary Lake (BLO) for mine baseline (2005 - 2013), construction (2014), and operational (2015) periods in the fall. Values represent mean $\pm$ SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.3 for information regarding Water Quality Guidelines (WQG). AEMP Benchmarks are specific to Mary Lake.

benchmarks during all 2015 sampling events¹² (Table 6.2; Appendix Table B.59). Temporal comparisons of the Mary Lake south basin water chemistry data suggested no differences in average concentrations of mine-related parameters in 2015 compared to the baseline (2005 – 2013) and mine-construction (2014) periods during each respective winter, summer and fall season (Figure 6.10). The lack of any temporal differences in water quality of the Mary Lake south basin provided additional support that elevated metal concentrations at the south basin were related to naturally higher turbidity rather than a mine influence on lake water quality.

6.2.2 Sediment Quality

Surficial sediment of the Mary Lake north basin (BLO-01) was comprised of silt loam with low TOC content (Figure 6.11). At the Mary Lake south basin, physical sediment properties showed some variability among stations, with silt and clay loams predominant but sand also present (Figure 6.11). Substrate containing iron (oxy)hydroxide material was uncommon at the Mary Lake north and south basins (Appendix Tables C.17 – C.18), 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. In addition, substrate of Mary Lake occasionally contained sub-surface black/dark colouration that suggested reducing (i.e., anoxic) sediment (Appendix Tables C.17 – C.18), which was similar to substrate observations at Reference Lake 3, where visible evidence of reducing sediment conditions was also observed. Sediment TOC content was significantly lower at profundal sediment stations of the Mary Lake south basin than at Reference Lake 3 (Appendix Table E.40), which may have implications for benthic invertebrate communities.

Sediment metal concentrations at the Mary Lake north basin were very similar to those observed at littoral stations of Reference Lake 3 (Table 6.3; Appendix Table C.20). Of those metals with established SQG, only manganese was above the respective guideline at the north basin of Mary Lake in 2015 (Table 6.3; Appendix Table C.19). However, as discussed in Section 3.3, average concentrations of iron and manganese were above respective SQG at Reference Lake 3, suggesting natural elevation of these metals in regional lake sediments. No metals were above AEMP benchmarks at the Mary Lake north basin with the exception of arsenic, but because arsenic was above the mine-exposed AEMP benchmark at Reference Lake 3 (Table 6.3; Appendix Table C.19), the criterion for arsenic may be overly conservative for use as an effects-related threshold.

Sediment metal concentrations at the Mary Lake south basin showed no spatial gradients with progression from the Mary River inlet to the lake outlet, suggesting that the Mary River

¹² Refer to footnote 2 (page 28) and Section 3.0 regarding phenol concentrations above WQG at the mine-exposed and reference areas of the Mary River Project LSA.

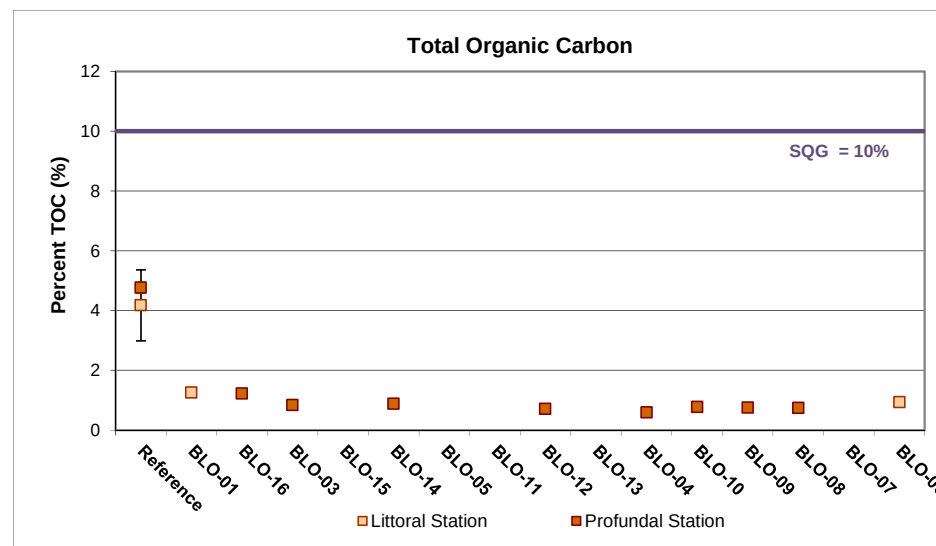
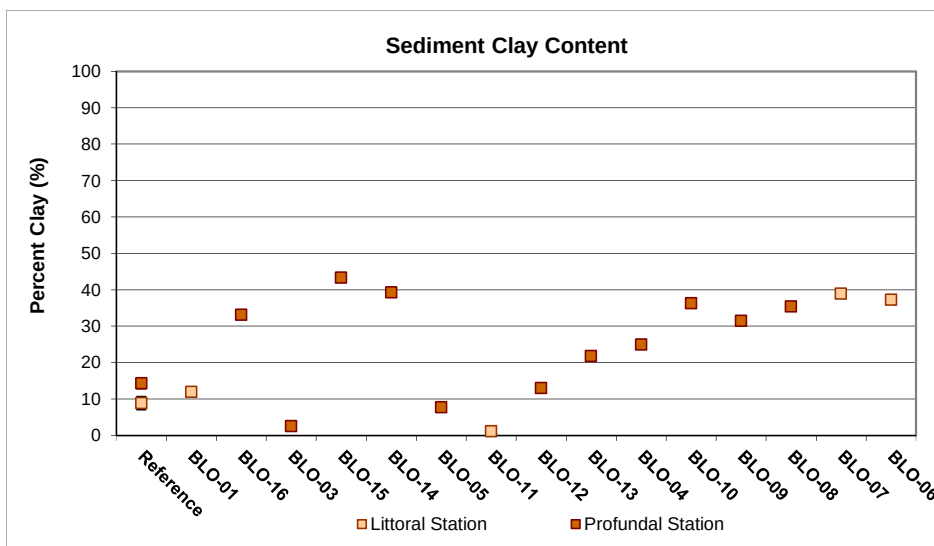
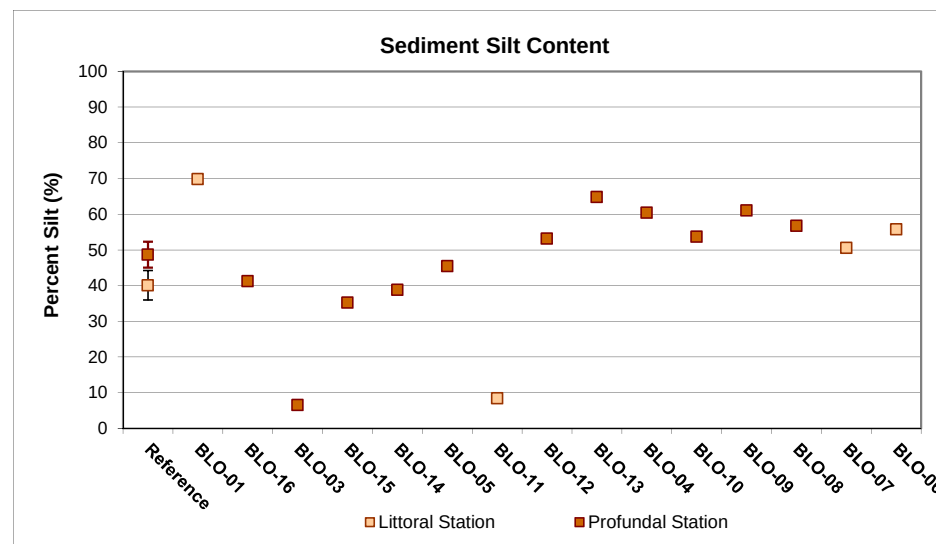
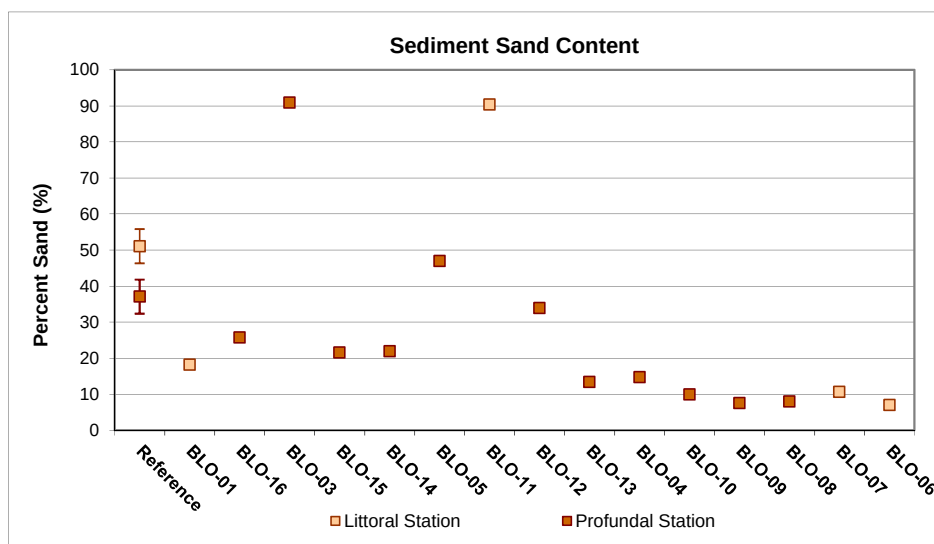


Figure 6.11: Sediment particle size and total organic carbon (TOC) content comparisons among Mary Lake (BLO) north and south basin sediment monitoring stations and to Reference Lake 3 averages (mean $\pm$ SE), Mary River Project CREMP, August 2015.

Table 6.3: 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 2015.

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=2)	Reference Lake (n = 5)	Mary Lake (South Basin) (n=8)
					Average ± Std. Error	Average	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error
Non-metals	Sand	%	-	-	51.1 ± 4.7	18.2	12.6 ± 5.6	37.0 ± 5	26.6 ± 9.8
	Silt	%	-	-	40.1 ± 4.1	69.8	62.8 ± 7.1	48.6 ± 4	46.4 ± 6.4
	Clay	%	-	-	8.87 ± 1.8	12.0	24.7 ± 12.7	14.3 ± 1	27.0 ± 4.6
	Moisture	%	-	-	84.1 ± 3.7	54.0	60.8 ± 6.8	86.0 ± 1	53.8 ± 2.7
	Total Organic Carbon	%	10 ^a	-	4.18 ± 1.2	1.26	1.10 ± 0.16	4.77 ± 0.16	0.82 ± 0.066
Metals	Aluminum (Al)	mg/kg	-	-	16,120 ± 1,372	14,700	21,300 ± 6,600	27,060 ± 1,745	24,913 ± 1,635
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	<0.10	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0
	Arsenic (As)	mg/kg	17	5.9	5.60 ± 1.22	5.99	4.92 ± 1.08	6.32 ± 0.34	5.24 ± 1.49
	Barium (Ba)	mg/kg	-	-	116 ± 16	80	94 ± 13	149 ± 8.0	98 ± 8.0
	Beryllium (Be)	mg/kg	-	-	0.69 ± 0.07	0.75	1.1 ± 0.35	1.04 ± 0.0438	1.2 ± 0.080
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0	0.200	0.240 ± 0.040	0.227 ± 0.00735	0.284 ± 0.0169
	Boron (B)	mg/kg	-	-	15.0 ± 1.38	22.5	33.0 ± 10.5	21.6 ± 0.919	36.5 ± 2.35
	Cadmium (Cd)	mg/kg	3.5	1.5	0.213 ± 0.027	0.0970	0.111 ± 0.0140	0.203 ± 0.016	0.140 ± 0.0105
	Calcium (Ca)	mg/kg	-	-	4,976 ± 430	8,960	6,995 ± 1,965	7,000 ± 542	4,583 ± 209
	Chromium (Cr)	mg/kg	90	98	53.9 ± 5.2	64.9	78.6 ± 13.7	85.1 ± 5.4	91.6 ± 5.48
	Cobalt (Co)	mg/kg	-	-	12.6 ± 0.641	14.2	16.1 ± 1.85	19.0 ± 1.2	17.6 ± 1.08
	Copper (Cu)	mg/kg	110	50	69.4 ± 8.79	27.3	31.2 ± 3.85	101.5 ± 6.34	34.5 ± 2.24
	Iron (Fe)	mg/kg	40,000 ^a	52,400	59,220 ± 15,044	35,000	38,750 ± 3,750	54,450 ± 3,037	43,019 ± 4,131
	Lead (Pb)	mg/kg	91.3	35	16.1 ± 1.0	16.8	22.1 ± 5.30	23.4 ± 0.5	25.3 ± 1.57
	Lithium (Li)	mg/kg	-	-	25.9 ± 2.4	28.0	42.3 ± 14.3	40.6 ± 2.0	47.0 ± 3.38
	Magnesium (Mg)	mg/kg	-	-	10,088 ± 858	14,400	15,750 ± 1,350	16,930 ± 1,089	16,063 ± 971
	Manganese (Mn)	mg/kg	1,100 ^{a,β}	4,370	871 ± 47	1,550	1,222 ± 328	1,756 ± 448	1,681 ± 715
	Mercury (Hg)	mg/kg	0.486	0.17	0.0453 ± 0.0107	0.0247	0.0354 ± 0.0107	0.0852 ± 0.0108	0.0502 ± 0.0042
	Molybdenum (Mo)	mg/kg	-	-	6.21 ± 1.63	0.650	0.750 ± 0.100	3.31 ± 0.50	1.00 ± 0.172
	Nickel (Ni)	mg/kg	75 ^{a,β}	72	43.3 ± 3.1	55.5	58.3 ± 2.80	59.7 ± 3.6	65.9 ± 4.21
	Phosphorus (P)	mg/kg	2,000 ^a	1,580	1,506 ± 463	1,100	947 ± 154	1,214 ± 62	984 ± 151
	Potassium (K)	mg/kg	-	-	3,960 ± 272	3,580	5,400 ± 1,820	6,491 ± 386	6,237 ± 425
	Selenium (Se)	mg/kg	-	-	0.66 ± 0.13	<0.20	0.23 ± 0.030	0.95 ± 0.058	0.23 ± 0.012
	Silver (Ag)	mg/kg	-	-	0.14 ± 0.02	<0.10	0.14 ± 0.035	0.31 ± 0.011	0.17 ± 0.010
	Sodium (Na)	mg/kg	-	-	283 ± 23	237	331 ± 93.5	492 ± 29	382 ± 24.4
	Strontium (Sr)	mg/kg	-	-	12.6 ± 0.709	13.3	15.3 ± 2.00	19.5 ± 1.77	16.4 ± 0.968
	Sulphur (S)	mg/kg	-	-	<5,000 ± 0	<5,000	<5,000 ± 0	<5,000 ± 0	<5,000 ± 0
	Thallium (Tl)	mg/kg	-	-	0.47 ± 0.040	0.36	0.54 ± 0.18	0.92 ± 0.035	0.62 ± 0.039
	Tin (Sn)	mg/kg	-	-	<2.0 ± 0	<2.0	<2.0 ± 0	2.15 ± 0.084	2.03 ± 0.025
	Titanium (Ti)	mg/kg	-	-	967 ± 61	952	1,401 ± 449	1,391 ± 110	1,565 ± 95.8
	Uranium (U)	mg/kg	-	-	14.5 ± 1.78	4.20	7.40 ± 3.20	27.1 ± 1.76	9.69 ± 0.624
	Vanadium (V)	mg/kg	-	-	52.8 ± 4.76	48.0	61.1 ± 13.1	75.8 ± 5.05	67.9 ± 4.11
	Zinc (Zn)	mg/kg	315	135	78.4 ± 7.53	50.5	71.0 ± 20.5	111.5 ± 7.31	82.2 ± 5.75

^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; BCME 2015)).

^b AEMP Sediment Quality Benchmarks developed by Intrinsic (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to Mary Lake.

Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

was not contributing disproportionate concentrations of metals (Appendix Table C.19). Sediment metal concentrations at Mary Lake south basin littoral and profundal sediment monitoring stations were comparable to average metal concentrations at like-depth stations of Reference Lake 3 (Table 6.3; Appendix Table C.20). Sediment chromium, iron, manganese, nickel and phosphorus concentrations were above respective SQG at one or more stations in the Mary Lake south basin but, on average, only chromium, iron and manganese were above respective SQG, of which iron and manganese concentrations were also above SQG at the reference lake (Table 6.3; Appendix Table C.19). These metals, and arsenic, were above sediment AEMP benchmarks at as many as three stations in the Mary Lake south basin (Appendix Table C.19), but on average, none were above respective benchmarks at the Mary Lake south basin.

Temporal comparisons of the sediment metals data suggested only a slight elevation (i.e., 2- to 5-fold higher) in calcium concentrations at Mary Lake littoral stations, and similar metal concentrations at profundal stations, compared to the baseline period (Figure 6.12; Appendix Table C.20). Although concentrations of several metals appeared to be elevated at Mary Lake littoral stations in 2015 compared to 2014, the average concentration of each respective metal was generally much lower in 2014 than during the baseline period (Appendix Table C.20), suggesting that changes in station location or other factors may have contributed to the apparent difference among studies. Overall, no mine influence on sediment quality was suggested at Mary Lake south basin in 2015 based on similar sediment metal concentrations to the reference lake in 2015 as well as to those during the baseline period.

6.2.3 Phytoplankton

Chlorophyll a concentrations at Mary Lake showed no consistent spatial changes with progression 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 2015 (Figure 6.13). Unlike the other mine-exposed lakes, no significant differences in chlorophyll a concentrations were shown among winter, summer and fall sampling events at either the north or south basins of Mary Lake in 2015 (Appendix Table D.8). In addition, chlorophyll a concentrations at the Mary Lake north and south basins did not differ significantly from those at Reference Lake 3 for both the summer and fall sampling events in 2015 (Appendix Tables D.9 and D.10). The Mary Lake chlorophyll a concentrations were also well below the AEMP benchmark of 3.7 µg/L during all winter, summer and fall sampling events in 2015 (Figure 6.13). Chlorophyll a concentrations at Mary Lake reflected an 'oligotrophic' primary productivity categorization (sensu Wetzel 2001), which agreed closely with an 'oligotrophic' CWQG

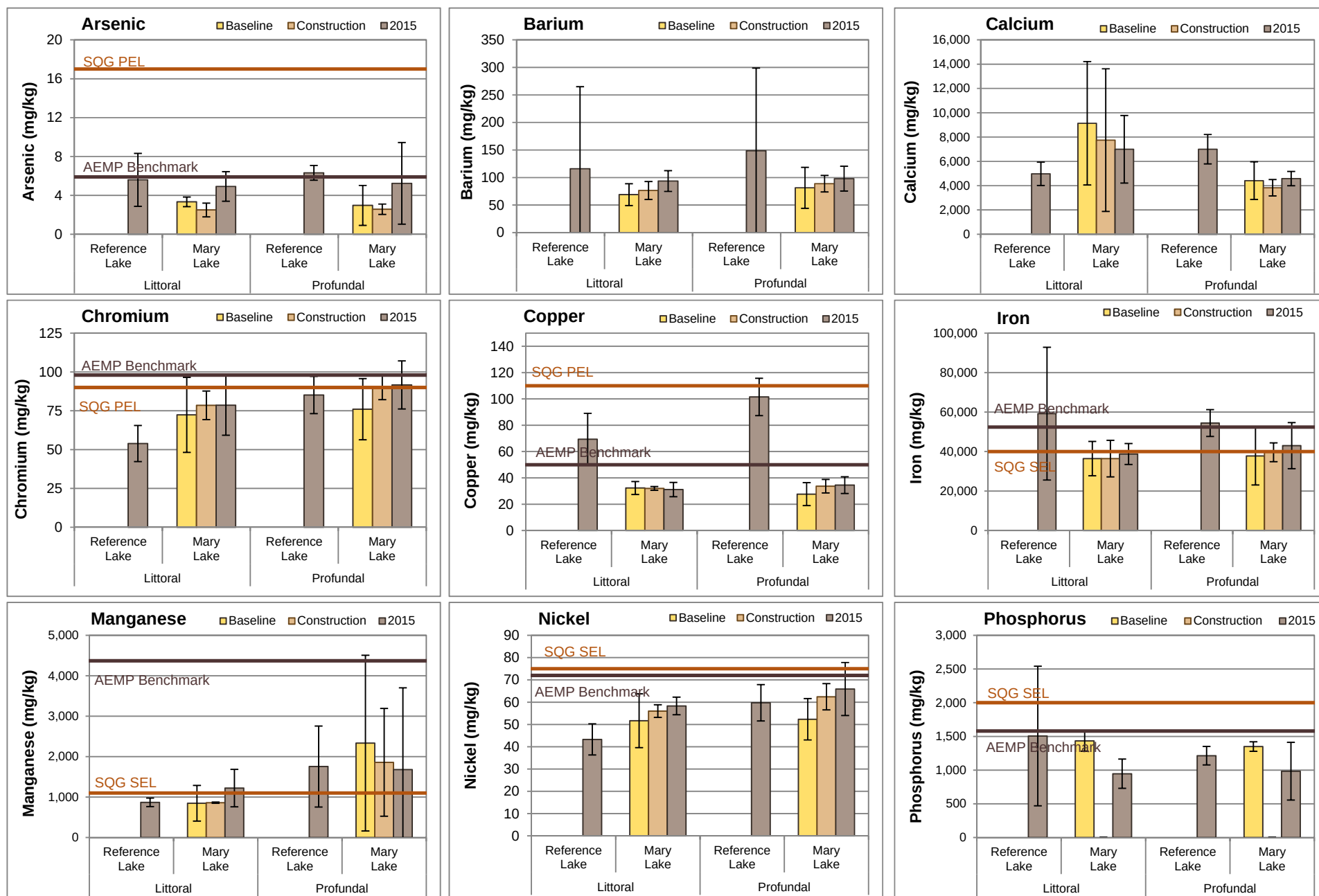


Figure 6.12: Temporal comparison of sediment metal concentrations (mean $\pm$ SD) at littoral and profundal stations of Mary Lake and Reference Lake 3 for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods, Mary River Project CREMP.



Figure 6.13: Chlorophyll a concentrations at Mary Lake (BLO) phytoplankton monitoring stations, Mary River Project CREMP, 2015. Values presented are averages of samples taken from the surface and the bottom of the water column at each station. Reference values represent mean $\pm$ standard deviation ($n = 3$). Reference Lake 3 was not sampled in winter 2015.

categorization based on mean aqueous total phosphorus concentrations ranging between 4 – 10 µg/L during all sampling events in 2015 at Mary Lake (Table 6.2; Appendix Table B.58 – B.59).

Temporal comparisons indicated no significant differences in chlorophyll a concentrations between 2015 and the mine construction (2014) period for any of the winter, summer or fall seasons at both the Mary Lake north and south basins (Figure 6.14; Appendix Table D.13). Similarly, no significant differences in chlorophyll a concentrations were indicated between years at each lake basin based on annual averages (ANOVA, $p = 0.847$ and 0.547 for north and south basins, respectively). Overall, this suggested that the trophic status of Mary Lake had not changed significantly between 2014 and 2015. No chlorophyll a baseline (2005 – 2013) data are available for Mary Lake, precluding comparisons to conditions prior to the mine construction period.

6.2.4 Benthic Invertebrate Community

Benthic invertebrate density and richness did not differ significantly between Mary Lake and Reference Lake 3 at littoral stations, but at profundal stations, both indices were significantly higher at Mary Lake (Tables 6.4 and 6.5). Simpson's Evenness also differed significantly between Mary Lake and Reference Lake 3, but the direction of the difference varied between the littoral and profundal habitat depths, and the magnitude of the difference was at or within ecologically relevant CES_{BIC} (i.e., $\pm 2 SD_{REF}$; Tables 6.4 and 6.5).

Some differences in benthic invertebrate community structure of Mary Lake and Reference Lake 3 were suggested by differences in Bray-Curtis Index (Tables 6.4 and 6.5). However, no ecologically meaningful differences in the relative abundance of dominant taxonomic groups were indicated between Mary Lake and Reference Lake 3 at either the littoral or profundal stations (i.e., CES_{BIC} within $\pm 2 SD_{REF}$). In addition, the relative abundance of metal-sensitive Chironomidae, although not significant, was slightly higher at Mary Lake than at the reference lake at all littoral and profundal stations (Tables 6.4 and 6.5). No significant differences in the relative abundance of dominant FFG or HPG were shown between Mary Lake and Reference Lake 3 littoral stations. Although the relative abundance of some FFG differed significantly between Mary Lake and Reference Lake 3 profundal stations, because the relative abundance of metal-sensitive taxa did not differ significantly between areas, the FFG relative abundance differences may have reflected differences in available food source rather than a metal-related influence. Similar to Camp Lake, significantly lower sediment TOC at profundal stations of Mary Lake compared to the reference lake (Appendix Table E.40) likely accounted for the lower relative abundance of collector-gatherers at Mary Lake.

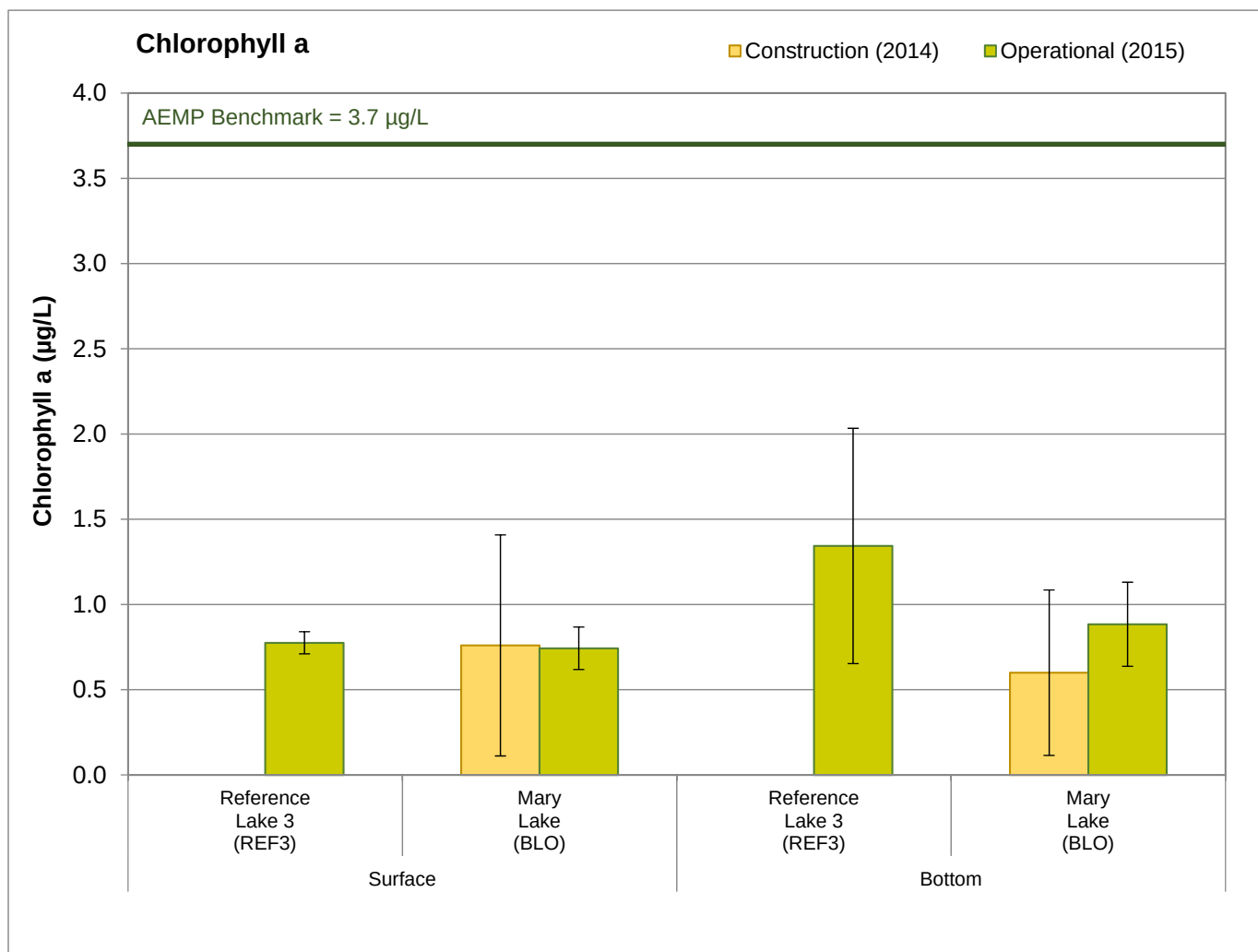


Figure 6.14: Temporal comparison of chlorophyll a concentrations at Mary Lake (BLO) and Reference Lake 3 (REF3) for mine construction (2014) and operational (2015) periods during the fall, Mary River Project CREMP. Average chlorophyll a concentrations ($\pm$ SD) from samples taken at the surface and bottom of the Mary Lake (n = 10) and Reference Lake 3 (n = 3) water column are presented.

Table 6.4: Benthic invertebrate community statistical comparison results between Mary Lake (BLO) and Reference Lake 3 for littoral stations, Mary River Project CREMP, August 2015.

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	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m ²)	NO	0.628	η	0.073	-	Reference Lake 3	1,278	888	397	553	2,819
						Mary Lake Littoral	2,453	2,186	1,093	337	4,621
Richness (Number of Taxa)	NO	0.150	ε	0.288	-	Reference Lake 3	12.6	4.1	1.8	9.0	18.0
						Mary Lake Littoral	9.0	1.8	0.9	7.0	11.0
Simpson's Evenness (E)	YES	0.026	α	0.679	-2.0	Reference Lake 3	0.865	0.052	0.023	0.804	0.936
						Mary Lake Littoral	0.761	0.058	0.029	0.706	0.841
Bray-Curtis Index	YES	0.010	α	0.844	2.1	Reference Lake 3	0.382	0.170	0.076	0.219	0.662
						Mary Lake Littoral	0.738	0.126	0.063	0.621	0.883
Nemata (%)	NO	0.949	β	0.050	-	Reference Lake 3	8.1%	7.4%	3.3%	0.0%	17.2%
						Mary Lake Littoral	5.6%	6.3%	3.1%	0.4%	13.6%
Ostracoda (%)	YES	0.028	β	0.658	-1.0	Reference Lake 3	20.9%	18.5%	8.3%	4.1%	45.2%
						Mary Lake Littoral	1.9%	2.2%	1.1%	0.0%	4.3%
Chironomidae (%)	YES	0.044	β	0.559	1.3	Reference Lake 3	66.5%	18.9%	8.4%	40.6%	91.0%
						Mary Lake Littoral	91.1%	7.7%	3.9%	81.0%	99.2%
Metal-Sensitive Chironomidae (%)	NO	0.613	β	0.075	-	Reference Lake 3	11.4%	12.6%	5.6%	1.5%	32.2%
						Mary Lake Littoral	15.8%	14.6%	7.3%	2.7%	31.6%
Collector-Gatherers (%)	NO	0.598	β	0.077	-	Reference Lake 3	81.4%	17.1%	7.7%	53.7%	95.2%
						Mary Lake Littoral	72.8%	23.1%	11.5%	42.5%	95.6%
Filterers (%)	NO	0.697	β	0.064	-	Reference Lake 3	11.4%	12.6%	5.6%	1.5%	32.2%
						Mary Lake Littoral	14.4%	16.2%	8.1%	0.0%	31.6%
Clingers (%)	NO	0.687	β	0.065	-	Reference Lake 3	13.5%	11.8%	5.3%	4.0%	33.9%
						Mary Lake Littoral	28.2%	36.9%	18.5%	2.7%	81.2%
Sprawlers (%)	NO	0.423	β	0.115	-	Reference Lake 3	70.1%	14.9%	6.7%	47.1%	84.3%
						Mary Lake Littoral	54.7%	37.4%	18.7%	5.1%	86.9%
Burrowers (%)	NO	0.861	β	0.053	-	Reference Lake 3	16.4%	6.8%	3.0%	8.3%	25.8%
						Mary Lake Littoral	17.1%	7.5%	3.7%	10.4%	27.6%

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

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 meaningful difference.

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 6.5: Benthic invertebrate community statistical comparison results between Mary Lake (BLO) and Reference Lake 3 for profundal stations Mary River Project CREMP, August 2015.

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	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m ²)	YES	0.028	η	0.677	14.5	Reference Lake 3	180	39	18	122	216
						Mary Lake Profundal	752	766	313	147	2,221
Richness (Number of Taxa)	YES	0.029	ε	0.639	5.8	Reference Lake 3	2.8	0.8	0.4	2.0	4.0
						Mary Lake Profundal	7.7	4.1	1.7	3.0	13.0
Simpson's Evenness (E)	YES	0.027	α	0.650	1.3	Reference Lake 3	0.397	0.232	0.104	0.160	0.732
						Mary Lake Profundal	0.696	0.142	0.058	0.546	0.873
Bray-Curtis Index	YES	0.003	α	0.954	4.0	Reference Lake 3	0.157	0.101	0.045	0.049	0.273
						Mary Lake Profundal	0.563	0.199	0.081	0.280	0.870
Nemata (%)	NO	0.966	γ	0.050	-	Reference Lake 3	1.0%	2.2%	1.0%	0.0%	5.0%
						Mary Lake Profundal	2.0%	2.6%	1.1%	0.0%	6.1%
Ostracoda (%)	NO	0.973	β	0.050	-	Reference Lake 3	9.7%	13.1%	5.9%	0.0%	31.9%
						Mary Lake Profundal	11.1%	10.9%	4.4%	0.0%	24.6%
Chironomidae (%)	NO	0.362	δ	0.138	-	Reference Lake 3	87.8%	13.2%	5.9%	68.1%	100.0%
						Mary Lake Profundal	83.8%	12.2%	5.0%	67.6%	97.7%
Metal-Sensitive Chironomidae (%)	NO	0.183	γ	0.253	-	Reference Lake 3	2.8%	2.6%	1.2%	0.0%	5.5%
						Mary Lake Profundal	9.5%	8.2%	3.3%	0.0%	24.8%
Collector-Gatherers (%)	YES	0.003	δ	0.947	-4.2	Reference Lake 3	96.6%	3.3%	1.5%	92.6%	100.0%
						Mary Lake Profundal	82.7%	5.9%	2.4%	73.7%	91.1%
Filterers (%)	YES	0.073	γ	0.443	2.8	Reference Lake 3	1.9%	2.7%	1.2%	0.0%	5.5%
						Mary Lake Profundal	9.4%	7.9%	3.2%	0.0%	24.0%
Clingers (%)	NO	0.147	β	0.295	-	Reference Lake 3	3.4%	3.3%	1.5%	0.0%	7.4%
						Mary Lake Profundal	12.8%	8.9%	3.6%	0.0%	27.1%
Sprawlers (%)	YES	0.039	β	0.576	-12.9	Reference Lake 3	94.8%	1.3%	0.6%	92.6%	95.8%
						Mary Lake Profundal	77.7%	24.9%	10.2%	27.9%	93.9%
Burrowers (%)	NO	0.674	β	0.068	-	Reference Lake 3	1.8%	2.5%	1.1%	0.0%	5.0%
						Mary Lake Profundal	9.5%	17.6%	7.2%	0.0%	45.0%

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

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 meaningful 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.

Temporal comparisons of the Mary Lake benthic invertebrate community data did not indicate any significant differences in density, richness and relative abundance of dominant taxonomic or functional feeding groups at littoral habitat depths between the 2015 mine operational and 2007 baseline periods (Figure 6.15; Appendix Table E.41). However, significantly lower density and relative abundance of Chironomidae, together with significantly higher Simpson's Evenness, were indicated at profundal stations in 2015 compared to the 2007 baseline period (Figure 6.15; Appendix Table E.42). Because no changes in water or sediment chemistry occurred between these periods at Mary Lake, these differences in the benthic invertebrate community between 2015 and the 2007 baseline study likely reflected natural temporal variability. Moreover, no mine influence on lotic benthic invertebrate communities were apparent (i.e., at lower Mary River), suggesting a low potential for mine-related effects on biota of Mary Lake. Therefore, factors other than mine-related metals influence likely accounted for the differences in the profundal benthic invertebrate community composition at Mary Lake in 2015 compared to the baseline period.

6.2.5 Fish Population Survey

6.2.5.1 Mary Lake (South) Fish Community

The Mary Lake fish community included Arctic charr and ninespine stickleback, which was the same fish species composition observed at Reference Lake 3 (Table 6.6). However, total fish CPUE was much higher at Mary Lake than at Reference Lake 3 for both 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 higher Arctic charr CPUE in 2015 than during the baseline (2006-2013) period, but comparable to that in the mine construction (2014) period (Figure 6.16). Arctic charr gill netting CPUE in 2015 was within the range of that observed during the baseline period, and agreed closely with the CPUE obtained during the mine construction period (Figure 6.16). Overall, the CPUE data suggested that the relative abundance of Arctic charr at the nearshore and littoral/profundal areas of Mary Lake in 2015 was within the range shown through baseline and mine construction periods.

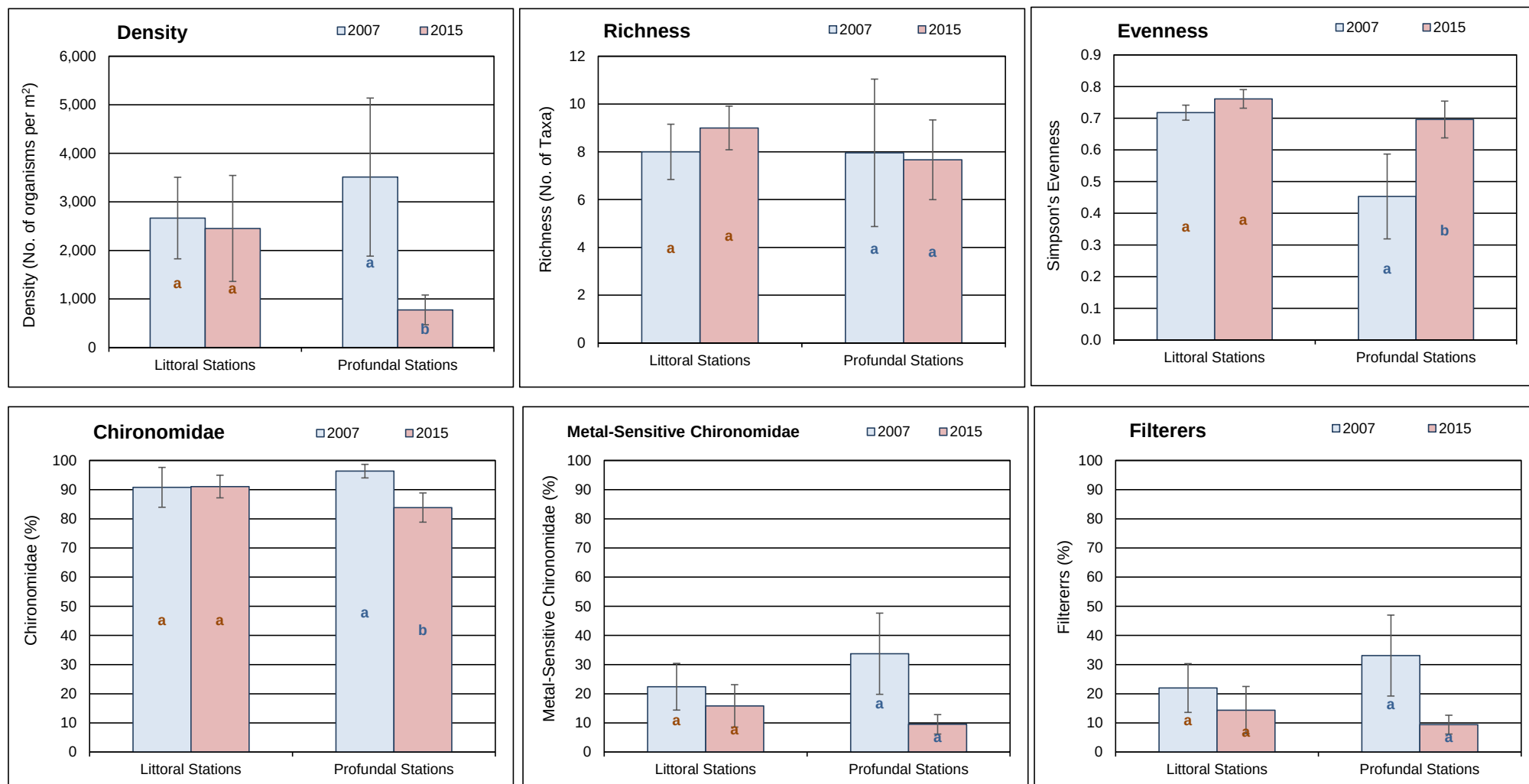


Figure 6.15: Comparison of key benthic invertebrate metrics (mean ± SE) at Mary Lake littoral and profundal stations between mine baseline (2007, 2008 and 2013) and operational (2015) periods, Mary River Project CREMP, 2015. The same like-coloured letter inside bars indicate no significant difference between study years for respective littoral and profundal station depths.

Table 6.6: Fish catch and community summary from backpack electrofishing and gill netting conducted at Mary Lake (BLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2015.

Lake	Method		Arctic Charr	Nine-spine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	99	8	107	2
		CPUE	0.71	0.05	0.77	
	Gill netting	No. Caught	6	0	6	
		CPUE	0.081	0	0.081	
Mary Lake	Electrofishing	No. Caught	107	3	110	2
		CPUE	2.75	0.08	2.83	
	Gill netting	No. Caught	113	0	113	
		CPUE	1.35	0	1.35	

CPUE - Catch-per-unit-effort. For electrofishing: number of fish per electrofishing minute. For gill netting: number of fish captured per 100 m hours.

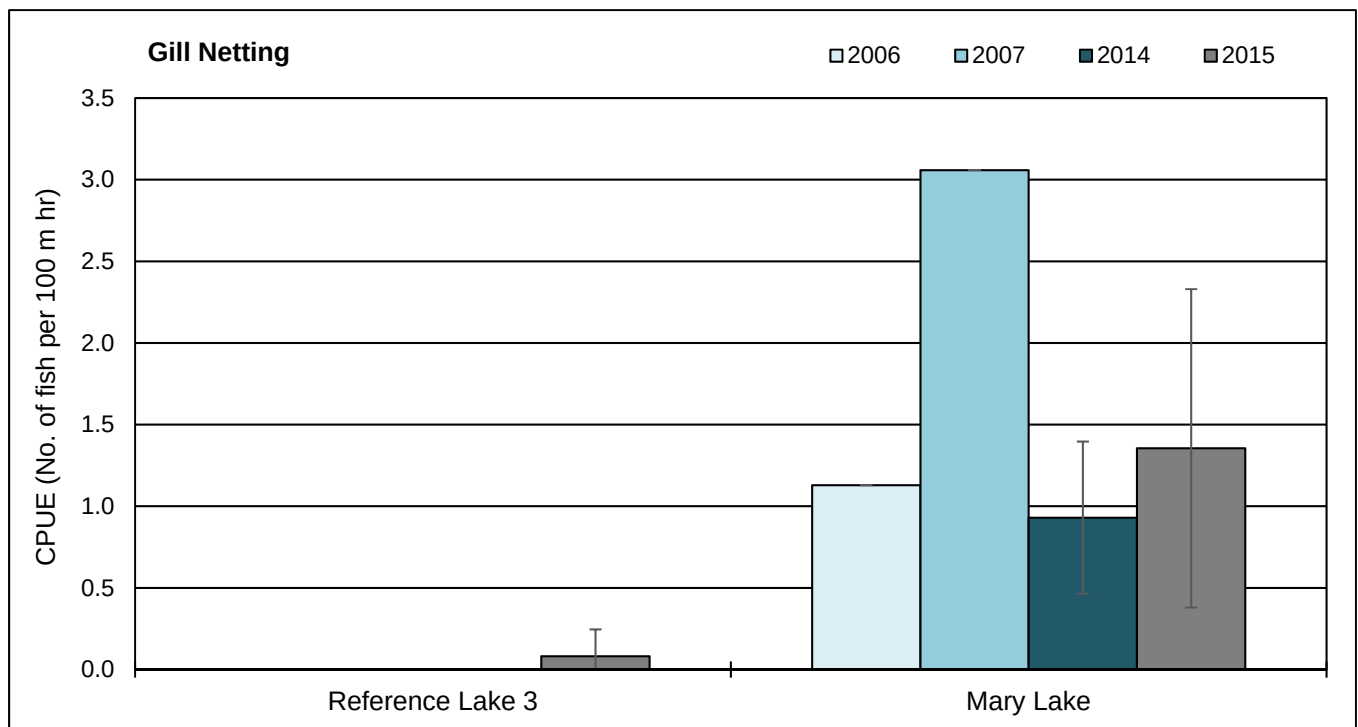
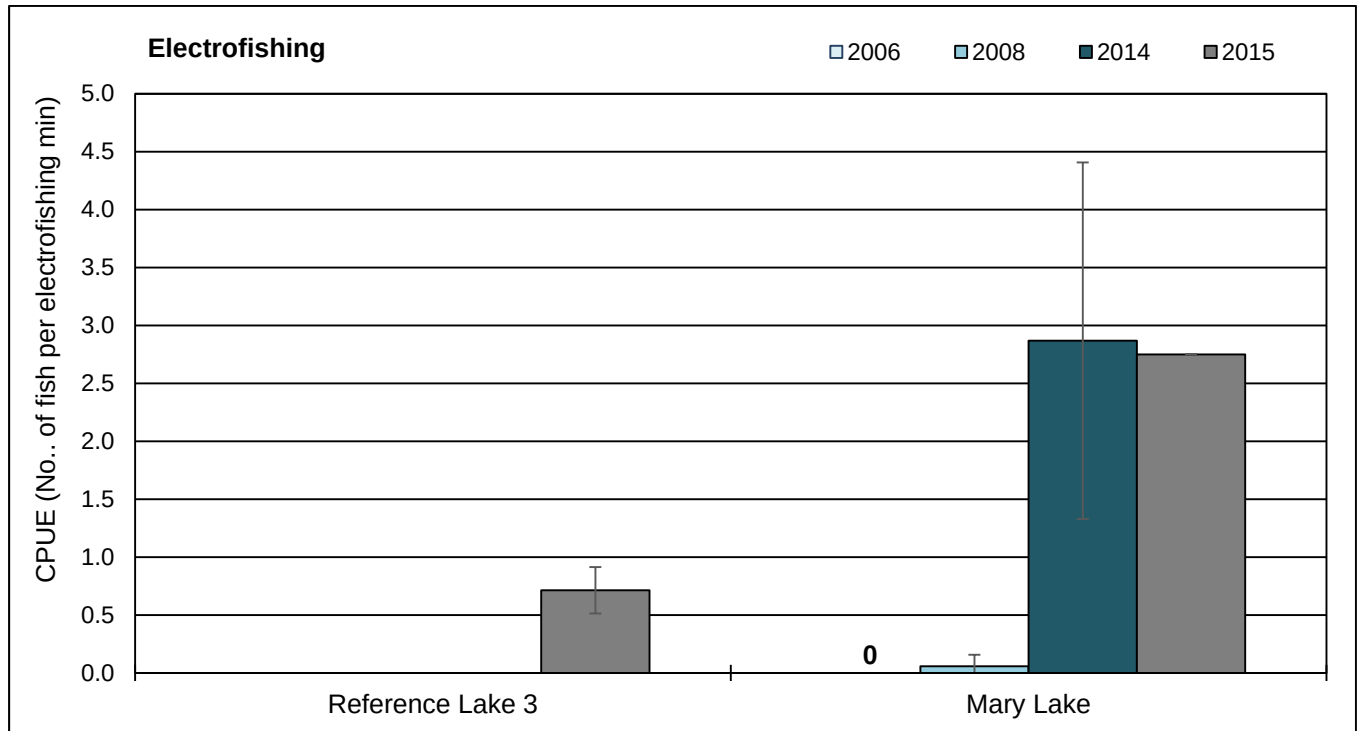


Figure 6.16: Catch-per-unit-effort (CPUE; mean $\pm$ SD) of Arctic charr captured by backpack electrofishing and gill netting at Mary Lake (BLO) for baseline (2006, 2007, 2008), mine construction (2014) and operational (2015) periods during the fall, Mary River Project CREMP.

6.2.5.2 Mary Lake (South) Fish Health Assessment

Nearshore Arctic Charr

Mine-related influences on the Mary Lake nearshore Arctic charr population were assessed based on a control-impact approach using 2015 data from Mary Lake and Reference Lake 3, and a before-after approach comparing Mary Lake 2015 data to mine construction period data. No baseline data were available from Mary Lake for nearshore Arctic charr population comparisons.

A total of 102 and 99 Arctic charr were captured at nearshore habitat of Mary Lake and the reference lake, respectively, in August 2015, for the control-impact analysis. Arctic charr YOY could be separated from older age classes at Mary Lake based on a fork length of approximately 5.0 cm using length-frequency distributions coupled with supporting age determinations (Figure 6.17). However, no separation of age classes was possible at Reference Lake 3, and therefore YOY were grouped with older age classes for the Mary Lake juvenile Arctic charr health assessment. Nearshore Arctic charr length-frequency distributions did not differ significantly between Mary Lake and Reference Lake 3 (Table 6.7; Figure 6.17; Appendix Table F.21). Although the mean age of Arctic charr individuals subsampled for growth at Mary Lake was significantly lower than at Reference Lake 3, the age distribution appeared to be similar between lakes (Table 6.7; Figure 6.17). Arctic charr captured at the Mary Lake nearshore were of similar size, but showed significantly greater growth than those captured at the reference lake (Table 6.7). The magnitude of the differences in weight-at-age growth was outside of the $\pm 25\%$ CES_{SG}, suggesting an ecologically meaningful difference in energy use between the nearshore Arctic charr populations of Mary Lake and Reference Lake 3 (Table 6.7). Nearshore Arctic charr of Mary Lake also showed a significant difference in condition compared to those captured at Reference Lake 3, but the magnitude of this difference was within the $\pm 10\%$ CES_C (Table 6.7) suggesting that this difference was not ecologically meaningful. Collectively, these data indicated no mine-related influences on juvenile Arctic charr survival at Mary Lake and, similar to the other mine-exposed lakes, the juvenile Arctic charr of Mary Lake grew significantly faster and had slightly greater condition compared to those captured at the reference lake.

Separate comparison of the 2015 nearshore Arctic charr population data to mine construction period data indicated no significant differences in length-frequency distributions, mean age and mean size between respective time periods at Mary Lake (Table 6.7; Appendix Table F.22). However, nearshore Arctic charr captured at Mary Lake in 2015 showed significantly slower growth (weight-at-age) and condition (weight-at-length) than

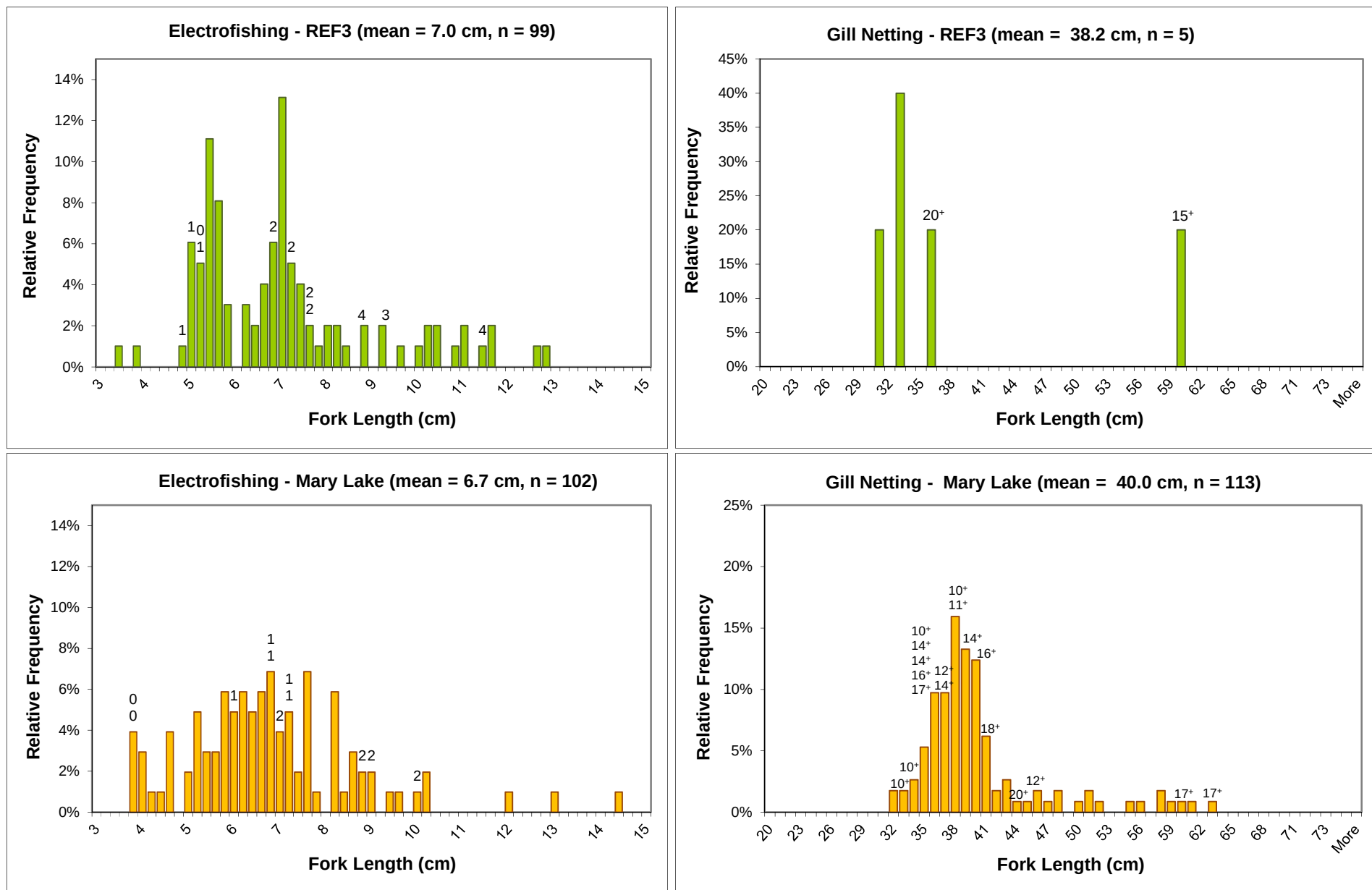


Figure 6.17: Length-frequency distributions for Arctic charr captured by backpack electrofishing and gill netting at Mary Lake and Reference Lake 3 (REF3), August 2015, Mary River Project CREMP. Fish ages are shown above the bars, where available.

Table 6.7: Summary of statistical results for Arctic charr population comparisons between the Mary Lake south basin and Reference Lake 3 for the mine operational period (2015), between Mary Lake mine-operational and baseline (2005 - 2013) periods, and between Mary Lake mine-operational and construction (2014) periods for fish captured by electrofishing and gill netting methods, Mary River Project CREMP, August 2015. 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	versus Sheardown Lake NW Mine Construction period
			2015	2005 - 2013	2014
Electrofishing Samples	Survival	Length-Frequency Distribution	No	-	No
		Age	Yes (-43%)	-	No
	Energy Use	Size (mean weight)	No	-	No
		Size (mean fork length)	No	-	No
		Growth (weight-at-age)	Yes (+99%)	-	Yes (-39%)
		Growth (fork length-at-age)	Yes (+23%)	-	No
	Energy Storage	Condition (body weight-at-fork length)	Yes (+3%)	-	Yes (- 12%)
Gill Netting Samples*	Survival	Length Frequency Distribution	-	Yes	No
		Age	-	No	-
	Energy Use	Size (mean weight)	-	Yes (+19%)	No
		Size (mean fork length)	-	Yes (+6%)	No
		Growth (weight-at-age)	-	No	-
		Growth (fork length-at-age)	-	No	-
	Energy Storage	Condition (body weight-at-fork length)	-	No	Yes (-4%)

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

those captured during the 2014 mine construction period (Table 6.7). The magnitude of these differences were outside of applicable CES for each endpoint (i.e., $\pm 25\%$ and $\pm 10\%$, respectively), suggesting ecologically meaningful lower growth and condition of nearshore Arctic charr in 2015 at Mary Lake compared to the mine construction period. Similar differences in juvenile Arctic charr condition were observed between the 2015 and mine baseline/construction periods at all mine-exposed lakes despite higher condition relative to reference conditions that, in turn, suggested that the differences in condition between 2015 and baseline likely reflected natural temporal variability.

Littoral/Profundal Arctic Charr

Non-spawners of reproductive age represented approximately 61% of the Mary Lake Arctic charr population during the August 2015 field study (Appendix Table F.37). On average, Arctic charr non-spawners were of similar age and size (length and weight), but had significantly lower LSI than those fish with developing gonads (ANOVA; $p = 0.012$). A high proportion of individuals (i.e., 94%) also contained body cavity parasites (Appendix Table F.37), 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 2015, and showed a 24.4 mm/yr average increase in fork length over the past 8 years (Table 6.8). This growth rate showed close agreement with the incremental changes in growth rate for resident populations in other Arctic lakes available in published literature, and was considerably higher than the growth rate observed for two tagged fish that were re-captured at Sheardown Lake SE in 2015 (i.e., mean of 6.3 mm/yr average increase; Table 5.12).

Mine-related influences on the Mary Lake littoral/profundal Arctic charr population were assessed using a before-after approach to separately evaluate differences in fish health endpoints between 2015 and to the mine baseline and construction periods. Length-frequency distributions of Arctic charr captured at littoral/profundal areas of Sheardown Lake NW in 2015 differed significantly from those captured during the baseline period, but not the mine-construction period (Table 6.7; Appendix Tables F.38 – F.39). On average, Arctic charr captured at littoral/profundal areas of Mary Lake in 2015 were significantly larger than those captured during the baseline period, but no significant differences in mean age, growth or condition of Arctic charr were shown between these mine periods (Table 6.7). No difference in adult Arctic charr size was indicated between the 2015 and 2014 studies at Mary Lake, and although adult Arctic charr condition differed significantly between the 2015 and 2014 studies, the magnitude of this difference was within the $\pm 10\%$ CES_C (Table 6.7), suggesting that this difference was not ecologically meaningful. Overall, the absence of any ecologically

significant differences in growth and condition for Arctic charr captured in 2015 compared to the mine baseline and construction periods at littoral/profundal areas of Mary Lake suggested no influences on the resident adult Arctic charr population following the initial year of mine operation.

Table 6.8: Length and weight measurement data for tagged Arctic charr captured at the Mary Lake south basin in August 2015, 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

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

Mary River

No mine-related influence on water quality was apparent at Mary River based on comparison of dissolved metals to the lotic reference stations, as well as on comparison of all parameters to the baseline period water chemistry. Mary River exhibited high turbidity, but because turbidity was consistently highest upstream of the mine (i.e., the GO series stations) during all mine baseline (2005 – 2013), construction (2014) and operational (2015) periods, the dominant source of turbidity to Mary River reflected natural (runoff) inputs unrelated to the mine operation. Strong, positive correlations between turbidity and total concentrations of various non-conservative metals (e.g., aluminum, iron and manganese) indicated that these metals were largely associated with, or comprised, the suspended particulate matter in Mary River. High turbidity at Mary River, which on average was 3.6 times higher than at the lotic reference stations and 2.7 – 4.1 times higher than during the baseline period in 2015, therefore confounded comparisons to WQG and AEMP benchmarks. Nevertheless, dissolved metals and conservative parameters typically associated with mining and other anthropogenic activity (e.g., chloride, sulphate, sodium) showed no substantial changes with progression from areas located upstream of the mine, to those located adjacent to or downstream of the mine in 2015 and compared to the baseline period for any of the season sampling events. This suggested no mine-related influences on Mary River water chemistry related with the Mary River Project operation in 2015.

Chlorophyll a concentrations were similar among the ten Mary River phytoplankton monitoring stations, and to the lotic reference stations. Although lower chlorophyll a

concentrations were indicated at individual Mary River stations in 2015 compared to the baseline and mine construction periods, these differences likely reflected higher natural turbidity in 2015, which would be expected to affect phytoplankton productivity by limiting the amount of light available for photosynthesis. No consistent differences in benthic invertebrate density, richness, Simpson's Evenness or relative abundance of metal-sensitive taxa were evident at the four Mary River mine-exposed benthic study areas assessed in 2015 compared to an upstream reference area, suggesting no adverse mine influence to the benthic invertebrate community of Mary River. Benthic invertebrate density and richness were significantly lower at Mary River mine-exposed areas situated adjacent to the mine property and not at areas upstream of the mine in comparisons between the baseline and 2015 periods. However, significantly higher Evenness and significantly lower relative abundance of (metal tolerant) Chironomidae at the mine-exposed areas in 2015 compared to the baseline period were not consistent with responses normally associated with mine effects, and therefore the temporal differences in benthic invertebrate metrics between 2015 and the baseline period likely reflected natural temporal variability unrelated to mine activity.

Mary Lake

At Mary Lake, turbidity and aqueous concentrations of aluminum, manganese and uranium were elevated (i.e., ≥ 3 -fold higher) compared to the reference lake in 2015, 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 2015 and, with the exception of slightly elevated (i.e., 2- to 3-fold higher) sediment calcium concentrations at littoral stations, were similar to concentrations observed during the baseline period. Although average concentrations of chromium, iron and manganese were above SQG, and the average concentration of arsenic was above the applicable AEMP benchmark, at Mary Lake in 2015, with the exception of chromium, these metals were also above respective criteria at the reference lake which in turn, suggested low potential for any adverse effects to biota associated with these metals.

Mary Lake chlorophyll a concentrations were similar to those at the reference lake and during the mine construction (2014) period in 2015, and were also well below the AEMP benchmark suggesting no adverse mine-related influences on phytoplankton of the lake. Benthic invertebrate density, richness and relative abundance of dominant groups including metal-sensitive taxa at littoral stations of Mary Lake did not differ from the reference lake, nor from baseline conditions, in 2015. In addition, no ecologically meaningful differences in benthic invertebrate density, richness and relative abundance of metal-sensitive taxa were indicated at Mary Lake profundal stations compared to the baseline period. Similar to the other mine-exposed lakes, higher Arctic charr CPUE suggested higher fish productivity at Mary Lake compared to the reference lake. Juvenile Arctic charr captured at Mary Lake showed significantly faster growth and no ecologically meaningful differences in size or condition compared to juveniles captured at the reference lake. As at the other mine-exposed lakes, significantly lower condition of juvenile Arctic charr was indicated at Mary Lake in 2015 compared to the baseline period which, based on weight-of-evidence, suggested that this difference reflected natural temporal variability. No significant (ecologically meaningful) differences in growth and condition of adult Arctic charr were indicated between 2015 and the mine baseline/construction periods at Mary Lake. Overall, no adverse mine-related influences to biota of Mary Lake were collectively suggested by the phytoplankton, benthic invertebrate community and fish population survey results based on close similarity with the reference lake and baseline conditions for the majority of biological endpoints.

7.0 CONCLUSIONS

The objective of the 2015 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 first full year of mine operation. To meet this objective, the CREMP transitioned from a characterization-based study used to provide baseline information for future evaluation of mine effects, to an effects-based study which incorporated 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 to applicable reference data and to available baseline data. General findings and system-specific conclusions of the 2015 CREMP are provided in separate sections below.

7.1 General Findings

General findings of the 2015 CREMP that were commonly observed between the mine-exposed systems and the respective reference areas related to: 1) spatial and temporal differences in water quality associated with naturally high turbidity at aquatic systems near the mine; and, 2) naturally higher productivity of the mine-exposed lakes compared to Reference Lake 3. These general findings are discussed briefly in the points below:

- **Naturally elevated turbidity.** Turbidity of the mine-exposed aquatic systems was naturally elevated in 2015 compared to reference and baseline conditions, and was most evident in the Mary River/Mary Lake and Sheardown Lake systems. Highest turbidity was observed upstream of the mine-exposed stations on Mary River (i.e., GO series stations), indicating that elevated turbidity was a natural phenomenon unrelated to the Mary River Project operations. In 2015, turbidity of Mary River was approximately 3- to 5-times higher than at the lotic reference stations and baseline, on average, with a similar multiple observed at Sheardown Lake and Mary Lake. Among other non-conservative metals, total aluminum, iron and manganese concentrations were often significantly, positively correlated with turbidity, suggested that these metals were bound to/comprised the suspended particulate matter. As a result, 'elevation' in total concentrations of these metals at mine-exposed areas compared to reference data, baseline data, and/or WQG and AEMP benchmarks

commonly reflected this naturally high turbidity as opposed to potential mine-related influences to water quality at each respective mine-exposed system.

- **Naturally greater biological productivity at mine-exposed lakes compared to Reference Lake 3.** Benthic invertebrate density, juvenile and adult Arctic charr CPUE, and juvenile Arctic charr growth were consistently (and in most cases, significantly) higher at all mine-exposed lakes compared to Reference Lake 3, which suggested that biological productivity was greater at the mine-exposed lakes. At each mine-exposed lake, no substantial changes in each of these metrics were observed between the 2015 and baseline studies, suggested that no mine-related factor accounted for greater productivity at these lakes. In turn, this suggested that productivity at Reference Lake 3 was naturally low among lakes within the mine LSA.

7.2 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). Concentrations of mine parameters including chloride, iron, nitrate and sulphate were the primary constituents reflecting a mine-related influence within CLT1 based on elevation (i.e., ≥ 3 -fold higher) relative to reference conditions and concentrations observed during the baseline (2005 – 2013) period. Of these parameters, only iron concentrations were above applicable water quality guideline (WQG) and AEMP benchmarks, but only at the upper-most monitoring station on the CLT1 main stem. Active quarrying at the QMR2 pit in 2015 likely served as the key source for these parameters at CLT1. Water chemistry at Camp Lake Tributary 2 (CLT2) and at Camp Lake was similar to reference areas 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 limited to the upper main stem of CLT1, with no effects suggested at CLT2 or Camp Lake itself, following the initial year of mine operation.

At Camp Lake, sediment arsenic and manganese concentrations were slightly elevated (i.e., 2- to 5-fold higher) at the single Camp Lake littoral station compared to mean reference lake concentrations in 2015, and these metals as well as calcium, molybdenum and phosphorus were also elevated compared to baseline conditions. No metals were elevated in sediment of the profundal stations compared to the reference lake, and with the exception of slightly elevated calcium and manganese concentrations, sediment metal concentrations at profundal stations were similar to the baseline period as well. Slightly elevated sediment metal concentrations at the Camp Lake littoral station suggested a mine-related influence to sediment quality near the CLT1 inlet, but this mine influence did not extend to the profundal

stations. No metals were elevated above SQG and/or AEMP sediment quality benchmarks at Camp Lake that were not also elevated above these criteria at the reference lake, which suggested natural elevation of certain metals (i.e., iron and manganese) at mine LSA lakes. In turn, this suggested a low potential for adverse effects to biota as a result of the elevation in concentrations of these metals relative to SQG and AEMP benchmarks at Camp Lake.

Chlorophyll a concentrations within the Camp Lake system showed no consistent differences relative to respective reference areas or to baseline conditions except at the CLT1 upper main stem. Chlorophyll a concentrations were elevated at the CLT1 upper main stem, which was consistent with a slight enrichment effect related to nitrate inputs from the mine. Nevertheless, chlorophyll a concentrations remained well below the AEMP benchmark at all Camp Lake system receivers in 2015 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 addition, the fish population survey indicated larger, faster growing juvenile Arctic charr at Camp Lake compared to the reference lake, and no ecologically meaningful differences in the health of juvenile or adult Arctic charr at Camp Lake between the 2015 and baseline periods, suggesting no mine-related effects on the resident fish population. 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 mine-related influences to the biota of the Camp Lake system following the initial year of mine operation at the Mary River Project.

7.3 Sheardown Lake System

At Sheardown Lake Tributary 1 (SDLT1), nitrate and sulphate were the only mine parameters elevated above average concentrations from the lotic reference stations and average concentrations during the baseline period, suggesting an on-going mine-related source of these parameters. However, no parameters were elevated above WQG or the AEMP benchmarks at SDLT1, suggesting limited potential for adverse effects on aquatic biota within SDLT1. Within Sheardown Lake, aluminum was the only mine parameter observed at elevated (i.e., ≥ 3 -fold higher) concentrations compared to the reference lake, but aluminum and all other parameter concentrations were similar to respective concentrations during the baseline period, and none were elevated above WQG or AEMP benchmarks, suggesting low potential for adverse effects to biota within the lake. Total aluminum concentrations at Sheardown Lake were positively correlated with turbidity (i.e., a proxy for suspended

particulate matter) introduced to the lake as a result of Mary River inflow, and therefore elevated aluminum concentrations did not reflect a mine influence on Sheardown Lake water quality. Sediment metal concentrations at Sheardown Lake were similar to the reference lake and, with the exception of slightly elevated (i.e., 2- to 3-fold higher) sediment arsenic and manganese concentrations at littoral stations, were similar to concentrations observed during the baseline period. No metals were present at concentrations above SQG or AEMP benchmarks that were not also above these criteria at the reference lake (iron and manganese only), suggesting low potential for any adverse effects to biota associated with these metals.

Chlorophyll a concentrations at SDLT1 and Sheardown Lake were similar to, or greater than, those at respective reference areas, and were also similar to chlorophyll a concentrations reported during baseline/construction periods. 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. No adverse mine-related influences to the benthic invertebrate community were apparent among the three SDLT1 reaches in 2015, although a significantly higher density and relative abundance of filterers at lower SDLT1 compared to the baseline period potentially indicated a slight enrichment influence in 2015 that may have been associated with higher aqueous nitrate concentrations. Benthic invertebrate community metrics at Sheardown Lake Tributary 12 (SDLT12) or Tributary 9 (SDLT9) were relatively unchanged between the mine baseline and operational (2015) periods, which suggested that biological conditions at these tributaries likely remained relatively unchanged since the initiation of mining activities in 2015. Benthic invertebrate density, richness and relative abundance metal sensitive taxa did not differ significantly, or were significantly higher, at Sheardown Lake than at the reference lake in 2015 which, coupled with close similarity (and no ecologically meaningful differences) in most benthic invertebrate community metrics relative to the baseline period, suggested no adverse mine-related effects on the benthic invertebrate community of Sheardown Lake in 2015. Juvenile Arctic charr at Sheardown Lake grew significantly faster than at the reference lake, and no significant (ecologically meaningful) differences in juvenile growth and adult growth and condition were indicated at the Sheardown Lake basins compared to the baseline period, which suggested no adverse mine-related influences on the Arctic charr population of Sheardown Lake in 2015. Similar to Camp Lake, condition of juvenile Arctic charr was significantly lower in 2015 than during the baseline period, but this difference was consistent with natural temporal variability. 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 mine-related influences to the biota of the Sheardown Lake system following the initial year of mine operation at the Mary River Project.

7.4 Mary River and Mary Lake System

At Mary River, no adverse mine-related influence on water chemistry was apparent based on evaluation of dissolved metals relative to the lotic reference stations, as well as on comparison of all parameters to the baseline period water chemistry. At Mary Lake, aluminum was the only mine parameter observed at elevated (i.e., ≥ 3 -fold higher) concentrations in water compared to the reference lake in 2015. However, concentrations of aluminum and all other parameters were not consistently elevated compared to concentrations observed during the baseline period, and none were ever above WQG or AEMP benchmarks. Highly turbid water at Mary River and Mary Lake originated from sources upstream of the mine, and therefore higher turbidity, as well higher total concentrations of aluminum and other metals potentially associated with this turbidity, was not related to mine activity. Therefore, the 2015 water quality data did not suggest any mine-related influences on water quality Mary River/Mary Lake system and, based on comparison to WQG and AEMP benchmarks, there was a low potential for adverse effects to biota within this system. Sediment metal concentrations at Mary Lake were similar to those at the reference lake in 2015 and, with the exception of slightly elevated (i.e., 2- to 3-fold higher) sediment calcium concentrations at littoral stations, were similar to concentrations observed during the baseline period. Although Mary Lake average concentrations of chromium, iron and manganese were above SQG, and the average concentration of arsenic was above the applicable AEMP benchmark, with the exception of chromium, concentrations of these metals were also above respective criteria at the reference lake, suggesting low potential for any adverse effects to biota associated with these metals.

Sediment metal concentrations at Mary Lake littoral and profundal stations were similar to those at the reference lake in 2015 and, with the exception of slightly elevated (i.e., 2- to 3-fold higher) sediment calcium concentrations at littoral stations, were similar to concentrations observed during the baseline period. Although 2015 Mary Lake average concentrations of chromium, iron and manganese were above SQG, and the average concentration of arsenic was above the applicable AEMP benchmark, with the exception of chromium, these metals were also above respective criteria at the reference lake which in turn, suggested low potential for any adverse effects to biota associated with these metals.

Chlorophyll a concentrations were similar between Mary River and Mary Lake compared to respective lotic and lentic reference areas and, for Mary Lake, compared to concentrations during the baseline period as well. Lower chlorophyll a concentrations were indicated at

individual Mary River stations in 2015 compared to the baseline and mine construction periods, but these differences likely reflected higher natural turbidity in 2015, 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 and Mary Lake was generally similar to respective lotic and lentic reference areas in 2015, and with the exception of significantly lower density and richness at Mary River mine-exposed areas, was generally similar to respective communities during the baseline period as well. The temporal differences in benthic invertebrate metrics between 2015 and the baseline period at Mary River were not consistent with responses normally associated with mine activity and therefore, were attributed to temporal variability. With the exception of significantly faster growing juvenile Arctic charr, no significant and/or ecologically meaningful differences in growth and condition of juvenile or adult Arctic charr were indicated at Mary Lake in 2015 compared to the reference lake or to the baseline period. Overall, no adverse mine-related influences to biota of Mary Lake were suggested by the phytoplankton, benthic invertebrate community and fish population survey results.

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APPENDIX A

WATER QUALITY REVIEW

APPENDIX A: DATA QUALITY REVIEW

A1.0	INTRODUCTION	1
A1.1	Background	1
A2.0	RESULTS	4
A2.1	Water Samples.....	4
A2.1.1	Sample Blanks	4
A2.1.2	Precision – Field Duplicates.....	5
A2.2	Sediment Samples	5
A2.2.1	Data Precision – Field Duplicate Samples.....	5
A2.3	Benthic Invertebrate Community Samples.....	6
A2.3.1	Subsampling Accuracy	6
A2.3.2	Organism Recovery	6
A3.0	DATA QUALITY STATEMENT	7

A1.0 INTRODUCTION

A1.1 Background

Data Quality Review (DQR) was conducted on data collected as part of the Mary River Project 2015 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 any conclusions made from the 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.

Data quality as a concept is meaningful only when it relates to the intended use of the data. That is, the context in which the data will be interpreted must be known in order to establish a relevant basis for judging whether or not the data set is adequate. The Mary River Project 2015 CREMP DQR involved comparison of field performance to generic data quality objectives (DQOs) established for the field component of environmental studies, including those for evaluation of field blanks, data precision and data accuracy. DQOs were established a-priori to reflect reasonable and achievable performance expectations. Overall, the intent of comparing data to DQOs 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 can therefore be used with confidence to derive conclusions. Thus, 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, which are defined as follows:

- **Blanks** 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 twice the method detection limit allows for slight “noise” around the detection limit.

- o **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 trip, transported with the regular sample bottles in the field, and remain unopened throughout the trip.
- o **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 samples (i.e., they are exposed to all the same potential sources of contamination as the sample), including handling and, in some cases, filtration and/or preservation.
- o **Equipment blanks** are samples of de-ionized water that have been used to rinse sampling equipment. These blanks are useful in identifying cross contamination from field equipment. An equipment blank sample is collected after completion of equipment decontamination, but prior to field sampling.
- **Field Duplicates** 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** are performed on benthic invertebrate community samples 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** for 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 21 times during the 2015 CREMP, including on 6 winter lake monitoring events, 2 spring stream monitoring events, 6 summer lake/stream monitoring events, and 7 fall lake/stream monitoring events. Of the 1674 total number of analyses conducted, 23 (1.3%) were above the DQO of less than five-times the laboratory method detection limit (Appendix Table A.1). Barium, silicon and sodium were the most frequent parameters detected in trip blanks that were above the DQO. Bottle contamination or contaminated deionized source water were the most likely sources of contamination. The deionized water used to create trip blanks originates from on-site stock, and was cited as the most likely source of trip blank contamination in previous CREMP (KP 2015).

Field blanks were assessed a total of 20 times during the 2015 CREMP, including on 6 winter lake monitoring events, 2 spring stream monitoring events, 7 summer lake/stream monitoring events, and 5 fall lake/stream monitoring events. Of the 1,557 analyses conducted, 36 (2.3%) were above the DQO of less than five-times the laboratory method detection limit (Appendix Table A.2). Similar to the trip blanks, barium, silicon and sodium were the most frequent parameters observed at concentrations above the DQO, with similar frequency in detection rates occurring between the total and dissolved fractions for these metals. 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.

Equipment blanks were conducted a total of 9 times during the 2015 CREMP, including on 2 winter lake monitoring events, 2 summer lake monitoring events, and 5 fall lake monitoring events. Of the 737 analyses conducted, 15 (2.0%) were above the DQO of less than five-times the laboratory method detection limit (Appendix Table A.3). Similar to the trip and field blanks, barium, silicon and sodium were the most frequent parameters observed at concentrations above the DQO in the equipment blank samples, with similar frequency in detection rates occurring between the total and dissolved fractions for these metals. A similar frequency of detection was observed between the trip, field and equipment blanks, which suggested that a similar source of contamination was common to all three DQR sample types.

Table A.1: Trip 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			MDL	JL0-0903	JL0-1003	J0-0103	MDL	D0-0003	BL0-01-A03	REF3-03-S103
Date Sampled				18-Jul-2015	19-Jul-2015	19-Jul-2015		29-Jun-2015	24-Aug-2015	24-Aug-2015
ALS Sample ID				L1645031-3	L1645029-10	L1645029-12		L1635675-11	L1664158-3	L1664154-3
Physical Tests	Conductivity	umhos/cm	3.0	<3.0	<3.0	<3.0	3.0	<3.0	<3.0	<3.0
	Physical Tests	mg/L	10	<10	<10	<10	10	<10	<10	<10
	pH	pH units	0.10	5.93	5.88	5.88	0.10	6.04	5.99	5.82
	Total Suspended Solids	mg/L	2.0	<2.0	<2.0	<2.0	2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids	mg/L	20	<10	<10	<10	20	<20	<10	<10
	Turbidity	NTU	0.10	<0.10	0.13	<0.10	0.10	<0.10	0.32	<0.10
Anions and Nutrients	Alkalinity, Total (as CaCO3)	mg/L	10	<10	55	<10	10	<10	<10	<10
	Anions and Nutrients	mg/L	0.050	<0.050	<0.050	<0.050	0.050	<0.050	<0.050	<0.050
	Bromide (Br)	mg/L	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
	Nitrate and Nitrite as N	mg/L	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
	Nitrite (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen	mg/L	0.15	<0.15	<0.15	<0.15	0.15	<0.15	<0.15	<0.15
	Total Phosphorus	mg/L	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	
Carbon	Dissolved Organic Carbon	mg/L	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
Total Metals	Aluminum (Al)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	0.0030	0.0042	<0.0030	<0.0030
	Antimony (Sb)	mg/L	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
	Barium (Ba)	mg/L	0.000050	0.000529	0.000136	0.000514	0.000050	0.000759	<0.000050	0.000119
	Beryllium (Be)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	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
	Calcium (Ca)	mg/L	0.050	0.096	0.065	0.079	0.050	0.183	<0.050	0.060
	Chromium (Cr)	mg/L	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
	Copper (Cu)	mg/L	0.00050	0.00101	<0.00050	0.00092	0.00050	0.00138	<0.00050	<0.00050
	Iron (Fe)	mg/L	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
	Lithium (Li)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	0.050	<0.050	<0.050	<0.050	0.050	<0.050	<0.050	<0.050
	Manganese (Mn)	mg/L	0.000070	0.000075	<0.000070	<0.000070	0.000070	0.000138	<0.000070	<0.000070
	Mercury (Hg)	mg/L	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
	Nickel (Ni)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.20	<0.20	<0.20	<0.20	0.20	<0.20	<0.20	<0.20
	Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.10	<0.10	<0.10	<0.10	0.10	0.57	<0.10	<0.10
	Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.050	0.190	<0.050	0.179	0.050	0.543	<0.050	<0.050
	Strontium (Sr)	mg/L	0.00010	0.00013	<0.00010	0.00014	0.00010	0.00033	<0.00010	<0.00010
	Thallium (Tl)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	0.010	<0.010	<0.010	<0.010	0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	0.0050	0.00424	0.00060	0.00261
	Antimony (Sb)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	0.000020	0.000036	<0.000020	<0.000020
	Arsenic (As)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	0.000020	0.000109	<0.000020	<0.000020
	Barium (Ba)	mg/L	0.000050	0.00053	0.00011	0.00063	0.000050	0.000757	0.000031	0.000111
	Beryllium (Be)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	0.000010	<0.000010	<0.000010	<0.000010
	Bismuth (Bi)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	0.0000050	0.0000244	<0.0000050	<0.0000050
	Boron (B)	mg/L	0.010	<0.010	<0.010	<0.010	0.0050	<0.0050	<0.0050	<0.0050
	Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	0.050	0.081	0.056	0.087	0.020	0.179	<0.020	0.051
	Chromium (Cr)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	0.00010	0.00012	<0.00010	<0.00010
	Cobalt (Co)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	0.000005	0.0000064	<0.0000050	<0.0000050
	Copper (Cu)	mg/L	0.00020	0.00087	<0.00020	0.00098	0.00010	0.00140	<0.00010	<0.00010
	Iron (Fe)	mg/L	0.010	<0.010	<0.010	<0.010	0.0010	0.0012	<0.0010	<0.0010
	Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	0.0000090	0.0000176	<0.0000090	<0.0000090
	Lithium (Li)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	0.00050	0.00053	<0.00050	<0.00050
	Magnesium (Mg)	mg/L	0.050	<0.050	<0.050	<0.050	0.0050	0.0137	<0.0050	<0.0050
	Manganese (Mn)	mg/L	0.000500	<0.00050	<0.00050	<0.00050	0.000070	0.000173	<0.000070	<0.000070
	Mercury (Hg)	mg/L	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
	Nickel (Ni)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	0.000090	<0.000090	<0.000090	<0.000090
	Potassium (K)	mg/L	0.050	<0.050	<0.050	<0.050	0.050	<0.050	<0.050	<0.050
	Selenium (Se)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	0.000040	<0.000040	<0.000040	<0.000040
	Silicon (Si)	mg/L	0.050	<0.050	<0.050	<0.050	0.050	0.578	<0.050	<0.050
	Silver (Ag)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	0.0000050	<0.0000050	<0.0000050	<0.0000050
	Sodium (Na)	mg/L	0.500	<0.50	<0.50	<0.50	0.020	0.550	<0.020	<0.020
	Strontium (Sr)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	0.000050	0.000318	<0.000050	<0.000050
	Thallium (Tl)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	0.0000020	<0.0000020	<0.0000020	<0.0000020
	Tin (Sn)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	0.000030	0.000044	<0.000030	<0.000030
	Titanium (Ti)	mg/L	0.00030	<0.00030	<0.00030	<0.00030	0.00050	<0.00050	<0.00050	<0.00050
	Uranium (U)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	0.0000070	<0.0000070	<0.0000070	<0.0000070
	Vanadium (V)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	0.000050	<0.000050	<0.000050	<0.000050
	Zinc (Zn)	mg/L	0.0010	0.0018	<0.0010	0.0012	0.00050	0.00082	<0.00050	0.00097
Other	Phenols (4AAP)	mg/L	0.0010	0.0016	0.0019	<0.0010	0.0010	<0.0010	<0.0010	0.0011
	Chlorophyll a	ug/L	0.10	<0.10	<0.10	<0.10	0.10	<0.10	<0.10	<0.10
	Phaeophytin a	ug/L	0.10	<0.10	<0.10	<0.10	0.10	<0.		

Table A.1: Trip 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			MDL	CLT-REF303	REF3-0203	BL0-0503	MRY-REF303	JL0-0103	C0-1003	DL0-01-403	REF3-0303	REF3-0303
Date Sampled				26-Jun-2015	28-Jul-2015	27-Jul-2015	21-Jul-2015	19-Aug-2015	16-Aug-2015	21-Aug-2015	22-Aug-2015	22-Aug-2015
ALS Sample ID				L1633808-7	L1650879-7	L1650065-3	L1647576-2	L1661680-8	L1658990-3	L1662516-13	L1662491-1	L1662491-1
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
	Physical Tests	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	pH	pH units	0.10	5.83	6.10	5.97	7.62	5.74	5.91	5.79	6.29	6.29
	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	<20	<10	<10	13	<10	<10	<10	<10	<10
	Turbidity	NTU	0.10	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients	Alkalinity, Total (as CaCO ₃)	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Anions and Nutrients	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	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	0.22	<0.15	<0.15	<0.15
	Total Phosphorus	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Sulfate (SO ₄)	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	<1.0	<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
Total Metals	Aluminum (Al)	mg/L	0.0030	0.0188	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	mg/L	0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00010	0.00032	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.000050	0.00176	<0.000050	0.000143	<0.000050	0.000124	<0.000050	0.000131	<0.000050	<0.000050
	Beryllium (Be)	mg/L	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	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	0.224	<0.050	0.050	<0.050	0.051	<0.050	0.056	<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	0.000139	<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	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.10	0.72	<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	0.390	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Strontium (Sr)	mg/L	0.00010	0.00053	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Thallium (Tl)	mg/L	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	0.00015	<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	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<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
Dissolved Metals	Aluminum (Al)	mg/L	0.0030	0.0187	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	mg/L	0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00010	0.00031	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.000050	0.00180	0.000155	0.000128	<0.000050	0.000133	<0.000050	0.000092	<0.000050	<0.000050
	Beryllium (Be)	mg/L	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	0.100	<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.						

Table A.1: Trip 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			MDL	DL0-02-06-03 (S1)	DL0-02-06-03 (B1)	BL0-01B-03 (S1)	BL0-01B-03 (B1)	BL0-04-03 (S1)	BL0-04-03 (B1)
Date Sampled				06-MAY-15	06-MAY-15	28-APR-15	28-APR-15	29-APR-15	29-APR-15
ALS Sample ID				L1608946-3	L1608946-4	L1605045-11	L1605045-12	L1606012-11	L1606012-12
Physical Tests	Conductivity	umhos/cm	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Physical Tests	mg/L	10	<10	<10	<10	<10	<10	<10
	pH	pH units	0.10	6.42	5.99	6.85	6.21	6.56	6.16
	Total Suspended Solids	mg/L	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids	mg/L	10	17	16	<10	<10	20	18
	Turbidity	NTU	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients	Alkalinity, Total (as CaCO ₃)	mg/L	10	<10	<10	<10	<10	<10	<10
	Anions and Nutrients	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Bromide (Br)	mg/L	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
	Nitrate and Nitrite as N	mg/L	0.021	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
	Nitrate (as N)	mg/L	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
	Total Kjeldahl Nitrogen	mg/L	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Total Phosphorus	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0039	<0.0030
Sulfate (SO ₄)	mg/L	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	
Carbon	Dissolved Organic Carbon	mg/L	1.0	<1.0	<1.0	<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
Total Metals	Aluminum (Al)	mg/L	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
	Arsenic (As)	mg/L	0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.000050	0.000516	0.000194	0.000151	0.000194	0.000169	0.000225
	Beryllium (Be)	mg/L	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	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
	Calcium (Ca)	mg/L	0.050	0.056	<0.050	<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
	Cobalt (Co)	mg/L	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
	Iron (Fe)	mg/L	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
	Lithium (Li)	mg/L	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
	Manganese (Mn)	mg/L	0.000070	0.000100	0.000116	0.000076	0.000104	0.000074	<0.000070
	Mercury (Hg)	mg/L	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
	Nickel (Ni)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.10	0.21	<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
	Sodium (Na)	mg/L	0.050	0.278	0.182	0.156	0.181	0.162	0.188
	Strontium (Sr)	mg/L	0.00010	0.00019	<0.00010	<0.00010	0.00011	<0.00010	0.00011
	Thallium (Tl)	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
	Titanium (Ti)	mg/L	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
	Vanadium (V)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	0.0030	<0.0030	0.0031	<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
	Arsenic (As)	mg/L	0.00010	0.00012	0.00013	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.000050	0.000518	0.000514	0.000152	0.000153	0.000142	0.000154
	Beryllium (Be)	mg/L	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	0.100	<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
	Calcium (Ca)	mg/L	0.050	0.058	0.058	<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
	Cobalt (Co)	mg/L	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
	Iron (Fe)	mg/L	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
	Lithium (Li)	mg/L	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
	Manganese (Mn)	mg/L	0.000070	0.000090	0.000108	0.000071	0.000166	0.000071	0.000083
	Mercury (Hg)	mg/L	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	0.000053	<0.000050	<0.000050
	Nickel (Ni)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.10	0.21	0.21	<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
	Sodium (Na)	mg/L	0.050	0.275	0.276	0.152	0.147	0.146	0.140
	Strontium (Sr)	mg/L	0.00010	0.00019	0.00018	0.00010	<0.00010	<0.00010	<0.00010
	Thallium (Tl)	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
	Titanium (Ti)	mg/L	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
	Vanadium (V)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Other	Phenols (4AAP)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chlorophyll a	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Phaeophytin a	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

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			MDL	DL0-01-5-02	JL0-10-S102	JL0-10-B102	F0-0102	MDL	E0-2102	BL0-0102	REF3-03-S102	BL0-0402
Date Sampled				20-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015		29-Jun-2015	24-Aug-2015	24-Aug-2015	23-Aug-2015
ALS Sample ID				L1646871-12	L1645029-7	L1645029-9	L1645027-2		L1635556-12	L1664158-10	L1664154-2	L1664032-13
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
	Physical Tests	mg/L	10	<10	<10	<10	<10	10	<10	<10	<10	<10
	pH	pH units	0.10	6.21	6.01	6.10	6.30	0.10	6.61	5.73	5.87	5.96
	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	20	<10	<10	<10	13	20	<20	<10	<10	<10
	Turbidity	NTU	0.10	0.24	<0.10	<0.10	<0.10	0.10	<0.10	0.13	<0.10	<0.10
Anions and Nutrients	Alkalinity, Total (as CaCO3)	mg/L	10	<10	59	<10	<10	10	<10	<10	<10	<10
	Anions and Nutrients	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	0.050	<0.050	<0.050	<0.050	<0.050
	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
	Total Phosphorus	mg/L	0.0030	<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	<0.30	
Carbon	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
	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	0.0046	<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	0.00011	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.000050	0.000127	0.000488	0.000642	0.000646	0.000050	0.000944	<0.000050	<0.000050	0.000061
	Beryllium (Be)	mg/L	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	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	0.063	<0.050	0.071	0.069	0.050	0.237	<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	0.00131	0.00132	0.00050	0.00140	<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	0.000136	0.000156	0.000166	0.000070	0.000192	<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	0.20	<0.20	<0.20	<0.20	<0.20	0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	0.10	0.58	<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	0.355	0.352	0.050	0.547	<0.050	<0.050	<0.050
	Strontium (Sr)	mg/L	0.00010	<0.00010	<0.00010	0.00023	0.00023	0.00010	0.00035	<0.00010	<0.00010	<0.00010
	Thallium (Tl)	mg/L	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	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<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
Dissolved Metals	Aluminum (Al)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	0.0207	0.00091	0.00092	0.00068
	Antimony (Sb)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.000020	0.000124	<0.000020	<0.000020	<0.000020
	Arsenic (As)	mg/L	0.00010	<0.00010	<0.00010	0.00012	0.00010	0.000020	0.000327	<0.000020	<0.000020	<0.000020
	Barium (Ba)	mg/L	0.000050	<0.00010	<0.00010	0.00048	0.00065	0.000050	0.00243	0.000040	0.000039	<0.000030
	Beryllium (Be)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Bismuth (Bi)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Boron (B)	mg/L	0.010	<0.010	<0.010	<0.010	<0.010	0.0050	<0.0050	<0.0050	<0.00500	

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

Client Sample ID			MDL	MRY-REF302	BL0-05 B02	DL0-02-7S102	DL0-02-402	F0-0102	DL0-01-2-02 (S1)	DL0-01-2-02 (B1)	BL0-01A-02 (S1)
Date Sampled				26-Jun-2015	27-Jul-2015	22-Jul-2015	20-Aug-2015	17-Aug-2015	06-MAY-15	06-MAY-15	28-APR-15
ALS Sample ID				L1633808-11	L1649802-4	L1647552-5	L1661722-9	L1659759-9	L1608946-7	L1608946-8	L1605045-7
Physical Tests	Conductivity	umhos/cm	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Physical Tests	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10
	pH	pH units	0.10	5.84	5.89	5.70	6.00	6.01	6.38	6.01	6.77
	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	<20	<10	<10	<10	<10	<10	<10	<10
	Turbidity	NTU	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients	Alkalinity, Total (as CaCO3)	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10
	Anions and Nutrients	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	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	1.20	<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	<0.025	<0.025	<0.025
	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	0.16	<0.15	<0.15	<0.15	<0.15	0.41
	Total Phosphorus	mg/L	0.0030	<0.0030	<0.0030	<0.0030	0.0061	<0.0030	<0.0030	<0.0030	<0.0030
Sulfate (SO4)	mg/L	0.30	<0.30	0.66	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	
Carbon	Dissolved Organic Carbon	mg/L	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
Total Metals	Aluminum (Al)	mg/L	0.0030	0.0036	<0.0030	<0.0030	<0.0030	<0.0030	0.0061	0.0057	<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	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	0.00014	0.00013	<0.00010
	Barium (Ba)	mg/L	0.000050	0.000723	<0.000050	<0.000050	<0.000050	<0.000050	0.000697	0.000660	0.000356
	Beryllium (Be)	mg/L	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	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	0.176	<0.050	<0.050	<0.050	<0.050	0.120	0.115	0.084
	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	0.00140	<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	0.000155	<0.000070	<0.000070	<0.000070	<0.000070	0.000109	0.000092	0.000085
	Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000019
	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	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.10	0.57	<0.10	<0.10	<0.10	<0.10	0.20	0.20	<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	0.548	<0.050	<0.050	<0.050	<0.050	0.262	0.259	0.154
	Strontium (Sr)	mg/L	0.00010	0.00032	<0.00010	<0.00010	<0.00010	<0.00010	0.00021	0.00022	0.00013
	Thallium (Tl)	mg/L	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	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<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	0.0030	<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	0.000801	<0.000050	<0.000050	<0.000050	<0.000050	0.000285	0.000319	0.000315
Beryllium (Be)		mg/L	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	0.100	<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	0.186	<0.050	<0.050	<0.050	<0.050	0.079	0.085	0.064
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	0.00145	<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	0.000066	<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	0.000169	<0.000070	<0.000070	<0.000070	<0.000070	0.000123	0.000124	0.000088
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	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Selenium (Se)		mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)		mg/L	0.10	0.55	<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	0.546	<0.050	<0.050	<0.050	<0.050	0.167	0.169	0.146
Strontium (Sr)		mg/L	0.00010	0.00031	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	0.00010	0.00011
Thallium (Tl)		mg/L	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	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)		mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)		mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Cesium (Cs)		mg/L									
Phosphorus (P)	mg/L										
Rubidium (Rb)	mg/L										
Sulfur (S)	mg/L										
Tellurium (Te)	mg/L										
Thorium (Th)	mg/L										
Tungsten (W)	mg/L										
Zirconium (Zr)	mg/L										
Other	Phenols (4AAP)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	0.0012	0.0022	<0.0010	<0.0010	<0.0010
	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	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	
	Phaeophytin a	ug/L	0.1								<0.10
	Oil and Grease, Total	mg/L									

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			MDL	BL0-01A-02 (B1)	BL0-05-02 (S1)	BL0-05-02 (B1)	MS-C-G02	
Date Sampled				28-APR-15	30-APR-15	30-APR-15	1-Jul-2015	
ALS Sample ID				L1605045-8	L1606372-3	L1606372-4	L1635675-7	
Physical Tests	Conductivity	umhos/cm	3.0	<3.0	<3.0	<3.0	<3.0	
	Physical Tests	mg/L	10	<10	<10	<10		
	pH	pH units	0.10	6.30	6.55	6.08	5.70	
	Total Suspended Solids	mg/L	2.0	<2.0	<2.0	<2.0	<2.0	
	Total Dissolved Solids	mg/L	10	<10	<10	<10		
	Turbidity	NTU	0.10	<0.10	0.10	<0.10		
Anions and Nutrients	Alkalinity, Total (as CaCO ₃)	mg/L	10	<10	<10	<10		
	Anions and Nutrients	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	
	Bromide (Br)	mg/L	0.10	<0.10	<0.10	<0.10		
	Chloride (Cl)	mg/L	0.50	<0.50	<0.50	<0.50		
	Nitrate and Nitrite as N	mg/L	0.021	<0.025	<0.025	<0.025		
	Nitrate (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	
	Nitrite (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050		
	Total Kjeldahl Nitrogen	mg/L	0.15	<0.15	<0.15	<0.15		
	Total Phosphorus	mg/L	0.0030	<0.0030	<0.0030	<0.0030		
	Sulfate (SO ₄)	mg/L	0.30	<0.30	<0.30	<0.30		
Carbon	Dissolved Organic Carbon	mg/L	1.0	<1.0	<1.0	<1.0		
	Total Organic Carbon	mg/L	1.0	<1.0	<1.0	<1.0		
Total Metals	Aluminum (Al)	mg/L	0.0030	<0.0030	<0.0030	<0.0030		
	Antimony (Sb)	mg/L	0.00010	<0.00010	<0.00010	<0.00010		
	Arsenic (As)	mg/L	0.00010	<0.00010	<0.00010	<0.00010		
	Barium (Ba)	mg/L	0.000050	0.000272	0.000280	0.000252		
	Beryllium (Be)	mg/L	0.00050	<0.00050	<0.00050	<0.00050		
	Bismuth (Bi)	mg/L	0.00050	<0.00050	<0.00050	<0.00050		
	Boron (B)	mg/L	0.010	<0.010	<0.010	<0.010		
	Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	<0.000010		
	Calcium (Ca)	mg/L	0.050	0.061	0.081	0.082		
	Chromium (Cr)	mg/L	0.00050	<0.00050	<0.00050	<0.00050		
	Cobalt (Co)	mg/L	0.00010	<0.00010	<0.00010	<0.00010		
	Copper (Cu)	mg/L	0.00050	<0.00050	<0.00050	<0.00050		
	Iron (Fe)	mg/L	0.030	<0.030	<0.030	<0.030		
	Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	<0.000050		
	Lithium (Li)	mg/L	0.0010	<0.0010	<0.0010	<0.0010		
	Magnesium (Mg)	mg/L	0.050	<0.050	<0.050	<0.050		
	Manganese (Mn)	mg/L	0.000070	0.000095	0.000071	0.000074		
	Mercury (Hg)	mg/L	0.000010	0.000018	<0.000010	<0.000010		
	Molybdenum (Mo)	mg/L	0.000050	<0.000050	<0.000050	<0.000050		
	Nickel (Ni)	mg/L	0.00050	<0.00050	<0.00050	<0.00050		
	Potassium (K)	mg/L	0.20	<0.20	<0.20	<0.20		
	Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	<0.0010		
	Silicon (Si)	mg/L	0.10	<0.10	<0.10	<0.10		
	Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	<0.000010		
	Sodium (Na)	mg/L	0.050	0.157	0.148	0.138		
	Strontium (Sr)	mg/L	0.00010	0.00012	0.00012	0.00011		
	Thallium (Tl)	mg/L	0.00010	<0.00010	<0.00010	<0.00010		
	Tin (Sn)	mg/L	0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)	mg/L	0.010	<0.010	<0.010	<0.010		
	Uranium (U)	mg/L	0.000010	<0.000010	<0.000010	<0.000010		
	Vanadium (V)	mg/L	0.0010	<0.0010	<0.0010	<0.0010		
	Zinc (Zn)	mg/L	0.0030	<0.0030	<0.0030	<0.0030		
Dissolved Metals	Aluminum (Al)	mg/L	0.0030	<0.0030	<0.0030	<0.0030		
	Antimony (Sb)	mg/L	0.00010	<0.00010	<0.00010	<0.00010		
	Arsenic (As)	mg/L	0.00010	<0.00010	<0.00010	<0.00010		
	Barium (Ba)	mg/L	0.000050	0.000231	0.000340	0.000417		
	Beryllium (Be)	mg/L	0.00050	<0.00050	<0.00050	<0.00050		
	Bismuth (Bi)	mg/L	0.00050	<0.00050	<0.00050	<0.00050		
	Boron (B)	mg/L	0.100	<0.010	<0.010	<0.010		
	Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	<0.000010		
	Calcium (Ca)	mg/L	0.050	0.054	0.078	0.078		
	Chromium (Cr)	mg/L	0.00050	<0.00050	<0.00050	<0.00050		
	Cobalt (Co)	mg/L	0.00010	<0.00010	<0.00010	<0.00010		
	Copper (Cu)	mg/L	0.00050	<0.00050	<0.00050	<0.00050		
	Iron (Fe)	mg/L	0.030	<0.030	<0.030	<0.030		
	Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	<0.000050		
	Lithium (Li)	mg/L	0.0010	<0.0010	<0.0010	<0.0010		
	Magnesium (Mg)	mg/L	0.050	<0.050	<0.050	<0.050		
	Manganese (Mn)	mg/L	0.000070	0.000072	0.000101	0.000086		
	Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)	mg/L	0.000050	<0.000050	<0.000050	<0.000050		
	Nickel (Ni)	mg/L	0.00050	<0.00050	<0.00050	<0.00050		
	Potassium (K)	mg/L	0.20	<0.20	<0.20	<0.20		
	Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	<0.0010		
	Silicon (Si)	mg/L	0.10	<0.10	<0.10	<0.10		
	Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	<0.000010		
	Sodium (Na)	mg/L	0.050	0.147	0.196	0.172		
	Strontium (Sr)	mg/L	0.00010	0.00010	0.00015	0.00014		
	Thallium (Tl)	mg/L	0.00010	<0.00010	<0.00010	<0.00010		
	Tin (Sn)	mg/L	0.00010	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)	mg/L	0.010	<0.010	<0.010	<0.010		
	Uranium (U)	mg/L	0.000010	<0.000010	<0.000010	<0.000010		
	Vanadium (V)	mg/L	0.0010	<0.0010	<0.0010	<0.0010		
	Zinc (Zn)	mg/L	0.0030	<0.0030	<0.0030	<0.0030		
		Cesium (Cs)	mg/L					
		Phosphorus (P)	mg/L					
		Rubidium (Rb)	mg/L					
		Sulfur (S)	mg/L					
		Tellurium (Te)	mg/L					
		Thorium (Th)	mg/L					
		Tungsten (W)	mg/L					
		Zirconium (Zr)	mg/L					
Other	Phenols (4AAP)	mg/L	0.0010	<0.0010	<0.0010	<0.0010		
	Chlorophyll a	ug/L	0.10	<0.10	<0.10	<0.10		
	Phaeophytin a	ug/L	0.10					
	Phaeophytin a	ug/L	0.1	<0.10	<0.10	<0.10		
	Oil and Grease, Total	mg/L	2.0				<2.0	

Table A.3: Equipment 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		MDL	BL0-0104	REF3-03-S104	MDL	DL0-01-1-04	JL0-0204	MDL	BL0-0504	DD-HAB9-STN1-S104	JL0-0204	DL0-01-5-04	BL0-05-A-04 (S1)
		Date Sampled	ALS Sample ID		24-Aug-2015	24-Aug-2015		20-Jul-2015	19-Jul-2015		27-Jul-2015	22-Aug-2015	19-Aug-2015	07-MAY-15	30-APR-15
					L1664158-11	L1664154-4		L1646871-3	L1645029-5		L1649802-1	L1662482-1	L1661680-1	L1610431-7	L1606372-9
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	<3.0
	Hardness (as CaCO ₃)	mg/L	10	<10	<10	10	<10	<10	10	<10	<10	<10	<10	<10	<10
	pH	pH units	0.10	5.86	5.84	0.10	6.04	6.70	0.10	5.92	5.95	6.04	6.89	6.72	6.72
	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	<2.0
	Total Dissolved Solids	mg/L	10	11	<10	10	15	<10	10	<10	<10	<10	29	<10	<10
	Turbidity	NTU	0.10	0.13	<0.10	0.10	0.22	<0.10	0.10	0.14	0.11	<0.10	<0.10	0.20	0.20
Anions and Nutrients	Alkalinity, Total (as CaCO ₃)	mg/L	10	<10	<10	10	<10	60	10	<10	<10	<10	<10	<10	<10
	Ammonia, Total (as N)	mg/L	0.050	<0.050	<0.050	0.050	<0.050	<0.050	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	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	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
	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	<0.025	<0.025	<0.025
	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	<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	<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	0.63	0.63
	Total Phosphorus	mg/L	0.0030	0.0040	<0.0030	0.0030	<0.0030	<0.0030	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Sulfate (SO ₄)	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	<0.30	<0.30
Carbon	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 Metals	Aluminum (Al)	mg/L	0.0030	<0.0030	0.0159	0.0030	<0.0030	<0.0030	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0031	<0.0030
	Antimony (Sb)	mg/L	0.00010	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	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
	Barium (Ba)	mg/L	0.000050	<0.000050	0.000296	0.000050	0.000127	<0.000050	0.000050	0.000085	0.000056	0.000062	0.000394	0.000348	0.000348
	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
	Bismuth (Bi)	mg/L	0.00050	<0.00050	<0.00050	0.00050	<0.00050	<0.00050	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	0.010	<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
	Calcium (Ca)	mg/L	0.050	<0.050	0.227	0.050	0.060	<0.050	0.050	<0.050	<0.050	<0.050	0.100	0.065	0.065
	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
	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
	Copper (Cu)	mg/L	0.00050	<0.00050	0.00160	0.00050	<0.00050	<0.00050	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00090
	Iron (Fe)	mg/L	0.030	<0.030	<0.030	0.030	<0.030	<0.030	0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	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
	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	0.050	<0.050	<0.050	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	0.000092	0.000070	<0.000070	<0.000070	0.000070	0.000089	<0.000070	<0.000070	0.000095	0.000106	0.000106
	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
	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	<0.000050	<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	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.20	<0.20	<0.20	0.20	<0.20	<0.20	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)	mg/L	0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.10	<0.10	1.35	0.10	<0.10	<0.10	0.10	<0.10	<0.10	<0.10	<0.10	0.14	<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	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.050	0.106	0.787	0.050	<0.050	0.068	0.050	0.076	0.056	<0.050	0.304	0.181	0.181
	Strontium (Sr)	mg/L	0.00010	<0.00010	0.00035	0.00010	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	0.00016	0.00015	0.00015
	Thallium (Tl)	mg/L	0.000												

A2.1.2 Precision – Field Duplicates

A total of 48 field duplicates were collected over the course of the 2015 Mary River Project CREMP. These included 10 winter lake monitoring events, 2 spring stream monitoring events, 19 summer stream/lake monitoring events, and 17 fall stream/lake monitoring events. In general, close agreement in parameter concentrations was observed between duplicate samples, with only 2.6% of analytes above the Relative Percent Difference (RPD) DQO of 25% out of 4,000 analyses conducted (Table A.4). Nutrients and organic parameters accounted for over half of the incidences in which the precision DQO was not achieved (i.e., 56%), of which duplicate results for total Kjeldahl nitrogen (TKN), total phosphorus and phenol most frequently were above the DQO (Table A.4). In the case of phenols, measured concentrations were close to the detection limit such that small differences in concentration resulted in relatively high RPD. However, for other nutrient and organic parameters, relatively high RPD likely reflected natural variability in actual concentrations in the field as the field duplicates were not collected side by side. In the majority of cases, and for key parameters of concern, the RPD in analyte concentrations was sufficiently low as to not affect interpretation of the data.

A2.2 Sediment Samples

A2.2.1 Data Precision – Field Duplicate Samples

Field duplicate sediment samples were collected at each of Camp Lake (Station JLO-14), Sheardown Lake NW (Station DLO-01-9), Sheardown Lake SE (DLO-02-2), Mary Lake (BLO-12) and Reference Lake 3 (REF03-10), which represented 12% of the total number of sediment quality monitoring stations for the 2015 CREMP. Close agreement in parameter concentrations were observed between duplicate samples, with only four incidences (2.2%) in which the 40% RPD DQO was not achieved (Table A.5). Relatively high RPD for barium, manganese and molybdenum were observed between the field duplicate samples collected at the Camp Lake station, as well as for molybdenum between the field duplicate samples collected at the Mary Lake station (Table A.5). The relatively high RPD between duplicate samples for these parameters may have been associated slight differences in the proportion of fines (i.e., silt- and clay-sized particles; Table A.5) between duplicates since metals tend to bind more with finer substrates. Therefore, natural variability in substrate characteristics, or inadequate homogenization of composite samples, likely accounted for the above parameters not meeting the DQO. However, on the whole, data precision for the sediment quality samples was high and considered acceptable for providing reliable interpretation of the data.

Figure A.4: Water sample field duplicate results. Highlighted values did not meet the data quality objective of ≤ 25% Relative Percent Difference (RPD).

Sample ID		JL0-10 (B1)	JL0-10-01 (B1)	%RPD	JL0-10 (S1)	JL0-10-01 (S1)	%RPD	DL0-01-1(B1)	DL0-01-1-01(B1)	%RPD	DL0-01-1(S1)	DL0-01-1-01(S1)	%RPD	DL0-02-03 (B1)	DL0-02-03-01 (B1)	%RPD	DL0-02-03 (S1)	DL0-02-03-01 (S1)	%RPD	BL0-01 (B1)	BL0-01-01 (B1)	%RPD	BL0-01 (S1)	BL0-01-01 (S1)	%RPD	BL0-06 (B1)	BL0-06-01 (B1)	%RPD
Date Sampled		26-APR-15	26-APR-15		26-APR-15	26-APR-15		07-MAY-15	07-MAY-15		07-MAY-15	07-MAY-15		03-MAY-15	03-MAY-15		03-MAY-15	03-MAY-15		28-APR-15	28-APR-15		28-APR-15	28-APR-15		28-APR-15	28-APR-15	
ALS Sample ID		L1603947-8	L1603947-10		L1603947-7	L1603947-9		L1610431-2	L1610431-4		L1610431-1	L1610431-3		L1607605-2	L1607605-4		L1607605-1	L1607605-3		L1605045-2	L1605045-4		L1605045-1	L1605045-3		L1606012-4	L1606012-6	
Physical Tests	Conductivity	153	153	0	168	160	5	144	144	0	144	143	1	151	150	1	151	149	1	200	194	3	204	199	2	86.2	87.1	1
	Hardness (as CaCO3)	73	72	1	75	76	1	72	71	1	70	70	0	71	70	1	71	71	0	92	95	3	102	96	6	41	41	0
	pH	8.07	8.05	0	8.04	8.08	0	7.93	7.97	1	7.89	7.94	1	7.86	7.9	1	7.86	7.88	0	8.1	8.07	0	8.02	8.08	1	7.91	7.91	0
	Total Suspended Solids	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0
	Total Dissolved Solids	71	73	3	88	76	15	76	91	18	83	94	12	82	80	2	80	81	1	105	96	9	105	102	3	70	66	6
	Turbidity	0.18	0.14	25	0.15	0.14	7	0.23	0.23	0	0.22	0.23	4	0.38	0.42	10	0.29	0.42	37	0.16	0.18	12	0.22	0.2	10	0.15	0.16	6
Anions and Nutrients	Alkalinity, Total (as CaCO3)	67	70	4	59	75	24	67	71	6	66	66	0	81	79	3	81	76	6	103	97	6	104	99	5	42	38	10
	Ammonia, Total (as N)	0.093	0.053	55	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	0.073	<0.050	37	<0.05	<0.05	0	<0.05	<0.05	0
	Bromide (Br)	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Chloride (Cl)	3.9	3.92	1	4.31	4.08	5	3.26	3.31	2	3.27	3.29	1	2.99	2.97	1	2.96	2.97	0	3.58	3.45	4	3.61	3.59	1	1.8	1.78	1
	Nitrate and Nitrite as N	<0.025	<0.025	0	<0.025	<0.025	0	0.038	0.04	5	0.037	0.039	5	<0.025	<0.025	0	<0.025	<0.025	0	0.035	0.03	15	0.036	0.036	0	<0.025	0.026	4
	Nitrate (as N)	<0.02	<0.02	0	<0.02	<0.02	0	0.038	0.04	5	0.037	0.039	5	<0.02	<0.02	0	<0.02	<0.02	0	0.035	0.03	15	0.036	0.036	0	0.024	0.026	8
	Nitrite (as N)	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0
	Total Kjeldahl Nitrogen	<0.15	<0.15	0	<0.15	0.19	24	0.134	<0.15	11	0.786	0.61	25	0.356	0.39	9	<0.15	0.82	138	0.24	0.3	22	0.35	0.33	6	0.29	<0.15	64
	Total Phosphorus	0.0045	0.0037	20	0.003	0.0037	21	0.0038	0.0127	108	0.005	0.0037	30	0.0071	0.0046	43	<0.003	0.0035	15	0.0036	0.0038	5	0.0047	0.0192	121	0.0034	0.0037	8
	Sulfate (SO4)	1.74	1.79	3	1.91	1.82	5	3.19	3.21	1	3.2	3.23	1	2.6	2.59	0	2.61	2.64	1	2.17	2.1	3	2.17	2.17	0	1.23	1.22	1
Carbon	Dissolved Organic Carbon	1.3	1.3	0	1.4	1.3	7	<1	<1	0	<1	<1	0	1.3	1.3	0	<1	1.1	10	1.2	1.1	9	1.2	1.2	0	1.5	<1	40
	Total Organic Carbon	1.4	1.2	15	1.4	1.5	7	1.2	1.1	9	1.6	1.1	37	1.3	1.3	0	1	1	0	1.5	1.2	22	2.3	1.3	56	<1	<1	0
Total Metals	Aluminum (Al)	<0.003	<0.003	0	<0.003	<0.003	0	<0.003	<0.003	0	<0.003	<0.003	0	<0.003	0.0051	52	<0.003	<0.003	0	0.0033	<0.0030	10	0.0376	0.0035	166	0.0042	0.0036	15
	Antimony (Sb)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0
	Arsenic (As)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	0.00012	0.0001	18	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0
	Barium (Ba)	0.00708	0.0071	0	0.00756	0.00738	2	0.00601	0.00609	1	0.0062	0.00616	1	0.00656	0.00663	1	0.0066	0.00679	3	0.00923	0.00933	1	0.01	0.00982	2	0.0047	0.00471	0
	Beryllium (Be)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0
	Bismuth (Bi)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0
	Boron (B)	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0
	Cadmium (Cd)	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0
	Calcium (Ca)	13.8	14.2	3	14.2	14.6	3	14	14	0	14.6	14.2	3	14	13.8	1	13.6	13.2	3	18	18.2	1	19.6	18.8	4	8.22	8.07	2
	Chromium (Cr)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0
	Cobalt (Co)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	

Figure A.4: Water sample field duplicate results. Highlighted values did not meet the data quality objective of $\leq 25\%$ Relative Percent Difference (RPD).

Sample ID		BL0-06 (S1)	BL0-06-01 (S1)	%RPD	L1-05	L1-0501	%RPD	C0-05	C0-0501	%RPD	L2-03	L2-0301	%RPD	L0-01	L0-0101	%RPD	JL0-02-B1	JL0-02-B101	%RPD	JL0-02-S1	JL0-02-S101	%RPD	JL0-07-B1	JL0-07-B101	%RPD	JL0-07-S1	JL0-07-S101	%RPD						
Date Sampled		29-APR-15	29-APR-15		23-Jun-15	23-Jun-15		29-Jun-15	29-Jun-15		17-Jul-15	17-Jul-15		17-Jul-15	17-Jul-15		17-Jul-15	17-Jul-15		19-Jul-15	19-Jul-15		19-Jul-15	19-Jul-15		18-Jul-15	18-Jul-15		18-Jul-15	18-Jul-15	18-Jul-15	18-Jul-15	18-Jul-15	18-Jul-15
ALS Sample ID		L1606012-3	L1606012-5		L1632455-2	L1632455-3		L1635556-7	L1635556-8		L1645030-8	L1645030-9		L1645030-3	L1645030-4		L1645029-3	L1645029-4		L1645029-1	L1645029-2		L1645031-6	L1645031-7		L1645031-4	L1645031-5							
Physical Tests	Conductivity	90.9	90.8	0	99.1	99.4	0	36.3	36.7	1	416	418	0	200	200	0	130	132	2	129	134	4	127	128	1	127	127	0						
	Hardness (as CaCO3)	43	43	0	50	50	0	18	18	0	174	174	0	96	96	0	64	64	0	64	62	3	61	62	2	61	61	0						
	pH	7.91	7.94	0	8.02	8.02	0	7.17	7.19	0	8.13	8.15	0	8.14	8.15	0	7.91	7.89	0	7.89	7.90	0	7.92	7.92	0	7.93	7.91	0						
	Total Suspended Solids	<2	<2	0	2	<2	0	3.2	3.2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0						
	Total Dissolved Solids	61	62	2	65	64	2	20	27	30	225	215	5	102	109	7	68	69	1	76	80	5	82	81	1	67	70	4						
	Turbidity	0.15	0.2	29	0.77	0.78	1	4.59	4.02	13	3.87	3.32	15	0.39	0.43	10	0.46	0.48	4	0.47	0.54	14	0.48	0.46	4	0.47	0.49	4						
Anions and Nutrients	Alkalinity, Total (as CaCO3)	42	41	2	43	47	9	18	15	18	133	135	1	95	95	0	57	<10	140	65	63	3	66	68	3	66	63	5						
	Ammonia, Total (as N)	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	0.074	0.075	1	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0						
	Bromide (Br)	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0						
	Chloride (Cl)	1.86	1.86	0	2.97	3.53	17	0.63	0.63	0	35.3	35.3	0	7.21	7.23	0	3.32	3.27	2	3.27	3.29	1	3.26	3.26	0	3.27	3.26	0						
	Nitrate and Nitrite as N	<0.025	<0.025	0	0.043	0.043	0	<0.021	<0.021	0	0.5692	0.5835	2	0.058	0.058	0	0.639	<0.021	187	<0.021	0.03	35	<0.021	<0.021	0	<0.021	<0.021	0						
	Nitrate (as N)	0.023	0.022	4	0.043	0.043	0	<0.02	<0.02	0	0.557	0.571	2	0.058	0.058	0	0.639	<0.02	188	<0.02	0.030	40	<0.02	<0.02	0	<0.02	<0.02	0						
	Nitrite (as N)	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	0.0122	0.0125	2	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0						
	Total Kjeldahl Nitrogen	0.57	0.69	19	<0.15	0.15	0	<0.15	<0.15	0	0.43	0.42	2	<0.15	<0.15	0	<0.15	<0.15	0	0.25	<0.15	50	<0.15	<0.15	0	<0.15	<0.15	0						
	Total Phosphorus	0.0044	0.013	99	<0.003	<0.003	0	0.0069	0.0083	18	0.0100	0.0074	30	0.0037	0.0041	10	0.0039	0.0053	75	0.0151	0.0053	96	0.0046	0.0073	45	0.0042	0.0031	30						
	Sulfate (SO4)	1.26	1.25	1	1.87	1.84	2	0.56	0.57	2	33.3	33.3	0	3.76	3.81	1	1.46	1.45	1	1.47	1.45	1	1.43	1.44	1	1.5	1.44	4						
Carbon	Dissolved Organic Carbon	<1	<1	0	1.8	1.7	6	1.1	1.1	0	5.2	5.2	0	2.6	2.8	7	1.6	1.6	0	1.6	1.6	0	1.7	1.7	0	1.8	1.6	12						
	Total Organic Carbon	1.7	<1	52	1.7	1.6	6	1.2	1.2	0	5.2	5.3	2	2.5	2.5	0	1.6	1.6	0	1.6	1.6	0	1.6	1.6	0	1.7	1.5	13						
Total Metals	Aluminum (Al)	0.0045	0.0039	14	0.0097	0.0106	9	0.102	0.117	14	0.0384	0.0271	35	0.0233	0.0166	34	0.0069	0.0071	3	0.0106	0.0059	57	0.0058	0.0101	54	0.0057	0.0061	7						
	Antimony (Sb)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0						
	Arsenic (As)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.00014	<0.0016	13	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0						
	Barium (Ba)	0.00505	0.00512	1	0.006	0.00613	2	0.00307	0.00311	1	0.0163	0.0164	1	0.0112	0.0111	1	0.00586	0.00589	1	0.00598	0.00592	1	0.00583	0.0057	2	0.00586	0.00584	0						
	Beryllium (Be)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0						
	Bismuth (Bi)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0						
	Boron (B)	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	0.017	0.017	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0						
	Cadmium (Cd)	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0						
	Calcium (Ca)	8.37	8.5	2	9.63	9.8	2	3.72	3.7	1	33.6	33.6	0	19.7	19.7	0	12.5	12.4	1	12.4	12.5	1	12.7	12.6	1	12.6	12.4	2						
	Chromium (Cr)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0						
	Cobalt (Co)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	0.00038	0.00037	3	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0						
	Copper (Cu)	0.0008	0.00084	5	0.00142	0.00141	1	0.00054	0.00054	0	0.00123	0.00110	11	0.00179	0.00182	2	0.00099	0.00100	1	0.00090	0.00081	11	0.00075	0.00078	4	0.00076	0.00076	0						
	Iron (Fe)	<0.03	<0.03	0	<0.03	<0.03	0	0.092	0.102	10	0.831	0.858	3	0.043	0.035	21	<0.03	<0.03	0	<0.03	<0.03	0	<0.03	<0.03	0	<0.03	<0.03	0						
	Lead (Pb)	<0.00005	<0.00005	0	<0.00005	<0.00005	0	0.000149	0.000138	8	0.000054	<0.00005	8	<0.00005	<0.00005	0	0.000061	<0.00005	20	<0.00005	0.000061	20	<0.00005	<0.00005	0	<0.00005	<0.00005	0						
	Lithium (Li)	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	0.0034	0.0034	0	0.0016	0.0016	0	0.0010	0.0010	0	0.0010	<0.001	0	0.0013	0.0012	8	0.0011	0.0013	17						
	Magnesium (Mg)	5.43	5.5	1	6.1	6.03	1	2.18	2.2	1	21.6	22.8	5	11.7	11.6	1	7.29	7.24	1	7.42	7.13	4	7.65	7.56	1	7.58	7.64	1						
	Manganese (Mn)	0.000309	0.000292	6	0.00151	0.00151	0	0.00254	0.00262	3	0.113	0.112	1	0.00176	0.00148	17	0.00169	0.00177	5	0.00181	0.00178	2	0.00188	0.0018	4	0.00184	0.00177	4						
	Mercury (Hg)	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0						
	Molybdenum (Mo)	0.00016	0.000156	3	0.000308	0.000315	2	0.00008	0.000088	10	0.00143	0.00147	3	0.000494	0.000489	1	0.000234	0.000231	1	0.000233	0.000233	0	0.000229	0.000223	3	0.000233	0.000218	7						
	Nickel (Ni)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	0.00165	0.00165	0	0.00083	0.00084	1	0.00058	0.00058	0	0.00063	0.00057	10	0.00056	0.00054	4	0.00056	0.00055	2						
	Potassium (K)	0.67	0.68	1	1.12	1.13	1	0.41	0.41	0	3.06	3.18	4	1.86	1.84	1	1.01	1.01	0	1.03	0.97	6	1.02	1.03	1	1.01	1.03	2						
	Selenium (Se)	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0						
	Silicon (Si)	0.46	0.45	2	0.35	0.36	3	0.48	0.52	8	0.69	0.70	1	0.89	0.88	1	0.38	0.39	3	0.39	0.37	5	0.4	0.38	5	0.37	0.38	3						
	Silver (Ag)	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0						
	Sodium (Na)	1.26	1.28	2	1.25	1.23	2	0.419	0.426	2	13.9	14.7	6	2.36	2.34	1	1.23	1.24	1	1.26	1.20	5	1.27	1.26	1	1.25	1.26	1						
	Strontium (Sr)	0.00726	0.00726	0	0.00676	0.0069	2	0.00284	0.00283	0	0.0320	0.0319	0	0.0203	0.0200	1	0.00931	0.00922	1	0.00925	0.00923	0	0.00913	0.00903	1	0								

Figure A.4: Water sample field duplicate results. Highlighted values did not meet the data quality objective of ≤ 25% Relative Percent Difference (RPD).

Sample ID		DL0-01-4-B1			DL0-01-4-S1	DL0-01-4-S101			DL0-02-3B1	DL0-02-3B101			DL0-02-3S1	DL0-02-3S101			G0-0901	G0-09			BL0-05B1	BL0-05B101			BL0-05S101	BL0-05S1			BL0-06B1	BL0-0601B1			BL0-06S1	BL0-06S101	
Date Sampled		20-Jul-15	20-Jul-15	%RPD	20-Jul-15	20-Jul-15	%RPD		21-Jul-15	21-Jul-15	%RPD		21-Jul-15	21-Jul-15	%RPD		19-Jul-15	19-Jul-15	%RPD		27-Jul-15	27-Jul-15	%RPD		27-Jul-15	27-Jul-15	%RPD		27-Jul-15	27-Jul-15	%RPD		27-Jul-15	27-Jul-15	%RPD
ALS Sample ID		L1646871-7	L1646871-9		L1646871-6	L1646871-8			L1647512-5	L1647512-8			L1647512-6	L1647512-7			L1645027-8	L1645027-7			L1650065-6	L1650065-9			L1650065-7	L1650065-8			L1649802-11	L1649802-12			L1649802-9	L1649802-10	
Physical Tests	Conductivity	113	113	0	114	113	1		93.6	93.5	0		93.9	93.7	0		72.2	72.4	0		58.6	58.6	0		62.3	62	0		57	57	0		56.9	56.8	0
	Hardness (as CaCO3)	56	55	2	55	55	0		44	43	2		44	43	2		34	33	3		29	29	0		34	34	0		31	30	3		30	30	0
	pH	7.93	7.95	0	7.91	7.94	0		7.75	7.76	0		7.89	7.9	0		7.89	7.92	0		7.52	7.55	0		7.74	7.72	0		7.61	7.61	0		7.63	7.63	0
	Total Suspended Solids	<2	<2	0	<2	<2	0		2.8	2.8	0		2.4	2.8	15		<2	2.4	18		<2	<2	0		2	<2	0		<2	<2	0		<2	<2	0
	Total Dissolved Solids	69	62	11	75	62	19		43	51	17		55	57	4		65	53	20		39	46	16		41	48	16		37	35	6		37	35	6
	Turbidity	1.35	1.13	18	1.11	1.26	13		2.21	2.37	7		2	2.27	13		10.1	10	1		2.57	2.41	6		4.56	3.65	22		2.04	2.14	5		2.26	2.22	2
Anions and Nutrients	Alkalinity, Total (as CaCO ₃)	58	59	2	59	71	18		44	40	10		45	43	5		37	34	8		29	27	7		31	31	0		27	29	7		30	29	3
	Ammonia, Total (as N)	<0.05	<0.05	0	<0.05	<0.05	0		<0.05	<0.05	0		<0.05	<0.05	0		<0.05	<0.05	0		<0.05	<0.05	0		<0.05	<0.05	0		<0.05	<0.05	0		<0.05	<0.05	0
	Bromide (Br)	<0.1	<0.1	0	<0.1	<0.1	0		<0.1	<0.1	0		<0.1	<0.1	0		<0.1	<0.1	0		<0.1	<0.1	0		<0.1	<0.1	0		<0.1	<0.1	0		<0.1	<0.1	0
	Chloride (Cl)	2.63	2.64	0	2.68	2.62	2		1.9	1.89	1		1.91	1.89	1		1.06	1.08	2		1.32	1.36	3		1.31	1.28	2		1.22	1.23	1		1.21	1.2	1
	Nitrate and Nitrite as N	<0.021	<0.021	0	<0.021	<0.021	0		<0.021	<0.021	0		<0.021	<0.021	0		<0.021	<0.021	0		<0.021	0.049	80		<0.021	<0.021	0		<0.021	0.024	13		<0.021	<0.021	0
	Nitrate (as N)	<0.02	<0.02	0	<0.02	<0.02	0		<0.02	<0.02	0		<0.02	<0.02	0		<0.02	<0.02	0		0.02	0.049	84		<0.02	<0.02	0		<0.02	0.024	18		<0.02	<0.02	0
	Nitrite (as N)	<0.005	<0.005	0	<0.005	<0.005	0		<0.005	<0.005	0		<0.005	<0.005	0		<0.005	<0.005	0		<0.005	<0.005	0		<0.005	<0.005	0		<0.005	<0.005	0		<0.005	<0.005	0
	Total Kjeldahl Nitrogen	<0.15	0.32	72	<0.15	<0.15	0		0.17	<0.15	13		0.19	0.17	11		<0.15	<0.15	0		<0.15	<0.15	0		<0.15	<0.15	0		<0.15	<0.15	0		<0.15	<0.15	0
	Total Phosphorus	0.0048	0.0031	43	<0.003	<0.003	0		0.0058	0.0044	27		<0.003	<0.003	0		0.0084	0.0095	12		0.0075	0.0047	46		0.0068	0.0075	10		0.0053	0.0041	26		0.0097	0.0052	60
	Sulfate (SO ₄)	2.55	2.53	1	2.65	2.53	5		1.71	1.71	0		1.69	1.69	0		0.84	0.84	0		0.76	0.76	0		0.84	0.84	0		0.72	0.74	3		0.72	0.72	0
Carbon	Dissolved Organic Carbon	1.8	1.8	0	1.8	1.8	0		1	1	0		1.1	1	10		<1	<1	0		<1	<1	0		<1	<1	0		<1	<1	0		<1	<1	0
	Total Organic Carbon	1.7	1.6	6	1.5	1.7	13		1.5	1.4	7		1.4	1.6	13		<1	<1	0		<1	<1	0		<1	1	0		<1	<1	0		<1	<1	0
Total Metals	Aluminum (Al)	0.0134	0.0132	2	0.0151	0.0153	1		0.0601	0.0653	8		0.0508	0.0619	20		0.126	0.144	13		0.052	0.0702	30		0.141	0.163	14		0.0515	0.052	1		0.0647	0.0548	17
	Antimony (Sb)	<0.0001	<0.0001	0	<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0
	Arsenic (As)	<0.0001	<0.0001	0	<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0		<0.0001	<0.0001	0
	Barium (Ba)	0.00522	0.00511	2	0.00508	0.00518	2		0.00479	0.00479	0		0.00449	0.00466	4		0.00609	0.006	1		0.00375	0.0039	4		0.00539	0.0053	2		0.00366	0.00389	6		0.00388	0.00378	3
	Beryllium (Be)	<0.0005	<0.0005	0	<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0
	Bismuth (Bi)	<0.0005	<0.0005	0	<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0		<0.0005	<0.0005	0
	Boron (B)	<0.01	<0.01	0	<0.01	<0.01	0		<0.01	<0.01	0		<0.01	<0.01	0		<0.01	<0.01	0		<0.01	<0.01	0		<0.01	<0.01	0		<0.01	<0.01	0		<0.01	<0.01	0
	Cadmium (Cd)	<0.00001	<0.00001	0	<0.00001	<0.00001	0		<0.00001	<0.00001	0		<0.00001	<0.00001	0		<0.00001	<0.00001	0		<0.00001	<0.00001	0		<0.00001	<0.00001	0</								

Figure A.4: Water sample field duplicate results. Highlighted values did not meet the data quality objective of ≤ 25% Relative Percent Difference (RPD).

Sample ID		REF3-01B1	REF3-01B101		REF3-01S1	REF3-01S101		L1-09	L1-0901		K0-01	K0-0101		JL0-10-B1	JL0-10-B101		JL0-10-S1	JL0-10-S101		J0-01	J0-0101		D1-00	D1-0001		DD-HAB9-STN1-B1	DD-HAB9-STN1-B101	
Date Sampled		28-Jul-15	28-Jul-15	%RPD	28-Jul-15	28-Jul-15	%RPD	18-Aug-15	18-Aug-15	%RPD	17-Aug-15	17-Aug-15	%RPD	20-Aug-15	20-Aug-15	%RPD	20-Aug-15	20-Aug-15	%RPD	16-Aug-15	16-Aug-15	%RPD	18-Aug-15	18-Aug-15	%RPD	22-Aug-15	22-Aug-15	%RPD
ALS Sample ID		L1650879-2	L1650879-4		L1650879-1	L1650879-3		L1660614-5	L1660614-6		L1659759-1	L1659759-2		L1661722-2	L1661722-4		L1661722-1	L1661722-3		L1658990-9	L1658990-10		L1660614-3	L1660614-4		L1662482-4	L1662482-5	
Physical Tests	Conductivity	74.2	74.7	1	76.3	75	2	262	261	0	220	220	0	134	134	0	132	132	0	130	130	0	273	276	1	125	124	1
	Hardness (as CaCO3)	35	35	0	34	35	3	126	125	1	116	117	1	64	64	0	63	64	2	66	68	3	135	137	1	60	60	0
	pH	7.67	7.56	1	7.61	7.57	1	8.18	8.16	0	8.17	8.18	0	7.97	8.03	1	7.96	8.02	1	7.94	7.85	1	8.14	8.1	0	7.98	7.92	1
	Total Suspended Solids	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	2.5	<2	22
	Total Dissolved Solids	51	38	29	55	43	24	133	125	6	108	121	11	66	56	16	68	62	9	59	62	5	140	134	4	59	60	2
	Turbidity	0.2	0.19	5	0.37	0.19	64	0.61	0.69	12	0.23	0.23	0	0.37	0.36	3	0.33	0.3	10	0.7	0.57	20	0.86	0.7	21	0.57	0.54	5
Anions and Nutrients	Alkalinity, Total (as CaCO3)	30	33	10	31	32	3	110	112	2	122	122	0	62	60	3	57	63	10	65	64	2	110	111	1	53	57	7
	Ammonia, Total (as N)	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Bromide (Br)	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Chloride (Cl)	1.26	1.29	2	1.3	1.32	2	13.7	13.7	0	2.43	2.43	0	3.44	3.42	1	3.39	3.36	1	3.38	3.41	1	8.88	8.85	0	2.79	2.79	0
	Nitrate and Nitrite as N	<0.021	<0.021	0	<0.021	<0.021	0	0.196	0.195	1	0.031	0.035	12	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0	0.572	0.572	0	<0.021	<0.021	0
	Nitrate (as N)	<0.02	<0.02	0	<0.02	<0.02	0	0.196	0.195	1	0.031	0.035	12	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0	0.572	0.572	0	<0.02	<0.02	0
	Nitrite (as N)	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0
	Total Kjeldahl Nitrogen	0.22	<0.15	38	<0.15	0.34	78	0.28	0.19	38	<0.15	<0.15	0	<0.15	0.16	6	<0.15	<0.15	0	0.19	0.26	31	0.17	0.18	6	0.18	0.21	15
	Total Phosphorus	0.0031	0.0031	0	0.0033	0.003	10	<0.003	<0.003	0	0.0033	<0.003	10	<0.003	0.0074	85	0.0032	<0.003	6	0.0036	0.0043	18	<0.003	<0.003	0	0.0131	0.0034	118
	Sulfate (SO4)	4.41	4.42	0	4.42	4.42	0	8.6	8.58	0	2.98	3.02	1	1.66	1.64	1	1.64	1.58	4	1.57	1.56	1	20.9	20.9	0	2.92	2.92	0
Carbon	Dissolved Organic Carbon	2.4	2.4	0	2.4	2.4	0	3.3	3.4	3	2.7	2.7	0	2	1.9	5	2.1	2	5	2	2	0	3.3	3.2	3	2.2	2	10
	Total Organic Carbon	2.5	2.4	4	2.7	2.4	12	3.5	3.6	3	4	3.1	25	2.3	2.1	9	2.1	2.2	5	2.1	2.2	5	3.3	3.4	3	2	2	0
Total Metals	Aluminum (Al)	<0.003	0.0031	3	0.0032	<0.003	6	0.011	0.0113	3	0.0126	0.0091	32	0.0056	0.0062	10	0.0054	0.0063	15	0.0065	0.0065	0	0.0317	0.0331	4	0.0066	0.0059	11
	Antimony (Sb)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0
	Arsenic (As)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0
	Barium (Ba)	0.00664	0.00674	1	0.00669	0.00662	1	0.0136	0.0135	1	0.012	0.0118	2	0.00579	0.00586	1	0.00582	0.00581	0	0.0062	0.00606	2	0.0138	0.0143	4	0.00528	0.00524	1
	Beryllium (Be)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0
	Bismuth (Bi)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0
	Boron (B)	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	0.011	0.011	0	<0.01	<0.01	0
	Cadmium (Cd)	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	<0.00001	<0.00001	0	0.000015	0.000015	0	<0.00001	<0.00001	0
	Calcium (Ca)	6.96	6.91	1	7.09	7	1	23.8	24.6	3	23.3	23.2	0	13	12.9	1	12.9	12.9	0	13.6	13.2	3	25.2	25	1	12.2	11.9	2
	Chromium (Cr)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0
	Cobalt (Co)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	0.0001	0.0001	0			

Figure A.4: Water sample field duplicate results. Highlighted values did not meet the data quality objective of ≤ 25% Relative Percent Difference (RPD).

Sample ID		DD-HAB9-STN1-S1	DD-HAB9-STN1-S101		DL0-02-7-B1	DL0-02-7-B101		DL0-02-7-S1	DL0-02-7-S101		BL0-01-B-B1	BL0-01-B-B101		BL0-01-B-S1	BL0-01-B-S101		E0-03	E0-0301		BL0-06-B1	BL0-06-B101		BL0-06-S1	BL0-06-S101		REF3-02B1	REF3-02B101		REF3-02S1	REF3-02S101	
Date Sampled		22-Aug-15	22-Aug-15	%RPD	21-Aug-15	21-Aug-15	%RPD	21-Aug-15	21-Aug-15	%RPD	24-Aug-15	24-Aug-15	%RPD	24-Aug-15	24-Aug-15	%RPD	16-Aug-15	16-Aug-15	%RPD	23-Aug-15	23-Aug-15	%RPD	23-Aug-15	23-Aug-15	%RPD	22-Aug-15	22-Aug-15	%RPD	22-Aug-15	22-Aug-15	%RPD
ALS Sample ID		L1662482-2	L1662482-3		L1662516-3	L1662516-4		L1662516-1	L1662516-2		L1664158-5	L1664158-7		L1664158-4	L1664158-6		L1658990-5	L1658990-6		L1664032-2	L1664032-4		L1664032-1	L1664032-3		L1662491-5	L1662491-7		L1662491-4	L1662491-6	
Physical Tests	Conductivity	124	124	0	108	108	0	108	108	0	147	149	1	147	147	0	138	138	0	68.8	69.2	1	69.4	69.6	0	76.6	78.6	3	75.7	76.4	1
	Hardness (as CaCO3)	60	60	0	52	52	0	52	52	0	72	72	0	70	71	1	68	69	1	32	32	0	33	33	0	35	35	0	35	35	0
	pH	7.96	8	1	7.92	7.94	0	7.86	7.92	1	8.11	8.01	1	8.08	8.12	0	7.98	8.02	0	7.69	7.74	1	7.56	7.75	2	7.52	7.65	2	7.61	7.69	1
	Total Suspended Solids	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0	2.8	3.6	25	<2	<2	0	<2	<2	0	<2	<2	0	<2	<2	0
	Total Dissolved Solids	45	57	24	53	54	2	43	55	24	78	77	1	71	78	9	78	74	5	33	36	9	27	37	31	40	36	11	42	37	13
Turbidity	0.5	0.55	10	1.72	1.69	2	1.8	1.91	6	0.75	0.57	27	0.84	0.72	15	8.11	8.58	6	1.43	1.37	4	1.44	1.26	13	0.24	0.26	8	0.19	0.18	5	
Anions and Nutrients	Alkalinity, Total (as CaCO3)	57	57	0	47	49	4	48	51	6	70	69	1	70	66	6	63	65	3	29	32	10	30	31	3	26	29	11	31	33	6
	Ammonia, Total (as N)	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Bromide (Br)	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Chloride (Cl)	2.83	2.78	2	2.17	2.17	0	2.16	2.16	0	2.56	2.55	0	2.59	2.6	0	4.05	4.06	0	1.44	1.44	0	1.48	1.45	2	1.29	1.29	0	1.28	1.27	1
	Nitrate and Nitrite as N	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0
	Nitrate (as N)	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0
	Nitrite (as N)	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0	<0.005	<0.005	0
	Total Kjeldahl Nitrogen	<0.15	<0.15	0	0.18	0.17	6	0.2	<0.15	29	<0.15	0.456	101	<0.15	0.16	6	<0.15	<0.15	0	<0.15	0.23	42	0.25	0.17	38	0.2	0.27	30	0.22	0.22	0
	Total Phosphorus	0.0039	0.0031	23	0.0041	0.0048	16	0.0053	0.0051	4	0.004	0.0037	8	0.003	0.0036	18	0.0085	0.0103	19	0.0038	0.0134	112	0.0264	0.0043	144	<0.003	0.0075	86	0.0031	0.0035	12
Sulfate (SO4)	2.9	2.89	0	2.01	2.01	0	2	2.01	0	1.37	1.37	0	1.38	1.41	2	3.32	3.3	1	0.96	0.96	0	0.98	0.96	2	4.36	4.38	0	4.38	4.36	0	
Carbon	Dissolved Organic Carbon	1.9	1.9	0	1.7	1.8	6	1.7	1.7	0	1.9	2	5	1.9	2	5	1.6	1.6	0	1.5	1.5	0	1.5	1.5	0	3.2	3.2	0	3.1	3.1	0
	Total Organic Carbon	2.2	2.2	0	1.9	1.8	5	1.9	1.9	0	2	2	0	1.9	2	5	1.6	1.7	6	1.6	1.6	0	1.8	1.6	12	3.3	3.5	6	3.3	3.4	3
Total Metals	Aluminum (Al)	0.0067	0.0088	27	0.0582	0.0524	10	0.064	0.0608	5	0.0187	0.0187	0	0.0169	0.0172	2	0.161	0.174	8	0.0453	0.0489	8	0.0436	0.0452	4	<0.003	<0.003	0	<0.003	<0.003	0
	Antimony (Sb)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0
	Arsenic (As)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0
	Barium (Ba)	0.00521	0.00526	1	0.00521	0.00509	2	0.00527	0.00535	2	0.00686	0.00695	1	0.00686	0.00701	2	0.00949	0.00962	1	0.00384	0.00385	0	0.00389	0.00389	0	0.00627	0.0065	4	0.00636	0.00629	1
	Beryllium (Be)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0
	Bismuth (Bi)	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0
	Boron (B)	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0
	Cadmium (Cd)	<0.00001	<0.00																												

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

Client Sample ID		Lowest Detection Limit	Units	REF-03-10	REF-03-DUP	% RPD	JLO-14	JLO-DUP	% RPD	BLO-12	BLO-DUP	% RPD	DLO-01-9	DLO-01-DUP	% RPD	DLO-02-2	DLO-02-DUP	% RPD
				25-Aug-2015	25-Aug-2015		22-Aug-2015	22-Aug-2015		21-Aug-2015	21-Aug-2015		19-Aug-2015	19-Aug-2015		26-Aug-2015	26-Aug-2015	
				ALS Sample ID	L1670047-67		L1670047-68	L1670047-7		L1670047-15	L1670047-41		L1670047-45	L1670047-23		L1670047-30	L1670047-48	
Physical Tests	% Moisture	0.10	%	85.2	85.1	-	71.8	72.8	-	47.6	49.3	-	85.0	82.3	-	48.7	45.6	-
	% Sand (2.0mm - 0.05mm)	0.10	%	36.4	57.0	-	42.4	33.8	-	39.3	28.5	-	35.1	52.2	-	21.1	19.1	-
	% Silt (0.05mm - 2µm)	0.10	%	51.6	28.8	-	49.4	52.6	-	51.4	54.8	-	49.9	36.5	-	62.1	64.8	-
	% Clay (<2µm)	0.10	%	11.9	14.2	-	8.17	13.5	-	9.26	16.7	-	15.0	11.3	-	16.8	16.2	-
Carbon	Fraction Organic Carbon	0.0010	g/g	0.0429	0.0476	10	0.0200	0.0149	29	0.0072	0.0071	1	0.0479	0.0546	13	0.0093	0.0096	3
	Total Organic Carbon	0.10	%	4.29	4.76	10	2.00	1.49	29	0.72	0.71	1	4.79	5.46	13	0.93	0.96	3
Total Metals	Aluminum (Al)	50	µg/g	28,100	26,500	6	21,100	20,300	4	16,200	18,600	14	18,600	20,000	7	17,200	20,400	17
	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	<0.10	<0.10	0
	Arsenic (As)	0.10	µg/g	6.07	6.01	1	10.3	10.7	4	2.42	3.05	23	5.71	8.38	38	2.76	2.88	4
	Barium (Ba)	0.50	µg/g	149	150	1	99.4	202	68	59.0	69.7	17	104	107	3	74.0	81.1	9
	Beryllium (Be)	0.10	µg/g	1.04	1.06	2	1.13	1.14	1	0.79	0.90	13	1.05	1.11	6	0.86	0.93	8
	Bismuth (Bi)	0.20	µg/g	0.23	0.22	4	0.39	0.36	8	<0.20	0.21	5	0.27	0.30	11	0.22	0.24	9
	Boron (B)	5.0	µg/g	19.7	22.7	14	31.4	29.7	6	23.8	27.9	16	31.3	33.6	7	25.1	33.0	27
	Cadmium (Cd)	0.020	µg/g	0.184	0.186	1	0.213	0.302	35	0.093	0.101	8	0.580	0.626	8	0.096	0.105	9
	Calcium (Ca)	50	µg/g	6,270	6,630	6	4,920	5,120	4	3,860	4,470	15	6,250	6,940	10	6,030	7,750	25
	Chromium (Cr)	0.50	µg/g	87.8	84.6	4	89.8	86.2	4	65.2	73.7	12	72.1	79.3	10	74.2	85.5	14
	Cobalt (Co)	0.10	µg/g	19.3	18.4	5	24.5	30.3	21	11.9	13.5	13	17.4	16.2	7	13.5	14.8	9
	Copper (Cu)	0.50	µg/g	106	98.8	7	56.6	55.9	1	22.3	25.4	13	70.4	73.8	5	27.3	30.9	12
	Iron (Fe)	50	µg/g	52,300	50,200	4	65,800	79,900	19	27,400	31,300	13	52,200	73,100	33	33,800	36,400	7
	Lead (Pb)	0.50	µg/g	22.5	22.2	1	27.5	25.8	6	16.5	19.0	14	22.6	24.1	6	18.5	20.0	8
	Lithium (Li)	2.0	µg/g	40.0	41.0	2	37.6	36.6	3	29.4	33.5	13	33.3	34.3	3	32.3	34.5	7
	Magnesium (Mg)	20	µg/g	17,600	16,700	5	15,200	14,900	2	11,400	12,800	12	12,400	13,800	11	13,300	15,600	16
	Manganese (Mn)	1.0	µg/g	1,310	1,210	8	1,380	6,460	130	991	1,050	6	407	462	13	450	477	6
	Mercury (Hg)	0.0050	µg/g	0.0646	0.0704	9	0.0547	0.0490	11	0.0321	0.0338	5	0.0600	0.0600	0	0.0261	0.0259	1
	Molybdenum (Mo)	0.10	µg/g	2.59	2.67	3	1.74	3.40	65	0.61	0.97	46	8.10	9.12	12	0.93	0.91	2
	Nickel (Ni)	0.50	µg/g	59.7	58.7	2	81.5	81	1	47.8	53.8	12	106	99.9	6	56.2	63.1	12
	Phosphorus (P)	50	µg/g	1,140	1,160	2	1,940	2,840	38	744	906	20	776	922	17	814	990	20
	Potassium (K)	100	µg/g	6,450	6,660	3	5,410	5,270	3	3,990	4,440	11	4,840	4,890	1	4,350	4,940	13
	Selenium (Se)	0.20	µg/g	0.78	0.93	18	0.57	0.54	5	<0.20	<0.20	0	0.76	0.80	5	<0.20	0.21	5
	Silver (Ag)	0.10	µg/g	0.30	0.31	3	0.18	0.17	6	0.11	0.14	24	0.24	0.23	4	0.14	0.17	19
	Sodium (Na)	50	µg/g	486	507	4	259	265	2	249	286	14	285	302	6	278	333	18
	Strontium (Sr)	0.50	µg/g	17.5	17.2	2	15.0	17.2	14	11.6	13.5	15	12.5	13.4	7	12.8	15.0	16
	Sulfur (S)	5,000	µg/g	<5,000	<5,000	0	<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	0.943	0.908	4	0.608	0.781	25	0.406	0.457	12	0.808	0.712	13	0.431	0.457	6
	Tin (Sn)	2.0	µg/g	2.1	2.0	5	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
	Titanium (Ti)	1.0	µg/g	1,310	1,420	8	1,020	840	19	1,190	1,370	14	1,110	1,130	2	1,260	1,650	27
	Uranium (U)	0.050	µg/g	28.4	26.2	8	9.46	8.87	6	6.70	7.70	14	15.8	16.2	2	6.35	6.82	7
	Vanadium (V)	0.20	µg/g	77.6	74.3	4	73.9	72.6	2	46.1	51.9	12	58.0	61.7	6	51.2	58.4	13
	Zinc (Zn)	2.0	µg/g	115	108	6	73.5	73.3	0	54.3	61.1	12	74.2	77.8	5	59.2	66.4	11
	Zirconium (Zr)	1.0	µg/g	4.4	3.5	23	5.5	3.8	37	17.1	20.0	16	23.1	21.8	6	21.5	25.8	18

A2.3 Benthic Invertebrate Community Samples

A2.3.1 Subsampling Accuracy

Sub-sampling of benthic invertebrate community samples was conducted on 18 of 68 stream samples (26%) and 15 of 50 lake samples (30%; total of 28%) with the sorted fraction for these samples ranging between 25% (1/4) 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 $\leq 20\%$ (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 $\leq 20\%$. 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 96% for each of the five lotic and five lentic samples evaluated (Table A.7a,b). Sorting efficiency for these samples achieved the DQO of $\geq 90\%$ 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, 2015.

a) Lotic (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
SLT9-US-B1		108	114			222	5.3	-	2.7	-
SLT9-US-B2	0	134	144			278	6.9	-	3.6	-
SLT1-R4-B1	0	145	150			295	3.3	-	1.7	-

b) Lentic (lake) samples

Station	Whole Organisms	Number of Organisms in Fraction 1	Number of Organisms in Fraction 2	Number of Organisms in Fraction 3	Number of Organisms in Fraction 4	Actual Density*	Precision		Accuracy	
							% range		min	max
DLO-01-11	0	108	112	117	148	485	3.6	27.0	3.5	22.1
DLO-02-1	0	110	123	125	145	503	1.6	24.1	0.6	15.3
DLO-01-11	0	225	260	-	-	485	13.5	-	7.2	-

* 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, 2015.

(a) Lotic (river) samples

Station	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
EO-20-B2	85	91	93.4%
GO-O3-B1	94	99	94.9%
GO9-B2	185	201	92.0%
SLT1-R2-B4	119	121	98.3%
SLT1-R4-B5 ^a	229	245	93.5%
Average % Recovery			95.9%

^a first eighth re-sorted.

b) Lentic (lake) samples

Station	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
REF-03-1	115	121	95.0%
DLO-01-2	153	163	93.9%
DLO-02-9	352	369	95.4%
JLO-1	123	124	99.2%
BLO-4	55	57	96.5%
Average % Recovery			96.0%

Table A.8: Sample fractions sorted for benthic macroinvertebrates samples, Mary River Project CREMP, 2015.

(a) Lotic (river) samples

Station	Fraction Sorted (500 um)	Station	Fraction Sorted (500 um)
SLT1-R1-B2	1/2	SLT1-R4-B3	1/2
SLT1-R1-B3	1/4	SLT1-R4-B4	1/4
SLT1-R1-B4	1/2	SLT1-R4-B5	1/4
SLT1-R2-B1	1/4	SLT9-US-B1	1/2
SLT1-R2-B2	1/2	SLT9-US-B3	1/4
SLT1-R2-B3	1/2	SLT9-US-B4	1/4
SLT1-R2-B4	1/2	SLT9-US-B5	1/4
SLT1-R2-B5	1/2	SLT12-DS-B1	1/4
SLT1-R4-B2	1/2	SLT12-DS-B2	1/2

b) Lentic (lake) samples

Station	Fraction Sorted (500 um)	Station	Fraction Sorted (500 um)
DLO-01-3	1/2	DLO-02-10	1/2
DLO-01-4	1/2	JLO-02	1/4
DLO-01-9	1/4	JLO-16	1/2
DLO-01-10	1/4	JLO-18	1/2
DLO-01-11	Whole ^a	JLO-21	1/2
DLO-02-1	Whole ^a	BLO-05	1/2
DLO-02-2	1/2	BLO-11	1/4
DLO-02-4	1/2		

^a four quarters sorted for subsampling error.

All samples not listed were sorted to a whole.

All Samples not listed were sorted to a whole.

SLT1-R4-B1 and SLT9-US-B2 sorted as two halves for sub-sampling error.

SLT9-US-B1 sorted as two quarters for sub-sampling error.

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, those 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. The benthic invertebrate community data quality was also acceptable, meeting all required precision, accuracy and percent recovery benchmarks. Overall, the data associated with the 2015 CREMP were considered defensible and acceptable for interpretation and derivation of conclusions with a reasonable level of confidence.

APPENDIX B

WATER QUALITY DATA

Table B.1: *In-situ* water quality data collected from lotic environments for the Mary River Project CREMP, spring 2015.

Study Area		Station	Sampling Date	<i>In-situ</i> Water Quality Parameter				
				Temperature (°C)	Dissolved Oxygen (% saturation)	pH	Conductivity (µS/cm)	Turbidity (NTU)
Camp Lake System	Reference Streams	CLT-REF3	26-Jun-15	2.6	103.2	7.62	51.2	0.30
		CLT-REF4	26-Jun-15	4.8	101.8	7.56	36.8	0.80
		MRY-REF2	26-Jun-15	8.5	103.1	7.70	68.9	0.40
		MRY-REF3	26-Jun-15	4.7	102.4	7.45	39.3	5.70
	CLT-1	L2-03	24-Jun-15	3.3	99.1	7.98	345.5	4.60
		L1-08	29-Jun-15	5.3	104.1	7.62	80.4	2.10
		L1-02	23-Jun-15	4.3	99.7	7.87	96.6	1.40
		L1-09	23-Jun-15	4.7	100.0	7.91	72.2	1.40
		L1-05	23-Jun-15	5.7	101.2	7.96	124.0	1.20
		L0-01	23-Jun-15	5.5	100.1	7.92	122.6	4.10
	CLT-2	K0-01	24-Jun-15	2.2	101.3	7.83	109.0	1.00
	Camp Lake	J0-01	24-Jun-15	2.6	102.5	7.83	144.5	1.30
Sheardown Lake System	SDL Tribs	D1-05	24-Jun-15	1.3	97.1	7.74	153.6	3.00
		D1-00	29-Jun-15	12.0	100.9	7.71	168.0	1.90
Mary River/Lake System	Mary North	I0-01	24-Jun-15	1.4	102.5	7.47	66.5	1.20
	Mary South Rivers	G0-09-A	29-Jun-15	3.2	96.0	7.35	20.4	19.40
		G0-09	29-Jun-15	3.7	98.4	7.42	24.7	11.60
		G0-09-B	29-Jun-15	3.6	95.9	7.37	23.5	13.60
		G0-03	29-Jun-15	6.4	99.9	7.44	23.9	9.10
		G0-01	29-Jun-15	6.9	103.5	7.56	39.0	2.70
		F0-01	29-Jun-15	6.4	105.3	8.19	43.9	2.00
		E0-10	29-Jun-15	8.6	101.5	7.68	27.6	4.30
		E0-03	29-Jun-15	7.0	102.9	7.48	24.2	7.20
		E0-21	29-Jun-15	7.5	101.9	7.40	24.3	7.20
		E0-20	29-Jun-15	9.6	107.6	7.85	25.3	9.10
		C0-10	29-Jun-15	8.5	103.9	7.67	26.4	4.80
		C0-05	29-Jun-15	6.8	105.5	7.66	36.7	4.60
		C0-01	29-Jun-15	6.3	105.0	7.74	35.2	8.30

Table B.2: *In-situ* water quality data collected from lotic environments for the Mary River Project CREMP, summer 2015.

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 Streams	CLT-REF3	21-Jul-15	9.96	92.4	7.99	73.0	-
		CLT-REF4	21-Jul-15	11.83	89.2	8.01	79.0	-
		MRY-REF2	21-Jul-15	17.17	91.0	8.01	93.5	-
		MRY-REF3	21-Jul-15	13.85	87.1	7.82	53.0	-
	CLT-1	L2-03	17-Jul-15	12.40	99.6	8.28	453.6	0.9
		L1-08	21-Jul-15	7.09	89.2	7.86	87.0	-
		L1-02	17-Jul-15	9.90	102.1	8.29	164.0	-1.9
		L1-09	17-Jul-15	10.90	102.4	8.31	206.0	-1.8
		L1-05	17-Jul-15	11.00	100.2	8.29	215.2	-0.9
		L0-01	17-Jul-15	11.00	102.8	8.38	217.2	-1.4
		CLT-2	K0-01	17-Jul-15	10.10	101.2	8.28	171.0
	Camp Lake	J0-01	19-Jul-15	10.00	110.3	8.07	124.6	4.9
Sheardown Lake System	SDL Tribs	D1-05	17-Jul-15	6.90	95.3	7.87	159.6	-1.5
		D1-00	17-Jul-15	12.00	99.8	8.27	260.3	-0.9
Mary River/Lake System	Mary North	I0-01	17-Jul-15	10.50	104.7	8.17	117.3	-1.6
	Mary South Rivers	G0-09-A	19-Jul-15	13.20	93.3	8.11	100.0	-
		G0-09	19-Jul-15	11.60	95.0	8.01	71.0	
		G0-09-B	19-Jul-15	11.14	92.9	7.97	71.0	-
		G0-03	19-Jul-15	11.00	93.5	7.93	70.0	-
		G0-01	19-Jul-15	9.50	94.3	8.06	83.0	-
		F0-01	19-Jul-15	7.83	91.9	8.18	179.0	-
		E0-10	19-Jul-15	9.43	93.5	8.04	79.0	-
		E0-03	19-Jul-15	12.27	85.6	7.99	80.0	-
		E0-21	19-Jul-15	11.85	88.6	8.06	80.0	-
		E0-20	19-Jul-15	11.86	91.9	8.08	83.0	-
		C0-10	19-Jul-15	12.60	92.7	8.08	82.0	-
		C0-05	19-Jul-15	13.03	92.8	8.08	76.0	-
		C0-01	19-Jul-15	13.40	92.2	8.04	81.0	-

Table B.3: *In-situ* water quality data collected from lotic environments for the Mary River Project CREMP, fall 2015.

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 Streams	CLT-REF3	13-Aug-15	4.5	102.7	8.04	114.6	0.2
		CLT-REF4	13-Aug-15	5.9	101.5	8.30	137.2	0.0
		MRY-REF2	13-Aug-15	6.4	99.9	8.12	137.1	1.2
		MRY-REF3	13-Aug-15	5.9	101.5	7.88	82.8	7.8
	CLT-1	L2-03	18-Aug-15	8.5	98.6	8.01	480.6	2.8
		L1-08	13-Aug-15	3.0	100.0	8.05	139.4	0.6
		L1-02	18-Aug-15	6.2	100.5	8.12	209.8	-0.6
		L1-09	18-Aug-15	7.4	101.4	8.07	273.5	0.0
		L1-05	17-Aug-15	7.6	99.9	8.11	282.1	0.8
		L0-01	17-Aug-15	5.9	100.7	8.14	279.0	0.4
		CLT-2	K0-01	17-Aug-15	4.7	99.3	8.14	241.2
Camp Lake	J0-01	16-Aug-15	8.4	100.2	7.83	107.3	-0.2	
Sheardown Lake System	SDL Tribs	D1-05	17-Aug-15	5.5	99.9	7.84	237.6	-0.3
		D1-00	18-Aug-15	7.8	100.0	8.07	793.4	0.8
Mary River/Lake System	Mary North	I0-01	16-Aug-15	5.2	101.1	8.01	163.5	0.3
	Mary South Rivers	G0-09-A	13-Aug-15	4.7	99.5	8.22	155.3	17.3
		G0-09	13-Aug-15	4.3	100.5	8.24	158.8	14.4
		G0-09-B	13-Aug-15	3.9	99.4	8.20	134.0	17.5
		G0-03	13-Aug-15	4.0	99.0	8.12	148.8	53.6
		G0-01	17-Aug-15	6.7	99.7	8.07	160.0	8.8
		F0-01	17-Aug-15	6.4	99.0	8.19	236.4	11.5
		E0-10	17-Aug-15	6.7	100.0	8.11	158.4	8.4
		E0-03	16-Aug-15	6.0	100.1	7.99	149.0	10.8
		E0-21	16-Aug-15	5.6	100.0	7.97	146.7	22.3
		E0-20	16-Aug-15	6.1	100.8	6.01	150.4	12.1
		C0-10	16-Aug-15	8.1	102.4	8.07	142.3	6.7
		C0-05	16-Aug-15	6.1	103.2	8.04	144.4	11.7
C0-01	13-Aug-15	8.3	100.6	8.28	165.3	17.4		

Table B.4: Dissolved metals concentrations at lotic (river) reference monitoring stations, Mary River Project CREMP, 2015.

[illegible]

Table B.5: *In-situ* water quality profile data collected at Reference Lake 3 water quality monitoring stations in summer^a, Mary River Project CREMP, 2015.

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	9.0	8.9	9.4	108.4	108.1	107.1	7.64	7.65	7.78	82.7	82.5	82.6
2.0	9.0	8.8	9.4	109.2	108.9	107.2	7.64	7.65	7.75	82.7	82.5	82.6
3.0	9.0	8.8	9.4	109.4	109.1	107.3	7.63	7.65	7.74	82.8	82.5	82.6
4.0	9.0	8.7	9.4	109.4	109.2	107.3	7.63	7.64	7.73	82.7	82.5	82.6
5.0	8.9	8.2	9.4	109.5	107.9	107.3	7.63	7.64	7.71	82.7	82.7	82.6
6.0	7.5	7.4	9.4	107.8	109.2	107.2	7.64	7.62	7.70	82.7	82.7	82.6
7.0	7.1	6.6	9.3	108.8	108.2	107.3	7.60	7.59	7.69	82.5	83.4	82.6
8.0	6.8	6.3	9.2	108.4	107.2	107.3	7.59	7.57	7.68	82.7	83.7	82.6
9.0	6.4	5.6	9.1	108.3	106.4	107.2	7.58	7.51	7.67	82.8	83.7	82.7
10.0	6.0	5.4	8.9	107.9	105.9	107.1	7.56	7.51	7.66	82.7	83.9	82.8
11.0	5.7	5.0	8.4	106.7	105.6	106.9	7.55	7.49	7.65	83.1	84.0	83.0
12.0	5.3	4.9	6.5	106.6	104.5	106.9	7.53	7.47	7.61	83.3	84.7	83.1
13.0	5.3	4.6	5.7	106.8	104.0	106.2	7.52	7.45	7.54	83.2	85.6	83.6
14.0	5.3	4.5	5.3	106.4	103.8	105.9	7.50	7.44	7.50	84.0	86.8	83.9
15.0	4.9*	4.4	5.1	105.4*	103.6	105.3	7.50*	7.42	7.47	85.6*	88.2	84.3
16.0		4.2	5.0		103.4	104.9		7.41	7.43		89.5	84.7
17.0		4.1	4.9		103.4	104.5		7.39	7.41		90.0	83.3
18.0		4.1	4.9		103.2	104.2		7.38	7.40		90.2	85.6
19.0		4.1	4.8		103.2	103.9		7.37	7.39		90.5	86.2
20.0		4.1	4.7		103.1	103.5		7.36	7.37		91.0	86.7
21.0		4.0	4.6		103.0	103.4		7.35	7.36		91.8	86.8
22.0		4.0	4.6		102.8	103.3		7.34	7.34		92.4	86.9
23.0		3.9	4.5		102.6	103.0		7.33	7.33		92.7	87.2
24.0		3.9	4.5		102.4	102.8		7.36	7.32		93.1	87.5
25.0		3.9	4.5		102.3	102.7		7.31	7.31		93.4	87.9
26.0		3.9	4.5		102.1	102.6		7.30	7.30		93.8	88.0
27.0		3.9	4.4		102.0	102.4		7.30	7.29		93.8	88.4
28.0		3.8	4.4		101.2	102.1		7.26	7.28		95.1	89.0
29.0		3.8	4.3		101.2	101.8		7.28	7.27		95.7	89.3
30.0		3.7*	4.3		101.2*	101.6		7.27*	7.27		96.2*	89.3
31.0			4.3			101.4			7.26			89.9
32.0			4.2			101.2			7.25			90.1
33.0			4.2			101.1			7.25			90.3
34.0			4.2			100.9			7.24			90.4
35.0			4.2			100.8			7.23			90.5
36.0			4.2			100.7			7.23			90.5
36.3			4.2*			100.7*			7.23*			90.6*

^a Sampling conducted on 28-July and 30-July, 2015.

^b Total depth at Stations REF3-01, REF3-02, and REF3-03 were 15.7, 30.8, and 37.3 m, respectively, at the time of summer sampling.

* The deepest *in situ* water quality reading at stations REF3-01, REF3-02, and REF3-03 were taken at 14.7, 29.8, and 36.3 m, respectively, at the time of summer sampling.

Table B.6: *In-situ* water quality profile data collected at Reference Lake 3 water quality monitoring stations in fall^a, Mary River Project CREMP, 2015.

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	8.5	8.5	8.4	103.2	103.2	103.4	7.87	7.84	7.80	81.9	81.6	81.6
2.0	8.4	8.4	8.3	103.2	103.2	103.4	7.83	7.81	7.79	81.8	81.6	81.6
3.0	8.4	8.2	8.3	103.4	102.9	103.1	7.81	7.80	7.79	81.9	81.6	81.7
4.0	8.4	8.2	8.2	103.3	103.0	103.1	7.79	7.79	7.79	81.9	81.7	81.6
5.0	8.4	8.2	8.1	103.4	103.0	103.0	7.78	7.78	7.78	81.9	81.7	81.6
6.0	8.3	8.2	8.1	103.4	102.9	102.9	7.77	7.78	7.78	81.9	81.7	81.6
7.0	8.2	8.1	8.0	102.6	102.6	102.8	7.77	7.77	7.78	81.9	81.7	81.6
8.0	7.7	7.9	8.0	101.6	102.1	102.6	7.76	7.77	7.78	81.7	81.6	81.6
9.0	7.6	7.8	8.0	101.3	101.9	102.4	7.75	7.76	7.77	81.6	81.6	81.6
10.0	7.5	7.8	7.9	100.9	101.7	102.7	7.74	7.76	7.77	81.6	81.6	81.6
11.0	7.5	7.7	7.8	100.6	101.3	101.8	7.74	7.74	7.76	81.6	81.6	81.6
12.0	7.4	7.6	7.7	100.2	100.9	101.5	7.72	7.74	7.75	81.6	81.6	81.6
13.0	7.4	7.5	7.6	100.0	100.4	101.0	7.71	7.73	7.74	81.6	81.6	81.6
14.0	7.4	7.5	7.6	99.8	100.1	100.5	7.71	7.72	7.73	81.6	81.6	81.6
15.0	7.4*	7.5	7.5	99.7*	99.8	100.1	7.71*	7.71	7.72	81.6*	81.6	81.6
16.0		7.4	7.5		99.7	100.0		7.70	7.71		81.6	81.6
17.0		7.4	7.5		99.6	99.5		7.69	7.70		81.6	81.5
18.0		7.4	7.5		99.5	99.4		7.69	7.68		81.6	81.6
19.0		7.4	7.4		99.5	99.1		7.68	7.68		81.6	81.6
20.0		7.4	7.4		99.4	99.0		7.68	7.67		81.6	81.6
21.0		7.4	7.4		99.2	98.9		7.67	7.67		81.6	81.6
22.0		7.4	7.4		99.0	98.7		7.67	7.67		81.6	81.6
23.0		7.4	7.3		99.0	98.6		7.67	7.66		81.7	81.6
24.0		7.3	7.3		98.8	98.4		7.66	7.65		81.6	81.6
25.0		7.3	7.3		98.6	98.3		7.66	7.65		81.7	81.6
26.0		7.3	7.3		98.4	98.0		7.65	7.63		81.7	81.7
27.0		7.3	7.3		98.1	97.9		7.64	7.63		81.7	81.6
28.0		7.3	7.3		97.8	97.8		7.63	7.62		81.7	81.7
29.0		7.3	7.3		97.1	97.7		7.61	7.61		81.9	81.6
30.0		7.2*	7.3		96.4*	97.6		7.60*	7.61		81.9*	81.7
31.0			7.3			97.5			7.60			81.6
32.0			7.3			97.4			7.60			81.7
33.0			7.2			97.1			7.59			81.7
34.0			7.2			96.5			7.58			81.7
35.0			7.2			96.0			7.57			81.7
36.0			7.1*			94.5*			7.55*			81.9*

^a Sampling conducted on 22-August and 24-August, 2015.

^b Total depth at stations REF3-01, REF3-02, and REF3-03 were 15.1, 30.4, and 37.5 m, respectively, at the time of fall sampling.

* The deepest *in situ* water quality reading at stations REF3-01, REF3-02, and REF3-03 were taken at 14.1, 29.4, and 36.0 m, respectively, at the time of fall sampling.

Table B.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 2015.

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Colour/ Clarity	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
								(mg/L)	(% sat.)		
Littoral (Shallow) Stations	REF 03-1	24-Aug-15	10.5	10.03	clear, colourless	surface	8.9	12.22	105.5	7.81	82
						bottom	7.6	11.84	98.8	7.72	82
	REF 03-2	24-Aug-15	9.1	bottom	clear, colourless	surface	8.9	11.99	103.5	7.79	82
						bottom	7.8	12.25	102.9	7.77	82
	REF 03-3	24-Aug-15	9.8	bottom	clear, colourless	surface	8.6	12.14	104.1	7.76	82
						bottom	7.7	12.21	102.3	7.75	82
	REF 03-4	25-Aug-15	8.4	bottom	clear, colourless	surface	8.8	11.66	100.4	7.79	82
						bottom	8.0	11.72	98.7	7.77	82
	REF 03-5	25-Aug-15	11.2	9.22	clear, colourless	surface	8.2	11.77	99.7	7.80	82
						bottom	7.9	11.73	98.8	7.76	82
Profundal (Deep) Stations	REF 03-6	24-Aug-15	20.5	11.41	clear, colourless	surface	8.8	12.08	100.4	7.77	82
						bottom	7.4	11.91	99.1	7.70	84
	REF 03-7	24-Aug-15	23.4	9.00	clear, colourless	surface	8.8	12.15	104.5	7.76	82
						bottom	7.4	11.94	99.3	7.69	82
	REF 03-8	24-Aug-15	18.5	9.33	clear, colourless - possible greenish hue	surface	8.6	12.13	103.9	7.78	82
						bottom	7.4	12.00	100.0	7.71	82
	REF 03-9	25-Aug-15	21.1	9.14	clear, colourless	surface	8.5	11.73	100.2	7.77	82
						bottom	7.1	11.43	95.2	7.60	82
	REF 03-10	25-Aug-15	19.5	8.04	clear, colourless	surface	8.2	11.71	99.4	7.86	82
						bottom	7.4	11.48	95.5	7.59	82

Table B.8: Statistical comparison of bottom in-situ water quality between littoral and profundal stations of Reference Lake 3, Mary River Project CREMP, August 2015.

Lake	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Station Type	N	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Reference Lake 3	Secchi Depth (m)	NO	0.683	α	Littoral	5	9.6	0.3	0.1	9.2	10.0
					Profundal	5	9.4	1.2	0.6	8.0	11.4
	Temperature (°C)	YES	0.001	γ	Littoral	5	7.8	0.2	0.1	7.6	8.0
					Profundal	5	7.3	0.1	0.1	7.1	7.4
	Dissolved Oxygen (mg/L)	NO	0.275	α	Littoral	5	12.0	0.3	0.1	11.7	12.3
					Profundal	5	11.8	0.3	0.1	11.4	12.0
	Dissolved Oxygen (% saturation)	NO	0.112	γ	Littoral	5	100.3	2.1	0.9	98.7	102.9
					Profundal	5	97.8	2.3	1.0	95.2	100.0
	pH (units)	YES	0.008	δ	Littoral	5	7.75	0.02	0.01	7.72	7.77
					Profundal	5	7.66	0.06	0.03	7.59	7.71
	Specific Conductance (umho/cm)	NO	0.347	γ	Littoral	5	82.0	0.0	0.0	82.0	82.0
					Profundal	5	82.4	0.9	0.4	82.0	84.0

^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 confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed using t-test assuming unequal variance.



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

Table B.9: Dissolved metals concentrations at Reference Lake 3 monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Summer Sampling Event						Fall Sampling Event					
			REF3-01S1 surface	REF3-01B1 bottom	REF3-02S1 surface	REF3-02B1 bottom	REF3-03S1 surface	REF3-03B1 bottom	REF3-01S1 surface	REF3-01B1 bottom	REF3-02S1 surface	REF3-02B1 bottom	REF3-03-S1 surface	REF3-03-B1 bottom
			28-Jul-2015	28-Jul-2015	28-Jul-2015	28-Jul-2015	31-Jul-2015	31-Jul-2015	22-Aug-2015	22-Aug-2015	22-Aug-2015	22-Aug-2015	24-Aug-2015	24-Aug-2015
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	0.0032	<0.0030	0.0056	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.00630	0.00108	0.00125
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000020	<0.000020
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.000036	0.000046
	Barium (Ba)	mg/L	0.00654	0.00658	0.00659	0.00766	0.00626	0.00653	0.00633	0.00629	0.00633	0.00641	0.00629	0.00648
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000010	<0.000010
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0000050	<0.0000050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.0050
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	6.89	7.01	7.16	8.07	6.92	7.49	7.15	7.18	7.14	7.21	7.06	7.05
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0000050	<0.0000050
	Copper (Cu)	mg/L	0.00077	0.000795	0.00081	0.00094	0.00079	0.00086	0.0008	0.00106	0.000785	0.00085	0.00075	0.00074
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.0033	0.004
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000071	<0.0000090	<0.0000090
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00057	<0.00050
	Magnesium (Mg)	mg/L	4.105	4.23	4.24	4.91	4.12	4.56	4.27	4.24	4.19	4.2	4.24	4.25
	Manganese (Mn)	mg/L	0.0001795	0.0002205	0.000245	0.000499	0.000226	0.000165	0.000143	0.000076	0.000134	0.0002125	0.00013	0.000082
	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	0.00013	0.0001405	0.000138	0.000161	0.000132	0.000138	0.000134	0.000134	0.000136	0.0001285	0.000129	0.000125
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.000322	0.000309
	Potassium (K)	mg/L	0.87	0.885	0.89	1.02	0.82	0.88	0.92	0.9	0.895	0.9	0.903	0.899
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000040	<0.000040
	Silicon (Si)	mg/L	0.40	0.41	0.40	0.52	0.39	0.46	0.40	0.39	0.39	0.42	0.39	0.40
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050
	Sodium (Na)	mg/L	0.784	0.8125	0.809	0.963	0.796	0.829	0.838	0.831	0.818	0.830	0.824	0.81
	Strontium (Sr)	mg/L	0.00799	0.00776	0.00795	0.00896	0.00776	0.00848	0.00792	0.00794	0.007905	0.007955	0.00798	0.00793
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0000020	<0.0000020
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000030	<0.000030
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.00050	<0.00050
	Uranium (U)	mg/L	0.000278	0.0002765	0.000286	0.000297	0.000271	0.000281	0.000281	0.000276	0.000278	0.000264	0.000267	0.000262
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.000055	<0.000050	
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.00082	0.00062	

Table B.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, 2015.
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
Conventional ^b	Conductivity (lab)	8.2	0.9	6.8	0.3	0.9	1.5	3.7	2.4	1.5	0.3	1.3	1.9	17.1	2.3	5.3	3.6	2.9
	pH (lab)	1.1	0.4	0.7	0.5	0.6	0.4	0.7	0.6	0.3	1.1	0.3	1.1	2.0	1.6	1.1	1.9	0.4
	Hardness (as CaCO ₃)	7.7	0	4.0	0.8	2.0	1.1	1.3	0.8	1.1	0.9	0.8	3.0	16.6	2.6	4.6	6.4	1.7
	Total Suspended Solids (TSS)	6.1	0	5.1	0	0	0	0	2.0	0	10.4	0	0	0	0	0	0	0
	Total Dissolved Solids (TDS)	6.3	12.1	13.6	8.7	4.7	8.2	3.4	10.3	7.2	7.1	13.2	8.7	15.8	5.9	6.4	8.4	7.7
	Turbidity	30.0	21.2	44.2	12.5	21.9	12.2	6.4	42.0	23.0	15.1	10.4	61.0	29.2	15.3	26.5	34.2	24.6
	Alkalinity (as CaCO ₃)	9.8	9.5	5.6	48.4	2.0	3.8	4.6	2.4	3.9	2.8	3.5	3.9	21.1	2.1	6.3	7.0	4.6
Nutrients and Organics	Total Ammonia	0	0	15.9	0	0	3.6	0	0	26.3	0	0	10.6	0	0	8.5	0	0
	Nitrate	0	0	29.0	34.4	0	4.4	0	0	1.2	0	0	42.4	16.4	0	17.7	9.0	0
	Nitrite	0	0	0	0	0	0	0	0	0	0	0	0	7.1	0	0	0	0
	Total Kjeldahl Nitrogen (TKN)	25.4	35.4	13.1	7.0	10.7	41.6	8.4	14.6	34.8	26.0	13.4	27.6	45.9	60.1	24.3	38.0	4.9
	Dissolved Organic Carbon	10.9	2.2	12.1	1.1	3.1	4.6	12.6	3.4	13.7	6.5	0.6	4.6	0	3.3	4.5	0	2.7
	Total Organic Carbon	8.7	2.6	15.2	1.2	1.4	35.9	17.6	5.7	12.5	17.3	3.8	18.0	6.3	4.0	5.6	15.9	1.7
	Total Phosphorus	17.7	22.5	26.4	40.4	23.5	43.1	33.7	61.0	34.1	28.9	19.3	61.1	27.8	11.0	51.9	32.8	40.7
	Phenols	87.3	5.5	0	17.7	21.2	0	29.1	19.0	0	24.6	41.4	0	32.4	0	0	27.0	5.8
Anions	Bromide (Br)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chloride (Cl)	10.6	0.9	21.6	0.4	1.4	0.6	2.5	0.5	1.5	0.9	0.8	2.2	45.9	5.8	3.9	17.1	5.9
	Sulphate (SO ₄)	7.5	1.2	6.1	0.8	1.5	0.5	3.3	0.7	1.7	0.9	1.1	10.3	60.8	3.5	3.7	17.4	8.1
Total Metals	Aluminum (Al)	4.2	0	13.5	16.7	5.5	5.7	11.0	19.6	12.1	44.1	16.6	54.1	22.2	18.6	23.8	39.2	39.1
	Antimony (Sb)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Arsenic (As)	0	0	0	0	0	0	0	0	2.4	0	0	6.1	0	0	0	0	0
	Barium (Ba)	7.2	0.8	4.2	1.3	0.8	1.7	1.3	0.8	1.2	3.8	1.6	5.8	16.1	3.3	5.2	9.3	11.2
	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	25.0	0	0	2.6	0
	Calcium (Ca)	7.1	1.1	4.5	1.0	2.7	1.4	1.0	1.3	4.1	1.4	1.0	3.5	20.6	3.7	6.8	5.3	3.3
	Chromium (Cr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.4
	Cobalt (Co)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.2
	Copper (Cu)	18.1	2.4	13.4	6.6	9.7	3.9	7.8	5.0	10.8	19.9	6.6	11.1	16.9	6.4	18.0	9.1	16.2
	Iron (Fe)	0	0	11.4	0	0	0	0	0	1.9	21.5	8.9	37.3	14.0	0	0	30.7	36.1
	Lead (Pb)	0	0	0	0	0	0	0	0	0	24.5	14.8	0	4.4	0	0	23.5	36.4
	Lithium (Li)	0	0	3.6	4.3	8.2	0.8	0	0	0	0	0	3.2	0	0	0	0	0
	Magnesium (Mg)	8.4	1.1	4.3	0.5	1.3	1.5	1.2	0.7	1.5	1.8	1.6	3.6	19.4	3.5	5.3	6.0	4.5
	Manganese (Mn)	23.9	7.2	46.3	1.9	8.6	31.5	9.0	19.3	12.9	63.6	21.4	75.3	32.6	15.8	28.7	15.9	40.6
	Mercury (Hg)	0	0	1.9	0	0	0	0	0	0	0	0	21.4	0	0	0	0	0
	Molybdenum (Mo)	5.2	4.5	10.3	1.8	3.5	1.9	1.8	1.5	2.9	5.0	3.4	12.0	27.9	4.6	7.6	17.2	11.7
	Nickel (Ni)	0	0	10.6	3.6	2.7	4.2	2.1	5.3	3.7	3.7	1.2	13.7	0	0	0	0.6	12.3
	Potassium (K)	6.7	1.3	5.3	0.7	0.7	1.7	1.2	0.7	1.7	2.6	1.4	4.5	18.9	3.4	7.8	8.7	4.4
	Selenium (Se)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Silicon (Si)	13.0	2.5	28.0	3.2	3.7	1.0	2.8	5.2	1.2	8.0	4.7	22.2	9.4	1.0	12.0	12.9	11.6
	Silver (Ag)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sodium (Na)	8.9	1.2	25.3	0.7	1.0	1.7	1.6	0.8	1.5	1.8	1.2	3.7	25.1	4.6	4.8	7.8	4.9
	Strontium (Sr)	7.3	0.9	8.4	0.5	1.9	1.7	0.7	0.5	1.2	1.6	0.9	2.6	22.2	5.0	6.1	9.1	5.1
	Thallium (Tl)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tin (Sn)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Titanium (Ti)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Uranium (U)	5.1	3.1	15.4	2.4	3.0	2.6	1.3	1.6	0.9	2.0	1.0	12.9	38.9	2.0	8.7	11.9	15.5
	Vanadium (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zinc (Zn)	0	0	0	0	0	0	0	0	0	4.7	0	0	6.1	0	0	0.9	0

Table B.11: *In-situ* water quality measurements collected at Camp Lake Tributary 1 and Tributary 2 benthic invertebrate community stations, Mary River Project CREMP, August 2015.

Study Area	Station	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Camp Lake Tributary 1 Upstream	CLT-1 US B1	4.47	11.52	88.6	7.96	184
	CLT-1 US B2	4.59	11.95	93.1	8.00	179
	CLT-1 US B3	4.61	11.70	90.9	7.99	185
	CLT-1 US B4	4.66	11.68	91.1	7.98	185
	CLT-1 US B5	4.71	11.81	91.7	8.00	185
Camp Lake Tributary 1 Downstream	CLT-1 DS B1	8.36	8.85	75.2	8.08	255
	CLT-1 DS B2	8.80	10.92	96.8	8.29	267
	CLT-1 DS B3	7.90	11.11	96.2	7.43	267
	CLT-1 DS B4	7.10	11.18	94.9	7.46	267
	CLT-1 DS B5	6.60	11.27	94.5	7.35	270
Camp Lake Tributary 2 Upstream	CLT-2 US B1	4.30	11.85	91.1	8.08	208
	CLT-2 US B2	4.29	11.39	87.9	8.06	205
	CLT-2 US B3	4.24	10.84	83.8	8.09	209
	CLT-2 US B4	4.21	10.34	79.8	8.08	210
	CLT-2 US B5	4.18	12.54	96.2	8.09	213
Camp Lake Tributary 2 Downstream	CLT-2 DS B1	3.66	11.27	85.2	8.06	216
	CLT-2 DS B2	3.74	10.97	83.3	8.08	225
	CLT-2 DS B3	3.75	11.07	83.5	8.07	191
	CLT-2 DS B4	3.73	10.89	82.6	8.05	225
	CLT-2 DS B5	3.79	12.43	94.8	8.05	223

Table B.12: Statistical comparison of *in-situ* water quality data between Camp Lake Tributary 1 Upstream (CLT-1 US) and Downstream (CLT-1 DS) benthic study areas, Mary River Project CREMP, August 2015.

Metric	Two-Sample Comparison			Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	p-value	Statistical Test					Lower Bound	Upper Bound		
Water Temperature (°C)	YES	0.0014	Student's T-test	CLT 1 Upstream	4.61	0.09	0.04	4.50	4.72	4.47	4.71
				CLT 1 Downstream	7.75	0.90	0.40	6.63	8.87	6.60	8.80
Dissolved Oxygen (mg/L)	YES	0.0079	MW U-test	CLT 1 Upstream	11.73	0.16	0.07	11.53	11.93	11.52	11.95
				CLT 1 Downstream	10.67	1.02	0.46	9.40	11.94	8.85	11.27
Dissolved Oxygen (% saturation)	NO	0.1508	MW U-test	CLT 1 Upstream	91.1	1.6	0.7	89.1	93.1	88.6	93.1
				CLT 1 Downstream	91.5	9.2	4.1	80.1	102.9	75.2	96.8
pH (units)	NO	0.2428	Student's T-test	CLT 1 Upstream	7.99	0.02	0.01	7.97	8.01	7.96	8.00
				CLT 1 Downstream	7.72	0.43	0.19	7.19	8.26	7.35	8.29
Specific Conductance (µS/cm)	YES	0.0079	MW U-test	CLT 1 Upstream	183.6	2.6	1.2	180.4	186.8	179.0	185.0
				CLT 1 Downstream	265.2	5.8	2.6	257.9	272.5	255.0	270.0

^a Analysis of Variance (ANOVA); MW U-test indicates application of Mann-Whitney U-test

Table B.13: Statistical comparison of *in-situ* water quality data between Camp Lake Tributary 2 Upstream (CLT-2 US) and Downstream (CLT-2 DS) benthic study areas, Mary River Project CREMP, August 2015.

Metric	Two-Sample Comparison			Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	p-value	Statistical Test					Lower Bound	Upper Bound		
Water Temperature (°C)	YES	0.0000	ANOVA	CLT 2 Upstream	4.24	0.05	0.02	4.18	4.31	4.18	4.30
				CLT 2 Downstream	3.73	0.05	0.02	3.68	3.79	3.66	3.79
Dissolved Oxygen (mg/L)	NO	1.0000	MW U-test	CLT 2 Upstream	11.39	0.86	0.38	10.33	12.46	10.34	12.54
				CLT 2 Downstream	11.33	0.63	0.28	10.54	12.11	10.89	12.43
Dissolved Oxygen (% saturation)	NO	0.5476	MW U-test	CLT 2 Upstream	87.8	6.4	2.8	79.9	95.6	79.8	96.2
				CLT 2 Downstream	85.9	5.1	2.3	79.6	92.2	82.6	94.8
pH (units)	YES	0.0546	ANOVA	CLT 2 Upstream	8.08	0.01	0.01	8.06	8.10	8.06	8.09
				CLT 2 Downstream	8.06	0.01	0.01	8.05	8.08	8.05	8.08
Specific Conductance (µS/cm)	NO	0.1508	MW U-test	CLT 2 Upstream	209.0	2.9	1.3	205.4	212.6	205.0	213.0
				CLT 2 Downstream	216.0	14.5	6.5	198.0	234.0	191.0	225.0

^a Analysis of Variance (ANOVA); MW U-test indicates application of Mann-Whitney U-test

Table B.14: Water chemistry at lotic Camp Lake Tributary (CLT) monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Spring Sampling Event							Summer Sampling Event						
					L2-03	L1-08	L1-02	L1-09	L1-05	L0-01	K0-01	L2-03	L1-08	L1-02	L1-09	L1-05	L0-01	K0-01
					24-Jun-2015	29-Jun-2015	23-Jun-2015	23-Jun-2015	23-Jun-2015	23-Jun-2015	24-Jun-2015	17-Jul-2015	21-Jul-2015	17-Jul-2015	17-Jul-2015	17-Jul-2015	17-Jul-2015	17-Jul-2015
Conventional	Conductivity (lab)	umho/cm	-	-	286	77.6	75.8	92.3	99.25	98.1	91.1	417	92	152	190	201	200	158
	pH (lab)	pH	6.5 - 9.0	-	8.17	7.58	7.97	8.01	8.02	7.93	7.98	8.14	7.82	8.03	8.11	8.1	8.145	8.04
	Hardness (as CaCO ₃)	mg/L	-	-	114	40	43	50	50	51	44	174	40	76	90	94	96	78
	Total Suspended Solids (TSS)	mg/L	-	-	3.1	6.4	<2.0	<2.0	2	<2.0	4.7	<2.0	2	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	156	37	53	61	64.5	63	57	220	45	79	101	100	105.5	72
	Turbidity	NTU	-	-	3.25	2.23	1.1	1.09	0.775	0.75	0.83	3.595	0.33	0.24	0.34	0.38	0.41	0.27
	Alkalinity (as CaCO ₃)	mg/L	-	-	95	34	35	35	45	43	43	134	43	75	88	88	95	85
Nutrients and Organics	Total Ammonia	mg/L	variable ^c	0.855	0.115	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.075	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Nitrate	mg/L	13	13	0.374	0.043	0.021	0.041	0.043	0.037	<0.020	0.564	0.141	<0.020	0.034	0.082	0.058	0.030
	Nitrite	mg/L	0.06	0.06	0.0079	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	< 0.012	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.35	0.22	0.34	0.3	0.15	0.25	<0.15	0.42500	<0.15	0.20000	<0.15	0.19000	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	3.6	1.4	1.3	1.6	1.75	2.1	1.3	5.2	1.3	2.4	2.7	2.8	2.7	1.4
	Total Organic Carbon	mg/L	-	-	3.9	1.4	1.3	1.5	1.65	1.6	1.3	5.25	1.3	2.3	2.7	2.7	2.5	1.5
	Total Phosphorus	mg/L	0.020 ^a	-	0.0064	0.0051	0.0033	<0.0030	<0.0030	<0.0030	0.0031	0.0087	0.0032	0.0033	0.0258	0.0116	0.0039	0.0035
	Phenols	mg/L	0.001 ^a	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0016	0.00365	0.0025	0.0031	0.0027	0.0021	0.00215	0.0031
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	26.9	1.25	0.7	2.79	3.25	2.51	0.83	35.30	0.95	0.96	7.27	8.78	7.22	1.13
	Sulphate (SO ₄)	mg/L	218 ^b	218	10.4	0.81	1.46	1.87	1.855	1.77	1.47	33.3	1.5	2.0	4.0	4.3	3.8	1.6
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0588	0.0424	0.0108	0.011	0.01015	0.0122	0.0317	0.0328	0.0240	0.0071	0.0067	0.0195	0.0200	0.0140
	Antimony (Sb)	mg/L	0.020 ^a	-	<0.00010	<0.00010	<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	0.000	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00994	0.00574	0.00558	0.00593	0.006065	0.00619	0.00518	0.0164	0.0069	0.0097	0.0109	0.0115	0.0112	0.0095
	Beryllium (Be)	mg/L	0.011 ^a	-	<0.00050	<0.00050	<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	-	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	< 0.017	<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	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	22.1	7.9	8.27	9.46	9.715	9.92	8.83	34	8	15	18	20	20	16
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009 ^a	0.004	0.00024	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.000375	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.00102	0.00186	0.00143	0.00141	0.001415	0.00134	0.00084	0.0012	0.0023	0.0021	0.0020	0.0019	0.0018	0.0012
	Iron (Fe)	mg/L	0.30	0.326	0.334	0.045	<0.030	<0.030	<0.030	<0.030	0.034	0.845	<0.030	<0.030	0.044	0.057	0.039	<0.030
	Lead (Pb)	mg/L	0.001	0.001	0.000078	0.000078	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.0022	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00340	<0.0010	<0.0010	0.00170	0.00170	0.00160	0.00110
	Magnesium (Mg)	mg/L	-	-	14.3	4.91	5.26	6.27	6.065	6.33	5.24	22.2	4.88	9.26	10.8	11.7	11.65	9.43
	Manganese (Mn)	mg/L	0.935 ^b	-	0.0441	0.00136	0.00038	0.00135	0.00151	0.00115	0.00128	0.11250	0.00088	0.00035	0.00278	0.00537	0.00162	0.00053
	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	-	0.00112	0.000205	0.000238	0.000289	0.0003115	0.000286	0.000152	0.00145	0.00056	0.00048	0.00053	0.00054	0.00049	0.00033
	Nickel (Ni)	mg/L	0.025	0.025	0.00107	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0017	<0.00050	0.0006	0.0007	0.0008	0.0008	<0.00050
	Potassium (K)	mg/L	-	-	2.34	1.05	1	1.12	1.125	1.13	0.8	3.12	1.60	1.66	1.81	1.91	1.85	1.43
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.6	0.61	0.36	0.35	0.355	0.38	0.47	0.70	0.61	0.79	0.80	0.84	0.89	0.73
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	11	0.341	0.446	1.24	1.24	1.11	0.589	14.300	0.428	1.010	2.350	2.540	2.350	1.290
	Strontium (Sr)	mg/L	-	-	0.0175	0.00417	0.00396	0.00582	0.00683	0.00705	0.00501	0.032	0.005	0.008	0.020	0.021	0.020	0.010
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	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	-	0.00408	0.000562	0.000273	0.000511	0.0004875	0.000434	0.000308	0.0049	0.0008	0.0011	0.0014	0.0015	0.0014	0.0009
	Vanadium (V)	mg/L	0.006 ^a	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	0.0111	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0204

^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 2.3 for information regarding WQG criteria.

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

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table B.14: Water chemistry at lotic Camp Lake Tributary (CLT) monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Fall Sampling Event						
					L2-03	L1-08	L1-02	L1-09	L1-05	L0-01	K0-01
					18-Aug-2015	13-Aug-2015	18-Aug-2015	18-Aug-2015	17-Aug-2015	17-Aug-2015	17-Aug-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	449	125	199	261.5	258	256	220
	pH (lab)	pH	6.5 - 9.0	-	8.12	7.92	8.14	8.17	8.15	8.18	8.175
	Hardness (as CaCO ₃)	mg/L	-	-	183	63	104	125.5	123	124	116.5
	Total Suspended Solids (TSS)	mg/L	-	-	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	241	66	90	129	140	131	114.5
	Turbidity	NTU	-	-	3.22	0.25	0.21	0.65	0.86	0.7	0.23
	Alkalinity (as CaCO ₃)	mg/L	-	-	142	59	97	111	107	113	122
Nutrients and Organics	Total Ammonia	mg/L	variable ^c	0.855	0.144	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Nitrate	mg/L	13	13	1.01	0.079	0.038	0.1955	0.257	0.23	0.033
	Nitrite	mg/L	0.06	0.06	0.0205	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.59	<0.15	0.17	0.235	0.19	0.29	<0.15
	Dissolved Organic Carbon	mg/L	-	-	4.8	2.6	2.6	3.35	3.7	3.4	2.7
	Total Organic Carbon	mg/L	-	-	5.1	2.2	2.8	3.55	3.4	3.5	3.55
	Total Phosphorus	mg/L	0.020 ^α	-	0.0051	0.004	0.0167	<0.0030	0.0039	0.004	0.00315
	Phenols	mg/L	0.001 ^α	-	0.0014	0.0046	0.0019	0.00135	0.0019	<0.0010	0.00185
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	48.2	1.79	1.62	13.7	14.1	12.7	2.43
	Sulphate (SO ₄)	mg/L	218 ^β	218	19.6	1.98	6.55	8.59	9.56	8.65	3
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.039	0.025	0.0066	0.01115	0.0122	0.015	0.01085
	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	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0163	0.00919	0.0118	0.01355	0.0136	0.0131	0.0119
	Beryllium (Be)	mg/L	0.011 ^α	-	<0.00050	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	0.025	<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	-	-	34.2	12.8	19.4	24.2	25	24.6	23.25
	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	0.00039	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.00098	0.0026	0.00221	0.00193	0.0019	0.0018	0.00141
	Iron (Fe)	mg/L	0.30	0.326	0.627	<0.050	<0.030	0.09	0.089	0.082	<0.030
	Lead (Pb)	mg/L	0.001	0.001	0.000085	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.0046	<0.0010	0.0012	0.0026	0.0022	0.0021	0.0012
	Magnesium (Mg)	mg/L	-	-	24.1	8.22	12.8	15.75	15.1	14.8	14.15
	Manganese (Mn)	mg/L	0.935 ^β	-	0.0741	0.00069	0.000508	0.00984	0.00786	0.00666	0.001039
	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	-	0.00297	0.000889	0.000679	0.001045	0.00109	0.000952	0.000404
	Nickel (Ni)	mg/L	0.025	0.025	0.00148	<0.00050	0.00067	0.00093	0.00095	0.00093	0.00057
	Potassium (K)	mg/L	-	-	3.59	1.98	1.85	2.165	2.2	2.11	1.615
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.94	0.833	1	1.05	1.04	1.1	0.99
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	20.1	0.57	1.34	4.88	4.74	4.36	1.9
	Strontium (Sr)	mg/L	-	-	0.0368	0.0073	0.00965	0.0277	0.0268	0.0248	0.01315
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	0.000013	<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	0.00123	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0108	0.00242	0.00208	0.003575	0.00343	0.00321	0.001795
	Vanadium (V)	mg/L	0.006 ^α	0.006	<0.0010	<0.00050	<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	0.0106

^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 2.3 for information regarding WQG criteria.

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

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table B.15: Dissolved metals concentrations at Camp Lake Tributary water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Spring Sampling Event							Summer Sampling Event							Fall Sampling Event						
			L2-03	L1-08	L1-02	L1-09	L1-05	L0-01	K0-01	L2-03	L1-08	L1-02	L1-09	L1-05	L0-01	K0-01	L2-03	L1-08	L1-02	L1-09	L1-05	L0-01	K0-01
			24-Jun-2015	29-Jun-2015	23-Jun-2015	23-Jun-2015	23-Jun-2015	23-Jun-2015	24-Jun-2015	17-Jul-2015	21-Jul-2015	17-Jul-2015	17-Jul-2015	17-Jul-2015	17-Jul-2015	17-Jul-2015	17-Jul-2015	18-Aug-2015	13-Aug-2015	18-Aug-2015	18-Aug-2015	17-Aug-2015	17-Aug-2015
Dissolved Metals	Aluminum (Al)	mg/L	0.00545	0.00798	0.00467	0.00423	0.00433	0.00372	0.00374	0.00530	0.00730	0.00550	<0.0050	0.00780	0.00530	<0.0050	0.00420	0.00670	0.00440	0.00370	0.00410	0.00360	0.00300
	Antimony (Sb)	mg/L	<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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)	mg/L	0.000084	0.000036	0.000034	0.000034	0.0000355	0.000037	0.000042	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Barium (Ba)	mg/L	0.00951	0.00561	0.00556	0.00581	0.00595	0.00594	0.00485	0.0159	0.00678	0.00971	0.0108	0.0114	0.0111	0.00930	0.0156	0.00819	0.0120	0.01335	0.0138	0.0131	0.0120
	Beryllium (Be)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.00050	<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	0.000006	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.000007	<0.000050	<0.00050	<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	0.0106	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.017	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.024	<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	<0.000010	<0.000010	<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	21.6	7.94	8.34	9.69	9.93	10.2	8.78	33.7	8.18	15.2	18.7	19.5	19.8	16.0	32.8	12.3	20.1	24.5	24.8	24.8	23.2
	Chromium (Cr)	mg/L	<0.00010	<0.00010	0.00017	<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
	Cobalt (Co)	mg/L	0.000204	0.0000175	0.0000224	0.0000344	0.00002545	0.0000264	0.0000154	0.000295	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00032	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00071	0.00171	0.00155	0.00133	0.00136	0.00131	0.00082	0.0009	0.0022	0.0020	0.0019	0.0018	0.0018	0.0010	0.00088	0.00242	0.00215	0.001845	0.00185	0.00185	0.001395
	Iron (Fe)	mg/L	0.132	0.0036	0.0053	0.0112	0.0101	0.0081	0.0042	0.194	<0.030	<0.010	0.024	0.028	0.015	<0.010	0.131	<0.030	<0.030	0.0305	0.041	0.035	<0.030
	Lead (Pb)	mg/L	0.0000123	0.0000092	0.0000134	<0.0000090	<0.0000090	0.0000112	<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
	Lithium (Li)	mg/L	0.0021	<0.00050	0.00053	0.00072	0.000795	0.00089	0.00053	0.00330	<0.0010	0.00100	0.00170	0.00180	0.00175	0.00110	0.0044	<0.0010	0.0014	0.00275	0.0022	0.0022	0.00135
	Magnesium (Mg)	mg/L	14.5	4.89	5.37	6.15	6.14	6.26	5.35	21.9	4.82	9.12	10.5	10.9	11.35	9.20	24.5	7.94	13.0	15.6	14.9	15.2	14.2
	Manganese (Mn)	mg/L	0.0424	0.000333	0.000193	0.000901	0.000829	0.00064	0.000594	0.10200	0.00041	<0.00050	0.00203	0.00414	0.00092	<0.00050	0.0674	0.000327	0.000363	0.00862	0.00642	0.00568	0.0008255
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.010	<0.010	<0.010	<0.010	<0.000010	<0.000010	<0.000010	<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	0.00114	0.000191	0.000239	0.000305	0.0003225	0.000284	0.000152	0.00150	0.00057	0.00047	0.00055	0.00052	0.00050	0.00033	0.00294	0.000833	0.000709	0.001055	0.00108	0.000991	0.000419
	Nickel (Ni)	mg/L	0.000963	0.000258	0.000748	0.000395	0.0004475	0.000473	0.000317	0.0015	<0.00050	0.0006	0.0007	0.0008	0.0008	<0.00050	0.00141	<0.00050	0.00065	0.00094	0.0009	0.00095	0.00055
	Potassium (K)	mg/L	2.34	1.04	1.01	1.1	1.115	1.12	0.8	3.11	1.57	1.65	1.78	1.79	1.80	1.39	3.45	1.84	1.84	2.15	2.19	2.14	1.605
	Selenium (Se)	mg/L	0.000045	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	0.0001	<0.0010	<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	0.52	0.56	0.34	0.35	0.35	0.39	0.40	0.67	0.58	0.78	0.79	0.86	0.88	0.72	0.86	0.78	0.97	1.04	1.04	1.11	0.98
	Silver (Ag)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000050	<0.000010	<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	11.2	0.34	0.463	1.23	1.23	1.12	0.606	14.05	0.416	1.00	2.28	2.40	2.32	1.27	20.0	0.522	1.35	4.86	4.70	4.46	1.90
Strontium (Sr)	mg/L	0.0173	0.00424	0.00398	0.00604	0.006915	0.00728	0.00498	0.0320	0.00473	0.00780	0.0203	0.0213	0.0205	0.0096	0.0371	0.00700	0.0100	0.02705	0.0264	0.0248	0.0133	
Thallium (Tl)	mg/L	0.0000042	0.0000086	0.0000055	0.0000068	0.0000037	0.0000032	0.0000036	<0.000010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<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	<0.00010	<0.00010	<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	<0.00050	<0.00030	<0.010	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Uranium (U)	mg/L	0.00406	0.000548	0.000271	0.000503	0.000489	0.000431	0.000294	0.00474	0.000811	0.000992	0.00138	0.00137	0.00139	0.000919	0.0105	0.00233	0.00210	0.00356	0.00345	0.00331	0.00181	
Vanadium (V)	mg/L	0.000082	0.000239	0.00012	0.000103	0.00011	0.000106	0.000075	<0.00050	<0.0010	<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	0.00154	0.00164	0.0021	0.0025	0.0014	0.0028	0.0115	0.0015	<0.0030	0.0013	0.0013	0.0014	0.0020	0.0209	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0107	

Table B.16: Summary of the magnitude of difference in aqueous metal concentrations between the Camp Lake Tributaries and mean lotic reference data for 2015 spring, summer, and fall sampling events, Mary River Project CREMP, 2015. No value presented for parameters in which concentrations were below laboratory method detection limits.

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)	1.9	7.1	2.4	2.2	1.7	5.7	2.7	2.1	1.5	4.3	2.5	2.1
pH (lab)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.0
Hardness (as CaCO ₃)	2.2	6.2	2.7	2.4	1.7	5.2	2.8	2.3	1.6	3.6	2.4	2.3
Total Suspended Solids (TSS)	1.8	1.3	0.8	2.0								
Total Dissolved Solids (TDS)	1.5	5.3	2.1	1.9	1.4	5.1	2.3	1.7	1.4	4.4	2.5	2.1
Turbidity	1.0	2.0	0.5	0.5	0.1	1.8	0.2	0.1	0.1	1.1	0.2	0.1
Alkalinity (as CaCO ₃)	2.0	5.4	2.3	2.5	1.6	3.6	2.4	2.3	1.7	3.1	2.4	2.7
Nitrate	6.4	74.8	8.1	1.0	5.0	20.1	2.1	1.1	2.3	40.4	9.1	1.3
Total Kjeldahl Nitrogen (TKN)									1.1	3.9	1.6	0.0
Dissolved Organic Carbon	0.8	2.1	1.1	0.8					1.5	2.8	2.0	1.6
Total Organic Carbon	0.7	2.0	0.8	0.7	1.5	4.4	2.2	1.3	1.4	3.0	2.0	2.1
Total Phosphorus	1.0	1.5	0.7	0.7	0.8	2.2	3.5	0.9	1.9	0.9	0.7	0.6
Chloride (Cl)	0.8	23.3	2.5	0.7	0.6	23.2	5.1	0.7	0.9	25.3	7.1	1.3
Sulphate (SO ₄)	1.0	8.9	1.6	1.3	1.0	19.3	2.3	0.9	1.3	6.2	2.8	0.9
Aluminum (Al)	0.6	1.3	0.2	0.7	0.3	0.5	0.3	0.2	0.1	0.2	0.1	0.1
Arsenic (As)												
Barium (Ba)	1.8	3.2	2.0	1.7	1.6	3.2	2.2	1.9	1.5	2.3	1.9	1.7
Boron (B)												
Cadmium (Cd)												
Calcium (Ca)	1.9	5.3	2.3	2.1	1.6	4.7	2.7	2.2	1.5	3.2	2.3	2.2
Chromium (Cr)												
Copper (Cu)	1.7	1.0	1.4	0.8	2.4	1.3	2.1	1.3	1.6	0.6	1.2	0.9
Iron (Fe)	0.4	3.2		0.3		12.0	0.7			3.8	0.5	
Lead (Pb)	0.7	0.7				0.3				0.3		
Magnesium (Mg)	2.2	6.3	2.7	2.3	1.9	5.9	3.0	2.5	1.7	3.9	2.5	2.3
Manganese (Mn)	1.0	51.6	1.6	1.5	1.1	197.6	5.7	0.9	0.3	35.1	3.8	0.5
Molybdenum (Mo)	1.7	8.7	2.3	1.2	1.8	5.1	1.8	1.2	2.0	7.5	2.6	1.0
Nickel (Ni)		1.5			1.0	2.7	1.3		1.0	2.1	1.4	0.8
Potassium (K)	2.3	5.3	2.6	1.8	2.5	4.8	2.9	2.2	2.4	4.5	2.7	2.0
Silicon (Si)	0.8	1.0	0.6	0.8	0.9	0.9	1.1	1.0	0.9	0.9	1.0	1.0
Sodium (Na)	0.6	17.6	1.9	0.9	0.7	13.5	2.3	1.2	0.6	13.2	3.1	1.3
Strontium (Sr)	1.1	4.5	1.7	1.3	0.8	4.3	2.8	1.3	0.8	3.5	2.5	1.3
Uranium (U)	1.3	12.8	1.5	1.0	1.1	5.8	1.7	1.1	0.8	3.9	1.2	0.6
Zinc (Zn)												

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

Table B.17: *In-situ* water quality profile data collected at Camp Lake water quality monitoring stations in winter^a, Mary River Project CREMP, 2015.

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	1.2	110.6	7.6	160.0	2.80	1.6	104.0	7.5	152.0	3.10	1.9	104.7	7.7	150.0	2.95	1.7	101.2	5.3	151.0	3.15	1.9	104.0	7.6	149.0
4.15	1.6	111.5	7.6	156.0	3.80	1.9	105.4	7.5	148.0	4.10	1.8	104.5	7.7	148.0	3.95	1.8	103.4	5.2	148.0	4.15	1.8	104.3	7.4	148.0
5.15	1.9	110.5	7.6	149.0	4.80	1.9	105.1	7.4	148.0	5.10	1.8	104.4	7.6	148.0	4.95	1.9	104.0	5.1	147.0	5.15	1.8	104.1	7.3	148.0
6.15	2.0	108.9	7.6	149.0	5.80	1.9	105.3	7.4	148.0	6.10	1.8	104.4	7.6	148.0	5.95	1.8	104.3	5.1	147.0	6.15	1.8	104.0	7.3	148.0
7.15	2.0	108.0	7.6	149.0	6.80	1.9	105.4	7.4	148.0	7.10	1.8	104.4	7.6	148.0	6.95	1.8	104.5	5.1	147.0	7.15	1.8	104.7	7.2	148.0
8.15	2.0	107.3	7.6	149.0	7.80	1.9	105.3	7.4	148.0	8.10	1.8	104.2	7.5	148.0	7.95	1.8	104.5	5.2	147.0	8.15	1.8	103.9	7.2	148.0
9.15	2.0	106.9	7.6	149.0	8.80	1.9	105.3	7.4	148.0	9.10	1.8	104.2	7.5	147.0	8.95	1.9	104.3	5.6	147.0	9.15	1.8	103.6	7.2	147.0
10.15	2.0	106.6	7.5	149.0	9.80	1.9	105.2	7.4	148.0	10.10	1.8	104.3	7.5	147.0	9.95	1.8	104.4	5.4	147.0	10.15	1.8	103.5	7.2	147.0
11.15	2.0	106.5	7.5	149.0	10.45	1.9	105.1	7.3	148.0	11.10	1.9	103.9	7.5	147.0	10.95	1.8	104.4	5.4	147.0	11.15	1.8	103.3	7.2	147.0
										12.10	1.9	103.9	7.5	148.0	11.95	1.9	104.4	5.6	147.0	12.15	1.8	103.0	7.2	147.0
										13.10	1.9	103.9	7.5	148.0	12.95	1.9	104.1	5.8	147.0	13.15	1.9	102.2	7.2	148.0
										14.10	1.9	104.2	7.5	148.0	13.95	1.9	104.0	5.9	147.0	14.15	1.9	102.6	7.2	147.0
										15.10	1.9	103.6	7.5	147.0	14.95	1.9	103.7	6.0	147.0	15.00	1.9	102.3	7.2	148.0
										16.10	1.9	102.4	7.5	147.0	15.95	1.9	103.5	6.1	147.0					
															16.95	1.9	101.7	6.2	145.0					
															17.95	1.9	99.0	6.3	145.0					
															18.95	2.0	96.7	6.3	144.0					
															19.95	2.0	95.7	6.4	144.0					
															20.95	2.0	93.7	6.4	144.0					
															21.95	2.0	92.4	6.4	144.0					
															22.95	2.1	91.0	6.5	144.0					
															23.95	2.1	87.4	6.5	143.0					
															24.95	2.2	85.2	6.5	143.0					
															25.95	2.3	72.0	6.5	143.0					
															26.95	2.4	66.8	6.6	144.0					
															27.95	2.5	60.2	6.6	145.0					
															28.95	2.5	55.0	6.6	148.0					
															29.95	2.6	44.1	6.6	151.0					

^a Sampling conducted on 25-April and 26-April, 2015.

^b Total depth at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 were not recorded 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, 1.80, 2.10, 1.95, and 2.15 m, respectively, at the time of winter sampling.

Table B.18: *In-situ* water quality profile data collected at Camp Lake water quality monitoring stations in summer^a, Mary River Project CREMP, 2015.

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	4.8	4.7	4.5	4.4	4.4	105.6	106.7	105.3	105.3	104.0	8.06	8.06	7.99	7.92	7.92	120.8	120.5	120.6	120.8	126.0
2.0	4.7	4.7	4.5	4.4	4.4	105.7	106.7	105.6	105.5	104.3	8.04	8.02	7.99	7.93	7.91	120.9	120.7	120.6	120.7	126.0
3.0	4.7	4.7	4.5	4.4	4.4	105.8	106.6	105.7	105.4	104.5	8.03	8.02	8.00	7.93	7.91	120.9	120.7	120.6	120.8	126.0
4.0	4.7	4.7	4.5	4.4	4.4	105.9	106.6	105.7	105.4	104.5	8.02	8.02	8.00	7.94	7.91	120.9	120.7	120.6	120.8	126.0
5.0	4.7	4.7	4.5	4.4	4.4	106.0	106.6	105.7	105.4	104.6	8.03	8.01	8.00	7.94	7.88	121.0	120.7	120.6	120.8	126.0
6.0	4.7	4.7	4.5	4.4	4.4	105.9	106.6	105.6	105.4	104.5	8.02	8.01	8.00	7.94	7.91	121.1	120.7	120.6	120.9	126.0
7.0	4.7	4.7	4.5	4.4	4.4	106.0	106.6	105.5	105.3	104.5	8.02	8.01	8.00	7.93	7.91	121.1	120.7	120.7	120.9	126.0
8.0	4.7	4.7	4.5	4.4	4.4	106.1	106.5	105.5	105.3	104.5	8.02	8.01	8.00	7.94	7.93	121.1	120.7	120.7	120.9	126.0
9.0	4.7	4.7	4.5	4.4	4.4	106.1	106.4	105.5	105.3	104.3	8.01	8.01	8.00	7.93	7.92	121.0	120.7	120.7	120.9	126.0
10.0	4.7	4.7	4.4	4.4	4.4	106.1	106.4	105.2	105.2	104.3	8.01	8.01	7.99	7.93	7.94	121.1	120.7	120.7	120.9	126.0
11.0	4.7		4.4	4.4	4.4	106.1		105.2	105.2	104.2	8.02		7.99	7.93	7.93	121.0		120.7	120.9	126.0
12.0			4.4	4.4	4.4			105.0	105.2	104.2			7.99	7.93	7.88			120.7	120.9	126.0
13.0			4.4	4.4	4.4			105.0	105.1	104.2			7.99	7.94	7.93			120.7	120.9	126.0
14.0			4.4	4.4	4.4			104.9	105.1	104.0			7.99	7.94	7.94			120.7	120.9	126.0
15.0			4.4	4.4	4.4			104.9	105.1	105.9			7.99	7.94	7.94			120.7	120.9	126.0
16.0				4.4	4.4				105.1	103.8				7.94	8.04				120.9	126.0
17.0				4.4					105.0					7.95					120.9	
18.0				4.4					105.0					7.95					120.9	
19.0				4.4					105.0					7.96					120.9	
20.0				4.4					104.9					7.96					120.9	
21.0				4.4					104.9					7.96					120.9	
22.0				4.4					104.8					7.96					120.9	
23.0				4.4					104.9					7.96					120.9	
24.0				4.4					104.8					7.96					120.9	
25.0				4.4					104.7					7.96					120.9	
26.0				4.4					104.7					7.97					120.9	
27.0				4.4					104.7					7.97					120.9	
28.0				4.4					104.6					7.97					120.9	
29.0				4.4					104.6					7.97					120.9	
30.0				4.4					104.6					7.97					120.9	
31.0				4.4					104.5					7.97					120.9	
32.0				4.4					104.5					7.97					120.9	
33.0				4.4					103.4					7.92					128.9	

^a Sampling conducted on 18-July and 19-July, 2015.

^b Total depth at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 were 12.8, 11.5, 17, 35, and 17 m, respectively, at the time of summer sampling.

Table B.19: *In-situ* water quality profile data collected at Camp Lake water quality monitoring stations in fall^a, Mary River Project CREMP, 2015.

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	8.2	8.2	8.2	8.1	8.0	100.5	99.6	100.1	100.2	100.3	8.02	8.88	8.03	8.01	8.02	141.5	140.7	141.2	139.7	139.7
2.0	8.1	8.0	8.0	7.9	8.0	99.9	100.0	100.2	100.3	100.3	8.00	8.10	8.01	8.00	8.01	141.1	140.3	139.9	139.4	139.7
3.0	7.8	8.0	7.9	7.9	7.9	99.9	100.0	100.3	100.1	100.2	8.00	8.07	8.00	8.00	8.00	140.0	140.3	139.9	139.4	139.7
4.0	7.7	8.0	7.8	7.9	7.9	99.8	100.2	100.3	100.2	100.2	7.99	8.05	8.00	8.00	7.99	140.3	140.3	139.9	139.4	139.7
5.0	7.7	7.9	7.8	7.9	7.9	99.8	99.9	100.4	99.9	100.1	7.99	8.04	7.99	8.00	7.99	143.2	140.2	139.9	139.4	139.7
6.0	7.6	7.8	7.8	7.8	7.9	99.7	99.9	100.2	99.9	100.1	7.99	8.03	7.98	7.99	7.98	140.9	140.3	139.9	139.4	139.7
7.0	7.6	7.7	7.8	7.8	7.9	99.6	99.7	100.2	99.9	100.1	7.99	8.02	7.98	7.99	7.98	140.3	140.6	139.9	139.4	139.7
8.0	7.6	7.7	7.8	7.8	7.8	99.5	99.5	100.2	99.8	99.8	7.99	8.01	7.97	7.99	7.98	140.0	140.5	139.9	139.4	139.7
9.0	7.6	7.7	7.7	7.7	7.8	99.3	99.4	100.2	99.7	99.6	7.90	8.00	7.97	7.99	7.97	140.0	140.4	139.8	139.5	139.7
10.0	7.5	7.6	7.7	7.7	7.7	99.2	99.3	99.9	99.6	99.4	7.90	7.99	7.96	7.99	7.96	139.8	140.9	139.6	139.5	139.7
11.0	7.5	7.6*	7.7	7.7	7.7	99.2	99.0*	99.8	99.6	99.3	7.90	7.89	7.96	7.99	7.96	139.8	142.3*	139.5	139.5	139.6
12.0	7.5*		7.7	7.7	7.6	99.5*		99.6	99.7	99.0	7.90		7.95	7.99	7.96	140.1*		139.4	139.5	139.4
13.0			7.6	7.7	7.6			99.4	99.5	98.8			7.95	7.99	7.95			139.4	139.4	139.5
14.0			7.6	7.7	7.6*			99.2	99.3	98.7*			7.94	7.99	7.95			139.3	139.3	139.5*
15.0			7.6	7.7				99.1	99.2				7.94	7.99				139.3	139.3	
16.0			7.6*	7.7				99.1*	99.1				7.93	7.98				139.4*	139.3	
17.0				7.6					99.0					7.98					139.3	
18.0				7.6					99.0					7.98					139.3	
19.0				7.6					98.9					7.98					139.3	
20.0				7.6					98.8					7.98					139.3	
21.0				7.6					98.7					7.97					139.4	
22.0				7.6					98.7					7.97					139.4	
23.0				7.6					98.6					7.97					139.3	
24.0				7.6					98.5					7.97					139.3	
25.0				7.6					98.4					7.96					139.3	
26.0				7.6					98.3					7.96					139.3	
27.0				7.5					98.2					7.96					139.4	
28.0				7.5					98.1					7.96					139.3	
29.0				7.5					98.0					7.96					139.4	
30.0				7.5					98.0					7.95					139.4	
31.0				7.5					97.7					7.95					139.5	
32.0				7.5*					97.1*					7.93					139.8*	

^a Sampling conducted on 19-August and 20-August, 2015.

^b Total depth at Stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 were 12.3, 11.7, 16.6, 32.7, and 14.3 m, respectively, at the time of fall sampling.

* The deepest *in situ* water quality reading at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 were taken at 11.3, 10.7, 15.6, 31.7, and 13.3 m, respectively, at the time of fall sampling.

Table B.20: 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 2015.

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Colour/ Clarity	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
								(mg/L)	(% sat.)		
Littoral (Shallow) Stations	JLO-21	15-Aug-15	9.9	6.87	clear, slight blue-green tinge	surface	7.73	11.73	97.4	7.89	129
						bottom	7.71	11.63	97.2	7.89	129
	JLO-20	15-Aug-15	6.9	bottom	clear, slight blue-green tinge	surface	7.73	11.31	95.3	7.91	129
						bottom	7.71	11.39	95.1	7.90	129
	JLO-19	15-Aug-15	7.5	6.86	clear, slight blue-green tinge	surface	7.78	11.37	95.1	7.89	129
						bottom	7.74	11.41	95.2	7.89	129
	JLO-18	15-Aug-15	12.2	6.82	clear, slight blue-green tinge	surface	7.75	9.67	80.9	7.88	129
						bottom	7.68	9.73	81.1	7.90	134
	JLO-02	13-Aug-15	11.3	- ^a	clear, slight blue-green tinge	surface	8.17	11.41	96.6	7.86	128
						bottom	7.93	11.44	96.8	7.85	128
Profundal (Deep) Stations	JLO-16	15-Aug-15	16.0	6.85	clear, slight blue-green tinge	surface	7.65	9.65	80.7	7.87	129
						bottom	7.58	9.77	81.7	7.88	131
	JLO-01	13-Aug-15	17.8	7.99	clear, slight blue-green tinge	surface	7.69	11.52	96.2	7.81	129
						bottom	7.62	11.39	95.4	7.48	129
	JLO-07	15-Aug-15	32.9	8.55	clear, slight blue-green tinge	surface	7.62	11.00	92.1	7.80	129
						bottom	7.65	10.73	90.0	7.82	129
	JLO-11	15-Aug-15	29.0	6.49	clear, slight blue-green tinge	surface	7.54	10.02	83.5	7.88	130
						bottom	7.55	10.11	81.6	7.88	130
	JLO-12	15-Aug-15	14.9 to 15.5	6.90	clear, slight blue-green tinge	surface	7.71	9.72	82.1	7.84	129
						bottom	7.61	9.88	82.6	7.88	131

^b Secchi depth was not measured due to choppy water and extreme weather conditions.

Table B.21: Statistical comparison of bottom in-situ water quality between littoral and profundal stations of Camp Lake, Mary River Project CREMP, August 2015.

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
Camp Lake	Secchi Depth (m)	NO	0.230	δ	Littoral	5	6.85	0.02	0.01	6.82	6.87
					Profundal	5	7.36	0.87	0.39	6.49	8.55
	Temperature (°C)	YES	0.013	γ	Littoral	5	7.75	0.10	0.05	7.68	7.93
					Profundal	5	7.60	0.04	0.02	7.55	7.65
	Dissolved Oxygen (mg/L)	NO	0.147	γ	Littoral	5	11.1	0.8	0.4	9.7	11.6
					Profundal	5	10.4	0.7	0.3	9.8	11.4
	Dissolved Oxygen (% saturation)	NO	0.135	γ	Littoral	5	93.1	6.8	3.0	81.1	97.2
					Profundal	5	86.3	6.2	2.8	81.6	95.4
	pH (units)	No	0.247	γ	Littoral	5	7.89	0.02	0.01	7.85	7.90
					Profundal	5	7.79	0.17	0.08	7.48	7.88
	Specific Conductance (umho/cm)	NO	0.867	γ	Littoral	5	129.8	2.4	1.1	128.0	134.0
					Profundal	5	130.0	1.0	0.4	129.0	131.0

^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 confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed using t-test assuming unequal variance.



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

Table B.22: Water depth and *in-situ* water quality summary statistics for littoral (<12 m) lake benthic stations, Mary River Project CREMP, August 2015. Five replicate littoral stations were sampled at all but Mary Lake, where four 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	9.80	1.11	0.49	8.43	11.17	8.40	11.20
	Camp	9.56	2.31	1.04	6.69	12.43	6.90	12.20
	Sheardown NW	7.92	0.29	0.13	7.55	8.29	7.50	8.20
	Sheardown SE	8.16	1.47	0.66	6.33	9.99	6.80	10.40
	Mary	9.68	2.50	1.25	5.69	13.66	6.70	12.80
Water Temperature (°C)	Reference 3	7.80	0.16	0.07	7.60	8.00	7.60	8.00
	Camp	7.75	0.10	0.05	7.63	7.88	7.68	7.93
	Sheardown NW	8.11	0.07	0.03	8.03	8.19	8.05	8.20
	Sheardown SE	7.79	0.11	0.05	7.66	7.93	7.62	7.89
	Mary	7.19	0.20	0.10	6.87	7.51	7.00	7.42
Dissolved Oxygen (mg/L)	Reference 3	11.95	0.26	0.12	11.63	12.27	11.72	12.25
	Camp	11.12	0.78	0.35	10.15	12.09	9.73	11.63
	Sheardown NW	11.04	0.64	0.29	10.24	11.83	10.14	11.83
	Sheardown SE	11.13	0.70	0.31	10.26	11.99	10.72	12.37
	Mary	11.34	1.35	0.67	9.19	13.49	9.42	12.55
Dissolved Oxygen (% saturation)	Reference 3	100.3	2.1	0.9	97.7	102.9	98.7	102.9
	Camp	93.1	6.8	3.0	84.7	101.5	81.1	97.2
	Sheardown NW	93.3	5.2	2.3	86.8	99.8	86.2	99.8
	Sheardown SE	93.9	5.5	2.5	87.0	100.7	90.8	103.7
	Mary	95.1	10.5	5.3	78.4	111.8	80.8	106.0
pH (pH units)	Reference 3	7.75	0.02	0.01	7.73	7.78	7.72	7.77
	Camp	7.89	0.02	0.01	7.86	7.91	7.85	7.90
	Sheardown NW	7.92	0.02	0.01	7.89	7.94	7.90	7.95
	Sheardown SE	7.77	0.09	0.04	7.66	7.88	7.61	7.82
	Mary	7.61	0.14	0.07	7.38	7.83	7.47	7.80
Specific Conductance (µS/cm)	Reference 3	82.0	0.0	0.0	82.0	82.0	82.0	82.0
	Camp	129.8	2.4	1.1	126.8	132.8	128.0	134.0
	Sheardown NW	122.2	1.1	0.5	120.8	123.6	121.0	124.0
	Sheardown SE	102.6	0.9	0.4	101.5	103.7	102.0	104.0
	Mary	89.8	35.0	17.5	34.1	145.4	69.0	142.0
Secchi Depth (m)	Reference 3	9.62	0.28	0.13	9.27	9.98	9.22	10.03
	Camp	6.85	0.02	0.01	6.82	6.87	6.82	6.87
	Sheardown NW	6.07	0.73	0.32	5.17	6.97	5.06	6.69
	Sheardown SE	1.86	0.10	0.04	1.74	1.98	1.72	1.96
	Mary	4.03	1.08	0.54	2.31	5.75	3.15	5.38

Highlighted values indicate significant difference between the mine-exposed area and Reference Lake 3 based on ANOVA p-value less than 0.10.

Table B.23: Water depth and *in-situ* water quality summary statistics for profundal (>12 m) lake benthic stations, Mary River Project CREMP, August 2015. Five replicate littoral stations were sampled at all but Mary Lake, where six profundal stations were sampled.

Metric	Lake	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Depth (m)	Reference 3	20.60	1.85	0.83	18.30	22.90	18.50	23.40
	Camp	22.18	8.18	3.66	12.03	32.33	15.20	32.90
	Sheardown NW	19.70	3.86	1.73	14.91	24.49	14.00	23.30
	Sheardown SE	12.44	1.18	0.53	10.98	13.90	11.00	13.70
	Mary	21.63	4.19	1.71	17.24	26.03	16.40	29.10
Water Temperature (°C)	Reference 3	7.34	0.13	0.06	7.17	7.51	7.10	7.40
	Camp	7.60	0.04	0.02	7.55	7.65	7.55	7.65
	Sheardown NW	8.07	0.06	0.03	8.00	8.15	8.02	8.16
	Sheardown SE	7.81	0.06	0.02	7.74	7.88	7.78	7.91
	Mary	7.06	0.30	0.12	6.74	7.38	6.69	7.60
Dissolved Oxygen (mg/L)	Reference 3	11.75	0.27	0.12	11.41	12.09	11.43	12.00
	Camp	10.38	0.68	0.30	9.53	11.22	9.77	11.39
	Sheardown NW	11.40	0.34	0.15	10.98	11.82	11.12	11.99
	Sheardown SE	11.00	0.15	0.07	10.81	11.18	10.81	11.21
	Mary	11.62	0.37	0.15	11.23	12.01	11.12	12.14
Dissolved Oxygen (% saturation)	Reference 3	97.8	2.3	1.0	95.0	100.7	95.2	100.0
	Camp	86.3	6.2	2.8	78.6	94.0	81.6	95.4
	Sheardown NW	96.5	3.1	1.4	92.7	100.3	93.7	101.7
	Sheardown SE	92.3	1.1	0.5	90.9	93.7	91.1	93.9
	Mary	95.8	3.4	1.4	92.3	99.4	91.1	100.7
pH (pH units)	Reference 3	7.66	0.06	0.03	7.59	7.73	7.59	7.71
	Camp	7.79	0.17	0.08	7.57	8.00	7.48	7.88
	Sheardown NW	7.74	0.16	0.07	7.53	7.94	7.49	7.87
	Sheardown SE	7.78	0.06	0.02	7.71	7.85	7.69	7.83
	Mary	7.44	0.27	0.11	7.15	7.72	6.96	7.68
Specific Conductance (µS/cm)	Reference 3	82.4	0.9	0.4	81.3	83.5	82.0	84.0
	Camp	130.0	1.0	0.4	128.8	131.2	129.0	131.0
	Sheardown NW	121.8	0.4	0.2	121.2	122.4	121.0	122.0
	Sheardown SE	102.0	0.0	0.0	102.0	102.0	102.0	102.0
	Mary	71.8	5.4	2.2	66.1	77.5	66.0	78.0
Secchi Depth (m)	Reference 3	9.38	1.24	0.55	7.85	10.92	8.04	11.41
	Camp	7.36	0.87	0.39	6.27	8.44	6.49	8.55
	Sheardown NW	6.20	0.73	0.33	5.29	7.11	5.40	6.94
	Sheardown SE	1.72	0.14	0.06	1.55	1.89	1.58	1.93
	Mary	4.78	0.31	0.13	4.46	5.11	4.21	5.13

Highlighted values indicate significant difference between the mine-exposed area and Reference Lake 3 based on ANOVA p-value less than 0.10.

Table B.24: Water chemistry at Camp Lake (JLO) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Winter Sampling Event										Spring Sampling
					JL0-02 surface	JL0-02 bottom	JL0-10 surface	JL0-10 bottom	JL0-01 surface	JL0-01 bottom	JL0-07 surface	JL0-07 bottom	JL0-09 surface	JL0-09 bottom	J0-01 outlet
					26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	25-Apr-15	25-Apr-15	24-Jun-15
Conventionals	Conductivity (lab)	umho/cm	-	-	165	154	164	153	164	152	156	167	161	152	121
	pH (lab)	pH	6.5 - 9.0	-	8.09	8.07	8.06	8.06	8.04	8.05	8.01	7.77	7.96	7.96	8.02
	Hardness (as CaCO ₃)	mg/L	-	-	80	73	75.5	72.5	72	71	74	70	73	73	58
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2	<2.0	2.4	3.1	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	79	114	82	72	77	78	63	74	67	68	74
	Turbidity	NTU	-	-	0.14	0.24	0.145	0.16	0.2	0.17	0.16	0.76	0.18	0.16	0.99
	Alkalinity (as CaCO ₃)	mg/L	-	-	76	72	67	68.5	72	67	71	64	71	69	55
Nutrients and Organics	Total Ammonia	mg/L	variable ^c	0.855	<0.050	<0.050	<0.050	0.073	<0.050	<0.050	0.066	<0.050	0.070	0.081	<0.050
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.126	<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
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	0.20000	0.17000	<0.15	0.16000	<0.15	0.18000	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.4	1.3	1.35	1.3	1.4	1.2	1.3	<1.0	1.2	1.3	1.9
	Total Organic Carbon	mg/L	-	-	1.6	1.3	1.45	1.3	1.3	1.2	1.3	<1.0	1.8	2	1.6
	Total Phosphorus	mg/L	0.020 ^α	-	0.004	0.006	0.003	0.004	0.005	0.005	0.004	0.006	0.004	0.003	0.003
	Phenols	mg/L	0.001 ^α	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	4.24	3.90	4.20	3.91	4.22	3.88	3.99	9.38	4.09	3.95	3.08
	Sulphate (SO ₄)	mg/L	218 ^β	218	1.9	1.7	1.9	1.8	1.9	1.7	1.8	1.9	1.8	1.8	1.4
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	0.0032	<0.0030	<0.0030	<0.0030	0.0055	0.0043	<0.0030	0.0031	0.0042	<0.0030	0.0140
	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	-	-	0.0077	0.0072	0.0075	0.0071	0.0074	0.0071	0.0078	0.0077	0.0071	0.0069	0.0059
	Beryllium (Be)	mg/L	0.011 ^α	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	15	14	14	14	15	14	14	13	14	14	12
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009 ^α	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.004	0.0012	0.0011	0.0012	0.0011	0.0011	0.0014	0.0010	0.0011	0.0011	0.0013	0.0008
	Iron (Fe)	mg/L	0.30	0.30	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.054	<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
	Lithium (Li)	mg/L	-	-	0.00120	0.00110	0.00105	0.00105	0.00110	0.00110	0.00110	<0.0010	<0.0010	0.00100	<0.0010
	Magnesium (Mg)	mg/L	-	-	10	9.25	9.585	9.14	9.3	9.03	9.12	8.8	9.2	9	6.88
	Manganese (Mn)	mg/L	0.935 ^β	-	0.00066	0.00065	0.00065	0.00071	0.00067	0.00065	0.00064	0.04090	0.00055	0.00071	0.00174
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000011	0.00001	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00032	0.00027	0.00029	0.00027	0.00029	0.00027	0.00027	0.00022	0.00027	0.00027	0.00022
	Nickel (Ni)	mg/L	0.025	0.025	0.0008	0.0007	0.0008	0.0007	0.0008	0.0007	0.0007	0.0009	0.0008	0.0007	0.0006
	Potassium (K)	mg/L	-	-	1.31	1.19	1.26	1.19	1.23	1.17	1.19	1.14	1.20	1.17	1.01
	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	-	-	0.49	0.45	0.47	0.46	0.47	0.45	0.46	1.99	0.46	0.46	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
	Sodium (Na)	mg/L	-	-	1.620	1.480	1.555	1.490	1.530	1.480	1.480	4.860	1.510	1.460	1.180
	Strontium (Sr)	mg/L	-	-	0.012	0.011	0.012	0.011	0.011	0.011	0.011	0.014	0.011	0.011	0.009
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0008	0.0007	0.0008	0.0007	0.0007	0.0007	0.0007	0.0004	0.0007	0.0007	0.0006
	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 2.3 for information regarding WQG criteria.

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

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD

 Indicates parameter concentration above the AEMP benchmark.

Table B.24: Water chemistry at Camp Lake (JLO) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Summer Sampling Event									
					JL0-02 surface	JL0-02 bottom	JL0-10 surface	JL0-10 bottom	JL0-01 surface	JL0-01 bottom	JL0-07 surface	JL0-07 bottom	JL0-09 surface	JL0-09 bottom
					19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15	18-Jul-15	18-Jul-15	18-Jul-15	18-Jul-15	18-Jul-15	18-Jul-15
Conventionals	Conductivity (lab)	umho/cm	-	-	131.5	131	129	129	128	128	127	127.5	127	128
	pH (lab)	pH	6.5 - 9.0	-	7.895	7.9	7.88	7.83	7.9	7.81	7.92	7.92	7.86	7.9
	Hardness (as CaCO ₃)	mg/L	-	-	63	64	63	64	61	61	61	61.5	61	61
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	78	68.5	70	72	77	84	68.5	81.5	66	67
	Turbidity	NTU	-	-	0.505	0.47	0.47	0.44	0.47	0.74	0.48	0.47	0.47	0.48
	Alkalinity (as CaCO ₃)	mg/L	-	-	64	22.5	59	<10	63	63	64.5	67	65	65
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	<0.050
	Nitrate	mg/L	13	13	0.025	0.330	<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	-	-	0.20000	<0.15	0.16000	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.38000
	Dissolved Organic Carbon	mg/L	-	-	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.8	1.7
	Total Organic Carbon	mg/L	-	-	1.6	1.6	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.6
	Total Phosphorus	mg/L	0.020 ^α	-	0.010	0.006	0.006	0.004	0.005	0.004	0.004	0.006	0.005	0.004
	Phenols	mg/L	0.001 ^α	-	0.00275	0.00285	0.0025	0.0034	0.0015	0.0018	0.0015	0.0016	0.0027	0.002
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.28	3.30	3.27	3.25	3.27	3.26	3.27	3.26	3.26	3.28
	Sulphate (SO ₄)	mg/L	218 ^β	218	1.5	1.5	1.4	1.4	1.4	1.4	1.5	1.4	1.5	1.5
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	0.0083	0.0070	0.0078	0.0065	0.0077	0.0067	0.0059	0.0080	0.0058	0.0055
	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	-	-	0.0060	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0058	0.0058	0.0059
	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	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	12	12	12	13	13	13	13	13	13	13
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	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	0.004	0.0009	0.0010	0.0008	0.0009	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009
	Iron (Fe)	mg/L	0.30	0.30	<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	0.00006	0.00006	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.00100	0.00100	0.00110	0.00110	0.00130	0.00120	0.00120	0.00125	0.00100	0.00110
	Magnesium (Mg)	mg/L	-	-	7.275	7.265	7.28	7.37	7.61	7.55	7.61	7.605	7.55	7.52
	Manganese (Mn)	mg/L	0.935 ^β	-	0.00180	0.00173	0.00182	0.00180	0.00183	0.00178	0.00181	0.00184	0.00181	0.00181
	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	-	0.00023	0.00023	0.00024	0.00023	0.00022	0.00023	0.00023	0.00023	0.00024	0.00024
	Nickel (Ni)	mg/L	0.025	0.025	0.0006	0.0006	0.0006	0.0006	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006
	Potassium (K)	mg/L	-	-	1.00	1.01	1.01	1.02	1.03	1.02	1.02	1.03	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
	Silicon (Si)	mg/L	-	-	0.38	0.39	0.38	0.37	0.37	0.39	0.38	0.39	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
	Sodium (Na)	mg/L	-	-	1.230	1.235	1.230	1.250	1.250	1.250	1.255	1.265	1.260	1.250
	Strontium (Sr)	mg/L	-	-	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	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	-	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
	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 2.3 for information regarding WQG criteria.

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

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD

 Indicates parameter concentration above the AEMP benchmark.

Table B.24: Water chemistry at Camp Lake (JLO) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Fall Sampling Event										
					JL0-02 surface	JL0-02 bottom	JL0-10 surface	JL0-10 bottom	JL0-01 surface	JL0-01 bottom	JL0-07 surface	JL0-07 bottom	JL0-09 surface	JL0-09 bottom	J0-01 outlet
					19-Aug-15	19-Aug-15	20-Aug-15	20-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15	16-Aug-15
Conventionals	Conductivity (lab)	umho/cm	-	-	137	135	132	134	135	134	133	134	134	134	130
	pH (lab)	pH	6.5 - 9.0	-	7.9	7.92	7.99	8	7.95	8.02	7.99	7.91	7.95	8	7.895
	Hardness (as CaCO ₃)	mg/L	-	-	67	66	63.5	64	67	65	65	67	67	66	67
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	64	67	65	61	68	64	64	62	64	62	60.5
	Turbidity	NTU	-	-	0.3	0.27	0.315	0.365	0.34	0.33	0.24	0.44	0.32	0.4	0.635
	Alkalinity (as CaCO ₃)	mg/L	-	-	62	61	60	61	61	60	59	60	60	58	64.5
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	<0.050	<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
	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	0.15500	<0.15	<0.15	<0.15	<0.15	<0.15	0.25000	0.23
	Dissolved Organic Carbon	mg/L	-	-	1.9	1.9	2.05	1.95	2	1.9	1.9	2	1.9	1.9	2
	Total Organic Carbon	mg/L	-	-	2	2	2.15	2.2	2.1	2.1	2	2	2	2.1	2.15
	Total Phosphorus	mg/L	0.020 ^α	-	0.004	0.004	0.003	0.005	0.003	0.004	0.004	0.006	0.004	0.003	0.004
	Phenols	mg/L	0.001 ^α	-	0.0023	0.0024	0.0019	0.00125	0.0018	0.002	0.0022	0.0016	0.0024	0.002	0.00235
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	3.53	3.44	3.38	3.43	3.33	3.32	3.32	3.40	3.32	3.33	3.40
	Sulphate (SO ₄)	mg/L	218 ^β	218	1.7	1.6	1.6	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	0.0057	0.0053	0.0059	0.0059	0.0053	0.0055	0.0056	0.0061	0.0054	0.0058	0.0065
	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	-	-	0.0061	0.0060	0.0058	0.0058	0.0057	0.0058	0.0059	0.0058	0.0059	0.0059	0.0061
	Beryllium (Be)	mg/L	0.011 ^α	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	13	13	13	13	13	13	13	13	13	13	13
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009 ^α	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.004	0.0009	0.0008	0.0008	0.0009	0.0008	0.0008	0.0008	0.0008	0.0009	0.0010	0.0008
	Iron (Fe)	mg/L	0.30	0.30	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.070
	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
	Lithium (Li)	mg/L	-	-	0.00130	0.00130	0.00100	0.00105	0.00140	0.00140	0.00120	0.00160	0.00130	0.00140	0.00125
	Magnesium (Mg)	mg/L	-	-	8.5	8.58	7.62	7.615	8.19	8.1	8.18	8.39	8.24	8.41	8.09
	Manganese (Mn)	mg/L	0.935 ^β	-	0.00109	0.00115	0.00099	0.00110	0.00095	0.00105	0.00105	0.00118	0.00107	0.00113	0.00377
	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	-	0.00025	0.00025	0.00024	0.00025	0.00024	0.00025	0.00024	0.00026	0.00025	0.00025	0.00027
	Nickel (Ni)	mg/L	0.025	0.025	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0008
	Potassium (K)	mg/L	-	-	1.01	1.02	1.01	1.02	0.99	0.98	0.99	0.99	0.98	0.99	0.94
	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	-	-	0.40	0.38	0.35	0.37	0.36	0.36	0.37	0.40	0.37	0.37	0.43
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.400	1.420	1.260	1.270	1.330	1.320	1.360	1.380	1.340	1.330	1.250
	Strontium (Sr)	mg/L	-	-	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0007	0.0007	0.0006	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
	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 2.3 for information regarding WQG criteria.

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

 Indicates parameter concentration above applicable Water Quality Guideline.

 **BOLD** Indicates parameter concentration above the AEMP benchmark.

Table B.25: Dissolved metal concentrations at Camp Lake water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters			Units	Winter Sampling Event								Spring Sampling		Summer Sampling Event						
				JL0-02 surface	JL0-02 bottom	JL0-10 surface	JL0-10 bottom	JL0-01 surface	JL0-01 bottom	JL0-07 surface	JL0-07 bottom	JL0-09 surface	JL0-09 bottom	J0-01 outlet	JL0-02 surface	JL0-02 bottom	JL0-10 surface	JL0-10 bottom	JL0-01 surface	JL0-01 bottom
				26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	25-Apr-15	25-Apr-15	24-Jun-15	19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15
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	0.0022	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000020	<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	0.000	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Barium (Ba)	mg/L	0.0077	0.0074	0.0074	0.0071	0.0072	0.0069	0.0072	0.0075	0.0073	0.0071	0.0055	0.0061	0.0058	0.0057	0.0057	0.0059	0.0059	
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000010	<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	<0.000001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0050	<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	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Calcium (Ca)	mg/L	15	14	14	14	14	14	14	14	14	14	12	13	13	13	13	13	12	
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<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	0.0000098	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)	mg/L	0.0011	0.0010	0.0010	0.0009	0.0011	0.0013	0.0012	0.0013	0.0011	0.0010	0.0008	0.0010	0.0010	0.0009	0.0009	0.0008	0.0009	
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.004	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.00010	0.00001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)	mg/L	0.00130	0.00130	0.00115	0.00115	<0.0010	0.00100	0.00110	<0.0010	<0.0010	0.00100	0.00092	0.00105	<0.0010	<0.0010	<0.0010	0.00120	<0.0010	
	Magnesium (Mg)	mg/L	10.2	9.27	9.55	9.205	9.2	8.86	9.33	8.89	9.14	9.12	6.96	7.615	7.815	7.62	7.7	7.32	7.33	
	Manganese (Mn)	mg/L	0.00055	0.00019	0.00022	0.00010	0.00020	0.00010	0.00014	0.01710	0.00014	0.00014	0.00057	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	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	0.00032	0.00028	0.00029	0.00027	0.00028	0.00026	0.00029	0.00023	0.00028	0.00028	0.00023	0.00024	0.00022	0.00023	0.00024	0.00024	0.00024	
	Nickel (Ni)	mg/L	0.0008	0.0008	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0008	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	
	Potassium (K)	mg/L	1.34	1.19	1.25	1.18	1.21	1.15	1.21	1.15	1.19	1.19	1.00	0.98	0.98	0.97	0.97	1.01	0.98	
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000040	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Silicon (Si)	mg/L	0.50	0.45	0.47	0.45	0.45	0.45	0.46	2.00	0.45	0.44	0.36	0.37	0.38	0.38	0.38	0.37	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	<0.0000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Sodium (Na)	mg/L	1.650	1.500	1.555	1.490	1.540	1.440	1.520	1.4930	1.500	1.510	1.160	1.260	1.255	1.210	1.230	1.220	1.220	
	Strontium (Sr)	mg/L	0.012	0.011	0.012	0.011	0.011	0.011	0.011	0.015	0.011	0.011	0.009	0.009	0.009	0.009	0.009	0.009	0.009	
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00000	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000030	<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	<0.00050	0.0003	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030		
Uranium (U)	mg/L	0.0009	0.0007	0.0008	0.0007	0.0007	0.0007	0.0007	0.0004	0.0007	0.0007	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006		
Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050		
Zinc (Zn)	mg/L	<0.0030	0.0031	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0014	0.0016	0.0011	0.0018	0.0015	0.0027	0.0023		

Parameters			Units	Summer Sampling Event					Fall Sampling Event										
				JL0-07 surface	JL0-07 bottom	JL0-09 surface	JL0-09 bottom	J0-01 outlet	JL0-02 surface	JL0-02 bottom	JL0-10 surface	JL0-10 bottom	JL0-01 surface	JL0-01 bottom	JL0-07 surface	JL0-07 bottom	JL0-09 surface	JL0-09 bottom	J0-01 outlet
				18-Jul-15	18-Jul-15	18-Jul-15	18-Jul-15	19-Jul-15	19-Aug-15	19-Aug-15	20-Aug-15	20-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15
Dissolved Metals	Aluminum (Al)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<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	<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	0.000	<0.00010	<0.00010	
	Barium (Ba)	mg/L	0.0058	0.0058	0.0058	0.0058	0.0059	0.0060	0.0059	0.0058	0.0059	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0060	
	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	<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	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Calcium (Ca)	mg/L	13	13	12	12	12	13	13	13	13	13	13	13	13	13	13	13	
	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	0.0007	0.0008	0.0009	0.0011	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0009	0.0010	0.0009	
	Iron (Fe)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.042	
	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	0.00100	0.00105	<0.0010	<0.0010	<0.0010	0.00170	0.00170	<0.0010	0.00100	0.00170	0.00140	0.00160	0.00170	0.00160	0.00160	0.00110	
	Magnesium (Mg)	mg/L	7.225	7.295	7.27	7.29	7.59	8.49	8.17	7.77	7.86	8.21	8.1	8.14	8.21	8.34	8.31	8.05	
	Manganese (Mn)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00080	0.00030	0.00013	0.00017	0.00013	0.00021	0.00011	0.00020	0.00013	0.00019	0.00009	0.00327	
	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	
	Molybden																		

Table B.26: Summary of the magnitude of difference in aqueous metal concentrations between 2015 Camp Lake and Reference Lake 3 data, Camp Lake 2015 and baseline period data, and Camp Lake 2015 and mine construction period for winter, summer, and fall sampling events, Mary River Project CREMP. No value presented for parameters in which concentration was below method detection limit, except those for winter 2015, where no reference data were collected.

Variable	Camp Lake								
	2015 vs Reference Lake 3			2015 vs Baseline			2015 vs 2014		
	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)		1.7	1.8	1.2	1.1	1.1		1.0	1.1
pH (lab)		1.0	1.0		1.0	1.0	1.1	1.0	1.0
Hardness (as CaCO ₃)		1.7	1.9	1.1	1.1	1.1	1.0	1.0	1.0
Total Dissolved Solids (TDS)		1.5	1.7	0.9	1.0	0.8	0.8	0.9	0.8
Turbidity		2.0	1.5	1.1	0.9	1.1	-0.2		
Alkalinity (as CaCO ₃)		1.8	2.0	1.1	0.9	1.0	1.0	1.0	1.0
Nitrate		8.9		0.3	0.5	0.2	0.3	0.5	0.2
Total Kjeldahl Nitrogen (TKN)		0.9	1.3	0.8	0.7	0.5	1.5	0.7	0.9
Dissolved Organic Carbon		0.7	0.6	0.7	0.9	1.1	0.9	1.0	1.3
Total Organic Carbon		0.6	0.6	0.7	0.8	1.1	0.8	0.9	1.3
Total Phosphorus		1.6	1.1	0.9	1.2	0.8	1.2	1.8	1.0
Phenols		1.7	0.7	1.0	1.8	2.0	1.0	2.3	2.0
Chloride (Cl)		2.4	2.6	2.7	1.7	1.5	1.0	1.1	1.1
Sulphate (SO ₄)		0.3	0.4	1.1	1.0	0.6	0.9	0.7	0.8
Aluminum (Al)		2.1	1.9	1.9	0.6	0.9	2.3	0.9	0.9
Arsenic (As)				1.0	1.0	1.0	1.0	1.0	1.0
Barium (Ba)		0.9	0.9	1.2	1.1	1.0	1.1	1.2	1.1
Boron (B)				1.0	1.0	1.0	0.9	1.0	1.0
Cadmium (Cd)				0.7	0.8	0.8	1.0	1.0	1.0
Calcium (Ca)		1.8	1.8	1.1	1.1	1.1	0.9	1.0	1.0
Chromium (Cr)								1.0	1.0
Copper (Cu)		1.0	1.0	1.0	0.3	1.0	1.2	0.9	0.9
Iron (Fe)				1.2	1.1	1.7	1.1	1.0	1.0
Lead (Pb)		1.1		0.5	0.6	1.0	0.4	1.0	1.0
Magnesium (Mg)		1.7	1.9	1.2	1.1	1.2	1.0	1.0	1.1
Manganese (Mn)		3.2	2.6	5.6	0.9	0.7	5.4	1.0	0.8
Molybdenum (Mo)		1.7	1.9	1.3	1.2	1.2	1.0		0.9
Nickel (Ni)		1.2	1.2	1.1	0.8	1.0	1.1	1.1	0.9
Potassium (K)		1.1	1.1	0.8	0.9	0.9	1.2	1.1	1.3
Silicon (Si)		0.9	0.9	1.3	0.9	0.9	1.1	0.9	0.9
Sodium (Na)		1.5	1.6	1.1	1.0	1.0	1.3	1.3	1.6
Strontium (Sr)		1.1	1.2	1.5	1.3	1.2	1.1	1.2	1.0
Uranium (U)		2.1	2.4	1.4	1.3	1.3	1.0	1.1	1.1
Zinc (Zn)				2.1	1.2	1.2	1.0	1.0	1.0



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



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



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

Table B.27: *In-situ* water quality measurements collected at Sheardown Lake Tributary 1, Tributary 9, and Tributary 12 benthic invertebrate community stations, Mary River Project CREMP, August 2015.

Study Area	Station	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Sheardown Lake Tributary 1 Reach 4	SDLT-1-R4 B1	6.0	11.32	93.2	7.96	226
	SDLT-1-R4 B2	5.4	11.69	95.1	7.97	220
	SDLT-1-R4 B3	5.1	11.89	96.6	7.98	201
	SDLT-1-R4 B4	4.7	11.67	93.2	8.22	223
	SDLT-1-R4 B5	4.1	11.75	92.6	7.87	227
Sheardown Lake Tributary 1 Reach 2	SDLT-1-R2 B1	5.5	12.65	100.4	8.25	329
	SDLT-1-R2 B2	6.4	12.51	101.5	8.28	387
	SDLT-1-R2 B3	6.3	12.46	101.1	8.28	287
	SDLT-1-R2 B4	6.8	12.52	102.8	8.22	285
	SDLT-1-R2 B5	6.9	12.38	101.7	8.27	265
Sheardown Lake Tributary 1 Reach 1	SDLT-1-R1 B1	4.2	12.87	98.7	7.60	302
	SDLT-1-R1 B2	4.6	12.76	98.9	8.05	327
	SDLT-1-R1 B3	4.6	12.64	98.2	8.15	335
	SDLT-1-R1 B4	4.8	12.61	98.4	8.19	335
	SDLT-1-R1 B5	5.3	12.58	99.2	8.25	322
Sheardown Lake Tributary 9	SDLT-9-US B1	7.8	10.29	89.1	8.19	199
	SDLT-9-US B2	6.1	9.46	78.7	8.20	202
	SDLT-9-US B3	4.2	11.00	86.6	7.89	202
	SDLT-9-US B4	4.4	11.18	88.5	7.97	204
	SDLT-9-US B5	5.1	11.42	92.1	8.06	204
Sheardown Lake Tributary 12	SDLT-12-DS B1	6.0	10.86	90.6	8.20	299
	SDLT-12-DS B2	5.6	10.80	89.1	8.19	297
	SDLT-12-DS B3	7.9	10.34	90.4	8.79	301

Table B.28: *In-situ* water quality summary statistics for Sheardown Lake Tributary 1, Tributary 9 and Tributary 12 benthic sampling areas, Mary River Project CREMP, August 2015.

Metric	Station	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Temperature (°C)	SDLT-1 R4	5.06	0.72	0.32	4.17	5.95	4.10	6.00
	SDLT-1 R2	6.38	0.55	0.25	5.69	7.07	5.50	6.90
	SDLT-1 R1	4.70	0.40	0.18	4.20	5.20	4.20	5.30
	SDLT9 - US	5.52	1.48	0.66	3.69	7.35	4.20	7.80
	SDLT12 - DS	6.50	1.23	0.71	3.45	9.55	5.60	7.90
Dissolved Oxygen (mg/L)	SDLT-1 R4	11.66	0.21	0.09	11.40	11.93	11.32	11.89
	SDLT-1 R2	12.50	0.10	0.04	12.38	12.63	12.38	12.65
	SDLT-1 R1	12.69	0.12	0.05	12.54	12.84	12.58	12.87
	SDLT9 - US	10.67	0.80	0.36	9.68	11.66	9.46	11.42
	SDLT12 - DS	10.67	0.28	0.16	9.96	11.37	10.34	10.86
Dissolved Oxygen (% saturation)	SDLT-1 R4	94.1	1.7	0.7	92.1	96.2	92.6	96.6
	SDLT-1 R2	101.5	0.9	0.4	100.4	102.6	100.4	102.8
	SDLT-1 R1	98.7	0.4	0.2	98.2	99.2	98.2	99.2
	SDLT9 - US	87.0	5.0	2.3	80.7	93.3	78.7	92.1
	SDLT12 - DS	90.0	0.8	0.5	88.0	92.1	89.1	90.6
pH (pH units)	SDLT-1 R4	8.00	0.13	0.06	7.84	8.16	7.87	8.22
	SDLT-1 R2	8.26	0.03	0.01	8.23	8.29	8.22	8.28
	SDLT-1 R1	8.05	0.26	0.12	7.72	8.37	7.60	8.25
	SDLT9 - US	8.06	0.14	0.06	7.89	8.23	7.89	8.20
	SDLT12 - DS	8.39	0.34	0.20	7.54	9.25	8.19	8.79
Specific Conductance (µS/cm)	SDLT-1 R4	219	11	5	206	233	201	227
	SDLT-1 R2	311	49	22	250	371	265	387
	SDLT-1 R1	324	14	6	307	341	302	335
	SDLT9 - US	202	2	1	200	205	199	204
	SDLT12 - DS	299	2	1	294	304	297	301

Table B.29: *In-situ* water quality statistical comparisons among Sheardown Lake Tributary 1 benthic sampling stations, Mary River Project CREMP, August 2015.

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	0.00138	ANOVA	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0086	Tukey's
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	NO	0.5932	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	YES	0.0015	
Dissolved Oxygen (mg/L)	YES	0.00000	ANOVA	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0000	Tukey's
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0000	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.1635	
Dissolved Oxygen (% Saturation)	YES	0.00191	KW H-test	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0004	Tamhane's
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0086	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	YES	0.0025	
pH (units)	YES	0.06985	ANOVA	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0754	Tukey's
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	NO	0.8958	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.1588	
Specific Conductance (µS/cm)	YES	0.00746	KW H-test	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0367	Tamhane's
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0000	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.9235	

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

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

Table B.30: Water chemistry at Sheardown Lake Tributary 1 (SDLT1) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Spring Sampling	Summer Sampling Event		Fall Sampling Event	
					D1-05	D1-05	D1-00	D1-05	D1-00
					24-Jun-2015	17-Jul-2015	17-Jul-2015	17-Aug-2015	18-Aug-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	128	148	239	217	274.5
	pH (lab)	pH	6.5 - 9.0	-	8	7.65	7.97	7.92	8.12
	Hardness (as CaCO ₃)	mg/L	-	-	60	69	114	104	136
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	82	83	125	113	137
	Turbidity	NTU	-	-	2.68	0.53	0.88	0.33	0.78
	Alkalinity (as CaCO ₃)	mg/L	-	-	56	64	101	84	110.5
Nutrients and Organics	Total Ammonia	mg/L	variable ^c	0.855	<0.050	<0.050	<0.050	<0.050	<0.050
	Nitrate	mg/L	13	13	0.164	0.200	0.415	0.401	0.572
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.2	<0.15	<0.15	0.37	0.175
	Dissolved Organic Carbon	mg/L	-	-	2.5	3.1	3.8	3.1	3.25
	Total Organic Carbon	mg/L	-	-	2.6	2.9	3.6	3.3	3.35
	Total Phosphorus	mg/L	0.020 ^{a,d}	-	0.0057	0.0040	0.0050	<0.0030	<0.0030
Anions	Phenols	mg/L	0.001 ^a	-	<0.0010	0.0053	0.0033	0.0014	0.0021
	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.25	2.62	7.66	7.23	8.865
Total Metals	Sulphate (SO ₄)	mg/L	218 ^{β,e}	218	3.23	6.3	14.90	22.3	20.9
	Aluminum (Al)	mg/L	0.100	-	0.0698	0.0224	0.0276	0.0135	0.0324
	Antimony (Sb)	mg/L	0.020 ^a	-	<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
	Barium (Ba)	mg/L	-	-	0.0069	0.0082	0.01420	0.0108	0.01405
	Beryllium (Be)	mg/L	0.011 ^a	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	0.010	0.012	0.011	0.011
	Cadmium (Cd)	mg/L	0.00012 ^f	-	0.000034	0.000031	<0.000010	0.000039	0.000015
	Calcium (Ca)	mg/L	-	-	11.4	13.9	21.6	19.6	25.1
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009 ^a	0.004	<0.00010	<0.00010	0.00013	<0.00010	0.0001
	Copper (Cu)	mg/L	0.002 ^g	-	0.00269	0.00364	0.00256	0.00302	0.002265
	Iron (Fe)	mg/L	0.30	-	0.085	<0.030	0.127	<0.030	0.08
	Lead (Pb)	mg/L	0.001 ^h	0.001	0.000214	0.000085	<0.000050	0.000061	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	0.0011	0.0018	0.0012	0.0021
	Magnesium (Mg)	mg/L	-	-	7.58	8.9	14.70	13.6	18.15
	Manganese (Mn)	mg/L	0.935 ^{β,i}	-	0.00171	0.00045	0.004410	0.000441	0.00389
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00192	0.00303	0.00228	0.00381	0.002745
	Nickel (Ni)	mg/L	0.025 ^j	0.025	0.00123	0.00130	0.00151	0.00125	0.001505
	Potassium (K)	mg/L	-	-	1.61	1.91	2.22	2.27	2.23
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	1.26	1.27	1.23	1.4	1.575
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.32	1.39	2.67	2.9	3.38
	Strontium (Sr)	mg/L	-	-	0.00733	0.0089	0.01450	0.0131	0.0161
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.00251	0.00281	0.00267	0.00496	0.005055
	Vanadium (V)	mg/L	0.006 ^a	0.006	<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	0.0034

^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 2.3 for information regarding WQG.

^b AEMP Water Quality Benchmarks developed by Intrinsik (2013) using background water quality data. The values are specific to the Sheardown Lake Tributaries.

 Indicates parameter concentration above applicable Water Quality Guideline.

 Indicates parameter concentration above the AEMP benchmark.

Table B.31: Dissolved metal concentrations at Sheardown Lake Tributary water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Spring Sampling	Summer Sampling Event		Fall Sampling Event	
			D1-05	D1-05	D1-00	D1-05	D1-00
			24-Jun-2015	17-Jul-2015	17-Jul-2015	17-Aug-2015	18-Aug-2015
Dissolved Metals	Aluminum (Al)	mg/L	0.00797	0.0062	0.0095	0.0043	0.0040
	Antimony (Sb)	mg/L	<0.000020	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.000065	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00661	0.0081	0.01350	0.0107	0.0139
	Beryllium (Be)	mg/L	<0.000010	<0.00010	<0.00010	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	0.000005	<0.000050	<0.000050	<0.00050	<0.00050
	Boron (B)	mg/L	0.0073	0.010	0.012	0.011	0.01
	Cadmium (Cd)	mg/L	0.000027	0.000032	<0.000010	0.000037	0.000012
	Calcium (Ca)	mg/L	11.3	13.5	22.2	19.5	25.1
	Chromium (Cr)	mg/L	0.0001	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.000043	<0.00010	0.00012	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00253	0.00349	0.00279	0.00295	0.00224
	Iron (Fe)	mg/L	0.0194	<0.010	0.085	<0.030	<0.030
	Lead (Pb)	mg/L	0.0000431	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.00088	0.0010	0.0017	0.0013	0.0022
	Magnesium (Mg)	mg/L	7.59	8.6	14.10	13.5	17.8
	Manganese (Mn)	mg/L	0.00081	<0.00050	0.00368	0.000325	0.00284
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.00194	0.00296	0.00236	0.00385	0.00274
	Nickel (Ni)	mg/L	0.00109	0.00124	0.00144	0.00126	0.00142
	Potassium (K)	mg/L	1.59	1.86	2.16	2.26	2.19
	Selenium (Se)	mg/L	0.000049	<0.000050	0.000055	<0.0010	<0.0010
	Silicon (Si)	mg/L	1.13	1.24	1.21	1.38	1.52
	Silver (Ag)	mg/L	<0.0000050	<0.000050	<0.000050	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.33	1.35	2.58	2.88	3.385
	Strontium (Sr)	mg/L	0.00741	0.0089	0.01420	0.0132	0.0162
	Thallium (Tl)	mg/L	0.0000109	0.000013	0.000011	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.000030	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	<0.00050	<0.00030	<0.00030	<0.010	<0.010
	Uranium (U)	mg/L	0.00243	0.00263	0.00268	0.00496	0.00505
	Vanadium (V)	mg/L	0.000141	<0.00050	<0.00050	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.0011	0.0022	0.0028	<0.0030	<0.0030

Table B.32: Summary of the magnitude of difference in aqueous metal concentrations between 2015 SDLT1 and lotic reference station data, SDLT1 2015 and baseline period data, and SDLT1 2015 and mine construction period for spring, summer, and fall sampling events, Mary River Project CREMP. No value presented for parameters in which concentration was below method detection limit, except those for spring at station D1-00, where no data were collected.

Variable	SDLT1 Station D1-05 (Reach 4)									SDLT1 Station D1-00 (Reach 1)								
	2015 vs Lotic Reference			2015 vs Baseline			2015 vs 2014			2015 vs Lotic Reference			2015 vs Baseline			2015 vs 2014		
	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
Conductivity (lab)	3.2	2.0	2.1	1.9	1.0	1.0	1.8	1.0	1.3		3.2	2.6		1.2	1.1		1.2	1.3
pH (lab)	1.1	1.1	1.0	1.1	1.0	1.1	1.2	1.0			1.1	1.0		1.0	1.0		1.0	
Hardness (as CaCO ₃)	3.2	2.1	2.0	1.7	1.0	1.0	1.7	0.9	1.3		3.4	2.7		1.1	1.1		1.2	1.3
Total Dissolved Solids (TDS)	2.8	1.9	2.1	1.9	0.9	0.8	1.7	0.8	1.0		2.9	2.5		1.0	0.9		1.0	1.0
Turbidity	1.7	0.3	0.1	3.8	1.5	1.0	2.1	1.8	1.1		0.4	0.3		1.3	2.2		0.9	0.2
Alkalinity (as CaCO ₃)	3.2	1.7	1.8	1.9	1.0	1.0	1.4	1.1	1.2		2.7	2.4		1.1	1.0		1.2	1.2
Nitrate	8.2	7.1	16.0	1.9	2.1	2.8	1.6	0.8	2.2		14.8	22.9		4.2	5.4		0.9	1.7
Total Kjeldahl Nitrogen (TKN)			2.4	1.5		3.4	1.5		1.6			1.1			1.4			0.7
Dissolved Organic Carbon	1.4		1.8	0.7	1.3	1.4	0.8	1.0	1.2			1.9		1.3	1.3		1.1	1.3
Total Organic Carbon	1.3	2.4	1.9	0.8	1.1	1.4	0.8	0.9	1.1		3.0	1.9		1.2	1.3		1.1	1.2
Total Phosphorus	1.3	1.0		0.5	0.9		1.9	1.3			1.3			1.1			1.7	
Chloride (Cl)	2.8	1.7	3.8	0.7	0.8	0.7	1.6	0.4	1.2		5.0	4.6		1.6	1.2		1.1	1.5
Sulphate (SO ₄)	2.8	3.7	7.1	4.0	1.4	2.3	1.6	1.3	5.6		8.7	6.6		2.7	2.4		3.0	4.2
Aluminum (Al)	1.5	0.4	0.1	2.1	1.5	1.3	2.0	1.2	1.4		0.5	0.2		1.3	2.9		0.9	0.2
Antimony (Sb)																		
Arsenic (As)																		
Barium (Ba)	2.3	1.6	1.5	1.7	1.1	1.1	1.6	1.1	1.5		2.8	2.0		1.3	1.1		1.5	1.3
Boron (B)					0.6	0.7		1.0						0.7	0.8			
Cadmium (Cd)				1.1	0.9	1.1	1.1	0.8	1.3						1.1			1.5
Calcium (Ca)	2.7	1.9	1.8	1.7	1.0	1.0	1.6	1.0	1.2		3.0	2.4		1.1	1.0		1.2	1.1
Chromium (Cr)																		
Copper (Cu)	2.7	3.9	1.9	0.9	1.2	1.2	0.9	0.9	0.8		2.8	1.5		1.1	1.3		0.8	0.8
Iron (Fe)	0.8			1.5			2.5				1.8	0.5		1.2	1.5		1.6	0.3
Lead (Pb)	2.0	0.6	0.2	0.8	0.8	0.8	2.4	0.7	1.2									
Magnesium (Mg)	3.3	2.4	2.2	1.7	1.0	1.1	1.7	1.0	1.4		3.9	3.0		1.2	1.3		1.2	1.4
Manganese (Mn)	2.0	0.8	0.2	2.0	0.6	0.9	3.2	0.7	1.2		7.7	1.8		1.7	2.6		1.5	0.9
Molybdenum (Mo)	15.0	10.7	9.6	2.2	1.3	1.3	1.1	1.2	1.1		8.0	6.9		1.1	1.4		1.2	1.1
Nickel (Ni)	1.7	2.1	1.8	0.8	1.2	1.3	0.9	0.9	1.0		2.5	2.2		1.1	1.3		0.9	0.9
Potassium (K)	3.7	3.0	2.8	1.8	1.2	1.2	1.5	1.1	1.5		3.4	2.8		1.3	1.3		1.3	1.5
Silicon (Si)	2.2	1.7	1.4	1.5	1.1	1.1	1.5	1.0	1.0		1.6	1.5		0.9	1.2		0.9	0.9
Sodium (Na)	2.1	1.3	1.9	4.5	1.4	1.4	1.5	0.5	1.6		2.5	2.2		2.1	1.6		1.1	1.8
Strontium (Sr)	1.9	1.2	1.3	2.2	1.1	1.1	1.6	1.0	1.4		2.0	1.5		1.2	1.1		1.3	1.3
Uranium (U)	7.9	3.4	1.8	3.9	1.1	0.7	4.1	1.2	1.0		3.2	1.8		1.1	1.2		1.0	1.2
Zinc (Zn)															1.2			1.1



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

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

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

Table B.33: *In-situ* water quality profile data collected at Sheardown Lake NW water quality monitoring stations in winter^a, Mary River Project CREMP, 2015.

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)
3.05	3.3	101.1	7.66	143	3.10	3.1	100.2	7.65	143	2.95	3.7	100.9	7.64	142	2.90	2.9	99.8	7.66	144	3.15	3.3	100.6	7.66	143	3.10	2.9	99.7	- ^d	146
4.05	3.3	101.4	7.66	143	4.10	3.2	100.5	7.64	143	3.95	3.6	100.8	7.62	141	3.90	3.3	100.7	7.66	143	4.15	3.3	100.8	7.65	143	4.10	3.1	101.5	- ^d	145
5.05	3.3	101.5	7.65	143	5.10	3.2	100.6	7.64	143	4.95	3.5	101.1	7.62	142	4.90	3.4	101.5	7.65	143	5.15	3.3	101.0	7.64	141	5.10	3.1	101.9	- ^d	144
6.05	3.3	101.5	7.65	143	6.10	3.2	100.8	7.64	143	5.95	3.5	101.0	7.61	141	5.90	3.4	102.0	7.65	143	6.15	3.3	100.9	7.63	142	6.10	3.1	102.0	- ^d	144
7.05	3.3	101.4	7.66	143	7.10	3.2	100.8	7.63	143	6.95	3.5	101.1	7.61	141						7.15	3.3	101.0	7.63	142	7.10	3.1	102.1	- ^d	144
8.05	3.3	102.0	7.67	143	8.10	3.2	100.8	7.63	143	7.95	3.5	101.1	7.61	142						8.15	3.3	101.0	7.62	143	8.10	3.1	102.1	- ^d	144
8.75	3.3	102.0	7.66	143	9.10	3.2	100.9	7.64	143	8.95	3.4	101.0	7.60	142						9.15	3.3	101.1	7.63	143	9.10	3.1	102.6	- ^d	144
					10.10	3.2	100.9	7.64	143	9.95	3.4	101.2	7.60	142						10.15	3.3	101.0	7.63	143	10.10	3.1	102.4	- ^d	144
					11.10	3.2	100.9	7.64	143	10.95	3.4	101.2	7.60	142						11.15	3.3	101.0	7.63	143	10.75	3.1	103.2	- ^d	144
					12.10	3.2	100.9	7.63	143	11.95	3.4	101.3	7.61	142						12.15	3.2	101.1	7.62	143					
					13.10	3.2	100.9	7.63	143	12.95	3.4	101.3	7.60	142						13.15	3.2	101.1	7.63	143					
					14.10	3.2	101.0	7.63	143	13.95	3.4	101.3	7.60	142						14.15	3.2	101.0	7.62	143					
					15.10	3.2	101.1	7.63	143	14.95	3.4	101.3	7.60	142						15.15	3.2	101.0	7.61	143					
					16.10	3.3	101.2	7.63	143	15.95	3.4	101.4	7.60	142						16.15	3.2	101.0	7.60	143					
					17.10	3.3	101.3	7.63	143	16.95	3.4	101.4	7.62	143						17.15	3.2	101.1	7.60	143					
					18.10	3.3	101.5	7.64	143	17.95	3.4	101.4	7.61	143															
					19.10	3.3	101.8	7.64	143	18.30	3.3	101.4	7.60	143															
					20.10	3.3	101.9	7.64	143																				
					21.10	3.3	102.2	7.65	143																				
					22.10	3.3	102.0	7.64	143																				
					22.75	3.3	101.8	7.62	143																				

^a Sampling conducted on 06-May and 07-May, 2015.

^b Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 were not recorded 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 2.05, 2.10, 1.95, 1.90, 2.15, and 2.10 m, respectively, at the time of winter sampling.

^d Unreliable pH reading.

Table B.34: *In-situ* water quality profile data collected at Sheardown Lake NW water quality monitoring stations in summer^a, Mary River Project CREMP, 2015.

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	12.2	8.6	8.3	8.7	8.2	8.7	104.2	108.1	105.9	108.6	107.1	107.5	8.00	8.17	8.11	8.14	8.14	8.15	115	113	113	113	113	113
2.0	11.0	8.5	8.0	8.6	8.2	8.5	107.8	107.1	105.8	107.6	106.8	107.0	8.10	8.16	8.11	8.14	8.13	8.15	115	113	113	113	113	113
3.0	10.2	8.1	7.9	8.1	7.8	8.4	107.1	106.8	105.5	107.1	106.4	106.8	8.14	8.16	8.11	8.14	8.14	8.15	113	113	113	113	113	113
4.0	9.5	7.9	7.8	7.8	7.8	8.1	107.8	106.7	105.8	106.9	106.3	106.7	8.17	8.16	8.11	8.14	8.14	8.15	112	113	113	113	113	113
5.0	9.3	7.9	7.7	7.7	7.7	8.0	108.0	106.5	105.8	106.9	106.1	106.4	8.18	8.15	8.11	8.14	8.13	8.14	113	113	113	113	113	113
6.0	8.9	7.9	7.7	7.7	7.6	7.8	107.0	106.4	105.7	106.9	106.0	106.3	8.19	8.15	8.11	8.14	8.13	8.14	113	113	113	112	113	113
7.0	8.2	7.9	7.7		7.6	7.7	107.2	106.1	105.6		105.9	106.1	8.20	8.15	8.11		8.13	8.13	113	113	113		113	113
8.0	7.9	7.8	7.6		7.6	7.7	107.0	106.0	105.5		105.9	105.8	8.19	8.14	8.10		8.13	8.13	113	113	113		113	113
9.0	7.8	7.7	7.6		7.5	7.6	106.9	105.9	105.5		105.7	105.8	8.18	8.14	8.10		8.12	8.12	113	113	113		113	113
10.0		7.7	7.6		7.5	7.6		105.8	105.3		105.4	105.8		8.13	8.10		8.12	8.11		113	113		113	113
11.0		7.7	7.6		7.4			105.5	105.2		105.3			8.13	8.10		8.11			113	113		113	
12.0		7.6	7.5		7.4			105.4	105.1		105.3			8.12	8.09		8.11			113	113		113	
13.0		7.4	7.4		7.4			104.3	104.9		105.2			8.10	8.09		8.10			113	113		113	
14.0		7.1	7.4		7.3			104.1	104.8		105.2			8.09	8.09		8.10			113	113		113	
15.0		7.0	7.3		7.2			104.0	104.3		104.7			8.08	8.08		8.09			113	113		113	
16.0		6.9	7.0		7.0			103.7	103.6		104.7			8.06	8.07		8.09			113	113		113	
17.0		6.8	6.9		7.0			103.6	103.7		103.8			8.06	8.05		8.06			113	113		113	
18.0		6.8	6.8		7.0			103.4	103.7		98.5			8.05	8.05		8.05			113	113		113	
19.0		6.7	6.8					103.2	103.6					8.04	8.04					113	113			
20.0		6.7						103.1						8.04						113				
21.0		6.6						102.9						8.04						113				
22.0		6.6						102.4						8.02						113				
23.0																								

^a Sampling conducted on 20-July and 22-July, 2015.

^b Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 were 9.5, 23.1, 21.1, 7.0, 18.1, and 10.9 m, respectively, at the time of summer sampling.

Table B.35: *In-situ* water quality profile data collected at Sheardown Lake NW water quality monitoring stations in fall^a, Mary River Project CREMP, 2015.

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	8.8	9.1	9.0	8.6	8.5	8.6	96.9	93.0	102.0	101.6	101.1	100.2	7.64	7.92	8.07	8.02	8.00	8.00	123	123	132	132	132	132
2.0	8.7	9.0	9.0	8.6	8.4	8.5	96.7	92.8	101.8	101.4	101.0	100.3	7.70	7.92	8.03	8.02	8.00	8.00	123	123	132	132	132	132
3.0	8.7	9.0	8.9	8.5	8.4	8.3	96.6	92.7	101.8	101.3	100.9	99.9	7.72	7.91	8.02	8.02	8.00	7.99	123	123	132	132	132	132
4.0	8.6	8.8	8.9	8.5*	8.4	8.3	96.6	92.6	101.6	101.1*	100.8	99.8	7.74	7.90	8.02	8.02	7.95	7.99	123	123	132	132	132	132
5.0	8.6	8.7	8.7		8.4	8.2	96.4	92.6	101.3		100.7	99.8	7.76	7.92	8.02		7.99	7.99	123	124	132		132	132
6.0	8.6	8.6	8.6		8.4	8.2	96.3	92.1	101.0		100.6	99.7	7.77	7.91	8.02		7.99	7.99	123	121	132		132	132
7.0	8.5	8.4	8.5		8.4	8.2	96.3	91.7	100.9		100.5	99.6	7.79	7.91	8.02		7.99	7.99	123	124	133		132	132
8.0	8.5	8.3	8.5		8.4	8.2	96.1	91.7	100.8		100.4	99.6	7.80	7.91	8.02		7.99	7.99	123	122	132		132	132
9.0	8.5	8.3	8.3		8.2	8.2	96.0	90.9	100.0		99.9	99.6	7.81	7.91	8.01		7.99	7.98	123	122	132		132	132
10.0	8.4*	8.3	8.2		8.2	8.2	95.7*	90.7	99.7		99.5	99.6	7.81	7.90	8.00		7.98	7.98	124	120	132		132	132
11.0		8.3	8.1		8.1	8.2*		90.6	98.9		98.9	99.5*		7.98	7.89		7.97	7.98		122	132		132	132
12.0		8.2	8.1		8.1			90.3	98.7		98.7			7.88	7.97		7.96			122	132		132	
13.0		8.1	8.1		8.1			89.8	98.4		98.4			7.86	7.96		7.95			123	132		132	
14.0		8.1	8.1		8.0			89.4	98.3		98.3			7.85	7.96		7.94			123	132		132	
15.0		8.1	8.1		8.0			89.2	98.2		98.0			7.84	7.96		7.93			123	132		132	
16.0		8.1	8.1		8.0			89.2	98.1		97.8			7.84	7.95		7.92			123	132		132	
17.0		8.1	8.1*		8.0*			88.9	97.9*		97.7*			7.84	7.95		7.92			123	132		132	
18.0		8.1						88.7						7.83						123				
19.0		8.0						88.6						7.82						123				
20.0		8.0						88.5						7.81						123				
21.0		8.0						88.5						7.80						123				
22.0		8.0						87.0						7.78						123				
23.0		7.7*						79.0*						7.61						124				

^a Sampling conducted on 20-August, 21-August and 22-August, 2015.

^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, 23.8, 17.3, 4.3, 17.5, and 11.4 m, respectively, at the time of fall sampling.

* The deepest *in situ* water quality reading at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 were taken at 9.3, 22.8, 16.3, 3.3, 16.5, and 10.4 m, respectively, at the time of fall sampling.

Table B.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 2015.

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Colour/ Clarity	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
								(mg/L)	(% sat.)		
Littoral (Shallow) Stations	DLO-01-9	18-Aug-15	7.8	6.45	clear, slight blue-green hue	surface	8.12	-	86.0	7.85	123
						bottom	8.09	10.14	86.2	7.91	124
	DLO-01-4	16-Aug-15	7.5	5.06	clear, slight blue-green hue	surface	8.26	11.25	95.5	7.97	123
						bottom	8.20	11.43	96.7	7.95	122
	DLO-01-3	16-Aug-15	8.2	5.55	clear, slight blue-green hue	surface	8.04	11.63	97.6	7.87	122
						bottom	8.06	11.83	99.8	7.91	121
	DLO-01-11	18-Aug-15	8.2	6.69	clear, slight blue-green hue	surface	8.45	10.71	90.7	7.90	123
						bottom	8.16	10.83	91.5	7.92	122
	DLO-01-10	18-Aug-15	7.9	6.6	clear, slight blue-green hue	surface	8.28	11.02	94.2	7.86	122
						bottom	8.05	10.96	92.2	7.90	122
Profundal (Deep) Stations	DLO-01-5	18-Aug-15	23.3	6.27	clear, slight blue-green hue	surface	8.35	11.31	96.3	7.65	122
						bottom	8.02	11.12	93.7	7.49	122
	DLO-01-14	16-Aug-15	22.0	6.94	clear, slight blue-green hue	surface	8.49	10.80	92.6	7.63	122
						bottom	8.16	11.32	96.3	7.83	122
	DLO-01-15	16-Aug-15	21.7	6.90	clear, slight blue-green hue	surface	8.23	11.88	100.6	7.44	122
						bottom	8.11	11.99	101.7	7.65	122
	DLO-01-2	16-Aug-15	17.5	5.40	clear, slight blue-green hue	surface	8.17	11.13	94.4	7.79	122
						bottom	8.05	11.33	96.0	7.84	121
	DLO-01-12	16-Aug-15	14.0	5.52	clear, slight blue-green hue	surface	7.96	10.97	91.8	7.76	122
						bottom	8.02	11.24	94.9	7.87	122

Table B.37: Statistical comparison of bottom in-situ water quality between littoral and profundal stations of Sheardown Lake NW, Mary River Project CREMP, August 2015.

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
Sheardown Lake NW	Secchi Depth (m)	NO	0.774	α	Littoral	5	6.07	0.73	0.32	5.06	6.69
					Profundal	5	6.20	0.73	0.33	5.40	6.94
	Temperature (°C)	NO	0.348	α	Littoral	5	8.11	0.07	0.03	8.05	8.20
					Profundal	5	8.07	0.06	0.03	8.02	8.16
	Dissolved Oxygen (mg/L)	NO	0.296	α	Littoral	5	11.0	0.6	0.3	10.1	11.8
					Profundal	5	11.4	0.3	0.2	11.1	12.0
	Dissolved Oxygen (% saturation)	NO	0.265	α	Littoral	5	93.3	5.2	2.3	86.2	99.8
					Profundal	5	96.5	3.1	1.4	93.7	101.7
	pH (units)	YES	0.038	γ	Littoral	5	7.92	0.02	0.01	7.90	7.95
					Profundal	5	7.74	0.16	0.07	7.49	7.87
	Specific Conductance (umho/cm)	NO	0.471	δ	Littoral	5	122.2	1.1	0.5	121.0	124.0
					Profundal	5	121.8	0.4	0.2	121.0	122.0

^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 confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed using t-test assuming unequal variance.



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

Table B.38: Water chemistry at Sheardown Lake NW (DLO-01) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Winter Sampling Event											
					DD-HAB 9-STN1 surface 6-May-2015	DD-HAB 9-STN1 bottom 6-May-2015	DL0-01-5 surface 7-May-2015	DL0-01-5 bottom 7-May-2015	DL0-01-1 surface 7-May-2015	DL0-01-1 bottom 7-May-2015	DL0-01-4 surface 6-May-2015	DL0-01-4 bottom 6-May-2015	DL0-01-2 surface 6-May-2015	DL0-01-2 bottom 6-May-2015	DL0-01-7 surface 3-May-2015	DL0-01-7 bottom 3-May-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	150	150	145	145	143.5	144	150	151	150	150	144	143
	pH (lab)	pH	6.5 - 9.0	-	8.02	8.03	7.95	7.97	7.915	7.95	7.99	8	7.99	8.03	7.89	7.97
	Hardness (as CaCO ₃)	mg/L	-	-	74	73	71	69	70	71.5	75	75	75	75	68	68
	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	-	-	70	86	90	95	88.5	83.5	74	80	89	84	82	79
	Turbidity	NTU	-	-	0.23	0.25	0.2	0.22	0.225	0.23	0.19	0.23	0.18	0.23	0.22	0.2
	Alkalinity (as CaCO ₃)	mg/L	-	-	75	71	70	65	66	69	74	72	80	78	78	78
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	<0.050	0.066	0.082
	Nitrate	mg/L	13	13	0.04	0.047	0.038	0.037	0.038	0.039	0.037	0.038	0.036	0.036	0.038	0.037
	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	0.19	0.2	<0.15	4.235	0.745	0.27	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.1	1	<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	1.1	1.1	1	1.35	1.15	<1.0	1.1	15.8	1.7	1.1	1
	Total Phosphorus	mg/L	0.020 ^a	-	<0.0030	0.0075	<0.0030	0.0032	0.00435	0.00825	0.0033	<0.0030	<0.0030	0.0033	<0.0030	0.0075
Anions	Phenols	mg/L	0.001 ^a	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	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	3.29	3.29	3.28	3.33	3.28	3.285	3.28	3.29	3.28	3.26	3.29	3.26
Total Metals	Sulphate (SO ₄)	mg/L	218 ^β	218	3.19	3.2	3.21	3.19	3.215	3.2	3.19	3.2	3.2	3.18	3.2	3.17
	Aluminum (Al)	mg/L	0.100	0.179,0.173 ^c	0.0032	<0.0030	<0.0030	0.0032	<0.0030	<0.0030	0.0036	<0.0030	<0.0030	0.0031	<0.0030	<0.0030
	Antimony (Sb)	mg/L	0.020 ^a	-	<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	-	-	0.00674	0.00661	0.0061	0.00607	0.00618	0.00605	0.00658	0.00665	0.00673	0.00662	0.00641	0.00621
	Beryllium (Be)	mg/L	0.011 ^a	-	<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	-	-	14.6	14.3	14.3	14.5	14.4	14	14.3	14.2	14.2	14.3	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	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009 ^a	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	0.00103	0.00101	0.00099	0.00094	0.001015	0.00095	0.00099	0.00097	0.00107	0.001	0.00092	0.00091
	Iron (Fe)	mg/L	0.30	0.30	<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	0.00105	<0.0010	<0.0010	0.001	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	9.38	9.19	8.36	8.77	8.335	8.38	9.05	9.13	9.26	9.21	8.92	8.93
	Manganese (Mn)	mg/L	0.935 ^β	-	0.0021	0.00209	0.00154	0.00356	0.00145	0.002255	0.00121	0.00167	0.00162	0.00171	0.000849	0.00113
	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	-	0.000838	0.0008	0.000845	0.000843	0.000846	0.0008315	0.000805	0.000783	0.000805	0.000815	0.000832	0.000837
	Nickel (Ni)	mg/L	0.025	0.025	0.00078	0.00082	0.00071	0.00077	0.000785	0.00075	0.00079	0.00083	0.0008	0.00079	0.00072	0.00073
	Potassium (K)	mg/L	-	-	1.22	1.17	1.11	1.12	1.115	1.105	1.16	1.18	1.19	1.18	1.1	1.12
	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	-	-	0.79	0.80	0.76	0.78	0.77	0.755	0.78	0.78	0.78	0.78	0.80	0.80
	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	1.52	1.52	1.59	1.485	1.51	1.5	1.51	1.54	1.53	1.45	1.46
	Strontium (Sr)	mg/L	-	-	0.00927	0.00901	0.00919	0.00934	0.009285	0.00903	0.00914	0.00933	0.00905	0.00912	0.00889	0.00892
	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	-	0.00107	0.00103	0.00105	0.00109	0.00105	0.001025	0.00103	0.000991	0.00101	0.00103	0.001	0.000999
	Vanadium (V)	mg/L	0.006 ^a	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 2.3 for information regarding WQG criteria.

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

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

 Indicates parameter concentration above applicable Water Quality Guideline.

 **BOLD** Indicates parameter concentration above the AEMP benchmark.

Table B.38: Water chemistry at Sheardown Lake NW (DLO-01) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Summer Sampling Event											
					DD-HAB9-STN1 surface 22-Jul-2015	DD-HAB9-STN1 bottom 22-Jul-2015	DL0-01-5 surface 20-Jul-2015	DL0-01-5 bottom 20-Jul-2015	DL0-01-1 surface 20-Jul-2015	DL0-01-1 bottom 20-Jul-2015	DL0-01-4 surface 20-Jul-2015	DL0-01-4 bottom 20-Jul-2015	DL0-01-2 surface 20-Jul-2015	DL0-01-2 bottom 20-Jul-2015	DL0-01-7 surface 21-Jul-2015	DL0-01-7 bottom 21-Jul-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	122	118	113	117	114	114	113.5	113	114	114	120	119
	pH (lab)	pH	6.5 - 9.0	-	8.08	7.96	7.97	7.86	7.83	7.85	7.925	7.94	7.87	7.91	7.97	7.95
	Hardness (as CaCO ₃)	mg/L	-	-	55	57	56	55	55	55	55	55.5	55	56	55	55
	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	63	62	65	72	71	68.5	65.5	73	73	75	69
	Turbidity	NTU	-	-	0.87	0.97	1.19	1.15	0.97	0.96	1.185	1.24	1.07	1.02	0.68	0.78
	Alkalinity (as CaCO ₃)	mg/L	-	-	55	53	59	58	57	57	65	58.5	53	48	56	57
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	<0.050	<0.050	<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	-	-	<0.15	0.16	<0.15	<0.15	0.15	<0.15	<0.15	0.235	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.3	1.3	1.7	1.6	1.3	1.6	1.8	1.8	1.7	1.2	1.5	1.3
	Total Organic Carbon	mg/L	-	-	1.1	1.8	1.6	1.6	1.7	1.6	1.6	1.65	1.5	1.5	1.8	1.1
	Total Phosphorus	mg/L	0.020 ^α	-	<0.0030	0.0056	0.0031	0.0088	0.0031	0.0032	<0.0030	0.00395	0.003	0.0035	<0.0030	<0.0030
	Phenols	mg/L	0.001 ^α	-	0.0029	0.0023	0.0035	0.0026	0.0015	<0.0010	0.0017	0.0032	<0.0010	0.0011	0.0025	0.0028
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	2.82	2.69	2.64	2.64	2.83	2.63	2.65	2.635	2.64	2.63	2.72	2.66
	Sulphate (SO ₄)	mg/L	218 ^β	218	2.87	2.58	2.58	2.53	2.64	2.53	2.59	2.54	2.55	2.54	2.54	2.52
Total Metals	Aluminum (Al)	mg/L	0.100	0.179,0.173 ^c	0.0126	0.0119	0.0136	0.0138	0.0166	0.0169	0.0152	0.0133	0.0125	0.0185	0.013	0.0137
	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	-	-	0.00509	0.00525	0.00514	0.00516	0.00521	0.00516	0.00513	0.005165	0.00515	0.00516	0.005	0.00512
	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	11.4	11.3	11.3	11.1	11.2	11.25	11.1	11.3	11.1	11.2	11.2
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<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	0.00084	0.0008	0.00098	0.00087	0.00084	0.00092	0.000825	0.00075	0.00087	0.00092	0.00085	0.0008
	Iron (Fe)	mg/L	0.30	0.30	<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	-	-	6.61	6.83	6.8	6.79	6.87	6.81	6.905	6.835	6.85	6.84	6.68	6.57
	Manganese (Mn)	mg/L	0.935 ^β	-	0.0018	0.00168	0.00198	0.00219	0.00192	0.00205	0.001805	0.00198	0.00209	0.00245	0.00176	0.00186
	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	-	0.00067	0.000691	0.000689	0.000676	0.000674	0.000683	0.000682	0.0006825	0.00068	0.000665	0.000694	0.000679
	Nickel (Ni)	mg/L	0.025	0.025	0.00056	0.00058	0.00061	0.0006	0.00061	0.00063	0.000595	0.00059	0.00061	0.00062	0.0006	0.00059
	Potassium (K)	mg/L	-	-	0.93	0.97	0.94	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.93	0.91
	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	-	-	0.51	0.53	0.54	0.55	0.54	0.55	0.535	0.535	0.53	0.58	0.52	0.52
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.15	1.19	1.16	1.19	1.18	1.18	1.18	1.175	1.17	1.18	1.16	1.13
	Strontium (Sr)	mg/L	-	-	0.00736	0.00744	0.00755	0.00755	0.00752	0.00759	0.007515	0.00745	0.00767	0.0076	0.00738	0.00735
	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	-	0.0008	0.000823	0.000832	0.000836	0.000821	0.000822	0.000828	0.0008005	0.00081	0.000811	0.000804	0.000795
	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 2.3 for information regarding WQG criteria.

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

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

 Indicates parameter concentration above applicable Water Quality Guideline.

 **BOLD** Indicates parameter concentration above the AEMP benchmark.

Table B.38: Water chemistry at Sheardown Lake NW (DLO-01) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Fall Sampling Event											
					DD-HAB9-STN1 surface 22-Aug-2015	DD-HAB9-STN1 bottom 22-Aug-2015	DL0-01-5 surface 22-Aug-2015	DL0-01-5 bottom 22-Aug-2015	DL0-01-1 surface 21-Aug-2015	DL0-01-1 bottom 21-Aug-2015	DL0-01-4 surface 21-Aug-2015	DL0-01-4 bottom 21-Aug-2015	DL0-01-2 surface 21-Aug-2015	DL0-01-2 bottom 21-Aug-2015	DL0-01-7 surface 20-Aug-2015	DL0-01-7 bottom 20-Aug-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	124	124.5	125	125	124	124	125	124	125	124	123	124
	pH (lab)	pH	6.5 - 9.0	-	7.98	7.95	8.01	7.88	7.9	7.92	7.96	7.99	7.98	7.96	7.92	7.98
	Hardness (as CaCO ₃)	mg/L	-	-	60	60	59	61	60	60	60	60	59	59	59	60
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	2.25	<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	-	-	51	59.5	61	53	62	65	64	60	64	57	59	65
	Turbidity	NTU	-	-	0.525	0.555	0.45	0.83	0.42	1.5	0.44	0.65	0.49	0.68	0.53	0.55
	Alkalinity (as CaCO ₃)	mg/L	-	-	57	55	58	56	55	57	59	59	58	59	56	57
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	<0.050	<0.050	<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	-	-	<0.15	0.195	0.25	0.28	<0.15	<0.15	<0.15	<0.15	0.25	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.9	2.1	2	2	1.9	1.9	2	2	2	1.9	1.9	2
	Total Organic Carbon	mg/L	-	-	2.2	2	2	2.1	1.9	2	2.1	2	2	2	2	2.2
	Total Phosphorus	mg/L	0.020 ^a	-	0.0035	0.00825	0.0034	0.0038	<0.0030	0.0037	0.0177	0.0041	0.0093	<0.0030	0.0039	<0.0030
Anions	Phenols	mg/L	0.001 ^a	-	0.00355	0.0034	0.0036	0.0036	0.0019	0.0026	0.0024	0.0025	0.0027	0.0025	0.002	<0.0010
	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	2.805	2.79	2.79	2.78	2.78	2.77	2.77	2.77	2.81	2.76	2.76	2.76
Total Metals	Sulphate (SO ₄)	mg/L	218 ^β	218	2.895	2.92	2.93	2.88	2.89	2.86	2.86	2.86	2.85	2.84	2.85	2.85
	Aluminum (Al)	mg/L	0.100	0.179,0.173 ^c	0.00775	0.00625	0.0063	0.0084	0.0053	0.0068	0.007	0.0066	0.0073	0.0098	0.0064	0.0069
	Antimony (Sb)	mg/L	0.020 ^a	-	<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	-	-	0.005235	0.00526	0.00529	0.00529	0.00521	0.00529	0.0053	0.00531	0.0053	0.00531	0.00512	0.00523
	Beryllium (Be)	mg/L	0.011 ^a	-	<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	-	-	11.9	12.05	11.5	12	12	11.9	11.8	11.9	11.8	11.9	11.9	11.9
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009 ^a	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	0.00074	0.000725	0.00077	0.00078	0.0008	0.00083	0.00078	0.00076	0.00082	0.00075	0.00073	0.00082
	Iron (Fe)	mg/L	0.30	0.30	<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	-	-	7.37	7.325	7.19	7.16	7.25	7.34	7.35	7.29	7.31	7.33	7.02	7.09
	Manganese (Mn)	mg/L	0.935 ^β	-	0.00116	0.001235	0.0011	0.00179	0.00122	0.00133	0.00128	0.00133	0.00109	0.0018	0.00118	0.00118
	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	-	0.0007015	0.0007205	0.000699	0.000708	0.000706	0.000707	0.000702	0.000705	0.000707	0.000679	0.000712	0.000716
	Nickel (Ni)	mg/L	0.025	0.025	0.000585	0.000565	<0.00050	0.00062	0.00059	0.00061	0.00058	0.00058	0.0006	0.00061	0.0006	0.00059
	Potassium (K)	mg/L	-	-	1.02	1.01	0.98	0.99	1	1.01	1.01	1.01	1.01	1.01	0.96	0.97
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.465	0.46	0.45	0.51	0.45	0.46	0.46	0.45	0.44	0.46	0.44	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	-	-	1.25	1.245	1.22	1.2	1.23	1.24	1.24	1.24	1.24	1.25	1.18	1.19
	Strontium (Sr)	mg/L	-	-	0.007665	0.007755	0.0078	0.00772	0.00771	0.00768	0.00774	0.00773	0.00775	0.00775	0.00763	0.00764
	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	-	0.0008195	0.000842	0.000838	0.000861	0.000831	0.000819	0.000821	0.000812	0.000839	0.000824	0.000865	0.000866
	Vanadium (V)	mg/L	0.006 ^a	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 2.3 for information regarding WQG criteria.

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

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

 Indicates parameter concentration above applicable Water Quality Guideline.

 **BOLD** Indicates parameter concentration above the AEMP benchmark.

Table B.39: Dissolved metals concentrations at Sheardown Lake NW water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters			Units			Winter Sampling Event										Summer Sampling Event							
						DD-HAB 9-STN1	DD-HAB 9-STN1	DL0-01-5	DL0-01-5	DL0-01-1	DL0-01-1	DL0-01-4	DL0-01-4	DL0-01-2	DL0-01-2	DL0-01-7	DL0-01-7	DD-HAB9-STN1	DD-HAB9-STN1	DL0-01-5-	DL0-01-5-	DL0-01-1-	DL0-01-1-
						surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom
						6-May-2015	6-May-2015	7-May-2015	7-May-2015	7-May-2015	7-May-2015	6-May-2015	6-May-2015	6-May-2015	6-May-2015	3-May-2015	3-May-2015	22-Jul-2015	22-Jul-2015	20-Jul-2015	20-Jul-2015	20-Jul-2015	20-Jul-2015
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	0.0036	<0.0030	<0.0030	<0.0030	<0.0050	<0.0050	<0.0050	<0.0050		
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010		
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010		
	Barium (Ba)	mg/L	0.00659	0.00667	0.00623	0.00598	0.0063	0.00629	0.0067	0.00663	0.00673	0.00668	0.00649	0.00624	0.005	0.0052	0.00511	0.00494	0.00503	0.00502	0.00502		
	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	<0.00010	<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		
	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	14.4	14.4	14.2	14.1	14.2	14.45	14.4	14.5	14.4	14.7	13.0	12.8	11.1	11.4	11.0	11.1	11.1	11.1	11.3		
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<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	0.00107	0.00099	0.00089	0.00096	0.001055	0.00099	0.00101	0.00095	0.00094	0.00099	0.00088	0.00089	0.0008	0.00084	0.00096	0.0011	0.00083	0.00077	0.00077		
	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	<0.010	<0.010	<0.010	<0.010	<0.010		
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<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	0.00105	0.001	0.0011	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0011	<0.0010	<0.0010		
	Magnesium (Mg)	mg/L	9.24	9.22	8.66	8.11	8.475	8.515	9.43	9.38	9.49	9.3	8.75	8.78	6.58	6.97	6.8	6.74	6.73	6.62	6.62		
	Manganese (Mn)	mg/L	0.000616	0.000608	0.000594	0.00181	0.000412	0.0006015	0.000747	0.000647	0.000685	0.000641	0.000451	0.000236	0.000118	0.000368	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050		
	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	0.000815	0.000799	0.000839	0.000834	0.0008445	0.000866	0.000839	0.000821	0.000817	0.000842	0.000855	0.000835	0.00069	0.000716	0.000694	0.000687	0.000692	0.000704	0.000704		
	Nickel (Ni)	mg/L	0.00074	0.00081	0.00075	0.00073	0.00072	0.000735	0.00079	0.00078	0.00077	0.00077	0.00071	0.00073	0.00055	0.00055	0.00056	0.00057	0.00058	0.00058	0.00058		
	Potassium (K)	mg/L	1.20	1.19	1.09	1.10	1.11	1.11	1.20	1.20	1.21	1.18	1.08	1.08	0.900	0.980	0.921	0.928	0.930	0.902	0.902		
	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050		
	Silicon (Si)	mg/L	0.79	0.8	0.76	0.77	0.78	0.76	0.78	0.78	0.8	0.78	0.79	0.78	0.49	0.5	0.515	0.527	0.507	0.519	0.519		
	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	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050		
	Sodium (Na)	mg/L	1.52	1.53	1.45	1.49	1.465	1.49	1.57	1.55	1.56	1.55	1.43	1.44	1.14	1.21	1.17	1.17	1.16	1.14	1.14		
	Strontium (Sr)	mg/L	0.00915	0.00888	0.0091	0.00913	0.00915	0.009285	0.0094	0.00919	0.00921	0.00912	0.00896	0.00888	0.00746	0.00753	0.0075	0.0076	0.0076	0.0076	0.0076		
	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	<0.000010	<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	<0.0											

Table B.40: Summary of the magnitude of difference in aqueous metal concentrations between 2015 Sheardown Lakes and Reference Lake 3 data, Sheardown Lake 2015 and baseline period data, and Sheardown Lake 2015 and mine construction period for winter, summer, and fall sampling events, Mary River Project CREMP. No value presented for parameters in which concentration was below method detection limit, except those for winter 2015, where no reference data were collected.

Variable	Sheardown Lake NW									Sheardown Lake SE								
	2015 vs Reference Lake 3			2015 vs Baseline			2015 vs 2014			2015 vs Reference Lake 3			2015 vs Baseline			2015 vs 2014		
	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)		1.5	1.6	1.0	1.0	1.0		1.0	1.0		1.2	1.4	1.0	0.9	0.9		1.0	1.0
pH (lab)		1.0	1.0		1.0	1.0	1.1	1.0	1.0		1.0	1.0		1.0	1.0	1.1	1.0	1.0
Hardness (as CaCO ₃)		1.5	1.7	1.1	1.0	1.0	1.0	0.9	1.0		1.2	1.5	1.0	0.9	1.0	1.0	1.0	1.0
Total Dissolved Solids (TDS)		1.4	1.6	0.9	0.9	0.8	0.8	0.9	0.8		1.1	1.4	0.8	0.8	0.7	0.8	0.9	0.7
Turbidity		4.4	2.9	0.9	1.3	1.2	1.0	1.1	1.1		9.0	8.6	0.9	1.3	1.1	1.3	0.7	1.5
Alkalinity (as CaCO ₃)		1.7	1.9	1.1	1.0	1.0	1.0	1.1	1.1		1.3	1.6	1.1	0.9	0.9	1.1	1.1	1.0
Nitrate				0.4									0.2					
Total Kjeldahl Nitrogen (TKN)				4.2	1.1	1.6	8.0	1.1	1.0				4.1	1.6	1.0	5.5	1.4	0.9
Dissolved Organic Carbon		0.6	0.6	0.6	0.9	1.2	1.1	1.0	1.6		0.4	0.6	0.6	0.7	1.1	1.1	0.8	1.8
Total Organic Carbon		0.6	0.6	1.4	0.8	1.1	2.0	0.9	1.3		0.6	0.6	0.6	1.0	1.1	0.9	0.9	1.4
Total Phosphorus			1.8	1.5	0.7	1.2	0.7		2.1		1.2	1.6	1.4	0.6	1.1		0.7	
Phenols		1.6	1.0		2.4	2.8		2.4	2.8		1.7	1.0		2.3	2.9		2.3	2.9
Chloride (Cl)		2.0	2.2	1.0	1.1	1.0	0.9	0.9	0.9		1.4	1.7	0.9	0.8	0.7	0.8	0.9	1.1
Sulphate (SO ₄)		0.6	0.7	1.0	1.0	0.9	0.9	0.9	1.0		0.4	0.4	0.9	0.8	0.8	0.9	0.8	1.0
Aluminum (Al)		4.4	2.4	1.1	1.0	0.3	0.2	0.7	0.6		15.4	20.4	0.6	0.7	0.9	0.8	0.4	1.1
Arsenic (As)													1.1					
Barium (Ba)		0.8	0.8	1.1	1.0	1.0	1.1	1.2	1.1		0.7	0.8	1.0	0.9	0.9	1.1	1.1	1.0
Boron (B)																		
Cadmium (Cd)																		
Calcium (Ca)		1.6	1.7	1.0	1.0	1.0	1.0	1.0	0.9		1.2	1.4	0.9	1.0	0.9	0.9	1.0	0.9
Chromium (Cr)																		
Copper (Cu)		1.0	0.9	1.0	0.9	0.6	1.0	1.0	0.8		0.9	0.9	0.8	0.7	0.8	1.0	0.9	1.0
Iron (Fe)											1.8	1.6	0.7	0.5	0.6	1.2	0.4	1.0
Lead (Pb)											2.0	1.3		0.9	0.7		0.6	1.2
Magnesium (Mg)		1.6	1.7	1.0	1.0	1.0	1.0	0.9	1.0		1.2	1.4	1.0	1.0	0.9	1.0	1.0	1.0
Manganese (Mn)		3.5	3.2	2.8	1.1	0.6	1.7	0.8	1.0		4.7	6.0	0.4	0.5	0.8	0.9	0.7	0.9
Molybdenum (Mo)		5.0	5.4	1.0	1.1	1.0	0.9	1.8	1.0		2.9	3.3	1.1	1.2	1.0	1.0	2.6	1.0
Nickel (Ni)		1.2	1.2	1.0	0.9	0.8	1.1	0.9	0.8		1.0	1.0	0.9	0.8	0.8	1.1	0.8	0.9
Potassium (K)		1.0	1.1	1.1	1.2	1.2	1.1	1.1	1.3		0.8	1.0	1.1	1.2	1.1	1.2	1.1	1.5
Silicon (Si)		1.3	1.1	1.0	0.9	0.7	1.0	0.9	0.7		1.1	1.3	0.9	0.7	0.7	1.2	0.7	0.7
Sodium (Na)		1.4	1.5	1.0	1.1	1.1	1.2	1.2	1.4		1.1	1.3	1.2	1.4	1.2	1.1	1.2	1.5
Strontium (Sr)		0.9	1.0	1.0	1.0	1.0	1.0	1.1	1.1		0.7	0.9	0.8	0.8	0.7	1.0	1.2	0.9
Uranium (U)		3.0	3.1	1.1	1.1	1.0	1.0	1.0	1.0		2.0	2.5	1.1	1.0	0.9	1.0	0.9	0.9
Zinc (Zn)														2.3				

 Denotes slight elevation (mean variable concentration 3 to 5 times higher than respective mean reference, baseline or construction period value).
 Denotes moderate elevation (mean variable concentration 5 to 10 times higher than respective mean reference, baseline or mine construction period value).
 Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference, baseline, or mine construction period value).

Table B.41: *In-situ* water quality profile data collected at Sheardown Lake SE water quality monitoring stations in winter^a, Mary River Project CREMP, 2015.

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)
3.05	3.6	98.5	7.1	168.0	3.10	4.0	111.5	4.0	151.0	3.00	3.5	112.7	6.1	152.0	3.30	3.4	111.7	6.8	152.0	3.10	3.6	116.1	- ^d	150.0
4.05	3.4	98.9	7.1	168.0						4.00	3.7	114.3	6.0	151.0	4.30	3.6	113.1	6.6	151.0	4.10	3.6	116.5	- ^d	150.0
5.05	3.3	99.0	7.1	168.0						5.00	3.7	114.7	6.0	151.0	5.30	3.6	114.0	6.5	151.0	5.10	3.6	116.6	- ^d	150.0
5.90	3.2	99.1	7.1	168.0						6.00	3.7	114.8	6.0	151.0	6.30	3.6	114.3	6.5	151.0	6.10	3.6	-	- ^d	150.0
										7.00	3.7	115.0	6.1	151.0	7.30	3.6	114.3	6.4	151.0	7.10	3.6	-	- ^d	150.0
										8.00	3.8	116.0	6.1	151.0	8.30	3.6	114.2	6.4	151.0	8.10	3.6	-	- ^d	150.0
															9.30	3.5	114.3	6.4	151.0	9.10	3.6	-	- ^d	150.0
															10.30	3.6	114.3	6.5	151.0	10.10	3.6	-	- ^d	150.0
															11.30	3.6	114.3	6.5	151.0	11.10	3.6	-	- ^d	150.0
																				12.10	3.7	-	- ^d	151.0
																				13.10	3.7	-	- ^d	151.0
																				13.65	3.7	-	- ^d	152.0

^a Sampling conducted on 01-May, 03-May and 06-May, 2015.

^b Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 were not recorded 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 2.05, 2.10, 2.00, 2.30, and 2.10 m, respectively, at the time of winter sampling.

^d Unreliable pH reading.

Table B.42: *In-situ* water quality profile data collected at Sheardown Lake SE water quality monitoring stations in summer^a, Mary River Project CREMP, 2015.

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	12.6	13.4	14.1	11.0	11.7	109.2	105.5	111.4	106.0	108.1	8.1	8.0	8.1	8.1	8.1	89.5	89.7	89.2	89.4	89.1
2.0	11.0	13.0	11.8	10.8	11.0	107.5	105.6	108.7	105.1	106.9	8.1	8.0	8.1	8.1	8.1	89.5	89.7	90.3	88.8	89.5
3.0	10.5	10.6	10.3	10.0	10.6	105.5	104.9	105.8	104.6	107.7	8.1	8.1	8.1	8.1	8.1	88.8	89.0	89.5	88.5	89.1
4.0	9.9		9.9	9.6	9.9	105.0		105.2	104.1	105.3	8.1		8.1	8.1	8.1	88.8		88.5	88.3	88.5
5.0	9.7		9.6	9.5	9.8	104.4		104.4	103.8	104.9	8.1		8.1	8.1	8.1	88.7		88.4	88.4	88.4
6.0			9.4	9.3	9.5			103.9	103.2	104.6			8.1	8.1	8.1			88.4	88.3	88.4
7.0			9.2	9.2	9.4			103.4	102.9	104.4			8.0	8.1	8.1			88.4	88.3	88.3
8.0			9.1	9.2	9.3			102.2	102.7	104.0			8.0	8.1	8.0			88.4	88.3	88.3
9.0				9.1	9.2				102.2	103.3				8.0	8.0				88.3	88.4
10.0				9.0	9.1				101.7	102.5				8.0	8.0				88.4	88.4
11.0				8.9	8.9				101.1	102.0				8.0	8.0				88.4	88.3
12.0				8.8	8.8				101.7	101.4				8.0	8.0				88.4	88.4
13.0					8.7					100.6					8.0					88.5
14.0					8.5					99.3					7.9					88.5

^a Sampling conducted on 21-July and 22-July, 2015.

^b Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 were 6.5, 4.3, 9, 13, and 14.5 m, respectively, at the time of summer sampling.

Table B.43: *In-situ* water quality profile data collected at Sheardown Lake SE water quality monitoring stations in fall^a, Mary River Project CREMP, 2015.

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	9.2	9.1	8.3	8.7	8.9	102.4	100.8	100.0	100.9	101.1	8.01	7.88	7.98	7.92	7.95	116.1	114.9	110.5	111.4	111.9
2.0	9.1	9.1	8.2	8.6	8.9	102.6	100.6	99.8	100.8	101.2	8.00	7.91	7.93	7.92	7.94	117.6	114.8	110.6	111.3	112.0
3.0	8.6	9.1*	8.1	8.4	8.9	101.3	100.8*	99.2	99.9	101.3	8.01	7.93	7.91	7.91	7.93	118.5	114.8*	110.6	111.0	112.0
4.0	8.1		8.0	8.2	8.6	100.3		99.0	99.5	100.6	8.00		7.90	7.90	7.93	116.1		110.4	110.8	111.3
5.0	8.0		8.0	8.2	8.4	99.8		98.6	99.2	100.0	7.99		7.90	7.89	7.92	115.8		110.5	110.7	111.1
6.0	7.9		7.9	8.0	8.1	99.2		98.2	98.3	99.1	7.97		7.88	7.88	7.90	115.9		110.5	110.9	110.7
7.0	7.8*		7.9*	7.9	7.9	99.0*		98.0*	97.9	98.0	7.97		7.87	7.87	7.88	115.9*		110.6*	110.8	110.4
8.0				7.9	7.9				97.6	97.5				7.88	7.86				110.6	110.3
9.0				7.9	7.9				97.3	97.3				7.85	7.85				110.3	110.2
10.0				7.8	7.8				97.0	97.0				7.83	7.84				110.2	110.3
11.0				7.8	7.8				96.6	96.1				7.82	7.82				110.2	110.5
12.0				7.8*	7.8				96.1*	95.6				7.81	7.80				110.3*	110.5
13.0					7.8*					95.1*					7.79					110.5*

^a Sampling conducted on 20-August and 21-August, 2015.

^b Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 were 7.1, 3.4, 8.05, 12.9, and 13.7 m, respectively, at the time of fall sampling.

* The deepest *in situ* water quality reading at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 were taken at 6.1, 2.4, 7.0, 11.9, and 12.7 m, respectively, at the time of fall sampling.

Table B.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 2015.

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Colour/ Clarity	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
								(mg/L)	(% sat.)		
Littoral (Shallow) Stations	DLO-02-11	17-Aug-15	6.8	1.81	slightly turbid, blue-green colour	surface	8.06	10.72	90.5	7.81	102
						bottom	7.75	10.81	92.2	7.81	103
	DLO-02-10	17-Aug-15	6.9	1.89	slightly turbid, blue-green colour	surface	8.02	10.60	89.8	7.81	102
						bottom	7.85	10.72	90.8	7.82	102
	DLO-02-4	17-Aug-15	8.1	1.94	slightly turbid, blue-green colour	surface	8.01	10.72	91.0	7.81	102
						bottom	7.86	10.85	91.1	7.81	102
	DLO-02-9	17-Aug-15	8.6	1.72	slightly turbid, blue-green colour	surface	8.04	10.88	91.8	7.79	102
						bottom	7.89	10.88	91.6	7.81	102
	DLO-02-1	17-Aug-15	10.2 to 10.6	1.96	slightly turbid, blue-green colour	surface	7.68	12.32	102.8	7.76	105
						bottom	7.62	12.37	103.7	7.61	104
Profundal (Deep) Stations	DLO-02-12	17-Aug-15	11.0	1.77	slightly turbid, blue-green colour	surface	8.23	10.68	90.5	7.81	102
						bottom	7.91	11.05	92.7	7.83	102
	DLO-02-8	17-Aug-15	12.9	1.63	slightly turbid, blue-green colour	surface	7.87	10.80	90.8	7.81	100
						bottom	7.80	11.00	92.4	7.82	102
	DLO-02-13	17-Aug-15	11.4	1.93	slightly turbid, blue-green colour	surface	7.84	10.66	89.8	7.77	102
						bottom	7.79	10.81	91.3	7.79	102
	DLO-02-2	17-Aug-15	13.7	1.70	slightly turbid, blue-green colour	surface	7.75	10.66	89.4	7.75	102
						bottom	7.78	10.92	91.1	7.78	102
	DLO-02-3	17-Aug-15	13.2	1.58	slightly turbid, blue-green colour	surface	7.73	11.03	92.5	7.59	102
						bottom	7.78	11.21	93.9	7.69	102

Table B.45: Statistical comparison of bottom in-situ water quality between littoral and profundal stations of Sheardown Lake SE, Mary River Project CREMP, August 2015.

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
Sheardown Lake SE	Secchi Depth (m)	YES	0.098	α	Littoral	5	1.86	0.10	0.04	1.72	1.96
					Profundal	5	1.72	0.14	0.06	1.58	1.93
	Temperature (°C)	NO	0.753	γ	Littoral	5	7.79	0.11	0.05	7.62	7.89
					Profundal	5	7.81	0.06	0.02	7.78	7.91
	Dissolved Oxygen (mg/L)	NO	0.699	γ	Littoral	5	11.1	0.7	0.3	10.7	12.4
					Profundal	5	11.0	0.1	0.1	10.8	11.2
	Dissolved Oxygen (% saturation)	NO	0.543	γ	Littoral	5	93.9	5.5	2.5	90.8	103.7
					Profundal	5	92.3	1.1	0.5	91.1	93.9
	pH (units)	NO	0.839	γ	Littoral	5	7.77	0.09	0.04	7.61	7.82
					Profundal	5	7.78	0.06	0.02	7.69	7.83
	Specific Conductance (umho/cm)	NO	0.172	γ	Littoral	5	102.6	0.9	0.4	102.0	104.0
					Profundal	5	102.0	0.0	0.0	102.0	102.0

^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 confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed using t-test assuming unequal variance.



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

Table B.46: Water chemistry at Sheardown Lake SE (DLO-02) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Winter Sampling Event								
					DL0-02-06	DL0-02-06	DL0-02-07	DL0-02-4	DL0-02-4	DL0-02-8	DL0-02-8	DL0-02-03	DL0-02-03
					surface	bottom	surface	surface	bottom	surface	bottom	surface	bottom
					6-May-15	6-May-15	3-May-15	1-May-15	1-May-15	1-May-15	1-May-15	3-May-15	3-May-15
Conventionals	Conductivity (lab)	umho/cm	-	-	181	177	150	151	152	154	150	150	150.5
	pH (lab)	pH	6.5 - 9.0	-	7.88	7.91	7.95	7.88	7.85	8.01	8.02	7.87	7.88
	Hardness (as CaCO ₃)	mg/L	-	-	89	88	73	72	72	74	72	71	70.5
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	92	106	82	80	73	77	81	80.5	81
	Turbidity	NTU	-	-	0.42	0.37	0.31	0.32	0.4	0.29	0.46	0.355	0.4
	Alkalinity (as CaCO ₃)	mg/L	-	-	92	92	83	84	77	79	83	78.5	80
Nutrients and Organics	Total Ammonia	mg/L	variable ^c	0.855	<0.050	<0.050	0.108	<0.050	<0.050	<0.050	0.161	<0.050	<0.050
	Nitrate	mg/L	13	13	0.02	0.021	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	0.18	<0.15	<0.15	<0.15	<0.15	<0.15	0.485	1.975
	Dissolved Organic Carbon	mg/L	-	-	1.4	1	<1.0	<1.0	<1.0	<1.0	<1.0	1.05	1.3
	Total Organic Carbon	mg/L	-	-	1.4	1.2	1.1	1.2	1.1	1.1	1.1	1	1.3
	Total Phosphorus	mg/L	0.020 ^α	-	0.0102	0.0142	0.0086	0.0044	0.004	0.0031	0.0045	0.00325	0.00585
	Phenols	mg/L	0.001 ^α	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.34	3.32	3	2.99	2.94	3.07	2.97	2.965	2.98
	Sulphate (SO ₄)	mg/L	218 ^β	218	2.84	2.81	2.64	2.64	2.6	2.69	2.61	2.625	2.595
Total Metals	Aluminum (Al)	mg/L	0.100	0.179,0.173 ^c	<0.0030	<0.0030	<0.0030	0.0031	<0.0030	0.0035	<0.0030	<0.0030	0.00405
	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	0.00011	<0.00010
	Barium (Ba)	mg/L	-	-	0.00823	0.00826	0.00644	0.00655	0.00659	0.00677	0.00662	0.006695	0.006595
	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	-	-	17.3	17.4	13.5	13.3	14.1	14.4	13.5	13.4	13.9
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	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	0.00095	0.00077	0.00079	0.00078	0.00101	0.0008	0.00086	0.00078
	Iron (Fe)	mg/L	0.30	0.30	0.037	0.04	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.0012	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	10.8	10.9	9.29	9.19	9.36	9.47	9.22	9.115	9.175
	Manganese (Mn)	mg/L	0.935 ^β	-	0.00755	0.00759	0.00334	0.00337	0.00377	0.00333	0.00394	0.003095	0.003895
	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	-	0.000555	0.000574	0.000558	0.000568	0.000554	0.00059	0.000563	0.0005705	0.0005645
	Nickel (Ni)	mg/L	0.025	0.025	0.00078	0.0008	0.00064	0.00066	0.00062	0.00065	0.00067	0.00065	0.00067
	Potassium (K)	mg/L	-	-	1.31	1.32	1.07	1.06	1.08	1.1	1.07	1.055	1.07
	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	-	-	0.95	0.96	0.78	0.76	0.76	0.79	0.77	0.76	0.75
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.7	1.72	1.48	1.47	1.49	1.52	1.47	1.465	1.465
	Strontium (Sr)	mg/L	-	-	0.0115	0.0115	0.0101	0.01	0.0101	0.0103	0.00998	0.0101	0.01005
	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	-	0.000982	0.000985	0.000925	0.0009	0.000901	0.000939	0.000924	0.0009145	0.0008985
	Vanadium (V)	mg/L	0.006 ^α	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

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

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

 Indicates parameter concentration above applicable Water Quality Guideline.

 **BOLD** Indicates parameter concentration above the AEMP benchmark.

Table B.46: Water chemistry at Sheardown Lake SE (DLO-02) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Summer Sampling Event									
					DL0-02-6 surface 21-Jul-15	DL0-02-6 bottom 21-Jul-15	DL0-02-7 surface 22-Jul-15	DL0-02-7 bottom 22-Jul-15	DL0-02-4 surface 21-Jul-15	DL0-02-4 bottom 21-Jul-15	DL0-02-8 surface 21-Jul-15	DL0-02-8 bottom 21-Jul-15	DL0-02-3 surface 21-Jul-15	DL0-02-3 bottom 21-Jul-15
Conventionals	Conductivity (lab)	umho/cm	-	-	93.7	93.6	93.8	93.6	93.6	92.9	93.4	93.4	93.8	93.55
	pH (lab)	pH	6.5 - 9.0	-	7.88	7.83	7.91	7.94	7.9	7.82	7.91	7.77	7.895	7.755
	Hardness (as CaCO ₃)	mg/L	-	-	44	43	44	43	43	43	43	43	43.5	43.5
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	2.8	<2.0	<2.0	2	<2.0	2.5	2.8	2.6	2.8
	Total Dissolved Solids (TDS)	mg/L	-	-	53	50	52	53	46	51	56	56	56	47
	Turbidity	NTU	-	-	2.1	2.45	2.07	2.03	1.74	2.08	1.77	2.48	2.135	2.29
	Alkalinity (as CaCO ₃)	mg/L	-	-	42	44	42	43	45	44	44	44	44	42
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	<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
	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	0.45	<0.15	<0.15	0.18	<0.15	<0.15	0.18	0.16
	Dissolved Organic Carbon	mg/L	-	-	1	1	1	1.2	1.1	<1.0	1.1	1.1	1.05	1
	Total Organic Carbon	mg/L	-	-	1.5	1.5	1.8	1.3	1.4	2.2	1.5	1.6	1.5	1.45
	Total Phosphorus	mg/L	0.020 ^a	-	0.0035	0.0041	<0.0030	0.0035	<0.0030	0.0039	0.0043	<0.0030	<0.0030	0.0051
	Phenols	mg/L	0.001 ^a	-	0.0018	0.0025	0.0024	0.0028	0.0023	0.0012	0.0026	0.0024	0.00235	0.00245
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	1.88	1.88	1.91	1.92	1.9	1.86	1.9	1.87	1.9	1.895
	Sulphate (SO ₄)	mg/L	218 ^β	218	1.68	1.7	1.72	1.71	1.68	1.67	1.69	1.67	1.69	1.71
Total Metals	Aluminum (Al)	mg/L	0.100	0.179,0.173 ^c	0.058	0.0575	0.0555	0.0497	0.0478	0.0637	0.0535	0.0044	0.05635	0.0627
	Antimony (Sb)	mg/L	0.020 ^a	-	<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	-	-	0.00474	0.00483	0.0048	0.0047	0.00467	0.00472	0.00482	0.0044	0.004575	0.00479
	Beryllium (Be)	mg/L	0.011 ^a	-	<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	-	-	8.82	8.74	8.96	8.8	8.73	8.8	8.79	8.81	8.54	8.845
	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 ^a	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	0.00077	0.00111	0.00089	0.00071	0.00116	0.00078	0.00069	0.00069	0.000705	0.000695
	Iron (Fe)	mg/L	0.30	0.30	0.055	0.057	0.048	0.048	0.05	0.062	0.051	<0.030	0.051	0.0695
	Lead (Pb)	mg/L	0.001	0.001	0.000096	0.000114	0.000093	0.000092	0.000098	0.000119	0.000093	<0.000050	0.0000955	0.0001225
	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	-	-	5.17	5.13	5.16	5.12	5.12	5.22	5.21	5.16	5.01	5.24
	Manganese (Mn)	mg/L	0.935 ^β	-	0.00256	0.00331	0.00244	0.00294	0.00253	0.00357	0.0027	0.000101	0.00257	0.004485
	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	-	0.000405	0.000381	0.000414	0.000387	0.000401	0.000391	0.000397	0.000409	0.000405	0.000379
	Nickel (Ni)	mg/L	0.025	0.025	0.00051	0.0005	0.00053	0.00051	0.00051	0.00051	0.00052	<0.00050	<0.00050	0.000545
	Potassium (K)	mg/L	-	-	0.78	0.76	0.78	0.76	0.76	0.77	0.76	0.75	0.75	0.79
	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
	Silicon (Si)	mg/L	-	-	0.52	0.5	0.51	0.48	0.49	0.51	0.49	0.42	0.495	0.55
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.893	0.887	0.907	0.895	0.888	0.895	0.905	0.9	0.861	0.9095
	Strontium (Sr)	mg/L	-	-	0.00611	0.00599	0.00618	0.00606	0.00614	0.00609	0.00607	0.00607	0.00596	0.006155
	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	-	0.000547	0.000553	0.000548	0.000535	0.000543	0.000543	0.000544	0.000516	0.000538	0.000544
	Vanadium (V)	mg/L	0.006 ^a	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	0.0038	<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 2.3 for information regarding WQG criteria.

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

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

 Indicates parameter concentration above applicable Water Quality Guideline.

 **BOLD** Indicates parameter concentration above the AEMP benchmark.

Table B.46: Water chemistry at Sheardown Lake SE (DLO-02) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Fall Sampling Event									
					DL0-02-6 surface 20-Aug-15	DL0-02-6 bottom 20-Aug-15	DL0-02-7 surface 21-Aug-15	DL0-02-7 bottom 21-Aug-15	DL0-02-4 surface 20-Aug-15	DL0-02-4 bottom 20-Aug-15	DL0-02-8 surface 21-Aug-15	DL0-02-8 bottom 21-Aug-15	DL0-02-3 surface 21-Aug-15	DL0-02-3 bottom 21-Aug-15
Conventionals	Conductivity (lab)	umho/cm	-	-	110	109	108	108	105	104	105	103	106	103
	pH (lab)	pH	6.5 - 9.0	-	7.98	8.01	7.89	7.93	7.92	7.9	7.85	7.82	7.85	7.84
	Hardness (as CaCO ₃)	mg/L	-	-	53	53	52	52	50	51	50	51	50	50
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	56	52	49	53.5	48	58	47	43	55	44
	Turbidity	NTU	-	-	1.74	1.63	1.855	1.705	2.02	2.12	1.85	2.47	1.68	1.74
	Alkalinity (as CaCO ₃)	mg/L	-	-	49	47	49.5	48	50	48	49	50	47	49
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	<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
	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	0.175	0.175	<0.15	<0.15	0.34	0.23	0.2	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.7	1.7	1.7	1.75	1.7	1.7	1.7	1.7	1.7	1.7
	Total Organic Carbon	mg/L	-	-	1.8	1.8	1.9	1.85	1.7	1.8	1.8	1.9	1.9	1.8
	Total Phosphorus	mg/L	0.020 ^α	-	0.0041	0.0042	0.0052	0.00445	0.0048	0.005	0.0041	0.0062	0.0115	0.0082
Anions	Phenols	mg/L	0.001 ^α	-	0.0016	0.0017	0.0034	0.00445	0.0031	<0.0010	0.0041	0.0033	0.0025	0.0015
	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	2.18	2.21	2.16	2.17	2.06	2.06	2.08	2.06	2.1	2.07
Total Metals	Sulphate (SO ₄)	mg/L	218 ^β	218	2.04	2.06	2.005	2.01	1.88	1.87	1.9	1.88	1.92	1.87
	Aluminum (Al)	mg/L	0.100	0.179,0.173 ^c	0.0482	0.0629	0.0624	0.0553	0.0706	0.0694	0.0518	0.069	0.0657	0.057
	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	-	-	0.00509	0.00514	0.00531	0.00515	0.00525	0.00523	0.00523	0.00534	0.0053	0.00537
	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	-	-	10.5	10.5	10.25	10.3	10	10.1	9.94	10.1	10.2	10
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009 ^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	0.00076	0.00075	0.000745	0.00079	0.00077	0.00091	0.0008	0.00079	0.0008	0.00074
	Iron (Fe)	mg/L	0.30	0.30	0.042	0.048	0.0435	0.0405	0.055	0.056	0.041	0.049	0.046	0.048
	Lead (Pb)	mg/L	0.001	0.001	0.000055	0.000062	0.0000505	0.000052	0.000086	0.00008	0.000052	0.000074	0.000059	0.00007
	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	-	-	6.28	6.37	6.305	6.225	5.96	5.87	5.99	6.09	6.12	5.98
	Manganese (Mn)	mg/L	0.935 ^β	-	0.00211	0.00243	0.00224	0.002105	0.00244	0.00291	0.00219	0.00269	0.00206	0.00338
	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	-	0.000466	0.000457	0.000465	0.0004475	0.000406	0.00042	0.000428	0.000419	0.000438	0.000414
	Nickel (Ni)	mg/L	0.025	0.025	0.00054	0.00054	0.000535	0.000525	0.00052	0.00051	0.0005	<0.00050	0.00051	<0.00050
	Potassium (K)	mg/L	-	-	0.86	0.88	0.895	0.875	0.83	0.83	0.86	0.88	0.87	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
	Silicon (Si)	mg/L	-	-	0.52	0.54	0.53	0.515	0.54	0.56	0.5	0.53	0.56	0.52
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.06	1.07	1.095	1.08	1.04	1.03	1.07	1.09	1.07	1.06
	Strontium (Sr)	mg/L	-	-	0.0071	0.00707	0.00716	0.00719	0.00692	0.00696	0.00702	0.00712	0.00714	0.00703
	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	-	0.000704	0.000697	0.0006595	0.000658	0.000676	0.000675	0.00064	0.00063	0.000652	0.00064
	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 2.3 for information regarding WQG criteria.

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

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

 Indicates parameter concentration above applicable Water Quality Guideline.

 **BOLD** Indicates parameter concentration above the AEMP benchmark.

Table B.47: Dissolved metals concentrations at Sheardown Lake SE water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters			Units			Winter Sampling Event						Summer Sampling Event									
						DL0-02-06	DL0-02-06	DL0-02-07	DL0-02-4	DL0-02-4	DL0-02-8	DL0-02-8	DL0-02-03	DL0-02-03	DL0-02-6	DL0-02-6	DL0-02-7	DL0-02-7	DL0-02-4	DL0-02-4	
						surface	bottom	surface	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	
						6-May-15	6-May-15	3-May-15	1-May-15	1-May-15	1-May-15	1-May-15	1-May-15	3-May-15	3-May-15	21-Jul-15	21-Jul-15	22-Jul-15	22-Jul-15	21-Jul-15	21-Jul-15
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.003	<0.0030	0.0066	0.0067	0.0056	0.0051	0.0051	0.0049			
	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	0.00011	<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			
	Barium (Ba)	mg/L	0.00813	0.00807	0.00668	0.00652	0.00658	0.00689	0.00662	0.00656	0.00669	0.00442	0.00456	0.00452	0.00436	0.00447	0.00431				
	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	17.4	17.3	14.0	13.6	13.7	14.1	13.6	13.6	13.4	8.88	8.61	8.95	8.75	8.84	8.67				
	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	0.00101	0.0009	0.00085	0.00084	0.00085	0.00089	0.00085	0.00078	0.00079	0.00066	0.00089	0.00097	0.00068	0.00074	0.00067				
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<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	0.0012	0.0012	<0.0010	<0.0010	<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	11	11	9.33	9.29	9.11	9.5	9.26	8.98	9.03	5.24	5.17	5.31	5.22	5.18	5.18				
	Manganese (Mn)	mg/L	0.00156	0.00118	0.001	0.000887	0.000516	0.00142	0.000452	0.0005695	0.0004265	0.00045	0.000191	0.000301	0.000274	0.000575	0.000111				
	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	0.00056	0.00055	0.000566	0.000574	0.00057	0.00057	0.000549	0.0005645	0.000556	0.000431	0.000425	0.000425	0.000424	0.000426	0.000407				
	Nickel (Ni)	mg/L	0.00075	0.00072	0.00067	0.00062	0.00062	0.00064	0.00065	0.000645	0.00062	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050				
	Potassium (K)	mg/L	1.32	1.33	1.07	1.06	1.06	1.1	1.06	1.05	1.05	0.75	0.74	0.77	0.75	0.75	0.74				
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010				
	Silicon (Si)	mg/L	0.95	0.96	0.75	0.75	0.75	0.78	0.75	0.735	0.755	0.4	0.41	0.4	0.4	0.41	0.41				
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010				
	Sodium (Na)	mg/L	1.72	1.73	1.49	1.51	1.47	1.53	1.49	1.45	1.45	0.903	0.9	0.931	0.897	0.898	0.899				
	Strontium (Sr)	mg/L	0.0117	0.0116	0.01	0.0101	0.00986	0.0102	0.0099	0.01003	0.009965	0.00614	0.00596	0.00616	0.00607	0.00612	0.00602				
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010				
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010				
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010				
	Uranium (U)	mg/L	0.000976	0.000957	0.000921	0.000928	0.000917	0.000933	0.000921	0.000914	0.000912	0.000532	0.000524	0.00054	0.000533	0.000538	0.000526				
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010				
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.003	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030				
Parameters			Units			Summer Sampling Event				Fall Sampling Event											
						DL0-02-8	DL0-02-8	DL0-02-3	DL0-02-3	DL0-02-6	DL0-02-6	DL0-02-7	DL0-02-7	DL0-02-4	DL0-02-4	DL0-02-8	DL0-02-8	DL0-02-3	DL0-02-3		
						surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom		
						21-Jul-15	21-Jul-15	21-Jul-15	21-Jul-15	20-Aug-15	20-Aug-15	21-Aug-15	21-Aug-15	20-Aug-15	20-Aug-15	21-Aug-15	21-Aug-15	21-Aug-15	21-Aug-15		
Dissolved Metals	Aluminum (Al)	mg/L	0.0049	0.05																	

Table B.48: *In-situ* water quality measurements collected at Mary River benthic invertebrate community stations, Mary River Project CREMP, August 2015.

Study Area	Station	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Mary River Upstream (GO-09)	GO-09 B1	2.0	12.30	94.6	8.15	154
	GO-09 B2	2.4	12.08	94.0	8.67	159
	GO-09 B3	3.1	11.95	94.8	8.00	158
	GO-09 B4	4.1	11.53	93.9	8.21	158
	GO-09 B5	4.1	11.48	93.4	8.33	157
Mary River Upstream (GO-03)	GO-03 B1	6.8	10.35	89.6	8.24	142
	GO-03 B2	6.9	10.86	94.1	8.21	141
	GO-03 B3	6.4	11.02	94.3	8.31	143
	GO-03 B4	5.7	11.26	94.1	8.14	137
	GO-03 B5	5.4	11.35	94.6	8.61	143
Mary River Downstream (EO-01)	EO-01 B1	5.2	11.70	96.2	8.42	150
	EO-01 B2	5.1	11.63	92.7	8.20	153
	EO-01 B3	4.8	11.60	93.3	8.18	155
	EO-01 B4	4.7	11.59	93.0	8.19	135
	EO-01 B5	4.7	11.63	93.2	8.20	155
Mary River Downstream (EO-20)	EO-20 B1	6.8	11.15	94.0	8.24	155
	EO-20 B2	6.6	11.12	93.4	8.41	155
	EO-20 B3	6.5	11.24	94.1	8.23	157
	EO-20 B4	6.0	11.24	92.6	8.17	155
	EO-20 B5	5.7	11.50	94.6	8.22	156
Mary River Downstream (CO-05)	CO-05 B1	5.3	11.48	93.8	7.98	138
	CO-05 B2	5.2	11.22	91.5	8.24	139
	CO-05 B3	5.2	11.69	95.3	8.20	134
	CO-05 B4	5.6	11.51	94.8	8.30	139
	CO-05 B5	5.6	11.52	95.0	8.21	117

Table B.49: *In-situ* water quality summary for Mary River benthic invertebrate community study areas, Mary River Project CREMP, August 2015.

Metric	Station	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Temperature (°C)	GO-09	5	3.14	0.96	0.43	1.95	4.33	2.00	4.10
	GO-03	5	6.24	0.67	0.30	5.41	7.07	5.40	6.90
	EO-01	5	4.90	0.23	0.10	4.61	5.19	4.70	5.20
	EO-20	5	6.32	0.45	0.20	5.76	6.88	5.70	6.80
	CO-05	5	5.38	0.20	0.09	5.13	5.63	5.20	5.60
Dissolved Oxygen (mg/L)	GO-09	5	11.9	0.4	0.2	11.4	12.3	11.5	12.3
	GO-03	5	11.0	0.4	0.2	10.5	11.5	10.4	11.4
	EO-01	5	11.6	0.0	0.0	11.6	11.7	11.6	11.7
	EO-20	5	11.3	0.1	0.1	11.1	11.4	11.1	11.5
	CO-05	5	11.5	0.2	0.1	11.3	11.7	11.2	11.7
Dissolved Oxygen (% saturation)	GO-09	5	83.3	24.6	11.0	52.8	113.8	39.4	94.8
	GO-03	5	93.3	2.1	0.9	90.7	95.9	89.6	94.6
	EO-01	5	93.7	1.4	0.6	91.9	95.5	92.7	96.2
	EO-20	5	93.7	0.8	0.3	92.8	94.7	92.6	94.6
	CO-05	5	94.1	1.5	0.7	92.2	96.0	91.5	95.3
pH (pH units)	GO-09	5	8.27	0.25	0.11	7.96	8.59	8.00	8.67
	GO-03	5	8.30	0.18	0.08	8.08	8.53	8.14	8.61
	EO-01	5	8.24	0.10	0.05	8.11	8.36	8.18	8.42
	EO-20	5	8.25	0.09	0.04	8.14	8.37	8.17	8.41
	CO-05	5	8.19	0.12	0.05	8.04	8.34	7.98	8.30
Specific Conductance (uS/cm)	GO-09	5	157.2	1.9	0.9	154.8	159.6	154.0	159.0
	GO-03	5	141.2	2.5	1.1	138.1	144.3	137.0	143.0
	EO-01	5	149.6	8.4	3.8	139.2	160.0	135.0	155.0
	EO-20	5	155.6	0.9	0.4	154.5	156.7	155.0	157.0
	CO-05	5	133.4	9.4	4.2	121.7	145.1	117.0	139.0

Table B.50: Statistical comparison of *in-situ* water quality variables among Mary River benthic invertebrate community study areas, Mary River Project CREMP, August 2015.

In-situ Variable	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
Temperature (°C)	YES	0.00000	ANOVA ^c	GO-09	GO-3	YES	0.0054	Tamhane's ^c
				GO-09	EO-01	NO	0.1240	
				GO-09	EO-20	YES	0.0066	
				GO-09	CO-05	YES	0.0539	
				GO-03	EO-01	YES	0.0791	
				GO-03	EO-20	NO	1.0000	
				GO-03	CO-05	NO	0.3491	
				EO-01	EO-20	YES	0.0081	
				EO-01	CO-05	YES	0.0863	
Dissolved Oxygen (% Saturation)	NO	0.89291	ANOVA ^d	EO-20	CO-05	NO	0.0645	Tukey's ^d
				GO-09	GO-3	NO	0.8914	
				GO-09	EO-01	NO	0.9842	
				GO-09	EO-20	NO	0.9906	
				GO-09	CO-05	NO	1.0000	
				GO-03	EO-01	NO	0.9950	
				GO-03	EO-20	NO	0.9906	
				GO-03	CO-05	NO	0.9156	
				EO-01	EO-20	NO	1.0000	
pH (pH units)	NO	0.83653	ANOVA ^d	EO-01	CO-05	NO	0.9906	Tukey's ^d
				EO-20	CO-05	NO	0.9950	
				GO-09	GO-3	NO	0.9982	
				GO-09	EO-01	NO	0.9971	
				GO-09	EO-20	NO	0.9998	
				GO-09	CO-05	NO	0.9143	
				GO-03	EO-01	NO	0.9690	
				GO-03	EO-20	NO	0.9893	
				GO-03	CO-05	NO	0.7864	
Specific Conductance (umho/cm)	YES	0.00001	ANOVA ^d	EO-01	EO-20	NO	0.9999	Tukey's ^d
				EO-01	CO-05	NO	0.9855	
				EO-20	CO-05	NO	0.9616	
				GO-09	GO-3	YES	0.0025	
				GO-09	EO-01	NO	0.2605	
				GO-09	EO-20	NO	0.9919	
				GO-09	CO-05	YES	0.0000	
				GO-03	EO-01	NO	0.1958	
				GO-03	EO-20	YES	0.0066	
				GO-03	CO-05	NO	0.2409	
				EO-01	EO-20	NO	0.4798	
				EO-01	CO-05	YES	0.0022	
				EO-20	CO-05	YES	0.0001	

^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 Data normally distributed. Untransformed data used for comparison(s).

^d Data non-normal. ANOVA result confirmed using KW H-test or MW U-test.

Table B.51: Water chemistry at Mary River water quality monitoring stations, Mary River Project CREMP, 2015.

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	C010	C0-05	C0-01
					29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	21.4	25.6	23.9	24.2	38.5	25.1	23.6	23.8	25.5	36.5	33.9
	pH (lab)	pH	6.5 - 9.0	-	6.86	6.94	7.06	7.13	7.23	7.28	6.93	6.95	7.05	7.18	7.29
	Hardness (as CaCO ₃)	mg/L	-	-	<10	13	11	12	20	12	12	12	13	18	17
	Total Suspended Solids (TSS)	mg/L	-	-	46.4	13.6	12.8	12	16.4	9.2	<2.0	6.4	<2.0	3.2	4.8
	Total Dissolved Solids (TDS)	mg/L	-	-	<20	<20	<20	<20	<20	<20	20	<20	20	23.5	<20
	Turbidity	NTU	-	-	16.6	8.08	8.75	5.42	2.39	4.46	4.4	5.65	4.33	4.305	4.58
	Alkalinity (as CaCO ₃)	mg/L	-	-	<10	11	<10	<10	16	12	<10	10	12	16.5	14
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	<0.050	<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
	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	0.21
	Dissolved Organic Carbon	mg/L	-	-	<1.0	1.3	1.1	1.2	<1.0	<1.0	1	<1.0	1	1.1	1.1
	Total Organic Carbon	mg/L	-	-	1.1	1.5	1.1	1.3	<1.0	1	2.5	1.2	1.8	1.2	1.2
	Total Phosphorus	mg/L	0.020 ^α	-	0.0862	0.0214	0.021	0.016	0.0066	0.0145	0.0092	0.0101	0.0072	0.0076	0.0073
	Phenols	mg/L	0.001 ^α	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
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	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.63	0.59
	Sulphate (SO ₄)	mg/L	218 ^β	218	0.33	<0.30	0.31	<0.30	0.61	0.31	0.33	0.31	0.41	0.565	0.52
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.374	0.159	0.213	0.174	0.0963	0.137	0.114	0.144	0.11	0.1095	0.115
	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	-	-	0.00553	0.00296	0.00368	0.00323	0.00244	0.00272	0.00252	0.00285	0.00278	0.00309	0.00298
	Beryllium (Be)	mg/L	0.011 ^α	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	2.63	2.94	2.65	2.64	4.12	2.67	2.53	2.61	2.68	3.71	3.53
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00083	<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	0.00031	0.00011	0.00016	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00119	0.00061	0.00078	0.00065	<0.00050	0.00053	<0.00050	0.00052	<0.00050	0.00054	0.00055
	Iron (Fe)	mg/L	0.30	0.874	0.512	0.155	0.256	0.189	0.105	0.133	0.099	0.134	0.089	0.097	0.107
	Lead (Pb)	mg/L	0.001	0.001	0.000602	0.000278	0.000303	0.00021	0.000144	0.00019	0.000144	0.000175	0.000126	0.0001435	0.000157
	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	-	-	1.58	1.56	1.48	1.49	2.43	1.49	1.45	1.5	1.54	2.19	2.01
	Manganese (Mn)	mg/L	0.935 ^β	-	0.0137	0.0055	0.00683	0.00507	0.00308	0.00347	0.00261	0.00355	0.00215	0.00258	0.00287
	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	0.000084	0.000076
	Nickel (Ni)	mg/L	0.025	0.025	0.00068	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.44	0.34	0.39	0.35	0.29	0.33	0.32	0.33	0.34	0.41	0.39
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.79	0.55	0.63	0.55	0.38	0.48	0.47	0.52	0.49	0.5	0.52
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.334	0.217	0.328	0.271	0.18	0.273	0.296	0.286	0.322	0.4225	0.39
	Strontium (Sr)	mg/L	-	-	0.00265	0.00208	0.00243	0.00219	0.00222	0.0021	0.00207	0.00216	0.00217	0.002835	0.00277
	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	-	-	0.028	<0.010	0.016	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.000356	0.000135	0.00021	0.000158	0.00008	0.000132	0.000117	0.000125	0.000117	0.0001895	0.000169
	Vanadium (V)	mg/L	0.006 ^α	0.006	0.001	<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 2.3 for information regarding WQG criteria.

^b AEMP Water Quality Benchmarks developed by Intrinsik (2013) using background water quality data. The values are specific to the Mary River system.

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table B.51: Water chemistry at Mary River water quality monitoring stations, Mary River Project CREMP, 2015.

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
					19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	104	72.3	72.2	72.1	83.3	184	77.9	81.3	85.2	81.1	84.6	84.1	83.1
	pH (lab)	pH	6.5 - 9.0	-	7.97	7.905	7.94	7.92	7.94	8	7.78	7.94	7.94	7.93	7.92	7.93	7.95
	Hardness (as CaCO ₃)	mg/L	-	-	49	33.5	33	34	40	90	37	39	40	39	40	40	39
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	2.2	2.8	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	51	59	43	41	40	93	48	46	47	45	54	51	51
	Turbidity	NTU	-	-	2.05	10.05	9.67	8.31	7.06	0.51	7.26	6.54	5.7	6.17	5.26	4.79	4.09
	Alkalinity (as CaCO ₃)	mg/L	-	-	52	35.5	35	35	41	83	36	41	41	39	39	43	42
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	<0.050	<0.050	<0.050	<0.050
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	0.149	<0.020	<0.020	0.032	<0.020	0.025	0.022	0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.20000	<0.15	0.31000	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.2
	Total Organic Carbon	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	<1.0	<1.0	<1.0	<1.0	1.5	<1.0	<1.0
	Total Phosphorus	mg/L	0.020 ^α	-	0.0056	0.00895	0.0134	0.0064	0.0061	<0.0030	0.0061	0.0055	0.0059	0.0092	0.0568	0.005	0.014
	Phenols	mg/L	0.001 ^α	-	<0.0010	<0.0010	<0.0010	<0.0010	0.0015	<0.0010	0.0025	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.54	1.07	1.09	0.93	1.05	2.58	0.97	1.02	1.06	1.02	1.04	1.07	1.03
	Sulphate (SO ₄)	mg/L	218 ^β	218	1.0	0.8	0.9	0.8	1.5	8.9	1.1	1.2	1.3	1.3	1.3	1.3	1.2
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.0815	0.135	0.119	0.152	0.236	0.0236	0.227	0.198	0.296	0.219	0.212	0.249	0.214
	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	-	-	0.0067	0.0060	0.0060	0.0061	0.0069	0.0092	0.0066	0.0068	0.0073	0.0069	0.0069	0.0069	0.0069
	Beryllium (Be)	mg/L	0.011 ^α	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	10	7	7	7	8	19	8	8	8	8	8	8	8
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	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	0.0008	0.0009	0.0008	0.0008	0.0007	0.0008	0.0009	0.0009	0.0008	0.0008	0.0008	0.0010
	Iron (Fe)	mg/L	0.30	0.874	0.046	0.114	0.100	0.117	0.149	<0.030	0.151	0.140	0.181	0.124	0.120	0.136	0.113
	Lead (Pb)	mg/L	0.001	0.001	0.00006	0.00018	0.00016	0.00017	0.00016	<0.000050	0.00018	0.00018	0.00023	0.00015	0.00013	0.00014	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	-	-	5.48	3.77	3.77	3.8	4.57	10.3	4.2	4.35	4.53	4.36	4.56	4.54	4.49
	Manganese (Mn)	mg/L	0.935 ^β	-	0.00065	0.00147	0.00132	0.00139	0.00148	0.00030	0.00162	0.00187	0.00284	0.00141	0.00139	0.00175	0.00159
	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	-	0.00016	0.00015	0.00015	0.00016	0.00018	0.00031	0.00018	0.00023	0.00026	0.00026	0.00027	0.00027	0.00027
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0006	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.86	0.78	0.76	0.75	0.82	0.99	0.80	0.83	0.86	0.83	0.85	0.86	0.84
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.90	0.74	0.72	0.78	1.00	0.77	1.00	0.94	1.12	0.98	0.98	1.09	1.00
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.610	1.130	1.120	1.040	1.040	1.100	1.040	1.060	1.090	1.070	1.110	1.100	1.080
	Strontium (Sr)	mg/L	-	-	0.009	0.008	0.008	0.007	0.008	0.012	0.008	0.008	0.008	0.008	0.008	0.008	0.008
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.0100	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0011	0.0010	0.0009	0.0007	0.0008	0.0018	0.0007	0.0008	0.0007	0.0007	0.0007	0.0007	0.0007
	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 2.3 for information regarding WQG criteria.

^b AEMP Water Quality Benchmarks developed by Intrinsik (2013) using background water quality data. The values are specific to the Mary River system.

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table B.51: Water chemistry at Mary River water quality monitoring stations, Mary River Project CREMP, 2015.

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
					13-Aug-2015	13-Aug-2015	13-Aug-2015	13-Aug-2015	17-Aug-2015	17-Aug-2015	17-Aug-2015	16-Aug-2015	16-Aug-2015	16-Aug-2015	16-Aug-2015	16-Aug-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	138	147	140	134	145	216	143	138	138	143	139	133
	pH (lab)	pH	6.5 - 9.0	-	8.03	8.01	8.01	7.98	8.05	8.2	8.05	8	8.01	7.99	7.99	7.92
	Hardness (as CaCO ₃)	mg/L	-	-	62	65	66	64	71	114	70	68.5	68	69	68	65
	Total Suspended Solids (TSS)	mg/L	-	-	5.6	3.2	4.4	14.4	2	9.2	<2.0	3.2	12	5.2	2	3.6
	Total Dissolved Solids (TDS)	mg/L	-	-	70	73	73	80	650	106	76	76	70	68	79	77
	Turbidity	NTU	-	-	16.5	13.8	17.7	45.9	7.53	9.48	7.35	8.345	18.9	11.2	6.68	9.67
	Alkalinity (as CaCO ₃)	mg/L	-	-	57	59	59	57	67	109	72	64	64	68	66	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	<0.050	<0.050	<0.050
	Nitrate	mg/L	13	13	0.021	<0.020	<0.020	0.021	<0.020	0.092	<0.020	<0.020	<0.020	<0.020	0.023	<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	0.16	<0.15	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.3	1.4	1.4	1.4	1.7	1.3	1.7	1.6	1.5	1.8	1.8	1.7
	Total Organic Carbon	mg/L	-	-	1.1	1.3	1.3	1.3	1.6	1.4	1.8	1.65	1.6	1.7	1.8	1.7
	Total Phosphorus	mg/L	0.020 ^α	-	0.0122	0.0079	0.0115	0.0246	0.0079	0.0147	0.0209	0.0094	0.0195	0.0124	0.0087	0.0303
	Phenols	mg/L	0.001 ^α	-	0.0048	0.004	0.005	0.004	0.0017	0.0018	0.0019	0.00265	0.0034	0.0022	0.0012	0.0028
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	6.48	5.38	5.21	4.27	4.18	3.96	4.19	4.055	4.02	3.83	3.72	3.66
	Sulphate (SO ₄)	mg/L	218 ^β	218	3.77	3.34	3.23	3.2	3.4	5.74	3.37	3.31	3.31	3.29	3.18	3.08
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.695	0.425	1.01	2.58	0.23	0.154	0.223	0.1675	0.238	0.194	0.161	0.23
	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	0.00012	0.00021	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.012	0.0111	0.0136	0.022	0.00987	0.0113	0.00999	0.009555	0.0106	0.01	0.00948	0.00918
	Beryllium (Be)	mg/L	0.011 ^α	-	<0.00010	<0.00010	<0.00010	0.0001	<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	<0.00050	<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	0.012	<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	-	-	13.1	14.1	13.9	13.3	14.7	23.6	14.6	14.45	14.4	14.3	14.4	13.7
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00109	0.00077	0.00168	0.00432	<0.00050	<0.00050	<0.00050	<0.00050	0.00072	0.00051	<0.00050	0.0005
	Cobalt (Co)	mg/L	0.0009 ^α	0.004	0.00024	0.00017	0.00032	0.00085	<0.00010	0.00014	<0.00010	0.000105	0.00024	0.00014	<0.00010	0.00014
	Copper (Cu)	mg/L	0.002	0.0024	0.0014	0.0013	0.0019	0.003	0.00102	0.00117	0.00107	0.00117	0.00164	0.00133	0.00143	0.00146
	Iron (Fe)	mg/L	0.30	0.874	0.559	0.367	0.75	2.01	0.16	0.146	0.158	0.159	0.304	0.209	0.133	0.244
	Lead (Pb)	mg/L	0.001	0.001	0.00044	0.00033	0.00052	0.00141	0.00019	0.00032	0.000179	0.0002155	0.000489	0.000299	0.000166	0.00028
	Lithium (Li)	mg/L	-	-	0.0011	<0.0010	0.0012	0.003	<0.0010	0.0012	<0.0010	0.00115	0.0013	0.001	<0.0010	0.0012
	Magnesium (Mg)	mg/L	-	-	7.53	8.21	8.17	8.44	8.17	13.7	8.17	7.99	8.17	8.24	7.84	7.44
	Manganese (Mn)	mg/L	0.935 ^β	-	0.0066	0.0046	0.0085	0.0221	0.0022	0.0057	0.0020	0.0031	0.0075	0.0045	0.0021	0.0042
	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	-	0.00041	0.00034	0.00044	0.00043	0.00034	0.00021	0.00031	0.00038	0.00024	0.00030	0.00041	0.00039
	Nickel (Ni)	mg/L	0.025	0.025	0.00083	0.0006	0.00111	0.00279	<0.00050	0.00086	<0.00050	0.00059	0.0011	0.00087	0.00057	0.00085
	Potassium (K)	mg/L	-	-	1.4	1.27	1.5	2.12	1.09	1.12	1.11	1.01	1.04	1.02	1.02	0.97
	Selenium (Se)	mg/L	0.001	-	<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	-	-	1.72	1.29	2.47	5.78	1.14	1.22	1.18	1.12	1.19	1.19	1.2	1.26
	Silver (Ag)	mg/L	0.00025	0.0001	<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	-	-	3.38	3.24	3.24	2.87	2.39	1.48	2.43	2.53	2.62	2.44	2.25	2.21
	Strontium (Sr)	mg/L	-	-	0.0166	0.0158	0.0166	0.0164	0.0141	0.0151	0.0142	0.015	0.0146	0.0141	0.0137	0.013
	Thallium (Tl)	mg/L	0.0008	0.0008	0.000014	0.000011	0.000017	0.000043	<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	-	-	0.0326	0.022	0.0449	0.133	<0.010	<0.010	<0.010	<0.010	0.015	0.011	<0.010	0.013
	Uranium (U)	mg/L	0.015	-	0.00437	0.00408	0.00388	0.00339	0.00301	0.00254	0.00304	0.00294	0.0029	0.00271	0.00253	0.00233
	Vanadium (V)	mg/L	0.006 ^α	0.006	0.00126	0.00091	0.00158	0.00393	<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	0.0049	<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 2.3 for information regarding WQG criteria.

^b AEMP Water Quality Benchmarks developed by Intrinsik (2013) using background water quality data. The values are specific to the Mary River system.

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table B.52: Dissolved metal concentrations at Mary River water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Spring Sampling Event											Summer Sampling Event							
			G0-09-A	G0-09	G0-09-B	G0-03	G0-01	E0-03	E0-20	E0-21	C010	C0-05	C0-01	G0-09-A	G0-09	G0-09-B	G0-03	G0-01	F0-01	E0-10	
			29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	29-Jun-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015	19-Jul-2015
Dissolved Metals	Aluminum (Al)	mg/L	0.0308	0.0134	0.0184	0.0169	0.00836	0.0157	0.0148	0.0149	0.0157	0.01365	0.0154	0.0086	0.0256	0.0286	0.0190	0.0148	0.0052	0.0191	
	Antimony (Sb)	mg/L	<0.000020	<0.000020	<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	<0.00010	
	Arsenic (As)	mg/L	0.000034	0.000035	0.000031	0.000029	0.00003	0.000029	0.000037	0.000032	0.00003	0.00003	0.00003	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Barium (Ba)	mg/L	0.00196	0.00168	0.00177	0.00192	0.00187	0.00181	0.00184	0.00184	0.00193	0.002315	0.00232	0.0059	0.0045	0.0046	0.0046	0.0052	0.0088	0.0051	
	Beryllium (Be)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
	Cadmium (Cd)	mg/L	0.0000205	<0.0000050	<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	<0.000010	
	Calcium (Ca)	mg/L	1.98	2.69	2.33	2.44	4.11	2.43	2.46	2.49	2.66	3.77	3.44	10	7	7	7	8	19	8	
	Chromium (Cr)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)	mg/L	0.0000218	0.0000111	0.0000145	0.0000131	0.0000093	0.0000131	0.0000102	0.000011	0.0000134	0.00001095	0.0000117	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)	mg/L	0.00059	0.00028	0.00038	0.00038	0.00025	0.00038	0.00038	0.00036	0.00038	0.00038	0.00038	0.0007	0.0006	0.0007	0.0006	0.0006	0.0007	0.0006	
	Iron (Fe)	mg/L	0.0178	0.0092	0.0102	0.0101	0.0054	0.0094	0.0087	0.0087	0.0091	0.0094	0.0112	<0.010	0.010	0.010	<0.010	<0.010	<0.010	<0.010	
	Lead (Pb)	mg/L	0.0000498	0.0000108	0.0000125	0.0000169	0.000017	0.0000129	0.0000133	0.0000129	0.0000126	0.00001265	0.0000149	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
	Magnesium (Mg)	mg/L	1.14	1.41	1.31	1.37	2.34	1.36	1.34	1.4	1.48	2.18	1.97	5.6	3.855	3.71	3.86	4.7	10.3	4.31	
	Manganese (Mn)	mg/L	0.00151	0.00109	0.00126	0.000904	0.000382	0.000782	0.000686	0.00075	0.000679	0.0007875	0.000819	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	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	0.000053	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000097	0.000084	0.00018	0.00023	0.00022	0.00021	0.00023	0.00031	0.00022	
	Nickel (Ni)	mg/L	0.00011	<0.000090	0.000129	0.000123	<0.000090	0.000099	0.000122	0.000114	0.000172	0.0002035	0.000207	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Potassium (K)	mg/L	0.425	0.278	0.32	0.296	0.253	0.278	0.274	0.287	0.293	0.37	0.347	0.73	0.66	0.64	0.62	0.65	0.93	0.66	
	Selenium (Se)	mg/L	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Silicon (Si)	mg/L	0.336	0.301	0.322	0.312	0.254	0.293	0.29	0.29	0.303	0.335	0.314	0.68	0.54	0.56	0.52	0.54	0.74	0.53	
	Silver (Ag)	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Sodium (Na)	mg/L	0.405	0.218	0.32	0.27	0.187	0.265	0.293	0.28	0.315	0.428	0.394	1.630	1.100	1.080	0.990	0.990	1.180	1.020	
	Strontium (Sr)	mg/L	0.00212	0.00181	0.00203	0.00199	0.00214	0.0019	0.00196	0.00194	0.00208	0.0028	0.00265	0.009	0.007	0.007	0.007	0.007	0.013	0.007	
Thallium (Tl)	mg/L	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010		
Tin (Sn)	mg/L	0.000147	<0.000030	<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	<0.00010		
Titanium (Ti)	mg/L	0.00092	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00030	0.0005	0.0006	0.0004	0.0004	<0.00030	0.0004		
Uranium (U)	mg/L	0.000123	0.00008	0.000109	0.0000915	0.0000603	0.0000839	0.0000816	0.000083	0.0000904	0.0001575	0.000133	0.0010	0.0009	0.0008	0.0006	0.0007	0.0017	0.0006		
Vanadium (V)	mg/L	0.000163	0.000117	0.000136	0.00012																

Table B.53: *In-situ* water quality profile data collected at Mary Lake water quality monitoring stations in winter^a, Mary River Project CREMP, 2015.

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)
3.25	0.8	114.4	7.4	96.0	2.95	1.1	105.3	6.5	94.0	2.95	1.1	108.8	7.4	94.0	3.10	0.8	108.9	7.5	93.0	3.15	0.9	112.0	7.7	95.0
4.25	1.3	115.3	7.4	95.0	3.95	1.6	102.6	6.5	88.0	3.95	1.4	109.1	7.4	89.0	4.10	1.3	108.5	7.5	90.0	4.15	1.4	110.1	7.6	91.0
5.25	1.5	114.8	7.4	93.0	4.95	1.7	102.1	6.6	87.0	4.95	1.7	105.4	7.4	87.0	5.10	1.6	104.9	7.5	88.0	5.15	1.6	108.0	7.5	89.0
6.25	1.2	112.4	7.4	92.0	5.95	1.7	101.5	6.6	86.0	5.95	1.8	103.4	7.4	86.0	6.10	1.8	103.7	7.4	86.0	6.15	1.8	107.0	7.5	88.0
6.55	1.7	113.0	7.4	93.0	6.95	1.8	100.8	6.7	86.0	6.95	1.8	102.6	7.4	86.0	7.10	1.8	102.8	7.4	85.0	7.15	1.8	106.4	7.5	88.0
					7.95	1.8	100.3	6.8	86.0	7.95	1.9	102.5	7.4	85.0	8.10	1.9	101.7	7.4	85.0	8.15	1.8	105.4	7.4	89.0
					8.95	1.8	100.0	6.8	86.0	8.95	1.9	101.2	7.4	85.0	9.10	1.9	100.7	7.4	85.0					
					9.95	1.8	99.5	6.8	86.0	9.95	1.9	100.5	7.4	84.0	10.10	1.9	100.3	7.4	84.0					
					10.95	1.8	99.1	6.9	86.0	10.95	1.9	99.7	7.4	84.0	11.10	1.9	99.5	7.4	84.0					
					11.95	1.9	98.1	6.8	85.0	11.95	1.9	99.2	7.4	84.0	12.10	1.9	98.8	7.4	84.0					
					12.95	1.9	98.3	6.9	85.0	12.95	2.0	98.2	7.4	84.0	13.10	2.0	98.4	7.4	83.0					
					13.95	1.9	98.0	6.9	85.0	13.95	2.0	97.8	7.4	83.0	14.10	2.0	98.1	7.4	83.0					
					14.95	1.9	97.2	6.9	84.0	14.95	2.0	96.7	7.4	83.0	15.10	2.0	97.4	7.4	83.0					
					15.95	2.0	96.0	6.9	84.0	15.95	2.0	96.1	7.3	83.0	16.10	2.0	97.0	7.4	83.0					
					16.20	2.0	95.8	6.9	84.0	16.95	2.0	95.7	7.3	83.0	17.10	2.1	96.3	7.3	82.0					
										17.95	2.1	94.7	7.3	82.0	18.10	2.1	95.1	7.4	82.0					
										18.95	2.1	94.0	7.3	82.0	19.10	2.1	94.3	7.3	82.0					
										19.95	2.1	91.4	7.3	82.0	20.10	2.1	92.2	7.3	82.0					
															21.10	2.1	91.1	7.3	83.0					
															22.10	2.1	90.3	7.3	83.0					
															23.10	2.2	90.3	7.3	83.0					
															24.10	2.2	87.1	7.2	83.0					
															25.10	2.3	84.1	7.2	85.0					
															26.10	2.3	80.5	7.2	84.0					
															27.10	2.4	75.5	7.2	84.0					
															28.10	2.4	72.1	7.1	85.0					
															29.10	2.4	68.9	7.1	85.0					

^a Sampling conducted on 28-April, 29-April and 30-April, 2015.

^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 not recorded 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 2, 2.05, 1.95, 2.15, 2.16, 2.25, 1.95, 1.95, 2.1, and 2.15 m, respectively, at the time of winter sampling.

^d Unreliable pH reading.

Table B.54: *In-situ* water quality profile data collected at Mary Lake water quality monitoring stations in summer^a, Mary River Project CREMP, 2015.

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	15.0	14.3	14.6	11.0	10.2	9.7	11.0	9.0	8.3	7.0	106.0	107.7	105.8	107.4	83.1	83.1	106.6	100.7	81.5	101.1
2.0	14.9	14.4	14.5	10.6	9.1	8.8	10.9	7.0	8.1	7.0	106.3	108.4	107.4	107.3	83.0	83.5	108.0	104.6	81.9	102.6
3.0	14.9	14.3	14.4	10.0	7.8	8.2	7.1	6.6	8.0	6.9	106.2	108.6	107.4	106.5	82.1	82.8	104.1	103.6	82.1	103.1
4.0	13.0	14.3	14.1*	7.0	7.4	7.7	6.3	6.5	7.2	6.9	105.6	108.7	107.8*	102.9	81.3	82.1	102.3	102.3	81.3	103.2
5.0	12.6	12.5		6.4	6.9	7.2	6.0	6.1	6.4	6.7	105.2	109.2		102.2	80.3	81.8	101.3	101.8	80.1	102.0
6.0	11.2	12.1		6.2	6.5	7.0	5.7	5.2	6.1		107.2	109.7		101.4	79.6	81.8	100.7	99.1	79.2	
7.0	10.6	11.1		5.7	6.2	6.6*	5.2	5.0	6.0		107.3	108.8		100.4	78.7	76.0*	100.0	98.4	79.0	
8.0	9.4	10.8		5.4	5.7		5.0	4.9	5.6		103.4	108.7		100.1	78.0		99.3	97.9	78.1	
9.0	9.2	9.0		5.1	5.4		4.8	4.8	5.4		102.0	104.0		99.0	77.2		98.7	97.5	77.6	
10.0	8.6			5.0	5.3		4.7	4.7	5.2		98.8			98.4	76.9		98.5	97.4	77.2	
11.0	8.2				5.1		4.5	4.7	5.1		94.4				76.4		97.9	97.2	76.8	
12.0	7.9				5.0		4.5	4.6	5.0		91.1				76.1		97.7	97.1	76.8	
13.0	7.7				4.9		4.5	4.6	4.9		89.5				75.8		97.6	97.0	76.6	
14.0	7.6				4.8		4.5	4.6	4.8		87.5				75.7		97.5	96.9	76.5	
15.0					4.7		4.5	4.5	4.8						75.6		97.5	96.5	76.4	
16.0					4.6		4.5	4.4	4.8						75.0		97.5	96.0	76.4	
17.0					4.5			4.3	4.7						75.3			95.9	74.4	
18.0					4.6			4.2	4.6						75.3			95.2	76.3	
19.0					4.5				4.5						75.0				76.1	
20.0					4.4*				4.4						75.0*				75.9	
21.0									4.4										75.8	
22.0									4.3										75.8	
23.0									4.3										75.8	
24.0									4.3										75.8	
25.0									4.2										75.5	
26.0									4.1										75.4	
27.0									4.1										75.4	
28.0									4.1										75.4	
29.0									4.1*										75.5*	

^a Sampling conducted on 26-July and 27-July, 2015.

^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, 9.8, 4.8, 11.7, 20.9, 14.2, 16.8, 20.7, 30.1, and 5.5 m, respectively, at the time of summer sampling.

* The deepest *in situ* water quality reading at stations BLO-01-B, BLO-05, BLO-05-B, and BLO-09 were taken at 3.8, 19.9, 6.3, and 29.1 m, respectively, at the time of summer sampling.

Table B.54: *In-situ* water quality profile data collected at Mary Lake water quality monitoring stations in summer^a, Mary River Project CREMP, 2015.

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	8.1	7.4	7.9	7.8	7.2	7.8	8.1	7.8	7.7	7.8	100.2	93.1	99.7	75.6	62.0	53.0	70.6	69.3	53.0	68.1
2.0	8.2	7.1	8.1	7.8	7.6	7.7	8.0	7.8	7.7	7.2	100.0	93.1	99.2	75.4	53.0	53.0	70.7	68.4	53.0	68.2
3.0	8.2	7.9	8.1	7.8	7.6	7.7	8.0	7.8	7.7	7.7	100.2	93.2	98.6	75.0	53.0	53.0	69.9	68.0	53.0	69.2
4.0	8.2	7.9	8.2*	7.9	7.6	7.7	8.0	7.8	7.6	7.7	97.8	93.1	93.1*	73.0	54.0	53.0	69.6	68.0	53.0	68.2
5.0	8.2	8.1		7.9	7.5	7.7	7.9	7.7	7.6	7.7	90.7	87.9		69.3	53.0	53.0	69.3	68.3	53.0	69.1
6.0	8.3	8.1		7.8	7.5	7.6	7.9	7.7	7.6		80.0	84.2		69.0	53.0	53.0	69.5	68.8	53.0	
7.0	8.3	8.1		7.8	7.5	7.7*	7.8	7.7	7.6		79.9	80.4		68.8	53.0	53.0*	69.9	68.4	53.0	
8.0	8.1	8.2		7.8	7.5		7.8	7.6	7.6		74.9	79.4		68.9	52.0		70.3	68.1	54.0	
9.0	8.0	8.1		7.7	7.5		7.8	7.6	7.5		73.9	73.3		68.9	53.0		70.8	67.9	53.0	
10.0	7.9			7.7	7.5		7.8	7.6	7.5		71.6			69.5	54.0		70.9	68.1	54.0	
11.0	7.8				7.5		7.7	7.6	7.5		70.4				54.0		71.6	68.1	54.0	
12.0	7.8				7.5		7.7	7.6	7.5		69.8				54.0		71.7	68.2	54.0	
13.0	7.7				7.5		7.7	7.6	7.5		69.5				54.0		71.7	68.3	54.0	
14.0	7.7				7.4		7.7	7.6	7.5		69.5				54.0		71.8	68.4	54.0	
15.0					7.4		7.7	7.5	7.5						54.0		71.8	68.9	54.0	
16.0					7.4		7.7	7.5	7.5						54.0		71.9	69.?	54.0	
17.0					7.4			7.5	7.4						54.0			69.5	54.0	
18.0					7.4			7.5	7.4						55.0			70.3	54.0	
19.0					7.4				7.4						55.0				55.0	
20.0					7.4*				7.4						55.0*				55.0	
21.0									7.4										55.0	
22.0									7.4										55.0	
23.0									7.4										55.0	
24.0									7.4										55.0	
25.0									7.4										55.0	
26.0									7.4										56.0	
27.0									7.4										56.0	
28.0									7.3										56.0	
29.0									7.3*										56.0*	

^a Sampling conducted on 26-July and 27-July, 2015.

^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, 9.8, 4.8, 11.7, 20.9, 14.2, 16.8, 20.7, 30.1, and 5.5 m, respectively, at the time of summer sampling.

* The deepest *in situ* water quality reading at stations BLO-01-B, BLO-05, BLO-05-B, and BLO-09 were taken at 3.8, 19.9, 6.3, and 29.1 m, respectively, at the time of summer sampling.

Table B.55: *In-situ* water quality profile data collected at Mary Lake water quality monitoring stations in fall ^a, Mary River Project CREMP, 2015.

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 ^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	8.6	8.5	8.5	7.7	8.3	8.4	9.0	8.5	8.2	8.7	103.2	104.1	97.4	100.6	104.8	104.3	105.4	104.2	103.3	105.1
2.0	8.2	8.4	8.1	7.7	8.2	8.1	8.9	8.0	8.0	8.6	104.0	104.7	100.2	100.6	104.1	103.8	105.3	103.0	103.0	105.1
3.0	8.0	8.0	7.9	7.6	8.1	7.7	8.8	7.6	7.8	8.3	104.3	104.3	100.7	100.6	103.9	103.1	104.3	102.1	102.8	104.8
4.0	7.9	7.9	7.8	7.6	8.0	7.5	8.6	7.5	7.8	8.2	104.4	103.9	100.2	100.5	103.7	102.3	103.9	101.3	102.7	104.5
5.0	7.9	7.7		7.5	8.0	7.3	8.4	7.2	7.7	8.1	104.5	103.1		100.2	103.5	101.5	103.5	100.3	102.6	104.1
6.0	7.8	7.7		7.3	7.6	7.3	7.9	7.1	7.6	8.0	104.5	102.9		99.8	103.1	101.4	102.5	99.9	102.4	103.9
7.0	7.7	7.6		7.3	7.4	7.3*	7.8	7.0	7.6	7.9*	104.4	102.4		99.8	102.0	101.3*	102.1	99.6	102.1	89.0*
8.0	7.6	7.5		7.2	7.2		7.7	7.0	7.4		104.3	102.1		99.2	101.2		102.0	99.4	101/5	
9.0	7.6	7.5*		6.9	7.1		7.6	6.9	7.4		104.2	101.7*		98.9	101.6		101.9	99.1	101.1	
10.0	7.6			6.9	7.1		7.6	6.9	7.3		104.1			98.6	100.8		101.7	98.9	100.9	
11.0	7.6			6.9	7.1		7.6	6.9	7.2		104.0			98.6	100.6		101.5	98.7	100.4	
12.0	7.5				7.0		7.4	6.9	7.1		103.9				100.4		101.4	98.7	100.0	
13.0	7.5				6.9		7.5	6.9	7.1		103.8				100.2		101.3	98.6	99.8	
14.0	7.4*				7.0		7.5*	6.9	7.0		103.3*				99.9		101.2*	98.5	99.5	
15.0					6.9			6.9	7.0						99.7			98.3	99.1	
16.0					6.9			6.9	7.0						99.3			98.0	98.9	
17.0					6.9			6.8	6.9						99.3			97.7	98.7	
18.0					6.9			6.8	6.9						99.1			97.3	98.5	
19.0					6.8			6.8	6.9						98.9			97.1	98.5	
20.0					6.8			6.7*	6.8						98.1			97.1*	98.6	
21.0									6.8										98.2	
22.0									6.8										98.1	
23.0									6.8										97.9	
24.0									6.7										97.6	
25.0									6.7										97.2	
26.0									6.7										96.7	
27.0									6.7										96.5	
28.0									6.7										96.2	
29.0									6.6										96.0	

^a Sampling conducted on 23-August and 24-August, 2015.

^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 14.65, 10, 5, 11.3, 21, 7.5, 14.6, 20.4, 30, and 6.8 m, respectively, at the time of fall sampling.

* The deepest *in situ* water quality reading at stations BLO-01A, BLO-1, BLO-05A, BLO-05B, BLO-03, BLO-04, and BLO-06 were taken at 13.7, 9.0, 10.3, 6.5, 13.6, 19.4, and 6.8 m, respectively, at the time of fall sampling.

Table B.55: *In-situ* water quality profile data collected at Mary Lake water quality monitoring stations in fall^a, Mary River Project CREMP, 2015.

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	7.7	7.9	7.8	7.8	7.7	7.6	7.8	7.8	7.8	7.7	145.0	143.0	146.0	80.2	71.0	71.0	73.1	74.8	75.2	69.0
2.0	7.8	7.9	7.9	7.8	7.6	7.6	7.8	7.8	7.8	7.7	145.0	143.0	148.0	80.2	72.0	71.0	73.2	76.0	74.8	69.0
3.0	7.9	8.0	7.9	7.8	7.7	7.6	7.8	7.8	7.8	7.7	146.0	143.0	147.0	80.3	73.0	71.0	73.2	75.6	74.8	69.0
4.0	7.8	8.0	8.0	7.8	7.6	7.6	7.8	7.8	7.8	7.7	147.0	146.0	145.0	80.2	75.0	71.0	73.5	75.4	74.4	69.0
5.0	7.9	8.0		7.7	7.6	7.6	7.8	7.8	7.8	7.7	148.0	149.0		80.1	76.0	71.0	73.4	75.6	74.1	69.0
6.0	7.9	8.0		7.7	7.6	7.6	7.8	7.7	7.7	7.7	149.0	150.0		80.4	81.0	71.0	72.9	75.4	74.0	69.0
7.0	7.9	8.0		7.7	7.7	7.6*	7.8	7.7	7.7	7.6*	147.0	150.0		80.8	75.0	71.0*	72.9	75.1	73.7	69.0*
8.0	7.9	8.0		7.7	7.6		7.8	7.7	7.7		149.0	149.0		81.2	71.0		72.8	75.4	73.4	
9.0	7.9	8.0*		7.7	7.6		7.7	7.7	7.7		149.0	149.0*		80.9	71.0		72.8	76.3	73.3	
10.0	7.9			7.7	7.6		7.7	7.7	7.7		149.0			80.7	72.0		72.8	77.0	73.3	
11.0	7.9			7.7	7.6		7.7	7.7	7.7		149.0			80.6	75.0		72.7	77.6	73.4	
12.0	7.9				7.6		7.7	7.7	7.6		149.0				77.0		72.6	78.6	73.3	
13.0	7.9				7.6		7.7	7.7	7.6		149.0				73.0		72.6	79.9	73.4	
14.0	7.9*				7.6		7.7*	7.7	7.6		149.0*				70.0		72.6*	80.9	73.5	
15.0					7.6			7.7	7.6						72.0			80.9	73.8	
16.0					7.6			7.6	7.6						72.0			80.9	73.8	
17.0					7.6			7.6	7.6						72.0			80.7	74.0	
18.0					7.6			7.6	7.6						72.0			80.3	74.2	
19.0					7.6			7.6	7.6						74.0			79.8	74.6	
20.0					7.5			7.6*	7.6						79.0			79.6*	74.8	
21.0									7.6										75.3	
22.0									7.6										75.5	
23.0									7.6										75.8	
24.0									7.6										76.8	
25.0									7.6										77.5	
26.0									7.6										77.8	
27.0									7.6										78.3	
28.0									7.6										80.5	
29.0									7.6										80.8	

^a Sampling conducted on 23-August and 24-August, 2015.

^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 14.65, 10, 5, 11.3, 21, 7.5, 14.6, 20.4, 30, and 6.8 m, respectively, at the time of fall sampling.

* The deepest *in situ* water quality reading at stations BLO-01A, BLO-1, BLO-05A, BLO-05B, BLO-03, BLO-04, and BLO-06 were taken at 13.7, 9.0, 10.3, 6.5, 13.6, 19.4, and 6.8 m, respectively, at the time of fall sampling.

Table B.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 2015.

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Colour/ Clarity	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
								(mg/L)	(% sat.)		
Littoral (Shallow) Stations	BLO-01	21-Aug-15	9.9	5.38	clear, slight blue-green colour	surface	8.48	11.66	99.6	7.99	141
						bottom	7.29	11.53	95.8	7.80	142
	BLO-11	20-Aug-15	9.3	4.44	clear, colourless, possibly very slight turbidity	surface	8.46	11.89	100.7	7.41	68
						bottom	7.42	12.55	106.0	7.47	72
	BLO-7	21-Aug-15	12.8	3.15	clear, slight blue-green colour	surface	7.38	11.90	99.0	7.62	68
						bottom	7.04	11.86	97.8	7.55	69
	BLO-6	20-Aug-15	6.7	3.16	clear, slight blue-green colour	surface	7.47	11.85	98.8	7.78	68
						bottom	7.00	9.42	80.8	7.60	76
	BLO-3	20-Aug-15	16.4	5.13	clear, slight blue-green colour	surface	8.15	12.10	102.5	7.46	67
						bottom	7.11	12.14	100.7	7.49	66
Profundal (Deep) Stations	BLO-15	20-Aug-15	29.1	4.85	clear, slight blue-green colour	surface	8.08	12.00	101.3	7.71	67
						bottom	6.69	11.26	91.1	7.28	68
	BLO-14	20-Aug-15	19.5	4.92	clear, slight blue-green colour	surface	7.87	11.93	100.3	7.78	67
						bottom	6.95	11.72	96.4	7.62	67
	BLO-13	20-Aug-15	21.8	4.86	clear, slight blue-green colour	surface	8.62	11.81	101.2	7.90	72
						bottom	6.95	11.67	96.1	7.68	78
	BLO-4	20-Aug-15	21.5	4.21	clear, slight blue-green colour	surface	8.40	11.77	100.3	7.60	70
						bottom	7.07	11.81	97.6	7.58	77
	BLO-5	20-Aug-15	21.5	4.76	clear, slight blue-green colour	surface	8.70	11.70	100.4	7.71	76
						bottom	7.60	11.12	93.1	6.96	75

Table B.57: Statistical comparison of bottom in-situ water quality between littoral and profundal stations of Mary Lake, Mary River Project CREMP, August 2015.

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
Mary Lake	Secchi Depth (m)	NO	0.137	δ	Littoral	4	4.03	1.08	0.54	3.15	5.38
					Profundal	6	4.78	0.31	0.13	4.21	5.13
	Temperature (°C)	NO	0.489	α	Littoral	4	7.19	0.20	0.10	7.00	7.42
					Profundal	6	7.06	0.30	0.12	6.69	7.60
	Dissolved Oxygen (mg/L)	NO	0.634	α	Littoral	4	11.3	1.3	0.7	9.4	12.6
					Profundal	6	11.6	0.4	0.2	11.1	12.1
	Dissolved Oxygen (% saturation)	NO	0.874	α	Littoral	4	95.1	10.5	5.3	80.8	106.0
					Profundal	6	95.8	3.4	1.4	91.1	100.7
	pH (units)	NO	0.287	α	Littoral	4	7.61	0.14	0.07	7.47	7.80
					Profundal	6	7.44	0.27	0.11	6.96	7.68
	Specific Conductance (umho/cm)	NO	0.239	γ	Littoral	4	89.8	35.0	17.5	69.0	142.0
					Profundal	6	71.8	5.4	2.2	66.0	78.0

^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 confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed using t-test assuming unequal variance.



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

Table B.58: Water chemistry at Mary Lake north basin (BLO-01) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Winter Sampling Event						Spring	Summer Sampling Event						
					BL0-01A surface	BL0-01A bottom	BL0-01 surface	BL0-01 bottom	BL0-01B surface	BL0-01B bottom	I0-01 river	I0-01 river	BL0-01A surface	BL0-01A bottom	BL0-01 surface	BL0-01 bottom	BL0-01B surface	BL0-01B bottom
					28-Apr-2015	28-Apr-2015	28-Apr-2015	28-Apr-2015	28-Apr-2015	28-Apr-2015	24-Jun-2015	17-Jul-2015	26-Jul-2015	26-Jul-2015	26-Jul-2015	26-Jul-2015	26-Jul-2015	26-Jul-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	198	193	201.5	197	200	198	55.2	112	82.9	58.4	77.4	66.6	81.1	79.9
	pH (lab)	pH	6.5 - 9.0	-	8.1	7.89	8.05	8.085	8.06	8.05	7.75	7.93	8.01	7.65	7.92	8	8.03	8
	Hardness (as CaCO ₃)	mg/L	-	-	95	93	99	93.5	95	96	26	52	44	32	41	35	43	44
	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	-	-	105	116	103.5	100.5	114	100	39	45	61	45	47	42	49	52
	Turbidity	NTU	-	-	0.17	0.96	0.21	0.17	0.16	0.2	1.11	0.39	0.63	1.16	0.71	0.93	0.65	0.66
	Alkalinity (as CaCO ₃)	mg/L	-	-	101	94	101.5	100	103	100	25	54	45	29	43	36	46	45
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	0.056	<0.050	<0.050	0.0615	<0.050	<0.050	<0.050	0.219	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Nitrate	mg/L	13	13	0.042	0.16	0.036	0.0325	0.045	0.045	<0.020	0.037	<0.020	<0.020	<0.020	<0.020	<0.020	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	<0.0050	0.0062
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.39	0.32	0.34	0.27	0.2	0.3	<0.15	0.22	0.31	0.17	0.21	<0.15	<0.15	0.24
	Dissolved Organic Carbon	mg/L	-	-	1.1	<1.0	1.2	1.15	1.1	1.1	1.9	1.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Organic Carbon	mg/L	-	-	1.2	1.1	1.8	1.35	1.1	1.3	2.2	1.1	1.1	<1.0	1.1	<1.0	<1.0	1
	Total Phosphorus	mg/L	0.020 ^α	-	0.0036	0.0055	0.01195	0.0037	0.0082	0.0057	0.0076	0.0035	0.0036	0.0048	0.0034	0.0043	0.0032	0.0044
	Phenols	mg/L	0.001 ^α	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0016	<0.0010	0.0027	0.0023	0.0028	0.0015	0.0016	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	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.54	3.44	3.6	3.515	3.56	3.51	1.03	1.24	1.09	0.7	1.07	0.88	1.1	2.41
	Sulphate (SO ₄)	mg/L	218 ^β	218	2.13	1.61	2.17	2.135	2.15	2.12	0.51	0.73	0.6	0.4	0.65	0.48	0.59	2.1
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.0035	<0.0030	0.02055	0.00315	<0.0030	<0.0030	0.0387	0.0112	0.0172	0.0307	0.0214	0.0225	0.0191	0.0201
	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	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00939	0.00871	0.00991	0.00928	0.00986	0.00955	0.00308	0.00562	0.00485	0.00366	0.00464	0.00383	0.00469	0.00475
	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	0.000022	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	18.2	18.1	19.2	18.1	20	20.8	5.36	10.7	9.34	6.47	8.96	7.48	9.46	8.77
	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	0.00109	0.00082	0.001165	0.00118	0.00106	0.0011	0.00107	0.0007	0.00074	0.00061	0.00107	0.00078	0.0007	0.0007
	Iron (Fe)	mg/L	0.30	0.30	<0.030	0.106	<0.030	<0.030	<0.030	<0.030	0.032	<0.030	<0.030	0.046	<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	0.000057	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.001	<0.0010	0.0011	0.0011	0.0011	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	11.8	11.6	12.4	11.5	11.9	12.1	3.06	6.14	5.32	3.58	4.84	4.05	5.05	5.12
	Manganese (Mn)	mg/L	0.935 ^β	-	0.0014	0.028	0.001695	0.0014	0.00229	0.00297	0.00101	0.000219	0.0016	0.00444	0.00185	0.0019	0.00162	0.00164
	Mercury (Hg)	mg/L	0.000026	-	0.000021	0.000018	0.0000245	0.000018	<0.000010	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000266	0.000205	0.000278	0.0002675	0.000278	0.000261	<0.000050	0.000143	0.000133	0.000076	0.000129	0.000099	0.000137	0.000133
	Nickel (Ni)	mg/L	0.025	0.025	0.00057	0.00068	0.00069	0.000555	0.00057	0.00058	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	1.04	0.99	1.1	1.035	1.13	1.16	0.48	0.74	0.63	0.44	0.63	0.51	0.61	0.61
	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	-	-	1.06	1.92	1.11	1.025	1.14	1.13	0.44	0.49	0.42	0.52	0.41	0.44	0.41	0.41
	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	-	-	2.48	2.44	2.715	2.485	2.6	2.58	0.634	1.22	0.918	0.551	0.893	0.693	0.902	0.902
	Strontium (Sr)	mg/L	-	-	0.014	0.0137	0.01435	0.01385	0.015	0.0147	0.00334	0.00702	0.00597	0.00401	0.00583	0.00475	0.00611	0.00571
	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	-	0.00197	0.00148	0.00205	0.001975	0.00206	0.00193	0.000138	0.00073	0.00046	0.000191	0.000422	0.000304	0.000467	0.00046
	Vanadium (V)	mg/L	0.006 ^α	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<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	0.0036	<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 2.3 for information regarding WQG criteria.

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

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD

 Indicates parameter concentration above the AEMP benchmark.

Table B.58: Water chemistry at Mary Lake north basin (BLO-01) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Fall Sampling Event						
					I0-01 river	BL0-01A surface	BL0-01A bottom	BL0-01 surface	BL0-01 bottom	BL0-01B surface	BL0-01B bottom
					16-Aug-2015	24-Aug-2015	24-Aug-2015	24-Aug-2015	24-Aug-2015	24-Aug-2015	24-Aug-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	155	146	149	144	150	147	148
	pH (lab)	pH	6.5 - 9.0	-	8.02	7.73	8.07	8.08	8.07	8.1	8.06
	Hardness (as CaCO ₃)	mg/L	-	-	76	71	73	71	73	70.5	72
	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	-	-	98	67	72	74	79	74.5	77.5
	Turbidity	NTU	-	-	1.2	0.86	1.08	0.64	0.6	0.78	0.66
	Alkalinity (as CaCO ₃)	mg/L	-	-	78	69	72	69	69	68	69.5
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	<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	<0.020
	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	-	-	0.21	0.2	0.19	<0.15	<0.15	0.155	2.355
	Dissolved Organic Carbon	mg/L	-	-	2.4	2.1	2	1.9	2	1.95	1.95
	Total Organic Carbon	mg/L	-	-	2	2.2	2	2	2	1.95	2
	Total Phosphorus	mg/L	0.020 ^α	-	0.0037	0.0039	0.004	0.0037	0.0043	0.0033	0.00385
	Phenols	mg/L	0.001 ^α	-	0.0021	<0.0010	<0.0010	<0.0010	<0.0010	0.00145	0.00145
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	2.36	2.52	2.68	2.44	2.69	2.595	2.555
	Sulphate (SO ₄)	mg/L	218 ^β	218	1.54	1.36	1.43	1.38	1.43	1.395	1.37
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.0352	0.0194	0.0149	0.0169	0.0138	0.01705	0.0187
	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	-	-	0.0074	0.00693	0.00714	0.00666	0.0071	0.006935	0.006905
	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	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	16.1	14.5	14.9	14.3	14.7	14.15	14.95
	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	0.00089	0.00093	0.00089	0.00086	0.00096	0.000905	0.00094
	Iron (Fe)	mg/L	0.30	0.30	<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
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	9.58	8.38	8.59	8.18	8.79	8.555	8.475
	Manganese (Mn)	mg/L	0.935 ^β	-	0.000583	0.00195	0.00212	0.00177	0.0024	0.00177	0.001935
	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	-	0.000214	0.000195	0.000208	0.000198	0.000194	0.0001865	0.0001965
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.79	0.83	0.85	0.79	0.85	0.835	0.83
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.9	0.69	0.68	0.69	0.69	0.685	0.695
	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	-	-	2.03	1.78	1.86	1.73	1.89	1.825	1.815
	Strontium (Sr)	mg/L	-	-	0.0105	0.00951	0.00999	0.00945	0.00992	0.00951	0.01002
	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	-	0.00172	0.00147	0.00151	0.00144	0.00149	0.00143	0.00143
	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 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 2.3

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

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD

 Indicates parameter concentration above the AEMP benchmark.

Table B.59: Water chemistry at Mary Lake south basin (BLO) water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Winter Sampling Event													
					BL0-05-A surface 30-Apr-2015	BL0-05-A bottom 30-Apr-2015	BL0-05 surface 30-Apr-2015	BL0-05 bottom 30-Apr-2015	BL0-05-B surface 30-Apr-2015	BL0-05-B bottom 30-Apr-2015	BL0-03 surface 29-Apr-2015	BL0-03 bottom 29-Apr-2015	BL0-04 surface 29-Apr-2015	BL0-04 bottom 29-Apr-2015	BL0-09 surface 29-Apr-2015	BL0-09 bottom 29-Apr-2015	BL0-06 surface 29-Apr-2015	BL0-06 bottom 29-Apr-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	91.7	87.7	93.7	89.5	95.6	94.1	88.4	81.1	91.4	88.5	89.7	81.5	90.85	86.65
	pH (lab)	pH	6.5 - 9.0	-	7.83	7.81	7.71	7.79	7.76	7.88	7.74	7.82	7.8	7.93	7.9	7.75	7.925	7.91
	Hardness (as CaCO ₃)	mg/L	-	-	41	40	41	39	44	44	42	39	43	42	42	38	43	41
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	50	45	47	50	50	53	59	65	72	70	67	67	61.5	68
	Turbidity	NTU	-	-	0.13	0.13	0.16	0.13	0.29	0.2	0.12	0.19	0.15	0.11	0.22	0.33	0.175	0.155
	Alkalinity (as CaCO ₃)	mg/L	-	-	41	37	42	40	43	42	41	39	43	40	40	36	41.5	40
Nutrients and Organics	Total Ammonia	mg/L	variable ^c	0.855	<0.050	<0.050	<0.050	0.067	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.068	<0.050	<0.050
	Nitrate	mg/L	13	13	0.028	0.028	0.027	0.028	<0.020	<0.020	0.029	0.032	0.028	0.029	0.03	0.086	0.0225	0.025
	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	0.28	<0.15	<0.15	<0.15	0.28	0.32	<0.15	<0.15	<0.15	<0.15	0.63	0.22
	Dissolved Organic Carbon	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.25
	Total Organic Carbon	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	1.35	<1.0
	Total Phosphorus	mg/L	0.020 ^{a,d}	-	0.0039	<0.0030	0.0038	0.003	0.0107	0.0034	0.0054	0.0032	0.0042	0.0033	0.0052	0.0031	0.0087	0.00355
Anions	Phenols	mg/L	0.001 ^a	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	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	1.75	1.7	1.8	1.74	1.92	1.84	1.84	1.85	1.88	1.82	1.9	2.08	1.86	1.79
Total Metals	Sulphate (SO ₄)	mg/L	218 ^{B,e}	218	1.11	1.09	1.16	1.13	1.21	1.17	1.19	1.15	1.24	1.24	1.27	1.12	1.255	1.225
	Aluminum (Al)	mg/L	0.100	0.13	0.0046	0.0038	0.0034	0.004	0.0046	0.0044	0.0034	0.0036	<0.0030	0.0039	0.0043	0.011	0.0042	0.0039
	Antimony (Sb)	mg/L	0.020 ^a	-	<0.00010	<0.00010	<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	-	-	0.00477	0.00453	0.00469	0.00441	0.00489	0.00482	0.00477	0.00441	0.00486	0.00476	0.00496	0.00468	0.005085	0.004705
	Beryllium (Be)	mg/L	0.011 ^a	-	<0.00050	<0.00050	<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 ^f	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	-	-	8.31	7.99	8.25	7.76	9.01	8.82	8.26	7.52	8.46	7.82	8.51	7.36	8.435	8.145
	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 ^a	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 ^g	0.0024	0.00082	0.00067	0.00075	0.00061	0.00069	0.00076	0.00069	0.00064	0.00085	0.00069	0.00091	0.00067	0.00082	0.00069
	Iron (Fe)	mg/L	0.30	0.30	<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 ^h	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	-	-	4.94	4.83	4.85	4.74	5.31	5.26	5.26	4.81	5.39	5.16	5.43	4.81	5.465	5.12
	Manganese (Mn)	mg/L	0.935 ^{B,i}	-	0.000326	0.000317	0.000291	0.000264	0.000966	0.000372	0.000357	0.000306	0.000331	0.00036	0.0003	0.000663	0.0003005	0.000299
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000146	0.000142	0.00015	0.000143	0.000156	0.000144	0.000138	0.000129	0.000135	0.000146	0.000149	0.000128	0.000158	0.0001455
	Nickel (Ni)	mg/L	0.025 ^j	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	-	-	0.6	0.56	0.6	0.56	0.64	0.61	0.63	0.57	0.66	0.63	0.68	0.59	0.675	0.63
	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	-	-	0.44	0.43	0.43	0.41	0.42	0.4	0.45	0.43	0.43	0.45	0.46	0.84	0.455	0.435
	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	-	-	1.26	1.14	1.12	1.1	1.24	1.23	1.22	1.11	1.24	1.21	1.24	1.28	1.27	1.195
	Strontium (Sr)	mg/L	-	-	0.00686	0.00662	0.0073	0.00675	0.00757	0.00715	0.00685	0.00632	0.00708	0.00681	0.00713	0.00665	0.00726	0.00677
	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	-	0.000672	0.000638	0.000675	0.000666	0.000697	0.000663	0.000622	0.000575	0.000627	0.000645	0.00067	0.000488	0.000681	0.000635
	Vanadium (V)	mg/L	0.006 ^a	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 2.3 for information regarding WQG criteria.

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

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD

 Indicates parameter concentration above the AEMP benchmark.

Table B.59: Water chemistry at lentic Mary Lake south basin (BLO) monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Summer Sampling Event													
					BL0-05-A surface	BL0-05-A bottom	BL0-05 surface	BL0-05 bottom	BL0-05-B surface	BL0-05-B bottom	BL0-03 surface	BL0-03 bottom	BL0-04 surface	BL0-04 bottom	BL0-09 surface	BL0-09 bottom	BL0-06 surface	BL0-06 bottom
					27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015
Conventional	Conductivity (lab)	umho/cm	-	-	57.5	62.4	62.15	58.6	56.5	56.6	63.2	60.1	57.5	57.7	56.1	59.3	56.85	57
	pH (lab)	pH	6.5 - 9.0	-	7.5	7.7	7.73	7.535	7.66	7.53	7.71	7.58	7.66	7.5	7.67	7.49	7.63	7.61
	Hardness (as CaCO ₃)	mg/L	-	-	28	31	34	29	30	30	32	31	30	30	27	31	30	30.5
	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
	Total Dissolved Solids (TDS)	mg/L	-	-	39	42	44.5	42.5	36	30	37	37	36	38	38	30	36	36
	Turbidity	NTU	-	-	2.47	4.26	4.105	2.49	1.61	1.97	1.11	1.36	1.2	2.26	2.25	3.01	2.24	2.09
	Alkalinity (as CaCO ₃)	mg/L	-	-	29	32	31	28	30	28	30	32	28	27	29	31	29.5	28
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	<0.050	<0.050	<0.050	<0.050	<0.050
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	0.0345	<0.020	<0.020	<0.020	<0.020	<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	<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	0.34	0.21	0.21	<0.15	0.2	5.37	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Organic Carbon	mg/L	-	-	<1.0	1.4	1	<1.0	1.5	<1.0	1.6	1.2	1	1.1	<1.0	<1.0	<1.0	<1.0
	Total Phosphorus	mg/L	0.020 ^{a,d}	-	0.0043	0.0041	0.00715	0.0061	0.0141	0.0037	0.0046	0.0041	0.0032	0.0043	0.0048	0.0051	0.00745	0.0047
Anions	Phenols	mg/L	0.001 ^a	-	0.0027	0.0028	0.0024	0.00265	0.0025	<0.0010	0.0036	0.0034	0.0016	0.0024	0.002	0.0023	0.004	0.00295
	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	1.32	1.26	1.295	1.34	1.18	1.23	1.25	1.26	<0.50	1.27	1.18	1.41	1.205	1.225
	Sulphate (SO ₄)	mg/L	218 ^{b,e}	218	0.76	0.84	0.84	0.76	0.71	0.72	0.64	0.7	<0.30	0.74	0.72	0.76	0.72	0.73
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.0683	0.105	0.152	0.0611	0.0488	0.0588	0.0232	0.0325	0.0376	0.0677	0.0494	0.0624	0.05975	0.05175
	Antimony (Sb)	mg/L	0.020 ^a	-	<0.00010	<0.00010	<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	-	-	0.00384	0.00426	0.005345	0.003825	0.00375	0.0038	0.00345	0.00352	0.00351	0.00405	0.00388	0.00378	0.00383	0.003775
	Beryllium (Be)	mg/L	0.011 ^a	-	<0.00050	<0.00050	<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 ^f	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	5.82	6.4	6.975	6.11	6.06	5.93	6.13	6.53	6.1	6.21	5.76	5.98	6.015	6.01
	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 ^a	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 ^g	0.0024	0.00065	0.00065	0.00077	0.000605	0.00056	0.00052	0.00086	0.00086	0.00054	0.00064	0.00052	0.00058	0.00057	0.000595
	Iron (Fe)	mg/L	0.30	0.30	0.056	0.076	0.1355	0.063	0.041	0.039	<0.030	<0.030	<0.030	0.059	0.041	0.06	0.043	0.0445
	Lead (Pb)	mg/L	0.001 ^h	0.001	0.000095	0.000103	0.0001645	0.000106	0.000067	0.000064	<0.000050	<0.000050	<0.000050	0.000097	0.000077	0.000112	0.000083	0.0000895
	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	-	-	3.35	3.65	3.985	3.435	3.57	3.42	3.7	3.82	3.81	3.78	3.23	3.48	3.515	3.615
	Manganese (Mn)	mg/L	0.935 ^{b,i}	-	0.00242	0.00263	0.00299	0.00287	0.0022	0.00181	0.00205	0.00202	0.00197	0.00277	0.00202	0.00315	0.00226	0.002275
	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	-	0.000095	0.000125	0.000163	0.0001065	0.000096	0.000106	0.000092	0.000098	0.00009	0.00011	0.000095	0.000104	0.0001035	0.00011
	Nickel (Ni)	mg/L	0.025 ^j	0.025	<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
	Potassium (K)	mg/L	-	-	0.51	0.58	0.68	0.51	0.48	0.48	0.51	0.48	0.47	0.5	0.49	0.52	0.48	0.485
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.54	0.58	0.69	0.55	0.47	0.49	0.39	0.46	0.44	0.54	0.46	0.55	0.5	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	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.796	0.872	1.0075	0.837	0.779	0.771	0.796	0.792	0.77	0.835	0.744	0.864	0.788	0.806
	Strontium (Sr)	mg/L	-	-	0.0046	0.00525	0.006145	0.004795	0.00461	0.00454	0.00437	0.00474	0.00442	0.00483	0.0045	0.00475	0.004585	0.004675
	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	-	0.000359	0.000452	0.000601	0.000379	0.000365	0.000346	0.000357	0.000369	0.000365	0.000373	0.000353	0.000365	0.000362	0.000364
	Vanadium (V)	mg/L	0.006 ^a	0.006	<0.0010	<0.0010	<0.0010	&										

^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 2.3 for information regarding WQG criteria.

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

 Indicates parameter concentration above applicable Water Quality Guideline.

 **BOLD** Indicates parameter concentration above the AEMP benchmark.

Table B.59: Water chemistry at lentic Mary Lake south basin (BLO) monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Water Quality Guideline (WQG) ^a	AEMP Benchmark ^b	Fall Sampling Event													
					BL0-05-A surface	BL0-05-A bottom	BL0-05 surface	BL0-05 bottom	BL0-05-B surface	BL0-05-B bottom	BL0-03 surface	BL0-03 bottom	BL0-04 surface	BL0-04 bottom	BL0-09 surface	BL0-09 bottom	BL0-06 surface	BL0-06 bottom
					23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015	23-Aug-2015
Conventionals	Conductivity (lab)	umho/cm	-	-	74.2	74.1	72.1	75.5	71.2	72.1	67.7	67.3	69.4	74	70.5	75.4	69.5	69
	pH (lab)	pH	6.5 - 9.0	-	7.72	7.71	7.76	7.73	7.7	7.73	7.74	7.74	7.74	7.69	7.71	7.67	7.655	7.715
	Hardness (as CaCO ₃)	mg/L	-	-	35	35	34	35	33	33	32	32	33	35	33	33	33	32
	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	-	-	31	31	30	35	38	36	27	28	24	30	33	33	32	34.5
	Turbidity	NTU	-	-	1.96	2.05	1.48	1.99	1.59	2.12	0.67	0.77	0.81	2.14	1.36	1.33	1.35	1.4
	Alkalinity (as CaCO ₃)	mg/L	-	-	37	33	33	35	32	33	32	33	33	35	32	31	30.5	30.5
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	<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	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.18	0.15	<0.15	<0.15	<0.15	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	<0.15	0.21	0.19
	Dissolved Organic Carbon	mg/L	-	-	1.5	1.6	1.7	1.6	1.6	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.5
	Total Organic Carbon	mg/L	-	-	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.6	1.6	1.6	1.7	1.6
	Total Phosphorus	mg/L	0.020 ^{a,d}	-	0.0071	0.0056	0.0045	0.0158	0.0039	0.0045	0.0041	0.0045	0.0041	0.0076	0.0046	0.0051	0.01535	0.0086
Anions	Phenols	mg/L	0.001 ^a	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.001665
	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	1.61	1.6	1.54	1.63	1.55	1.58	1.35	1.37	1.42	1.66	1.46	1.68	1.465	1.44
	Sulphate (SO ₄)	mg/L	218 ^{B,e}	218	1.12	1.11	1.04	1.12	1.05	1.07	0.83	0.85	0.89	1.16	0.97	1.15	0.97	0.96
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.0666	0.0616	0.0466	0.0666	0.0477	0.0553	0.0209	0.024	0.0279	0.0646	0.0486	0.184	0.0444	0.0471
	Antimony (Sb)	mg/L	0.020 ^a	-	<0.00010	<0.00010	<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	-	-	0.00436	0.00443	0.00406	0.00444	0.0041	0.00397	0.00354	0.0038	0.00374	0.00441	0.00387	0.0058	0.00389	0.003845
	Beryllium (Be)	mg/L	0.011 ^a	-	<0.00050	<0.00050	<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 ^f	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	-	-	7.21	7.04	6.95	7.12	7.03	6.7	6.73	6.74	6.71	7.06	6.76	7.25	6.595	6.665
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	0.00151	<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 ^a	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00018	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002 ^g	0.0024	0.00076	0.00065	0.00056	0.00063	0.00062	0.00058	0.00054	0.00056	0.00055	0.00065	0.00064	0.00112	0.000595	0.00057
	Iron (Fe)	mg/L	0.30	0.30	0.044	0.045	0.031	0.044	0.034	0.038	<0.030	<0.030	<0.030	0.045	0.033	0.24	0.03	0.0315
	Lead (Pb)	mg/L	0.001 ^h	0.001	0.000078	0.000066	<0.000050	0.000068	0.00005	0.000057	<0.000050	<0.000050	<0.000050	0.000072	0.000059	0.00048	0.000051	0.00005
	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	-	-	4.33	4.37	4.19	4.52	4.12	4.22	4.04	3.93	3.97	4.43	4.1	4.32	4.155	4.085
	Manganese (Mn)	mg/L	0.935 ^{B,i}	-	0.00232	0.00247	0.00131	0.00179	0.00128	0.0014	0.00108	0.00127	0.00119	0.00173	0.00131	0.0245	0.001235	0.0013
	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	-	0.000168	0.000156	0.00014	0.000155	0.000143	0.000132	0.000112	0.000118	0.000124	0.000139	0.000151	0.000102	0.0001285	0.0001295
	Nickel (Ni)	mg/L	0.025 ^j	0.025	<0.00050	0.00078	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00077	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.58	0.58	0.54	0.58	0.54	0.56	0.51	0.5	0.53	0.57	0.54	0.6	0.535	0.535
	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	-	-	0.52	0.53	0.46	0.53	0.45	0.47	0.38	0.38	0.42	0.54	0.46	0.63	0.45	0.47
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.989	1.01	0.946	1.03	0.943	0.942	0.857	0.846	0.873	1	0.901	0.975	0.915	0.908
	Strontium (Sr)	mg/L	-	-	0.00574	0.00562	0.00549	0.00579	0.0055	0.00526	0.00496	0.00496	0.00512	0.00565	0.00525	0.00586	0.005125	0.005265
	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	-	0.000627	0.000611	0.000546	0.000668	0.000552	0.000531	0.000417	0.000422	0.000458	0.000612	0.00049	0.000829	0.0004945	0.0004905
	Vanadium (V)	mg/L	0.006 ^a	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 2.3 for information regarding WQG criteria.

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

Indicates parameter concentration above applicable Water Quality Guideline.

BOLD

 Indicates parameter concentration above the AEMP benchmark.

Table B.60: Dissolved metal concentrations at Mary Lake north basin water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Winter Sampling Event						Spring Sampling	Summer Sampling Event							Fall Sampling Event						
			BL0-01A (S1) surface	BL0-01A (B1) bottom	BL0-01 (S1) surface	BL0-01 (B1) bottom	BL0-01B (S1) surface	BL0-01B (B1) bottom	I0-01 river	I0-01 river	BL0-01AS1 surface	BL0-01AB1 bottom	BL0-01S1 surface	BL0-01B1 bottom	BL0-01BS1 surface	BL0-01BB1 bottom	I0-01 river	BL0-01-A-S1 surface	BL0-01-A-B1 bottom	BL0-01-S1 surface	BL0-01-B1 bottom	BL0-01-B-S1 surface	BL0-01-B-B1 bottom
			28-Apr-2015	28-Apr-2015	28-Apr-2015	28-Apr-2015	28-Apr-2015	28-Apr-2015	24-Jun-2015	17-Jul-2015	26-Jul-2015	26-Jul-2015	26-Jul-2015	26-Jul-2015	26-Jul-2015	26-Jul-2015	16-Aug-2015	24-Aug-2015	24-Aug-2015	24-Aug-2015	24-Aug-2015	24-Aug-2015	24-Aug-2015
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	0.0031	<0.0030	0.003	0.00778	<0.0050	0.00575	0.00573	0.0056	0.00504	0.00526	0.00575	0.0053	0.00396	0.00336	0.00487	0.00382	0.00357	0.00348
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000020	<0.00010	<0.000020	<0.000020	0.00002	<0.000020	<0.000020	<0.000020	<0.00010	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Arsenic (As)	mg/L	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	0.000045	<0.00010	0.000049	0.000054	0.00013	0.000071	0.00004	0.000062	<0.00010	0.000056	0.000054	0.000056	0.000057	0.000058	0.000049
	Barium (Ba)	mg/L	0.00909	0.00887	0.009555	0.00914	0.00933	0.00973	0.00293	0.00575	0.00461	0.0035	0.00445	0.00368	0.00461	0.00454	0.00712	0.00687	0.007	0.00669	0.00698	0.00681	0.00682
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0000115	<0.000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.000010	<0.0000050	<0.0000050	0.0000187	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)	mg/L	18.4	19	18.7	18.2	18.6	19	5.43	10.8	9.23	6.47	8.31	7.29	8.81	8.91	15.3	14.3	14.9	14.4	14.9	14.4	14.5
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00050	<0.00010	0.00036	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.0000127	<0.00010	0.0000147	0.00001	0.0000144	0.0000094	0.000012	0.0000124	<0.00010	0.0000102	0.0000129	0.0000144	0.0000133	0.0000139	0.0000111
	Copper (Cu)	mg/L	0.0011	0.00093	0.001075	0.0011	0.00104	0.00109	0.00059	0.00073	0.00074	0.00086	0.00124	0.00072	0.0007	0.00072	0.00088	0.00087	0.00085	0.00084	0.00089	0.00084	0.000845
	Iron (Fe)	mg/L	<0.030	0.036	<0.030	<0.030	<0.030	<0.030	0.01	<0.010	0.0044	0.0121	0.0049	0.0041	0.0055	0.0044	<0.030	0.0051	0.0046	0.0052	0.0044	0.00445	0.00435
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.0000171	<0.000050	0.000009	0.0000152	0.0000169	0.0000114	0.0000111	<0.0000090	<0.000050	0.0000095	0.000015	0.0000169	<0.0000090	<0.0000090	<0.0000090
	Lithium (Li)	mg/L	<0.0010	<0.0010	0.00105	0.00105	<0.0010	0.001	<0.00050	<0.0010	0.00059	<0.00050	<0.00050	<0.00050	0.00054	<0.00050	<0.0010	0.00062	0.00067	0.00074	0.00067	0.00062	0.000705
	Magnesium (Mg)	mg/L	11.9	11.8	12.05	11.7	11.7	11.9	3.14	6.08	5.09	3.85	4.90	4.17	5.17	5.17	9.2	8.56	8.73	8.48	8.67	8.47	8.645
	Manganese (Mn)	mg/L	0.000701	0.0168	0.000777	0.000498	0.00124	0.00173	0.000476	<0.00050	0.000787	0.00147	0.000814	0.000491	0.000775	0.000733	0.000314	0.000305	0.000332	0.00032	0.000305	0.000303	0.000269
	Mercury (Hg)	mg/L	<0.000010	<0.000010	0.0000115	0.000011	<0.000010	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000264	0.000194	0.0002705	0.000263	0.000265	0.000274	0.000058	0.000161	0.000137	0.000085	0.000124	0.000106	0.000138	0.000122	0.000201	0.000195	0.0002	0.000196	0.00021	0.000193	0.0001985
	Nickel (Ni)	mg/L	0.00057	0.00069	0.00059	0.000535	0.00057	0.00059	0.000245	<0.00050	0.000291	0.000337	0.000418	0.000249	0.000273	0.000269	<0.00050	0.000318	0.000364	0.000329	0.000346	0.0003135	0.0003355
	Potassium (K)	mg/L	1.07	1.03	1.095	1.045	1.08	1.09	0.481	0.737	0.612	0.445	0.645	0.498	0.603	0.600	0.780	0.833	0.829	0.819	0.846	0.815	0.8355
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000040	<0.000050	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.0010	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040
	Silicon (Si)	mg/L	1.05	1.98	1.05	1.02	1.11	1.09	0.375	0.485	0.384	0.468	0.374	0.389	0.384	0.387	0.85	0.666	0.674	0.677	0.646	0.661	0.667
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Sodium (Na)	mg/L	2.56	2.56	2.62	2.57	2.59	2.61	0.644	1.20	0.935	0.569	0.924	0.697	0.899	0.896	2.03	1.83	1.89	1.80	1.89	1.81	1.85
	Strontium (Sr)	mg/L	0.0139	0.0138	0.0143	0.0137	0.0142	0.0145	0.0033	0.0073	0.00595	0.00398	0.00544	0.00468	0.00576	0.00576	0.0101	0.00961	0.00993	0.00945	0.0100	0.00960	0.00965
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.0000026	<0.000010	0.0000029	<0.0000020	0.0000028	0.0000021	0.0000028	0.0000024	<0.00010	0.000003	0.0000038	0.0000035	0.000004	0.000003	0.0000032
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000030	<0.00010	<0.000030	<0.000030	0.000041	<0.000030	<0.000030	<0.000030	<0.00010	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.00050	<0.00030	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Uranium (U)	mg/L	0.00197	0.00144	0.00205	0.00200	0.00199	0.00205	0.000138	0.00074	0.000482	0.000183	0.00041	0.000302	0.000471	0.000453	0.00175	0.00145	0.00154	0.00138	0.00152	0.00145	0.001455
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.000082	<0.00050	0.000166	0.000142	0.00014	0.000109	0.000141	0.000126	<0.0010	0.000133	0.000125	0.000139	0.000125	0.000122	0.000128
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.00112	0.0014	0.00191	0.00738	0.00501	0.00211	0.00207	0.00093	<0.0030	0.00093	0.00054	0.00128	0.00072	0.00054	0.000515

Table B.61: Dissolved metal concentrations at Mary Lake south basin water quality monitoring stations, Mary River Project CREMP, 2015.

Parameters		Units	Winter Sampling Event														Summer Sampling Event						
			BL0-05-A surface	BL0-05-A bottom	BL0-05 surface	BL0-05 bottom	BL0-05-B surface	BL0-05-B bottom	BL0-03 surface	BL0-03 bottom	BL0-04 surface	BL0-04 bottom	BL0-09 surface	BL0-09 bottom	BL0-06 surface	BL0-06 bottom	BL0-05-A surface	BL0-05-A bottom	BL0-05 surface	BL0-05 bottom	BL0-05-B surface	BL0-05-B bottom	BL0-03 surface
			30-Apr-2015	30-Apr-2015	30-Apr-2015	30-Apr-2015	30-Apr-2015	30-Apr-2015	29-Apr-2015	29-Apr-2015	29-Apr-2015	29-Apr-2015	29-Apr-2015	29-Apr-2015	29-Apr-2015	29-Apr-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015	27-Jul-2015
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	0.0034	0.0036	0.003	0.0031	<0.0030	<0.0030	<0.0030	<0.0030	0.0032	<0.0030	0.0038	0.0032	0.003	0.0066	0.0096	0.0126	0.0061	0.0065	0.0074	0.0068
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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	0.00469	0.00439	0.00464	0.00461	0.00512	0.00465	0.00481	0.00431	0.00482	0.00479	0.00482	0.0044	0.00494	0.00464	0.00319	0.00397	0.004495	0.00342	0.0035	0.00356	0.00333
	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	0.000018
	Calcium (Ca)	mg/L	8.33	8.13		8.32	9.46	8.7	8.25	7.77	8.35	8.21	8.16	7.54	8.445	7.955	5.84	6.44	7.055	6.01	6.08	6.04	6.28
	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	0.00072	0.00057	0.00068	0.00058	0.00067	0.00062	0.00072	0.00067	0.00076	0.00067	0.0006	0.00069	0.000735	0.000675	0.0006	0.00069	0.00089	0.00053	<0.00050	0.0005	0.00115
	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	<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	0.000127	<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	<0.0010
	Magnesium (Mg)	mg/L	4.8	4.61	5.03	4.89	5.55	5.19	5.08	4.86	5.32	5.29	5.13	4.75	5.37	5.07	3.27	3.72	3.955	3.46	3.64	3.65	3.86
	Manganese (Mn)	mg/L	0.00016	0.000177	0.000192	0.000167	0.000294	0.000156	0.000196	0.00015	0.000191	0.000159	0.000168	0.000235	0.0001985	0.00018	0.00103	0.000991	0.000918	0.0013	0.000838	0.000852	0.00111
	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	0.000148	0.000147	0.000144	0.000153	0.000176	0.000151	0.000138	0.00013	0.000154	0.000152	0.000155	0.00013	0.000163	0.000149	0.000102	0.000151	0.000195	0.0001155	0.000106	0.00011	0.000094
	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	0.58	0.57	0.61	0.58	0.68	0.61	0.58	0.54	0.61	0.6	0.61	0.53	0.63	0.59	0.46	0.56	0.62	0.495	0.47	0.47	0.53
	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	0.42	0.42	0.44	0.42	0.44	0.4	0.44	0.43	0.45	0.43	0.44	0.81	0.44	0.42	0.39	0.38	0.42	0.415	0.37	0.39	0.35
	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	1.18	1.07	1.17	1.13	1.29	1.16	1.16	1.11	1.21	1.23	1.2	1.25	1.235	1.17	0.769	0.923	1.025	0.846	0.774		

Table B.62: Summary of the magnitude of difference in aqueous metal concentrations between 2015 Mary Lake and Reference Lake 3 data, Mary Lake 2015 and baseline period data, and Mary Lake 2015 and mine construction period for winter, summer, and fall sampling events, Mary River Project CREMP. No value presented for parameters in which concentration was below method detection limit, except those for winter 2015, where no reference data were collected.

Variable	Mary Lake North Basin									Mary Lake South Basin								
	2015 vs Reference Lake 3			2015 vs Baseline			2015 vs 2014			2015 vs Reference Lake 3			2015 vs Baseline			2015 vs 2014		
	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)		1.0	1.9	0.8	0.7	0.9		0.9	1.1		0.8	0.9	0.9	0.9	0.9		1.1	1.0
pH (lab)		1.0	1.1		1.0	1.0	1.1	1.0	1.0		1.0	1.0		1.0	1.0	1.1	1.0	1.0
Hardness (as CaCO ₃)		1.1	2.1	0.8	0.7	0.8	0.8	0.9	1.1		0.8	1.0	0.9	0.9	0.9	1.0	1.2	0.9
Total Dissolved Solids (TDS)		1.0	2.0	0.7	0.7	0.7	0.7	0.9	0.9		0.8	0.8	0.9	0.8	0.6	1.1	1.1	0.7
Turbidity		3.4	3.5	1.5	0.3	0.9	1.2	0.8	0.9		9.9	6.9	0.3	1.3	1.3	0.9	0.7	1.0
Alkalinity (as CaCO ₃)		1.2	2.3	0.9	0.8	0.9	0.9	1.0	1.1		0.9	1.1	0.9	0.9	0.9	1.0	1.2	1.0
Nitrate				0.5	0.3		0.3						0.3	0.3		0.2		
Total Kjeldahl Nitrogen (TKN)		1.2		1.4	0.7	3.0	2.1	1.6	5.7				2.5	7.9	1.1	2.1	8.9	0.6
Dissolved Organic Carbon			0.6	0.5		1.1	0.6		1.5			0.5	0.8	0.7	1.1	1.3	0.9	1.6
Total Organic Carbon		0.4	0.6	0.6	0.7	1.2	0.6	0.6	1.3			0.5	0.8	0.8	1.1	1.2	0.8	1.2
Total Phosphorus		1.2	1.1	0.9	0.5	0.5	1.3				1.7	1.9	1.4	1.0	1.1	0.6	1.2	0.7
Phenols		1.4			2.0	1.5		2.0	1.5		1.9			2.7	1.4		2.7	1.4
Chloride (Cl)		0.9	2.0	0.4	0.7	0.6	0.5	0.8	1.3		0.9	1.2	0.6	0.5	0.5	0.7	1.3	1.0
Sulphate (SO ₄)		0.2	0.3	0.4	0.4	0.3	0.5	0.8	0.7		0.2	0.2	0.7	0.4	0.3	0.8	0.7	0.8
Aluminum (Al)		6.8	5.6	1.7	0.3	0.2	3.0	0.6	0.6		19.5	19.2	0.4	0.9	1.7	0.7	0.7	1.1
Arsenic (As)				1.2			1.0											
Barium (Ba)		0.7	1.1	0.8	0.7	0.7	0.9	1.1	1.3		0.6	0.7	0.9	0.9	0.8	1.1	1.2	1.1
Boron (B)																		
Cadmium (Cd)					1.9									1.0				
Calcium (Ca)		1.2	2.1	0.8	0.8	0.8	0.8	0.9	1.1		0.9	1.0	0.9	0.9	0.9	1.0	1.1	0.9
Chromium (Cr)															1.3			
Copper (Cu)		0.9	1.1	0.9	0.8	0.3	1.1	1.1	1.1		0.7	0.8	0.9	0.8	0.8	1.1	1.0	1.0
Iron (Fe)				1.6	0.3	0.3	1.4	0.7	0.8					0.8	1.2		0.6	1.0
Lead (Pb)					0.8			0.9						1.2	1.8		0.8	1.1
Lithium (Li)				0.3			1.3											
Magnesium (Mg)		1.1	2.0	0.8	0.7	0.8	0.9	0.9	1.1		0.8	1.0	1.0	1.0	1.0	1.0	1.1	1.0
Manganese (Mn)		3.8	4.8	1.0	0.5	0.2	2.0	1.1	1.1		4.2	7.7	0.4	1.1	2.7	0.8	0.8	2.0
Molybdenum (Mo)		0.9	1.5	0.8	0.9	0.9	0.9	2.4	3.2		0.8	1.0	1.0	1.0	1.0	1.0	0.7	1.9
Nickel (Ni)				0.8			1.0							1.0	1.5		1.0	1.6
Potassium (K)		0.6	0.9	0.8	1.0	1.1	1.0	1.2	1.2		0.6	0.6	0.9	1.1	1.1	1.1	1.1	1.2
Silicon (Si)		1.0	1.7	1.0	0.6	0.8	1.2	0.7	0.9		1.2	1.2	0.9	1.0	1.1	1.4	1.0	0.9
Sodium (Na)		1.0	2.2	0.6	1.0	0.9	0.8	1.1	1.3		1.0	1.1	0.9	1.0	0.9	1.0	1.4	1.2
Strontium (Sr)		0.7	1.2	0.9	0.8	0.8	1.0	1.0	1.3		0.6	0.7	0.7	0.7	0.7	1.1	1.2	1.0
Uranium (U)		1.4	5.5	0.6	0.5	0.6	0.8	0.9	1.3		1.4	2.1	0.9	0.8	0.8	1.0	1.2	1.0
Zinc (Zn)					1.9									1.5				

 Denotes slight elevation (mean variable concentration 3 to 5 times higher than respective mean reference, baseline or construction period value).
 Denotes moderate elevation (mean variable concentration 5 to 10 times higher than respective mean reference, baseline or mine construction period value).
 Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference, baseline, or mine construction period value).

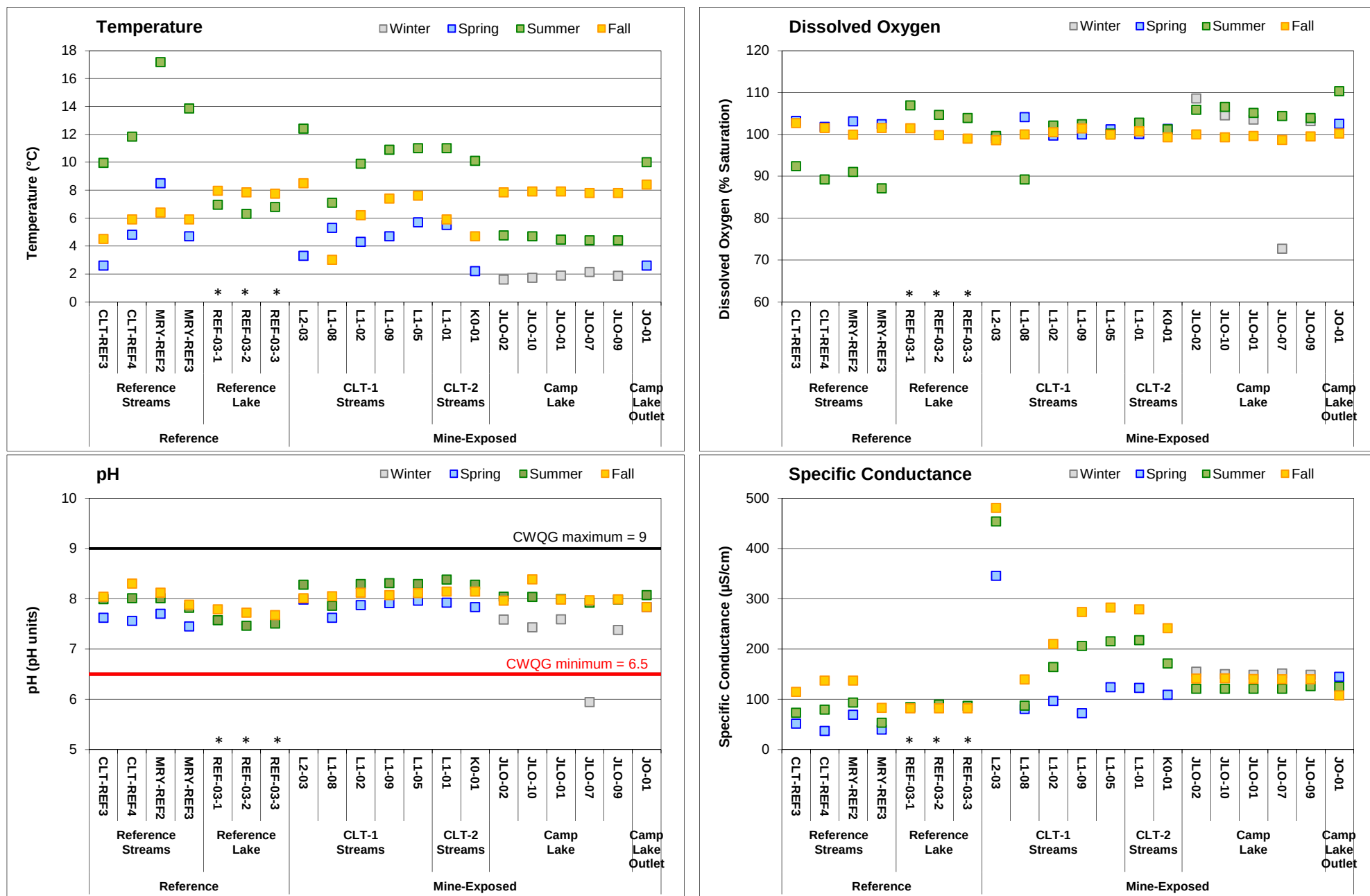


Figure B.1: Comparison of in-situ water quality variables measured at Camp Lake system water quality monitoring stations in winter, spring, summer, and fall 2015, Mary River Project CREMP. Lake values represent mean of surface and bottom in-situ water quality measurements. * Reference Lake 3 (REF-03) was not sampled in winter.



Figure B.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) periods in the fall. Values represent mean $\pm$ SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean $\pm$ 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.

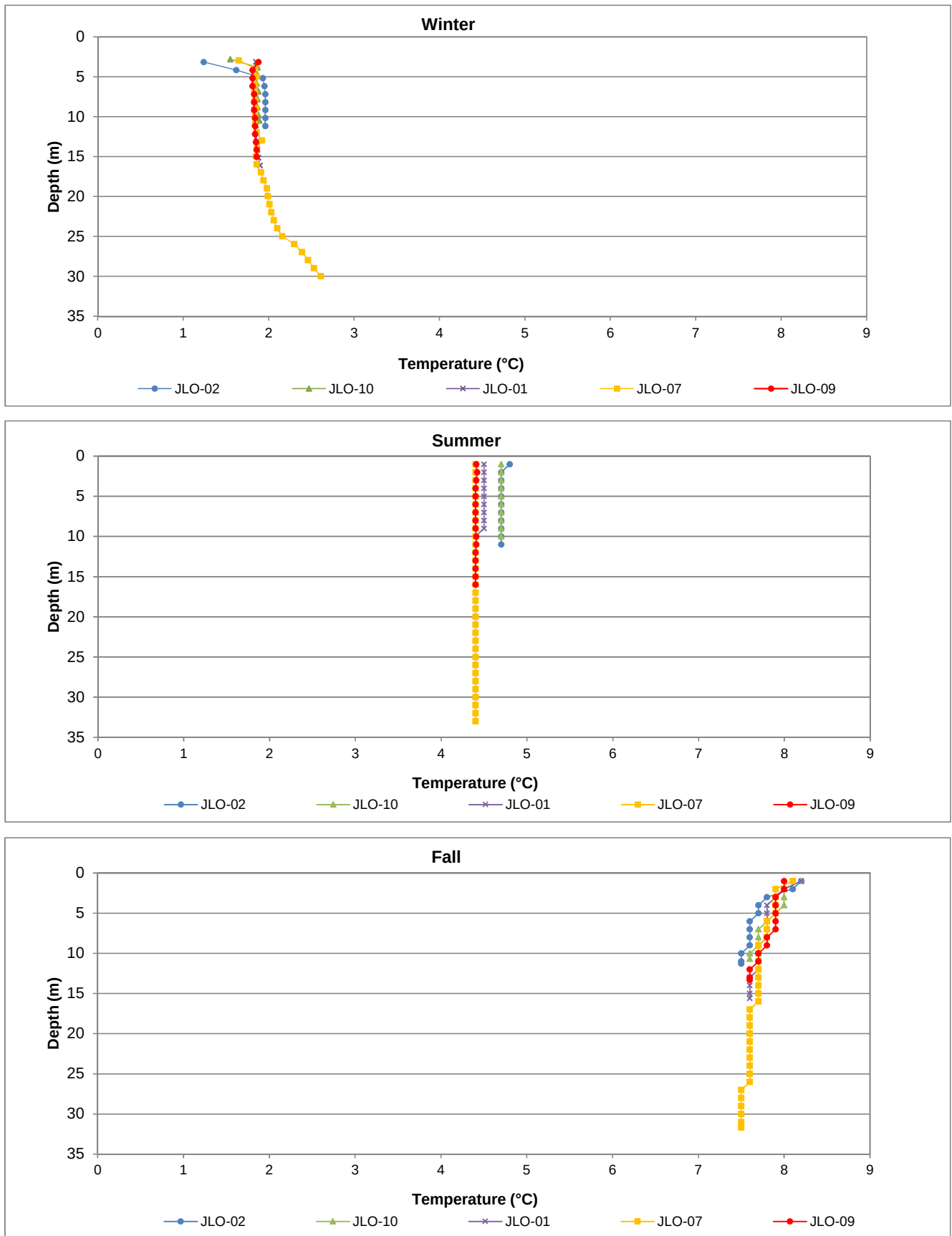


Figure B.3: Vertical profiles of temperature measured at Camp Lake in winter, summer and fall, 2015.

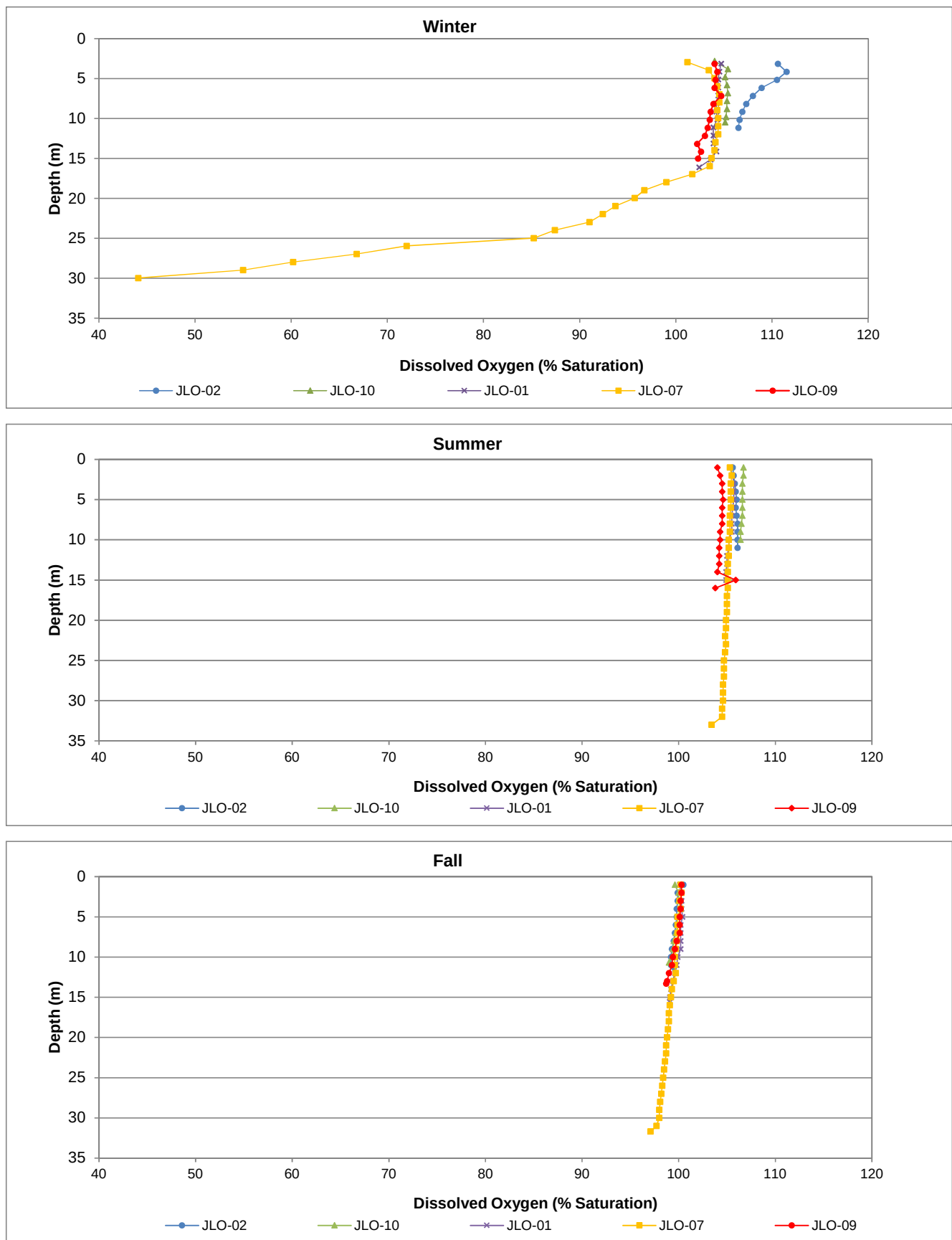


Figure B.4: Vertical profiles of dissolved oxygen measured at Camp Lake in winter, summer, and fall, 2015.

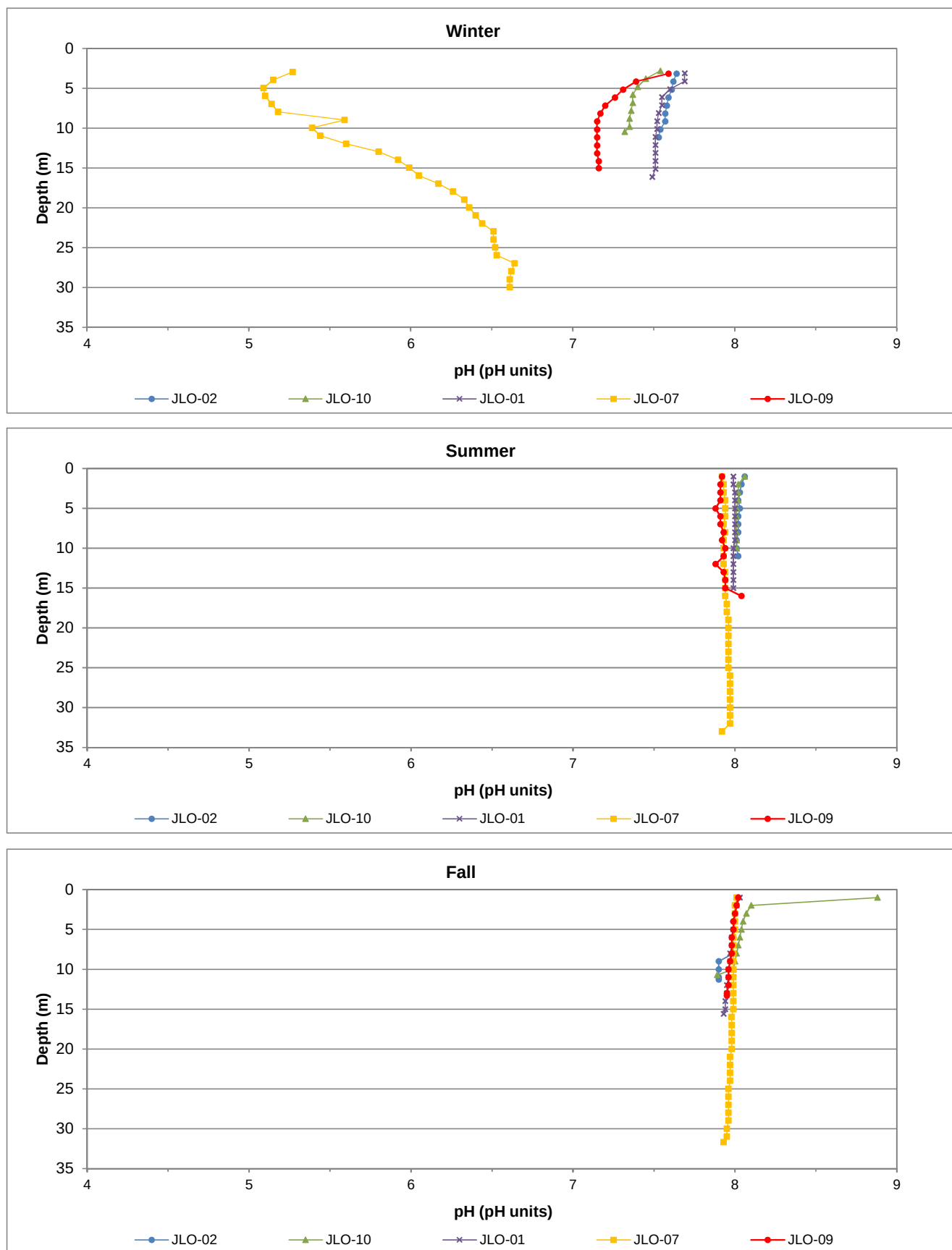


Figure B.5: Vertical profiles of pH measured at Camp Lake in winter, summer and fall, 2015.

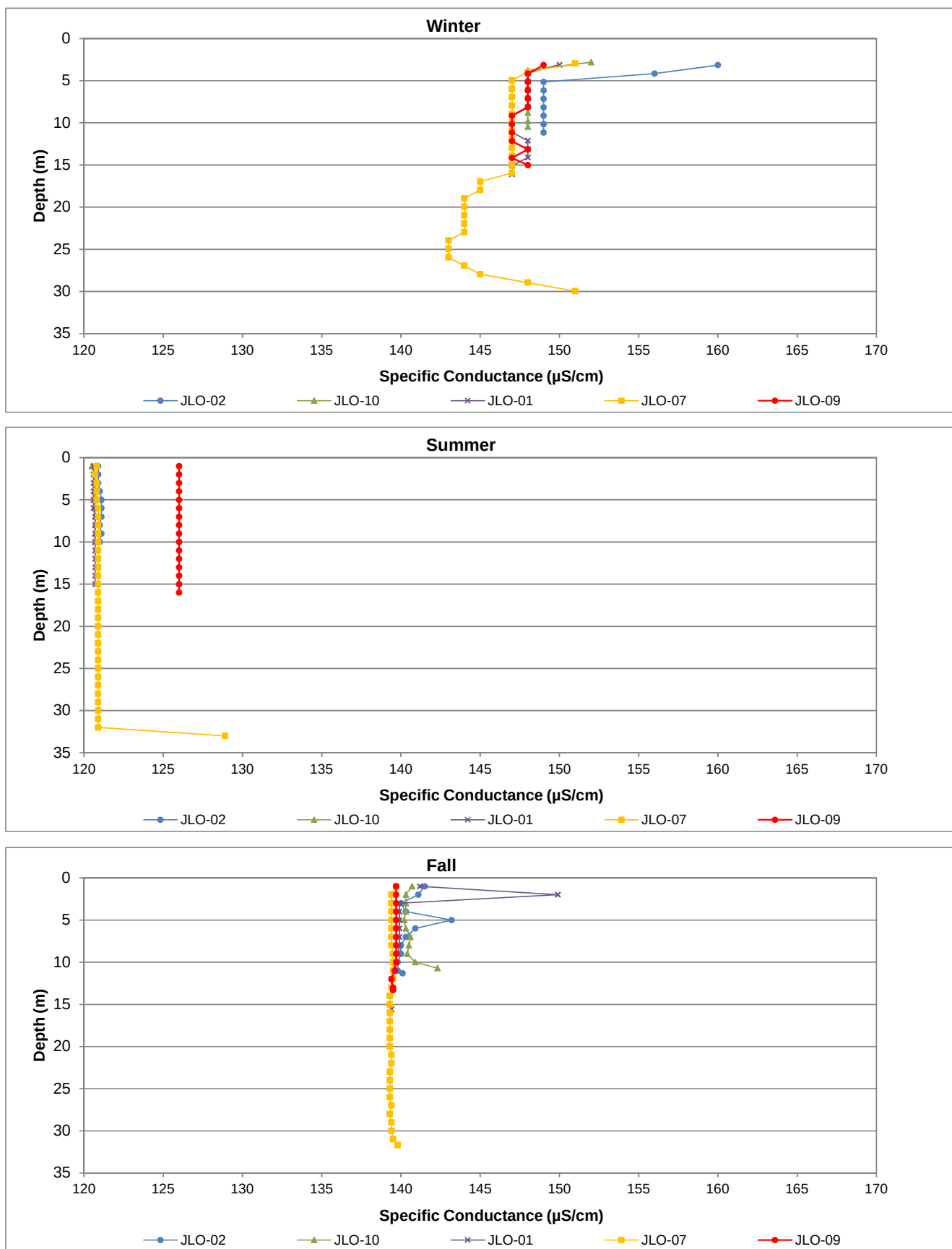


Figure B.6: Vertical profiles of conductivity measured at Camp Lake in winter, summer, and fall, 2015.

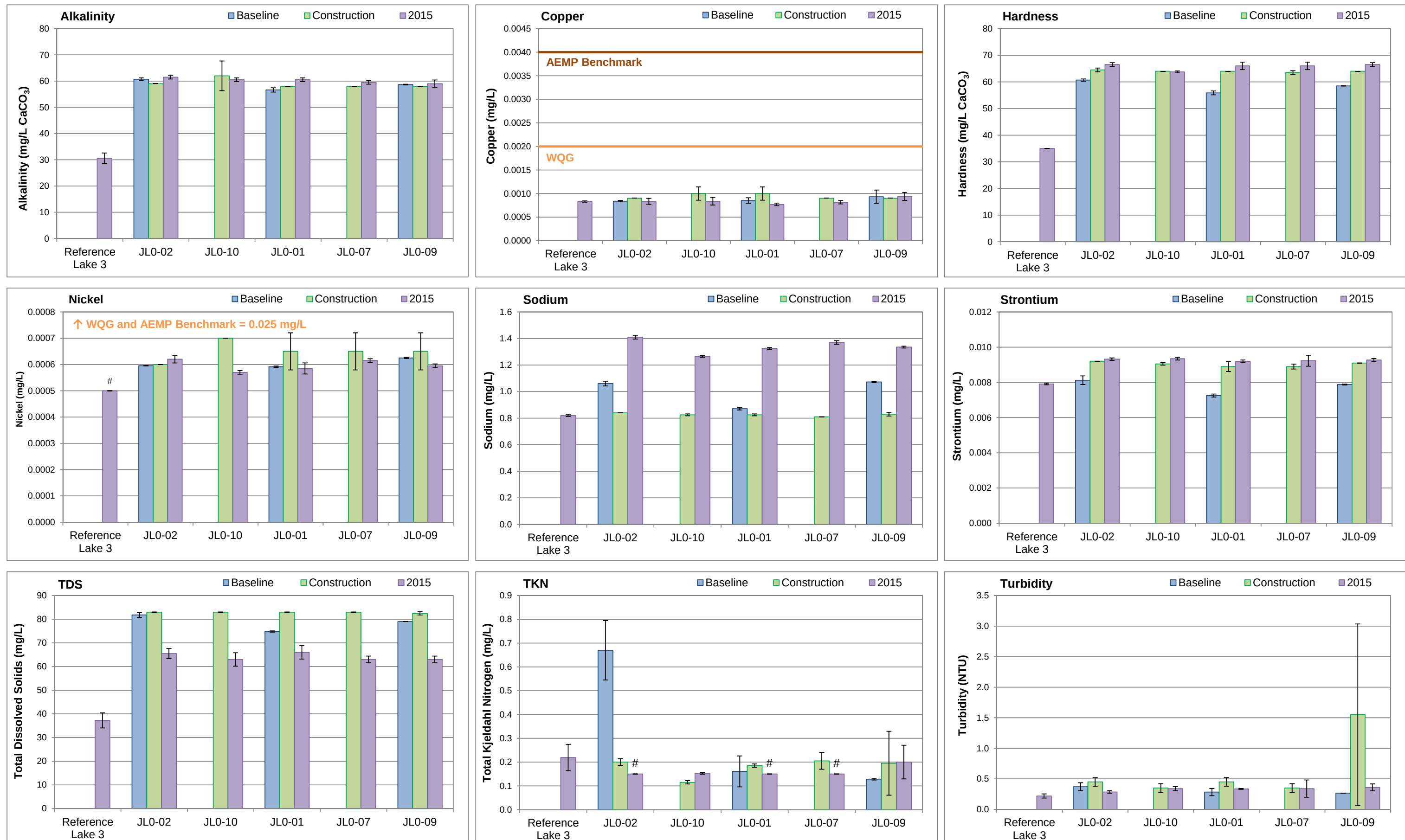


Figure B.7: Temporal comparison of water chemistry at Camp Lake (JLO) for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods during fall. Values represent mean $\pm$ SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.3 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Camp Lake.

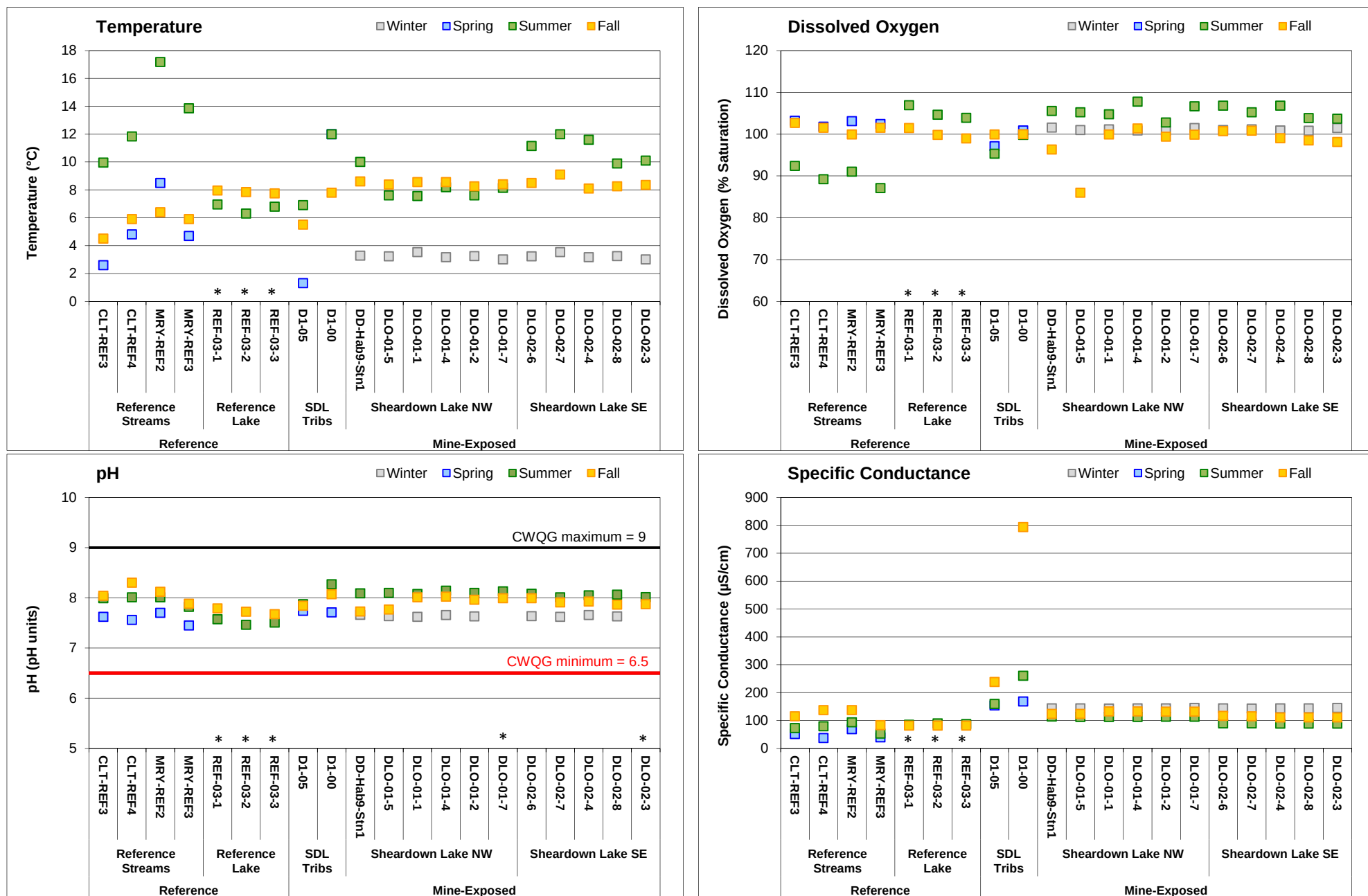


Figure B.8: Comparison of *in-situ* water quality variables measured at Sheardown Lake system water quality monitoring stations in winter, spring, summer, and fall 2015, Mary River Project CREMP. Lake values represent mean of surface and bottom in-situ water quality measurements. * Reference Lake 3 (REF-03) was not sampled in winter. The pH readings at DLO-02-3 and DLO-01-7 were unreliable in winter.

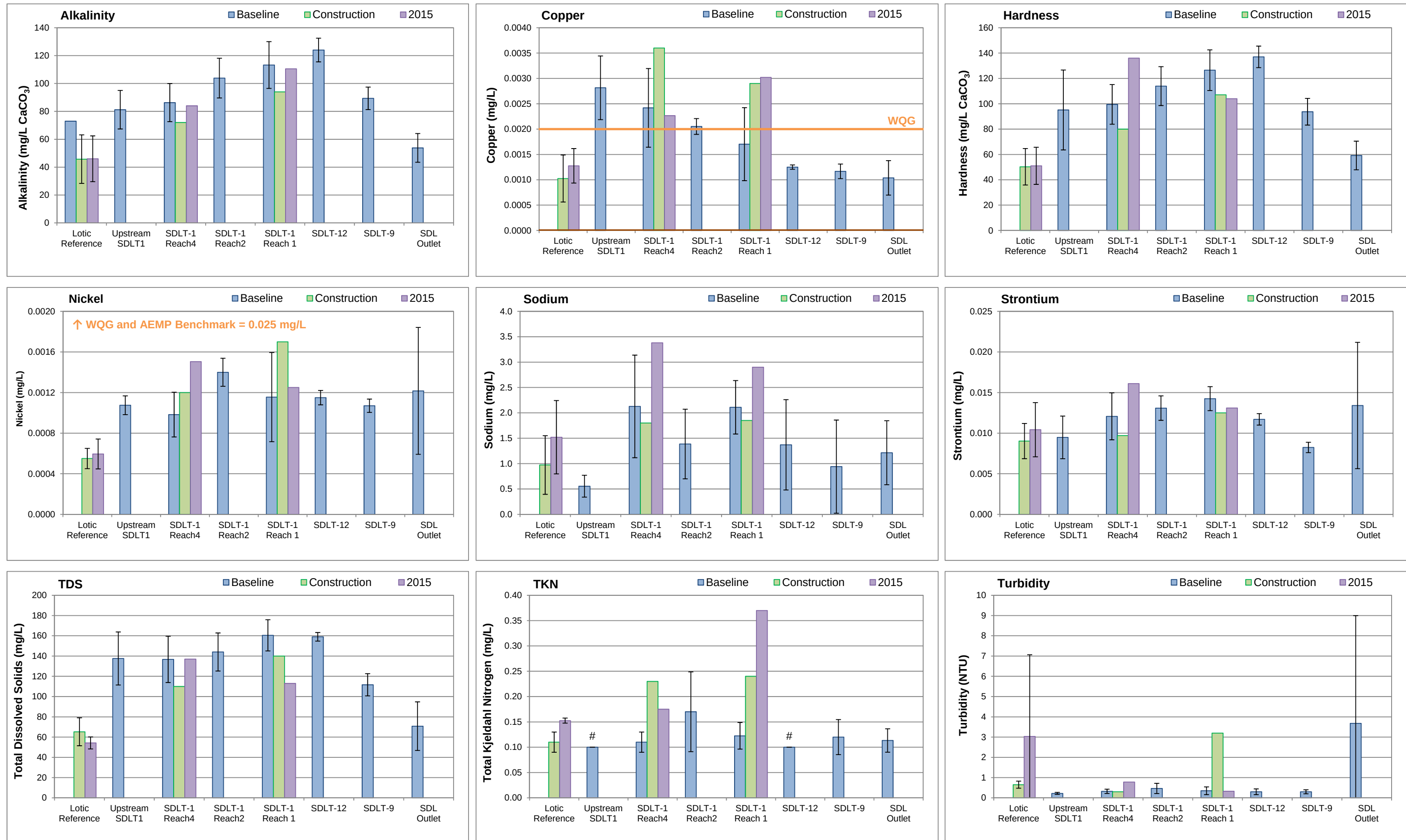


Figure B.9: Temporal comparison of water chemistry at Sheardown Lake Tributaries (SDLT) for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods during fall. Values represent mean $\pm$ SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean $\pm$ SD; n = 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 Sheardown Lake Tributaries.

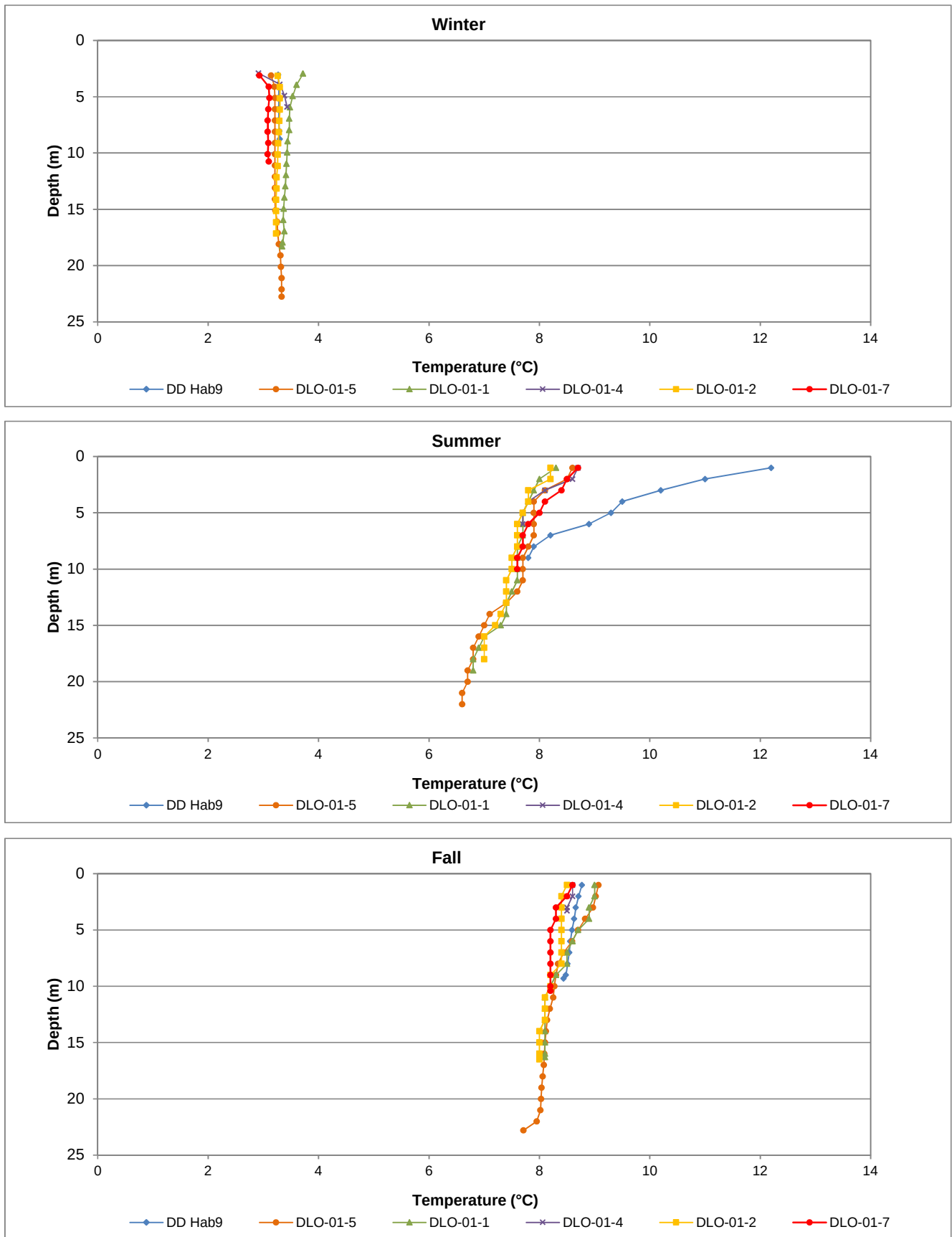


Figure B.10: Vertical profiles of temperature measured at Sheardown Lake NW in winter, summer, and fall, 2015.

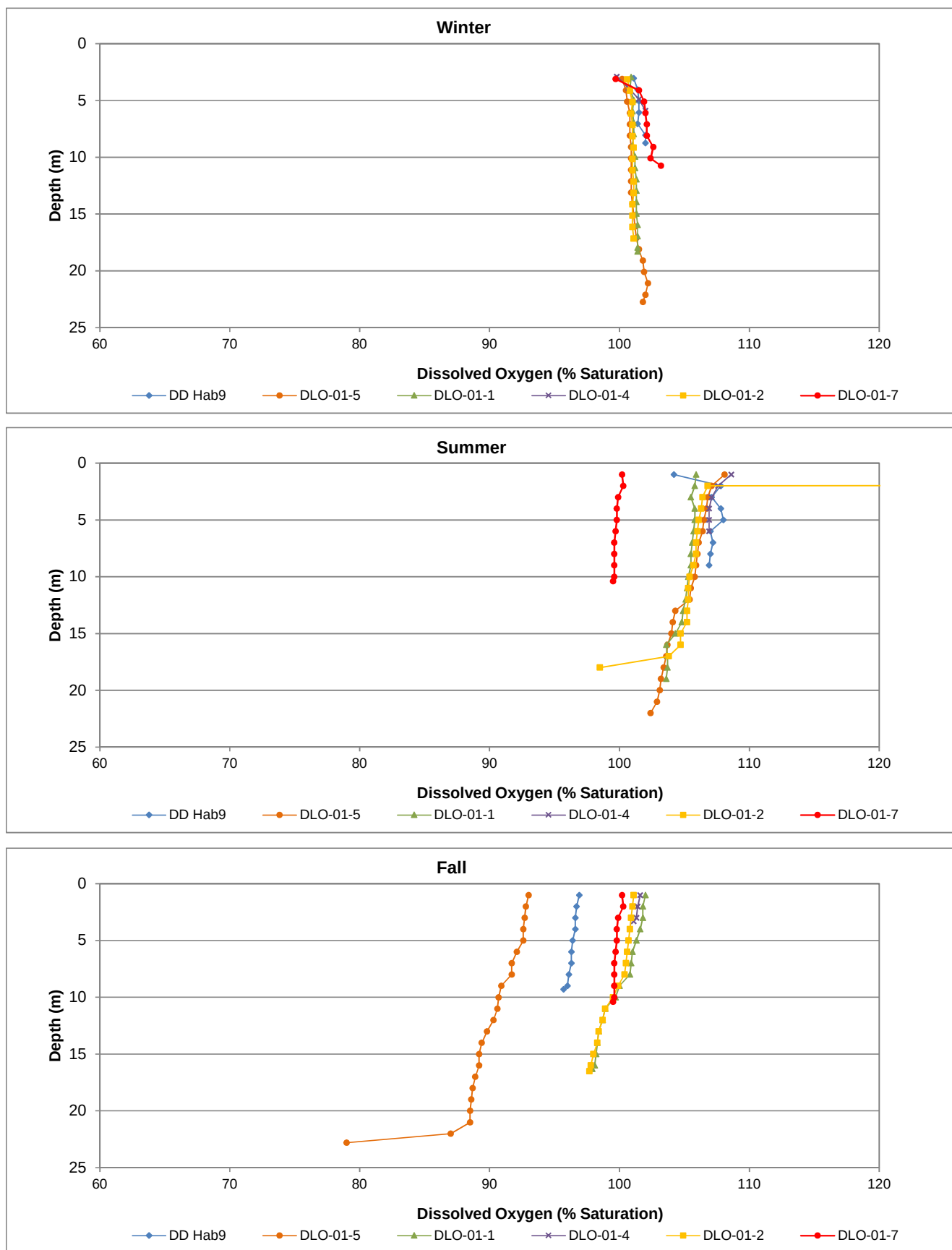


Figure B.11: Vertical profiles of dissolved oxygen measured at Sheardown Lake NW in winter, summer, and fall, 2015.

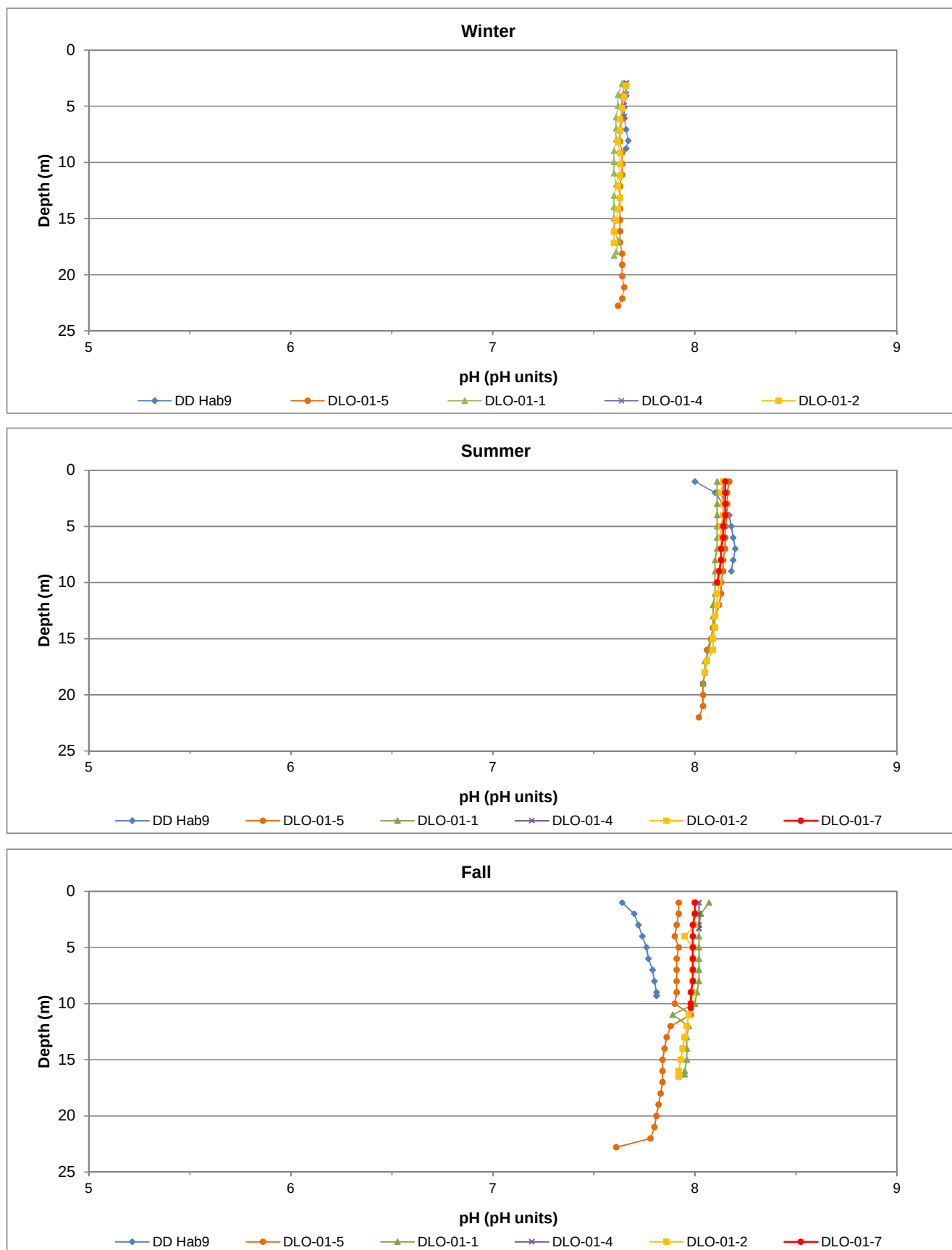


Figure B.12: Vertical profiles of pH measured at Sheardown Lake NW in winter, summer, and fall, 2015.

Note: No reliable pH data were collected for DLO-01-7 in winter.

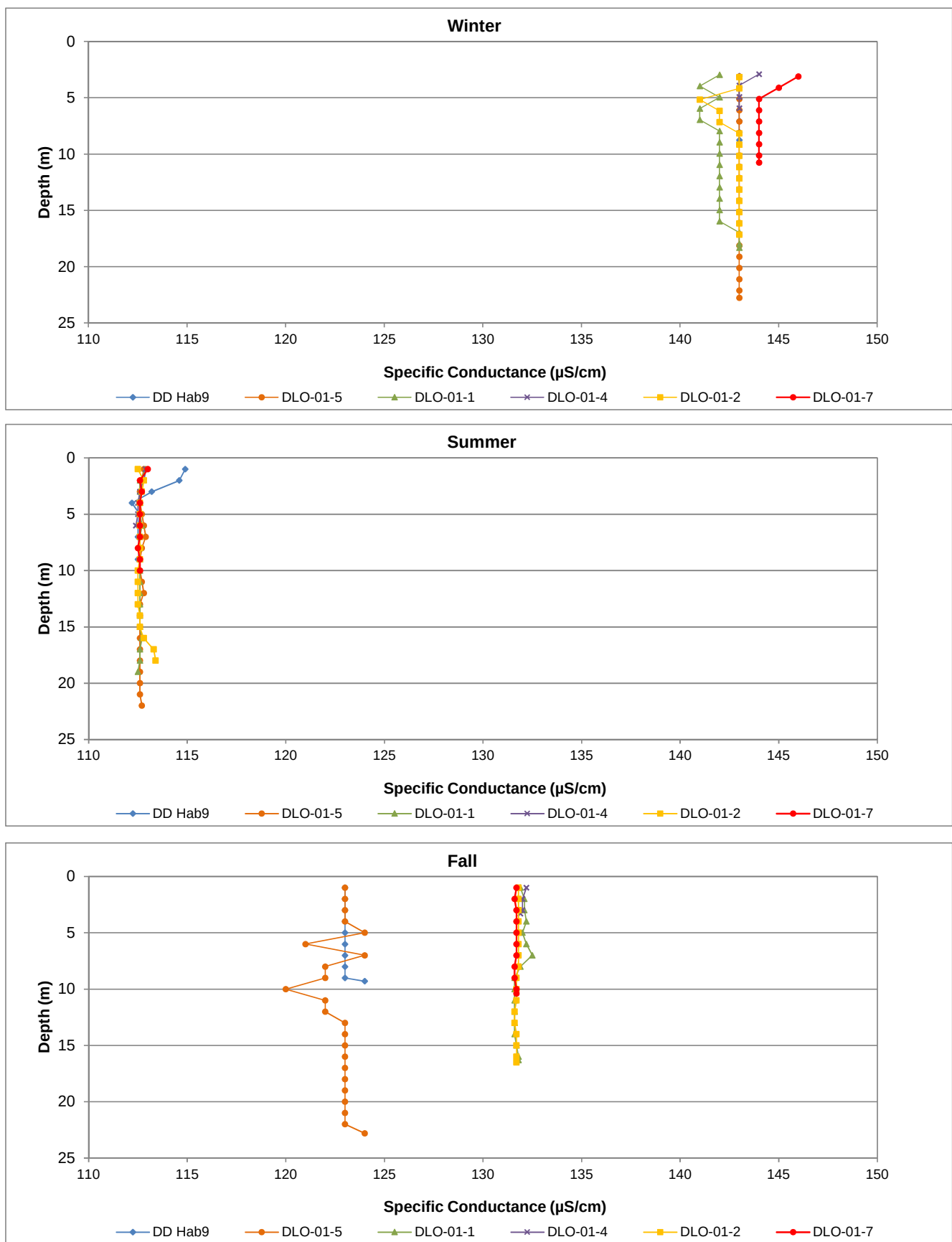


Figure B.13: Vertical profiles of conductivity measured at Sheardown Lake NW in winter, summer, and fall, 2015.

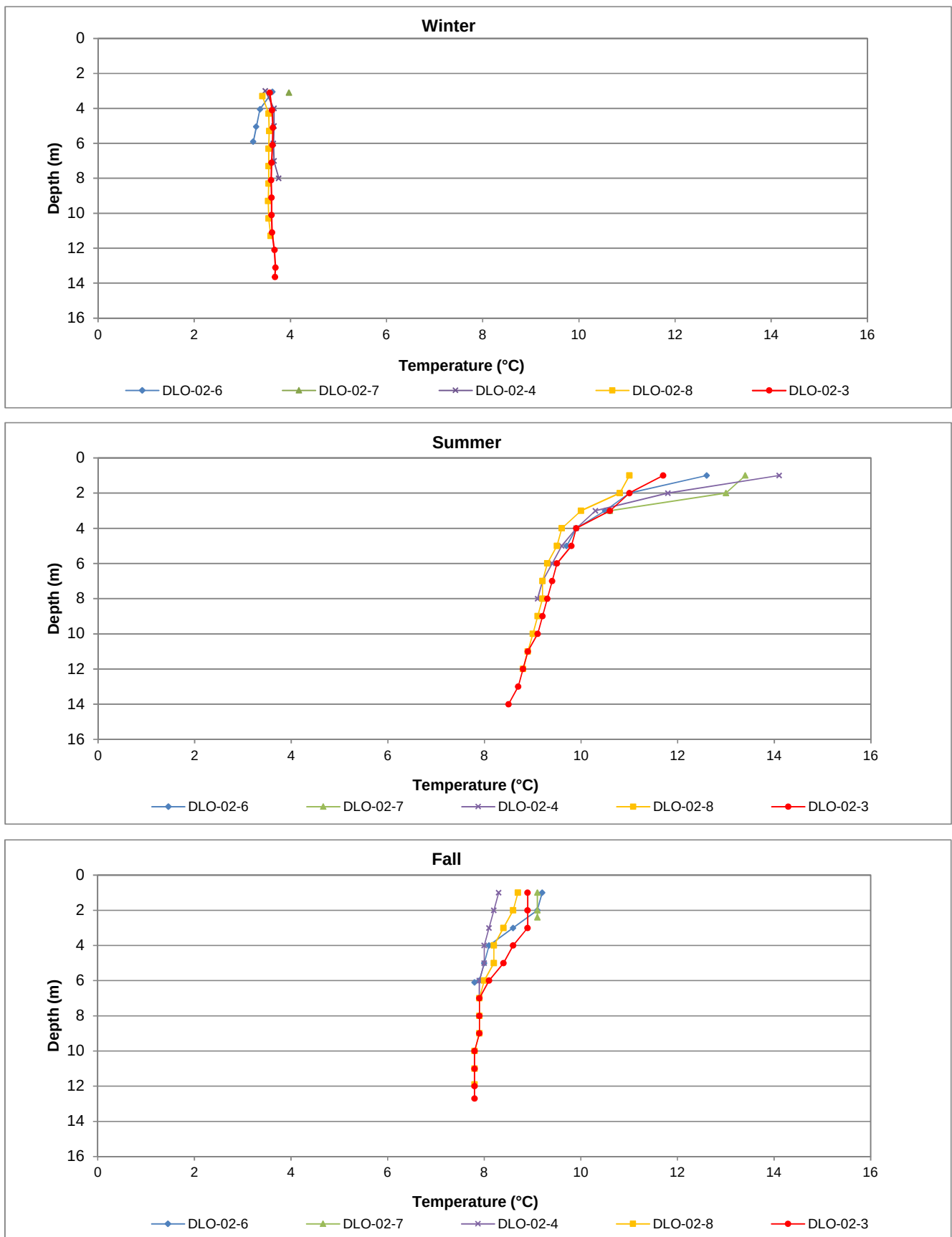


Figure B.14: Vertical profiles of temperature measured at Sheardown Lake SE in winter, summer, and fall, 2015.

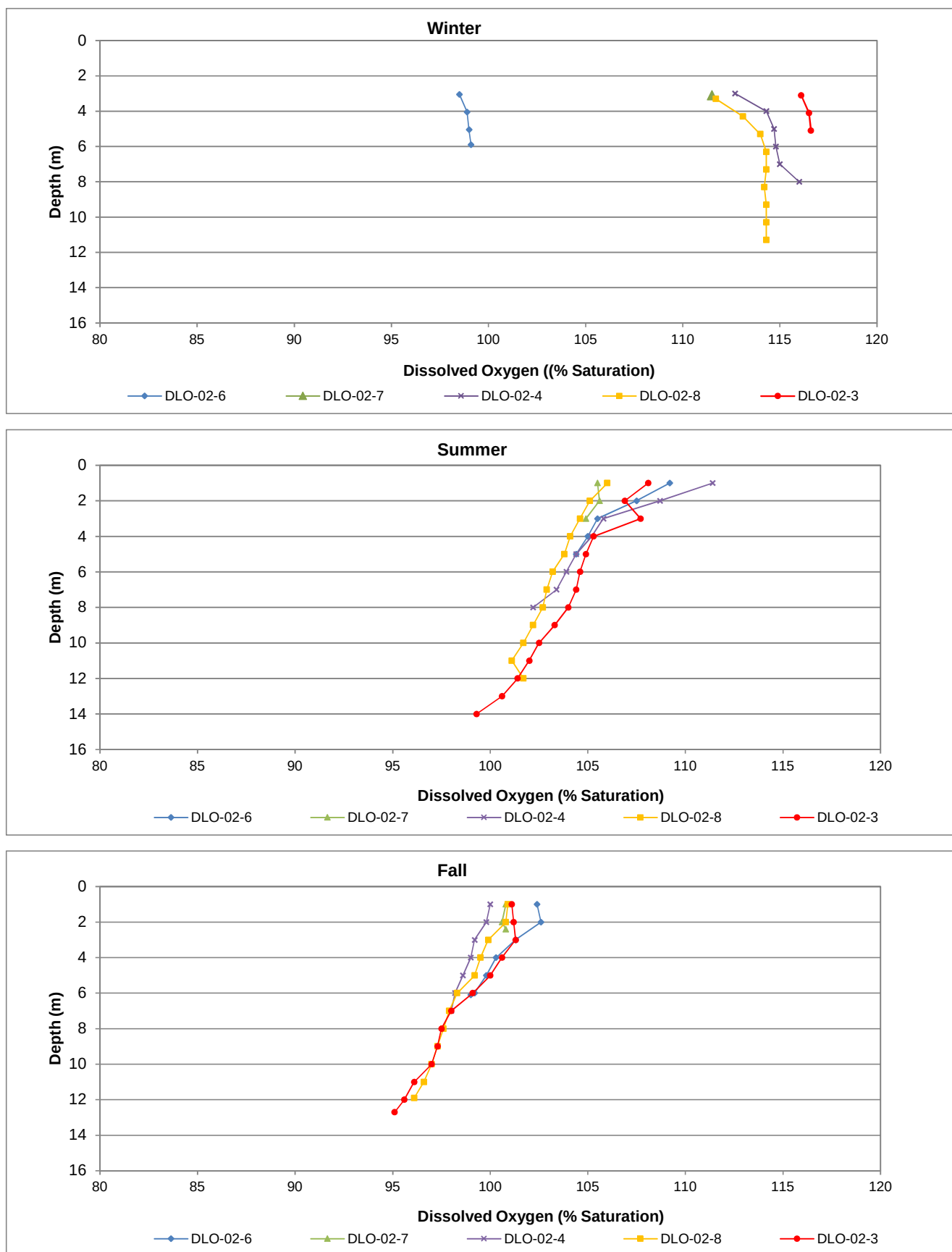


Figure B.15: Vertical profiles of dissolved oxygen measured at Sheardown Lake SE in winter, summer, and fall, 2015.

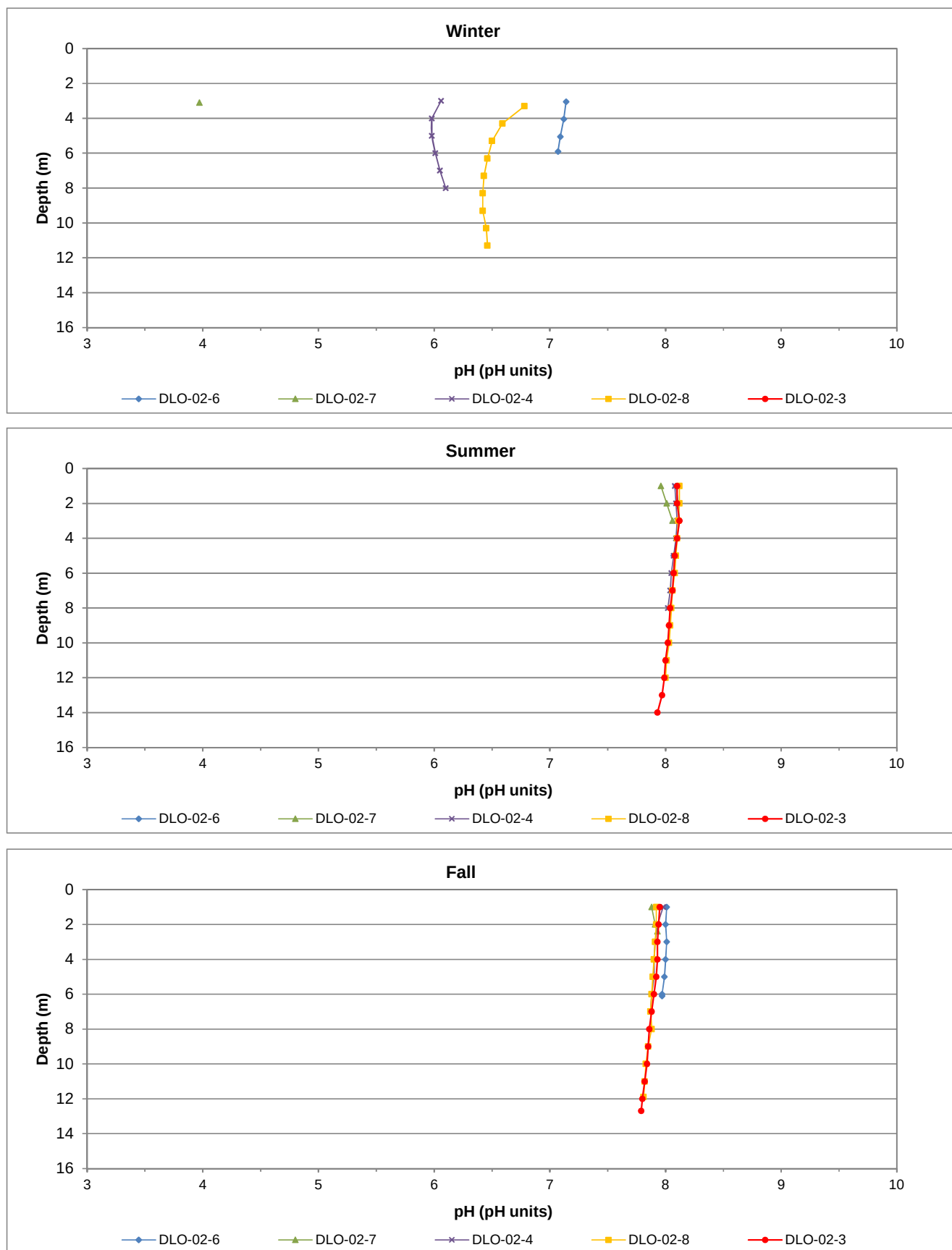


Figure B.16: Vertical profiles of pH measured at Sheardown Lake SE in winter, summer, and fall, 2015.
Note: No reliable pH data were collected for DLO-02-3 in winter.

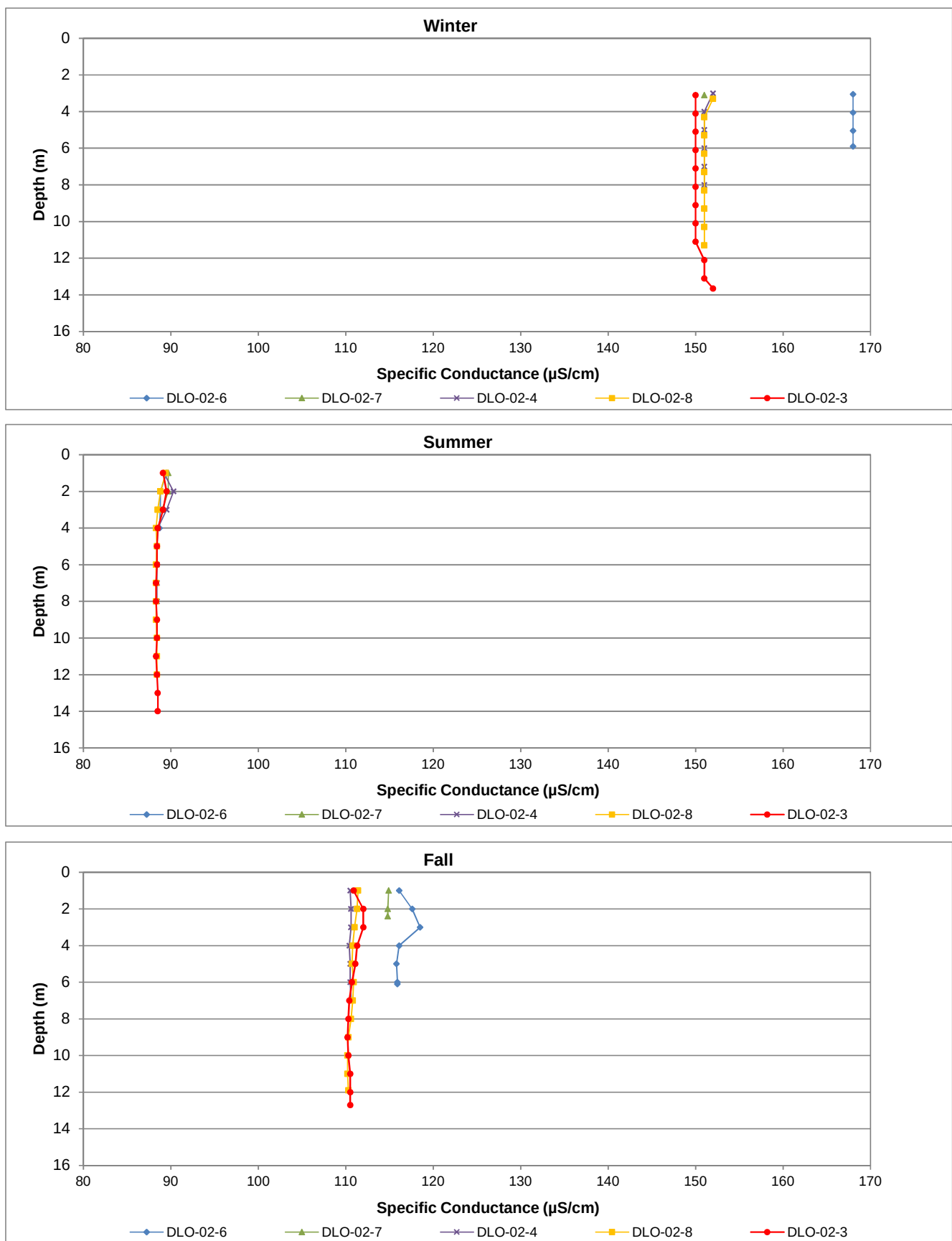


Figure B.17: Vertical profiles of conductivity measured at Sheardown Lake SE in winter, summer, and fall, 2015.

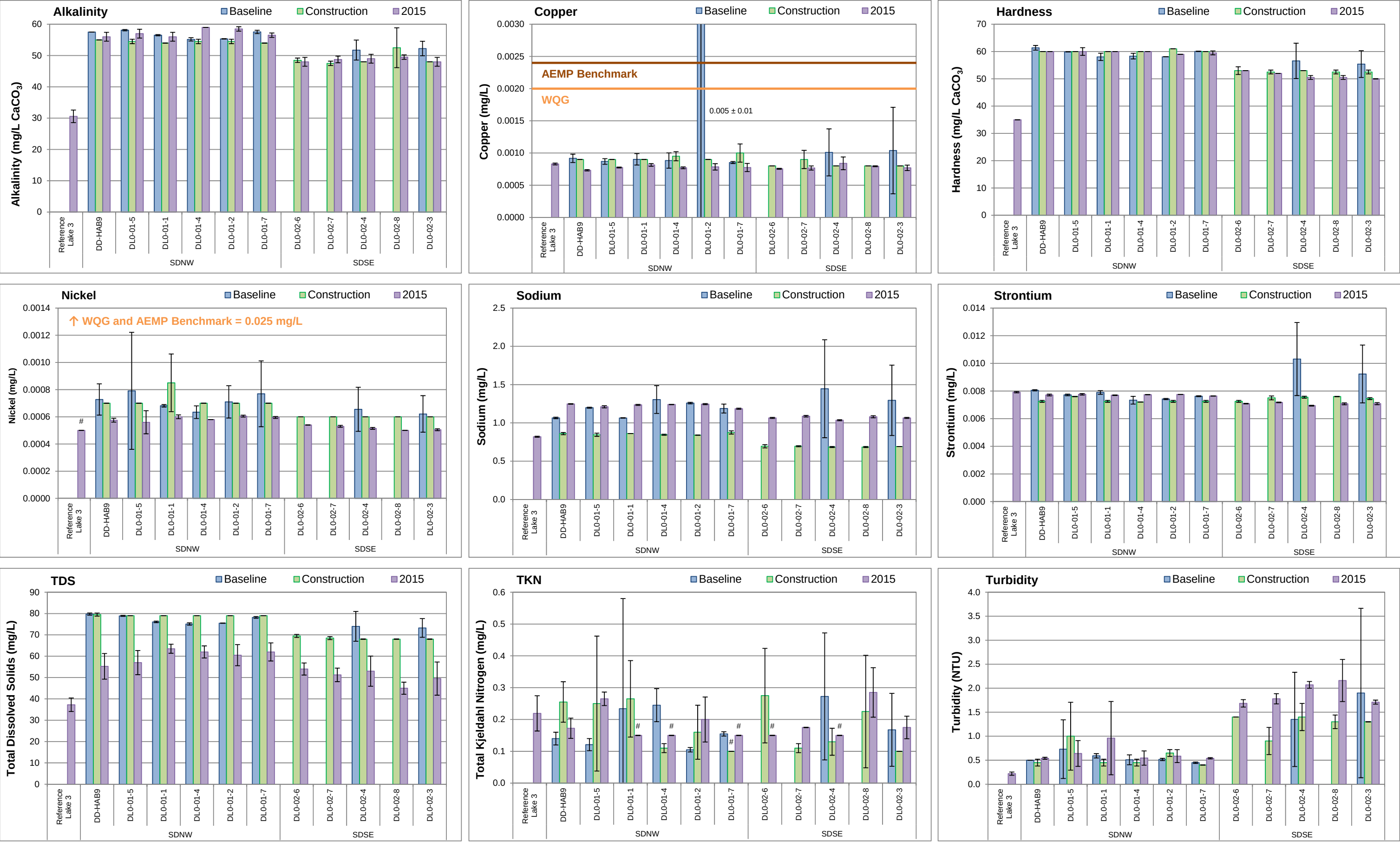




Figure B.19: Comparison of in-situ water quality variables measured at Mary River water quality monitoring stations in spring, summer, and fall 2015, Mary River Project CREMP.

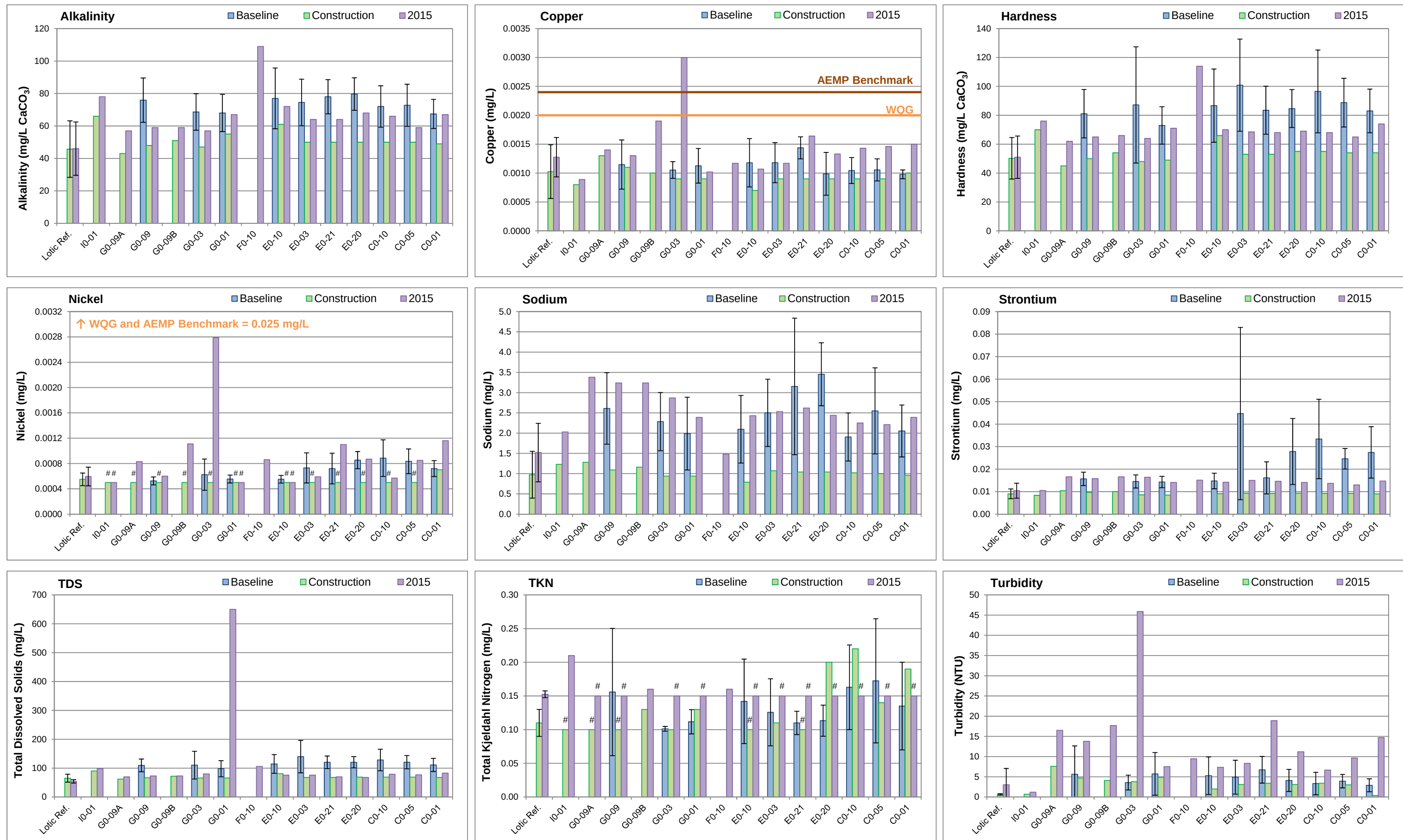


Figure B.20: Temporal comparison of water chemistry at Mary River stations for mine baseline (2005 - 2013), construction (2014) and operational (2015) periods in the fall. Values represent mean $\pm$ SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean $\pm$ SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.3 for information regarding Water Quality Guidelines (WQG) AEMP Benchmarks are specific to Mary River.

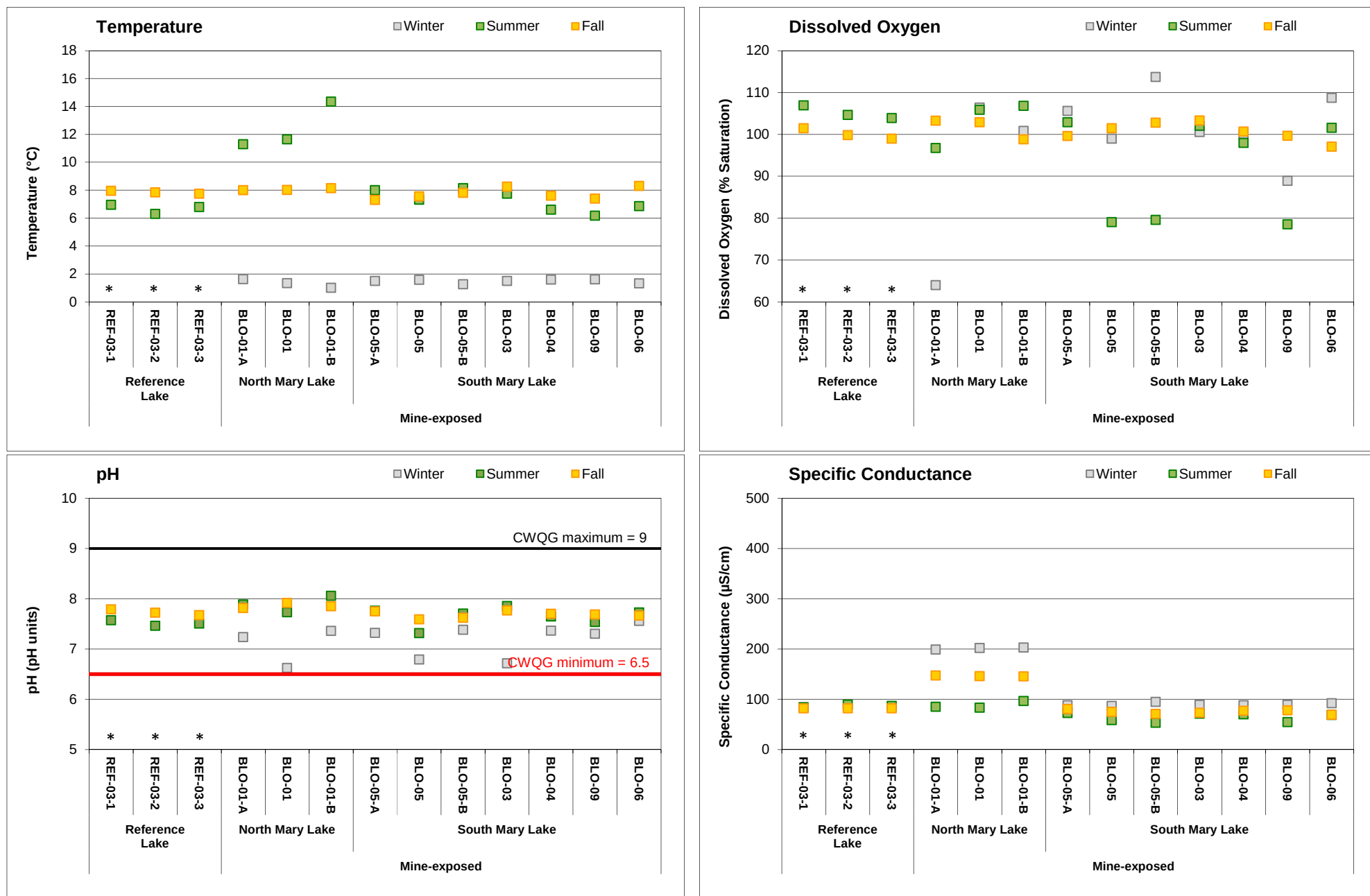


Figure B.21: Comparison of in-situ water quality variables measured at Mary Lake water quality monitoring stations in winter, summer, and fall 2015, Mary River Project CREMP. Lake values represent mean of surface and bottom in-situ water quality measurements.

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

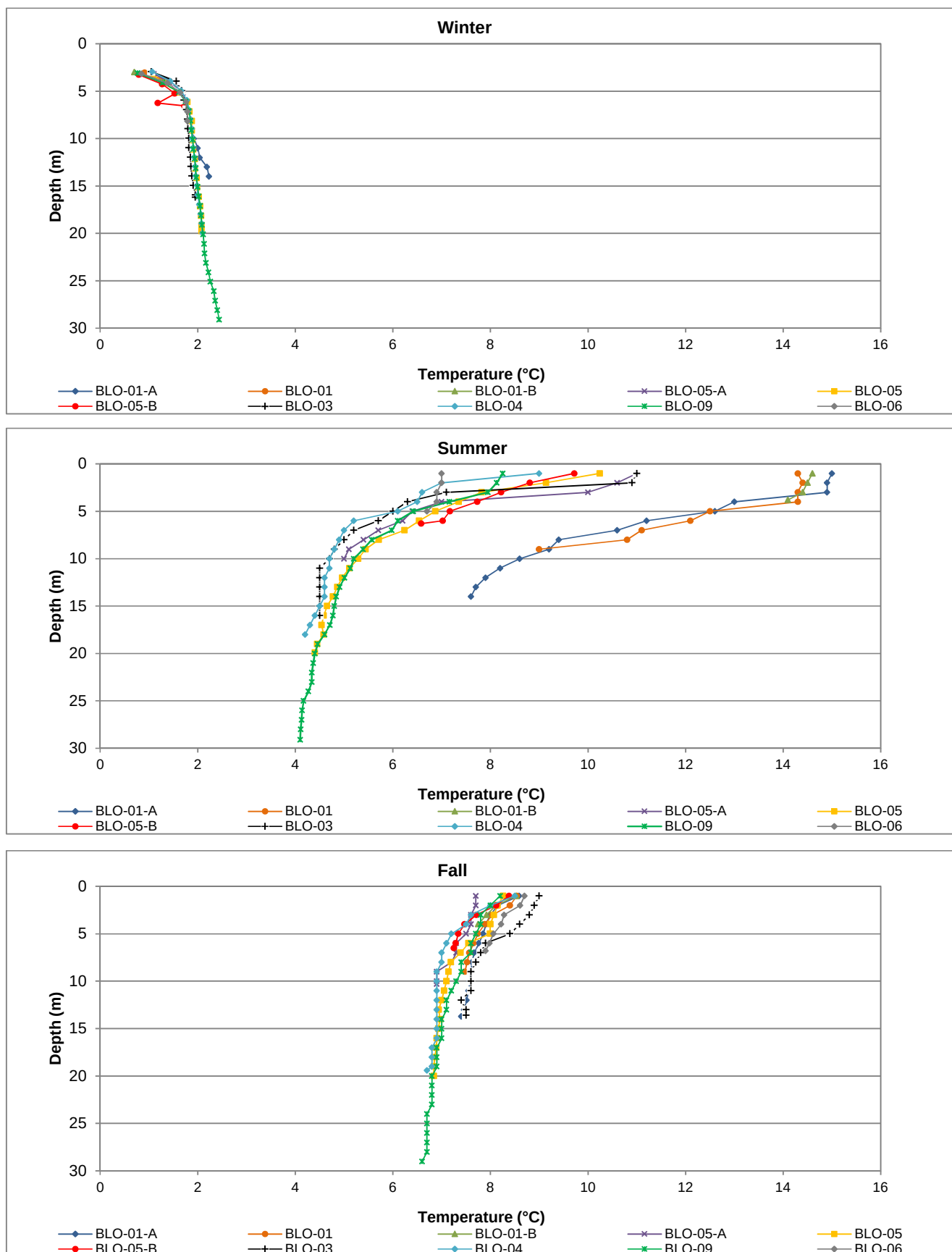


Figure B.22: Vertical profiles of temperature measured at Mary Lake in winter, summer, and fall, 2015.

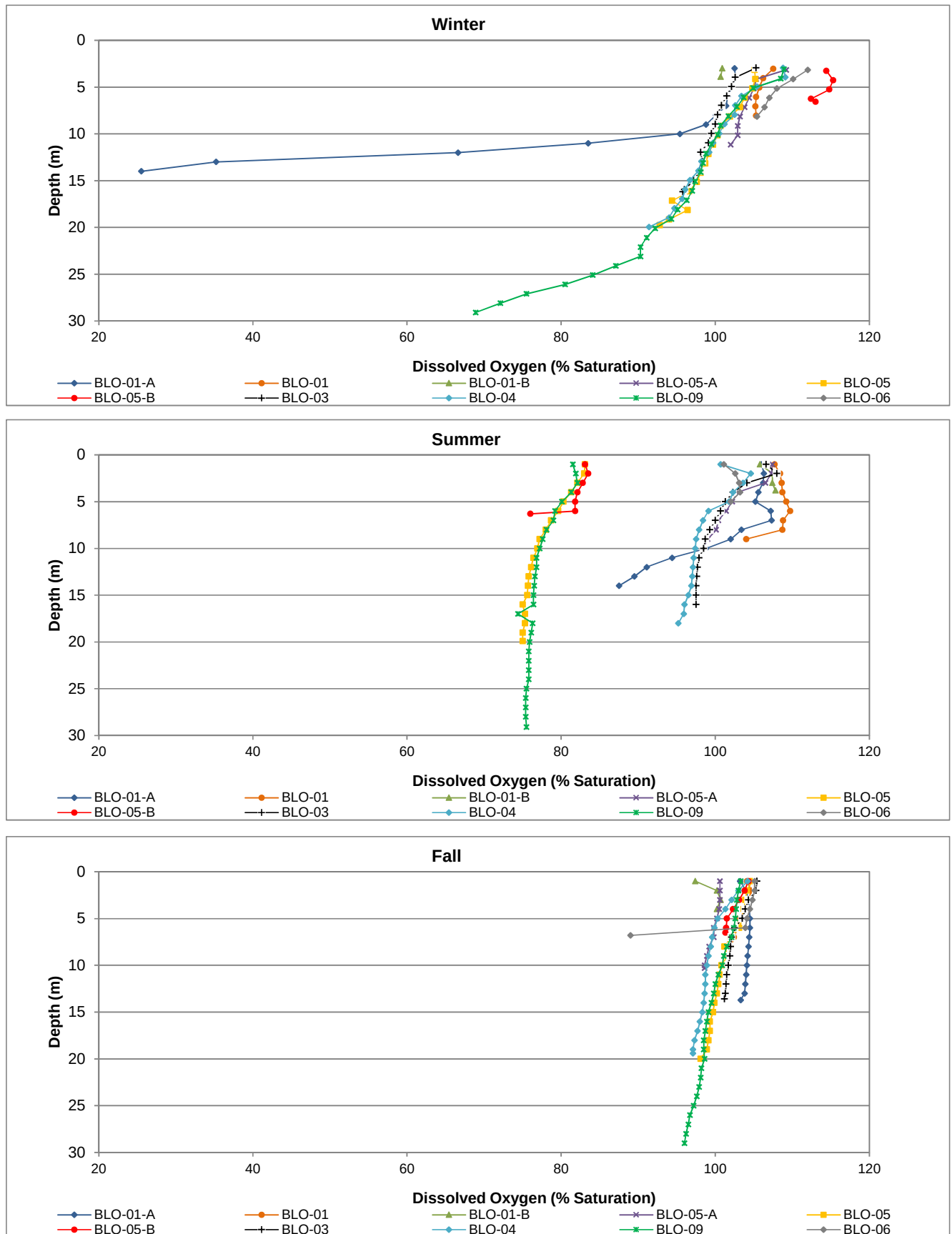


Figure B.23: Vertical profiles of dissolved oxygen measured at Mary Lake in winter, summer, and fall, 2015.

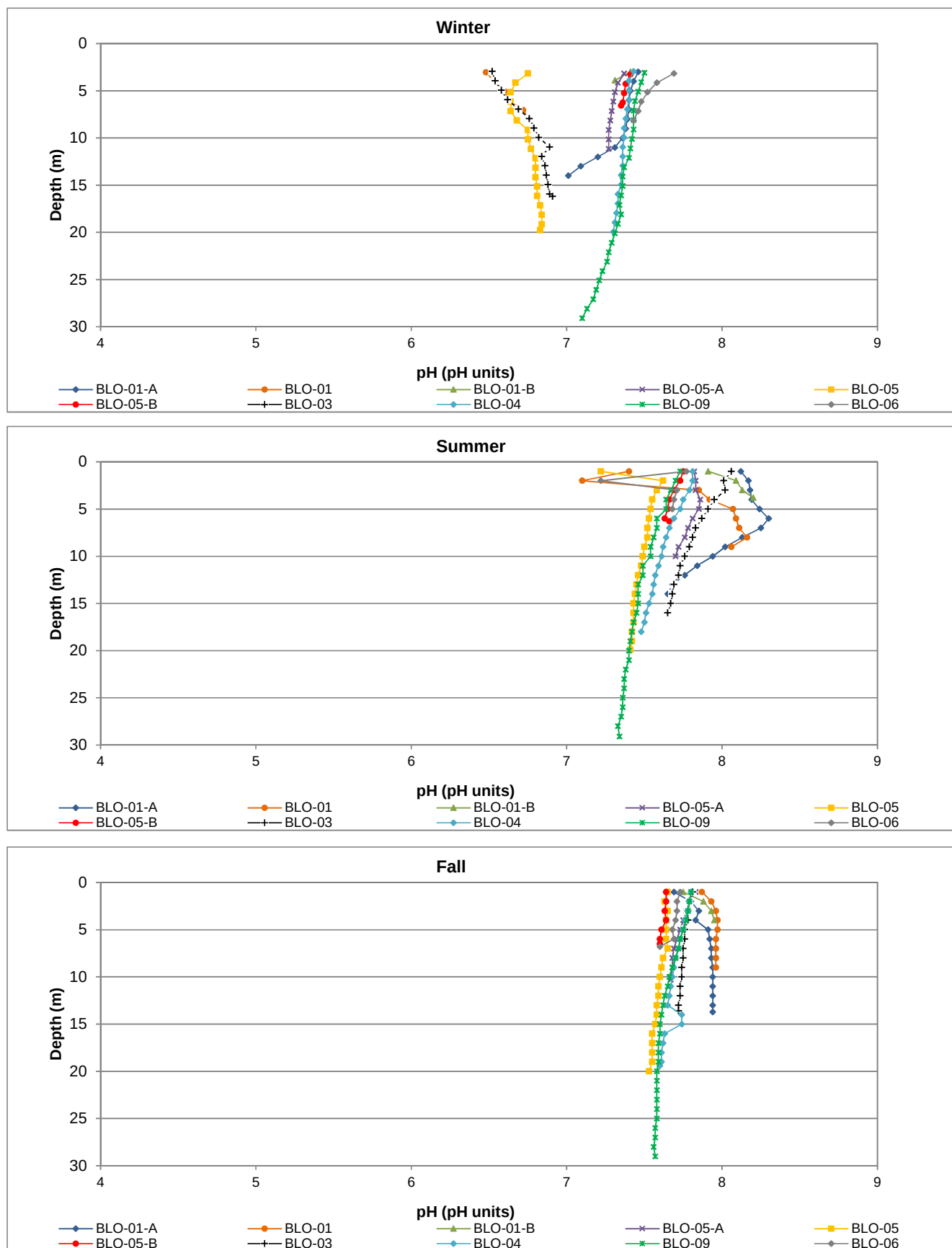


Figure B.24: Vertical profiles of pH measured at Mary Lake in winter, summer, and fall, 2015.

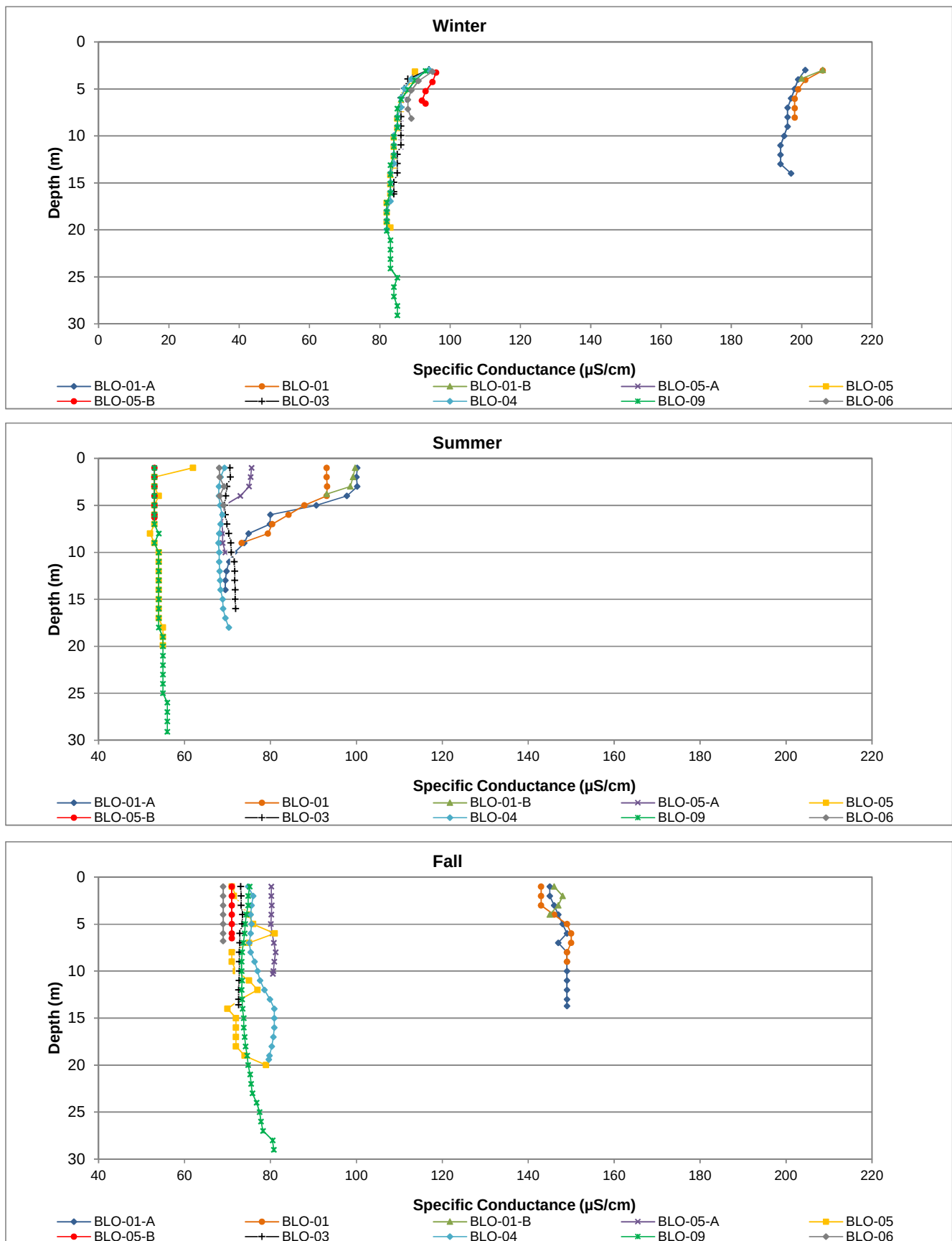


Figure B.25: Vertical profiles of conductivity measured at Mary Lake in winter, summer, and fall, 2015.



Figure B.26: Temporal comparison of water chemistry at Mary Lake (BLO) for mine baseline (2005 - 2013), construction (2014), and operational (2015) 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 Mary Lake.

APPENDIX C

SEDIMENT QUALITY DATA

Table C.1: Field observations at Reference Lake 3 (REF-03) benthic invertebrate community stations^a, Mary River Project CREMP, August 2015.

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia ^b	Plant or Algal Presence
REF-03-1	10.5	gray brown silt; no precipitate layer observed	none detected	sparse moss, sparse globular algae
REF-03-2	9.1	thin reddish-brown precipitate layer over brown-gray silt	none detected	sparse moss, sparse globular algae
REF-03-3	9.8	medium red-brown sandy-silt; compacted with depth	none detected	sparse globular algae
REF-03-4	8.4	medium brown silt over gray-brown silt; some fine sand	none detected	sparse globular algae
REF-03-5	11.2	iron oxide precipitate layer over gray-brown silt	none detected	globular algae (common)
REF-03-6	20.5	medium reddish-brown silt; no precipitate layer observed	none detected	none observed
REF-03-7	23.4	medium reddish-brown silt; sticky (silt-clay) composition	none detected	none observed
REF-03-8	18.5	red-brown silt, no precipitate layer observed	none detected	none observed
REF-03-9	21.1	medium brown silt; no precipitate layer observed	none detected	none observed
REF-03-10	19.5	red-brown silt; no precipitate layer observed	none detected	sparse globular algae

^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 C.2: Sediment core observations from cores collected in Reference Lake 3 (REF-03), Mary River Project CREMP, August 2015.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
REF-03-1	10.5	1	25.5	0 to 4	iron oxide precipitation
				4 to 25.5	gray brown silt with sand
		2	21.0	0 to 3	iron oxide precipitation
				3 to 21	gray brown silt with sand
		3	25.5	0 to 3	iron oxide precipitation
				3 to 21	gray brown silt with sand
REF-03-6	20.5	1	21.5	0 to 21.5	medium brown silt
		2	8.5	0 to 8.5	medium brown silt
		3	10.5	0 to 8	medium brown silt
				8 to 10.5	iron oxide layer, some black streaking
REF-03-2	9.1	1	32.0	0 to 32	gray-brown silt, iron oxide precipitation at surface
		2	35.5	0 to 35.5	gray-brown silt, iron oxide precipitation at surface
		3	31.0	0 to 31	gray-brown silt, iron oxide precipitation at surface
REF-03-7	23.4	1	14.0	0 to 9	medium brown silt
				9 to 14	gray-brown silt
		2	17.0	0 to 5	medium brown silt
				5 to 17	gray-brown silt
		3	11.5	0 to 11.5	medium brown silt
REF-03-3	9.8	1	9.0	0 to 6	brown silt
				6 to 9	gray-brown silt, bottom of core very compact
		2	19.0	0 to 8	brown silt
				8 to 19	gray-brown silt, bottom of core very compact
		3	10.5	0 to 5	brown silt
				5 to 10.5	gray-brown silt, bottom of core very compact
REF-03-8	18.5	1	11.0	0 to 11	medium brown silt
		2	23.0	0 to 6	medium brown silt
				6 to 7	iron oxide layer
				7 to 23	gray-brown silt
		3	17.0	0 to 7	medium brown silt
				7 to 17	gray-brown silt
REF-03-4	8.4	1	18.0	0 to 9	red-brown silt
				9 to 18	transition to gray-brown silt/sand
		2	15.0	0 to 6	red-brown silt
				6 to 15	transition to gray-brown silt/sand
		3	12.0	0 to 8	red-brown silt
				8 to 12	transition to gray-brown silt/sand
REF-03-9	21.1	1	13.5	0 to 13.5	red-brown silt
		2	17.0	0 to 17	red-brown silt
		3	18.0	0 to 18	red-brown silt
REF-03-5	11.2	1	29.5	0 to 2	iron oxide precipitate
				2 to 6	gray silt with black streaking at lower end of layer
				6 to 29.5	gray-brown silt
		2	26.0	0 to 1	iron oxide precipitate
				1 to 4.5	gray silt with black streaking at lower end of layer
				4.5 to 26	gray-brown silt
		3	29.0	0 to 1	iron oxide precipitate
				1 to 4	gray silt with black streaking at lower end of layer
				4 to 29	gray-brown silt
REF-03-10	19.5	1	22.5	0 to 15	medium red-brown silt
				15 to 22.5	rust-coloured oxidized gray silt
		2	17.0	0 to 14	medium red-brown silt
				14 to 17	rust-coloured oxidized gray silt
		3	11.0	0 to 11	medium red-brown silt
REF-03-DUP (Duplicate of REF-03-10)	19.5	1	14.0	0 to 12	medium red-brown silt
				12 to 14	rust-coloured oxidized gray silt, some black streaking
		2	27.5	0 to 22	medium red-brown silt
				22 to 27.5	rust-coloured oxidized gray silt, some black streaking
		3	25.5	0 to 19	medium red-brown silt
				19 to 25.5	rust-coloured oxidized gray silt, some black streaking

Table C.3: Sediment particle size, total organic carbon, and metal concentrations at Reference Lake 3 (REF-03) sediment stations, Mary River Project CREMP, August 2015.

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	%	-	59.6	39.7	48.8	18.8	42.3	39.8	64.4	40.2	40.2	46.7	44.1	12.4	3.93
	Silt	%	-	32.0	46.4	36.5	62.0	48.0	45.4	32.1	49.2	51.8	40.2	44.4	9.37	2.96
	Clay	%	-	8.40	13.9	14.7	19.2	9.74	14.7	3.51	10.6	8.02	13.1	11.6	4.44	1.40
	Moisture	%	-	91.1	87.7	90.9	86.9	71.2	87.6	80.6	82.4	86.5	85.2	85	5.85	1.85
	Total Organic Carbon	%	10 ^α	2.45	4.94	8.31	4.41	1.88	5.30	2.93	4.66	5.31	4.53	4.47	1.81	0.573
Metals	Aluminum (Al)	mg/kg	-	21,400	31,700	14,900	30,000	13,400	23,400	15,500	22,900	15,400	27,300	21,590	6,648	2,102
	Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
	Arsenic (As)	mg/kg	17	5.30	7.12	6.01	6.81	3.20	6.44	3.50	5.17	9.98	6.04	5.96	1.92	0.607
	Barium (Ba)	mg/kg	-	128	171	136	159	80.3	140	78.7	124	157	150	132	31.4	9.92
	Beryllium (Be)	mg/kg	-	0.95	1.13	0.64	1.13	0.60	0.93	0.65	0.94	0.61	1.05	0.86	0.22	0.069
	Bismuth (Bi)	mg/kg	-	<0.20	0.24	<0.20	0.24	<0.20	0.23	<0.20	<0.20	<0.20	0.23	0.21	0.0180	0.0057
	Boron (B)	mg/kg	-	19.8	23.5	15.0	23.9	11.9	20.0	12.7	19.3	15.5	21.2	18.3	4.27	1.35
	Cadmium (Cd)	mg/kg	3.5	0.189	0.257	0.242	0.205	0.287	0.206	0.125	0.160	0.222	0.185	0.21	0.047	0.015
	Calcium (Ca)	mg/kg	-	5,630	6,700	6,000	6,540	3,840	6,170	4,080	9,140	5,330	6,450	5,988	1,484	469.1
	Chromium (Cr)	mg/kg	90	72.7	101	49.4	91.7	42.0	74.0	49.2	72.7	56.2	86.2	69.5	19.9	6.28
	Cobalt (Co)	mg/kg	-	14.2	22.3	11.1	20.7	12.2	17.3	11.6	15.7	14.1	18.9	15.8	3.89	1.23
	Copper (Cu)	mg/kg	197	98.0	119	79.0	111	48.1	90.6	56.6	84.5	65.3	102	85.5	23.4	7.40
	Iron (Fe)	mg/kg	40,000 ^α	52,100	59,600	73,400	56,200	26,900	60,900	33,700	44,300	110,000	51,250	56,835	23,016	7,278
	Lead (Pb)	mg/kg	91.3	19.3	25.1	17.0	23.9	14.3	23.3	13.9	22.4	16.2	22.4	19.8	4.17	1.32
	Lithium (Li)	mg/kg	-	35.3	43.6	22.2	46.4	23.2	36.6	24.4	35.9	24.4	40.5	33.3	9.04	2.86
	Magnesium (Mg)	mg/kg	-	13,300	20,200	9,360	18,200	8,420	14,400	9,060	14,700	10,300	17,150	13,509	4,157	1,314
	Manganese (Mn)	mg/kg	1,100 ^{α,β}	850	1,520	827	1,480	1,050	3,510	774	1,010	853	1,260	1,313	817.4	258.5
	Mercury (Hg)	mg/kg	0.486	0.0461	0.0731	0.0744	0.0745	0.0198	0.0838	0.0231	0.127	0.0629	0.0675	0.0652	0.0309	0.00978
	Molybdenum (Mo)	mg/kg	-	5.66	3.15	6.77	3.27	3.62	5.17	2.91	2.32	12.1	2.63	4.76	2.96	0.936
	Nickel (Ni)	mg/kg	75 ^{α,β}	54.1	71.1	42.0	63.5	44.7	55.0	35.1	49.8	40.5	59.2	51.5	11.23	3.55
	Phosphorus (P)	mg/kg	2,000 ^α	1,240	1,400	1,420	1,320	732	1,100	847	1,100	3,290	1,150	1,360	713.6	225.7
	Potassium (K)	mg/kg	-	5,030	7,420	3,690	7,250	3,550	5,630	3,670	5,600	3,860	6,555	5,226	1,508	477.0
	Selenium (Se)	mg/kg	-	0.76	1.05	0.91	0.88	0.33	1.13	0.38	0.85	0.92	0.86	0.81	0.26	0.082
	Silver (Ag)	mg/kg	-	0.19	0.33	0.18	0.34	<0.10	0.29	<0.10	0.28	0.15	0.31	0.23	0.093	0.029
	Sodium (Na)	mg/kg	-	354	577	283	530	232	418	236	436	311	497	387	123	38.9
	Strontium (Sr)	mg/kg	-	13.9	18.2	13.0	19.1	10.6	16.6	11.2	26.4	14.1	17.4	16.0	4.64	1.47
	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	-	0.612	1.02	0.456	0.938	0.489	0.897	0.371	0.802	0.440	0.926	0.695	0.246	0.0779
	Tin (Sn)	mg/kg	-	<2.0	2.4	<2.0	2.3	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	2.1	0.15	0.047
	Titanium (Ti)	mg/kg	-	1,070	1,710	752	1,550	1,030	1,090	914	1,240	1,070	1,365	1,179	291	92.2
	Uranium (U)	mg/kg	-	19.4	29.9	15.3	31.9	14.7	24.4	8.29	22.2	14.6	27.3	20.8	7.66	2.42
	Vanadium (V)	mg/kg	-	71.3	89.8	50.0	83.9	43.9	65.1	49.3	64.2	49.5	76.0	64.3	15.9	5.04
	Zinc (Zn)	mg/kg	315	106	132	78.4	123	60.4	96.3	72.4	94.6	74.9	112	95	23.4	7.41
	Zirconium (Zr)	mg/kg	-	3.6	3.8	3.8	3.7	3.0	3.4	2.5	3.6	3.0	4.0	3.4	0.5	0.1

^a Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment

Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

Indicates paramter concentration above Sediment Quality Guideline (SQG).

Table C.4: Statistical comparison of substrate physical properties between littoral and profundal sediment stations of individual study lakes, Mary River Project CREMP, August 2015.

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	0.032	γ	Littoral	5	51.1	10.6	4.7	40.2	64.4
					Profundal	5	37.0	10.6	4.7	18.8	46.7
	Silt (% by weight)	NO	0.159	α	Littoral	5	40.1	9.2	4.1	32.0	51.8
					Profundal	5	48.6	8.1	3.6	40.2	62.0
	Clay (% by weight)	YES	0.045	α	Littoral	5	8.9	4.0	1.8	3.5	14.7
					Profundal	5	14.3	3.1	1.4	10.6	19.2
Camp Lake	TOC (%)	NO	0.646	δ	Littoral	5	4.2	2.7	1.2	1.9	8.3
					Profundal	5	4.8	0.4	0.2	4.4	5.3
	Sand (% by weight)	NO	0.528	β	Littoral	5	58.3	18.1	8.1	41.8	85.4
					Profundal	9	52.9	22.0	7.3	33.8	92.0
	Silt (% by weight)	NO	0.876	α	Littoral	5	39.1	16.5	7.4	14.1	54.4
					Profundal	9	40.7	18.8	6.3	7.1	60.0
Sheardown Lake NW	Clay (% by weight)	YES	0.077	α	Littoral	5	2.6	1.6	0.7	0.5	4.6
					Profundal	9	6.4	4.1	1.4	0.4	13.0
	TOC (%)	-	-	-	Littoral	1	3.4	.	.	3.4	3.4
					Profundal	9	1.3	0.6	0.2	0.2	2.1
	Sand (% by weight)	NO	0.165	γ	Littoral	7	44.2	15.4	5.8	32.2	76.9
					Profundal	7	36.7	27.5	10.4	16.7	96.2
Sheardown Lake SE	Silt (% by weight)	NO	0.318	γ	Littoral	7	46.2	12.7	4.8	20.5	57.1
					Profundal	7	48.0	20.2	7.6	3.7	62.4
	Clay (% by weight)	NO	0.137	α	Littoral	7	9.6	3.6	1.4	2.6	13.2
					Profundal	7	15.3	8.7	3.3	0.1	26.4
	TOC (%)	NO	0.343	β	Littoral	4	2.5	2.0	1.0	0.2	5.1
					Profundal	4	1.5	0.2	0.1	1.4	1.8
Mary Lake	Sand (% by weight)	NO	0.221	α	Littoral	5	13.6	4.0	1.8	8.8	19.3
					Profundal	5	17.6	5.5	2.4	12.0	24.6
	Silt (% by weight)	NO	0.512	δ	Littoral	5	68.2	2.6	1.2	64.5	70.3
					Profundal	5	66.3	5.5	2.5	59.7	72.7
	Clay (% by weight)	NO	0.458	δ	Littoral	5	18.2	5.8	2.6	10.8	25.0
					Profundal	5	16.1	0.6	0.3	15.3	16.6
Mary Lake	TOC (%)	-	-	-	Littoral	3	1.2	0.4	0.2	0.9	1.7
					Profundal	2	0.9	0.0	0.0	0.9	0.9
	Sand (% by weight)	NO	0.897	β	Littoral	4	31.6	39.5	19.8	7.0	90.4
					Profundal	11	26.8	24.4	7.4	7.5	90.9
	Silt (% by weight)	NO	0.939	δ	Littoral	4	46.1	26.4	13.2	8.5	69.8
					Profundal	11	47.0	16.6	5.0	6.6	64.8
Mary Lake	Clay (% by weight)	NO	0.657	δ	Littoral	4	22.3	18.8	9.4	1.1	38.9
					Profundal	11	26.3	13.5	4.1	2.6	43.3
Mary Lake	TOC (%)	-	-	-	Littoral	2	1.1	0.2	0.2	0.9	1.3
					Profundal	8	0.8	0.2	0.1	0.6	1.2

^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 confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed 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.5: Field observations at Camp Lake (JLO) benthic invertebrate community stations^a, Mary River Project CREMP, August 2015.

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia ^b	Plant or Algal Presence
JLO-02	11.3	gray-brown silt, fine sand; some reddish-brown material at sediment surface	none detected	none observed
JLO-01	17.8	brown-red silt	none detected	globular algae (sparse)
JLO-21	9.9	thin reddish layer over gray-brown silty loam with some fine sand	none detected	globular algae (common)
JLO-20	6.9	thin layer of reddish material over gray-brown material; mainly fine sand with silt, but some coarse sand present	none detected	globular algae (common)
JLO-19	7.5	reddish-brown layer (0.5 cm thick) at surface transitioning to grey-brown fine sand with embedded organics	none detected	none observed
JLO-07	32.9	brown gray sandy-silt	none detected	none observed
JLO-18	12.2	reddish-brown layer (0.5 cm thick) at surface transitioning to grey-brown fine sand with embedded organics	none detected	none observed
JLO-16	16.0	medium brown-grey fine sand-silt	none detected	none observed
JLO-11	29.0	medium brown silt with some fine sand	none detected	none observed
JLO-12	14.9 to 15.5	brown-red at surface with dark reddish/brown ferricrete-like layer at 2 cm depth, overlying medium gray-brown fine-medium grained sand	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 C.6: Sediment core observations from cores collected in Camp Lake (JLO), Mary River Project CREMP, August 2015.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
JLO-02	12.3 to 11.6	1	20.0	0 to 3	loose flocc
				3 to 20	gray-brown silt
		2	23.0	0 to 4	loose flocc
				4 to 23	gray-brown silt
		3	20.0	0 to 2	loose flocc
				2 to 20	gray-brown silt
JLO-01	16.9	1	11.0	0 to 11	brown silt throughout
		2	18.0	0 to 18	uniform brown silt throughout
JLO-14	26.5	1	24.5	0 to 2	reddish-brown (iron oxide) layer
				2 to 6	transition layer
				6 to 26.5	gray-brown silt (silt sand)
		2	23.0	0 to 4	reddish-brown (iron oxide) layer
				4 to 15	gray-brown silt
				15 to 23	brown silt
		3	26.0	0 to 1	reddish-brown (iron oxide) layer
				1 to 11	gray-brown silt-sand
				11 to 26	darker brown-red loam
JLO-17	15.6	1	25.0	0 to 2	reddish-brown (iron oxide) layer
				2 to 25	gray-brown silt
		2	24.0	0 to 2	reddish-brown (iron oxide) layer
				2 to 24	gray-brown silt
		3	22.0	0 to 3	reddish-brown (iron oxide) layer
				3 to 22	gray-brown silt
JLO-07	33.2	1	24.0	0 to 24	light brown to dark brown silt with depth
		2	18.0	0 to 18	light brown to dark brown silt with depth
		3	16.0	0 to 4	reddish oxidized layer (strong boundary)
				4 to 16	medium brown silt (some black streaking)
JLO-16	16.2	1	10.0	0 to 10	thin layer of organic silt over sand
		2	11.0	0 to 11	thin layer of organic silt over sand
		3	8.5	0 to 8.5	thin layer of organic silt over sand
JLO-15	16.9	1	18.0	0 to 18	oxidized material over gray-brown silt
		2	15.0	0 to 15	oxidized material over brown silt
		3	11.0	0 to 11	oxidized material over gray-brown silt
JLO-11	28.8	1	22.0	0 to 4	reddish-brown oxidized silt-flocc
				4 to 17	medium gray-brown silt
				17 to 22	darker gray-brown silt
		2	24.0	0 to 5	oxidized flocc-precipitate and silt
				5 to 5.5	black silt
				5.5 to 24	gray-brown silt
		3	20.0	0 to 4	oxidized flocc-precipitate and silt
				4 to 4.5	reddish-brown oxidized layer
				4.5 to 20	gray-brown silt
JLO-13	17.2	1	24	0 to 4	reddish-brown (iron oxide) layer
				4 to 24	gray-brown silt
		2	13	0 to 3.5	reddish-brown (iron oxide) layer
				3.5 to 13	gray brown silt, some black at bottom of layer
		3	16.5	0 to 3	reddish-brown (iron oxide) layer
				3 to 16.5	gray brown silt, some black at bottom of layer
JLO-12	16.4	1	9.5	0 to 9.5	fine sand - oxidized layer near surface (~2 cm down)
		2	9.0	0 to 9	fine sand - oxidized layer near surface (~2 cm down)
		3	20.0	0 to 3	oxidized layer
				3 to 20	gray-brown sand

Table C.7: Sediment particle size, total organic carbon, and metal concentrations at Camp Lake (JLO) sediment stations, Mary River Project CREMP, August 2015.

Analyte		Units	Sediment Quality Guideline (SQG) ^a	AEMP Benchmark ^b	Camp Lake Stations										Study Area Summary Statistics		
					JLO-02 (littoral)	JLO-01 (profundal)	JLO-14 (profundal)	JLO-17 (profundal)	JLO-07 (profundal)	JLO-16 (profundal)	JLO-15 (profundal)	JLO-11 (profundal)	JLO-13 (profundal)	JLO-12 (profundal)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	43	36	38	34	41	92	52	55	41	87	52	21	6.6
	Silt	%	-	-	52	56	51	60	46	7	42	38	53	13	42	18	5.7
	Clay	%	-	-	4.6	8.1	11	6.1	13	0.9	5.7	6.8	5.5	0.4	6.2	3.9	1.2
	Moisture	%	-	-	81	66	72	74	70	24	59	73	70	56	65	16	5.09
	Total Organic Carbon	%	10 ^α	-	3.44	1.34	1.75	1.99	2.05	0.17	0.97	1.70	1.56	0.61	1.56	0.90	0.284
Metals	Aluminum (Al)	mg/kg	-	-	15,900	18,900	20,700	15,900	20,500	5,430	14,100	17,200	19,300	6,840	15,477	5,371	1,698
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
	Arsenic (As)	mg/kg	17	5.9	14.60	4.98	10.50	14.3	4.64	1.10	3.68	9.54	7.00	3.43	7.38	4.67	1.48
	Barium (Ba)	mg/kg	-	-	174	75	151	216	91.5	24.3	53.0	99.4	122	55.7	106	59.8	18.9
	Beryllium (Be)	mg/kg	-	-	0.84	1.10	1.14	0.87	1.11	0.26	0.80	0.95	1.09	0.39	0.85	0.31	0.097
	Bismuth (Bi)	mg/kg	-	-	0.31	0.31	0.38	0.29	0.34	<0.20	0.24	0.34	0.34	<0.20	0.29	0.061	0.019
	Boron (B)	mg/kg	-	-	23.6	27.5	30.6	22.8	32.1	8.9	22.0	25.5	28.9	11.0	23.3	7.78	2.46
	Cadmium (Cd)	mg/kg	3.5	1.5	0.354	0.147	0.258	0.228	0.172	0.041	0.110	0.170	0.201	0.059	0.17	0.094	0.030
	Calcium (Ca)	mg/kg	-	-	6,310	5,610	5,020	4,940	4,690	16,600	3,560	4,240	5,050	2,120	5,814	3,959	1,252.0
	Chromium (Cr)	mg/kg	90	98	73.0	75	88	69.3	84.7	37.6	62.3	73.1	79.5	33.4	67.6	18.5	5.84
	Cobalt (Co)	mg/kg	-	-	21.5	18.3	27.4	21.7	18.3	5.86	14.2	17.9	23.6	9.71	17.8	6.46	2.04
	Copper (Cu)	mg/kg	197	50	57.0	44	56	41.7	55.2	13.0	33.0	45.5	47.3	15.3	40.8	15.9	5.02
	Iron (Fe)	mg/kg	40,000 ^α	52,400	62,300	32,400	72,850	66,100	40,900	11,800	26,400	53,200	63,400	30,400	45,975	20,422	6,458
	Lead (Pb)	mg/kg	91.3	35	21.1	25.3	26.7	21.3	25.4	5.92	17.5	21.7	24.7	7.90	19.7	7.30	2.31
	Lithium (Li)	mg/kg	-	-	28.1	35.3	37.1	29.5	38.0	9.6	26.5	30.8	35.5	13.0	28.3	9.82	3.10
	Magnesium (Mg)	mg/kg	-	-	13,600	13,600	15,050	12,000	14,600	14,900	11,200	12,500	13,900	5,990	12,734	2,684	849
	Manganese (Mn)	mg/kg	1,100 ^{α,β}	4,370	1,900	955	3,920	7,160	741	198	688	1,850	5,010	1,760	2,418	2,245.0	709.9
	Mercury (Hg)	mg/kg	0.486	0.17	0.0578	0.0623	0.0519	0.0381	0.0493	<0.0050	0.0214	0.0460	0.0358	0.0102	0.0378	0.0197	0.00624
	Molybdenum (Mo)	mg/kg	-	-	2.64	0.79	2.57	5.57	0.91	0.24	0.66	1.37	3.45	0.93	1.91	1.65	0.523
	Nickel (Ni)	mg/kg	75 ^{α,β}	72	83.7	66.1	81.3	75	68.1	36.3	55.1	69.1	72	33.3	64.0	17.3	5.48
	Phosphorus (P)	mg/kg	2,000 ^α	1,580	1,750	914	2,390	2,580	1,300	523	794	1,900	1,690	1,150	1,499	681	215
	Potassium (K)	mg/kg	-	-	4,090	4,980	5,340	4,060	5,450	1,520	3,620	4,430	4,970	1,720	4,018	1,394	441
	Selenium (Se)	mg/kg	-	-	0.56	0.30	0.56	0.45	0.49	<0.20	0.21	0.44	0.48	<0.20	0.39	0.15	0.046
	Silver (Ag)	mg/kg	-	-	0.15	0.14	0.18	0.11	0.20	<0.10	<0.10	0.14	0.15	<0.10	0.14	0.034	0.011
	Sodium (Na)	mg/kg	-	-	184	199	262	173	376	79	155	220	205	72	193	87	28
	Strontium (Sr)	mg/kg	-	-	11.1	19.0	16.1	11.5	22.5	10.3	10.9	11.7	13.0	5.76	13.2	4.80	1.52
	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	-	-	0.703	0.58	0.69	0.669	0.516	0.128	0.407	0.489	0.670	0.207	0.506	0.204	0.0646
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
	Titanium (Ti)	mg/kg	-	-	893	850	930	730	972	427	802	797	904	427	773	196	61.9
	Uranium (U)	mg/kg	-	-	9.7	5.8	9.2	6.24	7.60	1.12	4.61	7.26	7.19	1.93	6.06	2.81	0.890
	Vanadium (V)	mg/kg	-	-	60.8	62.5	73.3	57.7	65.9	20.4	49.3	59.8	65.2	25.2	54.0	17.6	5.56
	Zinc (Zn)	mg/kg	315	135	61.3	60.7	73.4	55.8	69.2	21.6	46.9	57.7	63.4	22.3	53.2	18.0	5.69
	Zirconium (Zr)	mg/kg	-	-	8.1	5.7	4.7	3.2	8.7	6.7	4.7	4.5	4.7	2.1	5.3	2.1	0.65

^a Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

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

Indicates paramter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table C.8: Summary of the magnitude of difference in sediment metal concentrations between 2015 Camp Lake and Reference Lake 3 data, Camp Lake 2015 and baseline period data, and Camp Lake 2015 and mine construction period (2014) data for littoral and profundal substrates, Mary River Project CREMP, 2015.

Variable	Camp Lake versus Reference Lake 3 2015				Camp Lake 2015 versus Baseline Period				Camp Lake 2015 versus Mine Construction (2014) Period			
	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 2014 Concentration (mg/kg)	Magnitude of Difference	Camp Lake 2014 Concentration (mg/kg)	Magnitude of Difference
Aluminum (Al)	16,120	1.0	27,060	0.6	18,267	0.9	15,175	1.0	14,900	1.1	12,648	1.2
Antimony (Sb)	0.1	1.0	0.1	1.0	1.0	0.1	1.0	0.1	1.0	0.1	1.0	0.1
Arsenic (As)	5.6	2.6	6.3	1.0	2.8	5.2	3.5	1.9	2.0	7.3	3.7	1.8
Barium (Ba)	116	1.5	149	0.7	105	1.7	68	1.5	77	2.3	76	1.3
Beryllium (Be)	0.7	1.2	1.0	0.8	1.0	0.8	1.0	0.9	1.0	0.8	1.0	0.9
Bismuth (Bi)	0.2	1.6	0.2	1.3	-	-	-	-	-	-	-	-
Boron (B)	15	1.6	22	1.1	1	32.2	2	12.7	1	47.2	1	46.5
Cadmium (Cd)	0.2	1.7	0.2	0.8	0.5	0.7	0.5	0.3	0.5	0.7	0.5	0.3
Calcium (Ca)	4,976	1.3	7,000	0.8	3,130	2.0	2,857	2.0	4,200	1.5	3,542	1.6
Chromium (Cr)	54	1.4	85	0.8	81	0.9	71	0.9	70	1.0	64	1.0
Cobalt (Co)	13	1.7	19	0.9	18	1.2	17	1.1	15	1.4	16	1.1
Copper (Cu)	69	0.8	102	0.4	45	1.3	40	1.0	39	1.5	39	1.0
Iron (Fe)	59,220	1.1	54,450	0.8	36,133	1.7	33,206	1.3	30,600	2.0	32,108	1.4
Lead (Pb)	16	1.3	23	0.8	18	1.2	19	1.0	15	1.4	17	1.2
Lithium (Li)	26	1.1	41	0.7	-	-	-	-	-	-	-	-
Magnesium (Mg)	10,088	1.3	16,930	0.7	13,967	1.0	10,113	1.2	14,200	1.0	10,717	1.2
Manganese (Mn)	871	2.2	1,756	1.4	699	2.7	942	2.6	539	3.5	1,636	1.5
Mercury (Hg)	0.045	1.3	0.085	0.4	0.100	0.6	0.100	0.4	0.100	0.6	0.100	0.4
Molybdenum (Mo)	6.2	0.4	3.3	0.6	1.0	2.6	1.0	1.8	1.0	2.6	1.3	1.4
Nickel (Ni)	43	1.9	60	1.0	67	1.2	63	1.0	58	1.4	59	1.0
Phosphorus (P)	1,506	1.2	1,214	1.2	800	2.2	1,125	1.3	-	-	-	-
Potassium (K)	3,960	1.0	6,491	0.6	3,450	1.2	3,771	1.1	3,200	1.3	3,625	1.1
Selenium (Se)	0.7	0.8	1.0	0.4	1.0	0.6	1.0	0.4	1.0	0.6	1.0	0.4
Silver (Ag)	0.1	1.0	0.3	0.4	0.3	0.5	0.3	0.4	0.2	0.8	0.2	0.7
Sodium (Na)	283	0.6	492	0.4	279	0.7	254	0.8	200	0.9	250	0.8
Strontium (Sr)	12.6	0.9	19.5	0.7	9.3	1.2	12.0	1.1	8.0	1.4	12.4	1.1
Sulphur (S)	5,000	1.0	5,000	1.0	-	-	-	-	-	-	-	-
Thallium (Tl)	0.5	1.5	0.9	0.5	1.0	0.7	1.0	0.5	1.0	0.7	1.0	0.5
Tin (Sn)	2.0	1.0	2.2	0.9	-	-	-	-	-	-	-	-
Titanium (Ti)	967	0.9	1,391	0.5	-	-	-	-	-	-	-	-
Uranium (U)	14	0.7	27	0.2	-	-	-	-	-	-	-	-
Vanadium (V)	53	1.2	76	0.7	69	0.9	57	0.9	56	1.1	49	1.1
Zinc (Zn)	78	0.8	111	0.5	67	0.9	57	0.9	65	0.9	72	0.7

Denotes slight elevation (mean variable concentration 2 to 5 times higher than respective mean reference, baseline or construction period value).

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

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

Table C.9: Field observations at Sheardown Lake Northwest (DLO-01) benthic invertebrate community stations^a, Mary River Project CREMP, August 2015.

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia ^b	Plant or Algal Presence
DLO-01-9	7.6	~ 1 mm layer of iron oxide precipitate over medium brown silt	none detected	decaying macrophytes (<i>Chara</i> sp. or moss), globular algae (common)
DLO-01-4	7.5	some iron oxide particulate over medium brown-gray silt	none detected	aquatic moss (sparse), globular algae (common)
DLO-01-3	8.2	medium dark brown-gray silt; no iron oxide precipitate	none detected	<i>Chara</i> sp. present (common)
DLO-01-11	8.2	thin iron oxide precipitate over brown silt	none detected	<i>Chara</i> sp. and aquatic moss (sparse), globular algae (sparse)
DLO-01-10	7.9	thin layer of reddish-brown iron oxide precipitate over sand-silt	none detected	aquatic moss (common), globular algae (sparse)
DLO-01-5	23.3	some iron oxide speckling at surface overlying gray-brown silt	none detected	globular algae (common)
DLO-01-14	22.0	thin reddish-brown layer over gray-brown silt with some intermixed sand; ferricrete-like layer present	none detected	globular algae (sparse)
DLO-01-15	21.7	reddish-brown silt with some (minor) sand	none detected	none observed
DLO-01-2	17.5	reddish-brown silt with some (minor) sand	none detected	globular algae (sparse)
DLO-01-12	14.0	reddish-brown, compact sand	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 C.10: Sediment core observations from cores collected in Sheardown Lake Northwest (DLO-01), Mary River Project CREMP, August 2015.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
DLO-01-05	23.1	1	26.0	0 to 4	reddish-brown oxidized material
				4 to 8	transition layer
				8 to 26	gray-brown silt
		2	26.0	0 to 2	reddish-brown oxidized material
				2 to 8	transition layer, with some black streaking
				8 to 26	gray-brown silt
		3	23.0	0 to 3	reddish-brown oxidized layer, loose flocc
				3 to 11	transition layer, with some black streaking
				11 to 23	gray-brown silt
DD-HAB 9-STN2	10.8	1	32.0	0 to 2.5	organic flocc layer, silt
				2.5 to 32	uniform gray-brown silt
		2	27.0	0 to 4	organic flocc layer, silt
				4 to 27	uniform gray-brown silt
		3	31.0	0 to 3	organic flocc layer, silt
				3 to 31	uniform gray-brown silt
DLO-01-08	11.5	1	30.0	0 to 20	reddish-brown silt
				20 to 30	compacted brown silt
		2	24.0	0 to 20	reddish-brown silt
				20 to 24	compacted brown silt
		3	22.0	0 to 20	reddish-brown silt
				20 to 22	compacted brown silt
DLO-01-01	20.8	1	16.5	0 to 16.5	medium reddish-brown silt
		2	14.0	0 to 14	medium reddish-brown silt
		3	18.0	0 to 18	medium reddish-brown silt
DLO-01-13	18.4	1	28.0	0 to 22	brown silt
				22 to 28	brown silt with black streaking
		2	22.5	0 to 18	brown silt transitioning to gray silt
				18 to 25.5	gray silt
DLO-01-2	18.6	1	16.0	0 to 3	reddish-brown oxidized layer
				3 to 8	gray-brown silt
				8 to 16	gray-brown silt with black streaking
		2	17.0	0 to 5	oxidized layer over gray-brown silt
				5 to 17	gray silt with some black streaking
		3	16.0	0 to 4	reddish-brown oxidized layer
				4 to 16	gray-brown silt with some black streaking
DLO-01-9	7.8	1	23.0	0 to 4	oxidized flocculent layer (<i>Chara</i> sp. in sample)
				4 to 17	light brown silt
				17 to 23	dark brown silt
		2	20.0	0 to 4	oxidized flocculent layer (<i>Chara</i> sp. in sample)
				4 to 20	light brown silt
		3	15.5	0 to 3	oxidized flocculent layer (<i>Chara</i> sp. in sample)
				3 to 11	light brown silt
				11 to 19.5	dark brown silt
DLO-01-10	7.6	1	13.0	0 to 1.5	reddish brown layer with some black streaking at bottom of layer
				1.5 to 13	brown silt and sand
		2	12.5	0 to 1.5	oxidized organic flocc layer
				1.5 to 5.5	gray sand
				5.5 to 12.5	gray-brown fine sand
		3	6.0	0 to 1.5	oxidized organic flocc layer
				1.5 to 6	gray sand

Table C.11: Sediment particle size, total organic carbon, metal concentrations at Sheardown Lake Northwest (DLO-01) sediment stations, Mary River Project CREMP, August 2015.

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-01-13 (profundal)	DLO-01-2 (profundal)	DLO-01-9 (littoral)	DLO-01-10 (littoral)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	21	46	35	40	36	26	44	77	40	17	6.0
	Silt	%	-	-	57	43	53	48	50	62	43	21	47	13	4.5
	Clay	%	-	-	22	11	12	12	14	12	13	2.6	12	5.3	1.9
	Moisture	%	-	-	77	80	79	71	65	72	84	26	69	18	6.5
	Total Organic Carbon	%	10 ^α	-	1.77	2.22	2.34	1.44	1.39	1.38	5.13	0.15	1.98	1.44	0.508
Metals	Aluminum (Al)	mg/kg	-	-	21,500	19,200	20,900	23,400	18,000	21,100	19,300	1,420	18,103	6,942	2,454
	Antimony (Sb)	mg/kg	-	-	0.11	<0.10	<0.10	<0.10	<0.10	0.10	0.10	<0.10	0.10	0.0035	0.0013
	Arsenic (As)	mg/kg	17	6.2	7.18	9.99	9.85	4.85	3.90	4.63	7.05	0.58	6.00	3.17	1.12
	Barium (Ba)	mg/kg	-	-	97.3	320	128	98.5	75.0	131	106	7.16	120	89.5	31.7
	Beryllium (Be)	mg/kg	-	-	1.17	1.03	1.15	1.22	0.96	1.08	1.08	<0.10	0.974	0.362	0.128
	Bismuth (Bi)	mg/kg	-	-	0.38	0.29	0.29	0.30	0.26	0.31	0.29	<0.20	0.29	0.050	0.018
	Boron (B)	mg/kg	-	-	32.9	30.3	33.6	35.2	27.6	31.4	32.5	<5.0	28.6	9.79	3.46
	Cadmium (Cd)	mg/kg	3.5	1.5	0.272	0.510	0.272	0.272	0.227	0.307	0.603	<0.020	0.310	0.178	0.0628
	Calcium (Ca)	mg/kg	-	-	4,300	5,110	5,140	4,800	4,170	5,110	6,595	800	4,503	1,668	589.7
	Chromium (Cr)	mg/kg	90	97	84.6	75.0	82.3	84.2	70.9	83.8	75.7	7.15	70.5	26.1	9.22
	Cobalt (Co)	mg/kg	-	-	17.7	17.8	21.9	17.4	14.3	17.8	16.8	1.27	15.6	6.16	2.18
	Copper (Cu)	mg/kg	197	58	51.3	57.1	47.9	50.4	40.5	45.5	72.1	2.84	46.0	19.82	7.01
	Iron (Fe)	mg/kg	40,000 ^α	52,200	57,200	67,700	95,400	41,900	33,400	41,000	62,650	5,490	50,593	26,691	9,437
	Lead (Pb)	mg/kg	91.3	35	25.8	24.0	24.2	25.2	21.6	24.0	23.4	2.49	21.3	7.71	2.73
	Lithium (Li)	mg/kg	-	-	38.0	33.2	36.7	39.8	31.2	35.9	33.8	2.8	31.4	11.9	4.20
	Magnesium (Mg)	mg/kg	-	-	14,600	13,000	13,800	14,200	12,100	14,100	13,100	1,100	12,000	4,477	1,583
	Manganese (Mn)	mg/kg	1,100 ^{α,β}	4,530	664	3,260	2,220	1,150	973	8,040	435	69	2,101	2,613	924
	Mercury (Hg)	mg/kg	0.486	0.17	0.0557	0.0528	0.0382	0.0387	0.0341	0.0342	0.060	<0.0050	0.0398	0.0174	0.00614
	Molybdenum (Mo)	mg/kg	-	-	2.88	9.97	19.4	2.04	1.78	8.36	8.61	0.53	6.70	6.29	2.22
	Nickel (Ni)	mg/kg	75 ^{α,β}	77	71.4	87	85.6	70.6	60.2	77	103	6.11	70.1	28.9	10.22
	Phosphorus (P)	mg/kg	2,000 ^α	1,958	1,390	1,510	1,460	885	822	930	849	262	1,014	421	149
	Potassium (K)	mg/kg	-	-	5,800	5,060	5,280	5,960	4,540	5,530	4,865	350	4,673	1,810	640
	Selenium (Se)	mg/kg	-	-	0.55	0.57	0.58	0.37	0.33	0.41	0.78	<0.20	0.47	0.18	0.064
	Silver (Ag)	mg/kg	-	-	0.24	0.19	0.17	0.21	0.16	0.18	0.24	<0.10	0.19	0.045	0.016
	Sodium (Na)	mg/kg	-	-	333	295	294	320	266	305	294	<50	270	90.9	32.1
	Strontium (Sr)	mg/kg	-	-	13.3	12.8	13.4	13.9	11.4	13.5	13.0	3.72	11.9	3.38	1.19
	Sulphur (S)	mg/kg	-	-	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	0	0
	Thallium (Tl)	mg/kg	-	-	0.603	0.721	0.662	0.711	0.593	0.735	0.760	<0.050	0.604	0.232	0.0821
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
	Titanium (Ti)	mg/kg	-	-	1,220	1,080	1,220	1,320	1,110	1,290	1,120	137	1,062	384	136
	Uranium (U)	mg/kg	-	-	10.3	11.3	7.65	9.86	8.02	8.50	16.0	0.726	9.04	4.28	1.51
	Vanadium (V)	mg/kg	-	-	61.3	59.5	63.2	65.7	54.2	62.3	59.9	6.00	54.0	19.7	6.96
	Zinc (Zn)	mg/kg	315	123	81.1	76.6	77.4	80.1	65.1	75.8	76.0	7.0	67.4	24.9	8.79
	Zirconium (Zr)	mg/kg	-	-	11.9	11.2	8.2	10.1	8.0	8.7	22.5	2.1	10.3	5.74	2.03

^a Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

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

Indicates paramter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table C.12: Summary of the magnitude of difference in sediment metal concentrations between 2015 Sheardown Lake NW and Reference Lake 3 data, Sheardown Lake NW 2015 and baseline period data, and Sheardown Lake NW 2015 and mine construction period (2014) data for littoral and profundal stations, Mary River Project CREMP, 2015.

Variable	Sheardown Lake NW versus Reference Lake 3 2015				Sheardown Lake NW 2015 versus Baseline Period				Sheardown Lake NW 2015 versus Mine Construction (2014) Period			
	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 2014 Concentration (mg/kg)	Magnitude of Difference	Sheardown Lake NW 2014 Concentration (mg/kg)	Magnitude of Difference
Aluminum (Al)	16,120	0.9	27,060	0.8	11,792	1.3	17,745	1.2	15,875	1.0	17,700	1.2
Antimony (Sb)	0.1	1.0	0.1	1.0	1.0	0.1	1.0	0.1	1.0	0.1	1.0	0.1
Arsenic (As)	5.6	1.2	6.3	0.8	3.0	2.3	3.2	1.6	3.5	2.0	3.8	1.4
Barium (Ba)	116	1.2	149	0.7	78	1.8	93	1.1	102	1.4	94	1.1
Beryllium (Be)	0.7	1.2	1.0	1.1	1.0	0.8	1.0	1.1	1.0	0.8	1.0	1.1
Bismuth (Bi)	0.2	1.3	0.2	1.4	-	-	-	-	-	-	-	-
Boron (B)	15	1.7	22	1.5	3	8.9	3	10.2	1	25.3	1	57.8
Cadmium (Cd)	0.2	1.6	0.2	1.3	0.5	0.7	0.5	0.5	0.5	0.7	0.5	0.5
Calcium (Ca)	4,976	0.9	7,000	0.7	2,697	1.6	3,558	1.3	4,325	1.0	3,775	1.2
Chromium (Cr)	54	1.1	85	1.0	53	1.1	81	1.0	77	0.8	85	1.0
Cobalt (Co)	13	1.1	19	0.9	10	1.4	15	1.1	14	1.0	16	1.1
Copper (Cu)	69	0.6	102	0.5	33	1.4	48	1.0	57	0.8	48	1.0
Iron (Fe)	59,220	1.0	54,450	0.8	28,120	2.1	40,382	1.1	41,175	1.4	40,525	1.1
Lead (Pb)	16	1.1	23	1.0	13	1.5	20	1.2	18	1.0	20	1.2
Lithium (Li)	26	1.0	41	0.9	-	-	-	-	-	-	-	-
Magnesium (Mg)	10,088	1.0	16,930	0.8	7,448	1.4	11,498	1.2	10,750	1.0	12,375	1.1
Manganese (Mn)	871	1.7	1,756	1.5	756	2.0	2,164	1.3	678	2.2	2,370	1.1
Mercury (Hg)	0.045	0.9	0.085	0.5	0.100	0.4	0.100	0.4	0.100	0.4	0.100	0.4
Molybdenum (Mo)	6.2	1.5	3.3	1.1	3.4	2.8	3.5	1.1	4.3	2.3	3.5	1.1
Nickel (Ni)	43	1.6	60	1.2	49	1.4	69	1.0	80	0.9	71	1.0
Phosphorus (P)	1,506	0.7	1,214	0.8	863	1.2	1,400	0.7	-	-	-	-
Potassium (K)	3,960	1.0	6,491	0.8	2,681	1.5	4,612	1.2	4,250	0.9	4,675	1.2
Selenium (Se)	0.7	0.8	1.0	0.4	1.0	0.5	1.0	0.4	1.0	0.5	1.0	0.4
Silver (Ag)	0.1	1.2	0.3	0.6	0.3	0.7	0.3	0.7	0.2	0.9	0.2	1.0
Sodium (Na)	283	0.8	492	0.6	249	0.9	342	0.9	225	1.0	275	1.1
Strontium (Sr)	12.6	0.9	19.5	0.7	7.2	1.5	11.4	1.1	9.0	1.2	11.0	1.2
Sulphur (S)	5,000	1.0	5,000	1.0	-	-	-	-	-	-	-	-
Thallium (Tl)	0.5	1.2	0.9	0.7	1.0	0.5	1.0	0.7	1.0	0.5	1.0	0.7
Tin (Sn)	2.0	1.0	2.2	0.9	-	-	-	-	-	-	-	-
Titanium (Ti)	967	0.9	1,391	0.9	-	-	-	-	-	-	-	-
Uranium (U)	14	0.6	27	0.3	-	-	-	-	-	-	-	-
Vanadium (V)	53	0.9	76	0.8	37	1.3	58	1.1	54	0.9	58	1.1
Zinc (Zn)	78	0.8	111	0.7	51	1.2	76	1.0	78	0.8	97	0.8

Denotes slight elevation (mean variable concentration 2 to 5 times higher than respective mean reference, baseline or construction period value).

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

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

Table C.13: Field observations at Sheardown Lake Southeast (DLO-02) benthic invertebrate community stations^a, Mary River Project CREMP, August 2015.

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia ^b	Plant or Algal Presence
DLO-02-11	6.8	reddish iron oxide and/or black oxidized layer (<0.5 cm thick) at surface overlying gray-brown silt	black oxidized layer (possibly due to decaying vegetation)	<i>Chara</i> sp. (common), globular algae (sparse)
DLO-02-10	6.9	gray-brown silt	none detected	<i>Chara</i> sp. (common), globular algae (sparse)
DLO-02-4	8.1	reddish-brown silt layer (~1 cm) over medium brown silt	none detected	globular algae (sparse)
DLO-02-9	8.6	reddish-brown layer (~ 1 cm) over medium brown silt	none detected	globular algae (sparse)
DLO-02-1	10.2 to 10.6	dark brown, compact silt	none detected	globular algae (sparse)
DLO-02-12	11.0	reddish layer (~1 cm thick) over medium brown silt	none detected	globular algae (sparse)
DLO-02-8	12.9	reddish-brown layer (~ 1 cm) over medium brown silt	none detected	globular algae (sparse)
DLO-02-13	11.4	thin red-brown layer (~1 cm) over dark brown silt	none detected	globular algae (sparse)
DLO-02-2	13.7	dark brown silt	none detected	none observed
DLO-02-3	13.2	dark brown silt	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 C.14: Sediment core observations from cores collected in Sheardown Lake Southeast (DLO-02), Mary River Project CREMP, August 2015.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
DLO-02-1	12.1	1	17.0	0 to 4	reddish-brown oxidized layer over silt
				4 to 8	gray silt
				8 to 17	sand
		2	7.5	0 to 6	gray-brown compact silt
				6 to 7.5	sand
		3	7.0	0 to 7	gray-brown silt over thin layer of oxidized material
DLO-02-11	7	1	21.0	0 to 0.5	orange floc layer with underlying thin black layer
				0.5 to 21	gray-brown silt
		2	16.5	0 to 0.5	orange floc layer with underlying thin black layer
				0.5 to 16.5	gray-brown silt
		3	16.0	0 to 0.5	orange floc layer with underlying thin black layer
				0.5 to 16	gray-brown silt
DLO-02-4	8.8	1	20.0	0 to 1	reddish-brown oxidized layer, silt
				1 to 20	brown-gray silt
		2	16.0	0 to 1	reddish-brown oxidized layer, silt
				1 to 16	brown-gray silt
		3	20.5	0 to 1	reddish-brown oxidized layer, silt
				1 to 20.5	brown-gray silt
DLO-02-2	15.4	1	18.0	0 to 1	reddish-brown oxidized layer, silt
				1 to 18	gray-brown silt
		2	13.0	0 to 1	reddish-brown oxidized layer, silt
				1 to 13	gray-brown silt
		3	7.5	0 to 7.5	oxidized layer at surface, gray brown silt below
DLO-02-3	14.5	1	10.0	0 to 10	dark brown silt
		2	11.5	0 to 11.5	silt, oxidized at surface
		3	11.0	0 to 11	reddish-brown oxidized layer over medium brown silt

Table C.15: Sediment particle size, total organic carbon, and metal concentrations at Sheardown Lake Southeast (DLO-02) sediment stations, Mary River Project CREMP, August 2015.

Analyte		Units	Sediment Quality Guideline (SQG) ^a	AEMP Benchmark ^b	Sheardown Lake Southeast Stations					Study Area Summary Statistics		
					DLO-02-1 (littoral)	DLO-02-11 (littoral)	DLO-02-4 (littoral)	DLO-02-2 (profundal)	DLO-02-3 (profundal)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	19	13	12	20	25	18	5.3	2.4
	Silt	%	-	-	70	65	70	63	60	66	4.4	2.0
	Clay	%	-	-	11	22	18	17	16	17	4.2	1.9
	Moisture	%	-	-	41	64	55	47	42	50	9.8	4.4
	Total Organic Carbon	%	10 ^α	-	0.94	1.66	0.95	0.95	0.91	1.08	0.32	0.145
Metals	Aluminum (Al)	mg/kg	-	-	15,900	20,700	18,800	18,800	18,400	18,520	1,717	768
	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	2.28	5.38	6.37	2.82	2.62	3.89	1.85	0.828
	Barium (Ba)	mg/kg	-	-	67.0	98.2	121	77.6	73.3	87.4	22.1	9.89
	Beryllium (Be)	mg/kg	-	-	0.76	1.01	0.89	0.90	0.81	0.87	0.10	0.043
	Bismuth (Bi)	mg/kg	-	-	<0.20	0.30	0.26	0.23	0.22	0.24	0.0390	0.0174
	Boron (B)	mg/kg	-	-	23.5	32.4	26.5	29.1	24.0	27.1	3.70	1.66
	Cadmium (Cd)	mg/kg	3.5	1.5	0.103	0.126	0.104	0.101	0.103	0.107	0.0105	0.00471
	Calcium (Ca)	mg/kg	-	-	6,240	5,870	5,690	6,890	6,600	6,258	497	222.5
	Chromium (Cr)	mg/kg	90	79	70.9	96.0	84.6	79.9	78.0	81.9	9.3	4.16
	Cobalt (Co)	mg/kg	-	-	13.0	16.4	15.5	14.2	14.2	14.7	1.32	0.590
	Copper (Cu)	mg/kg	110	56	25.4	34.6	29.5	29.1	28.8	29.5	3.30	1.47
	Iron (Fe)	mg/kg	40,000 ^α	34,400	30,400	50,500	52,000	35,100	33,600	40,320	10,135	4,532
	Lead (Pb)	mg/kg	91.3	35	16.9	21.4	19.5	19.3	18.3	19.1	1.65	0.74
	Lithium (Li)	mg/kg	-	-	29.0	36.2	32.9	33.4	31.1	32.5	2.69	1.20
	Magnesium (Mg)	mg/kg	-	-	12,800	15,700	14,200	14,450	14,400	14,310	1,031	461
	Manganese (Mn)	mg/kg	1,100 ^{α,β}	657	435	418	2,290	464	424	806	830	371
	Mercury (Hg)	mg/kg	0.486	0.17	0.0249	0.0267	0.0227	0.0260	0.0254	0.0251	0.00152	0.000680
	Molybdenum (Mo)	mg/kg	-	-	0.64	2.12	2.39	0.9	0.83	1.38	0.81	0.363
	Nickel (Ni)	mg/kg	75 ^{α,β}	66	55.2	75.6	73	59.7	59.1	64.5	9.15	4.09
	Phosphorus (P)	mg/kg	2,000 ^α	1,278	838	1,100	1,290	902	922	1,010	184	82.3
	Potassium (K)	mg/kg	-	-	3,850	5,390	4,700	4,645	4,360	4,589	560	250.6
	Selenium (Se)	mg/kg	-	-	<0.20	0.26	<0.20	0.21	0.22	0.22	0.025	0.0111
	Silver (Ag)	mg/kg	-	-	0.14	0.17	0.12	0.16	0.14	0.15	0.019	0.0084
	Sodium (Na)	mg/kg	-	-	255	351	290	306	281	297	35.6	15.9
	Strontium (Sr)	mg/kg	-	-	11.8	14.1	13.5	13.9	13.0	13.3	0.918	0.411
	Sulphur (S)	mg/kg	-	-	<5,000	<5,000	<5,000	<5,000	<5,000	<5,000	0	0
	Thallium (Tl)	mg/kg	-	-	0.408	0.522	0.487	0.444	0.440	0.460	0.0445	0.0199
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
	Titanium (Ti)	mg/kg	-	-	1,300	1,590	1,250	1,455	1,380	1,395	134	60.0
	Uranium (U)	mg/kg	-	-	5.73	7.29	5.91	6.6	6.19	6.34	0.621	0.278
	Vanadium (V)	mg/kg	-	-	47.3	62.1	54.1	54.8	52.9	54.2	5.29	2.37
	Zinc (Zn)	mg/kg	315	135	54.1	69.7	62.3	62.8	61.9	62.2	5.53	2.47
	Zirconium (Zr)	mg/kg	-	-	22.2	28.6	14.2	23.7	21.6	22.1	5.18	2.32

^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 Intrinsic (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to Sheardown Lake Southeast.

 Indicates paramter concentration above Sediment Quality Guideline (SQG).

 Indicates parameter concentration above the AEMP Benchmark.

Table C.16: Summary of the magnitude of difference in sediment metal concentrations between 2015 Sheardown Lake SE and Reference Lake 3 data, Sheardown Lake SE 2015 and baseline period data, and Sheardown Lake SE 2015 and mine construction period (2014) data for littoral and profundal stations, Mary River Project CREMP, 2015.

Variable	Sheardown Lake SE versus Reference Lake 3 2015				Sheardown Lake SE 2015 versus Baseline Period				Sheardown Lake SE 2015 versus Mine Construction (2014) Period			
	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 SE Baseline Concentration (mg/kg)	Magnitude of Difference	Sheardown Lake SE Baseline Concentration (mg/kg)	Magnitude of Difference	Sheardown Lake SE 2014 Concentration (mg/kg)	Magnitude of Difference	Sheardown Lake SE 2014 Concentration (mg/kg)	Magnitude of Difference
Aluminum (Al)	16,120	1.1	27,060	0.7	14,950	1.2	13,133	1.4	14,467	1.3	13,300	1.4
Antimony (Sb)	0.1	1.0	0.1	1.0	1.0	0.1	1.0	0.1	1.0	0.1	1.0	0.1
Arsenic (As)	5.6	0.8	6.3	0.4	1.9	2.5	1.5	1.8	1.7	2.8	1.0	2.7
Barium (Ba)	116	0.8	149	0.5	81	1.2	64	1.2	73	1.3	62	1.2
Beryllium (Be)	0.7	1.3	1.0	0.8	1.0	0.9	1.0	0.9	1.0	0.9	1.0	0.9
Bismuth (Bi)	0.2	1.3	0.2	1.0	-	-	-	-	-	-	-	-
Boron (B)	15	1.8	22	1.2	3	11.0	1	19.6	1	54.9	1	53.1
Cadmium (Cd)	0.2	0.5	0.2	0.5	0.5	0.2	0.6	0.2	0.7	0.2	0.5	0.2
Calcium (Ca)	4,976	1.2	7,000	1.0	6,310	0.9	8,925	0.8	6,633	0.9	9,350	0.7
Chromium (Cr)	54	1.6	85	0.9	78	1.1	72	1.1	66	1.3	69	1.1
Cobalt (Co)	13	1.2	19	0.7	13	1.2	12	1.2	12	1.2	12	1.2
Copper (Cu)	69	0.4	102	0.3	30	1.0	25	1.2	37	0.8	26	1.1
Iron (Fe)	59,220	0.7	54,450	0.6	32,284	1.4	29,117	1.2	30,167	1.5	26,850	1.3
Lead (Pb)	16	1.2	23	0.8	17	1.1	14	1.4	15	1.3	14	1.4
Lithium (Li)	26	1.3	41	0.8	-	-	-	-	-	-	-	-
Magnesium (Mg)	10,088	1.4	16,930	0.9	12,634	1.1	13,742	1.0	12,867	1.1	14,700	1.0
Manganese (Mn)	871	1.2	1,756	0.3	462	2.3	410	1.1	532	2.0	361	1.2
Mercury (Hg)	0.045	0.5	0.085	0.3	0.100	0.2	0.100	0.3	0.100	0.2	0.100	0.3
Molybdenum (Mo)	6.2	0.3	3.3	0.3	1.5	1.1	1.0	0.9	1.0	1.7	1.0	0.9
Nickel (Ni)	43	1.6	60	1.0	62	1.1	62	1.0	54	1.3	60	1.0
Phosphorus (P)	1,506	0.7	1,214	0.8	1,150	0.9	950	1.0	-	-	-	-
Potassium (K)	3,960	1.2	6,491	0.7	3,947	1.2	3,317	1.4	3,700	1.3	3,250	1.4
Selenium (Se)	0.7	0.3	1.0	0.2	1.0	0.2	1.0	0.2	1.0	0.2	1.0	0.2
Silver (Ag)	0.1	1.0	0.3	0.5	0.4	0.3	0.3	0.5	0.5	0.3	0.2	0.7
Sodium (Na)	283	1.1	492	0.6	353	0.8	330	0.9	367	0.8	300	1.0
Strontium (Sr)	12.6	1.0	19.5	0.7	16.0	0.8	11.0	1.2	11.3	1.2	11.5	1.2
Sulphur (S)	5,000	1.0	5,000	1.0	-	-	-	-	-	-	-	-
Thallium (Tl)	0.5	1.0	0.9	0.5	1.0	0.5	1.0	0.4	1.0	0.5	1.0	0.4
Tin (Sn)	2.0	1.0	2.2	0.9	-	-	-	-	-	-	-	-
Titanium (Ti)	967	1.4	1,391	1.0	-	-	-	-	-	-	-	-
Uranium (U)	14	0.4	27	0.2	-	-	-	-	-	-	-	-
Vanadium (V)	53	1.0	76	0.7	52	1.0	44	1.2	46	1.2	44	1.2
Zinc (Zn)	78	0.8	111	0.6	51	1.2	51	1.2	54	1.1	50	1.2

- Denotes slight elevation (mean variable concentration 2 to 4 times higher than respective mean reference, baseline or construction period value).
- Denotes moderate elevation (mean variable concentration 4 to 10 times higher than respective mean reference, baseline or mine construction period value).
- Denotes highly elevated concentration (mean variable concentration greater than 10 times higher than respective mean reference, baseline, or mine construction period value).

Table C.17: Field observations at Mary Lake (BLO) benthic invertebrate community stations^a, Mary River Project CREMP, August 2015.

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia ^b	Plant or Algal Presence
BLO-01	9.9	medium brown silt over gray-brown compact silt	none detected	none observed
BLO-11	9.3	medium gray-brown silty sand	none detected	aquatic moss (common)
BLO-7	12.8	medium brown silt	none detected	none observed
BLO-6	6.7	medium brown silt with some fine sand; no precipitate layer observed	none detected	none observed
BLO-3	16.4	sand; no precipitate layer observed	none detected	none observed
BLO-15	29.1	medium brown silt; black streaking at 1 cm depth in sediment	black streaking at 1 cm depth in sediment	aquatic moss (sparse)
BLO-14	19.5	medium brown silt; some minor black streaking in sediment	minor black streaking in sediment	none observed
BLO-13	21.8	medium brown silt, no unusual odours	none detected	none observed
BLO-4	21.5	medium brown silt	none detected	none observed
BLO-5	21.5	dark brown silt with some sand	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 C.18: Sediment core observations from cores collected in Mary Lake (BLO), Mary River Project CREMP, August 2015.

Sample Station	Station Depth (m)	Core #	Core Length (cm)	Core Horizon (cm)	Core Observation
BLO-01	9.9	1	12.5	0 to 4	medium brown silt
				4 to 12.5	gray-brown silt with some black streaking
		2	8.0	0 to 1	medium brown silt
				1 to 8	gray-brown silt with some black streaking
		3	12.0	0 to 1	medium brown silt
				1 to 12	gray-brown silt with some black streaking
BLO-16	31.4	1	30.0	0 to 1	iron oxide-like precipitate layer
				1 to 12	gray-brown silt
				12 to 30	dark gray-brown silt, some black streaking at depth
		2	32.5	0 to 3	iron oxide-like material
				3 to 32.5	red-brown silt
		3	28.0	0 to 1	iron oxide-like material
				1 to 28	red-brown silt, black streaking near bottom of core
BLO-03	18.2	1	22.0	0 to 9	medium brown silt
				9 to 22	gray-brown silt
		2	17.0	0 to 7	medium brown silt
				7 to 17	gray-brown silt
		3	16.0	0 to 7	medium brown silt
				7 to 16	gray-brown silt
BLO-14	19.4	1	13.5	0 to 13.5	reddish to grayish brown silt
		2	11.0	0 to 11	reddish brown silt throughout
		3	19.0	0 to 19	reddish brown silt throughout
BLO-12	21.7	1	15.0	0 to 3	light brown silt
				3 to 15	gray-brown silt
		2	17.0	0 to 6.5	light brown silt
				6.5 to 17	gray-brown silt
		3	14.5	0 to 7.5	light brown silt
				7.5 to 14.5	gray-brown silt
BLO-04	19.9	1	18.0	0 to 18	uniform gray-brown silt
		2	21.0	0 to 21	uniform gray-brown silt
		3	20.5	0 to 20.5	uniform gray-brown silt
BLO-10	18.7	1	19.0	0 to 8	light brown silt
				8 to 19	darker brown silt
		2	17.0	0 to 15	light brown silt
				15 to 17	darker brown silt
		3	24.0	0 to 16	light brown silt
				16 to 24	darker brown silt
BLO-09	29.8	1	19.0	0 to 19	gradient from lighter to darker brown silt
		2	21.0	0 to 8	light brown silt
				8 to 21	darker brown silt
		3	21.0	0 to 7	light brown silt
				7 to 21	darker brown silt
BLO-08	26.7	1	24.0	0 to 16	light brown silt
				16 to 24	darker brown silt (gradient)
		2	23.0	0 to 18	light brown silt
				18 to 23	darker brown silt (gradient)
		3	23.0	0 to 16	light brown silt
				16 to 23	darker brown silt (gradient)
BLO-06	9.4	1	13.0	0 to 13	uniform; black streaking through brown silt
		2	12.0	0 to 12	uniform; black streaking through brown silt
		3	12.0	0 to 12	uniform; black streaking through brown silt

Table C.19: Sediment particle size, total organic carbon, and metal concentrations at Mary Lake (BLO) sediment stations, Mary River Project CREMP, August 2015.

Analyte		Units	Sediment Quality Guideline (SQG) ^a	AEMP Benchmark ^b	Mary Lake Stations										Study Area Summary Statistics		
					BLO-01 (littoral)	BLO-16 (profundal)	BLO-03 (profundal)	BLO-14 (profundal)	BLO-12 (profundal)	BLO-04 (profundal)	BLO-10 (profundal)	BLO-09 (profundal)	BLO-08 (profundal)	BLO-06 (littoral)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	18	26	91	22	34	15	10	7.5	7.9	7.0	24	25	8.0
	Silt	%	-	-	70	41	6.6	39	53	60	54	61	57	56	50	18	5.6
	Clay	%	-	-	12	33	2.6	39	13	25	36	32	35	37	27	13	4.1
	Moisture	%	-	-	54	67	55	62	48	48	55	44	50	68	55	7.9	2.5
	Total Organic Carbon	%	10 ^α	-	1.26	1.23	0.84	0.88	0.72	0.59	0.78	0.76	0.74	0.94	0.87	0.22	0.069
Metals	Aluminum (Al)	mg/kg	-	-	14,700	24,600	24,900	28,200	17,400	19,700	27,700	25,000	31,800	27,900	24,190	5,351	1,692
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
	Arsenic (As)	mg/kg	17	5.9	5.99	15.50	3.68	4.30	2.74	2.91	3.90	4.17	4.71	3.84	5.17	3.74	1.18
	Barium (Ba)	mg/kg	-	-	80	125	83	109	64.4	70.5	102	117	113	107	97.1	20.9	6.62
	Beryllium (Be)	mg/kg	-	-	0.75	1.29	1.19	1.47	0.85	0.99	1.30	1.13	1.50	1.44	1.19	0.261	0.0827
	Bismuth (Bi)	mg/kg	-	-	0.20	0.30	0.26	0.30	0.21	0.24	0.30	0.31	0.36	0.28	0.28	0.050	0.016
	Boron (B)	mg/kg	-	-	22.5	39.8	37.0	44.3	25.9	29.7	37.1	33.4	44.7	43.4	35.8	7.80	2.47
	Cadmium (Cd)	mg/kg	3.5	1.5	0.097	0.151	0.121	0.158	0.0970	0.106	0.148	0.155	0.185	0.125	0.134	0.0296	0.00935
	Calcium (Ca)	mg/kg	-	-	8,960	4,140	3,910	4,600	4,165	4,390	4,820	4,850	5,790	5,030	5,066	1,471	465.2
	Chromium (Cr)	mg/kg	90	98	64.9	88.1	80.9	91.8	69.5	83.4	96.4	102	121	92.3	89.0	16.1	5.09
	Cobalt (Co)	mg/kg	-	-	14.2	18.5	16.1	18.7	12.7	14.4	18.3	20.0	22.1	17.9	17.3	2.90	0.917
	Copper (Cu)	mg/kg	110	50	27.3	37	32.9	38.3	23.9	27.7	36.4	35.5	44.1	35.0	33.8	6.04	1.91
	Iron (Fe)	mg/kg	40,000 ^α	52,400	35,000	66,600	37,100	43,100	29,350	31,800	42,600	43,400	50,200	42,500	42,165	10,609	3,355
	Lead (Pb)	mg/kg	91.3	35	16.8	26.4	24.7	29.4	17.8	20.3	26.9	25.4	31.2	27.4	24.6	4.83	1.53
	Lithium (Li)	mg/kg	-	-	28.0	49.2	49.4	56.9	31.5	36.6	52.2	41.7	58.3	56.6	46.0	11.0	3.47
	Magnesium (Mg)	mg/kg	-	-	14,400	15,600	15,000	17,400	12,100	13,300	17,200	16,900	21,000	17,100	16,000	2,509	793
	Manganese (Mn)	mg/kg	1,100 ^{α,β}	4,370	1,550	1,160	830	793	1,021	645	731	6,620	1,650	894	1,589	1,799	569
	Mercury (Hg)	mg/kg	0.486	0.17	0.0247	0.0637	0.0501	0.0655	0.0330	0.0368	0.0548	0.0426	0.0555	0.0461	0.0473	0.0133	0.00419
	Molybdenum (Mo)	mg/kg	-	-	0.65	1.97	0.61	0.73	0.79	0.63	0.74	1.50	1.00	0.85	0.95	0.44	0.14
	Nickel (Ni)	mg/kg	75 ^{α,β}	72	55.5	67.6	54.1	62.9	50.8	59.9	66.8	79	86.0	61.1	64.4	11.1	3.50
	Phosphorus (P)	mg/kg	2,000 ^α	1,580	1,100	2,010	691	783	825	756	819	984	1,000	793	976	385	122
	Potassium (K)	mg/kg	-	-	3,580	6,600	6,450	7,310	4,215	4,760	6,760	6,070	7,730	7,220	6,070	1,409	446
	Selenium (Se)	mg/kg	-	-	<0.20	0.28	0.22	0.28	<0.20	<0.20	0.21	0.22	0.26	0.26	0.23	0.033	0.011
	Silver (Ag)	mg/kg	-	-	<0.10	0.14	0.16	0.19	0.13	0.14	0.19	0.17	0.21	0.17	0.16	0.034	0.011
	Sodium (Na)	mg/kg	-	-	237	405	347	407	268	324	409	394	499	424	371	78.2	24.7
	Strontium (Sr)	mg/kg	-	-	13.3	20.5	14.8	17.6	12.6	14.0	16.4	16.0	19.7	17.3	16.2	2.64	0.833
	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	-	-	0.356	0.60	0.610	0.734	0.432	0.499	0.658	0.646	0.760	0.718	0.601	0.134	0.0423
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.2	<2.0	2.0	0.063	0.020
	Titanium (Ti)	mg/kg	-	-	952	1,270	1,480	1,640	1,280	1,360	1,740	1,690	2,060	1,850	1,532	327	103
	Uranium (U)	mg/kg	-	-	4.20	9.70	9.92	12.1	7.20	7.64	10.9	8.63	11.4	10.6	9.23	2.37	0.750
	Vanadium (V)	mg/kg	-	-	48.0	69.8	66.3	75.4	49.0	54.8	73.1	68.9	86.0	74.2	66.6	12.3	3.89
	Zinc (Zn)	mg/kg	315	135	51	82	79.3	92.3	57.7	64.4	89.2	82.4	110	91.5	79.9	17.9	5.67
	Zirconium (Zr)	mg/kg	-	-	9.8	14.5	21.6	27.5	18.6	20.5	27.3	25.6	30.4	26.3	22.2	6.49	2.05

^a Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

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

Indicates paramter concentration above Sediment Quality Guideline (SQG).

BOLD

Indicates parameter concentration above the AEMP Benchmark.

Table C.20: Summary of the magnitude of difference in sediment metal concentrations between 2015 Mary Lake and Reference Lake 3 data, Mary Lake 2015 and baseline period data, and Mary Lake 2015 and mine construction period (2014) data for littoral and profundal stations, Mary River Project CREMP, 2015.

Variable	Mary Lake versus Reference Lake 3 2015				Mary Lake 2015 versus Baseline Period				Mary Lake 2015 versus Mine Construction (2014) Period			
	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 2014 Concentration (mg/kg)	Magnitude of Difference	Mary Lake 2014 Concentration (mg/kg)	Magnitude of Difference
Aluminum (Al)	16,120	1.3	27,060	0.9	18,267	1.2	17,000	1.5	8,810	2.4	11,762	2.1
Antimony (Sb)	0.1	1.0	0.1	1.0	1.0	0.1	1.0	0.1	1.0	0.1	1.0	0.1
Arsenic (As)	5.6	0.9	6.3	0.8	2.8	1.8	3.7	1.4	1.5	3.3	3.4	1.5
Barium (Ba)	116	0.8	149	0.7	105	0.9	76	1.3	46	2.0	71	1.4
Beryllium (Be)	0.7	1.6	1.0	1.2	1.0	1.1	1.0	1.2	1.0	1.1	1.0	1.2
Bismuth (Bi)	0.2	1.2	0.2	1.3	-	-	-	-	-	-	-	-
Boron (B)	15	2.2	22	1.7	1	44.9	2	17.5	1	65.9	1	73.0
Cadmium (Cd)	0.2	0.5	0.2	0.7	0.5	0.2	0.5	0.3	0.5	0.2	0.5	0.3
Calcium (Ca)	4,976	1.4	7,000	0.7	3,130	2.2	2,934	1.6	5,350	1.3	3,336	1.4
Chromium (Cr)	54	1.5	85	1.1	81	1.0	76	1.2	44	1.8	59	1.5
Cobalt (Co)	13	1.3	19	0.9	18	0.9	18	1.0	9	1.8	15	1.2
Copper (Cu)	69	0.4	102	0.3	45	0.7	44	0.8	23	1.4	36	1.0
Iron (Fe)	59,220	0.7	54,450	0.8	36,133	1.1	35,654	1.2	18,260	2.1	30,707	1.4
Lead (Pb)	16	1.4	23	1.1	18	1.2	21	1.2	9	2.5	15	1.6
Lithium (Li)	26	1.6	41	1.2	-	-	-	-	-	-	-	-
Magnesium (Mg)	10,088	1.6	16,930	0.9	13,967	1.1	10,903	1.5	10,500	1.5	10,014	1.6
Manganese (Mn)	871	1.4	1,756	1.0	699	1.7	991	1.7	313	3.9	1,597	1.1
Mercury (Hg)	0.045	0.8	0.085	0.6	0.100	0.4	0.100	0.5	0.100	0.4	0.100	0.5
Molybdenum (Mo)	6.2	0.1	3.3	0.3	1.0	0.8	1.0	1.0	1.0	0.8	1.3	0.8
Nickel (Ni)	43	1.3	60	1.1	67	0.9	65	1.0	39	1.5	55	1.2
Phosphorus (P)	1,506	0.6	1,214	0.8	800	1.2	1,325	0.7	-	-	-	-
Potassium (K)	3,960	1.4	6,491	1.0	3,450	1.6	4,287	1.5	2,050	2.6	3,336	1.9
Selenium (Se)	0.7	0.3	1.0	0.2	1.0	0.2	1.0	0.2	1.0	0.2	1.0	0.2
Silver (Ag)	0.1	0.9	0.3	0.5	0.3	0.5	0.4	0.5	0.2	0.7	0.2	0.8
Sodium (Na)	283	1.2	492	0.8	279	1.2	284	1.3	150	2.2	229	1.7
Strontium (Sr)	12.6	1.2	19.5	0.8	9.3	1.6	13.3	1.2	6.0	2.6	11.5	1.4
Sulphur (S)	5,000	1.0	5,000	1.0	-	-	-	-	-	-	-	-
Thallium (Tl)	0.5	1.1	0.9	0.7	1.0	0.5	1.0	0.6	1.0	0.5	1.0	0.6
Tin (Sn)	2.0	1.0	2.2	0.9	-	-	-	-	-	-	-	-
Titanium (Ti)	967	1.4	1,391	1.1	-	-	-	-	-	-	-	-
Uranium (U)	14	0.5	27	0.4	-	-	-	-	-	-	-	-
Vanadium (V)	53	1.2	76	0.9	69	0.9	63	1.1	33	1.9	46	1.5
Zinc (Zn)	78	0.9	111	0.7	67	1.1	64	1.3	39	1.8	66	1.2

Denotes slight elevation (mean variable concentration 2 to 5 times higher than respective mean reference, baseline or construction period value).

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

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

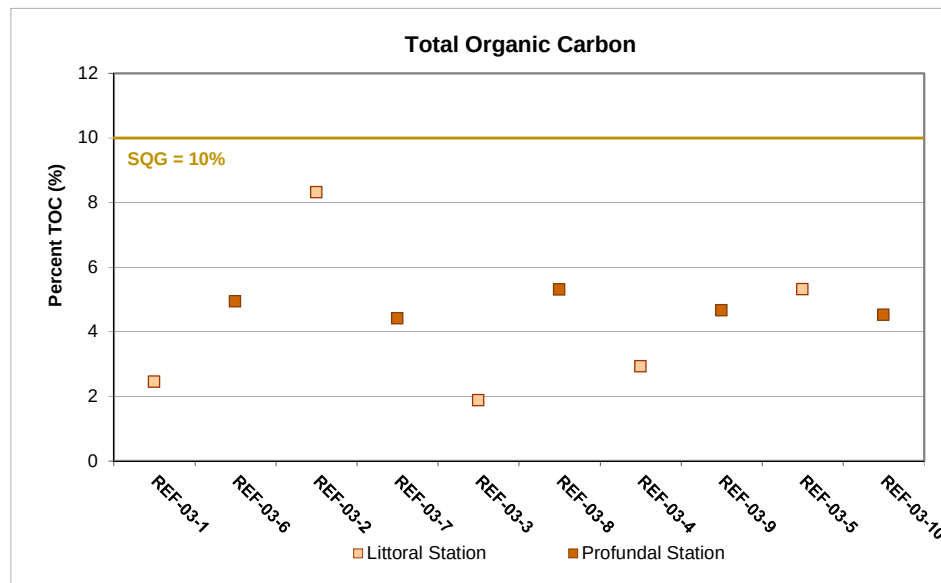
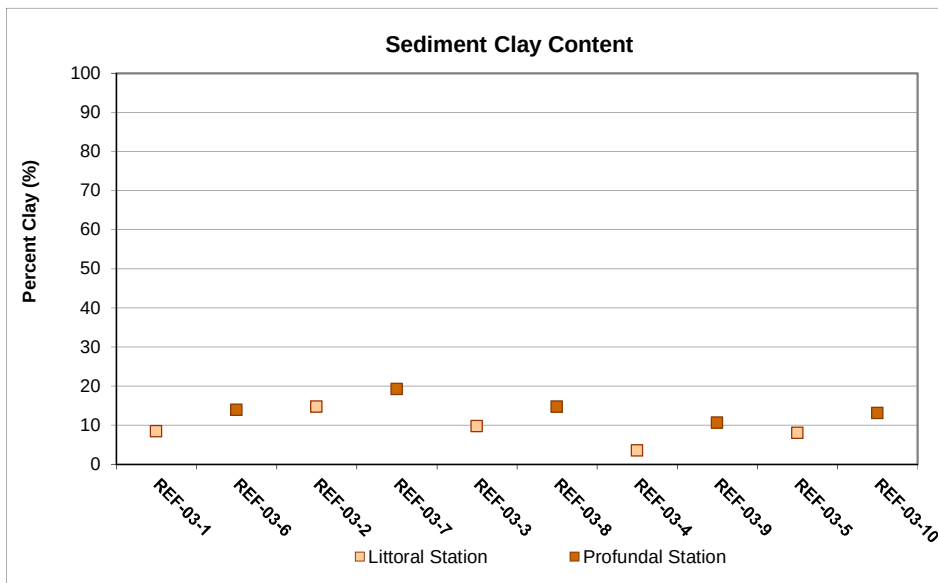
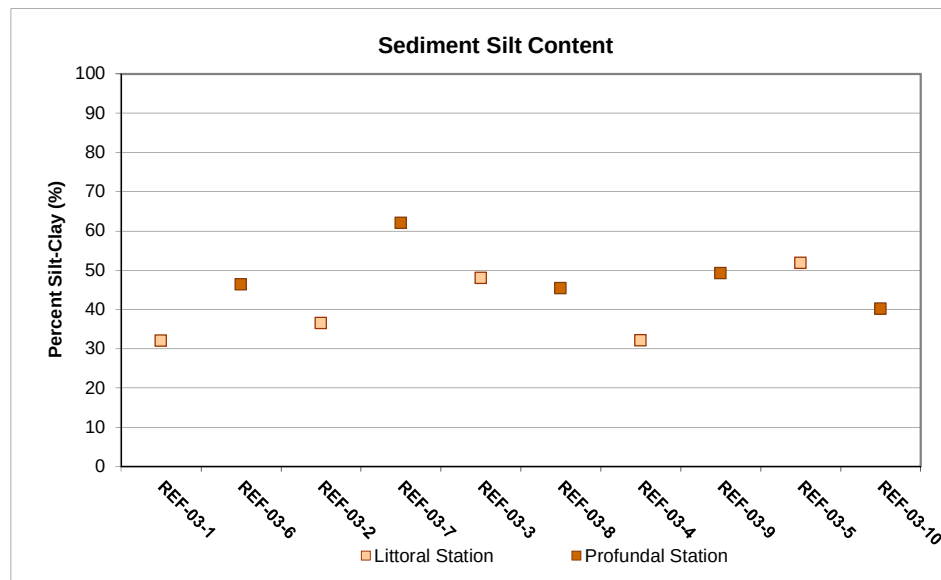
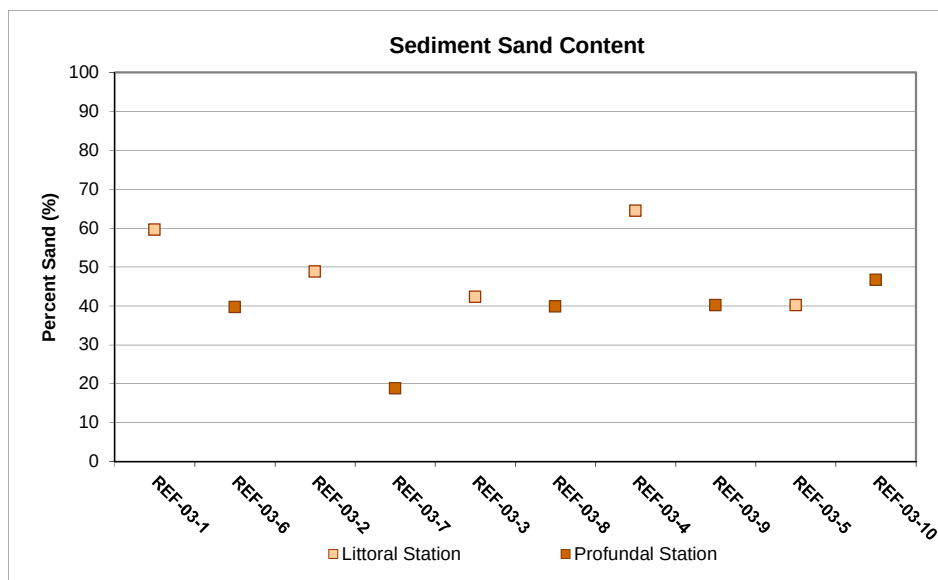


Figure C.1: Reference Lake 3 (REF-03) physical-chemical sediment quality at littoral and profundal sampling depths, Mary River Project CREMP, August 2015.

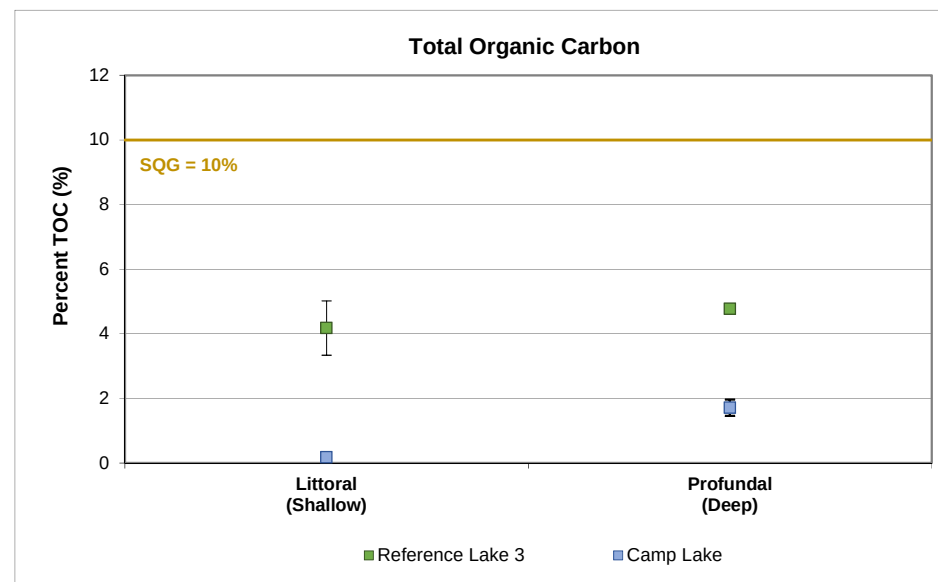
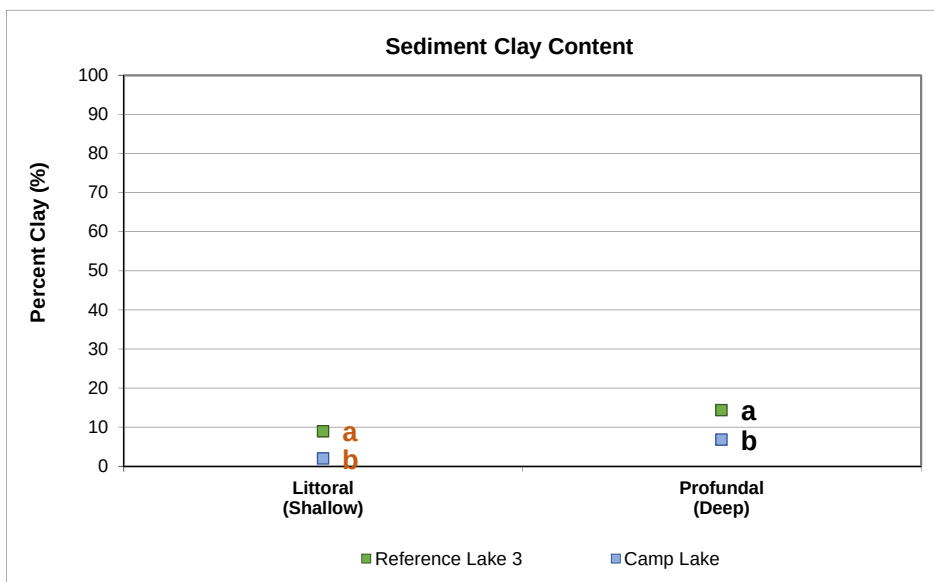
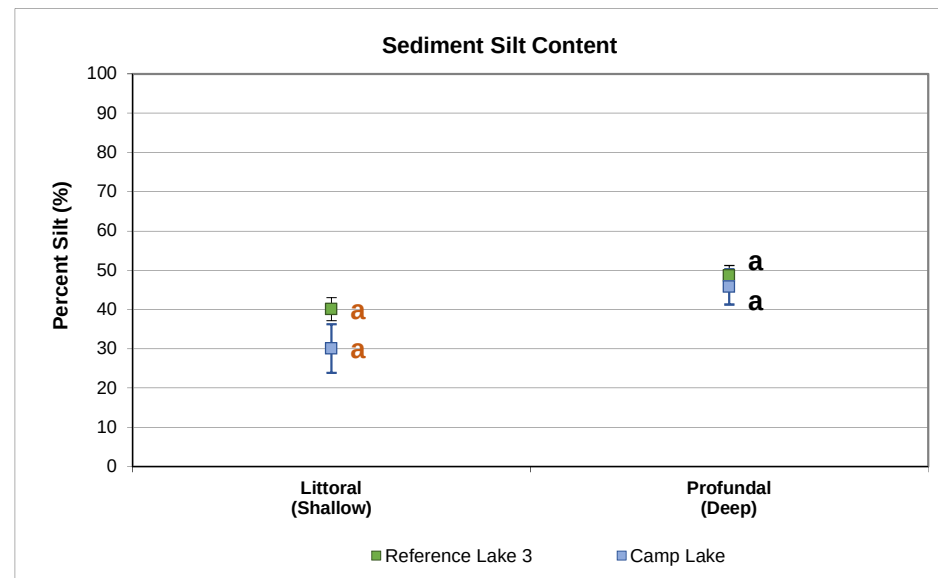
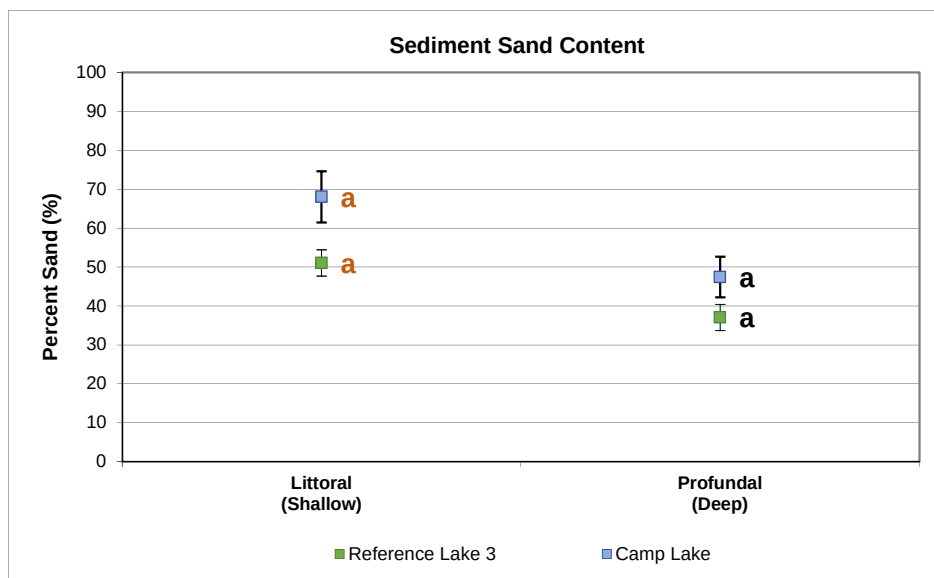


Figure C.2: Comparison of physical-chemical sediment quality (mean $\pm$ SE) measured at Cmap Lake (JLO) and Reference Lake 3 (REF3) at littoral and profundal benthic invertebrate community stations, Mary River Project CREMP, Augsut 2015. The same like-coloured letter beside data points indicate no significant difference between areas.

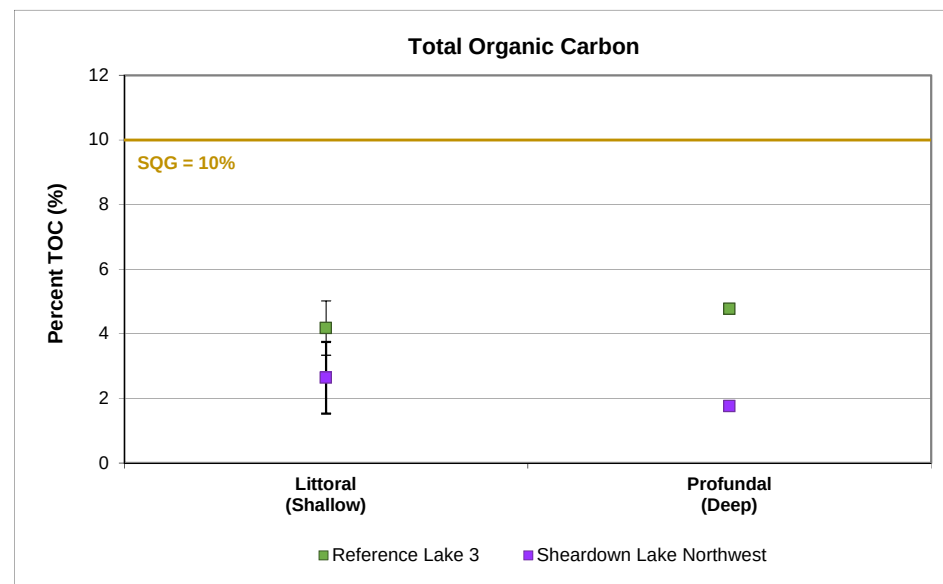
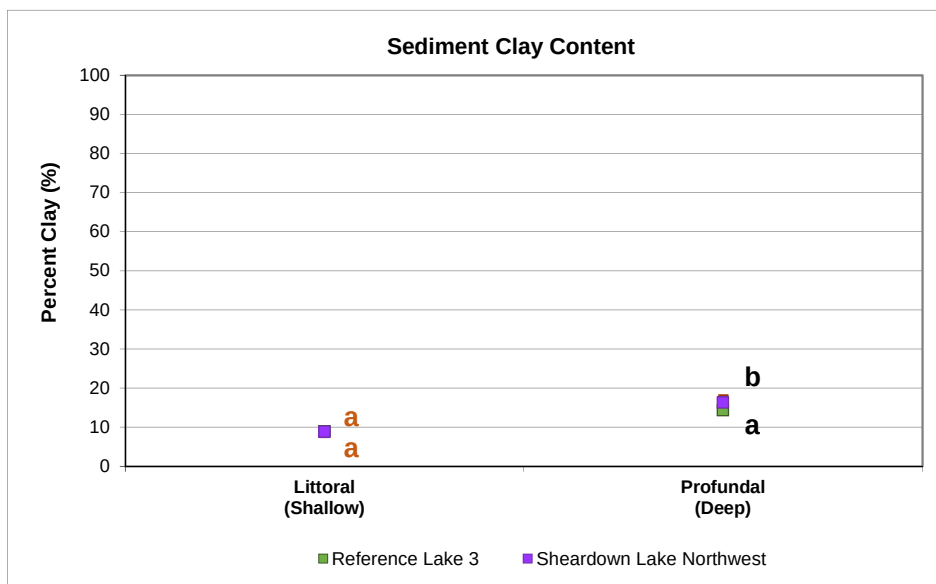
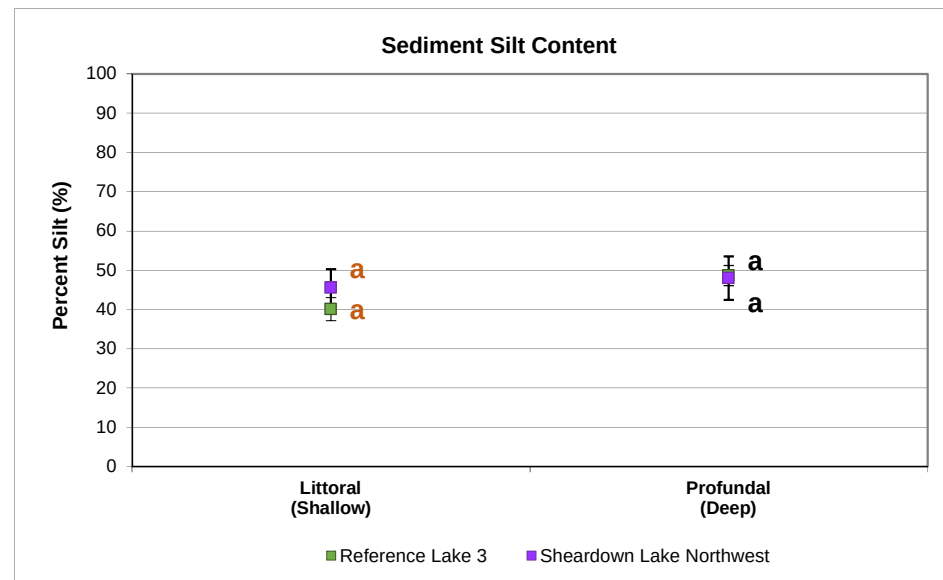
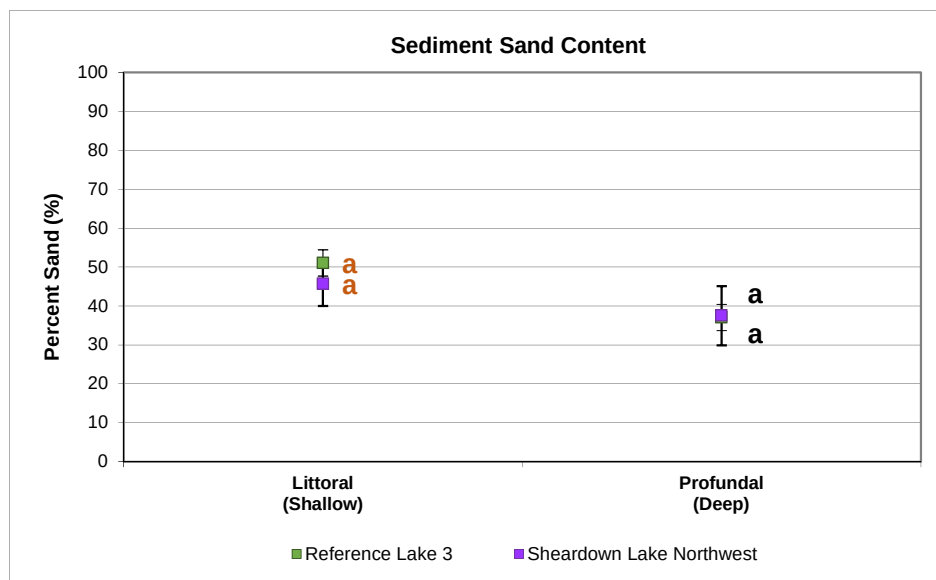


Figure C.3: Comparison of physical-chemical sediment quality (mean $\pm$ SE) measured at Sheardown Lake Northwest (DLO-01) and Reference Lake 3 (REF3) at littoral and profundal benthic invertebrate community stations, Mary River Project CREMP, August 2015. The same like-coloured letter beside data points indicate no significant difference between areas.

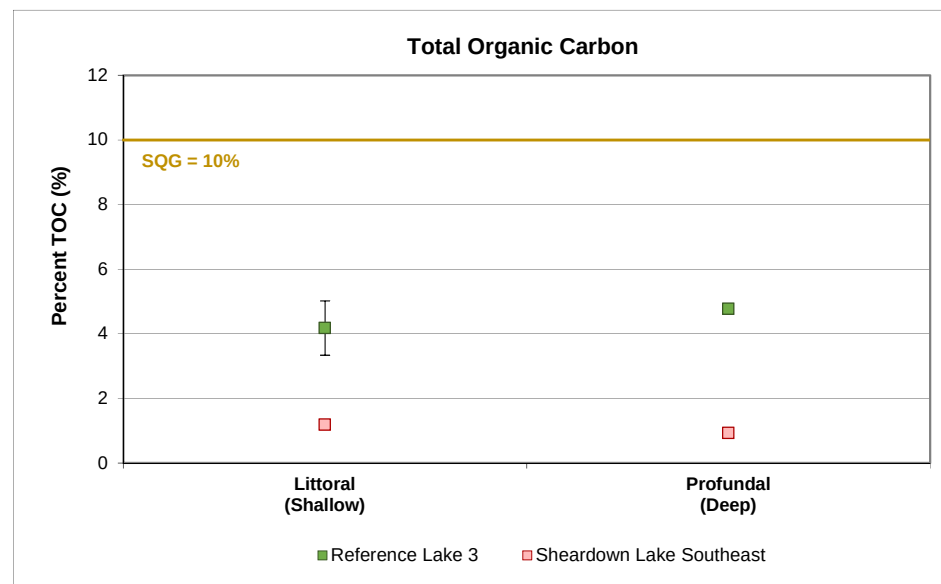
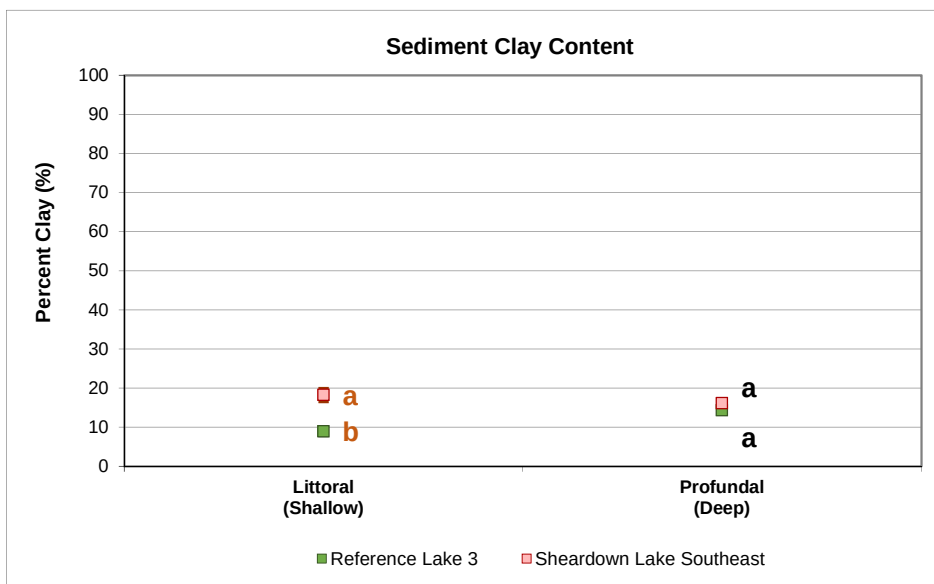
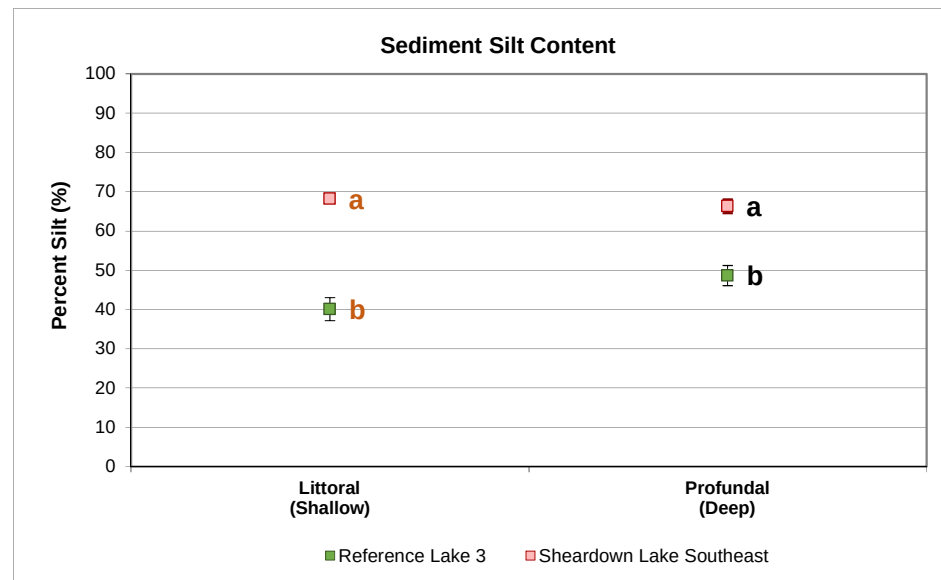
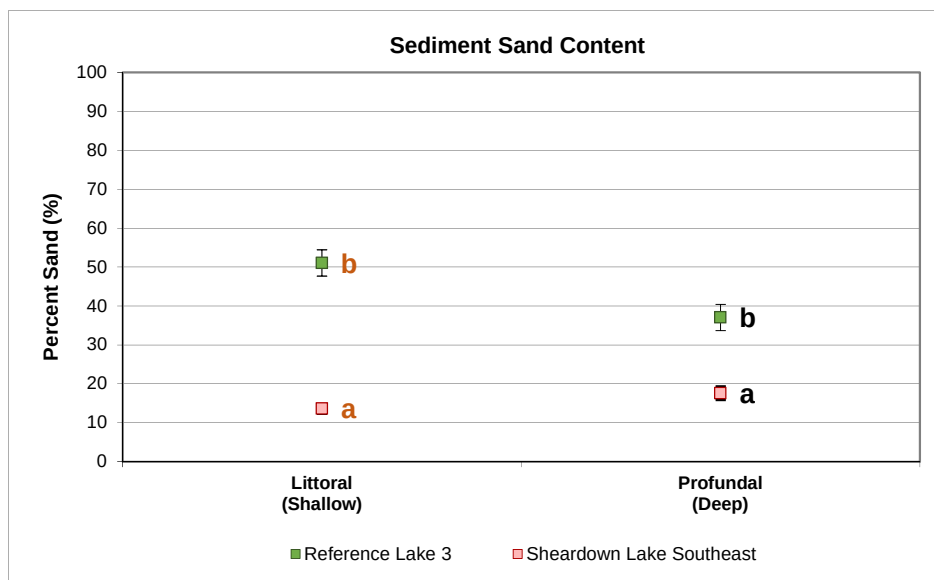


Figure C.4: Comparison of physical-chemical sediment quality (mean $\pm$ SE) measured at Sheardown Lake Southeast (DLO-02) and Reference Lake 3 (REF3) at littoral and profundal benthic invertebrate community stations, Mary River Project CREMP, Augsut 2015. The same like-coloured letter beside data points indicate no significant difference between areas.

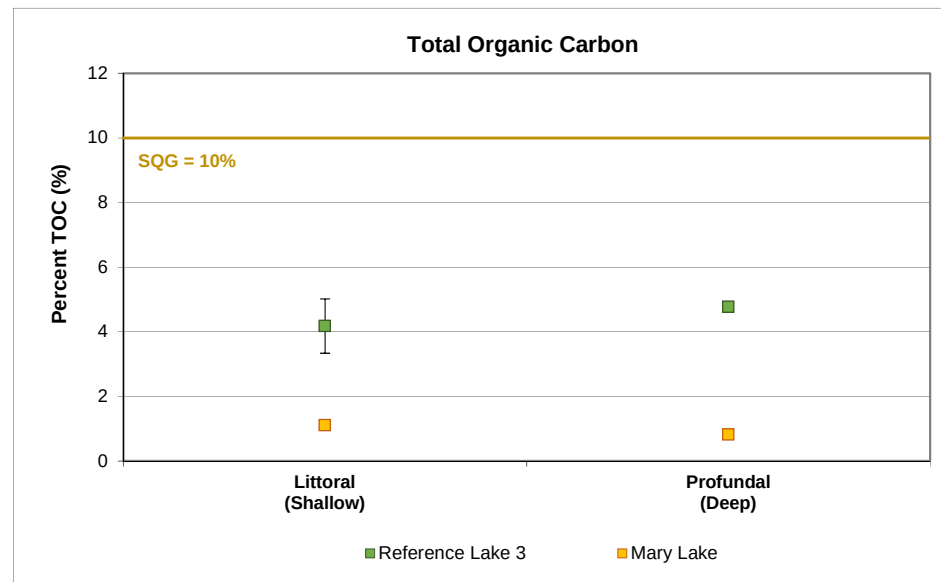
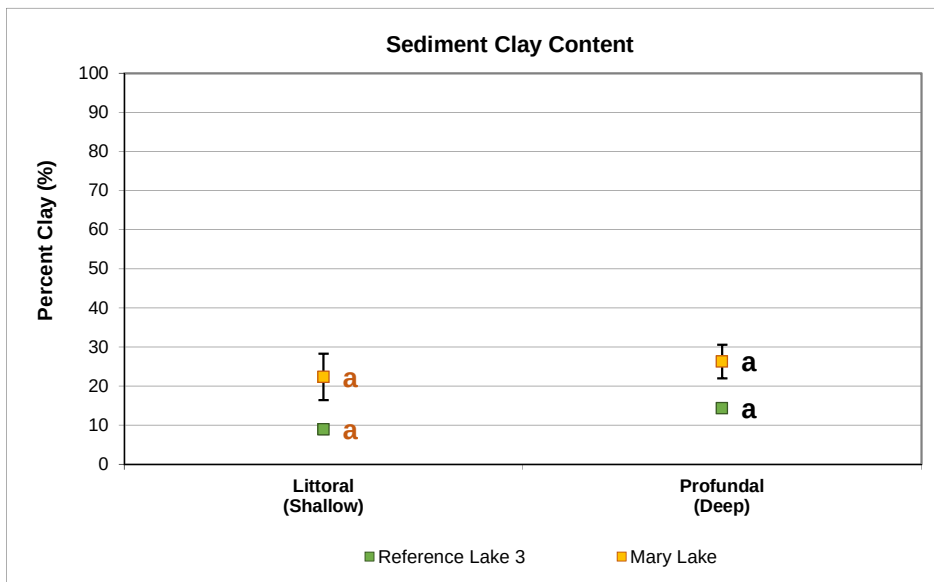
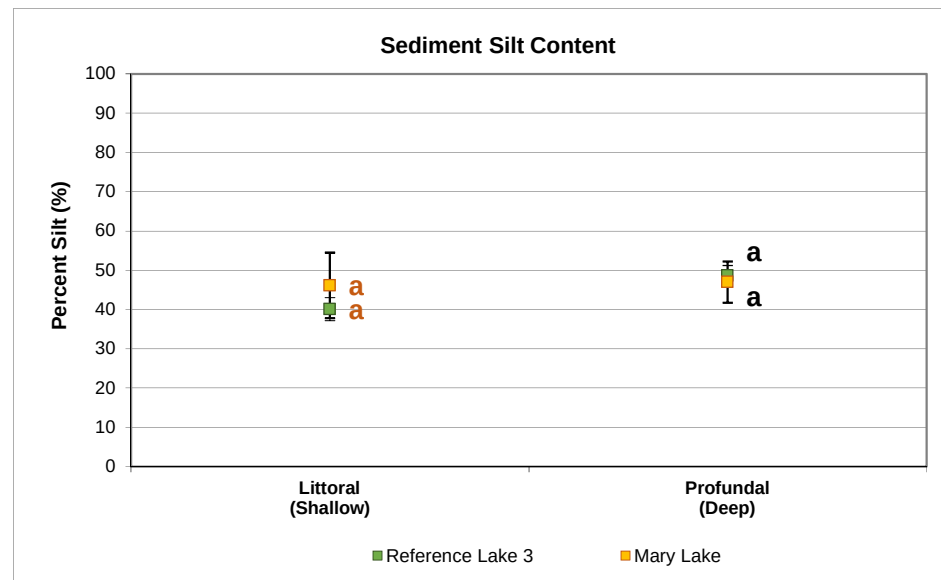
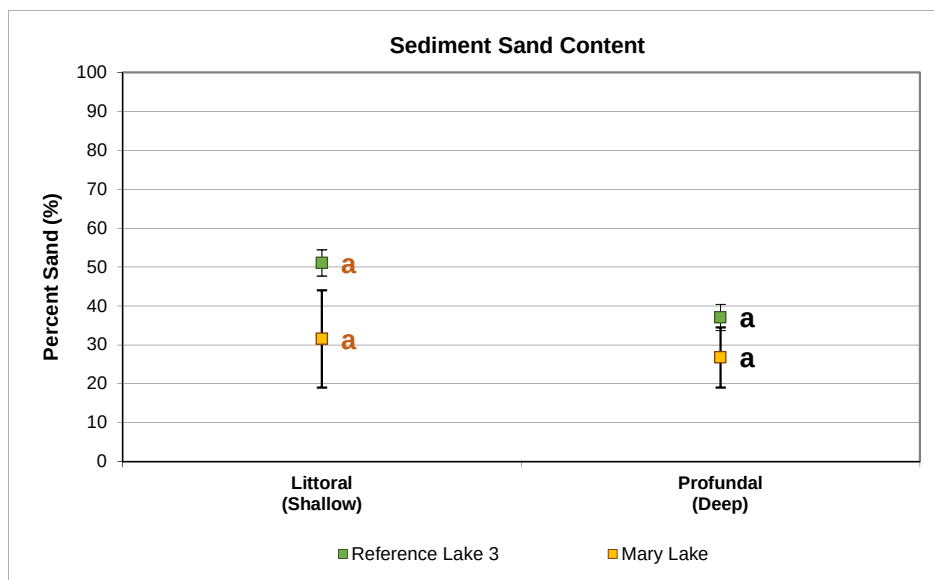


Figure C.5: Comparison of physical-chemical sediment quality (mean $\pm$ SE) measured at Mary Lake (BLO) and Reference Lake 3 (REF3) at littoral and profundal benthic invertebrate community stations, Mary River Project CREMP, Augsut 2015. The same like-coloured letter beside data points indicate no significant difference between areas.

APPENDIX D

PHYTOPLANKTON DATA

Table D.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, 2015.

Station		Lotic Reference 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	26-Jun-15	26-Jun-15	26-Jun-15	26-Jun-15	29-Jun-15	23-Jun-15	24-Jun-15	23-Jun-15	23-Jun-15	23-Jun-15	24-Jun-15	24-Jun-15	24-Jun-15	29-Jun-15	24-Jun-15
	Summer	21-Jul-15	21-Jul-15	21-Jul-15	21-Jul-15	21-Jul-15	17-Jul-15	17-Jul-15	17-Jul-15	17-Jul-15	17-Jul-15	17-Jul-15	19-Jul-15	17-Jul-15	17-Jul-15	17-Jul-15
	Fall	13-Aug-15	13-Aug-15	13-Aug-15	13-Aug-15	13-Aug-15	18-Aug-15	18-Aug-15	18-Aug-15	18-Aug-15	17-Aug-15	17-Aug-15	17-Aug-15	16-Aug-15	17-Aug-15	18-Aug-15
Chlorophyll a (µg/L)	Spring	0.21	0.48	0.63	0.27	<0.10	0.27	0.84	0.32	0.31	0.26	0.20	1.74	0.29	0.47	0.65
	Summer	0.26	0.27	0.15	0.15	0.13	0.29	1.57	0.46	0.43	0.47	0.13	1.12	0.17	0.65	0.13
	Fall	0.82	0.52	0.36	0.19	<0.10	0.26	0.87	0.40	0.42	0.41	0.14	0.52	0.16	0.27	0.28
	Average	0.43	0.42	0.38	0.20	0.11	0.27	1.09	0.39	0.39	0.38	0.16	1.13	0.21	0.46	0.35
	Standard Deviation	0.34	0.13	0.24	0.061	0.017	0.015	0.41	0.070	0.069	0.11	0.038	0.61	0.07	0.190	0.27
	Standard Error	0.20	0.078	0.14	0.035	0.010	0.009	0.24	0.041	0.040	0.062	0.022	0.35	0.04	0.110	0.15
Phaeophytin a (µg/L)	Spring	0.11	0.17	0.18	0.11	<0.10	0.13	0.32	0.15	0.14	0.18	<0.10	0.38	0.21	0.20	0.15
	Summer	0.17	0.19	0.11	0.11	<0.10	0.21	0.77	0.27	0.23	0.23	0.10	0.41	<0.20	0.31	0.14
	Fall	0.26	0.23	0.18	0.17	<0.10	0.10	0.28	0.18	0.17	0.13	<0.10	0.16	<0.10	0.10	0.12
	Average	0.18	0.20	0.16	0.13	<0.10	0.15	0.46	0.20	0.18	0.18	0.10	0.32	0.17	0.20	0.14
	Standard Deviation	0.08	0.031	0.040	0.035	0	0.057	0.27	0.063	0.046	0.050	0	0.14	0.06	0.105	0.015
	Standard Error	0.044	0.018	0.023	0.020	0	0.033	0.16	0.037	0.026	0.029	0	0.079	0.035	0.061	0.0088

Table D.2: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at Reference Lake 3 (REF-03), Mary River Project CREMP, 2015.

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	28-Jul-15	28-Jul-15	31-Jul-15	-	-	-	28-Jul-15	28-Jul-15	31-Jul-15	-	-	-
	Fall	22-Aug-15	22-Aug-15	24-Aug-15	-	-	-	22-Aug-15	22-Aug-15	24-Aug-15	-	-	-
Summer	Surface	0.84	0.76	1.07	0.89	0.161	0.093	0.39	0.39	0.42	0.40	0.017	0.010
	Bottom	1.25	0.74	0.74	0.91	0.29	0.17	0.81	0.49	0.31	0.54	0.25	0.145
	Average	1.04	0.75	0.91	0.90	0.15	0.084	0.60	0.44	0.37	0.47	0.12	0.069
Fall	Surface	0.70	0.82	0.81	0.78	0.065	0.038	0.34	0.43	0.57	0.45	0.116	0.067
	Bottom	0.97	2.14	0.92	1.34	0.69	0.40	0.6	0.99	0.63	0.74	0.22	0.13
	Average	0.84	1.48	0.87	1.06	0.36	0.21	0.47	0.71	0.60	0.59	0.12	0.069

Table D.3: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at Camp Lake (JLO), Mary River Project CREMP, 2015.

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	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	25-Apr-15	-	-	-	26-Apr-15	26-Apr-15	26-Apr-15	26-Apr-15	25-Apr-15	-	-	-
	Summer	19-Jul-15	19-Jul-15	18-Jul-15	18-Jul-15	18-Jul-15	-	-	-	19-Jul-15	19-Jul-15	18-Jul-15	18-Jul-15	18-Jul-15	-	-	-
	Fall	19-Aug-15	20-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15	-	-	-	19-Aug-15	20-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15	-	-	-
Winter	Surface	0.91	0.59	0.86	0.79	1.06	0.84	0.17	0.08	0.16	0.18	0.27	0.22	0.28	0.22	0.05	0.02
	Bottom	0.91	0.85	0.79	0.22	0.44	0.64	0.30	0.13	0.20	0.25	0.19	0.17	0.13	0.19	0.04	0.02
	Average	0.91	0.72	0.83	0.51	0.75	0.74	0.15	0.07	0.18	0.21	0.23	0.20	0.21	0.20	0.02	0.01
Summer	Surface	1.14	1.19	1.14	1.06	1.20	1.15	0.06	0.03	0.47	0.52	0.54	0.47	0.60	0.52	0.06	0.02
	Bottom	1.25	1.27	1.96	1.27	1.14	1.38	0.33	0.15	0.60	0.56	0.97	0.48	0.55	0.63	0.19	0.09
	Average	1.20	1.23	1.55	1.16	1.17	1.26	0.16	0.07	0.53	0.54	0.76	0.47	0.58	0.58	0.11	0.05
Fall	Surface	0.60	0.51	0.53	0.50	0.51	0.53	0.04	0.02	0.11	0.18	0.14	<0.10	0.13	0.13	0.03	0.01
	Bottom	0.75	0.71	0.72	1.02	0.66	0.77	0.14	0.06	0.21	0.24	0.22	0.56	0.16	0.28	0.16	0.07
	Average	0.68	0.61	0.63	0.76	0.59	0.65	0.07	0.03	0.16	0.21	0.18	0.33	0.15	0.20	0.07	0.03

Table D.4: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at Sheardown Lake Northwest (DLO-01), Mary River Project CREMP, 2015.

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	6-May-15	7-May-15	7-May-15	6-May-15	6-May-15	3-May-15	-	-	-
	Summer	22-Jul-15	20-Jul-15	20-Jul-15	20-Jul-15	20-Jul-15	21-Jul-15	-	-	-
	Fall	22-Aug-15	22-Aug-15	21-Aug-15	21-Aug-15	21-Aug-15	20-Aug-15	-	-	-
Winter	Surface	1.05	1.31	1.16	1.07	0.93	0.93	1.08	0.15	0.06
	Bottom	1.04	0.90	1.16	1.25	1.24	1.21	1.13	0.14	0.06
	Average	1.045	1.11	1.16	1.16	1.09	1.07	1.10	0.05	0.02
Summer	Surface	1.00	1.43	1.60	1.68	1.73	1.21	1.44	0.29	0.12
	Bottom	1.34	1.46	1.62	1.94	1.71	1.43	1.58	0.22	0.09
	Average	1.17	1.45	1.61	1.81	1.72	1.32	1.51	0.24	0.10
Fall	Surface	1.27	1.14	1.24	1.49	1.30	1.31	1.29	0.11	0.05
	Bottom	1.35	1.91	3.69	1.39	1.99	1.26	1.93	0.91	0.37
	Average	1.31	1.53	2.47	1.44	1.65	1.29	1.61	0.44	0.18

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	6-May-15	7-May-15	7-May-15	6-May-15	6-May-15	3-May-15	-	-	-
	Summer	22-Jul-15	20-Jul-15	20-Jul-15	20-Jul-15	20-Jul-15	21-Jul-15	-	-	-
	Fall	22-Aug-15	22-Aug-15	21-Aug-15	21-Aug-15	21-Aug-15	20-Aug-15	-	-	-
Winter	Surface	0.45	0.50	0.54	0.52	0.43	0.38	0.47	0.06	0.02
	Bottom	0.53	0.39	0.51	0.45	0.66	0.65	0.53	0.11	0.04
	Average	0.49	0.45	0.52	0.49	0.55	0.52	0.50	0.03	0.01
Summer	Surface	0.48	0.55	0.65	0.53	0.57	0.49	0.55	0.06	0.03
	Bottom	0.71	0.68	0.60	0.74	0.71	0.68	0.69	0.05	0.02
	Average	0.60	0.62	0.63	0.64	0.64	0.59	0.62	0.02	0.01
Fall	Surface	0.69	0.74	0.62	0.66	0.65	0.46	0.64	0.10	0.04
	Bottom	0.65	0.97	1.72	0.72	1.11	0.61	0.96	0.42	0.17
	Average	0.67	0.86	1.17	0.69	0.88	0.54	0.80	0.22	0.09

Table D.5: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at Sheardown Lake Southeast (DLO-02), Mary River Project CREMP, 2015.

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	6-May-15	3-May-15	1-May-15	1-May-15	3-May-15	-	-	-	6-May-15	3-May-15	1-May-15	1-May-15	3-May-15	-	-	-
	Summer	21-Jul-15	22-Jul-15	21-Jul-15	21-Jul-15	21-Jul-15	-	-	-	21-Jul-15	22-Jul-15	21-Jul-15	21-Jul-15	21-Jul-15	-	-	-
	Fall	20-Aug-15	21-Aug-15	20-Aug-15	21-Aug-15	21-Aug-15	-	-	-	20-Aug-15	21-Aug-15	20-Aug-15	21-Aug-15	21-Aug-15	-	-	-
Winter	Surface	2.56	1.07	1.42	0.91	1.38	1.47	0.65	0.29	0.86	0.51	0.53	0.58	0.79	0.65	0.16	0.07
	Bottom	2.34	-	1.56	1.70	1.75	1.84	0.34	0.17	0.84	-	0.76	0.76	0.74	0.77	0.05	0.02
	Average	2.45	1.07	1.49	1.31	1.56	1.58	0.52	0.23	0.85	0.51	0.65	0.67	0.76	0.69	0.13	0.06
Summer	Surface	0.56	0.77	0.76	0.83	0.69	0.72	0.10	0.05	0.33	0.26	0.34	0.37	0.31	0.32	0.04	0.02
	Bottom	1.37	0.91	1.23	1.02	1.00	1.11	0.19	0.08	0.74	0.46	0.86	0.58	0.56	0.64	0.16	0.07
	Average	0.97	0.84	1.00	0.93	0.84	0.91	0.07	0.03	0.54	0.36	0.60	0.48	0.43	0.48	0.09	0.04
Fall	Surface	0.90	0.83	1.06	0.94	1.03	0.95	0.09	0.04	0.29	0.36	0.46	0.51	0.51	0.43	0.10	0.04
	Bottom	1.07	0.87	1.22	1.05	0.95	1.03	0.13	0.06	0.46	0.39	0.51	0.64	0.52	0.50	0.09	0.04
	Average	0.99	0.85	1.14	1.00	0.99	0.99	0.10	0.05	0.38	0.37	0.49	0.58	0.52	0.46	0.09	0.04

Table D.6: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at the Mary River, Mary River Project CREMP, 2015.

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	C010	C0-05	C0-01
Sample Collection Date	Spring	29-Jun-15	29-Jun-15	29-Jun-15	29-Jun-15	29-Jun-15	29-Jun-15	29-Jun-15	29-Jun-15	29-Jun-15	29-Jun-15	29-Jun-15	29-Jun-15	29-Jun-15
	Summer	19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15	19-Jul-15
	Fall	13-Aug-15	13-Aug-15	13-Aug-15	13-Aug-15	17-Aug-15	17-Aug-15	17-Aug-15	16-Aug-15	16-Aug-15	16-Aug-15	16-Aug-15	16-Aug-15	13-Aug-15
Chlorophyll a (µg/L)	Spring	0.81	0.51	0.52	0.42	0.17	0.18	0.19	0.31	0.26	0.30	0.20	0.28	0.27
	Summer	0.14	0.20	0.15	0.16	0.16	0.20	0.19	0.17	0.19	0.21	0.12	0.11	0.21
	Fall	0.37	0.32	0.28	0.35	0.17	0.19	0.17	0.20	0.27	0.24	0.31	0.31	0.36
	Average	0.44	0.34	0.32	0.31	0.17	0.19	0.18	0.23	0.24	0.25	0.21	0.23	0.28
	Standard Deviation	0.34	0.16	0.19	0.13	0.01	0.01	0.01	0.07	0.04	0.05	0.10	0.11	0.08
	Standard Error	0.20	0.09	0.11	0.08	0.003	0.01	0.01	0.04	0.03	0.03	0.06	0.06	0.04
Phaeophytin a (µg/L)	Spring	0.40	0.28	0.25	0.19	<0.10	<0.10	0.11	0.14	0.13	0.15	0.11	0.16	0.12
	Summer	0.10	0.19	0.19	0.17	0.18	<0.10	0.21	0.13	0.15	0.17	<0.20	0.12	0.12
	Fall	0.29	0.25	0.24	0.30	0.15	0.14	0.12	0.13	0.16	0.18	0.18	0.18	0.19
	Average	0.26	0.24	0.23	0.22	0.14	0.11	0.15	0.13	0.15	0.17	0.16	0.15	0.14
	Standard Deviation	0.15	0.05	0.03	0.07	0.04	0.02	0.06	0.01	0.02	0.02	0.05	0.03	0.04
	Standard Error	0.09	0.03	0.02	0.04	0.02	0.01	0.03	0.003	0.01	0.01	0.03	0.02	0.02

Table D.7: Phytoplankton monitoring data (i.e., chlorophyll a and phaeophytin a concentrations) collected at Mary Lake (north and south basins; BLO), Mary River Project CREMP, 2015.

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	28-Apr-15	28-Apr-15	28-Apr-15	30-Apr-15	30-Apr-15	30-Apr-15	29-Apr-15	29-Apr-15	29-Apr-15	29-Apr-15	-	-	-
	Summer	26-Jul-15	26-Jul-15	26-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	-	-	-
	Fall	24-Aug-15	24-Aug-15	24-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15	-	-	-
Winter	Surface	0.38	2.17	0.30	0.28	0.74	1.67	0.84	0.75	0.86	1.42	0.94	0.63	0.20
	Bottom	0.10	0.72	0.25	0.10	0.58	0.76	0.10	0.36	0.10	0.49	0.36	0.27	0.08
	Average	0.24	1.44	0.28	0.19	0.66	1.22	0.47	0.56	0.48	0.95	0.65	0.43	0.13
Summer	Surface	0.63	0.79	0.55	1.09	0.69	0.52	1.21	0.81	0.90	0.85	0.80	0.22	0.07
	Bottom	0.70	1.43	0.86	0.61	0.54	1.11	0.64	0.58	0.55	0.95	0.80	0.29	0.09
	Average	0.67	1.11	0.71	0.85	0.61	0.82	0.93	0.70	0.73	0.90	0.80	0.15	0.05
Fall	Surface	0.64	0.73	0.58	0.56	0.94	0.69	0.86	0.80	0.82	0.81	0.74	0.12	0.04
	Bottom	0.55	0.68	0.56	0.77	1.04	1.25	1.12	1.13	0.85	0.89	0.88	0.25	0.08
	Average	0.60	0.71	0.57	0.67	0.99	0.97	0.99	0.97	0.84	0.85	0.81	0.17	0.05

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	28-Apr-15	28-Apr-15	28-Apr-15	30-Apr-15	30-Apr-15	30-Apr-15	29-Apr-15	29-Apr-15	29-Apr-15	29-Apr-15	-	-	-
	Summer	26-Jul-15	26-Jul-15	26-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	-	-	-
	Fall	24-Aug-15	24-Aug-15	24-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15	-	-	-
Winter	Surface	<0.10	0.62	<0.10	0.15	0.24	1.00	0.23	0.16	0.21	0.46	0.33	0.29	0.09
	Bottom	<0.10	0.20	<0.10	<0.10	0.23	0.59	<0.10	0.11	<0.10	0.16	0.18	0.15	0.05
	Average	0.10	0.41	0.10	0.13	0.24	0.80	0.17	0.14	0.16	0.31	0.25	0.22	0.07
Summer	Surface	0.32	0.38	0.28	0.46	0.36	0.39	0.63	0.51	0.62	0.54	0.45	0.12	0.04
	Bottom	0.36	1.00	0.31	0.39	0.33	0.66	0.44	0.33	0.32	0.57	0.47	0.22	0.07
	Average	0.34	0.69	0.30	0.43	0.34	0.53	0.54	0.42	0.47	0.55	0.46	0.12	0.04
Fall	Surface	0.34	0.38	0.35	0.56	0.83	0.61	0.70	0.62	0.66	0.67	0.57	0.16	0.05
	Bottom	0.39	0.42	0.35	0.74	0.97	1.05	0.87	1.07	0.71	0.85	0.74	0.27	0.09
	Average	0.37	0.40	0.35	0.65	0.90	0.83	0.79	0.85	0.69	0.76	0.66	0.21	0.07

Table D.8: Statistical comparisons of chlorophyll a concentrations among winter, spring, summer, and/or fall sampling events at mine-exposed and reference lotic (stream) and lake study areas, Mary River Project CREMP, 2015.

Study Lake	Overall 3-group Comparison			Pair-wise, post-hoc comparisons ^a				
	Significant Difference Among Areas?	p-value	Statistical Test ^b	(I) Area	(J) Area	Significant Difference Between 2 Areas?	p-value	Statistical Test
Lotic Reference Stations	NO	0.14382	ANOVA ^c	Spring	Summer	NO	0.2606	Tukey's ^c
				Spring	Fall	NO	0.9254	
				Summer	Fall	NO	0.1520	
Reference Lake 3	-	-	-	Winter	Summer	NO	-	ANOVA ^{a,c}
				Winter	Fall	NO	-	
				Summer	Fall	NO	0.5566	
Camp Lake	YES	0.00006	ANOVA ^{d,e}	Winter	Summer	YES	0.0004	Tukey's ^{d,f}
				Winter	Fall	NO	0.4966	
				Summer	Fall	YES	0.0001	
Sheardown Lake NW	YES	0.00537	ANOVA ^c	Winter	Summer	YES	0.0191	Tukey's ^c
				Winter	Fall	YES	0.0072	
				Summer	Fall	NO	0.8762	
Sheardown Lake SE	YES	0.00268	ANOVA ^c	Winter	Summer	YES	0.0034	Tukey's ^c
				Winter	Fall	YES	0.0109	
				Summer	Fall	NO	0.7887	
Mary Lake North Basin	NO	0.54876	ANOVA ^c	Winter	Summer	NO	0.8171	Tamhane's ^c
				Winter	Fall	NO	0.9565	
				Summer	Fall	NO	0.5718	
Mary Lake South Basin	YES	0.08296	ANOVA ^c	Winter	Summer	NO	0.4988	Tukey's ^{d,f}
				Winter	Fall	NO	0.2551	
				Summer	Fall	NO	0.3520	

^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 confirm results of ANOVA three-group comparison.

^f Mann-Whitney U-test used to confirm results of post-hoc tests for all pair-wise comparisons.

Table D.9: 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 2015.

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	Power	Magnitude of Difference					Lower Bound	Upper Bound		
Reference Lake 03	-	-	-	-	-	3	0.90	0.23	0.13	0.34	1.46	0.74	1.16
Camp Lake	YES	0.0294	γ	0.6050	1.6	5	1.26	0.16	0.07	1.06	1.46	1.16	1.55
Sheardown Lake NW	YES	0.0085	α	0.8726	2.7	6	1.51	0.24	0.10	1.26	1.77	1.17	1.81
Sheardown Lake SE	NO	0.8949	δ	0.0516	-	5	0.91	0.07	0.03	0.83	1.00	0.84	1.00
Mary Lake North	NO	0.7260	α	0.0601	-	3	0.83	0.25	0.14	0.22	1.44	0.67	1.11
Mary Lake South	NO	0.3191	α	0.1555	-	7	0.79	0.12	0.04	0.68	0.90	0.61	0.93

^a Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, single factor ANOVA test results confirmed using Mann-Whitney U-test; δ - data untransformed, single-factor ANOVA test results confirmed using t-test assuming unequal variance; and, ϵ - data untransformed, student's t-test assuming unequal variance used.

^b Magnitude calculated by comparing the difference between the reference area and effluent-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 D.10: 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 2015.

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	Power	Magnitude of Difference					Lower Bound	Upper Bound		
Reference Lake 03	-	-	-	-	-	3	1.06	0.36	0.21	0.16	1.96	0.84	1.48
Camp Lake	NO	0.1878	ϵ	0.5795	-	5	0.65	0.07	0.03	0.56	0.74	0.59	0.76
Sheardown Lake NW	YES	0.0561	β	0.5043	1.5	6	1.61	0.44	0.18	1.15	2.07	1.29	2.47
Sheardown Lake SE	NO	0.6975	δ	0.0639	-	5	0.99	0.10	0.05	0.86	1.12	0.85	1.14
Mary Lake North	NO	0.1107	δ	0.3474	-	3	0.62	0.07	0.04	0.44	0.80	0.57	0.71
Mary Lake South	NO	0.2883	δ	0.1713	-	7	0.90	0.12	0.05	0.78	1.01	0.67	0.99

^a Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data untransformed, single factor ANOVA test results confirmed using Mann-Whitney U-test; δ - data untransformed, single-factor ANOVA test results confirmed using t-test assuming unequal variance; and, ϵ - data untransformed, student's t-test assuming unequal variance used.

^b Magnitude calculated by comparing the difference between the reference area and effluent-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.

APPENDIX E

**BENTHIC INVERTEBRATE COMMUNITY
DATA**

Table E.1: Summary of habitat features at streams evaluated as part of the 2015 Mary River Project CREMP benthic invertebrate community assessment.

Habitat Characteristic		Camp Lake Tributary 1		Camp Lake Tributary 2		Sheardown Tributary 1			Sheardown Tributaries 9 and 12		Mary River Upstream		Mary River Downstream		
		CLT-1 US	CLT-1 DS	CLT-2 US	CLT-2 DS	SDLT-1 Reach 4	SDLT-1 Reach 2	SDLT-1 Reach 1	SDLT-12 DS	SDLT-9 US	GO-09	GO-03	EO-01	EO-20	CO-05
Mean Width (m)	Wetted	7.2	5.6	16.4	5.3	1.0	8.4	6.1	0.7	1.0	55.0	39.0	16.0	21.0	100
	Bankfull	9.6	15.9	17.8	7.1	7.0	8.4	6.7	15.0	1.0	72.5	52.0	84.0	30.0	104
Mean Depth (cm)	Average	13	10	16	7	13	12	12	10	8	25	34	70	27	28
Mean Velocity (m/s)	Average	0.25	0.26	0.48	0.23	0.30	0.34	0.26	0.15	0.15	0.47	0.39	1.00	0.70	0.49
Stream Morphology	% Pool	5	5	0	0	0	0	0	30	5	0	0	0	0	5
	% Rapid	20	0	10	0	0	0	0	0	0	20	0	30	20	0
	% Riffle	40	75	50	40	20	50	80	30	75	40	60	40	40	5
	% Run	35	20	40	60	80	50	20	40	20	40	40	30	40	90
Substrate (% areal coverage)		10% boulder 60% cobble 15% pebble 10% gravel 5% sand	60% cobble 20% pebble 15% gravel 5% sand	15% boulder 60% cobble 10% pebble 10% gravel 5% sand	10% boulder 40% cobble 20% pebble 20% gravel 10% sand	30% boulder 40% cobble 10% pebble 10% gravel 10% sand	5% boulder 80% cobble 10% pebble 5% gravel	30% boulder 50% cobble 10% pebble 10% gravel	70% boulder 30% cobble	55% cobble 15% pebble 15% gravel 15% sand	30% boulder 60% cobble 5% pebble 5% gravel	30% boulder 60% cobble 5% pebble 5% gravel	40% boulder 50% cobble 5% pebble 5% gravel	15% boulder 70% cobble 5% pebble 5% gravel 5% sand	15% boulder 45% cobble 15% pebble 15% gravel 10% sand
Aquatic Vegetation (% areal coverage)	Periphyton Coverage	25%	30%	20%	20%	5%	40%	40%	none observed	5%	10%	40%	20%	20%	none observed
	Periphyton Description	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	1 to 5 mm thick of attached algae/periphyton on rocks	1 to 5 mm thick of attached algae/periphyton on rocks	none observed	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	none observed
Functional Instream Cover (% areal coverage)		2% undercut banks 5% boulder	1% undercut banks	10% boulder	<5% boulder	20% boulder	1% undercut banks 1% boulder	10% boulder	50% boulder	5% undercut banks	20% boulder	30% boulder	30% boulder	5% boulder	1% boulder

Table E.2: Replicate grab data for benthic invertebrate community samples collected at the Camp Lake Tributaries, Mary River Project CREMP, August 2015.

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	13	8	11	0.22	0.31	0.20	6.2	5.8	6.6	25%	25%	25%
	CLT-1 US B2	14	13	16	0.28	0.26	0.31	6.6	6.7	4.3	25%	25%	25%
	CLT-1 US B3	11	9	8	0.28	0.20	0.29	4.2	5.0	4.6	25%	25%	25%
	CLT-1 US B4	11	12	17	0.28	0.23	0.23	7.5	6.5	6.0	25%	25%	25%
	CLT-1 US B5	15	11	16	0.28	0.19	0.31	5.2	5.5	5.5	25%	25%	25%
Camp Lake Tributary 1 Downstream	CLT-1 DS B1	13	15	15	0.12	0.18	0.22	6.3	5.2	6.2	25%	25%	25%
	CLT-1 DS B2	11	11	11	0.25	0.28	0.20	5.2	6.5	6.3	25%	25%	25%
	CLT-1 DS B3	14	10	12	0.21	0.24	0.24	5.0	4.5	5.8	25%	25%	25%
	CLT-1 DS B4	11	11	9	0.26	0.28	0.26	6.2	5.2	7.0	25%	25%	25%
	CLT-1 DS B5	16	13	10	0.21	0.28	0.24	4.6	5.8	6.4	25%	25%	25%
Camp Lake Tributary 2 Upstream	CLT-2 US B1	14	15	12	0.34	0.23	0.24	5.0	5.4	3.4	25%	25%	25%
	CLT-2 US B2	11	18	13	0.24	0.23	0.30	6.5	6.2	5.2	25%	25%	25%
	CLT-2 US B3	12	13	7	0.32	0.19	0.20	6.2	5.2	3.9	25%	25%	25%
	CLT-2 US B4	12	8	8	0.29	0.31	0.19	5.4	6.0	4.3	25%	25%	25%
	CLT-2 US B5	12	15	14	0.28	0.31	0.30	6.2	5.9	6.1	25%	25%	25%
Camp Lake Tributary 2 Downstream	CLT-2 DS B1	10	9	9	0.26	0.28	0.24	5.1	6.3	5.8	25%	25%	25%
	CLT-2 DS B2	9	10	9	0.21	0.26	0.27	5.3	5.2	5.7	25%	25%	25%
	CLT-2 DS B3	7	5	9	0.23	0.23	0.20	5.5	3.9	4.7	25%	25%	25%
	CLT-2 DS B4	9	8	10	0.19	0.25	0.26	5.9	5.1	4.9	25%	25%	25%
	CLT-2 DS B5	13	17	9	0.30	0.24	0.28	4.5	4.6	4.4	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 7 - 1 measurements per replicate grab, with a mean of 12 for the entire 2015 stream sampling program.

Table E.3: Statistical comparison of physical habitat features between Camp Lake Tributary 1 Upstream (CLT-1 US) and Downstream (CLT-1 DS) benthic invertebrate community study areas, Mary River Project CREMP, August 2015.

Metric	Two-Sample Comparison			Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	p-value	Statistical Test ^a					Lower Bound	Upper Bound		
Sampling Depth (cm)	NO	0.8737	ANOVA	CLT 1 Upstream	12	2.2	1.0	10	15	9	14
				CLT 1 Downstream	12	1.6	0.7	10	14	10	14
Water Velocity (cm/s)	NO	0.1589	ANOVA	CLT 1 Upstream	26	1.6	0.7	24	28	24	28
				CLT 1 Downstream	23	3.5	1.6	19	27	17	27
Substrate Size (cm diameter)	NO	0.9714	ANOVA	CLT 1 Upstream	5.7	0.8	0.3	4.8	6.7	4.6	6.6
				CLT 1 Downstream	5.7	0.4	0.2	5.2	6.3	5.1	6.1
Embeddedness (proportion)	NO	1.0000	ANOVA	CLT 1 Upstream	0.25	0.00	0.00	0.25	0.25	0.25	0.25
				CLT 1 Downstream	0.25	0.00	0.00	0.25	0.25	0.25	0.25

^a Analysis of Variance (ANOVA); MW U-test indicates application of Mann-Whitney U-test.

Table E.4: Statistical comparison of physical habitat features between Camp Lake Tributary 2 Upstream (CLT-2 US) and Downstream (CLT-2 DS) benthic invertebrate community study areas, Mary River Project CREMP, August 2015.

Metric	Two-Sample Comparison			Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	p-value	Statistical Test ^a					Lower Bound	Upper Bound		
Sampling Depth (cm)	YES	0.0790	ANOVA	CLT 2 Upstream	12	2.1	1.0	10	15	9	14
				CLT 2 Downstream	10	2.2	1.0	7	12	7	13
Water Velocity (cm/s)	NO	0.2211	ANOVA	CLT 2 Upstream	26	2.2	1.0	24	29	24	30
				CLT 2 Downstream	25	2.1	0.9	22	27	22	27
Substrate Size (cm diameter)	NO	0.5118	ANOVA	CLT 2 Upstream	5.4	0.6	0.3	4.6	6.2	4.6	6.0
				CLT 2 Downstream	5.1	0.5	0.2	4.5	5.8	4.5	5.7
Embeddedness (proportion)	NO	1.0000	ANOVA	CLT 2 Upstream	0.25	0.00	0.00	0.25	0.25	0.25	0.25
				CLT 2 Downstream	0.25	0.00	0.00	0.25	0.25	0.25	0.25

^a Analysis of Variance (ANOVA); MW U-test indicates application of Mann-Whitney U-test.

Table E.5: Benthic invertebrate community data for Camp Lake Tributary 1 study areas, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Camp Lake Tributary 1 - Upstream					Camp Lake Tributary 1 - Downstream				
	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	14	7	14	29	72	29	115	14	29	14
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	29	22	0	36	0	14	172	57	57	100
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina	0	0	0	0	0	14	0	0	0	0
F. Sperchonidae										
<i>Sperchon</i>	0	36	22	57	29	14	0	29	14	14
SEED SHRIMPS										
Cl. Ostracoda	0	0	14	7	14	14	29	0	0	0
SPRINGTAILS										
Cl. Entognatha										
O. Collembola	0	0	7	0	0	0	0	0	0	0
INSECTS										
Cl. Insecta										
BEETLES										
O. Coleoptera										
F. Dytiscidae										
indeterminate	0	0	0	0	0	0	0	0	0	0
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
<i>Acentrella feropagus</i>	0	0	0	0	0	0	0	0	0	0
STONEFLIES										
O. Plecoptera										
F. Capniidae										
immature	0	7	0	0	0	0	0	0	0	14
TRUE FLIES										
O. Diptera										
indeterminate	0	0	0	0	0	0	0	0	0	0
BITING-MIDGE										
F. Ceratopogonidae										
<i>Atrichopogon</i>	0	0	0	0	0	0	0	0	0	0
<i>Culicoides</i>	0	0	0	0	0	0	0	0	0	0
MIDGES										
F. Chironomidae										
chironomid pupae	129	79	57	79	187	72	230	86	100	86
S.F. Chironominae										
<i>Paratanytarsus</i>	0	0	0	0	0	0	0	14	0	0
S.F. Diamesinae										
<i>Diamesa</i>	0	0	0	0	0	0	29	0	0	0
<i>Pseudokiefferiella</i>	14	43	14	208	976	57	0	43	0	144
S.F. Orthoclaadiinae										
<i>Chaetocladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Cardiocladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Corynoneura</i>	14	0	0	22	14	29	0	0	29	43
<i>Cricotopus</i>	359	129	36	179	416	29	172	172	158	115
<i>Cricotopus/Orthoclaadius</i>	100	158	172	179	273	29	57	187	57	43
<i>Diplocladius</i>	0	0	0	7	0	0	0	0	0	0

Table E.5: Benthic invertebrate community data for Camp Lake Tributary 1 study areas, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Camp Lake Tributary 1 - Upstream					Camp Lake Tributary 1 - Downstream				
	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
<i>Hydrobaenus</i>	0	22	50	79	0	14	57	72	57	172
<i>Krenosmittia</i>	0	50	0	0	29	0	0	0	0	0
? <i>Limnophyes</i>	14	29	57	29	43	14	29	14	57	201
<i>Metriocnemus</i>	0	7	0	22	29	0	0	0	0	0
<i>Orthocladius (Euorthocladius)</i>	72	22	14	50	0	29	115	0	14	57
<i>Parakiefferiella</i>	0	0	0	0	0	14	0	0	14	86
<i>Paraphaenocladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Pseudosmittia</i>	57	22	0	129	244	273	431	402	273	402
<i>Synorthocladius</i>	0	0	0	0	0	0	29	0	0	0
<i>Thienemanniella</i>	0	0	0	0	0	0	29	0	0	0
<i>Tokunagaia</i>	201	187	43	79	72	29	57	86	100	316
<i>Tvetenia</i>	29	0	0	14	0	0	0	14	29	0
indeterminate	0	7	0	0	14	14	29	0	0	14
S.F. Podonominæ										
<i>Trichotanytus</i>	0	14	0	0	14	0	0	0	0	0
S.F. Tanypodinæ										
<i>Thienemannimyia complex</i>	0	0	0	7	0	0	0	0	0	0
F. Empididae										
<i>Clinocera</i>	0	0	14	43	43	0	0	0	14	14
F. Simuliidae										
<i>Gymnopsis</i>	0	0	0	0	0	0	0	0	0	0
<i>Prosimulium</i>	0	0	0	0	0	0	0	0	0	0
? <i>Metacnephia</i>	0	0	0	0	0	0	0	0	0	0
F. Tipulidae										
<i>Tipula</i>	151	169	165	262	370	14	36	43	32	86
Number of Organisms (No. organisms per m	1,183	1,010	679	1,517	2,839	702	1,616	1,233	1,034	1,921
Richness (total number of taxa)^a	12	16	13	19	15	15	14	13	15	16
Simpson's Evenness (E)	0.877	0.924	0.897	0.946	0.851	0.822	0.900	0.877	0.911	0.937
Bray-Curtis Index	0.325	0.184	0.269	0.234	0.540	0.557	0.562	0.334	0.417	0.573
Percent Composition										
% Nemata	1.2%	0.7%	2.1%	1.9%	2.5%	4.1%	7.1%	1.1%	2.8%	0.7%
% Oligochaeta	2.5%	2.2%	0.0%	2.4%	0.0%	2.0%	10.6%	4.6%	5.5%	5.2%
% Hydracarina	0.0%	3.6%	3.2%	3.8%	1.0%	4.0%	0.0%	2.4%	1.4%	0.7%
% Ostracods	0.0%	0.0%	2.1%	0.5%	0.5%	2.0%	1.8%	0.0%	0.0%	0.0%
% Chironomids	83.6%	76.1%	65.2%	71.4%	81.4%	85.9%	78.2%	88.4%	85.9%	87.4%
% Metal Sensitive Chironomids	1.2%	10.6%	2.1%	13.7%	35.9%	8.1%	1.8%	4.6%	0.0%	7.5%
% Tipulidae	12.8%	16.7%	24.3%	17.3%	13.0%	2.0%	2.2%	3.5%	3.1%	4.5%
Functional Feeding Group Composition										
% Shredders	51.6%	45.8%	54.9%	40.9%	37.3%	10.3%	16.4%	32.6%	23.9%	13.4%
% Scrapers	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Collector - Gatherers	48.4%	50.6%	39.8%	52.1%	60.2%	85.8%	83.6%	63.9%	73.4%	85.1%
% Filterers	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	0.0%
Habitat Preference Group Composition										
% Clingers	38.8%	32.0%	35.9%	30.2%	26.8%	12.3%	14.2%	31.5%	23.5%	9.7%
% Sprawlers	44.8%	47.7%	36.7%	46.8%	56.6%	79.6%	65.8%	59.3%	65.1%	79.9%
% Burrowers	16.4%	20.3%	26.4%	23.0%	16.6%	8.1%	20.0%	9.2%	11.4%	10.4%

^a Bold entries excluded from taxa count

Table E.6: Statistical results comparing 2015 and combined 2007/2011 benthic invertebrate community survey data for Camp Lake Tributary 1 using two-Way ANOVA, Mary River Project CREMP, 2015.

	Source	Significant Difference Among Areas?	p-value	Power
Density (No. organisms/ m ²)	Time	Yes	0.017	0.705
	Area	No	0.921	0.051
	Time*Area	No	0.597	0.080
Richness (No. of taxa)	Time	No	0.451	0.113
	Area	No	0.251	0.202
	Time*Area	No	0.161	0.283
Simpson's Evenness	Time	Yes	0.032	0.595
	Area	No	0.383	0.135
	Time*Area	No	0.216	0.229
Oligochaeta (% composition)	Time	No	0.548	0.089
	Area	Yes	0.019	0.680
	Time*Area	No	0.694	0.067
Chironomidae (% composition)	Time	No	0.462	0.110
	Area	No	0.949	0.050
	Time*Area	Yes	0.020	0.677
Metal-Sensitive Chironomidae (% composition)	Time	No	0.845	0.054
	Area	No	0.587	0.082
	Time*Area	No	0.123	0.335
Tipulidae (% composition)	Time	No	0.108	0.360
	Area	Yes	0.000	0.999
	Time*Area	Yes	0.000	0.996
Shredders (% composition)	Time	No	0.714	0.064
	Area	Yes	0.006	0.829
	Time*Area	Yes	0.011	0.766
Collector-Gatherers (% composition)	Time	Yes	0.053	0.499
	Area	No	0.287	0.180
	Time*Area	Yes	0.007	0.828

Table E.7: Benthic invertebrate community data for Camp Lake Tributary 2 study areas, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Camp Lake Tributary 2 - Upstream					Camp Lake Tributary 2 - Downstream				
	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	0	11	7	22	0	7	18	25	36	4
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	7	14	7	108	4	0	32	25	237	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina	0	0	0	7	0	0	0	0	0	0
F. Sperchonidae										
<i>Sperchon</i>	0	11	7	0	4	0	0	4	0	0
SEED SHRIMPS										
Cl. Ostracoda	0	4	0	0	4	0	0	0	0	0
SPRINGTAILS										
Cl. Entognatha										
O. Collembola	11	11	0	0	4	0	0	0	0	0
INSECTS										
Cl. Insecta										
BEETLES										
O. Coleoptera										
F. Dytiscidae										
indeterminate	4	0	0	0	0	0	0	0	0	0
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
<i>Acentrella feropagus</i>	0	0	0	0	0	0	0	0	14	0
STONEFLIES										
O. Plecoptera										
F. Capniidae										
immature	7	4	7	7	4	0	0	4	0	0
TRUE FLIES										
O. Diptera										
indeterminate	0	0	7	0	0	0	0	0	0	0
BITING-MIDGE										
F. Ceratopogonidae										
<i>Atrichopogon</i>	4	0	0	0	0	0	0	0	0	0
<i>Culicoides</i>	0	4	165	7	50	4	0	14	22	7
MIDGES										
F. Chironomidae										
chironomid pupae	83	147	93	122	25	11	57	7	72	50
S.F. Chironominae										
<i>Paratanytarsus</i>	0	0	0	0	0	0	0	0	0	0
S.F. Diamesinae										
<i>Diamesa</i>	11	7	0	0	0	0	4	0	7	0
<i>Pseudokiefferiella</i>	0	43	7	230	0	115	65	22	22	0
S.F. Orthoclaadiinae										
<i>Chaetocladius</i>	4	18	0	0	0	0	0	4	0	0
<i>Cardiocladius</i>	0	4	7	0	0	0	0	0	0	0
<i>Corynoneura</i>	0	7	7	0	7	4	4	4	0	4
<i>Cricotopus</i>	54	57	129	201	61	68	68	11	100	7
<i>Cricotopus/Orthoclaadius</i>	50	39	14	215	22	79	100	22	22	4
<i>Diplocladius</i>	0	0	0	14	0	0	0	0	0	0

Table E.7: Benthic invertebrate community data for Camp Lake Tributary 2 study areas, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Camp Lake Tributary 2 - Upstream					Camp Lake Tributary 2 - Downstream				
	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
<i>Hydrobaenus</i>	4	0	0	0	0	4	0	0	0	4
<i>Krenosmittia</i>	7	18	14	14	4	4	0	0	0	0
? <i>Limnophyes</i>	18	4	72	29	4	4	29	32	43	4
<i>Metriocnemus</i>	0	22	22	0	14	4	0	0	0	0
<i>Orthocladius (Euorthocladius)</i>	54	32	22	172	86	4	29	32	29	0
<i>Parakiefferiella</i>	0	0	0	14	0	0	0	0	0	0
<i>Paraphaenocladius</i>	14	0	0	0	0	0	36	0	0	0
<i>Pseudosmittia</i>	0	11	0	72	4	36	7	4	65	0
<i>Synorthocladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Thienemanniella</i>	0	0	0	0	4	0	0	0	0	0
<i>Tokunagaia</i>	115	32	165	129	14	36	104	68	93	4
<i>Tvetenia</i>	14	7	7	14	4	7	0	0	7	0
indeterminate	0	14	0	0	0	0	0	11	0	4
S.F. Podonominae										
<i>Trichotanytus</i>	39	7	29	14	11	0	0	11	0	0
S.F. Tanypodinae										
<i>Thienemannimyia complex</i>	0	0	0	0	0	0	0	0	0	0
F. Empididae										
<i>Clinocera</i>	0	0	7	14	4	11	14	0	0	0
F. Simuliidae										
<i>Gymnopais</i>	0	0	14	0	0	0	0	0	0	0
<i>Prosimulium</i>	7	0	7	0	4	4	0	7	0	0
? <i>Metacnephia</i>	0	0	0	0	0	0	4	0	0	0
F. Tipulidae										
<i>Tipula</i>	25	22	7	22	36	29	43	7	0	14
Number of Organisms (No. organisms per m	532	550	823	1,427	374	431	614	314	769	106
Richness (total number of taxa)^a	19	23	22	19	21	17	15	17	13	9
Simpson's Evenness (E)	0.920	0.960	0.892	0.926	0.910	0.895	0.945	0.943	0.908	0.982
Bray-Curtis Index	0.179	0.293	0.388	0.498	0.376	0.474	0.354	0.436	0.500	0.712
Percent Composition										
% Nemata	0.0%	2.0%	0.9%	1.5%	0.0%	1.6%	2.9%	8.0%	4.7%	3.8%
% Oligochaeta	1.3%	2.5%	0.9%	7.6%	1.1%	0.0%	5.2%	8.0%	30.8%	0.0%
% Hydracarina	0.0%	2.0%	0.9%	0.5%	1.1%	0.0%	0.0%	1.3%	0.0%	0.0%
% Ostracods	0.0%	0.7%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids	87.8%	85.3%	71.4%	86.9%	69.5%	87.2%	81.9%	72.6%	59.8%	76.4%
% Metal Sensitive Chironmids	10.7%	13.6%	6.1%	18.1%	4.0%	27.6%	11.2%	10.5%	3.8%	0.0%
% Tipulidae	4.7%	4.0%	0.9%	1.5%	9.6%	6.7%	7.0%	2.2%	0.0%	13.2%
Functional Feeding Group Composition										
% Shredders	25.6%	22.2%	19.1%	31.2%	32.9%	40.8%	34.4%	14.0%	15.9%	23.6%
% Scrapers	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Collector - Gatherers	71.6%	74.4%	55.8%	66.9%	50.5%	54.8%	62.7%	78.0%	81.3%	69.8%
% Filterers	1.3%	0.0%	2.6%	0.0%	1.1%	0.9%	0.7%	2.2%	0.0%	0.0%
Habitat Preference Group Composition										
% Clingers	20.9%	19.5%	21.6%	30.6%	25.4%	37.6%	30.3%	14.0%	15.9%	10.4%
% Sprawlers	70.3%	64.5%	52.2%	58.2%	45.7%	52.2%	54.6%	63.4%	45.8%	66.0%
% Burrowers	6.0%	14.0%	26.1%	11.1%	27.8%	10.2%	15.1%	22.6%	38.4%	23.6%

^a Bold entries excluded from taxa count

Table E.8: Statistical results comparing 2015 and combined 2007/2011 benthic invertebrate community survey data for Camp Lake Tributary 2 using two-Way ANOVA, Mary River Project CREMP, 2015.

	Source	Significant Difference Among Areas?	p-value	Power
Density (No. organisms/ m ²)	Time	No	0.225	0.218
	Area	No	0.473	0.105
	Time*Area	No	0.263	0.191
Richness (No. of taxa)	Time	Yes	0.096	0.384
	Area	No	0.547	0.088
	Time*Area	Yes	0.001	0.984
Simpson's Evenness	Time	Yes	0.000	1.000
	Area	Yes	0.073	0.440
	Time*Area	No	0.335	0.153
Oligochaeta (% composition)	Time	No	0.403	0.126
	Area	No	0.416	0.121
	Time*Area	No	0.482	0.103
Chironomidae (% composition)	Time	Yes	0.036	0.583
	Area	No	0.578	0.082
	Time*Area	No	0.643	0.072
Metal-Sensitive Chironomidae (% composition)	Time	No	0.586	0.081
	Area	No	0.382	0.133
	Time*Area	No	0.399	0.127
Tipulidae (% composition)	Time	No	0.723	0.063
	Area	No	0.546	0.088
	Time*Area	No	0.922	0.051
Shredders (% composition)	Time	No	0.750	0.060
	Area	No	0.454	0.110
	Time*Area	No	0.516	0.095
Collector-Gatherers (% composition)	Time	No	0.865	0.053
	Area	No	0.751	0.060
	Time*Area	No	0.480	0.103

**Table E.9: Replicate grab data for benthic invertebrate community samples collected at the Sheardown Lake Tributaries, Mary River
Project CREMP, August 2015.**

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
Sheardown Tributary 1 Reach 4	SLDT1 R4 B1	9	7	12	0.33	0.32	0.30	4.2	4.7	6.1	50%	50%	50%
	SLDT1 R4 B2	10	11	7	0.22	0.29	0.18	3.7	5.4	7.3	50%	75%	50%
	SLDT1 R4 B3	14	6	13	0.25	0.27	0.23	5.5	5.6	5.3	75%	50%	25%
	SLDT1 R4 B4	13	11	12	0.14	0.13	0.17	5.0	5.2	5.1	50%	75%	75%
	SLDT1 R4 B5	14	12	13	0.36	0.33	0.31	4.5	5.6	5.1	25%	25%	25%
Sheardown Tributary 1 Reach 2	SLDT1 R2 B1	9	12	9	0.31	0.26	0.21	6.9	9.0	5.4	25%	25%	25%
	SLDT1 R2 B2	15	15	11	0.30	0.28	0.26	6.3	4.5	4.5	25%	25%	25%
	SLDT1 R2 B3	10	6	14	0.30	0.22	0.29	5.4	5.5	5.2	25%	25%	25%
	SLDT1 R2 B4	13	14	12	0.25	0.30	0.29	7.9	6.3	7.6	25%	25%	25%
	SLDT1 R2 B5	9	7	6	0.21	0.23	0.25	6.4	6.5	6.8	38%	38%	38%
Sheardown Tributary 1 Reach 1	SLDT1 R1 B1	9	8	10	0.20	0.30	0.24	7.4	5.5	5.5	25%	25%	25%
	SLDT1 R1 B2	10	10	9	0.24	0.28	0.30	5.6	6.3	4.8	25%	25%	25%
	SLDT1 R1 B3	15	13	8	0.31	0.22	0.23	7.4	6.6	5.9	25%	25%	25%
	SLDT1 R1 B4	7	10	8	0.24	0.31	0.21	5.7	6.3	5.4	25%	25%	25%
	SLDT1 R1 B5	9	9	8	0.26	0.31	0.28	6.8	5.7	6.1	25%	25%	25%
Sheardown Tributary 9 Upstream	SDLT 9 US-B1	7	8	7	0.16	0.25	0.18	5.3	5.6	5.2	0%	0%	0%
	SDLT 9 US-B2	8	5	4	0.26	0.20	0.24	6.4	5.2	4.6	0%	0%	0%
	SDLT 9 US-B3	7	8	5	0.18	0.28	0.25	6.8	4.3	5.4	25%	25%	25%
	SDLT 9 US-B4	7	9	5	0.23	0.30	0.27	6.5	5.3	5.5	50%	25%	50%
	SDLT 9 US-B5	8	6	5	0.26	0.29	0.27	4.8	5.1	5.0	50%	25%	25%
Sheardown Tributary 12 Downstream	SLDT 12 DS-B1	6	6	6	0.13	0.11	0.14	8.8	5.8	6.3	38%	25%	50%
	SLDT 12 DS-B2	8	9	10	0.09	0.10	0.11	6.2	7.5	5.4	25%	38%	25%
	SLDT 12 DS-B3	15	8	12	0.24	0.34	0.16	5.4	5.2	6.3	0%	0%	0%

^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 - 1 measurements per replicate grab, with a mean of 12 for the entire 2016 stream sampling program.

Table E.10: Physical habitat summary for Sheardown Lake Tributary 1 (SDLT1), Tributary 9 (SDLT9) and Tributary 12 (SDLT12) study areas, Mary River Project CREMP, August 2015.

Metric	Station	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Sampling Depth (m)	SDLT1 Reach 4	5	11	1.6	0.7	9	13	9	13
	SDLT1 Reach 2	5	11	2.6	1.1	8	14	7	14
	SDLT1 Reach 1	5	10	1.5	0.7	8	11	8	12
	SDLT9 DS	5	7	0.6	0.3	6	7	6	7
	SDLT12 DS	3	9	2.8	1.6	2	16	6	12
Water Velocity (cm/s)	SDLT1 Reach 4	5	26	7.5	3.3	16	35	15	33
	SDLT1 Reach 2	5	26	2.1	0.9	24	29	23	28
	SDLT1 Reach 1	5	26	1.6	0.7	24	28	25	28
	SDLT9 DS	5	24	3.1	1.4	20	28	20	27
	SDLT12 DS	3	16	7.8	4.5	-4	35	10	25
Substrate Size (cm)	SDLT1 Reach 4	5	5.2	0.2	0.1	4.9	5.5	5.0	5.5
	SDLT1 Reach 2	5	6.3	1.0	0.4	5.1	7.5	5.1	7.3
	SDLT1 Reach 1	5	6.1	0.4	0.2	5.6	6.6	5.6	6.6
	SDLT9 DS	5	5.4	0.3	0.1	5.0	5.8	4.9	5.8
	SDLT12 DS	3	6.3	0.7	0.4	4.7	8.0	5.7	7.0
Embeddedness (proportion)	SDLT1 Reach 4	5	50%	16%	7%	31%	69%	25%	67%
	SDLT1 Reach 2	5	28%	6%	3%	21%	34%	25%	38%
	SDLT1 Reach 1	5	25%	0%	0%	25%	25%	25%	25%
	SDLT9 DS	5	20%	19%	9%	-4%	44%	0%	42%
	SDLT12 DS	3	22%	20%	11%	-27%	71%	0%	38%

Table E.11: Statistical comparison of physical habitat features among Sheardown Lake Tributary 1 (SDLT1) upper (Reach 4), middle (Reach 2), and lower (Reach 1) benthic study areas, Mary River Project CREMP, August 2015.

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
Sampling Depth (cm)	NO	0.47698	ANOVA ^c	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	NO	0.9936	Tukey's ^c
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	NO	0.5107	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.5736	
Water Velocity (cm/s)	NO	0.95200	ANOVA ^c	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	NO	0.9935	Tamhane's ^c
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	NO	0.9969	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.9977	
Substrate Size (cm diameter)	YES	0.04285	ANOVA ^d	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	NO	0.1960	Tamhane's ^d
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0133	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.9839	
Embeddedness (proportion)	YES	0.00222	ANOVA ^{d,e}	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0078	Tukey's ^{d,f}
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0031	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.8648	

^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 Data normally distributed. Untransformed data used for comparison(s).

^d Data non-normally distributed. Log transformation resulted in normal distribution, and thus the log transformed data used for comparison(s).

^e Kruskal-Wallis H-test used to confirm results of ANOVA three-group comparison.

^f Mann-Whitney U-test used to confirm results of post-hoc tests for all pair-wise comparisons.

Table E.12: Benthic invertebrate community data for Sheardown Lake Tributary 1 reaches 4 and 2, August 2015. Densities expressed in number of organisms per square metre.

Station Replicate	Sheardown Tributary 1 - Reach 4					Sheardown Tributary 1 - Reach 2				
	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	11	7	144	230	273	0	0	50	43	65
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	36	43	36	29	57	14	7	72	72	29
F. Lumbriculidae										
<i>Lumbriculus</i>	0	0	0	0	14	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
F. Lebertiidae										
<i>Lebertia</i>	0	0	0	0	0	0	0	0	7	0
F. Sperchonidae										
<i>Sperchon</i>	4	7	0	0	14	0	29	7	0	29
SEED SHRIMPS										
Cl. Ostracoda	4	0	50	14	14	57	36	29	36	7
SPRINGTAILS										
Cl. Entognatha										
O. Collembola	4	0	0	0	14	14	14	0	7	14
INSECTS										
Cl. Insecta										
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
<i>Acentrella feropagus</i>	22	36	36	0	0	0	0	14	0	0
CADDISFLIES										
O. Trichoptera										
F. Limnephilidae										
immature	0	0	0	0	0	0	0	0	0	0
TRUE FLIES										
O. Diptera										
BITING-MIDGE										
F. Ceratopogonidae										
<i>Probezzia</i>	0	0	0	0	0	0	0	0	0	0
MIDGES										
F. Chironomidae										
chironomid pupae	11	14	0	0	29	43	0	29	43	29
S.F. Chironominae										
<i>Cladotanytarsus</i>	0	0	0	0	0	43	0	7	0	7
<i>Micropsectra</i>	22	0	0	0	0	0	7	0	0	0
<i>Paratanytarsus</i>	0	0	14	0	0	29	50	50	57	36
<i>Rheotanytarsus</i>	0	0	0	0	0	0	0	0	0	0
<i>Stempellina</i>	0	0	0	0	0	14	7	0	0	0
<i>Stictochironomus</i>	0	7	0	0	0	0	0	0	7	0
<i>Tanytarsus</i>	0	0	0	0	0	43	7	22	36	7
S.F. Diamesinae										
<i>Diamesa</i>	0	0	0	0	0	0	0	0	0	0
<i>Pseudokiefferiella</i>	22	14	0	0	1,145	0	0	7	7	0
S.F. Orthoclaadiinae										
<i>Chaetocladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Corynoneura</i>	7	0	0	14	50	14	0	0	0	0
<i>Cricotopus</i>	36	158	251	215	782	201	179	431	165	545
<i>Cricotopus/Orthocladus</i>	50	86	79	301	104	100	0	65	22	100
<i>Diplocladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Doncricotopus</i>	0	0	0	0	0	0	0	0	14	14
<i>Eukiefferiella</i>	0	108	0	0	1,302	0	0	0	0	0
<i>Hydrobaenus</i>	305	309	556	1091	416	0	0	0	0	0
<i>Krenosmittia</i>	0	0	0	0	0	0	0	0	0	0
? <i>Limnophyes</i>	7	7	54	0	0	0	0	0	0	7
<i>Metriocnemus</i>	0	0	0	0	0	0	0	0	7	0
<i>Orthocladus (Euorthocladus)</i>	370	395	413	172	1,302	0	0	43	0	0
<i>Parakiefferiella</i>	0	0	0	0	0	29	50	0	7	7
<i>Paraphaenocladus</i>	0	0	0	14	0	0	0	0	0	0
<i>Psectrocladius</i>	0	0	0	0	0	14	7	0	0	7
<i>Pseudosmittia</i>	0	7	25	14	50	545	187	266	93	187

Table E.12: Benthic invertebrate community data for Sheardown Lake Tributary 1 reaches 4 and 2, August 2015. Densities expressed in number of organisms per square metre.

Station Replicate	Sheardown Tributary 1 - Reach 4					Sheardown Tributary 1 - Reach 2				
	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
<i>Rheocricotopus</i>	22	0	0	14	0	0	0	0	0	0
<i>Synorthocladius</i>	0	0	14	0	0	0	0	0	0	0
<i>Tokunagaia</i>	57	22	14	29	0	29	0	0	0	0
<i>Tvetenia</i>	7	0	14	0	50	0	0	7	29	43
indeterminate	0	0	0	0	782	14	0	0	0	0
S.F. Podonominae										
<i>Trichotanytus</i>	7	7	0	43	0	0	0	0	0	0
S.F. Tanypodinae										
<i>Thienemannimyia</i> complex	0	0	0	0	0	115	100	57	50	122
F. Empididae										
<i>Clinocera</i>	0	0	7	0	0	0	0	0	0	7
pupae	0	0	0	0	0	14	7	0	14	0
F. Muscidae	0	0	0	0	0	0	0	0	0	0
F. Simuliidae										
<i>Gymnopsis</i>	0	0	0	0	0	0	0	0	0	0
<i>Metacnephia borealis</i>	0	0	0	0	0	0	0	0	0	0
<i>Prosimulium</i>	0	0	0	0	0	0	0	0	0	0
<i>Simulium baffinense</i>	0	0	0	0	0	29	7	0	14	7
pupae	0	0	0	0	0	0	0	0	0	0
F. Tipulidae										
<i>Tipula</i>	57	50	57	0	47	18	29	32	93	36
Number of Organisms (No. organisms per m²)	1,061	1,277	1,764	2,180	6,445	1,379	723	1,188	823	1,305
Richness (total number of taxa)^a	19	16	16	13	16	18	16	16	20	20
Simpson's Evenness (E)	0.821	0.864	0.867	0.761	0.876	0.830	0.892	0.843	0.944	0.813
Bray-Curtis Index	0.263	0.196	0.094	0.351	0.628	0.736	0.782	0.632	0.684	0.670
Percent Composition										
% Nemata	1.0%	0.5%	8.2%	10.6%	4.2%	0.0%	0.0%	4.2%	5.2%	5.0%
% Oligochaeta	3.4%	3.4%	2.0%	1.3%	1.1%	1.0%	1.0%	6.1%	8.7%	2.2%
% Hydracarina	0.4%	0.5%	0.0%	0.0%	0.2%	0.0%	4.0%	0.6%	0.9%	2.2%
% Chironomids	87.0%	88.8%	81.3%	87.5%	93.3%	89.4%	82.2%	82.8%	65.2%	85.1%
% Metal Sensitive Chironomids	4.1%	1.1%	0.8%	0.0%	17.8%	9.4%	9.8%	7.2%	12.2%	3.8%
% Tipulidae	5.4%	3.9%	3.2%	0.0%	0.7%	1.3%	4.0%	2.7%	11.3%	2.8%
Functional Feeding Group Composition										
% Shredders	13.5%	23.0%	21.9%	23.7%	14.5%	23.1%	28.8%	44.4%	34.0%	52.2%
% Scrapers	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Collector - Gatherers	84.1%	76.4%	76.9%	76.3%	85.3%	57.1%	42.6%	43.5%	44.3%	31.3%
% Filterers	2.1%	0.0%	0.8%	0.0%	0.0%	10.4%	9.8%	6.6%	13.0%	4.4%
Mode of Existence Composition										
% Clingers	10.6%	19.7%	19.1%	23.7%	14.0%	29.1%	33.6%	44.2%	31.3%	53.3%
% Sprawlers	79.3%	72.0%	67.5%	64.4%	79.8%	64.5%	59.5%	42.3%	40.8%	35.2%
% Burrowers	9.8%	8.4%	13.4%	11.9%	6.1%	5.4%	5.0%	13.6%	27.0%	10.5%

^a Bold entries excluded from taxa count

Table E.13: Benthic invertebrate community data for SDLT1 Reach 1 and SDLT12 Downstream, August 2015.
Densities expressed in number of organisms per square metre.

Station Replicate	Sheardown Tributary 1 - Reach 1					Sheardown Tributary 12 - Downstream		
	B1	B2	B3	B4	B5	B1	B2	B3
ROUNDWORMS								
P. Nemata	7	29	129	22	36	57	7	0
ANNELIDS								
P. Annelida								
WORMS								
Cl. Oligochaeta								
F. Enchytraeidae	0	215	129	7	61	431	273	65
F. Lumbriculidae								
<i>Lumbriculus</i>	72	0	0	0	0	0	0	0
ARTHROPODS								
P. Arthropoda								
MITES								
Cl. Arachnida								
O. Acarina								
F. Lebertiidae								
<i>Lebertia</i>	0	0	0	7	0	0	0	0
F. Sperchonidae								
<i>Sperchon</i>	11	22	100	22	22	0	0	0
SEED SHRIMPS								
Cl. Ostracoda	4	0	14	0	0	0	0	0
SPRINGTAILS								
Cl. Entognatha								
O. Collembola	11	0	0	0	4	0	0	11
INSECTS								
Cl. Insecta								
MAYFLIES								
O. Ephemeroptera								
F. Baetidae								
<i>Acentrella feropagus</i>	0	0	0	0	0	0	0	0
CADDISFLIES								
O. Trichoptera								
F. Limnephilidae								
immature	0	0	0	0	0	0	0	0
TRUE FLIES								
O. Diptera								
BITING-MIDGE								
F. Ceratopogonidae								
<i>Probezzia</i>	0	0	0	0	0	0	0	0
MIDGES								
F. Chironomidae								
chironomid pupae	0	57	43	36	7	14	7	0
S.F. Chironominae								
<i>Cladotanytarsus</i>	0	0	0	0	0	0	0	0
<i>Micropsectra</i>	7	7	29	0	0	0	0	0
<i>Paratanytarsus</i>	0	14	14	0	4	0	0	0
<i>Rheotanytarsus</i>	0	22	29	22	7	0	0	0
<i>Stempellina</i>	0	0	0	0	0	0	0	0
<i>Stictochironomus</i>	0	0	14	0	0	0	0	0
<i>Tanytarsus</i>	0	0	0	0	11	0	0	0
S.F. Diamesinae								
<i>Diamesa</i>	0	0	0	0	0	0	0	0
<i>Pseudokiefferiella</i>	4	36	0	0	11	0	22	0
S.F. Orthoclaadiinae								
<i>Chaetocladius</i>	7	0	0	0	11	201	50	4
<i>Corynoneura</i>	0	0	0	0	0	29	7	4
<i>Cricotopus</i>	47	215	187	108	86	0	0	61
<i>Cricotopus/Orthoclaadius</i>	11	0	29	0	22	100	50	22
<i>Diploccladius</i>	0	0	0	0	0	57	144	104
<i>Doncricotopus</i>	0	0	0	0	0	0	0	0
<i>Eukiefferiella</i>	0	0	0	0	0	0	0	25
<i>Hydrobaenus</i>	0	0	0	0	0	0	0	0
<i>Krenosmittia</i>	0	0	0	0	4	0	0	4
? <i>Limnophyes</i>	4	0	14	0	0	72	7	0
<i>Metriocnemus</i>	7	0	0	0	7	72	36	0
<i>Orthoclaadius (Euorthoclaadius)</i>	0	0	0	0	0	0	0	0
<i>Parakiefferiella</i>	14	0	201	0	25	0	0	0
<i>Paraphaenoclaadius</i>	0	0	0	7	0	57	7	0
<i>Psectrocladius</i>	0	0	0	0	0	0	0	0
<i>Pseudosmittia</i>	86	65	459	208	111	29	7	0

Table E.13: Benthic invertebrate community data for SDLT1 Reach 1 and SDLT12 Downstream, August 2015.
Densities expressed in number of organisms per square metre.

Station Replicate	Sheardown Tributary 1 - Reach 1					Sheardown Tributary 12 - Downstream		
	B1	B2	B3	B4	B5	B1	B2	B3
<i>Rheocricotopus</i>	0	7	0	0	0	0	0	0
<i>Synorthocladius</i>	0	0	0	0	0	0	0	0
<i>Tokunagaia</i>	4	0	0	0	18	187	22	11
<i>Tvetenia</i>	14	43	14	0	11	0	0	0
indeterminate	7	0	29	7	0	100	79	4
S.F. Podonominae								
<i>Trichotanypus</i>	0	0	0	0	0	0	0	0
S.F. Tanypodinae								
<i>Thienemannimyia</i> complex	4	14	72	22	29	0	0	0
F. Empididae								
<i>Clinocera</i>	4	0	0	0	0	0	0	0
pupae	0	0	0	0	0	0	0	0
F. Muscidae	0	0	0	0	0	0	0	0
F. Simuliidae								
<i>Gymnopaia</i>	0	0	0	0	0	0	0	0
<i>Metacnephia borealis</i>	0	0	0	0	0	0	0	0
<i>Prosimulium</i>	0	0	0	0	0	0	0	0
<i>Simulium baffinense</i>	0	0	0	0	0	0	0	0
pupae	0	0	0	0	4	0	0	0
F. Tipulidae								
<i>Tipula</i>	11	0	43	7	14	57	14	14
Number of Organisms (No. organisms per m²)	336	746	1,549	475	505	1,463	732	329
Richness (total number of taxa)^a	19	12	16	10	20	12	13	11
Simpson's Evenness (E)	0.899	0.860	0.896	0.758	0.932	0.924	0.842	0.887
Bray-Curtis Index	0.874	0.722	0.686	0.827	0.755	-	-	-
Percent Composition								
% Nemata	2.1%	3.9%	8.3%	4.6%	7.1%	3.9%	1.0%	0.0%
% Oligochaeta	21.4%	28.8%	8.3%	1.5%	12.1%	29.5%	37.3%	19.8%
% Hydracarina	3.3%	2.9%	6.5%	6.1%	4.4%	0.0%	0.0%	0.0%
% Chironomids	64.3%	64.3%	73.2%	86.3%	72.1%	62.7%	59.8%	72.6%
% Metal Sensitive Chironomids	3.3%	10.6%	4.6%	4.6%	7.3%	0.0%	3.0%	1.2%
% Tipulidae	3.3%	0.0%	2.8%	1.5%	2.8%	3.9%	1.9%	4.3%
Functional Feeding Group Composition								
% Shredders	20.5%	28.8%	16.7%	24.2%	24.2%	10.7%	8.7%	29.5%
% Scrapers	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Collector - Gatherers	71.7%	60.6%	67.5%	60.4%	60.6%	89.3%	91.3%	70.5%
% Filterers	2.1%	5.8%	4.6%	4.6%	5.1%	0.0%	0.0%	0.0%
Mode of Existence Composition								
% Clingers	23.8%	35.7%	24.1%	33.5%	30.1%	6.8%	6.8%	25.2%
% Sprawlers	44.0%	31.6%	55.5%	58.9%	45.7%	51.0%	48.1%	47.4%
% Burrowers	28.9%	32.7%	20.3%	7.6%	23.4%	42.2%	45.1%	24.0%

^a Bold entries excluded from taxa count

Table E.14: Benthic invertebrate community data for Sheardown Lake Tributary 9 Upstream, August 2015.
Densities expressed in number of organisms per square metre.

Station Replicate	Sheardown Tributary 9 - Upstream				
	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	29	97	158	72	316
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	14	4	14	29	29
F. Lumbriculidae					
<i>Lumbriculus</i>	0	0	0	0	0
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
F. Lebertiidae					
<i>Lebertia</i>	0	0	0	0	0
F. Sperchonidae					
<i>Sperchon</i>	50	115	72	43	57
SEED SHRIMPS					
Cl. Ostracoda	43	18	43	57	0
SPRINGTAILS					
Cl. Entognatha					
O. Collembola	43	11	14	0	14
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
<i>Acentrella feropagus</i>	0	32	29	0	0
CADDISFLIES					
O. Trichoptera					
F. Limnephilidae					
immature	0	4	14	0	0
TRUE FLIES					
O. Diptera					
BITING-MIDGE					
F. Ceratopogonidae					
<i>Probezzia</i>	0	4	0	0	0
MIDGES					
F. Chironomidae					
chironomid pupae	86	29	273	201	215
S.F. Chironominae					
<i>Cladotanytarsus</i>	0	0	0	0	0
<i>Micropsectra</i>	0	7	0	0	0
<i>Paratanytarsus</i>	7	0	0	29	0
<i>Rheotanytarsus</i>	0	0	0	0	0
<i>Stempellina</i>	0	0	0	0	0
<i>Stictochironomus</i>	0	0	0	0	0
<i>Tanytarsus</i>	0	0	0	0	0
S.F. Diamesinae					
<i>Diamesa</i>	0	0	25	0	0
<i>Pseudokiefferiella</i>	0	0	126	0	14
S.F. Orthoclaadiinae					
<i>Chaetocladius</i>	7	0	108	0	0
<i>Corynoneura</i>	0	22	25	0	14
<i>Cricotopus</i>	574	165	79	348	0
<i>Cricotopus/Orthocladus</i>	266	169	269	161	502
<i>Diplocladius</i>	7	22	0	0	0
<i>Doncricotopus</i>	0	0	0	0	0
<i>Eukiefferiella</i>	0	0	108	0	0
<i>Hydrobaenus</i>	0	0	0	0	0
<i>Krenosmittia</i>	43	32	161	108	57
? <i>Limnophyes</i>	7	14	0	563	0
<i>Metriocnemus</i>	0	22	212	54	72
<i>Orthocladus (Euorthocladus)</i>	0	0	108	0	0
<i>Parakiefferiella</i>	0	0	0	0	0
<i>Paraphaenocladus</i>	0	0	0	0	0
<i>Psectrocladius</i>	0	0	0	0	0
<i>Pseudosmittia</i>	7	0	212	398	273

Table E.14: Benthic invertebrate community data for Sheardown Lake Tributary 9 Upstream, August 2015.
Densities expressed in number of organisms per square metre.

Station Replicate	Sheardown Tributary 9 - Upstream				
	B1	B2	B3	B4	B5
<i>Rheocricotopus</i>	0	0	0	0	0
<i>Synorthocladius</i>	0	0	0	0	0
<i>Tokunagaia</i>	0	22	427	0	230
<i>Tvetenia</i>	50	32	161	79	158
indeterminate	115	100	531	0	416
S.F. Podonominae					
<i>Trichotanypus</i>	50	14	0	29	14
S.F. Tanypodinae					
<i>Thienemannimyia</i> complex	7	0	25	0	0
F. Empididae					
<i>Clinocera</i>	0	0	14	14	0
pupae	0	0	0	14	0
F. Muscidae	29	0	0	0	0
F. Simuliidae					
<i>Gymnopais</i>	0	11	14	0	0
<i>Metacnephia borealis</i>	7	22	86	0	0
<i>Prosimulium</i>	0	7	0	0	0
<i>Simulium baffinense</i>	7	0	0	0	0
pupae	0	0	0	0	0
F. Tipulidae					
<i>Tipula</i>	144	25	201	29	25
Number of Organisms (No. organisms per m²)	1,592	1,000	3,509	2,228	2,406
Richness (total number of taxa)^a	20	23	25	15	14
Simpson's Evenness (E)	0.795	0.919	0.958	0.896	0.889
Bray-Curtis Index	-	-	-	-	-
Percent Composition					
% Nemata	1.8%	9.7%	4.5%	3.2%	13.1%
% Oligochaeta	0.9%	0.4%	0.4%	1.3%	1.2%
% Hydracarina	3.1%	11.5%	2.1%	1.9%	2.4%
% Chironomids	77.0%	65.0%	81.2%	88.4%	81.7%
% Metal Sensitive Chironomids	3.1%	3.9%	8.9%	6.1%	3.0%
% Tipulidae	9.0%	2.5%	5.7%	1.3%	1.0%
Functional Feeding Group Composition					
% Shredders	61.8%	36.3%	16.0%	24.1%	21.9%
% Scrapers	0.0%	0.0%	0.0%	0.0%	0.0%
% Collector - Gatherers	31.5%	47.1%	77.9%	71.4%	75.7%
% Filterers	1.3%	4.7%	2.8%	1.3%	0.0%
Mode of Existence Composition					
% Clingers	56.8%	49.6%	15.2%	26.0%	23.2%
% Sprawlers	26.9%	34.1%	67.7%	65.7%	57.8%
% Burrowers	13.6%	15.2%	16.7%	8.3%	18.4%

^a Bold entries excluded from taxa count

Table E.15: Benthic invertebrate community summary statistics for the Sheardown Lake tributaries, Mary River Project CREMP, August 2015.

Metric	Area	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Density (no. organisms / m ²)	Tributary 1 - Reach 4	5	2,545	2,223	994	-215	5,305	1,061	6,445
	Tributary 1 - Reach 2	5	1,084	294	131	719	1,448	723	1,379
	Tributary 1 - Reach 1	5	722	485	217	120	1,325	336	1,549
	Tributary 12 - Downstream	3	841	575	332	-587	2,269	329	1,463
	Tributary 9 - Upstream	5	2,147	942	421	977	3,317	1,000	3,509
Richness (Number of Taxa)	Tributary 1 - Reach 4	5	16	2	1	13	19	13	19
	Tributary 1 - Reach 2	5	18	2	1	16	20	16	20
	Tributary 1 - Reach 1	5	15	4	2	10	21	10	20
	Tributary 12 - Downstream	3	12	1	1	10	14	11	13
	Tributary 9 - Upstream	5	19	5	2	13	25	14	25
Simpson's Evenness	Tributary 1 - Reach 4	5	0.838	0.048	0.021	0.778	0.897	0.761	0.876
	Tributary 1 - Reach 2	5	0.864	0.053	0.024	0.798	0.931	0.813	0.944
	Tributary 1 - Reach 1	5	0.869	0.067	0.030	0.786	0.952	0.758	0.932
	Tributary 12 - Downstream	3	0.884	0.041	0.024	0.782	0.987	0.842	0.924
	Tributary 9 - Upstream	5	0.892	0.060	0.027	0.817	0.967	0.795	0.958
Bray-Curtis Index	Tributary 1 - Reach 4	5	0.306	0.203	0.091	0.054	0.558	0.094	0.628
	Tributary 1 - Reach 2	5	0.701	0.059	0.026	0.627	0.774	0.632	0.782
	Tributary 1 - Reach 1	5	0.773	0.077	0.034	0.678	0.868	0.686	0.874
	Tributary 12 - Downstream	0	.	.	.	.	.	.	.
	Tributary 9 - Upstream	0	.	.	.	.	.	.	.
Nemata (% of community)	Tributary 1 - Reach 4	5	4.9%	4.4%	2.0%	-0.5%	10.4%	0.5%	10.6%
	Tributary 1 - Reach 2	5	2.9%	2.7%	1.2%	-0.4%	6.2%	0.0%	5.2%
	Tributary 1 - Reach 1	5	5.2%	2.5%	1.1%	2.1%	8.3%	2.1%	8.3%
	Tributary 12 - Downstream	3	1.6%	2.0%	1.2%	-3.4%	6.7%	0.0%	3.9%
	Tributary 9 - Upstream	5	6.5%	4.8%	2.1%	0.6%	12.4%	1.8%	13.1%
Oligochaeta (% of community)	Tributary 1 - Reach 4	5	2.2%	1.1%	0.5%	0.9%	3.6%	1.1%	3.4%
	Tributary 1 - Reach 2	5	3.8%	3.5%	1.5%	-0.5%	8.1%	1.0%	8.7%
	Tributary 1 - Reach 1	5	14.4%	10.8%	4.8%	1.0%	27.8%	1.5%	28.8%
	Tributary 12 - Downstream	3	28.8%	8.8%	5.1%	7.0%	50.7%	19.8%	37.3%
	Tributary 9 - Upstream	5	0.8%	0.4%	0.2%	0.3%	1.4%	0.4%	1.3%
Hydracarina (% of community)	Tributary 1 - Reach 4	5	0.2%	0.2%	0.1%	-0.1%	0.5%	0.0%	0.5%
	Tributary 1 - Reach 2	5	1.5%	1.6%	0.7%	-0.5%	3.5%	0.0%	4.0%
	Tributary 1 - Reach 1	5	4.6%	1.6%	0.7%	2.6%	6.6%	2.9%	6.5%
	Tributary 12 - Downstream	3	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Tributary 9 - Upstream	5	4.2%	4.1%	1.8%	-0.9%	9.3%	1.9%	11.5%
Chironomidae (% of community)	Tributary 1 - Reach 4	5	87.6%	4.3%	1.9%	82.2%	92.9%	81.3%	93.3%
	Tributary 1 - Reach 2	5	81.0%	9.2%	4.1%	69.5%	92.4%	65.2%	89.4%
	Tributary 1 - Reach 1	5	72.0%	9.0%	4.0%	60.9%	83.2%	64.3%	86.3%
	Tributary 12 - Downstream	3	65.1%	6.7%	3.9%	48.4%	81.8%	59.8%	72.6%
	Tributary 9 - Upstream	5	78.7%	8.7%	3.9%	67.9%	89.4%	65.0%	88.4%
Metal Sensitive Chironomidae (% of community)	Tributary 1 - Reach 4	5	4.8%	7.4%	3.3%	-4.5%	14.0%	0.0%	17.8%
	Tributary 1 - Reach 2	5	8.5%	3.1%	1.4%	4.6%	12.4%	3.8%	12.2%
	Tributary 1 - Reach 1	5	6.1%	2.9%	1.3%	2.5%	9.7%	3.3%	10.6%
	Tributary 12 - Downstream	3	1.4%	1.5%	0.9%	-2.3%	5.2%	0.0%	3.0%
	Tributary 9 - Upstream	5	5.0%	2.5%	1.1%	1.9%	8.1%	3.0%	8.9%
Tipulidae (% of community)	Tributary 1 - Reach 4	5	2.6%	2.2%	1.0%	-0.1%	5.4%	0.0%	5.4%
	Tributary 1 - Reach 2	5	4.4%	4.0%	1.8%	-0.5%	9.3%	1.3%	11.3%
	Tributary 1 - Reach 1	5	2.1%	1.3%	0.6%	0.4%	3.7%	0.0%	3.3%
	Tributary 12 - Downstream	3	3.4%	1.3%	0.7%	0.2%	6.5%	1.9%	4.3%
	Tributary 9 - Upstream	5	3.9%	3.4%	1.5%	-0.3%	8.2%	1.0%	9.0%
Shredders (% of community)	Tributary 1 - Reach 4	5	19.3%	4.9%	2.2%	13.2%	25.4%	13.5%	23.7%
	Tributary 1 - Reach 2	5	36.5%	11.8%	5.3%	21.9%	51.1%	23.1%	52.2%
	Tributary 1 - Reach 1	5	22.9%	4.5%	2.0%	17.3%	28.5%	16.7%	28.8%
	Tributary 12 - Downstream	3	16.3%	11.4%	6.6%	-12.1%	44.7%	8.7%	29.5%
	Tributary 9 - Upstream	5	32.0%	18.2%	8.1%	9.4%	54.6%	16.0%	61.8%
Collector-Gatherers (% of community)	Tributary 1 - Reach 4	5	79.8%	4.5%	2.0%	74.2%	85.4%	76.3%	85.3%
	Tributary 1 - Reach 2	5	43.8%	9.1%	4.1%	32.4%	55.1%	31.3%	57.1%
	Tributary 1 - Reach 1	5	64.2%	5.2%	2.3%	57.7%	70.6%	60.4%	71.7%
	Tributary 12 - Downstream	3	83.7%	11.4%	6.6%	55.3%	112.1%	70.5%	91.3%
	Tributary 9 - Upstream	5	60.7%	20.5%	9.2%	35.3%	86.1%	31.5%	77.9%
Filterers (% of community)	Tributary 1 - Reach 4	5	0.6%	0.9%	0.4%	-0.6%	1.7%	0.0%	2.1%
	Tributary 1 - Reach 2	5	8.9%	3.4%	1.5%	4.7%	13.1%	4.4%	13.0%
	Tributary 1 - Reach 1	5	4.5%	1.4%	0.6%	2.7%	6.2%	2.1%	5.8%
	Tributary 12 - Downstream	3	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Tributary 9 - Upstream	5	2.0%	1.8%	0.8%	-0.2%	4.3%	0.0%	4.7%
Clingers (% of community)	Tributary 1 - Reach 4	5	17.4%	5.1%	2.3%	11.0%	23.8%	10.6%	23.7%
	Tributary 1 - Reach 2	5	38.3%	10.2%	4.5%	25.7%	50.9%	29.1%	53.3%
	Tributary 1 - Reach 1	5	29.4%	5.4%	2.4%	22.8%	36.1%	23.8%	35.7%
	Tributary 12 - Downstream	3	13.0%	10.6%	6.1%	-13.4%	39.3%	6.8%	25.2%
	Tributary 9 - Upstream	5	34.2%	18.0%	8.0%	11.8%	56.5%	15.2%	56.8%
Sprawlers (% of community)	Tributary 1 - Reach 4	5	72.6%	6.9%	3.1%	64.0%	81.1%	64.4%	79.8%
	Tributary 1 - Reach 2	5	48.4%	12.8%	5.7%	32.6%	64.3%	35.2%	64.5%
	Tributary 1 - Reach 1	5	47.2%	10.7%	4.8%	33.8%	60.5%	31.6%	58.9%
	Tributary 12 - Downstream	3	48.8%	1.9%	1.1%	44.1%	53.6%	47.4%	51.0%
	Tributary 9 - Upstream	5	50.5%	18.7%	8.4%	27.2%	73.7%	26.9%	67.7%
Burrowers (% of community)	Tributary 1 - Reach 4	5	9.9%	2.9%	1.3%	6.3%	13.5%	6.1%	13.4%
	Tributary 1 - Reach 2	5	12.3%	9.0%	4.0%	1.2%	23.4%	5.0%	27.0%
	Tributary 1 - Reach 1	5	22.6%	9.7%	4.3%	10.6%	34.6%	7.6%	32.7%
	Tributary 12 - Downstream	3	37.1%	11.4%	6.6%	8.7%	65.5%	24.0%	45.1%
	Tributary 9 - Upstream	5	14.4%	3.9%	1.7%	9.6%	19.2%	8.3%	18.4%

Table E.16: Statistical comparison of benthic invertebrate communitiy endpoints among Sheardown Lake Tributary 1 (SDLT1) upper (Reach 4), middle (Reach 2) and lower (Reach 1) benthic invertebrate community study areas, Mary River Project CREMP, August 2015.

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons ^a					
	Significant Difference Among Areas?	p-value	Staistical Test ^b	(I) Area	(J) Area	Significant Difference Between 2 Areas?	p-value	Magnitude of Difference	Statistical Test
Density (individuals/m2)	YES	0.01859	ANOVA ^d	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	NO	0.1907	-	Tukey's ^d
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0146	-0.8	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.3295	-	
Richness (number of taxa)	NO	0.39040	ANOVA ^c	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	NO	0.5622	-	Tukey's ^c
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	NO	0.9472	-	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.3898	-	
Simpson's Evenness ('E)	NO	0.65145	ANOVA ^c	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	NO	0.7419	-	Tukey's ^c
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	NO	0.6671	-	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.9912	-	
Bray-Curtis Index	YES	0.00020	ANOVA ^c	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0012	1.9	Tukey's ^c
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0003	2.3	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.6625	-	
Oligochaeta (% of community)	YES	0.03618	ANOVA ^e	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	NO	0.8986	-	Tukey's ^e
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0417	11.2	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	YES	0.0899	3.1	
Chironomidae (% of community)	YES	0.02519	ANOVA ^e	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	NO	0.3154	-	Tukey's ^e
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0198	-3.6	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.2582	-	
Metal-Sensitive Chironomidae (% of community)	NO	0.12207	ANOVA ^e	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	NO	0.1307	-	Tukey's ^e
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	NO	0.2347	-	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.9260	-	
Shredder FFG (% of community)	YES	0.01004	ANOVA ^e	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0096	3.5	Tukey's ^e
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	NO	0.6238	-	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	YES	0.0522	-1.2	
Collector-Gatherer FFG (% of community)	YES	0.00001	ANOVA ^f	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0000	-8.0	Tukey's ^g
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0038	-3.5	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	YES	0.0024	2.2	
Filterer FFG (% of community)	YES	0.00076	ANOVA ^f	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0397	9.1	Tamhane's ^g
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0715	4.3	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	YES	0.0982	-1.3	
Clinger HPG (% of community)	YES	0.00143	ANOVA ^e	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0012	4.1	Tukey's ^e
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0231	2.3	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.2438	-	
Sprawler HPG (% of community)	YES	0.00286	ANOVA ^e	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	YES	0.0071	-3.5	Tukey's ^e
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	YES	0.0051	-3.7	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.9801	-	
Burrower HPG (% of community)	YES	0.08312	ANOVA ^e	SDLT-1-R4 (Reach 4)	SDLT-1-R2 (Reach 2)	NO	0.9749	-	Tukey's ^e
				SDLT-1-R4 (Reach 4)	SDLT-1-R1 (Reach 1)	NO	0.1027	-	
				SDLT-1-R2 (Reach 2)	SDLT-1-R1 (Reach 1)	NO	0.1462	-	

^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 Data normally distributed. Untransformed data used for comparison(s).

^d Data non-normally distributed. Log transformation resulted in normal distribution, and thus the log transformed data used for comparison(s).

^e Logit transformed data were normally distributed. Parametric statistics applied.

^f Logit transformed data were non-normally distributed for data from at least one study area. ANOVA statistics for multiple group comparison were confirmed using KW H-test statistics.

^g Logit transformed data were non-normally distributed for data from at least one study area. Post hoc statistics for pair-wise comparisons were confirmed using MW U-test statistics.

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 E.17: Replicate grab data for benthic invertebrate community samples collected at the Mary River, Mary River Project CREMP, August 2015.

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	8	6	7	0.29	0.26	0.26	5.2	4.7	4.7	50%	50%	50%
	GO-09 B2	8	9	10	0.26	0.29	0.30	6.0	5.5	6.4	25%	25%	25%
	GO-09 B3	13	8	10	0.22	0.22	0.25	7.6	4.9	5.9	25%	25%	25%
	GO-09 B4	15	15	17	0.30	0.28	0.27	7.2	5.5	7.0	25%	25%	25%
	GO-09 B5	19	21	18	0.24	0.26	0.24	7.3	8.8	6.5	25%	25%	25%
Mary River Upstream	GO-03 B1	20	15	16	0.23	0.27	0.24	8.5	4.6	5.0	25%	25%	25%
	GO-03 B2	22	17	18	0.30	0.28	0.24	6.0	7.0	6.9	25%	25%	25%
	GO-03 B3	12	14	15	0.29	0.20	0.21	6.5	5.3	5.1	38%	38%	25%
	GO-03 B4	19	19	17	0.26	0.19	0.20	7.0	6.4	6.1	25%	25%	25%
	GO-03 B5	13	15	17	0.20	0.24	0.29	5.1	6.8	5.6	25%	25%	25%
Mary River	EO-01 B1	15	16	14	0.24	0.25	0.18	5.6	6.5	5.6	25%	25%	25%
	EO-01 B2	19	11	15	0.16	0.18	0.23	6.5	5.1	6.0	25%	25%	25%
	EO-01 B3	13	14	14	0.22	0.29	0.32	5.6	5.1	5.7	50%	50%	50%
	EO-01 B4	15	18	19	0.25	0.26	0.29	5.7	6.6	5.3	50%	25%	50%
	EO-01 B5	18	18	17	0.27	0.27	0.23	6.2	6.1	6.0	25%	25%	25%
Mary River	EO-20 B1	19	17	15	0.23	0.26	0.29	5.7	6.7	5.0	50%	50%	50%
	EO-20 B2	13	19	17	0.23	0.24	0.24	5.3	5.3	5.1	50%	50%	50%
	EO-20 B3	17	16	17	0.24	0.27	0.27	6.8	6.2	6.1	50%	50%	50%
	EO-20 B4	21	11	15	0.23	0.19	0.26	5.8	5.0	4.2	50%	50%	50%
	EO-20 B5	14	14	17	0.26	0.27	0.23	4.5	5.1	6.0	50%	50%	50%
Mary River Downstream	CO-05 B1	7	8	11	0.33	0.22	0.25	5.7	5.0	5.5	13%	13%	13%
	CO-05 B2	17	13	7	0.25	0.27	0.29	5.7	4.6	5.6	13%	13%	13%
	CO-05 B3	14	8	8	0.22	0.31	0.21	4.8	5.4	6.2	13%	13%	13%
	CO-05 B4	9	11	9	0.22	0.21	0.25	5.5	5.9	7.4	13%	13%	13%
	CO-05 B5	10	8	12	0.28	0.26	0.26	4.8	5.7	5.6	13%	13%	13%

^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 E.18: Statistical comparison of sampling station physical habitat features among Mary River benthic invertebrate community study areas, Mary River Project CREMP, August 2015.

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
Depth (cm)	YES	0.00364	ANOVA ^c	GO-09	GO-3	NO	0.7699	Tamhane's ^c
				GO-09	EO-01	NO	0.9049	
				GO-09	EO-20	NO	0.8358	
				GO-09	CO-05	NO	0.9949	
				GO-03	EO-01	NO	0.9992	
				GO-03	EO-20	NO	1.0000	
				GO-03	CO-05	YES	0.0109	
				EO-01	EO-20	NO	1.0000	
				EO-01	CO-05	YES	0.0051	
Water Velocity (m/s)	NO	0.61922	ANOVA ^c	EO-20	CO-05	YES	0.0009	Tukey's ^c
				GO-09	GO-3	NO	0.6761	
				GO-09	EO-01	NO	0.6761	
				GO-09	EO-20	NO	0.8431	
				GO-09	CO-05	NO	0.9876	
				GO-03	EO-01	NO	1.0000	
				GO-03	EO-20	NO	0.9978	
				GO-03	CO-05	NO	0.9139	
				EO-01	EO-20	NO	0.9978	
Substrate Diameter (cm)	NO	0.23533	ANOVA ^d	EO-01	CO-05	NO	0.9139	Tukey's ^c
				EO-20	CO-05	NO	0.9829	
				GO-09	GO-3	NO	0.9994	
				GO-09	EO-01	NO	0.8496	
				GO-09	EO-20	NO	0.3598	
				GO-09	CO-05	NO	0.3939	
				GO-03	EO-01	NO	0.9331	
				GO-03	EO-20	NO	0.4826	
				GO-03	CO-05	NO	0.5212	
Embeddedness (%)	YES	0.00000	ANOVA ^d	EO-01	EO-20	NO	0.9035	Tamhane's ^c
				EO-01	CO-05	NO	0.9254	
				EO-20	CO-05	NO	1.0000	
				GO-09	GO-3	NO	0.9997	
				GO-09	EO-01	NO	1.0000	
				GO-09	EO-20	NO	0.1501	
				GO-09	CO-05	NO	0.2228	
				GO-03	EO-01	NO	0.9646	
				GO-03	EO-20	YES	0.0015	
				GO-03	CO-05	YES	0.0105	
				EO-01	EO-20	NO	0.2932	
				EO-01	CO-05	NO	0.1557	
				EO-20	CO-05	NO	1.0000	

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

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

^c Data normally distributed. Untransformed data used for comparison(s).

^d Data non-normal. ANOVA result confirmed using KW H-test.

Table E.19: Benthic invertebrate community data for Mary River GO9 and GO3 study areas, August 2015.
Densities expressed in number of organisms per square meter.

Station Replicate	Mary River - GO9 Reference					Mary River - GO3 Mine-Exposed				
	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	4	7	0	0	0	0	0	0	0	0
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	14	14	0	0	0	0	0	0	0	4
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
F. Sperchonidae										
<i>Sperchon</i>	11	14	14	7	32	11	18	7	4	11
SPRINGTAILS										
Cl. Entognatha										
O. Collembola	0	0	0	0	0	0	0	0	0	0
INSECTS										
Cl. Insecta										
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
indeterminate	0	0	0	0	0	0	0	0	0	0
STONEFLIES										
O. Plecoptera										
F. Capniidae										
immature	0	0	0	0	4	0	0	0	0	0
TRUE FLIES										
O. Diptera										
indeterminate	0	0	0	0	0	0	0	0	0	0
BITING-MIDGE										
F. Ceratopogonidae										
<i>Culicoides</i>	0	0	0	0	0	0	0	0	0	4
MIDGES										
F. Chironomidae										
chironomid pupae	61	22	11	7	18	25	18	7	4	4
S.F. Chironominae										
<i>Micropsectra</i>	0	0	0	0	0	0	0	0	0	4
<i>Paratanytarsus</i>	0	0	0	0	0	0	0	0	0	0
S.F. Diamesinae										
<i>Diamesa</i>	29	14	14	0	7	4	0	0	0	0
<i>Pseudokiefferiella</i>	29	258	0	0	14	29	18	7	0	0
S.F. Orthoclaadiinae										
<i>Chaetocladius</i>	25	14	0	0	4	11	4	0	0	0
<i>Cardiocladius</i>	0	0	0	0	0	0	0	0	0	4
<i>Corynoneura</i>	0	4	0	4	0	0	14	4	0	0
<i>Cricotopus</i>	0	65	22	72	39	108	25	0	0	11
<i>Cricotopus/Orthoclaadius</i>	0	0	0	0	0	0	7	0	0	0
<i>Diplocladius</i>	0	25	0	0	0	0	0	0	0	0
<i>Eukiefferiella</i>	0	0	0	0	0	0	0	0	0	0
<i>Hydrobaenus</i>	93	61	36	7	14	14	32	11	14	11
<i>Krenosmittia</i>	0	0	0	18	0	4	7	4	0	4
<i>?Limnophyes</i>	0	4	0	0	0	0	4	0	0	0
<i>Metriocnemus</i>	0	11	0	0	0	0	0	0	0	0
<i>Orthoclaadius (Euorthoclaadius)</i>	154	50	43	54	144	0	11	7	0	7

Table E.19: Benthic invertebrate community data for Mary River GO9 and GO3 study areas, August 2015.
Densities expressed in number of organisms per square meter.

Station Replicate	Mary River - GO9 Reference					Mary River - GO3 Mine-Exposed				
	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
<i>Parakiefferiella</i>	0	0	0	0	0	0	0	0	0	0
<i>Paraphaenocladus</i>	0	0	0	0	0	0	0	0	0	0
<i>Pseudosmittia</i>	29	0	4	0	0	4	0	0	0	0
<i>Tokunagaia</i>	187	111	39	61	68	93	29	18	25	22
<i>Tvetenia</i>	7	0	0	0	0	4	0	0	0	0
indeterminate	79	11	4	14	43	0	11	0	0	4
S.F. Podonominae										
<i>Trichotanytus</i>	0	0	0	0	0	0	0	0	0	0
F. Empididae										
indeterminate	0	0	0	0	0	0	0	0	0	0
pupae	0	0	0	0	0	0	0	0	0	0
F. Simuliidae										
<i>Gymnopaia</i>	25	4	0	11	0	0	4	0	0	0
pupae	0	0	0	0	4	0	0	0	0	0
indeterminate larvae	4	0	0	0	0	0	0	0	0	0
F. Tipulidae										
<i>Ormosia</i>	0	0	0	0	0	0	0	0	0	0
<i>Tipula</i>	7	32	18	14	14	50	25	22	14	25
Number of Organisms (No. organisms per m²)	758	721	205	269	405	357	227	87	61	115
Richness (total number of taxa)^a	13	16	8	9	11	11	13	8	4	11
Simpson's Evenness (E)	0.868	0.861	0.953	0.889	0.818	0.855	0.964	0.949	0.896	0.943
Bray-Curtis Index	0.547	0.428	0.215	0.269	0.239	0.404	0.359	0.635	0.659	0.592
Percent Composition										
% Nemata	0.5%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Oligochaeta	1.8%	1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.5%
% Hydracarina	1.5%	1.9%	6.8%	2.6%	7.9%	3.1%	7.9%	8.0%	6.6%	9.6%
% Chironomids	91.4%	90.2%	84.4%	88.1%	86.7%	82.9%	79.3%	66.7%	70.5%	61.7%
% Metal Sensitive Chironomids	7.7%	37.7%	6.8%	6.7%	5.2%	10.4%	11.0%	12.6%	0.0%	7.0%
% Tipulidae	0.9%	4.4%	8.8%	5.2%	3.5%	14.0%	11.0%	25.3%	23.0%	21.7%
Functional Feeding Group Composition										
% Shredders	0.9%	0.13	0.20	0.32	0.14	0.44	0.25	0.25	0.23	0.31
% Scrapers	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Collector - Gatherers	93.8%	84.0%	73.7%	61.3%	77.0%	52.7%	65.2%	66.7%	70.5%	48.7%
% Filterers	3.8%	0.6%	0.0%	4.1%	1.0%	0.0%	1.8%	0.0%	0.0%	3.5%
Habitat Preference Group Composition										
% Clingers	5.3%	11.5%	17.6%	33.5%	18.5%	33.3%	23.8%	8.0%	6.6%	22.6%
% Sprawlers	91.4%	79.6%	73.7%	61.3%	78.0%	52.7%	65.2%	66.7%	70.5%	45.2%
% Burrowers	3.3%	8.9%	8.8%	5.2%	3.5%	14.0%	11.0%	25.3%	23.0%	32.2%

^a Bold entries excluded from taxa count

Table E.21: Benthic invertebrate community data for Mary River CO5 study areas, August 2015.
Densities expressed in number of organisms per square meter.

Station Replicate	Mary River - CO5 Mine-Exposed				
	B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	0	4	22	4	11
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	14	7	47	11	47
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina					
F. Sperchonidae					
<i>Sperchon</i>	4	7	4	0	0
SPRINGTAILS					
Cl. Entognatha					
O. Collembola	0	0	0	0	0
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
indeterminate	0	0	0	0	0
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature	0	0	0	0	4
TRUE FLIES					
O. Diptera					
indeterminate	0	0	4	0	0
BITING-MIDGE					
F. Ceratopogonidae					
<i>Culicoides</i>	0	0	0	0	0
MIDGES					
F. Chironomidae					
chironomid pupae	25	4	0	4	14
S.F. Chironominae					
<i>Micropsectra</i>	0	0	0	0	0
<i>Paratanytarsus</i>	0	0	0	0	4
S.F. Diamesinae					
<i>Diamesa</i>	0	0	0	0	0
<i>Pseudokiefferiella</i>	14	14	18	25	147
S.F. Orthoclaadiinae					
<i>Chaetocladius</i>	0	0	0	0	0
<i>Cardiocladius</i>	0	0	0	0	0
<i>Corynoneura</i>	0	0	4	0	4
<i>Cricotopus</i>	29	4	4	11	39
<i>Cricotopus/Orthocladus</i>	0	0	7	7	0
<i>Diplocladius</i>	0	4	0	0	0
<i>Eukiefferiella</i>	0	0	0	0	0
<i>Hydrobaenus</i>	4	0	18	4	0
<i>Krenosmittia</i>	0	0	0	0	0
<i>?Limnophyes</i>	4	4	79	7	29
<i>Metriocnemus</i>	0	7	4	11	7
<i>Orthocladus (Euorthocladus)</i>	0	0	0	0	0

Table E.21: Benthic invertebrate community data for Mary River CO5 study areas, August 2015.
Densities expressed in number of organisms per square meter.

Station Replicate	Mary River - CO5 Mine-Exposed				
	B1	B2	B3	B4	B5
<i>Parakiefferiella</i>	4	4	18	0	22
<i>Paraphaenocladus</i>	0	0	122	11	25
<i>Pseudosmittia</i>	7	0	18	18	50
<i>Tokunagaia</i>	11	14	4	0	36
<i>Tvetenia</i>	0	4	4	4	4
indeterminate	0	0	0	0	4
S.F. Podonominae					
<i>Trichotanytus</i>	0	0	0	0	0
F. Empididae					
indeterminate	0	0	0	0	0
pupae	0	0	4	0	0
F. Simuliidae					
<i>Gymnopais</i>	0	0	0	0	0
pupae	4	0	0	0	0
indeterminate larvae	0	0	0	0	0
F. Tipulidae					
<i>Ormosia</i>	0	0	0	0	0
<i>Tipula</i>	7	18	0	0	4
Number of Organisms (No. organisms per m²)	127	95	381	117	451
Richness (total number of taxa)^a	11	12	17	11	15
Simpson's Evenness (E)	0.926	0.960	0.877	0.960	0.892
Bray-Curtis Index	0.599	0.714	0.867	0.855	0.735
Percent Composition					
% Nemata	0.0%	4.2%	5.8%	3.4%	2.4%
% Oligochaeta	11.0%	7.4%	12.3%	9.4%	10.4%
% Hydracarina	3.1%	7.4%	1.0%	0.0%	0.0%
% Chironomids	77.2%	62.1%	78.7%	87.2%	85.4%
% Metal Sensitive Chironomids	11.0%	14.7%	4.7%	21.4%	33.5%
% Tipulidae	5.5%	18.9%	0.0%	0.0%	0.9%
Functional Feeding Group Composition					
% Shredders	28.3%	0.23	0.03	0.15	0.10
% Scrapers	0.0%	0.0%	0.0%	0.0%	0.0%
% Collector - Gatherers	65.4%	69.5%	95.0%	84.6%	88.7%
% Filters	3.1%	0.0%	0.0%	0.0%	0.9%
Habitat Preference Group Composition					
% Clingers	29.1%	11.6%	5.0%	15.4%	8.6%
% Sprawlers	54.3%	50.5%	75.9%	62.4%	76.1%
% Burrowers	16.5%	37.9%	19.2%	22.2%	15.3%

^a Bold entries excluded from taxa count

Table E.22: Benthic invertebrate community summary statistics for Mary River, Mary River Project CREMP, August 2015.

Metric	Area	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Density (no. organisms / m ²)	GO-09 Reference	5	472	255	114	155	789	205	758
	GO-03	5	169	122	55	17	321	61	357
	EO-01	5	116	97	43	-4	235	23	278
	EO-20	5	278	146	65	97	459	131	502
	CO-05	5	234	168	75	25	443	95	451
Richness (Number of Taxa)	GO-09 Reference	5	11	3	1	7	15	8	16
	GO-03	5	9	4	2	5	14	4	13
	EO-01	5	8	3	1	4	11	4	10
	EO-20	5	12	2	1	9	14	8	14
	CO-05	5	13	3	1	10	17	11	17
Simpson's Evenness	GO-09 Reference	5	0.878	0.049	0.022	0.817	0.939	0.818	0.953
	GO-03	5	0.921	0.045	0.020	0.865	0.977	0.855	0.964
	EO-01	5	0.873	0.095	0.043	0.755	0.992	0.753	0.988
	EO-20	5	0.726	0.140	0.063	0.552	0.900	0.526	0.920
	CO-05	5	0.923	0.038	0.017	0.876	0.971	0.877	0.960
Bray-Curtis Index	GO-09 Reference	5	0.340	0.143	0.064	0.162	0.517	0.215	0.547
	GO-03	5	0.530	0.139	0.062	0.358	0.702	0.359	0.659
	EO-01	5	0.639	0.207	0.093	0.381	0.897	0.315	0.894
	EO-20	5	0.478	0.054	0.024	0.411	0.545	0.422	0.560
	CO-05	5	0.756	0.112	0.050	0.616	0.896	0.600	0.870
Oligochaeta (% of community)	GO-09 Reference	5	0.8%	1.0%	0.5%	-0.5%	2.0%	0.0%	1.9%
	GO-03	5	0.7%	1.6%	0.7%	-1.2%	2.6%	0.0%	3.5%
	EO-01	5	1.8%	3.2%	1.4%	-2.2%	5.8%	0.0%	7.4%
	EO-20	5	0.7%	0.7%	0.3%	-0.2%	1.6%	0.0%	1.6%
	CO-05	5	10.1%	1.9%	0.8%	7.8%	12.4%	7.4%	12.3%
Hydracarina (% of community)	GO-09 Reference	5	4.1%	3.0%	1.3%	0.4%	7.9%	1.5%	7.9%
	GO-03	5	7.0%	2.5%	1.1%	4.0%	10.1%	3.1%	9.6%
	EO-01	5	2.1%	3.0%	1.4%	-1.6%	5.9%	0.0%	6.5%
	EO-20	5	3.8%	1.4%	0.6%	2.1%	5.5%	2.8%	6.2%
	CO-05	5	2.3%	3.1%	1.4%	-1.5%	6.2%	0.0%	7.4%
Chironomidae (% of community)	GO-09 Reference	5	88.1%	2.8%	1.2%	84.7%	91.6%	84.4%	91.4%
	GO-03	5	72.2%	8.8%	3.9%	61.3%	83.1%	61.7%	82.9%
	EO-01	5	82.6%	6.0%	2.7%	75.2%	90.0%	73.6%	89.0%
	EO-20	5	87.4%	5.1%	2.3%	81.1%	93.8%	79.2%	93.0%
	CO-05	5	78.1%	9.9%	4.4%	65.8%	90.4%	62.1%	87.2%
Metal Sensitive Chironomidae (% of community)	GO-09 Reference	5	12.8%	14.0%	6.2%	-4.5%	30.1%	5.2%	37.7%
	GO-03	5	8.2%	5.0%	2.2%	2.0%	14.4%	0.0%	12.6%
	EO-01	5	6.5%	5.7%	2.5%	-0.6%	13.5%	0.0%	15.1%
	EO-20	5	3.6%	2.0%	0.9%	1.2%	6.1%	1.6%	6.2%
	CO-05	5	17.1%	11.0%	4.9%	3.4%	30.7%	4.7%	33.5%
Tipulidae (% of community)	GO-09 Reference	5	4.6%	2.9%	1.3%	1.0%	8.1%	0.9%	8.8%
	GO-03	5	19.0%	6.2%	2.8%	11.4%	26.6%	11.0%	25.3%
	EO-01	5	7.9%	5.5%	2.5%	1.1%	14.7%	3.6%	17.4%
	EO-20	5	4.6%	2.4%	1.1%	1.7%	7.6%	1.2%	7.9%
	CO-05	5	5.1%	8.1%	3.6%	-5.0%	15.1%	0.0%	18.9%
Shredders (% of community)	GO-09 Reference	5	16.0%	11.2%	5.0%	2.0%	29.9%	0.9%	32.0%
	GO-03	5	29.8%	8.7%	3.9%	19.0%	40.5%	23.0%	44.3%
	EO-01	5	20.1%	18.3%	8.2%	-2.6%	42.9%	5.5%	52.2%
	EO-20	5	13.0%	3.9%	1.7%	8.2%	17.8%	7.9%	18.4%
	CO-05	5	16.0%	10.1%	4.5%	3.5%	28.6%	2.9%	28.3%
Collector-Gatherers (% of community)	GO-09 Reference	5	78.0%	12.1%	5.4%	63.0%	93.0%	61.3%	93.8%
	GO-03	5	60.7%	9.5%	4.2%	49.0%	72.5%	48.7%	70.5%
	EO-01	5	71.4%	16.9%	7.6%	50.4%	92.4%	47.8%	89.0%
	EO-20	5	77.1%	6.5%	2.9%	69.1%	85.2%	70.0%	85.5%
	CO-05	5	80.6%	12.7%	5.7%	64.9%	96.4%	65.4%	95.0%
Clingers (% of community)	GO-09 Reference	5	17.3%	10.5%	4.7%	4.2%	30.3%	5.3%	33.5%
	GO-03	5	18.9%	11.4%	5.1%	4.8%	33.0%	6.6%	33.3%
	EO-01	5	15.8%	11.4%	5.1%	1.6%	29.9%	5.5%	34.8%
	EO-20	5	13.1%	3.6%	1.6%	8.5%	17.6%	8.4%	18.4%
	CO-05	5	13.9%	9.3%	4.2%	2.4%	25.5%	5.0%	29.1%
Sprawlers (% of community)	GO-09 Reference	5	76.8%	10.9%	4.9%	63.3%	90.3%	61.3%	91.4%
	GO-03	5	60.0%	10.7%	4.8%	46.8%	73.3%	45.2%	70.5%
	EO-01	5	67.3%	17.8%	8.0%	45.2%	89.4%	47.8%	89.0%
	EO-20	5	75.5%	6.7%	3.0%	67.1%	83.8%	66.8%	84.2%
	CO-05	5	63.8%	11.9%	5.3%	49.1%	78.6%	50.5%	76.1%
Burrowers (% of community)	GO-09 Reference	5	5.9%	2.8%	1.2%	2.5%	9.3%	3.3%	8.9%
	GO-03	5	21.1%	8.6%	3.8%	10.4%	31.8%	11.0%	32.2%
	EO-01	5	16.9%	13.9%	6.2%	-0.3%	34.1%	5.5%	40.0%
	EO-20	5	11.0%	5.5%	2.5%	4.2%	17.9%	2.4%	16.8%
	CO-05	5	22.2%	9.2%	4.1%	10.9%	33.6%	15.3%	37.9%

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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 2 Areas?	p-value	Magnitude of Difference	Statistical Test
Density (individuals/m ²)	YES	0.02961	ANOVA ^c	GO-09 Reference	GO-3	NO	0.4388	-	Tamhane's ^d
				GO-09 Reference	EO-01	NO	0.2794	-	
				GO-09 Reference	EO-20	NO	0.8771	-	
				GO-09 Reference	CO-05	NO	0.7417	-	
				GO-03	EO-01	NO	0.9980	-	
				GO-03	EO-20	NO	0.9345	-	
				GO-03	CO-05	NO	0.9992	-	
				EO-01	EO-20	NO	0.5501	-	
Richness (number of taxa)	YES	0.06431	ANOVA ^c	EO-01	CO-05	NO	0.9141	-	Tukey's ^c
				EO-20	CO-05	NO	1.0000	-	
				GO-09 Reference	GO-3	NO	0.8077	-	
				GO-09 Reference	EO-01	NO	0.3160	-	
				GO-09 Reference	EO-20	NO	1.0000	-	
				GO-09 Reference	CO-05	NO	0.8592	-	
				GO-03	EO-01	NO	0.9027	-	
				GO-03	EO-20	NO	0.7497	-	
Simpson's Evenness ('E)	YES	0.00777	ANOVA ^c	GO-03	CO-05	NO	0.2676	-	Tukey's ^c
				EO-01	EO-20	NO	0.2676	-	
				EO-01	CO-05	YES	0.0542	2.0	
				EO-20	CO-05	NO	0.9027	-	
				GO-09 Reference	GO-3	NO	0.9212	-	
				GO-09 Reference	EO-01	NO	1.0000	-	
				GO-09 Reference	EO-20	YES	0.0623	-3.1	
				GO-09 Reference	CO-05	NO	0.9094	-	
Bray-Curtis Index	YES	0.00177	ANOVA ^c	GO-03	EO-01	NO	0.8905	-	Tukey's ^c
				GO-03	EO-20	YES	0.0109	-4.3	
				GO-03	CO-05	NO	1.0000	-	
				EO-01	EO-20	YES	0.0742	-1.5	
				EO-01	CO-05	NO	0.8764	-	
				EO-20	CO-05	YES	0.0101	1.4	
				GO-09 Reference	GO-3	NO	0.2400	-	
				GO-09 Reference	EO-01	YES	0.0222	2.1	
				GO-09 Reference	EO-20	NO	0.5371	-	Tukey's ^c
				GO-09 Reference	CO-05	YES	0.0012	2.9	
				GO-03	EO-01	NO	0.7332	-	
				GO-03	EO-20	NO	0.9758	-	
				GO-03	CO-05	NO	0.1185	-	
				EO-01	EO-20	NO	0.3915	-	
				EO-01	CO-05	NO	0.6827	-	
				EO-20	CO-05	YES	0.0371	5.2	

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Table E.23: Statistical comparison of benthic invertebrate community endpoints among Mary River benthic invertebrate community study areas, Mary River Project CREMP, August 2015.

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 2 Areas?	p-value	Magnitude of Difference	Statistical Test
Oligochaeta (% of community)	YES	0.00064	ANOVA ^e	GO-09 Reference	GO-3	NO	0.9981	-	Tukey's ^e
				GO-09 Reference	EO-01	NO	0.3785	-	
				GO-09 Reference	EO-20	NO	0.9492	-	
				GO-09 Reference	CO-05	YES	0.0009	9.0	
				GO-03	EO-01	NO	0.5489	-	
				GO-03	EO-20	NO	0.9929	-	
				GO-03	CO-05	YES	0.0018	6.1	
				EO-01	EO-20	NO	0.7935	-	
Hydracarina (% of community)	YES	0.07488	ANOVA ^e	EO-01	CO-05	YES	0.0523	2.6	Tukey's ^e
				EO-20	CO-05	YES	0.0046	13.1	
				GO-09 Reference	GO-3	NO	0.6995	-	
				GO-09 Reference	EO-01	NO	0.9885	-	
				GO-09 Reference	EO-20	NO	1.0000	-	
				GO-09 Reference	CO-05	NO	0.9188	-	
				GO-03	EO-01	NO	0.4682	-	
				GO-03	EO-20	NO	0.3491	-	
Chironomidae (% of community)	YES	0.00655	ANOVA ^e	GO-03	CO-05	NO	0.4994	-	Tamhane's ^e
				EO-01	EO-20	NO	0.9402	-	
				EO-01	CO-05	NO	0.9999	-	
				EO-20	CO-05	NO	0.8531	-	
				GO-09 Reference	GO-3	YES	0.0132	-5.7	
				GO-09 Reference	EO-01	NO	0.7582	-	
				GO-09 Reference	EO-20	NO	1.0000	-	
				GO-09 Reference	CO-05	NO	0.1586	-	
Metal-sensitive Chironomidae (% of community)	YES	0.08437	KW H-test ^d	GO-03	EO-01	NO	0.1483	-	Tukey's ^e
				GO-03	EO-20	YES	0.0142	1.7	
				GO-03	CO-05	NO	0.7374	-	
				EO-01	EO-20	NO	0.7759	-	
				EO-01	CO-05	NO	0.7492	-	
				EO-20	CO-05	NO	0.1679	-	
				GO-09 Reference	GO-3	NO	0.9200	-	
				GO-09 Reference	EO-01	NO	0.8661	-	
				GO-09 Reference	EO-20	NO	0.3198	-	Tukey's ^f
				GO-09 Reference	CO-05	NO	0.9205	-	
				GO-03	EO-01	NO	0.9999	-	
				GO-03	EO-20	NO	0.7856	-	
				GO-03	CO-05	NO	0.4867	-	
				EO-01	EO-20	NO	0.8556	-	
				EO-01	CO-05	NO	0.4057	-	
				EO-20	CO-05	YES	0.0761	6.8	

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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 2 Areas?	p-value	Magnitude of Difference	Statistical Test
Tipulidae (% of community)	YES	0.01526	ANOVA ^c	GO-09 Reference	GO-3	YES	0.0618	5.1	Tamhane's ^e
				GO-09 Reference	EO-01	NO	0.8604	-	
				GO-09 Reference	EO-20	NO	1.0000	-	
				GO-09 Reference	CO-05	NO	0.9928	-	
				GO-03	EO-01	NO	0.2155	-	
				GO-03	EO-20	YES	0.0310	-2.3	
				GO-03	CO-05	NO	0.3532	-	
				EO-01	EO-20	NO	0.8861	-	
Shredder (% of community)	NO	0.31194	ANOVA ^c	EO-01	CO-05	NO	0.8085	-	Tukey's ^e
				EO-20	CO-05	NO	0.9831	-	
				GO-09 Reference	GO-3	NO	0.2950	-	
				GO-09 Reference	EO-01	NO	0.9054	-	
				GO-09 Reference	EO-20	NO	0.9987	-	
				GO-09 Reference	CO-05	NO	0.9966	-	
				GO-03	EO-01	NO	0.7800	-	
				GO-03	EO-20	NO	0.4317	-	
Collector-Gatherer (% of community)	NO	0.15695	ANOVA ^c	GO-03	CO-05	NO	0.4749	-	Tukey's ^e
				EO-01	EO-20	NO	0.9741	-	
				EO-01	CO-05	NO	0.9843	-	
				EO-20	CO-05	NO	1.0000	-	
				GO-09 Reference	GO-3	NO	0.2848	-	
				GO-09 Reference	EO-01	NO	0.9585	-	
				GO-09 Reference	EO-20	NO	0.9966	-	
				GO-09 Reference	CO-05	NO	0.9837	-	
Filterer (% of community)	NO	0.72901	ANOVA ^c	GO-03	EO-01	NO	0.6602	-	Tukey's ^e
				GO-03	EO-20	NO	0.4614	-	
				GO-03	CO-05	NO	0.1161	-	
				EO-01	EO-20	NO	0.9971	-	
				EO-01	CO-05	NO	0.7484	-	
				EO-20	CO-05	NO	0.9038	-	
				GO-09 Reference	GO-3	NO	0.9898	-	
				GO-09 Reference	EO-01	NO	0.8405	-	
				GO-09 Reference	EO-20	NO	0.7073	-	Tukey's ^e
				GO-09 Reference	CO-05	NO	0.8939	-	
				GO-03	EO-01	NO	0.9790	-	
				GO-03	EO-20	NO	0.9231	-	
				GO-03	CO-05	NO	0.9919	-	
				EO-01	EO-20	NO	0.9990	-	
				EO-01	CO-05	NO	0.9999	-	
				EO-20	CO-05	NO	0.9953	-	

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	Significant Difference Among Areas?	p-value	Staistical Test ^b	(I) Area	(J) Area	Significant Difference Between 2 Areas?	p-value	Magnitude of Difference	Statistical Test
Clinger (% of community)	NO	0.93267	ANOVA ^e	GO-09 Reference	GO-3	NO	0.9983	-	Tukey's ^e
				GO-09 Reference	EO-01	NO	0.9999	-	
				GO-09 Reference	EO-20	NO	0.9942	-	
				GO-09 Reference	CO-05	NO	0.9851	-	
				GO-03	EO-01	NO	0.9924	-	
				GO-03	EO-20	NO	0.9564	-	
				GO-03	CO-05	NO	0.9269	-	
				EO-01	EO-20	NO	0.9989	-	
Sprawler (% of community)	NO	0.19834	ANOVA ^e	EO-01	CO-05	NO	0.9955	-	Tukey's ^e
				EO-20	CO-05	NO	1.0000	-	
				GO-09 Reference	GO-3	NO	0.2319	-	
				GO-09 Reference	EO-01	NO	0.8465	-	
				GO-09 Reference	EO-20	NO	0.9965	-	
				GO-09 Reference	CO-05	NO	0.4327	-	
				GO-03	EO-01	NO	0.7759	-	
				GO-03	EO-20	NO	0.3910	-	
Burrower (% of community)	YES	0.01056	ANOVA ^e	GO-03	CO-05	NO	0.9926	-	Tukey's ^f
				EO-01	EO-20	NO	0.9619	-	
				EO-01	CO-05	NO	0.9472	-	
				EO-20	CO-05	NO	0.6392	-	
				GO-09 Reference	GO-3	YES	0.0228	5.5	
				GO-09 Reference	EO-01	NO	0.1400	-	
				GO-09 Reference	EO-20	NO	0.6586	-	
				GO-09 Reference	CO-05	YES	0.0157	5.9	
				GO-03	EO-01	NO	0.8920	-	
				GO-03	EO-20	NO	0.2994	-	
				GO-03	CO-05	NO	0.9998	-	
				EO-01	EO-20	NO	0.8040	-	
				EO-01	CO-05	NO	0.8156	-	
				EO-20	CO-05	NO	0.2278	-	

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Table E.24: Benthic invertebrate community data for Reference Lake 3, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Reference Lake 03 - Littoral Stations					Reference Lake 03 - Profundal Stations				
	REF-01	REF-02	REF-03	REF-04	REF-05	REF-06	REF-07	REF-08	REF-09	REF-10
ROUNDWORMS										
P. Nemata	112	0	95	129	9	0	0	9	0	0
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Lumbriculidae										
<i>Lumbriculus</i>	0	0	0	0	0	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
F. Acalyptonotidae										
<i>Acalyptonotus</i>	43	34	9	9	0	0	0	0	0	0
F. Hygrobatidae										
<i>Hygrobates</i>	9	9	0	9	0	0	0	0	0	0
F. Lebertiidae										
<i>Lebertia</i>	26	60	26	9	9	0	0	0	9	0
SEED SHRIMPS										
Cl. Ostracoda	43	1009	69	500	60	0	0	17	9	69
INSECTS										
Cl. Insecta										
CADDISFLIES										
O. Trichoptera										
F. Apataniidae										
<i>Apatania</i>	9	9	0	0	0	0	0	0	0	0
TRUE FLIES										
O. Diptera										
MIDGES										
F. Chironomidae										
chironomid pupae	9	9	0	9	0	0	0	0	0	0
S.F. Chironominae										
<i>Chironomus</i>	0	0	0	0	0	0	0	0	0	0
<i>Corynocera</i>	0	0	0	0	0	0	0	0	0	0
<i>Lipiniella</i>	0	0	0	0	0	0	0	0	0	0
<i>Micropsectra</i>	198	34	9	17	69	9	9	0	0	0
<i>Paratanytarsus</i>	69	138	0	0	0	0	0	0	0	0
<i>Polypedilum</i>	0	0	0	0	0	0	0	0	0	0
<i>Sergentia</i>	0	0	0	0	0	0	0	0	0	0
<i>Stictochironomus</i>	86	233	0	0	216	0	0	0	0	0
<i>Tanytarsus</i>	69	181	0	0	9	0	0	0	0	0
S.F. Diamesinae										
<i>Diamesa</i>	0	0	0	0	0	0	0	0	0	0
<i>Protanypus</i>	0	0	0	0	0	0	0	0	0	9
<i>Pseudodiamesa</i>	34	34	9	0	17	0	0	0	9	0
S.F. Orthoclaadiinae										
<i>Abiskomyia</i>	216	672	155	216	336	0	0	0	0	0
<i>Cricotopus/Orthoclaadius</i>	0	0	0	0	0	0	0	0	0	0
<i>Heterotrissoclaadius</i>	26	78	147	69	129	207	155	155	95	138
<i>Mesocricotopus</i>	0	0	0	0	0	0	0	0	0	0
<i>Paracladius</i>	17	95	34	129	17	0	0	0	0	0
<i>Parakiefferiella</i>	0	0	0	0	0	0	0	0	0	0
<i>Psectrocladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Zalutschia</i>	17	155	0	0	0	0	0	0	0	0

Table E.24: Benthic invertebrate community data for Reference Lake 3, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Reference Lake 03 - Littoral Stations					Reference Lake 03 - Profundal Stations				
	REF-01	REF-02	REF-03	REF-04	REF-05	REF-06	REF-07	REF-08	REF-09	REF-10
Genus "Greenland"	17	17	0	0	0	0	0	0	0	0
S.F. Tanypodinae										
<i>Arctopelopia</i>	26	52	0	0	0	0	0	0	0	0
<i>Procladius</i>	17	0	0	9	0	0	0	0	0	0
<i>Thienemannimyia</i> complex	0	0	0	0	0	0	0	0	0	0
Density (No. organisms per m²)	1,043	2,819	553	1,105	871	216	164	181	122	216
Richness (total number of taxa)^a	18	16	9	10	10	2	2	3	4	3
Simpson's Evenness (E)	0.936	0.848	0.899	0.804	0.840	0.160	0.207	0.383	0.503	0.732
Bray-Curtis Index	0.318	0.662	0.219	0.405	0.307	0.184	0.055	0.049	0.273	0.226
Percent Composition										
% Nemata	10.7%	0.0%	17.2%	11.7%	1.0%	0.0%	0.0%	5.0%	0.0%	0.0%
% Hydracarina	7.5%	3.7%	6.3%	2.4%	1.0%	0.0%	0.0%	0.0%	7.4%	0.0%
% Ostracods	4.1%	35.8%	12.5%	45.2%	6.9%	0.0%	0.0%	9.4%	7.4%	31.9%
% Chironomids	76.8%	60.2%	64.0%	40.6%	91.0%	100.0%	100.0%	85.6%	85.2%	68.1%
% Metal Sensitive Chironmids	32.2%	12.5%	1.6%	1.5%	9.0%	4.2%	5.5%	0.0%	0.0%	4.2%
Functional Feeding Group Composition										
% Shredders	1.6%	5.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Scrapers	0.9%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Collector - Gatherers	53.7%	76.2%	92.0%	95.2%	90.0%	95.8%	94.5%	100.0%	92.6%	100.0%
% Filterers	32.2%	12.5%	1.6%	1.5%	9.0%	4.2%	5.5%	0.0%	0.0%	0.0%
Habitat Preference Group Composition										
% Clingers	33.9%	11.6%	8.0%	4.0%	10.0%	4.2%	5.5%	0.0%	7.4%	0.0%
% Sprawlers	47.1%	80.1%	74.9%	84.3%	64.2%	95.8%	94.5%	95.0%	92.6%	95.8%
% Burrowers	19.0%	8.3%	17.2%	11.7%	25.8%	0.0%	0.0%	5.0%	0.0%	4.2%

^a Bold entries excluded from taxa count

Table E.25: Statistical comparison of littoral and profundal habitat variables from Reference Lake 3 benthic invertebrate community monitoring locations, Mary River Project CREMP, August 2015.

Habitat Variable	Statistical Test Results			Summary Statistics					
	Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Area	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Depth (m)	YES	0.000	α	Littoral	9.80	1.11	0.49	8.40	11.20
				Profundal	20.60	1.85	0.83	18.50	23.40
Secchi Depth (m)	NO	0.819	α	Littoral	9.52	0.39	0.17	9.10	10.03
				Profundal	9.38	1.24	0.55	8.04	11.41
Sand (% by weight)	YES	0.070	α, γ	Littoral	51.1	10.6	4.7	40.2	64.4
				Profundal	37.0	10.6	4.7	18.8	46.7
Silt (% by weight)	NO	0.159	α	Littoral	40.1	9.2	4.1	32.0	51.8
				Profundal	48.6	8.1	3.6	40.2	62.0
Clay (% by weight)	YES	0.045	α	Littoral	8.9	4.0	1.8	3.5	14.7
				Profundal	14.3	3.1	1.4	10.6	19.2
TOC (%)	NO	0.647	α, δ	Littoral	4.2	2.7	1.2	1.9	8.3
				Profundal	4.8	0.4	0.2	4.4	5.3

^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 confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed using t-test assuming unequal variance.

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

Table E.26: Benthic invertebrate community statistical comparison results between littoral and profundal stations at Reference Lake 3 Mary River Project CREMP, August 2015.

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	0.025	ζ	-1.2	Reference Lake littoral	1,278	888	397	553	2,819
					Reference Lake profundal	180	39	18	122	216
Richness (Number of Taxa)	YES	0.005	ϵ	-2.4	Reference Lake littoral	12.6	4.1	1.8	9.0	18.0
					Reference Lake profundal	2.8	0.8	0.4	2.0	4.0
Simpson's Evenness (E)	YES	0.009	ϵ	-8.9	Reference Lake littoral	0.865	0.052	0.023	0.804	0.936
					Reference Lake profundal	0.397	0.232	0.104	0.160	0.732
Bray-Curtis Index	YES	0.035	α	-1.3	Reference Lake littoral	0.382	0.170	0.076	0.219	0.662
					Reference Lake profundal	0.157	0.101	0.045	0.049	0.273
Nemata (%)	NO	0.335	ζ	-	Reference Lake littoral	8.1%	7.4%	3.3%	0.0%	17.2%
					Reference Lake profundal	1.0%	2.2%	1.0%	0.0%	5.0%
Hydracarina (%)	NO	0.151	ζ	-	Reference Lake littoral	4.2%	2.7%	1.2%	1.0%	7.5%
					Reference Lake profundal	1.5%	3.3%	1.5%	0.0%	7.4%
Ostracoda (%)	NO	0.177	α	-	Reference Lake littoral	20.9%	18.5%	8.3%	4.1%	45.2%
					Reference Lake profundal	9.7%	13.1%	5.9%	0.0%	31.9%
Chironomidae (%)	YES	0.088	ϵ	1.1	Reference Lake littoral	66.5%	18.9%	8.4%	40.6%	91.0%
					Reference Lake profundal	87.8%	13.2%	5.9%	68.1%	100.0%
Metal-Sensitive Chironomidae (%)	NO	0.163	α	-	Reference Lake littoral	11.4%	12.6%	5.6%	1.5%	32.2%
					Reference Lake profundal	2.8%	2.6%	1.2%	0.0%	5.5%
Shredders (%)	NO	0.969	ϵ	-	Reference Lake littoral	1.4%	2.4%	1.1%	0.0%	5.5%
					Reference Lake profundal	0.0%	0.0%	0.0%	0.0%	0.0%
Collector-Gatherers (%)	YES	0.027	α	0.9	Reference Lake littoral	81.4%	17.1%	7.7%	53.7%	95.2%
					Reference Lake profundal	96.6%	3.3%	1.5%	92.6%	100.0%
Filterers (%)	YES	0.069	α	-0.8	Reference Lake littoral	11.4%	12.6%	5.6%	1.5%	32.2%
					Reference Lake profundal	1.9%	2.7%	1.2%	0.0%	5.5%
Clingers (%)	YES	0.070	ϵ	-0.9	Reference Lake littoral	13.5%	11.8%	5.3%	4.0%	33.9%
					Reference Lake profundal	3.4%	3.3%	1.5%	0.0%	7.4%
Sprawlers (%)	YES	0.000	α	1.7	Reference Lake littoral	70.1%	14.9%	6.7%	47.1%	84.3%
					Reference Lake profundal	94.8%	1.3%	0.6%	92.6%	95.8%
Burrowers (%)	YES	0.010	ϵ	-2.1	Reference Lake littoral	16.4%	6.8%	3.0%	8.3%	25.8%
					Reference Lake profundal	1.8%	2.5%	1.1%	0.0%	5.0%

^a Data analysis included: α - data untransformed, single factor ANOVA test conducted; ζ - data untransformed, single factor ANOVA test confirmed using Mann Whitney U-test; ϵ - data untransformed, single factor ANOVA test confirmed using t-test assuming unequal variance; η - data log transformed, single factor ANOVA test conducted; β - data logit transformed, single factor ANOVA test conducted; γ - data logit transformed, single factor ANOVA test results confirmed using Mann-Whitney U-test; and, δ - data logit transformed, single-factor ANOVA test results confirmed 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 $\alpha = \beta = 0.10$.

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 E.27: Benthic invertebrate community data for Camp Lake, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Camp Lake - Littoral Stations					Camp Lake - Profundal Stations				
	JLO-02	JLO-21	JLO-20	JLO-19	JLO-18	JLO-16	JLO-01	JLO-07	JLO-11	JLO-12
ROUNDWORMS										
P. Nemata	34	69	52	310	362	500	9	0	0	241
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Lumbriculidae										
<i>Lumbriculus</i>	0	17	0	0	0	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
F. Acalyptonotidae										
<i>Acalyptonotus</i>	0	69	86	9	86	17	17	0	0	0
F. Hygrobatidae										
<i>Hygrobates</i>	0	0	26	17	0	0	0	0	0	0
F. Lebertiidae										
<i>Lebertia</i>	0	0	9	9	0	69	52	0	26	17
SEED SHRIMPS										
Cl. Ostracoda	0	17	0	0	17	0	0	0	0	43
INSECTS										
Cl. Insecta										
CADDISFLIES										
O. Trichoptera										
F. Apataniidae										
<i>Apatania</i>	0	17	0	0	0	0	0	0	0	0
TRUE FLIES										
O. Diptera										
MIDGES										
F. Chironomidae										
chironomid pupae	0	0	17	0	0	155	9	0	17	0
S.F. Chironominae										
<i>Chironomus</i>	0	17	0	0	0	172	0	9	1517	0
<i>Corynocera</i>	0	0	0	0	0	0	0	0	0	0
<i>Lipiniella</i>	0	0	0	0	0	0	0	0	0	0
<i>Micropsectra</i>	0	397	2690	1474	3216	52	198	0	9	457
<i>Paratanytarsus</i>	69	0	34	0	0	0	0	0	0	0
<i>Polypedilum</i>	0	0	0	0	0	0	0	0	0	0
<i>Sergentia</i>	0	86	0	0	0	34	0	0	0	0
<i>Stictochironomus</i>	1379	1000	871	86	759	103	0	78	0	0
<i>Tanytarsus</i>	34	69	17	52	0	121	9	9	78	52
S.F. Diamesinae										
<i>Diamesa</i>	0	0	0	0	0	0	0	0	0	0
<i>Protanypus</i>	0	0	17	17	26	0	17	0	0	0
<i>Pseudodiamesa</i>	0	0	0	0	0	190	17	0	0	0
S.F. Orthocladiinae										
<i>Abiskomyia</i>	0	86	353	112	112	483	34	9	9	17
<i>Cricotopus/Orthocladius</i>	69	17	0	0	0	0	0	0	0	0
<i>Heterotrissocladius</i>	103	155	414	164	1,595	155	707	43	0	1,931
<i>Mesocricotopus</i>	0	0	0	0	0	0	0	0	0	0
<i>Paracladius</i>	0	0	121	267	103	0	0	0	0	0
<i>Parakiefferiella</i>	0	0	0	0	0	0	0	0	0	0
<i>Psectrocladius</i>	0	0	0	0	0	0	0	0	0	43
<i>Zalutschia</i>	0	17	95	0	34	0	0	0	0	0

Table E.27: Benthic invertebrate community data for Camp Lake, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Camp Lake - Littoral Stations					Camp Lake - Profundal Stations				
	JLO-02	JLO-21	JLO-20	JLO-19	JLO-18	JLO-16	JLO-01	JLO-07	JLO-11	JLO-12
Genus "Greenland"	0	17	34	0	0	0	0	0	0	0
S.F. Tanypodinae										
<i>Arctopelopia</i>	483	190	121	0	0	0	0	9	0	0
<i>Procladius</i>	34	34	43	17	34	17	0	0	0	9
<i>Thienemannimyia</i> complex	0	0	0	0	0	0	0	0	0	0
Density (No. organisms per m²)	2,205	2,274	5,000	2,534	6,344	2,068	1,069	157	1,656	2,810
Richness (total number of taxa)^a	8	17	16	12	11	12	9	6	5	9
Simpson's Evenness (E)	0.635	0.806	0.708	0.685	0.728	0.914	0.580	0.798	0.176	0.555
Bray-Curtis Index	0.856	0.737	0.810	0.705	0.867	0.861	0.749	0.732	1.000	0.890
Percent Composition										
% Nemata	1.5%	3.0%	1.0%	12.2%	5.7%	24.2%	0.8%	0.0%	0.0%	8.6%
% Hydracarina	0.0%	3.0%	2.4%	1.4%	1.4%	4.2%	6.5%	0.0%	1.6%	0.6%
% Ostracods	0.0%	0.7%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	1.5%
% Chironomids	98.5%	91.7%	96.5%	86.4%	92.7%	71.7%	92.7%	100.0%	98.4%	89.3%
% Metal Sensitive Chironmids	4.7%	20.5%	55.2%	60.9%	51.1%	8.4%	21.0%	5.7%	5.3%	18.1%
Functional Feeding Group Composition										
% Shredders	3.1%	1.5%	1.9%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%
% Scrapers	0.0%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Collector - Gatherers	68.8%	64.4%	37.6%	37.7%	46.9%	86.7%	74.2%	88.5%	93.2%	81.0%
% Filterers	4.7%	20.5%	54.8%	60.2%	50.7%	8.4%	19.4%	5.7%	5.3%	18.1%
Habitat Preference Group Composition										
% Clingers	4.7%	28.8%	56.6%	61.6%	52.0%	14.2%	25.8%	5.7%	6.8%	18.7%
% Sprawlers	31.2%	22.7%	24.6%	22.1%	29.9%	48.4%	71.7%	38.9%	1.6%	72.7%
% Burrowers	64.1%	48.5%	18.8%	16.3%	18.1%	37.5%	2.4%	55.4%	91.6%	8.6%

^a Bold entries excluded from taxa count

Table E.28: Statistical comparison of littoral and profundal habitat variables between Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2015.

Sampling Zone	Habitat Variable	Statistical Test Results			Summary Statistics					
		Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Area	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral	Depth (m)	NO	0.840	α	Reference Lake 3	9.80	1.11	0.49	8.40	11.20
					Camp Lake	9.56	2.31	1.04	6.90	12.20
	Secchi Depth (m)	YES	0.000	α, δ	Reference Lake 3	9.52	0.39	0.17	9.10	10.03
					Camp Lake	6.86	0.04	0.02	6.82	6.90
	Sand (% by weight)	NO	0.464	α	Reference Lake 3	51	11	5	40	64
					Camp Lake	58	18	8	42	85
	Silt (% by weight)	NO	0.912	α	Reference Lake 3	40	9	4	32	52
					Camp Lake	39	16	7	14	54
	Clay (% by weight)	YES	0.012	β	Reference Lake 3	9	4	2	4	15
					Camp Lake	3	2	1	0	5
Profundal	Depth (m)	NO	0.693	α, δ	Reference Lake 3	20.6	1.9	0.8	18.5	23.4
					Camp Lake	22.2	8.2	3.7	15.2	32.9
	Secchi Depth (m)	YES	0.017	β	Reference Lake 3	9.38	1.24	0.55	8.04	11.41
					Camp Lake	7.36	0.87	0.39	6.49	8.55
	Sand (% by weight)	NO	0.100	α, δ	Reference Lake 3	37	11	5	19	47
					Camp Lake	62	26	12	36	92
	Silt (% by weight)	NO	0.165	α, δ	Reference Lake 3	49	8	4	40	62
					Camp Lake	32	21	10	7	56
	Clay (% by weight)	YES	0.015	β	Reference Lake 3	14	3	1	11	19
					Camp Lake	6	5	2	0	13

^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 confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed using t-test assuming unequal variance.

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

Table E.29: Benthic invertebrate community statistical comparison results between Camp Lake littoral station 2015 and baseline (2013 data, Mary River Project CREMP, 2015.

Metric	Statistical Test Results				Summary Statistics					
	Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Magnitude of Difference ^b (No. of SD)	Study Year	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Station Depth (m)	NO	0.783	α	-	2013 Baseline	9.1	2.3	1.1	6.4	11.9
					2015	9.6	2.3	1.0	6.9	12.2
Density (Individuals/m ²)	NO	0.160	η	-	2013 Baseline	7,752	3,849	1,925	1,981	9,825
					2015	3,671	1,891	846	2,205	6,344
Richness (Number of Taxa)	YES	0.095	α	-1.2	2013 Baseline	18.0	4.4	2.2	13.0	23.0
					2015	12.8	3.7	1.7	8.0	17.0
Simpson's Evenness (E)	YES	0.003	α	-3.4	2013 Baseline	0.893	0.054	0.027	0.815	0.932
					2015	0.712	0.063	0.028	0.635	0.806
Nemata (%)	NO	0.728	β	-	2013 Baseline	5.6%	3.6%	1.8%	0.9%	9.0%
					2015	4.7%	4.6%	2.0%	1.0%	12.2%
Ostracoda (%)	NO	0.388	γ	-	2013 Baseline	0.7%	0.5%	0.2%	0.0%	1.1%
					2015	0.2%	0.3%	0.1%	0.0%	0.7%
Chironomidae (%)	NO	0.307	β	-	2013 Baseline	90.1%	4.4%	2.2%	85.2%	94.8%
					2015	93.1%	4.7%	2.1%	86.4%	98.5%
Metal-Sensitive Chironomidae (%)	NO	0.849	β	-	2013 Baseline	30.8%	14.6%	7.3%	13.0%	47.1%
					2015	38.5%	24.5%	11.0%	4.7%	60.9%
Collector-Gatherers (%)	NO	0.619	β	-	2013 Baseline	55.9%	12.4%	6.2%	41.8%	71.3%
					2015	51.1%	14.7%	6.6%	37.6%	68.8%
Filterers (%)	NO	0.855	β	-	2013 Baseline	30.8%	14.5%	7.2%	13.0%	46.8%
					2015	38.2%	24.3%	10.9%	4.7%	60.2%

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

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 E.30: Benthic invertebrate community statistical comparison results between Camp Lake profundal station 2015 and baseline (2007, 2013) data, Mary River Project CREMP, 2015.

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons ^a					
	Significant Difference Among Areas?	p-value	Statistical Test ^b	(I) Study Year	(J) Study Year	Significant Difference Between 2 Areas?	p-value	Magnitude of Difference	Statistical Test
Density (individuals/m2)	NO	0.29011	ANOVA ^d	2007 Baseline	2013 Baseline	NO	0.9623	-	Tukey's ^d
				2007 Baseline	2015	NO	0.3218	-	
				2013 Baseline	2015	NO	0.4107	-	
Richness (number of taxa)	YES	0.00822	ANOVA ^c	2007 Baseline	2013 Baseline	YES	0.0311	3.0	Tukey's ^c
				2007 Baseline	2015	NO	0.8918	-	
				2013 Baseline	2015	YES	0.0099	-2.0	
Simpson's Evenness ('E)	NO	0.58163	ANOVA ^c	2007 Baseline	2013 Baseline	NO	0.6528	-	Tukey's ^c
				2007 Baseline	2015	NO	0.9998	-	
				2013 Baseline	2015	NO	0.6322	-	
Nemata (% of community)	NO	0.65548	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.9127	-	Tukey's ^e
				2007 Baseline	2015	NO	0.8848	-	
				2013 Baseline	2015	NO	0.6298	-	
Ostracoda (% of community)	NO	0.36512	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.3482	-	Tukey's ^e
				2007 Baseline	2015	NO	0.5553	-	
				2013 Baseline	2015	NO	0.9095	-	
Chironomidae (% of community)	NO	0.51968	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.5170	-	Tamhane's ^e
				2007 Baseline	2015	NO	0.5170	-	
				2013 Baseline	2015	NO	0.8780	-	
Metal-Sensitive Chironomidae (% of community)	YES	0.00228	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.8992	-	Tukey's ^e
				2007 Baseline	2015	YES	0.0096	-4.9	
				2013 Baseline	2015	YES	0.0030	-1.6	
Collector-Gatherer FFG (% of community)	YES	0.00855	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.7305	-	Tukey's ^e
				2007 Baseline	2015	YES	0.0462	3.3	
				2013 Baseline	2015	YES	0.0086	1.4	
Filterer FFG (% of community)	YES	0.00248	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.8864	-	Tukey's ^e
				2007 Baseline	2015	YES	0.0108	-5.3	
				2013 Baseline	2015	YES	0.0032	-1.6	

^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 Data normally distributed. Untransformed data used for comparison(s).

^d Data non-normally distributed. Log transformation resulted in normal distribution, and thus the log transformed data used for comparison(s).

^e Logit transformed data were normally distributed. Parametric statistics applied.

^f Logit transformed data were non-normally distributed for data from at least one study area. ANOVA statistics for multiple group comparison were confirmed using KW H-test statistics.

^g Logit transformed data were non-normally distributed for data from at least one study area. Post hoc statistics for pair-wise comparisons were confirmed using MW U-test statistics.

 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 E.31: Benthic invertebrate community data for Sheardown Lake NW, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Sheardown Lake NW - Littoral Stations					Sheardown Lake NW - Profundal Stations				
	DLO-1-9	DLO-1-4	DLO-1-3	DLO-1-11	DLO-1-10	DLO-1-5	DLO-1-14	DLO-1-15	DLO-1-2	DLO-1-12
ROUNDWORMS										
P. Nemata	138	69	0	9	34	9	9	0	9	9
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Lumbriculidae										
<i>Lumbriculus</i>	0	0	0	0	0	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
F. Acalyptonotidae										
<i>Acalyptonotus</i>	0	0	0	78	0	17	17	9	17	52
F. Hygrobatidae										
<i>Hygrobates</i>	0	0	0	60	103	43	0	17	9	26
F. Lebertiidae										
<i>Lebertia</i>	0	0	0	17	0	9	0	0	17	9
SEED SHRIMPS										
Cl. Ostracoda	379	655	448	207	310	9	0	0	78	95
INSECTS										
Cl. Insecta										
CADDISFLIES										
O. Trichoptera										
F. Apataniidae										
<i>Apatania</i>	0	34	34	0	0	0	0	0	0	0
TRUE FLIES										
O. Diptera										
MIDGES										
F. Chironomidae										
chironomid pupae	34	0	0	0	0	26	0	0	0	9
S.F. Chironominae										
<i>Chironomus</i>	34	17	69	0	0	1302	0	0	0	0
<i>Corynocera</i>	0	0	0	0	0	0	0	0	0	0
<i>Lipiniella</i>	0	0	0	0	0	0	0	0	0	0
<i>Micropsectra</i>	759	569	86	353	310	0	0	0	0	43
<i>Paratanytarsus</i>	241	1500	241	43	724	52	0	0	0	9
<i>Polypedilum</i>	0	17	0	0	0	0	0	0	0	0
<i>Sergentia</i>	69	207	86	60	0	0	0	0	0	0
<i>Stictochironomus</i>	2310	5828	1586	2664	1724	0	9	0	0	0
<i>Tanytarsus</i>	241	345	34	60	103	34	0	0	0	0
S.F. Diamesinae										
<i>Diamesa</i>	0	0	0	0	0	0	0	0	0	0
<i>Protanypus</i>	69	0	0	17	34	17	9	17	9	17
<i>Pseudodiamesa</i>	0	0	0	0	0	190	0	0	0	0
S.F. Orthocladiinae										
<i>Abiskomyia</i>	207	155	86	95	103	17	0	0	0	0
<i>Cricotopus/Orthocladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Heterotrissocladius</i>	0	17	86	233	379	17	1,224	1,405	1,095	750
<i>Mesocricotopus</i>	0	0	0	0	0	0	0	0	0	0
<i>Paracladius</i>	0	0	17	0	310	0	0	0	0	129
<i>Parakiefferiella</i>	0	0	0	0	69	0	0	0	0	0
<i>Psectrocladius</i>	0	0	0	17	0	0	0	0	0	0
<i>Zalutschia</i>	0	0	0	0	0	0	0	0	0	0

Table E.31: Benthic invertebrate community data for Sheardown Lake NW, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Sheardown Lake NW - Littoral Stations					Sheardown Lake NW - Profundal Stations				
	DLO-1-9	DLO-1-4	DLO-1-3	DLO-1-11	DLO-1-10	DLO-1-5	DLO-1-14	DLO-1-15	DLO-1-2	DLO-1-12
Genus "Greenland"	0	17	0	0	0	0	0	0	0	0
S.F. Tanypodinae										
<i>Arctopelopia</i>	655	1,828	259	95	310	0	0	0	0	0
<i>Procladius</i>	0	34	34	155	69	0	43	34	172	34
<i>Thienemannimyia</i> complex	0	0	69	17	0	0	0	0	0	0
Density (No. organisms per m²)	5,136	11,292	3,135	4,180	4,582	1,742	1,311	1,482	1,406	1,182
Richness (total number of taxa)^a	11	15	13	16	14	12	6	5	8	11
Simpson's Evenness (E)	0.818	0.731	0.761	0.616	0.868	0.446	0.152	0.125	0.429	0.623
Bray-Curtis Index	0.828	0.927	0.801	0.829	0.827	0.973	0.790	0.812	0.791	0.756
Percent Composition										
% Nemata	2.7%	0.6%	0.0%	0.2%	0.7%	0.5%	0.7%	0.0%	0.6%	0.8%
% Hydracarina	0.0%	0.0%	0.0%	3.7%	2.2%	4.0%	1.3%	1.8%	3.1%	7.4%
% Ostracods	7.4%	5.8%	14.3%	5.0%	6.8%	0.5%	0.0%	0.0%	5.5%	8.0%
% Chironomids	89.9%	93.3%	84.6%	91.1%	90.2%	95.0%	98.0%	98.2%	90.8%	83.8%
% Metal Sensitive Chironmids	25.5%	21.4%	11.5%	11.3%	25.6%	5.9%	0.7%	1.1%	0.6%	5.8%
Functional Feeding Group Composition										
% Shredders	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Scrapers	0.0%	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Collector - Gatherers	63.1%	61.7%	75.9%	79.0%	64.7%	91.1%	95.4%	96.0%	84.7%	85.4%
% Filterers	24.2%	21.4%	11.5%	10.9%	24.8%	4.9%	0.0%	0.0%	0.0%	4.4%
Habitat Preference Group Composition										
% Clingers	20.8%	10.4%	7.7%	15.0%	11.3%	5.9%	1.3%	1.8%	3.1%	11.0%
% Sprawlers	29.5%	37.2%	39.6%	20.6%	49.6%	17.9%	96.6%	97.1%	95.7%	86.8%
% Burrowers	49.7%	52.4%	52.8%	64.4%	39.1%	76.2%	2.1%	1.1%	1.3%	2.2%

^a Bold entries excluded from taxa count

Table E.32: Statistical comparison of littoral and profundal habitat variables between Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2015.

Sampling Zone	Habitat Variable	Statistical Test Results			Summary Statistics					
		Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Area	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral	Depth (m)	YES	0.006	α	Reference Lake 3	9.80	1.11	0.49	8.40	11.20
					Sheardown Lake NW	7.92	0.29	0.13	7.50	8.20
	Secchi Depth (m)	YES	0.000	α	Reference Lake 3	9.52	0.39	0.17	9.10	10.03
					Sheardown Lake NW	6.07	0.73	0.32	5.06	6.69
	Sand (% by weight)	NO	0.585	α	Reference Lake 3	51	11	5	40	64
					Sheardown Lake NW	46	18	8	32	77
	Silt (% by weight)	NO	0.510	α	Reference Lake 3	40	9	4	32	52
					Sheardown Lake NW	46	15	7	21	57
	Clay (% by weight)	NO	0.975	α	Reference Lake 3	9	4	2	4	15
					Sheardown Lake NW	9	4	2	3	13
Profundal	Depth (m)	NO	0.651	α	Reference Lake 3	20.6	1.9	0.8	18.5	23.4
					Sheardown Lake NW	19.7	3.9	1.7	14.0	23.3
	Secchi Depth (m)	YES	0.001	α	Reference Lake 3	9.38	1.24	0.55	8.04	11.41
					Sheardown Lake NW	6.20	0.73	0.33	5.40	6.94
	Sand (% by weight)	NO	0.961	α, δ	Reference Lake 3	37	11	5	19	47
					Sheardown Lake NW	36	34	15	17	96
	Silt (% by weight)	NO	0.935	α, δ	Reference Lake 3	49	8	4	40	62
					Sheardown Lake NW	48	25	11	4	62
	Clay (% by weight)	YES	0.726	α, γ	Reference Lake 3	14	3	1	11	19
					Sheardown Lake NW	16	10	5	0	26

^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 confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed using t-test assuming unequal variance.

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

Table E.33: Benthic invertebrate community statistical comparison results between Sheardown Lake NW littoral station 2015 and baseline (2007, 2008, 2013) data, Mary River Project CREMP, 2015.

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons ^a					
	Significant Difference Among Areas?	p-value	Staistical Test ^b	(I) Study Year	(J) Study Year	Significant Difference Between 2 Areas?	p-value	Magnitude of Difference	Statistical Test
Density (individuals/m2)	NO	0.44941	ANOVA ^d	2007 Baseline	2008 Baseline	NO	0.9811	-	Tukey's ^d
				2007 Baseline	2013 Baseline	NO	0.5206	-	
				2007 Baseline	2015	NO	0.9992	-	
				2008 Baseline	2013 Baseline	NO	0.7212	-	
				2008 Baseline	2015	NO	0.9522	-	
				2013 Baseline	2015	NO	0.4229	-	
Richness (number of taxa)	YES	0.03457	ANOVA ^c	2007 Baseline	2008 Baseline	NO	0.4735	-	Tukey's ^c
				2007 Baseline	2013 Baseline	YES	0.0239	3.5	
				2007 Baseline	2015	NO	0.7178	-	
				2008 Baseline	2013 Baseline	NO	0.2362	-	
				2008 Baseline	2015	NO	0.9559	-	
				2013 Baseline	2015	YES	0.0981	-1.2	
Simpson's Evenness ('E)	NO	0.24881	ANOVA ^c	2007 Baseline	2008 Baseline	NO	0.6080	-	Tukey's ^c
				2007 Baseline	2013 Baseline	NO	0.4471	-	
				2007 Baseline	2015	NO	0.9982	-	
				2008 Baseline	2013 Baseline	NO	0.9807	-	
				2008 Baseline	2015	NO	0.4732	-	
				2013 Baseline	2015	NO	0.3360	-	
Nemata (% of community)	NO	0.73134	ANOVA ^e	2007 Baseline	2008 Baseline	NO	0.9660	-	Tukey's ^e
				2007 Baseline	2013 Baseline	NO	0.8931	-	
				2007 Baseline	2015	NO	0.9986	-	
				2008 Baseline	2013 Baseline	NO	0.6775	-	
				2008 Baseline	2015	NO	0.9164	-	
				2013 Baseline	2015	NO	0.9316	-	
Ostracoda (% of community)	NO	0.28391	ANOVA ^e	2007 Baseline	2008 Baseline	NO	0.9961	-	Tamhane's ^e
				2007 Baseline	2013 Baseline	NO	0.7030	-	
				2007 Baseline	2015	NO	0.9997	-	
				2008 Baseline	2013 Baseline	NO	0.3996	-	
				2008 Baseline	2015	NO	0.9974	-	
				2013 Baseline	2015	NO	0.1192	-	
Chironomidae (% of community)	YES	0.02335	ANOVA ^e	2007 Baseline	2008 Baseline	NO	0.9684	-	Tukey's ^e
				2007 Baseline	2013 Baseline	NO	0.2194	-	
				2007 Baseline	2015	NO	0.4053	-	
				2008 Baseline	2013 Baseline	NO	0.3907	-	
				2008 Baseline	2015	NO	0.2103	-	
				2013 Baseline	2015	YES	0.0154	2.0	
Metal-Sensitive Chironomidae (% of community)	NO	0.75724	ANOVA ^e	2007 Baseline	2008 Baseline	NO	0.9987	-	Tamhane's ^e
				2007 Baseline	2013 Baseline	NO	0.9444	-	
				2007 Baseline	2015	NO	0.9822	-	
				2008 Baseline	2013 Baseline	NO	0.9974	-	
				2008 Baseline	2015	NO	1.0000	-	
				2013 Baseline	2015	NO	0.9924	-	
Collector-Gatherer FFG (% of community)	NO	0.66404	ANOVA ^e	2007 Baseline	2008 Baseline	NO	0.6348	-	Tukey's ^e
				2007 Baseline	2013 Baseline	NO	0.8525	-	
				2007 Baseline	2015	NO	0.9642	-	
				2008 Baseline	2013 Baseline	NO	0.9886	-	
				2008 Baseline	2015	NO	0.8527	-	
				2013 Baseline	2015	NO	0.9764	-	
Filterer FFG (% of community)	NO	0.73142	ANOVA ^e	2007 Baseline	2008 Baseline	NO	0.9991	-	Tamhane's ^e
				2007 Baseline	2013 Baseline	NO	0.9365	-	
				2007 Baseline	2015	NO	0.9803	-	
				2008 Baseline	2013 Baseline	NO	0.9936	-	
				2008 Baseline	2015	NO	0.9998	-	
				2013 Baseline	2015	NO	0.9823	-	
				2013 Baseline	2015	YES	0.0032	-	

^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 Data normally distributed. Untransformed data used for comparison(s).

^d Data non-normally distributed. Log transformation resulted in normal distribution, and thus the log transformed data used for comparison(s).

^e Logit transformed data were normally distributed. Parametric statistics applied.

^f Logit transformed data were non-normally distributed for data from at least one study area. ANOVA statistics for multiple group comparison were confirmed using KW H-test statistics.

^g Logit transformed data were non-normally distributed for data from at least one study area. Post hoc statistics for pair-wise comparisons were confirmed using MW U-test statistics.

Highlighting indicates significant difference between study years 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 E.34: Benthic invertebrate community statistical comparison results between Sheardown Lake NW profundal station 2015 and baseline (2007, 2013) data, Mary River Project CREMP, 2015.

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons ^a					
	Significant Difference Among Areas?	p-value	Statistical Test ^b	(I) Study Year	(J) Study Year	Significant Difference Between 2 Areas?	p-value	Magnitude of Difference	Statistical Test
Density (individuals/m ²)	YES	0.00117	ANOVA ^d	2007 Baseline	2013 Baseline	YES	0.0024	4.2	Tukey's ^d
				2007 Baseline	2015	NO	0.9920	-	
				2013 Baseline	2015	YES	0.0015	-4.4	
Richness (number of taxa)	NO	0.46140	ANOVA ^c	2007 Baseline	2013 Baseline	NO	0.5631	-	Tamhane's ^c
				2007 Baseline	2015	NO	0.9079	-	
				2013 Baseline	2015	NO	0.8741	-	
Simpson's Evenness ('E)	NO	0.50631	ANOVA ^c	2007 Baseline	2013 Baseline	NO	0.7912	-	Tukey's ^c
				2007 Baseline	2015	NO	0.8416	-	
				2013 Baseline	2015	NO	0.4771	-	
Nemata (% of community)	NO	0.12918	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.1859	-	Tukey's ^e
				2007 Baseline	2015	NO	0.9931	-	
				2013 Baseline	2015	NO	0.1402	-	
Ostracoda (% of community)	NO	0.28592	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.2575	-	Tukey's ^e
				2007 Baseline	2015	NO	0.6970	-	
				2013 Baseline	2015	NO	0.5847	-	
Chironomidae (% of community)	NO	0.17182	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.2364	-	Tukey's ^e
				2007 Baseline	2015	NO	0.9944	-	
				2013 Baseline	2015	NO	0.1846	-	
Metal-Sensitive Chironomidae (% of community)	NO	0.20894	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.8934	-	Tukey's ^e
				2007 Baseline	2015	NO	0.2044	-	
				2013 Baseline	2015	NO	0.4631	-	
Collector-Gatherer FFG (% of community)	NO	0.31375	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.9557	-	Tukey's ^e
				2007 Baseline	2015	NO	0.3199	-	
				2013 Baseline	2015	NO	0.5312	-	
Filterer FFG (% of community)	NO	0.53674	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.7575	-	Tamhane's ^e
				2007 Baseline	2015	NO	0.6659	-	
				2013 Baseline	2015	NO	0.9983	-	

^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 Data normally distributed. Untransformed data used for comparison(s).

^d Data non-normally distributed. Log transformation resulted in normal distribution, and thus the log transformed data used for comparison(s).

^e Logit transformed data were normally distributed. Parametric statistics applied.

^f Logit transformed data were non-normally distributed for data from at least one study area. ANOVA statistics for multiple group comparison were confirmed using KW H-test statistics.

^g Logit transformed data were non-normally distributed for data from at least one study area. Post hoc statistics for pair-wise comparisons were confirmed using MW U-test statistics.

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 E.35: Benthic invertebrate community data for Sheardown Lake SE, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Sheardown Lake SE - Littoral Stations					Sheardown Lake SE - Profundal Stations				
	DLO-2-11	DLO-2-10	DLO-2-4	DLO-2-9	DLO-2-1	DLO-2-12	DLO-2-8	DLO-2-13	DLO-2-2	DLO-2-3
ROUNDWORMS										
P. Nemata	0	0	448	34	0	0	0	86	0	17
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Lumbriculidae										
<i>Lumbriculus</i>	0	0	0	0	0	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
F. Acalyptonotidae										
<i>Acalyptonotus</i>	129	17	224	52	60	34	17	78	0	9
F. Hygrobatidae										
<i>Hygrobates</i>	78	52	69	103	103	9	34	60	0	34
F. Lebertiidae										
<i>Lebertia</i>	17	0	0	0	9	0	0	9	0	9
SEED SHRIMPS										
Cl. Ostracoda	276	690	0	0	9	0	26	26	17	9
INSECTS										
Cl. Insecta										
CADDISFLIES										
O. Trichoptera										
F. Apataniidae										
<i>Apatania</i>	0	52	0	0	0	0	0	0	0	0
TRUE FLIES										
O. Diptera										
MIDGES										
F. Chironomidae										
chironomid pupae	0	0	0	0	0	0	0	0	0	0
S.F. Chironominae										
<i>Chironomus</i>	181	241	0	0	500	0	17	0	121	198
<i>Corynocera</i>	43	0	0	0	0	0	0	0	0	0
<i>Lipiniella</i>	0	0	0	0	0	0	0	0	0	0
<i>Micropsectra</i>	0	69	216	52	440	78	181	138	233	552
<i>Paratanytarsus</i>	534	655	0	0	0	0	0	0	0	0
<i>Polypedilum</i>	0	0	0	0	0	0	0	0	0	0
<i>Sergentia</i>	0	86	0	0	0	0	0	0	0	0
<i>Stictochironomus</i>	3000	328	2914	2043	2362	1198	1776	905	2690	2052
<i>Tanytarsus</i>	534	138	172	26	0	17	0	78	0	0
S.F. Diamesinae										
<i>Diamesa</i>	0	0	0	0	0	0	0	17	0	0
<i>Protanypus</i>	0	0	0	0	0	0	9	0	0	0
<i>Pseudodiamesa</i>	0	0	0	0	0	0	0	0	0	0
S.F. Orthocladiinae										
<i>Abiskomyia</i>	534	0	103	0	233	129	78	0	60	121
<i>Cricotopus/Orthocladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Heterotrissocladius</i>	138	17	0	9	26	17	0	0	0	0
<i>Mesocricotopus</i>	0	0	0	0	0	0	0	0	0	0
<i>Paracladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Parakiefferiella</i>	0	0	0	0	0	0	0	0	0	0
<i>Psectrocladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Zalutschia</i>	0	0	0	0	34	0	0	0	0	0

Table E.35: Benthic invertebrate community data for Sheardown Lake SE, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Sheardown Lake SE - Littoral Stations					Sheardown Lake SE - Profundal Stations				
	DLO-2-11	DLO-2-10	DLO-2-4	DLO-2-9	DLO-2-1	DLO-2-12	DLO-2-8	DLO-2-13	DLO-2-2	DLO-2-3
Genus "Greenland"	0	0	0	0	0	0	0	0	0	0
S.F. Tanytopodinae										
<i>Arctopelopia</i>	43	388	0	0	0	0	0	0	0	0
<i>Procladius</i>	1,388	190	2,560	862	560	1,690	595	1,853	121	517
<i>Thienemannimyia</i> complex	52	52	0	0	0	0	9	0	0	0
Density (No. organisms per m²)	6,947	2,975	6,706	3,181	4,336	3,172	2,742	3,250	3,242	3,518
Richness (total number of taxa)^a	13	13	8	8	11	8	10	10	6	10
Simpson's Evenness (E)	0.815	0.920	0.752	0.585	0.725	0.653	0.587	0.659	0.364	0.677
Bray-Curtis Index	0.870	0.872	0.906	0.901	0.840	0.990	0.994	0.995	0.995	0.995
Percent Composition										
% Nemata	0.0%	0.0%	6.7%	1.1%	0.0%	0.0%	0.0%	2.6%	0.0%	0.5%
% Hydracarina	3.2%	2.3%	4.4%	4.9%	4.0%	1.4%	1.9%	4.5%	0.0%	1.5%
% Ostracods	4.0%	23.2%	0.0%	0.0%	0.2%	0.0%	0.9%	0.8%	0.5%	0.3%
% Chironomids	92.8%	72.7%	89.0%	94.1%	95.8%	98.6%	97.2%	92.0%	99.5%	97.8%
% Metal Sensitive Chironmids	16.0%	29.0%	5.8%	2.5%	10.1%	3.0%	6.9%	7.2%	7.2%	15.7%
Functional Feeding Group Composition										
% Shredders	0.0%	0.0%	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%
% Scrapers	0.0%	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Collector - Gatherers	60.1%	45.8%	51.7%	65.6%	72.2%	42.4%	69.5%	31.8%	89.1%	68.1%
% Filterers	15.4%	29.0%	5.8%	2.5%	10.1%	3.0%	6.6%	6.6%	7.2%	15.7%
Habitat Preference Group Composition										
% Clingers	10.9%	13.9%	10.2%	7.3%	14.1%	4.4%	8.5%	11.2%	7.2%	17.2%
% Sprawlers	43.3%	67.0%	39.7%	27.4%	19.9%	57.9%	25.8%	58.3%	6.1%	18.4%
% Burrowers	45.8%	19.1%	50.1%	65.3%	66.0%	37.8%	65.7%	30.5%	86.7%	64.4%

^a Bold entries excluded from taxa count

Table E.36: Statistical comparison of littoral and profundal habitat variables between Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2015.

Sampling Zone	Habitat Variable	Statistical Test Results			Summary Statistics					
		Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Area	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral	Depth (m)	YES	0.081	α	Reference Lake 3	9.80	1.11	0.49	8.40	11.20
					Sheardown Lake SE	8.16	1.47	0.66	6.80	10.40
	Secchi Depth (m)	YES	0.000	α, δ	Reference Lake 3	9.52	0.39	0.17	9.10	10.03
					Sheardown Lake SE	1.86	0.10	0.04	1.72	1.96
	Sand (% by weight)	YES	0.001	α, δ	Reference Lake 3	51	11	5	40	64
					Sheardown Lake SE	14	4	2	9	19
	Silt (% by weight)	YES	0.002	α, δ	Reference Lake 3	40	9	4	32	52
					Sheardown Lake SE	68	3	1	65	70
	Clay (% by weight)	YES	0.018	α	Reference Lake 3	9	4	2	4	15
					Sheardown Lake SE	18	6	3	11	25
Profundal	Depth (m)	YES	0.000	α	Reference Lake 3	20.6	1.9	0.8	18.5	23.4
					Sheardown Lake SE	12.4	1.2	0.5	11.0	13.7
	Secchi Depth (m)	YES	0.000	α	Reference Lake 3	9.38	1.24	0.55	8.04	11.41
					Sheardown Lake SE	1.72	0.14	0.06	1.58	1.93
	Sand (% by weight)	YES	0.007	α, γ	Reference Lake 3	37	11	5	19	47
					Sheardown Lake SE	18	5	2	12	25
	Silt (% by weight)	YES	0.004	α	Reference Lake 3	49	8	4	40	62
					Sheardown Lake SE	66	6	2	60	73
	Clay (% by weight)	NO	0.242	α	Reference Lake 3	14	3	1	11	19
					Sheardown Lake SE	16	1	0	15	17

^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 confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed using t-test assuming unequal variance.

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

Table E.37: Benthic invertebrate community statistical comparison results between Sheardown Lake SE littoral station 2015 and baseline (2013) data, Mary River Project CREMP, 2015.

Metric	Statistical Test Results				Summary Statistics					
	Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Magnitude of Difference ^b (No. of SD)	Study Year	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m ²)	YES	0.012	η	-1.4	2013 Baseline	10,649	4,062	1,817	6,482	15,207
					2015	4,829	1,898	849	2,975	6,947
Richness (Number of Taxa)	NO	0.124	α	-	2013 Baseline	14.2	4.0	1.8	9.0	20.0
					2015	10.6	2.5	1.1	8.0	13.0
Simpson's Evenness (E)	NO	0.719	α	-	2013 Baseline	0.785	0.096	0.043	0.668	0.891
					2015	0.759	0.123	0.055	0.585	0.920
Nemata (%)	NO	0.989	γ	-	2013 Baseline	0.2%	0.2%	0.1%	0.0%	0.5%
					2015	1.5%	2.9%	1.3%	0.0%	6.7%
Ostracoda (%)	NO	0.770	γ	-	2013 Baseline	5.9%	8.8%	3.9%	0.0%	19.5%
					2015	5.5%	10.0%	4.5%	0.0%	23.2%
Chironomidae (%)	NO	0.873	β	-	2013 Baseline	89.9%	7.5%	3.4%	77.8%	95.9%
					2015	88.9%	9.4%	4.2%	72.7%	95.8%
Metal-Sensitive Chironomidae (%)	NO	0.646	β	-	2013 Baseline	15.1%	9.8%	4.4%	3.5%	28.8%
					2015	12.7%	10.4%	4.7%	2.5%	29.0%
Collector-Gatherers (%)	YES	0.042	β	1.8	2013 Baseline	44.6%	8.2%	3.7%	37.1%	56.2%
					2015	59.1%	10.6%	4.7%	45.8%	72.2%
Filterers (%)	NO	0.635	β	-	2013 Baseline	15.1%	9.8%	4.4%	3.5%	28.8%
					2015	12.5%	10.4%	4.6%	2.5%	29.0%

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

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 E.38: Benthic invertebrate community statistical comparison results between Sheardown Lake SE profundal station 2015 and baseline (2007, 2013) data, Mary River Project CREMP, 2015.

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons ^a					
	Significant Difference Among Areas?	p-value	Statistical Test ^b	(I) Study Year	(J) Study Year	Significant Difference Between 2 Areas?	p-value	Magnitude of Difference	Statistical Test
Density (individuals/m ²)	YES	0.00001	ANOVA ^d	2007 Baseline	2013 Baseline	YES	0.0165	4.6	Tukey's ^d
				2007 Baseline	2015	YES	0.0005	-5.2	
				2013 Baseline	2015	YES	0.0000	-3.9	
Richness (number of taxa)	NO	0.48899	ANOVA ^c	2007 Baseline	2013 Baseline	NO	0.6439	-	Tukey's ^c
				2007 Baseline	2015	NO	0.9910	-	
				2013 Baseline	2015	NO	0.4916	-	
Simpson's Evenness ('E)	NO	0.25521	ANOVA ^c	2007 Baseline	2013 Baseline	NO	0.4536	-	Tukey's ^c
				2007 Baseline	2015	NO	0.9606	-	
				2013 Baseline	2015	NO	0.2494	-	
Nemata (% of community)	NO	0.59489	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.7104	-	Tukey's ^e
				2007 Baseline	2015	NO	0.5827	-	
				2013 Baseline	2015	NO	0.9788	-	
Ostracoda (% of community)	NO	0.36643	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.3635	-	Tukey's ^e
				2007 Baseline	2015	NO	0.8654	-	
				2013 Baseline	2015	NO	0.5521	-	
Chironomidae (% of community)	NO	0.71896	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.7661	-	Tukey's ^e
				2007 Baseline	2015	NO	0.9968	-	
				2013 Baseline	2015	NO	0.7576	-	
Metal-Sensitive Chironomidae (% of community)	NO	0.11966	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.6098	-	Tukey's ^e
				2007 Baseline	2015	NO	0.5300	-	
				2013 Baseline	2015	NO	0.1035	-	
Collector-Gatherer FFG (% of community)	NO	0.60633	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.7164	-	Tukey's ^e
				2007 Baseline	2015	NO	0.5955	-	
				2013 Baseline	2015	NO	0.9813	-	
Filterer FFG (% of community)	NO	0.11175	ANOVA ^e	2007 Baseline	2013 Baseline	NO	0.5998	-	Tukey's ^e
				2007 Baseline	2015	NO	0.5161	-	
				2013 Baseline	2015	YES	0.0964	-	

^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 Data normally distributed. Untransformed data used for comparison(s).

^d Data non-normally distributed. Log transformation resulted in normal distribution, and thus the log transformed data used for comparison(s).

^e Logit transformed data were normally distributed. Parametric statistics applied.

^f Logit transformed data were non-normally distributed for data from at least one study area. ANOVA statistics for multiple group comparison were confirmed using KW H-test statistics.

^g Logit transformed data were non-normally distributed for data from at least one study area. Post hoc statistics for pair-wise comparisons were confirmed using MW U-test statistics.

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 E.39: Benthic invertebrate community data for Mary Lake, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Mary Lake - Littoral Stations				Mary Lake - Profunda Stations					
	BLO-1	BLO-11	BLO-7	BLO-6	BLO-3	BLO-15	BLO-14	BLO-13	BLO-4	BLO-5
ROUNDWORMS										
P. Nemata	17	34	26	112	14	0	9	0	0	34
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Lumbriculidae										
<i>Lumbriculus</i>	0	0	0	0	0	0	0	0	0	0
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
F. Acalyptonotidae										
<i>Acalyptonotus</i>	34	0	9	9	14	17	0	0	0	0
F. Hygrobatidae										
<i>Hygrobates</i>	9	0	0	0	0	0	0	0	0	17
F. Lebertiidae										
<i>Lebertia</i>	0	0	0	9	14	9	0	9	17	0
SEED SHRIMPS										
Cl. Ostracoda	198	0	0	26	72	26	0	155	121	0
INSECTS										
Cl. Insecta										
CADDISFLIES										
O. Trichoptera										
F. Apataniidae										
<i>Apatania</i>	0	0	0	0	0	0	0	0	0	0
TRUE FLIES										
O. Diptera										
MIDGES										
F. Chironomidae										
chironomid pupae	9	0	0	0	0	0	0	0	0	17
S.F. Chironominae										
<i>Chironomus</i>	17	103	0	0	0	0	0	0	0	276
<i>Corynocera</i>	0	0	0	0	0	0	0	0	0	0
<i>Lipiniella</i>	0	69	0	0	0	0	0	0	0	0
<i>Microsepectra</i>	1147	1276	0	0	29	26	0	69	43	431
<i>Paratanytarsus</i>	0	0	0	0	0	9	0	0	0	0
<i>Polypedilum</i>	0	0	0	0	0	0	0	0	0	0
<i>Sergentia</i>	0	2,000	0	0	0	0	0	0	0	52
<i>Stictochironomus</i>	1241	414	0	0	0	9	0	0	0	672
<i>Tanytarsus</i>	0	0	0	9	0	9	0	0	0	103
S.F. Diamesinae										
<i>Diamesa</i>	0	0	0	0	0	0	0	0	0	0
<i>Protanypus</i>	0	0	9	26	0	0	0	0	0	17
<i>Pseudodiamesa</i>	0	34	9	78	57	43	0	0	0	17
S.F. Orthoclaadiinae										
<i>Abiskomyia</i>	319	103	60	9	0	0	0	0	0	17
<i>Cricotopus/Orthoclaadius</i>	0	0	0	0	0	9	0	0	0	0
<i>Heterotrissoclaadius</i>	164	0	181	466	143	353	112	638	302	534
<i>Mesocricotopus</i>	0	0	0	0	0	9	0	9	0	0
<i>Paracladius</i>	0	0	0	69	0	0	0	0	0	0
<i>Parakiefferiella</i>	0	0	0	0	14	0	0	0	0	0
<i>Psectrocladius</i>	0	0	0	0	0	0	0	0	0	0
<i>Zalutschia</i>	0	0	0	0	0	0	0	0	0	0

Table E.39: Benthic invertebrate community data for Mary Lake, August 2015. Densities expressed in number of organisms per square meter.

Station Replicate	Mary Lake - Littoral Stations				Mary Lake - Profundal Stations					
	BLO-1	BLO-11	BLO-7	BLO-6	BLO-3	BLO-15	BLO-14	BLO-13	BLO-4	BLO-5
Genus "Greenland"	0	0	0	0	0	0	0	0	0	0
S.F. Tanypodinae										
<i>Arctopelopia</i>	0	0	0	0	0	17	0	0	0	0
<i>Procladius</i>	1,466	0	43	9	0	17	26	0	9	34
<i>Thienemannimyia</i> complex	0	0	0	0	0	0	0	0	0	0
Density (No. organisms per m²)	4,621	4,033	337	822	357	553	147	880	492	2,221
Richness (total number of taxa)^a	10	8	7	11	8	13	3	5	5	12
Simpson's Evenness (E)	0.841	0.733	0.765	0.706	0.869	0.626	0.577	0.546	0.692	0.863
Bray-Curtis Index	0.803	0.883	0.645	0.621	0.41651	0.543	0.280	0.686	0.500	0.870
Percent Composition										
% Nemata	0.4%	0.8%	7.7%	13.6%	4.2%	0.0%	6.1%	0.0%	0.0%	1.5%
% Hydracarina	0.9%	0.0%	2.7%	2.2%	8.3%	4.7%	0.0%	1.0%	3.5%	0.8%
% Ostracods	4.3%	0.0%	0.0%	3.2%	19.9%	4.7%	0.0%	17.6%	24.6%	0.0%
% Chironomids	94.4%	99.2%	89.6%	81.0%	67.6%	90.6%	93.9%	81.4%	72.0%	97.7%
% Metal Sensitive Chironmids	24.8%	31.6%	2.7%	4.3%	7.9%	8.0%	0.0%	7.8%	8.7%	24.8%
Functional Feeding Group Composition										
% Shredders	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	0.0%	0.0%	0.0%	0.0%
% Scrapers	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Collector - Gatherers	42.5%	68.4%	84.6%	95.6%	83.8%	79.6%	82.3%	91.1%	86.0%	73.7%
% Filterers	24.8%	31.6%	0.0%	1.1%	7.9%	8.0%	0.0%	7.8%	8.7%	24.0%
Habitat Preference Group Composition										
% Clingers	25.8%	81.2%	2.7%	3.3%	16.2%	12.7%	0.0%	8.9%	12.2%	27.1%
% Sprawlers	46.7%	5.1%	86.9%	79.9%	79.6%	85.7%	93.9%	91.1%	87.8%	27.9%
% Burrowers	27.6%	13.7%	10.4%	16.8%	4.2%	1.6%	6.1%	0.0%	0.0%	45.0%

^a Bold entries excluded from taxa count

Table E.40: Statistical comparison of littoral and profundal habitat variables between Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2015.

Sampling Zone	Habitat Variable	Statistical Test Results			Summary Statistics					
		Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Area	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral	Depth (m)	NO	0.922	α	Reference Lake 3	9.80	1.11	0.49	8.40	11.20
					Mary Lake	9.68	2.50	1.25	6.70	12.80
	Secchi Depth (m)	YES	0.001	α, δ	Reference Lake 3	9.52	0.39	0.17	9.10	10.03
					Mary Lake	4.03	1.08	0.54	3.15	5.38
	Sand (% by weight)	NO	0.318	α	Reference Lake 3	51	11	5	40	64
					Mary Lake	32	40	20	7	90
	Silt (% by weight)	NO	0.644	α	Reference Lake 3	40	9	4	32	52
					Mary Lake	46	26	13	8	70
	Clay (% by weight)	NO	0.248	α, δ	Reference Lake 3	9	4	2	4	15
					Mary Lake	22	19	9	1	39
Profundal	Depth (m)	NO	0.624	α	Reference Lake 3	20.6	1.9	0.8	18.5	23.4
					Mary Lake	21.6	4.2	1.7	16.4	29.1
	Secchi Depth (m)	YES	0.000	α	Reference Lake 3	9.38	1.24	0.55	8.04	11.41
					Mary Lake	4.78	0.31	0.13	4.21	5.13
	Sand (% by weight)	NO	0.883	α, γ	Reference Lake 3	37	11	5	19	47
					Mary Lake	35	30	12	13	91
	Silt (% by weight)	NO	0.514	α	Reference Lake 3	49	8	4	40	62
					Mary Lake	42	21	9	7	65
	Clay (% by weight)	NO	0.240	α, δ	Reference Lake 3	14	3	1	11	19
					Mary Lake	23	16	7	3	43

^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 confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed using t-test assuming unequal variance.

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

Table E.41: Benthic invertebrate community statistical comparison results between Mary Lake littoral station 2015 and baseline (2013 data, Mary River Project CREMP, 2015.

Metric	Statistical Test Results				Summary Statistics					
	Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Magnitude of Difference ^b (No. of SD)	Study Year	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m ²)	NO	0.890	α	-	2013 Baseline	2,667	1,454	840	998	3,666
					2015	2,453	2,186	1,093	337	4,621
Richness (Number of Taxa)	NO	0.521	α	-	2013 Baseline	8.0	2.0	1.2	6.0	10.0
					2015	9.0	1.8	0.9	7.0	11.0
Simpson's Evenness (E)	NO	0.326	α	-	2013 Baseline	0.718	0.041	0.024	0.686	0.764
					2015	0.761	0.058	0.029	0.706	0.841
Nemata (%)	NO	0.779	β	-	2013 Baseline	7.3%	11.2%	6.5%	0.1%	20.2%
					2015	5.6%	6.3%	3.1%	0.4%	13.6%
Ostracoda (%)	NO	0.424	β	-	2013 Baseline	0.2%	0.4%	0.2%	0.0%	0.7%
					2015	1.9%	2.2%	1.1%	0.0%	4.3%
Chironomidae (%)	NO	0.893	β	-	2013 Baseline	90.8%	11.8%	6.8%	77.2%	98.8%
					2015	91.1%	7.7%	3.9%	81.0%	99.2%
Metal-Sensitive Chironomidae (%)	NO	0.493	β	-	2013 Baseline	22.4%	13.8%	8.0%	7.1%	34.1%
					2015	15.8%	14.6%	7.3%	2.7%	31.6%
Collector-Gatherers (%)	NO	0.710	β	-	2013 Baseline	66.0%	26.7%	15.4%	38.3%	91.5%
					2015	72.8%	23.1%	11.5%	42.5%	95.6%
Filterers (%)	NO	0.319	δ	-	2013 Baseline	22.0%	14.5%	8.4%	5.9%	34.1%
					2015	14.4%	16.2%	8.1%	0.0%	31.6%

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

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 E.42: Benthic invertebrate community statistical comparison results between Mary Lake profundal station 2015 and baseline (2007) data, Mary River Project CREMP, 2015.

Metric	Statistical Test Results				Summary Statistics					
	Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Magnitude of Difference ^b (No. of SD)	Study Year	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m ²)	YES	0.065	η	-0.8	2007 Baseline	3,512	3,257	1,629	674	7,463
					2015	775	748	306	147	2,221
Richness (Number of Taxa)	NO	0.930	α	-	2007 Baseline	8.0	6.2	3.1	1.5	16.0
					2015	7.7	4.1	1.7	3.0	13.0
Simpson's Evenness (E)	YES	0.095	α	0.9	2007 Baseline	0.453	0.268	0.134	0.055	0.637
					2015	0.696	0.142	0.058	0.546	0.873
Nemata (%)	NO	0.947	β	-	2007 Baseline	1.3%	1.8%	0.9%	0.0%	3.9%
					2015	2.0%	2.6%	1.1%	0.0%	6.1%
Ostracoda (%)	NO	0.298	β	-	2007 Baseline	1.6%	2.2%	1.1%	0.0%	4.6%
					2015	11.1%	10.9%	4.4%	0.0%	24.6%
Chironomidae (%)	YES	0.052	β	-2.7	2007 Baseline	96.4%	4.7%	2.3%	89.6%	100.0%
					2015	83.8%	12.2%	5.0%	67.6%	97.7%
Metal-Sensitive Chironomidae (%)	NO	0.650	γ	-	2007 Baseline	33.7%	27.9%	13.9%	0.0%	61.4%
					2015	9.5%	8.2%	3.3%	0.0%	24.8%
Collector-Gatherers (%)	NO	0.962	δ	-	2007 Baseline	64.4%	27.7%	13.8%	37.4%	100.0%
					2015	82.7%	5.9%	2.4%	73.7%	91.1%
Filterers (%)	NO	0.659	γ	-	2007 Baseline	33.1%	27.8%	13.9%	0.0%	60.4%
					2015	9.4%	7.9%	3.2%	0.0%	24.0%

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

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.

APPENDIX F

**FISH POPULATION SURVEY
DATA**

Table F.1: Electrofishing catch records, Mary River Project CREMP, August 2015. 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)	
											Arctic Charr		Nine-spine Stickleback			
		Start		Finish			Output Voltage (volts)	Cycle Frequency (Hz)	Duty Cycle (%)		No. Captured	CPUE	No. Captured	CPUE	No. Captured	CPUE
		Easting	Northing	Easting	Northing											
Reference Lake 3	REF3-EF-1	574886	7853039	574605	7853047	23-Aug-15	330	30 - 40	8 - 12	3,242	28	0.52	5	0.09	33	0.61
	REF3-EF-2	574886	7853039	575063	7853061	24-Aug-15	500 - 600	50	3	2,549	39	0.92	3	0.07	42	0.99
	REF3-EF-3	575063	7853061	575170	7853090	24-Aug-15	600	50	3	2,722	32	0.71	0	0	32	0.71
	Totals									8,513	99	0.71	8	0.05	107	0.77
Camp Lake	CL-EF-2	557801	7914651	557810	7914602	13-Aug-15	500	50	1	1,810	106	3.51	0	0	106	3.51
Sheardown Lake NW	SNW-EF-1	560285	7913483	560055	7913528	15-Aug-15	500	50	1	1,843	106	3.45	0	0	106	3.45
Sheardown Lake SE	SSE-EF-1	560744	7912333	561223	7912014	15-Aug-15	500	50	1	4,120	109	1.59	0	0	109	1.59
Mary Lake	ML-EF-1	555421	7905155	555497	7905018	19-Aug-15	875	30	12	2,335	107	2.75	3	0.08	110	2.83

Table F.2: Gill netting catch records for Reference Lake 3, Mary River Project CREMP, August 2015. 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								½"	1"	1½"	2"	3"	4"	4½"	5"		
REF3-GN-1	½", 1½", 2", 3", 4"	576029	7852499	137.16	20-Aug-15	20-Aug-15	9:15	10:36	1.35	1.85	0	-	1	0	0	0	-	-	1	0.54
				137.16	20-Aug-15	20-Aug-15	10:54	14:02	3.13	4.30	0	-	0	0	0	0	-	-	0	0
REF3-GN-2	1½", 3", 5"	575490	7852586	91.44	20-Aug-15	20-Aug-15	9:33	10:20	0.78	0.72	-	-	0	-	0	-	-	0	0	0
REF3-GN-3	1", 2", 3", 4"	575316	7852908	121.92	20-Aug-15	20-Aug-15	9:45	11:28	1.72	2.09	-	0	-	0	0	0	-	-	0	0
REF3-GN-4	½", 1½", 2", 3", 4"	574555	7853032	137.16	20-Aug-15	20-Aug-15	9:53	11:51	1.97	2.70	0	-	0	0	0	0	-	-	0	0
REF3-GN-5	1½", 3", 5"	574510	7852439	91.44	20-Aug-15	20-Aug-15	10:28	12:15	1.78	1.63	-	-	0	-	0	-	-	0	0	0
REF3-GN-6	1", 2", 4", 4½"	574539	7853377	167.64	20-Aug-15	20-Aug-15	11:21	13:39	2.30	3.86	-	0	-	0	-	0	0	-	0	0
REF3-GN-7	1", 2", 3", 4"	575442	7852824	121.92	20-Aug-15	20-Aug-15	11:43	14:21	2.63	3.21	-	0	-	0	0	0	-	-	0	0
REF3-GN-8	½", 1½", 2", 3", 4"	574454	7853634	137.16	20-Aug-15	20-Aug-15	12:12	15:35	3.38	4.64	0	-	0	0	0	0	-	-	0	0
REF3-GN-9	1½", 3", 5"	574152	7852282	91.44	20-Aug-15	20-Aug-15	12:35	15:03	2.47	2.26	-	-	0	-	0	-	-	0	0	0
REF3-GN-10	1", 2", 4", 4½"	574209	7853580	167.64	20-Aug-15	20-Aug-15	13:46	14:00	0.23	0.39	-	0	-	0	-	0	0	-	0	0
REF3-GN-11	½", 1½", 2", 3", 4"	575600	7853056	137.16	20-Aug-15	20-Aug-15	14:19	17:12	2.88	3.95	0	-	0	0	0	0	-	-	0	0
REF3-GN-12	1", 2", 3", 4"	574924	7852983	121.92	20-Aug-15	20-Aug-15	14:42	17:20	2.63	3.21	-	0	-	0	0	0	-	-	0	0
REF3-GN-13	1½", 3", 5"	574713	7853834	91.44	20-Aug-15	20-Aug-15	15:11	17:40	2.48	2.27	-	-	0	-	0	-	-	0	0	0
REF3-GN-14	½", 1½", 2", 3", 4"	576153	7852516	137.16	23-Aug-15	23-Aug-15	11:50	16:54	5.07	6.95	0	-	0	2	0	0	-	-	2	0.29
REF3-GN-15	1", 2", 3", 4"	574951	7852892	121.92	23-Aug-15	23-Aug-15	12:00	17:18	5.30	6.46	-	0	-	2	0	0	-	-	2	0.31
REF3-GN-16	½", 1½", 2", 3", 4"	574685	7852886	137.16	23-Aug-15	23-Aug-15	12:20	17:45	5.42	7.43	0	-	0	0	0	0	-	-	0	0
REF3-GN-17	1½", 3", 5"	573595	7853545	91.44	23-Aug-15	23-Aug-15	12:40	16:00	3.33	3.05	-	-	0	-	1	-	-	0	1	0.33
Totals										60.97	0	0	1	4	1	0	0	0	6	0.08

Table F.3: Gill netting catch records for Camp Lake, Mary River Project CREMP, August 2015. 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								½"	1"	1½"	2"	3"	4"	4½"	5"		
CL-GN-1	½", 2", 3", 4", 5"	557582	7914475	152.40	16-Aug-15	16-Aug-15	8:40	10:55	2.25	3.43	0	-	-	2	0	1	-	0	3	0.87
CL-GN-2	1½", 2", 3", 4½", 5"	557624	7914642	182.88	16-Aug-15	16-Aug-15	8:50	11:20	2.50	4.57	-	-	3	3	3	-	1	0	10	2.19
					16-Aug-15	16-Aug-15	11:45	16:15	4.50	8.23	-	-	3	4	5	-	0	0	12	1.46
CL-GN-3	1", 2", 3", 4", 5"	556955	7913625	213.36	16-Aug-15	16-Aug-15	9:15	12:40	3.42	7.29	-	2	-	1	0	0	-	0	3	0.41
CL-GN-4	½", 1½", 3", 4", 5"	556587	7913514	152.40	16-Aug-15	16-Aug-15	9:35	13:00	3.42	5.21	0	-	0	-	4	0	-	0	4	0.77
CL-GN-5	½", 1½", 2", 3", 4"	556988	7914894	152.40	16-Aug-15	16-Aug-15	10:00	14:30	4.50	6.86	1	-	1	0	1	0	-	-	3	0.44
CL-GN-6	½", 1½", 2", 3", 5"	556701	7914822	152.40	16-Aug-15	16-Aug-15	10:20	14:50	4.50	6.86	0	-	2	2	0	-	-	0	4	0.58
CL-GN-7	½", 1½", 3", 4", 5"	556584	7913396	152.40	16-Aug-15	16-Aug-15	13:20	16:40	3.33	5.08	0	-	0	-	0	0	-	0	0	0
CL-GN-8	1", 2", 3", 4", 5"	557258	7914759	213.36	16-Aug-15	16-Aug-15	14:10	17:05	2.92	6.22	-	1	-	3	2	0	-	1	7	1.12
CL-GN-9	½", 1½", 2", 3", 4"	557742	7914721	152.40	16-Aug-15	16-Aug-15	15:05	17:15	2.17	3.30	0	-	3	6	2	0	-	-	11	3.33
CL-GN-10	1½", 2", 3", 4½", 5"	557627	7914675	182.88	17-Aug-15	17-Aug-15	8:25	10:40	2.25	4.11	-	-	1	1	1	-	1	0	4	0.97
					17-Aug-15	17-Aug-15	11:00	15:00	4.00	7.32	-	-	0	1	2	-	0	0	3	0.41
CL-GN-11	½", 2", 3", 4", 5"	557803	7914207	152.40	17-Aug-15	17-Aug-15	8:40	10:20	1.67	2.54	0	-	-	4	0	0	-	0	4	1.57
CL-GN-12	1", 2", 3", 4", 5"	557646	7914676	213.36	17-Aug-15	17-Aug-15	8:50	11:00	2.17	4.62	-	2	-	1	2	2	-	1	8	1.73
	½", 1½", 3", 4", 5"			152.40	17-Aug-15	17-Aug-15	14:00	16:45	2.75	4.19	0	-	0	-	1	0	-	0	1	0.24
CL-GN-13	½", 1½", 3", 4", 5"	557387	7914805	152.40	17-Aug-15	17-Aug-15	9:00	13:45	4.75	7.24	0	-	0	-	2	0	-	0	2	0.28
CL-GN-14	½", 1½", 2", 3", 4"	556150	7913820	152.40	17-Aug-15	17-Aug-15	9:25	12:45	3.33	5.08	0	-	0	0	0	0	-	-	0	0
CL-GN-15	½", 1½", 2", 3", 5"	556356	7914153	152.40	17-Aug-15	17-Aug-15	9:30	13:05	3.58	5.46	0	-	0	0	3	-	-	0	3	0.55
CL-GN-16	½", 2", 3", 4", 5"	557602	7914425	152.40	17-Aug-15	17-Aug-15	10:30	14:10	3.67	5.59	0	-	-	4	0	1	-	0	5	0.89
					17-Aug-15	17-Aug-15	14:30	17:20	2.83	4.32	0	-	-	4	0	0	-	0	4	0.93
CL-GN-17	1", 2", 3", 4", 5"	557496	7914735	213.36	17-Aug-15	17-Aug-15	12:15	15:45	3.50	7.47	-	0	-	3	3	0	-	0	6	0.80
CL-GN-18	½", 1½", 2", 3", 4"	557157	7915020	152.40	17-Aug-15	17-Aug-15	13:30	16:20	2.83	4.32	0	-	0	1	3	0	-	-	4	0.93
CL-GN-19	½", 1½", 2", 3", 5"	557703	7914535	152.40	17-Aug-15	17-Aug-15	15:35	17:20	1.75	2.67	0	-	0	2	0	-	-	0	2	0.75
Totals										121.97	1	5	13	42	34	4	2	2	103	0.92

Table F.4: Gill netting catch records for Sheardown Lake NW, Mary River Project CREMP, August 2015. 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								½"	1"	1½"	2"	3"	4"	4½"	5"		
SNW-GN-1	½", 1½", 2", 3", 4"	559924	7913545	137.16	13-Aug-15	15-Aug-15	14:20	10:00	43.67	59.89	4	-	20	13	4	7	-	-	48	0.80
SNW-GN-2	½", 1½", 2", 3", 4"	560005	7913416	137.16	15-Aug-15	15-Aug-15	11:30	13:47	2.28	3.13	2	-	1	2	0	1	-	-	6	1.92
SNW-GN-3	½", 1½", 2", 3", 4"	560360	7913183	137.16	15-Aug-15	15-Aug-15	12:00	14:56	2.93	4.02	0	-	0	0	0	0	-	-	0	0
SNW-GN-4	1½", 3", 5"	560314	7912959	91.44	15-Aug-15	15-Aug-15	12:20	15:32	3.20	2.93	-	-	0	-	1	-	-	0	1	0.34
SNW-GN-5	1", 2", 4", 4½"	560224	7913349	167.64	15-Aug-15	15-Aug-15	13:32	15:59	2.45	4.11	-	1	-	2	-	2	0	-	5	1.22
SNW-GN-6	½", 1½", 2", 3", 4"	559954	7913458	137.16	15-Aug-15	15-Aug-15	15:10	17:12	2.03	2.79	6	-	8	5	0	0	-	-	19	6.81
SNW-GN-7	1½", 3", 5"	560016	7913438	91.44	16-Aug-15	16-Aug-15	9:15	10:20	1.08	0.99	-	-	0	-	0	-	-	0	0	0
					16-Aug-15	16-Aug-15	10:25	11:39	1.23	1.13	-	-	0	-	0	-	-	0	0	0
SNW-GN-8	½", 1½", 2", 3", 4"	559853	7913527	137.16	16-Aug-15	16-Aug-15	9:25	10:40	1.25	1.71	0	-	2	1	0	0	-	-	3	1.75
					16-Aug-15	16-Aug-15	10:46	12:12	1.43	1.97	1	-	1	0	0	0	-	-	2	1.02
					16-Aug-15	16-Aug-15	12:30	14:45	2.25	3.09	0	-	1	0	0	0	-	-	1	0.32
SNW-GN-9	1", 2", 4", 4½"	560322	7913022	167.64	16-Aug-15	16-Aug-15	11:20	12:50	1.50	2.51	-	1	-	1	-	0	0	-	2	0.80
					16-Aug-15	16-Aug-15	13:13	15:19	2.10	3.52	-	1	-	0	-	0	0	-	1	0.28
SNW-GN-10	1½", 3", 5"	560474	7913158	91.44	16-Aug-15	16-Aug-15	12:00	14:30	2.50	2.29	-	-	1	-	1	-	-	0	2	0.87
					16-Aug-15	16-Aug-15	14:35	16:15	1.67	1.52	-	-	1	-	0	-	-	0	1	0.66
SNW-GN-11	½", 1½", 2", 3", 4"	559791	7913371	137.16	16-Aug-15	16-Aug-15	15:10	17:43	2.55	3.50	1	-	1	1	0	0	-	-	3	0.86
SNW-GN-12	½", 1½", 2", 3", 4"	559980	7913450	137.16	16-Aug-15	16-Aug-15	16:10	17:49	1.65	2.26	0	-	1	0	0	0	-	-	1	0.44
SNW-GN-13	1½", 3", 5"	559994	7913183	91.44	16-Aug-15	16-Aug-15	16:33	18:10	1.62	1.48	-	-	0	-	1	-	-	0	1	0.68
Totals										102.84	14	3	37	25	7	10	0	0	96	1.04

Table F.5: Gill netting catch records for Sheardown Lake SE, Mary River Project CREMP, August 2015. 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								½"	1"	1½"	2"	3"	4"	4½"	5"		
SSE-GN-1	½", 1½", 2", 3", 4"	561425	7911887	137.16	17-Aug-15	17-Aug-15	9:00	11:09	2.15	2.95	3	-	4	2	2	0	-	-	11	3.73
					17-Aug-15	17-Aug-15	11:20	14:20	3.00	4.11	2	-	0	4	0	1	-	-	7	1.70
					17-Aug-15	17-Aug-15	14:54	16:48	1.90	2.61	2	-	0	3	4	0	-	-	9	3.45
SSE-GN-2	1½", 3", 5"	561224	7911872	91.44	17-Aug-15	17-Aug-15	9:08	11:30	2.37	2.16	-	-	0	-	3	-	-	0	3	1.39
					17-Aug-15	17-Aug-15	11:50	15:05	3.25	2.97	-	-	0	-	4	-	-	0	4	1.35
					17-Aug-15	17-Aug-15	15:29	17:20	1.85	1.69	-	-	4	-	1	-	-	0	5	2.96
SSE-GN-3	1", 2", 4", 4½"	560961	7911980	167.64	17-Aug-15	17-Aug-15	9:44	13:30	3.77	6.31	-	0	-	7	-	0	0	-	7	1.11
SSE-GN-4	1", 2", 3", 4"	561039	7911943	121.92	17-Aug-15	17-Aug-15	9:53	12:10	2.28	2.78	-	2	-	2	8	0	-	-	12	4.31
					17-Aug-15	17-Aug-15	13:00	15:45	2.75	3.35	-	2	-	0	2	1	-	-	5	1.49
SSE-GN-5	½", 1½", 2", 3", 4"	560715	7912186	137.16	17-Aug-15	17-Aug-15	10:15	13:47	3.53	4.85	0	-	1	2	3	0	-	-	6	1.24
SSE-GN-6	1", 2", 3", 4"	561440	7911912	121.92	18-Aug-15	18-Aug-15	9:08	10:15	1.12	1.36	-	0	-	1	4	0	-	-	5	3.67
					18-Aug-15	18-Aug-15	10:40	14:45	4.08	4.98	-	0	-	2	2	0	-	-	4	0.80
SSE-GN-7	½", 1½", 2", 3", 4"	561294	7911888	137.16	18-Aug-15	18-Aug-15	9:25	11:02	1.62	2.22	1	-	4	6	2	0	-	-	13	5.86
					18-Aug-15	18-Aug-15	12:05	14:30	2.42	3.31	0	-	1	1	3	0	-	-	5	1.51
SSE-GN-8	1½", 3", 5"	561091	7911931	91.44	18-Aug-15	18-Aug-15	9:16	12:10	2.90	2.65	-	-	2	-	3	-	-	0	5	1.89
SSE-GN-9	½", 1½", 2", 3", 4"	560870	7912049	137.16	18-Aug-15	18-Aug-15	9:50	13:03	3.22	4.41	1	-	3	5	2	0	-	-	11	2.49
SSE-GN-10	1", 2", 4", 4½"	561177	7911825	167.64	18-Aug-15	18-Aug-15	10:08	14:00	3.87	6.48	-	1	-	5	-	1	0	-	7	1.08
Totals										59.21	9	5	19	40	43	3	0	0	119	2.22

Table F.6: Gill netting catch records for Mary Lake, Mary River Project CREMP, August 2015. 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								½"	1"	1½"	2"	3"	4"	4½"	5"		
ML-GN-1	1½", 2", 3", 4.5", 5"	552749	7906526	182.88	18-Aug-15	18-Aug-15	9:10	12:45	3.58	6.55	-	-	0	0	2	-	0	1	3	0.46
ML-GN-2	½", 2", 3", 4", 5"	552304	7906631	152.40	18-Aug-15	18-Aug-15	11:05	13:00	1.92	2.92	1	-	-	1	0	0	-	0	2	0.68
ML-GN-3	½", 1½", 2", 3", 5"	552262	7906461	152.40	18-Aug-15	18-Aug-15	11:15	13:15	2.00	3.05	0	-	0	2	1	-	-	0	3	0.98
ML-GN-4	1", 2", 3", 4", 5"	553325	7907346	213.36	18-Aug-15	18-Aug-15	11:45	14:40	2.92	6.22	-	1	-	3	1	0	-	0	5	0.80
					18-Aug-15	18-Aug-15	15:00	17:30	2.50	5.33	-	0	-	0	3	0	-	0	3	0.56
ML-GN-5	½", 1½", 3", 4", 5"	553720	7907836	152.40	18-Aug-15	18-Aug-15	12:00	15:30	3.50	5.33	0	-	4	-	6	0	-	2	12	2.25
ML-GN-6	½", 1½", 2", 3", 4"	553043	7908343	152.40	18-Aug-15	18-Aug-15	12:15	16:00	3.75	5.72	2	-	2	5	8	5	-	-	22	3.85
ML-GN-7	1½", 2", 3", 4½", 5"	552540	7906722	213.36	18-Aug-15	18-Aug-15	13:05	17:00	3.92	8.36	-	-	0	0	2	-	0	1	3	0.36
ML-GN-8	1½", 2", 3", 4½", 5"	554817	7906050	182.88	19-Aug-15	19-Aug-15	8:50	11:00	2.17	3.96	-	-	1	0	3	-	0	0	4	1.01
					19-Aug-15	19-Aug-15	11:20	15:00	3.67	6.71	-	-	0	4	2	-	0	0	6	0.89
ML-GN-9	½", 2", 3", 4", 5"	554877	7906036	152.40	19-Aug-15	19-Aug-15	9:00	11:50	2.83	4.32	5	-	-	3	2	0	-	0	10	2.32
					19-Aug-15	19-Aug-15	12:10	15:30	3.33	5.08	0	-	-	3	4	1	-	0	8	1.57
ML-GN-10	1", 2", 3", 4", 5"	555074	7905701	213.36	19-Aug-15	19-Aug-15	9:15	11:30	2.25	4.80	-	2	-	7	2	0	-	1	12	2.50
ML-GN-11	½", 1½", 3", 4", 5"	555206	7905360	152.40	19-Aug-15	19-Aug-15	9:30	13:00	3.50	5.33	0	-	0	-	3	0	-	0	3	0.56
ML-GN-12	½", 1½", 2", 3", 4"	555240	7905041	152.40	19-Aug-15	19-Aug-15	9:50	13:40	3.83	5.84	0	-	0	3	2	0	-	-	5	0.86
ML-GN-13	½", 1½", 2", 3", 5"	555888	7904020	152.40	19-Aug-15	19-Aug-15	10:05	14:00	3.92	5.97	0	-	0	2	7	-	-	3	12	2.01
Totals										85.50	8	3	7	33	48	6	0	8	113	1.35

Table F.7: Summary of Arctic charr gill net catches by mesh size, Mary River Project CREMP, August 2015.

Waterbody	Effort (m*hrs/100 m)	Arctic Charr Catch per Mesh Size								Total Catch	CPUE ^a	Mortalities
		½"	1"	1½"	2"	3"	4"	4½"	5"			
Reference Lake 3	60.97	0	0	1	4	1	0	0	0	6	0.08	3
Camp Lake	121.92	1	5	13	42	34	4	2	2	103	0.92	17
Sheardown Lake NW	102.84	14	3	37	25	7	10	0	0	96	1.04	44
Sheardown Lake SE	59.21	9	5	19	40	43	3	0	0	119	2.22	19
Mary Lake	86.26	8	3	7	33	42	6	0	8	107	1.35	18
Total	431.20	32	16	77	144	127	23	2	10	431	1.13	101

^a Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table F.8: Arctic charr measurements from fish captured at Reference Lake 3 by electrofishing, Mary River Project CREMP, August 2015.

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF3-ACJ-1	5.2	5.5	1.195	0	0.850
REF3-ACJ-2	6.9	7.4	2.886	2	0.879
REF3-ACJ-3	8.1	8.6	4.415	-	0.831
REF3-ACJ-4	9.9	10.7	8.159	-	0.841
REF3-ACJ-5	6.8	7.3	2.885	-	0.918
REF3-ACJ-6	7.0	7.5	2.728	-	0.795
REF3-ACJ-7	10.7	11.5	10.866	-	0.887
REF3-ACJ-8	11.3	12.2	11.624	-	0.806
REF3-ACJ-9	5.7	6.0	1.362	-	0.735
REF3-ACJ-10	5.5	5.8	1.465	-	0.881
REF3-ACJ-11	7.2	7.7	2.995	-	0.802
REF3-ACJ-12	6.9	7.4	2.545	-	0.775
REF3-ACJ-13	5.4	5.7	1.394	-	0.885
REF3-ACJ-14	6.9	7.5	3.018	-	0.919
REF3-ACJ-15	5.5	5.8	1.338	-	0.804
REF3-ACJ-16	7.9	8.4	3.825	-	0.776
REF3-ACJ-17	8.4	9.0	5.076	-	0.856
REF3-ACJ-18	8.8	9.6	5.478	-	0.804
REF3-ACJ-19	3.8	4.0	0.496	-	0.904
REF3-ACJ-20	5.3	5.6	1.188	-	0.798
REF3-ACJ-21	5.3	5.6	1.144	-	0.768
REF3-ACJ-22	6.9	7.3	2.705	-	0.823
REF3-ACJ-23	10.1	10.9	8.482	-	0.823
REF3-ACJ-24	7.2	7.7	3.069	-	0.822
REF3-ACJ-25	5.6	5.9	1.517	-	0.864
REF3-ACJ-26	5.0	5.3	1.063	-	0.850
REF3-ACJ-27	5.2	5.4	1.104	-	0.785
REF3-ACJ-28	5.3	5.6	1.288	-	0.865
REF3-ACJ-29	6.9	7.4	2.837	-	0.864
REF3-ACJ-30	6.5	7.0	2.448	-	0.891
REF3-ACJ-31	7.0	7.5	2.916	-	0.850
REF3-ACJ-32	10.1	10.9	8.080	-	0.784
REF3-ACJ-33	7.4	7.9	3.266	-	0.806
REF3-ACJ-34	7.4	7.9	4.191	-	1.034
REF3-ACJ-35	5.5	5.9	1.584	-	0.952
REF3-ACJ-36	6.9	7.4	2.590	-	0.788
REF3-ACJ-37	4.9	5.2	0.952	-	0.809
REF3-ACJ-38	5.5	5.7	1.446	-	0.869
REF3-ACJ-39	5.3	5.6	1.334	-	0.896
REF3-ACJ-40	5.2	5.5	1.167	-	0.830
REF3-ACJ-41	5.6	6.0	1.392	-	0.793
REF3-ACJ-42	5.0	5.3	1.067	-	0.854
REF3-ACJ-43	6.5	7.0	2.555	-	0.930
REF3-ACJ-44	5.7	6.0	1.716	-	0.927
REF3-ACJ-45	5.3	5.6	1.073	-	0.721
REF3-ACJ-46	6.1	6.5	2.432	-	1.071
REF3-ACJ-47	7.2	7.7	2.941	-	0.788
REF3-ACJ-48	5.4	5.7	1.239	-	0.787
REF3-ACJ-49	5.4	5.7	1.270	-	0.807
REF3-ACJ-50	7.0	7.5	3.495	-	1.019
REF3-ACJ-51	6.5	6.9	2.215	-	0.807
REF3-ACJ-52	6.7	7.1	2.505	-	0.833
REF3-ACJ-53	6.4	6.8	2.101	-	0.801
REF3-ACJ-54	11.4	12.4	12.423	-	0.839
REF3-ACJ-55	5.4	5.7	1.490	-	0.946
REF3-ACJ-56	5.4	5.7	1.223	-	0.777
REF3-ACJ-57	6.9	7.4	2.726	-	0.830
REF3-ACJ-58	6.7	7.2	2.826	-	0.940
REF3-ACJ-59	6.1	6.5	2.039	-	0.898

Table F.8: Arctic charr measurements from fish captured at Reference Lake 3 by electrofishing, Mary River Project CREMP, August 2015.

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF3-ACJ-60		3.4	3.5	0.274	-	0.697
REF3-ACJ-61		10.3	11.2	10.326	-	0.945
REF3-ACJ-62		5.3	5.5	1.177	-	0.791
REF3-ACJ-63		6.5	7.0	2.804	-	1.021
REF3-ACJ-64		5.0	5.4	1.053	-	0.842
REF3-ACJ-65		6.8	7.2	2.528	-	0.804
REF3-ACJ-66		6.8	7.2	2.725	-	0.867
REF3-ACJ-67		6.2	6.7	2.449	-	1.028
REF3-ACJ-68		7.0	7.5	2.617	-	0.763
REF3-ACJ-69		10.8	11.7	10.547	-	0.837
REF3-ACJ-70		10.8	11.7	12.144	-	0.964
REF3-ACJ-71		7.4	8.0	3.983	-	0.983
REF3-ACJ-72		6.4	6.8	2.239	-	0.854
REF3-ACJ-73		5.6	6.0	1.605	-	0.914
REF3-ACJ-74		7.9	8.5	4.114	-	0.834
REF3-ACJ-75		6.8	7.3	2.623	-	0.834
REF3-ACJ-76		8.7	9.4	6.469	-	0.982
REF3-ACJ-77		8.2	8.8	5.651	-	1.025
REF3-ACJ-78		12.6	13.8	15.846	-	0.792
REF3-ACJ-79		5.5	5.7	1.449	-	0.871
REF3-ACJ-80		9.1	9.9	6.118	-	0.812
REF3-ACJ-81		7.5	8.1	3.747	-	0.888
REF3-ACJ-82		4.8	5.0	0.914	-	0.826
REF3-ACJ-83		5.1	5.4	1.139	-	0.859
REF3-ACJ-84		7.0	7.4	2.684	-	0.783
REF3-ACJ-85		5.7	6.1	1.576	-	0.851
REF3-ACJ-86		7.2	7.7	3.803	-	1.019
REF3-ACJ-87		10.2	11.1	9.181	-	0.865
REF3-ACJ-88		12.5	13.6	15.536	-	0.795
REF3-ACJ-89		7.0	7.6	2.747	-	0.801
REF3-ACJ-90		7.2	7.7	3.166	-	0.848
REF3-ACJ-91		7.7	8.2	3.725	2	0.816
REF3-ACJ-92		5.0	5.3	0.945	1	0.756
REF3-ACJ-93		4.9	5.2	1.043	1	0.887
REF3-ACJ-94		9.5	10.3	7.444	3	0.868
REF3-ACJ-95		11.4	12.3	11.991	4	0.809
REF3-ACJ-96		9.1	9.9	6.056	4	0.804
REF3-ACJ-97		5.1	5.4	1.055	1	0.795
REF3-ACJ-98		7.6	8.3	3.795	2	0.865
REF3-ACJ-99		7.3	7.8	3.291	2	0.846
Overall Catch Summary	total number	99	99	99	11	99
	average	7.0	7.5	3.631	2.0	0.854
	median	6.8	7.3	2.623	2.0	0.841
	standard deviation	1.9	2.1	3.357	1.3	0.074
	standard error	0.2	0.2	0.337	0.4	0.007
	minimum	3.4	3.5	0.274	0.0	0.697
	maximum	12.6	13.8	15.846	4.0	1.071
Young-of-the-Year Catch Summary	proportion of YOY	2%				
	total number	2	2	2	1	2
	average	5.4	5.7	1.330	0	0.865
	median	5.4	5.7	1.330	0	0.865
	standard deviation	0.2	0.2	0.191	-	0.022
	standard error	0.2	0.2	0.135	-	0.015
	minimum	5.2	5.5	1.195	0	0.850
	maximum	5.5	5.8	1.465	0	0.881

Table F.9: Arctic charr measurements from fish captured at Camp Lake by electrofishing, Mary River Project CREMP, August 2015.

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
CL-ACJ-1	6.4	7.0	2.597	-	0.991
CL-ACJ-2	14.3	15.6	27.415	-	0.938
CL-ACJ-3	13.3	14.2	17.605	-	0.748
CL-ACJ-4	8.3	8.9	4.338	-	0.759
CL-ACJ-5	5.6	6.1	1.182	-	0.673
CL-ACJ-6	5.8	6.2	1.706	1	0.874
CL-ACJ-7	6.0	6.4	1.445	-	0.669
CL-ACJ-8	7.9	8.5	3.822	-	0.775
CL-ACJ-9	6.7	7.1	2.569	-	0.854
CL-ACJ-10	6.1	6.5	1.908	-	0.841
CL-ACJ-11	13.2	14.1	17.985	-	0.782
CL-ACJ-12	6.8	7.2	2.497	-	0.794
CL-ACJ-13	9.2	10.1	7.162	-	0.920
CL-ACJ-14	7.3	7.8	3.524	-	0.906
CL-ACJ-15	6.4	6.8	2.342	-	0.893
CL-ACJ-16	8.6	9.1	4.985	-	0.784
CL-ACJ-17	6.7	7.1	2.700	-	0.898
CL-ACJ-18	7.0	7.6	3.324	-	0.969
CL-ACJ-19	6.7	7.3	2.952	-	0.982
CL-ACJ-20	6.2	6.6	2.023	-	0.849
CL-ACJ-21	8.4	9.0	4.476	-	0.755
CL-ACJ-22	7.0	7.4	3.220	-	0.939
CL-ACJ-23	6.3	6.6	2.193	-	0.877
CL-ACJ-24	7.2	7.6	3.098	-	0.830
CL-ACJ-25	11.3	12.2	10.552	-	0.731
CL-ACJ-26*	10.9	11.8	6.716	-	0.519
CL-ACJ-27	11.2	12.1	10.912	-	0.777
CL-ACJ-28	10.4	11.3	8.698	-	0.773
CL-ACJ-29	15.0	16.3	30.221	-	0.895
CL-ACJ-30	13.1	14.3	19.451	-	0.865
CL-ACJ-31	15.0	16.5	31.279	-	0.927
CL-ACJ-32	5.8	6.1	1.432	-	0.734
CL-ACJ-33	5.9	6.2	1.862	1	0.907
CL-ACJ-34	15.1	16.4	34.221	-	0.994
CL-ACJ-35	18.0	19.4	49.812	-	0.854
CL-ACJ-36	15.2	16.7	29.132	-	0.830
CL-ACJ-37	13.4	14.7	22.550	-	0.937
CL-ACJ-38	7.1	7.7	3.142	-	0.878
CL-ACJ-39	11.0	11.9	10.316	-	0.775
CL-ACJ-40	8.8	9.4	6.179	-	0.907
CL-ACJ-41	5.5	5.7	1.401	-	0.842
CL-ACJ-42	15.8	17.2	27.820	-	0.705
CL-ACJ-43	16.9	18.4	30.126	-	0.624
CL-ACJ-44	12.0	13.1	12.595	-	0.729
CL-ACJ-45	7.6	8.2	4.081	-	0.930
CL-ACJ-46	6.6	7.0	2.730	-	0.950
CL-ACJ-47	5.0	5.2	1.194	-	0.955
CL-ACJ-48	14.0	15.3	21.881	-	0.797
CL-ACJ-49	17.4	19.1	38.891	-	0.738
CL-ACJ-50	13.8	15.0	21.982	-	0.836
CL-ACJ-51	12.0	13.0	13.596	-	0.787
CL-ACJ-52	9.5	10.1	6.575	-	0.767
CL-ACJ-53	6.6	7.0	3.002	-	1.044
CL-ACJ-54	8.2	9.0	5.097	-	0.924
CL-ACJ-55	9.0	9.7	6.189	-	0.849
CL-ACJ-56	8.4	9.1	5.464	-	0.922
CL-ACJ-57	6.4	6.8	2.286	-	0.872
CL-ACJ-58	10.0	10.9	7.783	2	0.778
CL-ACJ-59	11.0	11.9	10.203	-	0.767
CL-ACJ-60	8.3	9.0	3.976	-	0.695

Table F.9: Arctic charr measurements from fish captured at Camp Lake by electrofishing, Mary River Project CREMP, August 2015.

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
CL-ACJ-61		18.3	19.7	50.183	-	0.819
CL-ACJ-62		17.7	19.1	44.871	-	0.809
CL-ACJ-63		10.1	10.8	8.730	-	0.847
CL-ACJ-64		11.8	12.8	12.810	-	0.780
CL-ACJ-65		7.5	7.8	3.036	-	0.720
CL-ACJ-66		10.1	11.0	8.793	-	0.853
CL-ACJ-67		16.4	18.0	37.152	3	0.842
CL-ACJ-68		11.2	12.0	12.250	2	0.872
CL-ACJ-69		16.2	17.6	37.402	-	0.880
CL-ACJ-70		15.3	16.8	31.549	4	0.881
CL-ACJ-71		13.0	14.3	19.646	-	0.894
CL-ACJ-72		11.5	12.5	14.283	2	0.939
CL-ACJ-73		9.8	10.5	8.506	-	0.904
CL-ACJ-74		10.5	11.3	9.216	-	0.796
CL-ACJ-75		12.9	14.3	19.815	-	0.923
CL-ACJ-76		13.5	14.6	18.280	3	0.743
CL-ACJ-77		14.9	16.2	25.940	-	0.784
CL-ACJ-78		10.1	10.8	8.855	-	0.859
CL-ACJ-79		10.5	11.4	9.158	-	0.791
CL-ACJ-80		11.6	12.5	13.210	-	0.846
CL-ACJ-81		15.0	16.4	24.584	-	0.728
CL-ACJ-82		16.6	18.0	38.783	-	0.848
CL-ACJ-83		7.7	8.1	3.844	1	0.842
CL-ACJ-84		6.4	6.8	2.251	-	0.859
CL-ACJ-85		5.1	5.4	1.053	1	0.794
CL-ACJ-86		12.2	13.2	14.469	-	0.797
CL-ACJ-87		9.8	10.5	9.160	-	0.973
CL-ACJ-88		9.7	10.4	8.412	-	0.922
CL-ACJ-89		7.0	7.4	3.535	-	1.031
CL-ACJ-90		5.0	5.2	1.006	-	0.805
CL-ACJ-91		6.2	6.6	2.460	-	1.032
CL-ACJ-92		5.2	5.4	1.003	-	0.713
CL-ACJ-93		11.7	12.7	12.582	-	0.786
CL-ACJ-94		16.5	18.0	35.316	-	0.786
CL-ACJ-95		11.8	13.0	15.185	-	0.924
CL-ACJ-96		10.4	11.1	8.412	-	0.748
CL-ACJ-97		7.4	8.0	3.676	-	0.907
CL-ACJ-98		6.7	7.1	2.675	-	0.889
CL-ACJ-99		8.7	9.4	4.789	-	0.727
CL-ACJ-100		7.5	8.1	3.145	-	0.745
CL-ACJ-101		10.8	11.7	9.894	-	0.785
CL-ACJ-102		8.3	8.9	4.073	-	0.712
Overall Catch Summary	total number	102	102	102	10	102
	average	10.2	11.0	12.102	2.0	0.836
	median	9.8	10.5	8.098	2	0.842
	standard deviation	3.6	4.0	12.180	1.1	0.093
	standard error	0.4	0.4	1.206	0.3	0.009
	minimum	5.0	5.2	1.003	1	0.519
	maximum	18.3	19.7	50.183	4	1.044
Young-of-the-Year Catch Summary	proportion of YOY	0%				
	total number	0	0	0	0	0
	average	-	-	-	-	-
	median	-	-	-	-	-
	standard deviation	-	-	-	-	-
	standard error	-	-	-	-	-
	minimum	-	-	-	-	-
	maximum	-	-	-	-	-

* Initial screening indicated sample was an outlier, and therefore the sample was removed from all subsequent statistical analysis data sets.

Table F.10: 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 2015.

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
	Parameter	Covariate	Ref	Exp	Reference		Exposed					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	99	101	-	-	-	-	K-S Test	Yes	0.000	-
	Log ₁₀ Age (years)	none	11	10	-	-	-	-	ANOVA	No	0.875	-
Energy Use	Log ₁₀ Body Weight (g)	none	99	101	-	-	-	-	ANOVA	Yes	0.000	1.000
	Log ₁₀ Fork Length (cm)	none	99	101	-	-	-	-	ANOVA	Yes	0.000	1.000
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	10	10	0.988	0.000	0.894	0.000	ANCOVA	Yes	0.000	1.000
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	10	10	0.986	0.000	0.906	0.000	ANCOVA	Yes	0.000	1.000
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	99	101	0.989	0.000	0.991	0.000	ANCOVA	No	0.445	-

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	11	10	Mean	1.8	1.8	-	117	-54
Energy Use	Log ₁₀ Body Weight (g)	none	99	101	Mean	2.619	7.236	176	-	-
	Log ₁₀ Fork Length (cm)	none	99	101	Mean	6.8	9.5	41	-	-
	Body Weight (g)	Age (years)	10	10	Adjusted Mean	2.7	6.9	154	-	-
	Fork Length (cm)	Age (years)	10	10	Adjusted Mean	68.7	93.4	36	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	99	101	Adjusted Mean	4.4	4.3	-	4.0	-3.9

^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 ²r 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 F.11: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured at Camp Lake in 2015 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 (<i>p</i> -value)		Power
	Parameter	Covariate	Ref	Exp	Reference		Exposed					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	51	101	-	-	-	-	K-S Test	Yes	0.052	-
	Log ₁₀ Age (years)	none	0	0	-	-	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	51	101	-	-	-	-	ANOVA	Yes	0.003	0.914
	Log ₁₀ Fork Length (cm)	none	51	101	-	-	-	-	ANOVA	Yes	0.008	0.853
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	51	101	0.988	0.000	0.991	0.000	ANCOVA	Yes	0.002	0.939

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	0	0	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	51	101	Mean	12.303	7.236	-41.2	-	-
	Log ₁₀ Fork Length (cm)	none	51	101	Mean	11.2	9.5	-14.9	-	-
	Body Weight (g)	Age (years)	0	0	-	-	-	-	-	-
	Fork Length (cm)	Age (years)	0	0	-	-	-	-	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	51	101	Adjusted Mean	9.0	8.5	-6.3	-	-

^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 F.12: Arctic charr measurements from fish captured at Sheardown Lake NW by electrofishing, Mary River Project CREMP, August 2015.

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SNW-ACJ-1	6.6	7.2	2.560	-	0.890
SNW-ACJ-2	6.7	7.2	2.482	-	0.825
SNW-ACJ-3	9.2	9.9	6.441	-	0.827
SNW-ACJ-4	14.4	15.8	26.690	-	0.894
SNW-ACJ-5	11.6	12.5	13.545	-	0.868
SNW-ACJ-6	7.8	8.4	4.210	-	0.887
SNW-ACJ-7	7.5	8.1	3.700	1	0.877
SNW-ACJ-8	8.3	8.9	4.889	-	0.855
SNW-ACJ-9	8.5	9.2	5.570	-	0.907
SNW-ACJ-10	11.9	13.0	17.354	-	1.030
SNW-ACJ-11	6.9	7.4	3.188	-	0.970
SNW-ACJ-12	9.0	9.7	6.263	-	0.859
SNW-ACJ-13	7.3	7.8	3.329	-	0.856
SNW-ACJ-14	6.0	6.5	1.986	-	0.919
SNW-ACJ-15	9.4	10.2	7.682	-	0.925
SNW-ACJ-16	5.4	5.6	1.336	-	0.848
SNW-ACJ-17	14.4	15.8	27.102	-	0.908
SNW-ACJ-18	11.4	12.4	15.540	-	1.049
SNW-ACJ-19	11.3	12.2	13.003	-	0.901
SNW-ACJ-20	6.0	6.3	1.739	1	0.805
SNW-ACJ-21	8.5	9.1	5.019	-	0.817
SNW-ACJ-22	8.4	9.1	5.219	-	0.881
SNW-ACJ-23	9.3	10.0	6.832	-	0.849
SNW-ACJ-24	4.6	4.8	0.830	-	0.853
SNW-ACJ-25	6.9	7.4	2.749	-	0.837
SNW-ACJ-26	9.6	10.4	6.929	1	0.783
SNW-ACJ-27	6.6	7.1	2.624	-	0.913
SNW-ACJ-28	6.6	7.1	2.398	-	0.834
SNW-ACJ-29	12.5	13.6	15.504	-	0.794
SNW-ACJ-30	15.2	16.6	27.469	3	0.782
SNW-ACJ-31	8.6	9.2	5.432	-	0.854
SNW-ACJ-32	15.7	17.0	35.584	-	0.920
SNW-ACJ-33	14.6	15.9	30.029	-	0.965
SNW-ACJ-34	6.5	7.2	2.768	-	1.008
SNW-ACJ-35	7.3	7.6	3.188	-	0.820
SNW-ACJ-36	19.3	21.9	52.076	-	0.724
SNW-ACJ-37	8.9	9.6	6.109	-	0.867
SNW-ACJ-38	16.5	18.0	37.119	-	0.826
SNW-ACJ-39	10.9	11.8	10.860	-	0.839
SNW-ACJ-40	16.4	17.6	38.288	-	0.868
SNW-ACJ-41	11.4	12.3	11.473	3	0.774
SNW-ACJ-42	6.3	6.7	2.035	-	0.814
SNW-ACJ-43	8.9	9.6	5.830	-	0.827
SNW-ACJ-44	7.1	7.6	3.336	-	0.932
SNW-ACJ-45	8.5	9.1	5.109	-	0.832
SNW-ACJ-46	12.4	13.5	16.858	-	0.884
SNW-ACJ-47	8.7	9.2	4.953	2	0.752
SNW-ACJ-48	14.8	16.1	25.790	-	0.796
SNW-ACJ-49	8.7	9.4	6.269	-	0.952
SNW-ACJ-50	12.7	13.8	16.758	-	0.818
SNW-ACJ-51	11.7	12.9	14.203	-	0.887
SNW-ACJ-52	9.0	9.7	6.270	-	0.860
SNW-ACJ-53	6.3	6.7	2.476	-	0.990
SNW-ACJ-54	6.8	7.2	3.012	-	0.958
SNW-ACJ-55	7.0	7.6	3.120	-	0.910
SNW-ACJ-56	6.6	7.0	2.988	-	1.039
SNW-ACJ-57	11.5	12.5	13.222	-	0.869
SNW-ACJ-58	12.6	13.7	16.448	3	0.822
SNW-ACJ-59	16.6	18.0	28.164	-	0.616

Table F.12: Arctic charr measurements from fish captured at Sheardown Lake NW by electrofishing, Mary River Project CREMP, August 2015.

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SNW-ACJ-60		16.6	17.9	33.607	-	0.735
SNW-ACJ-61		13.9	15.1	22.050	-	0.821
SNW-ACJ-62		12.2	13.0	18.720	-	1.031
SNW-ACJ-63		8.9	9.5	5.583	-	0.792
SNW-ACJ-64		5.4	5.8	1.403	-	0.891
SNW-ACJ-65		6.2	6.6	1.766	-	0.741
SNW-ACJ-66		6.5	7.0	2.126	-	0.774
SNW-ACJ-67		9.4	10.3	8.236	-	0.992
SNW-ACJ-68		8.2	8.8	4.292	-	0.778
SNW-ACJ-69		9.1	9.8	6.786	-	0.901
SNW-ACJ-70		6.9	7.4	2.835	-	0.863
SNW-ACJ-71		9.0	9.6	5.927	-	0.813
SNW-ACJ-72		10.5	11.4	11.430	-	0.987
SNW-ACJ-73		9.3	10.0	7.112	-	0.884
SNW-ACJ-74		8.0	8.7	4.613	-	0.901
SNW-ACJ-75		8.3	8.8	4.774	-	0.835
SNW-ACJ-76		7.1	7.5	3.074	1	0.859
SNW-ACJ-77		6.2	6.6	2.050	-	0.860
SNW-ACJ-78		8.5	9.3	5.820	-	0.948
SNW-ACJ-79		8.2	8.9	4.613	-	0.837
SNW-ACJ-80		17.5	19.0	46.298	-	0.864
SNW-ACJ-81		6.3	6.7	2.142	-	0.857
SNW-ACJ-82		12.2	13.8	19.971	-	1.100
SNW-ACJ-83		6.4	6.7	2.427	-	0.926
SNW-ACJ-84		7.6	8.2	3.854	-	0.878
SNW-ACJ-85		8.7	9.3	5.169	-	0.785
SNW-ACJ-86		9.5	10.2	6.416	-	0.748
SNW-ACJ-87		7.4	7.9	3.904	-	0.963
SNW-ACJ-88		6.9	7.3	3.128	-	0.952
SNW-ACJ-89		9.1	9.8	6.348	-	0.842
SNW-ACJ-90		4.4	4.7	0.792	0	0.930
SNW-ACJ-91		7.0	7.6	3.201	-	0.933
SNW-ACJ-92		7.1	7.6	3.188	-	0.891
SNW-ACJ-93		7.9	8.5	4.949	-	1.004
SNW-ACJ-94		9.8	11.0	7.880	-	0.837
SNW-ACJ-95		5.6	6.0	1.500	-	0.854
SNW-ACJ-96		8.2	8.8	4.910	-	0.891
SNW-ACJ-97		9.4	10.2	7.679	-	0.925
SNW-ACJ-98		8.7	9.3	5.710	-	0.867
SNW-ACJ-99		5.8	6.2	1.676	-	0.859
SNW-ACJ-100		8.0	8.6	4.363	2	0.852
SNW-ACJ-101		4.2	4.4	0.683	-	0.922
SNW-ACJ-102		4.5	4.7	0.799	-	0.877
Overall Catch Summary	total number	102	102	102	10	102
	average	9.2	10.0	9.390	1.7	0.873
	median	8.5	9.2	5.194	1.5	0.865
	standard deviation	3.2	3.6	10.506	1.1	0.077
	standard error	0.3	0.4	1.040	0.3	0.008
	minimum	4.2	4.4	0.683	0	0.616
	maximum	19.3	21.9	52.076	3	1.100
Young-of-the-Year Catch Summary	proportion of YOY	4%				
	total number	4	4	4	1	4
	average	4.4	4.7	0.776	0	0.895
	median	4.5	4.7	0.796	0	0.899
	standard deviation	0.2	0.2	0.064	-	0.037
	standard error	0.1	0.1	0.032	-	0.018
	minimum	4.2	4.4	0.683	0	0.853
	maximum	4.6	4.8	0.830	0	0.930

Table F.13: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured between mine-exposed Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2015.

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
	Parameter	Covariate	Ref	Exp	Reference		Exposed					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	99	102	-	-	-	-	K-S Test	Yes	0.000	-
	Log ₁₀ Age (years)	none	11	10	-	-	-	-	ANOVA	No	0.371	-
Energy Use	Log ₁₀ Body Weight (g)	none	99	102	-	-	-	-	ANOVA	Yes	0.000	1.000
	Log ₁₀ Fork Length (cm)	none	99	102	-	-	-	-	ANOVA	Yes	0.000	1.000
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	10	10	0.988	0.000	0.783	0.001	ANCOVA	Yes	0.000	1.000
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	10	10	0.986	0.000	0.796	0.001	ANCOVA	Yes	0.000	1.000
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	99	102	0.989	0.000	0.992	0.000	ANCOVA	Yes	0.036	0.675

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	11	10	Mean	1.8	1.4	-	151	-60
Energy Use	Log ₁₀ Body Weight (g)	none	99	102	Mean	2.619	5.779	121	-	-
	Log ₁₀ Fork Length (cm)	none	99	102	Mean	6.8	8.7	29	-	-
	Body Weight (g)	Age (years)	10	10	Adjusted Mean	2.2	5.7	156	-	-
	Fork Length (cm)	Age (years)	10	10	Adjusted Mean	64.5	88.8	38	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	99	102	Adjusted Mean	3.9	4.0	3	-	-

^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 ²r 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 F.14: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured at Sheardown Lake NW in 2015 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 (<i>p</i> -value)		Power
	Parameter	Covariate	Baseline	2015	Baseline		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	285	102	-	-	-	-	K-S Test	Yes	0.093	-
	Log ₁₀ Age (years)	none	11	10	-	-	-	-	ANOVA	No	0.371	-
Energy Use	Log ₁₀ Body Weight (g)	none	285	102	-	-	-	-	ANOVA	No	0.101	-
	Log ₁₀ Fork Length (cm)	none	285	102	-	-	-	-	ANOVA	No	0.555	-
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	10	10	0.988	0.000	0.783	0.001	ANCOVA	Yes	0.000	1.000
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	10	10	0.986	0.000	0.796	0.001	ANCOVA	Yes	0.000	1.000
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	285	102	0.978	0.000	0.992	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	2015	Statistic	Baseline	2015		Increase	Decrease
Survival	Age (years)	none	11	10	Mean	1.8	1.4	-	151	-60
Energy Use	Log ₁₀ Body Weight (g)	none	285	102	Mean	7.214	5.779	-	42	-29
	Log ₁₀ Fork Length (cm)	none	285	102	Mean	9.0	8.7	-	12.5	-11.1
	Body Weight (g)	Age (years)	10	10	Adjusted Mean	2.2	5.7	155.8	-	-
	Fork Length (cm)	Age (years)	10	10	Adjusted Mean	64.5	88.8	37.7	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	285	102	Adjusted Mean	7.3	6.3	-13.3	-	-

^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 F.15: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured at Sheardown Lake NW in 2015 and during the mine construction (2014) 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 (<i>p</i> -value)		Power
	Parameter	Covariate	2014	2015	2014		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	17	102	-	-	-	-	K-S Test	Yes	0.043	-
	Log ₁₀ Age (years)	none	0	0	-	-	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	17	102	-	-	-	-	ANOVA	No	0.203	-
	Log ₁₀ Fork Length (cm)	none	17	102	-	-	-	-	ANOVA	No	0.411	-
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	17	102	0.975	0.000	0.992	0.000	ANCOVA	Yes	0.000	0.998

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	2014	2015	Statistic	2014	2015		Increase	Decrease
Survival	Age (years)	none	0	0	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	17	102	Mean	8.017	5.779	-	70	-41
	Log ₁₀ Fork Length (cm)	none	17	102	Mean	9.4	8.7	-	19.7	-16.4
	Body Weight (g)	Age (years)	0	0	-	-	-	-	-	-
	Fork Length (cm)	Age (years)	0	0	-	-	-	-	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	17	102	Adjusted Mean	6.6	5.9	-10.9	-	-

^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 ²*r* 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 F.16: Arctic charr measurements from fish captured at Sheardown Lake SE by electrofishing, Mary River Project CREMP, August 2015.

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SSE-ACJ-1	6.6	7.1	2.801	-	0.974
SSE-ACJ-2	7.1	7.7	3.033	-	0.847
SSE-ACJ-3	7.6	8.2	3.666	-	0.835
SSE-ACJ-4	6.6	7.0	2.733	-	0.951
SSE-ACJ-5	8.4	8.8	5.560	-	0.938
SSE-ACJ-6	4.9	5.3	1.026	-	0.872
SSE-ACJ-7	7.0	7.6	3.208	-	0.935
SSE-ACJ-8	6.4	6.8	2.372	-	0.905
SSE-ACJ-9	7.6	8.0	3.844	-	0.876
SSE-ACJ-10	6.4	6.7	2.224	1	0.848
SSE-ACJ-11	11.2	12.2	12.099	-	0.861
SSE-ACJ-12	6.9	7.4	2.828	-	0.861
SSE-ACJ-13	10.4	11.3	8.713	-	0.775
SSE-ACJ-14	6.5	6.9	2.176	-	0.792
SSE-ACJ-15	3.8	4.1	0.550	-	1.002
SSE-ACJ-16	6.6	7.0	2.398	-	0.834
SSE-ACJ-17	7.3	7.8	3.318	-	0.853
SSE-ACJ-18	7.3	7.8	3.840	-	0.987
SSE-ACJ-19	8.5	9.2	6.302	-	1.026
SSE-ACJ-20	7.5	8.0	3.776	1	0.895
SSE-ACJ-21	13.8	14.7	21.302	-	0.811
SSE-ACJ-22	9.1	9.8	6.396	-	0.849
SSE-ACJ-23	6.5	6.8	2.233	-	0.813
SSE-ACJ-24	6.5	7.0	2.258	-	0.822
SSE-ACJ-25	8.8	9.5	5.898	-	0.865
SSE-ACJ-26	6.7	7.0	2.664	-	0.886
SSE-ACJ-27	13.3	14.5	17.539	-	0.746
SSE-ACJ-28	6.9	7.3	3.407	-	1.037
SSE-ACJ-29	6.6	7.0	2.764	-	0.961
SSE-ACJ-30	6.6	7.0	2.666	1	0.927
SSE-ACJ-31	6.7	7.1	2.450	-	0.815
SSE-ACJ-32	11.6	12.5	12.556	-	0.804
SSE-ACJ-33	11.6	12.6	11.696	-	0.749
SSE-ACJ-34	7.6	8.2	4.250	-	0.968
SSE-ACJ-35	6.6	7.0	2.638	-	0.918
SSE-ACJ-36	4.9	5.1	0.937	-	0.796
SSE-ACJ-37	5.2	5.4	1.212	-	0.862
SSE-ACJ-38	8.6	9.1	5.416	-	0.851
SSE-ACJ-39	6.5	6.9	2.479	-	0.903
SSE-ACJ-40	6.4	6.8	2.460	-	0.938
SSE-ACJ-41	9.8	10.6	7.603	3	0.808
SSE-ACJ-42	7.7	8.2	3.773	-	0.826
SSE-ACJ-43	9.4	10.2	6.436	-	0.775
SSE-ACJ-44	6.6	7.1	2.479	-	0.862
SSE-ACJ-45	6.8	7.3	3.005	-	0.956
SSE-ACJ-46	7.6	8.1	4.045	-	0.921
SSE-ACJ-47	6.3	6.7	2.038	-	0.815
SSE-ACJ-48	9.1	9.7	6.388	-	0.848
SSE-ACJ-49	7.5	8.8	3.870	-	0.917
SSE-ACJ-50	6.2	6.5	1.915	-	0.804
SSE-ACJ-51	9.7	10.4	7.718	3	0.846
SSE-ACJ-52	7.7	8.2	3.581	-	0.784
SSE-ACJ-53	6.8	7.2	2.801	-	0.891
SSE-ACJ-54	4.3	4.5	0.653	0	0.821
SSE-ACJ-55	4.8	5.0	0.886	-	0.801
SSE-ACJ-56	7.2	7.8	3.148	-	0.843
SSE-ACJ-57	6.0	6.4	2.199	-	1.018
SSE-ACJ-58	6.7	7.2	2.956	-	0.983
SSE-ACJ-59	4.3	4.6	0.766	-	0.963

Table F.16: Arctic charr measurements from fish captured at Sheardown Lake SE by electrofishing, Mary River Project CREMP, August 2015.

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SSE-ACJ-60		7.9	8.4	3.913	-	0.794
SSE-ACJ-61		7.2	7.7	3.386	-	0.907
SSE-ACJ-62		7.1	7.6	3.378	-	0.944
SSE-ACJ-63		5.9	6.3	1.561	-	0.760
SSE-ACJ-64		6.4	6.8	2.522	-	0.962
SSE-ACJ-65		7.7	8.2	4.209	-	0.922
SSE-ACJ-66		6.4	6.9	2.736	-	1.044
SSE-ACJ-67		5.8	6.2	1.808	-	0.927
SSE-ACJ-68		4.3	4.5	0.793	-	0.997
SSE-ACJ-69		7.9	8.5	4.314	2	0.875
SSE-ACJ-70		7.9	8.5	3.745	-	0.760
SSE-ACJ-71		14.6	15.9	29.260	-	0.940
SSE-ACJ-72		7.3	7.9	4.236	-	1.089
SSE-ACJ-73		6.2	6.6	2.477	-	1.039
SSE-ACJ-74		7.1	7.5	3.080	-	0.861
SSE-ACJ-75		6.2	6.7	2.512	-	1.054
SSE-ACJ-76		4.8	5.0	0.938	-	0.848
SSE-ACJ-77		5.1	5.3	1.310	-	0.988
SSE-ACJ-78		5.7	6.0	1.644	1	0.888
SSE-ACJ-79		4.5	4.7	0.838	-	0.920
SSE-ACJ-80		6.9	7.3	3.666	-	1.116
SSE-ACJ-81		6.8	7.2	2.568	-	0.817
SSE-ACJ-82		7.1	7.6	3.231	-	0.903
SSE-ACJ-83		7.2	7.6	3.408	-	0.913
SSE-ACJ-84		4.6	4.8	0.884	-	0.908
SSE-ACJ-85		6.6	7.1	2.509	-	0.873
SSE-ACJ-86		6.5	7.0	2.414	-	0.879
SSE-ACJ-87		4.2	4.4	0.681	-	0.919
SSE-ACJ-88		4.2	4.4	0.656	-	0.885
SSE-ACJ-89		4.6	4.8	0.658	-	0.676
SSE-ACJ-90		4.0	4.2	0.538	-	0.841
SSE-ACJ-91		7.0	7.6	3.347	1	0.976
SSE-ACJ-92		6.6	7.0	2.282	-	0.794
SSE-ACJ-93		6.9	7.4	3.330	-	1.014
SSE-ACJ-94		6.8	7.2	2.442	-	0.777
SSE-ACJ-95		4.4	4.6	0.870	-	1.021
SSE-ACJ-96		5.5	5.9	1.588	-	0.954
SSE-ACJ-97		4.4	4.6	0.765	-	0.898
SSE-ACJ-98		4.5	4.7	0.870	-	0.955
SSE-ACJ-99		6.3	6.6	2.203	-	0.881
SSE-ACJ-100		9.1	9.9	6.226	2	0.826
SSE-ACJ-101		6.5	6.9	2.453	-	0.893
SSE-ACJ-102		6.9	7.4	3.042	-	0.926
Overall Catch Summary	total number	102	102	102	10	102
	average	7.0	7.5	3.777	1.5	0.891
	median	6.7	7.2	2.750	1	0.886
	standard deviation	2.0	2.2	4.102	1	0.083
	standard error	0.2	0.2	0.406	0.3	0.008
	minimum	3.8	4.1	0.538	0	0.676
	maximum	14.6	15.9	29.260	3	1.116
Young-of-the-Year Catch Summary	proportion of YOY	17%				
	total number	17	17	17	1	17
	average	4.4	4.7	0.783	0	0.890
	median	4.4	4.6	0.793	0	0.898
	standard deviation	0.3	0.3	0.141	-	0.088
	standard error	0.1	0.1	0.034	-	0.021
	minimum	3.8	4.1	0.538	0	0.676
	maximum	4.9	5.3	1.026	0	1.021

Table F.17: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured between mine-exposed Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2015.

a) Statistical results based on log-transformed data

Response	Endpoint		Sample Size		Regression Relationship Between Parameter and Covariate				Model	Statistical Difference Between Areas (<i>p</i> -value)		Power
	Parameter	Covariate	Ref	Exp	Reference		Exposed					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	99	102	-	-	-	-	K-S Test	No	0.164	-
	Log ₁₀ Age (years)	none	11	10	-	-	-	-	ANOVA	No	0.190	-
Energy Use	Log ₁₀ Body Weight (g)	none	99	102	-	-	-	-	ANOVA	No	0.732	-
	Log ₁₀ Fork Length (cm)	none	99	102	-	-	-	-	ANOVA	No	0.976	-
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	10	10	0.988	0.000	0.900	0.000	ANCOVA	Yes	0.000	0.997
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	10	10	0.986	0.000	0.912	0.000	ANCOVA	Yes	0.000	0.996
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	99	102	0.989	0.000	0.987	0.000	ANCOVA	Yes	0.001	0.951

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	11	10	Mean	1.8	1.3	-	143	-59
Energy Use	Log ₁₀ Body Weight (g)	none	99	102	Mean	2.619	2.720	-	39	-28
	Log ₁₀ Fork Length (cm)	none	99	102	Mean	6.8	6.7	-	11.6	-10.4
	Body Weight (g)	Age (years)	10	10	Adjusted Mean	2.0	3.8	85.3	-	-
	Fork Length (cm)	Age (years)	10	10	Adjusted Mean	62.5	75.7	21.2	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	99	102	Adjusted Mean	2.6	2.7	4.2	-	-

^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 F.18: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured at Sheardown Lake SE in 2015 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
	Parameter	Covariate	Baseline	2015	Baseline		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	16	102	-	-	-	-	K-S Test	Yes	0.058	-
	Log ₁₀ Age (years)	none	19	10	-	-	-	-	ANOVA	Yes	0.000	1.000
Energy Use	Log ₁₀ Body Weight (g)	none	16	102	-	-	-	-	ANOVA	No	0.494	-
	Log ₁₀ Fork Length (cm)	none	16	102	-	-	-	-	ANOVA	No	0.324	-
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	19	10	0.133	0.124	0.900	0.000	ANCOVA	No	0.589	-
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	19	10	0.087	0.221	0.912	0.000	ANCOVA	No	0.901	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	16	102	0.811	0.000	0.987	0.000	ANCOVA	Yes	0.073	0.561

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	19	10	Mean	0.3	1.3	272.5	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	16	102	Mean	2.371	2.720	-	50	-33
	Log ₁₀ Fork Length (cm)	none	16	102	Mean	6.3	6.7	-	14.6	-12.8
	Body Weight (g)	Age (years)	19	10	Adjusted Mean	1.7	1.3	-	140	-58
	Fork Length (cm)	Age (years)	19	10	Adjusted Mean	54.3	52.9	-	32.4	-24.5
Energy Storage	Body Weight (g)	Fork Length (cm)	16	102	Adjusted Mean	3.1	2.7	-14.4	-	-

^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: $[(\text{exposed adjusted mean} - \text{reference adjusted mean}) / \text{reference adjusted mean}] \times 100$.

^c ANCOVA with Interaction: magnitude of difference between predicted minimum and maximum values for reference and exposed areas calculated as: $[(\text{exposed predicted value} - \text{reference predicted value}) / \text{reference predicted value}] \times 100$.

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

Table F.19: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured at Sheardown Lake SE in 2015 and during the mine construction (2014) 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 (<i>p</i> -value)		Power
	Parameter	Covariate	2014	2015	2014		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	20	102	-	-	-	-	K-S Test	Yes	0.000	-
	Log ₁₀ Age (years)	none	0	0	-	-	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	20	102	-	-	-	-	ANOVA	Yes	0.000	0.999
	Log ₁₀ Fork Length (cm)	none	20	102	-	-	-	-	ANOVA	Yes	0.000	1.000
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	20	102	0.973	0.000	0.987	0.000	ANCOVA	Yes	0.017	0.774

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	2014	2015	Statistic	2014	2015		Increase	Decrease
Survival	Age (years)	none	0	0	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	20	102	Mean	1.088	2.720	150.1	-	-
	Log ₁₀ Fork Length (cm)	none	20	102	Mean	4.8	6.7	39.5	-	-
	Body Weight (g)	Age (years)	0	0	-	-	-	-	-	-
	Fork Length (cm)	Age (years)	0	0	-	-	-	-	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	20	102	Adjusted Mean	2.6	2.3	-11.8	-	-

^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 ²*r* 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 F.20: Arctic charr measurements from fish captured at Mary Lake by electrofishing, Mary River Project CREMP, August 2015.

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
ML-ACJ-1	8.2	8.7	5.207	-	0.944
ML-ACJ-2	5.1	5.3	1.328	-	1.001
ML-ACJ-3	6.8	7.2	2.600	-	0.827
ML-ACJ-4	8.2	8.8	4.910	-	0.891
ML-ACJ-5	6.4	6.9	2.790	-	1.064
ML-ACJ-6	5.0	5.3	1.305	-	1.044
ML-ACJ-7	7.6	8.2	3.879	-	0.884
ML-ACJ-8	7.5	8.0	4.320	-	1.024
ML-ACJ-9	5.3	5.6	1.315	-	0.883
ML-ACJ-10	5.1	5.3	1.355	-	1.021
ML-ACJ-11	7.5	7.9	3.499	-	0.829
ML-ACJ-12	6.6	6.9	2.930	1	1.019
ML-ACJ-13	14.2	15.6	24.915	-	0.870
ML-ACJ-14	11.8	12.7	14.285	-	0.869
ML-ACJ-15	7.3	7.8	3.103	-	0.798
ML-ACJ-16	5.8	6.1	1.746	-	0.895
ML-ACJ-17	6.0	6.4	1.899	-	0.879
ML-ACJ-18	6.3	6.7	2.559	-	1.023
ML-ACJ-19	3.9	4.1	0.499	-	0.841
ML-ACJ-20	3.8	4.1	0.515	0	0.939
ML-ACJ-21	8.4	9.1	5.144	-	0.868
ML-ACJ-22	10.0	10.9	9.875	-	0.988
ML-ACJ-23	6.6	7.0	2.596	-	0.903
ML-ACJ-24	7.8	8.4	3.577	-	0.754
ML-ACJ-25	10.0	10.8	8.515	-	0.852
ML-ACJ-26	6.8	7.3	2.669	-	0.849
ML-ACJ-27	6.8	7.3	2.904	-	0.924
ML-ACJ-28	7.6	8.0	4.007	-	0.913
ML-ACJ-29	5.6	5.9	1.616	-	0.920
ML-ACJ-30	6.9	7.4	2.735	2	0.833
ML-ACJ-31	6.8	7.2	2.931	-	0.932
ML-ACJ-32	4.2	4.4	0.757	-	1.022
ML-ACJ-33	3.9	4.1	0.550	-	0.927
ML-ACJ-34	6.5	7.0	2.334	-	0.850
ML-ACJ-35	4.5	4.7	0.839	-	0.921
ML-ACJ-36	5.1	5.3	1.040	-	0.784
ML-ACJ-37	5.9	6.3	1.770	-	0.862
ML-ACJ-38	5.6	5.9	1.400	-	0.797
ML-ACJ-39	5.1	5.4	1.302	-	0.982
ML-ACJ-40	3.8	4.0	0.494	0	0.900
ML-ACJ-41	6.5	6.9	2.761	-	1.005
ML-ACJ-42	6.9	7.3	3.220	-	0.980
ML-ACJ-43	5.0	5.3	1.275	-	1.020
ML-ACJ-44	8.5	9.0	4.590	-	0.747
ML-ACJ-45	8.5	9.1	5.060	-	0.824
ML-ACJ-46	8.5	9.2	5.331	-	0.868
ML-ACJ-47	6.2	6.5	2.120	-	0.890
ML-ACJ-48	6.0	6.4	1.893	-	0.876
ML-ACJ-49	9.4	10.0	7.135	-	0.859
ML-ACJ-50	9.9	10.8	8.415	2	0.867
ML-ACJ-51	12.8	13.8	17.083	-	0.815
ML-ACJ-52	6.1	6.5	1.771	-	0.780
ML-ACJ-53	5.9	6.2	1.880	-	0.915
ML-ACJ-54	7.6	8.1	3.654	-	0.832
ML-ACJ-55	6.8	7.2	2.712	-	0.863
ML-ACJ-56	7.2	7.6	3.119	-	0.836
ML-ACJ-57	7.6	8.2	3.795	-	0.865
ML-ACJ-58	3.8	4.0	0.591	-	1.077
ML-ACJ-59	5.8	6.2	1.799	-	0.922

Table F.20: Arctic charr measurements from fish captured at Mary Lake by electrofishing, Mary River Project CREMP, August 2015.

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
ML-ACJ-60		6.1	6.6	2.146	1	0.945
ML-ACJ-61		6.3	6.6	2.406	-	0.962
ML-ACJ-62		5.4	5.7	1.359	-	0.863
ML-ACJ-63		6.9	7.4	2.683	-	0.817
ML-ACJ-64		8.2	8.7	5.203	-	0.944
ML-ACJ-65		7.3	7.8	2.853	-	0.733
ML-ACJ-66		8.7	9.3	6.062	-	0.921
ML-ACJ-67		7.2	7.7	3.271	-	0.876
ML-ACJ-68		9.3	10.0	6.331	-	0.787
ML-ACJ-69		8.2	8.7	3.950	-	0.716
ML-ACJ-70		7.2	7.6	3.413	1	0.914
ML-ACJ-71		7.5	8.0	3.406	-	0.807
ML-ACJ-72		7.1	7.6	3.038	-	0.849
ML-ACJ-73		3.7	3.9	0.498	-	0.983
ML-ACJ-74		5.3	5.5	1.147	-	0.770
ML-ACJ-75		5.7	6.2	1.655	-	0.894
ML-ACJ-76		7.1	7.5	2.956	-	0.826
ML-ACJ-77		6.1	6.5	1.883	-	0.830
ML-ACJ-78		6.0	6.4	1.954	-	0.905
ML-ACJ-79		8.1	8.7	4.208	-	0.792
ML-ACJ-80		8.7	9.3	5.413	2	0.822
ML-ACJ-81		6.1	6.5	2.261	-	0.996
ML-ACJ-82		5.8	6.2	1.575	-	0.807
ML-ACJ-83		6.4	6.7	2.375	-	0.906
ML-ACJ-84		5.5	5.9	1.337	-	0.804
ML-ACJ-85		6.6	7.0	2.404	-	0.836
ML-ACJ-86		4.3	4.4	0.565	-	0.711
ML-ACJ-87		6.9	7.4	3.017	-	0.918
ML-ACJ-88		6.7	7.1	3.044	-	1.012
ML-ACJ-89		4.5	4.7	0.632	-	0.694
ML-ACJ-90		6.7	7.3	2.609	1	0.867
ML-ACJ-91		5.2	5.5	1.171	-	0.833
ML-ACJ-92		5.7	6.0	1.523	-	0.822
ML-ACJ-93		4.5	4.7	0.669	-	0.734
ML-ACJ-94		5.8	6.2	1.502	-	0.770
ML-ACJ-95		4.6	4.8	0.956	-	0.982
ML-ACJ-96		4.0	4.2	0.491	-	0.767
ML-ACJ-97		9.0	9.8	6.372	-	0.874
ML-ACJ-98		6.2	6.7	2.632	-	1.104
ML-ACJ-99		6.5	7.0	2.614	-	0.952
ML-ACJ-100		9.0	9.8	6.292	2	0.863
ML-ACJ-101		8.1	8.6	4.435	-	0.835
ML-ACJ-102		6.4	6.8	2.190	-	0.835
Overall Catch Summary	total number	102	102	102	10	102
	average	6.7	7.2	3.301	1.2	0.883
	median	6.6	7.0	2.612	1	0.870
	standard deviation	1.8	2.0	3.370	0.8	0.086
	standard error	0.2	0.2	0.334	0.2	0.009
	minimum	3.7	3.9	0.491	0	0.694
	maximum	14.2	15.6	24.915	2	1.104
Young-of-the-Year Catch Summary	proportion of YOY	15%				
	total number	15	15	15	2	15
	average	4.2	4.4	0.709	0.0	0.904
	median	4.2	4.4	0.591	0	0.927
	standard deviation	0.4	0.5	0.273	0.0	0.127
	standard error	0.1	0.1	0.070	0.0	0.033
	minimum	3.7	3.9	0.491	0	0.694
	maximum	5.0	5.3	1.305	0	1.077

Table F.21: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured between mine-exposed Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2015.

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
	Parameter	Covariate	Ref	Exp	Reference		Exposed					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	99	102	-	-	-	-	K-S Test	No	0.610	-
	Log ₁₀ Age (years)	none	11	10	-	-	-	-	ANOVA	Yes	0.056	0.623
Energy Use	Log ₁₀ Body Weight (g)	none	99	102	-	-	-	-	ANOVA	No	0.445	-
	Log ₁₀ Fork Length (cm)	none	99	102	-	-	-	-	ANOVA	No	0.292	-
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	11	10	0.949	0.000	0.891	0.000	ANCOVA	Yes	0.000	0.999
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	11	10	0.953	0.000	0.908	0.000	ANCOVA	Yes	0.000	0.998
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	99	102	0.989	0.000	0.985	0.000	ANCOVA	Yes	0.015	0.786

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	11	10	Mean	1.8	1.0	-43.3	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	99	102	Mean	2.619	2.405	-	39	-28
	Log ₁₀ Fork Length (cm)	none	99	102	Mean	6.8	6.5	-	11.6	-10.4
	Body Weight (g)	Age (years)	11	10	Adjusted Mean	1.8	3.7	98.6	-	-
	Fork Length (cm)	Age (years)	11	10	Adjusted Mean	60.5	74.6	23.2	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	99	102	Adjusted Mean	2.5	2.5	3.2	-	-

^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 F.22: Results of health endpoint statistical comparisons for nearshore (juvenile) Arctic charr captured at Mary Lake in 2015 and during the mine construction (2014) 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
	Parameter	Covariate	2014	2015	2014		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	29	102	-	-	-	-	K-S Test	No	0.209	-
	Log ₁₀ Age (years)	none	27	10	-	-	-	-	ANOVA	No	0.146	-
Energy Use	Log ₁₀ Body Weight (g)	none	29	102	-	-	-	-	ANOVA	No	0.488	-
	Log ₁₀ Fork Length (cm)	none	29	102	-	-	-	-	ANOVA	No	0.954	-
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	27	9	0.669	0.000	0.973	0.000	ANCOVA	Yes	0.040	0.672
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	27	9	0.679	0.000	0.976	0.000	ANCOVA	No	0.118	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	29	102	0.956	0.000	0.985	0.000	ANCOVA	Yes	0.000	0.999

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	2014	2015	Statistic	2014	2015		Increase	Decrease
Survival	Age (years)	none	27	10	Mean	0.7	1.0	-	122	-55
Energy Use	Log ₁₀ Body Weight (g)	none	29	102	Mean	2.709	2.405	-	53	-34
	Log ₁₀ Fork Length (cm)	none	29	102	Mean	6.5	6.5	-	15.0	-13.1
	Body Weight (g)	Age (years)	27	9	Adjusted Mean	2.9	1.8	-38.9	-	-
	Fork Length (cm)	Age (years)	27	9	Adjusted Mean	65.8	57.7	-	17.4	-14.8
Energy Storage	Body Weight (g)	Fork Length (cm)	29	102	Adjusted Mean	2.7	2.4	-12.1	-	-

^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 ²r 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 F.23: Arctic charr measurements from fish captured at Reference Lake 3 by gill netting, Mary River Project CREMP, August 2015.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF3-AC-01	2	32.9	35.8	320	-	0.899
REF3-AC-02	2	32.6	35.4	290	-	0.837
REF3-AC-03	2	30.7	33.5	245	-	0.847
REF3-AC-04	2	35.2	38.0	395	20	0.906
REF3-AC-05	3	59.4	62.3	2,250	15	1.074
Overall Catch Summary	total number	5	5	5	2	5
	average	38.2	41.0	700	17.5	0.912
	median	32.9	35.8	320	17.5	0.899
	standard deviation	12.0	12.0	868	3.5	0.095
	standard error	5.4	5.4	388	2.5	0.043
	minimum	30.7	33.5	245	15.0	0.837
	maximum	59.4	62.3	2,250	20.0	1.074

Table F.24: Arctic charr measurements from fish captured at Camp Lake by gill netting, Mary River Project CREMP, August 2015.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
CL-AC-01	4	36.8	40.5	505	-	1.013
CL-AC-02	2	34.4	37.8	410	-	1.007
CL-AC-03	2	35.8	39.1	400	15	0.872
CL-AC-04	4.5	33.1	36.1	360	-	0.993
CL-AC-05	3	38.2	41.6	510	-	0.915
CL-AC-06	3	36.6	39.7	485	-	0.989
CL-AC-07	3	36.8	40.0	490	-	0.983
CL-AC-08	2	34.1	37.6	395	-	0.996
CL-AC-09	2	35.5	38.3	395	-	0.883
CL-AC-10	2	31.7	34.7	355	-	1.114
CL-AC-11	1.5	34.2	37.4	385	-	0.962
CL-AC-12	1.5	43.8	47.3	720	-	0.857
CL-AC-13*	1.5	35.9	38.9	260	-	0.562
CL-AC-14	2	33.7	36.7	350	16	0.914
CL-AC-15	1	35.2	38.2	400	-	0.917
CL-AC-16	1	38.0	41.5	555	-	1.011
CL-AC-17	3	36.1	39.2	455	-	0.967
CL-AC-18	3	35.6	39.0	370	-	0.820
CL-AC-19	3	37.0	41.2	470	-	0.928
CL-AC-20	3	34.7	38.0	405	-	0.969
CL-AC-21	3	35.0	38.5	380	-	0.886
CL-AC-22	1.5	37.0	40.5	495	-	0.977
CL-AC-23	0.5	32.8	35.7	380	-	1.077
CL-AC-24	2	34.3	38.0	465	14	1.152
CL-AC-25	2	33.5	36.6	355	-	0.944
CL-AC-26	1.5	54.1	54.2	1,210	-	0.764
CL-AC-27	1.5	36.7	40.4	485	-	0.981
CL-AC-28	3	34.4	37.4	420	-	1.032
CL-AC-29	3	36.2	39.6	485	-	1.022
CL-AC-30	3	35.5	38.9	435	-	0.972
CL-AC-31	3	37.7	41.2	505	-	0.942
CL-AC-32	3	63.5	67.6	2,140	-	0.836
CL-AC-33	2	36.2	39.5	415	-	0.875
CL-AC-34	2	33.3	36.1	380	-	1.029
CL-AC-35	2	35.2	39.2	435	-	0.997
CL-AC-36	2	36.2	39.5	445	14	0.938
CL-AC-37	1.5	51.9	55.9	1,440	-	1.030
CL-AC-38	1.5	34.1	37.5	420	-	1.059
CL-AC-39	1.5	37.3	40.5	455	-	0.877
CL-AC-40	5	36.2	39.1	430	-	0.906
CL-AC-41	3	45.2	49.2	835	12	0.904
CL-AC-42	3	35.5	37.9	360	-	0.805
CL-AC-43	2	34.8	37.6	415	13	0.985
CL-AC-44	2	34.0	36.8	380	16	0.967
CL-AC-45	2	33.4	36.3	330	10	0.886
CL-AC-46	1	32.6	35.6	385	-	1.111
CL-AC-47	3	34.7	38.0	490	-	1.173
CL-AC-48	3	35.0	38.0	375	-	0.875
CL-AC-49	2	33.8	36.8	365	-	0.945
CL-AC-50	2	32.7	35.6	330	-	0.944
CL-AC-51	2	36.1	38.9	440	-	0.935
CL-AC-52	2	37.6	40.9	440	-	0.828
CL-AC-53	2	36.8	39.6	385	-	0.773
CL-AC-54	2	37.7	40.9	490	-	0.914
CL-AC-55	1.5	37.3	40.9	470	-	0.906
CL-AC-56	1.5	33.8	36.8	330	-	0.855

Table F.24: Arctic charr measurements from fish captured at Camp Lake by gill netting, Mary River Project CREMP, August 2015.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
CL-AC-57	1.5	33.5	36.2	305	-	0.811
CL-AC-58	2	32.8	35.6	325	13	0.921
CL-AC-59	2	34.3	37.3	365	-	0.905
CL-AC-60	2	36.8	40.1	415	-	0.833
CL-AC-61	2	35.4	38.3	405	-	0.913
CL-AC-62	4.5	32.8	35.3	330	-	0.935
CL-AC-63	3	35.5	38.4	415	-	0.928
CL-AC-64	2	36.5	40.3	475	-	0.977
CL-AC-65	1.5	31.6	34.5	325	-	1.030
CL-AC-66	5	35.3	38.7	445	-	1.012
CL-AC-67	4	38.0	41.1	485	-	0.884
CL-AC-68	4	31.8	34.5	305	-	0.948
CL-AC-69	3	36.8	39.7	435	-	0.873
CL-AC-70	3	35.7	39.1	455	-	1.000
CL-AC-71	2	37.0	40.0	420	-	0.829
CL-AC-72	1	33.2	36.3	385	-	1.052
CL-AC-73	1	33.5	36.6	385	-	1.024
CL-AC-74	3	59.0	63.8	1,900	-	0.925
CL-AC-75*	3	46.4	49.8	560	-	0.561
CL-AC-76	3	34.7	38.0	350	-	0.838
CL-AC-77	3	42.2	46.1	660	-	0.878
CL-AC-78	3	38.3	41.6	525	-	0.934
CL-AC-79	2	35.3	38.3	410	-	0.932
CL-AC-80	2	32.1	34.7	315	-	0.952
CL-AC-81	2	34.7	37.6	375	13	0.898
CL-AC-82	2	34.6	37.2	485	12	1.171
CL-AC-83	4	34.4	37.7	410	14	1.007
CL-AC-84	3	34.5	38.2	405	-	0.986
CL-AC-85	3	40.9	44.3	580	-	0.848
CL-AC-86	2	37.3	40.6	455	16	0.877
CL-AC-87	3	34.2	37.4	395	-	0.987
CL-AC-88	3	36.4	39.6	430	-	0.892
CL-AC-89	3	36.5	40.1	455	-	0.936
CL-AC-90	2	36.7	40.3	455	-	0.920
CL-AC-91	2	35.4	38.6	415	14	0.935
CL-AC-92	2	35.3	38.7	455	13	1.034
CL-AC-93	3	36.5	39.7	480	-	0.987
CL-AC-94	3	36.0	39.7	430	-	0.922
CL-AC-95	3	35.5	38.8	450	-	1.006
CL-AC-96	2	36.2	39.4	400	-	0.843
CL-AC-97	3	35.4	38.4	425	-	0.958
CL-AC-98	2	35.8	38.6	405	12	0.883
CL-AC-99	2	34.7	38.7	395	-	0.945
CL-AC-100	2	36.3	39.8	495	-	1.035
CL-AC-101	2	35.5	39.4	405	-	0.905
CL-AC-102	2	34.1	36.9	405	15	1.021
CL-AC-103	2	35.1	38.6	435	-	1.006
Overall Catch Summary	total number	103	103	103	17	103
	average	36.5	39.7	477	13.6	0.939
	median	35.5	38.7	420	14.0	0.936
	standard deviation	4.9	5.0	265	1.7	0.096
	standard error	0.5	0.5	26	0.4	0.009
	minimum	31.6	34.5	260	10.0	0.561
	maximum	63.5	67.6	2,140	16.0	1.173

* Initial screening indicated sample was an outlier, and therefore the sample was removed from all subsequent statistical analysis data sets.

Table F.26: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Camp Lake littoral/profundal areas in 2015 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 (<i>p</i> -value)		Power
	Parameter	Covariate	Baseline	2015	Baseline		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	63	101	-	-	-	-	K-S Test	Yes	0.010	-
	Log ₁₀ Age (years)	none	30	17	-	-	-	-	ANOVA	Yes	0.000	0.992
Energy Use	Log ₁₀ Body Weight (g)	none	63	101	-	-	-	-	ANOVA	No	0.154	-
	Log ₁₀ Fork Length (cm)	none	63	101	-	-	-	-	ANOVA	Yes	0.081	0.543
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	29	16	0.605	0.000	0.031	0.517	ANCOVA	No	0.408	-
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	30	16	0.689	0.000	0.067	0.331	ANCOVA	No	0.432	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	63	101	0.971	0.000	0.936	0.000	ANCOVA	No	0.120	-

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	30	17	Mean	9.1	13.5	48.1	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	63	101	Mean	385.4	445.8	-	34	-25
	Log ₁₀ Fork Length (cm)	none	63	101	Mean	34.0	36.2	6.3	-	-
	Body Weight (g)	Age (years)	29	16	Adjusted Mean	294.3	388.5	-	66	-40
	Fork Length (cm)	Age (years)	30	16	Adjusted Mean	303.4	341.6	-	16.5	-14.2
Energy Storage	Body Weight (g)	Fork Length (cm)	63	101	Adjusted Mean	425.9	414.5	-	5.6	-5.3

^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 F.27: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Camp Lake littoral/profundal areas in 2015 and during the mine construction (2014) 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 (<i>p</i> -value)		Power
	Parameter	Covariate	2014	2015	2014		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	20	101	-	-	-	-	K-S Test	Yes	0.051	-
	Log ₁₀ Age (years)	none	0	0	-	-	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	20	101	-	-	-	-	ANOVA	Yes	0.052	0.621
	Log ₁₀ Fork Length (cm)	none	20	101	-	-	-	-	ANOVA	Yes	0.023	0.444
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	20	101	0.888	0.000	0.936	0.000	ANCOVA	Yes	0.060	0.597

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	2014	2015	Statistic	2014	2015		Increase	Decrease
Survival	Age (years)	none	0	0	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	20	101	Mean	385.942	445.804	15.5	-	-
	Log ₁₀ Fork Length (cm)	none	20	101	Mean	34.8	36.2	4.0	-	-
	Body Weight (g)	Age (years)	0	0	-	-	-	-	-	-
	Fork Length (cm)	Age (years)	0	0	-	-	-	-	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	20	101	Adjusted Mean	417.1	436.9	4.7	-	-

^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 ²*r* 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 F.28: Arctic charr measurements from fish captured at Sheardown Lake NW by gill netting, Mary River Project CREMP, August 2015.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SNW-AC-01	-	74.9	80.4	4,050	-	0.964
SNW-AC-02	-	34.7	38.0	410	-	0.981
SNW-AC-03	-	26.8	29.1	185	-	0.961
SNW-AC-04	-	34.7	37.5	415	-	0.993
SNW-AC-05	-	26.6	28.6	192	-	1.020
SNW-AC-06	-	40.6	44.0	655	-	0.979
SNW-AC-07	-	37.2	40.2	495	-	0.962
SNW-AC-08	-	40.1	42.9	545	-	0.845
SNW-AC-09	-	17.7	19.3	51.0	-	0.920
SNW-AC-10	-	17.6	19.2	53.5	-	0.981
SNW-AC-11	-	33.9	36.7	340	-	0.873
SNW-AC-12	-	33.6	36.5	340	-	0.896
SNW-AC-13	-	34.5	38.0	400	-	0.974
SNW-AC-14	-	40.2	42.9	530	-	0.816
SNW-AC-15	2	29.7	32.2	245	-	0.935
SNW-AC-16	0.5	25.0	26.9	138	-	0.883
SNW-AC-17*	0.5	27.1	29.3	105	-	0.528
SNW-AC-18	3	37.2	40.9	480	-	0.932
SNW-AC-19	1	30.4	33.2	290	-	1.032
SNW-AC-20	2	36.0	38.4	440	-	0.943
SNW-AC-21	4	40.6	43.8	655	-	0.979
SNW-AC-22	0.5	22.4	24.1	120	-	1.068
SNW-AC-23	0.5	20.2	21.9	82.0	-	0.995
SNW-AC-24	0.5	22.8	24.6	103	-	0.869
SNW-AC-25	0.5	23.9	25.5	124	-	0.908
SNW-AC-26	0.5	23.7	25.5	139	-	1.044
SNW-AC-27	0.5	26.5	28.5	148	-	0.795
SNW-AC-28	2	27.7	29.9	194	-	0.913
SNW-AC-29	2	26.0	28.0	167	-	0.950
SNW-AC-30	2	26.9	29.0	183	-	0.940
SNW-AC-31	2	30.3	32.5	238	-	0.856
SNW-AC-32	2	32.7	35.4	390	-	1.115
SNW-AC-33	1.5	20.7	22.4	80	-	0.902
SNW-AC-34	1.5	20.2	21.9	76	-	0.922
SNW-AC-35	1.5	22.5	24.2	109	-	0.957
SNW-AC-36	1.5	21.1	22.8	82	-	0.873
SNW-AC-37	1.5	22.0	23.6	99	-	0.930
SNW-AC-38	1.5	27.0	29.0	176	7	0.894
SNW-AC-39	1.5	24.8	26.8	138	8	0.905
SNW-AC-40	1.5	26.5	27.9	173	8	0.930
SNW-AC-41	2	34.2	36.8	380	11	0.950
SNW-AC-42	2	32.5	35.8	315	11	0.918
SNW-AC-43	4	51.4	54.6	1,190	22	0.876
SNW-AC-44	2	31.1	34.8	274	15	0.911
SNW-AC-45	1.5	26.2	28.3	180	8	1.001
SNW-AC-46	-	27.6	29.8	211	5	1.004
SNW-AC-47	-	31.4	34.3	320	9	1.034
SNW-AC-48	-	22.7	24.5	91	7	0.778
SNW-AC-49	-	34.0	37.1	355	12	0.903
SNW-AC-50	-	26.2	28.5	169	5	0.940
SNW-AC-51	-	35.8	38.8	420	15	0.915
SNW-AC-52	-	32.6	35.7	288	14	0.831
SNW-AC-53	-	18.1	19.6	52.5	5	0.885
SNW-AC-54	-	26.3	28.5	182	7	1.000
SNW-AC-55	-	22.8	24.6	75.5	5	0.637
SNW-AC-56	-	21.7	23.5	91.5	4	0.895

Table F.28: Arctic charr measurements from fish captured at Sheardown Lake NW by gill netting, Mary River Project CREMP, August 2015.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SNW-AC-57	-	35.3	38.4	410	13	0.932
SNW-AC-58	-	24.3	26.3	132	4	0.920
SNW-AC-59	-	29.8	32.3	235	7	0.888
SNW-AC-60	-	25.8	28.2	178	7	1.036
SNW-AC-61	-	29.0	31.4	230	8	0.943
SNW-AC-62	-	27.2	29.8	202	8	1.004
SNW-AC-63	-	27.4	29.6	186	7	0.904
SNW-AC-64	-	29.1	31.6	229	7	0.929
SNW-AC-65	-	29.2	31.8	190	7	0.763
SNW-AC-66	-	32.2	35.3	345	12	1.033
SNW-AC-67	-	27.2	29.3	188	6	0.934
SNW-AC-68	-	32.6	35.9	320	11	0.924
SNW-AC-69	-	38.4	41.5	450	8	0.795
SNW-AC-70	-	33.0	36.5	345	14	0.960
SNW-AC-71	-	34.9	37.9	425	12	1.000
SNW-AC-72	-	29.1	31.5	196	7	0.795
SNW-AC-73	-	23.1	24.9	120	6	0.974
SNW-AC-74	-	22.5	24.5	114	6	1.001
SNW-AC-75	-	17.5	19.0	41.0	4	0.765
SNW-AC-76	-	18.7	20.1	57.0	4	0.872
SNW-AC-77	-	7.4	8.0	4.075	-	1.006
SNW-AC-78	-	9.5	10.2	7.622	-	0.889
SNW-AC-79	-	55.2	59.2	1,870	17	1.112
SNW-AC-80	1.5	34.7	37.3	425	-	1.017
SNW-AC-81	1.5	34.0	37.0	390	-	0.992
SNW-AC-82	1.5	33.0	35.7	360	-	1.002
SNW-AC-83	0.5	30.2	32.9	285	-	1.035
SNW-AC-84	2	38.4	41.2	530	-	0.936
SNW-AC-85	1	33.4	36.0	355	-	0.953
SNW-AC-86	1.5	33.8	36.6	365	-	0.945
SNW-AC-87	1.5	34.3	37.1	380	-	0.942
SNW-AC-88	3	32.8	35.7	330	-	0.935
SNW-AC-89	1	35.0	38.0	385	-	0.898
SNW-AC-90	1.5	33.4	35.9	330	-	0.886
SNW-AC-91	0.5	32.8	35.5	320	-	0.907
SNW-AC-92	2	33.8	36.5	345	-	0.893
SNW-AC-93	2	24.2	26.1	120	-	0.847
SNW-AC-94	3	37.8	41.4	555	-	1.028
SNW-AC-95	1.5	33.8	37.3	380	13	0.984
SNW-AC-96	2	37.5	40.3	575	16	1.090
Overall Catch Summary	total number	96	96	96	42	96
	average	29.9	32.4	326	9.1	0.930
	median	29.8	32.3	237	8.0	0.935
	standard deviation	8.8	9.4	454	4.2	0.088
	standard error	0.9	1.0	46.4	0.6	0.009
	minimum	7.4	8.0	4.075	4.0	0.528
	maximum	74.9	80.4	4,050	22.0	1.115

* Initial screening indicated sample was an outlier, therefore the sample was removed from all subsequent statistical analysis data sets.

Table F.29: Additional meristics collected from adult Arctic charr incidental mortalities at Sheardown Lake NW in 2015, Mary River
Project CREMP, August 2015.

Specimen ID		Age (years)	Fork Length (cm)	Total Length (cm)	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
Sheardown Lake NW	SNW-AC-75	4	17.5	19.0	41	0.77	unknown	0.318	0.78	-	-	-	-
	SNW-AC-50	5	26.2	28.5	168	0.94	unknown	1.095	0.65	-	-	-	-
	SNW-AC-55	5	22.8	24.6	75	0.64	unknown	0.775	1.04	-	-	-	-
	SNW-AC-67	6	27.2	29.3	186	0.93	unknown	2.142	1.15	-	-	-	-
	SNW-AC-38	7	27.0	29.0	174	0.89	unknown	1.734	1.00	-	-	1.5	-
	SNW-AC-48	7	22.7	24.5	90	0.78	unknown	1.151	1.28	-	-	-	-
	SNW-AC-54	7	26.3	28.5	181	1.00	unknown	1.255	0.69	-	-	-	-
	SNW-AC-60	7	25.8	28.2	176	1.04	unknown	1.615	0.92	-	-	-	-
	SNW-AC-63	7	27.4	29.6	186	0.90	unknown		0.00	-	-	-	-
	SNW-AC-64	7	29.1	31.6	227	0.93	unknown	2.284	1.01	-	-	-	-
	SNW-AC-72	7	29.1	31.5	194	0.80	unknown	1.584	0.81	-	-	-	-
	SNW-AC-69	8	38.4	41.5	445	0.79	unknown	4.697	1.05	-	-	-	body cavity parasites (worms)
	SNW-AC-41	11	34.2	36.8	376	0.95	unknown	3.973	1.06	-	-	2	-
	SNW-AC-68	11	32.6	35.9	318	0.92	unknown	2.100	0.66	-	-	-	-
	SNW-AC-71	12	34.9	37.9	422	1.00	unknown	3.020	0.72	-	-	-	-
	SNW-AC-57	13	35.3	38.4	407	0.93	unknown	3.203	0.79	-	-	-	-
	SNW-AC-95	13	33.8	37.3	376	0.98	unknown	3.749	1.00	-	-	1.5	body cavity parasites (worms)
	SNW-AC-70	14	33.0	36.5	342	0.96	unknown	3.064	0.90	-	-	-	-
	SNW-AC-51	15	35.8	38.8	415	0.92	unknown	4.625	1.11	-	-	-	-
	SNW-AC-43	22	51.4	54.6	1177	0.88	unknown	13.267	1.13	-	-	4	body cavity parasites (worms)
	SNW-AC-66	12	32.2	35.3	341	1.03	unknown	3.217	0.94	0.823	0.241	-	-
	SNW-AC-47	9	31.4	34.3	317	1.03	unknown	3.263	1.03	-	-	-	-
	SNW-AC-61	8	29.0	31.4	227	0.94	unknown	2.719	1.20	-	-	-	-
	SNW-AC-59	7	29.8	32.3	232	0.89	unknown	2.576	1.11	-	-	-	-
	SNW-AC-74	6	22.5	24.5	113	1.00	unknown	1.144	1.01	-	-	-	-
	SNW-AC-46	5	27.6	29.8	210	1.00	unknown	1.080	0.51	-	-	-	-
	SNW-AC-56	4	21.7	23.5	92	0.90	unknown	-	-	-	-	-	-
	SNW-AC-58	4	24.3	26.3	131	0.92	unknown	1.451	1.11	-	-	-	-
	SNW-AC-76	4	18.7	20.1	57	0.87	unknown	-	-	-	-	-	-
	SNW-AC-45	8	26.2	28.3	177	1.00	male	2.102	1.19	0.532	0.300	1.5	-
	SNW-AC-73	6	23.1	24.9	117	0.97	female	2.531	2.16	0.267	0.228	-	-
	SNW-AC-53	5	18.1	19.6	52	0.89	female	0.398	0.77	0.285	0.550	-	-
	SNW-AC-62	8	27.2	29.8	199	1.00	female	1.934	0.97	0.603	0.302	-	-
	SNW-AC-39	8	24.8	26.8	135	0.90	female	1.865	1.38	0.643	0.475	1.5	-
	SNW-AC-42	11	32.5	35.8	310	0.92	female	3.408	1.10	1.816	0.586	2	body cavity parasites (worms)
	SNW-AC-44	15	31.1	34.8	268	0.91	female	4.065	1.52	2.058	0.768	2	body cavity parasites (worms)
	SNW-AC-49	12	34.0	37.1	349	0.90	female	3.170	0.91	3.209	0.920	-	-
	SNW-AC-96	16	37.5	40.3	567	1.09	female	3.763	0.66	3.878	0.684	2	-
	SNW-AC-40	8	26.5	27.9	158	0.93	female	3.395	2.15	11.89	7.539	1.5	-
	SNW-AC-79	17	55.2	59.2	1512	1.11	female	39.350	2.60	318.687	21.078	-	body cavity parasites (worms)
	SNW-AC-52	14	32.6	35.7	285	0.83	female	2.583	0.90	-	-	-	-
	SNW-AC-65	7	29.2	31.8	188	0.76	female	1.959	1.04	-	-	-	body cavity parasites (worms)
Adult Non- Spawner Statistics	Average	8.5	29.2	31.7	265	0.92	-	2.735	0.91	-	-	-	-
	St. deviation	4.1	6.8	7.3	212	0.09	-	2.453	0.26	-	-	-	-
	Minimum	4	17.5	19.0	41	0.64	-	0.318	0.00	-	-	-	-
	Maximum	22	51.4	54.6	1177	1.04	-	13.267	1.28	-	-	-	-
	Sample Size (N)	29	29	29	29	29	29	26	27	-	-	-	-
Females Statistics	Average	10.6	31.0	33.6	345	0.94	-	5.702	1.35	34.334	3.313	-	-
	St. deviation	4.1	9.3	10.0	391	0.10	-	10.645	0.63	99.971	6.619	-	-
	Minimum	5	18.1	19.6	52	0.76	-	0.398	0.66	0.267	0.228	-	-
	Maximum	17	55.2	59.2	1512	1.11	-	39.350	2.60	318.687	21.078	-	-
	Sample Size (N)	12	12	12	12	12	12	12	12	10	10	-	-

Table F.30: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Sheardown Lake NW littoral/profundal areas in 2015 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
	Parameter	Covariate	Baseline	2015	Baseline		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	118	95	-	-	-	-	K-S Test	Yes	0.000	-
	Log ₁₀ Age (years)	none	30	42	-	-	-	-	ANOVA	Yes	0.000	0.995
Energy Use	Log ₁₀ Body Weight (g)	none	118	95	-	-	-	-	ANOVA	Yes	0.000	1.000
	Log ₁₀ Fork Length (cm)	none	118	95	-	-	-	-	ANOVA	Yes	0.000	1.000
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	30	42	0.680	0.000	0.743	0.000	ANCOVA	No	0.191	-
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	30	42	0.717	0.000	0.744	0.000	ANCOVA	No	0.595	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	118	94	0.965	0.000	0.993	0.000	ANCOVA	Yes	0.000	0.998

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	30	42	Mean	12.7	8.3	-34.7	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	118	95	Mean	411.828	219.944	-46.6	-	-
	Log ₁₀ Fork Length (cm)	none	118	95	Mean	36.2	28.7	-20.7	-	-
	Body Weight (g)	Age (years)	30	42	Adjusted Mean	238.4	285.8	-	35	-26
	Fork Length (cm)	Age (years)	30	42	Adjusted Mean	302.6	313.1	-	10.1	-9.2
Energy Storage	Body Weight (g)	Fork Length (cm)	118	94	Adjusted Mean	304.8	329.1	8.0	-	-

^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 F.31: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Sheardown Lake NW littoral/profundal areas in 2015 and during the mine construction (2014) 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 (<i>p</i> -value)		Power
	Parameter	Covariate	2014	2015	2014		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	22	95	-	-	-	-	K-S Test	Yes	0.001	-
	Log ₁₀ Age (years)	none	0	0	-	-	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	22	95	-	-	-	-	ANOVA	Yes	0.004	0.906
	Log ₁₀ Fork Length (cm)	none	22	95	-	-	-	-	ANOVA	Yes	0.003	0.915
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	22	94	0.960	0.000	0.993	0.000	ANCOVA	No	0.581	-

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	2014	2015	Statistic	2014	2015		Increase	Decrease
Survival	Age (years)	none	0	0	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	22	95	Mean	405.595	219.944	-45.8	-	-
	Log ₁₀ Fork Length (cm)	none	22	95	Mean	35.2	28.7	-18.5	-	-
	Body Weight (g)	Age (years)	0	0	-	-	-	-	-	-
	Fork Length (cm)	Age (years)	0	0	-	-	-	-	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	22	94	Adjusted Mean	242.4	248.3	-	4.5	-4.3

^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 F.32: Arctic charr measurements from fish captured at Sheardown Lake SE by gill netting, Mary River Project CREMP, August 2015.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SSE-AC-01*	1.5	33.0	35.6	195	-	0.543
SSE-AC-02	1.5	34.4	37.1	390	-	0.958
SSE-AC-03	2	36.8	40.0	530	-	1.063
SSE-AC-04	0.5	35.3	38.5	380	-	0.864
SSE-AC-05	3	44.0	47.4	745	-	0.875
SSE-AC-06	0.5	30.4	32.9	283	-	1.007
SSE-AC-07	1.5	40.9	43.5	610	-	0.892
SSE-AC-08	1.5	36.0	38.5	465	-	0.997
SSE-AC-09	1.5	37.4	41.3	485	-	0.927
SSE-AC-10*	1	28.1	30.1	123	-	0.554
SSE-AC-11	1	30.8	33.6	299	-	1.023
SSE-AC-12	2	40.8	43.5	610	-	0.898
SSE-AC-13	3	34.2	37.3	440	-	1.100
SSE-AC-14	3	38.9	42.4	580	-	0.985
SSE-AC-15	3	35.7	38.7	410	-	0.901
SSE-AC-16	3	37.7	41.3	575	-	1.073
SSE-AC-17	3	33.7	36.5	385	-	1.006
SSE-AC-18	3	36.0	39.2	460	-	0.986
SSE-AC-19	3	37.2	40.0	475	-	0.923
SSE-AC-20	3	34.9	37.3	380	-	0.894
SSE-AC-21	2	41.7	44.7	645	-	0.890
SSE-AC-22	2	35.4	38.9	470	-	1.059
SSE-AC-23	2	34.4	37.0	375	-	0.921
SSE-AC-24	2	54.7	57.8	1,700	-	1.039
SSE-AC-25	2	32.2	34.8	315	-	0.944
SSE-AC-26	1.5	32.7	35.4	315	-	0.901
SSE-AC-27	2	37.9	40.6	485	-	0.891
SSE-AC-28	3	35.0	37.2	380	-	0.886
SSE-AC-29	3	38.2	41.4	515	-	0.924
SSE-AC-30	3	39.6	43.1	595	-	0.958
SSE-AC-31	0.5	37.2	40.1	505	-	0.981
SSE-AC-32	0.5	36.8	39.7	485	-	0.973
SSE-AC-33	4	37.9	40.7	550	-	1.010
SSE-AC-34	2	38.9	41.8	515	-	0.875
SSE-AC-35	2	36.7	39.4	460	-	0.931
SSE-AC-36	2	39.2	41.8	515	-	0.855
SSE-AC-37	3	39.7	43.1	615	-	0.983
SSE-AC-38	3	34.5	37.6	415	-	1.011
SSE-AC-39	3	35.4	38.0	460	-	1.037
SSE-AC-40	3	36.3	39.2	450	-	0.941
SSE-AC-41	4	36.5	39.4	490	-	1.008
SSE-AC-42	3	36.5	40.0	510	-	1.049
SSE-AC-43	3	34.0	36.8	360	-	0.916
SSE-AC-44	3	38.5	41.2	595	-	1.043
SSE-AC-45	3	33.9	36.8	370	-	0.950
SSE-AC-46	3	37.3	40.5	535	-	1.031
SSE-AC-47	3	36.8	40.2	520	-	1.043
SSE-AC-48	3	38.5	41.6	510	-	0.894
SSE-AC-49	3	40.0	42.6	615	-	0.961
SSE-AC-50	0.5	31.4	34.4	325	-	1.050
SSE-AC-51	0.5	32.0	34.6	305	-	0.931
SSE-AC-52	3	39.9	42.6	555	-	0.874
SSE-AC-53	1.5	32.8	35.1	360	-	1.020
SSE-AC-54	1.5	32.9	35.2	294	-	0.826
SSE-AC-55	1.5	33.7	36.6	370	-	0.967
SSE-AC-56	1.5	32.0	34.9	350	-	1.068

Table F.32: Arctic charr measurements from fish captured at Sheardown Lake SE by gill netting, Mary River Project CREMP, August 2015.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SSE-AC-57	2	33.4	36.1	375	14	1.006
SSE-AC-58	2	31.8	34.7	315	7	0.980
SSE-AC-59	2	33.5	36.0	345	8	0.918
SSE-AC-60	2	33.9	36.6	365	9	0.937
SSE-AC-61	2	35.5	38.2	580	12	1.296
SSE-AC-62	2	32.6	36.0	390	13	1.126
SSE-AC-63	2	33.0	35.4	335	11	0.932
SSE-AC-64	2	32.6	35.6	390	13	1.126
SSE-AC-65	1.5	32.1	34.8	365	11	1.104
SSE-AC-66	1.5	33.6	36.3	385	8	1.015
SSE-AC-67	1.5	30.9	33.4	310	9	1.051
SSE-AC-68	3	40.8	43.6	585	20	0.861
SSE-AC-69	2	33.4	36.2	355	-	0.953
SSE-AC-70	3	38.5	41.2	500	-	0.876
SSE-AC-71	3	36.7	39.4	505	-	1.022
SSE-AC-72	3	38.2	41.3	460	-	0.825
SSE-AC-73	3	37.5	41.0	505	-	0.958
SSE-AC-74	0.5	40.7	44.1	500	-	0.742
SSE-AC-75	3	38.8	41.7	610	-	1.044
SSE-AC-76	3	34.7	37.3	395	-	0.945
SSE-AC-77	1.5	31.5	34.3	335	-	1.072
SSE-AC-78	1.5	19.5	21.1	66	-	0.890
SSE-AC-79	1.5	19.9	21.6	71	-	0.901
SSE-AC-80	1.5	24.4	26.4	130	-	0.895
SSE-AC-81	2	33.7	36.6	345	-	0.901
SSE-AC-82	2	31.6	33.9	275	-	0.872
SSE-AC-83	2	35.3	37.9	405	-	0.921
SSE-AC-84	2	36.5	39.5	500	-	1.028
SSE-AC-85	3	30.4	32.6	320	-	1.139
SSE-AC-86	3	35.5	38.7	450	-	1.006
SSE-AC-87	3	36.4	39.7	445	-	0.923
SSE-AC-88	1.5	34.0	37.2	395	-	1.005
SSE-AC-89	1.5	36.6	40.0	455	-	0.928
SSE-AC-90	1.5	19.0	20.5	64	-	0.933
SSE-AC-91	1.5	17.9	19.1	53	-	0.924
SSE-AC-92	1.5	19.3	20.8	64	-	0.890
SSE-AC-93	2	35.9	38.9	420	-	0.908
SSE-AC-94	2	35.9	39.0	455	-	0.983
SSE-AC-95	2	33.6	36.2	375	-	0.989
SSE-AC-96	3	40.9	43.9	565	-	0.826
SSE-AC-97	3	35.4	38.0	420	-	0.947
SSE-AC-98	3	41.9	44.6	565	-	0.768
SSE-AC-99	2	32.2	34.7	350	10	1.048
SSE-AC-100	2	34.8	38.0	425	14	1.008
SSE-AC-101	2	35.5	38.4	435	11	0.972
SSE-AC-102	2	32.9	35.7	340	12	0.955
SSE-AC-103	2	35.5	38.6	440	14	0.983
SSE-AC-104	2	35.4	38.6	500	13	1.127
SSE-AC-105	2	30.8	33.8	320	10	1.095
Overall Catch Summary	total number	105	105	105	19	105
	average	34.9	37.7	430	11.5	0.959
	median	35.4	38.2	425	11.0	0.958
	standard deviation	5.1	5.4	183	3.0	0.102
	standard error	0.5	0.5	17.82	0.7	0.010
	minimum	17.9	19.1	53.00	7.0	0.543
	maximum	54.7	57.8	1,700	20.0	1.296

* Initial screening indicated sample was an outlier, and therefore the sample was removed from all subsequent statistical analysis data sets.

Table F.34: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Sheardown Lake SE littoral/profundal areas in 2015 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 (<i>p</i> -value)		Power
	Parameter	Covariate	Baseline	2015	Baseline		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	90	103	-	-	-	-	K-S Test	Yes	0.000	-
	Log ₁₀ Age (years)	none	9	19	-	-	-	-	ANOVA	No	0.158	-
Energy Use	Log ₁₀ Body Weight (g)	none	90	103	-	-	-	-	ANOVA	Yes	0.000	1.000
	Log ₁₀ Fork Length (cm)	none	90	103	-	-	-	-	ANOVA	Yes	0.000	0.999
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	9	19	0.418	0.060	0.460	0.001	ANCOVA	Yes	0.043	0.666
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	9	19	0.323	0.111	0.429	0.002	ANCOVA	No	0.933	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	90	103	0.841	0.000	0.970	0.000	ANCOVA	No	0.173	-

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	9	19	Mean	12.9	11.2	-	34	-25
Energy Use	Log ₁₀ Body Weight (g)	none	90	103	Mean	535.959	396.363	-26.0	-	-
	Log ₁₀ Fork Length (cm)	none	90	103	Mean	37.9	34.5	-8.8	-	-
	Body Weight (g)	Age (years)	9	19	Adjusted Mean	338.5	399.8	18.1	-	-
	Fork Length (cm)	Age (years)	9	19	Adjusted Mean	338.4	339.2	-	7.8	-7.3
Energy Storage	Body Weight (g)	Fork Length (cm)	90	103	Adjusted Mean	454.0	450.3	-	4.4	-4.2

^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 F.35: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Sheardown Lake SE littoral/profundal areas in 2015 and during the mine construction (2014) 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
	Parameter	Covariate	2014	2015	2014		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	43	103	-	-	-	-	K-S Test	Yes	0.033	-
	Log ₁₀ Age (years)	none	0	0	-	-	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	43	103	-	-	-	-	ANOVA	Yes	0.054	0.615
	Log ₁₀ Fork Length (cm)	none	43	103	-	-	-	-	ANOVA	Yes	0.024	0.737
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	43	103	0.972	0.000	0.970	0.000	ANCOVA	Yes	0.083	0.538

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	2014	2015	Statistic	2014	2015		Increase	Decrease
Survival	Age (years)	none	0	0	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	43	103	Mean	482.926	396.363	-17.9	-	-
	Log ₁₀ Fork Length (cm)	none	43	103	Mean	37.2	34.5	-7.3	-	-
	Body Weight (g)	Age (years)	0	0	-	-	-	-	-	-
	Fork Length (cm)	Age (years)	0	0	-	-	-	-	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	43	103	Adjusted Mean	407.7	422.3	3.6	-	-

^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 F.36: Arctic charr measurements from fish captured at Mary Lake by gill netting, Mary River Project CREMP, August 2015.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
ML-AC-01	5	60.1	64.3	1,720	17	0.792
ML-AC-02	3	38.1	41.1	490	-	0.886
ML-AC-03	3	37.4	40.4	480	-	0.918
ML-AC-04	2	46.5	50.3	940	-	0.935
ML-AC-05	5	41.0	44.5	725	-	1.052
ML-AC-06	3	37.2	40.5	525	-	1.020
ML-AC-07	2	37.5	40.4	395	10	0.749
ML-AC-08	2	35.8	38.3	355	16	0.774
ML-AC-09	3	35.5	38.8	410	-	0.916
ML-AC-10	2	35.6	38.7	415	10	0.920
ML-AC-11	2	35.5	38.6	425	14	0.950
ML-AC-12	2	40.0	43.6	565	-	0.883
ML-AC-13	0.5	37.8	41.1	465	-	0.861
ML-AC-14	5	49.1	52.9	1,100	-	0.929
ML-AC-15	3	60.0	64.2	1,940	-	0.898
ML-AC-16	3	39.6	42.8	590	-	0.950
ML-AC-17	3	37.1	40.5	495	-	0.969
ML-AC-18	3	36.0	39.1	505	-	1.082
ML-AC-19	3	39.5	43.0	490	-	0.795
ML-AC-20	3	42.0	45.5	580	-	0.783
ML-AC-21	3	45.2	49.3	930	-	1.007
ML-AC-22	1.5	33.5	36.5	355	10	0.944
ML-AC-23	1.5	54.7	59.7	1,720	-	1.051
ML-AC-24	1.5	37.1	40.3	445	-	0.871
ML-AC-25	1.5	42.2	46.0	660	-	0.878
ML-AC-26	0.5	43.3	46.4	670	20	0.825
ML-AC-27	1	40.8	44.0	535	-	0.788
ML-AC-28	1.5	36.2	39.2	410	12	0.864
ML-AC-29	1.5	36.0	39.4	475	14	1.018
ML-AC-30	2	39.2	42.9	535	16	0.888
ML-AC-31	2	32.1	34.8	310	10	0.937
ML-AC-32	2	31.5	34.1	330	-	1.056
ML-AC-33	2	36.6	40.4	435	-	0.887
ML-AC-34	2	37.3	40.7	505	-	0.973
ML-AC-35	3	38.9	42.2	530	-	0.900
ML-AC-36	3	40.1	43.8	510	-	0.791
ML-AC-37	3	39.8	43.2	570	-	0.904
ML-AC-38	3	36.1	39.3	420	-	0.893
ML-AC-39	3	37.9	41.1	580	-	1.065
ML-AC-40	3	39.3	42.8	525	-	0.865
ML-AC-41	3	34.5	37.7	390	-	0.950
ML-AC-42	3	36.5	39.4	415	-	0.853
ML-AC-43	4	37.8	40.8	455	-	0.842
ML-AC-44	4	40.0	43.5	595	-	0.930
ML-AC-45	4	37.1	40.1	475	-	0.930
ML-AC-46	4	37.6	41.0	495	-	0.931
ML-AC-47	4	39.8	43.5	575	-	0.912
ML-AC-48	3	36.6	40.8	495	-	1.010
ML-AC-49	3	38.4	41.4	540	-	0.954
ML-AC-50	3	35.9	38.9	440	-	0.951
ML-AC-51	5	50.5	54.4	1,160	-	0.901
ML-AC-52	3	57.6	61.2	1,450	-	0.759
ML-AC-53	3	39.4	42.5	510	-	0.834
ML-AC-54	3	35.9	39.0	465	17	1.005
ML-AC-55	3	37.6	40.6	520	-	0.978
ML-AC-56	3	38.8	42.0	500	-	0.856
ML-AC-57	1.5	37.2	40.4	510	-	0.991
ML-AC-58	0.5	34.3	37.2	290	-	0.719
ML-AC-59	0.5	44.3	47.9	660	-	0.759
ML-AC-60	0.5	33.5	36.5	365	-	0.971
ML-AC-61	0.5	36.0	38.9	405	-	0.868

Table F.36: Arctic charr measurements from fish captured at Mary Lake by gill netting, Mary River Project CREMP, August 2015.

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
ML-AC-62	0.5	36.8	39.9	485	-	0.973
ML-AC-63	2	36.9	39.7	465	-	0.925
ML-AC-64	2	37.8	41.0	505	-	0.935
ML-AC-65	2	38.8	42.4	550	-	0.942
ML-AC-66	3	42.3	45.9	600	-	0.793
ML-AC-67	3	34.9	37.7	415	-	0.976
ML-AC-68	5	63.0	66.7	1,920	17	0.768
ML-AC-69	3	38.6	41.6	520	-	0.904
ML-AC-70	3	38.7	42.3	600	-	1.035
ML-AC-71	2	40.9	44.5	540	18	0.789
ML-AC-72	2	33.2	35.9	305	-	0.833
ML-AC-73	2	36.3	39.6	540	-	1.129
ML-AC-74	2	50.4	54.2	1,010	-	0.789
ML-AC-75	2	35.7	38.3	400	-	0.879
ML-AC-76	2	38.4	41.4	510	-	0.901
ML-AC-77	2	40.8	44.5	600	-	0.883
ML-AC-78	0.5	39.4	42.3	455	-	0.744
ML-AC-79	0.5	36.8	39.7	415	-	0.833
ML-AC-80	3	39.0	42.6	490	-	0.826
ML-AC-81	3	38.1	41.2	480	-	0.868
ML-AC-82	3	39.2	42.4	525	-	0.872
ML-AC-83	3	38.7	41.7	570	-	0.983
ML-AC-84	3	34.8	37.7	375	-	0.890
ML-AC-85	2	38.1	41.7	560	-	1.013
ML-AC-86	2	34.5	37.4	445	-	1.084
ML-AC-87	2	32.0	34.9	295	-	0.900
ML-AC-88	5	51.4	55.6	1,400	-	1.031
ML-AC-89	5	55.8	60.2	1,540	-	0.886
ML-AC-90	5	48.0	52.7	850	-	0.769
ML-AC-91	3	58.7	62.9	2,250	-	1.112
ML-AC-92	3	37.6	40.9	490	-	0.922
ML-AC-93	3	57.5	61.6	1,620	-	0.852
ML-AC-94	3	37.6	40.9	545	-	1.025
ML-AC-95	3	41.8	44.6	595	-	0.815
ML-AC-96	3	40.5	43.3	650	-	0.978
ML-AC-97	3	45.5	48.8	730	12	0.775
ML-AC-98	2	39.0	43.0	580	14	0.978
ML-AC-99	2	38.0	41.0	595	-	1.084
ML-AC-100	3	36.3	39.3	435	-	0.909
ML-AC-101	3	38.6	41.9	525	-	0.913
ML-AC-102	2	35.3	38.4	425	-	0.966
ML-AC-103	2	34.3	37.5	430	-	1.066
ML-AC-104	2	39.5	42.3	525	-	0.852
ML-AC-105	2	42.9	46.4	600	-	0.760
ML-AC-106	4	36.2	39.3	505	14	1.065
ML-AC-107	3	37.2	40.1	410	11	0.796
ML-AC-108	3	47.8	51.8	795	-	0.728
ML-AC-109	3	39.1	42.2	495	-	0.828
ML-AC-110	3	40.5	43.5	555	-	0.835
ML-AC-111	2	38.9	42.3	535	-	0.909
ML-AC-112	2	37.1	40.3	585	-	1.146
ML-AC-113	2	39.1	42.6	460	-	0.770
Overall Catch Summary	total number	113	113	113	18	113
	average	40.1	43.4	624	14.0	0.908
	median	38.4	41.4	510	14.0	0.904
	standard deviation	6.3	6.7	364	3.1	0.097
	standard error	0.6	0.6	34.3	0.7	0.009
	minimum	31.5	34.1	290	10.0	0.719
	maximum	63.0	66.7	2,250	20.0	1.146

Table F.38: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Mary Lake littoral/profundal areas in 2015 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 (<i>p</i> -value)		Power
	Parameter	Covariate	Baseline	2015	Baseline		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	161	113	-	-	-	-	K-S Test	Yes	0.024	-
	Log ₁₀ Age (years)	none	39	45	-	-	-	-	ANOVA	No	0.643	-
Energy Use	Log ₁₀ Body Weight (g)	none	161	113	-	-	-	-	ANOVA	Yes	0.025	0.726
	Log ₁₀ Fork Length (cm)	none	161	113	-	-	-	-	ANOVA	Yes	0.030	0.701
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	39	45	0.450	0.000	0.499	0.000	ANCOVA	No	0.601	-
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	39	45	0.479	0.000	0.529	0.000	ANCOVA	No	0.624	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	161	113	0.964	0.000	0.937	0.000	ANCOVA	No	0.565	-

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	39	45	Mean	13.2	12.8	-	19	-16
Energy Use	Log ₁₀ Body Weight (g)	none	161	113	Mean	472.565	562.279	19.0	-	-
	Log ₁₀ Fork Length (cm)	none	161	113	Mean	37.4	39.6	6.0	-	-
	Body Weight (g)	Age (years)	39	45	Adjusted Mean	484.4	451.4	-	50	-33
	Fork Length (cm)	Age (years)	39	45	Adjusted Mean	370.2	362.0	-	14.7	-12.8
Energy Storage	Body Weight (g)	Fork Length (cm)	161	113	Adjusted Mean	507.6	512.8	-	4.6	-4.4

^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 F.39: Results of health endpoint statistical comparisons for (adult) Arctic charr captured at Mary Lake littoral/profundal areas in 2015 and during the mine construction (2014) 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
	Parameter	Covariate	2014	2015	2014		2015					
					r	p-value	r	p-value				
Survival	Fork Length Distribution	none	66	113	-	-	-	-	K-S Test	No	0.263	-
	Log ₁₀ Age (years)	none	0	0	-	-	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	66	113	-	-	-	-	ANOVA	No	0.970	-
	Log ₁₀ Fork Length (cm)	none	66	113	-	-	-	-	ANOVA	No	0.535	-
	Log ₁₀ Body Weight (g)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
	Log ₁₀ Fork Length (cm)	Log ₁₀ Age (years)	0	0	-	-	-	-	-	-	-	-
Energy Storage	Log ₁₀ Adj. Body Weight (g)	Log ₁₀ Fork Length (cm)	65	113	0.957	0.000	0.937	0.000	ANCOVA	Yes	0.021	0.753

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	2014	2015	Statistic	2014	2015		Increase	Decrease
Survival	Age (years)	none	0	0	-	-	-	-	-	-
Energy Use	Log ₁₀ Body Weight (g)	none	66	113	Mean	563.745	562.279	-	22	-18
	Log ₁₀ Fork Length (cm)	none	66	113	Mean	39.1	39.6	-	6.8	-6.4
	Body Weight (g)	Age (years)	0	0	-	-	-	-	-	-
	Fork Length (cm)	Age (years)	0	0	-	-	-	-	-	-
Energy Storage	Body Weight (g)	Fork Length (cm)	65	113	Adjusted Mean	577.6	555.8	-3.8	-	-

^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 ²r 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).

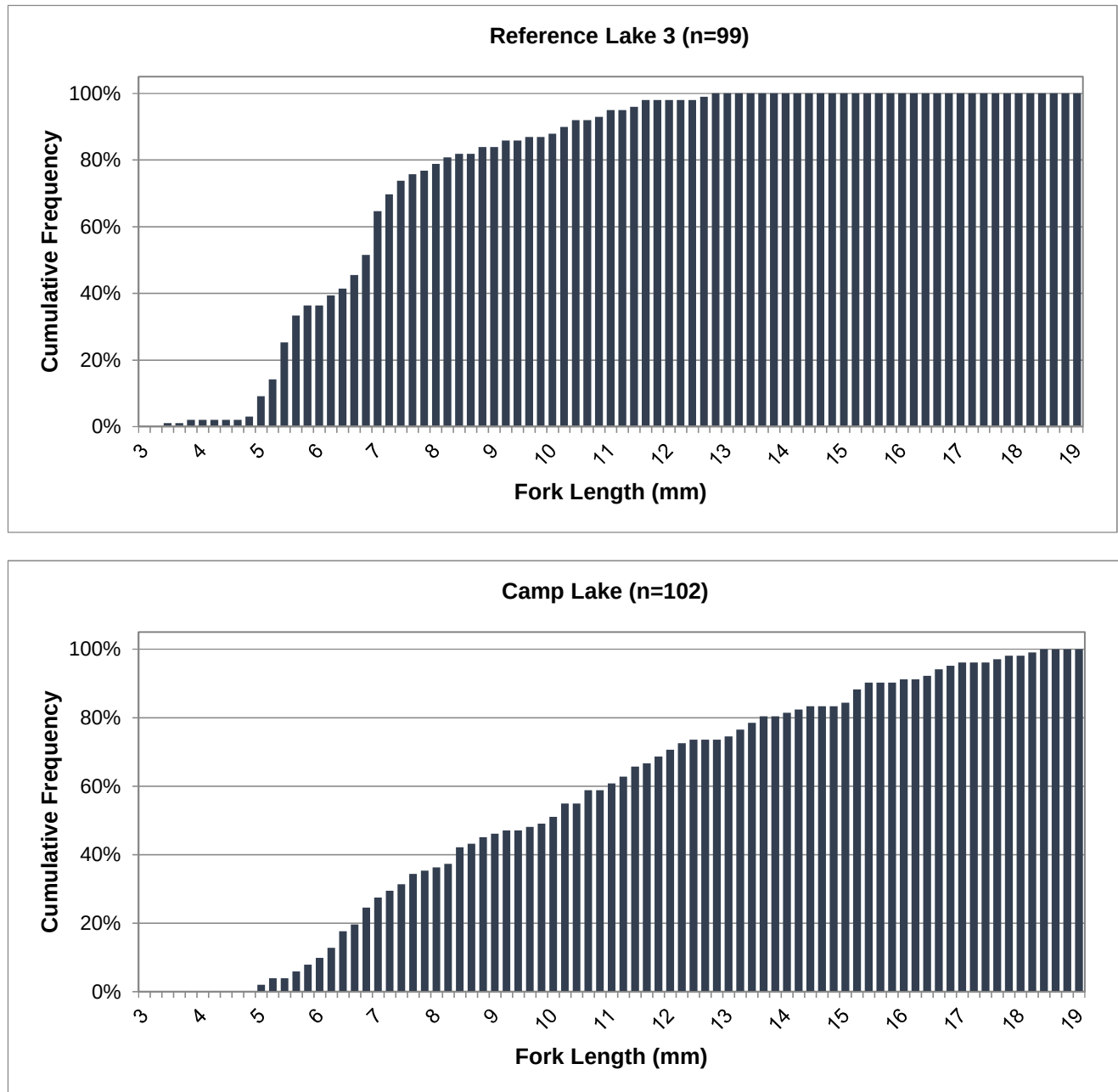


Figure F.1: Cumulative length-frequency distributions for juvenile Arctic charr captured by electrofishing at nearshore areas of Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2015.

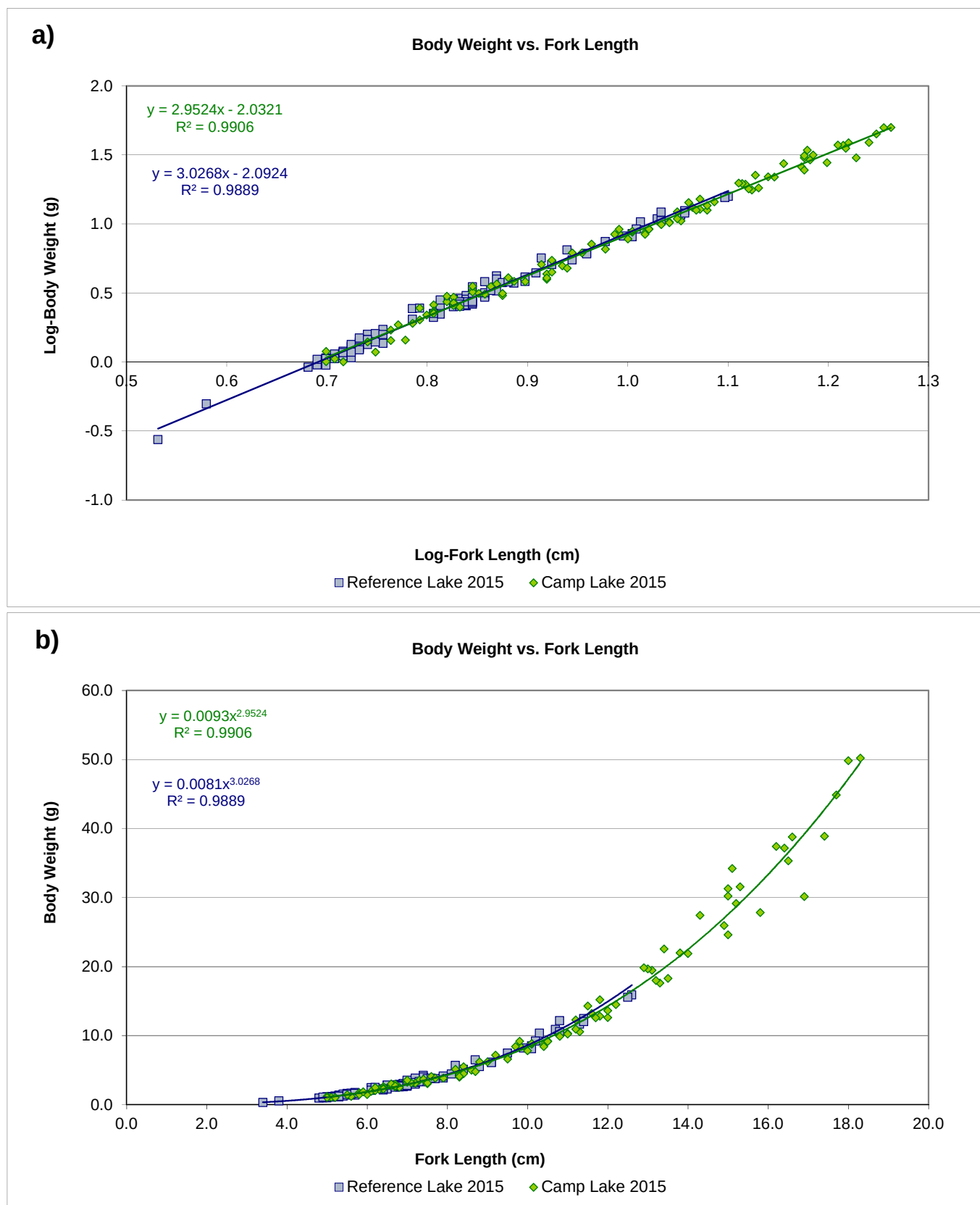
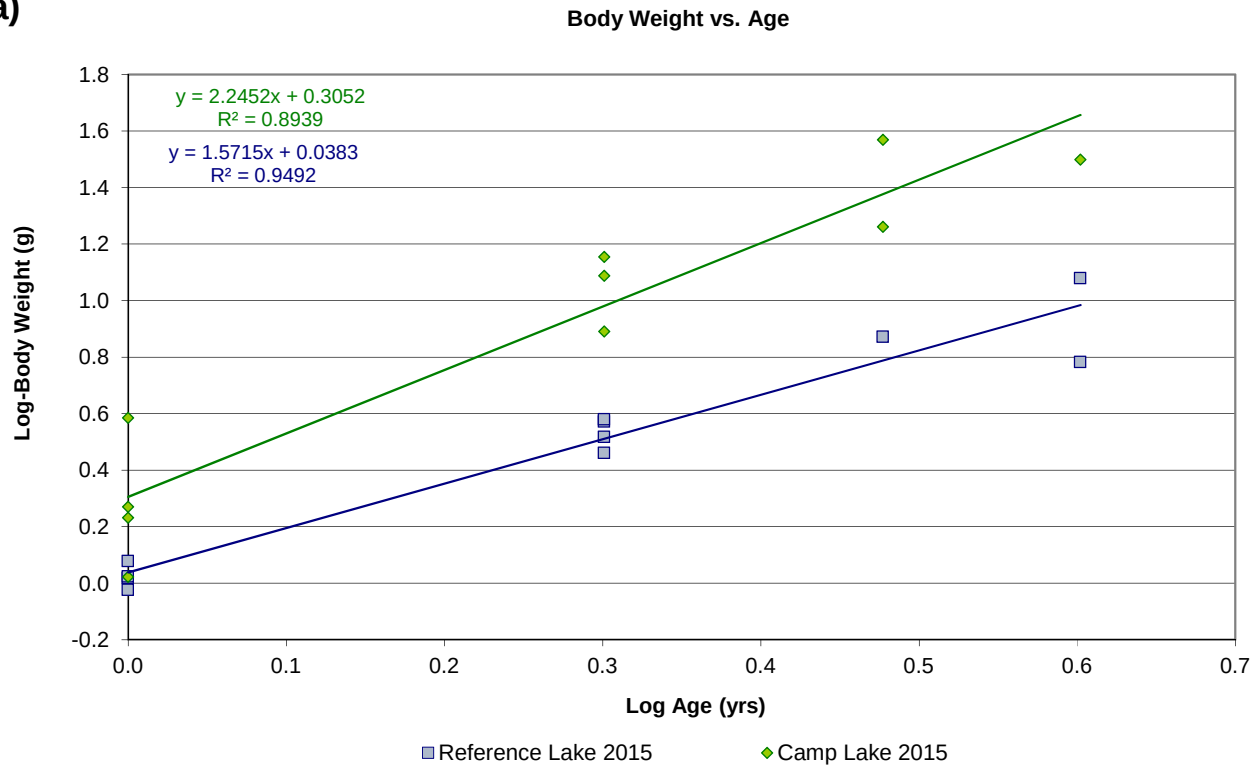


Figure F.2: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected at the nearshore area of Camp Lake and Reference Lake 3 in August 2015 using log-transformed (a) and untransformed (b) data, Mary River Project CREMP, 2015.

a)



b)

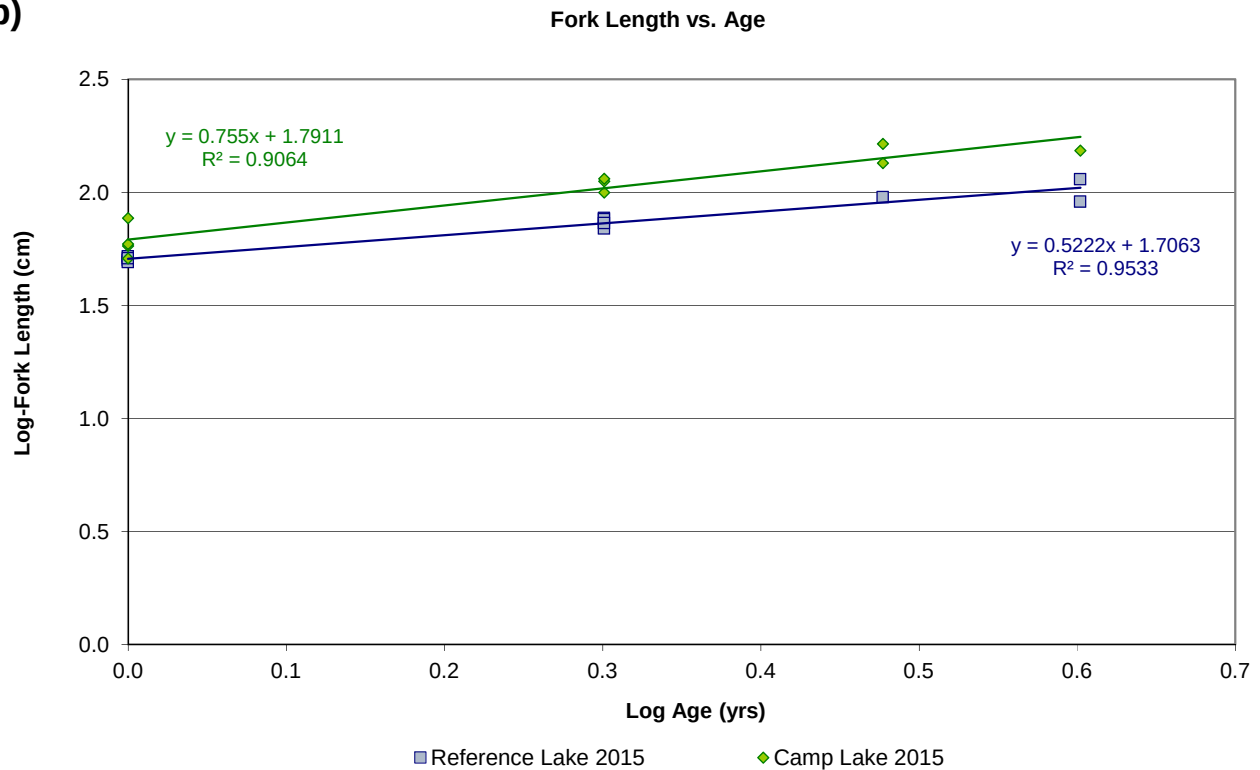


Figure F.3: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected at the nearshore area of Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2015.

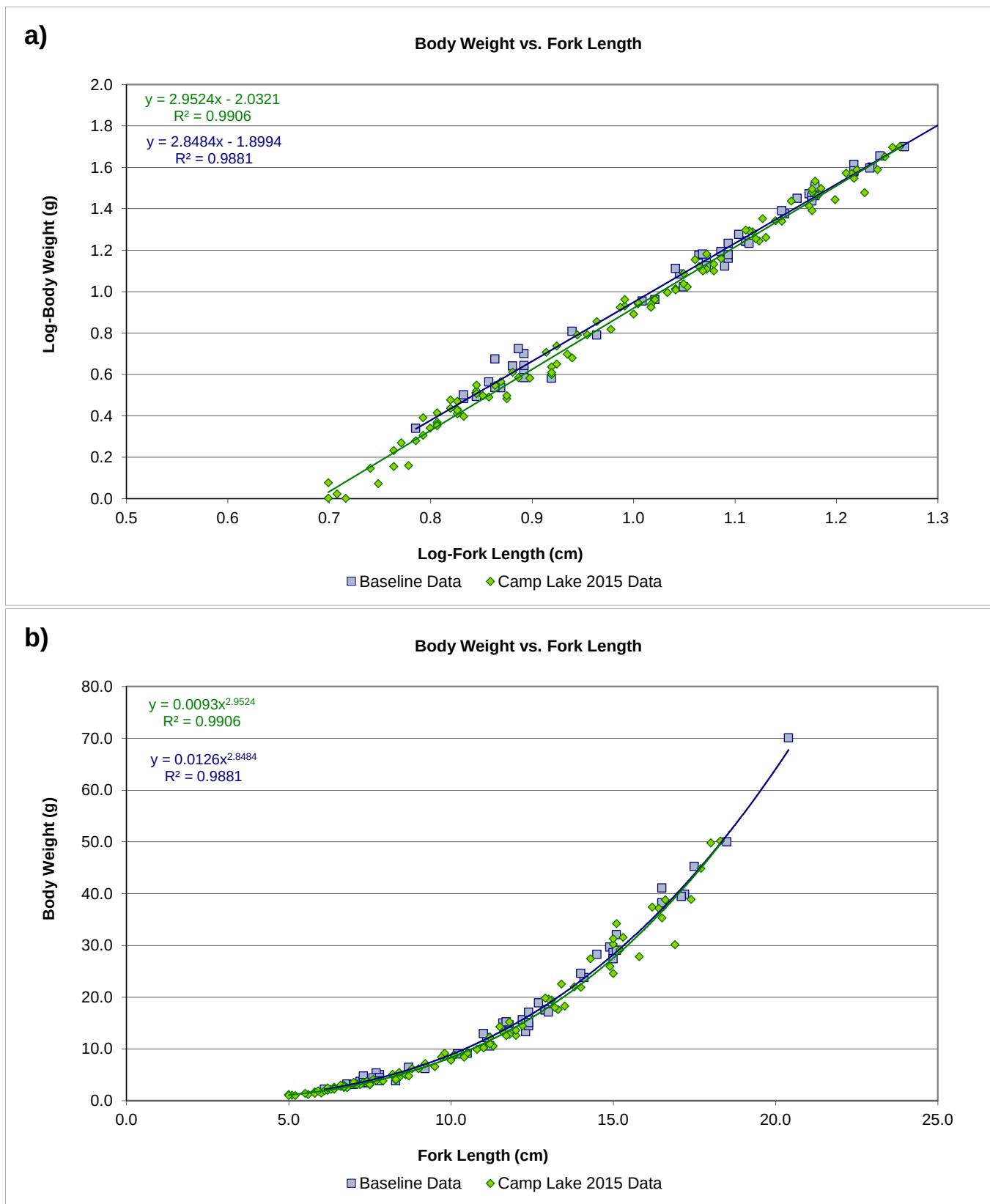


Figure F.4: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Camp Lake nearshore areas in 2015 and over the mine baseline period (2013) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

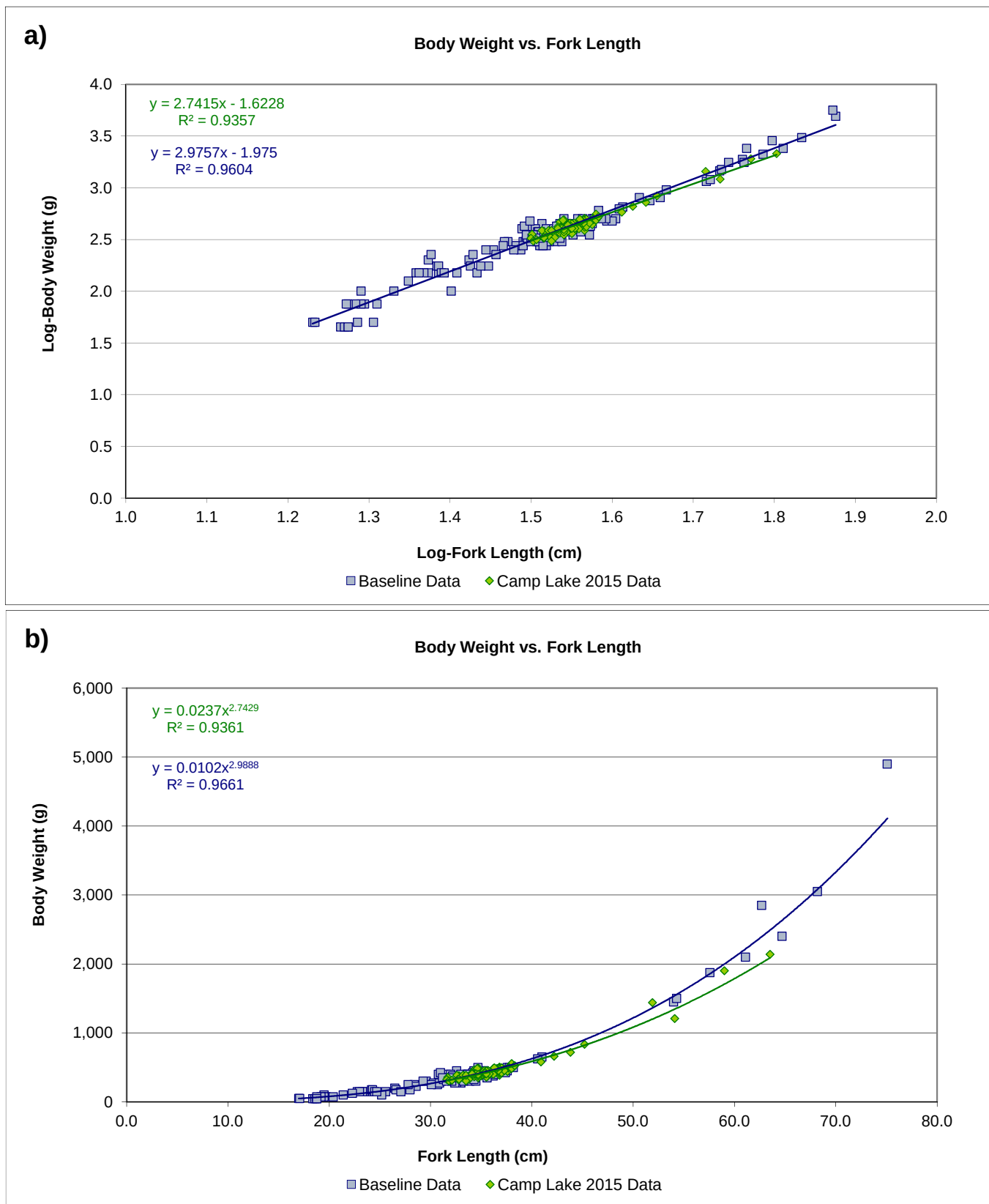


Figure F.5: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Camp Lake littoral/profundal areas in 2015 and over the mine baseline period (2006, 2007, 2008, 2013) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

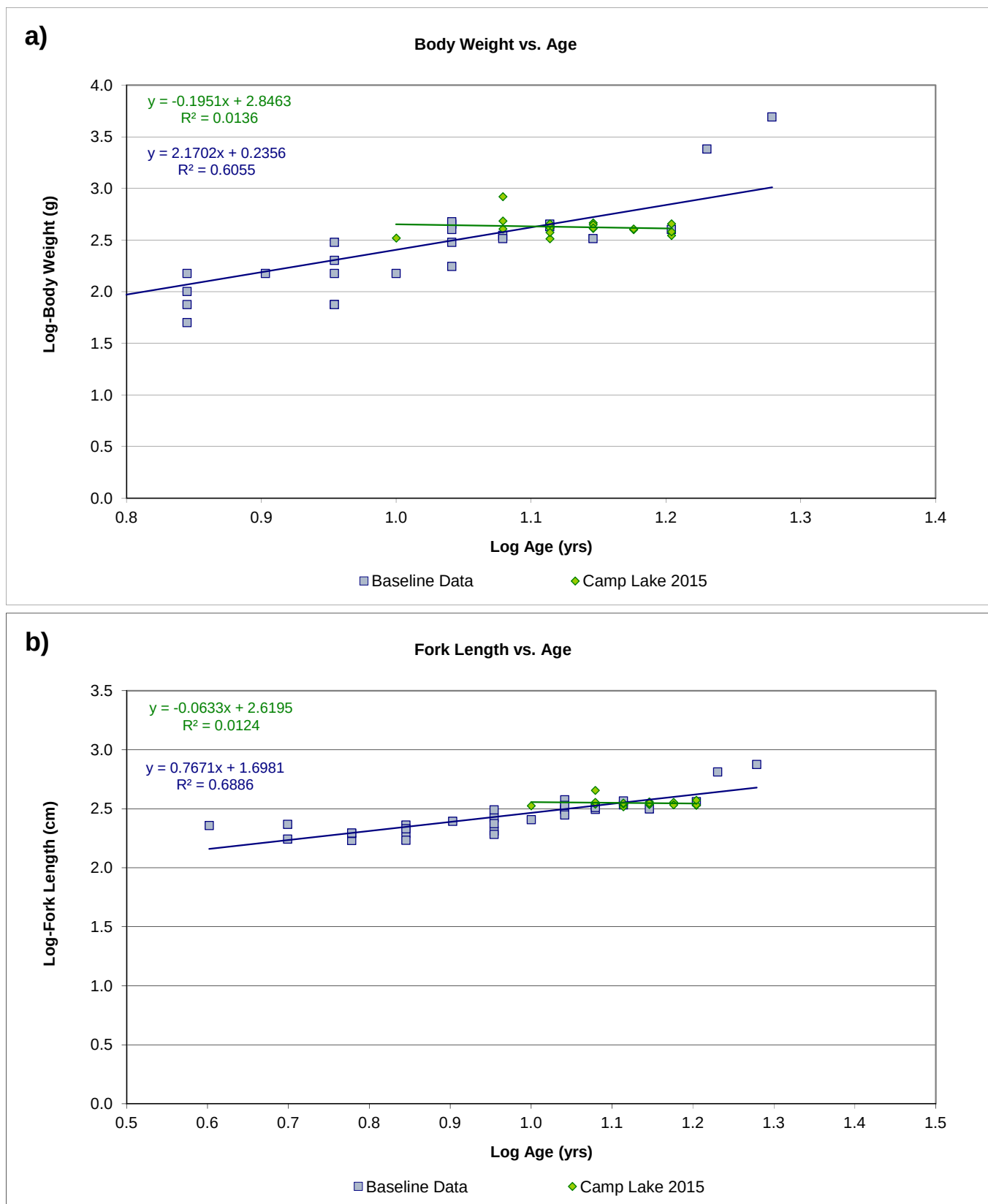


Figure F.6: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected in fall (August-September) at Camp Lake nearshore areas in 2015 and over the baseline period (2006, 2007, 2013), Mary River Project CREMP.

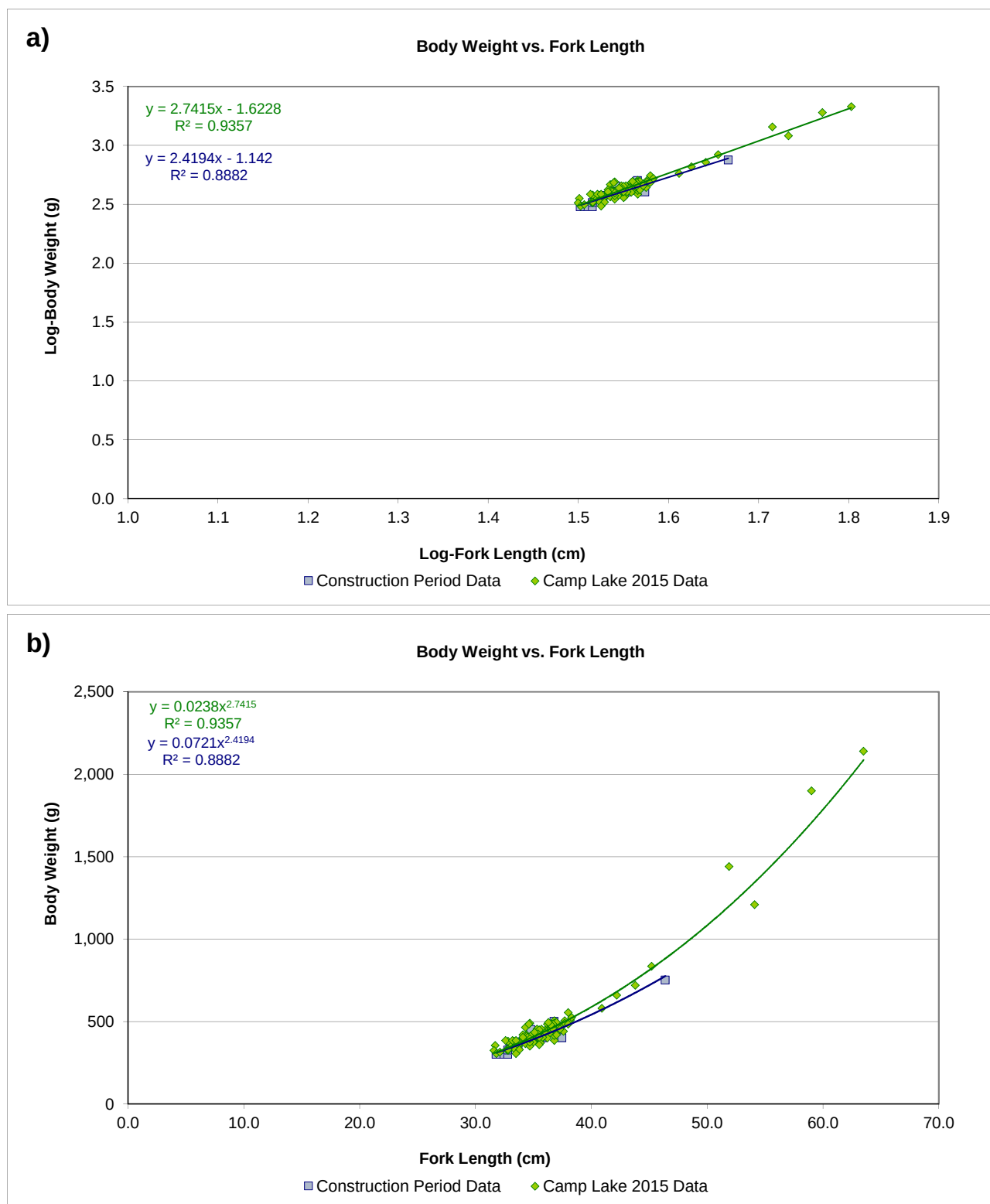


Figure F.7: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Camp Lake littoral/profundal areas in 2015 and over the mine construction period (2014) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

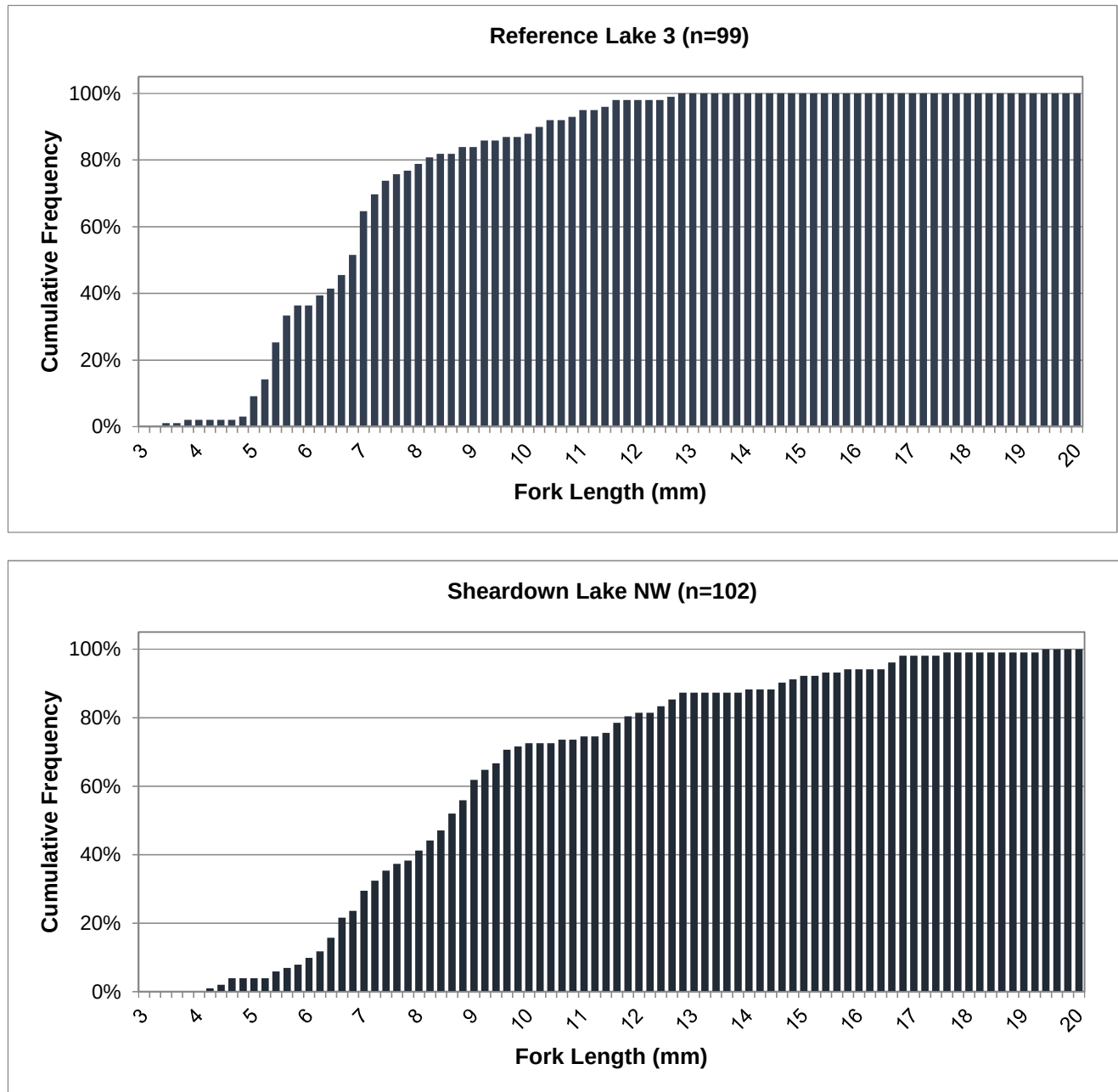


Figure F.8: Cumulative length-frequency distributions for juvenile Arctic charr captured by electrofishing at nearshore areas of Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2015.

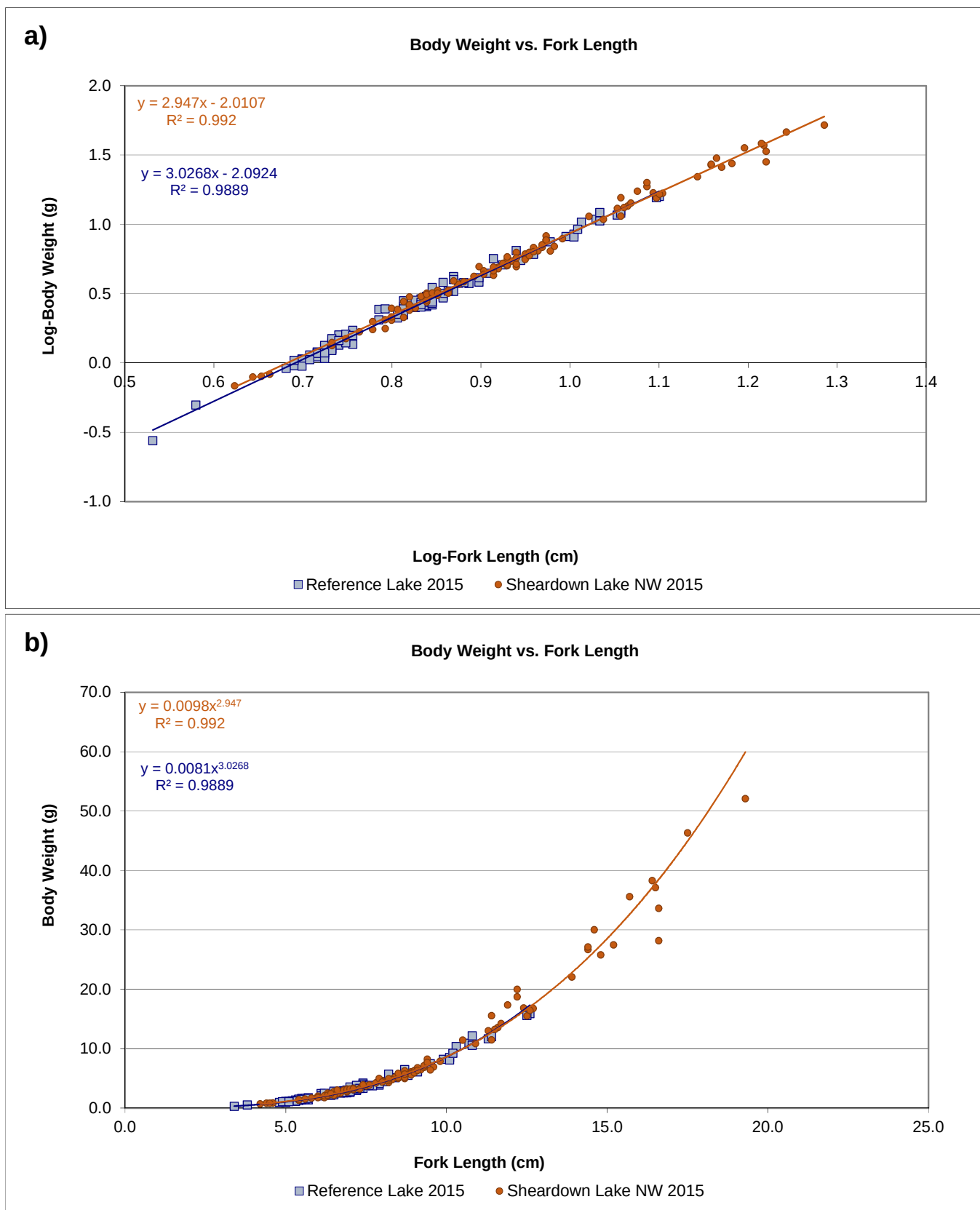


Figure F.9: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected at the nearshore area of Sheardown Lake NW and Reference Lake 3 in August 2015 using log-transformed (a) and untransformed (b) data, Mary River Project CREMP, 2015.

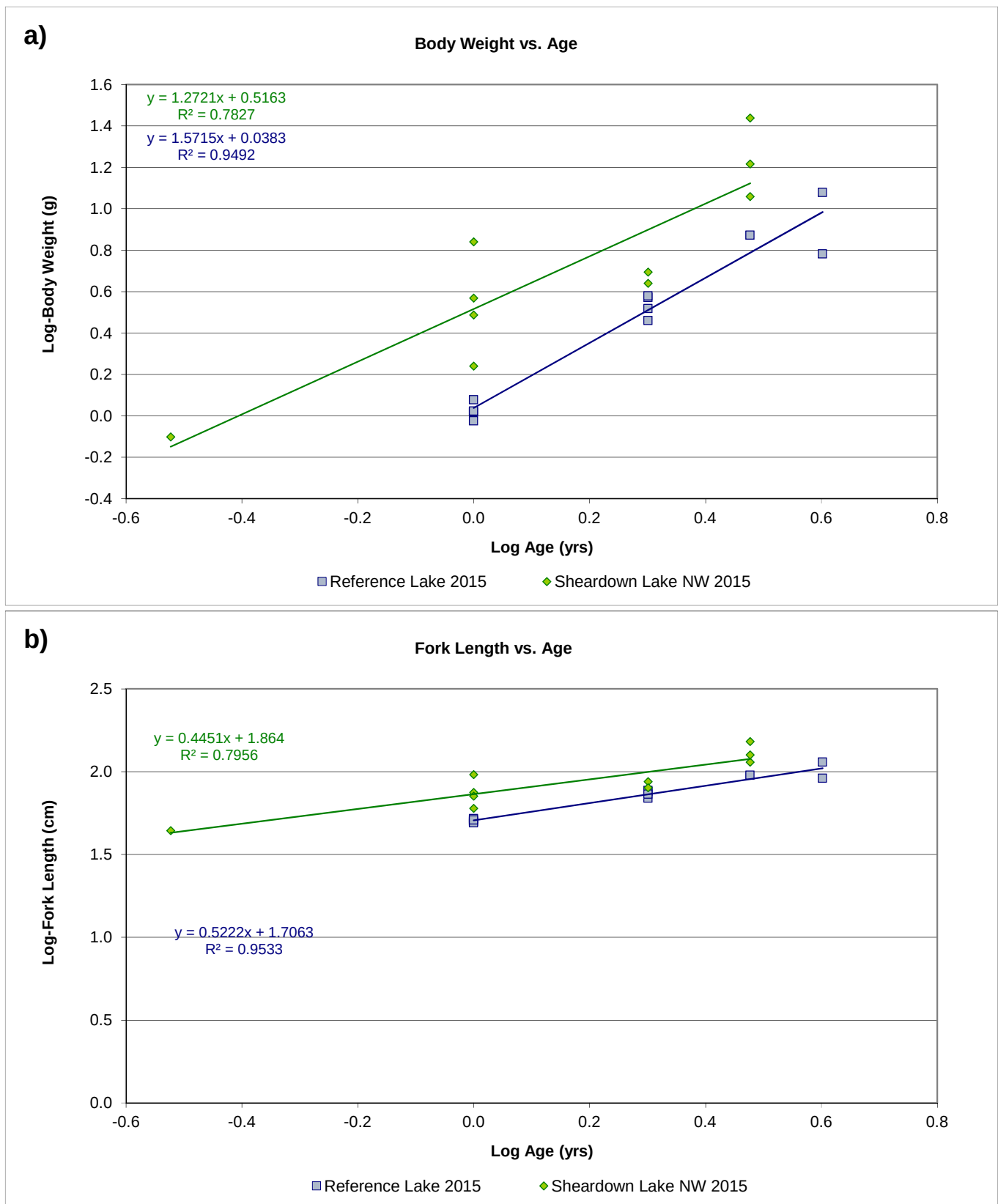


Figure F.10: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected at the nearshore area of Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2015.

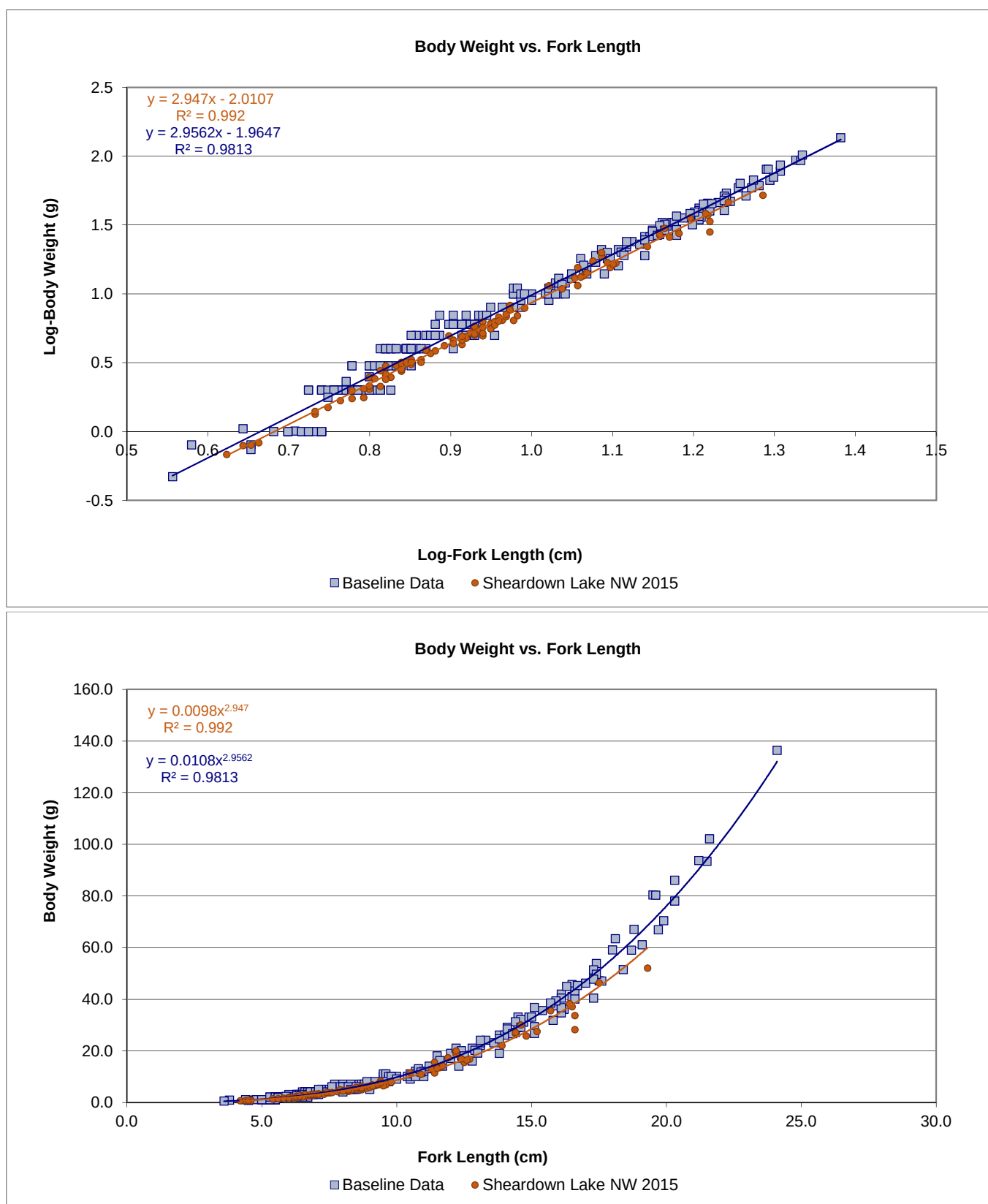


Figure F.11: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake NW nearshore areas in 2015 and over the mine baseline period (2007, 2008, 2013) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

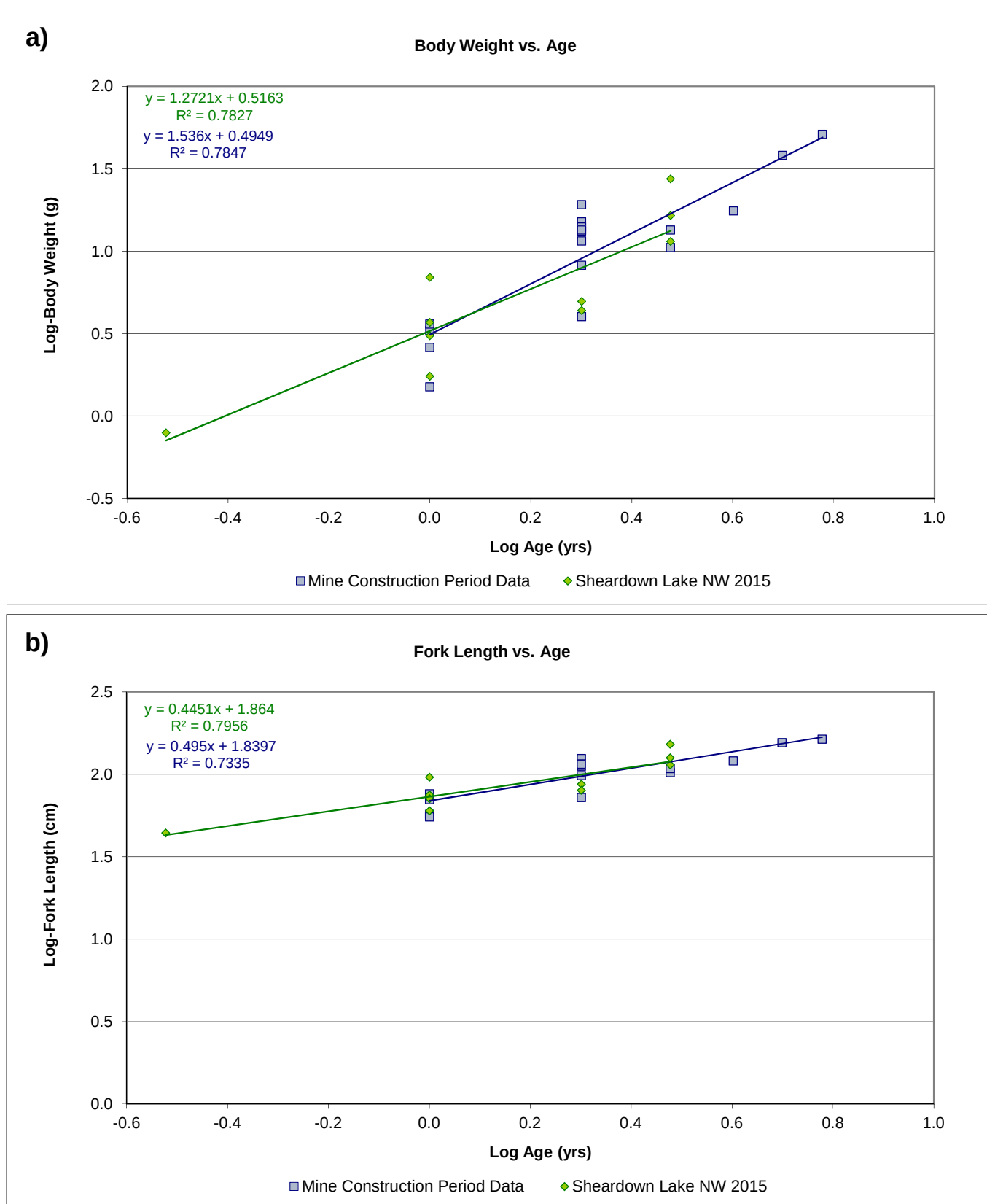


Figure F.12: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected in fall (August-September) at Camp Lake nearshore areas in 2015 and during the mine-construction (2014) period, Mary River Project CREMP.

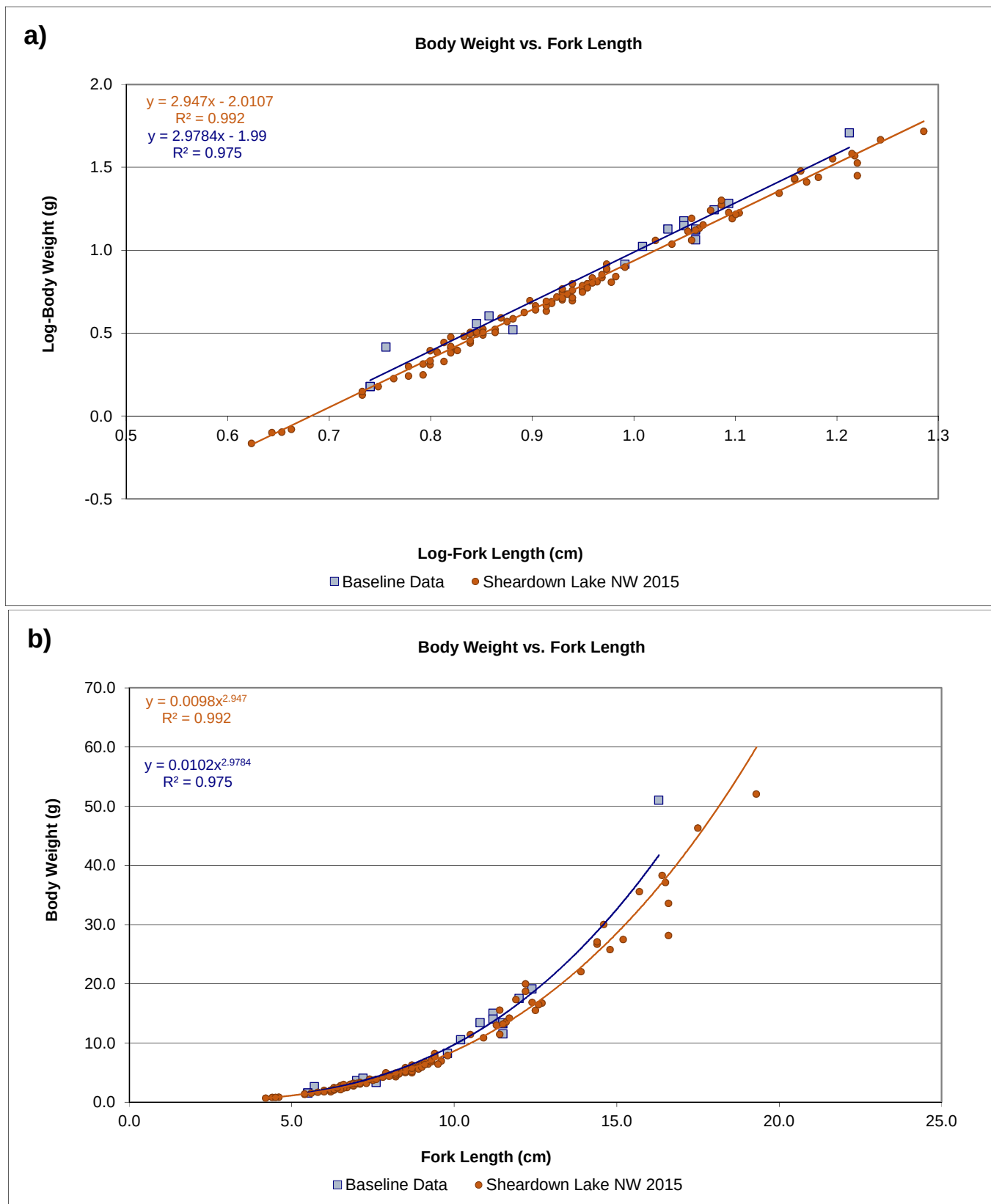


Figure F.13: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake NW littoral/profundal areas in 2015 and over the mine construction period (2014) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

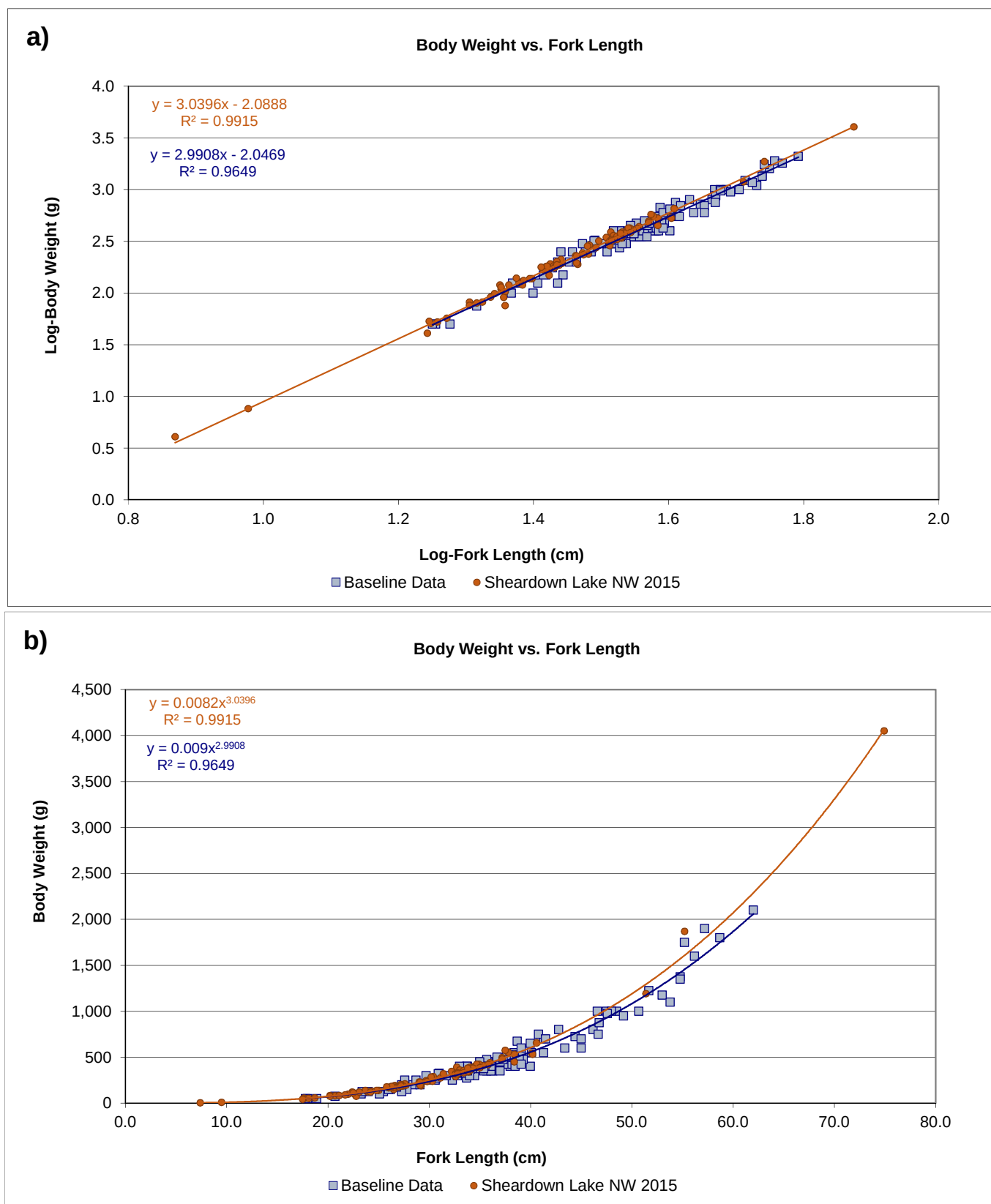


Figure F.14: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake NW nearshore areas in 2015 and over the mine baseline period (2006, 2007, 2008, 2013) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

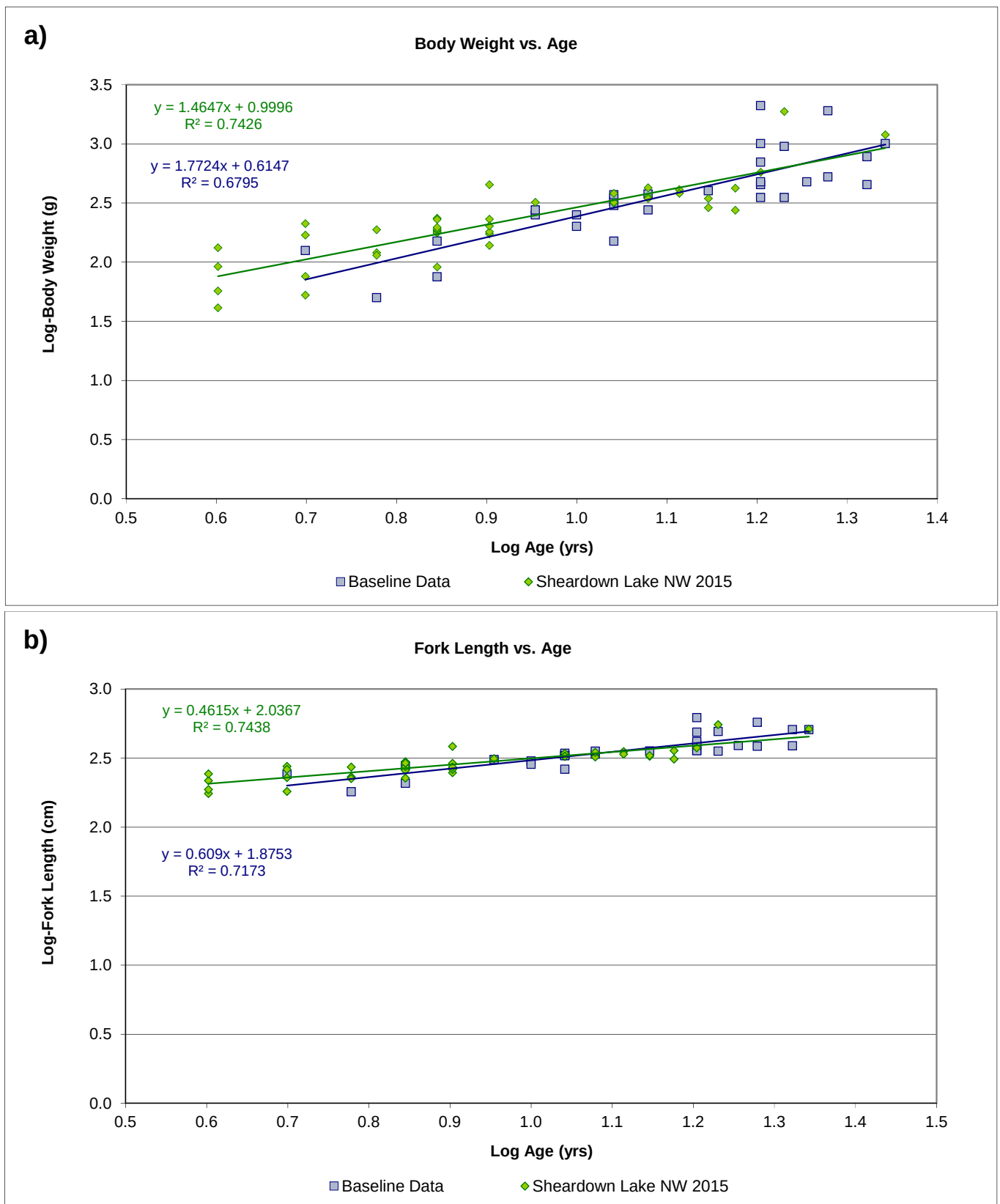


Figure F.15: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected in fall (August-September) at Sheardown Lake NW nearshore areas in 2015 and over the baseline period (2006, 2007, 2013), Mary River Project CREMP.

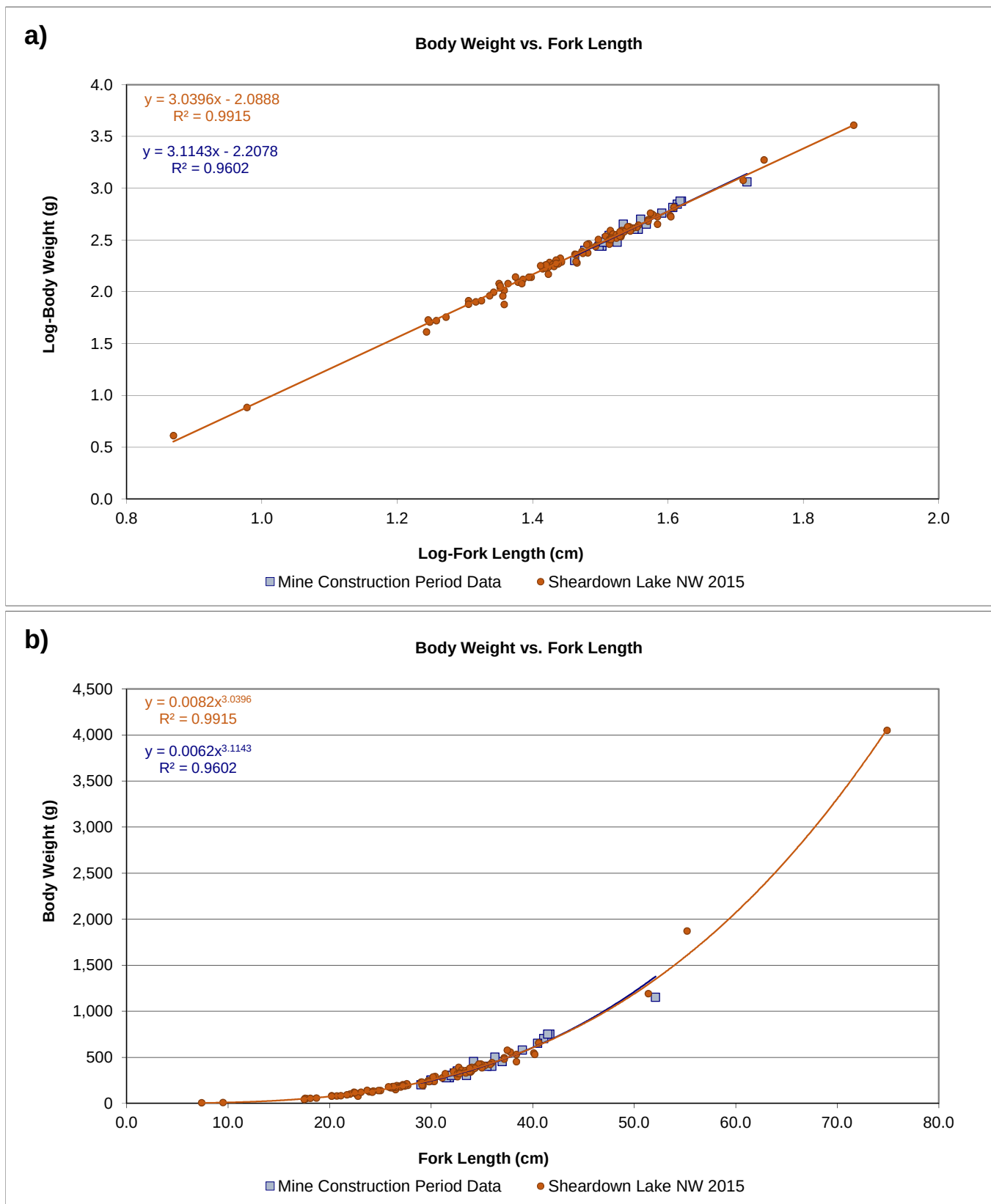


Figure F.16: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake NW littoral/profundal areas in 2015 and over the mine construction period (2014) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

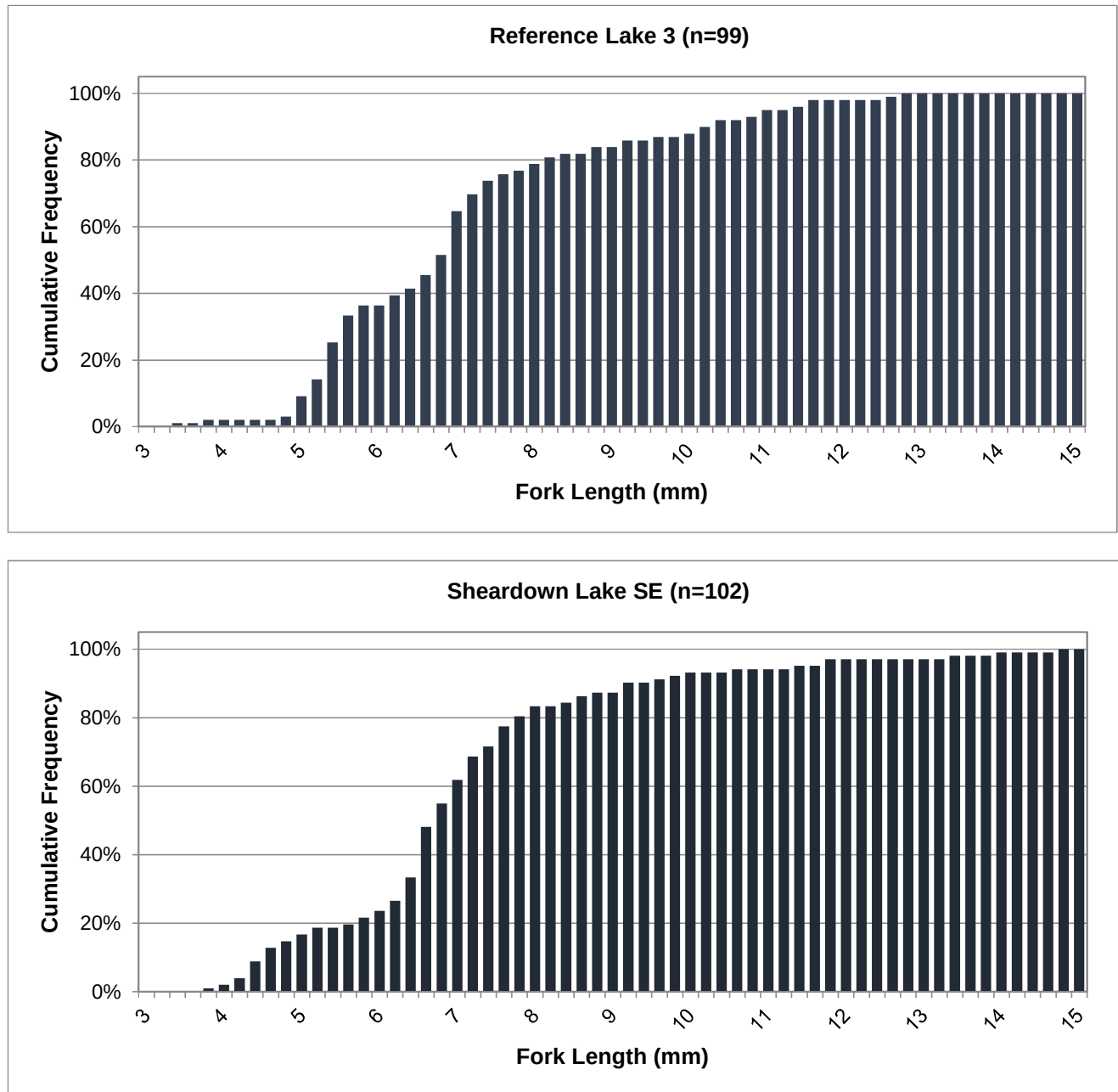


Figure F.17: Cumulative length-frequency distributions for juvenile Arctic charr captured by electrofishing at nearshore areas of Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2015.

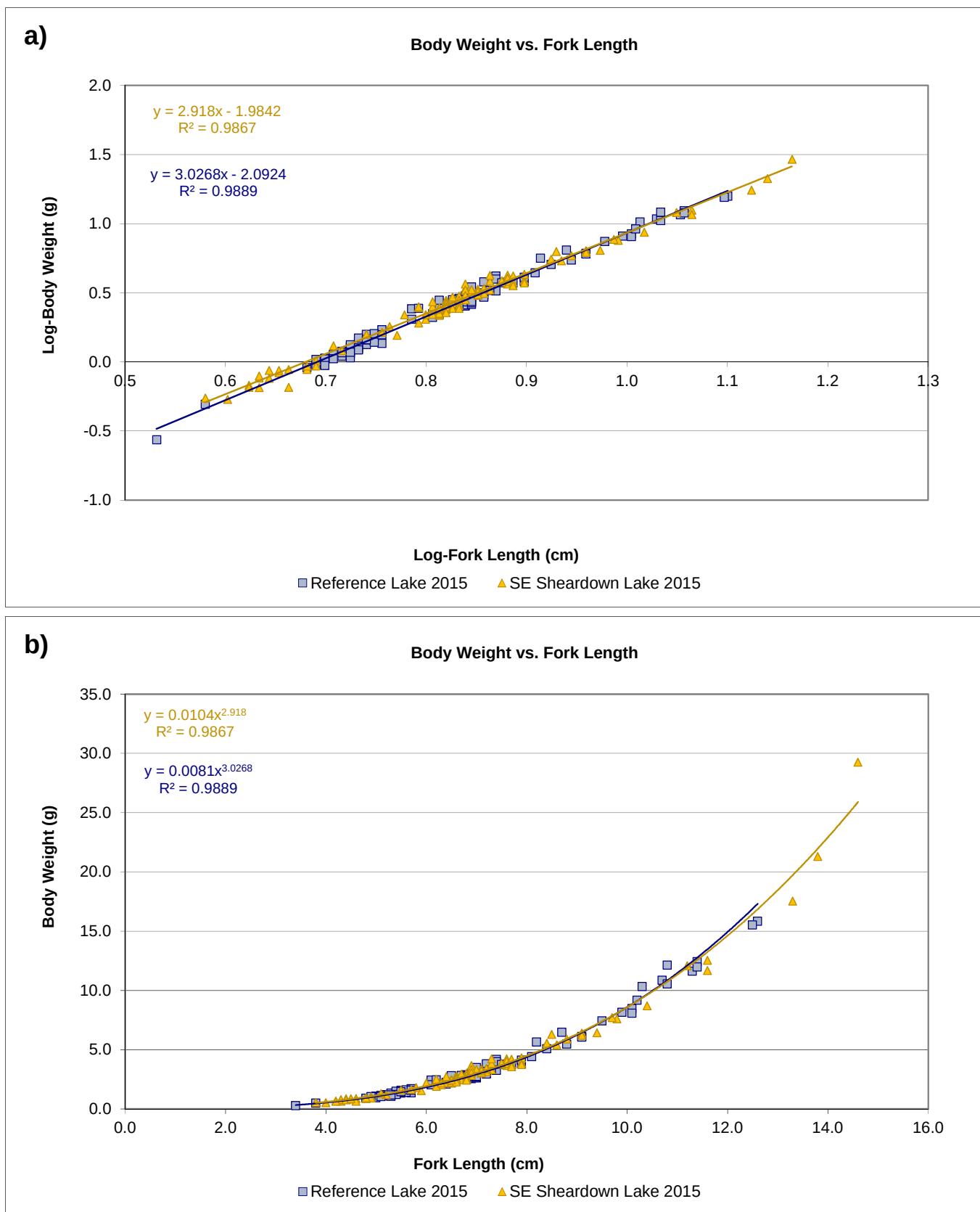


Figure F.18: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected at the nearshore area of Sheardown Lake SE and Reference Lake 3 in August 2015 using log-transformed (a) and untransformed (b) data, Mary River Project CREMP, 2015.

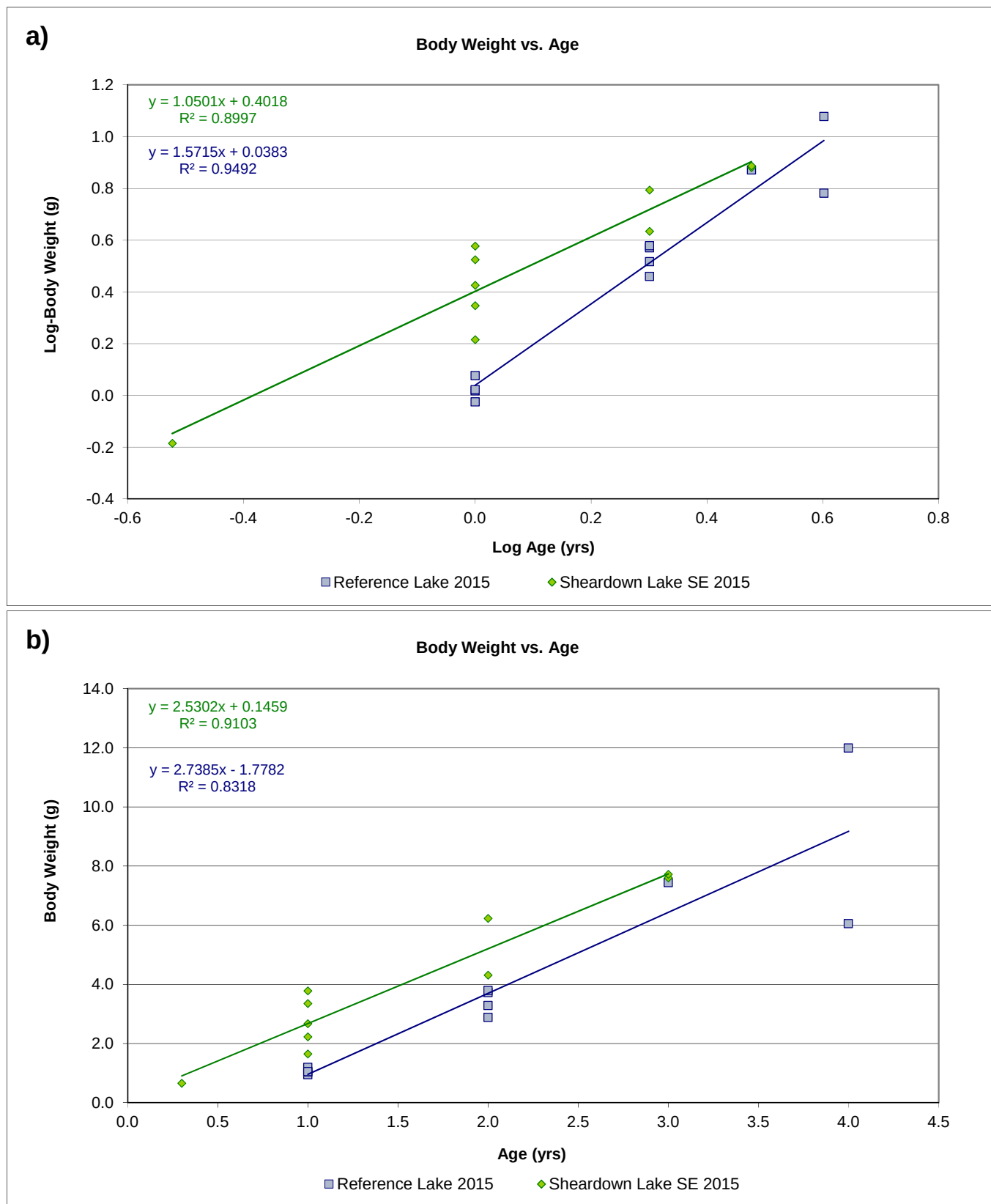


Figure F.19: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected at the nearshore area of Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2015.

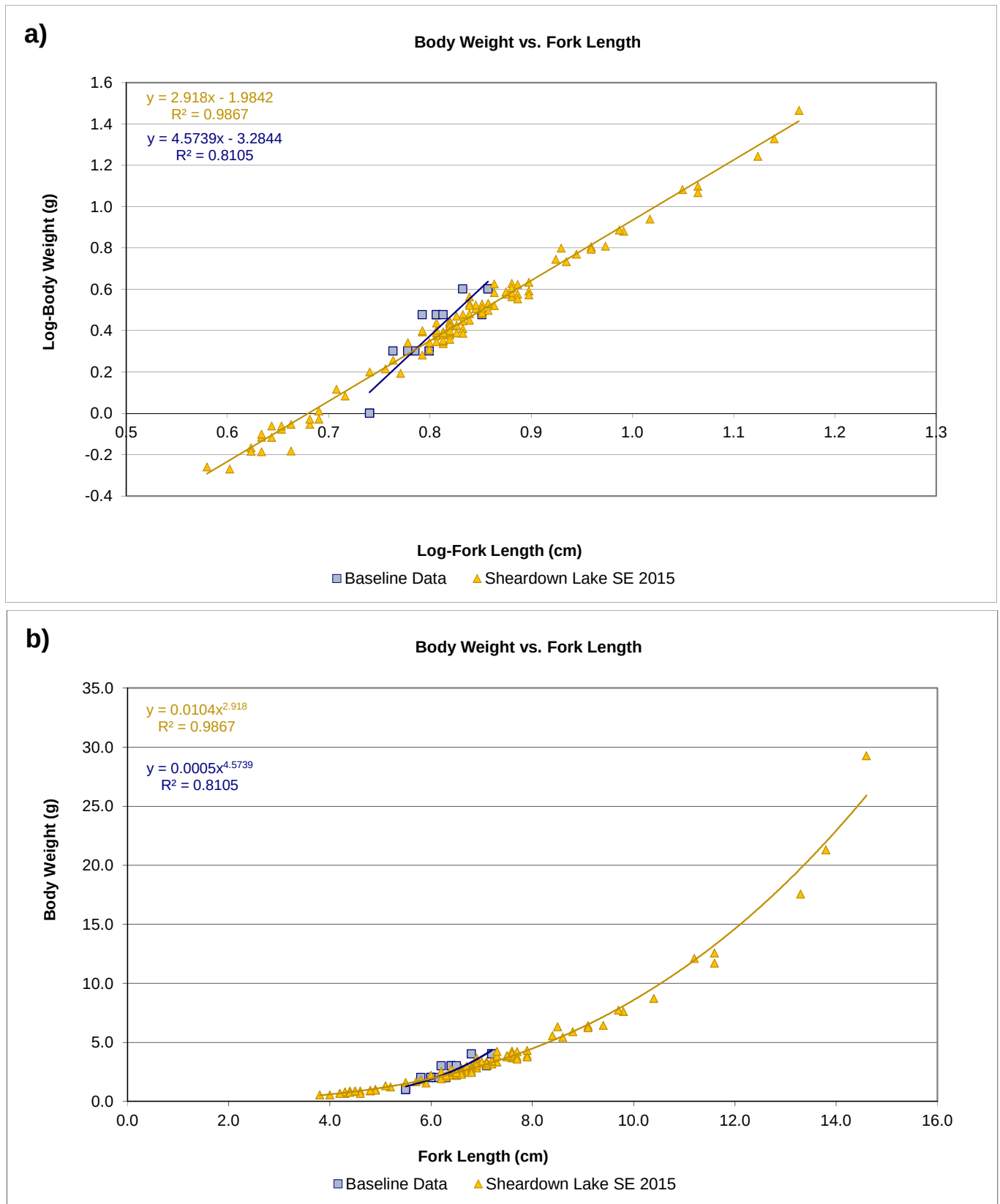


Figure F.20: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake SE nearshore areas in 2015 and over the mine baseline period (2007) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

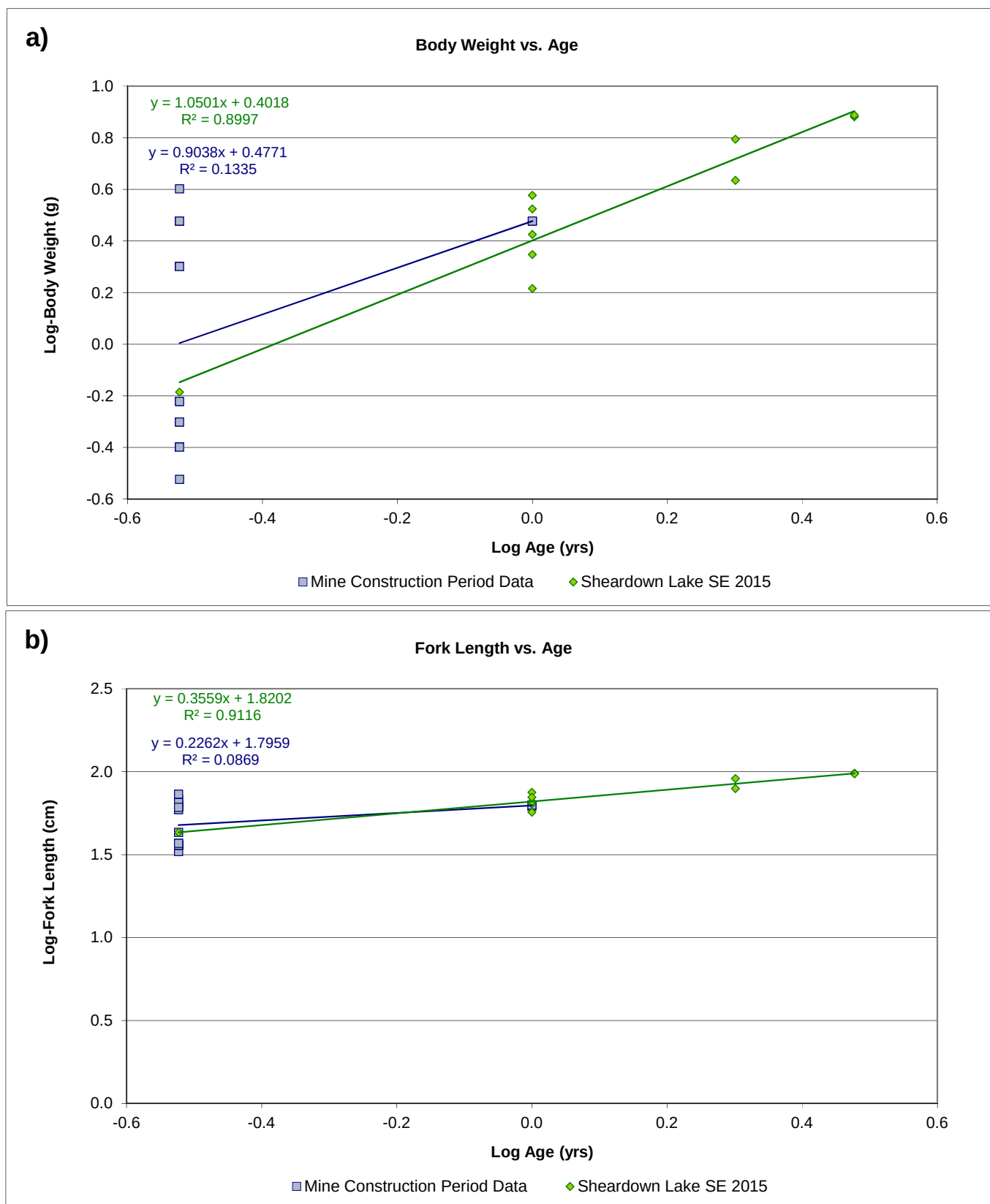


Figure F.21: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected in fall (August-September) at Sheardown Lake SE nearshore areas in 2015 and during the mine construction period (2014), Mary River Project CREMP.

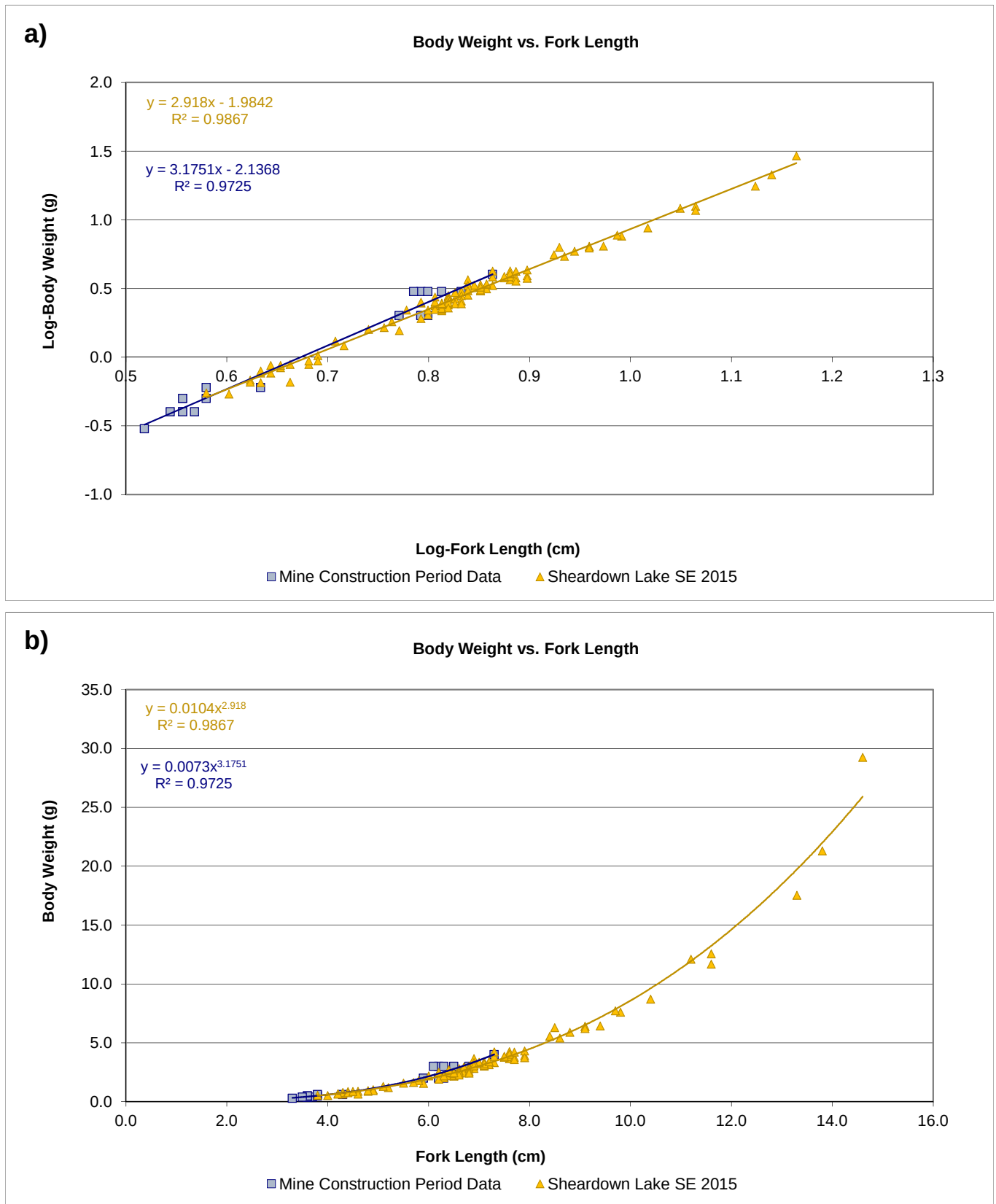


Figure F.22: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake SE littoral/profundal areas in 2015 and over the mine construction period (2014) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

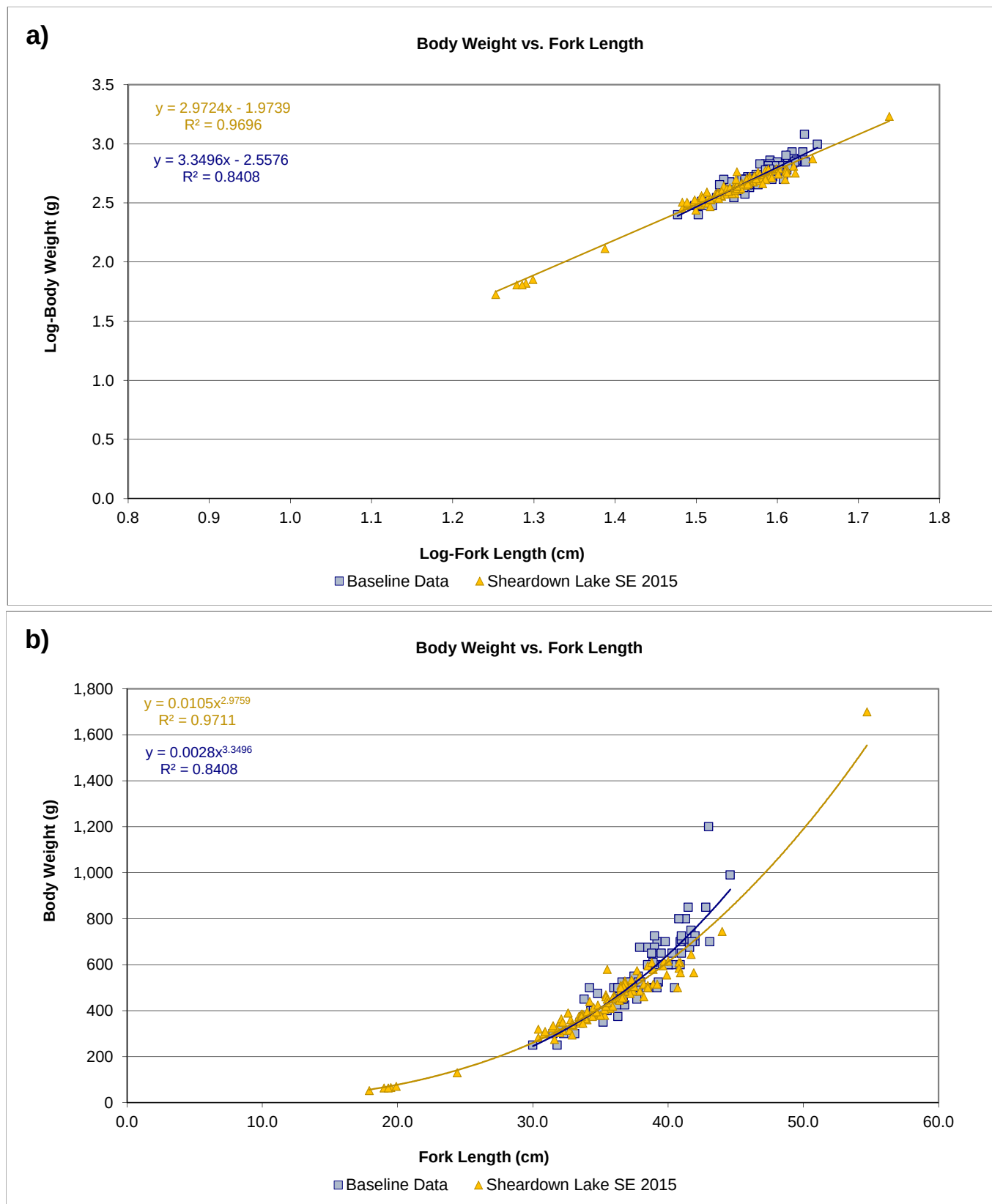


Figure F.23: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake SE nearshore areas in 2015 and over the mine baseline period (2007, 2008) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

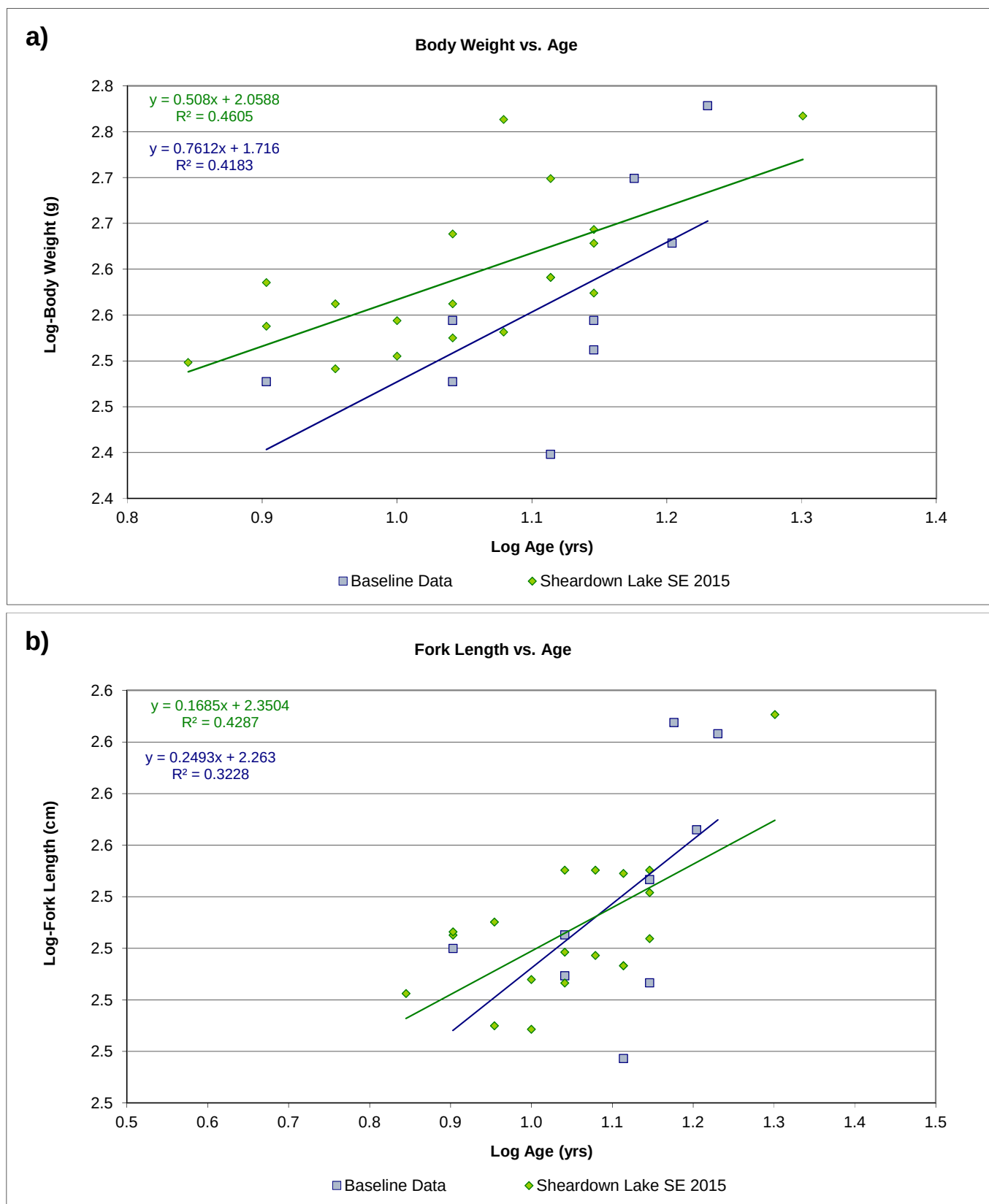


Figure F.24: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected in fall (August-September) at Sheardown Lake SE nearshore areas in 2015 and over the baseline period (2007), Mary River Project CREMP.

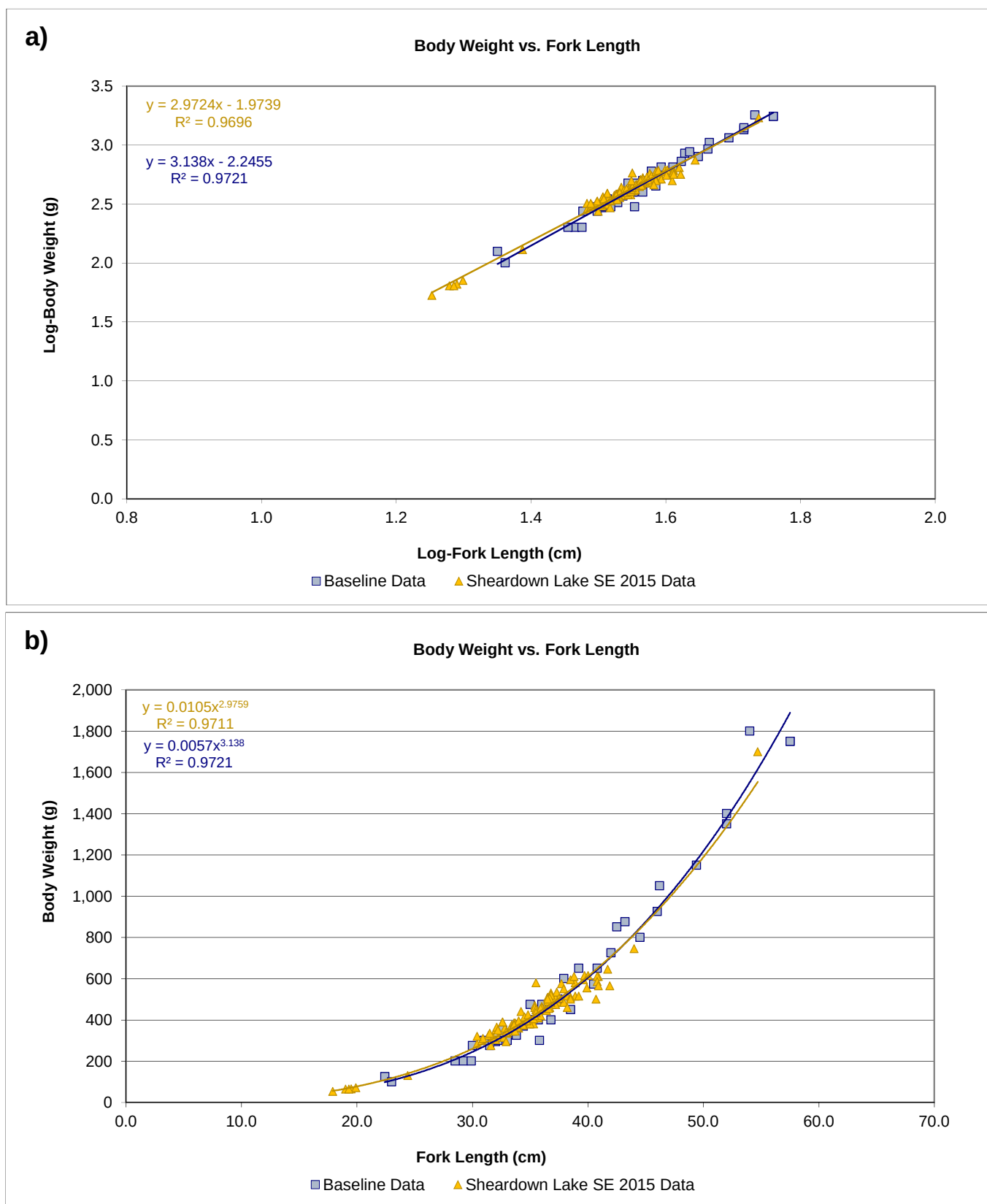


Figure F.25: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Sheardown Lake SE littoral/profundal areas in 2015 and during the mine construction period (2014) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

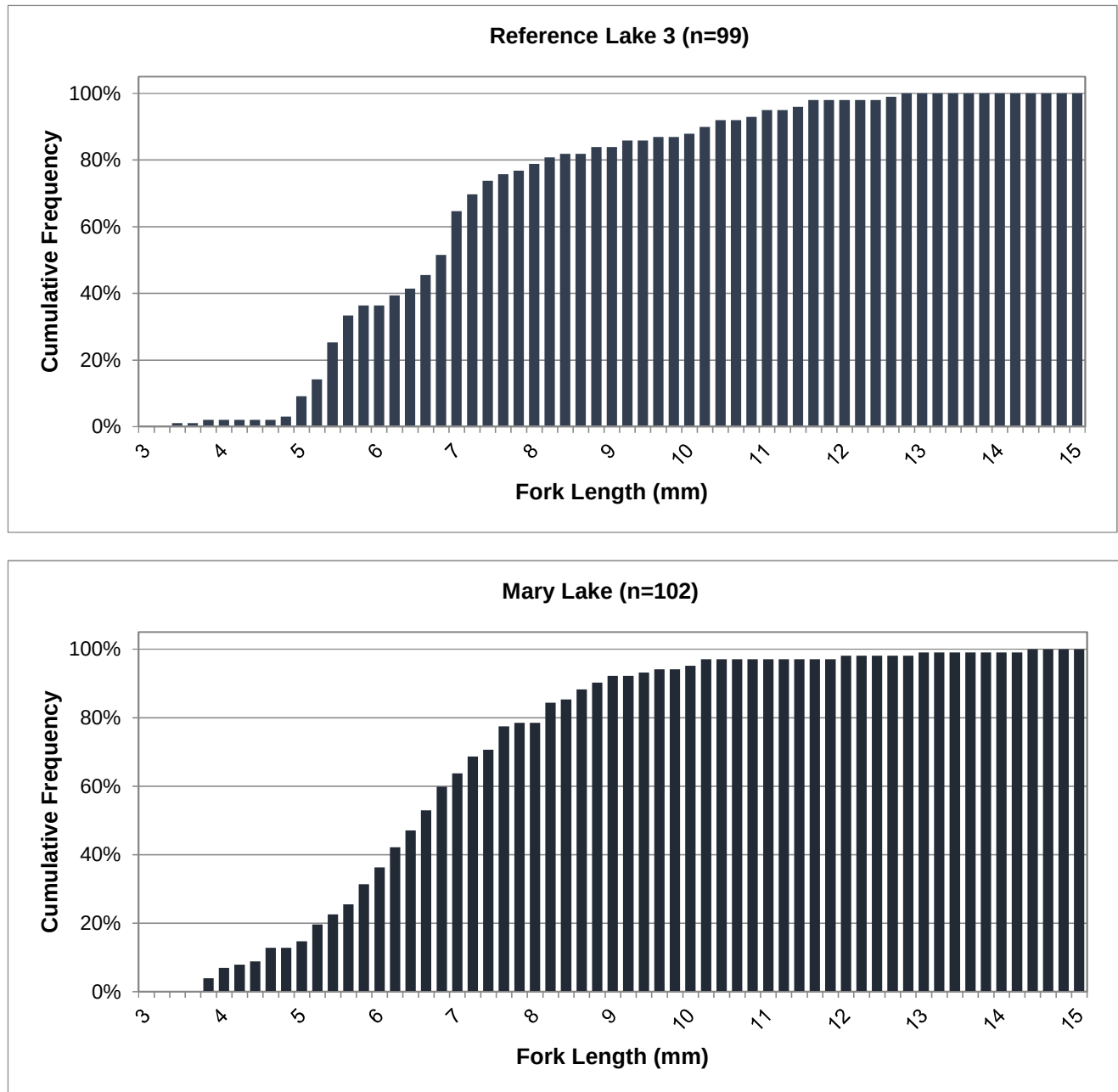


Figure F.26: Cumulative length-frequency distributions for juvenile Arctic charr captured by electrofishing at nearshore areas of Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2015.

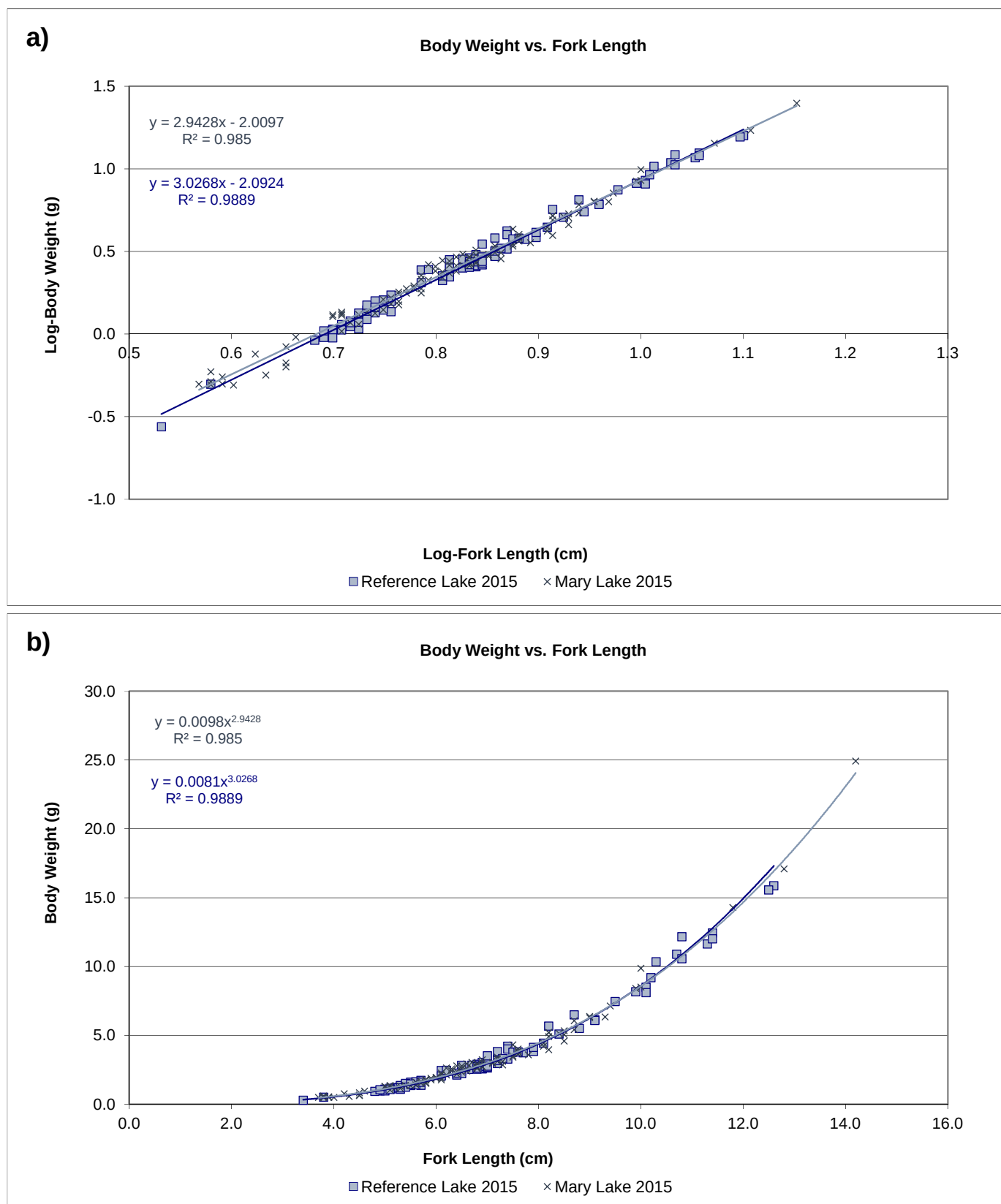


Figure F.27: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected at the nearshore area of Mary Lake and Reference Lake 3 in August 2015 using log-transformed (a) and untransformed (b) data, Mary River Project CREMP, 2015.

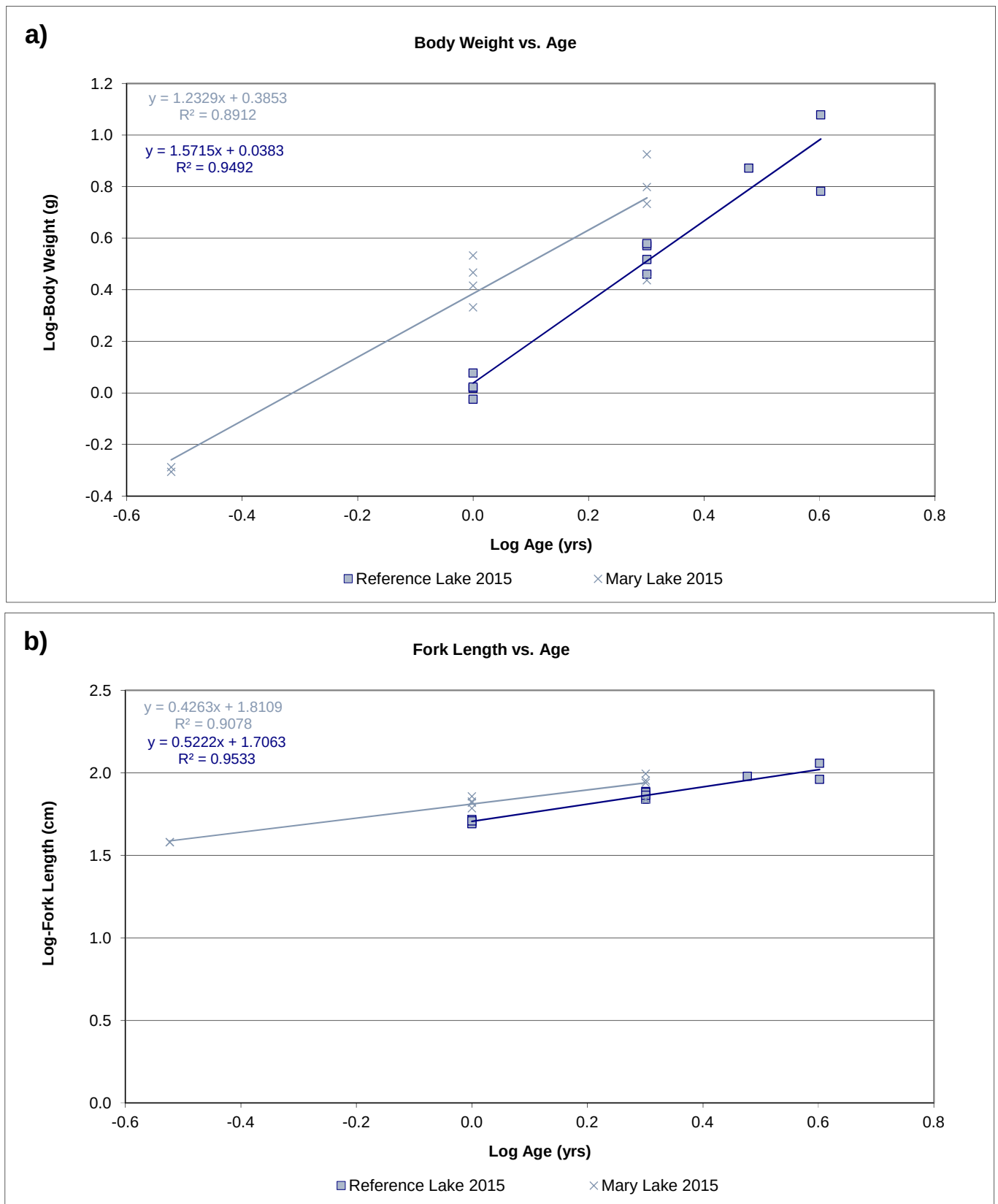


Figure F.28: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected at the nearshore area of Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2015.

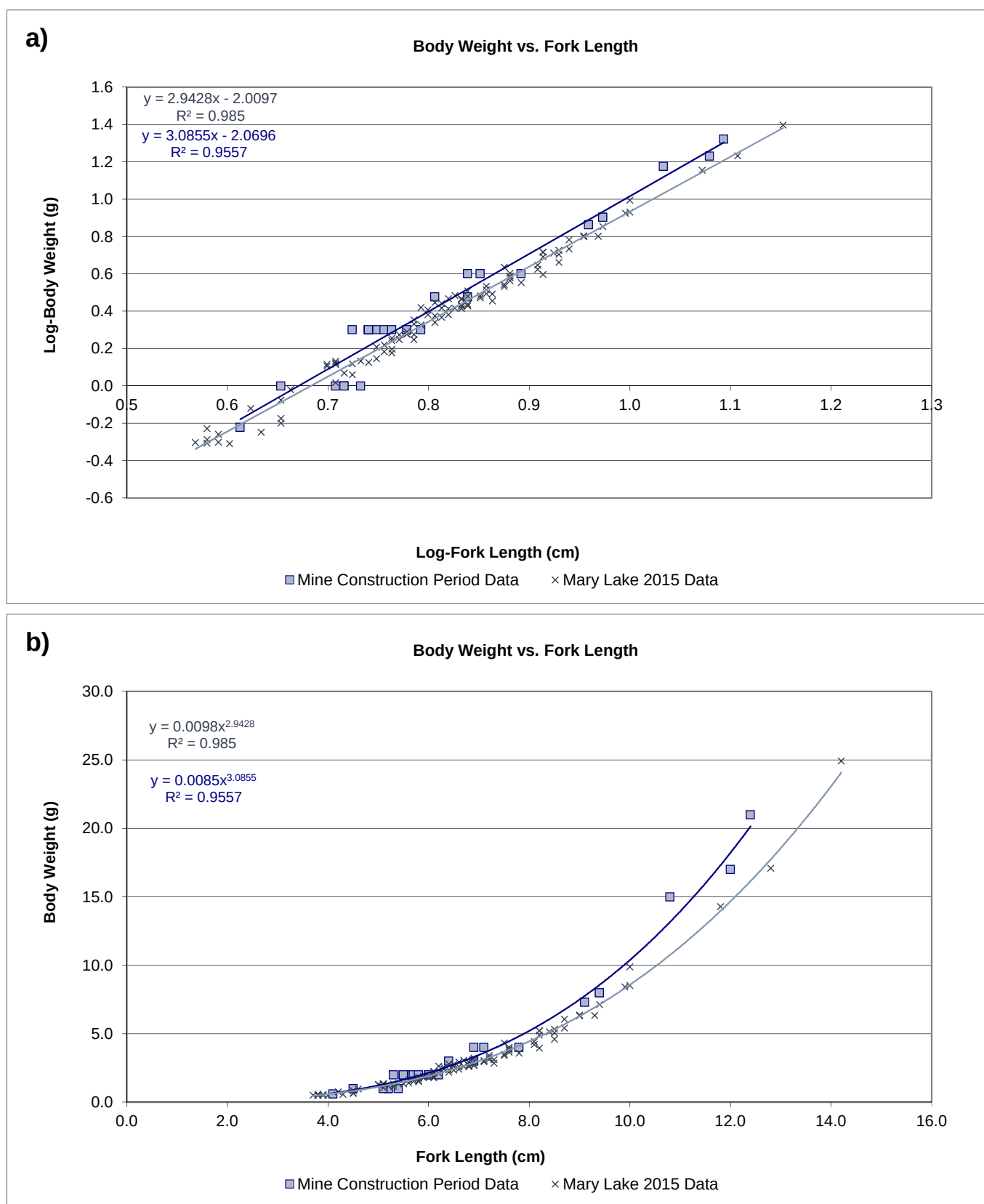


Figure F.29: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Mary Lake nearshore areas in 2015 and during the mine construction period (2014) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

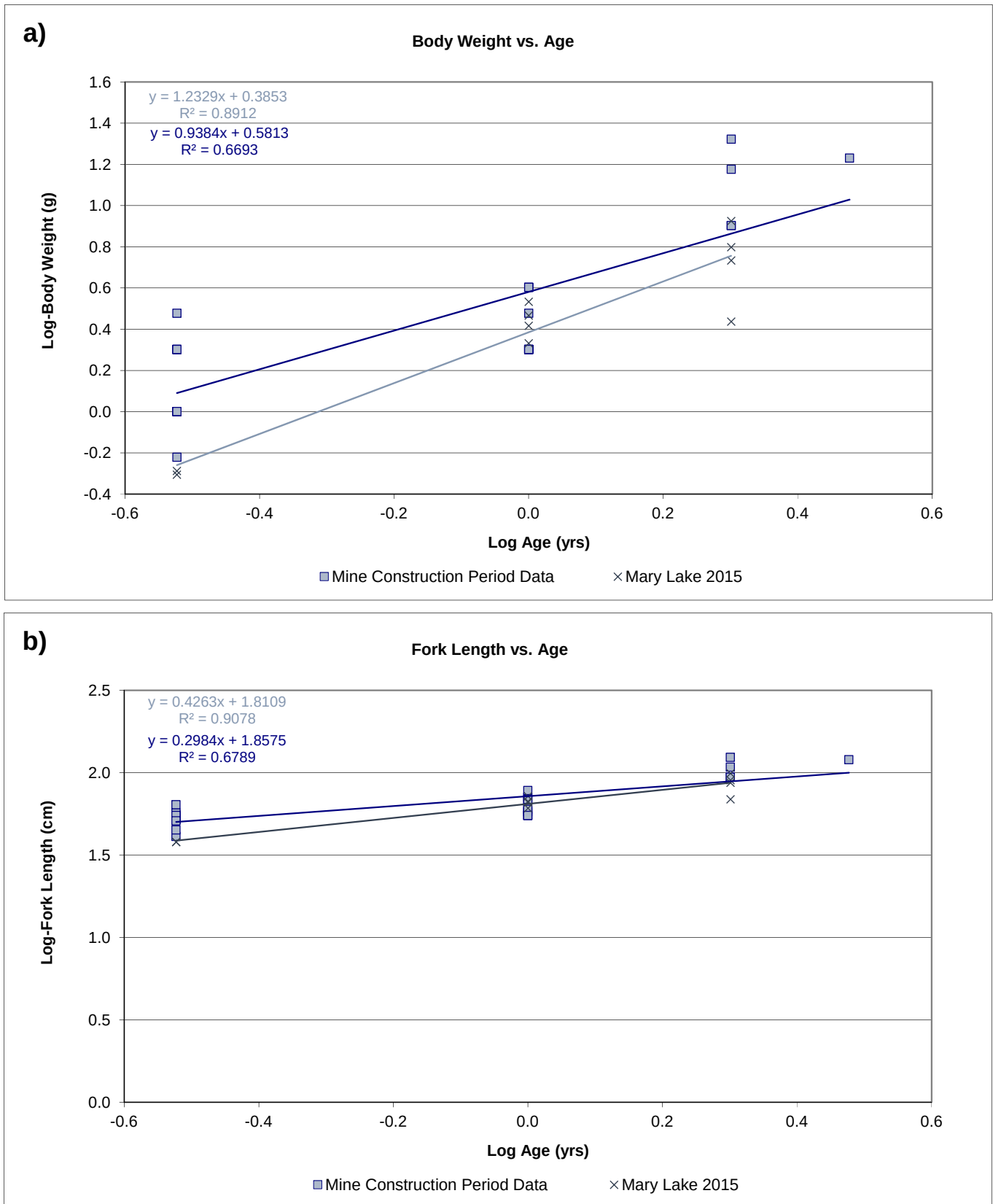


Figure F.30: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected in fall (August-September) at Mary Lake nearshore areas in 2015 and during the mine construction period (2014), Mary River Project CREMP.

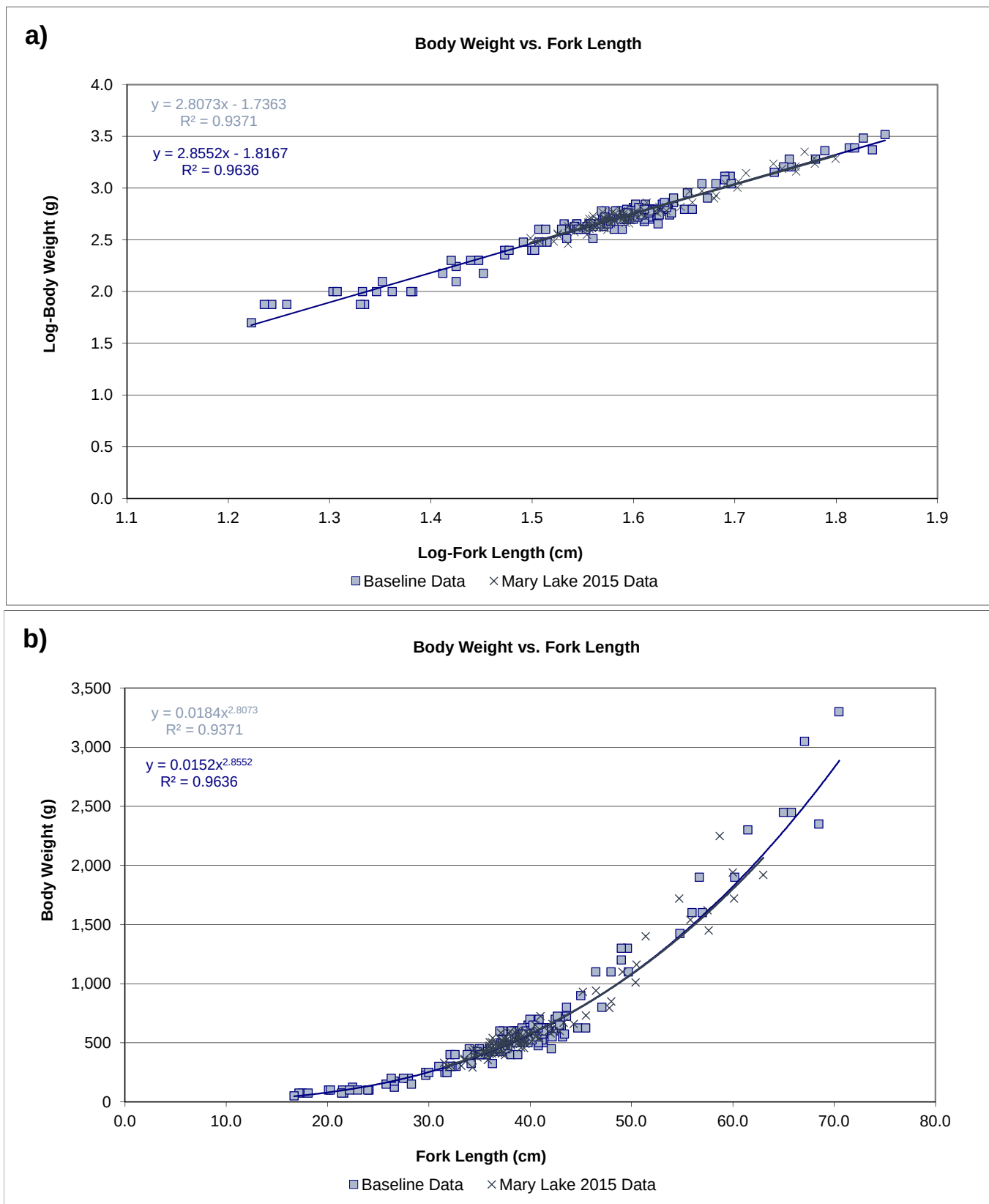
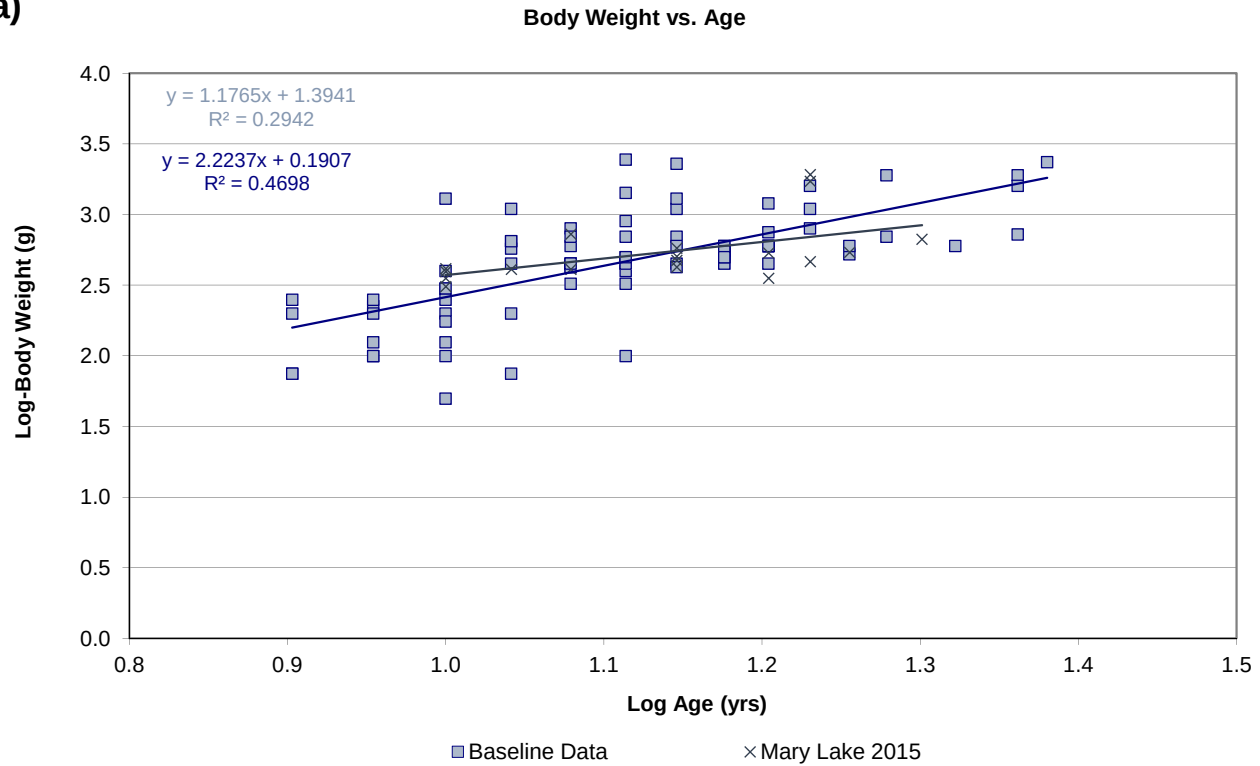


Figure F.31: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Mary Lake nearshore areas in 2015 and over the mine baseline period (2006, 2007) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

a)



b)

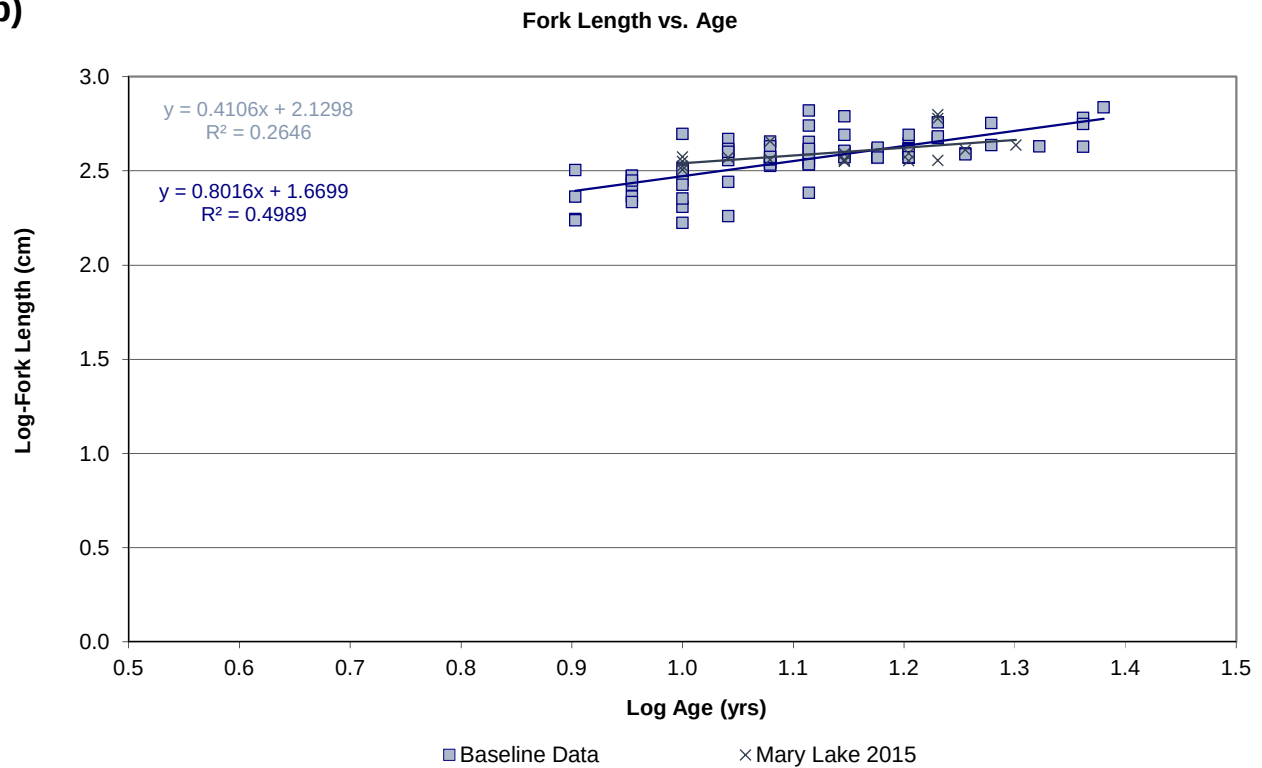


Figure F.32: Weight-at-age (a) and length-at-age (b) growth relationships for Arctic charr collected in fall (August-September) at Mary Lake nearshore areas in 2015 and over the baseline period (2006, 2007), Mary River Project CREMP.

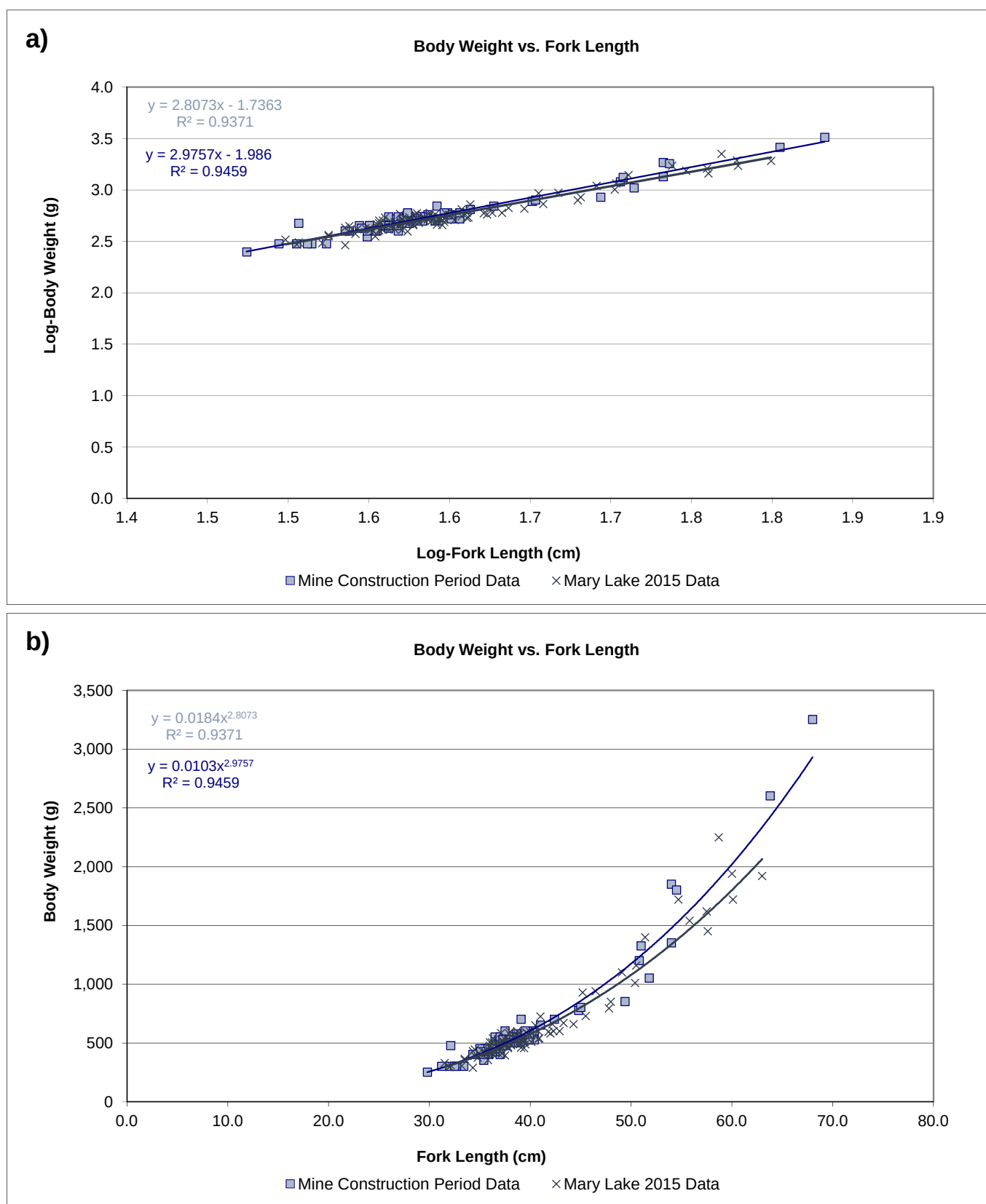


Figure F.33: Comparison of condition (weight-at-fork length relationship) for Arctic charr collected in fall (August-September) at Mary Lake littoral/profundal areas in 2015 and during the mine construction period (2014) using log-transformed (a) and untransformed (b) data, Mary River Project CREMP.

APPENDIX E.10.2

2015 LAKE SEDIMENTATION MONITORING PROGRAM



**Mary River Project 2014 - 2015
Lake Sedimentation Monitoring
Report**

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

Prepared By:
Minnow Environmental Inc.
Georgetown, ON

March 2016

Mary River Project 2015 Lake Sedimentation Monitoring Report

Prepared for:

**Baffinland Iron Mines Corp.
Mary River Project**

Prepared by:

Minnow Environmental Inc.

A handwritten signature in black ink, appearing to read 'P. LePage', with a horizontal line underneath it.

**Paul LePage, M.Sc.
Project Manager**

March 2016

TABLE OF CONTENTS

TABLE OF CONTENTS.....	I
1.0 INTRODUCTION.....	1
1.1 Background.....	1
1.2 Report Organization	2
2.0 STATION LOCATIONS AND STUDY METHODS	3
2.1 Station Locations.....	3
2.2 Field and Laboratory Methods	3
2.3 Data Analysis	5
3.0 RESULTS	7
3.1 Sedimentation Rates.....	7
3.2 Sediment Accumulation Estimate	8
4.0 CONCLUSIONS.....	9
5.0 REFERENCES.....	10

APPENDIX A SEDIMENTATION DATA

LIST OF FIGURES

After Page ...

Figure 1.1: Mary River Project and Sheardown Lake NW location.....	1
Figure 2.1: Sheardown Lake NW sedimentation monitoring stations	3
Figure 3.1: Sheardown Lake NW sedimentation rates, 2014 - 2015	7

LIST OF TABLES

After Page ...

Table 2.1: Sheardown Lake NW sedimentation monitoring station information	3

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 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. The Mary River Project has the potential to result in increased sediment deposition in mine area water bodies through fugitive dust deposition, surface runoff/erosion from the mine site and/or increased biological productivity (i.e., eutrophication due to treated sewage discharge). In aquatic environments, these deposits could potentially lead to physical habitat alteration (e.g., changes in substrate composition) and/or chemical alteration (e.g., changes in metals, nutrients, organic content) that, in turn, can alter biotic assemblages and lead to adverse ecological effects (e.g., physical smothering, direct chemical response).

In order to better understand rates of sediment deposition potentially associated with the Mary River Project operation and the potential implications of this sediment deposition on aquatic biota, Lake Sedimentation Monitoring was included as a special investigation component of the mine Aquatic Effects Monitoring Program (AEMP; Baffinland 2014; NSC 2014a). The primary issue of concern regarding any increased sedimentation due to Mary River Project operation is the potential effects to Arctic charr (*Salvelinus alpinus*) populations at mine area lakes, which can possibly be affected through:

- Changes in benthic invertebrate community structure and/or density due to habitat alteration that, in turn, alter the Arctic charr food base;
- Loss of Arctic charr spawning habitat resulting from entrapment of fine material on suitable substrates, leading to increased substrate embeddedness; and,
- Limiting the amount of oxygen available in Arctic charr spawning beds during the overwinter incubation period, resulting in reduced egg hatching success and/or larvae survival following hatch (Berry et al. 2003).

The Mary River Project Lake Sedimentation Monitoring study is a year-round sampling program that was designed to track total dry weight sediment deposition at Sheardown Lake NW separately over open-water and ice-cover periods (Baffinland 2014; NSC 2014a,b, 2015). Sheardown Lake NW is expected to receive the highest inputs of sediment inputs through dust

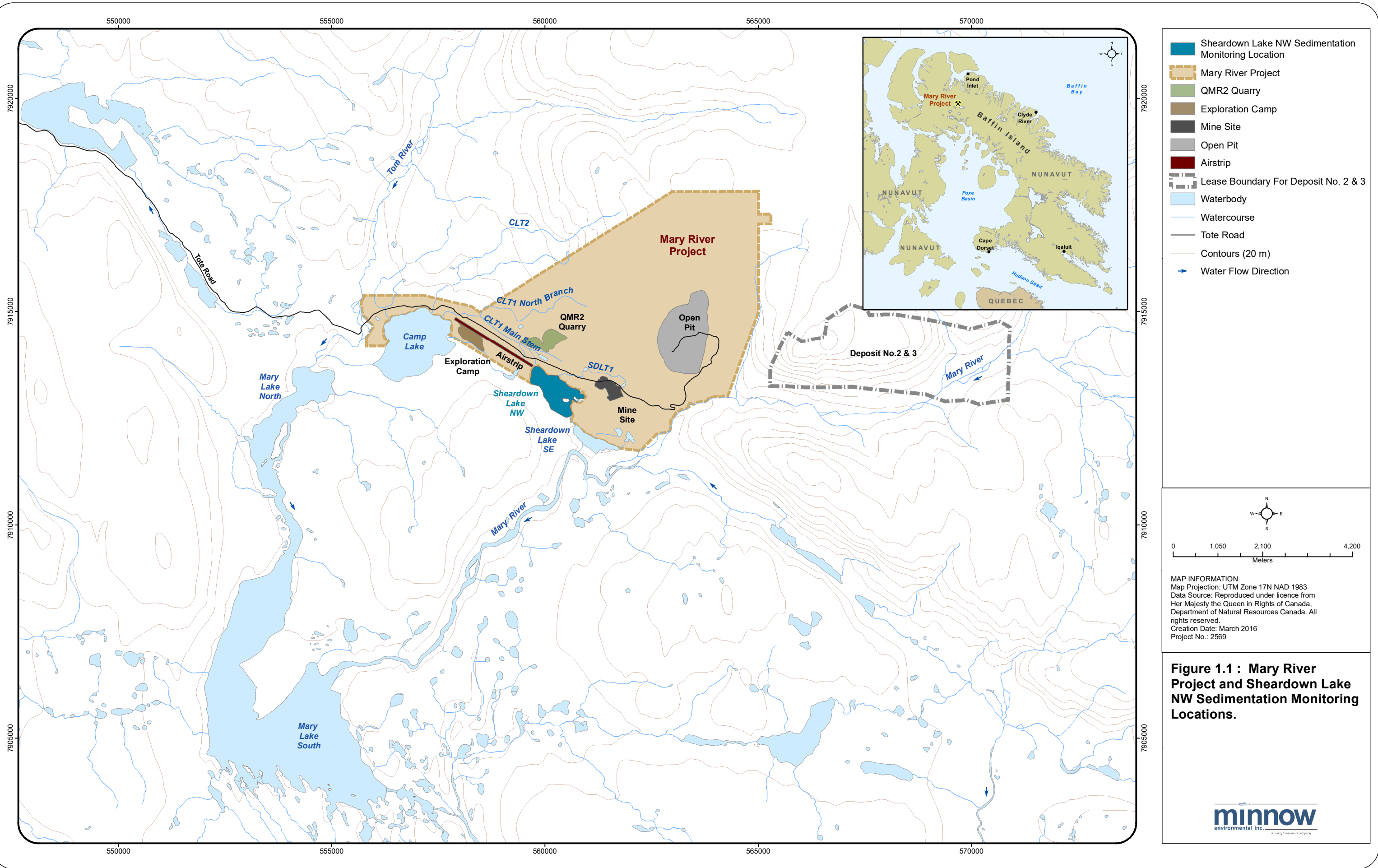


Figure 1.1 : Mary River Project and Sheardown Lake NW Sedimentation Monitoring Locations.

deposits and site runoff compared to other local waterbodies, and therefore this lake serves as the focus for the monitoring of lake sedimentation (Figure 1.1; NSC 2014b). Sedimentation monitoring data collection was initiated in 2013, with the data collected to date (i.e., fall 2013 to fall 2014) reflecting baseline information for one full ice-cover and open-water season. The baseline data will serve as the basis for the evaluation of potential effects of active Mary River Project operation on lake sedimentation. This report presents the results of the 2014 – 2015 Lake Sedimentation Monitoring study, including the evaluation of potential Mary River Project-related influences on sedimentation at Sheardown Lake NW following the first full year of mine operation.

1.2 Report Organization

The content of this report reflects the approach outlined in the Lake Sedimentation Monitoring study design (Baffinland 2014; NSC 2014a,b). A description of the study areas that serve as the focus for the Lake Sedimentation Monitoring study, as well as detailed methods used for the field sample collection, sample processing, sedimentation rate calculation, and data analysis for the 2014 - 2015 study are provided in Section 2.0. The lake sedimentation results are presented in Section 3.0, and conclusions of the 2014 – 2015 Lake Sedimentation Monitoring study are provided in Section 4.0. Finally, all references cited within this document are listed in Section 5.0.

2.0 STATION LOCATIONS AND STUDY METHODS

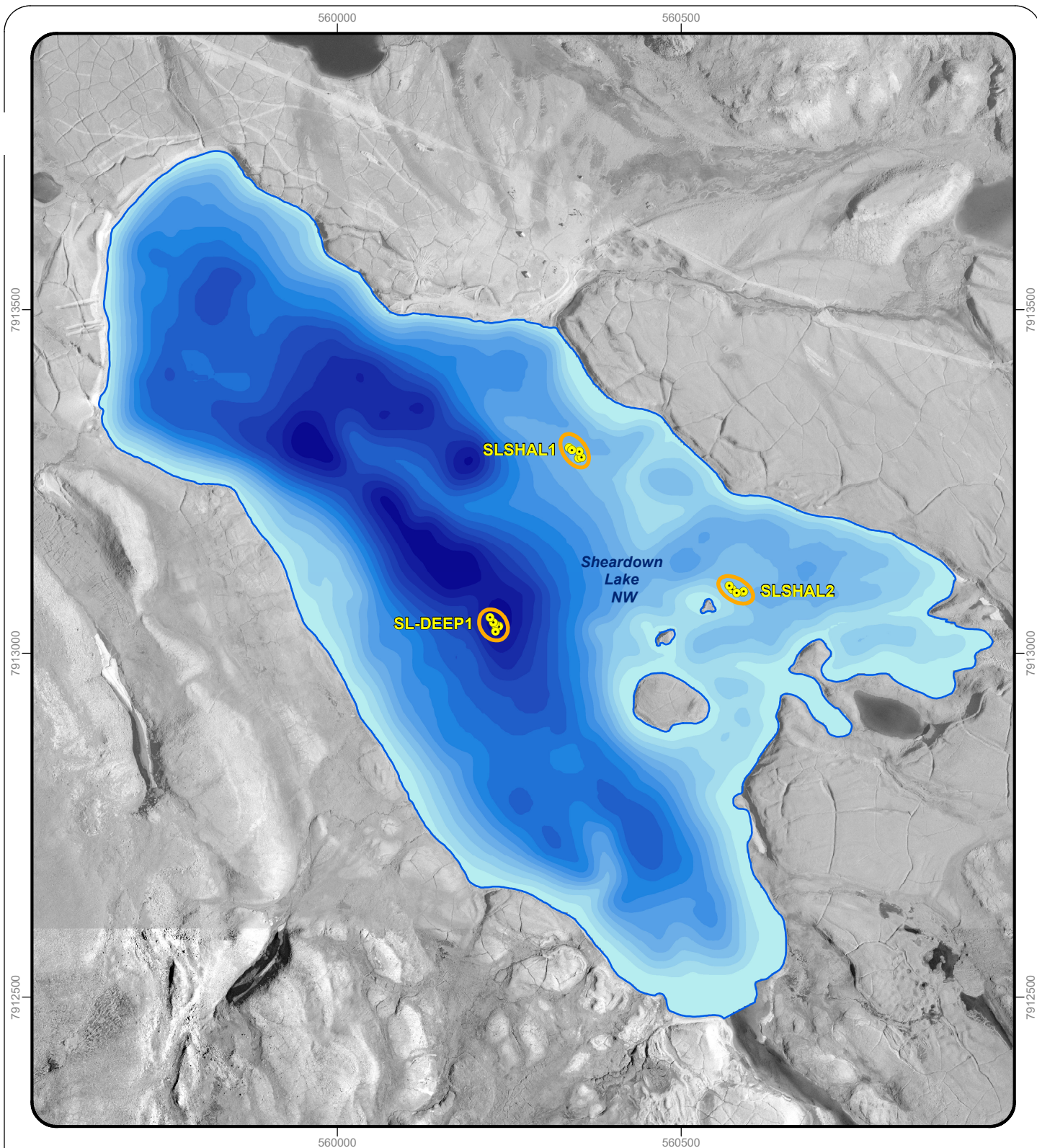
2.1 Station Locations

Increased sedimentation has the potential to affect Arctic charr populations by altering the benthic invertebrate food base (e.g., reduced density and/or altering community structure), reducing the quantity and/or quality of spawning habitat, and reducing egg hatching success (NSC 2014a,b). Therefore, three sedimentation monitoring stations were established in Sheardown Lake NW that took into account a combination of dominant benthic habitat types present in the lake, as well as areas considered to be important for assessing risks to the Arctic charr population associated with increased sedimentation. Lake sediment deposition was assessed using sediment traps deployed at the three stations in Sheardown Lake NW (Figure 2.1; Table 2.1) as follows:

1. Shallow Depositional Station (SL-SHAL1): Silt-loam represents the dominant substrate type in Sheardown Lake NW, and therefore increased sedimentation on habitat with this substrate has the greatest potential to affect overall lake benthic invertebrate density and/or community structure. In turn, any benthic invertebrate community changes in this habitat type has a high potential to affect the Arctic charr population. Silt substrate in the lake littoral zone (i.e., 2 – 12 m depth) was targeted for placement of this station to represent a potentially high sediment deposition habitat.
2. Shallow Hard-Bottom Station (SL-SHAL2): Increased sedimentation at hard-bottom areas could possibly reduce the amount of available spawning habitat and/or reduce egg hatching/reproductive success. Therefore, this station was established on coarse substrate (i.e., gravel, cobble) in the lake littoral zone at an area considered to provide suitable spawning habitat for Arctic charr.
3. Deep Profundal Station (SL-DEEP1): Because the main basin is the ultimate depositional zone for the lake, highest sediment deposition rate is expected at this area that, in turn, provides a 'maximum' sedimentation site. This station was established on silt substrate at the main lake basin in the lake profundal zone (30 m deep; Figure 2.1).

2.2 Field and Laboratory Methods

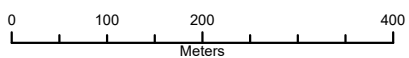
Five replicate sediment traps were deployed at each station to monitor lake sedimentation (Figure 2.1; Table 2.1). The sediment traps were constructed of three 50 cm long, 5 cm inside diameter polyvinyl chloride (PVC) pipes (i.e., 58.9 cm² surface area) sealed at the bottom and clamped together to create a single trap 'unit'. The sediment traps were designed to provide an aspect ratio of approximately 10:1, which meets the $\geq 5:1$ aspect ratio generally



 Sedimentation Monitoring Station

Bathymetry (m)

 0 - 2	 16 - 18
 2 - 4	 18 - 20
 4 - 6	 20 - 22
 6 - 8	 22 - 24
 8 - 10	 24 - 26
 10 - 12	 26 - 28
 12 - 14	 28 - 30
 14 - 16	



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 2016
 Project No.: 2569

Figure 2.1 : Sheardown Lake NW Lake Sedimentation Monitoring Locations, Mary River Project, 2014 - 2015.


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Table 2.1: Sediment trap replicate station coordinates, habitat information and deployment and retrieval information, Sheardown Lake NW Sedimentation Monitoring Study, 2014 - 2015.

Station	Station Replicate	Location (UTM; Zone 17W)		Station Depth (m)	Substrate	Ice - Cover Period (2014 - 2015)			Open-Water Period (2015)		
		Easting	Northing			Date Deployed	Date Retrieved	Set Duration (days)	Date Deployed	Date Retrieved	Set Duration (days)
Shallow 1 (SL SHAL1)	SL-SHAL-1A	560351	7913284	9.1	cobble	31-Aug-14	18-Jul-15	321	19-Jul-15	6-Sep-15	49
	SL-SHAL-1B	560355	7913285	9.1	cobble	31-Aug-14	18-Jul-15	321	19-Jul-15	6-Sep-15	49
	SL-SHAL-1C	560352	7913294	8.9	cobble	31-Aug-14	18-Jul-15	321	19-Jul-15	6-Sep-15	49
	SL-SHAL-1D	560337	7913299	8.8	cobble	31-Aug-14	22-Jul-15	325	22-Jul-15	6-Sep-15	46
	SL-SHAL-1E	560341	7913296	8.8	cobble	1-Sep-14	22-Jul-15	324	22-Jul-15	6-Sep-15	46
Shallow 2 (SL SHAL2)	SL-SHAL-2A	560590	7913089	6	silt	31-Aug-14	18-Jul-15	321	19-Jul-15	6-Sep-15	49
	SL-SHAL-2B	560591	7913090	5.9	silt	31-Aug-14	19-Jul-15	322	19-Jul-15	6-Sep-15	49
	SL-SHAL-2C	560574	7913093	6.2	silt	31-Aug-14	18-Jul-15	321	19-Jul-15	6-Sep-15	49
	SL-SHAL-2D	560570	7913098	6.2	silt	31-Aug-14	-	-	-	-	-
	SL-SHAL-2E	560581	7913088	6.3	silt	31-Aug-14	18-Jul-15	321	19-Jul-15	6-Sep-15	49
Deep 1 (SL DEEP1)	SL-DEEP-1A	560235	7913039	29.5	silt	31-Aug-14	22-Jul-15	325	22-Jul-15	6-Sep-15	46
	SL-DEEP-1B	560229	7913043	29.4	silt	31-Aug-14	22-Jul-15	325	22-Jul-15	6-Sep-15	46
	SL-DEEP-1C	560227	7913045	29.5	silt	31-Aug-14	22-Jul-15	325	22-Jul-15	6-Sep-15	46
	SL-DEEP-1D	560230	7913032	29.6	silt	31-Aug-14	22-Jul-15	325	22-Jul-15	6-Sep-15	46
	SL-DEEP-1E	560222	7913052	29.5	silt	31-Aug-14	22-Jul-15	325	22-Jul-15	6-Sep-15	46

recommended for cylindrical sediment traps to effectively monitor sediment deposition (Mudroch and MacKnight 1994). The sediment trap unit was secured to a float-anchor system designed to maintain the trap in an upright position for the duration of deployment. Under this system, the mouth of the sediment trap unit is situated approximately 1 m above the substrate.

Sedimentation was assessed separately for applicable ice-cover and open-water periods at Sheardown Lake NW. The seasonal timing of the ice breakup and freeze-up period at Sheardown Lake NW generally corresponds to early July and mid-September, respectively. For the 2014 – 2015 study, ice-cover period sediment traps were deployed 31 August – 01 September 2014 and retrieved 18 – 22 July 2015 (321 – 325 day duration), and open-water period sediment traps were deployed 19 – 22 July 2015 and retrieved 06 September 2015 (46 – 49 day duration; Table 2.1). For the open-water period, a surface marker buoy was attached to each sediment trap line to aid with trap location during retrieval. For the ice-cover period, the marker buoy was submerged approximately 2 m below the water surface to avoid entrapment of the buoy by ice, and a grappling tool was then required to retrieve the sediment trap by securing the marker buoy. One sediment trap was unable to be located at Station SL-SHAL2 following the ice-cover period in 2015, which was suspected to be due to buoy entrapment by ice and subsequent relocation of the sediment trap. Supporting information recorded at each station during sediment trap deployment included water depth, Global Positioning System (GPS) coordinates, and substrate description.

Sediment trap retrieval involved pulling the entire unit to the surface very slowly to minimize sediment re-suspension in, or loss from, each sediment trap. The entire contents of the trap, including all water and deposited sediment, was transferred into a 4 L plastic container pre-labelled with station identification and collection date information. Ambient water was used to rinse all sediment from each sediment trap, applied as a pressurized spray where appropriate. Upon complete removal of all material, the sediment traps were redeployed at approximately the same locations of retrieval. Following collection of all sediment, the sample containers were sealed and stored upright in the dark until submission to the analytical laboratory. The lake sedimentation samples were shipped to ALS Canada Ltd. (ALS; Waterloo, ON) for analysis of sediment total dry weight. At the laboratory, the sedimentation samples were filtered through a pre-weighed 0.70 µm glass fibre filter. The filter apparatus and container were rinsed three times to ensure complete removal of all sediment. The filter and residual sample material was dried at 105°C for two hours, allowed to cool for one hour, and were then weighed to the nearest milligram using an appropriate balance with draft shield. As in previous studies, low sample volumes were encountered for each sediment trap replicate, and each station, for both

of the 2014 – 2015 ice-cover and open-water period samples, precluding any additional analysis of the sedimentation material (e.g., sediment metal concentrations, dry bulk density).

2.3 Data Analysis

Sedimentation (deposition) rate was calculated for each replicate sediment trap using the equation (Kemp et al. 1974):

$$\text{Sedimentation rate (mg/cm}^2\text{day}^{-1}) = \frac{\text{dry weight (g)}}{\text{total area (cm}^2\text{)}} \div \text{deployment time period (day)}$$

The sedimentation data were evaluated statistically as follows: 1) spatial comparisons among the three stations for separate ice-cover and open-water periods; 2) seasonal comparisons at each station between the ice-cover and open-water periods; and, 3) temporal comparisons at each station between baseline and 2015 data sets separately for ice-cover and open-water periods. For the statistical analysis, raw data were assessed for normality and homogeneity of variance, and log-transformed as necessary to meet test assumptions, prior to conducting Analysis-of-Variance (ANOVA) and *post-hoc* tests, where appropriate. For multiple station comparisons, Tukey's Honestly Significant Difference (HSD) and Tamhane's *post-hoc* tests were conducted in cases in which normal data with equal and unequal variance, respectively, were encountered. In instances where normality could not be achieved through data transformation, non-parametric Mann-Whitney U-test statistics were used to confirm pair-wise statistical results, and Kruskal-Wallis H-tests were used to confirm multiple station statistical results from the ANOVA using the log-transformed data. Similarly, in instances in which normal data exhibited unequal variance despite log transformation, Student's t-tests were used assuming unequal variance to confirm the statistical findings of the ANOVA tests for two-group comparisons. All statistical comparisons were conducted using SPSS Version 12.0 software (SPSS Inc., Chicago, IL).

In addition to the analysis of sedimentation rates, an estimate of the uncompacted thickness (i.e., mm) of sediment accumulation was also calculated separately for each of the ice-cover and open-water periods using the equation (Kemp et al. 1974):

$$\text{Annual accumulation thickness (mm}\cdot\text{yr}^{-1}) = \frac{\text{Sedimentation rate (mg}\cdot\text{cm}^{-2}\text{yr}^{-1})}{\text{Dry bulk density (mg}\cdot\text{cm}^{-3})}$$

In lieu of sufficient sample volumes to determine bulk density of sedimentation material at Sheardown Lake NW, bulk density information from similar sedimentation studies conducted by Minnow Environmental Inc. (Minnow; unpublished data) at Canadian Shield lakes in northern Ontario was used as a surrogate for the calculation of sediment accumulation.

Because these Minnow data were collected over the summer open-water period at temperate latitudes where aquatic biological productivity can be expected to be higher than at polar latitudes, the calculation of annual accumulation thickness using the Minnow bulk density information is likely to overestimate actual accumulation thickness for Sheardown Lake NW. Therefore, the derived accumulation thicknesses for the Mary River Project using these methods were considered conservative estimates of actual values. Adverse effects on fish egg survival have been documented for a sediment accumulation thickness exceeding approximately 1 mm during the egg incubation period (Morgan et al. 1983; Fudge and Bodaly 1984). Therefore, an accumulation thickness of 1 mm was used as a threshold for the evaluation of potential effects to Arctic charr egg incubation associated with sediment deposits at the Mary River Project. On Baffin Island, Arctic charr spawning occurs in autumn (September-October) and although egg hatch occurs in early April, larval emergence generally does not occur until ice breakup in mid-July (Scott and Crossman 1998). Because this period essentially mirrors the ice-cover period used in this study, accumulation thickness for the ice-cover period was used to evaluate potential effects of depositing sediment on Arctic charr egg survival at Sheardown Lake NW.

3.0 RESULTS

3.1 Sedimentation Rates

Spatially within Sheardown Lake NW, sedimentation rates were lower at the shallow littoral stations (i.e., SL-SHAL1 and SL-SHAL2) than at the deep profundal station (i.e., main basin Station SL-DEEP1) during both the ice-cover and open-water periods (Figure 3.1; Appendix Tables A.1 and A.2). On average, sedimentation rates did not differ significantly between hard- and soft-bottomed stations within the littoral zone of the lake (i.e., Stations SL-SHAL1 and SL-SHAL2, respectively) for either the ice-cover or open-water periods (Appendix Table A.4), suggesting relatively uniform deposition patterns at littoral station depths within the lake, regardless of substrate type. The average sedimentation rate at the main basin profundal station was significantly higher than at the hard-bottom littoral station, but did not differ significantly with the soft-bottom littoral station for either seasonal period (Figure 3.1; Appendix Table A.4). The observed patterns in sedimentation with depth at Sheardown Lake NW were generally consistent with normal lake deposition patterns with consideration of depth and bathymetric features (e.g., Wetzel 2001). Between seasons, sedimentation rates were significantly higher for the open-water period compared to the ice-cover period at all three Sheardown Lake NW sedimentation monitoring stations (Appendix Table A.5). On average, sedimentation rates were approximately 4.1 – 5.0 times greater during the open-water period compared to the ice-cover period, potentially reflecting a combination of greater sources of sediment generated by the mine during the summer (e.g., fugitive dust) and/or naturally greater organic (e.g., phytoplankton) productivity during this period.

Sedimentation rates observed at Sheardown Lake NW in 2014-2015, based on calendar year averages, varied from 15.5 mg/cm²/year at the shallow littoral stations, to 24.5 mg/cm²/year at the deep profundal station. These rates were within the range of those observed at other Canadian arctic lakes (7 – 50 mg/cm²/year; Lockhart et al. 1998) and much lower than at proglacial lakes in south-east Greenland (mean of 790 mg/cm²/year; Hasholt et al. 2000), suggesting that sedimentation rates at Sheardown Lake NW in 2014 – 2015 were not unusually high.

No significant differences in sedimentation rates were observed between the mine baseline (2013 – 2014) and operational (2014 – 2015) phases over the ice-cover period at any of the Sheardown Lake NW lake sedimentation monitoring stations (Appendix Table A.6). Although sedimentation rates were significantly higher at stations SL-SHAL1 and SL-DEEP1 during the open water season in 2015 compared to 2014 (Appendix Table A.6), mean sedimentation rates in the 2015 open-water season were comparable to those observed in 2013 (Figure 3.1).

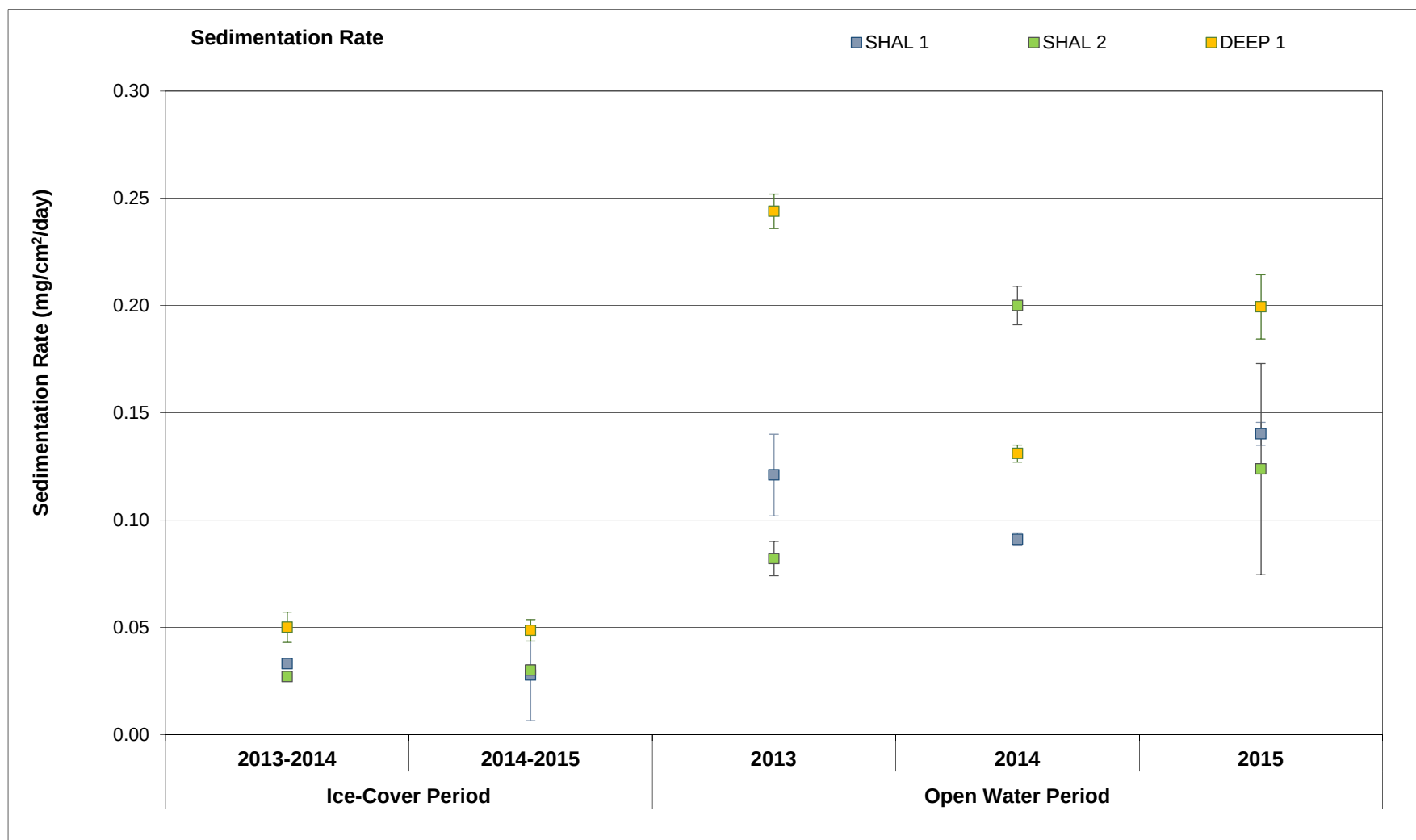


Figure 3.1: Sedimentation rates during ice-cover and open-water periods at Sheardown Lake NW over mine baseline (2013 - 2014) and operational (2015) phases, Mary River Project Lake Sedimentation Monitoring Study.

Moreover, annualized sedimentation rates in 2014 - 2015 (i.e., 15.5 – 24.5 mg/cm²/year) were similar to rates calculated for the 2013 - 2014 baseline period (i.e., 14.3 – 21.2 mg/cm²/year; from NSC 2014a). Overall, these comparisons suggested no substantial changes in sedimentation rates at Sheardown Lake NW between mine baseline (2013 – 2014) and operational (2014 – 2015) phases and, by extension, no adverse mine-related influences on sedimentation at Sheardown Lake NW associated with the first year of mine operation.

3.2 Sediment Accumulation Estimate

Annual accumulation thickness of sediment calculated for Sheardown Lake NW ranged from 0.79 mm/year at shallow littoral stations (i.e., SL-SHAL1 and SL-SHAL2) to 1.25 mm/year at the deep profundal station (i.e., main basin SL-DEEP1). These sediment accumulation thicknesses were comparable those observed among seven arctic lakes in western Greenland, which ranged from 0.27 ± 0.12 to 1.2 ± 0.32 mm/year and averaged 0.54 mm/yr (Sobek et al. 2014). These results supported the findings of the sedimentation rate analysis, and suggested that sedimentation at Sheardown Lake NW was within normal ranges for arctic lakes and hence, not adversely influenced by the Mary River Project operation.

As indicated previously, adverse effects on fish egg survival have been documented for a sediment accumulation thickness exceeding approximately 1 mm during the egg incubation period (Morgan et al. 1983; Fudge and Bodaly 1984). The sediment accumulation thickness calculated for the Arctic charr egg incubation/larval pre-emergence period (i.e., approximately mid-September to mid-July; Scott and Crossman 1998) at Sheardown Lake NW ranged from 0.52 ± 0.40 mm at the littoral hard-bottomed station (i.e., SL-SHAL1) to 0.56 ± 0.04 mm at the littoral silt-bottomed station (i.e., SL-SHAL2). The highest sediment accumulation thickness for Sheardown Lake NW over the anticipated Arctic charr egg incubation/larval pre-emergence period was predicted for the profundal soft-bottomed station at the main basin of the lake (0.90 ± 0.09 mm). Because the accumulation thickness was below 1 mm over the duration of the anticipated Arctic charr egg incubation/larval pre-emergence period, no adverse influences to hatch success as a result of sedimentation levels were suggested for Sheardown Lake NW.

4.0 CONCLUSIONS

Lake Sedimentation Monitoring is included as a special investigation component of the Mary River Project AEMP to track sedimentation, and evaluate the potential for adverse influences on resident Arctic charr populations related to excessive sedimentation, at a representative lake (Sheardown Lake NW) within the immediate area of mine influence (NSC 2014a,b, 2015). Sedimentation monitoring was initiated in 2013 – 2014 to provide information prior to the start-up of active mine operations. The principal conclusions of 2014 – 2015 lake sedimentation monitoring study, which provide evaluation of potential Mary River Project-related influences on sedimentation at Sheardown Lake NW following the first full year of mine operation, are as follows:

- Sedimentation rates at Sheardown Lake NW in 2014 – 2015 were within the range observed at other Canadian arctic lakes that are largely uninfluenced by anthropogenic activities, suggesting no adverse influence on sedimentation of mine area lakes associated with the Mary River Project
- No significant differences in sedimentation rates were observed between the mine baseline (2013 – 2014) and operational (2014 – 2015) phases over the ice-cover period at Sheardown Lake NW. In addition, annualized sedimentation rates in 2014 - 2015 were similar to those during the 2013 - 2014 baseline period. Therefore, the temporal data suggested no substantial changes in sedimentation rates at Sheardown Lake NW between mine baseline (2013 – 2014) and operational (2014 – 2015) phases.
- Annual accumulation thickness of sediment at Sheardown Lake NW was comparable to that of other arctic lakes that have not been influenced by anthropogenic inputs, suggested that sedimentation at Sheardown Lake NW was within normal ranges. Sediment accumulation thickness over the duration of the anticipated Arctic charr egg incubation/larval pre-emergence period at Sheardown Lake NW was below a threshold effect level of 1 mm of sediment deposition, suggesting that no adverse influences to hatch success were likely as a result of sedimentation levels at Sheardown Lake NW in 2014 - 2015.

5.0 REFERENCES

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APPENDIX A

SEDIMENTATION INFORMATION

Table A.1: Sediment trap results for the 2014 - 2015 ice-cover period at Sheardown Lake NW, Lake Sedimentation Monitoring Study, 2014 - 2015.

Station	Station Replicate	Location (UTM; Zone 17W)		Station Depth (m)	Date Deployed	Date Retrieved	Set Duration (days)	Total Dry Weight (g)	Sedimentation Rate (mg/cm ² /day)
		Easting	Northing						
Shallow 1 (SL SHAL1)	SL-SHAL-1A	560351	7913284	9.1	31-Aug-14	18-Jul-15	321	0.440	0.023
	SL-SHAL-1B	560355	7913285	9.1	31-Aug-14	18-Jul-15	321	0.333	0.018
	SL-SHAL-1C	560352	7913294	8.9	31-Aug-14	18-Jul-15	321	0.261	0.014
	SL-SHAL-1D	560337	7913299	8.8	31-Aug-14	22-Jul-15	325	0.359	0.019
	SL-SHAL-1E	560341	7913296	8.8	1-Sep-14	22-Jul-15	324	1.25	0.065
	Average						322	0.529	0.028
	Standard Deviation						1.9	0.408	0.021
Shallow 2 (SL SHAL2)	SL-SHAL-2A	560590	7913089	6	31-Aug-14	18-Jul-15	321	0.53	0.028
	SL-SHAL-2B	560591	7913090	5.9	31-Aug-14	19-Jul-15	322	0.565	0.030
	SL-SHAL-2C	560574	7913093	6.2	31-Aug-14	18-Jul-15	321	0.631	0.033
	SL-SHAL-2D	560570	7913098	6.2	31-Aug-14	-	-	-	-
	SL-SHAL-2E	560581	7913088	6.3	31-Aug-14	18-Jul-15	321	0.544	0.029
	Average						321	0.568	0.030
	Standard Deviation						0.5	0.045	0.002
Deep 1 (SL DEEP1)	SL-DEEP-1A	560235	7913039	29.5	31-Aug-14	22-Jul-15	325	0.871	0.045
	SL-DEEP-1B	560229	7913043	29.4	31-Aug-14	22-Jul-15	325	1.09	0.057
	SL-DEEP-1C	560227	7913045	29.5	31-Aug-14	22-Jul-15	325	0.844	0.044
	SL-DEEP-1D	560230	7913032	29.6	31-Aug-14	22-Jul-15	325	0.935	0.049
	SL-DEEP-1E	560222	7913052	29.5	31-Aug-14	22-Jul-15	325	0.907	0.047
	Average						325	0.929	0.049
	Standard Deviation						0.0	0.096	0.005

Table A.2: Sediment trap results for the 2015 open-water period at Sheardown Lake NW, Lake Sedimentation Monitoring Study, 2014 - 2015.

Station	Station Replicate	Location (UTM; Zone 17W)		Station Depth (m)	Date Deployed	Date Retrieved	Set Duration (days)	Total Dry Weight (g)	Sedimentation Rate (mg/cm ² /day)
		Easting	Northing						
Shallow 1 (SL SHAL1)	SL-SHAL-1A	560351	7913284	9.1	19-Jul-15	6-Sep-15	49	0.413	0.143
	SL-SHAL-1B	560355	7913285	9.1	19-Jul-15	6-Sep-15	49	0.411	0.142
	SL-SHAL-1C	560352	7913294	8.9	19-Jul-15	6-Sep-15	49	0.379	0.131
	SL-SHAL-1D	560337	7913299	8.8	22-Jul-15	6-Sep-15	46	0.392	0.145
	SL-SHAL-1E	560341	7913296	8.8	22-Jul-15	6-Sep-15	46	0.378	0.140
	Average						47.8	0.395	0.140
	Standard Deviation						1.6	0.017	0.005
Shallow 2 (SL SHAL2)	SL-SHAL-2A	560590	7913089	6	19-Jul-15	6-Sep-15	49	0.159	0.055
	SL-SHAL-2B	560591	7913090	5.9	19-Jul-15	6-Sep-15	49	0.375	0.130
	SL-SHAL-2C	560574	7913093	6.2	19-Jul-15	6-Sep-15	49	0.399	0.138
	SL-SHAL-2D	560570	7913098	6.2	-	-	-	-	-
	SL-SHAL-2E	560581	7913088	6.3	19-Jul-15	6-Sep-15	49	0.496	0.172
	Average						49.0	0.357	0.124
	Standard Deviation						0	0.142	0.049
Deep 1 (SL DEEP1)	SL-DEEP-1A	560235	7913039	29.5	22-Jul-15	6-Sep-15	46	0.523	0.193
	SL-DEEP-1B	560229	7913043	29.4	22-Jul-15	6-Sep-15	46	0.602	0.222
	SL-DEEP-1C	560227	7913045	29.5	22-Jul-15	6-Sep-15	46	0.537	0.198
	SL-DEEP-1D	560230	7913032	29.6	22-Jul-15	6-Sep-15	46	0.549	0.203
	SL-DEEP-1E	560222	7913052	29.5	22-Jul-15	6-Sep-15	46	0.491	0.181
	Average						46	0.540	0.199
	Standard Deviation						0	0.041	0.015

Table A.3: Sedimentation (mg/cm²/day) summary statistics for Sheardown Lake NW, Lake Sedimentation Monitoring Study, 2014 - 2015

Study Period	Station	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Ice-Cover 2014 - 2015	SL SHAL 1	5	0.028	0.021	0.010	0.001	0.054	0.014	0.065
	SL SHAL 2	4	0.030	0.002	0.001	0.026	0.034	0.028	0.033
	SL DEEP1	5	0.049	0.005	0.002	0.042	0.055	0.044	0.057
Open-Water 2015	SL SHAL 1	5	0.140	0.005	0.002	0.134	0.147	0.131	0.145
	SL SHAL 2	4	0.124	0.049	0.025	0.045	0.202	0.055	0.172
	SL DEEP1	5	0.199	0.015	0.007	0.181	0.218	0.181	0.222

Table A.4: Statistical comparison of sedimentation among Sheardown Lake NW stations for ice-cover and open-water periods, Lake Sedimentation Monitoring Study, 2014 - 2015.

Study Period	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
Ice-Cover 2014 - 2015	YES	0.02987	ANOVA ^d	SL SHAL1	SL SHAL2	NO	0.5966	Tukey's ^d
				SL SHAL1	SL DEEP1	YES	0.0256	
				SL SHAL2	SL DEEP1	NO	0.1787	
Open-Water 2015	YES	0.02737	ANOVA ^d	SL SHAL1	SL SHAL2	NO	0.8545	Tamhane's ^d
				SL SHAL1	SL DEEP1	YES	0.0003	
				SL SHAL2	SL DEEP1	NO	0.3000	

^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 Data normally distributed. Untransformed data used for comparison(s).

^d Data non-normally distributed. Log transformation resulted in normal distribution, and thus the log transformed data used for comparison(s).

Table A.5: Statistical comparison of sedimentation (mg/cm²/day) between the 2014-2015 ice-cover and 2015 open-water periods at Sheardown Lake NW, Lake Sedimentation Monitoring Study, 2014 - 2015.

Station	Statistical Test Results			Summary Statistics						
	Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Period	N	Mean	Standard Deviation	Standard Error	Minimum	Maximum
SL SHAL1	YES	0.000	β , γ	Ice-Cover 2014-2015	5	0.028	0.021	0.010	0.014	0.065
				Open-Water 2015	5	0.140	0.005	0.002	0.131	0.145
SL SHAL2	YES	0.002	β , γ	Ice-Cover 2014-2015	4	0.030	0.002	0.001	0.028	0.033
				Open-Water 2015	4	0.124	0.049	0.025	0.055	0.172
SL DEEP1	YES	0.000	β , γ	Ice-Cover 2014-2015	5	0.049	0.005	0.002	0.044	0.057
				Open-Water 2015	5	0.199	0.015	0.007	0.181	0.222

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

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

Table A.6: Statistical comparison of sedimentation rates between mine baseline (2013 - 2014) and operational (2014 - 2015) phases at Sheardown Lake NW during ice-cover and open-water periods, Lake Sedimentation Monitoring Study, 2014 - 2015.

Lake Status	Station	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	p-value	Statistical Analysis ^a	Period	N	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Ice-Cover	SL SHAL1	NO	0.282	β , γ	2013 - 2014	4	0.034	0.002	0.001	0.031	0.036
					2014 - 2015	5	0.028	0.021	0.010	0.014	0.066
	SL SHAL2	NO	0.072	β , γ	2013 - 2014	5	0.027	0.001	0.001	0.026	0.029
					2014 - 2015	4	0.030	0.002	0.001	0.028	0.033
	SL DEEP1	NO	0.687	β , γ	2013 - 2014	4	0.050	0.007	0.003	0.045	0.059
					2014 - 2015	5	0.049	0.005	0.002	0.044	0.057
Open-Water	SL SHAL1	YES	0.006	β , ϵ	2014	5	0.082	0.022	0.010	0.042	0.095
					2015	5	0.140	0.005	0.002	0.131	0.145
	SL SHAL2	NO	0.735	β , γ	2014	4	0.200	0.206	0.103	0.060	0.500
					2015	4	0.124	0.049	0.025	0.055	0.172
	SL DEEP1	YES	0.000	β , γ	2014	5	0.131	0.004	0.002	0.125	0.136
					2015	5	0.199	0.015	0.007	0.181	0.222

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

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

APPENDIX E.10.3

2015 Hydrometric Monitoring Program



To: Jim Millard
Environmental Manager
Baffinland Iron Mines

From: Andrew Rees, Ph.D., EP
Senior Environmental Scientist

Re: 2015 Hydrometric Monitoring Program

Date: 3 February 2016

SEI Proj No: 199-01-09

1 Introduction

The 2015 Mary River Hydrometric Monitoring Program was initiated in late June around the onset of the spring melt period. Site visits were conducted by Story Environmental Inc. ("SEI") re-install pressure transducers and conduct flow measurements at six previously established monitoring stations (Table 1.1). The hydrometric stations are a part of the streamflow monitoring program supporting the Aquatic Effects Monitoring Plan ("AEMP").

Table 1.1 2015 Hydrometric Monitoring Stations

Station ID	Station Name	Period of Record	Drainage Area (km ²)	Coordinates (UTM)	
				Easting	Northing
H01	Phillips Creek Tributary	2006-2008, 2011-2015	250	532831	7946247
H02	Tom River near outlet to Mary Lake	2006-2008, 2010-2015	210	555712	7915514
H04	Camp Lake Tributary (CLT-2)	2006-2008, 2010-2015	8.3	557639	7915579
H05	Camp Lake Tributary (CLT-1)	2006-2008, 2010-2015	5.3	558906	7915079
H06	Mary River	2006-2008, 2010-2015	240	563922	7912984
H11	Sheardown Lake Tributary (SDLT-1)	2011-2015	3.6	560503	7913545

Final site visits were made by Baffinland Iron Mines ("BIM") staff between September 1 and 2 to remove the stations prior to winter freeze-up. During the June site visit, benchmark and water level surveys were conducted and pressure transducers were installed or downloaded. Discharge was measured using the velocity-area technique and a wading current meter where lower flows permitted safe access to the channel. No discharge measurements were made at H06 during the June 2015 site visit due to ice in the channel.

2 Stage-Discharge Measurements

The stage-discharge data obtained in 2015 were compared to the existing rating curves summarized in the 2014 Hydrometric Monitoring Program Summary (KP, 2015). The rating curves for each station,



inclusive of the 2015 measurements, are shown on Figures 1 to 6. A discussion and interpretation of the fit of the current data to the existing rating curves is provided in the following sections:

- **H01 (Phillip's Creek Tributary)** - A stage-discharge measurement was recorded at H01 during the June site visit and is consistent with the existing rating curve (Figure 1). As such, the existing rating curve was used for the development of the 2015 streamflow record.
- **H02 (Tom River)** - A stage-discharge measurement was recorded at H02 during the June site visit and plots lower than the existing rating curve (Figure 2). The channel at H02 appears to be stable, however, the data from 2013 to 2015 suggest a possible shift in the rating curve. Additional high flow measurements are recommended at H02 to verify the upper half of the rating curve and determine if the curve should be adjusted. The existing rating curve was used for the development of the 2015 flow record, however, it is considered provisional as the existing curve may be underestimating discharge.
- **H04 (Camp Lake Tributary CLT-2)** - A stage-discharge measurement was recorded at H04 during the site visit and is consistent with the rating curve shift proposed in KP, 2015 (Figure 3). Higher flow measurements were not obtained in 2015 to validate the upper half of the rating curve and there is less confidence in the accuracy of flows recorded above 0.4 m³/s. Additional measurements are recommended across a range of flows to further validate the rating curve at H04. The updated rating curve was used for the development of the 2015 flow record.
- **H05 (Camp Lake Tributary CLT-1)** - Stage-discharge measurements were recorded at H05 during the June site visit and are consistent with the existing rating curve (Figure 4). The rating curve was used for the development of the 2015 flow record.
- **H06 (Mary River)** - No stage-discharge measurements were recorded at H06 in 2015 due to ice in the channel, which prevented an accurate measurement of stage. The rating curve at H06 has been consistent over the past several years and the channel appears to be stable. As such, the existing rating curve (Figure 5) was used for the development of the 2015 flow record. Additional stage-discharge measurements are recommended to validate the existing rating curve.
- **H11 (Sheardown Lake Tributary SDLT-1)** - Stage-discharge measurements were recorded at H11 during the June site visit and are generally consistent with the rating curve updated in 2014 (Figure 6). There remains uncertainty around higher stage-discharge conditions at H11 due to the lack of field measurements for validation. In future years, higher flow measurements should be obtained at H11 to validate the updated rating curve.

3 Streamflow Hydrographs

Streamflow records were developed for each station by applying the water level records to the corresponding rating curves. The discharge hydrographs for H01, H02, H04, H05, H06, and H11 are presented on Figures 7 to 12. Each water level record underwent a quality review and periods

affected by channel ice or other anomalies were removed from the record. The discharge hydrographs for H02 and H04 are considered provisional until additional data are available to validate the full rating curve.

The discharge records were converted to equivalent unit runoff (discharge per unit area) and are compared to the daily precipitation records on Figure 13. The records of unit runoff generally agree well with each other, exhibiting similar timing and magnitude of runoff events and similar patterns to previous years. As during previous years, the station at H11, with a generally lower elevation catchment, exhibited a much smaller freshet and muted response to precipitation events.

A strong diurnal melt pattern is evident through the first half of July and the peak of freshet flows occurred earlier than in previous years, from June 28 to July 4. The peak flows were lower than previous years and of shorter duration. A summary of flows at H05 from 2006 to 2015 is shown on Figure 14. The total annual runoff in 2015 at the H05 station was the lowest recorded from 2006 to 2015. The mean monthly discharge and unit runoff for each station in 2015 are summarized in Table 3.1.

Table 3.1 Summary of 2015 Mean Monthly Runoff

STATION	Mean Monthly Estimated Discharge (m ³ /s)				Period of Record
	June	July	August	September	
H01	15.7*	8.8	3.5	-	June 20 to August 31
H02	14.5*	6.0	2.3	0.9*	June 21 to September 2
H04	0.41*	0.20	0.2	0.03*	June 19 to September 2
H05	0.13*	0.06	0.08	0.03*	June 19 to September 1
H06	18.6*	9.2	3.8	1.1*	June 19 to September 2
H11	0.026*	0.038	0.063	0.030*	June 18 to September 1

STATION	Mean Monthly Unit Runoff (l/s/km ²)				Period of Record
	June	July	August	September	
H01	65.3*	36.8	14.9	-	June 20 to August 31
H02	69.5*	28.5	11.1	4.2*	June 21 to September 2
H04	50.1*	24.2	19.8	4.0*	June 19 to September 2
H05	23.9*	12.2	15.8	5.5*	June 19 to September 1
H06	77.4*	38.3	16.0	4.4*	June 19 to September 2
H11	7.3*	10.6	17.7	8.5*	June 18 to September 1

Note:

- Months with incomplete data records are indicated with an asterix.



4 Summary

The 2015 Hydrometric Monitoring Program allowed for the continued monitoring of streamflow at the AEMP hydrometric stations. The data collected confirmed the rating curves at several stations and identified possible control changes at other stations. It is recommended that future hydrometric monitoring includes more frequent site visits during the season to ensure the proper operation of data loggers and to confirm or improve rating curves.

5 References

Knight Piésold Ltd. (KP), 2014. Memorandum to: Jim Millard, Baffinland Iron Mines Corporation. Re: *2014 Hydrometric Monitoring Program*. December 16. North Bay, Ontario. Ref. No. NB14-00636.

Prepared by:

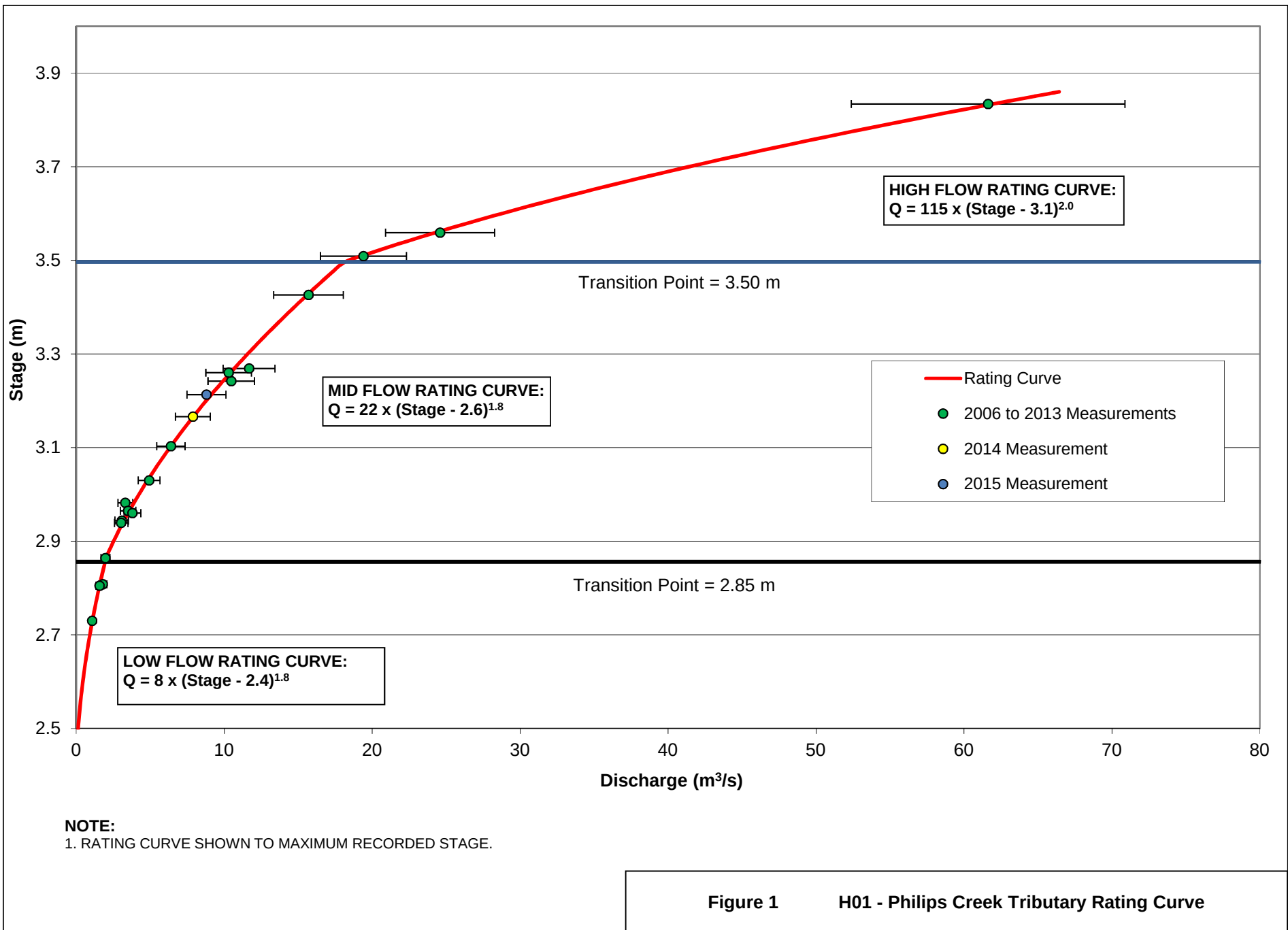
Andrew Rees, Ph.D., EP
Senior Environmental Scientist

Reviewed by:

Maria Story, P.Eng.
President

Attachments:

Figure 1	H01 - Phillip's Creek Tributary Rating Curve
Figure 2	H02 - Tom River Rating Curve
Figure 3	H04 - Camp Lake Tributary (CLT-2) Rating Curve
Figure 4	H05 - Camp Lake Tributary (CLT-1 L1) Rating Curve
Figure 5	H06 - Mary River Rating Curve
Figure 6	H11 - Sheardown Lake Tributary (SLDT-1) Rating Curve
Figure 7	H01 - Phillip's Creek Tributary 2015 Streamflow Record
Figure 8	H02 - Tom River 2015 Streamflow Record
Figure 9	H04 - Camp Lake Tributary (CLT-2) 2015 Streamflow Record
Figure 10	H05 - Camp Lake Tributary (CLT-1) 2015 Streamflow Record
Figure 11	H06 - Mary River 2015 Streamflow Record
Figure 12	H11 - Sheardown Lake Tributary (SLDT-1) 2015 Streamflow Record
Figure 13	2015 Unit Runoff and Daily Precipitation
Figure 14	H05 - Measured Streamflow Hydrographs 2006-2015



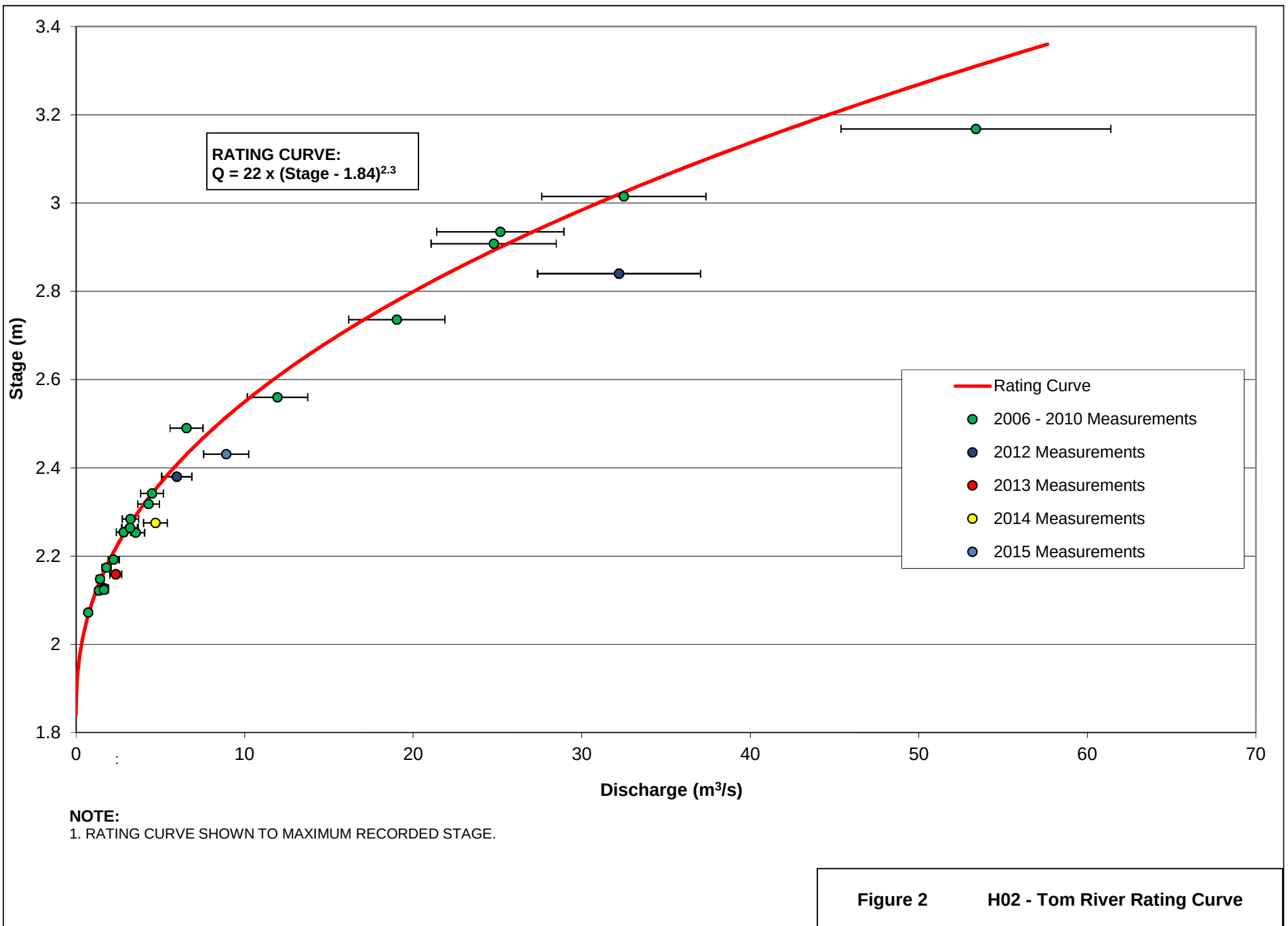
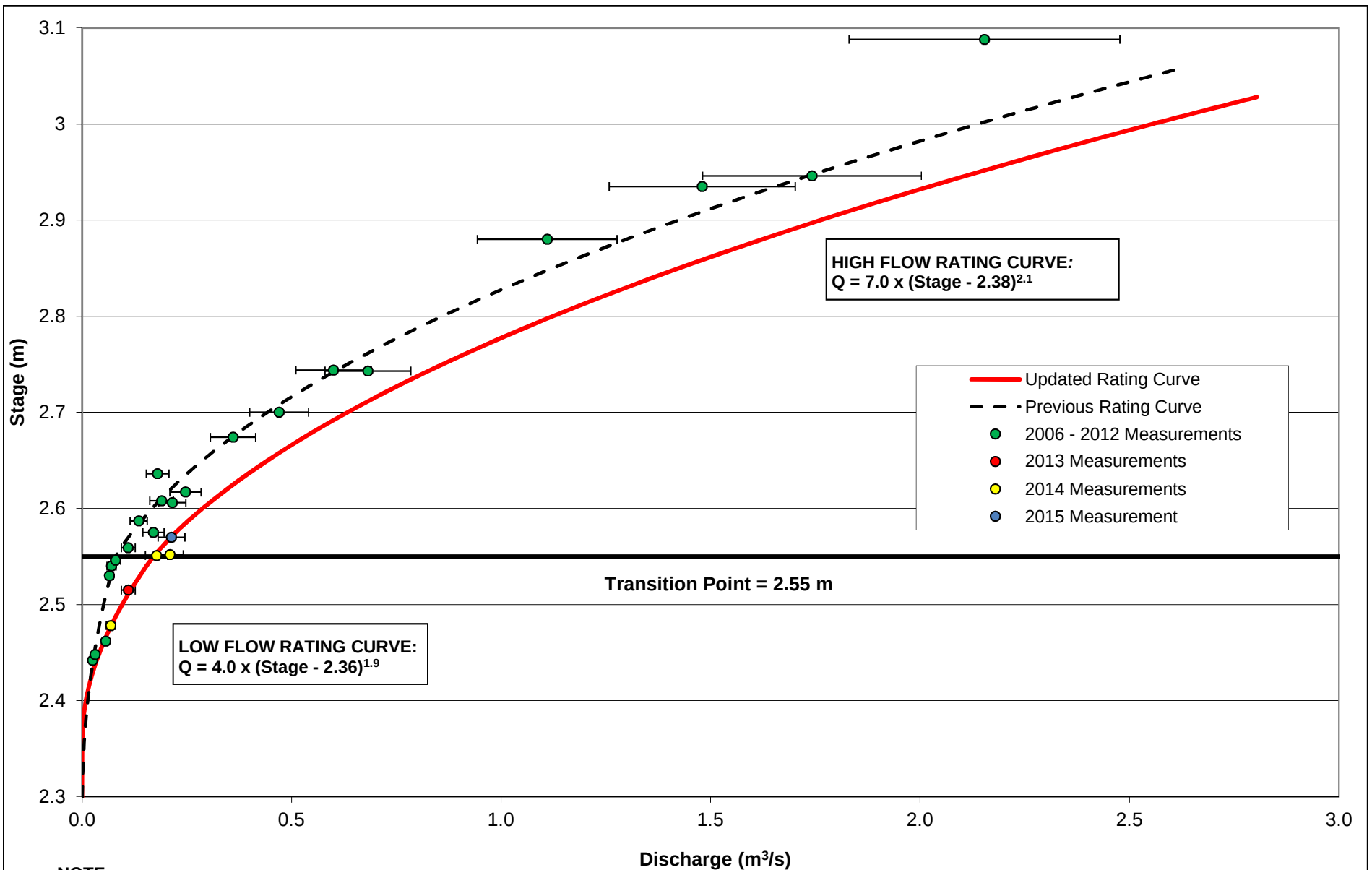
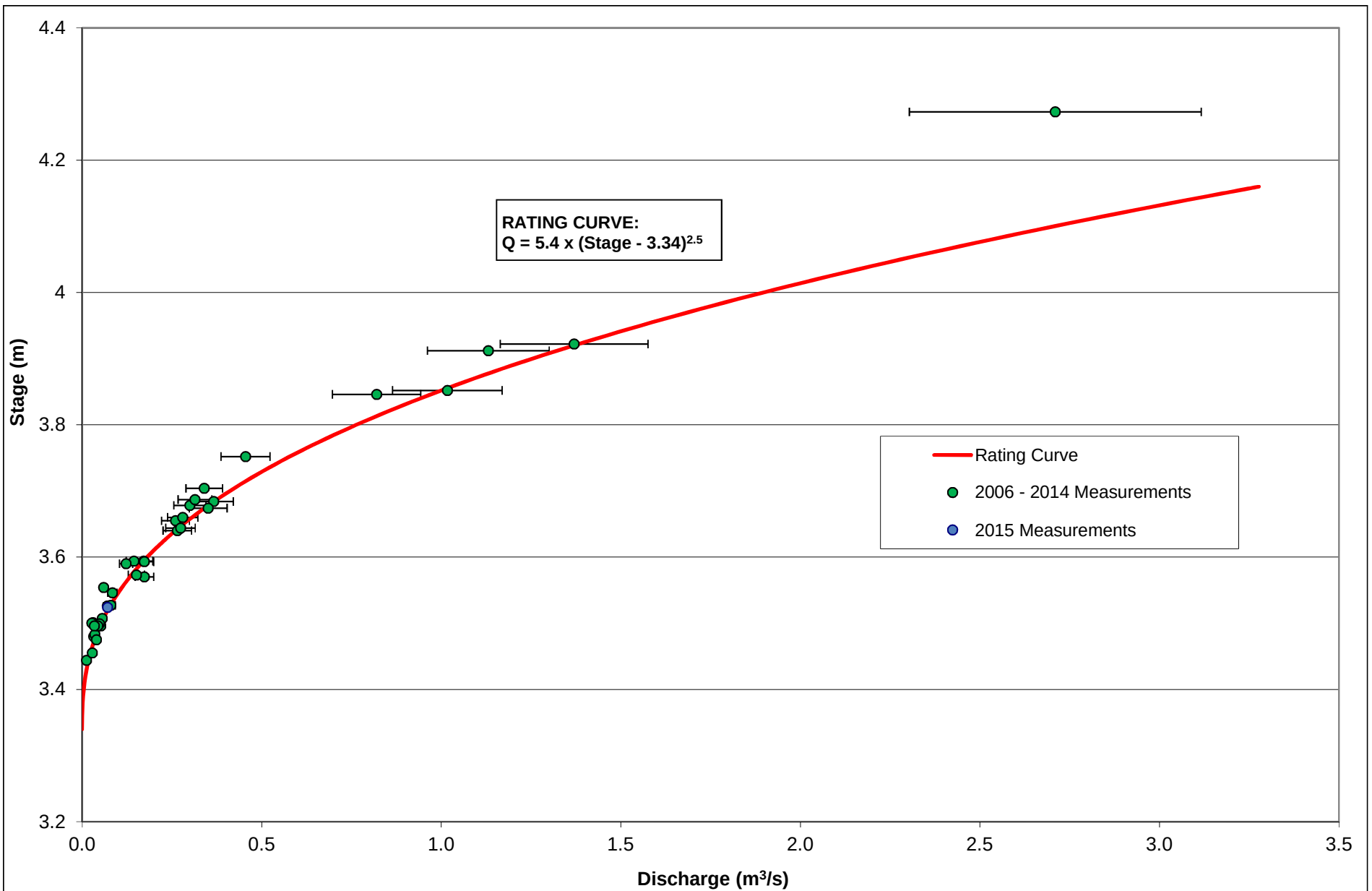


Figure 2 H02 - Tom River Rating Curve



NOTE:
 1. RATING CURVE SHOWN TO MAXIMUM RECORDED STAGE.

Figure 3 H04 - Camp Lake Tributary (CLT-2) Rating Curve



NOTE:

1. RATING CURVE SHOWN TO MAXIMUM RECORDED STAGE.

Figure 4

H05 - Camp Lake Tributary (CLT-1) Rating Curve

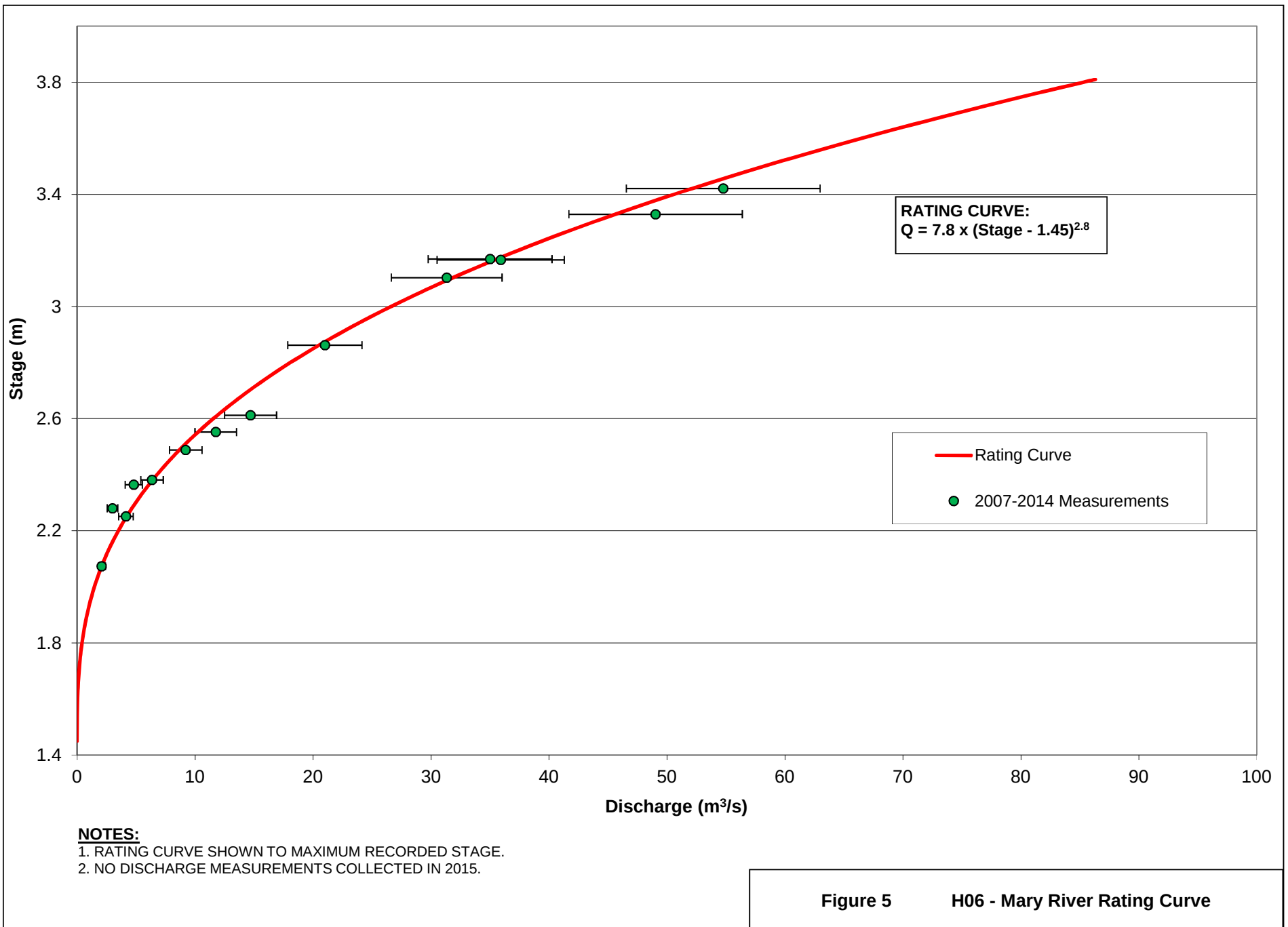
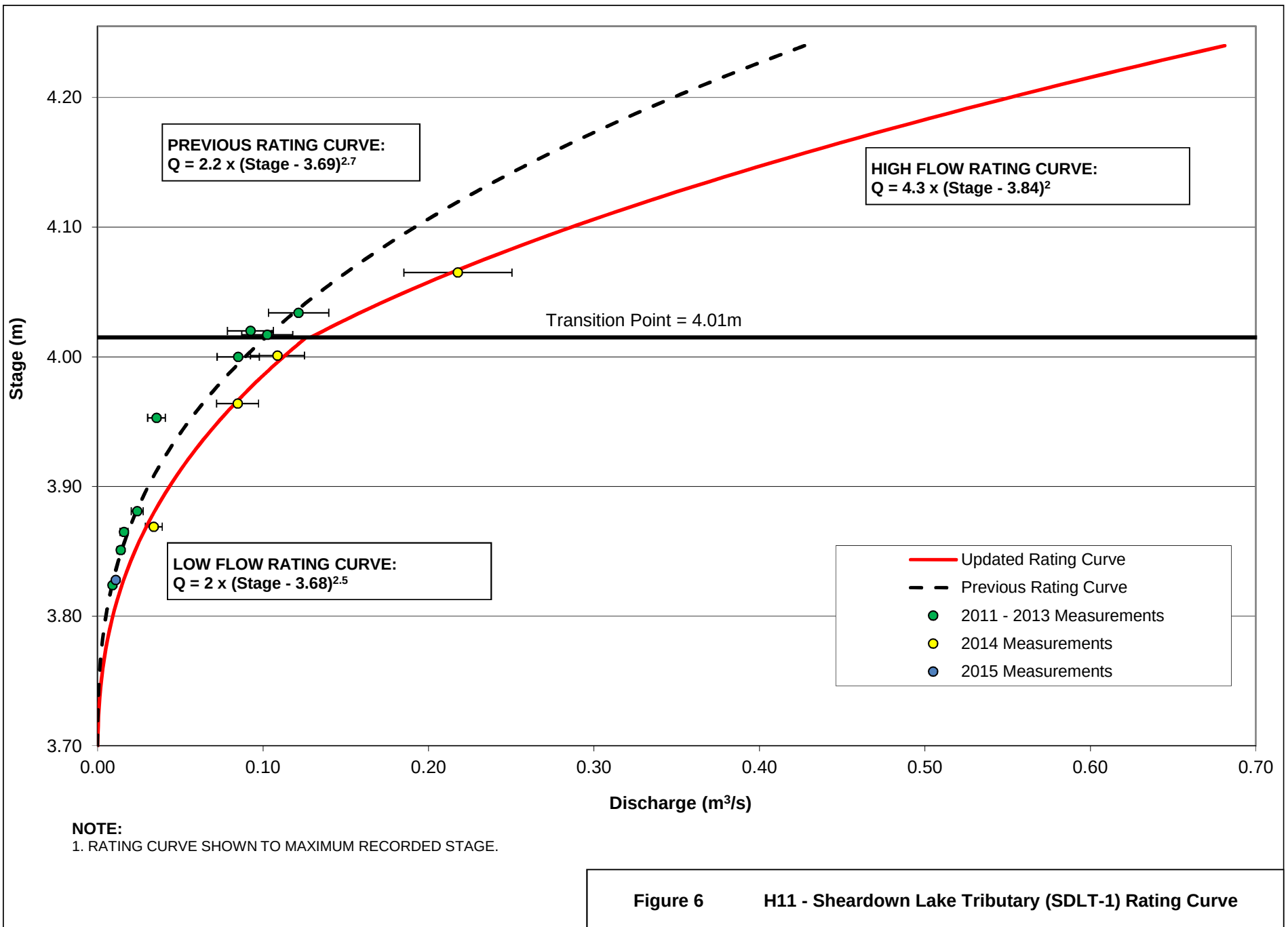


Figure 5

H06 - Mary River Rating Curve



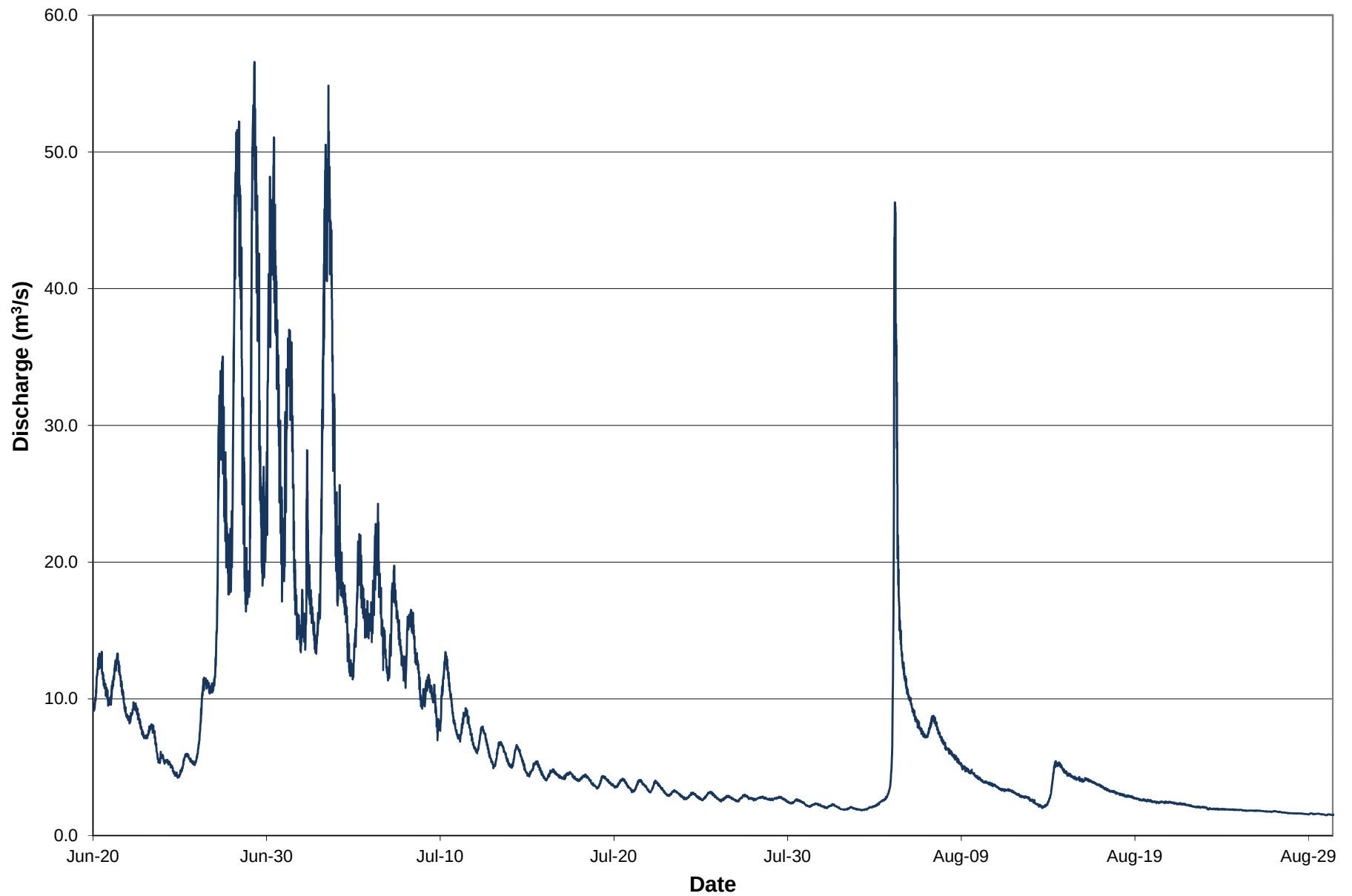


Figure 7 H01 - Philips Creek Tributary 2015 Streamflow Record

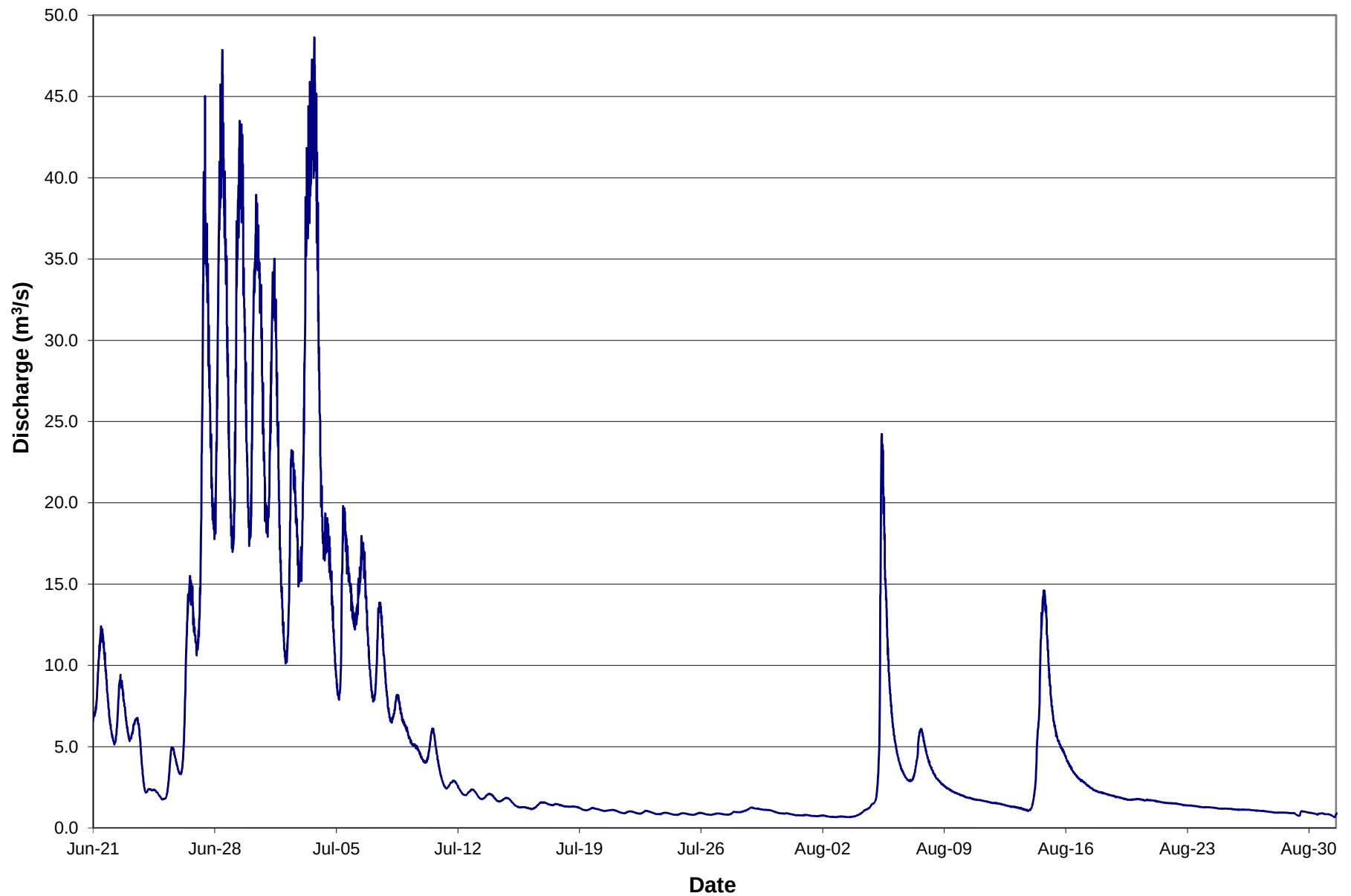


Figure 8 **H02 - Tom River 2015 Streamflow Record**

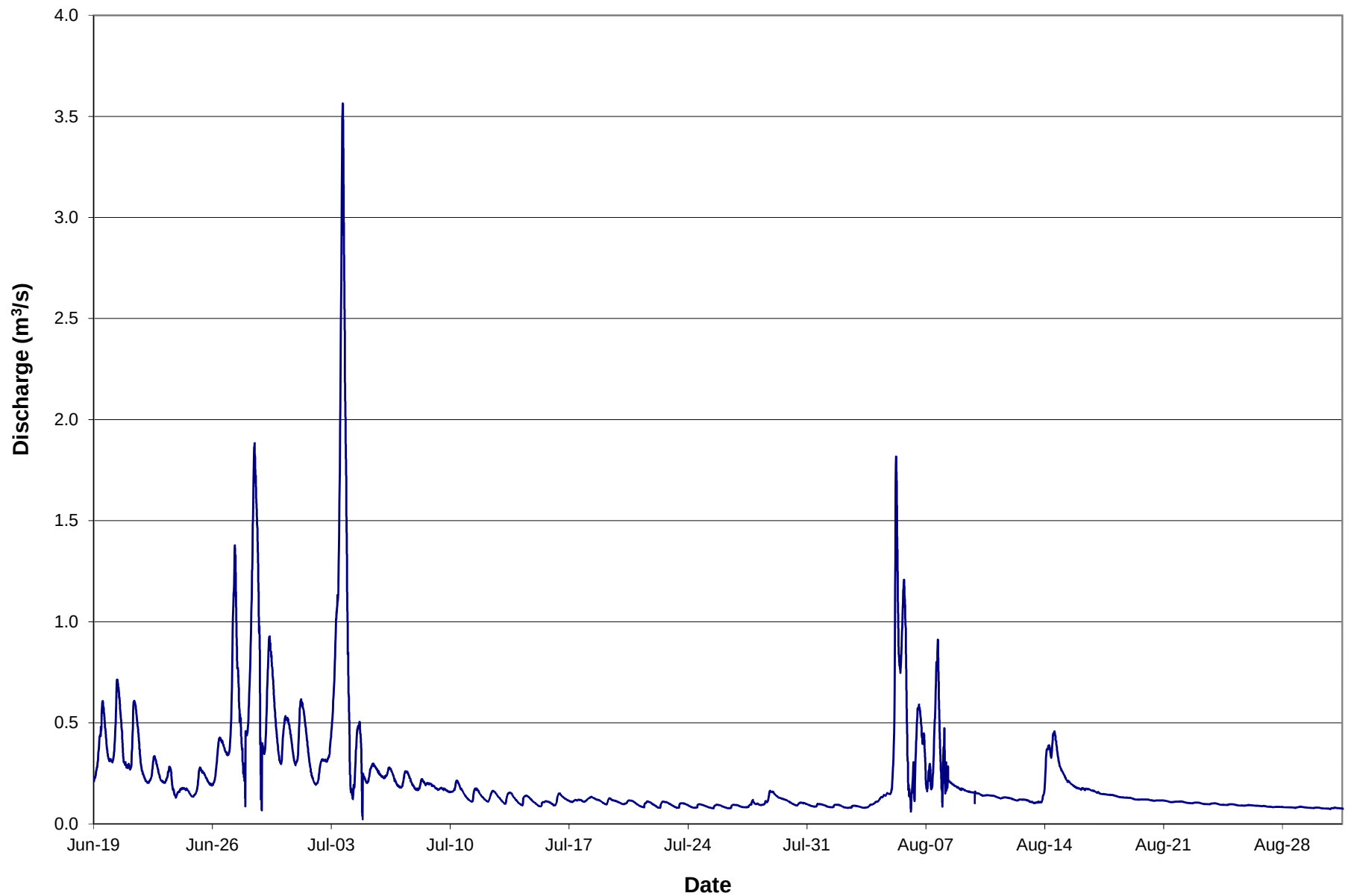


Figure 9 H04 - Camp Lake Tributary (CLT-2) 2015 Streamflow Record

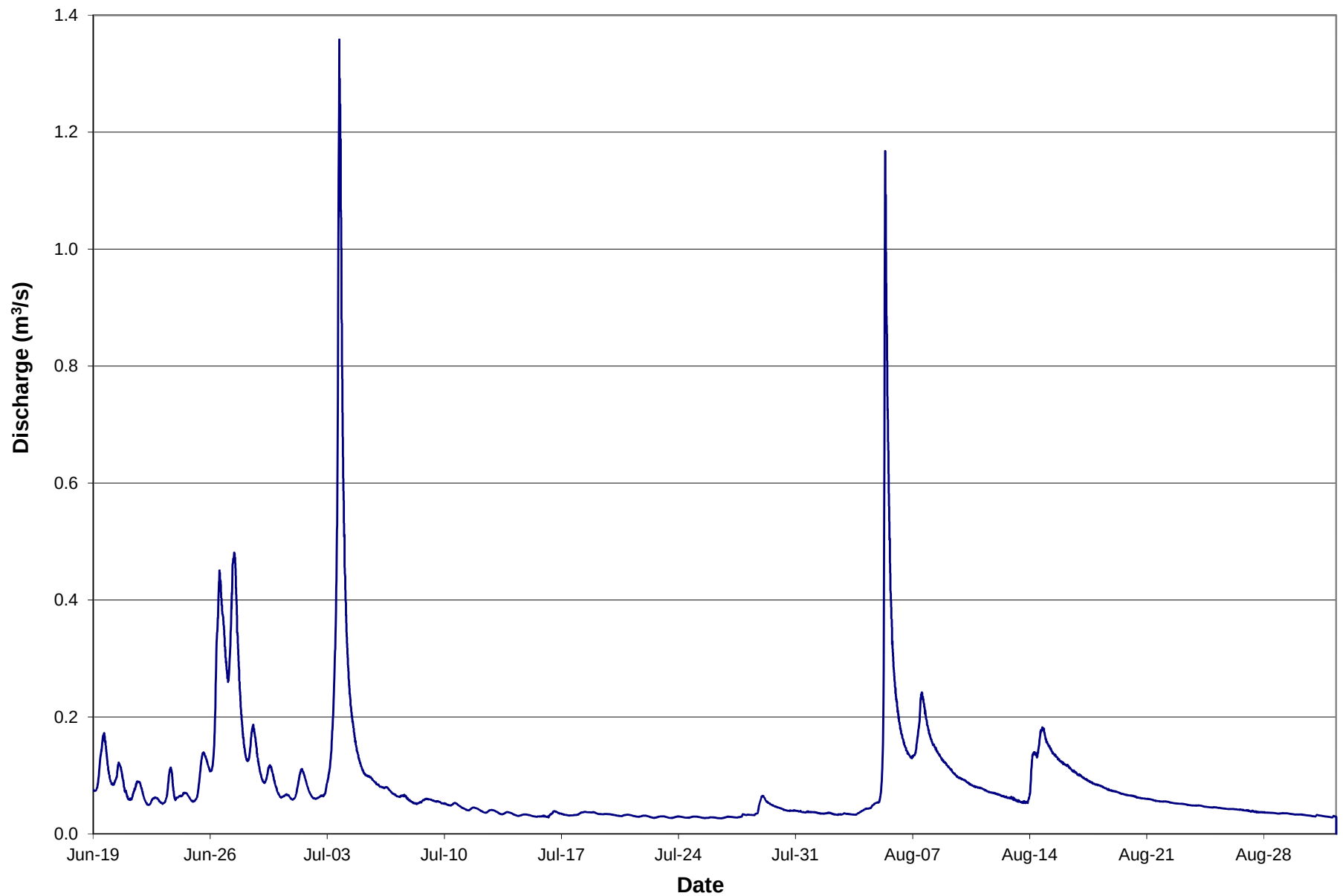


Figure 10 H05 - Camp Lake Tributary (CLT-1) 2015 Streamflow Record

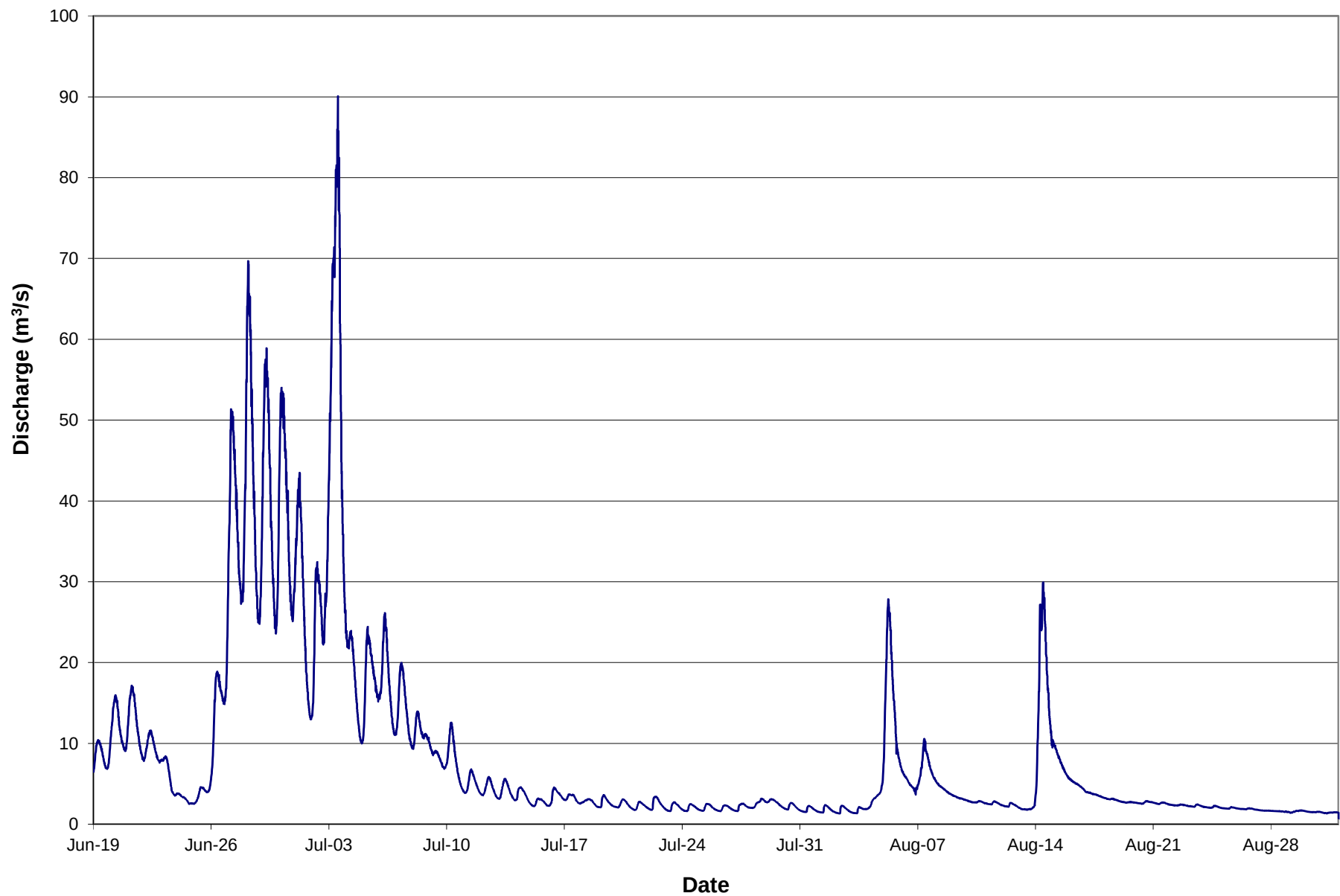


Figure 11 **H06 - Mary River 2015 Flow Record**

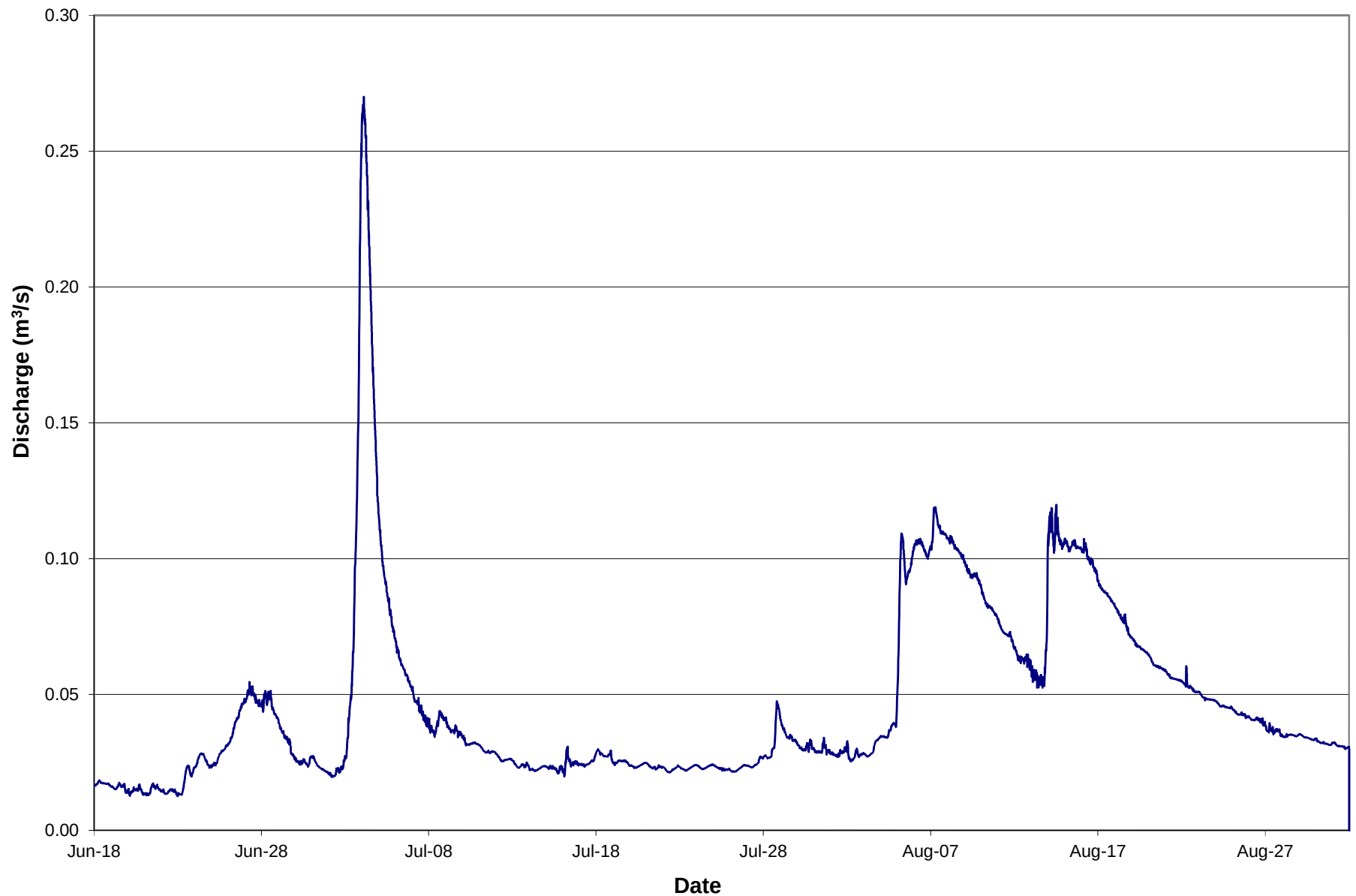


Figure 12 H11 - Sheardown Lake Tributary (SDLT-1) 2015 Streamflow Record

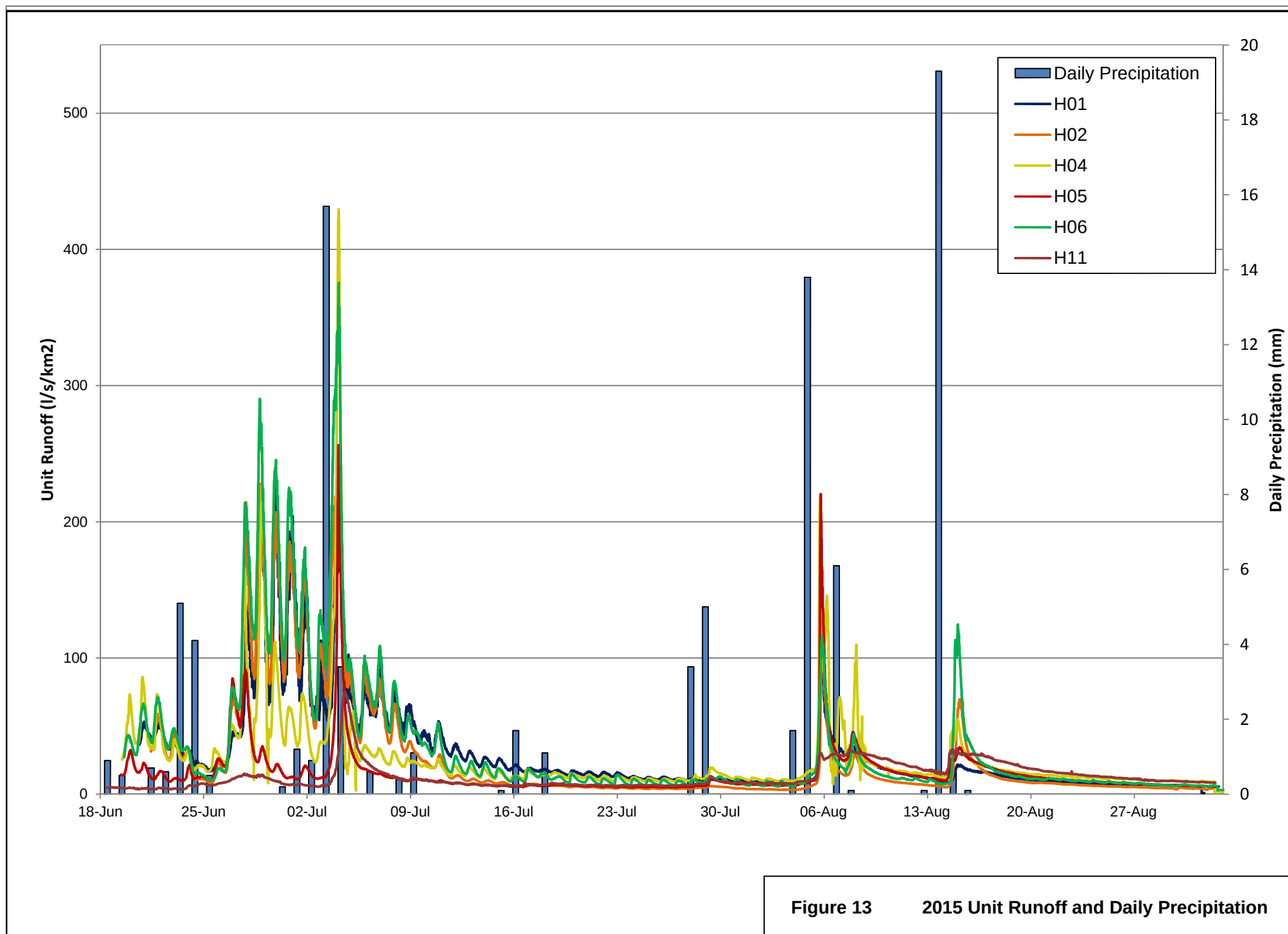


Figure 13 2015 Unit Runoff and Daily Precipitation

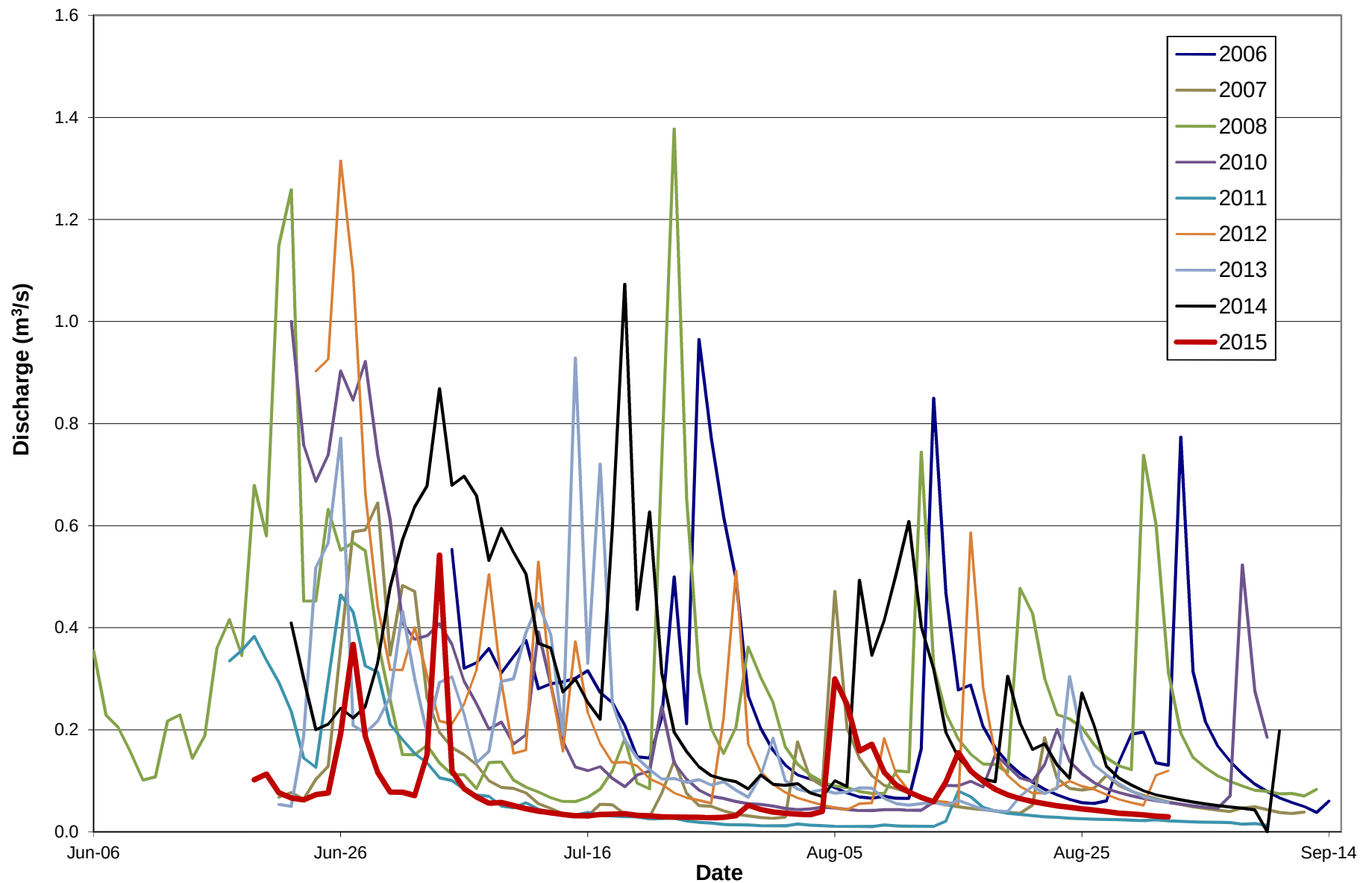


Figure 14 H05 - Measured Streamflow Hydrographs 2006 - 2015